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Book of abstracts

The book contains abstracts of reports which are to be presented during European Week of Astronomy and Space Science (JENAM-2011). The meeting will take place July 4–8, 2011 in Saint-Petersburg, Russia.

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Plenary talks

BepiColombo — a comprehensive exploration of planet Mercury

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BepiColombo is a joint project between the European Space Agency (ESA) and the Japanese Aerospace Exploration Agency (JAXA). The Mission consists of two orbiters, the Mercury Planetary Orbiter (MPO) and the Mercury Magnetospheric Orbiter (MMO). The mission scenario foresees a launch of both spacecraft with an ARIANE V in July 2014 and an arrival at Mercury in the second half of 2020. From their dedicated orbits the two spacecraft will be studying the planet and its environment. The MPO scientific payload comprises eleven instruments/instrument packages; the MMO scientific payload consists of five instruments/instrument packages. Together, the scientific payload of both spacecraft will perform measurements to find clues to the origin and evolution of a planet close to its parent star. The Nominal Science Mission of BepiColombo will cover 1 terrestrial year and be divided into 2 six-month phases, tentatively called the global mapping and target mapping phases. The latest status of the BepiColombo mission will be given with special emphasis on the scientific return of its payload complement.

The central role of X-ray observations in the future of European Astrophysics

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The science goals of Astrophysics for the next decade or two have been spelled out by a number of scientific roadmaps, including the Astronet Science Vision, ESA Cosmic Vision 2015-25, etc. Themes like galaxy evolution, formation of large-scale structure, matter under extreme conditions, call for a very central role of X-ray observations. I will sketch a number of these themes for which an observatory-class X-ray space mission will be necessary to make real progress, including co-eval growth of stars and supermassive black holes in galaxies, structure and evolution of galaxy clusters, finding the missing baryons in the Warm and Hot Intergalactic Medium, chemical abundances in groups and clusters, probing General Relativity around black holes, inferring the Equation of State of matter at supra-nuclear densities via mass and radius of neutron stars, etc. I will also give an update on the ESA-led observatory class mission Athena (Advanced Telescope for High Energy Astrophysics), which is under study as a large mission candidate for the Cosmic Vision 2015-2025 programme, with a targeted launch date of around 2022.

Accretion disks around black holes with magnetic fields, advection, and jet formation

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The problem of the formation of a large-scale magnetic field in the accretion disks around black holes is reconsidered, with account the non-uniform vertical structure of the disk. The high electrical conductivity of the outer layers of the disk prevents the outward diffusion of the magnetic field. The solution for a stationary state with a large magnetic field in the inner parts of the accretion disk, and strong vertical stratification is analyzed.

Global solution of advective accretion disk structure around a black hole is constructed numerically. At high luminosity there is a continuous transition between the optically thick outer and optically thin inner disk regions. Models of accretion flows with large mass accretion rates are considered using a bridging formula for radiative losses at high and low effective optical depths. Contrary to the models neglecting advection, the global solutions have been found for all investigated range of accretion rates. The presence of the effectively optically thin regions in the innermost part of accretion disks results in a significant increase of the plasma temperature in those regions and this increase can be discriminated in observations in the form of the observed

hard radiation tails. The temperature of the inner region is increasing with a growth of the angular momentum of the black hole, and may reach pair formation conditions for rotating black holes.

Models of a magnetic jet collimation are constructed in a simplified approximation.

Cosmic Vision 2015-2025: ESAXs long term plan in Space Sciences

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ESA's Space Science Programme will be presented, focussing on its long term plan, "Cosmic Vision 2015-2025". The mission selection process will be presented as well as the current status of the different projects currently under assessment, focussing in particular on the new M3 Mission candidates, EChO, LOFT, STE-QUEST and Marco-Polo-R. The on-going and future technological developments underpinning the plan will be briefly outlined, as well as the programmatic and international context.

A century of extragalactic astronomy

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It was only in 1925, with the first measure of the distance of a "spiral nebula" by Hubble, that one realized that the cosmos was not limited to the Milky Way. At the same epoch, the extraordinary coincidence of the discovery of the Hubble law and of the emergence of General Relativity allowed Cosmology to become a scientific domain, and later Extragalactic Astronomy became a part of Cosmology. Incredible progress has been achieved thanks to the development of giant or dedicated telescopes, new detectors, space research, and more recently thanks to big numerical simulations and large surveys leading to enormous data samples. Our view of the Universe has thus changed drastically over eighty years. I will review some aspects of the subject, focussing on a few cornerstones: how supermassive black holes became ubiquitous, how the world of galaxies was discovered to be always changing, how most of the matter in the Universe was found to be dark and strange and to be accelerating in an unexpected way... My aim will be to show that the ideas people take for granted presently had difficulties to emerge and to gain credence. We will see that research is not "a long quiet river" but evolves in an erratic way, guided by observations and by theories which do not occur always at the "right" time, and that widely accepted models can be rejected at any moment.

Gaia: surveying one billion stars with one billion pixels

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Gaia is the next space astrometry mission of the European Space Agency, following up on the success of the Hipparcos mission. With a focal plane containing more than 100 CCD detectors, Gaia will survey the sky and repeatedly observe the brightest 1000 million objects during its 5-year lifetime. Gaia's science data will comprise absolute astrometry, broad-band photometry, and low-resolution spectro-photometry. Medium-resolution spectroscopic data will be obtained for the brightest 150 million sources. Gaia's primary science goal is to unravel the kinematical, dynamical, and chemical structure and evolution of the Milky Way. In addition, Gaia's data will touch many other areas of research, for instance stellar physics, solar-system bodies, fundamental physics, and exo-planets. The Gaia spacecraft is currently in its integration and qualification phase. With a launch foreseen in 2013, the final catalogue is expected in 2021. The science community in Europe, organised in the Data Processing and Analysis Consortium (DPAC), is responsible for the processing of the Gaia data. This formidable task is in full preparation. This presentation will provide a status overview of the Gaia project, including the expected science performance.

ESO and the E-ELT

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The European Southern Observatory is an intergovernmental organization for astronomy. Its mission is to enable scientific discoveries by constructing and operating powerful observational facilities and to organize collaborations in astronomy. ESO operates medium-sized optical telescopes on Cerro La Silla, the Very Large Telescope, the Interferometer and the survey telescopes VISTA and VST on Cerro Paranal, widely considered to be the most advanced optical/infrared observatory in the world, as well as the sub-millimeter observatory APEX on Llano Chajnantor, all located in Northern Chile. ESO represents Europe in a partnership with North America and East Asia that is constructing the Atacama Large Millimeter/sub-millimeter Array on Chajnantor. ESO is designing the 40m-class European Extremely Large Telescope (E-ELT) with adaptive optics built-in, to be constructed on Cerro Armazones near Paranal. The talk will summarize the current program, will discuss the E-ELT project and briefly touch on the science it will enable.

X-ray observations of binaries in external galaxies, star-formation and the problem of SNIa progenitors

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The X-ray appearance of majority of normal galaxies is determined by radiation from accreting neutron stars and stellar mass black holes in X-ray binaries. Chandra and XMM-Newton observations revealed that their populations scale with the star-formation rate and stellar mass of the host galaxy. Thus, the X-ray luminosity of a star- forming galaxy can be used as a star-formation rate proxy. The luminosity distributions of X-ray binaries in young and old galaxies obey respective universal luminosity functions. There is a qualitative difference between the two LFs, reflecting the difference in the accretion regimes in high- and low-mass X-ray binaries. The numbers of high-mass X-ray binaries observed in star-forming galaxies indicate the rather high probability for a massive star to become an accretion powered X-ray source once upon its lifetime. This explains the unexpectedly high contribution of accreting compact objects of stellar mass to the Cosmic X-ray background, ∼7-10%.

Underneath bright X-ray binaries, unresolved emission is present in all types of galaxies, which is partly due to unresolved faint compact sources, including accreting white dwarfs. The luminosity of unresolved emission and statistics of classical novae can be used to place an upper limit on the total rate of mass accumulation by white dwarfs via accretion. For elliptical galaxies, derived upper limits are by a factor of ~ 50 smaller than mass growth rate required to explain the frequency of type Ia supernovae, assuming that the latter occur upon achieving by the white dwarf the Chandrasekhar mass limit. This fact suggests that the white dwarfs accreting from a donor star in a binary system and detonating at the Chandrasekhar mass limit can account for no more than a few per cent of type Ia supernovae observed in old stellar populations. The majority of snIa in elliptical galaxies are due to coalescence of white dwarfs or their explosions at sub-Chandrasekhar masses.

The high energy view of Super Massive Black Holes

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During the last nine years the hard X-ray sky has been surveyed by the ESA INTEGRAL Space Observatory providing the community with deep observations of the Galactic Plane and of the whole sky in the soft Gamma ray range reaching a sensitivity better than typically 1 mCrab above 20 keV. The extra-galacticsky is populated by nearly 300 sources, mostly associated with Super Massive Black Holes in Active Galactic Nuclei (AGN) and belonging to a wide variety of AGN classes. Here we present an overview of the high energy properties of the AGN detected by INTEGRAL, by discussing the implications of our results on the current Unified Model

of AGN, on the radiative and accretion processes acting close to the inner regions of the black hole and their cosmological relevance

The Tycho Brahe Prize award lecture: "Hipparcos in Perspective"

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ESA's Hipparcos astrometry mission was a particularly innovative project in space astronomy. The satellite was launched in 1989 (already more than 20 years ago) with the final Hipparcos and Tycho Catalogues fully published just eight years later. Exceeding the original scientific specifications in terms of both accuracy and in numbers of objects measured, Hipparcos provided not only by far the best stellar parallaxes and proper motions, essentially free of systematic errors, but also the largest single improvement factor in the subject's long history, exceeding even that achieved by Tycho Brahe himself. I will summarise the fundamental principles of the measurement concept, and provide some topical examples of the scientific advances made with the data: including the central problem of the astronomical distance scale, and the fortuitous advances made possible by the very large numbers of exoplanet host stars contained in the celestial survey. Since the European Astronomical Society's Tycho Brahe Prize isspecifically awarded in recognition of the development or exploitation of European instruments, I will also discuss some aspects of the organisation and development of large astronomical projects in Europe more generally: some of the specific challenges posed by their organisation and execution, and a perspective of the special conditions required for their success. This will be in the spirit of passing on some experiences of scientific management possibly relevant for the many exciting astronomy instrumentation projects now ongoing or under planning.

Exoplanets, the beginning of a new paradigm

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Today spectroscopic and transit exoplanets surveys are revealing a large population of multiple planetary systems composed of Neptune and super-Earth mass planets. These results, combined with the upper mass constraints on planet mass obtained from astrometry and the measurements of the angle of the planetary orbits measured from on-transit spectroscopic, leads us to revisit our views on planet formation and their composition. A new paradigm on the formation, structure and composition of planets is emerging, wider than what we had anticipated from our Solar System.

The European Research Council: Funding Opportunities for Researchers from Anywhere in the World

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The European Research Council (ERC) is a European funding organization, funded through the EUXs Seventh Research Framework Programme with a budget of EUR 7.51 bn for 7 years and designed to support the best scientists, engineers and scholars in Europe. The ERC supports investigator-initiated frontier research across all fields of research, on the basis of scientific excellence. Two types of ERC grants are currently available: ERC Starting Independent Researcher Grant (ERC Starting Grant) and ERC Advanced Investigator Grant (ERC Advanced Grant). The ERC actions are open to researchers of any nationality who intend to establish and conduct their research activity in any EU Member State or Associated Country. The composition of the research team is flexible and may involve team members in countries outside the EU, if their participation is fully justified by the scientific added value they bring to the project.

S1: Magnetic Universe

Conveners:
Yuri Gnedin (Pulkovo Obs. Russia),
Jean-Francois Donati (CNRS/U. Toulouse, France)

Magnetism of Cataclysmic Variable Stars: Polarization and Spectra of Accretion Columns

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Theoretical and observational results of polarization and spectra of cyclotron emission from the accretion columns are reviewed. Effects of the asymmetries of distribution of the plasma density and other parameters are discussed, particularly, inclination of the column, ellipticity of its cross-section, different laws of density distribution, dependence of the cyclotron frequency on height ("rainbow" column). Results are compared to classical ones in the monograph by Dolginov, Gnedin and Silantjev. Various mechanisms of instability of accretion column are reviewed, which are caused by inhomogeneities of the accretion column. Results of modeling of the "red noise" are compared with theoretical models. We discussed a discovery of two-component "red noise" (170 and 10 sec time-scales) from the CHANDRA unprecedentedly long run, which is interpreted by "Z-pinch"-like magnetic instability and fragmentation of the accretion "spaghetties" into smaller blobs. Contrains of the structure of gravi-magnetic rotators from a newly discovered object RXSJ 072518.2+733433 are discussed.

Monotonous and thousands-of-years cyclic components of isolated radiopulsars spindown

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Pulsars' spin frequency second derivatives are 1e2..1e6 times larger than expected for canonical magnetodipolar pulsar braking. and even negative for about the pulsars. We explained these paradoxical features on the basis of the analysis of the spin parameters of 297 ordinary isolated pulsars. We argued in favour of the existence of cyclic variations of pulsars' spindown rate on the timescales of several thousands of years alongside with its monotonous evolutionary decrease. We used the maximum likelihood technique to estimate an evolutionary braking index n and constant relative amplitude A of f1 cyclic variations. The result of estimation is: n lies within the interval 2.5..4 and $\langle A \rangle$ in 0.5..0.9 with 99% confidence, while standard deviation of A over the subset is close to 0.1. Consequently, the real ages of pulsars will be a factor of 0.5-3 of the characteristic ones. The physical nature of such long term variational process is also discussed.

Magnetic Fields of Active Galactic Nuclei and Quasars with Polarized Broad Line Regions

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We present the results of determination of magnetic field in a number of AGNs from the Spectropolarimetric atlas of Smith et al. (2002). Our estimations are based on the observed degrees of linear polarization and the positional angles of spectral lines (H_alpha)(broad line regions of AGNs) and nearby continuum. The observed polarization degree is lower than that known in the Milne problem in non-magnetized atmosphere. We suppose that polarized radiation escapes from optically thick magnetized accretion disks. The Faraday rotation depolarization of the radiation allows us to explain both the value of polarization and the position angle. This gives the estimation of magnetic field in the broad line region. Assuming the power-low dependence of magnetic field inside the accretion disk, we obtain the estimation of magnetic field strength at first stable orbit near the central supermassive black hole (SMBH) for a number of AGNs from the mentioned Spectropolarimetric atlas.

A New Look at Spherical Accretion in HMXBs

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Spherical accretion of a magnetized (beta about a unity) matter onto a neutron star or black hole is considered. We show that the magnetic field in the accretion flow grows rapidly and appears to be a key parameter in the accretion process already at a large distance from the compact star. The magnetic field of the flow tends to decelerate the accretion flow and to disintegrate it into dense filaments. The rate of radial motion of the filaments depends on the rate of annihilation of the magnetic field and efficiency of cooling processes in the accretion flow. We discuss the structure of the magnetized accretion flow in the vicinity of the neutron star magnetosphere and the mechanism of plasma penetration into the stellar magnetic filed. An application of the model to the interpretation of the accretion picture in long-period X-ray pulsars will be discussed.

Population synthesis model for isolated neutron stars

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We investigate the birth and evolution of isolated neutron stars (NS) in the whole volume of our Galaxy with our new code of NS population synthesis. Our modeling started from the birth of the massive OB stars. We reproduce the distribution of massive stars within the spiral arms. After the supernova explosion we integrate the equations of motion of the newly borned NS in the averaged Galaxy gravitational field for their different initial velocities. The mean kick velocities of 300 km/s is estimated from a comparison the model NS Z-distribution with that for galactic NS. Next we proceed with our new population synthesis code and with different birth properties of the pulsars. The decay of the NS's magnetic field decay are taken into account. We suppose that NS loss the significant part of their magnetic field occur during the first million years of a their life. The rotational evolution of NS with taking into account the magnetic field decay was analyzed. We model the subsample of galactic pulsars using the radio beaming model with inhomogeneous distribution of radio emission in the cone to obtain the correct fraction of detected pulsars. Our model distributions of pulsar periods (P), derivatives of periods (Pdot) and pulsar magnetic fields B and found to be in a good agreement with those taken from ATNF pulsar catalogue.

Magnetic fields of massive stars: statistics and evolution

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Statistical properties of mean magnetic fields and magnetic fluxes for OB stars, white dwarfs and neutron stars (NS) are investigated. We use all recent magnetic field measurements including our new detections for ten O-type stars (Hubrig et al. 2011). Our new measurements support conclusion that large-scale organized magnetic fields with polar fields in excess of 1 kG are not widespread among O-type stars. Only one star, HD156154 with a detected magnetic field, belongs to an open cluster at high probability. According to kinematical studies, four magnetic O-type stars in our sample are well-known candidate runaway stars. The field distribution for OB stars has a steep drop in a magnetic field region [B]<400 G. This drop may be connected with a dissipation of the weak stellar magnetic field proposed by Auriere et al. (2007). Magnetic fluxes of all studied objects are log.-normally distributed. We estimate the mean magnetic fluxes F (in units G cm^2) of all massive stars with measured magnetic field and(log(F)=27.7) and a value of log(F)=24.5 for a whole ensemble of Galactic NS.

Magnetocavitation models for the acceleration of the astrophysical jets

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Reasons of the jet acceleration in the compact astrophysical objects are investigated. Magnetocavitation models for the acceleration of the jets are developed. According to these models the jet acceleration is produced due to the collapse of the magnetosphere interacting with accreting plasma. This collapse is associated with the process of instability in the accreting plasma. The jet parameters are estimated. The results agree with the observational data.

Magnetic stars in open clusters

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This talk discusses the first unambiguous observational evidence of how the fossil magnetic fields of magnetic Ap stars evolve during the long main sequence phase of evolution. Our study of this evolution is based on a survey of magnetic fields among Ap stars that are members of open clusters. Such stars have relatively well-determined ages. We have estimated the RMS longitudinal field strength of each star, and study how this quantity varies with age through the 10^8 to 10^9 yr of main sequence life. Dividing our sample of more than 80 stars into mass bins of $2-3$, $3-4$, and $4-5M_{\odot}$, we find that both the typical field strength and the total magnetic flux emerging from the stellar surface decline (but not to zero) on a time scale that is a modest fraction of the main sequence lifetime in each of the three mass bins. This relatively rapid evolution, and the strong variation of the field evolution time scale with stellar mass, are not yet understood.

Formation of Jets and Magnetic Fields

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We are studied super fine structure of AGN cores in radio emission. It was opened accretion discs and regions of ejections of bipolar outflows. The bipolar outflows are accelerated and collimated. The structure and kinematics of the objects appears to be an anti-centrifuge which is accreting the surrounding medium moving it along the arms towards the centre and ejecting the rotating bipolar outflow. The outflow consists of a central relativistic plasma jet surrounded by a no relativistic low-velocity stream. A low-velocity outflow is ejected by the outer part or the disk, and the high-velocity by the centre part of it. Reactive force of the outflow determines the precession of an ejector and helical structure with increasing step of the jet. Polarization of the jet emission corresponds to magnetic field orientation parallel to axis - velocity of the outflow. Rotated disc and a plasma streams are generating circular current and magnetic field oriented along rotated axis. The currents and the magnetic fields are accelerating and stabilized formation of the structure. The magnetic fields of the structures are parallel. The jet is moving along the magnetic field, but counter jet — opposite that determined its smaller extent.

Early stage of formation of astronomical objects

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We are studied of the super fine structure of Orion KL star formation region and AGN objects. These absolutely different objects have one principal peculiarity — structure, which corresponds to anti-centrifuge. The surrounding matter accretes to disk, moves to center, and ejects bipolar outflow. The reactive forces of an ejecting matter excite precession and formation helix structure of stream with decreasing step. Interaction with surrounding matter collimated and accelerated bipolar outflow. In the case of plasma streams are generated currents and magnetic fields which accelerated process formation structure and stabilized it. The same influence had been formation of a central body of a big mass.

Rotational period variations in magnetic chemically peculiar star HD 37776

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Three decades of a precise photometric and spectroscopic monitoring of the young hot magnetic chemically peculiar star HD 37776 have revealed its continual rotational deceleration, increasing the period by a remarkable 18 s! The deceleration was interpreted as the rotational braking of the outer stellar layers due to the angular momentum loss in the stellar magnetosphere. Observational data have been recently supplemented by own new photometric data. We present here the results of the sophisticated analysis of all available observed data showing that the period reached its maximum of 1.538766 d in the year 2004, when the rotation period began to decrease. The nature of such unpredicted period changes and the paradox of the spin-down time are briefly discussed.

Relativistic kinetic equation for Compton scattering of polarized radiation in a strong magnetic field

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Relativistic kinetic equation for Compton scattering of polarized radiation in a strong magnetic field is deduced using Bogolyubov's method. Induced scattering and the Pauli principle are taken into account. Polarization of electron gas is taken into account as well in the common form of the kinetic equation. Special forms of equation for the cases of non-polarized electrons, rarefied electron gas and 2-modes distribution of radiation are found. Results can be useful for construction of models of atmospheres and magnetospheres of neutron stars.

Magnetic chemically peculiar stars

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We present a survey of observational data on the magnetic fields and physical parameters of CP stars for the past 15 years. It appears that the traditional notions on chemically peculiar stars as very stable objects with frozen atmospheres are in need of revision. Analysis of new high-precision observational data allows to

detect such subtle phenomena as pulsations of brightness and radial velocities of stars, vertical stratification of chemical elements in their atmospheres. A relationship was found between weak anomalies in the energy distribution in the continuum and the magnetic field strength. An analysis of the Q and U-Stokes parameter profiles in the spectral lines of some stars has shown that these observations can be described under the assumption of the field of complex topology, which can not be represented in the form of low-order multipoles. We found large vertical gradients from the lines formed on different levels with height in the atmospheres. These facts indicate much more complex atmospheric structures in chemically peculiar stars than was considered only 15 years ago.

Measurements of magnetic fields in Herbig Ae/Be stars, stars with debris disks and classical Be stars at the VLT: statistical results of our long-term programs

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We summarize the results of our search for magnetic fields in representative samples of Herbig Ae/Be stars, stars with debris disks, and classical Be stars, carried out over the last eight years. The spectropolarimetric data were obtained at the European Southern Observatory with the multi-mode instruments FORS1 and FORS2, installed at the VLT. Among the 23 Herbig Ae/Be stars studied, stellar magnetic fields of about 100-150G have been detected in 11 stars (i.e. ∼50%). The largest longitudinal magnetic field, $\langle Bz \rangle$ = -454±42G, was detected in the Herbig Ae/Be star HD101412 using hydrogen lines. The magnetic field geometry of four Herbig Ae stars was studied using time series of magnetic field measurements. The presence of circumstellar polarization signatures formed in the stellar wind supports the assumption that the magnetic centrifuge is one of the main mechanisms of the wind acceleration. No field detection at a significance level of 3σ was achieved in the six stars with debris disks. Among the 28 classical Be stars studied, detections of a magnetic field were achieved in eight stars (i.e. ∼30%). The detected magnetic fields are rather weak, not stronger than ∼150G. Among the Be stars studied with time series, one Be star, λ Eri, displays cyclic variability of the magnetic field with a period of 21.12 min. Possible models of the magnetic field configuration in stars from our programs of different evolutionary status are discussed.

POSTERS

S1-1. HD52721 — an unique binary system among Herbig Ae/Be stars

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Results of photometric and high-resolution spectroscopic observations of the Herbig Be star HD52721 between October, 2009 and October, 2010 are presented. We have confirmed the cyclic character of photometric variability of HD52721 with the period of 0.805 days revealed earlier by other investigators. Variability exhibits itself in a form of two minima on the light-curve, typical for eclipsing binaries and separated by 0.805 days. ASAS data taken with a time span of 6 years (from September, 2003 till December, 2009) revealed a difference between two neighboring photometric minima thus showing that the real orbital period of the system should be twice this value (1.610 days). This is confirmed by our spectroscopic data. The gravity centre of the emission H-alpha line and the profile of the HeI 6678 line with a developed circumstellar component demonstrate a clear correlation with the period of 1.610 days. Apparently, HD52721 is a close binary, containing two B2 stars with similar parameters. We assume that cyclic variations of circumstellar parameters can be connected with the presence of global azimuthal inhomogeneity rotating synchronously with system components. It's origin can be a result of peculiar properties of stellar magnetic field.

S1-2. Polarization properties and magnetic field of 3C273

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Results of processing of the VLBA observational data for some epochs are presented. Object of interest is a well known quasar 3C273. Polarization maps are presented. Astrophysical parameters of object, magnetic field value, their changes in time, and the possibility of usage of the data processing technologies in the future project 'Radioastron' are discussed.

S1-3. Structure of regions with low degree of ionization in accretion disks of young stars

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In frame of Shakura-Sunyaev approximation we elaborate (1+1)D magnetohydrodynamic model of magnetized stationary accretion disk of young stars. Ionization structure of the disk is calculated taking into account thermal ionization, ionization by X-Rays, cosmic rays and UV radiation. Sizes and position of arisen "dead zone" with very low ionization degree are estimated for the different efficiency of magnetic diffusion. Numerical estimations show that inner edge of the "dead zone" is placed at 1 a.u. and is determined by thermal ionization. Outer edge locates between few and few tens of a.u. and depends strongly on ionization and magnetic diffusion efficiency. "Dead zone" height exceeds disk scale height, so we conclude that MRI-induced turbulence can't be considered as dominant mechanism of angular momentum transport in protoplanetary disks.

S1-4. Spectroscopic peculiarity of the southern Be star HD152478

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We present results of the spectroscopic investigation of the southern Be star: HD 152478. Five spectra of the object were obtained in 2007–2009 with the high-resolution (R=48000) FEROS spectrograph mounted at the 2.2m telescope of the European Southern Observatory (La Silla, Chile). The analysis of a very reach linear spectrum of the star in the wide spectral region from 3700 to 9000Å has shown remarkable differences in temporal behaviour of different groups of spectral lines. A long-term change of the emission double-peaked profiles of the Balmer lines and the numerous FeII line profiles resemble the so-called V/R variability typical for classical Be stars containing a precessing one-armed perturbation in their gaseous disks. But a sufficient phase shift of the variability observed in Balmer and FeII lines speaks not in favour of this model. The alternative hypothesis of a variable magnetized stellar wind of flattened geometry flowing close to the equatorial disk can qualitatively explain the observed profile variations. We analyze also other lines of the emission linear spectrum of HD 152478, the most notable of them are the HeI 5876, 6678Å lines, the IR multiplate of CaII (8498, 8542 and 8662 Å) , OI 7774 , 8446 Åand high members of the Pashen series. The helium abundance of this star derived from NLTE synthetic spectra calculation is near solar.

S1-5. Observational signatures of the magnetospheric oscillations in the Herbig Ae/Be star ABAur

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The analysis of high-resolution spectra of the Herbig Ae/Be star ABAur obtained at the 2.6m Shajn telescope of the Crimean Astrophysical Observatory starting from 1986 has shown a clear anti-correlation between variability of equivalent widths of the HeI 5876 and DNaI emission lines. This fact allows us to consider the Goodson & Winglee model of magnetospheric oscillations near the inner boundary of the accretion disk as a possible interpretation of the variability. Estimation of the accretion rate of AB Aur and determination of the period of variations P = 124 days speak in favour of suitability of this model for ABAur.

S1-6. Spectroscopic study of M-dwarf binary systems: surface magnetic fields and rotational velocity from FeH lines

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M-dwarfs are most numerous stellar objects in our Galaxy. Because of their low masses and relatively cool temperatures, they turn to be very interesting targets for many fields of astrophysics. Search for first habitable planets, stellar activity, and evolution of magnetic fields are among the hot topics associated with these objects. In this work we make use of very high-resolution spectra of ten M-dwarf binary systems obtained with CRIRES (VLT) in FeH lines of Wing-Ford transitions covering the wavelength range 9925 − 9972 ÅÅ. For every system we derive rotational velocities and the surface magnetic field modulus by direct magnetic spectra synthesis. Our results provide new insight into the magnetic fields of partially and fully convective stars and efficiency of the rotational breaking in binary systems.

S1-7. Variability of C III and Si III lines in the ultraviolet spectral region of the magnetic Bp star a Centauri

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The variability of twice ionized lines of carbon and silicon in the ultraviolet spectral region of the magnetic Bp star *a* Centauri is investigated. This study is based on the archival *International Ultraviolet Explorer* data obtained through the large aperture and in the low-dispersion mode. A comparison of the average IUE high-dispersion spectrum of *a* Cen with full synthetic spectrum as well as those including only lines of one element showed that six C III and six Si III lines are responsible for the depressions of the flux at $\lambda\lambda$ 1175.5 and 1300 Å, respectively. Investigation of the variability of flux in the core of depression at λ 1775.5 Å indicate that the fluxes do not vary within errors of measurements. On the other hand, the fluxes in the core of depression at λ 1300 Å varies significantly with amplitude of $\sim$0.2 mag. Moreover, the variability of this depression are in anti-phase with helium lines in the visual spectral region.

S2: Planets of the Solar System and Beyond

Conveners:
Mikhail Marov (Vernadsky Inst. Geochemistry/ Keldysh Inst. Appl. Math., Russia),
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Use of Quadrupole Magnetic Field for Spacecraft Radiation Protection

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There are several methods to shield spacecraft from SEPs and GCRs, but the possible one is use of superconducting magnet technology for habitable volume of spaceships. That method only suggested 9T for magnetic shield intensity because of neglecting GCR effects on human body. That shield is heavy and needs to fuel. In order to solve these problems, hyper thin torus ring is supposed. This design is lighter than superconducting technology and protect whole of spaceship instead of habitable volume only. This design doesn't need to fuel that carry through travel and its magnetic field intensity is 10 times more than superconducting magnet technology method.

Fireballs associated with the asteroid 2004MB6

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In 2009 August two bright fireballs of the -9.2 and -8.5 maximum absolute magnitudes and with initial masses of the meteoroids produced fireballs of 5.7 and 7.8 kg were captured by the Tajikistan fireball network. The fireballs luminosities were terminated at the heights 39.3 and 35.4 km. It turned out, that the coordinates of radiants and orbits of fireballs, which according to the PE criterion belong to the II fireball group having asteroidal origin [1], are nearly identical to each other. Two meteorite-dropping fireballs with the similar parameters earlier were recorded by the MORP camera network in Canada [2]. We undertook a search for the possible progenitor of this group among the near-Earth asteroids (NEAs). It was found that their orbits are very close to the orbit of the NEA 2004MB6, that is confirmed by their mutual values of the Southworth and Hawkins D-criterion [3] satisfying the condition $D \leq 0.25$. For verification of the revealed association the orbital evolution of the 2004MB6 and the meteoroid produced TN170809a was investigated using the Halphen-Goryachev method [4] for the time about 7 kyrs. As a result, both objects have well coincidence of the secular perturbations of orbital elements and the values of the modified D-criterion [5] of similarity of two orbits — of the asteroid and meteoroid does not exceed the value of 0.14 during the all time. We suggested that a source of origin of the meteorite-dropping fireballs under consideration, probably, are fragments of the NEA 2004MB6 and these large bodies were constituent components of the asteroidal meteoroid stream for which the asteroid 2004MB6 is the progenitor.

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Review of the latest results on the solar wind – Moon interaction and the lunar environment

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We review the results on the solar wind – Moon interaction and the lunar environment obtained by the recent missions. The focus will be given to observations carried out by the SARA experiment (Sub-keV Atoms Reflecting Analyzer) onboard the Indian Chandrayaan-1 mission. We will also show the relevant results from the Japanese Kaguya mission, Chinese Chang'e-1 and 2, and NASA Artemis. Three main scientific topics will

be discussed, the plasma-surface interaction, the solar wind interaction with lunar magnetic anomalies, and the lunar wake. Recently it was unexpectedly discovered that the solar wind protons are effectively reflected by the lunar regolith. The reflected fluxes of protons constitute 0.1–1% of the incoming solar wind flux and the flux of neutralized fast hydrogen atoms up to 20%. The fast hydrogen atoms backscattered from the surface can be used to map the solar wind flux impinging the surface. Such mapping conducted onboard Chandrayaan-1 revealed the presence of the partial solar wind voids associated with magnetic anomalies. These structures of an order of 100 km and a magnetic field strength of up to 300 nT are unique objects for the field of the solar wind interactions because correspond to obstacles of an intermediate size between proton and electron gyroradii. Chandrayaan-1 and Kaguya also showed that the solar wind protons entry the lunar wake in the form of ion beams either parallel to the magnetic field (plasma expansion to vacuum) or perpendicularly as gyrating protons reflected from the surface. We conclude discussing how the recent observations at the Moon will contribute to understanding measurements to be carried at Mercury on the coming missions.

Observations of Steins and Lutetia with OSIRIS on board the Rosetta mission

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Rosetta is a cornerstone mission of the European Space Agency towards Comet Churiumov-Gherasimenka, foreseen to be reached in 2014. After the launch in March 2004, Rosetta has successfully accomplished its secondary science, namely the fly-by of two asteroids of the Main Belt, Steins in Sept. 2008 and Lutetia in July 2010.

During the fly-by phases, the two cameras of the imaging system OSIRIS have acquired excellent images. The paper will present the main results obtained on shape, volume, craters, surface morphology, mineralogical characteristics of the two asteroid.

Composition properties of Transneptunian objects

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The study of the small bodies that orbit the Sun beyond Neptune, the Transneptunian Objects (TNOs), has completely changed our view of the formation and evolution of the Solar System. The investigation of their surface composition provides constraints on the formation processes of the early solar nebula, as well as of other planetary systems. The ESO-Very Large Telescope in Chile has played an important role in the spectroscopy of TNOs over the past years. Various surface compounds have been detected, including ices of water, methane, nitrogen, methanol, ethane and ammonia. Some silicates are also present, as well as complex refractory carbonaceous compounds. An overview for all available data on TNOs and Centaurs will be presented analyzing the ice content with respect to the physical and dynamical characteristics. The major new results are: i) all objects with neutral surface (classified as BB class) have icy surfaces; ii) the presence of CH3OH has primarily been detected on very red surfaces (RR classobjects) and iii) the majority of Centaurs observed multiple times have an heterogeneous composition.

The astrobiological potential of the satellites of the giant planets

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The outer giant planets' satellites offer exciting astrobiological potential. In Jupiter's system, Europa and Ganymede are thought to contain oceans of liquid water beneath their surfaces, to be characterized by the Europa Jupiter System mission to be launched around 2022. In the Kronian system, two satellites are of

particular interest for astrobiologists: Titan and Enceladus. Titan is a complex world more like the Earth than any other: it has a dense, mostly nitrogen atmosphere with about 2% of methane, and active climate and meteorological cycles where the working fluid, methane, behaves the way that water does on Earth. Titan is very rich in organic molecules. Its geology features lakes and seas, broad river valleys, dunes and mountains. Beneath this panoply of Earth-like processes an ice crust floats atop what may be a liquid water ocean. Enceladus, a smaller moon, ejects large amounts of water and organics in the space from plumes located in its southern pole, implying liquid water reservoirs under its surface, significantly broadening the diversity of solar system environments where one might possibly expect conditions suitable for living organisms, and calls for future exploration of the Saturnian system with orbiting and in situ elements.

CoRoT: hunting planets from space-based observations

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Pioneer in the space-based searches for exoplanets, the CoRoT satellite is now entering its fifth year of operations. Designed to explore the transiting exoplanet population at short orbital period, the instrument has observed about 150000 stars in fields in two opposite directions in the Galactic plane for durations ranging from 25 up to more than 150 days. To date, the team has identified nearly 480 transit planet candidates, considered with different priorities for complementary follow-up observations. These associated follow-up observations are indeed of prime importance to assess the nature of the transiting bodies and infer the planet's masses. We will present an overview of CoRoT's recent discoveries and how they contribute to our understanding of the properties of planets.

Cosmochemical constraints on the Titan and Enceladus formation

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Formation of the regular Saturnian moons is one of the major tasks modern cosmochemistry. The largest satellite of Saturn — Titan and its atmosphere is the unique satellite in the Solar system, having a dense steady atmosphere, besides its N2–CH4 composition is presumably similar to the composition of an early atmosphere of the Earth. Enceladus also has various volatile compounds. During 2005-2010 with help "Cassini-Guigens" the quantitative data on component, phase and isotope structure of an atmosphere of the Titan at its different heights (from 1000 kms and up to a surface) for the first time were received. The structure water plumes, open on Enceladus was also in detail analysed. The received information in aggregate with the data on structure of atmospheres of the Jupiter and Saturn, substance of comets and parent bodies carbon hondrites allows to reveal system cosmochemical constraints on models of accumulation volatiles during formation of the Titan and Enceladus.

The composition of the Martian atmosphere by infrared remote sensing

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Most of the gaseous molecular signatures seen in the infrared spectrum of Mars can be attributed to its main constituent CO_2 (95%), and to its two minor species H_2O and CO. Water vapor shows strong local seasonal variations associated to the condensation/sublimation of H_2O at the poles, which have been identified since the Viking era. As a non-condensible species, CO also shows significant seasonal variations which have been identified by CRISM/MRO, in agreement with the GCMs. The detection of trace species (O_3, H_2O_2, and possibly CH_4) illustrates the capabilities of ground-based high-resolution infrared spectroscopy for studying

minor species in the Martian tenuous atmosphere. Recent results on minor species will be reviewed and the question of methane will be discussed.

The portraits of the Rosetta asteroid targets 2867 Stains and 21 Lutetia

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The European probe Rosetta had a flyby of the asteroid 2867 Steins on September 5th, 2008 and the asteroid 21 Lutetia on July 10, 2010. These have been the first scientific steps of a long interplanetary journey that will carry the probe to hover and then to orbit the comet Churimov Gerasimenko (2014/2015). A quick overview of the history of this multigenerational mission is made through the challenges and the successes that have characterized its different phases, focusing the attention to the scientific return already acquired with the data taken during the Steins' and Lutetia's fly-bys.

Asteroid soil and the YORP-effect

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In my talk I'll address the question of how the heat conductivity and the surface structure of an asteroid influences the YORP-effect. First I'll discuss conditions under which YORP effect is independent of the thermal model of the soil. The most crucial of these conditions is smoothness of the surface on meter scale, that is though very questionable for real asteroids holds for all the accessible asteroids' shape models. It allows us to assume zero heat conductivity and to construct a simple analytical theory for convex asteroid shapes and a ray-tracing program for concave asteroids. Then I'll address decimeter scales, where a qualitatively new effect that we call "tangential YORP" originates. It implies drag forces parallel to the surface, so that even a symmetric asteroid can experience YORP acceleration. At the end I'll briefly discuss the overall evolution of an asteroid subjected to the YORP effect.

Structure and origin of short-perihelion

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New regularities for short-perihelion comets are found. Distant nodes of cometary orbits of kreutz family are concentrated in a plane with ascending node 770 and inclination 2660 at the distance from 1.4 up to 2.0 a.u. and in a very narrow interval of longitudes. Similar regularities are obtained regarding to the cometary families of Meyer, and Kracht. Distant nodes of these comets are concentrated close two planes (their parameters are brought in the article) and at distances 2.2; 6.5 a.u. accordingly. It is made a conclusion that these comet groups were formed as a result of collision of parent bodies with meteoric streams. One more group, consisted of 14 comets is identified in the studied system.

On the exactness of Kholshevnikov – Antonov estimates of the general term of the Laplace series for celestial bodies

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Any planet attracts its satellite according the law of universal gravitation. To calculate the attracting force it is necessary to know the density of the matter in every point of the planet. But the density is measured with an accuracy far from the astronomical one. This obstacle was overcame by our predecessors: the gravity potential of any celestial body was presented by means of the Laplace series in spherical harmonics V_n depending on the distance from the satellite, its latitude, and longitude, as well as on the set of harmonic coefficients, distinct for different bodies. For practice it is important to know the decay rate of V_n when n increases. This problem was solved by K. V. Kholshevnikov and V. A. Antonov in 1960-ies for bodies with irregular structure: the maximal value of $|V_n|$ on the sphere passing through the most distant from the center point of the planet decreases as $Cn^{-\sigma}$ with $\sigma = 5/2$. The exactness of this estimate was established: there exists a wide class of bodies for which the estimate is attainable. It seemed this class contains all irregular bodies. It is shown in this report that it is not so. There exists another wide class of bodies (smooth bodies with a finite set of mountains) for which $\sigma = 3$, and V_n decrease more rapidly. The Mount Chimborazo summit is the most distant point from the planet's center for the Earth.

Modeling outer field of planets via gravitating needles

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Proposed model consists of three gravitating needles with given mass distribution. The needles are located along the coordinate axes and are inside the planet's surface. The model allows to match an arbitrary number of zonal harmonics in the well-known expansion of potential in a series. We consider two classes of distribution — polynomial and piecewise linear (saw-edged). Models of a mass point and of two immobile centres are special cases of our model. A number of finite relatively simple expressions of elementary functions are obtained for the potential. Some equipotential plots for the simplest distributions are presented. The model can be used for approximation of real gravitational field of various planets and for studying orbits of small bodies by numerical experiments. Some calculated trajectories are demonstrated.

Herschel's View of Debris Disks

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Debris disks around main-sequence stars are thought to consist of planetesimals that failed to grow to planets, typically at a system's periphery, similar to the Kuiper belt in our solar system. These disks are observable, thanks to the thermal emission of dust these planetesimals produce in mutual collisions. The Herschel Open Time Key Program DUNES (DUst around NEarby Stars, PI: C. Eiroa) is an unbiased, volume-limited survey that aims at the detection and analysis of debris disks nearly as faint as the Kuiper belt. We have detected dust around one-quarter of the stars in our sample, almost doubling the previous detection rates for Sun-like stars. Our detections include a new class of debris disks, best described as extremely cold, both in terms of temperature and dynamical excitation. Brighter, well-resolved objects, exemplified by q1 Eri and HD 207129, are studied individually. I will review the first DUNES results and show how they help to better understand planetary systems.

The imminent destruction of the comet Hartley 2 nucleus

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The difference in relatively smooth "neck" and other parts of the comet Hartley 2 nucleus suggests that the celestial body is at destruction. Continuous elongation of the neck under the centrifugal force is opposed by the mutual gravity of the nucleus parts and the gradual slowing down of its rotation. Calculations were constructed so that the results do not depend on the density. But the density is required to find the strength and stress in the material of the nucleus. At an averaged density of 320 $kg{\cdot}m^{-3}$ the total centrifugal stretch in a narrow section of the neck is $1.15 \cdot 10^6$ N (the rotation period of the nucleus is 18.1 hour). Stress in the narrow section is 7.2 $N{\cdot}m^{-2}$. Centrifugal force is the greater, the higher the density of the material is and proportional the speed of rotation squared. In contrast to the tensile forces, compressive forces depend on the density of the material squared. In the neck the tensile stress dominates excessing the forces of compression by 2.4 times. The nucleus of comet Hartley 2 is kept from destruction only a small force of friction in the neck. Without them, the fragments would have to detach to a distance (not exceeding 900 m).

Internal structure of icy satellites of Jupiter and subsurface oceans

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Models of the internal structure of icy satellites of Jupiter have been constructed on the basis of the mass and moment of inertia constraints, geochemical constraints on composition of chondrites, and thermodynamic data on the equations of state of minerals and high-pressure ices. The density variations in the mantle and Fe-S core radii are found by the Monte-Carlo method. The allowed thickness of an outer water-ice shell and core sizes for Europa, Ganymede and Callisto are estimated. We show that Callisto must only be partially differentiated into an outer ice-I layer, a water ocean, a rock-ice mantle, and a rock-iron core. The results of modelling support the hypothesis that Callisto may have an internal liquid-water ocean. A comparison of the internal structure of Ganymede and Callisto with that of Titan has been made.

Variability of solar/stellar activity and its influence on planetary habitability

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This work discusses factors which are important for the evolution of habitable Earth-like planets such as the effects of the host star dependent radiation and particle fluxes on the evolution of atmospheres and initial water inventories. New insights and the latest observations and research regarding the evolution of the solar radiation, plasma environment and solar/stellar magnetic field from the observations of solar proxies with different ages will be given. We show that the extreme radiation and plasma environments of the young Sun/stars have important implications for the evolution of planetary atmospheres. Furthermore, we discuss related habitability aspects on which stellar and geophysical conditions allow Earth-analog planets to evolve so that complex multi-cellular life forms may originate and habitats on which life may evolve but due to stellar and geophysical conditions that are different, the planets rather evolve toward Venus- or Mars-type worlds where complex life-forms may not develop. Finally a new innovative idea how we can characterize extremely EUV exposed upper atmospheres of transiting Earth-like exoplanets via energetic neutral atom (ENA) observations around M dwarfs by space observatories such as the WSO-UV, can be used for testing atmospheric evolution

scenarios. Such observations would enhance our understanding on the habitability impact on the activity of the young Sun to the early atmospheres of Venus, Earth, Mars and other Solar System bodies as well as exoplanets.

Missions to Uranus: Exploring the Origins and Evolution of Ice Giant Planets

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Contrary to Jupiter and Saturn ("gas giants", with a composition dominated by hydrogen and helium), Uranus and Neptune are mostly constituted of water ice around a rocky core, with a comparatively small fraction of the mass in the atmosphere. Our understanding of these "ice giants" is severely incomplete, with a number of fundamental questions unanswered. There is therefore a growing interest in the science community worldwide for missions to the outer giant planets, in particular Uranus, easier to access than Neptune and with specific interests such as the location of its polar axis close to the orbital plane. Uranus Pathfinder is a mission concept which was proposed to ESA in response to its 2010 call for medium-class missions. While eventually not selected, Uranus Pathfinder attracted very positive reviews by the relevant ESA advisory group. Uranus Pathfinder proposed to explore the fundamental processes at work in the planet itself (its interior and atmosphere) and in its planetary environment (magnetosphere, satellites, and rings). Such a mission would provide observations and measurements that are vital for understanding the origin and evolution of Uranus as an Ice Giant planet, providing a missing link between our Solar System and planets around other stars. This proposal had extensive community support with 164 scientists worldwide (108 in Europe) lending their support to the mission. The mission architecture for Uranus pathfinder is that of all missions to Uranus with chemical propulsion, a 15 year transfer to Uranus implementing Venus, Earth and possibly Saturn gravity assists so as to insert the spacecraft into an eccentric polar orbit The exploration of outer giant planets has recently received a major boost with the publication in the US of the decadal survey for solar system exploration, which retained a Uranus mission as one of the three "flagship missions", to be considered for a launch in the 2020-2025 time frame even if the two higher priority flagship missions (Max-C and EJSM/JEO, which have to meet stringent budget caps) can be implemented. The Uranus Pathfinder proposal provides an excellent basis for defining a possible collaboration of ESA with NASA on a Uranus mission. In this talk we describe the science case, mission concept, and scientific payload which was considered for this proposal.

Results from the LEND instrument aboard the Lunar Reconnaissance Orbiter

I. Mitrofanov

No abstract submitted

Locating planetesimal belts in planetary systems

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Debris disks are disks of dust that surround a significant fraction of stars of a wide range of masses and ages. From dust lifetime arguments it is inferred that these particles originate from the collision of planetesimals, similar to the asteroids, comets and KBOs in our Solar system. The presence of debris disk around planet-bearing stars indicate that, as is the case of the Sun, other stars also harbor planetary systems composed of

planets and planetesimals belts. Using Spitzer and Herschel data we set constraints on the location of these dust- producing planetesimals. We use a radiative transfer model to analyze the spectral energy distributions and imaging of the dust disks, and a dynamical model to assess the long-term stability of the planetesimals' orbits. This study can help us learn about the diversity of planetary systems.

Circumbinary planets and brown dwarfs

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Searching for planetary and brown dwarf companions to evolved close binary stars (e.g., sdB+dM and WD+dM binaries) can provide insight into the formation and the ultimate fate of circumbinary substellar objects, as well as can shed light on the late evolution of binary stars (e.g., the evolution of common envelope (CE)). Since the timing method has most successfully been applied to detect extrasolar planets around stars evolved beyond the first red giant branch, we have monitored some evolved eclipsing binaries for a few years. In my talk, I will review current observational results of circombinary planets and brown dwarfs with different methods. Then, I will present some of our findings including the circumbinary brown dwarf with the shortest distance to the central binary and a few multiple planetary systems orbiting evolved binaries. Finally, by comparing the observational properties of substellar objects companion to different types of host binaries, the fate of the orbiting circumbinary objects as well as for their effect on the evolution of the host binaries will be discussed.

The December 2010 outbreak of a major storm in Saturn's atmosphere

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On December 5, 2010, a major storm erupted in Saturn's northern hemisphere at a planetographic latitude of 41.0 deg. These phenomena are known as "Great White Spots" (GWS) and they have been observed once per Saturn year since the first case confidently reported in 1876. The last event occurred at Saturn's Equator in 1990 (Sánchez-Lavega et al., Nature, Vol. 353, 397.1991). A GWS differs from similar smaller-scale storms in that it generates a planetary-scale disturbance that spreads zonally spanning the whole latitude band. We report on the evolution of the cloud field and motions of the new GWS and its associated disturbance during the months following the outbreak, based mainly on high quality images obtained in the visual range and submitted to the International Outer Planet Watch PVOL database. The high temporal coverage allows us to study the dynamics of the GWS in detail and multi-wavelength observations provide information on its cloud top structure. We also present non-linear simulations using the EPIC code of the evolution of the potential vorticity generated by an impulsive and localized Gaussian heat continuous source, comparing the results to the cloud field (both acting as passive tracers of the flow) of the GWS.

Venus Express: five years of observations

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Since April 2006 Venus Express has been performing a global survey of the remarkably dense, cloudy, and dynamic atmosphere of our near neighbour. More than 300 radio-occultation experiments covering all latitudes and local times on had been acquired so far. They reveal highly variable temperature structure in the mesosphere and within the clouds. Joint analysis of several experiments indicated coordinated latitudinal changes of the cloud top structure with high dispersed cloud tops in the low latitudes and relatively low dense clouds in the cold collar and the polar region. UV imaging monitors strongly variable cloud patterns showing for the first time middle latitudes and polar regions in unprecedented detail. Tracking cloud features at both

UV and thermal infrared wavelengths characterizes the global wind field and its variations, including pioneering reconstruction of the velocity patterns inside the polar eye of the hemispheric vortex. The observations are supported by development of General Circulation Models. Spectroscopic observations in both nadir and occultation geometries continuously sound composition of the mesosphere and discover significant latitudinal variations of water vapour and sulphur dioxide that form cloud particles. Contrary to expectations the observations indicate no apparent correlations with UV brightness patterns. Non-LTE infrared emissions in the lines of O_2, NO, CO_2, OH originating near the mesopause at 95-105 km altitude are being mapped on the night side. The data show that the airglow peak intensity occurs close to the anti-solar point and its location depends on particular specie. A consistent picture of the climate on the neighbouring planet is emerging from the Venus Express observations supported by extensive modelling efforts. The results of the studies will be published in about 40 original papers in the special issue of Icarus to appear in 2011.

Thermal Structure and Interior Dynamics of the First Rocky Exoplanets

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This study is aimed at the interior structure and thermal state of massive rocky exoplanets. We have modeled the interior structure of confirmed super-Earths CoRoT-7b and Kepler-10b, applying a mixing length approach for the radial temperature distribution. 2-D cylindrical mantle convection simulations are performed using the compressible anelastic approximation. These demonstrate the importance of the usage of depth-dependent thermodynamic parameters such as thermal expansivity, conductivity, and density. The calculations indicate that CoRoT-7b and Kepler-10b are similarly composed. Whereas thermal conductivity and density increase with depth by a factor of two, thermal expansivity decreases by more than an order of magnitude across the mantle. The planform of mantle convection is strongly modified in the presence of depth-dependent material properties with hot plumes rising across the whole mantle and cold downwellings assimilated in the mid mantle.

Planetesimals and dust around nearby stars

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More than 500 nearby stars are known to have orbiting extrasolar planets, and a similar number are known to have orbiting debris, i.e., dust, asteroids and comets. Just as in the Solar System, observations of extrasolar debris disks provide unique information on the structure, formation and evolution of the planetary systems in which they reside. They have even been used to predict the presence of unseen planets that have later been confirmed through direct imaging. As the numbers of systems found to have both extrasolar planets and debris disks grows, the connection between these two phenomena is becoming clearer. In this talk I will describe what we have learnt about what's around nearby stars from studies of their debris disks, including results from DEBRIS, a key programme currently underway using the Herschel Space Observatory to search for cold dust emission toward the nearest ∼500 stars.

Mission Venera-D — scientific goals and scientific payloads

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The mission Venera-D is included in the Russian Federal Space Program (2006-2015), being in phase A now. It is the mission for investigation of the surface, atmosphere and plasma environment to understand the

formation and evolution of the planet and its atmosphere. This mission includes the lander, orbiter and small subsatellite. The complex of the scientific experiments is aimed for the following:

– investigation of structure, chemical composition of the atmosphere, including noble gases, abundance and isotopic ratio, structure and chemistry of the clouds; study of dynamics and nature of the superrotation, radiative balance, nature of an enormous greenhouse;

– study of the structure, mineralogy and geochemistry of the surface, search volcanic and electrical activity, interaction of the atmosphere and the surface;

– investigation of the upper atmosphere, ionosphere, magnetosphere, and the escape rate of the atmosphere.

POSTERS

S2-1. The Scorpiids meteoroid complex

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As a result of investigation of the orbital evolution of the 9 near-Earth asteroids 2003HP32, 2006WX29, 2007JD, 2007TB14*, 2007VH189, 2007WT3, 2007WY3, 2008UM1*, 2008UU95* discovered in 2003-2008, during one cycle of variations of the argument of perihelion (4-10 kyrs) it was found that all of them are associated with the same meteoroid stream which can produce four meteor showers. As a result of the search in published catalogues of observable showers these theoretically predicted showers were identified with the active night-time χ- Scorpiids (the coordinates of radiant $\alpha = 247.7^o$, $\delta = -13.1^o$, the maximum of activity 01.06) and δ - Scorpiids ($\alpha = 239.7^o$, $\delta = -21.1^o$; 31.05) [1-4], and day-time Northern ($\alpha = 230.9^o$, $\delta = -7.3^o$; 15.11) and Southern Lybrids ($\alpha = 225.3^o$, $\delta = -24.3^o$; 11.11). Moving on nearly identical comet-like orbits of these 9 objects (the Tisserand invariant Tj$\leq$3) and existence of related active meteor showers indicate that these objects are in fact dormant comet nuclei or fragments of a larger cometary body, and should be considered as the constituent components of the Scorpiids meteoroid stream producing mentioned showers.

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S2-2. High resolution heterodyne NIR spectrometer for studies of planetary atmospheres

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We present the development of an ultra-high resolution heterodyne spectrometer operating in the near-infrared spectral range (1.5–4 micron). The signal from a telescope is mixed with heterodyne radiation in a single mode optical fiber, that provides wavefront alignment. The frequency resolution is restricted by linewidth and jitter of a local oscillator. The frequency of a narrow-line (1 MHz) DFB laser is swept using a feedback with a reference gas cell, with dynamical stabilization accuracy up to 500 kHz. This allowed to reach spectral resolution of $\sim 10^8$. The mixer is based on a NbN hot electron bolometer (HEB) operating at 10 K and cooled by liquid helium closed cycle machine, revealing the sensitivity close to the quantum limit. The expected resolution will allow for Doppler measurements of wind velocities in planetary atmospheres, thermal profiling and monitoring of minor constituents with high signal-to-noise ratio.

S2-3. The behavior of the ammonia absorption band NH3 787 nm on Jupiter's disk

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During the last years the program of the spectrophotometric study of Jupiter included the measurements of the ammonia absorption band NH3 787 nm. This band is blended with more wide CH4 absorption. To detect NH3 band we have used the ratio of Jovian spectra to the spectrum of Saturn equatorial region. because the ammonia absorption on Saturn is significantly weaker than on Jupiter. The results of the spectrograms processing have been analyzed for years 2007-2010. The variations of the NH3 band with latitude show regularly the depression of the absorption at low and temperate latitudes of Jovian northern hemisphere. The equivalent width decreases approximately from 18-16 A to 14-12 A More or less symmetric and more steep decrease of absorption from the disk center to limbs was obtained for the equatorial belt of Jupiter. It should be noted that the ammonia decrease in northern hemisphere was detected also from radioobservations. of Jupiter.

S2-4. Discovery and investigation of comet 67P/Churyumov-Gerasimenko — the main target of the "Rosetta" space mission

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The Jupiter family short period comet 67P/Churyumov-Gerasimenko was selected as main target of the European space mission Rosetta. Comet 67P was discovered in 1969 by Klim Churyumov and Svitlana Gerasimenko on the five plates got Sept. 9, 11 and 21, 1969 with the help of 50-cm f/2.4 Maksutov telescope in Alma-Ata. On the basis of photometric processing of the two photographic images of comet 67P obtained in Nizhny Arkhyz with the help of the 6- BTA reflector of SAO of RAS some physical parameters of the magnetic field of the comet plasma tail (coefficients of diffusion D_{par}, D_{per} and induction of magnetic field B) were determined. On March 2, 2004 Rosetta space mission successfully started from the Kourou cosmodrom to comet 67P/Churyumov-Gerasimenko nucleus. Rosetta will be the first spacecraft to orbit a comet's nucleus. It will be the first spacecraft to fly alongside a comet as it heads towards the inner Solar System. Rosetta will be the first spacecraft to examine from close proximity how a frozen comet is transformed by the warmth of the Sun. A lander, named Philae, will be deployed and attempt to make the first ever controlled landing on a comet.

S2-5. Dynamical simulations of late stages of multiple planet systems formation

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Dynamical processes leading to the formation of giant planet systems with various orbital characteristics are investigated. The model includes gravitational interactions of planets and migration of planets due to the presence of a gas disc. For the system of four giant planets like the Solar system, we show how capture of all planets into resonances occurs at Type I migration. The resonant motion can remain after transition to Type II migration as well as after dissipation of gas. For the GJ 876 system, it is shown how planets can migrate to orbits located inside the orbit of the most massive planet. Features of subsequent capture of planets into low-order resonances are investigated too. For the planetary system HD 102272, capture of planets into high-order resonances and subsequent evolution to high-eccentricity orbits are studied. We explain also how planetary

systems similar to the GJ 581 system form. This work was supported by RFBR Grant 09-02-00511 and the Federal Targeted Programme 'Scientific and Educational Human Resources of Innovation-Driven Russia' for 2009–2013.

S2-6. Spectroscopic characterization of exoplanets' atmospheres

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The detection of many exoplanets by transits now makes possible their characterisation by infrared spectroscopy. During primary transits (when the planet passes in front of the star), the exoplanet's atmosphere is probed through the detection of absorption features. Before and after secondary transits (when the planet passes behind the star), the reflected/scattered component provides information on molecular abundances through the observation of absorption bands. In the thermal regime, the spectrum can show emission or absorption features, depending on the gradient of the thermal profile. It is important to observe both the reflected/scattered component and the thermal component, and also to observe, for a given atmospheric species, several bands of different intensities to probe different atmospheric levels. This requires the simultaneous observation of the infrared range (1-16 μm). The EchO mission, preselected by ESA for the Cosmic Vision M3 program, is designed for this purpose.

S2-7. Resonance motion of exoplanets with regard to Lidov-Kozai effect

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In this report, special features of the motion of exoplanets being in resonance of mean motions are studied having regard to the Lidov-Kozai effect (so called the "Kozai resonance") for the case of high inclinations. A variety of planets' configurations and masses are considered. Eccentricity oscillations characteristic for the Lidov-Kozai effect can still persist in the case of few order resonances of mean motions.

S2-8. Light curves and photometrical peculiarities of some comets last years

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The light curves of last bright comets (C/2006 W3 (Christensen), C/2007 Q3 (Siding Spring), C/2009 K5 (McNaught), C / 2009 R1 (McNaught), 10P/Tempel, 81P/Wild, 103P/Hartley) have been constructed on the base of estimates of the integrated brightness, published in the International Comet Quarterly. The photometrical parameters of these comets were determined and peculiarities of their outburst activity were investigated. A comparison of the photometrical behavior of these comets with a change in the level of solar activity was made.

S2-9. Cavities as a source of outbursts from comets

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Analysis of observations of natural and triggered outbursts from different comets testifies in favor of existence of large cavities with material under gas pressure below a considerable fraction of a comet's surface. Based on analysis of images of the cloud of material ejected from Comet 9P/Tempel 1 after the collision of the Deep Impact (DI) module with the comet, we studied the time variations in the rate and velocities of ejection of observed particles. The studies testify in favor of that the upper boarder of the main cavity excavated by DI could be located at about 5-10 meters below the surface of the comet. This research was supported in part by American Astronomical Society's Small Research Grant Program.

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S2-10. Latitudinal variations of molecular absorptions on Saturn between the equinoxes 1995 and 2009

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The space-time variations of the methane absorption bands on Saturn's disk were investigated during the period between equinoxes 1995 and 2009 using zonal CCD-spectrograms and spectrograms of central meridian of the planet. The atlases of the CH4 absorption bands profiles and latitudinal variations of absorption have been prepared Along with latitudinal variations connected with the change of an inclination of Saturn's equator the regular absorption increase in a southern temperate belt of Saturn is revealed. In 2009 almost symmetric distribution of absorption in southern and northern hemispheres was observed in contrast with 1995 when the absorption was much more in northern hemisphere. It is explained by the differences in heliocentric distances of Saturn before approaches of equinoxes 1995 and 2009. Last years there were noted also the distinctions in the NH3 647 nm absorption band intensity which was stronger at midlatitudes of northern hemisphere than at southern one.

S2-11. The Orionids 2006-2008 from TV observations by the FAVOR camera

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We present the results of single-station TV observations by the high-sensitive hybrid FAVOR camera for the period 2006–2008. The limiting magnitude of this camera for meteors is about 9m...10m in the field of view 400 square degrees. 12359 single-station meteors were obtained through the period of observations. 245 of the meteors observed belong to the Orionid meteor stream. The Index of meteors activity (distribution of the influx rate to the Earth) of Orionids for the period from 2006 to 2008 is calculated. The distribution of Orionid meteors by stellar magnitude are also presented. The comparison with the data obtained by other researchers is carried out.

S2-12. The thermal atmospheric mass loss history of CoRoT-7b and Kepler-10b

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We present thermal mass loss calculations of the super earths CoRoT-7b and Kepler-10b. We use an energy limited approach considering Roche lobe effects, proper heating efficiencies, and power laws which represent the stellar EUV flux evolution. We find that both exo-planets experienced only small mass loss over their lifetime (in the order of one earth mass). In addition we show that Jupiter or Saturn mass planets at an orbital location of 0.017AU do not loose such an amount of atmospheric mass that objects like CoRoT-7b and Kepler-10b could remain.

S2-13. Could the radius excess of hot Jupiter be an indicator of planet formation in binary mergers?

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It is well known that many transiting hot Jupiters have radii much larger than expected from the ages inferred from their host stars. In this paper we examine the hypothesis that radius excess of hot Jupiters could be an indicator of their cooling age after they have formed in the excretion disk produced by the merger of a low-mass contact binary. Pros and cons of this hypothesis are discussed in the framework of the observational properties of exoplanets.

S2-14. Strange attractors in the rotational dynamics of minor planetary satellites

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We accomplish a numerical-experimental research of the conditions for emergence of strange attractors in the rotational dynamics of minor planetary satellites, when the vicinity of synchronous resonance in the course of the tidal evolution of the rotational motion is reached. We assume that the satellite has an arbitrary form and moves in a fixed elliptic orbit in the gravitational field of a point mass; the axis of rotation is orthogonal to the orbit plane. The value of the dissipation parameter (the parameter responsible for dissipation of the rotational energy) is determined at which the strange attractor appears visually on sections of the rotational motion phase space. The dependence of the Lyapunov exponents of the motion on the dissipation parameter value is numerically determined, allowing one to fix the moment of the attractor emergence. Proceeding from analytical expressions for the dissipation parameter, we determine the conditions for a physical opportunity of emergence of the strange attractors in the rotational dynamics of real minor planetary satellites.

S2-15. Mass loss history of close-in exoplanets

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Planets located close to their host stars are expected to experience substantial atmospheric mass loss during their lifetime. We study the mass loss history of the transiting Super-Earth GJ 1214b. The evolution of the host star's activity, as well as Roche lobe effects are taken into account. Our results indicate that GJ 1214b has lost less than one Earth-mass during its evolution by thermal escape. Additional non-thermal losses induced by stellar wind interaction are lower than thermal ones, or at maximum comparable if very strong stellar mass loss is assumed.

S2-16. Escape statistics in triple systems: implications for survival of exoplanets

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We study the escape process statistics in the general three-body problem by means of numerical simulations. The lifetime distributions are constructed on large survival timescales. The lifetime is the survival time of a triple system as a bound system. We confirm that the distributions have algebraic tails. The power-law index values are in the narrow range from -1.7 to -1.4 (for the lifetime differential distributions). The index does not exhibit substantial dependence on the virial ratio. We compare our results to other authors' results obtained for particular variants of the three-body problem. We show that the revealed properties of the escape statistics are of particular importance for modelling the dynamical evolution of the two-planet extrasolar systems and, generally, hierarchical exoplanetary systems. We consider prototype examples for such systems.

S2-17. Formation of the Solar system in large region of star formation

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The fundamental problems of planetary cosmogony and construction of the standard scenario of the origin of the Solar system are discussed. We studied influence of environment on the planetary systems formed in the close proximity to surrounding young stars. After contacts with expanding supernova remnants and powerful streams of stellar winds from young giants, new portions of short-lived nuclides (26Al, 60Fe, ..., 182Hf ...) could be added to material of the protoplanetary disk at different stages of its evolution. Being deposited on the surface of dust and small particles, they could change the "initial" abundances and cause "rejuvenescence" of cosmo- and geo-chronometers. Generalization of the classical problem of growth of the Earth and other planets allows us to obtain estimates of the growth time of massive bodies, which are consistent with modern isotopic data based both on the U-Pb system and on the Hf-W system.

S2-18. Raman laser spectrometer for ExoMars

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The Raman Laser Spectrometer (RLS) is one of the Pasteur Payload instruments, within the ESA's Aurora Exploration Programme, ExoMars mission. Purpose: Two missions are foreseen within the ExoMars programme: one consisting of an Orbiter plus an Entry, Descent and Landing Demonstrator (to be launched in 2016) and the other, with a launch date of 2018, which will include an ESA Rover. The ESA Rover will carry a drill and a suite of instruments dedicated to exobiology and geochemistry research. ExoMars 2018 main Scienti c objective is 'Searching for evidence of past and present life on Mars'. Particularly, the RLS scientific objectives within ExoMars Mission are as follows: identify organic compound and search for life identify the mineral products and indicators of biologic activities characterize mineral phases produced by water-related processes characterize igneous minerals and their alteration products characterise water/geochemical environment as a function of depth in the shallow subsurface Methodology: Raman Spectroscopy is used to analyse the vibrational modes of a substance either in the solid, liquid or gas state. It relies on the inelastic scattering (Raman Scattering) of monochromatic light produced by atoms and molecules. The radiation-matter interaction results in the energy of the exciting photons to be shifted up or down. The shift in energy appears as a spectral distribution and therefore provides an unique fingerprint by which the substances can be identified and structurally analyzed. The RLS is being developed by an European Consortium composed by Spanish, French, German and UK partners. It will perform Raman spectroscopy on crushed powdered samples inside the Rover's Analytical Laboratory Drawer. Results: RLS expected main characteristics are as follows: Laser excitation wavelength: 533 nm Irradiance on sample: 0.6 1.2 kW/cm^2 Spectral range: 150-3800 cm^{-1} Spectral resolution: 6 cm^{-1} lower spectral wavenumbers; 8 cm^{-1} long spectral wavenumbers Spectral accuracy: $<$1 cm^{-1} Spot size: 50 microns 1 Conclusions: The RLS is a key tool to achieve ExoMars objectives and its current technological development provides a promising future for being used on other planetary missions as a non destructive analysis technique.

S2-19. The 1.27μm oxygen nightglow in the Venus atmosphere from the VIRTIS-M data

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The results of the O2 nightglow analysis, which is a passive tester of circulation, are present. To obtain the O2 emission rate from the nadir VIRTIS-M data, the thermal emission of the lower atmosphere and reflection from the clouds were taken into account. The averaged O2 emission rate map in coordinates "local time – latitude" shows that at latitudes $< 20°$S, the circulation is SS-AS. At higher latitudes the maximum emission is observed before midnight and deep minimum — after midnight. Correlation with the horizontal wind speed was found: the maximum emission (before midnight) correlates with the minimum of horizontal wind speed, where also the direction of wind changes, which indicates to downward flow in these areas. Minimum emission rate after midnight correlates with high horizontal wind speed. The influence of the retrograde zonal superrotation was not identified in the S-hemisphere. From limb measurements (N-hemisphere), at latitudes $< 50°$N the maximum emission is shifted to 1h of localtime, it may indicate to the input of zonal superrotation there. Limb profiles with the double emission maxima, similar to those in the Earth atmosphere, may indicate to activity of the gravity waves.

S2-20. Gravitational instability of gas-dust Keplerian disk

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Gravitational stability of self-gravitating axisymmetric Keplerian disc is analytically investigated. In our issue gravitational stability of accretion disks of young stars is considered as a possible mechanism of planet formation. Dispersion relation for the gravitational instability is derived in two-fluid (gas+dust) approximation using small perturbations theory. Pressure gradient doesn't affect the relatively large dust particles, but stabilizes gas. The contraction of the dust component is stabilized with the rotation and the friction with gas. We show that conditions for gravitational instability of accretion disks are changed qualitatively in presence of dust.

S2-21. Massive identification of asteroids in three-body resonances

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An appreciable role in the asteroidal dynamics is played by the so-called three-body mean motion resonances. Identification of asteroids in three-body (namely, Jupiter-Saturn-asteroid) resonances was first accomplished by Nesvorny and Morbidelli (1998), who found 836 asteroids to be located in such resonances. They determined the association to resonance visually by analyzing the time behaviour of the resonant argument. We develop specialized algorithms and software for massive automatic identification of asteroids in the three-body Jupiter-Saturn-asteroid resonances of arbitrary order. All essential perturbations are taken into account. The project is intended for the resonance analysis of the orbital data presented at the "Asteroids — Dynamic Site" (AstDyS) maintained by A. Milani, Z. Knežević and their coworkers. We integrate the asteroidal orbits on the time interval of 100000 years and identify objects in the three-body resonances of order up to 7 in the AstDyS database of more than 400000 asteroids.

S2-22. Possible collisions of asteroid Apophis

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Asteroid Apophis is now one of extremely dangerous NEO. As a result of trajectories scattering after approach of asteroid Apophis with the Earth in 2029 and possible approach in 2036, many hazard trajectories arise, including trajectories with collisions. Our goal is to search for such trajectories. We applied the Everhart integrator. We know more than 50 possible collisions in XXI century, including 13 collisions after 2036, before 2050. The minimum geocentric distances, derived using different ephemerides (DE405, DE423), differ from each other small. For collisions before 2050, we derive the size of holes. The similar results, presented in (Yeomans D. K. et al., Deflecting a hazardous Near-Earth Object. The 1st IAA Planetary Defense Conference: Protecting Earth from Asteroids, Granada, Spain, 27-30 April 2009), are in agreement with our results.

S2-23. The molecular absorption bands behavior on Jupiter before and at the southern equatorial belt disappearance

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The disappearance of dark Southern Equatorial Belt (SEB) in 2010 is not exclusive but very rare event on Jupiter. Spectral observations of Jupiter on the observatory of Fessenkov Astrophysical Institute are fulfilling regularly during each season of this planet visibility There were 14 observational nights in June-October 2009 and 18 nights in July-December 2010. All data of 2010 observations show the absence of clearly expressed anomalies in SEB which may be visible in the molecular absorption. The band CH4 890 nm is seemed even stronger in SEB than in NEB as seen from the comparison of their spectral profiles. The ammonia absorption in the band 787 nm in 2010 is keeping the depression in Northern hemisphere as in preceding years and do not show anomalies in SEB. The decrease of the NH3 absorption was detected also in the Great Red Spot region

S2-24. AMPLE 3 — Multi-purpose Software Package for Minor Planets and Comets

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New package AMPLE 3 for dealing with minor planets has been developed in the Institute of Applied Astronomy of RAS. The package combines quality and features of three existing packages: 1) AMPLE (Adaptable Minor PLanet Ephemerides) with annually updated database; 2) AMPLE for Comets (for study of short-period comets); 3) MUSE — monthly updated package for solving some typical problems connected with calculation of ephemeris information and study of the asteroid belt in the Solar system. At present three branches of the package are ready for use: 1) Tables of elements of small bodies (sampling, sorting, construction of histograms, 2- and 3-dimensional distributions etc.); 2) Visualization of orbits; 3) Ephemeris calculations. The package AMPLE 3 is developed for Windows operating systems (XP, Vista, 7 etc.) and Linux. Inclusion of one more branch in the package for dealing with observations (calculation of O – C, identification, working with CCD-frames etc.) is supposed.

S3: The Sun: New Challenges

Conveners:
Vladimir Obridko (IZMIRAM, Russia),
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Solar Corona Heating

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The coronal heating problem has been narrowed down by substantial progress in theoretical modeling with MHD codes, new high-resolution imaging with the SXT, EIT and TRACE telescopes, and with more sophisticated data analysis using automated pattern recognition codes. The total energy losses in the solar corona range from $F = 3 \cdot 10^5$ erg/s cm^2 in quiet Sun regions to $F = 10^7$ erg/s cm^2 in active regions. Theoretical models of coronal heating mechanisms include the two main groups of DC and AC models, which involve as a primary energy source chromospheric footpoint motion or upward leaking Alfven waves, which are dissipated in the corona by magnetic reconnection, current cascades, MHD turbulence, Alfven resonance, resonant absorption, or phase mixing. There is also strong observational evidence for solar wind heating by cyclotron resonance, while velocity filtration seems not to be consistent with EUV data. Progress in theoretical models has mainly been made by abandoning homogeneous fluxtubes, but instead including gravitational scale heights and more realistic models of the transition region, and taking advantage of numerical simulations with 3D MHD codes. From the observational side we can now unify many coronal small-scale phenomena with flare-like characteristics, subdivided into microflares (in soft X-rays) and nanoflares (in EUV) solely by their energy content. Scaling laws of the physical parameters corroborate the unification of nanoflares, microflares, and flares; they provide a physical basis to understand the frequency distributions of their parameters and allow estimation of their energy budget for coronal heating. Synthesized data sets of microflares and nanoflares in EUV and soft X-rays have established that these impulsive small-scale phenomena match the radiative loss of the average quiet Sun corona, which points to small-scale magnetic reconnection processes in the transition region and lower corona as primary heating sources of the corona.

New analytical models of thin reconnecting current layers with MHD shock waves of finite length

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In the considered models the flow pattern near current layer with attached MHD shock waves is not prescribed but is determined from a self-consistent solution of the MHD problem in the approximation of a strong magnetic field. Generalized analytical solutions are found taking into account the possibility of a current layer rupture in the region of anomalous plasma resistivity. The global structure of the magnetic field in the reconnection region and its local properties near the current layer and attached discontinuities are studied. In the reconnection regime with reverse current in the current layer, the attached discontinuities occur to be trans-Alfvenic shock waves near the current layer edges. Two types of transition of nonevolutionary shocks into evolutionary ones along discontinuous flows are shown to be possible, depending on the geometrical model parameters. The relationship between the results obtained and numerical magnetic reconnection experiments is discussed.

Sub-Thz radiation in solar flares: implications for particle acceleration and transport

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Observations in the sub-THz range of large solar flares have revealed a mysterious spectral component increasing with frequency and hence distinct from the microwave component commonly accepted to be produced by gyrosynchrotron (GS) emission from accelerated electrons. Evidently, having a distinct sub-THz component requires either a distinct emission mechanism (compared to the GS one), or different properties of

electrons and location, or both. We discuss a number of emission mechanisms, capable of producing a sub-THz component, both well-known and new in this context, including the Cherenkov emission. Full understanding of the nature of this component requires, apparently, (1) detailed knowledge of the electron acceleration and transport in flares, the current state-of-the-art of which will be overviewed, and (2) more detailed observations at this range, which might be performed by new ALMA instrument. Within the context of modern concepts and newest radio and X-ray constraints on the electron acceleration and transport we discuss the possible role of the mechanisms in forming the sub-THz emission and emphasize their diagnostics potential for flares.

The unusual sunspot minimum — challenge to the solar dynamo theory

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During the recent decades, much progress was achieved in the development of the solar dynamo theory. The beginning solar cycle 24 is the first one attempted to be predicted not only from extrapolation or precursor methods, but also based on physically consistent dynamo models. However, the predictions for the next sunspot maximum, based on virtually the same dynamo models, range from the lowest one in the last 150 years to the highest one during the whole sunspot observational period. Furthermore, the unusually low and prolonged minimum between cycles 23 and 24 was not expected, not explained, and with unclear consequences for the future solar activity. In the present talk we summarize the solar, heliospheric and geospace observations during this unusual minimum, and their implications for the solar dynamo theory.

On our Ability to Predict Major Solar Eruptions

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As human society becomes increasingly dependent on space-based assets and infrastructure a reliable forecasting of inclement space weather conditions poses more as a vital necessity rather than as an optional luxury. In this presentation we focus on what does, and what does not, work when attempting to forecast the solar end of space weather, namely, solar flares and coronal mass ejections. We further explain why it is more likely for solar eruption forecasting to remain inherently probabilistic. Two recently introduced, but tested and found promising, flare forecasting metrics are discussed in some detail. Future challenges, as well as ongoing efforts to adapt these metrics for use with magnetic field data acquired by the newly launched Solar Dynamics Observatory mission are also highlighted.

On the Interaction of the Solar Rotational Discontinuities with a Contact Discontinuity Inside the Solar Transition Region as a Source of Plasma Heating in the Solar Corona

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The selfsimilar MHD problem of the oblique interaction of a solar Alfven or rotational discontinuity with a stationary contact discontinuity is examined. Since there exist numerous solar Alfven waves observed in the solar plasma, there is a real occasion to have a solar rotational discontinuity going through the transition region to the solar corona. When the density on C drops significantly, as in the case considered, the MHD slow waves generated in the interaction are always shock waves. It is possible to have a real source of plasma heating due to damping of the dissipative slow MHD shock waves in the result of the well-known Landau damping. The dissipative slow MHD shock waves with small change of the magnetic field do appear as the result of refraction of the solar undissipative rotational discontinuities against a contact discontinuity inside the

transition region. The explosive events may also be triggered in the chromospheric plasma. Thus, a new model of plasma heating of the coronal plasma is proposed. The work was supported by grant RFFI 11-01-00235 and by Program OFN-15.

Evolution of the cyclic activity of the sun in the context of physical processes on late-type stars

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Features of the solar cycle in the context of stellar activity are investigated. We discovered reliably differential rotation in chromospheres of some stars and presented the first stellar butterfly diagrams. They do not demonstrate excellent cycles and possess less regular variability. This is the first evidence for differences of the solar activity from processes on stars with Excellent cycles. We compare indices of the chromospheric activity of the Sun with that for above 1300 northern and southern stars whose activity revealed during planet search programs. We argue the matter pro and con for two possible ways of an evolution of activity from a contraction phase to 10 Gyrs. When a young star brakes down, the chromospheric and the coronal activity go down synchronously, whereas on the second way the chromospheric activity diminishes up to the solar level, while coronae stay stronger than the solar one. Effects of magnetic fields of various scales and exoplanets are also discussed.

Observations of solar flares from GHz to THz frequencies

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The discovery of a new solar burst spectral component with sub-THz fluxes increasing with frequency, simultaneous but separated from the well known microwave component, brings serious constraints for interpretation. Suggested explanations and their limitations are briefly reviewed. The knowledge of THz continuum spectral shape is essential to investigate the nature of the emission mechanisms involved. New 45 and 90 GHz high sensitivity solar polarimeters are being installed at El Leoncito high altitude observatory, where sub-THz (0.2 and 0.4 THz) solar flare flux data are being obtained regularly since several years. The technical challenges to build THz photometers for continuum solar observations are shortly described. They should be carried in space or at few selected frequency windows at exceptional ground-based sites. A 3 and 7 THz dual photometer system has been developed. The use Golay cell sensors, preceded by a low pass membrane filter (f<15 THz), resonant metal mesh band-pass filters, and tuning fork resonant chopper. The incoming solar signal is collected by 75 mm diameter Cassegrain telescopes with rough surfaces (to diffuse most of the visible and near IR thermal radiation). Brazil funding agency FAPESP has recently approved the construction of the dual THz frequency photometer system to be flown in a long duration stratospheric balloon flight in Antarctica (two weeks circumnavigation) in cooperation with University of California, Berkeley, together with GRIPS (Gamma-Ray Imaging Polarimeter for solar flares) experiment. One test flight is planned for 2012. USA. Another long duration balloon flight over Russia (one week) is considered between 2014-2016, in a cooperation with Moscow Lebedev Physics Institute.

Dynamics of the electric currents in the flaring coronal magnetic loops

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Analyzing the low-frequency modulation of coronal magnetic loops microwave emission a peculiar modulation was found. Its frequency increases several times directly before the flare and decreases to the initial value during the flare event. It is shown, that such modulation type can be an evidence of the abrupt current increase in the loop directly before the flare process, resulting in coronal plasma heating and growing energy release. We suggest the flute instability as a cause of the current rapid increase. The scale of the process can be different, varying from the huge flares observed in the X-rays to the microflares. The observed increase and oscillations of the current can also cause the onset of the induced electric field leading to particle acceleration in the coronal part of the loop. The accelerated particles travel to the loop footpoints where they collide with the chromosphere. The possibility of plasma heating due to this process is also discussed. This work was partially supported by the RFBR project N 11-02-00103-a, by the project NK-21P of the Education Ministry of the Russian Federation and by the EU grant N 228319 in the framework of the Project Europlanet RI-FP7.

Solar irradiance: Is the change between 1996 and 2008 peculiar?

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Different proxies of solar activity suggest that the minimum in 2008 was deeper and longer than the previous minima since the beginning of the 20th century. Also solar total irradiance showed a lower level compared to the previous two minima covered by space-based measurements. Moreover, the amplitude of the decrease in the total solar irradiance (TSI) between 1996 and 2008 relative to the cycle amplitude was found to be larger than the corresponding magnitude shown by other proxies. This has been interpreted as evidence against solar surface magnetism as the main driver of the secular change in the TSI. We have reconstructed the TSI over cycle 23 using our SATIRE-S model based on 60-min averaged MDI magnetograms and continuum images. We find that the change in the TSI between the minima in 1996 and 2008 is consistent with the solar surface magnetism mechanism.

On nonlinear magnetic diffusion in solar atmosphere and its implications for chromospheric heating

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It was shown earlier that electrical conductivity of coronal and chromospheric plasma should be described taking into account Cowling conductivity. The dependence of diagonal conductivity tensor components on magnetic field B leads to nonlinear magnetic diffusion. This work presents numerical and analytical results for diffusion widening of a plasma loop in corona, and for the process of formation of a magnetic tube by sweeping magnetic flux together by a convergent plasma flow including plasma heating due to dissipation of inhomogeneities of the magnetic field in the inflowing plasma. We show that a sharp boundary with a steep gradient of the magnetic field between the regions with high B (the nonlinear mode) and with low B (the linear mode) should form and persist unlike the case of the regular linear magnetic diffusion, and that plasma heating by the mechanism mentioned above is localised near that boundary.

The Nature of Solar Dynamo in the Light of New Observational Inputs and Modeling Results

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In my talk I review the mechanisms of generation of cyclic and migrating magnetic activity in the Sun. I discuss the key principles of the dynamo mechanism as well as its simplest forms. There are a number of recent advances in theoretical modeling of turbulent magneto-convection in rotating compressible plasmas of solar and stellar envelopes. Supercomputer simulations enable numerous features of the resulting magnetic fields. Moreover, a series of attempts is made to unveil the regularities in the solar cyclic activity by introduction of various ingredients that specifically contribute to the generation processes, such as the α-effect. Important inputs to our understanding of dynamos are new observational data on dynamics of high resolution three-component magnetic fields. They contain important information on solar turbulence and scale separation in convection. Furthermore, new observational quantities probing the solar magneto-convection become available, such as spatial distribution of magnetichelicity over the solar cycle, which imposes an additional constrain to magnetic manifestations of the solar cyclic activity.

Evolutionarity of Discontinuous Flows near Reconnecting Current Layers in Solar Flares

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The question about the interpretation of laboratory and numerical experiments on magnetic reconnection in solar flares is considered. A correspondence between the standard classification of MHD discontinuities and the parameters characterizing the mass flux through a discontinuity and the magnetic field configuration has been established within a classical formulation of the problem on discontinuous MHD flows. A relationship between the angles of the magnetic field relative to the normal to the discontinuity plane on both its sides has also been found. Conditions of evolutionary transitions between different types of discontinuities by gradual changing of plasma's parameters are obtained. The result is applied to the problem on the magnetic field structure in the vicinity of a reconnecting current layer. The regions of nonevolutionary shocks are shown to appear near the edges of a current layer with reverse currents.

Formation of the two component frequency spectrum in microwave and Sub-THz emission

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The sub-THz component of solar flares is an emission observed in some flares as a secondary peak in the spectrum, typically above 100 GHz. Up to now, several mechanisms are suggested to explain this phenomenon. Among them are inverse Compton, gyrosynchrotron, free-free, Cherenkov, and synchrotron emission in stochastic medium. However, none of them can explain the full set of known properties of sub-THz emission and its relations to other emissions like microwave, hard X-ray etc. In this paper we search for specific reasonable conditions in flaring loops which allow to produce the sub-THz emission component in solar flares. We study in detail the gyrosynchrotron and free-free emission/absorption mechanisms in a combination with different non-stationary spatial distributions of relativistic electrons and plasma density/magnetic field distributions in magnetic loops. The proposed model is able to explain the appearance of the two spectral peaks (microwave and sub-THz) simultaneously, even from a single flaring loop, as well as the center-to-limb assymetry of sub-THz emission, and other observables.

Slow Magnetoacoustic Waves in Two-Ribbon Flares

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We demonstrate that disturbances observed to propagate along the axis of the arcade in two-ribbon solar flares at the speed of a few tens km/s, well below the Alfvén and sound speeds, can be interpreted in terms of slow magnetoacoustic waves. The waves can propagate across the magnetic field, parallel to the magnetic neutral line, because of the wave-guiding effect due to the reflection from the footpoints. The perpendicular group speed of the perturbation is found to be a fraction of the sound speed, which is consistent with observations. The highest value of the group speed grows with the increase in the ratio of the sound and Alfvén speeds. For a broad range of parameters, the highest value of the group speed corresponds to the propagation angle of 25-28 degrees to the magnetic field. This effect can explain the temporal and spatial structure of quasi-periodic pulsations observed in two-ribbon flares.

Chromospheric Evaporation Seen at HXR

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Chromospheric evaporation is the mass upflow along the loops from the chromosphere layer to corona in the impulsive phase of solar flare. The evidences of evaporation are well detected at radio, EUV and HXRs. In particular, such process indicates the movement of HXR emission targets. From the observations, HXR shows the double footpoint sources rising upward along the flaring loop and finally mergence into a single source at the same position as the looptop source. Here we present the observational evidences of chromospheric evaporation from RHESSI observations.

On the Problem of Heat Transport in the Solar Atmosphere

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In the context of the problem of energy transport in the solar atmosphere, we present new results on physical properties of transition region between the hot and cold plasma in quiet regions and in flares. In quiet regions, the transition region between the corona and chromosphere is shown to be a very thin layer, in which however the classical collisional approach is valid. A stability of the transition region is investigated. It is shown to be stable, i.e. it is a stable consequence of the thermal instability in the condensation mode regime. We have developed also three types of mathematical models for describing plasma heating in the corona and chromosphere by heat fluxes from a super-hot reconnecting current layer. It is shown that heat fluxes, calculated in the frames of self-similar solutions using the classical Fourier's law, are significantly higher real values. It is related with the fact that applicability conditions of classical heat conductionare not valid in the flare transition region and at the higher temperatures. Introducing the anomalous heat conduction, produced by interaction of thermal runaway electrons with ion-acoustic turbulence, does not give a simple solution of the problem because yields unstable temperature profiles. Models, accounting the effect of collisional relaxation better describe heat transport in flares than Fourier's law and the anomalous heat conduction.

The morphology of convection and magnetoconvection in solar and stellar envelopes

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talk presents the current status of our understanding of the geometrical structure of compressible convection in the Sun and stars. In the simplest case of nonmagnetic convection in a chemically homogeneous layer this problem was basically solved 20 years ago and recent work only focused on a better understanding of intermittency and fine structures. In the understanding of semiconvection a breakthrough has recently been made by H. C. Spruit et al. in Garching. The study of magnetoconvection is the subject of ongoing research, realistic simulations being developed in the MPI Lindau while idealized experimental setups have been studied by Weiss et al. in Cambridge and recently by our group in Budapest. A common feature of semiconvection and magnetoconvection is the importance of subcritical onset of convective transport, making considerations based on linear stability theory irrelevant for the nonlinear problem. Our most recent simulations, however, indicate that in the strong field case this subcritical mode has a structure corresponding more closely to the so-called "convectons" of nonlinear analytic theory than to the structure previously found by Weiss et al. The relation of small scale structure observed in sunspots, such as umbral dots and light bridges, to the structures seen in the simulations is discussed.

Complex magnetic evolution and magnetic helicity in the solar atmosphere

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Solar atmosphere is not simply a collection of individual features. Rather, it is a single system unified by the presence of large-scale magnetic fields. The field emerging through the photosphere must interact with existing magnetic fields. This localized interaction may lead to re-arranging magnetic connectivity on larger scales. And some of these changes in magnetic field topology may create conditions for flare/CME eruptions somewhere else in the corona. Helicity, a topological measure of complexity of magnetic systems, has proven to be a very useful "tool" in answering many still-puzzling questions about origin and evolution of solar magnetic fields. In my talk, I will present an overview of helicity studies conducted by different research groups, provide an observational evidence for the complex evolution of solar magnetic fields, and discuss some future developments.

Relativistic Electron Acceleration — Magnetic Reconnection and Whistler Bootstrap

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Acceleration of electrons to (super) relativistic energies, which constitute the main source of the ensuing observed radiation, is one of the most important processes in space sciences and in astrophysics. It is suggested that an analogous physical process at various magnetic configurations may enhance a subset of (ultra) relativistic electron fluxes. The mechanism requires an existence of a stressed, large-scale magnetic structure, injection of seed non-isotropic electrons due to reconnection, and energization at numerous resonances via the bootstrap mechanism on closed magnetic fields lines. Recent in-situ satellite observations confirm the small scale, over the electron skin depth, of the reconnection process. Similar process may apply to jets where the small-scale magnetic arcs, formed via Weibel instability, undergo reconnection resulting in injection of low energy electrons. The injected electrons excite coherent whistler waves that propagate and reflect along the closed field lines, interacting efficiently with the tail of the electron population and boosting its energy to (ultra) relativistic energies. Since the whistler wave amplitude scales with the background magnetic field it is

expected that the time scale of the solar energization process is significantly shorter than the magnetospheric time scale, while the availability of a huge number of resonances for the jet electrons makes the energization of the super relativistic electrons extremely fast. Large amplitude whistlers, similarly to the recently observed via explicit wave form capture may form two solar populations, when the lower energy part emits the standard gyrosynchrotron while the separate, higher energies become the source of the THz radiation.

Spatial-temperature stratification of EUV oscillation above sunspots

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Using Solar Dynamic Observation (SDO/AIA) observations we detected for the first time spatial-temperature stratification of EUV emission in a sunspot-associated sources for the main oscillation modes. We obtained narrowband images of the oscillation sources at ten temperature wavelengths. There is a symmetrical linear decrease in frequency of waves depending from the distance to the center of sunspot. The shape of narrowband 3-min oscillation sources has a symmetrical circular structure, filling whole umbra. The spatial distribution of 5- min components shows the circular emitting sectors, located on the border between umbra and penumbra. The shape of more low-frequency oscillations of narrowband sources are fragmented by the ring-shaped power structures, expanding with decreasing frequency. Originate of 3-min waves from the underphotosphere levels to the corona connect with theirs helical propagating. The wave sources are localized in the center of the sunspot umbra as pulsating bright areas of small angular size. To explain these results, we consider the spaghetti model, which assumes the structure of sunspot magnetic field as a bundle of twisted thin magnetic flux tubes emerging from subphotospheric layers to the corona, where we observed waves propagating.

Variations of the solar supergranulation according observations in CaIIK line in period 1907-2010

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The analysis of the characteristic size of the cells of the chromospheric network over the daily observations in CaIIK line observatories Kodaiknal (1907-1999), Meudon (1983-2011), Sacramento Peak (1965-2002), Mount Wilson (1915-1985). Analysis of the characteristic size was performed using weighted wavelet transform. Pre-contrast images on the chromospheric network increased by subtracting the intensity and gradient on the solar disk. It was found that the characteristic size of the chromospheric cells is $\sim$ 36 Mm, but the variation is associated with a solar activity of $\sim$ 2 Mm. The largest cell size is observed typically $\sim$ 1.5 years after solar maximum. Between cell size and the maximum amplitude of the next cycle of activity, there was a positive correlation (R = 0,83), thus the supergranulation size connected with solar activity and precede of it $\sim$ 8.8 years.

Nonlinear long-wavelength torsional Alfvén waves

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We studied nonlinear phenomena accompanying long-wavelength torsional (Alfvén) waves in solar and stellar coronae. Analysis is based upon the second order thin flux-tube approximation of Zhugzhda, describing axisymmetric (sausage) magnetohydrodynamic perturbations of a straight untwisted and non-rotating magnetic flux-tube, representing a polar plume or a jet, or a coronal loop or a prominence filament. Attention is paid to the compressible motions nonlinearly induced by long-wavelength torsional waves of small, but finite

amplitude. We obtained that propagating torsional waves induce compressible perturbations oscillating with double the frequency of the torsional waves. In contrast with plane shear Alfvén waves, the amplitude of compressible perturbations is independent of the plasma-β.

Moreover, nonlinear evolution of torsional waves is not affected by the singularity appearing at the height when the local Alfvén speed is equal to the sound speed. This result significantly reduces the efficiency of nonlinear cascade, and hence suggests that the present theories of the solar and stellar wind heating and acceleration by Alfvén waves require modification. Standing torsional waves induce compressible perturbations of two kinds, that grow with the characteristic time inversely proportional to the sound speed, and that oscillate at double the frequency of the driving torsional wave. The growing density perturbation saturates at the level, inversely proportional to the sound speed

POSTERS

S3-1. Solar Convection And Self-Similar Atmosphere's Structures

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We present a new model of large-scale multilayer of the solar and in solar type stars convection. This model allows us to understand such self-similar structures observed at solar surface as granulation, supergranulation and giant cells. We study the slow-rotate hydrogen star without magnetic field with the spherically-symmetric convective zone. The photon's flux comes to the convective zone from the central thermonuclear zone of the star. The interaction of these photons with the fully ionized hydrogen plasma with $T > 10^5 K$ is carried out by the Thomson scattering of photon flux on protons and electrons. Under these conditions plasma is optically thick relative to the Thomson scattering. This fact is the fundamental one for the multilayer convection formation. We find the stationary solution of the convective zone structure. This solution describes the convective layers responsible to the formation of the structures on the star's surface.

S3-2. SDO in Pulkovo Observatory

Elena Benevolenskaya, Vyacheslav Efremov, Vladimir Ivanov, Nikolay Makarenko, Eugene Miletsky, Oleg Okunev, Yuri Nagovitsyn, Leonid Parfinenko, Alexander Soloviev, Alexander Stepanov, Andrei Tlatov

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We discuss the effective applications of the data obtained with Solar Dynamics Observatory from both instruments: The Helioseismic Magnetic Imager (HMI) and The Atmospheric Imaging Assembly (AIA). The purpose of this presentation is to show the most important problems of solar activity which are the main subjects in the Pulkovo Observatory. There with uniform data sets of magnetic fields and coronal emission in Extreme Ultraviolet bands are needed. Thus, we are planning to create SDO center in the Pulkovo Observatory, which will helps us in collaboration with existed SDO centers and provides more convenient data downloading for solar physics.

S3-3. New opportunities for investigating of the structure of the lower solar corona at microwaves

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The study of solar atmosphere using radio astronomy method remain be important for obtaining data on the characteristics of the active plasma at the heights, which inaccessible to modern satellite techniques. The

ground-based observations are carried out in the radio window of transparency of the atmosphere of the Earth to study the thin low-contrast structural formations in the levels of the chromosphere, the lower corona and transition region between them. This is important for understanding the origin of the dense plasma in the formation of floccules, prominences, release of the new magnetic flux, which are the sources of future high-power active objects. With a view to a detailed study of the vertical structures in the active plasma, a unique spectral-polarization receiving complex with high spectral resolution (1%) with coverage of several octaves at microwaves. In combination with high spatial resolution of large radio telescope RATAN-600, this complex is capable of receiving information from both the faint sources at solar flux units and from the powerful flare of objects with temperatures of 10 K–10^9 K.

S3-4. Solar activity indices in 21, 22 and 23 cycles

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The monthly averaged values of the main global solar activity indices were studied for 21, 22 and 23 cycles. We show that Gnevyshev-Ohl rule is disturbed for the cycle 23 through all the activity indices values show the descending trend in global solar activity during period from 1975 to 2007. We assume that this fact is related to the superposition of 11-year and secular solar cycles. Also we found out that the values of yearly determined correlation coefficients for solar indices versus 10,7 cm radio flux $F_{10,7}$ show the cyclic variations with period closed to the half path of 11-year solar activity period.

S3-5. On Diagnostics of the Quiet Sun's Magnetic Fields: Application of the SIR Inversion to the Full-Disk Stokes-Meter Observations

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Although quiet solar magnetic fields are weak and they are difficult to measure, they cover most of the solar disk, even the whole one during epochs of minimal activity. They are basically responsible for the formation of the open flux from the Sun, and, consequently, reliable diagnostics of them are very important. In this study, we use the whole range of heliocentric distances of high precision Stokes-meter measurements of the quiet solar magnetic fields in 15 simultaneously recorded lines in the vicinity of FeI 525.02 nm. A two-component model atmosphere and the SIR (Stokes Inversion based on Response functions) approach were used for theoretical modeling. Problems in the interpretation of one-line observations and big advantages using many lines with different atomic parameters are illustrated. Basic parameters of the magnetic component, such as filling factor and magnetic field strength, are determined, as well as their center-to-limb variations. Because the magnetic flux density values determined for individual lines differ significantly, we suggest to use the one constructed from all measured spectral lines as the most reliable magnetic parameter. An application of the obtained results for the urgent issue to calibrate SOHO/MDI magnetograms is presented. Some problems arising from the limitations of the SIR approach are discussed.

S3-6. Variations of microwave emission and MDI topology in the Active Region NOAA 10030 before the power flare series

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Evolution of microwave emission and MDI topology in the AR NOAA 10030 during 11-18 July, 2002 is considered. Two X, six M and 33 C-class flares (GOES) were detected in AR in this period. We concentrate on the microwave emission and MDI topology in AR during some days before the X3 flare occurred on 2002 July 15. Daily solar observations with the RATAN-600 in the range 1.8-5.0 cm have been used. The radio

emission associated with the regions between the main sunspots in AR began to be detectable two days before X3 flare. The peaks of radio emission coincided with the places of greatest values of the emission measure calculated by two lines of UV emission (SOHO/EIT). A topological method for detecting the new emergence of magnetic flux using the SOHO/MDI images of the solar disk is proposed. The successive MDI-images of AR have been analyzed. It was found that a number of disconnected components increases directly before the development of a series of power flares (in particular, before the event on 2002 July 15) or accompanies this process.

S3-7. To the selfconsistent kinetic description of Solar Streamers, CME and Solar Flares

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We give examples of self-consistent 3D approach in terms of the Vlasov and Maxwell large scale kinetic (LSK) equations (non MHD approach) to formation of a separate solar streamer at the solar maximum state, to formation of a belt of e.m. interacting streamers at the solar minimum state and to the solar flare ignition process. We consider these objects as a result of the solar corona particles velocity distribution function (VDF) dynamics near high plasma beta magnetoactive regions. Plasma characterized by the "momentum" and "energy" dimensionless e.m. anisotropies which are new kinetic parameters and they are differently defined by shape of the VDF only. The ratio of these anisotropies is a new governing e.m. LSK plasma parameter G which is similar to non e.m. independent acoustic Mach number M. Collisionless plasma behaves as: conductor for small $G \ll 1$ — streamer formation, diamagnetic $1/|G| \ll 1$ — belt structure, quasi-current-free media $G \sim -1$ — solar flare ignition. Parameter G nonadiabatic variations via shape of the VDF deformation define variation of the e.m. properties of plasma — appeared as the CME effect in a streamer.

S3-8. A Model of Soft X-ray Radiation of the Sun for Aeronomic Estimations

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A model of soft X-ray fluxes in the region of 0.05-10 nm was suggested for calculation of solar activity's effects on lower ionosphere (D and E layers). It was proposed to use the satellite monitoring data of radiation fluxes in 0.05-0.3 nm(I0.05-0.3) as an input parameter of the model. According to long term observations of X-ray emission on-board the GOES satellites a dependence between I0.05-0.3 and the fluxes in 0.1-0.8 nm band (I0.1-0.8) was received. The dependence was a power function, its coefficients and exponent being similar as for the quiet Sun as well as for a case of flares. Finally it became possible to use the models of X-ray radiation of the quiet Sun and flares elaborated before for aeronomic estimations. But these models should be corrected in accordance with the latest satellite measurements.

S3-9. On the possible method of the sun limb darkening evaluation using data on solar eclipse

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In the model approximation the mean brightness of the solar disk part non shadowed by the Moon (Inorm) during solar eclipse has been weighted with the part of the solar disk non shadowed by the Moon (X). It is shown that Inorm-X dependence allows us to determine the character of the solar limb darkening. The model calculations have been compared with solar eclipse on May, 31, 2003 observations, which were taken at some wavelengths by instruments on the CORONAS-F satellite. The theoretical values of Inorm(X) are in

accordance with the observations in the visible spectral region where tabular data of the solar limb darkening are available. The suggested method allows us to obtain the data about the darkening at the limb of the Sun for those wavelengths of short-wavelength region, for which such data are not available now.

S3-10. Mapping the solar corona using the UTR-2 decameter array

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The UTR-2 radio telescope has some effective means for mapping the solar corona in decameter wavelengths. Firstly this is the heliograph capable of producing the two-dimensional brightness distribution images of the outer corona of the Sun. It uses a serial regime in which the beam of the UTR-2 antenna array pattern occupies five consecutive positions along V and eight positions along U coordinate in the UV-plane. The matrix image contains 5 rows and 8 columns spaced along declination and hour angle, respectively, at 25'. As a receiver-recorder device, the digital spectral processor (DSP) is applied. On the other hand the UTR-2 radio telescope allows us to provide the multi-frequency radio emission observations in the regime of one-dimensional heliograph by concurrent scanning of some independent beams of the antenna array. The measurements give the flux density and the angular size of the solar corona from scan to scan. By this equipment configuration the solar map observations have been carried out in summer of 2010. Preliminary results are presented.

S3-11. Scenario of Minimum 23

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The solar wind in circumsolar space ($R < 70$Rs) was studied by radio astronomic methods. The experiments were carried out using the DCR-1000 and RT-22 radio telescopes of the Radio Astronomic Observatory of the Russian Academy of Sciences (Pushchino). The new methods developed in the recent years were used to study the minimum epoch of cycle 23. The solar wind evolution was reconstructed for the period 2006-2009. Unusual features were revealed in the evolution of heliolatitude structure of the solar wind, which proved to be associated with fluxes of different types, including a new, formerly unknown flux — slow solar wind from small-scale equatorial coronal holes, which was detected first in 2008.

S3-12. Solar magnetic fields as a clue to the solar wind mystery

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Data on the regular solar wind (RSW) speeds measured on board Ulysses (SWOOPS) are analyzed, generalized and interpreted. A finding of a principal importance resulting from Ulysses' observations is a discovery of clear-cut inverse coupling between the SW speeds and the solar magnetic fields (SMF) [the stronger close MF the slower SW, and vice versa] that we interpret as a sign of SW outflow decelerating by the MFs near the solar surface. Insertion of SMF into consideration leads to the alternative paradigm of the SW: "slowing-down instead of the acceleration". Within alternative paradigm both the SW and solar corona involves the product of the interaction of high velocity plasma outflow ejected from the photosphere with SMFs. The latters not only divide SW into fast and slow outflows; they also create and heat the corona through the plasma capture and stoppage in the magnetic traps. Observational arguments are represented in favor of an idea considered. Also mechanisms of high speed plasma ejections from the photosphere are discussed.

S3-13. MHD simulations of X-ray sources positions of solar flares

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3D MHD simulations demonstrate flare energy accumulation in the current sheet magnetic field created by disturbances focusing in a vicinity of an X-type singular line. All initial and boundary conditions are set from observations in the pre-flare state. To stabilize the numerical instabilities numerical methods are developed and programming realized in the PERESVET code. The calculations are initiated several days before the flare, when strong disturbances are absent, and magnetic field above an active region is the potential one. Simulation for AR 10365 is carried out. The system of visualization of MHD simulation results is developed. It has permits to find the form of current sheet in 3D space as the arc by analyzing of the current density distributions in several parallel planes crossed by the current sheet and by tracing magnetic lines in 3D space. The graphical system is developed for search of the locations of current sheets and tracing field with field-aligned currents. Such method permits to compare of MHD simulation results and X-ray measurements. The main task of investigations is comparison positions of current sheets and thermal X-ray sources.

S3-14. The solar flare mechanism based on energy accumulation in the current sheet magnetic field

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Flare energy accumulation occurs in the magnetic field of a current sheet, which is formed in the corona by floating of a new magnetic flux in the active region. Powerful flares (X class) arise when the active region magnetic flux becomes $\sim 10^{22}$ Max. Over a complicated active region several current sheets are formed before the set of flares. Each of sheets is responsible for an elementary flare. The magnetic flux of the active region does not change significantly during the flare that excludes any mechanism of flare photospheric magnetic field dissipation. The flare electrodynamical model explains bursts of thermal and beam of X-ray emission, CME $\sim 10^{15}$ g, flux of relativistic protons, and radio emission. The prompt component of relativistic protons brings information about the mechanism of solar cosmic rays creation. It is shown that approximation of the field in an active region by local magnetic sources is too rough. For analysis of flare development the maps of the photospheric magnetic field are used. The typical rate of reconnection estimated during a flare $\sim 10^7$ cm/s. Solar flare is the universal phenomenon typical to stars, possessing the magnetic field.

S3-15. Two off phase dynamo waves detected by PCA analysis in the cycles 21-23 and their implications to dynamo theory

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The variations in latitude and time of the solar background and sunspot magnetic fields in the cycle 21-23 are analyzed with the Principle Component Analysis technique. We identified the two main latitude periodical components of the opposite polarities reflecting two primary waves of the background magnetic field in each hemisphere travelling slightly off-phase. We built the latitudinal distribution for these waves and study the phase relations between the weak background solar magnetic (poloidal) field and strong magnetic field associated with sunspots (toroidal) field. In the attempt to interpret the outcome of PCA analysis, some preliminary model simulations are carried out for the modified Parker's dynamo theory for few regimes. The outcome is discussed in relation to a weaker solar activity in the cycle 24.

S3-16. Extreme space weather events and solar activity in 1841-1870

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Eruptive activity of the Sun produces a chain of extreme geophysical events, in particularly, severe geomagnetic storms that form an important component of space weather. In this work we present a catalogue and an analysis of very intense magnetic storms registered in 1841-1870 by the Russian network of geomagnetic observatories. This period covers solar cycles 8-11. We considered great geomagnetic storms with magnitudes that approximately correspond to Dst < -200 nT (or Kp$\geq$ 8). For our collection of storms high solar activity plays a critical role in generating very intense storms in 1841-1870: only one peak in solar cycle which falls into years of maximal activity (or little earlier) is found. Our analysis shows two-fold increase of great storms in solar maxima (or little earlier) in comparison with periods of lower activity. Such distribution is characteristic for the storms which are associated with interplanetary magnetic clouds.

S3-17. On space weather effects of the super solar flare on September 1859: an analysis of Russian and Italian historic magnetic data

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On 1 Sep 1859 near the center of the solar disk the first-ever registered flare was detected in enhanced continuum emission in optical wavelengths (white light) by Carrington and Hodson. Moreover, it is the first-ever registered solar-geomagnetic event, which marked the beginning of space weather science. The Carrington flare produced a coronal mass ejection which after 17 hours triggered a giant geomagnetic storm. We present an analysis of this event performed on the basis of geomagnetic data registered in Russia (St. Petersburg, Yekaterinburg, Barnaul, Nerchinsk and Sitka) and Italy (Rome). The geomagnetic storm on 2-3 September appears to fall into three subepisodes. This multiple event could be caused by series of solar flares erupted within 40 hours from the complex sunspot region observed at that time. During the first severe magnetic disturbance, which is associated with the Carrington flare, its current system showed the character of a strongly asymmetric circuit that connected the partial ring current in the equatorial atmosphere to the current jet in the auroral zone, which was much shifted to the south relatively to it's usual location.

S3-18. 23rd "northern" and "southern" cycles of solar activity

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Comparison of the basic properties of 23rd cycle of activity on all solar disk and on northern and to southern hemisphere separately is held. As the basic indicators of development of a cycle the data of daily and monthly average data of sunspots numbers Wolf — W and the areas of sunspots groups — Sp , flare index — FI were used. It is shown that duration of the basic phases of a cycle appears different for northern and southern hemispheres. Thus integrated indicators of indexes on all solar disk are only superposition of real physical processes occurring in northern and southern hemispheres. At the same time incidental "synchronisation" of activity of both hemispheres of the Sun is marked. With application of a method correlation, periodogramm and wavelet the analysis the cores "spectra of the periods" changes of indexes and their evolution throughout all cycle of activity are defined. "Spectra of the periods" are formed by occurrence on a disk of complexes of active areas (CAR) and activity complexes (CA) well distinguishable on maps of millimeter radiation of the Sun (RT-22 KrAO, PT-14 the Helsinki University, a radio observatory of Nobejama and radio telescope SSPT in Irkutsk), to ultra-violet and x-ray images of the Sun of space observatories: SOXO, SDO, the STEREO.

S3-19. Some manifestations of ion-acoustic instability caused by significant heat flux in the Solar transition region

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We have shown that the instability of ion-acoustic oscillations can be realized in a plasma without any current and particle fluxes but with an anisotropic distribution function corresponding to the heat flux. We chose the model distribution function by taking into account the conditions imposed on the mass and heat fluxes. The growth rate of ion-acoustic oscillations was investigated as a functional of the parameters of the distribution function. As a result, we established the threshold condition for the anisotropic part of the distribution function under which ion-acoustic oscillations with wave vectors opposite to the heat flux begin to grow. We determined the local critical heat flux that corresponds to the ion-acoustic instability threshold. In our opinion, there are good prospects for the studies of the effect of ion-acoustic oscillations on the structure of the transition region in the chromosphere. The goal of these studies is to develop a selfconsistent model of heat transfer with ion-acoustic turbulence, ultraviolet radiation, and ionization balance and to compare theoretical conclusions with currently available experimental data.

P. A. Bespalov, O. N. Savina. Generalized Wiedemann-Franz law and temperature jump in space plasmas with ion-acoustic turbulence. Mon. Not. R. Astron. Soc. 2007, v. 382, L63-L66. doi:10.1111/j.1745-3933.2007.00389.x.

P. A. Bespalov, O. N. Savina. Heat flux as a source of ion-acoustic oscillations in the transition region of the Solar atmosphere. Astronomy Letters, 2009, v. 35, No. 5, p. 343-348.

S3-20. The evidence of magnetic reconnection for emerging flux model during a partially limb-occulted flare of July 20, 2002

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In this talk, we present a multiwavelength analysis for the partially limb-occulted solar flare of July 20, 2002. The data are X-ray observations made by the RHESSI and GOES, 195 Å images obtained by EIT on board SoHO, the routine full disk H_α observations made at BBSO, and microwave observation made by Ovens Valley Solar Array. The flare is a long duration event with decay time up to ~ 8 hours. This is also an event with a very long early phase and the duration of rising of soft X-ray emission lasts over one hour before the final onset of the impulsive phase. The nice viewing angle permits us to see a pre-flare EUV magnetic configuration, which consists of a magnetic loop (height: 30 Mm, Span: 60 Mm) and a nearly open field inclined toward the magnetic loop. There is a dark lane between the magnetic loop and the inclined open field. Following features suggest that magnetic reconnection occurs in the dark lane region. 1) The magnetic loops become open after the flare and the material contained by the loop erupts as an energetic CME. The configuration of the CME appears as a open structure. 2) EUV and H_α flaring loops emerges near the dark lane region. 3) There occur H_α and X-ray jets during the very early phase of the flare, and both kind of jets are roughly in the direction of the dark lane. 4) The X-ray sources at different energies are aligned in the direction of the dark lane during the most times of the flare. Along with other features, e.g., no filament eruption is associated with this flare, we suggest that the magnetic reconnection occurs in the dark lane region and the whole magnetic reconnection scenario supports an emerging flux model.

S3-21. Two types of coronal bright points in an extraordinary cycle of 24

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We have previously studied the main features of coronal bright points (CBPs) and separated these points into two types. In the researches, we used an automatic identification program of CBPs by applying it to data obtained by SOHO/EIT, taken in the spectral range of 195Å ionized iron Fe XII (which corresponds to the quiet corona outside coronal holes) from the end of 23 to early 24 solar cycle. We investigate total number CBPs and its changes in the beginning of the given cycle of solar activity with a view of possibility of forecasting of character of its development. For primary reference point 24 of the solar cycle, we take the emergence of high-latitude sunspot with reversed polarity appeared in January 2008. Research in this area showed that the observed number of CBPs reaches the highest value near the minimum of solar activity, which in turn may result from the effect of visibility. Observed at this time of minimum solar activity gives us the opportunity to freely register the number of CBPs with the highest accuracy, with his uniform latitudinal distribution. We further study the properties of CBPs in a new cycle of solar activity 24.

S3-22. Dissipative Collapse of Force-Free Magnetic Power Ball: Formation of Jets, Acceleration of Particles...

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We consider the dissipative evolution of magnetic spherical vortex immersed in an external potential field in resistive medium. The magnetic field in the ball is force-free structure and represents a set of concentric magnetic toroids, confined in spherical layers (Chandrasekhar's model, 1956). A new exact MHD solution, describing a uniform radial compression of force-free magnetic spheroid, with uniform density and pressure growing inside its with the time. The dissipative evolution of the system is stipulated by the finite plasma conductivity. This leads to a continuous conversion of magnetic energy into heat, and this reduces the magnetic pressure into the ball. At the same time outside of the ball, in the potential field, the dissipative processes are absent, then the pressure of the external magnetic field, which compresses the ball, remains constant. This results in spontaneous radial compression of the spheroid, automatically eliminating the recurring imbalance of magnetic pressures. Formally, the magnetic ball shrinks to zero in finite time (magnetic collapse). Compression time may be relatively small, within a few days, even for the ball with a radius of several Mm, if its magnetic helicity (proportional to the number of magnetic toroids in the volume of the ball) is sufficiently large. The magnetic system is open along the axis of symmetry. On this axis, the magnetic and electric fields are strictly radial and alternating along the radius, so along this axes the plasma will be thrown out on both sides (narrowly focused jets!) at a rate fast growing with time, and charged particles will be effectively accelerated. The application of the solution obtained to the solar flares mechanism is discussed.

S3-23. Temperature stratification and spatial structure of the sources of EUV emission oscillations and waves above sunspots

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The study of wave and oscillatory processes above the sunspot NOAA 1131 on the 8th of December 2010 in the EUV band with the use of the high time and spatial resolution data obtained with the Solar Dynamics Observatory Atmospheric Imaging Assembly (SDO/AIA) are presented. The spatial structure of the sources of the main oscillating modes was identified for the first time using images taken in 10 different observational wavelengths, corresponding to different heights above the sunspots. In all observational channels, in the

sunspot's umbra, well-pronounced 3-min (5.6 mHz) oscillations are found. At the photospheric heights (white light, and 1600 and 1700 A), the 3-min oscillation source has a circular shape, filling in the umbra and confined to its boundary. In the chromosphere (304 A), the 3-min oscillations are seen as waves propagating radially in the plane-of-sky up to the umbra-penumbra boundary. The centre of the spiral is near the centre of the sunspot. The wave fronts have a spiral shape. In the corona (171, 193 and 211 A), we observe the formation of radially extended structures, situated over the penumbra, which apparently coincide with coronal magnetic flux tubes. These waveguiding structures are seen in both open and closed coronal fields. Individual structures are characterised by specific frequencies of the propagating 3-min waves. On the other hand, the sources of longer-period (3-min) oscillations are of the ring shape. In the azimuthal direction, the oscillation power has a patchy distribution. In general, there is a radial, with respect to the centre of the sunspot, decrease in the frequency of the oscillations. In particular, 5-min oscillations are observed to be situated in a broad ring, with the maximum of the oscillation power at the umbra-penumbra boundary. Longer-period rings are usually broader. At the photospheric height, the value of the dominating spectral peak changes rather abruptly. In the chromosphere, frequencies of the dominating spectral peak decrease with the distance from the sunspot centre gradually from 5.6 mHz (3 min) in the umbra to 0.8 mHz (20 min) in the penumbra. A possible interpretation of the results obtained could be connected with the twist of the spaghetti-like magnetic flux tubes, emerging from the sub-photospheric regions. The flux tubes act as wave-guides of the slow magnetoacoustic waves, responsible for the observed oscillations.

S3-24. PROGNOSIS: a web based environment for the monitoring of the Sun atmosphere in multi octave microwave range

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We are developing a web based data analysis system called 'PROGNOSIS' for monitoring the solar activity based on multi octave microwave observations with RATAN-600 radiotelescope in combination with solar data from other solar observatories available on the Internet. The system performs automatic collection, quality control, pre-processing of the data, and provides interactive web applications written in IDL and ION (IDL on The Net) Script for the interactive data analysis, modeling, and visualization. Automated methods for plasma parameters calculation, and spectral/temporal/spatial features recognition provide the basis for studying the physical processes in wide height ranges of the solar atmosphere, and further development of an automated powerful solar flares forecasting tool.

S3-25. Coronal mass ejections on the Sun and their relationship with flares and magnetic helicity

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A brief review on results of observations of coronal mass ejections (CMEs) during last decades from SOHO and STEREO is presented. Relations between properties of CMEs and associated flares are considered. Analysis of correlations would help us to understand better the nature of space weather and gives a possibility to predict a CME occurrence. The flare-associated CMEs have statistically higher velocities comparing to with the CMEs not accompanied by flares. The fastest CMEs tend to decelerate. The widest, fastest and most massive CMEs are associated with the most energetic flares.The coronal magnetic helicity of an active region seems to play an important role whether a confined or a CME-associated flare will be produced. The dynamical evolution of CMEs with helical structures shows that the total energy is relatively constant and the energy released in radio and other forms of radiations is not significant. Data from published papers and Internet have been used. The work was supported by the RFBI grant 11-02-00843 a.

S4: Solar System Measurements of the Next Decade

Conveners:
Andrey Finkelstein (Inst. Appl. Astron., Russia),
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Halley — Electronic Catalogue of Comets

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Halley — Electronic Catalogue of Comets is application to work with the comets database, containing Keplerian orbital elements, non-gravitational and physical parameters of the comet, and other data. The database is updated in case the new data become available. The tasks performed by the electronic catalogue include calculation of the orbital evolution of comets and visualization of comet dynamics, detection of close approaches with the major planets in a given time interval, as well as a number of other tasks.

declinations are presented here.

Circumstances of (99942) Apophis' approaches with the Earth in 2029-2036

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The nearest in time close approach of potentially hazardous asteroid (99942) Apophis with the Earth will take place on 13 April 2029 when the minimum distance of the asteroid from the Earth center will be as small as about 38000 km. The error of this value is within the range 106–469 km for solutions of IAA, JPL, and NEODyS based on observations in 2004–2008. New observations made in 2011 demonstrate similar O–C for all considered solutions. However, our estimations of collision probability in 2036 for different solutions vary over many orders of magnitude, from practically 0 to 0.000027 for NEODyS solution. The attempt was made to evaluate non-gravitational perturbations which are known as Yarkovsky effect. It was found the value of this effect, which can increase the probability of Apophis collision with the Earth in 2036 up to 0.0022. On the other hand, we have estimated such limiting value of Yarkovsky effect which completely excludes probability of collision in 2036.HCF

On combined processing of different space geodetic observations

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A software for combined processing of different space geodetic observations is developed along with the work on the co-location of various observational techniques at the observatories of the "Quasar" VLBI network. The software realizes the combination of standardized SINEX-files and works in the following two modes: 1) a combined solution within one observational technique on the appointed time interval; 2) an inter-technique combination of daily SINEX-files. A special task-forming language has been constructed on the basis of the same formalism used in the description of SINEX-files format. The main features of the developed software are presented. Various aspects of the combined processing of different types of space geodetic observations are also discussed.

On constructing the analytical Moon's theory

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The analytical Moon's theory is treated in the form compatible with the general planetary theory GPT (V. Brumberg, Springer, 1995). The Moon is considered as an additional planet in the field of eight major planets. Hence, according to the technique of the GPT the theory of the orbital lunar motion can be presented by means of the series of the evolutionary eccentric and oblique variables with quasi-periodic coefficients in mean longitudes of the planets and the Moon. The dependence of the evolutionary variables on time is determined by the trigonometric solution of the autonomous secular system describing the secular motions of the lunar perigee and node with taking into account the secular planetary inequalities. In the present paper this solution is obtained within the frames of the main problem taking into account the indirect planetary perturbations. All analytical calculations are performed by the echeloned Poisson series processor EPSP (T. Ivanova, Celest. Mech. & Dyn. Astron., 80, 2001).

Search for possible sources of short-period comets

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Orbit evolutions for 100 real Jupiter-Family comets (JFC) and for 300 model ones (Q<6 AU) were calculated. It was obtained, all JFC during 16,000 ys should be go to more long-period orbits. To date comets with longer periods and Centaurs are considered as possible sources of JFC. Orbit evolutions for comets with Q>7 AU and with periods less then 200 years (200 orbits), and for Centaur with absolute magnitude H<17.0m (800 orbits) were calculated. It is obtained that during 16,000 ys numbering of JFC was replenished from these comets and Centaurs not more then by 25 bodies. Hence the intensity of JFC migration outside of the Jupiter's orbit an order of magnitude greater then the comet inflow from possible out sources. Thus, the sources of JFC nuclei should seek inside the Jupiter's orbit. The distributions of orbital elements for JFC were analyzed. It was found that the distribution on longitude of perihelion can not be explained by the comets transition from outside of the Jupiter's orbit. This distribution is very similar to the corresponding distribution for Hilda group asteroids and Trojans. So these groups of bodies should be considered as sources of JFC.

Global VLBI data processing results

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VLBI data from 1980 to 2010 was processed with QUASAR software developed in IAA RAS. New CRF and TRF catalogues and EOP series were obtained. Comparisons with the international catalogues shows high accuracy of our results and possibility of using it in routine data processing and other applications.

VLBI data from 1980 to 2010 were processed with QUASAR software developed in IAA RAS. We obtained new CRF catalogue for more than 3000 radio sources, TRF catalogue for 142 VLBI station positions and consistent EOP series. Comparison with the international catalogues shows high accuracy of our results and possibility of using it in routine data processing and other applications.

Establishing celestial reference frames in different ranges of wavelengths

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The current fundamental celestial reference frame is the second realization of the International Celestial Reference Frame (ICRF2) derived from dual frequency VLBI observations at 13/3.6 cm. The ICRF2 catalog includes ∼3000 compact radio sources, largely quasars, of which 295 defining sources establish the coordinate axes with an accuracy of ∼10 microarcseconds. More limited catalogs have been developed at 1.2 cm using the VLBA (∼300 sources) and at 3.6/0.9 cm using the Deep Space Network (∼500 sources), primarily to support spacecraft navigation. Anticipating the prospective Gaia optical catalogue, a set of ∼400 radio weak but optically bright (V $\leq$ 18) objects is being studied at 13/3.6 cm for the radio-optical frame tie using the high sensitivity of the EVN + VLBA. The Gaia QSO catalog currently has ∼100,000 defining objects whose morphology and variability are being tabulated. The characteristics, limitations and future development of the various wavelength catalogs will be discussed along with the anticipated radio-optical frame transfer.

Analysis of Polar motion variations from 170-year observation series

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The work is devoted to investigation of low frequency variations in Polar motion (PM). It has been shown that the main PM features can be effectively investigated using not only time series of the Pole coordinates, but also using series of latitude variations obtained from observations at one observatory. Such an approach allows us to increase the length of observation series available for analysis. In our study, we extended IERS PM series back to 1840. We investigate trends and (quasi)harmonic oscillations with periods from one year to decades. The main results were obtained making use of the Singular Spectrum Analysis. Other methods were also used for specific analysis and independent check. The most interesting results are detection of two new large phase jumps in the 1840s and 2000s, and revealing of 80-year period in the PM variations.

Physical and dynamical parameters of particles in outbursting Comet 17 P/Holmes

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The brightness of the comet 17P/Holmes has increased hundreds of times on October 23, 2007. About two billion tons of gas and dust were ejected from the surface of the comet nucleus at the moment of outburst. We determined the time depending offset between the center of light and center of mass of the comet nucleus by positional observations of the comet. It is assumed that the offset is caused by the motion of particles ejected from the nucleus. The dynamic model of particles motion in the vicinity of the comet nucleus was developed. Calculations showed that the size of the particles should be about 54 m in diameter and had the initial velocity of 1.2 m/sec at the moment of outburst. The angle between the velocity vector and the direction to the Sun was 35 degrees and 25 degrees with the orbital plane. Within 20 days after the explosion the size of particles decreased to about 5 mm. The motion of these particles allowed to simulate the subsequent offset between the center of light and center of mass of the comet nucleus obtained from positional observations.

Estimations of the change of the gravitation constant and the Sun's mass from high-accuracy observations of planets and spacecraft

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More than 635 000 positional observations (mostly radiotechnical) of planets and spacecraft (1961-2010) have been used for estimating possible changes of the gravitation constant, the solar mass, and semi-major axes of planets. The analysis of the observations has been performed on the basis of the numerical ephemerides of planets and the Moon EPM2010 of IAA RAS. The estimation of the change of the geliocentric gravitation constant has been obtained $(G\dot{M}_\odot)/GM_\odot = (-5.0 \pm 4.1) \cdot 10^{-14}$ per a year. The positive century changes of semi-major axes have been determined for the planets provided with high-accuracy sets of observations, as expected if the geliocentric gravitation constant is decreasing century wise. It has been found that the variation of the gravitation constant falls within the interval $-4.2 \cdot 10^{-14} < \dot{G}/G < +7.5 \cdot 10^{-14}$ per a year with the 95% probability.

The IAA RAS fundamental ephemerides of planets and the Moon (EPM): their model, parameters, accuracy

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In the 70-th of the last century Ephemerides of Planets and the Moon (EPM) of IAA RAS originated and have since been developed. The last version of the planet part of EPM ephemerides includes 1) the improved dynamical model with perturbations from Trans-Neptunian Objects at the mean distance of 43 au in addition to the perturbations from the major planets, the Moon, the Sun, and asteroids of the main belt, 2) the new values of parameters and 3) the expanded database (1913-2010). More than 260 parameters have been determined while improving EPM to more than 635000 observations. The estimated values of the parameters (e.g. Astronomical Unit, geliocentric gravitation constant, their possible variations) are discussed. The real uncertainty of EPM ephemerides has been checked by comparison with the observations (residuals of all data do no exceed their a priori errors) and with the JPL's DE ephemerides. The access to EPM ephemerides with their TT-TDB are available via ftp://quasar.ipa.nw.ru/incoming/EPM/.

Construction of the numerical motion theories for the main satellites of Mars, Jupiter, Saturn and Uranus in IAA RAS

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This work presents the motion theories of the main satellites of Mars (Phobos, Deimos), Jupiter (Io, Europa, Ganymede, Callisto), Saturn (Mimas, Enceladus, Tethys, Dione, Rhea, Titan, Hyperion, Iapetus) and Uranus (Ariel, Umbriel, Titania, Oberon, Miranda) as constructed by numerical integration within the framework of the program package ERA (Ephemeris Research in Astronomy). The dynamical models include the mutual perturbations of the satellites, disturbances of the Sun, major planets and oblateness of the central planet (J2, J4). For the Phobos motion, the tidal perturbations from Mars are taken into account. The initial values of the coordinates and velocities were improved using the astrometric observations of different types. In addition, several improved parameters (mass, J2 and pole coordinates of the planet, and masses of the satellites) were obtained for some satellite systems. The residuals, rms and comparison of our results with those obtained by other authors are given.

Space debris VLBI ranging with Irbene RT-32 radio telescope

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Since 2007 VLBI Space Debris radio location is one of ongoing activities in Ventspils International Radioastronomy Center (VIRAC). The bulk of observations happened in colaboration with so called LFVN (Low Frequency VLBI Network) Work on upgrade and repair of receiving hardware of RT-32 is of high priority in VIRAC. During the last year the receiving station at second focus of the telescope was reconstructed and a new 5GHz single-band receiver was installed. At the moment data registration systems are Mark II and the original terminal TH-16 (developed in Niznij Novgorod Radiophysical Research institute). Correlator for VLBI data processing and program complex for calculation of orbit elements and prediction of their coordinates are under active development. During this effort the conclusion is made that simultaneous optical observations of the same objects could sufficiently increase the precision of determination of the trajectory of the observed space debris. Results of last test session with renewed equipment and gained lessons are discussed. This work is supported by project of European Social foundation Nr. 2009 /0231 /1DP/ 1.1.1.2.0/09/APIA/VIAA/151

Space debris and near-Earth objects observations made by Nikolaev astronomical observatory

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Observations of artificial space objects and space debris on all Earth orbit types and near Earth objects (NEOs) are carried out in RI NAO. Several telescopes are used for observations: FRT (D=300mm, F=1500mm); MobiTel complex of telescopes: KT-50 (D=500mm, F=3000mm), AFU-75 (D=280mm, F=750mm), TV (D=48mm, F=135mm). All observations are carried out on unmovable telescope with use of the combined observation method. Specifically developed ephemerides calculation software is used for estimation of space debris observation errors. Observation results of geosynchronous space debris from FRT telescope have RMS error in range of 0.26"–0.91". For space objects having corner reflectors comparison of observations results with ephemerides of International laser ranging system was made. Observations RMS error for TV telescope is 3.56"–3.68"; for KT-50 0.53"–0.57"; for AFU-75 0.57"–1.63". Observed coordinates of 11 NEOs were sent to Minor Planet Center. Observations mean residuals is in range ±0.3", RMS error is 0.17"-0.42".

Earth Orientation Parameters with high temporal resolution from VLBI observations

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Time series of pole coordinates and Universal Time (dUT1) with high temporal resolution are calculated from data processing of the series of CONTs – continuous VLBI observations campains (CONT96, CONT94, IVS-CONT02, IVS-CONT05, IVS-CONT08). Stations of the Russian VLBI-network "Quasar" participated in the last two IVS-CONT campains. "Svetloe" observatory participated in the IVS-CONT05 and IVS-CONT08, "Zelenchukskaya" observatory participated in the IVS-CONT08.

Subdiurnal variations of Earth orientation parameters (pole coordinates and Universal Time) obtained from the analysis of observations were compared with the tidal model of intraday EOP variations and with available results of GPS data processing for CONT02, CONT05, CONT08 campaigns.

The discrepancies seen between the theoretical models (ocean and atmospheric tides) and the observations at the M2 and S1 frequencies as well as sub-diurnal signals related to M3 and S3 tidal phenomena in the oceans and the atmosphere are under investigations.

EOP determination from observations of Russian VLBI-network QUASAR

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Russian VLBI network QUASAR consists of 3 observatories "Svetloe" (Leningradskaya Province), "Zelenchukskaya" (North Caucasus) and "Badary" (Republic Buryatia). Since 2006 QUASAR makes the monitoring of Earth Orientation Parameters (EOP). The observations at domestic VLBI network QUASAR are carried out weekly in the framework of two national programs: 24-hour sessions for the determination of all EOPs using all three QUASAR network observatories (Ru-E program) and 1-hour sessions for UT1 determination at "Zelenchukskaya" — "Badary" baseline (Ru-U program) using e-VLBI mode. Correlation data processing performs at the IAA correlator. Secondary data treatment are hold at the IAA VLBI analysis center. For the Ru-E program the accuracy of EOPs (RMS of EOP deviations from the IERS 08 C04 series) is about 0.95 mas for pole coodinates, 35 μs for UT1-UTC, and 0.40 mas for celestial pole position. For the Ru-U program the RMS of UT1 deviation from IERS 08 C04 series is about 71 μs within the time period since 2009 till now. For e-vlbi Ru-U program (since September 2009 with few test sessions in April and May 2009) the RMS is about 59 μs.

Model for motion of comet Encke during all its apparitions

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The shrinking of the ice fraction is considered as the principal factor in the variation of nongravitational effects for 2P/Encke. Equations are $A_i = A_{i_0}\chi^2(\chi_0^3+1)/(\chi_0^2(\chi^3+1))$, $d\chi/dt = -\alpha g(r(t))$, where A_i and g are Marsden's parameters and function, r is the heliocentric distance, t is time, $\chi \geq 0$ varies directly with the radius of the icy surface, $\alpha = \text{const} \geq 0$ is the ablation rate in units of χ at unit r, the 0 index refers to a fixed moment. Heliocentric ecliptic J2000.0 orbital elements and nongravitational parameters for 2P/Encke are t = JD 2455880.5 TDB, $\omega = 186.542423°$, $\Omega = 334.576668°$, $i = 11.778395°$, $e = 0.84812929$, $a = 2.21431556$ AU, $M = 139.265222°$, $A_1 = -0.0027500$ AU/(10^4 days)^2, $A_2 = -0.000256603$ AU/(10^4 days)^2, $A_3 = -0.01089$ AU/(10^4 days)^2, $\alpha = 0.0000288473$ days^{-1}, $\chi = 0.0465840$, from 2695 observations 1786–2010, $\sigma_{apo} = 32.7\sigma_{apr}$.

New version of EPM-ERA Lunar theory

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The numerical lunar theory EPM-ERA has been developed in IAA RAS. The dynamical model of the Moon motion has been constructed by simultaneous numerical integration of the equations of orbital and rotational motions of the Moon, major planets and asteroids. Potential of the Moon is calculated up to the 4-th order of zonal index, that of the Earth includes the 2nd order harmonics C_{20} and C_{22}. Tidal perturbations in the lunar orbital motion caused by tidal dissipation on the Earth's body was calculated according to the model with the constant lag. A new version of EPM-ERA Lunar theory was corrected by the improved model of dissipative effect of the lunar rotation by integrating orbital and rotational motions with the retarded argument. The

comparison of the improved dynamical model with 17315 LLR data from 1970 till 2011 has been made. A new set of LLR observations has been also processed with three versions of DE ephemeredes of JPL (USA) and with INPOP10 French ephemeris.

Comparison of the ICRF 2 and the XPM catalogues

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Results of comparison of the XPM with the ICRF 2 and other catalogues are presented and discussed.

The XPM catalogue is a recent realization of the extragalactic reference frame in optical and near infrared wavelengths. It contains about 300 million objects in magnitude range from 10 to 22 magnitude, among which about one thousand can be found in the ICRF 2.

Some ideas of construction of the ICRF in optical range of wavelengths (new version of the HCRF) are proposed.

POSTERS

S4-1. Masses of some binary asteroids determined by the dynamical method

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To determine masses of asteroids by the dynamical method from the ill-conditioned systems of linear equations three methods (the non-negative least squares method, the method of regularization of A. N. Tikhonov, and the method of singular value decomposition) were used in this paper along with the least squares method. To compare the efficiency of these methods we have determined masses of several binary asteroids: 22, 45, 87, 90, 107, 121, 130, 283, 617, 762. For these asteroids mass values were obtained with great accuracy by other authors using observations of their satellites. Therefore found values can be used as test ones. We evaluated mass value of each perturbing asteroid using optical observations of a number of perturbed asteroids (test particles) in common solution. The obtained results are discussed and some recommendations are given.

S4-2. Tidal evolution in the secular quadrupolar three-body problem

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We investigate the dynamical evolution of hierarchical three-body systems under the effect of tides, when the ratio of the orbital semi-major axes is small, but the eccentricities and/or the inclinations can be high. Using the quadrupolar non-restricted approximation for the gravitational interactions and the viscous linear friction for tides, we derive the averaged equations of motion in a very simplified vectorial formalism, which is suitable to model the evolution for long-term studies. This model can be used to study the behavior of satellites around the Earth, or be applied to asteroids and extra-solar planets. Because our model is valid for the non-restricted problem, it can be used to study systems of equivalent masses or the outer restricted problem, such as the evolution of a satellite in a orbit around the Earth-Moon system. We show that under certain conditions tidal effects combined with gravitational interactions can transform initially prograde orbits in final retrograde orbits and vice-versa.

S4-3. The independent latitude stations data and corrected proper motions in declination of some Hipparcos stars

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The latitude data (made over many decades) of 7 so-called independent latitude — IL stations (Belgrade with code BLZ, Blagoveschtschensk — BK, Irkutsk — IRZ, Mizusawa — MZL, Poltava — POL, Pulkovo — PU/PUZ and Warsaw — VJZ) were used to calculate the corrections of proper motions in declination of common IL/Hipparcos stars. The IL data were collected during the last century in line with the Earth rotation programmes for determining the Earth Orientation Parameters (EOP), and were included into the data of a few international organizations (Bureau International de l'Heure — BIH, International Polar Motion Service — IPMS, etc.). There are numerous IL observations of stars referred to the Hipparcos Catalogue (ESA, 1997), and I used these latitude data for the inverse investigations — to improve the proper motions in declination of mentioned Hipparcos stars. The results are in good agreement with the new Hipparcos (van Leeuwen, 2007) data. The method of calculations and the calculated values of proper motions in declinations are presented here.

S4-4. Astrometry and Photometry Observations of Asteroids at the RTT150 in 2008-2010

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The participating institutions of France, Ukraine, Russia and Turkey are engaged in the joint project complementary to one of the Gaia outputs for research of Solar system objects, namely determination of masses for large asteroids. The idea consists in observing and thus providing astrometry observations for the selected asteroids, which are already or will be perturbed before the launch of Gaia mission in 2012. These observations will provide the orbit at the time of maximum deflection angle or perturbation useful for the later mass determination together with the Gaia data. For the time being passed, from 2008 till 2010, there were observed 24 asteroids selected from the IMCCE list. Thus, there were obtained more than 2700 observations. About 60% of the observations were successfully reduced to the positions with the UCAC3 catalogue. Standard errors of the positions are 0.16". in right ascension and 0.14". in declination. Photometry of several asteroids was made in BVR Bessel system performed for the images where secondary standards of SDSS7 catalogue were presented. Standard errors of photometry are 0.14 mag. in B-band, 0.09 mag. in V-band, 0.14 mag in R-band. Current status of the project, problems and possibilities are discussed.

S4-5. Geometric method for determination of parabolic orbits

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A modification of geometric Kuryshev-Perov method for determination preliminary parabolic orbit from four observations is presented. Using of the geometric relationships between heliocentric distances for object on parabolic orbit (two conditions of coplanarity and expression of semiparameter via two vectors of heliocentric distances) is allowed to obtain rigorous system of two algebraic equations relatively two geocentric distances. In these equations, the intervals of times between the observations are not used. The method may be used on any intervals of time between the observations, but don't worked for orbits nearby ecliptic. As an example, the orbit of long-periodic comet 153P/Ikeya-Zhang is computed. The five solutions were obtained and analyzed.

S4-6. Forthcoming mutual events of planets and astrometric radio sources

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Very long baseline interferometry (VLBI) observations of close approaches of the Solar system planets to compact radio sources, as well as radio source occultations by planets may be of large interest for planetary sciences, dynamical astronomy, and testing gravity theories. In this presentation, we will show an extended lists of occultations of astrometric radio sources by planets, and close approaches of planets to radio sources expected in the nearest 40 years. For selected occultations, the map of the shadow path is provided. Computations are made making use of the EPOS software package. Complete tables of the forthcoming approaches and occultations of planets and radio sources for the period till 2050 are available at the Web page http://www.gao.spb.ru/english/as/ac_vlbi/.

S4-7. Accuracy assessment of the UT1 prediction method based on 100-year series analysis

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A new method has been developed at the Siberian Research Institute of Metrology (SNIIM) for highly accurate prediction of UT1 and Pole coordinates. The method is based on construction of a general harmonic model of the variations of the Earth rotation parameters using all the data available for the last 80-100 years, and modified autoregression technique. In this presentation, a detailed comparison was made of real-time UT1 predictions computed making use of this method in 2006-2010 with simultaneous predictions computed at the International Earth Rotation and Reference Systems Service (IERS). Obtained results have shown that proposed method provides better accuracy at different prediction lengths.

S4-8. Comparison of earth and space data about craters sizes on surfaces of asteroids 21 Lutetia and 4 Vesta

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Research of the reflected and dispersed sunlight contain the information of surfaces composition of solid atmosphereless Solar system bodies. The spectral-frequency method (SFM) has been devised for mark of details sizes on surfaces of such celestial bodies. Spacecraft "Rosetta" has approached with the asteroid 21 Lutetia on July, 10th 2010 and has taken pictures which shows big crater in diameter about 70 km, three craters in the size 30, 25 and 22 km and many small craters. Comparison of this data with the data, received by means of SFM, shows that on the asteroid surface there is a large crater and its size practically coincides with the size defined at earth observation and craters about 20-30 km. The known crater size on the southern hemisphere of the asteroid 4 Vesta was shown full accord with results of SFM color index B-V and definitions of the crater diameter determined from observations with the space telescope Hubble.

S4-9. The mass of the asteroid belt

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The mass of the main asteroid belt is estimated as 13.5×10^{-10} Msun. Hidden mass does not exceed two percent of this value. It is shown that all asteroids with absolute magnitude H<14 are found up to the distance 3.8 a.u. from the Sun. Estimations of mass for different zones of the asteroid belt, including the Trojans, are obtained. The total mass of the belt, including the Trojans, is estimated as 14×10^{-10} Msun. Perturbations, produced by the asteroid belt, excluding of 300 large asteroids, are described as the attraction of an inclined to the ecliptic plane gravitating ellipse with uniformly distributed mass of 1.1×10^{-10} Msun. The elements of this ellipse are calculated: $a = 2.85 \pm 0.01$a.e., $e = 0.04 \pm 0.01$, $\lambda = 358^\circ \pm 7^\circ$, $i = 1^\circ.1 \pm 0^\circ.2$, $\Omega = 100^\circ \pm 5^\circ$.

S5: Physics of Stars

Conveners:
Anatol Cherepashchuk (U. Moscow, Russia),
Lyudmila I. Mashonkina (Astron. Inst., Moscow, Russia),
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Stochastic Variability of Luminous Blue Variables

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Using the archives of the AAVSO and our own data, we analyse the long-term variability of several well-studied Luminous Blue Variables (LBVs) aiming on a general picture of stochastic variability of these objects. The power density spectra of all the selected objects may be generally described by a single power law contaminated by observational noise at higher frequencies. The slopes of the power-law component are close to $p = 2$ (where $PDS \propto f^{-p}$, and f is frequency) for strongly variable flaring objects like AG Car and significantly smaller ($p \sim 1.3$) for P∼Cyg where brightness variation amplitude is $\lesssim 1$ and dominated by slow low-amplitude variability. The slope holds for about two orders of magnitude in the frequency domain, though peaks and curvatures are present at $f \simeq 10^{-2} \div 10^{-3}\mathrm{d}^{-1}$. We show that pseudo-photosphere approach to variability may explain the power-law shape of the variability spectrum at higher frequencies. However, the observed spectra are actually rather "red" than "brown": flux variations are correlated up to tens of years that is much longer than the characteristic refreshment time scales of the pseudo-photosphere. We propose that several stochastic noise components produce the power spectra of LBVs.

Magnetic Cataclysmic Variables: 35 Years of Surprises from AM Her-Type Stars

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We review theoretical and observational results on structure and evolution of magnetic cataclysmic variable stars: classical (AM Her-type), asynchronous (BY Cam) and intermediate (DQ Her) polars. Besides, a new class of "magnetic dwarf novae" (or "outbursting intermediate polars") of DO Dra-type is considered. These types of objects are excellent laboratories to study ∼25 physical mechanisms with characteristic time scales from 0.1sec to dozens billions of years. Contrary to interacting binary stars with neutron stars with much larger magnetic fields, radius of magnetosphere is much larger relative to the orbital separation, and may even reach the inner Lagrangian point. The accretion structure is strongly dependent on the accretion rate, orientation of the magnetic axis of the white dwarf and magnetic field strength. Of special interest are non-linear effects of interaction of different physical mechanisms. They are illustrated by results of the "Polar" part of the international observational campaign "inter-Longitude Astronomy".

Physical processes in close binary stars

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The main focus of the talk is the discussion of physical processes in close binary stars leading to their observed variability. In the talk I discuss the main details of the flow pattern in binaries which are found in three-dimensional HD and MHD numerical simulations. It is shown that in systems having no magnetic field the leading role belongs to such gas dynamic features as an accretion disk and a number of shock waves. Among those shocks we can pick out two arms of the tidal spiral shock, bow shock caused by the motion of the accretor and disk in gas of the circum-binary envelope, and so called "hot line", a shock occurring due to interaction between the circum-disk halo and the stream from the inner Lagrange point L_1. When the magnetic field of the accretor is taken into account, new structural elements appear. The magnetosphere region becomes distinguishable, and matter is accreted through the accretion columns. Analysis of numerical simulations shows that mainly the toroidal magnetic field is in

Star formation in the Local Group

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We have undertaken a systematic study of pre-main-sequence (PMS) stars spanning a wide range of masses (0.5–4 Msolar), metallicities (0.1–1 Zsolar) and ages (0.5–30 Myr). We have used the HST to identify and characterise a large sample of PMS objects in three star forming regions in the local group, namely NGC 3603 in the Milky Way, 30 Doradus in the Large Magellanic Cloud and NGC 346 in the Small Magellanic Cloud. Thanks to a novel method that we have developed to combine broad-band (V,I) photometry with narrow-band Halpha imaging, we have determined the physical parameters (temperature, luminosity, age, mass and mass accretion rate) of more than 2000 bona-fide PMS stars still undergoing active mass accretion. This is presently the largest and most homogeneous sample of PMS objects with known physical properties. I will present the main results of this research, including the fact that mass accretion rate appears to scale with the first power of the stellar mass, with the square root of the age, and approximately with the inverse of metallicity. These results are bound to have important implications for, and constraints on our understanding of the star formation process.

Unusual Classical Nova CI Cam

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We propose to use the properties of Classical Novae X-ray emission for testing their theoretical models. We developed the model of the CN explosion in the binary system CI Cam in 1998. According to it the stellar wind from the optical component (B[e] star) heated by a strong shock produced when matter was ejected from the WD due to a thermonuclear explosion on its surface is the source of the X-ray emission in the 3-20 keV energy band. This model allows to explain dependence of the X-ray luminosity and the mean temperature of the heated material on time during the explosion and gives velocity estimates of the matter, ejected from the WD surface. Discrepancies between model and observations, for example theoretical luminosity decreases slower than observed one, are likely caused by roughness of spherically-symmetric assumption. Using 3D calculations we show possible density perturbations (accretion wake, disk-like stellar wind) which can reconcile theory with observations.

Deriving physical and chemical stellar parameters: how well can we do it?

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The knowledge of the stellar parameters is of paramount importance in several astrophysical fields. How reliable and accurate are our estimates of their values? How precisely can we measure the photospheric abundances? Do we need to improve our techniques, and if so, how? These questions are particularly crucial to fully exploit the data from current and future observational facilities. In particular, we expect that the analysis of data from the GAIA, and maybe PLATO, mission will lead to fundamental advances in stellar astrophysics. Present and future studies strongly rely on accurate determinations of the stellar fundamental parameters and composition. A solid basis for the modelling of the stellar spectra is necessary to face the new coming challenges. In this talk I will review the current way of interpreting stellar spectra and obtaining stellar parameters and abundances for stars of various spectral types, highlighting recent advances and standing problems.

Evolutionary Trends in the Photometric Activity of UX Ori Type Stars

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The UX Ori type stars are photometrically the most active young objects. The algol-type brightness minima observed in these stars are caused by the strong changes of extinction in their circumstellar disks inclined to the line-of-sight under a small angle. There are evidences to suppose that a large contribution to the variable extinction is given by the innermost disk region near to the dust sublimation zone. In the talk we give the observables pointing to that some minima in the UX Ori stars are caused by the dust formed due to the dissipation of the large solid bodies (planetezimals) approaching the star, and that the relative contribution of such events to the algol-type eclipses increases during the evolution of the circumstellar disks.

Disappearance of main pulse of Crab pulsar as a result of change mechanisms of radio emission

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An explanation for detected by Moffet and Hankins [1] disappearance of the main pulse of PSR B0531 +21 at a frequency of 8.4 GHz is given. For all that, the interpulse intensity increases in comparison with low frequencies. The effect is associated with breaking of coherent radiation of accelerated electrons in a pulsar vacuum gap, which manifests itself also in the high-frequency cut-off of the pulsar spectra. The mechanism change accompanies with the change of the angular distribution of pulsar radio emission. As a result, the main pulse is found outside of the narrow aberration diagram of the low-frequency tail of relativistic radiation and the interpulse, in contrast, falls in it. The effect may serve as a confirmation of the proposed mechanism of pulsar radio emission [2].

1. D. Moffet, T. Hankins. ApJ, 468, 779 (1996).
2. V. Kontorovich, A. Flanchik. Actual problems of extragalactic astronomy 2011. Abstracts. http://www.prao.ru/conf/28_conf/registration/docs.php.

Radiation pressure in Massive Star Formation

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We investigate several effects of radiation pressure in the formation of massive stars via one-, two-, and three-dimensional self-gravity radiation hydrodynamics simulations of massive pre-stellar core collapses. In contrast to previous research, we consider frequency dependent radiation feedback, use a newly developed hybrid radiation transport, including ray-tracing as well as flux limited diffusion (Kuiper et al. 2010, A&A vol. 511), resolve the dust sublimation front in the vicinity of the forming star down to 1.27 AU, compute the whole accretion phase of the new born star up to several 10^5 yr, and perform a broad survey of the parameter space (47 simulations by now). On the one hand, the simulations demonstrate, how the well-known radiation pressure problem in the formation of massive stars can be circumvented via classical disk accretion (Kuiper et al. 2010, ApJ vol. 722). On the other hand, we analyze in detail the (in)stability of radiation pressure driven outflows.

Can we reliably determine stellar parameters of very metal-poor stars?

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The surface gravity of the very metal-poor stars HD 84937 (Teff = 6350 K, [Fe/H] = -2.08) and HD 122563 (4600 K, -2.56) was determined using various methods. With the Hipparcos parallax based gravities of log g = 4.09 and 1.60, respectively, the Fe I/Fe II and Ca I/Ca II ionization balance is achieved for each star when line formation is treated not assuming LTE. The LTE analysis gives a 0.2 and 0.5 dex lower gravity for HD 84937 and HD 122563, respectively. We inspected the position of each star on evolutionary tracks of Yi et al. (2003). HD 84937 is a turn-off star, and it sets well on the track of 0.75 solar mass at a star age of 13.6 Gyr. Different case is HD 122563. To set the star on the track, one would require either a gravity of log g = 1 or a temperature of Teff = 4800-4900 K, many standard deviations away from the measured parameters. Similar behavior was found for other two VMP cool giants with Hipparcos parallax available. We caution against using stellar evolution calculations for determining the gravity of ultra and hyper metal-poor stars which are mostly cool giants.

Physical properties of components in multiple stars and their dynamics

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We have considered a few multiple stars which have a weak hierarchy: HD 40887, HD 76644 (*iota* UMa), HD 136176, HD 150680, HD 217675 (*o* And), HD 222326, and HD 284419 (T Tau). We have calculated the masses of components and orbital elements of the subsystems, using the data from literature and original observations by the 1.5-m Russian-Turkey Telescope RTT 150 at Tyubitak (spectroscopic observations) and 6-m telescope BTA in the Special Astrophysical Observatory (speckle-interferometry). We have determined the structure and multiplicity of the systems more accurately. For systems HD 222326 and HD 136176 new components were discovered, so both systems are probablyquadruple. The spectroscopic observations were used to obtain new estimates of the component masses. The speckle-interferometric data were attracted to calculate the orbital parameters for close subsystems. The orbital parameters were found by classic Thiele-Innes method and apparent motion parameter method developed in Pulkovo Observatory. To determine the dynamical stability of the systems, we have applied the well-known stability criteria for triple systems, as well as the numerical simulations of the N-body problem. The stability and instability regions were outlined within the set of orbital parameters and masses. The unstable scenario is probable for the quadruple system HD 76644 (*iota* UMa). Other systems are probably stable. We discuss possible reasons to violate the stability: inner dynamical evolution of the young multiple system, encounters with massive objects of the Galactic field and moving groups, temporal capture of the field star by binary or multiple system, merging of components in close multiple system. Also we discuss possible future efforts in studies of multiple stars.

New discoveries of variable stars and implications for variability-type statistics

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The Moscow team of variable-star researchers, known for its work on the General Catalogue of Variable Stars (GCVS), is currently engaged in several projects aimed at variable-star discoveries, in cooperation with

other groups. Some of these projects deal with CCD photometry of selected star fields imaged with wide-field telescopes at different sites in Russia. We are also working on digitalization of the Moscow stacks of sky photographs, and our searches in the fields already digitized result in discoveries of hundreds of new variable stars. Besides, we analyze, in the course of our GCVS work, the flow of variable-star discoveries in the literature, both discoveries of individual variables and discoveries in the frame of large-scale automatic surveys. One of unexpected interesting results of the new discoveries is the feeling that statistics of variable-star types, as represented with the present contents of the GCVS, is biased, and the amount of bias is not always easy to explain with obvious factors of observational selection. The talk will describe the most interesting variables discovered by our group and discuss the implications for our understanding of the frequency of different variable-star types and of their period distribution.

Resolving enigmas of peculiar stars

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Chemically peculiar (CP) stars belong to the group of B-F main sequence stars which photometric and spectroscopic parameters may dramatically differ from the ones of majority of "normal" stars with the same temperatures and gravities. Large surface magnetic fields and abundance anomalities caused by efficient microscopic diffusion of chemical elements are main mechanisms that drive CP phenomenon, but its theoretical explanation still requires more sophisticated model atmospheres and atomic data. In this work we present and discuss new approach to the modelling of atmospheres of these interesting objects, as well as some of recent results. For CP stars with known parallaxes the modelling procedure allows us to derive stellar radii that agree well with the direct interferometric measurements thus validating our approach.

Activity and rotation of planet-harboring CoRoT stars

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During the eclipse of a star by its planet, spots on the stellar surface can be occulted, causing small variations in the light curve. The detailed study of these variations during transits provides information about the properties of the spots such as size, position, temperature (or intensity), and lifetime. It is also possible to estimate the stellar rotation period and whether there is differential rotation. Applying a model that simulates planetary transits of stars like HD 209458, CoRoT-2, CoRoT-4, CoRoT-5, CoRoT-6, and CoRoT-8 allows us to study the physical characteristics of spots. The results from the analysis of the light curves and the comparison of the spot properties from these different stars will be presented and discussed.

Is there a magnetic field in the radiative interior of solar type stars?

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Thanks to helioseismology, we know that the Sun's radiative interior is rotating quasi uniformly, contrary to its convection zone, where the equator rotates faster than the poles, as observed at the surface. One way to explain that quasi rigid rotation of the inner region is to invoke a magnetic field of fossil origin. However, recent 3-dimensional numerical simulations demonstrate that such a field would expand into the convection zone, due to Ohmic diffusion, and that it would imprint the differential rotation of that region on the radiation zone, which is not observed. Thus another mechanism must be responsible for the uniform rotation of the solar radiative interior.

POSTERS

S5-1. Non-LTE line formation for Dy II/III in A and Ap stars

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Aims. Non-local thermodynamical equilibrium (non-LTE) line formation for singly-ionized and doubly-ionized dysprosium is considered through a range of effective temperatures between 7000 K and 9000 K. We evaluate the influence of departures from LTE on Dy abundance determinations. Methods. A comprehensive model atom for Dy II/III is presented based on the measured and the predicted energy levels, in total, 19303 levels of DyII and DyIII and the ground state of Dy IV. Calculations of the Dy II energy levels and oscillator strengths for the transitions in Dy II and Dy III are described. Results. The dependence of non-LTE effects on the atmospheric parameters is discussed. Departures from LTE lead to overionization of Dy II and, therefore, to systematically depleted total absorption in the line and positive abundance corrections. The non-LTE effects strengthen the DyIII lines and lead to negative abundance corrections. Non-LTE corrections grow with effective temperature for the DyII lines, and, in contrast,they decline for the Dy II lines. We find that the lines of both ionization stages are described for the vertical distribution of the praseodymium where the Dy enriched layer with [Dy/H] ≥ 4 exists in the outer atmosphere at $\log \tau 5000 < -4$. The departures from LTE for Dy II/III are strong in the stratified atmosphere and have the opposite sign for the Dy II and Dy III lines. The dysprosium stratification analysis of roAp stars has to be performed based on non-LTE line formation.

S5-2. Modeling light curves of binary systems: accounting for extended winds

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A synthesis model of an eclipsing binary system including one component with strong stellar wind (usually a Wolf-Rayet star) is presented. The components geometry is defined by the Roche model, one component loses material through stellar wind. In our model the wind is assumed to be smooth and homogeneous, the main absorption agent in the optical continuum is electron scattering. The electron density of the wind is defined by the mass loss rate, the velocity law (e.g., the commonly used beta-law), the chemical abundance of the wind material and its ionization stage. We present the results of numerical simulations which show that the shape of the light curve (and in particularly the width of the minima) strongly depends on the wind parameters. These simulations show that accounting for the absorption in the expanding wind is crucial in modeling light curves of binaries including WR stars and obtaining the parameters of the components.

S5-3. Bimodal brightness oscillations in the weak-lined T Tauri star V718 Per (HMW 15, H 187)

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The weak-lined T Tauri star V718 Per is known by its unusually long eclipses with a period of 4.7 years. During the last observational seasons we have found that the star demonstrated also the low-amplitude oscillations with the period of 213 d. In contrast with the large-scale eclipses accompanied by the star's reddening, the low-amplitude oscillations are neutral in character. Such bimodal oscillations arise due to the periodical changes of extinction in the two different zones of circumstellar disk perturbed by the companion(s). As this

star reveals no signatures of spectroscopic binarity, the perturbing body can be either a giant planet or a sub-stellar companion.

S5-4. Retrieving semi-major axis distribution of binary stars

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The semi-major axis is a key fundamental parameter of binary stellar systems. Its values vary over a huge range of several orders of magnitude. Certainly, initial distribution of semi-major axis puts constraints on theories of star formation. Generally accepted log-flat distribution (Opik's law) implies the equal number of close and wide systems and efficiently means that this property of binary stars is scale free. In order to obtain current semi-major axis distribution we use statistical approach and investigate volume-limited sample in the solar neighborhood, as well as catalogs of binaries, corrected for observational biases. The obtained distribution shows unsatisfactory agreement with the canonical Opik's law. Possible reasons for the disagreement are discussed in the presentation.

S5-5. Transient high frequency optical oscillations on three flares of the red dwarf AD Leonis

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Thorough investigations on the red dwarf EV Lac, YZ CMin and AD Leo indicate that transient high frequency oscillations occur during the flare event and during the quiet-star phase as well. The postulation that this is a general characteristic of the active red dwarf is a very important task. In the frame of this consideration we present in this paper the results of the analysis of the B-light curve for the flares of the red dwarf AD Leo, which were observed on March of 2000, with the help of the 30-inch Cassegrain telescope of the Stephanion Observatory. The combined use of Fractal analysis, DFT-analysis and Wavelet analysis enable us to estimate the proper random noise and detect possible weak transient optical oscillations. In accordance to the results of the previous studies the results of the present study indicate that: (1) Transient high frequency oscillations occur during the flare event (2) The Observed frequencies range between 0.0083Hz (period 2min) and 0.130Hz (period 8s) not rigorously bounded. This result is in favour of (or does not contradict) the suggested explanation, i.e. the evolution of a fast mode magneto-acoustic wave generated at the impulsive phase of the flare and travelling through the magnetic loop. This procedure may occur many times during the development of a large flare.

S5-6. Transient high frequency optical oscillations on two weak flares of the red dwarf V390 Auri

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Thorough investigations on the red dwarf EV Lac, YZ CMin and AD Leo indicate that transient high frequency oscillations occur during the flare event and during the quiet-star phase as well. The postulation that this is a general characteristic of the active red dwarf is a very important task. In the frame of this consideration we present in this paper the results of the analysis of the U-light curve for the flares of the red dwarf V390 Auri, which were observed on February of 2002, with the help of the 30-inch Cassegrain telescope of the Stephanion Observatory. The combined use of Fractal analysis, DFT-analysis and Wavelet analysis enable us to estimate the proper random noise and detect possible weak transient optical oscillations. In

accordance to the results of the previous studies the results of the present study indicate that: (1) Transient high frequency oscillations occur during the flare event (2) The Observed frequencies range between 0.011Hz (period 1.5min) and 0.083Hz (period 12s) not rigorously bounded. This result is in accordance with the results of the observation of transient optical oscillation on strong and medium flares.

S5-7. Light element abundances in mild barium stars

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We derived carbon, nitrogen, oxygen, and lithium abundances as well as $^{12}C/^{13}C$ isotopic ratios for a group of five giants found to be mildly enriched in s-process elements ([s/Fe]$\sim 0.3 - 0.4$ dex). The high-resolution spectra of these stars were obtained with the FEROS echelle spectrograph at the 2.2m telescope of ESO, Chile. The light element abundances of these stars were derived via spectrum synthesis method using C_2, ^{12}CN, ^{13}CN, [O I], and Li I λ6708 Å lines. Our results show that all studied stars have [C+N/Fe] ratios higher than the corresponding values for the first red giant branch stars. The excess of C+N abundances and enhanced abundances of the s-process elements permit us to classify these stars as mild barium stars which chemical peculiarities may be explained in terms of the mass-transfer phenomenon. The oxygen abundance in the low-metallicity giant CD-65°2893 ([Fe/H]$= -0.8$) follows the same trend as seen for halo stars of the samemetallicity. For two stars, HD 56523 and HD 68812, we found high rotation velocity ($v \sin i = 8.0$ and 11.0 km s^{-1}, respectively) which is not expected for single giants and may be caused by binary nature of these stars.

S5-8. Tidal torque constants as a critical test for an evolution of close eclipsing binaries

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Mutual tidal-rotary deformation of components in eccentric close eclipsing binaries (CEB) result in a several effects noticeable in secular evolution: apsidal motion, components synchronization, circularization of the orbit as well as magnetic braking if CEB have convective envelopes. The collation of these timescales with nuclear evolution rate and with CEB's age allows to specify the evolutionary status of a CEB. Solution of such problem became possible owing to evolutionary stellar models by Claret, 2004 with built-in set of tidal torque constants associated with damping mechanisms such as turbulent or radiative dissipation. We developed numerical algorithm based on isochrone method allowing to compute tidal torque constants set for given CEB. Reliability of calculated data was tested in comparison of known observed and theoretical apsidal period for given CEB. CEB are taken from the catalogue by Svechnikov&Perevozkina, 1999 and gives statistics allowing to predict priority of components synchronization in CEB, to compare synchronization rates for massive and low-massive CEB, to clarify magnetic braking role in CEB tidal evolution, and to resolve the problem of several CEB with the noticeable relativistic effect.

S5-9. Modern Theory of Star Formation

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The base features of modern theory of star formation are discussed. The particular attention is paid to the numerical simulations of star formation under the influence of rotation, turbulence and magnetic field. The 2D and 3D numerical simulations of the collapse of protostellar clouds drastically change our modern picture of

star formation. The base question of our contemporary investigation concerns the problem of fragmentation. Multidimentional numerical simulations show that during early stages of colllapse of protostellar clouds only 2-3 fragments are formed. These results disagree with the famous Hoyle's theory of fragmentation.

S5-10. Fast line profile variability and magnetic field of zeta Ori

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We report the results of observations of supergiant zeta Ori A on 6-meter telescope of the Special Astrophysical Observatory, Russia. We found the fast regular line profile variability (LPV) in spectra of the star with a period of 1–3 hours. Probable connection of LPV with nonradial pulsations is proposed. Presence the weak magnetic field of zeta Ori A (B=50-100 G) reported by Bouret et al. (2008) is not confirmed.

S5-11. The probability of discovering contact close binary stars in the case of total limb darkening

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The probability of discovering contact close binary stars as eclipsing variables is calculated as a function of the mass of the principal component, the mass ratio, and the angle of inclination of the orbit. We examine contact systems of early spectral classes (CE systems) and late spectral classes (CW systems) according to Svechnikov's classification. The case of total limb darkening of the star's disk (hypothesis "D") is studied. A comparison with previous results for uniformly bright stellar disks (hypothesis "U") shows that the difference between the two cases is small.

S5-12. FR Cnc Revisited: Photometry, Polarimetry and Spectroscopy

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This is a part of a multiwavelength study aimed at use of complementary photometric, polarimetric and spectroscopic data to achieve an understanding of the activity process in late-type stars. Here we present the study of FR Cnc, a young, active and spotted star. We performed analysis of ASAS-3 data for 2002–2008 and amended the value of the rotational period to be 0.826518 d. The amplitude of photometric variations decreased abruptly in 2005, while the mean brightness remained the same, which was interpreted as a quick redistribution of spots. BVR_cI_c photometric calibration was performed for 166 stars in FR Cnc vicinity. The photometry at Terskol Observatory shows two brightening episodes, one of which occurred at the same phase as the flare of 2006 November 23. Polarimetric BVR observations indicate the probable presence of a supplementary source of polarization. We monitored FR Cnc spectroscopically during 2004–2008. We concluded that the radial velocity changes cannot be explained by the binary nature of FR Cnc. We determined the spectral type of FR Cnc as K7V. Calculated galactic space-velocity components (U, V, W) indicate that FR Cnc belongs to the young disc population and might also belong to the IC 2391 moving group. Based on Li I λ6707.8 measurement, we estimated the age of FR Cnc to be between 300–600 Myr. Doppler Tomography was applied to create a starspot image of FR Cnc. We optimized the goodness of fit to the deconvolved profiles for axial inclination, equivalent width and $v \sin i$, finding $v \sin i = 46.2$ km s^{-1} and $i = 55°$. The starspot distribution of FR Cnc is also of interest since it is one of the latest spectral types to have been imaged. No polar spot was detected on FR Cnc.

S5-13. Star formation region of the Orion KL, epoch 2003

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We conducted VLBI research of the active star formation region in the Orion KL in the H2O maser emission epoch 2003 with 0.15 mas resolution. At this time the maser emission decreased until F = 20 kJy, and velocity shifted from 7.65 to 8 km/s relatively of epoch 1999. The structure remains the same — highly collimated bipolar outflow with the compact fragments. A velocity of outflow ejection reaches $\sim$ 50 km/s. Line of sight velocity of the outflow is increased with the distance from the nozzle $\sim$ 0.3 km/s. The fragments of outflow are visible up to 45 AU and have width $\sim$ 0.2 AU, which corresponds to very high collimation $\sim$ 250. The helix structure of outflow is determined by ejector precession of which is T $\sim$ 10 yrs. The structure appears to be anti-centrifuge, which is accreting the surrounding neutral gas, moving it along the arms towards the centre ejecting rotating bipolar outflow. The outflows are interacting with surrounding matter that causes collimation and growth of velocity of the outflows.

S5-14. On selection effects in the study of visual binaries

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An investigation of physical properties of different kinds of binary stars can get us an invaluable information about star formation and evolution. To obtain present-day distributions of binaries along various parameters from catalogues, selection effects should be taken into account. In this presentation some catalogues of visual binaries were explored with respect to selection effects. We have studied and corrected for selection distributions of binaries with respect to the separation of components, limiting magnitude and magnitude difference.

S5-15. Planet formation processes around young stars

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The results of the analysis of long-term spectral and photometric observations of classical T Tauri stars T Tau, BP Tau, SU Aur and DI Cep were reported. For researches we have following methods: 1) an analysis of long-term summary UBV-light curves of stars, 2) to study the variability of the spectrum in the visible and UV ranges, 3) to carry out the spectral energy distribution (SED) in the range of 0.36-100μm. The analysis was showed that the SED curves of searched stars can be interpreted as a combined thermal radiation of at least 2-3 circumstellar bodies with temperatures from 3000 to 500 K and the emission of dust with a temperature of about 100 K. On the method of statistical spectral analysis of the average light curves of selected stars, and using the two more significant periods for each star we are carried out synthetic Fourier light curves. The results show in the first approximation a good agreement of the synthetic curves with the observed light curves.

S5-16. A brightness and spectrum variability of RY Tau

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Results of 10-year monitoring of the emission doublet MgIIλ 2800 Å in the UV spectrum of the star RY Tau has presented. Emission MgII λ2800 Å was not showed synchronal variability with the UBV-photometric data. Firstly was detected a periodic variability of the intensity of this emission doublet with a period of 23 days. Spectral observations found that in the line Hα while the blue emission component and the central absorption are shows synchronously variability with the same period, the emission in the red wing of the line have not significant variations. A SED curve of the star can be represent by thermal radiation of bodies with temperatures of 6000, 3000, and 90 K. On the spectral analysis of light curves revealed probable orbital periods of the components for 14 years and 6 years.

S5-17. Fast Line profile variations in spectra of early-type stars

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We report results of a studying the fast line profile variability (LPV) in spectra of bright OB stars. Spectral and spectropolarimetric observations of eleven bright OB stars were made during last ten years in a framework of the program of searching for regular and stochastic line-profile variability in the spectra of OB stars (Kholtygin et al., 2003). All spectra were obtained with 6-m telescope of Russian Special Astrophysical Observatory (SAO) and 1.8-m telescope of Bohyunsan Optical Astronomy Observatory (Korea). We detect both the stochastic LPV, connected with the formation of small-scale structures in the stellar wind and the regular LPV induced by the large-scale structures in the wind. The obtained periods of regular LPV appeared in the range from hours to days. The mechanisms of the formation both large-scale and small-scale in the wind structures are investigated. For program stars rho Leo (B1Iab) we measure the effective magnetic field. The impact of the moderate magnetic field on the LPV is studied.

S5-18. Photometric Observations of Population-II pulsating variables

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Population-II pulsating variables are evolved, low-mass stars that often used as standard candles to measure galactic distances. They are an ideal tool for studies of the structure and kinematics of the halo of our Galaxy as well. Many of them are known (about 7500 such stars are listed in the General Catalogue of Variable Stars), but only small fraction of such stars have reliable light curves and, as a result, distances. We have started a new project of photometric observations of a large sample of Population-II variables using the SAAO 0.75m telescope. During 2009-2011 about 30000 CCD frames in BVIc filters were taken for about one hundred of RR Lyrae, W Vir, and RV Tau-type variables. We present the first results of this project.

S5-19. Identification of New Galactic LBV and WR Stars from Optical Spectroscopy

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Luminous Blue Variable (LBV) stars represent an extremely rare class of very luminous and massive stars. Only about a dozen confirmed Galactic LBVs are known to date, which precludes us from determining a solid evolutionary connection between these and other evolved massive stars. We identified a sample of possible LBV candidates from the Spitzer MIPSGAL survey via detection of their circumstellar nebulae. Subsequent optical and infrared follow-up of stars from our sample confirmed that most of them are evolved massive ones, including LBV and WR stars. In the present poster we report the results of optical spectral classification of some of these stars.

S5-20. Elemental abundances in FGK dwarfs of the Galaktic disk

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We present the alpha-element (O, Mg, Si), the iron peak (Ni) and neutron-capture element (Y, Zr, Ba, La, Ce, Nd , Sm and Eu) abundances for about 280 FGK dwarfs in the region of metallicity of -1 < [Fe/H] < +0.3. The spectra of investigated stars were obtained with the ELODIE echelle spectrograph at the Observatoire de Haute-Provence (France). Effective temperatures were estimated by the line depth ratio method and from the Halpha line-wing fitting. Surface gravities (log g) were determined by two methods: parallaxes and ionization balance of iron. Abundance determination was carried out by LTE approximation, taking into account the hiperfine structure for Eu, the abundance of Ba was computed in NLTE approximation. Behaviour of the alpha-element (O, Mg, Si), the iron peak (Ni) and neutron-capture elements with [Fe/H] was analyzed for different substructures of the Galaxy that were separated (divided) according to kinematic criteria. The alpha-elements shown an abundance increasing with metallicity decreasing, the nickel abundance has the trend close to zero with small scatter. n-capture elements have different trends, that indicates to the complexity of enrichment sources by these elements.

S5-21. The completely bounded electron-proton states with the positive energy in the photospheres of magnetic white dwarfs

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We prove that an electron with the positive energy can make the completely bounded classical motion in the Coulomb field of a motionless proton embedded in a homogeneous magnetic field. Near the proton, the completely bounded trajectories can occupy the significantly larger sector of the electron velocity directions than the free trajectories with the same energy. For this, the electron Larmor radius must less than the typical impact parameter of the close Coulomb collisions in the absence of magnetic field. The required physical conditions are achieved in the photospheres of the magnetic white dwarfs. The bounded electrons with the positive energy can produce the spectral lines in absorption in the infrared spectra of the magnetic white dwarfs. These lines are not so numerous than the lines which could stem from the highly excited Rydberg states.

S5-22. Indications of stellar mass ejections

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Presented is an analysis of NASA/FUSE spectra and lightcurves of three young and active late-type main-sequence stars (AD Leo, AU Mic, and AB Dor). The spectra are investigated regarding line asymmetries related to stellar mass ejections. Such phenomena are expected to endanger planetary atmospheres of objects which orbit closely to the star and of objects with a weak planetary magnetic field, which acts as a protector against the highly energetic charged particles. Therefore it is crucial to know parameters of stellar mass ejections. We find in the data of AD Leo a line asymmetry shifted by 84km/s in the OVI(1032A) line which might be related to a flare preceding the asymmetry by more than two hours. In addition we compue the CIII(1176A)/CIII(977A) line ratio for all stars, known to be sensitive to electron density. The ratio is for all stars increased during stellar flaring. To investigate the solar case we use TIMED/SEE and SORCE/Solstice spectra and compute the carbon ion ratio during flares. Because TIMED and SORCE do not operate coordinated there is only a small sample of coinciding events. From these we find that only for strong solar flares the carbon ion ratio is increased. Wether mass ejections cause an increase in the carbon ion ratio can not be investigated as no solar mass ejection event was covered by both instruments simultaneously.

S5-23. Determination of homogenized effective temperatures from stellar catalogs

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Some selected catalogs of effective temperatures for F, G and K stars are analyzed. By an improved technique we estimate the external errors of these catalogs from data intercomparisons. The temperatures are then averaged with the appropriate weights to produce a mean homogeneous catalog based on the selected data. This catalog containing 800 stars is compared with some other independent catalogs for estimating their external errors. The data may be used as a source of reliable effective temperatures, together with their errors.

S5-24. Analysis of mid-resolution near-infrared spectra of late-M dwarfs

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Using 1D LTE model atmospheres we have analyzed near-infrared mid-resolution spectra of late-M dwarfs in the solar vicinity. The data were obtained with Keck/NIRSPEC high-resolution mode. Synthetic fits to the observed spectra will be presented.

S5-25. Modeling Hydrogen-Rich Wolf-Rayet Stars in M33

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Most massive stars spend a short time as a Luminous Blue Variables (LBVs) before becoming WN stars. But detailed connection between LBV, WN and hydrogen-rich WN (WNH) stars is little known. Studying WNH demonstrating spectral variability and strong mass loss is very important for understanding stellar evolution. We present the results of spectral variability studies for two very luminous stars in the M33 galaxy – LBV V532 and late WN star (possibly, formant LBV) FSZ35. We studied spectral variability of V532,

derived its atmosphere parameters and showed that the bolometric luminosity of V532 varied during the flare in 2005 by a factor of ∼1.5. Using CMFGEN, we determined wind parameters for both objects. Since both stars are located at distances of about 100 pc from the nearest association, we supposed that they may be massive runaway stars with velocities of the order 100 km/s.

S5-26. Proper motions and CCD-photometry of stars in the region of the open cluster M 50(NGC2323)

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The results of a complex study of the galactic open cluster M50 are presented. Relative proper motions of 1204 stars up to the limit magnitude B∼16.7 mag the cluster area were derived from the positions measured by means of the automated measuring complex "Fantasy" on 6 plates of the Normal astrograph and cluster region from the USNO-A 2.0, USNO-B1, and 2MASS catalogues. Astrometrical selection of cluster members was made. The positions of stars on the CMD(V B-V,J∼J-K) and CCD(U-B∼B-V,J-H∼J-K) diagrams of the clusters were used as the second and third criteria for the member segregation. 506 stars appeared to be reliable members of M50. They were used to determine physical parameters of the cluster: E(B-V)=0.25 mag, (V-M_v)=9.85 mag and the cluster age of 140 myr. The luminosity and mass functions were constructed and the value of the slope 3.19 was determined. The question of the belonging to the cluster of the red and blue giants, variable, double and multiplied stars was considered.

S5-27. On the evolutionary status of the UX Ori type star RZ Piscium

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The star RZ Psc (Sp = K0IV) is one of the most unusual variable stars. According to the properties of its light curve, it belongs to the family of young stars of the UX Ori type. At the same time, RZ Psc shows none of the classical signs of youth: it has neither infrared (JHK) excess, nor emission in the H-alpha line. The star lies at the Galactic latitude $b = -35°$, far from the star formation regions. We estimated the kinematic age of RZ Psc based on the proper motion of the star using the Tycho-2 catalog and found that the star has escaped from its assumed birthplace near to the Galactic plane about 20 Myr ago. This age essentially exceeds the characteristic time of dissipation of protoplanetary disks. This means that RZ Psc is a post-UXOr star and its sporadic eclipses are caused by material from the debris disk.

S5-28. Physical Parameters and Chemical Composition of a Group of Mild Barium Stars

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We present the results of the spectroscopic study of five stars (CD-65°2893, HD 22229, HD 66812, HD 56523, and HD 31341) suspected to have enhanced abundance of s-process elements. The high resolution spectra were obtained with the FEROS echelle spectrograph at the 2.2 m telescope of ESO, Chile, in 2008. We determined fundamental parameters of these stars, such as $T_{\rm eff}$, $\log g$ and microturbulent velocity, and derived abundances of 14 chemical elements including light and heavy s-process elements. Our analysis showed that all studied stars have enhanced abundance of s-process elements (from +0.3 to 0.4 dex) relative to their iron-peak elements which permit to classify them as mild barium stars. The overabundance of the elements heavier than iron may be explained by mass transfer in a binary system from a former asymptotic giant branch (AGB) star, now a white dwarf. Derived abundances are compared with theoretical predictions for AGB stars.

S5-29. A fast Silicon photomultiplier Photometer

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Astronomical sources with fast variability are basically of three kinds: pulsars, interactive binaries, pulsating stars. Time scales variabilities range from hours to thousandths of seconds: amplitude variations in the optical band range from 100% (Pulsars) down to a 0.1% (O Subdwarfs). For fast time scales the only detectors available in optical band were the classical photomultipliers. In recent times a new class of detectors, Silicon Photo Multipliers (SiPM) have been developed, whose astronomical use is still to explore in details. We have built a prototype of fast astronomical photometer, based on SiPM detectors, commercially available from the well known Hamamatsu firm. We report in this work our first astronomical results. First tests have shown that the current configuration reaches with the Cassini Telescope of Loiano observatory, visibility source as faint as 16 mag with 1 ms integration time and a signal to noise ratio (S/N) of ~ 1. The calibration of the number of photons detected by our photometer has been obtained comparing the convolution integral of the absolute flux derived from stars in the Jacoby catalog, with the SiPM PDE and with the transmittance of the Johnson filters B and V, respectively. The fastest acquisition rate allowed by the software provided with the detectors by the Hamamatsu Multi Pixel Photon Counter, is 1 ms; we have nearly halved the rate with a dedicated electronic system named "P3E0", (Pulsar Pulse Period Extractor), developed at the Physics Departement of La Sapienza University — Rome. On February 5-th 2011 we observed the Crab Pulsar for 3300 seconds with a sampling of 0.55 ms and 1 ms. A first look to the data using autocorrelation function and Fourier Transform showed typical Crab Pulsar characteristics as expected both in time and in frequency. The peak at about 30 Hz is clearly present in both cases. In real time S / N is $\sim$1, but this value can be increased by using acquired and processed data, corrected for the Earth orbital motion around the Sun and overlapping consecutive temporal slices, each one with duration equal to an integer multiple of Crab Pulsar period. In fact, for our MPPC0 and P3E0 detectors, we have seen a good Crab Pulsar signal by overlapping n=1025 and n=517 slices obtaining a S / N $\sim$32 and $\sim$23, respectively.

S5-30. An radio/X-ray study of the southern supernova remnant G296.8-0.3

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In this work we report a multiwavelenght study of the G298.6-0.3 supernova remnant (SNR). Our attention is focused on radio and X-ray observations performed with the MOST radiotelescope and the XMM observatory, respectively. In order to study the possible evolutionary scenarios involved in this source, we carry out a detailed comparative study between both observed emissions. At radio frequencies the SNR displays an unusual morphology, well correlated with internal X-ray emission. Close to the geometrical center of the radio structure we also find a compact X-ray source without a radio counterpart. Its radio and X-ray properties appear to be consistent with those typically found in the so called compact central objects (CCO).

S5-31. Estimation of Central Bodies Masses for Selected Globular Clusters

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The estimation of masses of the central bodies has been fulfilled for selected globular clusters such as 47 Tuc, M15, NGC 6397 and others on the base of dispersions of their radial velocities according to data published in the astronomical literature. Radial velocities of stars are considered near to the center of cluster for two extreme cases: 1) regulated rotation of stars around the center and 2) chaotic rotation. We made the assumption that stars are on short distance to the center and are rotating around this center as planets around

the Sun, according to laws of Newton. In both cases the estimated masses are in range of 100–10 000 masses of the Sun and are in agreement with parameters of black holes of intermediate masses (IMBH) and also are comparable with estimations of other authors made by means of statistic methods and radio- observations. Other result of our work is determination of the characteristic size of additional measurement - l. Taking into account the age and the mass of globular cluster NGC 6397 and in the connection with new theory of gravitation we estimated the size l, which is found in the range from 0.02 to 0.14 mm.

S5-32. What can we learn from high-resolution dynamical spectra of the benchmark Blazhko star RR Lyr?

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The knowledge of accurate stellar parameters is a keystone in several fields of stellar astrophysics, such as asteroseismology and stellar evolution. In case of high amplitude pulsating stars the stellar parameters vary significantly over the pulsation cycle, thus making it difficult and often impossible to infer accurate values. We present a self-consistent spectral analysis of the star RR Lyr, which is the primary target of our study of the Blazhko effect. We describe in detail the methodology adopted to derive the fundamental parameters and the abundances at the phase of maximum radius at which the spectra are least disturbed by the pulsation and which we define as "quiet phase". We then derive temperature changes for a set of pulsational phases to be compared with theoretical predictions. From the abundance analysis, we find clear indications of a depth-dependent microturbulent velocity, that we quantify.

S5-33. Classification of stars with WBVR photometry

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Fundamental stellar parameters as well as interstellar extinction value can be derived from spectroscopic observations. However, the object should be bright enough to obtain a high dispersion spectrum. Therefore, astronomers have long been using the multi-color photometry to resolve the problem of classification of stars. The existence and availability of massive and sufficiently precise multi-color photometric surveys make the problem of classification of stars more actual and timely. Analyzing photometry of an object, one can try to determine not only its spectral type and luminosity class, but also the interstellar reddening to the object, which characterizes the interstellar medium. The purpose of this work is to construct a method of classification of object by multi-color photometry, i.e. determine its spectral type, luminosity class and interstellar extinction with a good reliability. The idea behind the method is the ability to simulate observed photometry, using modeled spectra of different luminosity classes and spectral types and a model of interstellar extinction law. Using half-empiric stellar spectral flux library by Pickles (1998), model of interstellar extinction law obtained by Fluks et al. (1994) and observational WBVR data, we have tested the method with stars with known spectral classification and distances. The main result of this study is a list of spectral types / luminosity classes, which can be classified relatively reliably with the method, described above. Effect of photometrical unresolved binaries is also discussed.

S5-34. The r- and s-process contributions to heavy element abundances of a halo star HD29907

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A detailed heavy element abundance analysis of a moderately r-process enhanced halo star, HD29907, for which [Fe/H] = -1.55 and [r/Fe] = 0.63 is presented. In the Ba-Yb range, the element abundance pattern of HD29907 is in excellent agreement with those previously derived for the strongly r-process enhanced stars (r-II stars with [Eu/Fe] $>$ 1, [Ba/Eu] $<$ 0) and also with the scaled Solar r-process pattern and the high-entropy wind calculations. Thus, HD29907 reveals a pure r-process origin of Ba-Yb. The higher abundances of Sr, Y, and Zr were obtained for HD29907 compared to the r-II stars in agreement with the data for other moderately r-process enhanced stars. These results confirm the existence of additional source of Sr-Zr in the early Galaxy, before the onset of the s-process in AGB stars. We conclude that the contribution of AGB stars to heavy element enrichment of the interstellar gas was small, if any, at the epoch of the HD29907 formation.

S5-35. The influence of the radiative non- symmetric ion-atom collisions on the stellar atmospheres in UV and VUV region

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The aim of this work is to draw attention to the processes of radiative charge exchange in strongly non-symmetric ion-atom collisions as factors of influence on the opacity of stellar atmospheres in UV and VUV regions. Therefore for several ion-atom systems ($He + H^+$ and $H + A^+$, where A = Na, Mg, Si etc.) some characteristics have been determined, such as molecular potential curves and dipole matrix elements. Then, using these characteristics, calculations have been carried out to determine coefficients of spectral absorption due to these processes together with the corresponding molecular photo-dissociation processes, in the atmosphere of the Sun and of some of DB white dwarfs. The standard models of the considered atmospheres have been used in the calculations. It has been established that the examined processes generate rather wide and firm molecular absorption stripes in the UV and VUV regions, which should be taken into account at interpretation of the data obtained from measurements.

S5-36. The disk wind in the radiation of hot young stars

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Young stars with intermediate (1.5-10$M_\odot$) masses (Herbig Ae/Be stars) possess with the circumstellar gas and dust disks of the complex dynamics and structure. Observations indicate to the presence of accretion and outflow processes in these stars. We consider the role of the disk wind in the formation of the hydrogen emission spectra in these stars. We showed that (i) the disk wind could be an additional (together with the circumstellar disk itself) source of the dust that influenced an extinction especially when viewed the system "star + disk" nearly edge-on, (ii) the disk wind contributed significantly to the hydrogen emission spectrum explaining all types of the profiles of the Balmer lines, and (iii) the disk wind of the hot young stars successfully reproduced interferometric properties obtained from the observations in the Brγ line.

S5-37. V1687 Cyg (=WR 140): Infrared Photometry, 2001-2010

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The results of our infrared observations of WR 140 (=V1687 Cyg) in 2001-2010 are presented. Analysis of the observations has shown that the J brightness at maximum increased near the periastron by about $0^m.3$; the M brightness increased by $\sim 2^m$ in less than 50 days. The minimum J brightness and the minimum L and M brightnesses were observed 550-600 and 1300-1400 days after the maximum, respectively. The JHKLM brightness minimum was observed in the range of orbital phases 0.7-0.9. The parameters of the primary O5 component of the binary have been estimated to be the following: R(O5) $\approx 24.7 R_\odot$, L(O5) $\approx 8 \times 10^5$ $L_\odot$ and M_{bol}(O5) $\approx -10^m$. At the infrared brightness minimum, Tg $\approx$ 820-880 K, Rg $\approx 2.6 \times 10^5 R_\odot$, the optical depth of the shell at 3.5 Mm is $\sim 5.3 \times 10^{-6}$, and mass is $\approx 1.4 \times 10^{-8} M_\odot$. At the maximum, the corresponding parameters are $\sim$ 1300 K, $8.6 \times 10^4 R_\odot$, $\sim 2 \times 10^{-4}$, and $\sim 6 \times 10^{-8} M_\odot$; the mean rate of dust inflow (condensation) into the dust structure is $\sim 3.3 \times 10^{-8} M_\odot yr^{-1}$. The mean escape velocity of the shell from the heating source is $\sim$ 103km sec^{-1} and the mean dispersal rate of the shell is $\sim 1.1 \times 10^8 M_\odot$ yr^{-1}.

S5-38. IR Variability of the Nucleus of the Seyfert Galaxy NGC 1068, 1998-2010

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Our 13-year-long *JHKLM* photometry of the Seyfert galaxy NGC 1068 has confirmed its IR variability. The amplitudes of the brightness variations in the J (1.25 μm) and K (2.2 μm) bands are within $0^m.10$ and $0^m.3$, respectively.The IR brightness of the galaxy decreased from 1998 until 2007 and then the brightness increase has begun. The K brightness of the galaxy has reached level of 2002 to the beginning 2011. The IR brightness and color variations observed in 1998-2007 are attributable to the dispersal of the dust envelope that formed around the galactic nucleus some 30 years ago and reached its maximum density in 1994-1995. The nucleus of NGC 1068 is a variable source and complex structured object, which can be at different phases of activity. At least two sources radiate in the wavelength range 1.25-5 μm: a hot source whose radiation shows up in the range 1.25-1.65 μm and a cold source radiating at long wavelengths (2.2-5 μm). The color temperature of the hot source increased from 2300 K (the beginning of our observations) to 2700 K (minimum of IR brightness of 2007). In contrast, the temperature of the cold source decreased by several tens of degrees (in the temperature range 800-900 K). Our analysis of the spectral energy distributions for the galaxy has shown that the observed radiation in the range 1.25-5 μm can be represented as the sum of radiations from two blackbody sources. For the first period of our observations (JD 2451400), the temperatures of the hot and cold sources are nearby 3100 and 760 K, respectively. For the minimum IR brightness ($\sim$JD 2454160), they are $\sim$ 3200 and 720 K, respectively. The hot source is relatively compact; it is smaller in size than the cold source by several tens of times. The mean sizes of the hot and cold sources are $\sim 2.35 \times 10^{16}$ and $\sim 7.8 \times 10^{17}$ cm, respectively. The optical depth of the dust envelope averaged over the spectrum of the hot source is $\sim$1.5. In 2007, the state of the dust envelope almost returned to its 1974 level, i.e., the dust envelope formation and dispersal cycle was $\sim$ 11 000 days ($\sim$ 30 yr).

S5-39. The third edition of "The Spectrophotometrical catalogue of star"

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In the beginning 2011 the third, added and processed, edition of Alma-Ata "The Spectrophotometric Catalogue of stars" appeared (authors Kharitonov A. V., Tereschenko V. M., Knyazeva L. N.) In the catalogue

the absolute distribution of energy in spectral region 320-760 nm for 1273 stars is presented. The resolution of data equal 5 nm, the units — [W m^{-2} m^{-1}], standard error — 3-5%. The observations carry out on 0.5-m and 1-m telescopes with single-canal spectrometer Seya-Namioka by differential method. The energetic scale of catalogue is set Vega. For Vega the compilation Hayes"es energy distribution was take. In third edition of catalogue the stars of 7^m-9^m and the C, S and late M-supergiants, which absent in previous editions, is are available. In catalogue the system errors are absent but accidental large deviation take place. The data catalogue can used for standardization of the spectrophotometrical observations and other goals.

S5-40. Initial mass function and observed distributions of binary systems.

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The initial mass function (IMF) of stars is a fundamental law that is used in various fields of astrophysics. The IMF is based on data on dynamical masses from brown dwarfs to most massive stars. However, the form of the IMF (especially for low- and high- mass stars), is constantly revised. In the present study we collect data from literature on various hypotheses on systems and components IMFs, carry out Monte Carlo simulations of binary systems, compare resulting mass ratio and other distributions with observed ones and make conclusions on conformity of different published IMFs with observations.

S5-41. Newly Discovered Binary System VSX J052807.9+725606 — the Only "Twin" of V361 Lyr

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During more than 20 years the well studied short periodic binary system V361 Lyr with an extremely asymmetric light curve figured in many papers as a unique system with a direct impact of matter which caused rather large steady hot region. According to the classical model of this star, due to the hot spot, the phase curve exhibits a strong asymmetry. However, another star VSX J052807.9+725606 was discovered, which shows similar features of the light curves: very strong asymmetry of maxima, wavelength dependence of amplitude and the shift of the secondary minimum from the phase 0.5. We also present results of further multi-color B, V, R photometrical study of this exotic star, obtained with the 1.25 m telescope of the Crimean Astrophysical Observatory. The variability of color indices yields the corresponding changes of the color temperature. We also compare both stars and analyze the first models of VSX J052807.9+725606, based on pure photometry, computed using the Wilson-Devinney code.

S5-42. 1RXS J180834.7+101041 is a new cataclysmic variable with non-uniform disc

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Results of photometric and spectroscopic investigations of the recently discovered disc cataclysmic variable star 1RXS J180834.7+101041 are presented. Emission spectra of the system show broad double peaked hydrogen and helium emission lines. Doppler maps for the hydrogen lines demonstrate strongly non-uniform emissivity distribution in the disc, similar to that found in IP Peg. It means that the system is a new cataclysmic variable with a spiral density wave in the disc. Masses of the components (MWD = 0.8±0.22M and MRD = 0.14±0.02 M), and the orbit inclination (i = 78 ±1.5) were estimated using the various well-known relations for cataclysmic variables

S5-43. Eclipsing binary IM Mon in OB association Ori OB1a

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All available photometric and spectroscopic observations were collected and used as the basis of a detailed analysis of the close binary IM Mon. The orbital period of the binary was refined to 1.19024249(0.00000014) d. IM Mon is classified to be a detached binary system in contrast to the contact configuration estimations in the literature. The absolute parameters of IM Mon were derived by the simultaneous solutions of light and radial velocity curves as $M_{1,2}$ = 5.50(0.24) $M_\odot$ and 3.32(0.16) $M_\odot$, $R_{1,2}$ = 3.15(0.04) $R_\odot$ and 2.36(0.03) $R_\odot$, $T_{\rm eff1,2}$ = 17500(350) K and 14500(550) K implying spectral types of B4 and B6.5 ZAMS stars for the primary and secondary components respectively. The modelling of the high resolution spectra revealed the rotational velocities of the component stars as as $V_{\rm rot1}$ = 147(15) km s^{-1} and $V_{\rm rot2}$ = 90(25) km s^{-1}. The photometric distance of 353(59) pc was found more precise and reliable than Hipparcos distance of 341(85) pc. The evolutionary age of 11.5(1.5) Myr was obtained for IM Mon. Kinematical and dynamical analysis support the membership of the young thin-disk population system IM Mon to the Ori OB1a association dynamically. Using the membership of IM Mon to Ori OB1a, we reached to the distance, age and metallicity information of Ori OB1a sub-group.

S5-44. HCN(1-0) and CS(2-1) survey of northern methanol masers

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We search for the HCN(J=1-0) and CS(J=2-1) emission towards 60 northern methanol masers (I and II class) with the RT-22 radio telescope (CrAO). The association with the IRAS point sources is examined. The velocity differences between the masers and HCN and CS emission are analyzed. The HCN spectra towards ∼10% of maser sources demonstrate the unusual complex structure.

S5-45. Interaction of the SNR W49B with the molecular material

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The study of the molecular environment of the galactic supernova remnant W49B by results of ^{13}CO(J=1-0) observations was carried out. The structure of molecular clouds is investigated. The radiation at the radial velocity of 44.5 km/sec shows clear morphological correspondence with a continuum structure of the supernova remnant that can be a result of the SNR/molecular cloud interaction. We reveal the molecular cloud at the radial velocity of 66 km/sec that overlaps supernova remnant W49B in the south-western part. This cloud can be responsible for the increased levels of continuum absorption and absorption in various molecular species that is seen along this line of sight.

S6: Combined Radio/X-rays Approaches to Relativistic Astrophysics

Conveners:
Elena Gallo (U. Michigan, USA),
Andrea Merloni (TUM and MPE, Germany)

Results from Chandra imaging of the low-redshift 3CRR radio galaxies

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We recently completed a project to make high-resolution X-ray images of all 36 3CRR radio sources at redshift < 0.1. These images reveal a number of new X-ray jets and other features, and this contribution summarizes the differences seen between sources with different radio morphology and power, different environments, and different optical properties. Indications of strong interaction between the radio plasma and X-ray gas are common, and we discuss how these features might reflect different physical parameters of the AGN outflows.

A Detailed Study of AGN Feedback in the Cool Core Cluster A2052

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We present results from a very deep (650 ksec) Chandra X-ray observation and archival VLA radio observations of Abell 2052, one of the clearest cases of AGN feedback in a cool core cluster of galaxies. The data reveal exquisite detail in the inner parts of the cluster, including bubbles evacuated by the AGN's radio lobes, compressed bubble rims, filaments, and loops. Two concentric shocks are seen, and a temperature rise is measured for the innermost one. Initial evidence for previously unseen bubbles at larger radii related to earlier outbursts from the AGN is presented. On larger scales, an excess surface brightness spiral feature is detected. The spiral has cooler temperatures and higher abundances than its surroundings, and is likely the result of sloshing gas initiated by a previous cluster-cluster or sub-cluster merger.

Host galaxies properties of radio selected radio-quiet AGN

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Key ingredients to study the SMBH and galaxies co-evolution are an unbiased AGN sample and large auxiliary data to determine the galaxies physical properties. We built a highly complete AGN sample combining deep X-ray and 1.4 GHz VLA observation in the ECDFS. In the X-ray we select as AGN objects with an unabsorbed Lx>1042 erg/s. In the radio we use a multi-wavelength approach to separate AGN and SFG considering the FIR-radio emission and optical-radio flux ratios, IRAC colors and Lx level. We use this new radio selected AGN sample twofold. 1) We cross-correlate it with the X-ray one to quantify the completeness of the AGN selection in the 0.5-10 keV band. 2) We focus on the study of the host galaxy properties of radio quiet AGN. According to our analysis, their radio emission is produced by star-formation activity rather than accretion on the SMBH. We use the radio emission itself to estimate the star-formation level in the host. We complement this information with the estimate of the host stellar mass derived using a SED fitting technique. We compare the SSFR (SFR/Mstar) of these hosts with that of a parent sample of inactive galaxies selected in similar z and stellar mass bins.

AGN evolution from large area and deep X-ray surveys

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Over the last few years, the existence of mutual feedback effects between accreting supermassive black holes powering AGN and star formation in their host galaxies has become evident. This means that the formation and the evolution of AGN and galaxies should be considered as one and the same problem. As a consequence, the search for, and the characterization of the evolutive and physical properties of AGN over a large redshift interval is a key topic of present research in the field of observational cosmology. Significant advances have been obtained in the last ten years thanks to the sizable number of XMM-Newton and Chandra surveys, complemented by multiwavelength follow-up programs. I will review some of the recent results from the COSMOS and CDFS surveys and the ongoing efforts aimed at obtaining a complete census of accreting Black Holes. Particular emphasis will be given to the star-formation/AGN connection at z=1-3 and to the status on our knowledge of the X-ray selected high-z (z¿3) AGN population. Perspectives for present on-going surveys for future missions (i.e. eROSITA, and ATHENA) will also be outlined.

Panchromatic Observations of the Nuclei of z<0.5 3CRR Radio Galaxies: Implications for Feeding, Feedback, and Black Hole Spin

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We present a radio through X-ray study of the nuclei of 3CRR radio galaxies at z¡0.5. This unique data set allows us to answer three key questions about radio-loud AGN: (1) What is the origin of X-ray emission? We show that the X-ray emission from low-excitation radio galaxies is dominated by a parsec-scale jet and shows no evidence for a torus. High excitation radio galaxies, on the other hand, are dominated by luminous accretion disks. (2) How does accretion take place? By estimating the kinetic jet power, we show that Bondi accretion of the hot IGM can power the majority of LERGs, but not the most powerful of these outbursts (see talk by B. McNamara). The Bondi paradigm fails altogether for HERGs. (3) How are jets powered? We next consider models for extracting jet power from rotating black holes. We demonstrate that both the jet power and time evolution of radio-loud AGN fit into a model in which black hole spin varies from retrograde to prograde with respect to the accreting material

Black Hole Jet Scaling Relations in Low Luminosity AGN

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In the work I present, me and my collaborators analyzed a sample of 17 low-luminosity, radio loud AGNs in massive galaxies. For these sources we measured core X-ray emission with Chandra and radio emission with the VLA. We studied the correlation between emission line properties, radio luminosity, radio spectral slopes and X-ray luminosity, as well as more complex relations involving black hole mass, such as the fundamental plane of black hole activity. We find that 15 out of 17 sources of our sample can be classified as Low-Excitation Galaxies and their observed properties suggest X-ray and radio emission to originate from the jet basis. We also find that X-ray emission does not appear to be affected by nuclear obscuration and can be used as a reliable jet-power estimator. These findings may be explained by a lack of cold gaseous structures in the innermost region of these massive galaxies. Finally, in the frame of future radio studies on AGN, I present some of the latest images and results on AGN collected by LOFAR.

Accretion and jets in black hole X-ray binaries

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I will review the current state of the art in understanding the connection between accretion and ejection in X-ray binaries, including a comparison with supermassive black holes in active galactic nuclei. Latest results include a global study of accretion states and disc winds, discovery of a new mode of accretion, and a comparison of jet power with reported spin measurements.

MHD Simulations of Relativistic Jets from Accretion Disks

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In this talk I review the current status of jet formation in direct numerical simulations of black-hole accretion disks and magnetospheres. I will begin with a short review of what I think are the most salient results in the literature to date. I will touch on questions such as: What constitutes the jet? What is the launching mechanism? Where is the launching point? What is the Lorentz factor? What is the opening angle? How is the jet collimated? Then I will dedicate the remainder of the talk to addressing the nagging questions: Why has it been so difficult to make a connection between the jets seen in simulations and the ones observed in nature? What is "missing" in the simulations? What else needs to be done?

The universal BH X-ray binary radio-x ray correlation, 8 years later

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Empirical evidence for a tight correlation between the core radio and x-ray luminosity of black hole x-ray binaries was first reported in 2003 for the prototypical source GX 339-4 while in the hard x-ray state. Shortly afterwards, the same empirical scaling was shown to hold for an ensemble of galactic hard state black hole x-ray binaries for which nearly simultaneous radio and x-ray observations were available.

This non-linear scaling — extending over several orders of magnitude in x-ray luminosity — was then termed 'a universal radio/x-ray correlation' for hard state black hole x-ray binaries. Over the last eight years or so, new observations, as well as newly discovered sources, have yielded a much more complex picture of the behavior of black hole x-ray binaries in the radio x-ray domain. Most notably, the possibility of two 'parallel tracks' has emerged, spurring challenges for theorists and observers. In this talk, I will briefly review and the most relevant results on simultaneous radio and x-ray observations of black hole x-ray binaries since 2003, and (try to) address the question as to whether there still exists a universal radio/x-ray correlation.

A fully relativistic twisted disk around a slowly rotating Kerr black hole

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I am going to discuss equations describing dynamics and stationary configurations of a twisted fully relativistic thin accretion disc around a slowly rotating black hole. It is found that the disc dynamics and stationary shapes are determined by a pair of equations for two complex variables describing orientation of the

disc rings and velocity perturbations in the disc. Shapes of stationary twisted configurations are analysed. It is shown that the stationary configurations depend on two parameters — the αparameter and $\tilde{\delta} = \delta_*/\sqrt{a}$, where $\delta_* \sim h/r$ is the disc opening angle (h is the disc halfthickness) and a is the black hole rotational parameter. When $a > 0$ and $\tilde{\delta} \ll 1$ the shapes depend drastically on value of α. When α is small the disc inclination angle oscillates with radius with amplitude and radial frequency of the oscillations dramatically increasing towards the last stable orbit. For moderate values of α the oscillations do not take place but the disc does not align with the equatorial plane at small radii. Its inclination angle is either increasing towards R_{ms} or exhibits a non-monotonic dependence on the radial coordinate. Finally, when α is sufficiently large the disc aligns with the equatorial plane at small radii. When $a < 0$ the disc aligns with the equatorial plane for all values of α. The results reported here may have implications for determining structure and variability of accretion discs close to R_{ms} as well as for modelling of emission spectra coming from different sources, which are supposed to harbour black holes.

Gas Accretion and Feedback in Radio Galaxies and Clusters

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The gaseous atmospheres of galaxies and clusters serve as repositories for the energy output from AGN over cosmic time. X-ray observations have shown that cooling of the dense, keV gas in the cores of galaxies and clusters is strongly suppressed, and feedback from supermassive black holes is a likely heating agent. The energy pouring out of the nuclei of central cluster galaxies often rivals that of quasars. Unlike quasars, their vast power output is channeled into mechanical energy rather than light. I will use the mechanical power output of AGN to estimate the accretion rates onto supermassive black holes, and I will discuss the modes of accretion that may be fueling them. I will consider black hole spin as a power source.

Coupled radio and X-ray observations of accreting Galactic compact objects

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The past decade has seen significant progress in furthering our understanding of the coupling between the phenomena of accretion and jet production, thanks largely to simultaneous monitoring of Galactic X-ray binary sources with radio and X-ray facilities. This has led to the 'Unified model' for disc-jet coupling in Galactic black hole candidates. I will give a brief overview of the model and some of the seminal observations that led to its development, and highlight the areas where further work is required. I will conclude by outlining an ongoing large project to use high angular resolution radio observations, coupled with multi-wavelength monitoring in the X-rays, to compare the outbursts of Galactic black hole candidates, neutron stars, and even accreting white dwarf systems. This project will address how the disc-jet coupling varies with the depth of the gravitational potential well, and the presence or absence of a stellar surface and stellar magnetic field.

Historic cosmological evolution of black hole binaries

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I will review the cosmic evolution of stellar black hole binaries and the role these objects may have had in the early evolution of the universe.

The role of radio jets in gas outflows and negative feedback

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The characteristics (ionisation, kinematics etc.) of the different phases of gas in the circumnuclear regions of active nuclei hold clear signatures of the influences that the black hole activity has on its surroundings. I will report on recent results we have obtained on the study of fast AGN driven outflows of cold and warm gas and of their implications for the evolution of the host galaxy. In particular, I will concentrate on the effects of radio jets in generating the strong negative feedback of the kind invoked in current scenarios for galaxy evolution. Part of the talk will concentrate on the recent finding of objects (like MrK 231) were fast outflows of both atomic neutral and molecular gas are present and will compare the derived parameters (kinetic energy, mass outflow rate etc.) from these two different diagnostics.

AGN surveys in the local universe

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The Swift BAT hard x-ray survey is changing our understanding of AGN. The ability to find AGN independently of their optical, UV, IR or radio properties has produced a large sample of objects which has allowed independent measures of their total luminosity, broad band spectral characteristics and perhaps most importantly the nature of their host galaxies and indications of the reasons that a particular galaxy is an AGN. I will discuss our recent IR, optical, UV and x-ray data and indicate directions for future research.

The sub-parsec radio cores of radio quiet AGN

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The accretion-ejection mechanism acting in radio-quiet Active Galactic Nuclei (AGN) is still poorly understood, specifically at lower luminosities where the transition from inactivity to activity occurs. Strong correlations between the nuclear 2-10 keV X-ray and radio luminosities suggest that the accretion flow and the radio source are strongly coupled even in radio-quiet AGN. We have surveyed the sub-parsec scale radio cores of a complete sample of well known local AGN, mapping the faintest and least luminous nuclei at a level of sub-mJy flux densities. A wide variety of sub-parsec cores and structures is found, not always easy to interpret within a common physical scenario. The VLBI radio and X-ray luminosity correlation will also be discussed and related to the accretion physics.

Discovery of Radio Emission Trailing Geminga Pulsar: a Genuine Jet, a Ram-pressure Collimated Outflow or What?

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A deep Very Large Array observation of the Geminga pulsar field led to the discovery, at a higher than 10σ significance level, of radio emission trailing the neutron star proper motion. This $\sim 10''$-long radio feature, detected with a flux of $\sim$0.4 mJy at 4.8 GHz, is positionally coincident with the X-ray axial tail ascribed to the pulsar wind nebula recently discovered by *Chandra*. We discuss the implications of the radio feature in the frames of shocked pulsar wind collimated by the ram pressure, magneto-hydrodynamic jet models, and

radio-emitting electron leakage directly from the open field lines of the magnetosphere. The Geminga axial tail could represent the first jet-like radio feature clearly associated to an isolated neutron star and its detection was possible due to the proximity of the pulsar and its radio-quiet nature, not hindering the radio structure.

The Role of Shock Heating in AGN Feedback

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Feedback between the intracluster medium (ICM) and the central AGN is the most likely solution to the so-called "cooling flow problem" in clusters of galaxies. AGN jets inflate cavities in the ICM, which are often filled with diffuse radio emission, and which subsequently detach from the jets and rise buoyantly in the ICM. Although it has been shown that generally the internal energy of these cavities is large enough to offset radiative cooling in the gas in principle, the details of how and where this energy gets deposited in the ICM are currently not well understood. AGN outburst shocks, which are driven by the rapid inflation of the X-ray cavities early in their lifetimes, can play an important role in the feedback process. These shocks heat the ICM isotropically and close to the central AGN, as required for AGN feedback to operate. I will discuss the role of outburst shocks in AGN feedback, focusing on multiwavelength observations of the nearby galaxy group NGC 5813 as an example.

Giant radio flares in microquasars

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We discuss recent bright radio flares in microquasars SS433, GRS1915+105, Cyg X-3 that were detected with the RATAN-600 radio telescope at 1-30 GHz. The multi-frequency light curves and spectra provide the key temporal properties of the massive relativistic ejections from these X-ray binaries. Generally there are the very fast stages of increasing (1-3d) and slow decreases (10-100d) of the flux after maxima. Decays of the flares could follow to exponential or power laws from frequency, and the gradients of the fall increase with frequency. In SS433 we clearly see the lag of the maximum fluxes with decrease of frequency. The very characteristic flares occur in Cyg X-3, when the fluxes after very low values ($\sim$ 10 mJy) increase up to $\sim$ 20 Jy. Usually we can find the associated events in sort or hard X-rays (RXTE and Swift/BAT data) for giant radio flares. Some intensive radio events from Cyg X-3 were detected in gamma-rays (Tavani et al. 2009, and Bulgarelli et al. 2010). According to hardness-intensity diagram (RXTE PCA data) and relevant radio data we may expect the bright flares in Cyg X-3 in the X-ray spectrum becomes the ultra-soft (Koljonen et al. 2010).

A model for optical/X-ray correlation in black hole X-ray binaries

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Origin of the optical radiation in low-mass X-ray binaries has been put under question by the simultaneous optical/X-ray observations with high time resolution. The cross-correlation functions observed in three black-hole binaries appear to have a complicated shape. They show a dip of the optical emission a few seconds before the X-ray peak and the optical flare just after the X-ray peak. The behaviour could not be explained in terms of standard optical emission candidates (e.g., emission from cold accretion disk or a jet). A number of sophisticated models were proposed to explain such CCF, all of them seem to fail with the detailed predictions. We propose a novel model capable of explaining both optical to the X-ray spectra and the variability properties.

AGN heating and ICM cooling in galaxy groups using X-ray and Radio data

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We present results for a luminosity limited sample of 26 galaxy groups with Chandra data, to discern central cooling and heating properties on the group scale. We classified the groups on the basis of the Central Cooling Time, as Strong Cool Core, Weak Cool Core and Non Cool Core groups. AGN heating pointers were identified by the presence of radio sources within 50 kpc of the X-ray emission peak, from radio catalogs. The NIR bulge luminosity of the BCG was also determined from the 2MASS catalog. The fraction of SCC, WCC and NCC groups are comparable to clusters, as is the fraction of groups with a CRS, with some notable anomalies. For the HIFLUGCS cluster sample, we see an anti-correlation trend between the radio luminosity and the CCT for WCC and NCC clusters, breaking down for SCC clusters. In groups, this trend is absent. Some interesting differences between clusters and groups vis-a-vis the BCG and large scale group properties are also presented. Anomalous cases are discussed.

The energetically-dominant AGN jet population

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X-ray studies with Chandra and XMM-Newton have demonstrated over a range of radio power that jet mechanical power is considerable, either through measuring the energy in the cavities they bore in cluster gas or through modelling the jet X-ray emission on large scales as inverse Compton scattering of the Cosmic Microwave Background. However the jets at these extremes of radio power are observationally very different — in one case the momentum flux appears to spread easily where in the other it does not. The energetically-dominant jet population that that must be effective if radio-mode feedback is to be widely important lies in between these two extremes. This presentation will approach from both directions and highlight outstanding observational issues.

POSTERS

S6-1. Self-gravitating obscuring torus in AGN: N-body simulation

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Obscuring tori in AGN are the link in the feedback between the accretion disk and the wind. One of the puzzling properties of dusty tori is their thick structure (the ratio of a minor radius to a major one is about 0.7). We investigated the problem of N-body simulation for the torus composed of 10^4 clouds in gravitational field of a central mass with their orbital motions taken into account. As the initial condition, we used solution for an orbital torus with mass of about percent (or less) of the central mass, in which the clouds are orbiting with a significant scatter in inclinations. Numerical simulation shows that in the state of equilibrium the torus has an oval-shaped cross-section. The distribution of clouds in this cross-section is found. An important result is that the torus remains to be thick, with a smooth transition to the broad line region (BLR). This result is consistent with the independent predictions based on analysis of the AGN spectra in infrared.

S6-2. A new model for Extragalactic Gamma-ray Background

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We study the Extragalactic Gamma-Ray Background (EGB) in the 0.1–100 GeV range as measured by Fermi. We proposed that EGB can be explained as the sum of three components: non blazar AGNs, star-forming galaxies and blazars. Our model has only two free parameters, namely the normalization of blazar and star-forming contribution. The first has been set by fitting the differential blazar log N–log S measured by Fermi by assuming the blazar gamma-ray luminosity function direct proportional to the radio luminosity function (both FR I and FR 2) computed by Willott et al. 2001. Blazar radio and gamma-ray luminosity are linked by the blazar SED (Fossati et al. 1998).The star-forming galaxies contribution is built assuming that the gamma-ray coming from the decaying of π^0 is closely linked with the cosmic star-formation rate (Stecker & Venters 2010) . The non blazar AGNs contribution is taken from Inoue et al. 2008. Our model fully explains the total observed EGB: the non blazar AGNs dominate in the low (< 0.1 GeV) energy range, whereas blazars account for the background at E > 10 GeV. Cosmic rays from star-forming galaxies are needed to fully explain the EGB at intermediate energies. In this context we discuss the possible contribution of annihilating dark matter to the EGB.

S6-3. A 18 cm wavelength range VLBI test for the 'Radioastron' project

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We present results of processing of VLBI data of observations have been made in 2011 February at L frequency band (wavelength is 18 cm). The observations goal is testing of a ground based network for the 'Radioastron' project. All the IAA antennae in Svetloe, Zelenchuckskaya, and Badary were used in that experiment. Additionally, the Puschino 22 m antenna (Russia) and Medicina 32 m antenna (Italy) were also included into the observations. 7 well known sources (3 quasars, 2 pulsars, 2 masers) were observed at 10 baselines during 10 hours. The data have been recorded with a Mark 5 format at the Medicina, and all the IAA antennae. The RDR registrator was used in Puschino. The raw data correlation was made at the software correlator in ASC (Moscow). The resulting values of the main parameters of correlation function for all the baselines are presented. The estimated parameters of the sources observed radio structure are also presented. The main conclusion is the opportunity to use the different registration systems for the 'Radioastron' project.

S6-4. Radio structure and jet properties of 1803+784. Results of Space VLBI data processing

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Result of processing of data of ground-space VLBI experiment titled V053 is presented. These observations were made in 1997 October with 10 antennas of American interferometer VLBA and Japan satellite VSOP (VLBI Space Orbital Program). Data were transferred from NRAO (National Radio Astronomy Observatory, USA) archive and processed with the software titled Astro Space Locator (ASL for Windows). The main result of such processing is the image of the quasar titled 1803+784. Some conclusions about the radio structure of jet of this object are made from this image. This result is not in conflict with other results of processing of Space VLBI data for 1803+784 published earlier with other authors.

S6-5. AGN-driven radio activity in X-ray luminous AGN

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The deep and rich radio observations available in the Deep VLA-SWIRE field are exploited to identify AGN driven radio activity in a sample of X-ray luminous AGN. We detect a large (about 70%) fraction of X-ray AGN at radio frequencies, and about 6% of them are radio intermediate or radio loud AGN. AGN-driven radio activity is found in a surprisingly large fraction (about 40%) of the sample. The radio spectra and sizes are analyzed and compared to the sources' spectral energy distributions and X-ray spectral properties. We also report on the discovery of sources with unusually weak radio fluxes relative to the mid-infrared emission. Our results are discussed in the light of recent evolutionary theories and of the possibility that the AGN might interact with the host galaxy through the mechanical energy carried out by a radio jet.

S6-6. Analysing ALMA data with CASA

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The radio astronomical data analysis package "CASA" was selected to be the designated tool for observers to analyse the data from the Atacama Large mm/sub-mm Array (ALMA) which is under construction and will take its first science data in late 2011. The call for proposals went out in March 2011.

S6-7. Dynamics of development of process of activity of a quasar 3C273 in a Radio-X/ray

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Dynamics of development of activity process of a quasar 3C273 according to published data of radio, ultra-violet and x-ray supervision are investigated. Periodogram and wavelet analysis methods are applied for definition of the basic periods of variability in each range and dynamics of their changes for 30-40 years of observation. Properties of the separate periods of activity during 6-8 years are considered. On spectral indexes, time shifts, spectra of maximum activity and data VLBI of observation properties of extreme displays of activity in system "core-accretion disk-jet" are defined.

S6-8. Radio and X-ray emission from the W43 central cluster

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We present a new analysis of archival VLA and Chandra data for the central cluster of the star forming region W43. The cluster radio emission appears to be clearly non-thermal with spectral index of about -0.5 based on VLA maps at the 20, 6 and 3.5 cm wavelengths with similar angular resolution. This fact is interpreted as a collective effect due to stellar winds from the Wolf Rayet and luminous O stars in the cluster. Using archival near-infrared images with excellent seeing taken with one of the VLT units, we are able to resolve the cluster brightest star W43#1 into two components separated by 0.4 arcseconds. This object was catalogued as a Woft Rayet star and this is the first time that its binary nature is clearly revealed. One of its components is clearly coincident with the Chandra source that dominates the cluster X-ray emission. All this

new information is discussed together in the context of a possible association with the TeV gamma-ray source HESS J1848-018.

S6-9. Fine structure of the radio galaxy M87 core

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The fine core-jet structure of the radio galaxy M87 has been investigated at millimeter-decimeter wavelengths with angular resolution reached 50-100 μas. It was opened an accretion disk and a bipolar outflow. The outflow consists of a highly collimated relativistic plasma jet surrounded by a nonrelativistic low-velocity stream. The high-velocity jet observed at distance until 500 mas at decimeter wavelengths. The helical structure of jet is determined by precession. Polarization of jet emission corresponds to magnetic field orientating of which is parallel to axis. The low-velocity outflow includes a helical structure observable up to a distance of 20 mas or 1.6 pc. The counter jet is observing at distance $\rho(\lambda) \approx 0.036\lambda$ pc, where λ in cm.

S6-10. Optimal growth of global hydrodynamical perturbations in sub-Keplerian toroidal flows

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A hypersonic rotational polytropic flow in the vicinity of a gravitating body has no global spectral modes which grow on the dynamical timescale. However, it is also known that due to the non-orthogonality of eigenmodes in a shear background there can exist a particular initial perturbations which exhibit a substantial (optimal) growth in energy at finite time intervals. Here we study such sort of inertial-acoustic perturbations in thin compressible configurations with free boundaries assuming that $h/\Delta << 1$, where h is the flow half-thickness and Δ is its finite radial size. The results obtained here can be related to the problem of angular momentum transfer and various temporal phenomena in Keplerian flows.

S7: Far-Infrared Spectroscopy comes of age: the Herschel view

Conveners:
Dimitra Rigopoulou (Oxford/RAL, UK),
Matthew Griffin (U. Cardiff, UK),
Göran Pilbratt (Hershell Project Scientist)

Protoplanetary disks in the infrared: comprehensive structure modeling

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Protoplanetary disk (PPD) observations and their interpretation allow us to reveal conditions pertinent to early phases of planet formation. Thanks to the progress of the last two decades we can make a retrospective view at the origin of the Solar System evolution. There is a number of successful models of PPDs structure (e.g. D'Alessio et al. (1998), Dullemond & Dominik (2004) , Nomura et al. (2007), Woitke et al. (2009)) where various micro-physical processes are investigated with different degrees of detail. We introduce a model of a protoplanetary disk, that is "balanced" in terms of simplicity/reliability and adequate consideration of such factors as dust evolution, radiation transfer, chemistry and energy balance of gas. This model is a suitable tool to interpret line and continuum PPD observations in the far-infrared and submillimeter bands.

Chemical and dynamical evolution of interstellar clouds interacting with shocks

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Using 3D parallel gas dynamic code "AstroChemHydro" we study dynamical and chemical evolution of interstellar HI clouds interacting with strong planar shock waves. Our non-equilibrium chemical network involves dominant atomic and molecular species, while thermodynamics include the radiative cooling and heating from external sources. A special attention is paid to the time-dependent kinetics of molecule formation on dust grains in the irregular field behind the shock. We discuss the consequences of the irregularities of the post-shock flow on CO-to-H2 conversion factor in the Galaxy.

HERUS: Complete Herschel-Spitzer Legacy Survey of the low-redshift ULIRG Population

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We are now witnessing what might be termed a 'Golden Age' of far-IR spectroscopy, with the outstanding quality data now arriving from Herschel, the imminent arrival of ALMA, and powerful new facilities such as SPICA only slightly further afield. In this talk I will briefly review some of the key diagnostics that far-IR spectroscopy provides for both star formation and AGN activity in IR-luminous galaxies, and then go on to discuss some recent Herschel observation from our own program that is observing low-redshift ULIRGs.

SHINING: studying physical processes in the intersellar media of galaxies

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I will review some of the recent results from the Herschel guaranteed time key program SHINING. Using the PACS spectrometer we are studying the far-infrared properties of a sample of more than 100 galaxies that includes local starbursts, Seyfert galaxies, low-metallicity systems, and infrared luminous galaxies at low and high redshift. We find that galaxies with extreme Lfir/MH2 ratios tend to have weaker fine structure lines relative to their far-infrared continuum. We interpret these line deficits as an effect produced by the much higher values of the ionization parameter in these galaxies. I will also show the detection of massive molecular outflows, traced by the hydroxyl molecule (OH), in the far-infrared spectra of several ultraluminous infrared

galaxies and discuss the implications of these results on the evolution of their molecular gas content. The effect of AGN radiation on the properties of the interstellar medium will also be discussed.

Space-borne Far Infrared Fourier Transform Spectroscopy: Herschel-SPIRE and SPICA-SAFARI

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SPIRE, the Spectral and Photometric Imaging Receiver, is Herschel's submillimetre camera and spectrometer. SPIRE is fully functional in flight, with performance meeting or exceeding pre-flight estimates in all respects. The SPIRE imaging Fourier Transform Spectrometer (FTS) covers simultaneously the wavelength range 194–671 microns, and provides a measurement of both spectral features and of the underlying continuum. The FTS performance and scientific capabilities will will be described. The next generation FIR space observatory, the Japanese-led SPICA mission, will carry a 3-m cold (6 K) telescope. Its suite of instruments will include, SAFARI, an imaging FTS which will achieve a huge improvement in sensitivity compared to Herschel as a result of SPICA's cold aperture. The prospects for FIR spectroscopy with SPICA will be briefly outlined.

Physical conditions and chemical evolution of the gas towards the Orion Bar photodissociation region using Herschel/PACS and SPIRE spectro-imaging observations

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Due to its proximity and edge on orientation, the Orion Bar is a luminous prototypical PDR. We will present new spectral-imaging of the Orion Bar obtained with the Herschel/PACS and SPIRE instruments, as part of the Evolution of interstellar dust Key Project of the SPIRE consortium. These fully sampled maps cover the entire region from the illuminating star to/and across the Bar. Such spatial coverage coupled with the angular resolution of Herschel enable us to trace the synergy between the physical conditions and chemical evolution of the gas across the illuminated interfaces in the PDRs. In particular, we make use of the main cooling lines ([CII], [OI], [NII], [CI], CO) to derive the local conditions of the gas and to provide fully sampled maps with the distribution of important molecular species (e.g. CH+, CO, H2O). The observed atomic and molecular spatial distribution and variation in the line fluxes will be discussed in relation to the underlaying complex geometry and linked to the energetics associated with the Trapezium stars.

Spectroscopy with Herschel: The heterodyne view of HIFI

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The Far-InfraRed is the last wavelength window to be explored in astrophysics. The Herschel Space Observatory has now been in orbit for almost two years and has been able to excel in mapping the near and far-Universe as well as doing detailed spectroscopic studies. HIFI — the Heterodyne for the Far Infrared, has the ability to spectroscopically resolve all molecular, ionic and atomic lines available in its frequency range. As such it is a very powerful tool for mapping gas-motions in the Interstellar medium, like tenuous filaments or dense star-forming regions. In this presentation I will show examples where the high spectral resolution provided clues on the gas-dynamics as well as showing examples of different molecular lines probing very different regimes in the ISM. Both are essential for our knowledge of the composition of the ISM and the way gas cycles between different phases.

WISH: Water in Star-forming Regions with Herschel

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WISH is a key program on the Herschel Space Observatory designed to probe the physical and chemical structures of young stellar objects using water and related molecules and to follow the water abundance from collapsing clouds to planet-forming disks. About 80 sources are targeted, covering a wide range of luminosities (over 5 orders of magnitude) and a wide range of evolutionary stages — from cold prestellar cores to warm protostellar envelopes and outflows to disks around young stars. Both HIFI and the PACS spectrometer are used to probe a variety of lines of water and chemically related species. With WISH a new picture emerges on the role of water in star-formation, very much related to the dynamics in the region. The superb spectral resolution of HIFI makes it possible to zoom in on these dynamically complex regions. We also will look at the chemically related hydrides OH+ and H2O+, which were found unexpectedly widespread; and to the water content of proto-planetary disks.

Herschel View of the Galactic Center

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The Galactic Center has been observed with the Herschel Space Observatory as part of the Key Program HiGAL. This data at 5 photometric bands, combined with that from other two Space Missions, Spitzer and WISE, provides an exceptional data set and a "low resolution" spectra (or Spectral Energy Distribution) that permits to study the properties of the Interstellar Medium in a very complex environment.

The Herschel mission

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The ESA Herschel Space Observatory was launched on 14 May 2009, together with Planck. In the initial two months in-flight Herschel successfully completed the commissioning phase, and then went in the performance verification phase. Since late 2009 Herschel has been performing science observations, initially PACS and SPIRE observations, but since spring 2010 using also the HIFI instrument. More than 200 science papers based on Herschel observations were published already in 2010, and the number is steadily increasing. Herschel has already provided fundamental contributions in several different fields of astronomy from the observations of objects in our solar system, the interstellar medium and star formation in our own galaxy, disks and infrared excess of stars and evolved stars, galaxies, and cosmology. I will provide a mission status update, present a selection of science highlights, and discuss the future of the mission including the final call for observing time proposals.

Extragalactic Spectroscopy with Herschel/PACS

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With Herschel, we have, for the first time, reached sufficient sensitivity and spatial as well as spectral resolution, combined, to study processes like star formation and nuclear activity in dust-rich galaxies with sufficient depth and detail to fully complement observations at other wavelengths. In nearby galaxies, we can use maps of the neutral or ionized medium to determine the physical conditions in different components of

a galaxy, e.g., to separate nuclear regions from disc components. This is of particular interest for galaxies hosting AGNs, where we can study nuclear activity and interaction with the host. For (U)LIRGS with their typically extreme extinction toward the sources of their luminosity, FIR spectroscopy provides a unique tool to study what powers them as well as strong feedback to the galaxy, giving new insight in essential phases of galaxy evolution. Spectroscopy of diagnostic FIR lines from galaxies at higher redshift reveal that — in spite of their high luminosities — they are not the equivalents of present-day ULIRGs but maintain similarly high rates of star formation in a totally different mode.

Probing the ISM of nearby galaxies with SPIRE-FTS spectroscopy

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I will present high resolution Herschel SPIRE Fourier-transform observations of the nearby starburst galaxy IC342. The full spectrum (194-670 microns) shows the full 12CO rotational ladder from J=4-3 to J=13-12 as well as 13CO lines. In addition we detect the far-infrared fine structure lines [CI] and [NII]. The CO transitions are used to probe the fundamental properties of the molecular gas. CO line rotational temperature diagrams and detailed radiative transfer modeling based on the 12CO and 13CO lines indicate a very warm molecular gas component of 400K which agrees well with previous estimates from Spitzer and ISO. We discuss the origin of the excitation and demonstrate the power of FTS in probing the conditions in the molecular clouds of nearby galaxies. SPIRE-FTS is paving the way for understanding the physical properties of the ISM in nearby galaxies while ALMA will allow us to extend these studies to the high redshift Universe.

Far-Infrared Spectroscopy in the Nearby Universe

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The processes that shape galaxy evolution – the cycles of gas consumption, stellar formation, dust production, starlight heating and gas cooling – occur on small physical scales within galaxies. The powerful combination of sensitivity and spatial resolution offered by Herschel is revolutionizing our ability to study these processes directly in the nearby universe. I will report on early spectroscopic results from KINGFISH, an open time key program which is mapping a widely selected sample of nearby galaxies with Herschel/PACS in 5 key diagnostic cooling lines. When combined with deep spectroimaging at similar spatial resolution from Spitzer/IRS, we can for the first time follow all sides of the crucial balance between gas heating and cooling, and place this balance in the context of the thermal dust emission which dominates the infrared output of galaxies, and the rates of star formation which drive it. I will also highlight our efforts to resolve nearby galaxies beyond the peak of their infrared emission with SPIRE/FTS spectroscopy, probing directly the material from which stars can form, and providing another powerful handle on the state of the heated gas.

Physical conditions of the interstellar medium of high-redshift, strongly lensed submillimetre galaxies from the Herschel-ATLAS

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We present Herschel-SPIRE Fourier Transform Spectrometer (FTS) and radio followup observations of two Herschel-ATLAS (H-ATLAS) detected strongly lensed distant galaxies. In one of the targeted galaxies H-ATLAS SDP.81 we detect [O iii] 88um and [C ii] 158um lines at a signal-to-noise ratio of 5. We do not have any positive line identification in the other fainter target H-ATLAS SDP.130. Currently SDP.81 is the faintest sub-mm galaxy with positive line detections with the FTS, with continuum flux just below 200 mJy in the 200-600um wavelength range. The derived redshift of SDP.81 from the two detections is $z = 3.043 \pm 0.012$, in

agreement with ground-based CO measurements. This is the first detection by Herschel of the [O iii] 88um line in a galaxy at redshift higher than 0.05. Comparing the observed lines and line ratios with a grid of photo-dissociation region (PDR) models with different physical conditions, we derive the PDR cloud density n=2000cm-3 and the far-UV ionizing radiation field G0 =200 (in units of the Habing field — the local Galactic interstellar radiation field of 1.6x10-6 W m-2). Using the CO derived molecular mass and the PDR properties we estimate the effective radius of the emitting region to be 500-700 pc. These characteristics are typical for star-forming, high redshift galaxies. The radio observations indicate that SDP.81 deviates significantly from the local FIR/radio correlation, which hints that some fraction of the radio emission is coming from an AGN. The constraints on the source size from millimeter-wave observations put a very conservative upper-limit of the possible AGN contribution to less than 33%. These indications, together with the high [O iii]/FIR ratio and the upper limit of [O i] 63um/[C ii] 158um suggest that some fraction of the ionizing radiation is likely to originate from an AGN.

Herschel spectroscopy of evolved stars

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We present results obtained by the Mass Loss from Evolved StarS (MESS) consortium using the PACS and SPIRE spectrographs on board the Herschel Space Observatory. The superior spectral resolution and sensitivity of these instruments allows unprecedented views of the far infrared region of the EM spectrum, hitherto difficult or impossible to observe. Among the significant results are the detection and confirmation of water in a number of carbon-rich objects, with the Herschel observations providing strong constraints on where the water is located; the detections of several species previously suspected but not confirmed in circumstellar environments; the first detection of the J=1-0 transition of CH+; and much clearer constraints on the physical conditions prevailing in the outflows from evolved stars than were previously available.

POSTERS

S7-1. Identification of Class I Methanol Masers with Objects of Near and Mid-Infrared Bands

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An identification has been conducted of class I methanol masers with 1) short-wave infrared objects EGO (extended green objects) - tracer bipolar outflow of matter in young stellar objects, and 2) isolated pre-protostellar gas-dust cores of the interstellar medium which are observed in absorption in the mid-infrared range in the Galactic plane. For comparison three catalogues, containing a large number of objects were used: the new version of the class I methanol masers catalog (MMI) presented on the web as a database http://www.asc.rssi.ru/MMI which includes 198 sources, the catalog of near infrared objects (EGO) from a survey of GLIMPSE (SPITZER) and a catalog of infrared dark clouds (IRDC) of the MSX survey in the middle infrared band. The situation with CD-objects (globules) and SDC (Spitzer Dark Clouds) is also discussed. It is shown that in the new version of the MMI catalog more than 50% of class I methanol masers are identified with bipolar outflows, considering the objects EGO as bipolar outflows (as compared with the result of 22% in the first version of the MMI catalog that contains no information about EGO). This result is strong evidence in favor of the fact that the objects of EGO are indeed active bipolar outflows. 104 class I methanol maser are identified with IRDC. A detailed statistical analysis showed that the number of significant identifications exceeds the random value. Thus, it seems possible that the MMI can be formed in isolated self-gravitating condensations, which are the IRDC.

S7-2. FIR diagnostics of radiative shocks in the gamma-ray brightest supernova remnant IC 443

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The extended supernova remnant IC443 (G189.1+3.0) is a textbook example of a supernova remnant (SNR) interacting with ISM clouds. Broad molecular lines were detected along the southern ridge of IC 443 (e.g. Burton et al. 1988; van Dishoeck et al. 1993; Cesarsky et al. 1999). The molecular emission from the southern ridge is evidence for the interaction of a blast wave with a molecular cloud. IC 443 is the brightest GeV-regime gamma-ray SNR observed by CGRO and Fermi, indicating the presence of substantial non-thermal components. Optical spectrophotometry of IC 443 has revealed an incomplete shell of filaments in the northeastern (NE) part of the remnant that indicate the presence of a radiative shock with a preshock number density of 10 – 20 cm(-3) and postshock densities up to 500 cm(-3) (e.g. Fesen and Kirshner, 1980; Fesen, 1984). ISO observations (Oliva et al. 1999, Rho et al. 2001) has shown that several strong lines dominate the medium-IR (MIR) spectrum of the shell. Being confronted with the modern quantitative models of infrared emission from radiative shocks and combined with the existing ISO data, Herschel observations of the shock in the NE shell of IC 443 allow one to constrain parameters of the interstellar medium around the shock, such as the shock velocity, ambient density, and magnetic fields, thus providing an important probe of fundamental physics of collisionless radiative shocks, modified by accelerated particles. Such observations are important to disentangle hardronic and leptonic contributions to the gamma-ray spectrum of the remnant.

S8: Status and prospects in high-energy & particle astrophysics across the electromagnetic spectrum

Conveners:
Pietro Ubertini (INAF/IASF-Rome, Italy),
Andrej Bykov (Ioffe Phys.-Thech. Inst., Russia)

The growth of super-massive black holes and the generation of the hard X-ray Background

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I will review our present knowledge of the evolution and growth of super-massive black holes in the Universe and show how they contribute during their active phase to the generation of the hard X-ray background. I will also show exciting results about the local Universe where low luminosity AGN, likely accreting at low Eddington luminosities, appear to be preferentially unobscured. Morever, current hard X-ray surveys are effective in constraining the number density of extremely massive black holes in the high redshift Universe. This can have important consequences for the mechanisms of black hole formation at early epochs.

Study of GRB prompt emission in Lomonosov space mission

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Study of GRB prompt emission (PE) is one of the main goals of "Lomonosov" space mission, which is under preparation now in Moscow State University. A number of instruments including GRB monitor (BDRG) and wide-field optical cameras (SHOK) are intended for detection of GRB PE as well as progenitors. The BDRG instrument consists of three identical NaI(Tl)/CsI(Tl) (d13.0x2.0 cm) phoswich detectors, which axe form the Cartesian coordinate system. This allows to locate GRB source comparing the output data from the detectors. The SHOK instrument consists of two identical wide-field cameras with field of view (FOV) ∼1000 square degrees totally overlapped by corresponding FOV of BDRG detector which gives the trigger in the case of GRB detection. The expected number of GRB appearing in FOV of SHOK is 1-2 per month. Due to the absence of pointing process GRB PE optical light curve will be obtained without any delay relatively gamma-rays, which is crucial for GRB central engine understanding.

GRB spectral evolution in the internal shock model: confrontation with Fermi observations

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Using a time-dependent numerical model in which the prompt gamma-ray burst emission is calculated in the framework of the internal shock model on a broad energy range (from soft X-ray to GeV energies), we compute GRB lightcurves and time-evolving spectra. We show how the spectral evolution in this model is determined by the evolution of the physical conditions in the shocked regions, and by the dominant radiative process for the effective microphysics parameters. The predictions of a model are confronted with the observations in the standard sub-MeV energy range, as well as with high energy bands observed by Fermi. The scenario where the soft gamma-ray component is due to synchrotron radiation from shock accelerated electrons gives the best agreement with observations. In this scenario a variable inverse Compton component is expected at high energies (> 100 MeV). We examine the effect of this component on the observed light curve and spectral properties. In particular, we investigate if the properties of Fermi LAT observations (the delayed onset of HE component, the prolonged duration with respect to GBM emission) can be accommodated within our model.

Synchrotron X-ray structures in supernova shells: polarized X-ray emission

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Supernova remnants (SNRs) are bright sources of the X-ray radiation. Some of them (Tycho, SN 1006, RX J1713 and others) have nonthermal X-ray emission components that are likely due to the synchrotron emission of TeV regime electrons accelerated at supernova shock waves. Particle acceleration by supernova shocks is most likely accompanied by efficient amplification of fluctuating magnetic field. The turbulent magnetic field will affect the formation of SNR X-ray emission especially at energies near the synchrotron spectrum cut off. We present results of modeling of X-ray images and spectra of SNRs with efficient particle acceleration and strong magnetic field fluctuations. The study of the synchrotron structures in the high resolution Chandra and XMM-Newton images of supernova shells like e.g. Tycho's SNR allows to obtain unique information on the particle acceleration mechanism and nonlinear plasma dynamics. The X-ray emission in some of the structures is highly polarized. We discuss the perspective of X-ray polarization observations of supernova shells with the next generation of X-ray observatories.

ICM physics and AGN feedback

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Radio and X-ray observations show clear signatures of a dramatic impact of the central AGN on the ICM. The details of the AGN/ICM interaction depend on the microphysics of the ICM, while model independent estimates suggest that the amount of energy supplied by the AGN is sufficient to offset gas cooling losses in the systems ranging from individual elliptical galaxies up to most massive clusters. Future high energy resolution X-ray observatories have the capabilities to pin down remaining uncertain elements of this picture.

Hard X-ray sky surveys

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The 4th IBIS soft gamma ray survey comprises more than 700 high-energy sources detected in the energy range 17-100 keV, including both transients and faint persistent objects that can only be revealed with very long exposure times. This source list together with the results coming from the survey performed in a similar energy range with Swift/BAT imaging instruments, allow us to show a complete picture of the whole sky in the soft gamma ray.

UHECRs Acceleration in Intracluster Medium Bubbles

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Jets from Active Galactic Nuclei produce at late times subsonically expanding low density cavities in the clusters of galaxies. Long term stability of these cavities requires presence of magnetic fields. We find self-consistent analytical structure of cavities containing large-scale electromagnetic fields and plasma which expand self-similarly. Unlike the force-free structures of spheromaks, these solutions have no surface currents and, thus, are less susceptible to resistive decay. If the adiabatic index of the plasma within the cavity is

$\Gamma > 4/3$, the expansion leads to the sudden formation of large-scale current sheets. We demonstrate that the ensuing explosive reconnection of the magnetic field can accelerate UHECRs. We speculate that the enhanced flux of UHECRs towards Centaurus A originates due to the magnetic reconnection in the cavities associated to the lobes.

Chemical evolution of clusters of galaxies: prospects

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Clusters of galaxies are excellent laboratories to study the chemical evolution of the Universe. Thanks to their deep potential well, all heavy elements produced over the cluster's lifetime remain within the cluster volume. A study of the chemical composition of clusters can reveal the history of the metal production, and by measuring a large number of elements the contributions from various sources (core-collapse, type Ia supernovae; AGB stars) can be disentangled. We show what current instruments have learned us, and look forward to the expected contribution from new missions such as Astro-H (launch 2014) and Athena (presently studied by ESA).

Self-consistent magnetostatic structures in astrophysical plasmas with arbitrary energy distribution of particles

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We analytically find a new broad class of neutral current configurations in collisionless multicomponent plasma, relativistic or not. It allows for a functional freedom to choose particle distribution functions and spatial profiles of corresponding magnetic field, greatly overcovering the majority of known analytical results. We describe their general properties and obtain a number of new planar, and cylindrical magnetostatic structures (localized and delocalized), which are self-consistent with inhomogeneous anisotropic particle distributions with essentially arbitrary energy profiles. Such solutions are valuable for analysis of physical properties of current sheets and filaments, including their synchrotron radiation, the current localization and value, the degree of anisotropy of particle distribution, and possible equipartition of particle and magnetic energy densities. In particular, the results may be applied to the problem of long-living magnetic field in astrophysical collisionless plasma for various dynamical structures, e.g., shocks, winds, jets, and accretion disks.

The Antares neutrino telescope

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The ANTARES detector is currently the largest deep-sea neutrino telescope in the Northern Hemisphere. Located on the bottom of the Mediterranean Sea, 40 km off the French coast, it consists of a three-dimensional array of 885 photomultiplier tubes which detect the Cherenkov light induced by the muons produced in the interaction of high energy cosmic neutrinos with the matter surrounding the detector. The main goal of ANTARES is to search for point-like sources such as active galactic nuclei, Gamma-ray bursters, micro-quasars and other Galactic sources. In this talk we present the results obtained with the first years of data collected by ANTARES, including searches for a diffuse high-energy cosmic neutrino flux, neutrinos from point-like sources. We also describe the search program based on a multi-messenger approach.

Fermi/GBM results of Magnetars

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Magnetars are magnetically powered rotating neutron stars with extreme magnetic fields (over 10^{14} Gauss). They were discovered in the X- and gamma-rays where they predominantly emit their radiation. Very few sources (roughly 18) have been found since their discovery in 1987. NASA's Fermi Gamma-ray Space Telescope was launched June 11, 2009; since then the Fermi Gamma-ray Burst Monitor (GBM) recorded emission from four magnetar sources. Two of these were brand new sources, SGR J0501+4516, discovered with Swift and extensively monitored with Swift and GBM, SGR J0418+5729, discovered with GBM and the Interplanetary Network (IPN). A third was SGR J1550-5418, a source originally classified as an Anomalous X-ray Pulsar (AXP 1E1547.0-5408), but exhibiting a very prolific outburst with over 400 events recorded in January 2009. In my talk I will give a short history of magnetars and describe how this, once relatively esoteric field, has emerged as a link between several astrophysical areas including Gamma-Ray Bursts. Finally, I will describe the exciting new results of Fermi in this field and the current status of our knowledge of the magnetar population properties and magnetic fields.

Hard X-ray background of the Milky Way with INTEGRAL observatory

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The origin of Galactic ridge X-ray emission (GRXE) was remaining a puzzle for the years after its discovery in early 80th of the last century. Only complex view on Galaxy background with surveys at different frequencies made it possible to achieve great progress in GRXE understanding. Using near-infrared Galaxy maps measured with DIRBE experiment and data from hard X-ray surveys of RXTE and INTEGRAL observatories, one can demonstrate that galactic background is originated from stellar population of the Galaxy which is in contrast to diffuse nature believed before. I will review the observational campaign of INTEGRAL observatory performed in the hard X-ray domain.

FACT, the First Cherenkov Telescope for ground based VHE gamma-astronomy using a G-APD Camera

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The First G-APD Cherenkov Telescope (FACT) collaboration is currently completing the construction of a novel camera for ground based gamma ray astronomy using 1440 Geiger mode avalanche photodiodes (G-APD). It will be installed in June 2011 at the refurbished Hegra CT3 telescope in La Palma, which features a 9m2 mirror and 4.6deg field of view. By using the telescope and measuring known gamma ray sources we aim to demonstrate that G-APDs are an excellent alternative to photo-multiplier tubes presently used in Cherenkov telescopes for gamma-astronomy. Their potential for the Cherenkov Telescope Array (CTA), in particular for the small telescopes, will be discussed. Moreover, the FACT telescope is planned to be used to closely monitor the brightest TeV blazars, thus allowing a detailed study of their variability and of the emission mechanisms involved. Status and first results will be reported.

GeV-TeV connection in galactic cosmic ray sources

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Cosmic rays with energies up to 10^{17} eV originate from sources located in our Galaxy. Several candidates are: supernova remnants, cluster of massive stars, pulsars wind nebulae and possibly compact objects like micro-Quasars. The recent developments of gamma-ray telescopes have conducted to changes in our view of the physics of these objects. This review will summarize the observations obtained by Tcherenkov telescopes and by the Fermi satellite on supernova remants and star clusters mainly. Consequences on the standard model of cosmic ray will then be addressed. Future observational and theoretical prospects will be discussed in conclusion.

A broad-band view of hard X-ray selected Pulsar Wind Nebulae

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The extended non-thermal nebulae formed by pulsar winds expanding into the surrounding medium are observed across the electromagnetic spectrum. Their morphological and spectral characteristics at different wavelengths provide constraints on the long-term evolution of the accelerated particles injected by the parent pulsars. Here I report on some recent observations of Pulsar Wind Nebulae in hard X-rays (e.g., Vela X, Kookaburra and Rabbit, IGR J18490-0000), and compare their broad-band emission with the expectations of the current understanding of the nebular evolution.

The unequivocal evidence of efficient hadronic acceleration in Tycho's Supernova Remnant

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We apply the non-linear diffusive shock acceleration theory in order to describe the properties of SN 1572 (G120.1+1.4, hereafter simply Tycho). Analyzing the multi-wavelength spectrum we conclude that Tycho is accelerating protons up to ∼400 TeV, channelling into cosmic rays more than 10 per cent of the shock kinetic energy. Our model allows us to take into account self-consistently the dynamical reaction of the accelerated particles, the generation of magnetic fields in the shock proximity and the dynamical reaction of the magnetic field as well. We find that the streaming instability induced by cosmic rays is consistent with all the observational evidences indicating a very efficient magnetic field amplification (up to $\sim$ 300 uG), in particular the radio and X-ray morphology of the remnant. In such a strong magnetic field, the velocity of the scattering centers in the upstream may be enhanced and make accelerated particles feel an effective compression factor lower than 4, in turn leading to an energy spectrum steeper than the standard prediction $\propto E^{-2}$. Accounting for this important piece of information, we can unequivocally explain the gamma-ray spectrum from the GeV up to the TeV band, recently measured respectively by Fermi-LAT and VERITAS, as due to pion decay produced in nuclear collisions by accelerated nuclei scattering against the background gas. We also work out the details of the thermal and non-thermal emission due to accelerated electrons, building up a model simultaneously consistent with Tycho's inferred hydrodynamics, morphology and radio to gamma-ray spectrum.

Gamma-ray emission from non-blazar AGNs

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We present preliminary results for an alternative (to misaligned jet emission) scenario for non-blazar AGNs. We refine and extend previous works on tenuous, two-temperature accretion flows by including a self-consistent, fully GR description of both the dynamical and the radiative (both leptonic and hadronic) processes. We find that the hadronic (i.e. initiated by proton-proton interactions) processes dominate the formation of the overall SED in a flow surrounding a rapidly rotating black hole. The gamma-ray luminosities of such flows are sufficient to explain the Fermi/LAT observations of FR Is and NLSy1s. We compare our modelling results to the observed, broad-band spectra of Cen A and M87.

INTEGRAL/IBIS survey of AGN

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We present the study of a the sample of AGN detected by INTEGRAL/IBIS in the 20-100 keV band and reported in most recent surveys. The sample contains type 1-1.5, type 1.8-2, QSO/BL Lac/Blazar as well as a number of XBONG, Liners and Narrow Line Seyfert 1. For all these AGN classes, we have performed broad band data analysis resulting from the combination of IBIS data above 20 keV and data below 10 keV (Suzaku, XMM-Newton, Chandra, Swift/XRT). Results on the absorption/reflection, multi-wavelenght and accretion properties will be here discussed.

Fermi observations of blazars: implications for gamma-ray production

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Fermi Gamma-ray Space Telescope has detected hundreds of AGNs, most of them are blazars. Spectra of blazars show clear correlation with the luminosity confirming blazar sequence. Interestingly, the GeV spectra of the brightest blazars cannot be described by a simple power law model or any smoothly curved models. A much better description is obtained with a broken power law, with the break energies of a few GeV. The sharpness and the position of the breaks can be well reproduced by absorption of gamma-rays via photon-photon pair production on He II and H I Lyman recombination continuum and lines. This is the first direct observational proof that the blazar zone lies inside the broad-line region within a few light-months from a super-massive black hole. This also implies that the jet is fully accelerated to relativistic velocities at 1000 Schwarschild radii from the black hole. I will also discuss the implications for the gamma-ray production mechanisms from spectral variability of blazars during flares.

Fundamental planes of gamma-ray emission from globular clusters

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We report on the discovery of gamma-ray emission from several globular clusters (GCs), including Terzan 5, the second known gamma-ray GCs. By now, more than a dozen GCs are known to emit gamma-rays at energies above 100 MeV, thus enabling us to carry out the first detailed correlation study with several

cluster properties. We found strong correlations between the observed gamma-ray luminosities and four cluster parameters: stellar encounter rate, metallicity [Fe/H], and energy densities of the soft photons at the cluster locations. These "fundamental planes" of gamma-ray GCs put an intimate relation of the observed gamma-rays to the underlying millisecond pulsar population and have important implications on the origin of the gamma-ray emission of GCs.

Diffuse gamma-ray emission from the Milky Way: 8 years of INTEGRAL/SPI observations

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We present results of extensive analysis of diffuse emission from the Milky Way using data obtained with SPI spectrometer onboard INTEGRAL observatory during 8 years of operating at the orbit. The origin and properties of this emission in MeV energy range is still under debates. We study properties of the diffuse emission in the most interesting spectral region of a transition from emission of unresolved compact objects (Galactic X-Ray Ridge emission) to truly diffuse emission at ~ 100 keV and up to a few MeV. We also discuss technical difficulties of signal registration at this domain. To place strong constraints on the morphology and energy spectrum shape of the Galactic diffuse emission the data during specially performed latitude scans were used.

High energy mission perspectives: Space Astronomy

Pietro Ubertini, Neil Gehrels, Ian Corbett, Paolo De Bernardis, Marcos Machado, Matt Griffin, Michael Hauser, Ravinder K. Manchanda, Nobuyuki Kawai, Shuang-Nan Zhang Mikhail Pavlinsky

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The COSPAR President on April 20, 2010 appointed the "Future of Space Astronomy" Working Group, chaired by P. Ubertini under the aegis of Commission E, with the aim to analyze the difficult situation of space astronomy over the next two decades and recommend ways to improve the prospects.

Having assessed the scientific needs and the current plans of the main space agencies worldwide, the WG has identified some major concerns about the lack of a secured future for Space Astronomy. In fact, astronomers today have access to an impressive set of space missions and ground-based observatories that gives them nearly continuous coverage of the electromagnetic spectrum from the gamma-ray to the radio regions. But the picture becomes concerning and critical in the next 10–15 years, when current space astronomy missions will have ended and new missions will be much less numerous. Astronomy is a difficult observational science requiring continuous and simultaneous access to the full electromagnetic spectrum to explore our complex Universe and to pursue answers to fundamental scientific questions. The history of space astronomy, especially the past three decades, has demonstrated clearly the importance and benefits of access to the gamma-ray, X-ray, UV-optical, near IR and far-IR spectrum from space. To build on this success, continuing technical and scientific advances and commitment to space science on the part of the world's space agencies are going to be needed. It will be essential to complement the powerful ground-based facilities that will soon be available and to ensure that the next generation of astronomers can make use of the whole spectrum.

So far the only planned observatory class missions, proposed to NASA-ESA-JAXA etc are JWST, time frame 2016-18, WFIRST/EUCLID, time frame 2018-2020, and other two, Athena (ex IXO), timeframe 2025, and LISA, 2025. The latter two are now under re-scope in an ESA alone scenario, with a cost not exceeding 1Beuro, and under down selection process in competition with the EJSM mission to Europa and Ganymede.

We will present the main WG outcome with a number of recommendations and, finally, suggest a road map for the next decades.

Staring down the gravity well: X-ray studies of strong gravity across the black hole mass scale

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I will give an overview of the latest developments in using X-ray observations to study strong gravity across the mass scale from stellar mass black holes in X-ray binary systems to supermassive black holes in AGN. To date, much of the progress in this area has been made using X-ray spectroscopy of the fluorescent iron K line from the accretion disc, but I will also highlight the latest advances made using disc thermal emission, X-ray timing and also reverberation time delays to study the space-time close to the black hole. I will also discuss the future prospects for these studies with new X-ray missions.

Ground Astronomy: CTA-Cerenkov Telescope Array (CTA)

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The Cherenkov Telescope Array (CTA) project aims at building the next generation very high energy gamma-ray observatory. CTA will improve by about one order of magnitude the sensitivity of the current telescope arrays, cover 5 decades in energy and have enhanced angular and energy resolutions. CTA is a worldwide endeavor currently in a preparatory phase for three years leading to the construction. The physics case, status and observatory aspects of CTA will be presented.

Contributions of the "Great" X-ray Observatories (XMM-Newton and Chandra) to Astronomy and Astrophysics

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NASA's Chandra X-ray Observatory and ESA's XMM-Newton made their first observations over a decade ago. The unprecedented and complementary capabilities of these observatories to detect, image, and measure the energy of cosmic X-rays, achieved less than 50 years after the first detection of an extra-solar X-ray source, represent an increase in sensitivity comparable in going from naked-eye observations to the most powerful optical telescopes over the past 400 years. In this presentation we highlight some of the many discoveries made using these powerful X-ray observatories that have transformed 21st century astronomy. We briefly discuss future prospects for this truly exciting field.

Gamma-Ray Bursts

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Gamma-ray bursts are the most powerful explosions, and by far the brightest emitters of light, in the Universe. This makes them extremely attractive objects both for the study of physical law under extreme conditions and for the study of the very distant/early Universe. I will discuss the current state of understanding of GRBs, and discuss some open issues in relation to future possibilities for addressing them.

POSTERS

S8-1. The dwarf galaxy dark-matter halo occupancy

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We show results based on a set of Nbody-SPH simulations of dwarf galaxies, both with initially cusped and initially cored DM halos, as well as DM-only simulations. Our Nbody-SPH simulations include star formation, stellar feedback, radiative cooling and metal enrichment. For the cusped halo we employ the NFW profile; for the cored halo a Kuz'min Kutuzov (KK) profile is used. Both dark matter halos have been proven to be stable. Our simulations are compared with, and are in good agreement with, observations of dwarf galaxies in the Local Group and in nearby clusters. The NFW simulations including gas dynamics and star formation reveal a gradual transition from a cusped density distribution to a cored density distribution, unlike our DM-only control simulations. The KK simulations on the other hand remain relatively stable, both with and without gas dynamics and star formation. Besides differences in the evolution of DM distributions we can also see effects on the baryonic component. The simulations with NFW halos have a lower star formation rate, lower metallicity, and lower circular velocity than the simulations with a KK halo of comparable mass and scalelength. This brings our NFW simulations in close agreement with detailed observations of dwarf galaxy stellar populations, of the dark-matter halo occupancy (particularly the slope of the M_halo vs. M_star relation), and of the Tully-Fisher relation.

S8-2. The dynamics of supernova remnants: 3d numerical simulations

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We simulate the expansion of SNR in non-uniform ISM in 2d and 3d numerical hydrodynamical approach with a high spacial resolution — up to 0.05 pc. In our models we take into account the most important physical factors such as radiative processes and thermal conductivity and also a different intercloud filling factor. The evolution of SNR was studied up to the effective radii about 100 pc. The results demonstrate that the radiative stage of SNR become on a very early times of the expansion beforehand the shell formation due to the cooling effect of clouds. On the latter stages of the expansion the heavy layer of turbulent clouds and hot gas forms in the aftershock flow. In detailed review we discuss the results of our research of time-dependent transformations of ISM phases and characteristics of advancing turbulence.

S8-3. Electromagnetic fields near a drifting Kerr black hole

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We perform a survey of the structure of electric and magnetic fields arising from the interplay between the frame-dragging effect and the uniform magnetic field with general orientation with respect to the rotation axis of the Kerr source. We further generalize our electro-vacuum model by allowing the black hole to move translationally in a general direction with respect to the magnetic background. In such circumstances we observe formation of magnetic null points. Interaction of strong gravity of drifting and rotating compact object with the ordered magnetic field thus provides conditions suitable for magnetic reconnection and effective acceleration of charged matter.

S8-4. Short gamma-ray transients registered by SPI/INTEGRAL

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The analysis of data obtained by SPI/INTEGRAL since launch and up to the end of 2009 was made in order to find short gamma-ray transients of duration from 1 ms and up to 10 s. The algorithm for the selection of gamma-ray events in the high level of background of a large number of interactions of charged particles with the detectors was developed. Among 45 cosmic gamma-ray bursts (GRB) detected by SPI, one third of the events was never reported by IBIS/ISGRI of the INTEGRAL. In addition we found well pronounced activity of known soft gamma repeaters and anomalous X-ray pulsars. We also present candidates to the gamma-ray bursts and soft gamma-ray events most likely associated with the activity of SGR and AXP, which were not previously reported.

S8-5. Features of the break steep spectrum sources

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We study the break steep spectrum sources from the UTR-2 catalogue. The break steep spectrum is observed for near 10 per cent of detected extragalactic sources at the decameter band. In the framework of the LCDM model of the Universe the main physical parameters of the sample sources are estimated. We reduce the derived values of luminosities to the frame of radio sources. Quasars and galaxies with break steep spectrum in our sample display the high radio luminosity and Mpc-scale radio structure. The ratio of monochromatic luminosities of sample steep spectrum sources at the decameter, centimeter, infrared, optical bands versus their redshifts indicates on the noticiable cosmological evolution of the object luminosity.

S8-6. Supernova remnant colliding with a stellar wind: a new class of gamma-ray sources

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A model of energetic particle acceleration in the vicinity of expanding supernova shell and a powerful stellar wind of a young massive star is presented. We show that the source at some evolution stage is characterized by unusually hard spectral energy distribution in X-and gamma-ray energy bands. A few of the sources can be detected in the galaxy by ground-based Cherenkov TeV telescopes.

S8-7. Possibilities of positron diagnostics for research of dust space plasma

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The analysis the scale-spectra [1], received by an observatory INTEGRAL, has allowed authors to draw a conclusion, that the observable-line with energy 0,511 MeV is caused of positron annihilation from parapositronium state. In this connection in [1,2] it has been shown, that positronium formation in dust space plasma with the big concentration of the charged particles of a dust can occur as processes of interaction of positrons to atoms and free electrons [1], and processes of interaction of a positron with negatively charged particles [3,4] of dust space plasma with formation of positronium atom [2]. In such space plasma the positronium

output about what speak experimental data of space laboratory Integral [1] is possible practically 100%. In the lead reasonings it was supposed, that depth of implantation of positrons in particles of a dust does not exceed length of diffusion of thermalized positrons in the environment, otherwise a part of positrons annihilated in a free condition, or participating in pick-off-annihilation, that will lead to increase in a share of the -annihilation channel. Depth of implantation l depends on energy of positrons E and from properties (density) of environment [5]. Knowing diffusion coefficient (terrestrial experiments) and time of a life of positrons in the environment, it is possible to estimate the size of particles of a dust and initial energy of positrons. So, for example, diffusion lengths of positrons in Si and Al are accordingly equal 0,5 and 0,15 microns [5], and for the majority of the condensed environments have the same order. The share of positrons (positronium), reaching a surface from the general number of positrons in the environment, depends on energy of positrons, i.e. from a parity of length of diffusion and length of absorption. So, lengths of absorption of positrons with energy 1.5 MeV in Si and Al accordingly will be ∼600 and ∼500 microns, and for positrons with energy 2 keV the same sizes will be already on three orders less. Broadening of annihilation lines 511 keV in experiments the INTEGRAL makes size (2,37±0,25) keV [1]. To it broadening there corresponds energy of annihilation electron-positron pairs in some (1÷2) eV, i.e. energy of quasithermalized positronium.

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S8-8. Time and spectral characteristics of activity of quasars and blazars in a radio range

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With application of methods of wavelet analysis and the analysis of time numbers laws of changes of fluxes of extragalactic radio sources 3C120, 3C345, 3C279, 3C446, OJ287, BL Lac, 3C454.3 received in supervision on 26- meter radio telescope of Michigan University from 1965 for 2011 are considered. The received results were compared with the data of spectral indexes received on initial supervision and taking into account time shifts in each cycle of activity on frequencies 4.8, 8 and 14.5 GHz. From given episodically VLBI supervision the contribution of a core to the general activity of a source is defined and with application of the given calculations dynamics of development of activity "core-jet" on all observable period is considered.

S8-9. Shifting radio flares maxima in orbital phase of VHE γ-ray binary LSI+61°303

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In 2003 and 2009 we have monitored very high-energy γ-ray binary LSI+61°303 with the RATAN-600 radio telescope. The multi-frequency light curves were measured during 4 and 6 orbital periods ($P_1 = 26.5$d). LSI+61°303 is periodically flaring source from radio waves to VHE γ-ray band. In both sets we detected flaring fluxes within 150-350 mJy, while its quiet fluxes were 10-20 mJy. We measured near the phases $\theta_2 = 0.6 - 0.7$ (2003) and $\theta_2 = 0.0$ (2009) of the super-orbital period $P_2 = 1667$ days, which modulated peaks of the radio flares according to the ephemerids of Gregory (2002) based on the GBI monitoring data. Comparison of the mean orbital light curves with the GBI data, received in 1990th for the same super-orbital phases showed that flares in 2003 Feb-May and in 1994 Feb-June (GBI data) started at the same orbital phases ($\theta_1 = 0.35$), while

the maxima of the flares were at orbital phases near 0.45 in 1994 and 0.55 in 2003. In 2009 the starts and the maxima of the flares were drifted to the phases 0.6 and 0.7 respectively, meanwhile these phases were rather 0.5 and 0.6 in the GBI data of 1996. Probably the super-orbital period is variable.

S9: Galaxy Evolution: the key for Galaxy Formation

Conveners:
Brigitte Rocca-Volmerange (Institut d'Astrophysique de Paris, France),
Andrey Doroshkevich (Astro Space Center, Russia)

Evolution of spiral galaxies since z=1

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We have constructed a data set of > 250 disk galaxies at redshifts up to $z = 1$ with Very Large Telescope spectroscopy and Hubble Space Telescope imaging. We investigate disk sizes, maximum rotation velocities (Vmax), total masses, stellar population properties etc. The results favor a HIERARCHICAL buildup of the dark matter halos the disks reside in, and an ANTI-HIERARCHICAL evolution of the stellar populations (aka "downsizing"), possibly due to supernova feedback. In a recent campaign, we took very deep spectra of distant disks at the extremes of the galaxy mass function: sub-M* and super-M* spirals. We will present first results of this project which aims at a better understanding of the interplay between galaxy mass and i) the evolution of scaling relations like the Tully-Fisher (luminosity-Vmax) and ii) star formation history. We will also utilize the correlation between Vmax and central velocity dispersion to study bulge growth in spirals since z=1.

Star forming galaxies within the epoch of reionization

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I will review recent progress in discovering star-forming galaxies at redshift 6 and beyond, including with new WFC3 IR data from HST. The rest-UV colours of these early galaxies are very blue, and spectroscopy reveals some Lyman-alpha emission at $z \sim 6$. I will discuss the evolution of this drop-out population, the implications for the reionzation of the Universe from the integrated UV background (from the SFR density) and future JWST observations.

The universality of galaxy colours and star formation histories

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Although the optical colour-magnitude diagram of galaxies allows one to select early-type (red sequence) systems, neither can it be used for galaxy classification without additional observational data such as spectra or high-resolution images, nor to identify blue galaxies at unknown redshifts. We show that adding the near ultraviolet colour to the optical CMD reveals a tight relation in the three-dimensional colour-colour-magnitude space smoothly continuing from the "blue cloud" to the "red sequence". Using Virtual Observatory technologies, we compiled a sample of 225,000 multi-wavelength spectral energy distributions of low-redshift galaxies (Z<0.27). We found that 98 per cent of them follow a smooth surface g-r=F(M,NUV-r) with a standard deviation of 0.03-0.07 mag making it the tightest known galaxy photometric relation. There is a strong correlation between morphological types and integrated NUV-r colours. Rare galaxy classes such as E+A or tidally stripped systems become outliers that occupy distinct regions in the 3D parameter space. Using stellar population models for galaxies with different SFHs, we show that (a) the (NUV-r, g-r) distribution is formed by objects having constant and exponentially declining SFR with different characteristic timescales; (b) colour evolution for exponentially declining models goes along the relation suggesting its weak evolution up-to a redshift of 0.9; (c) galaxies with truncated SFHs have very short transition phase offset from the relation thus explaining the rareness of E+A galaxies. This relation can be used as a powerful galaxy classification tool when morphology remains unresolved.

Evolution of Galaxies with IRAM: Present and Future

Pierre Cox

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In recent years, major changes were done at the IRAM Plateau de Bure interferometer and 30-meter telescope, in particular in the areas of receivers and back-ends. These enhancements increased in significant ways both the sensitivity and the efficiency of both IRAM facilities. I will present results obtained on high-z ($2 < z < 6.4$) sub-millimeter galaxies and quasars that illustrate the progress that has been made, emphasizing recent follow-up observations of sources that were uncovered in the Herschel surveys. The talk will end with a presentation of the NOrthern Extended Millimeter Array (NOEMA), a project to further enhance the IRAM interferometer in the ALMA era.

The merger rate of galaxies from the GAMA survey

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We present estimates for the galaxy merger rate from dynamically close pairs in the GAMA redshift survey. We consider the dependence of the merger rate on mass and environment and analyze the properties of merging galaxies. Finally, AGN activity in these objects is explored.

Constraining the formation of the most massive galaxies

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The formation and assembly of massive galaxies constitutes an ideal testbed of our understanding of the mechanisms driving the transformation of gas into stars in galaxies. In this talk I will present recent work on the evolution of massive galaxies over the past 10 Gyr by comparing low and high redshift samples. The superb spatial resolution and low background of the Hubble Space Telescope allow us to tackle the evolution both from a structural point of view (via surface brightness distributions) and from a stellar populations point of view (using ACS and WFC3 in slitless grism mode). The observations give important constraints on the formation and growth mechanisms, suggesting a very short-lived and intense burst of star formation during which the bulk of the stellar mass is formed, followed by a number of minor mergers that result in a significant increase in size. Observations will be confronted with the latest galaxy formation models.

PEGASE-3: Modeling the spectral evolution of galaxies from the ultraviolet to the far-infrared

Michel Fioc

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We present PEGASE-3, the latest version of the PEGASE code of spectral evolution. Compared to its predecessors, which calculated the spectral energy distribution of galaxies from the ultraviolet to the near-infrared, the main improvement of PEGASE-3 is the extension to the mid- and far-infrared. To this purpose, the code computes (1) the chemical evolution of the galaxy, in particular the amount of dust, and this consistently with the star formation history; (2) the radiation field, taking into account absorption and scattering by dust; and (3) the emission of dust in the interstellar medium and HII regions, including stochasting heating for small grains and PAHs.

As for previous versions, the source files of PEGASE-3 will be publicly available.

The Evolution of Early-Type Galaxies in VIPERS

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The VIMOS Public Extragalactic Redshift Survey (VIPERS) is an ongoing ESO Large Program to map in detail the spatial distribution of galaxies and to measure its statistical properties and related cosmological parameters over an unprecedented volume of the Universe at $0.5 < z < 1.2$ (Guzzo et al. 2011). Based on 5-band accurate photometry from the CFHTLS, VIPERS is using VIMOS at the VLT to measure 100,000 redshifts for galaxies down to $I_{AB} < 22.5$ over an area of $\sim$24 deg^2. This is the largest galaxy redshift survey ever performed at ESO and is comparable to the 2dF Galaxy Redshift Survey in the local Universe. There is a great synergy with other surveys at various wavelengths, such as e.g. GALEX, UKIDSS, VISTA, SWIRE, VLA, XMM-LSS. We will present first results from the VIPERS EDR and explore the properties of early-type galaxies up to $z \sim 1$. We discuss the rest-frame colours, spectral properties, and luminosities for a representative sample of early-type galaxies at intermediate redshift ($M_V < -19.5$) and derive their evolutionary histories for different environments using the colour-magnitude relation. These results allow for the first time a detail view on the environmental dependence of the evolution of lower mass galaxies and to establish the connection to their higher mass counterparts.

The rise and fall of globular clusters in hierarchical galaxy formation

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Modern hydrodynamic simulations of galaxy formation are able to predict accurately the rates and locations of the assembly of giant molecular clouds in early galaxies. These clouds could host star clusters with the masses and sizes of real globular clusters. I will describe current state-of-the-art simulations aimed at understanding the origin of the cluster mass function and the age and metallicity distributions. Metallicity bimodality appears to be a natural outcome of hierarchical formation and gradually declining fraction of cold gas in galaxies. Globular cluster formation was most prominent at redshifts $z > 3$, when massive star clusters contributed as much as 20% of all galactic star formation.

Near field cosmology with CLUES (Constrained Local UniversE Simulations)

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During the last decade our understanding of the formation of structure in the universe grew substantially. Due to the non-linear nature of the gravitational dynamics and the complicated gas-astrophysical processes numerical simulations have been the driving force behind much of this theoretical progress.

Cosmological simulations must cover a large dynamical and mass range. A representative volume of the universe should be large, but this comes at the expense of the resolution. To overcome this problem we have developed a new approach which consists of using observations of the nearby universe as constraints imposed on the initial conditions of the simulations. The resulting constrained simulations successfully reproduce the observed structure within a few tens of megaparsecs around the Milky Way.

I will discuss the formation of the Local Group and the Local Volume based on a series of simulations performed within the CLUES project — Constrained Local UniversE Simulations (http://www.clues-project.org/) and briefly introduce the new data base http://www.multidark.org/MultiDark/.

The SFR-density relation and the role of stellar mass in the early universe

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We study the relation between star formation rates and local galaxy environment of a stellar mass selected galaxy sample in the redshift range $1.5 < z < 3$. We use near-infra-red imaging from an extremely deep Hubble Space Telescope survey, the GOODS-NICMOS Survey to measure star-formation rates based on rest-frame UV fluxes as well as local galaxy densities based on the nearest neighbour approach. Galaxies down to a colour-independent stellar mass completeness limit of log $M^* = 9.5$ $M_\odot$ at $z \sim 3$ are used in this study. We find a dependence of average star formation rates on local environment only in the highest relative over-densities and only up to $z \sim 2$, such that galaxies in over-densities of a factor of > 5 have on average lower star formation rates. We do not see any significant correlation between SFR and local density at $z > 2$. We also investigate the influence of the very local environment on star-formation activity by counting neighbours within 30 kpc radius. This shows that galaxies with two or more close neighbours have on average significantly lower star formation rates as well as lower specific star formation rates up to $z \sim 2.5$. We suggest that this might be due to star formation quenching induced by galaxy merging processes.

Pulkovo program of investigation of stars with large proper motions: trigonometric parallaxes and $\Delta\mu$-binaries candidates.

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Determination of distances to low-luminosity objects and detection of their binary nature within solar neighborhoods ($d < 50pc$) contribute to better understanding of Galaxy subsystems formation. This became the motivation for Pulkovo program of observations of stars with large proper motions. Trigonometric parallaxes of 86 stars of the LSPM catalogue were determined with 26-inch Refractor (D/F = 0.65m/10.5m, 200 mas/pix). The mean standard error is 4 mas. Parallaxes of 50 low-luminosity stars have been determined for the first time. Short-term proper motions have been calculated by linear fitting of positional data taken with Normal Astrograph (D/F = 0.33m/3.5m, 900 mas/pix) and M2000, CMC14, 2MASS, SDSS for 414 LSPM stars (mean standard error is 5 mas/yr, epochs differences are about 10 yr). The short-term proper motions of 70 stars significantly differ from according long-term motions from LSPM and I/306. These 70 stars may be considered as $\Delta\mu$-binaries candidates.

A synthetic library of Galaxy spectra for classification and parametrisation Of unresolved galaxies detected by Gaia

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Gaia will observe millions of stars in our galaxy and at least a few million unresolved galaxies (seen as point sources). The classification of objects will be done during the mission, so a significant effort is being done to prepare the necessary software in order to classify and parametrize the various sources detected. Our team is developing suitable libraries of synthetic galaxy spectra and is preparing the necessary software (UGC) for classification and parametrization of the observed galaxies.

For the preparation of synthetic spectral libraries we use the code (of galaxy population synthesis) PEGASE2 developed at IAP (www.iap.fr/pegase). The major requirement is to obtain not just a typical set of synthetic spectra, but to enlarge the sample in order to predict all the variety of the expected galaxy spectra. The construction and optimization of the synthetic library using specific statistical tests and criteria is discussed.

On the cosmological evolution of the black hole — host galaxy relation in quasars

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Quasars are ideal tracers of the cosmological evolution of the black hole — host galaxy relation. We compare the expectations of Semi-Analytical Models (SAMs) of galaxy evolution to the available observational datasets on quasar host galaxies out to $z = 3$. High redshift quasars are observationally consistent with no evolution from the local M(BH) — L(host) relation, while SAMs predict them to be systematically brighter by ~ 1 mag. At $z < 1.5$, this over-luminosity is mostly a consequence of the fact that SAMs associate quasars with recent galaxy mergers; but at $z > 1.5$ it affects the global galaxy population, indicating a more general problem of under-massive black holes. This is confirmed considering the mass function of black holes in quasars at high z. We suggest effective quasar feedback quenching star formation, combined with alternative mechanisms to form very massive black holes at high z, as a possible way to solve the over-luminous/under-massive black hole problem. The observations also suggest a significant increase in the mass ratio M(BH)/M(host) from $z = 0$ to $z = 3$. At face value, this strong evolution should favour SAMs where quasar feedback plays a major role. However, due to quasars preferentially tracing very massive black holes (10^9 – 10^{10} Msun) toward the steep end of the galaxy luminosity function, we find that the ensuing selection biases may reconcile SAMs that do not include quasar feedback with the observations. The full interpretation of quasar host data thus requires the global approach of SAMs to account for statistical biases.

Planck Early Results and galaxy evolution

Guilaine Lagache, on behalf of the Plank collaboration

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Planck is a satellite mission that has been operating since August 2009, and the two Instruments will yield four complete all-sky surveys at nine frequency bands (30-857 GHz) with 30-5 arcminute resolution. In January 2011, the Planck collaboration released the first results from the mission, based on the first ten months of survey data. These results do not address the cosmology yet but they cover a wide range of topics, from galaxy clusters, radio and dusty star-forming galaxies to interstellar dust.

After introducing briefly the Planck mission itself and its behavior in flight, I will detailed a subset of the Planck Early Results, focusing on the galaxy evolution science. I will present, in particular, the early extragalactic source sample (clusters and galaxies) and first multi-wavelength analyses that have shed new light on the structure formation process in the Universe. I will then spend more time on the Cosmic Infrared Background anisotropies that probe the clustering properties of dusty star-forming galaxies.

Deep spectroscopic redshifts surveys with VIMOS on the VLT

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Deep surveys are a key tool to understand galaxy formation and evolution. The knowledge of the spectroscopic redshift of large samples of galaxies makes numerous investigations possible. I will describe the latest results from the VIMOS VLT Deep Survey, which has assembled more than 30000, 12000 and 1000 redshifts for galaxies in the wide, deep and ultra-deep surveys, respectively, going as faint as iAB=24.75. I will particularly focus on the star formation rate history, and the merger rate history, over the redshift range $1 < z < 5$.

Simplicity in galaxy evolution

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Analysis of SDSS and more distant surveys such as COSMOS reveal a number of striking simplicities in the evolving galaxy population to $z \sim 2$. These in turn indicate the action of two main processes quenching star-formation galaxies: mass-quenching which is independent of environment and environment-quenching which is independent of mass. The latter is shown to act only on satellite galaxies, and is controlled by the local density rather than by the dark matter halo mass. The former must have a particular form, with a quenching rate proportional to the SFR, or a survival probability given simply by $\exp(-m/M^*)$. These quenching mechanisms reproduce the precise Schechter shapes of the mass functions of active and passive galaxies over a range of environments, and also of active and passive central and satellite galaxies in groups. They precisely produce the relative values of the parameters in these various Schechter functions.

Cosmological standard model and its extrapolation back in time

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We analyse experimental and theoretical grounds of the standard model, consider lessons of its extrapolation back in time and discuss physics of Hubble flow formation.

Paschen Star Formation History of the Universe

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The study of the star formation history of the Universe and of the star formation rate as a function of epoch is crucial for the understanding of galaxy formation and evolution, however the star formation (SF) indicators are numerous. H-alpha is a well calibrated SF tracer in the nearby Universe, although, like all Balmer lines, is dust obscured. HiZELS (High-z Emission Line Survey) has found, in its narrow-band K filter, a wide-range of line emitters, of which about half are potential non-H-alpha emitting galaxies and among those some are likely Paschen (Pa) line emitters at redshifts 0.13 (Pa-alpha), 0.66 (Pa-beta) and 0.95 (Pa-gamma). Because the lines in the Pa series are essentially unaffected by dust, these could become an alternative to H-alpha and be used as SF tracers. Hence, we aim at obtaining the first-ever derived SF rate history from Pa emitters and compare with the existing luminosity functions derived from H-alpha within HiZELS. Moreover, these Pa emitting galaxies are expected to yield some constraints on the low z ($0 < z < 1$) end of the H-alpha luminosity function. We present the early results from a spectroscopic campaign using the AAOmega instrument to confirm the identifications of these non-H-alpha emitters, and Paschen luminosity functions derived using these and photometric redshifts.

PEP: The redshift evolution of mid-to-far IR SED of distant galaxies revealed by Herschel

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We use Herschel-PACS deep far-infrared imaging of the GOODS fields from the PEP project, as well as Spitzer photometry and spectroscopy to resolve the infrared SEDs of galaxies between $0.7 < z < 2.5$. We find

that galaxies which lie parallel to the main-sequence of star-forming galaxies tend to have similar IR SEDs and in particular, rest-frame 8um emission relative to total IR luminosity (LIR). The SEDs evolve with increasing distance from the main-sequence in a similar way at all studied redshifts. Previous findings of mid-IR excess that leads to over-estimation of SFRs at $z \sim 2$ are fully explained by this redshift evolution with the main-sequence. No significant MIR emission from obscured AGNs is required or found. We provide calibrations for SED libraries by LIR and by distance from the main-sequence. The results are verified with a sample of deep IRS spectroscopy. Finally, we compare the IR SEDs of a sample of $z \sim 2$ moderate luminosity AGN hosts to star-forming galaxies.

The role of gas in the evolution of early-type galaxies

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I will present the results from ATLAS^{3D}, a large project on early-type galaxies. This involves a multi-waveband survey of a volume-limited sample of 260 early-type galaxies, combined with extensive theoretical work. This project addresses many aspects of the structure and evolution of early-type galaxies, including dynamical structure and star formation history. In my presentation, I will focus on the results of the large WSRT survey we have done (of about 100 early-type galaxies) as part of the ATLAS^{3D} project. The results of the WSRT work will change the ideas about the role of cold gas in the evolution of early-type galaxies. Although early-type galaxies are generally perceived to be cold-gas-poor, our HI work shows that about 50% of the early-type galaxies that are in field environments have detectable amounts of neutral hydrogen (ranging from a few 10^6 to almost 10^{10} $M_\odot$ of HI). Moreover, in about 50% of the detections, the HI is found to be in a regularly rotating disk. I will discuss the implications for the role of HI in the evolution of early-type galaxies, and in the evolution of AGN which are found in many of the sample galaxies. In denser galaxy environments, we find a much lower detection rate, which we connect with other differences in properties between field and cluster early-type galaxies, such as stellar population I will also discuss the Tully-Fisher relation (TFR) we have derived for the sample, using the regularly rotating HI disks found in many sample galaxies. Our work shows that for low luminosities, the TFR for early-type galaxies is very similar to that of spiral galaxies, but for more luminous galaxies the TFR breaks down and for a given rotation velocity there is a very large dispersion in luminosities.

Factors that determine the internal structure of dark matter halos

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The analytical derivation of the shapes of dark matter (DM) halos is still a challenge and the most of their properties are studied only in simulations. However, the comparison of simulation results with observations demonstrate severe disagreement in some cases (e.g. the cusp problem). In the present work the formation of halos is simulated with very simple initial conditions composed of a plane wave of density and some additional fluctuations which are set in a periodical box. The simulations are conducted in the framework of a standard ΛCDM Universe. Such simple model allows to distinguish between different factors by changing the parameters of simulations and the additional fluctuations. The analysis shows that main factors that can determine the shape of DM halos are the epoch of collapse, the anisotropy of initial conditions, the thermal velocities of particles and the small-scale substructure.

The impact of AGN activity on the molecular gas in obscured QSOs at high redshifts.

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Galaxy evolution models postulate that active nuclei interact with the gas in their host galaxy and regulate the on-going star formation activity. We present observations of the molecular gas in two powerful obscured AGNs at z∼3.5 which may represent the first evidence of such a process in the early universe. The molecular gas is highly perturbed and its dynamics suggests that it is entrained by an AGN-driven wind. Our observations also suggest that in spite of their gas richness, the stars in these systems are forming less efficiently than in other gas rich galaxies at high redshift. We speculate that this could be a consequence of the AGN perturbing the molecular gas and that this property might be more common in obscured AGN than in other type of sources at high redshift.

Galaxy evolution from SPITZER/ISO faint counts with Pegase-3: Duality Starburst-AGN in HzRGs

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Deep faint galaxy counts from UV-optical (HDF) to MIR (Spitzer, ISO) are analyzed in a consistent way with the evolution code PEGASE-3 (Rocca-V. et al, 2007). The modeling follows coherently UV-to-IR emission and extinction from dust, stars and gas for 7 spectral types at all z. The best fit is revealing a population of massive active distant elliptical galaxies, ultra luminous in the IR but partly obscured in the UV. The source of activity (AGN or Starburst) is researched from the UV-to-IR spectral analysis with Pegase-3 of the High-z Radio Galaxy sample (HzRGs), recently observed with Spitzer. Consequences on galaxy evolution and formation models are discussed.

Constraining the early-phases of the mass assembly of early-type galaxies

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Understanding the formation and the evolution of early-type galaxies (ETGs) is one of the priorities of the observational cosmology since they contain most (∼70%) of the present-day stars and baryons. Recent observations have shown that in spite of the majority of ETGs lies on well defined scaling relations up to $z \sim 1.5-2$, a significant fraction of them deviate appearing significantly smaller in spite of the same mass. This evident non homogeneity of ETGs has to originate at an earlier epoch ($z > 2$), in the preceeding 3 Gyr, when they have been assembled. The relevant question is which formation scenario and early physical conditions can account for the observed different properties of ETGs yet observed at $z \sim 2$? We combined proprietary and archival HST observations to collect a sample of ~ 60 ETGs at $1 < z < 2$ with spectroscopic confirmation of their redshift and spectral type. In this talk I will present the results of the analysis we conducted on these ETGs aimed at constraining their past star formation and assembly histories.

Stellar metallicity at z¿3: a critical test for hierarchical formation models

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From the integrated SINFONI spectra of high redshift galaxies, we have found a clear evidence for a strong metallicity evolution of galaxies at $z > 3$, with high redshift galaxies having lower gas-phase metallicities at given stellar mass than in the local universe. This implies important constraints on the hierarchical models of galaxies formation, favoring models in which galaxies at $z > 3$ form by asssembly of un-evolved subunits. These results may, however, be affected by possible systematic effects, which should be checked using indipendent measurements of metallicity. Stellar metallicities have a smaller dispersion with respect to gas metallicity, and are a more direct measure of the amount of metals present in the galaxy. Measuring stellar metallicities at high redshift is challenging and require spectra of high signal to noise ratio. I will present the results of a project aimed at measuring stellar metallicities in a sample of UV-selected galaxies at $z > 3$ using very deep (37h per objects) VLT/FORS spectra. The goal of this project is to look any systematic differences between stellar and gas metallicity, and measure, for the first time, the stellar metallicity — mass relation at $z \sim 3.3$. I will also present the new set of metallicity indicators that we developed for the exploitation of these data.

Halo occupation properties of X-ray AGNs

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We discuss clustering properties of AGNs detected by the Chandra in the Bootes field over a redshift interval from z=0.17 to z 3. The measured correlation lengths are consistent with no redshift trend within the sample. The availability of accurate spectroscopic redshifts allows us to use the two-point correlation functions projected on the sky plane and in the line of sight to show that the X-ray AGNs are predominantly located at the centers of dark matter halos with $M_{\rm tot} > 4 \cdot 10^{12} h^{-1} M_{\rm sun}$, and tend to avoid satellite galaxies in halos of this or higher mass. The halo occupation properties inferred from the clustering data of Chandra AGNs — the mass scale of the parent dark matter halos, the lack of significant redshift evolution of the clustering length, and the low satellite fraction — are broadly consistent with the scenario of quasar activity triggered by mergers of similarly-sized galaxies.

A New Estimation of SMBH Mass Function in the Local Universe

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We present the latest measurement of the supermassive black hole (SMBH) mass function at redshift zero, using 1800 elliptical galaxies extracted from the Galaxy and Mass Assembly (GAMA) sample. Using the empirical correlations between the mass of the black hole and the properties of the galaxy, $M_{\rm bh} - L$ and $M_{\rm bh}-$ sigma, we estimate the SMBH mass of each galaxy and from this construct empirically derived SMBH mass functions. We compare the derived SMBH mass function with our previous estimates based on early and late-type galaxy samples derived from the B-band Millennium Galaxy Catalogue (MGC) and semi-analytic SMBH mass functions. These empirical SMBH mass functions provide an accurate constraint on the evolution of the SMBHs. Also, by combining the SMBH mass functions we produce an accurate measurement of the supermassive black hole mass density in the local Universe and an estimation of the fraction of baryons that are currently locked up in supermassive black holes. In addition, using a sample of 30nearby elliptical and spiral galaxies, we will present new results showing the near-IR correlation between bulge photometric properties and SMBH mass.

RC J0311+0507 Radio Galaxy Is an Unusual Object of the Early Universe

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RC J0311+0507 is one of the most luminous objects in the high redshift radio Universe having $L_{\rm radio} \sim 3 * 10^{29}$ W/Hz at 500 MHz. A very steep radio spectrum and an indication of a Fanaroff-Riley type II (FRII) structure from early VLA maps suggested the presence of a super massive black hole (SMBH) inside the parent galaxy. New MERLIN and VLBI maps (intensity, polarization) of this object at 1.7 GHz (L-Band) and 5 GHz (C-Band) with an order of magnitude better resolution than that of the VLA are presented. The radio morphology now suggests that this high redshift radio galaxy may indeed be classified as having an FRII structure, but with an extreme flux-density asymmetry, a complex jet structure in its southern lobe, and with a relatively strong nuclear emission. A bending of the overall structure, possibly because of the presence of cluster gas, can also be seen. The physical parameters of this object have been estimated and the possible origin of such objects in the very early Universe, including the possibility of a black-hole merger, which would result in a high black-hole spin velocity and a high radio luminosity, are discussed. The presence of a $10^9 M_{\rm sun}$ black hole in first generation galaxies needs to be understood.

A Spectroscopic Survey of starforming sources beyond the Virgo Cluster

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We will present the first results from the Virgo Spectroscopic Survey (VSS), a program for obtaining deep, multi-slit spectroscopy of narrow-band excess sources to identify and study high-redshift emission line galaxies beyond the Virgo Cluster. The VSS employs various narrow- and broad-band filters centered between $5000 < z < 7200$ Å with the primary aim of delivering large identically selected samples of star forming galaxies at $z \sim 1$ and $z \sim 3$ to perform detailed investigations of the evolution of the volume averaged star formation rate. Of particular interest are the faint galaxies with strong star formation missing in broad-band selected surveys, allowing to explore the specific star formation rates and downsizing effect. We discuss the Very Large Telescope VIMOS observations of a field, located in the Northern outskirts of the Virgo Cluster. We identify 87 emission line galaxies at $z \sim 1$, reaching emission lines to a flux limit of $\geq 3 \times 10^{-18}$ ergs cm^{-2} s^{-1} (3σ).

POSTERS

S9-1. Galactic disk formation

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We argue in favor of a very short time-scale formation of the galactic disc, namely: $t_f \sim 2$ Gyrs. Our scenario of disk formation enables to solve the problem of the lack of intergalactic gas infall, i.e. the very low present integrated rate of gas infall onto the disc 0.1–0.2 $M_\odot$ yr^{-1}, whereas the integrated star formation rate is expected to be 1–2 $M_\odot$ yr^{-1}. Higher level of the current global star formation rate needed too high rate of gas infall onto the galactic disc or unrealistically high gaseous and stellar current densities at the solar galactocentric distance.

S9-2. Fractal model of the Universe

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The analysis of modern galaxy and quasar catalogues shows their distributions have fractal properties. The fractal cosmological model permitting physical treatment of these fractal properties of the Universe's large-scale structure is constructed. The hypothesis of the Gaussian spectrum of the initial density perturbations implies they had the fractal properties. However the equations of GR-theory are not scale invariant, and the fractal properties may not remain during evolution. Therefore, we consider the hypothesis of the rotary symmetry of the charged scalar meson matter field. The cosmological model with scale invariant Lagrange's field equation and the Einstein's equation is constructed. The field energy densities (which are constant) and the space-time metrics differ in a constant factor. Therefore the space-time volumes with field values relating by the scaling are geometrically similar and evolve similarly. Due to this the fractal properties of the initial density perturbations remain and lead to presence of the fractal properties of the Universe's large-scale structure.

S9-3. On fractal properties of distribution for SDSS quasars

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Analysis of quasars distribution according to the Seventh Data Release of the Sloan Digital Sky Survey containing more than 100 thousand quasars and ranging to redshift $z = 5,46$ is carried out. The analysis shows that the quasar distribution is characterized by fractal properties: 1) in the range $0,35 < z < 2,30$ number of quasars in a volume with radius r centered in an observer has power-law dependence on r, the correlation dimension equals $d_c = 2,71$ approximately for the flat Universe filled with dust; 2) on the celestial sphere for every quasar in a concentration region number of neighbour quasars with angular distances less than α has power-law dependence on $sin(\alpha/2)$, correlation dimension equals $d_c = 1,49 - 1,58$ on the average.

S9-4. Does the formation scenario of lenticular galaxies depend on their luminosity?

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Lenticular (S0) galaxies were originally conceived as a morphological transition class between elliptical galaxies and early-type spirals by Hubble (1936). Detailed study indicates that the formation scenario for lenticular galaxies is more complex in reality. Barway et al. (2007; 2009) have presented evidence to support the view that the formation history of lenticular galaxies depends upon their luminosity. According to this view, low–luminosity lenticular galaxies likely formed by the stripping of gas from the disc of late–type spiral galaxies, which in turn formed their pseudo bulges through secular evolution processes. On the other hand, more luminous lenticulars likely formed at early epochs through a rapid collapse followed by rapid star formation, similar to the formation of elliptical galaxies. To investigate various possible formation scenario, we use GALEX/SDSS/2MASS photometry to construct color-color relationship for the sample of lenticular galaxies. We divide the sample into bright and faint group as suggested by Barway et al. (2007). We find the FUV-NUV versus NUV-K correlation has larger scatter for faint lenticular galaxies while bright lenticular galaxies show much tighter relation similar to elliptical galaxies. Simple Stellar Population (SSP) analysis show that the elliptical galaxies and bright lenticular galaxies are of the age 10^9 year while faint lenticular galaxies are as young as 10^8 years reflecting the presence of star formation activity.

S9-5. Surface density distribution of resolved stellar populations in nearby dwarf galaxies

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Gaia, an ESA mission planned for launch in 2012, will create the largest and most precise three dimensional chart of our Galaxy by providing unprecedented positional and radial velocity measurements for about one billion stars in our Galaxy and throughout the Local Group. It is expected to resolve nearby galaxies in stars, improving greatly our knowledge of them. After obtaining the spatial distribution of different stellar components in the Magellanic Clouds we are now investigating other galaxies in the Local Group, some of which are likely to be resolved in stars by Gaia. Using the tools of the Virtual Observatory we are investigating the stellar content and spatial distribution of several galaxies in and near the Local Group. We are using catalogues of UBVRI photometry data from the "Survey of the Resolved Stellar Content of Nearby Galaxies Currently Forming Stars" by Massey et al. (2006).

S9-6. Investigation of structure of the galaxy cluster A1656 (Coma)

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Studying the scale structure of large gravitational systems of galaxies — rich galaxy clusters, one can get the information about the symmetry properties of the gravitational interaction. One of the richest and nearby clusters is the well known cluster A1656 (Coma). During the last thirty years by different authors several cluster's substructures are discovered. Among new methods of analysis of the distribution of galaxies within clusters should be noted that the wavelet analysis has already proved its efficiency in other areas of science. We consider the wavelet analysis of two-dimensional map of galaxies in Coma. 1. 18 substructures, containing tens of galaxies, are found on the map of cluster using the isotropic wavelet transform. 2. This substructures form the self- similar concentric rings. The radiuses of the rings form geometric progression. It is the evidence of fractal properties of the distribution of galaxies in the Coma cluster 3. It is shown that the property of fractality is related to the collective resistance identified 18 groups of galaxies of Coma cluster on their mutual gravitational tidal destruction.

S9-7. Group behavior: The case of galaxies

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Is galaxy evolution (at a given stellar mass) modulated by the interaction of galaxies with their host dark matter haloes, or by their location within the cosmic web? I will present new results directly addressing this question from an observational survey of 1500 galaxies which are members of 150 nearby groups in the mass range $\sim 10^{12.3} - 10^{13.5} M_{\rm sun}$. For both the central galaxy and the satellite populations, I will show (1) at fixed stellar mass, (2) in separate bins of Hubble type, (3) when suitable, separately for bulges and disks, how structural and stellar population properties depend on three distinct environmental quantities, namely group halo mass, location within a bound halo (group-centric distance),and large-scale-structure overdensity. Our survey shows for example that the previously reported global reddening (at constant stellar mass) of the satellite population relative to the population of central galaxies is (a) limited to halo masses above $\sim 10^{13} M_{\rm sun}$, (b) true within galaxies of similar Hubble types, and (3) driven by a relative reddening of the cores/bulges rather than the outer disks. We also detect very interesting radial trends within halos, including e.g. a substantial increase towards the group centers in the surface mass density of M* late-type satellites. The emerging picture from the data is that local density is more important than halo mass in shaping galactic properties. Furthermore, a direct comparison with hydrodynamical simulation indicates that halo physics shapes the satellites population and AGN feedback controls the growth of the central galaxies.

S9-8. Disentangling the BCG in the core of Abell 3827: a super-giant cannibal with strong gravitational lensing features

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Abell 3827 ($z = 0.1$) is one of the most massive galaxy clusters known. The center of the cluster is dominated by a multi-component BGC that is probably the most massive galaxy ever seen in the local universe. The BGC in Abell 3827 is perhaps the most extreme example of ongoing galaxy cannibalism known: a super-giant elliptical that appears to be in the throes of devouring at least four other galaxies located within 20 kpc of each other. This super-giant galaxy shows features arising from strong gravitational lensing, the most prominent being a surrounding, magnified ring-shaped configuration of four similarly shaped images. The strong lensing images surrounding the ellipticals provide a unique opportunity to study the mass distribution and the evolution of BCGs with unprecedented spatial details. In this work we analyze the galaxy content, the dynamics and the mass distribution in the core of Abell 3827 using optical and X-ray data.

S9-9. The evidence of Hyades cluster rotation according to proper motions of the its members

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The Hyades cluster rotation was indicated by the analysis of astrometric parameters. The subset consisting of 123 stars with probability of membership equal 1 was taken from Perryman e.a. catalogue based on observations made with the Hipparcos satellite. We have studied the proper motions behavior in the rectangular coordinate system connected with apex direction. The proper motions and parallaxes was used. The estimation of rotation velocity was made.

S9-10. Instabilities in the Milky Way disc

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Many authors have tried to form a picture of the global structure of the Milky Way. In general, the conclusion is that Milky Way is a barred spiral galaxy. The bar rotates fast at a pattern speed of $\Omega_{\rm bar} \sim 50 - -60$ km/s/kpc while the spiral arms rotate slower at $\Omega_{\rm spiral} \sim 17 - -28$ km/s/kpc. We performed a linear mode analysis of a Milky-Way-like stellar disc to investigate which instabilities it can self-consistently support. We show that the dominant $m = 2$ and $m = 4$ modes have precisely the properties to allow CR-ILR coupling in the non-linear regime. This coupling produces a 2-armed beat mode with a pattern speed of $\Omega \approx 24$ km/s/kpc, in good agreement with that of the Milky Way spiral. This analysis corroborates the idea that the Milky Way's bar and spiral have grown through the non-linear coupling of overlapping modes (in the sense that the $m = 2$'s corotation radius coincides with the $m = 4$'s inner Lindblad resonance).

S9-11. Star Formation History of Galaxies in Compact Groups

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We present a statistical study of the star formation history for a sample of 210 galaxies in Hickson Compact Groups (HCGs). We performed an analysis of stellar population synthesis using new long slit spectra and spectra from the SDSS-DR7. As a control sample we carried out the same analysis for 407 isolated galaxies with SDSS spectra. The spectra were analyzed using the STARLIGHT code. We measured the stellar population and we determine the star formation history in both samples. We divided the galaxies in 3 bins of morphology: Early-type(E-S0a), Early-Spirals(Sa-Sb) and Late-Spirals(Sbc-Im). For early-types we found that the fraction of stars formed in the last 5 Gyr is higher in HCG galaxies than in the isolated ones. Early-spirals appear quite similar in both environments. In late-spirals we find that HCG galaxies show a deficit of recent stellar populations compared to the control sample. This could be produced by the group environment which may suppress star formation.

S9-12. The mass of the central body of the galaxy Mark 1095 and orbits of two emission objects, moving near this body

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The spectral observations of Mark 1095 in 1975–2011 have allowed to construct the orbits of two emission objects, moving near the central body of this galaxy. The variable radial velocities of these objects were used.. Emission features, obliged to the first object were observed on the blue wings of the broad emission lines Hα and H β, and emission features on the red wings corresponded to the second object. The following parameters of the orbits were obtained. For the first object (moving to us) an inclination of the orbit's plane to a line of sight equals to 62.6 deg. The minimal distance from the central body (R=$3.77{\cdot}10^{14}$m) was achieved on 20.05.1982, the module of the object's velocity was equaled to $1.056 \cdot 10^7$ m/sec. For the second object (moving from us) an inclination of its orbit equals to 57.1 deg., the minimal distance R=$2.404 \cdot 10^{15}$m with the module velocity V=$4.275 \cdot 10^6$ m/sec. was achieved on 14.04.1984. Eccentricity of the both orbits are close to 1. The most probable value of the central body mass equals to $1.61 \cdot 10^8 \pm 5\%$ Msun .

S9-13. Core — cusp problem for galaxy formation

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We discuss the possible influence of initial random perturbations of particle velocity to the density profile of high density halos.

S9-14. cD-galaxy as a code of the dynamic history of a galaxy cluster

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The origin of cD-galaxies is related to baryonic and dark matter (DM) budget of the host galaxy cluster. In view of intangibility of DM-particles in modern experimental physics, the role of numerical experiments

increases. It is known that almost all galaxy clusters have cD-galaxies that indicate to the universal scenario able to explain their origin. Dynamic braking being effective in the collisional medium is a good candidate to solve the problem. Our model deals with three components: galaxies, DM-"grains", and ICM-gas (intra-cluster-medium). First two components are treated in the framework of N-body problem and third component is described as barostatic gaseous ball with given temperature profile. Account for three rival factors ICM ram pressure, tidal braking, and dynamic friction produced by gravitating matter, allows within evolutionary significant timescale to "sculpture" dense core in which intensive merging of massive inert galaxies results in the formation of central massive body known as cD-galaxy accumulating 1-2% of total cluster mass that well reproduces the observations.

S9-15. The evolutionary paths among galaxy types on the Red Sequence at 0.3<z<1.5

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We have studied the main evolutionary paths among the galaxy types residing on the massive end of the Red Sequence during the last 9 Gyr of cosmic history. The morphological and star formation properties of a sample of red galaxies at $0.3 < z < 1.5$ with stellar masses $M_* > 6 \times 10^{10}$ Msun from the GOYA photometric catalogue have been analysed. We provide direct observational evidence for the first time of the existence of three main evolutionary paths among the different red galaxy types since $z \sim 1.5$, revealing the nature of the processes that have governed the assembly of present-day massive quiescent galaxies. The results are in excellent agreement with the hierarchical evolutionary framework proposed in the Eliche-Moral et al. (2010) model.

S9-16. The most recent burst of star formation in the massive elliptical galaxy NGC 1052

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Two observational facts rule out the passive evolution of massive galaxies since z=0.8: 1) the presence of Recent Star Formation (RSF), and 2) size growth by a factor of two since z=1. Minor merger events could explain both effects in these galaxies. In this context, NGC 1052 is one of the best nearby examples of a massive elliptical undergoing a recent minor merger with RSF. High-spatial resolution near-infrared (NIR) images of the central 24×24 arcsec2 ($\sim 2 \times 2$ kpc2) in this galaxy reveal a total of 25 compact sources randomly distributed in the region. Fifteen of them exhibit Hα luminosities an order of magnitude above the estimate for an evolved population of extreme horizontal branch stars. Their Hα equivalent widths and optical-to-NIR spectral energy distributions are consistent with them being young stellar clusters aged < 7 Myr. We consider this to be the first direct observation of spatially resolved star-forming regions in the central kiloparsecs of an elliptical galaxy.

S9-17. The Evolution of Early-Type Galaxies Since z=1

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We analyse the kinematic and chemical evolution of about 200 distant early-type (elliptical and S0) galaxies at $0.2 < z < 1$ which are located in different environments (rich clusters, low-mass clusters and in the field). VLT/FORS, Gemini/GMOS and CAHA/MOSCA spectroscopy with intermediate-resolution have been

acquired to measure the internal kinematics and stellar populations of the galaxies. From HST/ACS and HST/WFPC2 imaging, surface brightness profiles and structural parameters were derived for half of the galaxy sample. The scaling relations of the Faber-Jackson and Kormendy relation as well as the Fundamental Plane indicate a moderate evolution for the whole galaxy population in each density regime. In all environments, S0 galaxies show a faster evolution than elliptical galaxies. For the cluster galaxies a slight radial dependence of the evolution out to one virial radius is found. Dividing the cluster samples with respect to their mass, a mass dependent evolution with a stronger evolution of lower-massgalaxies ($M < 2 \times 10^{11} M_{\rm sun}$) is detected. This down-sizing in the evolution of the galaxies is independent from the environment. The results will be compared to predictions of stellar population models to constrain the formation and evolution of these galaxies.

S9-18. Dynamics of the Milky Way disk from SDSS/SEGUE and RAVE data

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I'll talk on the application of SEGUE and RAVE data for reconstructing the dynamics of the Milky Way disk. I'll study the spatial variations of velocity dispersions within the disk. I'll recover the shape of the velocity ellipsoid and the distribution of stars over energies of the vertical motion. I'll use the vertical motion of stars to reconstruct the vertical gravitational potential of the disk. I'll apply SEGUE, RAVE and Hipparcos samples to constrain the behavior of the rotation curve of the Milky Way in the solar neighborhood. Supplementing these data by other measurements of the rotation curve allows me to construct an improved density model of the Milky Way.

S9-19. Measuring the physical properties of galaxy components in modern multi-wavelength surveys

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Most galaxies are fundamentally multi-component systems, comprising a spheroidal bulge and a thin disk. As these components have largely independent origins, separating them provides important information to constrain models of galaxy formation and evolution. Current methods are not sufficiently developed for routine use of this technique on large samples of galaxies. We will introduce the MegaMorph project, in which we develop an accurate, robust tool for measuring the key physical quantities of the individual structural components of galaxies imaged by large multi-band surveys. The focus of our work is the extension of current tried-and-tested galaxy fitting/decomposition techniques (e.g. GALAPAGOS & GALFIT) to fully utilise multi-band imaging, as routinely produced by modern surveys, both ground- and space-based. Using all the available multi-colour information in the galaxy fitting process enables much more robust decompositions in terms of physically-meaningful parameters.

S9-20. Resolved star formation in nearby galaxies

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The increasing amount of high-resolution imagery of galaxies demands robust means of automatic object identification to fully utilize the available data. We present an automated method for adaptive aperture size photometry based around the Source Extractor software. We use this method to identify resolved populations of star forming regions in a sample of LVL survey galaxies. Object selection is made with reference to GALEX

FUV and ground-based Hα observations. We will present a comprehensive analysis of the two populations. Our approach allows us to discuss the significance of the selection band on the inferred star forming properties of the regions. Discrepancies arising between the two tracers will be discussed in light of the ageing of the stellar population responsible for the HII region ionisation.

S9-21. Relic stellar population of the Milky Way

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Population III stars are the sources of heavy elements (metals) in the initial enrichment of the Universe. Such stars are believed to be massive and explode in a short time as supernovae. Subsequent stellar population formed from the metal-enriched gas should carry information about the star formation during early ages of the Milky Way progenitors. A fraction of stars of this population (in the low mass end of the initial mass function) can survive till the present day and be associated with extremely metal-poor stars observed in our Galaxy. Using the hierarchical merger tree we follow the star formation and enrichment history of the Milky Way progenitors. We study the abundance patterns of such relic stars in the Milky Way depending on the initial mass function. A special attention is paid to the well-known indicators of the chemical evolution, such as [Na/Mg], [Al/Mg], [Mg/Fe]. We present estimates of the number of the relic stars in the solar neighbourhood.

S9-22. The features of gas component in spiral galaxies of the Virgo cluster

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Since the star formation in galaxies is determined by the amount of molecular hydrogen, and the formation of molecules is associated with gas pressure, it is important to analyse the radial dependence of the molecular gas density, as well as to investigate the fraction of molecular gas $\eta = \Sigma H2/\Sigma HI$ depending on the gas pressure P. We construct the self-consistent model of an axisymmetric disc with finite thickness in a gravitational field of dark halo taking into account a self-gravitation of gas and stars in order to get volume density of components and gas pressure. The galaxies inside and outside of Virgo cluster have been compared in order to study the influence of the environment on interstellar medium. Possible reasons for the unusual behaviour of Virgo galaxies sample on the plot $\eta(P)$ is discussed.

S9-23. Galaxy Evolution in the view of 3D-spectroscopy

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Galaxies are complex objects, consisting of many components such as disk, bar, bulge and halo and are made of stars, dust, gas and dark matter. Their evolution involves different star formation histories and possible minor and major mergers. To further constrain galaxy formation theories, observations covering a wide parameter space are needed. 3D- or integral-field spectroscopy is one of the most powerful observing techniques to obtain spectral information of spatially resolved galaxies. The Leibniz Institute for Astrophysics Potsdam (AIP) is involved in the scientific exploration of the CALIFA galaxy survey, currently undertaken at Calar Alto Observatory with the PMAS multi-aperture spectrophotometer. Also, AIP is a consortiums member in the development of the multi-unit spectroscopic explorer MUSE for the ESO-VLT. Both instruments target galaxies at various redshifts to observe their key parameters, and to better understand their structure and formation history.

S9-24. Scenario of the Galactic bulge and bar formation

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The modern data concerning the planetary nebulae (PNe) in the bulge and disk of the Milky Way are used to study the chemical history of bulge and scenarios of bulge formation. We show that abundance pattern is similar for PNe in the bulge and Peimbert's type II PNe which progenitors belong to the thin disk population older than 4–6 Gyr. Moreover, we found that the metal rich disk subsystem of globular clusters (GCs) forms in smoothed spatial maps for GC metallicity a bar-like structure which parameters are very close to those for the Galactic bar. This evidences that the most of highest metallicity GCs were formed within the already existing Galactic bar, which age, consequently, may be 10 Gyr or more. We propose an scenario of the successive star formation in the bulge, bar and thin disk.

S9-25. Dynamic models of galactic polar rings

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Using the methods of N-body and Tree-SPH were constructed evolutionary models of galactic polar rings taking into account self-gravitation and the external gravitational field of the host galaxy. The kinematics of the polar component for some of the galaxies studied form a dark halo. Three-dimensional modeling was to estimate the destruction of the ring structures, depending on the parameters of the host galaxy, the shape and mass of dark halo

S9-26. Galaxy evolution in the infrared: inferring the PAH lifecycle

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Polycyclic aromatic hydrocarbons (PAH) are now widely recognized as an important component of the interstellar medium and a promising tracer of star formation activity. However, a proper understanding of the PAH formation and destruction cycle, which is necessary to interpret observations, is still lacking. In this contribution, we present a model of the galactic infrared spectrum, with contributions from PAHs and stochastically-heated small grains taken into account. This model is coupled to the one-zone model of the evolution of the galaxy. This makes it possible to investigate various scenarios of PAH formation and destruction, to infer their relation to the evolution of the galaxy on the whole, and to check the sensitivity of the infrared spectrum to these various scenarios.

S9-27. Continuous mass-loss in N-body models of galaxies: probabilistic versus deterministic implementations

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Despite huge progress in cosmological simulations, they predict the formation of disk galaxies with most of their mass in the bulge contrary to the observations. Including continuous recycling could reduce the bulge fraction issue, because star formation and stellar mass-loss help the disks to survive interactions and mergers — the main processes responsible for bulge growing. On the other hand,there are several ways of matter exchange cycle implementation and some of them have influence of kinematics. So, their diversity may

affect the evolution through changes in the angular momentum distribution, different inflow or outflow rates etc. Therefore, we compare two of the used and very different methods of matter recycling — stochastic and deterministic. The deterministic implementation leads to a more localized mass exchange between particles in time and space. It also differs in how momentum, angular momentum and energy are redistributed among stellar and gas particles. Both methods are also sensitive to certain type of parameters (mass and dynamical resolution, number of particles etc). Such differences are critical and affect evolution of disk galaxy models in many ways.

S9-28. Investigations of the Large-Scale Structure of Linear Polarization in the Galaxies

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Observations of the galaxies and other expanded sources in the sky, the measurements of their linear polarization often meet the problems making the standard polarimetric methods (as for point-like sources) invalid. The basic problems follow: 1) Surface brightness of the galaxies is like the one for the sky background; 2) The image size of the galaxy is often wider than the field size of the camera, so the simultaneous measurements of the galaxy and background are impossible; 3) To receive the sufficient signal, the long exposures are required; 4) The linear polarization of the galaxies is weak. The object images with different polarization filter directions are often received with different background level and the atmospheric transparency. The method suggested here is based on the spatial brightness variations of the object. The measuring value is not the polarization itself, but its differential parameters. The properties of large-scale polarization distribution in the galaxies are compared with available data.

S9-29. Observational study of peculiar galaxies UGC 8387 and NGC 3310 resulted by merging

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We present new 2D- and 1D-spectral data for two peculiar galaxies UGC 8387 and NGC 3310. The observations of objects were carried out on the Russian 6-m telescope. Their circumnuclear regions were observed with integral-field spectrograph MPFS; the large-scale velocity fields of the ionized gas were constructed from observations with scanning interferometer Fabry-Perot. For both galaxies long-slit spectra along their outer filaments were obtained. We have constructed intensity maps and velocity fields for both ionizing gas and stars and analyzed our long-slit data. The results of the study of objects' complex multicomponent structure are presented. It is suggested that their peculiar structure results from the merging of interacting galaxies in the past.

S9-30. Disk galaxy models driven by stochastic self-propagating star formation

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We present a model of chemical and spectrophotometric evolution of disk galaxies based on a stochastic self-propagating star formation scenario. The model incorporates galaxy formation through the process of accretion, chemical and photometric evolution treatment, based on simple stellar populations, and parameterized gas dynamics inside the model. The model reproduces observational data of a late-type spiral galaxy M 33 reasonably well. Promising test results prove the applicability of the model and the adequate accuracy for the interpretation of disk galaxy properties.

S9-31. Merging of galaxies: formation of state for the radial motion instabilities

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Merging of galaxies obviously can lead to a relatively "cold" state with some small value of the initial virial ratio. In the result of the merging a size of the new system will expand slightly that leads to a decreasing of the total "temperature" and then this expansion is changed to a collisionless collapse. So the Jeans instability of radial motions will take place certainly. One of the authors (SNN), together with V. A. Antonov earlier (1981) found theoretical criterion $(2T/|U|)_0 < 0.1$ for the formation of elliptical galaxies. Here we have studied the main types of instability of radial motions on the background of two non-stationary models. We have carried out a comparative analysis of the instability growth rates of radial motions for all oscillation modes.

S9-32. Intensity and polarization of radiation of point source which was active at the recombination epoque

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The radiation of point source which was active at the period of expansion of the universe near the epoque when recombination of hydrogen and helium performed is investigated. Optical distances on the Thompson scattering at that period quickly decreased with time. The plane cosmological model is supposed. This model is close to the model that usually is accepted as the most adequate to the real universe. The system of two integral equations is formulated for two source functions. As a result of solution of this system the intensity and the degree of linear polarization of radiation which can be registered by contemporal observer are calculated. The contrast of the source radiation with various spectrum on the CMB, observed source angular size, duration and polarization of its radiation are estimated.

S9-33. An additional BLR associated with the jet

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Analysis of UV and optical spectra of the radio galaxy 3C 390.3 shows that the observed line ratios for the broad components of lines CIV/Lα, Lα/Hβ and Hα/Hβ can be explained best by two system of clouds (two components to the BLR). One BLR component has an electron density 10^{10-12}cm^{-3} and is located in the equatorial plane at the distance ≈20 days from the center. This disk-like region emits predominantly low-ionization lines (including Hβ and Hα). The second BLR corresponds to the region with somewhat lower (10^{8-9}cm $^{-3}$), located out of the equatorial plane in the direction of radio-jet. Gas in this region could extend out to a distance of ≈ 40-80 days from the center. This region emits the high-ionization CIV line, a significant part (≈60%) of Lα and far wings of the Balmer lines.

S9-34. A complex investigation of the lenticular galaxy NGC 4150

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We performed a complex analysis of available archive spectral and photometric data in order to study the disc-dominated early type galaxy NGC 4150 in different wavelength ranges between far-UV and mid-IR. Hubble Space Telescope and Spitzer images were used to build colour maps of the galaxy and perform the multi-component decomposition of its light profile. We use deep long-slit spectroscopic data from Special Astrophysical Observatory, SAURON and GEMINI optical integral-field spectroscopy, recovering stellar and gas kinematics, distribution of age and metallicity with the NBursts full spectral fitting code. The galaxy NGC 4150 is found to have a metal-rich stellar population and the nuclear ring of star formation. These results conflict with recent results by the HST WFC3 science team based on the HST photometry without using spectroscopic data.

S9-35. Collisionless and Collisional Early Dynamical Evolution of Galaxies

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We discuss collisionless and collisional processes governing an early evolution of galaxies, such as the violent relaxation and scattering stars on globulars. External tidal perturbations (that may by chaotic) can be a trigger mechanism for stochastization. Virial oscillations of the gas component of the galaxy will damp. The more intensive star formation star formation will be when its size is minimal. So, one may expect a discreteness in a distribution of stellar ages.

S9-36. EROs in the ALHAMBRA Survey

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We present new results on the spatial distribution and properties of extremely red objects (EROS) detected in the ALHAMBRA Survey. EROS were selected as galaxies with r-Ks$>$ 3.1 (AB) and Ks brighter than 22. ALHAMBRA is a photometric survey primarily intended for cosmic evolution studies. The observations were obtained at the 3.5m telescope at Calar Alto and the survey covered about 2.5 square degrees. The photometric system consists in 20 contiguous equal width filters from 350 nm to 970 nm plus the standard JHKs filters in the NIR. With this setup and the depth of the survey it is possible to derive accurate photometric redshifts and an estimation of the spectral type. Most of the EROS appear as early type with a small fraction of extincted late spirals and a few red obscured qso's. The redshift distribution appears bimodal with maxima at $z \sim 0.7$ and $z \sim 0.9$ although objects up to $z \sim 2.3$ were detected. An estimation of the luminosity function is performed at different redshifts.

S9-37. Properties of unusual void LSBDs versus cosmological simulations predictions

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We present the study of several unusual galaxies – low-mass ($M_{\rm bar} \sim 3 \cdot 10^7$ to $\sim 10^9$ Mo, and $M_B \sim -(12 - 14.5)$) Low Surface Brightness Dwarfs (LSBD) residing in a nearby Lynx-Cancer void. We confront their properties with results of recent cosmological simulations, predicting both dynamical properties of low-mass objects and connecting their formation and evolution. In particular, we compare $V_{\rm rot}$, baryon mass $M_{\rm bary}$, total dynamical mass within R(HI) — $M_{\rm dyn}$, with predictions of Hoeft & Gottloeber (2010), which account for the suppression of gas accretion to the low-mass DM halos. We also use for comparison the lower resolution "Bolshoj" simulations by Trujillo-Gomez et al. (2010), well matching galaxy dynamical properties in a wide range of $V_{\rm rot}$. For both simulations, we find that for some of our void LSBDs, the observed parameters roughly match the predictions. However, for the others, the differences are very large and suggest either atypical evolutionary history of the studied LSBDs, or probable caveats in models, or both. More work, both observations and modelling, is necessary to resolve these apparent inconsistencies.

S9-38. The giant low surface brightness galaxy Malin2: general structure and molecular gas content

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We constructed the mass distribution model for the low surface brightness galaxy Malin2 using the photometry from SDSS and GMOS-N data, as well as an available rotation curve. Photometrical and dynamical mass estimates are in good agreement and correspond to the dark halo mass fraction of about 80% within four disc radial scalelengths (∼100 kpc). The disc surface density extrapolated to the galaxy center is by an order of magnitude lower than that of normal galaxies. We used our dynamical model to obtain radial profiles of the equilibrium disc volume density and gas pressure in the galaxy plane based on available HI and CO data. The observed molecular gas fraction appears to be much higher than in high surface brightness galaxies for a similar gas pressure. Possible reasons of this peculiarity are discussed.

S9-39. The stellar mass function at $0.6 < z < 4.5$ from deep WFC3 data

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I will present recent results on the Galaxy Stellar Mass Function (GSMF) at $0.6 < z < 4.5$ obtained using the Early Release Science observations taken with the Wide Field Camera 3. Deep WFC3 near-IR data (Y down to 27.3, J and H down to 27.4 AB mag at 5 sigma), as well as the deep K (down to 26 at 5 sigma) Hawk-I band, allow a better investigation on the faint-end slope of the GSMF with respect to previous surveys. Good agreement is found with previous works, with respect to whom our data provide a deeper probe of low mass galaxies. Our results show that the slope of the faint-end is increasing with redshift, from $\alpha \sim -1.4$ at $z = 0.8$ to $\alpha \sim -2$ at $z = 4$. Although this steep faint-end slope, the well known inconsistency between the mass density and the integrated star formation history is still not solved, the latter exceeding the previous. The comparison with theoretical predictions shows that the models predict a larger abundance of lower mass galaxies, at least up to $z = 3$, with respect to observations.

S9-40. Angular momentum as a second parameter in dwarf galaxy evolution

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We show results based on a large suite of N-Body/SPH simulations of isolated, flat dwarf galaxies, both rotating and non-rotating [Schroyen et al.]. The main goal is to investigate possible mechanisms to explain the observed dichotomy in radial stellar metallicity profiles of dwarf galaxies: dwarf irregulars (dIrr) and flat, rotating dwarf ellipticals (dE) generally possess flat metallicity profiles, while rounder and non-rotating dEs show strong negative metallicity gradients. These simulations show that flattening by rotation is key to reproducing the observed characteristics of flat dwarf galaxies. Rotation proves particularly efficient in producing flat metallicity profiles, while non-rotating dEs in flattened dark-matter haloes are not able to do this. The addition of angular momentum causes a "centrifugal barrier" which slows down the infall of gas, so that the low-level star formation and the accompanying feedback are not centrally concentrated but occur galaxy-wide. This also prevents large-scale oscillations in the SFR, turning a so-called "breathing" SFH into a more continuous SFH, and causes low density holes to be created in the gas, which is observed in dIrrs. This mechanism of smearing out the SF in space and time proves to be the principal reason for the flat metallicity profiles of dIrrs and flat dEs, instead of the previously suggested "fountain mechanism". We therefore propose our "centrifugal barrier mechanism" which is able to explain the observations. Our general conclusion is that rotation has a significant influence on the evolution and appearance of dwarf galaxies, and we suggest angular momentum as a *second parameter* (after galaxy mass as the dominant parameter) in dwarf galaxy evolution. Angular momentum differentiates between SF modes, making our fast rotating models qualitatively resemble dIrrs, which does not seem possible without rotation

S9-41. Scaling relations for galaxies in different environments

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We present our results of photometric, structural parameters and metallicity determination for a representative sample of low surface brightness dwarf galaxies within ∼20 Mpc. The work was made using Hubble Space telescope and SDSS data. The sample contains objects in nearby loose groups, in the Virgo cluster, and in the field, including recently found very isolated dwarfs. We consider different relations between the obtained quantities and compare them with the corresponding relations for normal galaxies. We discuss the results in the context of galaxy evolution.

S9-42. Timing and environment of lenticular galaxy formation

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Lenticular galaxies proposed by Edwin Hubble as an intermediate morphological type between ellipticals and spirals are in fact very different from the both. Since they have large-scale stellar disks but lack visible spiral arms and star formation regions, the common opinion is established that they are (trans-)formed from spirals by removing their initial gas content and quenching their star formation by some, probably external, mechanisms. When in the late 70th Butcher and Oemler found the effect named after them – the disappearance of red S0s and their replacement by blue spirals in galaxy clusters at z=0.4 – everybody thought that the time, 4 Gyr ago, and the place, galaxy clusters, of S0 arising was discovered. Many theoretical works developing particular mechanisms of cluster environment impact onto galactic disks infalling into clusters have been fulfilled. However now some observational data, and the properties of the stellar populations in the outer disks of lenticular galaxies first of all, are starting to contradict this commonly accepted paradigm.

S9-43. Seyfert galaxies that are undergoing merging but look non-interacting

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We present new broad-band optical images of some merging Seyfert galaxies that were earlier considered to be non-interacting objects. On our deep images obtained at the Russian 6-m telescope we have detected elongated tidal envelopes belonging to satellites debris with a surface R-band brightness about 25-26.5 mag arcsec^2. These structures are invisible in the SDSS pictures because of their photometric limit. We found that 35 per cent of the sample of isolated galaxies are undergoing merging during the last 0.5-1 Gyr. Our results suggest that statistic studies based on popular imaging surveys (SDSS or POSS-II) can lead to underestimation of the fraction of minor mergers among galaxies with active nuclei (AGN). This fact impacts on statistics and must be taken into consideration in finding connection between minor/major merging or interactions and nuclei activity.

S9-44. Spectroscopy of "Big Trio" Objects with steep spectra using the "Scorpio" spectrograph of 6m telescope of Special Astrophysical observatory

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We present the results of optical spectroscopy of 71 objects (54 radio galaxies and 17 quasars) with steep and ultra steep spectra from the "Big Trio" (RATAN-600-VLA-BTA) project using the "Scorpio" spectrograph installed on 6-m telescope of SAO (Russia). Redshifts were determined for 37 radio galaxies and 17 quasars. We also present several parameters of sources, such as their R magnitudes, maximum radio sizes in seconds of arc, flux densities at 500, 1425 and 3940 MHz, radio luminosities at 500 and 3940 MHz, and morphology. Of the total number of radio galaxies studied, four have redshifts $1 < z < 2$, three have $2 < z < 3$, one has z = 3.138 (RC J0105+0501) and one has z = 4.514 (RC J0311+0507). This object happened to be the most powerful radio galaxy in the Early Universe. All 9 radio galaxies with $z > 1$ have LAS $< 12''$. Thirteen sources have redshifts $0.7 < z < 1$ and 15 have $0.2 < z < 0.7$. Among the quasars studied, five have redshifts $0.7 < z < 1$, seven have $1 < z < 2$, four have $2 < z < 3$, and one has $z = 3.57$ (RC J1740+0502). We did not detect any spectral lines for 17 objects. This work was partially supported by RFBR (project N 11-02-00489a).

S9-45. The chain of dwarf galaxies

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We present results of observations of 5 dwarf galaxies at the Russian 6-m optical telescope and at the Giant Metrewave Radio Telescope. The kinematics of individual galaxies was studied. These dwarfs line up in the chain with a length of about 200 kpc. The chain's shape leads to the idea that it is just at the beginning of its history. Most likely, we see the group of galaxies in process of formation. The mass-to-luminosity ratio exceeds 100 in solar units. Thus, the chain is formed under the influence of dark matter.

S9-46. The unique archive of wide-field astronomical plates in Uzbekistan: Problems of digitization and virtual observatory

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A virtual observatories need base of the observant data, one of which can be the digitized images of sky areas received on wide-field astronomical plates (AP). Up to day many observatories of the world implement the digitization of AP, including and Uzbekistan ones. The archive of plates of Ulugh Bek Astronomical institute was received images from Tashkent and Kitab observatories during over hundred years. It was carried out by us the following: sorting, double cataloguing of AP by telescopes; partial scanning with saving in the TIFF format; working out of a technique of images primary processing, the analysis for carrying out of measurements by help of the IRAF software package, etc. Results of work will be a basis of a digital database and can be integrated into already existing bases of virtual observatories. It is appropriate, in particular, a working out unified rules for digitization of AP for all observatories of the world.

S9-47. Mixing metals in first supernovae and galactic extremely metal-poor stars

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We explore numerically dynamics of a shell formed by a supernova explosion in a dwarf protogalaxy with total mass 10^7 $M_\odot$ at redshift $z = 12$. We study how mixing of metals in the shell depends on the explosion energy varied in the range $10^{50} - 10^{53}$ erg. We determine the explosion energy needed for the shell to re-collapse, such that all metals ejected by the supernova become confined inside the host protogalaxy (self-enrichment scenario). We study mixing efficiency during the re-collapse phase, and properties of the clumps formed in the fragmented shell. We find that the lower limit of the metallicity in them is close to the value observed in extremely-metal poor stars in the Milky Way Galaxy. We discuss possible origin of such stars.

S9-48. HII zones around first stars

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Evolution of HII regions formed by first stars within the mass range $25 - 200$ $M_\odot$ in a dwarf protogalaxy with total mass 10^7 $M_\odot$ at a redshift $z = 12$ is studied numerically. We show that the Rayleigh-Taylor instability develops efficiently inside the HII region and leads to distortion of the HII front. Further leads the distortion to form small clumps stripped (or photoevaporated) by the ionizing radiation from the central star. In these conditions a fraction of ionizing photons leaks the galaxy. The escape fraction is estimated.

S9-49. The integrated galactic stellar initial mass function — From star clusters to galaxies

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No abstract submitted

S9-50. Star formation in low density regions of disc galaxies

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Azimuthally averaged midplane volume density of gas ρ_0 is calculated for the equilibrium disc models for several galaxies of LSB and S0 types, where a low starforming activity is observed. We do not find any principal differences between the outer discs of normal spiral galaxies and low density discs of LSBs. Although the star formation rate (SFR) follows the Schmidt law down to $\rho_0 \sim 10^{-26}$[g/cm^3], the efficiency of star formation (SFE), defined as SFR over gas mass ratio, decreases continuously parallel with the disc surface density. Turbulent gas motion and magnetic field in the outskirts of galaxies prevent the formation of clouds in the absence of strong initial gas inhomogeneities. Possible mechanisms causing the observed star formation in the low density regions are shortly discussed.

S9-51. Population gradients: a dwarf to giant sequence

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We studied the stellar populations of 40 early-type galaxies using medium resolution long-slit spectroscopy along their major axes (and along the minor axis for two of them). The sample, including elliptical and lenticular galaxies as well as dwarf galaxies, is combined with other previously published data in order to discuss the systematics of the radial gradients of age and metallicity over a large mass range, from 10^7 Msol to 10^{12} Msol ($-9.2 > M_B \gg -22.4$ mag). The well-known $M_B \gg$ mass-metallicity relation is continuous throughout the whole mass range, in the sense that more massive galaxies are more metal-rich. The age-mass relation is consistent with the idea of downsizing: smaller galaxies have more extended star-formation histories than more massive ones. The transition type dwarfs (intermediate between dwarf irregular and dwarf elliptical galaxies) deviate from this relation having younger mean age, and the low-mass dwarf spheroidals have older ages, marking a discontinuity in the relation, possibly due to selection effects.

In all mass regimes, the mean metallicity gradients are approximately -0.2 and the mean age gradients $+0.1$ dex per decade of radius. The individual gradients are widely spread: $-0.1 < \nabla_{\rm Age} < 0.4$ and $-0.54 < \nabla_{\rm [Fe/H]} < +0.2$. We do not find evidence for a correlation between the metallicity gradient and luminosity, velocity dispersion, central age or age gradient. Likewise, we do not find a correlation between the age gradient and any other parameter in bright early-type galaxies. In faint early-types with $M_B \gtrsim -17$ mag, on the other hand, we find a strong correlation between the age gradient and luminosity: the age gradient becomes more positive for fainter galaxies. Together with the observed downsizing phenomenon this indicates that, as time passes, star formation persists in dwarf galaxies and becomes more centrally concentrated. However, this prolonged central star formation is not reflected in the metallicity profiles of the dwarfs in our sample.

We conclude that various physical mechanisms can lead to similar gradients and that these gradients are robust against the environmental effects.

In particular, the gradients observed in dwarfs galaxies certainly survived the transformation of the progenitors through tidal harassment or/and ram-pressure stripping. The diversity of metallicity gradients amongst dwarf elliptical galaxies may reflect a plurality of progenitors' morphologies. The dwarfs with steep metallicity gradients could have originated from blue compact dwarfs and those with flat profiles from dwarf irregulars and late type spirals.

SPS1: Close binaries with compact objects

Conveners:
Dmitry Bisikalo (Institute of Astronomy RAS, Moscow, Russia),
Klaus Werner (U. Tubingen, Germany)

Optical Investigations of X-ray Binary Systems

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Modern methods of analyses of the line profiles and radial velocity curves for optical stars in X-ray binary systems are described. Resent results of mass estimate for stellar mass black holes are summarized. Some peculiarities in the mass distribution of the neutron stars and black holes are discussed.

Young binary systems with low-mass secondaries on noncoplanar orbits

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The model of a young star with a low-mass (q = M2 /M1 $\sim$ 0.1) companion is considered. It is assumed that the system accretes matter from the remnants of a protostellar cloud (circumbinary disk), the orbit of the companion is circular and not co-planar with the disk plane. We have computed grids of hydrodynamic models for such a system by the SPH method. The inclination of the orbit plane to the circumbinary disk was taken from 5 to 20 degrees. The mass ratio and parameter, that define the viscosity of a system, was varied too.

On the nature of the Sco X-1 like super-Eddington sources

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The super-Eddington Z-track sources are important members of the low mass X-ray binary class having three states, for which there is no generally accepted physical explanation. In one state, relativistic jets are observed allowing us to determine via the X-ray spectra conditions needed for jet launching. For the Cygnus X-2 like sub-group, we have proposed a physical model based on increase of mass accretion rate on the Normal and Horizontal Branches, and unstable nuclear burning in flaring. We now present a model for the Sco X-1 like group based on extensive spectral investigations with RXTE. These sources: Sco X-1, GX 349+2 and GX 17+2 are dominated by flaring and we compare the flare rate with the Cyg-like sources using 15 years of ASM data. The main physical difference is the higher neutron star temperature kT $\sim$ 2.2 keV compared with kT $\sim$ 1.2 keV in the Cyg-like sources. An exceptional observation of Sco X-1 with 150 ksec between flares has kT $\sim$ 1.8 keV. We thus propose that the almost continuous flaring deposits large amounts of heat energy in the surface layers of the neutron star for which the radiative cooling timescale is relatively long. The ability to explain all groups of Z-track sources provides strong support for the extended ADC emission model on which the analysis is based.

The orbital period evolution of the black hole binary XTEJ1118+480

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The orbital motion of secondary stars of a X-ray binary system is believed to vary with time due to different phenomena which depends essentially on the mass ratio of the binary components and duration of the period itself. Black hole binary systems with large mass-ratios and short periods of several hours are expected to change their orbital period due to magnetic breaking, gravitational radiation or even more

sophisticated theories which use alternative descriptions of gravity, like the Braneworld gravity. The black hole X-ray binary XTE J1118+480 offers a unique opportunity to test these models, composed by a subsolar-mass late type secondary star orbiting a 6 solar-mass black hole in a 4.1-hr period. We have obtained spectroscopic observations in two nights of January and February at the 10.4m GTC telescope installed in the Observatorio del Roque de los Muchachos in La Palma (Spain) with the OSIRIS medium-resolution spectrograph. Using these data we determine the time at the inferior conjunction of the secondary star in each night which in combination with previous determinations has allowed us to derive the orbital period derivative. Here we present the detection of a negative period derivative in the black hole X-ray binary XTE J1118+480 and discuss the implications for magnetic braking and black hole mass evaporation.

Supergiant Fast X-ray Transients and the Corbet diagram

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Supergiant wind-fed X-ray binaries and Be-systems occupy different regions in the Pspin-Porbit diagram (known as the Corbet diagram). The previous attempts to explain this diagram were not fully satisfactory. We propose a new explanation for the observed dependencies which takes into account the fact that the accreting matter in such systems has smaller angular momentum than the Keplerian one. We review properties of the Supergiant Fast X-ray Transients recently discovered with INTEGRAL and note that their location in the Corbet diagram can be a key to understanding of the accretion mechanism responsible for their outbursts.

Type Ia supernovae and the DD scenario

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It is widely accepted that the outcome of the merger of two white dwarfs with a total mass larger than the Chandrasekhar's mass is an accretion induced collapse to a neutron star instead of a thermonuclear supernova. However, there are compelling observational evidences that mergers should also produce SNIa outbursts. In this talk we discuss the different issues to this problem.

The flow structure in a binary star with high mass ratio

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The structure of the accretion disk in a semidetached binary system, characterized by a small (q=0.05) mass ratio is considered. The results of numerical simulation of gas dynamics allowed us to study the most significant elements of the flow structure in the accretion disk. It is shown that the influence of tidal waves and of the shock wave produced by stream of matter from the inner Lagrange point (L_1) is relatively small for systems with a small mass ratio. This allows the formation of a strong precessional density wave in the accretion disk. In addition, the interaction of the stream from L_1 with circumdisk halo results in formation of thickenings at the outer edges of the accretion disk, located on the phases ~ 0.25 and ~ 0.7 — this can explain the formation of double-peaked light curve, observed in some cataclysmic variables.

Investigations of SS Cygni in different states of activity

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We present a review of the comprehensive study of the close binary system SS Cygni. The investigations have been performed in the period of 2006-2010. During this period we obtained spectral observations of the system during both the states of activity (quiescence and outburst). Using the results of the spectral observations we computed Doppler tomograms of the system for the quiescence and outburst. Besides we performed numerical simulations of the flow structure in this system and computed synthetic Doppler maps. Comparisons of the observational and synthetic maps allowed us to identify the main flow elements which exist in the system in both the states. Analysis of the tomograms obtained for different epochs showed changes which take place when the system passes from state of activity to another.

High mass black hole binaries

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I will review the theoretical models and observations on the formation of high mass black hole binaries. I will show that the formation rate and properties of these close massive binaries with black holes have important consequences for different areas of astrophysics and cosmology.

Spectral modeling of accretion disks

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Spectral modeling of accretion disks AcDc is a NLTE code to compute self-consistently the vertical structure and emergent spectrum of accretion disks. We have applied it to the quantitative spectral analysis of disks in rather different environments during the last years: H-rich disks in cataclysmic variables, He-rich disks around white dwarf accretors in AMCVn binaries, C/O/Ne-dominated disks around neutron stars in ultra-compact low-mass X-ray binaries, Fe-dominated supernova fallback disks, and C/N/O/Ca-dominated gaseous debris disks around white dwarfs. Wompat is a Monte-Carlo based code for the calculation of accretion disk wind. It is still under development but first results are promising. We will present results of our work on accretion disks in AMCVn binaries as well as first accretion disk wind models.

Neutron stars in low-mass X-ray binaries: X-ray bursts and persistent emission

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In this talk I review recent models for the persistent emission and the advances in spectral modeling of X-ray bursts. X-ray bursts are a powerful tool to determine neutron star masses and radii, if the Eddington flux and the apparent radius in the cooling tail can be measured accurately, and distances to the sources are known. I present a novel "cooling tail" method of determining stellar parameters using the data from the whole cooling phase of the photospheric radius expansion bursts. We apply this method to a number of X-ray bursters and constrain their radii and masses. We also find that spectral evolution of the bursts strongly

depends on the persistent flux. The spectra of bursts at high accretion rates are strongly affected by the accretion flow and cannot there be used for determination of the neutron star parameters. I will then review the models of the boundary/spreading layer and its spectral properties.

White Dwarfs in Cataclysmic Variables

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Hubble Space Telescope and FUSE far ultraviolet spectroscopy, along with X-ray and EUV spectroscopy using HUT, Orfeus, Chandra, XMM-Newton, EUVE, EXOSAT, ROSAT and ASCA have led to a windfall in our knowledge of the underlying white dwarfs in cataclysmic variables and how they are affected by the accretion process. These space observatories have made it possible to detect numerous underlying white dwarf accretors, the boundary layer between the accretion disk and the WD surface, the accretion disk itself and wind outflow in the wavelength domains where they emit most of their energy (between ∼3 and 2000Å) while optical detections of many underlying white dwarfs in low accretion rate CVs from the Sloan Digital Sky Survey have added to the growing sample size. Thus, it has become possible to determine many poorly known basic physical properties of these systems both above and below the cataclysmic variable period gap, an orbital period range between two and three hours in which very few systems are found. Among the newly determined physical properties are surface temperatures T_{eff}, mass accretion rates, gravitational redshift masses, gravity log g, rotational velocities Vsini, chemical abundances, the accretion energy budget and how accretion and thermonuclear runaways can drastically alter the structure, evolution and atmospheric chemistry of the accreting WD over time. With surface temperatures between 12,000K and 60,000K, these WD emit primarily in the UV/FUV. Since the brightened accretion disk (with wind outflow) and the bright accretion columns dominate the FUV and optical spectra during high accretion states (dwarf nova outbursts and nova-like and Polar high states), the underlying white dwarf photospheres are exposed only during the quiescent state between dwarf nova outbursts, the low optical, brightness states of nova-like variables, and the low accretion states of Polars when the emission lines due to cyclotron and thermal bremstrahlung processes become very weak or vanish.

Accretion processes in young binary stars

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We present a study of the gas flow structure in the envelope of young T Tauri type binary stars by means of numerical simulations of gas dynamics. The envelope of a young binary star consists of protostellar cloud remnants, e.g., a protoplanetary disk. The accretion of gas from the protoplanetary disk is accompanied by redistribution of matter between the components that affects the evolution of the binary system and makes it important to study how the accretion works in this type of binaries. Observations of T Tauri stars show that in many systems inner gaps (rarefied regions) exist in the system. We propose that the gap size is governed by bow shock waves formed due to the motion of the system components in the circumstellar media. Analysis of the simulation results shows that the proposed mechanism of the gap formation is in better agreement with observational estimates of the gap size in comparison with those predicted by the theory of resonances.

Period–magnitude relation for persistent LMXBs in the near-infrared

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We describe period–magnitude relation for persistent low-mass X-ray binaries (LMXBs) in the near-infrared (NIR) spectral range. First noted by van Paradijs & McClintock (1994) in optics, it allows posing constraints on systems periods using observationally efficient approach by means of single epoch magnitude estimate. Non-perfect selection of studied systems as long as limited accuracy of optical extinction estimates for highly obscured systems did not allow van Paradijs & McClintock (1994) to establish this correlation at the sufficient precision level. In this talk we present significantly more accurate correlation as well as its application for meaningful periods and expected magnitudes estimates for a set of bright persistent binaries in the Galaxy. We consider separation between thermal accretion disk emission and other (including non-thermal) components in observed NIR flux of LMXBs as another possible outcome of this relation.

POSTERS

SPS1-1. Formation of accretion disks in magnetic close binary stars

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Results of three-dimensional MHD numerical simulations are used to investigate the plasma flow in semidetached binary systems, where the accretor possesses a strong proper magnetic field. The presented numerical model accounts for processes of the magnetic field diffusion due to the dissipation of electric currents in turbulent vortices, magnetic buoyancy and wave MHD turbulence. We performed simulations of the flow structure in a close binary system with different values of the induction of the accretor's dipole magnetic field in the range of 10^5 G – 10^8 G. In the talk conditions of the disk formation are discussed. We also present a criterion separating two types of the flows corresponding to intermediate polars and polars.

SPS1-2. Non-monotonic Keplerian velocity profiles around near-extreme braneworld Kerr black holes

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We study the non-monotonic LNRF-related Keplerian velocity profiles in the field of near-extreme braneworld Kerr black holes and naked singularities in which the non-local gravitational effects of the bulk are represented by a braneworld tidal charge b and the 4D geometry of the spacetime structure is governed by the Kerr–Newman geometry. We show that positive tidal charge has a tendency to restrict the values of the black hole dimensionless spin a admitting existence of the non-monotonic Keplerian LNRF-velocity profiles; the non-monotonic profiles exist in the black hole spacetimes with tidal charge smaller than $b = 0.41005$ (and spin larger than $a = 0.76808$). With decreasing value of the tidal charge (which need not be only positive), both the region of spin allowing the non-monotonicity in the LNRF-velocity profile around braneworld Kerr black hole and the velocity difference in the minimum-maximum parts of the velocity profile increase implying growing astrophysical relevance of this phenomenon.

SPS1-3. The dynamics and structure of interacting flows in accretion binaries with white dwarf

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We present here results of our study related to the processes of flow's interaction in close binary star system. Inflowing mater of donor star contacts with the accretion disc matter and circumdisc halo of the companion star. The aim in the survey is to be examined the established formation and configurations during the streams influx and after that. The gas is considered to be gas-dynamical and then the examination of the properties of this interaction requires using the system of gas-dynamical equations. This system allows applying of 3D numerical modeling of structure of the flowing matter. It is revealed the shock character of this interaction. The results show the appearing of wave structures with high density in the disc's area and in the rarefied gas around the accretion disc. It is estimated the perturbations in the stellar component with disc and the velocity acceleration by the sound value. The modeling is performed in non-inertial frame of reference and quadratic with cylindrical 3D set.

SPS1-4. Hydrodynamics in X-ray Binaries

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The Roche lobe overflow and the isotropic radial stellar wind were traditionally considered as two competitive scenarios to explain the regime of mass-loss from a companion star which can feed an accretion disc around a compact object in interacting binaries and X-ray binaries in particular. A New radiation-hydrodynamic model of circumstellar matter is currently being developed. This model would allow to numerically simulate the properties of the evaporative stellar wind from a supergiant component of a binary. These simulations include full 3D radiation-hydrodynamics and take into account the Coriolis force and radiative pressure in the continuum and lines. The Coriolis force influences the mass-loss and thus also the accretion rate. Our preliminary results show that non-radial models are necessary to reach quantitative information about the angular modulation of the wind with an accuracy of about tens of percents. Furthermore, the focusing of the stellar wind by the gravity of the companion leads to the formation of a gaseous tail. This phenomenon can be understood as a modified version of the BHL accretion and its existence in interacting binaries is confirmed observationally.

SPS1-5. Magnetic field estimates for accreting neutron stars in massive binary systems and comparison with magnetic field decay models

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Some modern models of neutron star evolution predict that initially large magnetic fields rapidly decay down to some saturation value $\sim$ few10^{13} G. Lower magnetic fields do not decay significantly (Pons et al., 2008). It is difficult to check predictions of the model for initially highly magnetized objects on the time scale of few million years. We propose to use Be/X-ray binaries for this purpose. We use several different methods to estimate magnetic field of neutron stars in this accreting systems using the data obtained by the RXTE satellite (Galache et al., 2005). Only using the most modern approach proposed by Shakura et al., (2011) we are able to obtain a field distribution compatible with predictions of the theoretical model of field decay: even neutron stars with the longest spin periods then have magnetic fields $<$ few10^{13} G.

SPS1-6. A visual component in triple system V505 Sgr

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The multiple system V505 Sgr (HIP 97849, HR 7571, HD 187949) is composed of three components. The eclipsing pair was first discovered in 1934. It is known to belong to the Algol subgroup of the semidetached system with a variable period. That it is also a spectroscopic binary was discovered in 1949. The existence of the third visual component classified as a late F-type dwarf (F7V or F8V) was first indicated from spectroscopic measurements to be confirmed afterwards by speckle interferometry in 1985. It was named CHR 90. In the paper new orbital elements for visual pair WDS 19531-1436 = CHR 90 of the triple system V505 Sgr obtained from speckle interferometric measurements are reported. Up to now 23 speckle measurements have been made. For this binary orbits were determined earlier. Our orbit has a period of 94 years and it is significantly longer than those found earlier. The mass sum predicted from our elements is (7.0 ± 1.4) solar masses. Our visual orbit leads then to the dynamical parallax of 9.8 mas (distance 102 pc), somewhat exceeding the new Hipparcos parallax of (8.40 ± 0.57) mas.

SPS1-7. Activity of dwarf nova WZ Sagittae in different spectral bands

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We report the results of the analysis of the different states of activity of the dwarf nova WZ Sagittae in 2001 year based on our hight-speed synchronous UBVRI photometry of the system and data published by other authors. The difference in the behaviour of the light curves in the ultraviolet and the longer wavelengths and possible causes for this diversity are considered.

SPS1-8. On the activity of the classical symbiotic star Z And

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The results of study of the classical symbiotic star Z And during the recent activity period that began in 2000 are presented. Up to now series of six outbursts took place. Comparison of observational data with the results of gasdynamic modeling allow us to suggest the possible scenario for activity in this system describing all stages of an outburst development — from the mechanism of transition to the outburst and outburst development to the behavior of the system during all the activity period. Particularly, the proposed scenario explains the principal difference between outbursts — the presence of high-velocity bipolar collimated optical outflows in strong recurring outbursts. We have not found contradictions with the available data for previous outbursts of Z And. We assume that the proposed scenario could be also typical for other classical symbiotic stars.

SPS1-9. Orbital models of 3:2 QPOs: constraints on black hole spin in microquasar GRS 1915+105

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The spectral fitting estimates of the spin in microquasar GRS 1915+105 indicate a value higher than $a = 0.98$. However, there are certain doubts concerning this extremal number. Resolving this issue and

confirming the high value $a > 0.9$ would have a significant impact on the theory of high-frequency quasiperiodic oscillations (HF QPOs). We discuss its possible implications assuming several often quoted orbital models of 3:2 HF QPOs. We show that the estimate of $a > 0.9$ rather excludes two hot-spot (relativistic precession and tidal disruption) models and the warped disc resonance model. On the contrary the epicyclic resonance and discoseismic model assuming the c- and g- modes are favoured. We extend the discussion on these findings also to other two microquasars that display the 3:2 HF QPOs. Frequencies of these QPOs scale roughly inversely to the microquasars masses, and the differences in the individual spins, such as $a = 0.9$ vs. $a = 0.7$, represent a generic problem for most of the discussed geodesic 3:2 QPO models. In order to explain the observations of all the three microquasars by one unique mechanism, these models would be forced to accommodate very large non-geodesic corrections.

SPS2: Massive stars formation

Conveners:
Igor Zinchenko, (Institute of Applied Physics RAS, Russia),
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Physical processes in high-mass star formation

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The formation of high-mass stars requires to overcome many obstacles: They form in dense, cold and massive gas clumps in a clustered mode, rotational structures (disks?) develop, magnetic fields are present (important for cloud support?), and diverse feedback processes take place (e.g., outflows and/or radiation). I will present recent observational results in this field and outline potential future directions, in particular regarding the advent of ALMA.

Theories of massive star formation

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No abstract submitted

Hot molecular cores, outflows, disks and the formation of high-mass stars

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Young massive (OB-type) stars are luminous objects which heat up and ionize the gas in their surroundings, evaporating grain mantles and thus enriching the gas phase with complex molecules. These obvious facts indicate that hot molecular cores (HMCs) are the most likely birth places of such stars. These are molecular condensations presenting strong emission in high temperature and high density tracers, such as complex N- and O-bearing species. Although the earliest (protostellar) phase of OB stars is probably to be searched inside the cold gas of IR-dark clouds, HMCs can still teach us a lot on the first evolutionary stages of these important objects. In particular, a detailed analysis of their structure and velocity field can help setting constraints on theoretical predictions and shed light on the high-mass star formation process. With this in mind, I will illustrate the connection between HMCs and important phenomena such as outflows and disks, by presenting recent findings obtained from observationalstudies ranging from the parsec scale to a few 100 AU. In particular, the results for a number of template objects will be described and the impact on our view of high-mass star formation will be discussed.

Observations of early structures corresponding to massive body formation — epoch 2003

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Early phase of protostar formation in Orion KL (dense molecular cloud OMC-1) are accompanied by powerful H_2O maser emission in several active zones. We determine corresponding 3-dimensional structure: rigid-body rotating disk and highly collimated bipolar outflow. We conducted VLBI research of active regions in epoch 2003 with 150 microarcsecond resolution. We detect highly collimated (~ 250) bipolar outflow with size 15 AU, $T_b \sim 10^{14}$ K, and its compact fragments — ejections on distances ~ 42 AU in one of active zones. The fragments are visible because of collisions with dense clouds of matter. Such clouds was detected 50 AU

to the east of the outflow and have line of sight velocities 30-36 km/s. Four rotating ring structures was discovered within 10 AU zone. Diameter of the ring structures is 1.5-2 AU, rotation velocity ~ 1 km/s. Mass estimate is $\sim 0.001 M_{\odot}$. Generation of bipolar outflow was not observed in these structures, that corresponds to very early stage of massive body formation.

Deuteration as an evolutionary tracer in massive star formation

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Theory predicts, and observations confirm, that the column density ratio of a molecule containing D to its counterpart containing H can be used as an evolutionary tracer in the low-mass star formation process. Since it remains unclear if the high-mass star formation process is a scaled-up version of the low-mass one, we investigated whether the relation between deuteration and evolution can be applied to the high-mass regime. With the IRAM-30 m telescope, we observed rotational transitions of N2D+ and N2H+ and derived the deuterated fraction in 27 cores within massive star-forming regions understood to represent different evolutionary stages of the massive-star formation process. The abundance of N2D+ is higher at the pre-stellar/cluster stage, then drops during the formation of the protostellar object(s) as in the low-mass regime, remaining relatively constant during the ultra-compact HII region phase. The objects with the highest fractional abundance of N2D+ are starless cores with properties very similar to typical pre-stellar cores of lower mass. The abundance of N2D+ is lower in objects with higher gas temperatures as in the low-mass case but does not seem to depend on gas turbulence. Our results indicate that the N2D+-to-N2H+ column density ratio can be used as an evolutionary indicator in both low- and high-mass star formation, and that the physical conditions influencing the abundance of deuterated species likely evolve similarly during the processes that lead to the formation of both low- and high-mass stars.

Herschel and HOBYS view of Star Formation in the Galaxy

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With its unprecedented spatial resolution and high sensitivity, Herschel is revolutionising our understanding of high mass star formation in the far-infrared to submillimetre regime. The Herschel imaging survey of OB Young Stellar objects (HOBYS) key program (see Motte, Zavagno, Bontemps et al: see http://www.herschel.fr/cea/hobys/en/index.php) specifically targets nearby burgeoning young stellar objects. HOBYS aims to discover and characterise the earliest evolutionary stages of intermediate to high-mass stars and assess the importance of triggering in these regions. For the first time, Herschel allows us to make a census of star formation in the Galactic Plane. I will present some of the first results from the HOBYS program. In Vela C, structural analysis indicates that the ridge of filaments in which the HII region RCW 36 is embedded, is the most massive and dense component of the Vela C molecular complex, and is likely to support further star formation. The southern part of the complex is, in contrast, made up of a large number of filaments which appear to have formed in a turbulent manner. The temperature map suggests that there is evacuation of material perpendicular to the column density at or near RCW 36 (Hill et al., 2011). I will also present a comparison between Herschel, Spitzer, NIR and molecular line data toward the RCW 36 HII region (Minier et al., 2011) which reveals a very unique view into this very active site of star formation. I will also briefly present some of the early results from M16 — home to the Pillars of Creation — and NGC 7538.

A Molecular Line Survey of IRDC Star Forming Clumps with the Nobeyama 45M Telescope

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What constitutes the initial condition for massive star formation is hardly known. Infrared dark clouds (IRDCs) are objects seen in absorption against the bright diffuse Galactic mid-infrared background and their cold dense nature with substantial masses strongly suggests IRDCs are sites for massive star and/or cluster formation in its earliest evolutionary stage. To achieve a more complete and unbiased census of the physical and chemical properties of IRDCs, we undertook a pilot molecular line survey of the star/cluster forming clumps MM1, MM4, and MM9 in IRDC G28.34+0.06 at the 3mm atmospheric window utilizing the Nobeyama Radio Observatory 45M Telescope. The survey has achieved at the moment a frequency coverage from 86 GHz to 98 GHz at a rms noise level of 20 mK. Additional coverage over selected lines/frequencies at 40‘GHz and 300 GHz bands were also obtained with the NRO 45M and ASTE, respectively. Dramatically different spectral signatures are found among these clumps, signifying their different physical and chemical properties likely related to the evolutionary stages.

Massive stars distribution in young LMC star clusters

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In the Large Magellanic Cloud young and populous star clusters can be found, which are almost absent in the Milky Way. We investigate the density distribution of stars of various masses in young LMC star clusters imaged by HST. Their ages range from 6 to 80 Myr. Here we present our findings. The massive stars in the studied clusters are more concentrated than the less massive stars suggesting that mass segregation of primordial origin is observed in these young clusters.

The RMS Survey: All Massive Young Stellar Objects in the Galaxy

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The RMS survey is the largest comprehensive galaxy-wide survey of massive young stellar objects (MYSOs) to date. The near-IR spectroscopic observations for the survey are now complete, and provide a wealth of data to be exploited. The survey has returned a well-defined sample of 400 MYSOs and 400 HII regions. Follow-on observations and statistical studies are now underway. I will discuss the first results from this survey, including high spectral and spatial resolution observations, present the luminosity functions of the objects and discuss the implications on the study of massive star formation.

Triggred Star Formation

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I will review on star formation in dense and cold places of the ISM, which are compressed by external mechanisms. One episode of star formation leads to the formation of an expanding shell of swept-up interstellar gas in which another generation of stars is born. The pre-existing clouds are compressed by hot an high pressure

medium triggering star formation. Galactic collision compress the giant molecular clouds converting them into massive star clusters. I shall discuss if the triggered star formation produce the observed IMF and what fraction of stars appear this way.

An infrared study of massive protostellar candidates

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A coordinated study including sub-arcsec near-IR images at JHK broad-bands, narrow band Brg and H2 collected at the Magellan Baade 6.5m telescope at Las Campanas Observatory (Chile), and HIGAL Herschel PACS and SPIRE images at 70, 160,250, 350 and 500 micr is presented for a sample of southern hemisphere IRAS sources associated with high mass protostellar objects. From the analysis of the spectral energy distributions (SEDs) derived from our data and IRAC/SPITZER data, we derive the physical characteristics of the candidate high mass protostars. In addition the young stellar population is studied for each field analysing the near-IR color-color and the Spitzer color-color plots.

Methanol Masers and Formation of Massive Stars

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Methanol masers are well known tracers of the regions where massive stars form. This is a consequence of their pumping mechanisms which put tight constraints on the physical, chemical and evolutionary status of the regions where these masers originate. Recently methanol masers proved being important tools in investigations of the structure of the Galaxy. Observations with such radioastronomical instruments as SMA, ALMA and EVLA will provide new information on the methanol masers which has high scientific importance. Research was in part supported by the Russian Foundation for Basic Research (grants 10-02-00589-a and 11-02-01332-a).

The Extremely High-Velocity Outflow from the Luminous Young Stellar Object G5.89-0.39

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We have imaged the high-velocity outflowing gas in CO (2−1) and (3−2) at a resolution of $\sim 3''$ associated with the shell-like ultracompact \htwo region G5.89−0.39 with the Submillimeter Array. The integrated high-velocity ($\gtrsim$45 km s^{-1}) CO emission reveals at least three blueshifted lobes (denoted as B-N lobe, B-NW lobe and B-S lobe) and two redshifted lobes (denoted as R-N lobe and R-S lobe). B-S lobe and R-N lobe represent a pair of outflow driven by the sub-mm dust source SMA1. B-NW lobe and R-S lobe demonstrate another pair of outflow along the NW-SE direction, likely identical to previously detected Brγ outflow. All outflow lobes clearly show a Hubble-like kinematic structure, i.e., the outflow velocity increases linearly with distance from the outflow origin. Using SMA CO (2−1) and (3−2) results, we have, for the first time, estimated the temperature of the outflowing gas as a function of velocities with the LVG calculations. The results clearly indicate that high-velocity gas tend to have high temperature.

POSTERS

SPS2-1. The Infrared Environments of Methanol Maser Rings

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Methanol maser emission in the 6.7 GHz transition is believed to only be associated with the earliest phases of massive star formation. Maser emission has been shown from very long baseline interferometry observations to come from multiple discreet locations called "maser spots" near forming massive stars. The distribution of these maser spots often appear to form organized structures like lines or arcs. Recently, Bartkiewicz et al. (2009) discovered nine sources with ring-like maser distributions with typical sizes having major axes of 0.2-0.3 arcsec. We have obtained the highest spatial resolution NIR (70-150mas at 2 microns) and MIR (150mas at 8 microns) imaging available from ground based facilities to explore the true nature of the maser rings. The aims of our observations were threefold: (i) to verify whether stellar sources lie at the center of the methanol rings (a necessary condition if they are tracing circumstellar disks or torii), (ii) to resolve any circumstellar dust emission at NIR and MIRwavelengths to determine the nearby dust environment of the masers, and (iii) to derive fluxes and physical properties (e.g., luminosity, mass, dust temperature) for these massive young stellar objects.

SPS2-2. Complex molecules in massive star forming regions

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Gas in massive star forming regions is rich in complex molecules. An investigation of the chemical evolution in massive protostellar objects is thus a promising and actively developing field of star formation studies, that deepens our understanding of the processes taking place in protostellar clouds and may also reveal a possible contribution from processes that have not yet deserved a proper attention. We present results of a comprehensive modeling of DR21(OH) molecular content based on observations of Kalenskii et al. (2010). The utilized model incorporates a modified treatment of surface chemistry that is necessary to study the synthesis of complex molecules (like C2H, H2CO, CH2NH). We show that this simple model allows to reproduce observationally inferred column densities for a rich variety of molecules, from simple diatomic compounds to polyatomic organic species.

SPS2-3. Structure of W40 dense core

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One of the nearby regions of high-mass star formation W40 (also known as Sharpless 64) contains large blister HII region which lies at the front edge of extended molecular cloud. The interior of the cloud shows no evidences of embedded sources and has long been considered to be cold and quiescent. Yet, the star formation probably still takes place in dense parts of the cloud. Recent CO study of the W40 cloud (Zhu et al. 2006, Chin.J. A&A 6, 61) revealed weak outflow implying an existence of very young embedded source that is not associated with any known infrared or radio source. In order to study physical structure and chemical composition of dense gas in the W40 cloud, the observations in 1.2 mm continuum and in the CS(2-1 and 5-4), N2H+(1-0), HCN(1-0), HCO+(1-0) and some other molecular lines have been done. The observations revealed complex structure of the region. The continuum map shows a clumpy arc-like structure probably caused by expansion of the HII region. The CS(5-4) and N2H+(1-0) intensity distributions peaks at different parts of the arc probably indicating star-forming and starless clumps, respectively. The CS(2-1) intensity distribution

correlates in general with dust continuum while the HCN(1-0) and HCO+(1-0) show more diffuse structure probably tracing the surrounding gas. Physical parameters of dust clumps and preliminary results of molecular line modeling are given. The results are compared with other existing data in order to get physical picture of the cloud.

SPS2-4. Estimation of physical parameters for condensation 1 in RCW 120 using APEX observation of methanol radiolines

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RCW 120 is a well-studied H II region with ongoing star formation. APEX was used to observe methanol lines in mm range around Condensation 1 in RCW120 (hereafter, objects are named according to Deharveng et al., 2009: D2009). We estimated physical parameters in the object which fit the observed 1 mm methanol line data in LVG approximation. Influence of the infrared emission of dust on the populations of quantum energy levels has been taken into account. Estimated physical parameters for cores #42, #38 with masses 0.6—1.3 $M_\odot$ do not contradict assumption that star formation "has occurred in the collected layer, probably resulting from gravitational instabilities". Physical parameters for core #47 (4—10 $M_\odot$) satisfy the requirements of presence of Class 0 YSO objects, where triggered star formation is probably at work (D2009). This work was supported by FASI (contract N 02.740.11.0247 from 07.07.2009) and RFBR (grants 10-02-00589-a and 11-02-01332-a).

SPS2-5. Massive Star Formation in the Cygnus Onsala 2 Complex

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The Onsala 2 (ON 2) region in Cygnus shows clear evidence of active high-mass star-formation including masers, compact and ultracompact HII regions, and massive outflows. ON 2 is thought to be physically associated with the young stellar cluster Berkeley 87 which contains several optically-revealed OB stars and the rare oxygen-type Wolf-Rayet star WR 142. Previous studies suggest that the powerful hypersonic wind of WR 142 is producing dissipative shock waves throughout the region. We present results of a Chandra X-ray observation of ON 2, supplemented by infrared data. Chandra reveals a diverse range of X-ray behavior including soft emission from optically-identified OB stars, hard heavily-absorbed emission from WR 142, and diffuse emission associated with embedded OB stars in compact HII regions. We will discuss representative X-ray spectra in the context of both thermal models based on shocks and nonthermal processes.

SPS2-6. Gas and dust parameters in massive star forming regions S235 and S235AB

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Sh2-235 (S235 for short) is a well-developed HII region surrounded by a molecular gas shell with three dense gas clumps. Earlier, we suggested that formation of star clusters East1, East2, and Central, that are embedded into these clumps, has been triggered by the expansion of the HII region. Here we present results of new studies of the S235 clusters along with observations of another neighboring HII region, S235AB. Clusters in S235 and S235AB were observed with RT-22 telescope in Pushchino, Russia, as well as with the 100-m telescope in Effelsberg, Germany. Lines NH_3(1,1) and NH_3(2,2) were detected in all observed positions. In 20% of locations, line NH_3(3,3) was also detected. Using these data, we determined NH_3 column density, gas density, and temperature. Archival Spitzer Space Telescope data were also used to estimate dust temperature and column density. It is found that East1 cluster is more compact and embedded into denser gas than East2

and Central clusters, which is consistent with its earlier evolutionary stage. In general, gas around S235 and S235AB regions is noticeably hotter and denser than in a surrounding quiescent molecular cloud. Some dense gas seen in the far infrared dust emission is not traced by either ammonia emission or 24 micron dust emission. These dense clumps have probably just formed due to the influence of S235 shock or East1 stellar winds.

SPS2-7. The combined effect of turbulence, magnetic field and rotation on the fragmentation of prestellar cores

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With the help of 3D MHD simulations we investigate the isothermal collapse and fragmentation of rotating turbulent prestellar core embedded into turbulent medium. The numerical code is based on a high resolution Godunov-type finite-difference scheme. Initial turbulence is represented by the ensemble of Alfven waves with power law spectrum. Our computations show that slightly supersonic initial turbulence is sufficient to stimulate the fragmentation. Its probability is very sensitive to the initial ratio of rotational to gravitational energy but is less sensitive to thermal and magnetic energies contributions. Under realistic parameters only two bound fragments can appear when the density increases at 10^3–10^5 times. The distance between the fragments is about 0.01–0.1 of the initial core radius that can explain the origin of binary stars with separation 0.001–0.01 pc in the Galaxy field.

SPS2-8. Anatomy of an infrared dark cloud

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According to the present consensus Infrared Dark Clouds (IRDC) represent the earliest phase of massive star formation. It is important to investigate in detail their properties and various stages of the star formation process in these objects. The IRDC 351.78–0.54 (at a distance of 1 kpc) provides a very promising opportunity for such study. It contains a hot core associated with bright IR source, maser emission and UC H II region. The mid-IR maps reveal a chain of emission features in this IRDC away from the hot core. Most probably they represent younger clumps at the onset of star formation. We obtained maps of this cloud in continuum at 0.87 mm and in several molecular lines including CO isotopes, N_2H^+(3–2), HNCO, etc. at APEX. Our maps show extended structures around the compact core which trace the dark lanes of this IRDC in the Spitzer 8 μm image. It looks probable that the hot core discussed here formed at the edge or in the interiors of this IRDC. In the vicinity of the hot core our APEX data confirm the high velocity outflow, show strong emission in the high-excitation lines and indicate a rotation of the core on scales of $\sim 10''$. We discuss properties of the cloud as a whole and properties of individual clumps in this cloud.

SPS3: Science with the Virtual Observatory

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Going beyond coordinate searches in the VO

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The Virtual Observatory provides the framework for astronomy data archives to work together. Many VO enabled archives have adopted the interoperability standards for sky coordinate based searches, allowing astronomers to make a query for 'all the data' available in a given region of the sky. Recent developments in the VO standards and tools provide the possibility of going beyond coordinate searches, by allowing astronomers to search on a wider set of standardized parameters, and indeed on any information field that appears in tables published to the VO. I will describe how such queries can include selection by object type and other curated information, and the ability to use user defined lists of targets. I will describe how curated astronomy information is being exposed via VO services, and the efforts to foster wider implementation of VO standards.

Science with the VO: Spectroscopic studies of pre-main sequence stars

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The Virtual Observatory is opening up new ways of exploiting the huge amount of data provided by the ever growing number of ground-based and space facilities, as well as by computer simulations. Using the tool VOSpec, a multi-wavelength spectral analysis tool, developed by the ESA-VO Team at ESAC, and new developments on scripting with VOSpec (VOScript), we have started to undertake a comprehensive study of spectral data in the VO on young stars, Herbig Ae/Be and also T Tauri stars. By studying the line strengths, variabilities and spectral energy distributions, from the X-ray to sub-mm, we aim to gain insights into the accretion rates, processes and disk properties of a large sample of these objects. In this presentation I will show the initial findings for the spectroscopic data and will briefly discuss the new scripting tool being developed by the team.

Extragalactic science with the Virtual Observatory

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Nowadays, following years of technological development, VO standards, resources, and services became powerful enough to help astronomers making real science on everyday basis. Here I will present examples of successful VO-powered projects in the extragalactic astrophysics with the results published in peer-reviewed journals.

(1) The GalMer database is the first VO-resource providing access to the results of tree-SPH simulations of galaxy interaction. We have developed a set of value-added tools related for data visualization and post-processing with available VO-interfaces, including the spectrophotometric modelling of galaxy properties, making GalMer the most advanced resource providing online access to the results of numerical simulations which can be directly compared with imaging and spectroscopic observations.

(2) We have cross-identified three large sources of photometric data: GALEX (UV), SDSS (optical), UKIDSS (NIR) and compiled a homogeneous FUV-to-NIR catalogue of spectral energy distributions of nearby and intermediate-redshift galaxies (z¡0.6). This led us to the discovery of a universal very tight relation of galaxy optical and UV colours and luminosities.

(3) We have used a VO-fed workflow to automatically analyse a large amount of HST data and discovered a population of compact elliptical (M32-like) galaxies in nearby clusters and groups. We performed follow-up observations of some of these galaxies and then modelled their formation and evolution using dedicated numerical simulations. Presentation of these three examples aim at stimulating usual astronomers to carry out VO-enabled research on everyday basis. Although minor infrastructural difficulties still exist, VO-enabled research beyond data mining is already possible. We foresee a growing amount of VO-powered studies to arrive in near future.

CDS services in the VO era: data center 2.0

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CDS was created in 1972, and has provided the astronomical community with reference services long before the Virtual Observatory (VO) started operations. The CDS services have evolved with new emerging technologies (like the WWW in the early 1990s) as a consequence of a sustained and long-term research and technology policy.

We will present the role played by CDS in the development of the astronomical VO, and describe how the VO in return impacted the existing CDS services. There have been many changes and new features, whether it be for data formats, metadata description, data access protocols, interaction between services and tools, etc.

In addition, we recently opened the capability for users to add annotations in CDS services. This feature, even if not widely used at present, represents a paradigm shift, with the users contributing to the contents of services without prior validation, like in the Web 2.0.

We will conclude with foreseen evolutions of the CDS services and what challenges datacentres might face in the near future.

Using VO technologies to access CADC collections

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The Canadian Astronomy Data Centre (CADC), operated by the National Research Council's Herzberg Institute of Astrophysics, is the national facility serving many of Canada's space-based and ground-based telescopes as well as other important data collections. These collections are a very heterogeneous lot comprising multiple wavelengths, pointed and survey observations, multiple missions, facilities and instruments each with their own data model, meta-data descriptors and data formats. Several years ago, in its role as a major astronomy data centre, the CADC committed to making its data collections and services available through Virtual Observatory protocols. Today, we report on the supported data models (ObsCore, CAOM), data access services (SIA, TAP, ObsTAP) and user services (storage, annotations and processing) now available at the CADC. We will describe how to access these services and give examples on how they are being used by the astronomy community.

Science Initiatives of the US Virtual Astronomical Observatory

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The United States Virtual Astronomical Observatory program is the operational facility successor to the National Virtual Observatory development project. The primary goal of the US VAO is to build on the standards, protocols, and associated infrastructure developed by NVO and the International Virtual Observatory Alliance partners and to bring to fruition a suite of applications and web-based tools that greatly enhance the research productivity of professional astronomers. To this end, and guided by the advice of our Science Council (advisory committee), we are focusing on five primary science initiatives in the first year of VAO operations: 1) scalable cross-comparisons between astronomical source catalogs, 2) dynamic spectral energy distribution construction, visualization, and model fitting, 3) integration and periodogram analysis of time series data from the Harvard Time Series Center and NASA Star and Exoplanet Database, 4) integration of VO data discovery and access tools into the IRAF data analysis environment, and 5) a web-based portal to VO data discovery, access, and display tools. Initial versions of these applications and web-based services will be released over the course of the summer and fall of 2011.

Presentation on VAMDC

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Atomic and molecular data plays an important role in the analysis of astrophysical plasma. These data are usually organized as databases, however it's not an easy task for the user to combine all necessary data from different databases because of a variety of formats and structures employed. We present a European project of FP7 'Virtual Atomic and Molecular Data Centre (VAMDC)' developed to create well documented interoperable interface to the differently organised existing Atomic and Molecular databases.

The infrastructure of the project is based on definition of a data Model XML Schema for Atoms, Molecules and Solids (XSAMS) and on a Data Access Protocol (Table Access Protocol) derived from the International Virtual Observatory Alliance. All the data services are referenced in a registry coming from IVOA model that allows user to automatically discover all available data in an uniform format.

We present the complete description of the infrastructure, its current state, with a particular attention to the user's support, which includes documentation, tutorials, etc. VAMDC also provides access to grid facilities which is an important part in time-consuming atomic and molecular calculations.

At last we make a short tour through 19 (21 ?) databases entered to VAMDC project describing their content and scientific applications.

Cross catalog matching with VO and parameterization of stars

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Virtual Observatory facilities allow users to make a fast and correct cross-matching of objects from various surveys. It yields multiphotometry data (color indices) on registered objects and makes it possible to determine stellar parameters. A method of catalogues cross-matching, as well as its application to various areas in the sky and preliminary results of stellar parameterization, are discussed in the presentation.

Discoveries of ultracool subdwarfs with VO tools

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Using VO tools we have discovered the faintest ultracool subdwarf known to date. We report on new discoveries of ultracool subdwarfs confirmed with follow-up spectroscopy. We also report on our plans to make efficient use of the Vista public surveys using a VO approach.

Large astronomical surveys, archives and databases

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At present the development of astronomy is strongly dependent on the large surveys, archives and databases. The multiwavelength data complement each other and allow new discoveries. Especially useful are all-sky or large-area surveys providing homogeneous data for vast amount of objects and making possible studies on various kinds of objects over large surfaces. This huge information on various properties of stars, nebulae and

galaxies allows making research really multiwavelength; such surveys/catalogs are ROSAT in X-ray, GALEX in UV, SDSS and several POSS1/2 based catalogs (APM, MAPS, USNO, GSC) in optical, 2MASS in NIR, IRAS and AKARI in MIR/FIR, NVSS and FIRST in radio and some others. A few others (e.g. WISE in NIR/MIR) will be available soon. Hundreds of thousands, millions and even billion (USNO and GSC) objects are present in each of them having accurate positional, photometric and some other data. Most of the modern databases give at present VO access to the stored information. This makes possible not only the open access but also a fast analysis and managing of these data. Analyzing and matching data from various surveys and catalogs one can find out a dataset that itself is new, though published long ago in different catalogs. New discoveries this way become possible. Cross-correlations result in revealing new objects and new samples. Very often dozens of thousands sources hide a few very interesting ones that are needed to be discovered. Spectroscopic databases are unique among all others. Very few such databases are available: The Digitized Hamburg Quasar Survey (HQS), the Digitized First Byurakan Survey (DFBS), and the Sloan Digital Sky Survey (SDSS), altogether covering about 25000 sq. degrees at high Galactic latitudes. New scientific projects as well as existing surveys will benefit by the digitized images and the ready-to-use extracted spectra which will allow an efficient computer-based analysis of the dataset. We are going to show, how the discoveries come when a comparative analysis of data from various catalogs and their correlation is made. However, one must be careful with inhomogeneity and make necessary correction and transformations. In addition, new efficient tools for analysis of large catalogs are needed.

The Serbian Virtual Observatory: Current Status of Belgrade Wide Field Plate Archive. Future Plans and Topics

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The authors present the basic results of the six -years intensive activities of the Department of Dynamics of Solar System bodies at Belgrade Observatory on Data Collection and digitization of 15000 astrophotographic plates from the period 1935–1997. The criteria for chosen objects, the search methods, as well as the identification, determination and verification of the celestial objects are discussed. Recently, the old plates with newly discovered asteroids from Belgrade Observatory, comets and other Solar System objects with magnitude up to 16, are analysed. The computer — readable Catalogue of the all original plates are prepared in the accepted WF Plate Database format. Astronomical observational records have been scanned also and included into the Main Catalogue.

VODKA: as VO-tools can be useful for data mining science

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Currently, Virtual Observatory users interact with the VO infrastructure as the main actors. In particular, each time they want to fetch data from the VO they have to choose an application and trigger it. Vodka (VO Data Keeping-up Agent) is a new VO actor which monitors the state of the VO seeking for changes in services and datasets and notifying users for those changes and updates. These snapshots are persistent so that users can manage them and, when new interesting data is found, download them.

UkrVO Joint Archive and Scientific Projects

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The UkrVO data base consists of about 200,000 astronegatives and about 50,000 CCD-frames containing the unique astroinformation obtained from 1898 year at 8 observatories and allowing to formulate important scientific tasks.

This paper deals with 4 main UkrVO scientific projects, which are currently under development. They are: creation of the Joint Digitized Archive (JDA); compilation of new stellar catalogues; search for the new Solar System small bodies; search for the new variable stars and optical GRB's counterparts.

The UkrVO core is developing on the basis of JDA astronegative's collection in order to open access to these data with scientific aims (currently it includes about 7,000 digitized images). Two new stellar catalogues compilations with the use of JDA are currently in process. They are the enhancement of the FONAC stellar catalogue up to the fainter stars (MAO NASU), and the Catalogue of positions and proper motions of 17,000 stars in the ecliptical zone (Nikolaev AO). The unique software for the search of small celestial bodies with the identification on vast stellar catalogues has been developed in Kharkiv (KhNURE). Its pilot version allowed already to discover about 20 minor planets and Comet/Elenin. JDA is also applying for the study of stellar fields around GRBs (MAO NASU and Crimean AO). Plates of different collections together with CCD-frames give an opportunity to form the observational time series for variable stars studies (for example, since 2009 the Ukrainian astronomers discovered more than 30 variable stars). Some of these results will be presented.

Multifrequency Study of Radio Sources of the RCR Catalogue with the Virtual Observatory Tools

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Mass identification of a list of radio sources with the sky surveys of different ranges of the electromagnetic spectrum has undoubted interest to astronomers. Identification of the radio sources is not a straightforward procedure because of the different angular resolution, sensitivity limit, coordinate precision of the radio catalogues, as well as due to the morphological structure of radio sources themselves. We have developed an approach to bulk identification of the RC catalogue obtained with the largest Russian radiotelescope RATAN-600, using web services that provide access, visualization and analysis of data from optical, infrared and radio surveys, which are the resources of a virtual observatory. About 25% of the RC catalogue radio sources were not confirmed in the radio survey NVSS, so to refine the coordinates and flux densities were re-processed of "Cold" surveys for 1980-1999 and got a catalogue of radio sources RC Refined (RCR). By means of an interactive sky atlas Aladin (Perl API for the command interface and macrocontroller) and pysao (Python-interface to SAOImage DS9) implemented workflow on a radio source list for data preparation and result visualization. The RCR radio sources were identified with five sky radio survey VLSS, TXS, NVSS, FIRST, GB6 (74, 365, 1440 and 4850 MHz), two optical surveys DSS2 and SDSS (bands u, g, r, i, z) and infrared survey LAS UKIDSS (band J, H, K). Since it is assumed further analysis of multi-frequency data, special attention is paid to the compilation of diverse information into one resource namely a search information system ObjectRadioSky. We developed a database schema that takes into account the addition of new catalogues, the integration of their parameters with UCDs and relations between objects of the catalogues. We implemented a web-based interface to display all available information about the selected radio source. This work was supported by RFBR grants N09-07-00320 and N10-07-00412.

Galactic science with the Virtual Observatory

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In this talk I outline several original research use-cases of the Virtual Observatory (VO) that have recently resulted in scientific publications in major peer-reviewed astronomical journals. These independent studies

were devoted to obtaining physically meaningful constraints for the various kinds of Galactic objects: open clusters, cataclysmic variables and low-mass X-ray binaries. The only common point was the intensive usage of the VO data and services as a crucial element in this research approach. Specific methods themselves ranged from large multi-color photometrical catalogs processing to mining of data archives for images across electromagnetic spectrum obtained in the past with different purposes to dedicated observations and the development of own VO tools. The goal of this contribution is hence to showcase by mature examples the significant potential and broad scientific exploitation perspectives of the VO which contains structured data of a great value already useful for studies of entirely different astronomical objects in the Galaxy.

The Kyiv Meridian Circle' observation archive as the UkrVO scientific resource

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The Kyiv meridian axial circle (MAC) is a refractor (D=180 mm, F=2.3 m) which is used now in a CCD astrometric survey of the equatorial zone with the aim of measuring the equatorial stars positions, proper motions, and magnitudes. The MAC photometric system reproduces standard V photometric system; the limiting magnitude is about V=17mag (accuracy for star pixel coordinates is equal to 0.02 pxs and for star fluxes is to 0.02 mag). The MAC' CCD archive contains about of 16 000 CCD frames obtained from 2001 to 2003 in the equatorial zone of sky and till 2011 was not systematized. Starting from 2009, this archive is growing with new observations. By these reasons, in frame of the Ukrainian Virtual Observatory (UkrVO) projects the decision was adopted to create the MAC' CCD database in 2011. In this paper the MAC archive structure and developed software for information management and accumulation of the new data (in IVOA standards) is presented.

POSTERS

SPS3-1. The lower main sequence of stars in the solar neighborhood: model predictions versus observations

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We will present a comparison of the predictions of available stellar models with the properties of the lower main sequence defined by a kinematically unbiased sample of K and M dwarfs in the solar neighborhood. A variety of astronomical surveys and databases were used to extract photometric data on these stars, while the data on luminosity are solely based on Hipparcos astrometry. The available observational data have been complemented by our own radial velocity measurements. Particular attention has been paid to identifying unresolved double/multiple stars by multiple radial-velocity observations. We note significant offsets of model sequences with respect to observational data.

SPS3-2. The new version of Binary stars database (BDB)

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The new version of BDB database that combines data from a variety of catalogues of binary stars is presented. The main goal of BDB is to allow user to interrogate of data for all categories of binary stars.

The technologies, which the current version of BDB was built on, don't allow effectively integrate it into a modern infrastructure. So, in 2010 it was decided to create a new version using the recent tools. The new version is written in Python and based on Nagare framework, which allows to create web applications with natively integrated Web 2.0 features. The PostgreSQL database is used for data storage. To date, the backend parts of the new version is almost done, including the tools for importing catalogues from VizieR. At present, efforts are focused on frontend modules, including searching, real-time communications with other databases and cross-identification tools.

SPS3-3. Pulkovo observatory astronegative library

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Pulkovo library contains over 40000 photoplates produced from 1893 through 2005. Almost all of them have been digitized in low resolution (600 dpi) for the online catalogue. Since 2010 digitizing for research purposes is carrying out with Pulkovo observatory astrographic machine (optical resolution 8460 dpi, positioning accuracy 0.1μ). So far about 15% of the total collection has been scanned. The scans (5 Tb) are stored in the local database as individual images. The software allows to take coordinate and photometric measurements of stellar images based on individual frames as well as complete reconstruction field assembled from individual frames.

SPS3-4. Pulkovo observatory nanometrical measuring machine

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Described below are the results of reconstruction of the astrographic measuring system originally installed in Pulkovo observatory in 1986. Virtually a new system has been created on the basis of its electromechanical components (metal table and linear electric motors). The CRT and photoelectronic multiplier have been replaced with CMOS cameras (optical resolution 8460 dpi). The positioning system is based on incremental and absolute linear encoders by Reninshaw (UK). Its carriage positioning accuracy is less than 0.1μ and measurement accuracy — 1 nm (target for this summer). The control, photographic plate digitization and image processing software allows to assemble separate frames into a complete image as well as search, recognize and identify stellar images and measure stellar coordinates.

SPS3-5. Spectral Analysis with the Virtual Observatory Service TheoSSA

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In the framework of the Virtual Observatory, the service TheoSSA was developed to provide access to theoretical stellar spectral energy distributions. In a pilot phase, this service is based on the well established Tuebingen NLTE Model-Atmosphere Package (TMAP) for hot, compact stars. We demonstrate the present possibilities and future extensions of TheoSSA.

SPS3-6. Digital archive of plate collection of the astrograph of the Zvenigorod observatory of Institute of Astronomy of the Russian Academy of Sciences

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The plate collection of the 40-sm Carl Zeiss astrograph of the Zvenigirod observatory is considered in details. Photonegatives are received during with 1972 till 1996 years at scheduled observations of the field stars, comets, asteroids, Pluto and Mars. The electronic library of photo plate is built up by scanning of the archive of astronegatives. There is an information on the observation programs on the telescope and structure of the glass library here. Separately the lists of the plates with asteroids, comets and planets are given. The access to catalogues of archive is provided on the INASAN site. There are the capabilities of a choice of plates by date of the observation, by the set area of the sky, by the different type objects and viewing image previews

SPS4: What powers AXPs and SGRs?

Conveners:
Nick Kylafis (U. Crete, Greece),
Joachim Trumper (MPE, Garching, Germany)

Evolution of the Soft Gamma- ray Repeater SGR 0418+5729

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The recently reported upper limit on the period derivative of SGR 0418+5729 (Rea et al. 2010) clearly shows that the magnetic dipole field of the source is less than 10^{13} G on the surface of the neutron star. Intrinsic cooling luminosity of a neutron star decays on a timescale ($\sim 10^6$ yr) much shorter than the minimum characteristic age ($> 10^7$ yr) indicated by the period and the period derivative upper-bound of SGR 0418+5729. Considering the long period and low magnetic field of the source, we conclude that SGR 0418+5729 underwent an efficient spin-down epoch with external torques other than dipole radiation in vacuum. We show that a neutron star with B $\sim 10^{12}$ G and with a fallback disk follows an evolutionary path that can simultaneously produce the properties of SGR 0418+5729 with a minimum age of a few 10^5 yr.

Broad-band high-energy observations of bursting Magnetars

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Over the last years a wealth of new X- and hard-X-ray data could be collected on Magnetars, thanks to the combined use of high-energy satellites, like XMM, Chandra, INTEGRAL, Fermi, RXTE, Swift, or Suzaku. I will review the recent observational results on Magnetars focusing on spectral and timing properties of the the steadily growing class of the so-called "transient Magnetars", (e. g. SGR 0418+5729, SGR 0501+4516, 1E 1547-5408, etc.) sources which can undergo a flux variation up to two orders of magnitude over a hundred days.

Cyclotron resonant scattering feature in persistent X-ray emissions from AXPs?

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Over the last decade observational evidence has mounted that Anomalous X-ray Pulsars (AXPs) and Soft Gamma-Ray Repeaters (SGRs) belong to the same class of objects. However, there is no consensus on what powers the persistent X-ray emission from these objects. Two scenarios are being discussed, i) the magnetar scenario in which the decay of a super-strong magnetic field powers the source, and ii) the fallback-disk scenario powered by accretion. Phase-resolved spectroscopy of the X-ray emission from AXP 1RXS J170849-400910 reveals a spectral feature which can be interpreted as an electron cyclotron resonant feature generated in a region with magnetic-field strength of a few 10^{11} G. A similar feature might be present in the spectrum of AXP 4U 0142+61. In this talk I will confront the general observational characteristics of the persistent emission of AXPs in the X-ray band and this indication for a cyclotron resonant feature with the above mentioned model scenarios.

Evidence for accretional power in the persistent emission of AXPs and SGRs

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Using published data regarding X-ray spectra, fluxes, distances, and pulse profiles of the persistent emission of AXPs and SGRs, we examine whether accretion from a fallback disk is consistent with them. We find that several of the correlations that we have found are suggestive of accretion. In addition, we find that the change of the pulse profile during the 1998, August 27, burst of the SGR 1900+14 can be naturally explained with our picture of accretion.

The solar flare paradigm for magnetar flares

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The two competing models of magnetar flares associate the released energy with either the elastic energy in the crust, in a manner similar to the Earth quakes, or, alternatively, with the magnetic energy in the magnetosphere, in a manner similar to the Solar flares. We demonstrate that the magnetic tension in a neutron-star crust dramatically suppresses the efficiency of the energy release during a sudden rupture of the stressed crust, excluding the star quakes as a mechanism to power magnetar flares. I will discuss a model of giant flares driven by unwinding of the internal non-potential magnetic field followed by a sudden onset of reconnection in the magnetosphere. The evolution of magnetars and their high energy activity parallels, in some respects, that of the Solar flares, from the production of magnetic field in a turbulent dynamo in the interior of the star to generation of bright X-ray flares and powerful ejections.

On the Relation of Gamma-ray Bursts and the Soft Gamma-ray Repeaters

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It is well possible that in the databases of the short-hard gamma-ray bursts (GRBs) there are some hidden soft-gamma repeaters (SGRs). The question of these hidden SGRs is discussed in this contribution.

Spectra and Magnetic Field Strengths of AXPs and SGRs

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In this talk, I will review the spectral, timing, and bursting properties of Anomalous X-ray Pulsars and Soft Gamma-ray Repeaters and present the evidence for the presence of very strong magnetic fields in these sources. Detailed modeling of their broadband spectra as well as the analysis of their pulse profiles not only constrains their magnetic field strengths but is also beginning to reveal their magnetic field geometry. I will conclude my talk by describing some intriguing puzzles that remain in the study of AXPs and SGRs, such as the origin of the differences in certain source properties within the AXP-SGR population, the differences between these sources and high-field radio pulsars, and the origin of their high energy emission. Further observations and theoretical work can shed light on these open questions.

Electric circuit model for high-frequency QPOs in magnetars: Diagnostics of trapped fireball plasma

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A model for high-frequency (20–2400 Hz) quasi-periodic pulsations from SGRs based on the description of coronal magnetic loops as an equivalent electric (RLC) circuits is proposed. The interpretation of observed periods of QPOs and very high quality factors, $Q \sim 10^4 - 10^5$; is given. The trapped fireball, to which the 'ringing tail' is generally related, is presented as a set of current-carrying magnetic loops of various sizes. It is shown from the model that QPOs can excite not only in the 'ringing tail', but also before the main pulse of a flare. We have estimated the parameters of the source of the pulsations — a trapped fireball of SGR 1806-20: the electric current $I \sim 3 \times 10^{19}$ A, the number density of electrons $n \sim 2 \times 10^{16}$ cm^{-3}, and the magnetic field value $B \sim 10^{13}$ G $< B_q = 4.4 \times 10^{13}$ G.

Radio Observations of AXPs

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The new results of the observations of three AXPs (1E 2259+586, 4U 0142+61 and XTE J1810-197) are reported. The observations have been carried out on two sensitive transit radio telescopes of PRAO ASC LPI at low frequencies 62–111MHz. The main parameters of radio emission for three AXP, as well as pulse profiles and dynamic spectra are presented.

An accretion model for the quiescent broadband X-ray emission of Soft Gamma Ray Repeaters and Anomalous X-ray Pulsars

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The quiescent X-ray emission of Anomalous X-ray pulsars and Soft Gamma Ray Repeaters having luminosities of $\sim$ 1035 erg/s can be explained as result of accretion from a fallback disk. In this model the soft X-ray component of the spectrum is attributed mainly to the photospheric emission from the hot polar cap of the neutron star, while the hard X-ray tail is produced by bulk and thermal (BMC/TC) comptonization in the accretion column. Using the well studied AXP 4U 0142+61 as an example it can be shown that this model gives an excellent fit to the spectrum from $\sim$ 1 keV up to $\sim$ 150 keV. The comptonized flux from the column is emitted as a fan beam, part of which hits the polar cap where it is absorbed or reflected. A spectral bump at $\sim$ 60 keV in the reflected component can be interpreted in terms of resonant cyclotron reflection, leading to a polar magnetic (dipole) field of $\sim 7 \times 1012(1 + z)$ G. The similarity of the AXP/SGR X-ray spectra, as well as their periods and magnetic dipole fields with those of the low luminosity X-ray binary 4U 1626-67 suggests that in the luminosity range around $\sim$ 1035 erg/s the transverse optical depth of the accretion column is favourable for the production and escape of BMC/TC photons. The energetic bursts which cannot be explained by the accretion model, are probably produced by mechanisms discussed in the classical magnetar literature, operating in localized multipole fields which may be much larger than the dipole field, just like in our sun.

Spectral modeling of supernova-fallback disks

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Accretion from SN fallback disks could explain the spectral properties of AXPs and SGRs. For example, the mid-IR emission from 4U0142+61 has been successfully modeled with blackbody emission from a gaseous, viscously heated disk (Ertan et al. 2007). In order to overcome the simplifying assumption of local blackbody spectra being emitted by such disks, we have performed detailed non-LTE radiation transfer calculations in disk models being composed of pure iron or silicon-burning ash. Heavy iron line blanketing and limb darkening cause strong deviations from blackbody-like spectra.

POSTERS

SPS4-1. An update on long-wavelength observations of 4U 0142+61

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4U 0142+61 is the best candidate for a infrared-detected fallback disk around a neutron star. We will present an update on long-wavelength observations (IR to radio) of this magnetar and discuss consequential constraints within the fallback disk model.

SPS5: Minor merging as a driver of galaxy evolution

Conveners:
Olga Sil'chenko, (Sternberg Astron. Inst., Russia),
Francoise Combes, (Obs. Paris, LERMA, France)

The importance of minor mergers in hierarchical galaxy formation

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I will give an overview of the role that minor mergers of galaxies play in the formation and evolution of galaxies in a cold dark matter universe. The timescale on which such mergers happen has been studied extensively using numerical simulations. However, despite recent progress, much work remains to understand the consequences of such mergers for the form of the merger remnant and any star formation triggered by the event.

Large scale nested stellar discs in NGC7217

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NGC7217 is an unbarred early-type spiral galaxy having a multi-segment exponential light profile and a system of starforming rings of the unknown origin; it also possesses a circumnuclear gaseous polar disc. We analysed new long slit spectroscopic data for NGC7217 and derived the radial distributions of its stellar population parameters and stellar and gaseous kinematics up to the radius of $r \approx 100''$ ($\sim$ 8 kpc). We performed the dynamical analysis of the galaxy by recovering its velocity ellipsoid at different radii, and estimated the scaleheights of its two exponential discs. The inner exponential stellar disc of NGC7217 appears to be thin and harbours intermediate age stars ($t_{SSP} \approx$ 5Gyr). The outer stellar disc seen between the radii of 4 and 7kpc is very thick (z_0 =1...3kpc), metal-poor, [Fe/H]< -0.4 dex, and has predominantly young stars, $t_{SSP} =$ 2Gyr. The remnants of minor mergers of gas-rich satellites with an early-type giant disc galaxy available in the GalMer database well resemble different structural components of NGC7217, suggesting two minor merger events in the past responsible for the formation of the inner polar gaseous disc and large outer starforming ring. Another possibility to form the outer ring is the re-accretion of the tidal streams created by the first minor merger.

The formation and evolution of massive galaxies

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The most recent results on the formation and evolution of massive galaxies, from high to low redshift, will be reviewed. Massive galaxies represent key probes to trace the cosmic history of mass assembly and its relative processes (from formation of stars to major and minor merging), and allow critical tests of the hierarchical models of structure formation. In the last decade, the wide range of results obtained from the ground and from space are proving a new view of these important issues.

Can Minor Mergers Drive Dramatic Galaxy Growth at $z > 1$?

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Minor mergers are predicted to be a major method of forming galaxies at high redshifts, yet we have very little to no proof that this process is occurring in the early universe. We present this evidence using extremely

deep and high resolution HST NICMOS imaging in the GOODS field as part of the GOODS NICMOS Survey (GNS). We study a population of 81 very massive galaxies at $1.7 < z < 3$ with stellar masses $M_* > 10^{11} M_{\rm sol}$. We construct a minor merger history for these galaxies via a close pair method, probing down to a mass ratio of $\sim 1:100$, thus investigating the minor merging to an unprecedented mass sensitivity at high redshifts. We find that there are ~ 4.5 mergers with galaxies with stellar masses greater than 1/100th of the host massive galaxy from $z = 3$ to the present, with most of these being classically defined as 'minor' mergers. By use of a simple argument based on the assumption of virialised minor merging, we show that this number of mergers can lead to a size increase of up to a factor of six, sufficient alone to account for the dramatic size evolution observed between these redshifts for massive galaxies.

The role of minor vs major mergers in the mass assembly of early-type galaxies

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The role of mergers in the mass assembly of galaxies, especially the early-type ones, has been the matter of strong debate: is it mainly due to minor vs major mergers, a combination of them, or purely secular evolution? Numerical simulations have recently provided a wealth of constrains for these scenarios. On the observational side, systematic surveys have revealed that ETGs show a large variety of properties and may in fact belong to several families of objects, each formed by a specific scenario. I will review these issues, with a special emphasis on the imprints of each type of mergers on the outskirts of galaxies, tidal tails, shells and other fine structures.

Shell Galaxies: Minor Merger Products

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We adopted a model of formation of shell galaxies in a radial minor merger proposed by Quinn (1984) and developed a method (based on Merrifield & Kuijken, 1998) using the shells to constrain the distribution of dark matter halos of the host galaxy. The method uses the kinematic imprint of shell's stars in a spectral line. We present a theoretical analysis of the line profile as well as several sets of numerical simulations of mergers. Our simulations consist of time dependent analytical potentials together with millions of test particles. We introduce the dynamical friction and the gradual disruption of the dwarf galaxy. The combination of these effects has a dramatic impact on the positions and luminosities of the shells. These phenomena need to be considered in the context of probing the history of the merger in a shell galaxy. We do not use fixed Coulomb logarithm in Chandrasekhar formula but we take into account the changes of the density and velocity dispersion over the giant elliptical galaxy and compare the results with self-consistent simulations using GADGET-2. Furthermore we investigate the effect of the dark matter content. The dark halo of host galaxy exerts a strong acceleration onto the dwarf galaxy, thus preventing the creation of the shells at low radii, what is in a direct contradiction with some observations, for example in the case of NGC 3923.

Formation of stellar inner discs and rings in spiral galaxies through minor mergers

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Recent observations show that inner discs and rings (IDs and IRs) are not preferentially found in barred galaxies, pointing to formation mechanisms different to the traditional bar-origin scenario. We have investigated the capability of minor mergers to trigger the formation of IDs and IRs in spiral galaxies through collisionless N-body simulations. All the simulated minor mergers develop thin rotationally-supported ICs out of satellite material. A wide morphological zoo of ICs has been obtained (including IDs, IRs, pseudo-rings, nested IDs, and combinations of them), all with structural, photometric, and kinematical properties similar to observational cases. The present models prove that minor mergers are an efficient mechanism to form rotationally-supported stellar ICs in spiral galaxies, neither requiring strong dissipation nor noticeable bars, and suggest that their role in the formation of ICs must have been much more complex than just bar triggering.

Born to be bright: The morphological evolution of massive galaxies in groups

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Galaxy groups host many massive (∼L* and above) galaxies in the local Universe and are considered to be the prime environment that fosters their morphological transformations. Groups are thus an ideal laboratory to unravel the evolution of such galaxies over cosmic history. I will present the results of cosmological, hydrodynamical simulations of galaxy groups down to z=0 with sufficient resolution and adequate physical modeling in order to follow the morphological evolution of their central galaxies and their massive, non-central members. The success of these simulations in producing luminous early-type galaxies at the group centers and a mixture of Hubble morphologies among the satellites allows us, among other things, to study when and where the formation of ∼L* elliptical galaxies takes place. I will discuss these results and their implications for our understanding of structure formation in the Universe.

The minor merger history of the most massive galaxies since z=1

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We present the first observational determination of the minor (mass ratio $1/4 < \mu < 1/10$) merger rate of massive galaxies by close pairs to $z = 1$. We search for close pairs of bright ($L_B > L_B^*$) and massive ($M_{\rm star} > 10^{11} M_{\rm Sun}$) galaxies in VVDS-Deep spectroscopic survey and in COSMOS field. We find that the minor merger rate of bright/massive galaxies is roughly constant with redshift, in contrast with the increase in the major (mass ratio higher than 1/4) merger rate of the same galaxies. If we parametrize the merger rate evolution with a power-law, $R = R_0(1+z)^m$, the power-law index is $m \sim 2$ for major mergers and $m \sim 0$ for minor mergers. We find that minor mergers are more numerous than major ones since $z \sim 0.5$. Our measured merger rates implies ~ 0.7 mergers (0.35 major, 0.35 minor) per bright/massive galaxy since $z = 1$, with an stellar mass increase of $\sim 25\%$. The relative contribution of major/minor mergers to this mass growth is 75%/25%. When we split our bright galaxies into red and blue by their rest-frame NUV-r colour, we find that the merger rate of red galaxies is higher than the one of blue galaxies. From the latter we estimate that minor mergers are not common enough to drive a spiral to elliptical transformation, but likely a late to early spiral one.

Inner polar disks and rings: observational properties

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I briefly review current observational results on morphology and kinematics of inner polar structures. Most of these structures were detected only from their kinematical tracers being hard to be noticed against the high-brightness bulges. The majority of the known inner polar structures has been discovered or confirmed with the 3D spectroscopic facilities at the SAO RAS 6-m telescope. Starting from 1990s the number of kinematically confirmed inner polar structures increased, but their origin and evolution is not understood yet. Our current sample contains about forty galaxies with circumnuclear structures ranging from 100 pc to 2 kpc. It's possible that minor merging is a main mechanism for the inner polar disc formation. Pro and contra arguments are considered.

Minor mergers and their impact on the observed properties of galaxies

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I will review some of the most recent studies on the impact of minor mergers on the morphological and kinematical properties of bulges, disks and stellar halos. I will discuss in particular the impact of minor mergers on the formation and properties of thick disks, comparing N-body simulations to the observational data currently available for the Milky Way and for external galaxies.

POSTERS

SPS5-1. N-body simulations of shell galaxies using multi-component models

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Insight into the process of creation of shell galaxies, which are thought to be by-products of minor mergers, can contribute to probing mass distribution of the progenitor-type objects. In this poster we discuss the effect of the initial phase space structure of the satellite and of the host galaxy on the formation of the shell debris system in the TreePM simulations with the code GADGET-2. While creating initial conditions of merging galaxies, we use various self-consistent multi-component density models (to distinguish between dark and luminous matter).

SPS5-2. Formation of elliptical galaxy — a treatment under multivariate paradigm

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NGC 5128 is the nearest giant extragalactic elliptical galaxy whose formation mechanism has been studied through the various structural parameters as well as spectroscopically determined Lick indices, and radial velocities observed for its large ensemble of globular clusters. The optimum set of parameters for this type of analysis is selected through a modified technique of principal component analysis, which differs from the

classical one in the sense that it takes into consideration the effects of outliers present in the data followed by a mixture model based classification technique. On the basis of the above classification scheme three coherent groups of GCs have been found. It is proposed that the clusters of one group originated in the original cluster formation event that coincided with the formation of the elliptical galaxy, and that the clusters of the two other groups are of external origin, from tidally stripped dwarf galaxies on random orbits around NGC 5128 for one group, and from an accreted spiral galaxy for the other.

SPS5-3. Dwarf galaxy merger trees

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We present results based on a set of Nbody-SPH simulations of dwarf galaxy mergers. Dwarf galaxies, like giant galaxies, have grown through a hierarchical merging process. We have followed the evolution of dwarf galaxies through a series of mergers with cosmologically motivated initial orbital parameters taken from Benson (2005). This approach has the advantage that we achieve the required high resolution to reliably predict dwarf galaxy properties and that we take into account a dwarf galaxy's merger history without the necessity of running a full-blown cosmological simulation. Our simulations include gas dynamics and also star formation, stellar feedback, radiative cooling and metal enrichment. We ran simulations with cusped NFW and cored Kuz'min Kutuzov dark matter profiles. We compare the properties of the simulated dwarf galaxies both with observations and with isolated simulated galaxies. The properties of the simulated galaxies are in good agreement with the scaling relations of observed dwarf galaxies. For the most low mass systems ($\sim 10^8$ Mo), mergers lead to an increased star-formation rate while in more massive systems ($\sim 10^{9.5}$ Mo) this is much less pronounced. We reproduce the observed kinematic and photometric scaling relations and the dark-matter halo occupancy (particularly the slope of the $M_{\rm halo}$ vs. $M_{\rm star}$ relation).

SPS5-4. The Stellar Populations of the Most Massive Galaxies

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Understanding the formation and properties of massive galaxies allows us to constrain current models of galaxy formation. Within the hierarchical CDM framework, massive galaxies are assumed to form by a combination of dry mergers from several smaller sub-halo systems at $z < 1$ and additional AGN feedback. In the context of the mass assembly, one third of the present-day brightest cluster galaxies are expected to have build up half of their stellar mass since $z \sim 0.5$. We are conducting a project which aims to study a well defined sample of massive galaxies at $0.1 < z < 0.4$ identified through a systematic search of the SDSS database. Using a combination of HST/ACS data and Gemini/GMOS spectroscopy we explore the photometric and spectroscopic properties of these massive systems. The global properties and scaling relations of these systems are different than those for the total early-type galaxy population. Our galaxies are located either in high or low-density environments and show a variety of small sub-structure. With the high S/N GMOS spectra we will be able to measure precise kinematics and study in detail the stellar populations of these galaxies. These new results will put stringent constraints on the formation histories of massive galaxies.

SPS5-5. Merger of Supermassive Black Hole Binaries in Merging Galaxies

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In standard Cosmology, Galaxies formed by hierarchical mergers. Observations show that each sizable galaxy has a Supermassive Black Hole (SMBH) at the center with mass ranging from a few Million Solar

Masses to ∼1-Billion times the mass of our Sun. The prospect that low-frequency gravitational wave radiation will be detected by LISA, the laser interferometer space antenna has motivated theoretical studies into the formation and evolution of binary supermassive black holes (SMBHs). Early numerical studies show that in spherical galaxy models, SMBHs have difficulty in reaching subparsec scale due to depletion of stars on orbits that intersect the massive binary- "the final parsec problem". With a set of N-body galaxy merger simulations, I shall discuss that non spherical shapes of megrer remnant lead to a larger population of orbits that interact with binary thus avoiding "final parsec problem".

SPS5-6. On the role of minor encounters in LSB dwarf galaxy evolution

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Evidence for the importance of galaxy encounters in general, and of mergers in particular, for the enhanced SFR in galaxies have grown up during the last years. More evidence also appeared on the significant effect of minor mergers on starbursts and galaxy evolution. Most of these results are limited, however, by more massive and/or actively star-forming galaxies. Incidence of minor encounters and their effects on the low surface brightness (LSB) dwarfs are practically unknown due to the severe observational selection effects. To address this issue, one needs LSBD samples with M_B, say $> -(14-15)$ mag, for which their surroundings should be examined for "companions" of roughly 2.5 mag fainter. For typical apparent magnitude limited ($B_{\rm tot} \sim 18$ mag) redshift surveys, this immediately implies the use of the nearby volume with distances $\lesssim 15$ Mpc, which is not very rich of cataloged LSBDs. We present the results of the study of a fraction of LSBD population in the nearby Lynx-Cancer void which suggest that the incidence of "minor" encounters among LSBDs can be substantial. The implications of this factor for LSBD evolution should be studied more carefully observationally and be examined in numerical simulations.

SPS5-7. On the Kinematics of Halo Stars from the Solar Neighbourhood

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The kinematics of the local halo stars is modelled following a particular Gaussian distribution of their random velocities. As the mean motion of the halo a weak rotation is admitted. Assuming a given value for the galactocentric speed of LSR it is possible to model the same halo sample in its motion with respect to LSR. Here one has five parameters: three velocity dispersions, rotation speed and LSR speed. Varying these parameters the authors find the fraction of halo stars occupying a given volume in the velocity subspace centred on the LSR. Small volumes are of special interest since halo stars are usually thought to move around the Milky Way centre in a way quite different from the circular motion.

SPS5-8. Dynamics of Sinking Galaxies

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Gross-dynamics equations for a satellite sinking into a host galaxy are deduced. They are tensor Lagrange-Jacobi equations generalized to take into account the external gravitational field. changes in the form of the satellite are studied.

SPS5-9. Structure and dynamics of Malin 1

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Malin 1 is a unique, extraordinarily large low surface brightness galaxy. The structure and the origins of the galaxy are poorly understood. The reason for such a situation is an absence of detailed observational data, especially, of high-resolution kinematics. In order to investigate stellar kinematics of Malin 1, we have performed spectroscopic study of the galaxy with the Russian 6-m telescope. We discovered a small companion galaxy — Malin 1B, — and concluded that Malin 1 undergoes a minor merger with this companion galaxy. This galaxy is at the projected distance of 14 kpc and shows a small velocity difference with Malin 1 systemic velocity (dV = 65 km/s). Accreting companion might be responsible for the main morphological features in the central part of Malin 1. It could produce a two-armed inner structure and trigger the bar instability. Also, one can relate this companion with one-armed spiral pattern in Malin 1 disc. Malin 1 is found to be in low-density large-scale spatial environments typical for LSB galaxies. We discuss the possible origins of Malin 1 global structure due to a bygone head-on collision with a massive intruder — SDSS J123708.91+142253.2. Spectral data were also used for "matching" the central stellar kinematics corrected for asymmetric drift with HI kinematics in the outer regions. This allowed us to recover the rotation curve up to 150 kpc from the nucleus! We analysed the whole rotation curve and determined the contribution of the dark halo.

SPS5-10. Stellar Streams as Probes of Dark Halo Morphology

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Tidal streams provide a powerful tool by means of which the matter distribution of the dark matter halos of their host galaxies can be studied. The analysis is not straightforward because streams do not delineate orbits, and for most streams, especially those in external galaxies, kinematic information is absent. However, these obstacles can be overcome in certain cases. In this talk, I will present a method wherein streams are fit with simple corrections made to possible orbits of the progenitor, using a Bayesian technique known as Parallel Tempering to efficiently explore the parameter space and show that it is possible to constrain the shape of the host halo potential or its density distribution using only the projection of tidal streams on the sky. I will also present the fits found for the stellar stream around NGC 5907 and the structural parameters of its dark matter halo thus obtained.

SPS6: Space Projects

Conveners:
Lev Zelenyi (Space Research Institute, Russia),
Arvind Parmar (ESAC, Spain)

MarcoPolo-R: Near Earth Asteroid Sample Return Mission selected for the assessment study phase of the ESA Cosmic Vision 2 program

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MarcoPolo-R, a sample return mission to a primitive Near-Earth Asteroid (NEA) in collaboration with NASA, has been selected for the assessment study phase of the ESA Cosmic Vision 2 program. It will rendezvous with a primitive NEA, scientifically characterize it at multiple scales, and return a unique sample to Earth unaltered by the atmospheric entry process or terrestrial weathering. MarcoPolo-R will return bulk samples from an organic-rich asteroid to Earth for laboratory analyses, allowing us to explore the origin of planetary materials and initial stages of habitable planet formation, and to identify and characterize the organics and volatiles in a primitive asteroid. The baseline mission scenario to a binary asteroid (175706) 1996 FG3 is as follows: a single primary spacecraft provided by ESA, carrying the Earth Re-entry Capsule, sample acquisition and transfer system provided by NASA, will be launched by a Soyuz-Fregat rocket from Kourou into GTO. MarcoPolo-R takes advantage of three industrial studies completed as part of the previous Marco Polo mission and of the expertise of the US (APL-JPL) consortium.

Lomonosov space mission: astrophysical and astro-particle aspects

Vitaly Bogomolov, V. A. Sadovnichii, M. I. Panasyuk, I. V. Yashin, Il Park, B. Grossan, B. A. Hrenov, V. M. Lipunov, S I. Svertilov, N M. Veden'kin, V. V. Bogomolov, V. L. Petrov, P. A. Klimov

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"Lomonosov" space mission is under preparation now in Moscow State University. A large number of astrophysical and astro-particle tasks among the mission goals include the study of ultra-high energy cosmic rays — UHECR (TUS experiment), simultaneous detection of cosmic gamma-ray burst (GRB) prompt emission (PE) in visible light, ultraviolet (UV), X-rays and gamma-rays (BDRG-SHOK and UFFO experiments) etc. The TUS instrument is able to detect UHECR by the ionization light tracks in the Atmosphere with the use of large-area mirror. BDRG-SHOK experiment is designed to study without any delay the GRB PE as well as progenitors by wide-field optical cameras co-aligned with GRB monitor detectors. UFFO instrument consists from X-ray imager (UBAT) and re-orientated UV telescope (SMT). It also provides fast-response ($\sim$ 1 s) UV/optical observations of GRBs and other transient astrophysical phenomena. Magnetosphere and near-Earth physics research will be also realized during the Lomonosov mission which launch is planned on 2011, November.

Space VLBI project RadioAstron

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A 10-m radio telescope of the ground-space VLBI project RadioAstron is scheduled to be launched in 2011. The interferometer will have baselines up to about 350,000 km. This will provide a tool to study space objects in the radio band with an angular resolution better than 10 microarcseconds. In this talk we will review the current status and prospects of the project, its early and key science program.

The Hubble Space Telescope and the evolution of space astronomy

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The Hubble Space Telescope (Hubble) is a mission like no others. In orbit since April 1990, Hubble continues expanding the boundaries of astronomical knowledge, and producing the spectacular images that mesmerize and inspire the public at large. The original design of the mission, and the capability of being refurbished in space, has provided a very successful alternative to the standard template of a space mission with a limited lifetime. Astronauts have used the Shuttle to successfully complete five serving missions to Hubble, installing each time new sophisticated instrumentation, and replacing failed or obsolete subsystems. At the end of each refurbishment mission, Hubble was left a new observatory, powerful and well suited to address the fast evolving landscape of science. As we contemplate the completion of the Shuttle program, Hubble is more powerful than ever, with a full complement of six operating instruments spanning wavelengths from the ultraviolet to the near- infrared. I will review the history of this fascinating mission, and I will discuss the role that Hubble has played in changing the way space astronomy is now done. I will review the latest, most significant, astronomical results, and will provide a preview of what is yet to come.

Hubble has been a very successful collaboration between NASA and ESA, and has paved the way to future collaborations such as the James Webb Space Telescope, targeted for launch in a few years.

Herschel: mission status, science highlights, and future

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The ESA Herschel Space Observatory was launched on 14 May 2009, together with Planck. In the initial two months in-flight Herschel successfully completed the commissioning phase, and then went in the performance verification phase. Since late 2009 Herschel has been performing science observations, initially PACS and SPIRE observations, but since spring 2010 using also the HIFI instrument. More than 200 science papers based on Herschel observations were published already in 2010, and the number is steadily increasing. Herschel has already provided fundamental contributions in several different fields of astronomy from the observations of objects in our solar system, the interstellar medium and star formation in our own galaxy, disks and infrared excess of stars and evolved stars, galaxies, and cosmology. I will provide a mission status update, present a selection of science highlights, and discuss the future of the mission including the final call for observing time proposals.

eROSITA & ART-XC — The SRG-Mission

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SRG is a Russian-German X-ray astrophysical observatory. Germany (Max-Planck-Institut für extraterrestrische Physik) responsible for the development of the key mission instrument — the X-ray grazing-incident mirror telescope eROSITA with an energy range between 0.5 and 10 keV. The second instrument is ART-XC — an X-ray mirror telescope extending energy range up to 30 keV. ART-XC is being developed by Russia (IKI, Moscow and VNIIEF, Sarov). The S/C-bus Navigator is developed by Lavochkin Association (Russia). Spectrum-RG will be delivered to L2 point with the use of Zenit-2SB rocket and Fregat booster. The total mass of the SRG is 2385 kg. It will be launched in 2013 from Baikonur and the mission will last 7 years. The first 4 years will be devoted to an all-sky survey, the first one in that energy range using imaging telescopes. The main mission goal is the detection of 50-100.000 Clusters of Galaxies up to a redshift of $z \sim 1,5$ in order to study the nature of Dark Energy and Dark Matter. Further, we will discover all obscured accreting Black Holes in nearby galaxies and about 3 million new distant AGN up to a redshift $z \sim 9$ in order to study the

accretion physics and its cosmic evolution. The remaining mission lifetime will be spent on follow-up pointed observations of a selected objects.

WSO-UV as a major UV observatory of the decade

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Continuous access to the UV domain has been considered of importance to astrophysicists and planetary scientists since mid-sixties. However, the future of UV missions for the post-HST era is believed by significant part of astronomical community to be less encouraging. We argue that key science problems of the coming years will require further development of the UV observational technologies. Among these hot astrophysical issues are: search for missing baryons, revealing the nature of astronomical engines, properties of atmospheres of exoplanets as well as of the planets of the Solar System etc. We give a brief review of UV-missions both in the past and in the future. We conclude that UV astronomy has a great future but the epoch of very large and efficient space UV facilities seems to be a prospect for the next decades. As to the current state of the UV instrumentation we think that this decade will be dominated by the HST and coming World Space Observatory-Ultraviolet (WSO-UV) with 1.7 m Uvtelescope onboard. The international WSO-UV mission is briefly described. It will allow to carry out high resolution/ high sensitivity imaging and high/low resolution spectroscopy since mid of the decade.

Highlights of the Planck Mission

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Planck (http://www.esa.int/Planck) is an astronomical satellite part of the Scientific Programme of the European Space Agency, which is designed to image the anisotropies of the Cosmic Microwave Background (CMB) over the whole sky, with unprecedented sensitivity ($\Delta T/T \sim 2^{-6}$) and angular resolution ($\sim$5 arcminutes). Planck will provide a major source of information relevant to several cosmological and astrophysical issues, such as testing theories of the early universe and the origin of cosmic structure. The ability to measure to high accuracy the angular power spectrum of the CMB fluctuations will allow the determination of fundamental cosmological parameters with an uncertainty better than a few percent. In addition to the main cosmological goals of the mission, the Planck sky survey will be used to study in detail the very sources of emission which "contaminate" the signal due to the CMB, and will result in a wealth of information on the properties of extragalactic sources, and on the dust and gas in our own galaxy. The ability of Planck to measure polarization across a wide frequency range (30-350 GHz), with high precision and accuracy, and over the whole sky, will provide unique insight into specific cosmological questions, but also into the properties of the interstellar medium. Planck was launched together with Herschel on 14 May 2009. By July 2011, it will have completed almost four full sky surveys. In January 2011 the first data products and scientific results were released to the public. I will present an overview of the Planck mission, its scientific objectives, the key elements of its technical design, current status, and first scientific results.

The Interhelioprobe Mission

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The description of Interhelioprobe mission (ballistic scheme, scientific goals, scientific payload) for the study of inner heliosphere and the Sun from close distances and from out-of-ecliptic positions is given. The main goals of the mission are to study fine structure and small-scale dynamics of solar atmosphere, subpolar regions

of the Sun. the nature of the processes underlying the heating of solar corona and solar wind acceleration, initiation of the flares and eruptions. In-situ measurements are aimed for the study of characteristics of solar wind in inner heliosphere and on the latitude distant from ecliptic plane, their correlation with the phenomena on the surface. The ballistic scenario of the mission supposed that after a short ecliptic phase during which the spacecraft due to the gravity-assist maneuvers at Venus approaches to the Sun up to 60-70 solar radii the subsequent gravity-assisted maneuvers at Venus will be used for maximal inclination of the orbit to the ecliptic plane for out-of ecliptic observations. Possibility of the second spacecraft for an interrupted out-of-ecliptic observations of the Sun and ecliptic plane is considered

POSTERS

SPS6-1. Optimal condition for correction of orbit of potential dangerous asteroid Apophis

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In April, 2029 asteroid Apophis should pass at a very little distance from the Earth. There is a probability that in 2036 this asteroid can threaten with collision with our planet. This threat will disappear if in 2029 it will pass at a significantly larger distance from Earth. For that it is possible to make an artificial correction of the asteroid orbit by means of bombardment its surface by massive bodies or exploding charges. There were carry out model calculations for change the asteroid velocity at different moments of its orbit evolution. Additional velocity vectors were changed by directions and by values. Then numerical integrations of the corrected orbits to April 2029 were performed. In all cases for increasing the minimum distance of the asteroid from the Earth in April 2029, the most effective additional momentum should be in the direction of the asteroid orbital movement. Convenient period for the strike "in the asteroid back" is the first half of January, 2013, and launching of the spacecraft — the end of December, 2012. At additional speed of 2 cm/s minimum distance in April, 2029 will increase 1.5 times. This will eliminate a potential threat in 2036.

SPS6-2. The study of ground-level ozone over Kyiv and its impact on public health

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Ground-level ozone in Kyiv for the episode of its high content in August 2000 is simulated with the model of urban air pollution UAM-V. The study of total ozone over Kyiv and of its concentration changes with height in the troposphere is made on the basis of ground-based observations with the infrared Fourier-spectrometer at the Main Astronomical Observatory of the National Academy of Sciences of Ukraine as a part of the ESA-NIVR-KNMI project no 2907. In 2008, the satellite Aura-OMI data OMO3PR on profiles of the atmosphere ozone became available. The data include the ozone content in the lower layer of the atmosphere, beginning in 2005. They can be used for the evaluation of the ground-level ozone concentrations in all cities of Ukraine. Some statistical investigation of ozone air pollution in Kyiv and medical statistics data on respiratory system diseases is carried out with the application of the "Statistica" package. The regression analysis, prognostic regression simulation, and retrospective prognosis of the epidemiological situation with respect to respiratory system pathologies in Kyiv during 2000–2007 are performed.

SPS6-3. Current status of Millimetron Mission: Science with Millimetron, Cryotelescope & Instrumentation of Millimetron

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The Millimetron space observatory is designed for the exploration of astronomical sources in the MM and near Infra-Red wavebands. It will have two modes of operation: a single dish telescope mode with extremely high sensitivity and a space-Earth radiointerferometer mode with ultra-long base length to achieve ultra-high angular resolution. In this talk on behalf of Millimetron consortium we would like to outline main scientific goals of Millimetron mission and report the current status of the cryotelescope and its instrumentation development.

SPS7: The Missing Baryons and the Warm-Hot Intergalactic Medium: Current State and Future Prospects

Conveners:
Fabrizio Nicastro (INAF-OAR, Italy),
Martin Elvis (SAO, USA)

Missing matter in a Tidal Dwarf Galaxy

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Tidal Dwarf Galaxies (TDGs) form in galaxy mergers, from the recycled gaseous material expelled during the interaction of the 2 parent galaxy disks. According to the current model of galaxy collision, the amount of non baryonic dark matter in TDGs can not exceed a few percent. Here, thanks to high resolution VLA observations of the spectral HI gas, we report the presence of an abundant "unseen component" in the TDG located in the protype merger NGC 7252. This unseen component is likely to be part of the missing baryonic matter, in form of a cold molecular gas showing that the missing baryons may not only reside in the WHIM.

Future Observational Prospects for WHIM Studies in the Radio Band

Shea Brown

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Shocks and turbulence generated during large scale structure formation are predicted to produce large scale, low surface brightness synchrotron emission. On the largest scales, this emission is globally correlated with the thermal baryon distribution (the Warm-Hot Intergalactic Medium), and constitutes the "Synchrotron Cosmic Web". I present the observational prospects and challenges for detecting this faint emission with the EVLA and other upcoming SKA pathfinders

Studying the Hot Phase of the IGM through Absorption Line X-ray Spectroscopy using WHIMEx

Webste Cash

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The need for high resolution x-ray spectroscopy grows ever more urgent, yet there are still no space missions planned that can provide the needed capabilities. In February of this year the teams of scientists and engineers who had been developing the high resolution (grating) channel of the International X-ray Observatory proposed WHIMEx, the WARM Hot Intergalactic Medium Explorer. This mission uses IXO technology repackaged to achieve over 300square centimeters of collecting area with spectral resolution 4000 in a low cost Explorer package to be launched in 2017. In this talk I will present the concept and show how it was optimized around the scientific goal of studying the hot phase of the WHIM through detection of the O VII and O VIII lines in absorption toward AGN's. But I will also show that such an observatory would address a wide range of important other scientific areas from stellar activity to AGN outflows through an active guest observer program.

Current FUV and X-ray evidence of the WHIM

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Cosmological simulations predict the majority of WHIM are distributed in the filaments that connect the large-scale structure, and can be probed in X-ray/UV bands. With low density and moderate temperature, the WHIM poses a serious challenge to observers. In the past decade, thanks to space telescopes such as HST/FUSE/Chandra/XMM, significant progresses have been made in UV and X-ray observations. In this talk, I will review the latest development and current status of WHIM observations. I will also discuss how the observations confront our current theory of galaxy formation and evolution, as well as the challenges for future theory/observation development.

The missing baryons in the WHIM clouds

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Unseen (missing) baryons in the warm-hot intergalactic medium (WHIM) can be sought through emission and/or absorption in metal lines previously ejected and presumably mixed in the WHIM. When however metals are injected into the IGM by galactic wind and outflows they are confined into denser clumps which not always are easily mixed, but rather remain confined into dense condensations. This circumstance nay heavily burden detection of both emission and absorption in metal lines resulting in a serious underestimate of the mass of missing metals.

The Theory of WHIM: Current State of the Art

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Numerical simulations have proven invaluable to our understanding of the nature of the warm/hot intergalactic medium (WHIM) and the larger problem of the missing baryons at low redshift. It has been understood since the earliest simulations that shocks created by the gravitational collapse and formation of cosmic structure are primarily responsible for the heating of cold gas into the WHIM phase. However, many more mysteries remain largely unsolved, such as the precise influence of star formation and galactic-scale feedback on the evolution of the WHIM and the truly best means for WHIM detection. As computer power has increased significantly over the past decade, numerical simulations are reaching the ability to simulataneously follow the evolution of the IGM on scales of tens of Mpc as well as the galaxies responsible for its enrichment on kpc scales. State of the art simulations have succeeded in matching numerous observational metrics and are now well poised to make important predictions. In thistalk, I will discuss the latest advances in WHIM theory as well as what may be coming shortly over the horizon

Nonequilibrium ionization states in the WHIGM

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We consider nonequilibrium ionization and thermal evolution of the enriched gas ejected from galaxies into the warm-hot intergalactic medium aiming determination of the abundance pattern from observations of the trace ions, such as SiIV, CIV, OVI, NV. We show that at certain conditions the ejected gas falls on to different thermal phases and shows considerable difference between nonequilibrium and equilibrium approaches. As an example we apply our model to the intergalactic gas toward the z=2.73 quasar HS 1700+6416 as a representative field of the WHIM.

Tying galaxy filaments to the X-ray WHIM

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Galaxies and intergalactic gas are expected to follow the same dark matter potential wells, so WHIM absorption lines and large-scale galaxy structures should often be spatially coincident. The interpretation of such correlations is not necessarily straightforward since warm-hot gas also resides in individual galaxy halos

and groups (as seen ubiquitously in the Milky Way/Local Group environment), so this "WHIM" absorption may in fact be attributable to multiple phenomena. Nonetheless, recent observations targeting large-scale structures with Chandra and XMM have convincingly detected high-ionization absorption lines. I will present results from the "reverse" experiment: characterization of the galaxy environments around previously reported X-ray absorption line detections, along with implications for the nature of the lines, possible caveats, and potential ways forward.

SPS8: Astronomy Education and Public Outreach in Europe

Conveners:
P. Russo (IAU/Leiden, NL),
I. Robson (Edinburgh, UK),
M. Stavinschi (Bucharest, Romania),
Rosa Maria Ros (Barcelona, Spain),
Olga Dluzhnevskaya (Russia)

Hands-On Universe — Europe (EU-HOU)

Roger Ferlet

IAP, FR

The EU-HOU project is a collaboration of hundreds of teachers and scientists from 15 countries with the purpose of creating a way for students to get excited by science, primarily through the use of astronomy. Astronomy is one of the most popular subjects for students of all ages, and the chance to use real astronomical data to investigate volcanoes and craters on Mars or the moons of Jupiter, to discover a new planet outside our solar system, to weigh a galaxy and discover the existence of dark matter, or to identify the black hole at the center of the Milky Way, can engage our students in the wonders of scientific discovery, and arouse the natural scientist contained in all young and old people alike.

Scientific Journalism and Astronomy Outreach in Armenia

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Recently a Scientific Journalism group has been created in Armenia to facilitate and promote scientific (mostly astronomical) publications in mass media. It involves 91 people; mostly journalists from various mass media (TV, radio, newspapers, Internet media), as well as young scientists. Astronomers directly distribute press-releases and other information materials on various space topics: astronomy and astrophysics, space flights, space catastrophes, archaeoastronomy, astrobiology, extraterrestrials, etc. We have also created a Facebook group on Scientific Journalism as well to get science-writing journalists in Armenia together and share information. It is planned that from time to time we invite the group members to Byurakan for meetings, where science news will be presented and scientific journalism matters will be discussed. Gradually it will turn to a real collaboration between the scientists and journalists. A press conference was given on December 22, 2010 in "Armenpress" News Agency presentingthis initiative. During the first 4 months, already 50 press-releases were circulated to the group members that resulted in more than 300 publications in newspapers and Internet web-sites. Articles were about the Byurakan Astrophysical Observatory (BAO), Armenian Astronomical Society (ArAS), grants, International Astronomical Olympiad, anniversaries of astronomers, astronomy events and news, state of astronomy in Armenia, virtual observatories, astronomy and astrology, etc. Moreover, a number of interviews and press-conferences were taken additionally. To encourage popular astronomy publications and programs in Armenia, ArAS and the Oxford Armenian Society (OxArm) have jointly established four annual popular astronomy prizes: 1) for the best newspaper/journal/online article, 2) for the best radio/TV program, 3) for the most active journalist, 4) for the best astronomical photo. On April 16, the First Seminar on Scientific Journalism was organized in Armenia, and some 35 people were present. Next year in 2012, the 1400th anniversary of the great Armenian medieval astronomer and mathematician Anania Shirakatsi will be celebrated, and astronomers and scientific journalists have a number of ideas to accomplish related to this event.

Global Astronomy Month — continuing the celebration of the Universe

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One of the most successful global outreach efforts during International Year of Astronomy 2009 was 100 Hours of Astronomy. Astronomers Without Borders organization captured the energy of the 100HA and momentum given by IYA2009 and refocused it as an ongoing annual celebration of the Universe by organizing Global Astronomy Month; a worldwide celebration of astronomy in all its forms in every April. In 2010, the program saw professionals and amateur astronomers, educators and astronomy enthusiasts from around the globe participating together in the spirit of International Year of Astronomy 2009 and provided a global stage for established programs and a framework for partnerships. The 2011 version of the program saw much bigger

participation with several global partner organizations joining in creating more than 40 global level programs throughout the month. Within a short period of time, Global Astronomy Month has evolved to a much needed global platform after International Year of Astronomy 2009.

Astronomy Olympiads and their importance

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International Astronomy Olympiads appear as an important tool in astronomy education. The author wants to present part of his own experience.

Need of amateur astronomy

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Being engaged with the group solely dedicated for the promotion of astronomy for the development of our society I am so delighted to be able to do science from small telescopes with NASO providing an amateur observatory for observation and its programmes has a good impact in flourishing astronomical awareness. Also being a research scholar of Cosmology and Astrophysics Research group of Tribhuvan University I got to go through both amateur and professional Astronomy. Programmes conducted by both astronomy and their impacts including collaborations, way of working (data analysis techniques and used software) etc will be discussed in parallel for both amateur and professional astronomy in our country. Other assisting factors like social media, book drive, internet, Our TV programmes, etc will also be discussed meticulously that makes possible for our Astronomy education and public outreach programmes including the results and future plans.

European Universe Awareness

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The European Universe Awareness (EU-UNAWE) programme uses the beauty and grandeur of the cosmos to encourage young children, particularly those from underprivileged backgrounds, to develop an interest in science and technology and to foster a sense of global citizenship. EU-UNAWE is already active in 40 countries and comprises a global network of almost 500 astronomers, teachers and other educators. The programme was recently awarded a grant of 1.9 million euros by the European Union so that it can be further developed in five European countries and South Africa. The grant will be used to organise teacher training workshops and to develop educational materials, such as an astronomy news service for children and games. During this presentation we will outline some of the biggest achievements of EU-UNAWE to date and discuss future plans for the programme.

Are we prepared to face natural disasters that are threatened by the media?

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Every day the media threaten us with either solar flares or with changes to the Earth's axis of magnetic pole position, either by eclipse or meteor impacts, not to mention the "imminent" end of the world, announced first for 2012, now postponed a little bit later. Are we prepared to face this unprecedented media aggression? My own opinion is we are not yet. Teachers and scientists journalists have to work together for a deeper education of all generation, especially of the youth to understand the ground base of the phenomena, of the events, to offer them the scientific explanation, to avoid panic and, contrary, to prepare a lot of people to be the link between scientists and general public. A lot of international or national programs could answer to the big questions about the Universe. A general education can help to prepare a generation for whom the planet Earth must be protected from the ground or from the space. Several methods of education in this respect will be proposed.

POSTERS

SPS8-1. AstroGarden at Roma Tre University — An open air physics laboratory

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In the heart of the Department of Physics of Roma Tre University there is a garden where, in spring time, daisies bloom, students sit on the grass studying and discussing, and professors pass by, lost in their deep thoughts. In this garden recently flourished two new astronomical structures: an oriented-Globe (oriented just like Planet Earth) and a small observatory. So this garden has become our "Astrogarden". The oriented-Globe gives you the opportunity to make many simple experiences of orientation in space and on Earth-Sun relationships. The observatory — in addition to visual observations of the Moon and Planets — permits to gain skills in photometry and spectroscopy, with the aid of modern CCD's. In a city like Rome, where light pollution never lets real night come, the Astrogarden is one of the few places where direct contact between man and sky is possible. The Astrogarden raises interest by students and all visitors, drawing people to astronomy.

SPS8-2. A multidisciplinary educational laboratory based on meteorite samples

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The italian national project Piano Lauree Scientifiche (PLS) www.progettolaureescientifiche.eu is addressed to high school students in order to promote their interest in physics and science with the aim of increasing professional vocations and enrollments in scientific faculties. In the PLS framework, at Roma Tre University we developed an itinerant educational laboratory based on meteorites analysis by means of a portable kit. The activity is performed at school and the students are directly involved in the study of meteorite features and in measurements of physical properties of the samples. Students are intriguingly introduced in the scientific method working together in acquisition and analysis of data, and writing a final report. Lessons and laboratories were developed in collaboration between researchers and high school teachers. Thanks to their

multidisciplinary character the activities represent an excellent tool for stimulating the interest in different fields of science as astronomy, physics, geology and biology.

SPS8-3. Astronomical olympiads in Russia

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Astronomy Olympiads are being held in Russia (first, in the Soviet Union) for more than 60 years. Russian National Astronomy Olympiad was organized on the base of several regional astronomy Olympiads in 1994. It is held under the guidance and with the financial support of the Ministry of Education. The main goal of the Russian National Astronomy Olympiad is to find talented pupils and to lend them support. The Olympiad is divided into 4 stages. There are also Astronomy Olympiads which do not depend on the Ministry of Education. They are held by the leading Russian Universities. The largest of them are Olympiads in Saint-Petersburg, Moscow and Kazan which are organized by Saint-Petersburg, Moscow and Kazan State Universities respectively. The main goal of these Olympiads is to find future students of astronomy departments of Universities and to lend them support. The winners and awardees of these Olympiads form national teams which are sent to the International Astronomy Olympiad.

SPS8-4. An astronomical simulation expanded views of educational technology in postgraduate training

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We tested a hypothesis that the geographical location of some ancient cities could be chosen after astronomical observations and geometric constructions completed in their foundation or rebuilding. And we may argue in favor of the hypothesis on the basis of computer-simulation derived data. In particular the ecliptic latitude of a zenith above Alexandria founded by Alexander the Great becomes equal $1/2 \times 109°28'$ and the ecliptic latitude of a zenith above the historic Beijing rebuilt during the Ming Dynasty becomes exactly equal $63°26'$ if the observation moment was noon of a day of winter solstice in the year 1440 when an angle between equator and ecliptic planes becomes equal to $1/3 \times 70°32'$. Angles $109°28'$, $63°26'$, $70°32'$ are dihedral angles of tetrahedron, icosahedron, hexahedron. Undergraduate historians were asked to take part in researches after the results publication. Then it was that we felt the necessity for a course of lectures on astronomy and solid geometry for historians.

SPS8-5. Analysis of the properties of intercluster medium

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One of the problems in modem physics of clusters of galaxies is solution cooling flows problem. Today in all models use hypothesis about only one source of heating intracluster gas. Energy of heating is used up X-ray and convection mixing of gas. The existence filaments in clusters point to possibility existence of convection mixing of gas. If this large-scale mixing exists, that gas from centre of cluster drift to periphery of cluster, cooling, and emit in optics. The more energy in X-ray, the less energy in gas convection, and the less gas participate in creation of optical luminosity, and the less filaments are observed. For discovery dependence between X-ray and optics the statistical analysis of properties of 213 rich clusters of galaxies is performed. The existence of correlations between the X-ray luminosity and the temperature of the intracluster medium, the X-ray luminosity and the velocity dispersion of the galaxies is confirmed. New anti-correlation between

optical luminosities and X-ray luminosities of intracluster gas in clusters is discovered. This anti-correlation is consequence of the hypothesis about one source of heating intracluster gas.

SPS8-6. The Aula Espazio and the Master of Space Science & Technology in the Universidad del País Vasco (Spain)

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We present the Aula Espazio, a facility dedicated to teach Space Sciences and Technology at Master and Doctorate level at the Universidad del País Vasco (Spain) and to promote development in this field in both the public and private sectors. A new University Observatory which homes a 50 cm telescope, a solar telescope and other instruments is also associated to the Aula. The most important actuivities of the Aula are developed within the context of the Master in Space Science and Technology offered in the Engineering School of Bilbao (Spain) which is designed to provide a link between basic research and space technology. The Master in Space Science and Technology is a one year master designed to give an overall view of the science and technology involved in space projects. It is open for graduates in Engineering and graduates in Physics. This master covers both the basic science aspects of space science and the technological development that space activities require. It is a multidisciplinary master with several University departments participating (Applied Physics, Theoretical Physics, Systems Engineering and Automatic control and Electronics and Telecommunications) and with important contributions from companies involved in space technology and Spanish public organisms in the space area. More information at: http://www.ehu.es/aula-espazio/.

SPS9: Amateur & Professional Astronomers in Europe

Conveners:
N. Samus (Euro-Asian Astron. Soc., Russia),
P. Russo (IAU/Leiden, NL),
J.-L. Dighaye (EAS),
V. Surdin (Sternberg Astron. Inst., Russia),
I. Andronov (U. Odessa, Ukraine)

Mathematical Models of Physical Variability in Stars

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We review a wide variety of types of variability of stars, methods for data reduction of astronomical signals and numerous examples of Am-Pro collaboration. An expert system for advanced time series analysis was elaborated for multi-channel multi-component signals with (generally) non-regular distribution of arguments. Among studied signals, are mono-, multi-, quasi-, (newly discovered) "transient" periodic; chaotic and "shot-noise". For each type of signals, we discuss methods for statistically optimal modeling. Results are illustrated by highlights of the international observational campaign "inter-Longitude Astronomy", which has parts "Polar", "Superhumper", "Stellar Bell", "New variable". This project joins professional telescopes from 2.6 to 1m and amateur/planetaria/small observatories with 30-60cm class telescopes. The expert system was applied to >1400 variable stars of different types (including newly discovered ones), mainly interacting binary systems and pulsating stars. We used the satellitedata, CCD, photopolarimetric monitoring, but also advanced time series analysis of long-period variables based on the AFOEV, VSOLJ and AAVSO international databases. Results and perspectives/call for observations are discussed with a special emphasis on Am-Pro collaboration.

Exoplanet transits, target for both professional and amateur astronomers

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Amateur astronomers equipped with modern CCD detectors can produce precise stellar photometry. Wide spread of CCD detectors among amateurs came along with discoveries of transiting exoplanets in last 10 years and brings on new field of amateur astronomy. It is demonstrated the ability of backyard astronomers to measure exoplanet transits and described are methods for increasing photometric precision. It is also discussed the perspective of amateurs contribution to exoplanet research and introduced is an internet portal Exoplanet Transit Database.

Pro-Am Collaborations: An Overview

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At the occasion of the second JENAM after the end of the International Year of Astronomy 2009 — which constituted a unique opportunity to foster communication and cooperation between professional and amateur astronomers (Pro-Am) — it is time to reflect on the legacy of "Beyond IYA" projects, and to assess basic issues, such as: – Which aspects should Pro-Am explicitly include or exclude? Are professional astronomy communicators and professional providers of astronomy-related goods or services part of Pro-Am? – Which new development areas should be encouraged? Is social networking an appropriate tool for Pro-Am? What is the difference between science and citizen science? – How do amateur astronomers perceive other amateurs and professionals? What is the perception of the professionals? In that regard, a poll was conducted within active members of the EurAstro association. While some results could have been expected — professionals are enthusiastic about their job, and amateurs even more enthusiastic about their hobby, other results show intriguing discrepancies between the perceived outstanding qualities of the professionals and those of the amateurs.

ProAm collaboration in Educational and Public Outreach

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Professional-Amateur collaborations in Astronomy have expanded from small telescope research to space and ground based research facilities to online data mining. These collaborations have lead to create innovative programs in Educational and Public Outreach globally pushing the boundaries in science education among public, giving the opportunity to engage directly with scientific research. Thorough overview of recent ProAm EPO efforts shows why such collaborations are important for both public understanding of science and for scientific purposes.

The connection of Hungarian amateur and professional astronomers, from the past to the present

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In this talk we overview the history of the amateur astronomy in Hungary since the 19th century up to the present in a nutshell. Our milestones are some emblematic key-persons, some important dates and scientific results which are highly respected by the astronomical community of the World. The numerous amateurs and professional astronomers had a close connection during the end of 19th century. Later this situation has been changed to a rather separate, independent group of a few enthusiast dilettantes and the scientists. The amateur astronomy had a dynamic development by Dr. Kulin in 1946. The parallel walk of life of amateurism and professionalism started to approach each other after the 80's, when both the computer technics and commercial optical instruments turned to be available for more people. Nowadays there are a lots of well-equipped amateur observatories supporting the professionals with utilizable data in many fields of astronomy, even some of them produced numerous discoveries as well. On the other side, the professionals organize educational courses and personal meetings for the amateurs to share experiences, to give advices and feed-back.

Phenomenological modelling — an efficient tool for variable stars research

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The phenomenological (mathematical) modelling of the observed stellar variability respecting the individuality of each studied variable object comes to be a surprisingly potent instrument for the variable stars research. Particularly, it is effective in solutions of everyday problems of observers engaged in the observation of periodical or nearly periodical types of variable stars and enables to exploit all available observational data as fully as possible. The phenomenological modelling is open for everybody who mastered the basis of PC programming. It enables the reliable determination of times of light curves extrema, the improvement of linear or more complex ephemeris of periodic variables, the study of apsidal motion of binaries and the influence of the third body in the system. At the top, the mathematic modelling applied primarily to original observational data due its transparency and straightforwardness is able to reveal the lacks in the basic treatment of the obtained observational material better than the favoured complex physical modelling. The efficiency of the new approach is documented by several examples.

50 years of my variable star observing

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A talk not only about amateur variable star observing.

A platform for ProAm Collaborations

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During my presentation I will present the concept for a platform for collaboration between amateur and professional astronomers. This platform will increase the collaborations between professional and amateurs astronomers as well as other astronomy enthusiasts. It is intended to foster pro-am collaborations, raise awareness of the results coming from pro-am collaborations and provide standards to pro-am collaborations.

The electronic journal "Peremennye Zvezdy/Variable Stars": what does it give to amateur astronomers

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The professional, peer-reviewed journal "Peremennye Zvezdy/Variable Stars" was founded in 1928 by Boris Kukarkin who later became a famous variable-star researcher, professor of Moscow University. In 2005, the journal was re-started as a purely electronic, English-language scientific journal on all aspects of variable-star research. It consists of the main journal and the supplement, devoted to standard-format publications of observational character. The journal is fully covered by ADS, reflected in SIMBAD and VSX. Because of editorial policies of many astronomical journals, "Peremennye Zvezdy/Variable Stars" is currently almost the only place for professional and amateur astronomers open to publications on any variable-star discoveries, from original observations or from data mining, on studies of variables of "ordinary" types (with all kinds of stars among them that can eventually become quite interesting astrophysically!). The journal attracts many submissions from astronomers of different countries. Our everyday work with amateur astronomers reveals great potential of non-professional variable-star researchers but also teaches important lessons on errors in writing papers and preparing manuscripts typical of amateurs.

Meteors as a Tool to Foster Pro-Am Collaboration

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The International Meteor Conference held in Armagh on 16-19 September 2010 (IMC 2010) [1] put in evidence that the collaboration between professional (Pro) and "amateur" (Am) astronomers is fundamental for the improvement in the knowledge of the morphology of single meteors and meteor showers. In this paper the main results of the IMC 2010, in both the optical and radio meteors observations will be revised and the past and present EurAstro Association projects of meteors radio observations in Munich will be presented.

Discovery, Study, Classification and Modeling of Variable Stars

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We present a review of methods of discovering and studying of new variable stars, based on photometry of all objects seen at the field of CCD images. The statistical search for variable stars proved to be the most effective. This method had been realized already in computer programs "MuniWin" (for Windows platform) and VaST (for Linux platform). We also review statistical methods for analyzing the photometric data, which allows determining all parameters needed for the General Catalog of Variable Stars and for publishing the new discovery. We illustrate the effectivity of these methods on variable stars, which we have discovered, and discuss their classification. As the most common discoveries are new binary systems, we also review modeling as the method of further advanced investigation of these variables. Most of the programs for modeling binary systems are based on the Wilson-Devinney code. Some results obtained using this code are presented; the problems and features are discussed.

Binary star research using nanotelescopes

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Most observatories have replaced photoelectric photometers by CCD cameras at present. This caused new possibilities but also troubles in obtaining new photometric observations of bright stars. We offer simple solution using nanotelescopes equipped by CCD cameras which could be used mainly by amateur astronomers and for teaching of astronomy. Several examples of results are given.

POSTERS

SPS9-1. Open European Journal on Variable stars

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We introduce Open European Journal on Variable stars, the electronically issued journal founded in 2005. It is focused mainly on short papers about variable stars. Although authors are mostly amateur astronomers, the international editorial board guarantee high quality content of all issued papers. The journal is issued in free access mode.

SPS9-2. Ukrainian Astronomy Amateur's Society (UAAS) activities for increasing interest of astronomy learning

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Ukrainian astronomy amateurs' society (UAAS) joins amateurs and amateurs' societies of Ukrainian towns. UAAS is associated member of Ukrainian Astronomical Association. The president of UAAS is prof. Churyumov K. I. and vice-president is prof. Andronov I. L.

UAAS divisions are such as the Ukrainian Association of Variable Star Observers (UAVSO), Ukrainian cometary division, divisions of observing Sun, planets, Moon, meteors and Deep-sky objects, astronomy with computer and CCD, building of telescopes, art of astrophotography and distance astronomy education (Odessa Correspondence Astronomical Courses). Every year in Ukraine are hold astronomy amateurs festival called ASTROFEST (by UAAS) since 2000 and UkrAstroForum (by astronomy amateurs of Kharkov city) since 2002. There are lectures of professional astronomers, observations of celestial bodies and data reduction, presentations of astronomical guides, popular and methodological papers, and amateurs presentations. In these festivals take part many young people, pupils and students, astronomy educators, teachers and professors. Practical activities with telescopes and computers, active learning, enthusiasm of amateurs and professionals, beauty of night sky etc. follow to increase astronomical interest of young people.

Amateur conferences like ASTROFEST and UkrAstroForum and popular and scientific magazines for Ukrainian amateurs like "Our Sky"("Nashe Nebo") and "Universe" ("Vselennaya") are good tools for to get excite by astronomy and for general astronomy education. Activity and results of astronomical observations of UAAS' members are discussed.

SPS9-3. Positional and photometrical observations of comets and variable stars at the city station of AI KhNU

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Two telescopes: AZT-7 (Maksutov reflector, D = 20 cm, F = 200 cm) and a new Baker-Schmidt reflector (D = 40 cm, F = 230 cm), created by Alexander P. Zheleznyak, are located at the city station of the Astronomical Institute of V. N. Karasin Kharkov National University. These telescopes were equipped with cameras Canon EOS 300D and Canon EOS 350D. The results of observations of comets 17P/Holmes, S/2006 W3 (Christensen), C/2008 J1 (Boattini), 103P/Hartley, and some variable stars, obtained with the help of these telescopes, are presented and discussed.

SPS9-4. How did from the calendar reform of Maksim Trpković (1864-1924) made the Trpković-Milanković's calendar (or Milanković's calendar)

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In 1900 Maksim Trpković (1864–1924) proposed a calendar reform by which two years are leap from the 9 secular years which are leap in the Julian and Gregorian calendar (whereas according to the rule that their number is divisible with 4 without a remainder), and only those which after being divided by 9 yield a remainder of 0 or 4, and the rest 7 are common years. In this way he obtains a calendar year which differs from the mean tropical year by only 2 seconds. At the Pan-Orthodox Congress in 1923, after the presentation of Trpković's calendar, to get a longer parallel with the Gregorian calendar (until 2800), the famous scientist Milutin Milanković(1879–1958) changed Trpković's intercalation rule (the order of secular leap years) in a way that from the 9 secular years two are leap ones which divided with 9 yield a remainder of 2 and 6, and the rest 7 stay common. The Congress accepted such calendar modification which was named Reformed Julian Calendar. In the Serbian wider public this calendar was represented as Milanković's calendar, while in the several scientific papers it was called Trpković-Milanković's calendar, because of the creative contribution of Trpković to this calendar. It is understandable that in this calendar solution the difference between calendar year and the tropical one is also 2 seconds, which comes from the basic idea of Trpković's project.

SPS9-5. Multidecade scientific collaboration between Belgrade Astronomical Observatory and Pulkovo Observatory of RAS

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The authors give historical retrospect of the scientifics collaboration of the Belgrade Astronomical Observatory with Pulkovo Observatory of RAS. Many astronomers of the Belgrade Observatory have sojourn for prefection in the fundamental astronomy at the Pulkovo Observatory which present central institution in this field of astronomy.

SPS10: European Astronomy: Moving Forward

Conveners:
J. Andersen, (Niels Bor Institute, Denmark)

ASTRONET policy reviews and implementation activities

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The ASTRONET network of funding agencies was founded in 2005, with support from the EU Commission, to establish a comprehensive strategy for the development of all of astronomy in all of Europe. Through 2010, it has prepared and published its Science Vision and Infrastructure Roadmap reports as a basis for future planning. Several large/global infrastructure projects are now being discussed by the appropriate host organisations (ESO, ESA, etc.) on the background of this agreed, common European policy.In areas such as the existing 2-4m optical/IR telescopes and radio facilities, policy reviews are completed or under way, and action towards implementation is being initiated. Plans for other fields (laboratory astrophysics, software, ...) are also in preparation. These and several other activities will continue under a new EC contract for 2011-2014.

OPTICON: Forging a European 2-4m telescope system

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With support from the European Commission's FP6 and FP7 programmes, OPTICON has been working for some years to foster closer co-operation between Europe's 2-4m optical and infrared telescopes. In 2010 OPTICON began to operate a single international time allocation process for all observing time supported directly by the EC OPTICON grant. I will report on how this process has operated, on the statistics of the observing time awarded and describe how this offers a possible model for the wider co-operation proposed by the report commissioned by ASTRONET on the future rationalisation and optimisation of Europe's 2-4m telescopes.

Current plans in astroparticle physics

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I will report on the recent update of the European Astroparticle roadmap under the auspices of the AStroParticle European Research Area network (ASPERA) and Astroparticle Physics European Coordination (ApPEC); the status of realisation of the main priority infrastructures and the steps taken to increase the overall coherence in R&D and industrial procurement. I will also report on the current steps towards permanent coordination schemes of the field in Europe as well as the efforts to coordinate the construction of Astroparticle infrastructures in a worldwide context within the OECD coordination group APIF (Astroparticle International Forum).

Regional development and training aspects

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We explore the connection of the astronomical communities in Albania, Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Serbia, Slovakia, Slovenia and Ukraine and other countries to the mainstream European astronomy as it is described in the ASTRONET Roadmap. We analyze the

obstacles complicating relations, and we propose suitable actions that may accelerate the regional development and training to achieve more integration in the future. We would like to identify the most promising research activities and research groups and discover their key financial and other needs.We would also like to help in developing national roadmaps and recommend suitable institutional and agency policies to enable better access to European telescopes via OPTICON and RADIONET, and to prepare a possible future membership in ESO.

The European Extremely Large Telescope project

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ESO is currently in the final stages of the detailed design of a 40-m class Extremely Large Telescope. The telescope will be situated on Cerro Armazones in close proximity to the VLT and will be the world's biggest eye on the sky. The E-ELT is an adaptive optics telescope, delivering images with some level of correction for the atmosphere at all times. The optical design of the telescope is an anastigmatic 3-mirror system, together with two folding flats that are used to extract the beam to a Nasmyth focus. An extensive instrument suite has been studied as part of the design process. An overview of the E-ELT will be presented outlining the current design and programmatic status.

RadioNet — current status and future developments

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RadioNet is an EC FP7 integrating activity that brings together all the major radio observatories in Europe, covering the frequency range of 30 MHz to 1 THz. The overall aim is to support the radio astronomy community in general, and to improve the capabilities of, and enhance access to, the major radio astronomy facilities in Europe and beyond. The current status of the overall project will be presented with a focus on the telescope facilities being made available and on the Joint Research Activities.

New funding for the continuation of RadioNet beyond 2012 has recently been secured and the new programme is expected to start on 1 January 2012. An overview of the new developments supported by this new subsidy will also be presented.

Optimising the European radio telescope system

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As a result of the ASTRONET Science Vision and Roadmap exercises, plans have been prioritised for new instruments and actions for the future of European Astronomy, and also some reviews of existing types of facility have been requested. One example is the review of 2-4m class optical/IR telescopes, which has been completed. The topic of this talk is a review of European Radio Telescope Facilities covering the time frame to 2025, which is starting up. Among the major questions the review will address are: How will these facilities contribute to achieving the goals of the Science Vision? How do they fit in with all other facilities and plans in the Vision and Roadmap? What is the interaction between existing radio facilities and their future plans, and new facilities that are envisaged? I will discuss plans for how to conduct the review and to engage the observatories, the experts, and the full European astronomy community into the process optimally.

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List of presenters