Taras Shevchenko National University of Kyiv
Department of Astronomy and Space Physics

21th Young Scientists' Conference on Astronomy and Space Physics

Abstracts

Kyiv, 2014

21th Young Scientists' Conference on Astronomy and Space Physics

April 28-May 3, 2014
Kyiv, Ukraine

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Preface

This year Young Scientists' Conference on Astronomy and Space Physics is held for the twenty first time. We all have been looking forward to the annual meeting of astronomers at Taras Shevchenko National University of Kyiv. Now it has friendly opened its doors for participants from all over the world.

Young Scientists' Conference has a long history. The first meeting was organized by Physics faculty of the Taras Shevchenko National University of Kyiv as a students' conference in 1994. Since 1996 our conference has welcomed young researchers from other universities and scienti c institutions. During 1994-2011 participants from Ukraine, Russia, Poland, France, Germany, Spain, Sweden, Libya, Egypt, Japan, Finland, Turkey, China, Slovakia, Armenia, USA, Romania, Iran, Armenia, Georgia, Morocco, South Africa and other countries participated in Young Scientists' Conference.

The conference is aimed at strengthen the position of astronomy and promote space physics research. The lectures and reports presented by the participants traditionally reflect modern trends and actual problems of the science, the sessions facilitate informational exchange about the latest innovations and achievements.

On behalf of the organizing committee we would like to express our gratitude to the invited lecturers and participants for contributing lectures and reports. We are especially grateful to Prof. V. M. Ivchenko for the help in conference organization.

Kateryna Frantseva and
Local Organizing Committee

PROGRAMME

Monday, April 28

09.00-13.00 - Registration
13.00-13.30 - Official opening

Section 'Solar System & Exoplanets'

13.30-13.45 Tanya Gromakina, I. N. Belskaya, J. L. Ortiz, V. G. Shevchenko *(V. N. Karazin Kharkiv National University, Kharkiv, Ukraine) Rotation and shape of the dwarf planet Makemake* **(12+3)**

13.45-14.00 Oleksii Matsiaka, Yu. Kuznyetsova, V. Krushevska *Taras Shevchenko National University of Kyiv, Kyiv, Ukraine) Parameters estimation obtained from the photometric data considering red noise in the wavelet-based framework* **(12+3)**

14.00-14.15 Olena Shubina, O. V. Ivanova, V. L. Afanasiev *(Taras Shevchenko National University of Kyiv, Kyiv, Ukraine) Spectral and polarymetry investigation of the comet C/2012 J1 (Catalina) at 6 meter telescope SAO RAS* **(12+3)**

14.15-14.30 Vasyl Ponomarenko, K. I. Churyumov, V. V. Kleshchonok *(Astronomical Observatory of Taras Shevchenko National University of Kyiv, Kyiv, Ukraine) The dusty atmosphere, some physical parameters and the luminescent continuum in the spectra of comets C/2006 W3 (Christensen), C/2007 N3 (Lulin), C/2009 P1 (Garradd)* **(12+3)**

14.30-15.00 tea-break

15.00-15.05 Alyona Mozgova, K. I. Churyumov, V. O. Smirnov *(Astronomical Observatory of Taras Shevchenko National University of Kyiv, Kyiv, Ukraine) The temporal evolution of the meteor spectrum of 21 October, 1958* **(poster)**

15.05-15.10 Julia Andrienko, O. Ivanova, V. Reshetnyk , A. Golovin *(Taras Shevchenko National University of Kyiv, Kyiv, Ukraine) Photometric investigation of comet 2013 A1* **(poster)**

15.10-15.15 Sergiy Kolisnyk *(Taras Shevchenko National University of Kyiv, Kyiv, Ukraine) Dynamical model of the motion of bodies in the Solar System* **(poster)**

Tuesday, April 29

Section 'Stellar Astrophysics and Interstellar Medium'

09.00-09.30 morning coffee

09.30-09.45 Iryna Kushniruk, Ya. V. Pavlenko *(Taras Shevchenko National University of Kyiv, Kyiv, Ukraine) Abundances in the atmosphere, effective temperature and surface gravity of the subdwarf metal-poor star G 224-58 A* **(12+3)**

09.45-10.00 Mykola Malygin, R. Kuiper, H. Klahr, Th. Henning, C. P. Dullemond *(Max-Planck-Institut für Astronomie, Heidelberg, Germany) Advanced Gas Opacity for Circumstellar Environments* **(12+3)**

10.00-10.15 Vitalii Breus, K. Petrik, A. Baransky, T. Hegedus *(Odessa National Maritime University, Odessa, Ukraine) Photometric Study of the Intermediate Polar V2306 Cyg* **(12+3)**

10.15-10.30 Maxim Mogoryan, N. A. Virnina , F. Martinelli *(Odessa Mariinskaya High School, Odessa, Ukraine) Discovery of New Variable Stars* **(12+3)**

10.30-11.00 tea-break

11.00-11.15 Natalia A. Virnina, F. Martinelli, T. Krajci, M. Mogoryan *(Odessa Mariinskaya High School, Odessa, Ukraine) Period and light curve variations of the binary star XY Boo* **(12+3)**

11.15-11.30 Sergii Pokhvala, B. E. Zhilyaev, V. M. Reshetnyk *(ain Astronomical Observatory of the National Academy of Sciences of Ukraine, Kyiv, Ukraine) Spectral observations of chromospherically active stars 61Cyg AB with slitless spectrograph on small telescopes* **(12+3)**

11.30-11.35 Alisa Shchurova, A. Sklyanov, E. Pavlenko, V. Malanushenko, K. Antonyuk, N. Pit *(Taras Shevchenko National University of Kyiv, Kyiv, Ukraine) Dwarf nova MN Dra: evolution of the negative superhumps between different outbursts* **(poster)**

11.35-11.40 Andrew Simon, V. V. Vasylenko, N. V. Metlova *(Taras Shevchenko National University of Kyiv, Kyiv, Ukraine) Optical observations of the 1H1936+541 in 2008-2014* **(poster)**

Wednesday, April 30

Section 'Extragalactic Astrophysics'

09.00-09.30 morning coffee

09.30-09.45 Artem Bohdan, B. I. Hnatyk *(Taras Shevchenko National University of Kyiv, Kyiv, Ukraine) Study of short-term variability of the weak X-ray sources. Variability of nodes of jet of Centaurus A* **(12+3)**

09.45-10.00 Olena Torbaniuk, G. Ivashchenko *(Taras Shevchenko National University of Kyiv, Kyiv, Ukraine) Dependence of equivalent width of quasar emission lines on UV spectral index, quasar luminosity and BH mass* **(12+3)**

10.00-10.15 Anatoliy Tugay *(Taras Shevchenko National University of Kyiv, Kyiv, Ukraine) Extragalactic filament detection with layer smoothing method* **(12+3)**

10.15-10.20 Teymur Saifollahi *(K.N.Toosi University of Technology, Tehran, Iran) Star formation rate (SFR) – local density relation in Virgo galaxy cluster using Hα observations* **(poster)**

10.20-10.25 Alla Gotsulyak, E. Panko *(Odessa I. I. Mechnikov National University, Odessa, Ukraine) Morphological Classification of 248 PF Galaxy Clusters* **(poster)**

10.25-10.30 Kateryna Sukach, V. V. Marchenko *(Taras Shevchenko Chernihiv National Pedagogical University, Chernihiv, Ukraine) Analysis of spatial and temporal properties of Jets in AGN with CIAO* **(poster)**

10.30-10.35 Iuliia Tsykaliuk, Yu. Kudrya *(Taras Shevchenko Chernihiv National Pedagogical University, Chernihiv, Ukraine) Dark matter in the Local group* **(poster)**

10.35-11.10 tea-break

Section 'Gravitation & Cosmology'

11.10-11.55 Peter Berczik (Main Astronomical Observatory, National Academy of Sciences of Ukraine, Kyiv, Ukraine) *Dynamical modelling of supermassive black hole binary evolution during the galaxy mergers. The "final parsec problem" is not a problem* **(invited)**

11.55-12.10 Margarita Sobolenko, P. Berczik, R. Spurzem, G. Kupi *(Main Astronomical Observatory, National Academy of Sciences of Ukraine, Kyiv, Ukraine) Large scale galaxy collisions simulations with central Post Newtonian Binary Black Hole* **(12+3)**

12.10-12.25 Maksym Teslyk, O. M. Teslyk *(Taras Shevchenko National University of Kyiv, Kyiv, Ukraine) Scalar entanglement entropy at Schwarzschild horizon* **(12+3)**

Thurthday, May 1

Section 'High Energy Astrophysics'

09.00-09.30 morning coffee

09.30-09.45 Ievgen Vovk, A. Neronov, D. Malyshev *(Max Planck Institute for Physics, Munich, Germany) Comparison of the expected and observed supernova remnant counts with Fermi/LAT* **(12+3)**

09.45-10.00 Taras Kuzyo, O. Petruk *(Ivan Franko National University of Lviv, Lviv, Ukraine) Gamma-ray image of Tycho SNR* **(12+3)**

10.00-10.15 Anton Dmytriiev, A. Neronov, D. Malyshev *(Taras Shevchenko National University of Kyiv, Kyiv, Ukraine) Detection and study of very high energy cosmic rays with Imaging Atmospheric Cherenkov Telescope* **(12+3)**

10.15-10.30 Chioma Franklynda Okany *(University of Nigeria, Nsukka, Nigeria) A Statistical of Glitch Activity in 85 Pulsars* **(12+3)**

10.30-10.45 Roman Gnatyk *(Taras Shevchenko National University of Kyiv, Kyiv, Ukraine) Transition from Galactic to extragalactic cosmic rays based on KASCADE-Grande data* **(12+3)**

10.45-11.15 tea-break

11.15-11.20 Yair Israel Piña López, P. R. Hugo Francisco *(National Autonomous University of Mexico (UNAM), Mexico, Mexico) Charged particle detection using a CMOs sensor in the space environment* **(poster)**

11.20-11.25 Nino Chkheidze *(Center for Theoretical Astrophysics, ITP, Ilia State University, Tbilisi, Goergia) Cosmic Ultra-high energies and their realization mechanisms* **(poster)**

11.25-11.30 Anatoliy Vasylenko *(Taras Shevchenko National University of Kyiv, Kyiv, Ukraine) Dependencies of X-ray spectral parameters for a sample of BAT AGNs* **(poster)**

11.30-11.35 Lidiia Zadorozhna, B. I. Hnatyk *(Taras Shevchenko National University of Kyiv, Kyiv, Ukraine) Electromagnetic emission bursts from the shock wave around the near-cusp region of superconducting cosmic string in cosmic plasma* **(poster)**

Section 'Solar Physics and Heliosphere'

11.35-11.55 Olga Botygina, V. G. Lozitsky *(Astronomical Observatory of Taras Shevchenko National University of Kyiv, Kyiv, Ukraine) Which is spectral line minimum in spectra of prominences?* **(12+3)**

11.55-12.10 Oleg Lozitsky *(Taras Shevchenko National University of Kyiv, Kyiv, Ukraine) Creation and usage of program code for strong subtelescopic solar magnetic field diagnostics* **(12+3)**

12.10-12.15 Olexandra Baran *(Astronomical Observatory of Ivan Franko National University of Lviv, Lviv, Ukraine) The dynamics of the observed solar granulation: spatio-temporal variations of line of sight velocity and thermodynamic parameters* **(poster)**

12.15-12.20 Antonina Klyuyeva *(Main Astronomical Observatory of the National Academy of Sciences of Ukraine, Kyiv, Ukraine) The influence of two types of the solar wind high-speed streams on the cosmic ray intensity* **(poster)**

12.20-12.25 Yuriy Fursiak *(Crimean Astrophysical Observatory, Nauchny, Ukraine) Sunspot groups with X class flare activity in solar cycle 24: dynamics and features* **(poster)**

Friday, May 2

Section 'Atmospheric studies and space geophysics'

09.00-09.30 morning coffee

09.30-09.45 Eliana Amazo-Gomez, , J. D. Alvarado-Gomez, B. Calvo-Mozo, F. Mozer *(Universidad Nacional de Colombia, Bogotá, Cundinamarca, Colombia) Determination of the Geomagnetic Bow Shock position and interaction angle with the Solar Wind using THEMIS Data* **(12+3)**

09.45-10.00 Eugen Tkachenko, Yu. Rapoport, Yu. Selivanov, V. Ivchenko, V. Grimalsky, V. Fedun *(Taras Shevchenko National University of Kyiv, Kyiv, Ukraine) The theory and modeling MHD large-scale vortex-like excitations in the ionosphere* **(12+3)**

10.00-10.15 Vladyslav Mogylchak, L. V. Kozak *(Taras Shevchenko National University of Kyiv, Kyiv, Ukraine) Characteristic dependencies of the temperature, partial pressure and relative humidity for various areas Ukraine* **(12+3)**

10.15-10.30 Andrew Prokhorenkov, L. V. Kozak, A. T. Y. Lui *(Taras Shevchenko National University of Kyiv, Kyiv, Ukraine) Magnetic field fluctuation properties in the transition layer of the EarthâĂŹs magnetosphere* **(12+3)**

10.30-10.45 Vitaliy Zhaborovskyy *(Main Astronomical Observatory of the National Academy of Sciences of Ukraine, Kyiv, Ukraine) Quantitative analysis of the atmospheric density models applicable to determination of artificial satellite deceleration* **(12+3)**

10.45-10.50 Igor Gala, L. V. Kozak, J. Hopkins *(Taras Shevchenko National University of Kyiv, Kyiv, Ukraine) Diffusion processes in the Earth's magnetosphere* **(poster)**

10.50-12.00 Poster section + tea-break

12.00-12.30 Official closure

Saturday, May 3

08.30-12.00 Excursions to Kyiv-Pechersk Lavra

13.00-15.00 Museum of Folk Architecture and Life of Ukraine

INVITED LECTURES

Dynamical modelling of supermassive black hole binary evolution during the galaxy mergers. The "final parsec problem" is not a problem

Peter Berczik

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The hierarchical galaxy formation picture suggests that supermassive black holes (SMBH) observed in galactic nuclei today have grown from coalescence of SMBH binary after galaxy merging. Once the components of a SMBH binary become gravitationally bound, strong three-body encounters between the SMBH binary and stars dominate its evolution in a "dry" gas free environment, and change the SMBH binary's energy and angular momentum (semi-major axis, eccentricity and orientation). Here we present high accuracy direct N-body simulations of spherical and axisymmetric (rotating) galactic nuclei with order of million stars and two massive black holes that are initially unbound. We analyze the properties of the ejected stars due to slingshot effects from three-body encounters with the SMBH binary in detail. Our new results show many more phase space details of how the process works, and also show the influence of stellar system rotation on the process. We detect that the angle between the orbital plane of the SMBH binary's and that of the stellar system (when it rotates) influences the phase-space properties of the ejected stars. We also find that massive SMBH binary tend to switch stars with counter-rotating orbits into co-rotating orbits during their interactions.

During a galaxy merger, the SMBH in each galaxy is thought to sink to the center of the potential and form a supermassive black hole binary; this binary can eject stars via 3-body scattering, bringing the SMBH's ever closer. In a static spherical galaxy model, the binary stalls at a separation of about a parsec after ejecting all the stars in its loss cone - - this is the well-known "final parsec problem". Earlier work has shown that the centrophilic orbits in triaxial galaxy models are key in refilling the loss cone at a high enough rate to prevent the black holes from stalling. However, the evolution of binary SMBH's has never been explored in axisymmetric galaxies, so it is not clear if the final parsec problem persists in these systems. Here we use a suite of direct N-body simulations to follow SMBH binary evolution in galaxy models with a range of ellipticity.

For the first time, we show that mere axisymmetry can solve the final parsec problem; we find the the SMBH evolution is independent of N for an axis ratio of c/a=0.8, and that the SMBH binary separation reaches the gravitational radiation regime for c/a=0.75.

Continuum polarization of stars as a result of occultation by transiting exoplanets

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According to Exoplanet Transit Database more than 200 stars with transiting exoplanetary systems have been discovered. The occultation of the star by a transiting planet causes incomplete cancellation of the stellar limb polarization and, as a result, non-zero polarization. This suggests polarization as a possible tool to detect such planets. In order to estimate the continuum polarization of exoplanetary systems as a result of the occultation effect it is necessary to know the limb-darkering law and the center-to-limb variation of the continuum polarization in the stars under consideration. Most of the stars with transiting exoplanetary systems belong to the F, G, K spectral classes. However, most studies of the continuum polarization for such stars have used modelling data for the linear polarization of the Sun's continuous radiation.

Here we present results on the center-to-limb variation of the stellar continuum intensity and polarization produced in the atmospheres of stars of F, G, K types. We use a grid of Kurucz ATLAS9 one-dimensional atmosphere models with overshooting. The computations are presented for metallicities ranging from -0.5 up to $+0.5$ solar abundances, with gravity varying between 3.0 and 4.8, effective temperatures between 4600–6400 K and for the wavelength range between 300–800 nm. We account for the physics of Rayleigh scattering from the ground level of neutral hydrogen and of Thomson scattering at free electrons to describe polarization for these stars. The numerical method of solution is based on the iterative methods developed by Trujillo Bueno and Manso Sainz.The continuum polarization for several representarive stars with extrasolar planetary systems are discussed in detail. Among them are HD189733, CoRoT-2, TrES-3, ÂăWASP-4. We applied the results of our modeling to predict polarization curves produced during planetary transits. We find that the linear polarization signal caused by the occultation effect is small but larger than the accuracy of today's polarimeters.

SOLAR SYSTEM & EXOPLANETS

Rotation and shape of the dwarf planet Makemake

Tanya Gromakina[1], I. N. Belskaya[2], J. L. Ortiz[3], V. G. Shevchenko[2]

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We present the results of the CCD photometry of the dwarf planet Makemake. Photometric observations were carried out in 2012–2013 in the broadband BVR filters at five observatories. They were aimed to define more precisely the rotation period and magnitude phase dependence of Makemake. The measured lightcurve has an amplitude as small as 0.05 mag. The shape of lightcurve assumes slightly elongated shape of Makemake rather than albedo spots at the surface of a spherical body. This result does not contradict to the constraints of Makemake's shape from the stellar occultation data. The magnitude phase function was measured in the phase angle range of 0.6–1.1 deg. The V-R and B-V colours of Makemake were also determined.

Parameters estimation obtained from the photometric data considering red noise in the wavelet-based framework

Oleksii Matsiaka[1], Yu. Kuznyetsova[2], V. Krushevska[2]

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One of the most complicated problem of modern transit surveys is a large amount of different noise sources. It is very difficult to take them into account. Noise sources may have a both natural ("shot noise") and artificial origins. A large class of noises which gives mutual correlation between data points on a different timescales is called "red noise". Existence of the red noise requires special procedure to deal with such data in contrast to only pure Poisson processes ("white noise").

We represent comparison of parameters estimation for several transiting systems using wavelet-based framework and more simple white-noise method. Both methods realized throughout standart MCMC procedure. The main attention is paid to the correct error estimating.

Spectral and polarymetry investigation of the comet C/2012 J1 (Catalina) at 6 meter telescope SAO RAS

Olena Shubina[1], O. V. Ivanova[2], V. L. Afanasiev[3]

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We report measurements of the comet C/2012 J1 (Catalina) obtained using long-slit and polarimetry mode. The observations of the comet were carried out on November 15, 2012, when the cometary heliocentric and geocentric distances were 3.166 and 2.440 AU, respectively. Spectral measurements in the range 3600–7200 Å and imaging linear polarimetry in V filter were carried out with the SCORPIO-2 focal reducer at the 6-m telescope of the Special Astrophysical Observatory (Russia). The degree of polarization of light scattered by comet C/2012 J1 (Catalina) changes from $-2.2\pm0.2\%$ to $4.9\pm0.2\%$ at phase angles 13.7°. These values are in a good agreement with those for dusty comets at the respective phase angles.

We carried out also the identification of row spectral features in comet spectrum. We found no significant emissions in our spectrum.

The dusty atmosphere, some physical parameters and the luminescent continuum in the spectra of comets C/2006 W3 (Christensen), C/2007 N3 (Lulin), C/2009 P1 (Garradd)

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We present results of the observations and study of the middle-resolution optical spectra ($\lambda/\Delta\lambda \approx 4500$ and $\lambda/\Delta\lambda \approx 15000$) of comets C/2006 W3 (Christensen), C/2007 N3 (Lulin), C/2009 P1 (Garradd). The spectra were obtained with the echelle spectrograph on the 2-m Zeiss reflector of the High-mountain astronomical station of Institute of Astronomy of Russian Academy of Sciences and Main Astronomical Observatory of National Academy of Sciences of Ukraine at Terskol in 2009–2011 years.

The luminescent cometary continuum level (nonsolar origin) in the spectra of comets was detected. The parameters of luminescent continuum were obtained

(wavelength 3800 Å $< \lambda <$ 7000 Å). The energy distributions in the spectra for the near nucleus regions of comets were built and the identification of the emission lines in the spectra was made. The physical parameters of the neutral coma of comets (velocities of gas expansion, lifetime of the molecules C_2, C_3 and CN and other parameters) were calculated with using the Shulman's and Haser's models. The comparative analysis of the spectra of three comets was made. Also, was built the change of the albedo variations with the wavelength.

The temporal evolution of the meteor spectrum of 21 October, 1958

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The reprocessing of the meteor spectrum obtained in October 21, 1958 in Ashgabat was conducted. It is known that the data about conditions of spectrum observations published earlier in the Bulletin CCM number 5. The meteor spectrogram digitized by Epson Expression 10000XL scanner with a resolution of 1200 dpi at the Main Astronomical Observatory of NAS of Ukraine. The digital photo processed by the algorithm and software developed specifically for photographic studies of meteor spectra. It designed by Jiri Borovicka who is a Head scientist of the Interplanetary matter Department of Astronomical Observatory of the Academy of Sciences of the Czech Republic. The evolution of main emissions in the considered prism spectrum along visible meteor path was investigated. The spectrogram in the brightest point of the meteor trajectory during an outbreak was obtained. The optical prism produces a spectrum with a nonlinear dispersion. The spectral resolution in violet part of the spectrum is better than in red part. As a result, we do not see clear emission lines in the spectrogram obtained using a prism. Instead, we have a set of bands that are combinations of spectral lines. In this spectrum revealed 13 such characteristics. The table of spectral components identifications identified in the meteor spectrum was built. There are two components in meteor spectra: the main component (temperature ~4400 K) and the high temperature component (temperature of ~10000 K). The lines of neutral atoms belong to the main spectral component and the lines of ionized atoms belong to the high temperature component. There is a band of molecular nitrogen in the red part of the spectrum. Meteor spectrograms since the start of the glow until the flash were built. The strip of the molecule N_2 dominate in this spectrograms. It has the atmospheric origin. We can see an increasing of intensities of spectral lines with decreasing altitude. Most of spectral features appear just during a meteor outbreak. Intensities are reaching maximum values.

The band of the spectral lines combination of different elements is on the spectrogram, which displays the time of the meteor outbreak. Emission lines of ionized calcium are the main component among them. Intensities of the spectral lines is rapidly decreasing immediately after the flash. Borovichka and Majden found that high-temperature component in meteor spectra associated with the formation of a shock wave in front of meteoroids. Lines of CaII are also belong to this component. The intensity of the high-temperature component increases at the time when the so-called continuous flow is formed around meteoroid. That is, when the value of molecules free path in the plasma becomes smaller than the size of the meteoroid. Light curves for the identified features in the considered spectrum were constructed. The attempt to compare the results of the processing of the present meteor spectrum with the meteor spectra processed earlier was made.

Photometric investigation of comet C/2013 A1

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C/2013 A1 (Siding Spring) is discovered on 3 January 2013 by Robert H. McNaught at Siding Spring Observatory. Our observations of comet C/2013 A1 were performed on December 12 and December 13, 2013. Heliocentric distance of comet C/2013 A1 changed from 4.16 to 4.15 AU and geocentric distance from 3.645 to 3.643 AU. The observations were obtained with V and R filter. During image processing we select all bright stars with SNR more then 100 as photometric standard. The azimuthally average surface brightness profiles were built. Using PSF and coma model we estimate upper limit of comet nuclear size. C/2013 A1 will approach to the Sun on minimal distance 1.4 AU. The comet with such size probable will survive approaching to the Sun in perihelion. There was also founded color index of C/2013 A1 V-R = 0.49±0.03 on December 12, 2013 and V-R = 0.41±0.02 on December 13, 2013. As one can see comet have turned red possible a large amount of the dust particles was emitted by comet nuclear between our observation nights.

Dynamical model of the motion of bodies in the Solar System

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For many-body problem is not analytical solution and scientists usually use different numerical methods. In our work, we have developed software which is based on a simplified mathematical model DE431/LE431 ephemeris. The basic equations of motion are Einstein-Infeld-Hoffman equation. This equation describes the gravitational interaction of point masses in isotropic, parameterized metric N bodies.

The integrator takes into account the gravitational effects of the Sun, planets, Moon, Pluto, 3 largest asteroids (Ceres, Pallas, Vesta) and 340 small asteroids.

Long-term accuracy of the integrated orbits requires the inclusion of the figures of the Earth and Sun in the mathematical model. In our model the gravitational effects due to figures include: the dynamical form-factor of the Sun J_2, the force of attraction between the zonal harmonics (through fourth degree) of the Earth and the point-mass Moon, Sun, Venus, and Jupiter, the force of attraction between the zonal harmonics (through fourth degree) of the Moon and the point-mass Earth, Sun, Venus, and Jupiter.

The initial position and velocity are taken from the online system dynamic ephemeris HORIZONS of JPL Laboratory. Masses are taken from the configuration file DE431/LE431. Integration interval is 100 years.

We compare results with the data of HORIZONS. The comparison criterion is the difference between modules of radius-vectors i-th body of our models and HORIZONS.

Absolute and relative error for the major bodies are < 0.03 km, $< 5 \cdot 10^{-10}$ (Mercury); < 0.002 km, $< 2 \cdot 10^{-11}$ (Venus), < 0.01 km, $< 6 \cdot 10^{-10}$ (Earth); < 0.5 km, $< 2 \cdot 10^{-9}$ (Mars); < 0.0008 km, $< 8.5 \cdot 10^{-13}$ (Jupiter); < 0.0002 km, $< 1.5 \cdot 10^{-13}$ (Saturn); < 0.0006 km, $< 2 \cdot 10^{-13}$ (Uranus); < 0.0003 km, $< 8 \cdot 10^{-14}$ (Neptune); < 0.0006 km, $< 8 \cdot 10^{-14}$ (Pluto) and $< (5 \div 5.5)$km and $< (5 \cdot 10^{-8})$ (Moon) respectively.

Absolute errors for asteroids are slightly larger, between 15 km and 200 km, depending on the asteroid.

Currently integrator was used to calculate the orbits of NEA asteroids and predicting the orbits of new comets.

Exoplanet systems and Titius–Bode law

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It was analyzed the characteristics of the stars hosting planets near the Sun. The distribution of effective temperatures photosphere (spectral class) and metallicity was investigated. High metallicity most of them indicates early phases of the evolution of stars and appropriate to them planetary system. The structural features exoplanet systems was considered. Using systems with three or more planets as an example were found similarities of its planetary orbits structure and thus the universality of Titius-Bode law was confirmed.

STELLAR ASTROPHYSICS & INTERSTELLAR MEDIUM

Abundances in the atmosphere, effective temperature and surface gravity of the subdwarf metal-poor star G 224-58 A

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We present results of our computations of elemental abundances in the atmosphere of the metal-poor star G 224-58 A, its effective temperature and surface gravity. This star is the bigger component of binary system G 224-58 AB (esdK2 + esdM5.5). We used model atmosphere method. All the researches were carried out in program Wita6.

Advanced Gas Opacity for Circumstellar Environments

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We present new mean gas opacity tables suited for usage in radiative transfer modelling of circumstellar environments. We argue for the beneficial employment of these opacities in solving radiative transfer associated with circumstellar disks, planet atmospheres, circumstellar dust-free environments during star formation as well as in modelling dust formation physics around AGB stars. We show that the radiative instability in optically thin medium, which originates from molecules formation, is reliably recaptured when considering the two-temperature Planck mean opacity and yields the equilibrium temperature degeneracy.

Photometric Study of the Intermediate Polar V2306 Cyg

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We conducted our own photometric monitoring of pulsating X-ray source 1WGAJ1958.2 + 3232. The star was named as V2306 Cyg in 2003. 4 nights of VR photometry were obtained using 50-cm reflector at Baja Astronomical Observatory in 2009, 2 nights using MEADE LX-200 in 2009 and 5 nights (VR) using 60-cm Zeiss – Cassegrain at Hlohovec in 2012–2013, 1 night of BVR photometry was obtained by A. Baransky in Kiev in 2013. Additionally, we analyzed all 14 CCD time series from the AAVSO data archive.

Periodogram analysis shows different peaks, including the orbital period and it's aliases. Using data from different instruments we obtained the values of the orbital period of P=0.18162 d and P=0.18189 d. It's clearly seen on the phase curves, that approximation using trigonometric polynomial with this period has larger amplitude than the one, calculated using any alias.

Periodogram analysis for whole available time series reveals a prominent peak, which corresponds to the period of 0.3998 d, which is double value of 0.1999, which is a beat period of the orbital one and previously unknown one (P=2.01832 d). This new period is visible at the larger range periodogram. We calculated phase curves using the data, obtained in Slovakia in 2012 and 2013. It's worth to note that the phase curve in V has much larger amplitude than in R filter, so this variability may be interpreted as possible precession of the accretion disk in this system. However, we have lack of data in previous years to cover all 2-day phase curve and confirm it.

Using the latest data, obtained in Kyiv, we conducted a periodogram analysis in the vicinity of the spin period of the white dwarf. The only prominent peak is 735.25 s (B filter). It is consistent with previously published data of other scientists.

Due to large scatter during some nights, we have too few precisely determined spin maxima timings, and almost no maxima timings were published before. Thus, we are unable to do full O-C analysis, but available data shows the spin-down of the white dwarf in V2306 Cyg.

Discovery of New Variable Stars

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We've discovered seven new variable stars in the field $20' \times 40'$ centered on R.A.(2000) = 22^h48^m, Dec(2000) = $+34^d23^m$ at the borderline of Pegasus and Lacerta.

The initial unfiltered observations were made at the Montecatini Astronomical Centre in Italy using $10''$ Mead telescope equipped with SBIG KAF 1600 CCD camera, the field of view was $19' \times 28.4'$. We searched for new variables using C-Munipack software, and found 3 new binary stars. Maximum of quantum efficiency of used camera turned to be between standard R and V bands, thus we've got to collect filtered observations. New R-band observations were collected on the telescope T5 of i.Telescope.net observatory (USA) under the grant program on educational projects. T5 is remotely controlled 250-mm Takahashi Epsilon telescope equipped with ST-10XME CCD camera. As the field of view of this telescope is wider ($40.4' \times 60'$), we've not just confirmed new variables, but also discovered 4 additional variable stars. We've determined all main parameters of new variables: coordinates, magnitudes in minimum and maximum, period, type and initial epoch. All 7 new variables turned to be binary stars of different types: 4 binaries of EW-type, 2 – of EA-type, 1 – of EB-type (USNO B1.0 1240-0526950). Three discovered stars have so called O'Connell effect – the difference between maxima brightness; two binaries have total eclipses, which indicate the declination close to 90 deg.

The most interesting star is USNO B1.0 1240-0526950. Taking into account the features of its phase curve, USNO B1.0 1240-0526950 was classified as EB-type binary. However the period P=0.4844 d is typical for EW-type binaries which usually demonstrate physical and thermal contact. A big difference between minimum depths on its phase curve indicates the absence of thermal contact. We suppose that this star belongs to a narrow class of binaries, whose components are in physical contact (or close to it), but not in thermal contact. These stars are important for understanding of evolution of binary systems. All discovered variable stars were registered in VSX catalogue of AAVSO.

Period and light curve variations of the binary star XY Boo

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The variable star XY Boo is a close binary system with low mass ratio, which has been discovered by Von C. Hoffmeister in 1935. Since that time there were a lot of observations of this star, which gave us an opportunity to collect minima timings, to analyze period variations using O-C diagram, and to find the values of period change and mass transfer.

XY Boo has three curious features. The first one is an extraordinary rapid increase of period, clearly visible on the O-C parabolic diagram, which could be explained by the mass transfer from the less massive to the more massive component. Another one is the presence of additional quasi-periodic oscillations of period, which we've noticed in O-C residuals after subtracting the main polynomial fit. We didn't find any clear periodicity in these variations, which also has non-stable amplitude. As these variations of period are not periodical, they could not be explained by the presence of a third body in the system. The third feature of XY Boo is variability of the phase curve. Our main hypothesis is that there are some migrating cool spots in the photosphere of one or both components of this binary.

We collected BVRI observations in 2011, which cover the phase curve of XY Boo completely. Our observations show rather rapid changes of the phase curve shape – the difference is noticeable during a month of observations. We've calculated two sets of models and found a suitable combined solution for all published observations. Each of these sets presents models with common main parameters of the binary for every year of observations, and differs only by parameters of the spot. For the first set we've adopted spectral mass ratio $q = 0.16$, for the second one we've calculated statistically optimal photometric mass ratio $q = 0.207$. For the first case, using known radial velocities and its errors, we've determined that the period increases by $5.94(\pm0.05)\times10^{-7}$days/year = 5.134 sec/century, and the rate of mass transfer is $9.5(\pm6.3)\times10^{-8}M_{\odot}$/year.

Spectral observations of chromospherically active stars 61Cyg AB with slitless spectrograph on small telescopes

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The present study is concerned with observations of active-chromosphere 61 Cyg A and 61 Cyg B stars in the sub-second range using a slitless UBVR spectrograph on small telescopes. Spectral observations of 61 Cyg A and 61 Cyg B were conducted with slitless spectrograph (R∼200) on the 60-cm telescope at the private observatory in Andrushivka. It is found that active-chromosphere dwarf 61 Cyg A and 61 Cyg B stars have powerful spots on their surfaces exhibit rapid variations in the hydrogen lines, ionized calcium, Ca II H, K, chromospheric b Mg I triplet in time scale of 2 seconds to about 3 minutes.

Dwarf nova MN Dra: evolution of the negative superhumps between different outbursts.

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We perform the photometric study of the dwarf nova MN Dra in 2012 during a multi-longitudinal observational campaign. We confirmed the existence of the negative superhumps – light variations caused by the nodal precession of the titled accretion disk in quiescent state and normal outbursts in 2012. We present the evolution of the negative superhumps period between different accretion events. This period undergoes the jump-like change during outbursts. The period is larger then its mean value 0.09598 days before the outburst and is smaller after the outburst.

Optical observations of the 1H1936+541 in 2008–2014

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We report results of observations of Be/X-ray binary system 1H1936+541. All the data were obtained on the base of Lisnyky oservational station of AO KNU and Southern Station of the Sternberg Astronomical Institute MSU with the help of three different CCDs in U, B, V, R, I filters from 2008 till 2014. During this time photometrical variability were occured in all bands but the most significant changes are present in U and I bands. Variability in these bands anticorrelates with each other and are in good agrement with the model of decretion disk around Be star. So, photometrical variability indicates about changes in decretion disk structure. Further photometrical and spectral observations will help us to creat a real model of this system.

EXTRAGALACTIC ASTROPHYSICS

Study of short-term variability of the weak X-ray sources. Variability of nodes of jet of Centaurus A

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One of the tasks of X-ray astronomy is the study of the nature and causes of variability of X-ray sources. In our work we analyze the methods of study variability of the sources. It is shown that commonly used Gregory-Loredo algorithm loses effectiveness in cases of sources with a small number of detected photons. Proposed to use for the analysis of such sources p-method. In particular, using new method we studied short-term variability of knots of jet of Centaurus A.

Dependence of equivalent width of quasar emission lines on UV spectral index, quasar luminosity and BH mass

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We present the analysis of quasar emission lines properties within the wavelength range 1215-1450 Å and their dependence on quasar luminosity, mass and spectral index. For this purpose a set of composite spectra is compiled from subsamples of SDSS DR7 medium resolution quasar spectra with similar α_λ at this wavelength range and similar monochromatic luminosities at 1450 Å (l_{1450}). We consider the α_λ range of $-2.3.. - 0.7$, the $\log(l_{1450})$ range of 42.2..43.4, and emission features around Lyα+NV+SiII, OI+SiII, CII and SiIV+OIV. It is found, that equivalent width decreases with increase of luminosity (the Baldwin effect) and also with spectrum steepening. It is worth noting, that the spectral index does not depend on luminosity and redshift, but due to selection effects of optical survey subsamples of higher luminosity have higher redshift. We also calculated virial mass of the central supermassive black hole for 3535 individual quasars (using the CIV emission line) and found that quasar luminosity increases with the black

hole's mass, which is expected. But on the other hand, the virial mass of the black hole does not depend on spectral index.

Extragalactic filament detection with layer smoothing method

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Filaments are clearly visible in galaxy distributions, but hardly detected by computer algorithms. Most methods of filament detection can be used only with numerical simulations of large-scale structure. New simple and effective methods for real filament detection should be developed. The method of smoothed galaxy density field was applied in this work to SDSS data of galaxy positions. Five concentric layers of 100 Mpc were considered and the minimal gradient method was used in each layer. It was shown that such method of filament detection is not effective. The method of density maxima distribution was also applied to detect filaments. The distribution of voids in layer shows that characteristic size of void in local Universe is close to 50 Mpc.

Star formation rate (SFR) – local density relation in Virgo galaxy cluster using Hα observations

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Star formation rate (SFR) studies in galaxies which are in a galaxy cluster, is a way to study the effects of environment and other galaxies to a one, specified galaxy. previous observations display the reduction of SFR in crowded environments. in this project, we use Hydrogen-α observations to obtain amount of SFR for more than 1000 galaxies in Virgo galaxy cluster and demonstrate the predicted result. this computations have been derived with a simple assumption which is the galaxies are projected on a 2-dimensional surface. subsequently, we use 3-dimensional analysis results to compare with 2-dimensional values to examine trustworthy of our assumption.

Morphological Classification of 248 PF Galaxy Clusters

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We present the morphological classification of 248 galaxy clusters of the southern hemisphere according to Abell, Zwicky, Bautzen & Morgan and Rud & Sastry criteria. The sample of galaxies forming the clusters was obtained from the Catalogue of Galaxies of MRSS. 248 galaxy clusters were selected from Catalogue of Galaxy Structures PF as rich clusters with the counterparts in ACO clusters catalogue. We assigned the adapted to using data morphological types to these clusters using numerical criteria too.

Analysis of spatial and temporal properties of Jets in AGN with CIAO

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In the resent paper we consider internal structure of jets in AGN using CIAO. X-ray data for analysis were processed with CIAO 4.2 – a software package for Chandra interactive analysis of observations. Transverse profiles of knots were studied in the X-ray and radio bands. We analysed point spread function (PSF) in order to assess the real size of knots. We used Chandra Ray Tracer (Chart) to simulate the Chandra PSF selected knots. Investigated the spatial and temporal properties of relativistic jets in AGN using special tool of CIAO. These results are used in simulation of the active galaxies' radiation and in study in temporal and spatial characteristics of relativistic jets in active galaxies.

Dark matter in the Local group

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In recent years many papers with the estimates of the mass of our galaxy the Milky Way (MW) and the Local Group (LG) were published. The values of these masses are of particular interest in connection with the test of cold dark matter (DM) paradigm in terms of our immediate environment. The distribution of DM relative to the visible stellar matter remains still an unsolved problem.

The estimates show significant variation in the masses depending on the determination method. One of the methods to determinate the mass of galaxy groups is based on the concept of projected mass. If in a group it dominates one galaxy, surrounded by dwarf satellites "suite", the mass determined by this method is called orbital mass. The method is based only on the information about distances (R_p) projected onto the picture plane and relative radial velocities. Using the known distribution of eccentricities of the satellites orbits the mass estimate is unbiased. The central limit theorem ensures the convergence of statistical estimates with the error that is proportional to $N^{-1/2}$, where N is number of satellites.

This method was applied to the MW and the galaxy M31 in Andromeda. Observational data (coordinates, stellar mass, difference of radial velocities) were taken from the recently published "Updated Nearby Galaxy Catalog". Boundaries of groups MW and M31 were determinated by the so-called tidal index, zero value of which determines the "sphere of zero velocity". Orbital masses MW and M31 were determined, correspondingly, using 27 and 39 of their satellites. The obtained values of orbital masses were $M^{orb}_{MW} = (1.44 \pm 0.46) \cdot 10^{12}$ M_{Sun} and $M^{orb}_{M31} = (1.76 \pm 0.33) \cdot 10^{12}$ M_{Sun}. Simply mass addition gives the value of Local group mass were $M_{LG} = (3.2 \pm 0.6) \cdot 10^{12}$ M_{Sun}. Stellar masses MW and M31 were taken following $M^{*}_{MW} = 5.0 \cdot 10^{10}$ M_{Sun} and $M^{*}_{M31} = 5.4 \cdot 10^{10}$ M_{Sun}. The sum of the masses of the "patron" and satellites, correspondingly, for MW and M31 are $M^{*}_{MW+sat} = 5.3 \cdot 10^{10}$ M_{Sun} and $M^{*}_{M31+sat} = 6.0 \cdot 10^{10}$ M_{Sun}.

The dark matter content is characterized by us using the ratio χ of orbital mass to stellar mass. This ratio is $\chi = 27$ and $\chi = 29$, correspondingly, for MW and M31. If it is taken $\chi = 6$ for galaxies within their apparent size, the increase of scales approximately the order of magnitude (from the size of the visible galaxies to the mean projected distance $\langle R_p \rangle$ of satellites) causes the increase of relative content of DM about 5 times. The obtained values of χ are significantly less than those corresponding to the standard CDM cosmological model with $\Omega_m = 0.28$, they correspond the "local" value $\Omega_m \approx 0.09$.

COSMOLOGY & GRAVITATION

Large scale galaxy collisions simulations with central Post Newtonian Binary Black Hole

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We present the set of direct N-body numerical simulations (up to N = 1M particles) with the large scale different mass galaxy-galaxy collisions. The central Black Holes (BH) are simulated as a special particles with the Post Newtonian (PN) force corrections (up to PN3.5 terms) implemented only for the BH interactions. Our results shows that the so call "mass deficit" effect in the realistic galaxy-galaxy merging mass ratio can reach up to the $\sim$30% level.

Scalar entanglement entropy at Schwarzschild horizon

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We consider scalar field entanglement entropy generated at the Schwarzschild black hole horizon. The presented approach implies the unitary evolution of gravity. We found that the area law is valid only for the black holes with mass $M > 1$ in planck units. In this case the obtained corrections to the massive radiation component are found to have both negative and positive values, hence witnessing on the possibility of the information outflow from the black holes. For the (sub)planck mass scale the entropy dependence on the dimension of the Hilbert space for degrees of freedom located behind the horizon is taken into account.

HIGH-ENERGY ASTROPHYSICS

Comparison of the expected and observed supernova remnant counts with Fermi/LAT

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SNRs are commonly believed to be the accelerators of the galactic cosmic rays – mainly protons – and are expected to produce γ-rays through the inelastic proton-proton collisions. Fermi/LAT was expected to detect many of those, but only a dozen is listed in the most up to date Fermi/LAT 2nd Source catalogue.

To test whether the observed number of SNRs is in agreement with the assumption that they are indeed the sources of the galactic cosmic rays. We use a simplified model of an SNR and calculate the predicted amount of the observable remnants taking into account their distribution in the Galaxy and the sensitivity of Fermi/LAT.

We find that the observed number of SNRs agrees with the prediction of our model if we assume a low, $\ll 1$ cm^{-3}, number density of the SNR's ambient medium.

The results, presented here, agree well with the assumption, that on average the supernova explosions happen in the under-dense regions, such as bubbles, creating by the winds of the progenitor stars. Under this natural assumption our results find an agreement with the assumption, that the observed population of supernovae remnants is indeed responsible for the production of the galactic cosmic rays.

Gamma-ray image of Tycho SNR

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There are two main physical processes that are responsible for the gamma-ray emission in supernova remnants (SNR). Namely, inverse-Compton effect (IC) and pion decay which are caused by the high-energy electrons and protons respectively. We develop a method to synthesize the gamma-ray map of SNR with the use of information about those particles from maps of SNR in different parts of

electromagnetic spectrum (radio and X-rays) and from the integral spectrum of SNR (from radio to very-high energy gamma-rays). The method is applied to produce gamma-ray maps of Tycho SNR with relevant contributions from both IC and pion-decay emission.

Detection and study of very high energy cosmic rays with Imaging Atmospheric Cherenkov Telescope

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The method of observation and study of high energy cosmic rays consists in detection them by IACT (Imaging Atmospheric Cherenkov Telescope). The IACT works by imaging the very short flash of Cherenkov Ultra-Violet radiation generated by the cascade of relativistic charged particles. Stereo vision technique enables reconstruction of three-dimensional geometry of the Extensive Air Showers (EAS) and measurement of the number of photons from each EAS as function of altitude. To get information about initial particle, the vertical profile of this distribution has to be analysed.

We have performed Monte-Carlo simulations of vertical profiles of Chernekov light. Our modelling is based on Cosmic Ray Simulalions for KAscade (CORSIKA) Monte-Carlo simulations of EAS. We simulate vertical EAS initiated by cosmic rays (photons, protons, iron nuclei etc.) in the energy range 100 GeV – 10 TeV. Using our calculations we studied some other important properties of EAS, such as distributions of secondary particles, photon surface density on the ground, photon time arrival and other. For correct interpretation of observations, telescope sensitivity should be taken into account. Telescope parameters dependence on energy was calculated by modelling the detection process of Cherenkov photons by IACT together with Monte-Carlo simulations of cascades.

Presence of clouds or any other atmospheric inhomogeneities perturbs astronomical observations of Cherenkov Telescopes, because Earth atmosphere is used as a giant cosmic rays detector. But we show that it is possible to restore the observations affected by atmosphere. Cherenkov light, produced by the cosmic rays particles, represents a powerful tool for the remote sensing of clouds. Our method can be used to find out the properties of scattering of light in clouds. Obtained knowledge of atmosphere parameters in the region of observation can be applied to measured data correction.

A Statistical of Glitch Activity in 85 Pulsars

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Discrete discontinuities in pulsars rotation are believed to originate from the activities in the interiors of underlying neutron stars. Here, we analysed the data on 686 resolved jumps (266 microglitches and 420 macroglitches) in the rotation of 159 pulsars. The results of analyses reveal that (i) 85 pulsars have glitch activity which is inversely proportional to pulsar's characteristics age for macroglitches and microglitches with correlations ($r = -0.69$ and -0.47); (ii) pulsar characteristic age is proportional to the logarithm of the spin-down rate ($\dot{\nu}$) with correlations ($r = -0.90$) for both macro and micro glitches (iii) microglitches are exhibited by pulsars of long characteristics age $\tau_c \leq 10^6$ while macroglitches are exhibited by pulsars of short characteristic age $\tau_c \geq 10^6$ (iv) the fractional frequency change for microglitches have a mean value of $(\Delta\nu/\nu)_{mean} \sim 10^{-7.4}$ while macroglitches have the mean of $(\Delta\nu/\nu)_{mean} = 10^{-9.2}$ respectively.

Transition from Galactic to extragalactic cosmic rays based on KASCADE-Grande data

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We explore the region of the total (Galactic and extragalactic) energy spectrum of cosmic rays, where the transition from Galactic (at low energies) to extragalactic (at high energies) cosmic rays is expected. For this purpose, we use the recent data of the KASCADE-Grande experiment concerning the relative abundances of light and heavy nuclei in the total flux of cosmic rays at different energies. These data show an unexpected hardening of light component's spectrum from γ=3.2 to γ=2.6 in the energy region 10^{17} eV. We explain this hardening as a signature of extragalactic component of cosmic ray flux in the energy range lg E(GeV) = 8.1–9.0 and show that an extrapolation of this flux to the higher energies in the frame of the proton model of the ultra high energy cosmic rays (UHECRs) agrees with AUGER and Telescope Array data. We find that the best fit value of the spectral index γ is equal to 2.6 in the frame of proton model of UHECRs for the explanation of modern experimental data.

Charged particle detection using a CMOs sensor in the space environment

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In the universe, studies on space physics of high energy, is important the measurement of particle's energy for the stellar events detection through particles detectors, such as photodetector sensors, in turn, these detectors can be part of satellites. Photodetectors sensors may detect the incident energy of a particle into measurable electric current for average analysis about incident energy in the atmosphere. The performance of such a sensor depends on APS architecture. Consequently, a CMOS technology has been integrated in an electric circuit and tested under space environment. The sensor has an area of 426 pixels per 640 pixels; this sensor contains an activated amplifier which in turns sends signals to the Pc.

The sensor was exposed to different radioactive sources, such as: Natural Uranium with 0.002 g of (235U, 234U and 238U), this source emits gamma rays, alpha particles and electrons. The results of this source were 4.2677 MeV's on incident energy; Americium (241Am), a source of 0.0025 g, only emits alpha particles with photons, the total incident energy was 5.6345 MeV's. Finally, the fastest emission of neutron source of Americium andBarium, were around 5.02 MeV's in a temperature range from 253K to 353K. As far as high energy is concerned, sensor shows the capability to be part of a satellite due to the different radiation sources of energy detected. Further, the detector was irradiated within a period of one day per source without any functional loss.

Cosmic Ultra-high energies and their realization mechanisms

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We investigate one of the most problematic issues of the high energy astrophysics, the origin of ultra high energy cosmic ray particles and radiation. It is assumed, that the pulsars are the sources of energetic cosmic ray electrons. We suppose that the processes running in the pulsar magnetosphere provide conditions for the realization of plasma acceleration mechanisms. The relativistic electron positron plasma is located in the co-rotating magnetosphere. The value of the magnetic field is so big that it inevitably provides the "frozen in" condition for the plasma particles. Consequently, electrons and positrons are forced to follow the co-rotating magnetic filed lines. This fact allows rotational energy pumping in

plasma particles. We present essentially new "parametric" instability mechanism of rotational energy pumping into the plasma particles. The mentioned relativistic mechanism develops through two principal steps. At frist the rotational energy is pumped into the natural oscillations of the pair plasma. This process is realized through the development of parametric instability, which is excited due to periodical action of time dependent centrifugal reaction force on plasma particles. At the second step of the mechanism, the rotationally induced plasma waves damp on the energetic particles accelerating them to very high energies. Even a small fraction of enormous rotational energy of pulsars would be enough to explain the observed ultra high energy electrons and radiation from these objects.

Dependencies of X-ray spectral parameters for a sample of BAT AGNs

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In this report we present results of processing a homogeneous sample of active galactic nuclei, which are part of the Swift/BAT AGN catalogue. For this sample we analyzed X-ray data from XMM-Newton and INTEGRAL satellites in 0.5-300 keV energy range. We built and examine such dependences as "power-law index – relativity reflection", "equivalent width of Fe K line – intrinsic luminosity" (Baldwin effect) in middle 2-10 keV and hard 20-100 keV energy ranges, "power-law index – cut-off energy" and "absorption value-equivalent width of Fe K line". We find, that X-ray Baldwin effect is not confirmed in hard energy range with Spearman's rank coefficient $r = -0.06$, although for the middle energy range the correlation coefficient increases to $r = -0.45$, still indicating a weak correlation. Dependence of "power-law index – relativity reflection" for Seyfert 1/2 and the radio loud-quiet galaxies were investigated separately. We found that this dependence is not clearly approximated by model with the assumption that spectral shape is determined by the bulk-motion velocity of the X-ray emitting plasma.

Electromagnetic emission bursts from the shock wave around the near-cusp region of superconducting cosmic string in cosmic plasma

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Cosmic strings are topological defects which can be formed during symmetry breaking phase transitions in the early Universe, their existence finds support in modern superstrings theories, both in compactification models and in theories with extended additional dimensions.

Strings can hold currents, effectively become electrically superconducting wires of astrophysical dimensions. Such strings can serve as powerful sources of non-thermal radiation in magnetized intergalactic medium.

We have studied the motion of the near-cusp region of a superconducting cosmic string in the cosmic plasma with a large Lorentz-factor. The characteristics of nonthermal emission of electrons of the cosmic plasma which are accelerated on the front of a shock wave around of the near-cusp region are calculated. We have considered all important emission channels: synchrotron, synchrotron self-Compton (inverse Compton effect on own synchrotron photons), and external inverse Compton (on external, in particular relict, photons) emissions. Directed data concerning expected emitting impulses for typical near-cusp region's Lorenz-factors is considered for different regimes of cooling – fast and slow. It is shown that, due to the relativistic collimation of the emission flow and the Doppler shift of its frequency, the hard (X-ray and gamma) emission of cosmic strings (loops) can be registered even at cosmological distances. The emission flows are periodic and narrow-directed and has character of bursts. Synchrotron spectrum has maximum at hard roentgen and Compton stretches till TeV diapason. Expected fluxes $\nu^{obs} F_{\nu}^{obs} \sim 10^{-12}$–$10^{-14}$(erg/cm^2/s), specifically, for GUT scale strings, can be registered by modern cosmic X-rays and earth-based Cherenkov telescopes.

SOLAR PHYSICS & HELIOSPHERE

Which is spectral line minimum in spectra of prominences?

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It is known that line in the spectra of astrophysical objects are extended mainly by temperature and turbulent radial velocities, pressure and magnetic field also. Solar prominences are cool dense formations which the temperature of about 7000 K, and electron density from 10^9 to 10^{11} cm^{-3}. With such parameters Hα line width is about 1Å and the D3 HeI line width is about 0.5Å. However, these values correspond to averaged characteristics which arising from direct observations with typical spatial resolution for ground-based observations. Because of in prominence and in other formations of solar atmosphere are likely inseparable spatial structure which significantly different from average local characteristics, the local magnetic field, temperature and other parameters can significantly differ from the average values. The influence of magnetic field on non-magnetic physical conditions can be separate based on the spectral- polarization observations. These observations concerning active prominences have shown that they have more spliting of I±V profiles in the nucleus than in the wings of the Hα and D3 HeI lines (so-called V-effect).

Model calculations show that this effect is possible with two-layered structure of the magnetic field, but with a very narrow line profiles in a component with a strong (10^3G) magnetic field. In some cases the width of D3 HeI line in inseparable spatial component should be about 0.1Å (maybe even less), which corresponds to the temperature at 10^2 K. Obviously, there appears a strong ordering effect of magnetic field on the thermal and turbulent motions in the solar plasma, which requires a detailed study in the future.

Creation and usage of program code for strong subtelescopic solar magnetic field diagnostics

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Strong magnetic fields on the Sun ($\sim 10^3$ Gs) are measured basing on analysis of spectral manifestation of Zeeman effect. This effect is essentially a splitting of spectral lines on several components, distance between which is the more, the

stronger magnetic field is. It is also accompanied by polarization of split components. Usage of polarization analyzers allows us to define the magnetic field polarity and also measure weak and moderate magnetic fields, when value of Zeeman split is less than spectral width of magnetic sensitive line (which Lande factor is not 0). However comparatively small visual splitting of spectral line can also be in another case – at two-component structure of magnetic field, when we have comparatively weak "background field", and also areas with strong field, which take tiny part of solar surface. During measurement on spectral slot fall both areas of background field and areas with strong field. The summary pattern of observed Zeeman effect, the unification of splitting patterns will occur, and this will give specific spectral manifestation, with which we can not also detect sub telescopic magnetic fields (which are not divided directly) but also measure the value of their tension. On of the simplest methods – the investigation of bisector form of profiles I±V. At really weak and uniform magnetic fields these bisectors have to be parallel between themselves. At two-component structure of magnetic field there occurs local extremums on bisector splitting from distance from line center function. The location of these extremums in relation to the line center allows the estimation of magnetic field value. A program code was created and used for observation analysis, which allowed us to build BSF (bisector splitting function) and basing on averaging of a large quantity of observation data, detect very weak spectral manifestations of sub telescopic magnetic fields for both equal and different polarity. The diagnostics of magnetic fields with BSF method can be useful not also for Sun investigation but also for exploration of other stars, where small-scale areas of strong magnetic fields (an analogue to the solar sunspots) cannot be divided.

Influence of the small-scale photospheric magnetic field on the solar abundances of CNO-elements

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Three chemical elements of carbon, oxygen and nitrogen contribute significantly to the solar metallicity Z/X. A recent revision of Z/X from 2.75 % to 1.65 % still contradicts modern helioseismological observations due to the anomalously small theoretical estimate for the sound speed in the Sun. We studied how the small-scale magnetic field may influence the abundances of CNO-elements determined by the spectroscopic methods. We used a series of three-dimensional radiation-MHD model atmospheres performed by Prof. Matthias Rempel. The models resulted from a magneto-convection simulation with the local dynamo generation mechanism. The models have the average vertical magnetic flux densities of 0.5, 7.6, 51, and 80 G respectively. The magnetic field causes both a direct (Zeeman broadening) effect on spectral lines with non-zero Landé factor and an

indirect effect on temperature-sensitive lines via the change in the photospheric height stratification. We calculated the change of CI, NI, and OI line profiles due to these effects and the resulting correction to the elemental abundances.

The dynamics of the observed solar granulation: spatio-temporal variations of line of sight velocity and thermodynamic parameters

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We investigate the dynamics of the solar granulation using neutral iron line $\lambda \approx 639.3$ nm profiles from the observations with high spatial resolution taken around the centre of the solar disc in the non-pertubed region. We reproduce spatio-temporal variations of kinematic and thermodynamic parameters of the solar convection. We analyze the temporal changes of the variations of vertical velocity, temperature and density within granular cells at different heights of the solar photosphere ($h = -25 \div 500$ km).

The influence of two types of the solar wind high-speed streams on the cosmic ray intensity

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The high-speed of the solar wind streams produce geomagnetic disturbances and changes on the level of the cosmic ray intensity. The influence of two types of high speed solar wind streams – from coronal holes and solar flares associated on the cosmic ray intensity has been studied using the neutron monitor data of five stations for the period 2000 – 2013.

The magnitude, the duration, the time delay of Forbush decreases and other changes in the level of the cosmic ray intensity are studied. Was found the dependence between the size of the modulation area of galactic cosmic rays and the phase of the solar activity cycle for both types of the cosmic rays decreases.

Sunspot groups with X class flare activity in solar cycle 24: dynamics and features

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Purpose of work is study the dynamics of active regions with X-class flare activity. We used data from some space and ground-based solar telescopes. The analysis is based on data of X-class solar flares in the solar cycle 24 (for the period from January 2009 to February 2014).

ATMOSPHERIC STUDIES & SPACE GEOPHYSICS

Determination of the Geomagnetic Bow Shock position and interaction angle with the Solar Wind using THEMIS Data

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In this work we calculated the average position of the bow shock, through the eigenvalues and corresponding eigenvectors of the covariance matrix for the magnetic field developed from 10 different crosses shock events recorded by THEMIS A, during the years 2009 and 2010. With data obtained from previous calibration and the propagation direction of the magnetic field of the plasma is able to find the interaction quasi perpendicular angle Theta (B,n) which depends on the direction normal shock and the direction of incidence of field magnetic plasma. The importance of this type of analysis is that the understanding of the phenomenology of the bow shock, which is vital for the characterization of processes such as magnetic reconnection between magnetospheric lines terrestrial and interplanetary field lines carrying a large contribution from the Sun apparently lines will also be important for the description of how to enter the plasma charged particles from impacting the bow shock to the internal field lines to these particles subsequently lead to the Earth's atmosphere, these initially enter through the polar region (Polar Cusp) and then disseminated depending on the conditions of the plasma into the Earth's atmosphere, and parameters such as the position of the bow shock, this variation and interaction angle Theta (B,n) are basic to reach a minimal representation of the phenomenon. In events of great magnitude can have undesirable effects on satellites, power lines, communications and air travel, the latter is the interest on discrimination of some parameters of the phenomenon presented in this work. The study of the Bow shock, bow shock and Magnetospheric has as its starting point a detailed description of Earth's magnetosphere and solar wind phenomena must be understood independently initially and then trying to relate in terms of their interaction and communion in their respective limits, parameters such as the balance between dynamic and magnetic pressure, density, temperature, shape, size, irregular structure and other characteristics of the phenomenon. Much of the qualitative description of bow shock is given a certain way. Now an analytical representation of the bow shock is not so simple, however there are methodologies that considering some approaches led us to reconstruct much of the phenomenon geometrically as a surface of discontinuity, the relationship between states on both sides of a shock wave a unidimensional

flow could be described in terms of the magnetic field with the minimum variance method, where the related parameters such as the angle of incidence, the deflection angle of the flow, and mainly incident magnetic field.

The theory and modeling MHD large-scale vortex-like excitations in the ionosphere

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In this paper we developed the new analysis-method of excitation and propagation of planetary electromagnetic waves (PEMW) in the ionosphere of the Earth. There was derived the nonlinear system of equations for describing PEMW, that s valid for any height from D to F regions. As well the system of nonlinear one-fluid MHD equations was obtained in the b-plane approximation, valid for F region. At the last step of derivations of the equations we included the series expansion, that occurs in a small, relatively to the local geomagnetic field, non-stationary magnetic field. Obtained equations can be successfully reduced to system with Larichev-Reznik vortex solution in the equatorial region. The excitation of PEMW has been investigated numerically for different initial perturbations.

Characteristic dependencies of the temperature, partial pressure and relative humidity for various areas Ukraine

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In the 17-18 centuries, first steps were taken in the study of the laws of atmospheric processes. During this period, have been invented and improved apparatus for measuring wind velocity, rainfall, humidity, weather, and other variables. You can start the systematic observation of the atmosphere, using the equipment, first in separate paragraphs, and in the future (from the late 18th century) on a network of meteorological stations.

Certainly Geographic position to exert a decisive influence on the climate of Ukraine. Remoteness from oceans and plains formed by the predominance of

moderate continental climate in most parts of the territory of Ukraine. Subtropical climate characterized by a narrow coastal strip of the southern coast.

At the same time in Ukraine there are quite marked differences in temperature and humidity, and other meteorological parameters.

The analysis of diurnal and annual changes in temperature, partial pressure and humidity in Kyiv, Chernihiv, Odesa, Lviv and Kharkiv in 2011 – 2013 years.

Among the obtained results it can be noted: the presence of anti-correlation between changes in temperature and humidity, the air in coastal and south-western regions of Ukraine is more humid than in the central and eastern and northern; humidity affects the sea surface, water vapor partial pressure is very dependent on season, humidity fluctuations clearly visible throughout the year.

Magnetic field fluctuation properties in the transition layer of the Earth's magnetosphere

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Turbulence is a natural state of space plasma, so study of the plasma characteristics is a vital for understanding the fundamental properties of nature. Meanwhile, in MGD theory the turbulence properties is being affected by both the boundaries and electro-magnetic structure scales. Simple medium with weak turbulence was studied so far. Strong turbulence have been studied only in some rare special cases. Therefore, complex study of turbulence processes is an ongoing work in study of the Earth's magnetosphere transition layers.

In this work we have done spectral and wavelet analysis of the fluctuation of magnetic field in the different regions of the Earth's magnetosphere and Solar wind plasma. We used different methods to study turbulence; the result have been compared with a simple 1D model of turbulence properties. Space mission Cluster-II data for 2007–2009 with a temporal resolution 22.5 Hz have been used for this work.

Result shows significant difference in spectral and statistical properties of magnetic field fluctuation in different regions of magnetosheath and solar wind plasma.

The work is done in the frame of complex program of NAS of Ukraine on space researches for 2012-1016, within the framework of the educational program No.2201250 "Education, Training of students, PhD students, scientific and pedagogical staff abroad" launched by the Ministry of Education and Science of Ukraine and under a partial support of the grant No. F 53.2/039.

Quantitative analysis of the atmospheric density models applicable to determination of artificial satellite deceleration

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For determination of Earth orientation parameters from satellite laser ranging their motion should be modelled with the precision of the ranging (3 – 5 mm). For low Earth orbits (1000 km or lower) the procedure needs the atmospheric deceleration force.

Precise values of the atmosphere density are main difficulty there. There are a lot of atmosphere density models for heights to 1500 km.

This article deals with empirical atmosphere density models NRL-MSISE-00, DTM-2012 and JB2008 wich are applicable for this task. The quantitative analysis of models precision is given and some recommendations for this use are formulated.

Diffusion processes in the Earth's magnetosphere

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As part of the work carried out description, analysis and testing of methods and approaches of diffusion processes experimental study in the Earth's magnetosphere and solar wind plasma using measurements of satellite "Tango" (the "Cluster 2" project with a frequency of 22.5 Hz) for 2007 – 2010. It should be noted that the data analysis with high time separation in plasma allowed to select examples of nonlinear fluctuation and determine the homogeneity or heterogeneity of diffusion processes.

At the analysis of diffusive processes two independent approaches have been used: analysis of the height of maximum probability density function of fluctuations of the magnetic field and the analysis of the structure functions of high orders.

Intermittence parameters and geometry of dissipative structures determined from the analysis of satellite measurements could be related with the value of the generalized diffusion coefficient for different time scales.

It was discovered that the nature of transfer has super-diffusion character (anomalous diffusion) in the magnetosheath and in the magnetosphere boundary regions that is necessary to take into account when building quantitative models of transfer and for the solar wind plasma in the absence of sharp jumps of parameters a classical diffusion process is taking place.

The work is done in the frame of complex program of NAS of Ukraine on space researches for 2012-1016, within the framework of the educational program No.2201250 "Education, Training of students, PhD students, scientific and pedagogical staff abroad" launched by the Ministry of Education and Science of Ukraine and under a partial support of the grant No. F 53.2/039.

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