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

20th Young Scientists' Conference on Astronomy and Space Physics

Abstracts

Kyiv, 2013

20th Young Scientists' Conference on Astronomy and Space Physics

April 22-27, 2013
Kyiv, Ukraine

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Preface

This year Young Scientists' Conference on Astronomy and Space Physics is held for the twentieth time. We all have been looking forward to the annual meeting of astronomers at the 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 scientific institutions. During 1994-2012 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' Conferences.

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
the Local Organizing Committee

PROGRAMME

Monday, April, 22

09.00-13.00 - Registration
14.00-14.30 - Official opening

Section 'Variable Stars'

Chair: Oleksiy Ivanyuk

14.30-15.15 Nino Chkheidze (Ilia State University, ITP, Centre for Theoretical Astrophysics, Tbilisi, Georgia) The multiwavelength properties and possible unification of different classes of pulsars (invited)

15.15-15.45 tea-break

15.45-16.00 Ghada Farouk Mohamedien, A. Essam (National Research Institute of Astronomy and Geophysics, Cairo, Egypt) CCD photometry and modelling of the SWASP variable 1SWASP J064501.21+342154.9 (12+3)

16.00-16.15 Michał Żejmo, M. Rybicka, K. Krzeszowski, A. Slowikowska, K. Gozdziewski (Kepler Institute of Astronomy, University of Zielona Góra, Zielona Góra, Poland) Photometric statistical criteria for identification of binary systems with white dwarfs (12+3)

16.15-16.30 Katarzyna Drozd, E. Ragan, E. Świerczyński (Toruń Centre for Astronomy, Nicolaus Copernicus University, Toruń, Poland) V407 Cyg and RS Oph – comparison of two exotic variables (12+3)

16.30-16.45 Przemyslaw Mroz (Warsaw University Observatory, Warsaw, Poland) On the new dwarf novae in the Galactic Disk (12+3)

16.45-17.00 Elena Babina, S. A. Artemenko, P. P. Petrov, K. N. Grankin (Crimean Astrophysical Observatory, Nauchny, Ukraine) Characteristic times of wind variability in classical T Tauri stars (12+3)

17.00-17.15 Svetlana Artemenko, K. N. Grankin, P. P. Petrov (Crimean Astrophysical Observatory, Nauchny, Ukraine) Rotation effects in classical T Tauri stars (12+3)

17.15-17.30 Vitalii Breus, I. L. Andronov, P. Dubovsky, T. Hegedus, P. Beringer, K. Petrik, I. Kudzej (Odesa National Maritime University, Odesa, Ukraine) Variability of the spin period of the intermediate polar V405 Aur (12+3)

17.30-17.35 Aleksey Sosnovskij, E. P. Pavlenko (Crimean Astrophysical Observatory, Nauchny, Ukraine) Color study of the eclipsing cataclysmic variable 1RXJ 003829 in an inactive state 2010–2012 (poster)

17.35-17.40 Alex Rublevskii, V. V. Prokofjeva (Crimean Astrophysical Observatory, Nauchny, Ukraine) Comparison of the observations results of asteroid 4 Vesta obtained with spectral-frequency method and the results of NASA's Dawn Mission (poster)

17.40-17.45 Alexandr Savushkin, D. Mkrtichian (Crimean Astrophysical Observatory, Nauchny, Ukraine) Discovery of 47-min pulsation in oEA system LT Her (poster)

17.45-17.50 Sergey Belan, D. N. Shakhovskoy (Crimean Astrophysical Observatory, Nauchny, Ukraine) Long-term photopolarimetric variability of DD Ser (poster)

17.50-17.55 Alisa Shchurova, E. Pavlenko, V. Malanushenko (Tavrida National V. I. Vernadsky University) The two accretion state of the polar 1RXS J184542 in 2012 (poster)

17.55-18.10 Mariusz Tarnopolski (Astronomical Observatory, Jagiellonian University, Cracow, Poland) Titan's influence on Hyperion's rotational dynamics (12+3)

18.30-21.00 Excursion to the Main Astronomical Observatory of the National Academy of Sciences of Ukraine

Tuesday, April, 23

Section 'Atmosphere Studies'

Chair: Anatolii Koval

09.00-09.25 morning coffee

09.25-09.40 Andrii Bovchaliuk, G. Milinevsky, V. Danylevsky, V. Kabashnikov, N. Miatselskaya (Taras Shevchenko National University of Kyiv, Kyiv, Ukraine) Aerosol distribution over Europe: the comparison of satellite POLDER/PARASOL and model GEOS-Chem data (12+3)

09.40-09.45 Valentyn Bovchaliuk (Taras Shevchenko National University of Kyiv, Kyiv, Ukraine) Variability of the aerosol characteristics by transect observations over Ukraine (poster)

09.45-09.50 Vladyslav Mogylchak, L. V. Kozak (Taras Shevchenko National University of Kyiv, Kyiv, Ukraine) Effect of water vapour on the absorption of light in the Earth's atmosphere (poster)

09.50-09.55 Igor Gala, L. V. Kozak (Taras Shevchenko National University of Kyiv, Kyiv, Ukraine) Lightning discharges in Earth's atmosphere: terms of occurrence and main characteristics (poster)

09.55-10.00 Sergii Pylypenko (Taras Shevchenko National University of Kyiv, Kyiv, Ukraine) Variations of winds in the upper atmosphere over the cyclones (poster)

10.00-10.05 Tetyana Zaets, L. V. Kozak, A. Odzimek (Taras Shevchenko National University of Kyiv, Kyiv, Ukraine) The analysis of the features of the TLE phenomena in the Earth's atmosphere (poster)

10.05-10.10 Maureen Chioma Umeh, B. G. Ayantunji (Nnamdi Azikiwe University, Awka, Nigeria) Seasonal dependence of relative humidity on Solar radiation (poster)

10.10-10.15 Evgeniy Udodov (Taras Shevchenko National University of Kyiv, Kyiv, Ukraine) Ozone vertical distribution over Kiev-Goloseyev station (poster)

Section 'Ionosphere & Heliosphere Studies'

Chair: Anatolii Koval

10.15-11.00 Oleksiy Agapitov (LPC2E/CNRS, University of Orleans, France; Taras Shevchenko National University of Kyiv, Ukraine) Plasma waves and electron dynamics in the radiation belts (invited)

11.00-11.30 tea-break

11.30-12.15 Yuri Yasyukevich (Institute of Solar-Terrestrial Physics SB RAS, Irkutsk, Russia) GPS/GLONASS studying the ionosphere dynamic mode (invited)

12.15-12.30 Yuri Yasyukevich, N. P. Perevalova, V. A. Sankov (Institute of Solar-Terrestrial Physics SB RAS, Irkutsk, Russia) Peculiarities of different wave propagation mode during the 11 March 2011 Tohoku earthquake (12+3)

12.30-12.45 Ilya Edemskiy, Yu. V. Yasyukevich, S. V. Voeykov, P. L. Malkova (Institute of Solar-Terrestrial Physics SB RAS, Irkutsk, Russia) Latitudinal variations of solar terminator generated wave packets parameters, derived from 2008 year data for different regions (12+3)

12.45-13.00 Sviatoslav Shevchenko, O. K. Cheremnykh, S. O. Cheremnykh, A. S. Parnowski (National Technical University of Ukraine "Kyiv Polytechnical Institute", Institute of Physics and Technology, Kyiv, Ukraine) On damping mechanisms of ULF MHD modes in the inner magnetosphere of Earth (12+3)

13.00-13.15 Alexander Tsupko, L. V. Kozak (Taras Shevchenko National University of Kyiv, Kyiv, Ukraine) Some features of turbulent processes in the Earth's magnetosphere from "Cluster II" mission measurements (12+3)

13.15-13.30 Eugen Tkachenko, Yu. G. Rapoport, Yu. A. Selivanov, V. M. Ivchenko, V. V. Grimalsky (Taras Shevchenko National University of Kyiv, Kyiv, Ukraine) AGW and PEMW in inhomogeneous system "atmosphere-ionosphere" (12+3)

13.30-13.35 Nataliya Nosikova, V. A. Pilipenko, N. V. Yagova, A. Y. Schekotov, V. V. Surkov (National Research Nuclear University "MEPhI", Moscow, Russia) Parameters of natural electromagnetic emissions in the frequency range 5-20 Hz in the F-layer of the Earth's ionosphere as measured by CHAMP (poster)

13.35-13.40 Edyta Puchalska (Nicolaus Copernicus University, Toruń, Poland) The mystery of Auroras (poster)

13.40-13.55 Doha Al-Feadh, A. Al-Sawad, W. Al-Ramdhan (University of Basrah, Basrah, Iraq) Estimating of times and heliospheric location of the accelerated energetic protons associated with two CMEs in the Multi Eruption Solar Energetic Particle (MESEP) events (12+3)

13.55-14.10 Svetlana Glubokova, I. V. Chashei, S. A. Tyul'bashev (Pushchino Radio Astronomy Observatory, Lebedev Physical Institute, Russian Academy of Science, Pushchino, Russia) Interplanetary plasma turbulence parameters from observations of 3C 48 and 3C 298 near minimum of solar activity (12+3)

14.10-15.00 lunch

15.30-19.00 City tour

Wednesday, April, 24

Section 'Theoretical Cosmology & Gravitation'

Chair: Dmytro Iakubovskyi

09.00-09.15 morning coffee

09.15-09.30 Dmytro Iakubovskyi (Bogolyubov Institute for Theoretical Physics, Kyiv, Ukraine) Refined scaling relation between dark matter halo parameters (12+3)

09.30-09.45 Iryna Ivanchenko, V. M. Gorkavenko, Yu. A. Sitenko (Taras Shevchenko National University of Kyiv, Kyiv, Ukraine) Induced vacuum current and magnetic field in the background of a cosmic string modelled by impenetrable magnetic-flux-carrying tube (12+3)

09.45-10.00 Rakeshwar Purohit (Mohanlal Sukhadia University, Udaipur, India) Magnetized Bianchi type IX bulk viscose fluid (12+3)

10.00-10.15 Margarita Sobolenko, P. Berczik (Main Astronomical Observatory of the National Academy of Sciences of Ukraine, Kyiv, Ukraine) Dynamic analysis of the endproducts after galaxies merging (12+3)

10.15-10.20 Lidiia Zadorozhna, B. I. Hnatyk, Yu. A. Sitenko (Taras Shevchenko National University of Kyiv, Kyiv, Ukraine) Magnetic field of cosmic strings in the early Universe (poster)

10.20-10.25 Alexander Agapov, I. K. Rozgacheva (Peoples' Friendship University of Russia, Moscow, Russia) Fractal model of the Universe's large-scale structure (poster)

10.25-10.30 Anita Bagora (Jaipur National University, Jagatpura, India) Conformally flat V Bianchi magnetized titled cosmological model (poster)

10.30-10.35 Emily Stukalo, V. I. Zhdanov (Taras Shevchenko National University of Kyiv, Kyiv, Ukraine) Spherically symmetric solutions of General Relativity with a scalar field within the Dark Energy model that mimics ΛCDM (poster)

10.35-11.00 tea-break

Section 'Observational Cosmology'

Chair: Dmytro Iakubovskyi

11.00-11.45 Antonino Del Popolo (Catania University, Catania, Italy) The small scale problems of the ΛCDM model (invited)

11.45-12.00 Olga Sergijenko, B. Novosyadlyj (Astronomical Observatory, Ivan Franko National University of Lviv, Lviv, Ukraine) Dynamical dark energy with barotropic equation of state: observational constraints from Planck data (12+3)

12.00-12.15 Andrei Borisov, I. K. Rozgacheva (Peoples' Friendship University of Russia, Moscow, Russia) Galaxy clusters' substructures in optics and X-rays (12+3)

12.15-12.30 Anatoliy Tugay (Taras Shevchenko National University of Kyiv, Kyiv, Ukraine) Bright X-ray galaxies in SDSS filaments (12+3)

12.30-12.45 Olga Vasylenko, G. Ivashchenko (Taras Shevchenko National University of Kyiv, Kyiv, Ukraine) Redshift dependence of the β parameter describing non-Hubble motions of quasars (12+3)

12.45-13.00 Ganna Ivashchenko, O. Vasylenko (Astronomical Observatory, Taras Shevchenko National University of Kyiv, Kyiv, Ukraine) Cross-correlation function of SDSS quasars and WiggleZ galaxies: parameters of non-Hubble motions (12+3)

13.00-13.15 Olena Torbaniuk, G. Ivashchenko (Taras Shevchenko National University of Kyiv, Kyiv, Ukraine) Redshift dependence of the mean transmission in the Lyα-forest: effects of the continuum fitting technique (12+3)

13.15-13.20 Kateryna Agienko (Main Astronomical Observatory of the National Academy of Sciences of Ukraine, Kyiv, Ukraine) Nitrogen abundance estimation in WR galaxies of SDSS DR7 (poster)

13.20-13.25 Talieh Mohamadi, A. B. Sepehr (Iranian National Observatory, Islamic Azad University Central Tehran Branch, Tehran, Iran) The evolution of the absolute magnitude function of quasars in the Milliquas, Master and 2QZ quasar catalogs (poster)

13.25-13.30 Rouhollah Joveini, Teymur Saifollahi, Soroush Sotoudeh (Sharif University of Technology, K. N. Toosi University of Technology, Tehran, Iran) The relation between the star formation rate and local density for the Virgo galaxy cluster (poster)

13.30-14.00 lunch

Section 'High-Energy Astrophysics'

Chair: Ievgen Vovk

14.00-14.45 Ericson Lopez (Space Sciences Telescope Institute, USA; Quito Astronomical Observatory of National Polytechnic School, Ecuador) Constraining the intrinsic energy of GRB events (invited)

14.45-15.00 Dmytro Iakubovskyi (Bogolyubov Institute for Theoretical Physics, Kyiv, Ukraine) Search for a radiative dark matter decay signatures using combination archival XMM-Newton observations of galaxies (12+3)

15.00-15.15 Denys Malyshev, A. Boyarsky, O. Ruchayskiy (Bogolyubov Institute for Theoretical Physics, Kyiv, Ukraine) Spectral and spatial variations of the diffuse gamma-ray background in the vicinity of the Galactic plane and possible nature of the feature at 130 GeV (12+3)

15.15-15.30 Mykhailo Sydorenko, B. I. Hnatyk, V. V. Marchenko (Taras Shevchenko National University of Kyiv, Kyiv, Ukraine) Stochastic acceleration of charged particles in turbulent magnetic fields (12+3)

15.30-15.45 Iryna Lypova, M. A. Shayduk, G. Maier (Taras Shevchenko National University of Kyiv, Kyiv, Ukraine) Investigation of gamma/electron separation methods for CTA (12+3)

15.45-16.15 tea-break

16.15-16.30 Dmytro Rogozin, L. V. Zadorozhna, B. I. Hnatyk (Taras Shevchenko National University of Kyiv, Kyiv, Ukraine) Synchrotron self-Compton and inverse Compton radiation of the superconducting cosmic strings (12+3)

16.30-16.35 Iurii Babyk, M. Chernyakova (Dublin Institute for Advanced Studies, Dublin, Ireland) Suzaku observations of the relativistic pulsar wind in PSR B1259/SS2883 system (poster)

16.35-16.40 Roman Gnatyk (Taras Shevchenko National University of Kyiv, Kyiv, Ukraine) Transition from galactic to extragalactic cosmic rays (poster)

Section 'Active Galactic Nuclei'

Chair: Ievgen Vovk

16.40-16.55 Ievgen Vovk, A. Neronov (ISDC Data Centre for Astrophysics, Versoix, Switzerland) On the question of the breaks in the GeV spectra of blazars (12+3)

16.55-17.10 Alexandr Butenko, R. D. Dagkesamanskii, V. A. Samodurov, S. A. Tyulbashev (Pushchino Natural Sciences Institute, Pushchino, Russia) Search of giant radio sources in the 102.5 MHz Nothern Sky survey (12+3)

17.10-17.25 Artem Bohdan, V. V. Marchenko, B. I. Hnatyk (Taras Shevchenko National University of Kyiv, Kyiv, Ukraine) The transverse and longitudinal structure of 3C273 X-ray jet (12+3)

17.25-17.40 Anton Dmytriiev, E. V. Fedorova (Taras Shevchenko National University of Kyiv, Kyiv, Ukraine) Studying Fe Kα line profile in Sy2 galaxy NGC 4388 (12+3)

17.40-17.45 Denis Sokolov, V. V. Marchenko (Taras Shevchenko Chernigiv National Pedagogical University, Chernigiv, Ukraine) An image of diffuse emission for Centaurus A (poster)

17.45-17.50 Ekaterina Sukach, V. V. Marchenko (Taras Shevchenko Chernigiv National Pedagogical University, Chernigiv, Ukraine) Analysis of spatial and temporal properties of active galaxies' relativistic jets (poster)

17.50-17.55 Anatoliy Vasylenko, E. V. Fedorova, V. I. Zhdanov (Taras Shevchenko National University of Kyiv, Kyiv, Ukraine) Observations of AGN in Sy2 galaxy NGC 3281 by XMM-Newton and INTEGRAL satellites (poster)

18.30-22.00 Organ hall / opera hall

Thursday, April, 25

Section 'Exoplanets'

Chair: Oleksiy Ivanyuk

09.00-09.30 morning coffee

09.30-09.45 Damian Puchalski, G. Maciejewski (Toruń Centre for Astronomy of Nicolaus Copernicus University, Toruń, Poland) Observations of transiting exoplanets in Toruń Centre for Astronomy (12+3)

09.45-10.00 Artem Burdanov, A. A. Popov, V. V. Krushinsky, K. I. Ivanov (Ural Federal University, Ekaterinburg, Russia) Two transiting exoplanet candidates in Cygnus from the MASTER-Net project (12+3)

10.00-10.15 Oleksiy Matsiaka, Yu. Kuznyetsova, V. Krushevska, M. Andreev (Taras Shevchenko National University of Kyiv, Kyiv, Ukraine) Analysis of the light curve of exoplanet transit systems TrES-3 and WASP-3 (12+3)

10.15-10.20 Yana Shliakhetskaya, Yu. Kuznyetsova, A. Vid'machenko (Taras Shevchenko National University of Kyiv, Kyiv, Ukraine) Spectral studies of exoplanet transit system WASP-33 during some transit phenomena (poster)

10.20-10.25 Damian Puchalski, G. Maciejewski (Toruń Centre for Astronomy of Nicolaus Copernicus University, Toruń, Poland) Searching for TTV signal in HAT-P-16 system (poster)

10.25-11.00 tea-break

Section 'Stellar Astrophysics'

Chair: Oleksiy Ivanyuk

11.00-11.45 Michael Mishchenko (New York, USA) Polarimetric remote sensing of terrestrial aerosols: from Maxwell's equations to space missions (invited)

11.45-12.00 Kateryna Frantseva, N. G. Shchukina (Taras Shevchenko National University of Kyiv, Kyiv, Ukraine) One-dimensional radiative transfer modelling of the polarization of the continuous spectrum of the late-type stars (12+3)

12.00-12.15 Kateryna Rieznik, V. M. Reshetnyk (Taras Shevchenko National University of Kyiv, Kyiv, Ukraine) Spectrophotometry of flares on EV Lac in 2010-2011 (12+3)

12.15-12.30 Bartlomiej Debski (Astronomical Observatory of the Jagiellonian University, Kraków, Poland) Overcontact binaries in the Kepler mission: migration of the dark spots (12+3)

12.30-12.45 Oleksiy Ivanyuk (Main Astronomical Observatory of the National Academy of Sciences of Ukraine, Kyiv, Ukraine) Spectroscopic properties of the 107 stars from the CHEPS sample (12+3)

12.45-13.00 Iryna Kushniruk, Ya. V. Pavlenko, B. Kaminskiy (Taras Shevchenko National University of Kyiv, Kyiv, Ukraine) MgH lines in spectrum of Arcturus (12+3)

13.00-13.15 Mario Pasquato (Yonsei University, Seoul, Korea) Dynamically enhanced mass-loss on the Red Giant Branch: a solution to the second-parameter problem? (12+3)

13.15-13.20 Andrew Simon (Taras Shevchenko National University of Kyiv, Kyiv, Ukraine) Optical study of RX J0440.9+4431 in 2010-2012 (poster)

13.20-14.00 lunch

Section 'Solar System'

Chair: Oleksiy Ivanyuk

14.00-14.45 Bojan Novakovic, H. Hsieh, A. Cellino (University of Belgrade, Belgrade, Serbia) Linking main-belt comets to asteroid families (invited)

14.45-15.15 tea-break

15.15-15.30 Anton Pomazan (Research Institute "Nikolaev Astronomycal Observatory", Mykolaiv, Ukraine) Analysis of astrometric measurements of selected asteroids for determination of Yarkovsky effect (12+3)

15.30-15.35 Olena Shubina, I. V. Kulyk, P. P. Korsun, Ya. O. Romaniuk (Taras Shevchenko National University of Kyiv, Kyiv, Ukraine) Photometry of the distant active comet C/2010 S1 (LINEAR) (poster)

15.35-15.40 Sergiy Zaitsev, V. Rosenbush, N. Kiselev (Main Astronomical Observatory of the National Academy of Sciences of Ukraine, Kyiv, Ukraine) Database of polarimetry of planetary satellites (poster)

15.40-15.45 Alyona Mozgova, K. I. Churyumov, N. S. Kovalenko, A. M. Mozgova, V. O. Ponomarenko (Taras Shevchenko National University of Kyiv, Kyiv, Ukraine) The spectrum of a meteor of 9/10 August 1965 (poster)

15.45-15.50 Kostyantyn Radchenko (National Aviation University, Kyiv, Ukraine) Peculiarities of the dynamics and the origin of retrograde satellites of planets (poster)

15.50-15.55 Pasha Plotko, F. P. Velichko, S. V. Zaitsev, V. A. Psarev (Lyceum of Kharkiv Institute of Physics and Mathematics, Kharkiv, Ukraine) Photometry and polarimetry of asteroid 4 Vesta (poster)

15.55-16.00 Olexandr Baransky, A. I. Zhdanov (Astronomical Observatory, Taras Shevchenko National University of Kyiv, Kyiv, Ukraine) 2P/Enke, 4P/Faye, 6P/d'Arrest, 21P/Giacobini-Zinner and 27P/Crommelin comets' disintegration study (poster)

16.00-16.05 Vasyl Ponomarenko, K. I. Churyumov, V. V. Kleshchonok, A. O. Simon (Astronomical Observatory, Taras Shevchenko National University of Kyiv, Kyiv, Ukraine) Changes in the spectrum of the star HIP 54721 during its coverage by comet C/2009 P1 (Garradd) (poster)

Section 'Positional Astronomy & Astronomical Equipment'

Chair: Oleksiy Ivanyuk

16.05-16.20 Vadym Tkachuk, V. Ya. Choliy (Taras Shevchenko National University of Kyiv, Kyiv, Ukraine) Processing of VLBI data of MAO NASU analysis centre with new SteelBreeze software (12+3)

16.20-16.35 Mohammad Khasawneh (Kordan University, Amman, Jordan) Site selection of an optical telescope in Jordan (12+3)

16.35-16.40 Sergii Pokhvala, V. M. Reshetnyk, B. E. Zhilyaev (Main Astronomical Observatory of the National Academy of Sciences of Ukraine, Kyiv, Ukraine) Tests of commercial color CMOS cameras in astronomical applications (poster)

16.40-16.45 Andry Dolgov, S. Plachinda (Taurida National V. I. Vernadsky University, Simferopol, Ukraine) Comparison of two methods for processing images spectropolarimetric echelle spectrograph on the example of a magnetic star B CrB (poster)

16.45-16.50 Arthur Pulatov (Sevastopol National Technical University, Sevastopol, Ukraine; Crimean Astrophysical Observatory, Nauchny, Ukraine) Registration a rapidly changing electromagnetic waves, using a modern electronic equipment (poster)

19.00-22.00 Conference dinner

Friday, April, 26

Section 'Interstellar Medium'

Chair: Ganna Ivashchenko

09.00-09.15 morning coffee

09.15-09.30 Ihor Koshmak, B. Ya. Melekh (Ivan Franko National University of Lviv, Lviv, Ukraine) Modelling of low-metallicity HII region emission with bubble-like structure inside (12+3)

09.30-09.45 Oleh Buhajenko, B. Ya. Melekh (Ivan Franko National University of Lviv, Lviv, Ukraine) Optimization of the integration step in calculation procedure of the nebular diffuse radiation (12+3)

09.45-10.00 Yanina Soichuk, B. Ya. Melekh, V. Holovatyi, N. Havrylova (Ivan Franko National University of Lviv, Lviv, Ukraine) On the search of optimal photoionization models of planetary nebulae (12+3)

10.00-10.15 Taras Kuzyo, V. Beshley, O. Petruk (Ivan Franko National University of Lviv, Lviv, Ukraine) Magnetic field in dynamics of post-adiabatic supernova remnants (12+ 3)

10.15-10.30 Mateusz Daszuta, W. Lewandowski, J. Kijak (University of Zielona Góra, Zielona Góra, Poland) Long-term observation scintillation of PSR B0823+26 (12+3)

Section 'Solar Physics'

Chair: Kateryna Frantseva

10.30-10.45 Ievgeniia Sadovenko, M. I. Pishkalo (Astronomical Observatory, Taras Shevchenko National University of Kyiv, Kyiv, Ukraine) Structure of the solar corona during total solar eclipses in solar cycle 23 and modelling of coronal magnetic field in the potential approach (12+3)

10.45-11.00 Olga Botygina, V. G. Lozitsky, N. I. Lozitska (Astronomical Observatory, Taras Shevchenko National University of Kyiv, Kyiv, Ukraine) Magnetic fields in limb solar flares (12+3)

11.00-11.15 Yuriy Fursiak (Crimean Astrophysical Observatory, Nauchny, Ukraine) Fast-growing sunspot groups AR 1618, AR 1619, AR 1620, AR 1640 and their features (12+3)

11.15-11.20 Roman Zhygalkin (Crimean Astrophysical Observatory, Nauchny, Ukraine) TST Spectra View application (poster)

11.20-11.25 Olexandra Baran (Astronomical Observatory, Ivan Franko National University of Lviv, Lviv, Ukraine) Power spectra of convective motions in the solar photosphere (poster)

11.25-11.30 Valery Krivodubskij, Ie. Sadovenko (Astronomical Observatory, National Taras Shevchenko University of Kyiv, Kyiv, Ukraine) The macroscopic turbulent diamagnetism and stability of sunspots (poster)

11.30-12.30 Poster section + tea-break

12.30-13.00 Official closure

Saturday, April 27

09.00-12.00 Excursion to Museum of Folk Architecture and Life of Ukraine

INVITED LECTURES

The multiwavelength properties and possible unification of different classes of pulsars

Nino Chkheidze

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Pulsars are the highly magnetized and rapidly rotating neutron stars, with the broad band radiation ranging from radio up to very high energy gamma-ray emission. More than 40 years have passed since the discovery of pulsars and there is still no consensus on the basic emission mechanism. At the present time, there are about 12 competing theories, which differ both in the physical effects responsible for the radiation and in the locations where they operate. Probably the only point of agreement between all these theories is the association of pulsars with magnetized, rotating neutron stars. By contrast, there is so much observational data available that none of the existing theories can explain all the main observational facts. The study of these objects appears to be more promising due to large amount of data that is collected and combined from modern telescopes. More over the recent development in the field of the high energy observational astrophysics (facilities that are operating in the gamma-ray range – INTEGRAL, Agile, Fermi and up to the highest energies covered by ground based Cherenkov telescopes, like HESS, MAGIC, VERITAS) revealed that pulsars can emit even in the VHE domain (up to 400 GeV for the Crab pulsar). Measurements in the HE domain stimulated new branch of the emission models, the so called outer gap models as the polar cap models are unable to explain the production of HE gamma-rays. It is generally accepted that the radio pulsars are rotation-powered, where the loss of rotational energy of the star provides the power. The emission models that are based on this assumption faced explicit problem after discovery of the new classes of pulsars. One of such classes are the so called magnetars, these are the anomalous pulsars as their emission can't be explained by pulsar rotation. One of the interesting class is the so called X-ray Dim Isolated Neutron Stars, that reveal pure Planckian spectrum in the X-ray domain, and thus their emission requires development of the thermal emission models for the neutron stars. In the following report, we will review the working pulsar emission models for different classes of neutron stars and will talk about possible emission model that could describe the observed different kinds of properties of pulsars in the framework of one emission scenario.

Plasma waves and electron dynamics in the radiation belts

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ELF/VLF waves play a crucial role in the dynamics of radiation belts, and are responsible for the loss and the acceleration of energetic electrons. Modelling of wave-particle interactions requires the best possible knowledge of wave energy and wave-normal directions distribution in L-shells for different magnetic latitudes and magnetic activity conditions. We performed a statistical study for ELF/VLF emissions using a whistler frequency range for ten years (2001-2010) of Cluster measurements. We utilized data from the STAFF-SA experiment, which spans the frequency

range from 8.8 Hz to 3.56 kHz and present distributions of wave magnetic and electric field amplitude and wave-normals in dependence on MLat, MLT, L-shell and geomagnetic activity in a form of probability levels, which were directly applied for electrons diffusion coefficients estimation in the outer radiation belt. We show that whistler wave normals are directed approximately along the magnetic field (with the mean value about 10– 15 degrees) in a vicinity of the geomagnetic equator. The distribution changes with magnetic latitude, the angle for a given frequency tends to the resonance cone and as a result at latitudes about 30 degrees, wave-normals become nearly perpendicular to the magnetic field. Above 20 degrees of latitude the field aligned wave population appears which is explained by Landau damping effects of waves propagation and is confirmed by numerical calculations. The observed angular distribution is significantly different from Gaussian and the width of the distribution increases with latitude. The new technique for wave normal estimation which allows to include wave data from projects without three components magnetic field measurements into analysis has been developed. The obtained results were proved by use of numerical ray tracing simulation. The calculations take into account realistic effects of the spreading of the signal due to propagation in the inhomogeneous and anisotropic magnetized plasma, the dependence of signal propagation characteristics upon initial conditions, etc. Our calculations make possible to follow the wave packets and calculate their properties in the desired regions, e. g. the regions where an efficient wave-particle interaction is expected to occur. Distributions for the diffusion coefficients for day and night sectors and for different geomagnetic activity regimes are obtained. The diffusion coefficients from these distributions are compared with coefficients calculated under assumption of whistler parallel propagation with constant value of variance and wave amplitude along magnetic field line. The analytical validation of diffusion rates was made. Results were proved by use of numerical ray tracing simulation. The increase of the mean value and the variance of the wave vector distribution with latitude results in significant growth of the pitch-angle diffusion rates due to significant increase of the contribution of higher order cyclotron resonances at large latitudes, which is the most efficient for electrons with small equatorial pitch-angles. The new acceleration mechanism of radiation belts electron based on Landau resonance which explains energy gain up to 1 MeV has been developed.

GPS/GLONASS studying the ionosphere dynamic mode

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The data from the network of ground-based stations of global navigation satellite systems (GNSS) allow us to carry out monitoring of the Earth's ionosphere at the new methodological and technological level. At the ISTP SB RAS these investigations began in 1997 under supervision of Prof. E. L. Afraimovich (12 March 1940 – 8 November 2009). On behalf of GNSS-monitoring workgroup we present the review of studies carried out at the ISTP SB RAS during 1998-2012. The main results of GNSS radio sounding of ionospheric disturbances associated with solar eclipses, solar flares, solar terminator, earthquakes, tropical cyclones, large-scale ionospheric disturbances of auroral origin, field-aligned large-scale irregularities are shown. Dynamics of global electron content is analysed. The special attention is paid on the influence of solar flares and ionospheric irregularities on GPS and GLONASS operation. The work was supported by Russian Foundation for Basic Research (grant #12-05-33032-a), by

the Ministry of Education and Science of the Russian Federation (under agreement #8699) and by Russian Federation president grant MK-3771.2013.5.

The small scale problems of the ΛCDM model

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Notwithstanding the ΛCDM model is noteworthy successful in explaining observation at large and intermediate scales, on small scales a strong tension exists between predictions and observations that has been actively explored during the last decade (Spergel 2007; Del Popolo 2007, Perivoloropoulos 2008). Some examples are: a) the fact that substructure may not be as common as is expected on the basis of numerical simulations of cold (collisionless) dark matter, b) the tension between the CDM predictions and observational results of sizes and angular momenta of galactic disks (Mayer et al. 2008), c) the Cusp/Core problem, namely the fact that the observed rotation curves of dwarf spiral and LSB galaxies (e.g. Flores & Primack 1994; Moore 1994; Gentile et al. 2007; Del Popolo 2009) seem to indicate that the shape of the dark matter halo density profile at small scales is significantly shallower than what is found in numerical simulations. Such discrepancies have been signalled as a genuine crisis of the standard scenario, and several alternatives have been suggested (Ostriker & Steinhardt 2003). I will discuss how the connection of the small scale problems with the baryons physics, usually not taken into account in simulations.

Constraining the intrinsic energy of GRB events

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Considering a GRB event as a relativistic flux where the relativistic beam makes radiation anisotropic, we are able to show that the required intrinsic energy associated with these events is significantly smaller than those values commonly presented in the literature. Our results show energy values around 10^{44} ergs for Lorentz Γ-factor ~ 10 and around 10^{38} ergs for $\Gamma \sim 300$, values which are much more compatible with energies involved in AGN events rather than those related to formation of stellar black holes and hypernovas.

Polarimetric remote sensing of terrestrial aerosols: from Maxwell's equations to space missions

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It is widely recognized that aerosol and cloud particles exert a strong influence on the environment as well as on the global and regional climates. This explains the utmost scientific and societal importance of detailed and accurate knowledge of physical and chemical properties of these particles. More often than not it is impracticable to

collect samples of such particles and subject them to a laboratory test. Therefore, in most cases one has to rely on theoretical analyses of remote measurements of light scattered by the particles. Fortunately, the scattering properties of small particles often exhibit a strong dependence on their size, shape, and refractive index. This factor makes remote sensing an extremely useful and often the only practicable means of physical and chemical particle characterization. For a long time remote-sensing studies had relied on measurements of only the scattered intensity. Eventually it has become recognized that polarization characteristics of the scattered radiation contain much more specific and accurate information about such important properties of particles as their size, morphology, and chemical composition. Continuing progress in electromagnetic scattering theory coupled with improved measurement capabilities produced numerous examples of the unmatched efficacy of polarimetry as a particle characterization technique. As a consequence, polarimetry has become one of the most informative and accurate means of ground-based, airborne, and satellite remote sensing.

Linking main-belt comets to asteroid families

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Main belt comets (MBCs) are objects that are dynamically indistinguishable from main belt asteroids, but which exhibit comet-like activity due to the sublimation of volatile ice. To date, eight such objects have been discovered. MBCs are important because they represent a new reservoir of comets in the solar system, and may give insights into the role of main belt objects in the primordial delivery of water to the Earth as well as to provide constraints on the composition of the protosolar disk.

Wherever MBCs originate from, their activity is likely triggered by the impact-excavation of subsurface ice because completely exposed surface ice is unstable against sublimation at their heliocentric distances over Gyr time-scales. Thermal modelling shows that buried ice on a main-belt comet can in fact survive over the life of the solar system. However, while thermal devolatization may not preclude the existence of present-day ice in the main asteroid belt, there is the additional problem of collisional devolatization. Each time an impact triggers activity in a MBC by exposing a small amount of subsurface ice to direct solar heating, that particular area of the surface is effectively devolatilized. An estimates of the areas required to produce the activity observed for MBCs suggests that this activity was most likely triggered by meter-sized impactors. Over Gyr time-scales, the cumulative effect of such impacts could be to devolatilize a significant portion of the surface of an ice-bearing asteroid. On the other hand, more deeply buried ice could persist, safe from both thermal and collisional depletion. The problem is that it would also be inaccessible by activity triggering impacts. The mechanism that is capable to bring deeply buried ice close to (or even at) the surface is collisional disruption of an ice-bearing asteroid. This is the reason why scientists believe that MBCs may be preferentially found among the members of collisionally-formed asteroid families (AFs).

Here we present our results obtained by applying different methods in order to establish a link between the MBCs and AFs, i. e, to possibly find additional line of evidence supporting the hypothesis that MBCs may be preferentially found among the members of AFs.

VARIABLE STARS

CCD photometry and modelling of the SWASP variable 1SWASPJ064501.21+342154.9

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The first BVRI CCD photometric observations of the newly discovered SWASP variable 1SWASP J064501.21+342154.9 are presented. The observed light curves are analyzed with the Wilson-Devinny program in order to derive the geometric and photometric elements of the system.

Photometric statistical criteria for identification of binary systems with white dwarfs

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We are searching for statistical criteria of identification of binary systems containing white dwarfs. Our analysis is based on the white dwarfs sample derived from the Villanova University White Dwarf Catalog containing 14,235 objects. Coordinates of these WDs were correlated with the GALEX, SDSS, 2MASS and UKIDSS catalogues to obtain their photometric brightness in the following filters: FUV, NUV, u, g, r, i, z, Y, J, H, K. The retrieved data allow us to construct colour-colour diagrams and determine regions characteristic for binary systems with a white dwarf companion. The aim of this study is also to determine a sample of binary systems that will be potential targets reached by the GAIA mission. This has a rich context of growing number of binaries hosting exoplanets. The calibration making use of our criteria might be useful to interpret and analyse the precision GAIA astrometry and to make it possible to early discriminate between different astrometric models explaining (O-C) variations for these objects.

Cyg and RS Oph – comparison of two exotic variables

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V407 Cyg and RS Oph are two similar but isolated case of objects. One can say, they are individual type of stars. During the quite state they seem to be symbiotic stars. However both of them showed nova-like outbursts in their history. The reason of why they went ballistic is unknown. Also there are many incomprehensible in behaviour after outbursts. I would like to look closer and compare those two unique objects. I am also tempted to propose some physical explanations.

On the new dwarf novae in the Galactic Disk

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Dwarf novae are close binary systems, in which matter lost from a low-mass main-sequence star forms an accretion disk around a white dwarf. Under some conditions the disk becomes unstable what results in outburst. The search for dwarf novae is very demanding since this variables exhibit a vast diversity of photometric behaviour. So far, there wasn't any large searches for this stars. I analysed the light curves of about 9 million stars (located in the Galactic Disk fields), observed during the third phase of the Optical Gravitational Lensing Experiment (OGLE-III). In this sample I found 40 dwarf novae, all of them haven't been observed before. I will discuss the selection procedure and properties of found dwarf novae. I will describe a few interesting objects in more details. This observations shed a new light on SU UMa stars, a subgroup of dwarf novae.

Characteristic times of wind variability in classical T Tauri stars

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Observations of short-term variability of wind in classical T Tauri stars DR Tau and RW Aur are presented. As an indicator of the wind density, the ratio of the H and K CaII equivalent widths is used, because the H CaII emission is absorbed by the blue-shifted H formed in the expanding wind at $-120\,\mathrm{km/s}$. We found that the wind density in DR Tau and RW Aur varies with a characteristic times of 4 to 5 days, which is somewhat shorter than the rotational periods of the stars. The result is interpreted in the framework of the conical wind model, where cyclic repetitions of the accretion and wind events are caused by interactions of the stellar magnetosphere with the ionized gas at the inner edge of the accretion disk.

Rotation effects in classical T Tauri stars

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Surface temperature inhomogeneities in classical T Tauri stars (CTTS) induced by magnetic activity and mass accretion lead to rotational modulation of both photometric and spectroscopic parameters of these stars. Using the extended photometric catalogue we have derived the periods and amplitudes of the rotational modulation of brightness and color for 31 CTTS; for six of them, the periods have been revealed for the first time. The inclinations of the rotation axis and equatorial rotational velocities of CTTS have been determined. We show that the known periods of brightness variations for some of the CTTS are not the axial rotation periods but are the Keplerian periods near the inner boundary of the dusty disk. We have found that the angular velocity of CTTS with a mass of 0.3–3 $M_\odot$ in the Taurus–Auriga complex remains constant in the age range 1–10 Myr. CTTS on radiative evolutionary tracks rotate

faster than completely convective CTTS. The specific angular momentum of CTTS depends on the absolute luminosity in the Hα line.

Variability of the spin period of the intermediate polar V405 Aur

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We present the results of photometric CCD observations of the magnetic cataclysmic variable V405 Aurigae obtained using 1m VNT and 28cm Pupava reflectors in Vihorlat Astronomical Observatory, Humenne, Slovakia, 35cm BAT and 50cm reflector in Baja Astronomical Observatory, Hungary and 20cm MEADE LX-200 at the Observatory and Planetarium in Hlohovec, Slovakia. In an addition to our own time series, we have used the SuperWASP public archive. We analysed variability of the spin period of the white dwarf in the V405 Aur (RX J0558.0+5353) system using our observations and previously published maxima timings. The spin period of the system in 2010-2012 is $P = 545.4558163(94)$ s. Contrary to a suggestion of Pirola et al. (2008), the points for the recent years show a distinct period decrease. A weighted fit to the phases of maxima leads to the following quadratic ephemeris: $T_{max} = HJD\ 2452495.42319235270(62) + 0.006313147268(30) \cdot (E - E_0) - 9.42(73) \cdot 10^{-16} (E - E_0)^2$. The value of the quadratic term Q reaches 13σ, what means that the period decrease is statistically significant at a rate $\dot{P} = (-30 \pm 2) \cdot 10^{-14}$, corresponding to a time scale $\tau = P/|dP/dt| = (58 \pm 4)$ Myr. Another hypothesis is that the period has underwent change in 2007 $T_{max} = HJD\ 2455882.4705 + 0.006313146022(457) \cdot E$. As we have gaps in observational data we present both hypotheses of the spin period variability of this system.

Color study of the eclipsing cataclysmic variable 1RXJ 003829 in an inactive state in 2010–2012

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We present color photometry of the dwarf nova 1RXJ 003829. It's a cataclysmic variable star in period gap. The observation were obtained with the 2.6 meters Shain's Mirror Telescope (CrAO) during 3 years (2010-2012). Duration of discovered eclipse is about 15 min, with magnitude 0.5m. The calculated mass ratio (q) is 0.09451(1) d (Kato, Pavlenko, Sosnovskij et al., PASJ, 2012). Periods of superhumps calculated in outburst time is 0.0972(2) d.

Comparison of the observations results of asteroid 4 Vesta obtained with spectral-frequency method and the results of NASA's Dawn Mission

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Developing new methods of ground-based optical observations are relevant today. Data from the spacecraft are the most informative, but the main method of study of the Solar system, which allows to make big scope objects, are optical ground-based observations. The spectral-frequency method (SFM) of asteroids study is briefly described. This method is based on the detection of irregularities in the light curves with test frequencies. It is assumed that heterogeneity corresponds to the formation of impact crater on the asteroid surface. We compare the size of structures on the asteroid 4 Vesta surface, obtained in the Crimean Astrophysical Observatory, with those identified on the map derived from NASA's Dawn Mission. The comparison showed a good agreement of the results, which allows to use this method for the primary study of asteroids.

Discovery of 47-min pulsation in oEA system LT Her

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We present results of photometric and spectroscopic observations of the eclipsing binary LT Herculis. We detected the asymmetry of the ascending branch of the secondary minimum. Were discovered 47-min pulsations in the accreting substance secondary component.

Long-term photopolarimetric variability of DD Ser

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We present some results of UBVRI-photopolarimetric observations of DD Ser, a poorly studied and understood Ae-star. The long-term component of light variation is detected, with the period of about 15 years. Variability of the degree and positional angle of linear polarisation is observed as well. Analysis of correlation between photometric and polarimetric data shows that observed light minima are likely caused by variability of circumstellar extinction by dust.

The two accretion states of the polar 1RXS J184542 in 2012

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We present the photometric investigation of the newly discovered magnetic cataclysmic variable (polar) 1RXS J184542 during ∼200 days in 2012. We used the CCD R observations obtained with 0.5-m ARCSAT telescope of the Apache Point Observatory. It was found that during this time the object changed its relatively high accretion state to the low one. There was a two-pole accretion at the high state and one-pole accretion at the low state.

ATMOSPHERE STUDIES

Aerosol distribution over Europe: the comparison of satellite POLDER/PARASOL and model GEOS–Chem data

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Aerosol influences not only the radiative balance of terrestrial atmosphere and therefore the climate on the regional and global scales, but also has considerable impact on air quality. The aerosol parameters and their impact on the climate are studied by using the ground-based measurements and satellite observations of optical radiation scattered by the Earth atmosphere and surface. Geochemical modelling is widely used for air monitoring and prediction of environmental problems. Model allows the changes prediction in atmospheric composition, to identify the sources, sinks and pathways of pollutants, and to evaluate the conditions of air quality in areas with absence of monitoring stations. The GEOS–Chem model is a global 3-D model of atmospheric composition driven by assimilated meteorological observations from the Goddard Earth Observing System (GEOS) of the NASA Global Modeling and Assimilation Office. The maps of aerosol concentration distribution over Europe are presented using a regional version of the model GEOS–Chem (horizontal resolution of 0.5° latitude, 0.667° longitude, 47 vertical levels up to 80 km). Aerosol distribution for the period of 2003–2011 using satellite POLDER/PARASOL and POLDER-2/ADEOS-2 measurements of aerosol characteristics and AERONET ground-based sunphotometer data over Eastern Europe have been analyzed (Bovchaliuk et al., 2013). The comparison of data obtained by GEOS–Chem model and POLDER/PARASOL measurements over Europe for 2010-2011 is presented and discussed.

Variability of the aerosol characteristics by transect observations over Ukraine

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An aerosol is a particles diverse in size, shape and chemical composition in the Earth atmosphere. They are produced by natural and human activities and have direct and indirect effect in the regional and global climate change. Coincident measurements produced in and out of the city is the best way to determinate aerosol and their characteristics by human activities. Deficiency in second instrument forced us to some creativity and were decided to do transect observations. There were observations from Kyiv to Odesa, from Donetsk to Evpatoria and to Kyiv, at South coast of the Crimea, from Kyiv to Dnipropetrovsk. Observation were carried out by the hand-held multi-wavelength Microtops II sunphotometer that can save up to 800 measurements and than data can be transferred to computer. Advantages of the Microtops II are portability and ease usage of the instrument and also high accuracy of measurements. The poster presented main aerosol characteristics, namely

aerosol optical thickness (AOT) and Angstrom exponent (α) obtained by transect observations. Weather conditions and air backtrajectory analysis are discussed.

Effect of water vapour on the absorption of light in the Earth's atmosphere

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Clouds are a small but extremely optically active part of the atmosphere: they scatter sunlight in a wide spectral range. This results in a significant redistribution of solar energy in the atmosphere, which significantly affects the distribution of energy in the Earth's atmosphere and Earth's surface. As in the case of atmospheric aerosols, the problem of light scattering cloud splits into two problems: a particle of light scattering and light scattering aggregate particles. For the analysis of water vapour absorption of incident electromagnetic radiation was used particle size distribution for the model Clouds C2. This is defined features of absorption and scattering of light within the Mie theory. The influence of both the radiation wavelength and particle size on the absorption is characterised by indicatrix. We defined dependence of the intensity of absorption on the localization clouds. Among the results can be noted the following: with increasing wavelength of the incident electromagnetic radiation scattering indicatrix becomes similar to Rayleigh, increasing the size of the particles increases the absorption coefficient of incident radiation in the interval from -45° to 45°.

Lightning discharges in the Earth's atmosphere: terms of occurrence and main characteristics

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Today a few mechanisms which explain the formation of storm clouds and lightning are known. The main drawback of all known ideas about formation of storm clouds is that they have a problem with a source of energy that could provide the development of storm clouds, and with an answer to a question about formation of lightning discharges (lightning in the clouds appears when the electric field exceeds 3 kV/cm, while the breakdown voltage of air heights of cloud formation is 10–30 kV/cm). We analysed the mechanisms of formation, development and dissipation of storm clouds. We studied the role of rising and convective flow and high-energy particles in these processes. We considered the features of lightning discharges and analysed storm stability: the value of the charge that is transferred by lightning; the current in the lightning channel; the number of repeated strikes on one channel; the intensity of the thunderstorm activity. We analysed and compared the models of lightning discharges such as Cho Raynforkt's and Stekolnikov's. We found the properties of current changes with time in different models.

Variations of winds in the upper atmosphere over the cyclones

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In this work we investigated the change of dynamics of the upper atmosphere over hurricanes. We studied characteristics of the horizontal component of the wind speed within 8–300 km range of altitudes. We analysed data obtained by WINDI (Wind Imaging Interferometer) onboard UARS satellite for hurricane intensities of 4 and 5 points by Saffir–Simpson scale. We plotted the distributions of the zonal and meridional velocity components on height. We found an increase of wind dynamics over strong tropospheric perturbations for altitudes up to 105 km. Acoustic-gravity waves (AGW) may be responsible for propagation of perturbations from the troposphere up, therefore we made a numerical modelling of fluctuations of the vertical and horizontal velocity components when AGW are present in the atmosphere. Moreover, we studied changes of the velocity components due to variation of wave period and horizontal wave number and considered spatial scales of such changes as well.

The analysis of the features of the TLE phenomena in the Earth's atmosphere

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We present the review of our study of the TLE (Transient Luminous Events). These are sprites, elves, blue jets, and upside lightings. The analysis of their preconditions and genesis are made. Two video streams were processed with the specially assigned hardware. That hardware consists of video camera (Watec 902H), frame grabber (Pinacle Studio), GPS receiver and a laptop with the appropriate software. Starting from the reference star catalogue, the calibration photometric curve have been build which helped us to estimate the energy of the sprites and elves in the optical range. The characteristic sizes of the TLE were estimated too. The results of the numerical simulation of temporal and spatial dynamics of the electric field during the electric charge intervention into the Earth, atmosphere capacitor, are presented along with the comparison with the analytical solution.

Seasonal dependence of relative humidity on solar radiation

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The study of seasonal dependence of relative humidity was carried out using data collected by Campbell automatic weather station located at Kogi State University Anyigba, Nigeria, latitude $70^{\circ}30'$N and longitude $70^{\circ}9'$E for January to December 2011. The result showed that while the monthly variation of relative humidity has no dependence on solar radiation (R2=0.034), the diurnal variation has dependence on the season under consideration. The results showed that diurnal variation of relative humidity has stronger dependence on solar radiation variation for summer solstice (R2=0.83) and autumn equinox (R2=0.6) than winter solstice (R2=0.46) and spring equinox (R2=0.15).

Ozone vertical distribution over Kiev-Goloseyev station Evgeniy Udodov

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In the last three decades of the 20th century scientists observed reduction of total ozone content in the atmosphere. On common scientists opinion it has happened due to increased level of chlorofluorocarbons (CFCs) in the stratosphere mostly due to industrial production of Freon. The measures were undertaken to reduce the amount of chlorine in the atmosphere therefore the level of ozone column became recover since mid 90th. Interesting that ozone recover take place in different atmosphere conditions than state before reducing (beginning of 80th years) due to climate change. These conditions provide different pattern of ozone dynamics which depends of altitudinal ozone distribution. Therefore the study of ozone height ozone profiles is important task for ozone recovery processes monitoring. For that purposes we use the Umkehr method which provides useful instrument for explore vertical distribution of ozone. We processed the observation data obtained for this type of measurements at Kiev-Goloseyev station for a period 2010-2013.

IONOSPHERE & HELIOSPHERE STUDIES

Peculiarities of different wave propagation mode during the 11 March 2011 Tohoku earthquake

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The 11 March 2011 powerful Tohoku earthquake in Japan (Mw=9.0, 05:46:24 UT, 38.322°N, 142.369°E) caused different types of intensive ionospheric disturbances. We analysed these disturbances using total electron content data obtained from GPS. We registered 3 wave propagation modes. Large-scale (LS) disturbances were recorded at 05:50-06:25 UT; their wavelength was about 600 km, and their average propagation velocity was ∼700-950 m/s. Medium-scale (MS) disturbances were observed after 06:25 UT; their wavelength was ∼200 km, horizontal velocity ∼150-300 m/s. Velocity of fast mode corresponding to Rayleigh wave was ∼2-2.2 km/s. Most of fast mode energy was found to move in the south-west direction along the line of the plate contact. Amplitude of LS and MS disturbances was maximal in the north-west direction. We also registered non-wave turbulent long-lived disturbance in the north-eastern part of Japan at 8-9:45 UT. After 10:35 similar turbulent area began to develop again. It existed up to 12 UT. The work was supported by Russian Foundation for Basic Research (grant #12-05-33032-a) by the Ministry of Education and Science of the Russian Federation (agreement #8699) and by Russian Federation president grant MK-3771.2013.5.

Latitudinal variations of solar terminator generated wave packets parameters, derived from 2008 year data for different regions

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Our previous investigations of solar terminator effects in ionosphere showed that its motion generates middle scale wave disturbances. These wave packets are recorded in total electron content (TEC) and have a form of wave packets. It was shows by us that at least part of them have a magneto-hydrodynamic nature. It was approved by good accordance of disturbances recording time with a moment of ST passage in magneto-conjugate point. We proposed a hypothesis that ST movement generates magneto-hydrodynamic waves, which propagate to another hemisphere and modulate electron density over the region. In this case, wave disturbances recording starts almost at the same time as ST crosses MC region. It this work, using South hemisphere sites data, we recorded wave disturbances distributions in ST local time system and made preliminary analysis of latitudinal features of them. An apparent behaviour of the distributions is not in a complete agreement with the generation mechanism believed before. Distributions, calculated with Brazilian data, show several clear peaks, but there is no pronounced connection with ST movement in MC region, especially for equatorial area. The work was supported by Russian Foundation for Basic Research (grants #12-05-33032-a and #12-05-31069-a) and by the Ministry of Education and Science of the Russian Federation (agreement #8699).

On damping mechanisms of ULF MHD modes in the inner magnetosphere of Earth

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Understanding plasma wave damping processes in the inner magnetosphere is quite important for space geophysics. Those processes could be divided into two groups: dissipative and nondissipative. The latter ones are the subject of present report. To study the damping on continuous spectrum an equation describing poloidal Alfven waves was obtained from ideal MHD equation system. WKB approximation and perturbation theory methods were used to find the solutions. As a result, a spectrum of poloidal Alfven waves was obtained and their damping on continuous spectrum was demonstrated.

Some features of turbulent processes in the Earth's magnetosphere from "Cluster II" mission measurements

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Statistical features of the magnetic field fluctuations in the bound regions of the Earth's magnetosphere are investigated on the different time scales. The "Cluster II" mission measurements made from 2004 to 2009 are used for our analysis. Changes in the shape and parameters of the probability distribution function for magnetic field fluctuations are studied for the time intervals when the satellite was within the magnetosheath, solar wind plasma, and magnetopause regions. The evolution of the change of the probability distribution functions' maxima and kurtosis values are considered, and the structure functions of different orders are investigated as characteristics of turbulent processes for different time scales. Two asymptotic modes of the change in the maximum height for the probability distribution function are found which can be described using different power laws. On the basis of the investigation of structure functions of high orders (up to the ninth order), the character of turbulent processes is determined, and diffusion in the regions under consideration is studied. It is found that the type of turbulent processes in solar wind plasma differ greatly from that observed in the magnetosheath. Besides, super-diffusion is revealed in transitional regions of the Earth's magnetosphere.

AGW and PEMW in inhomogeneous system "atmosphere-ionosphere"

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The paper discusses some recently solved problems of wave dynamics in the ionosphere as well as the methods developed for analysis and solving of them: a possibility of waveguiding AGW in upper atmosphere; resonant atmospheric gravity waves (AGW) in inhomogeneous atmospheric waveguide; planetary electromagnetic waves (PEMW) in the system "Lithosphere-Atmosphere Ionosphere-Magnetosphere (LAIM)" and means for waves detection and data processing. The paper also discusses the prospects of further studies and emphasizes the role of PEMW as indicators of ionospheric processes.

Parameters of natural electromagnetic emissions in the frequency range 5-20 Hz in the F-layer of the Earth's ionosphere as measured by CHAMP

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Parameters of 5-20 Hz quazi-periodical disturbances above the maximum of electron concentration are studied. It is shown that the occurrence rate is maximal at polar latitudes. We use cross-correlative analysis of data measured simultaneously at CHAMP and at ground station Karimshino (Kamchatka, Russia) to find a possible relation to Schumann resonances. We have found no relation to Schumann in magnetic disturbances measured at CHAMP. Dependencies on the magnetic field and plasma parameters in the magnetosphere are analysed and possible mechanism of generation are discussed.

The mystery of auroras

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An aurora is a natural light display in the sky particularly in the high latitude regions, caused by the collision of energetic charged particles with atoms in the high altitude atmosphere. The charged particles originate in the magnetosphere and solar wind and, on Earth, are directed by the Earth's magnetic field into the atmosphere. Aurora is classified as diffuse or discrete aurora. Most aurorae occur in a band known as the auroral zone, which is typically 3° to 6° in latitudinal extent and at all local times or longitudes. The auroral zone is typically 10° to 20° from the magnetic pole defined by the axis of the Earth's magnetic dipole. During a geomagnetic storm, the auroral zone expands to lower latitudes. The diffuse aurora is a featureless glow in the sky that may not be visible to the naked eye, even on a dark night. It defines the extent of the auroral zone. The discrete aurorae are sharply defined features within the diffuse aurora that vary in brightness from just barely visible to the naked eye, to bright enough to read a newspaper by at night. Discrete aurorae are usually seen only in the night sky, because they are not as bright as the sunlit sky. Aurorae occasionally occur poleward of the auroral zone as diffuse patches or arcs, which are generally invisible to the naked eye.

Interplanetary plasma turbulence parameters from observations of 3C 48 and 3C 298 near minimum of solar activity

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The observational results are presented of the strong radio sources 3C 48 and 3C 298 interplanetary scintillations (IPS) observations in the period close to the minimum of solar activity. Observations were carried out with the radio telescope BSA FIAN at the frequency 111 MHz. Radio sources positions relative to the Sun corresponded to elongations $\varepsilon \in (20°–40°)$, when IPS reaches its maximum value. During the observation series the state of the interplanetary plasma was relatively quiet. The temporal scintillation spectra are used for estimation parameters of turbulence interplanetary plasma: velocity of the solar wind, the turbulent plasma spectral index (n) and the sources angular sizes. We find connections between the velocity of solar wind and elongation, between velocity of solar wind and n, between n and elongation. The dependence between velocity of the solar wind and the elongation, well explained by the stable bimodal structure of the solar wind during the period of low solar activity, is obtained. Obtained results show that the exponent of three-dimensional turbulence spectrum decreases by the transition from high-latitude solar wind speed to the slow low-latitude. The dependence of the turbulent plasma spectral index from the solar wind velocity is a real effect, and not the result of the influence of the bimodal structure in the period of minimum solar activity. This method for the analysis of the observations will significantly expand the informativeness the monitoring data of the interplanetary plasma.

THEORETICAL COSMOLOGY & GRAVITATION

Refined scaling relation between dark matter halo parameters

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The presence of the dark matter component is now established in a variety of gravitationally bound astrophysical objects, including dwarf spheroidal galaxies, spiral and elliptical galaxies, galaxy groups and galaxy clusters. In our previous work arXiv:0911.1774, by compilation of ∼1000 dark matter density distributions from ∼300 objects found in literature we have constructed a new scaling relation between two parameters of dark matter haloes (virial mass and column density inside the characteristic radius of dark matter profile) insensitive to exact choice of dark matter distribution in a given object. The obtained scaling relation grows universally (S $\sim M^{0.2}$) consistent with expectations from up-to-date LCDM N-body simulations and semi-analytical secondary infall model of structure formation. During the talk, we will present the newer version of scaling relation obtained in arXiv:0911.1774. First, we analyse larger sample of dark matter objects compiled from literature. Second, we adopt more stringent physical criteria to remove 'outliers'. Third, we now measure the total mass of dark matter halo with 'large-scale' measurements (probing virial radius of the halo; e. g. weak lensing or Sunyaev-Zeldovich data) only. The obtained results further strengthen the evidence of small universal growth of dark matter column density with halo mass.

Induced vacuum current and magnetic field in the background of a cosmic string modelled by impenetrable magnetic-flux-carrying tube

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Vacuum polarization effects in a magnetic cosmic string background are considered. Cosmic string is modelled by finite radius magnetic-flux-carrying tube that is impenetrable for quantum matter. The vacuum polarization depends on the choice of a boundary condition at the edge of the tube. We impose the Neumann boundary condition at the edge of the tube on the charged massive scalar matter field which is quantized outside the tube. We find that a current is induced in the vacuum of the quantized scalar field of mass m and that the current circulates around the string. As a consequence of the Maxwell equation, a magnetic field strength is also induced in the vacuum and is directed along the cosmic string. The behaviour of the current and the field strength is comprehensively analysed. Both the current and the field strength are decreasing exponentially with the distance from the string. In contrast to the model of singular magnetic cosmic string magnetic field strength is finite at the edge of the string. Vacuum polarization effects strongly depend on the tube radius r_0. They are quite negligible at $mr_0 > 1$, whereas it become noticeable at $mr_0 \ll 1$. The possibility of the cosmic string detection due to the induced external magnetic field was considered.

Magnetized Bianchi type IX bulk viscous fluid

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Two tilted Bianchi type IX cosmological models filled with dust fluid of perfect fluid and heat conduction in presence of magnetic field and bulk viscousity are investigated. To get determinate solution, it has been assumed that the universe is filled with pressure less fluid i. e. $p = 0$ together with $A = Bn$, where A, and B are metric potentials and n is constant. The coefficient of bulk viscosity is assumed to be power function of mass density. It has been shown that tilted nature of the model is preserved due to magnetic field. The various physical and geometrical aspects of the models are discussed. The nature of the models in presence and absence of magnetic field and bulk viscosity are also discussed.

Dynamic analysis of the endproducts after galaxies merging

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In the present work the merging scenario of the objects with galaxies masses is studied at close passes. Initial conditions are accepted as simple spherical mass distribution in objects (Plammer's type). As entry parameters we vary both masses of these objects and impact parameters of approach. After dynamic analysis of merging physical parameters we determine masses and forms of remnant objects. Gravitationally bound uniform object yields to the analysis of orbits of the central black holes about their merge. For the N-body simulations we use the parallel version of GPU tree-code. Results of high-speed performance of this code exceed in 100 and more times the similar codes written for CPU.

Magnetic field of cosmic strings in the early Universe

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Cosmic strings are relicts of the early Universe which can be formed during the phase transitions of fields with spontaneously broken symmetry. Cosmic strings are topologically stable, one-dimensional defects in the vacuum, their existence finds support in modern superstrings theories, both in compactification models and in theories with extended additional dimensions. We study a possibility of generating a magnetic field around a GUT scale cosmic string in the early Universe after the deconfinement-confinement phase transition. A circular current and a magnetic field,

which is directed along the string, are induced around the string in the vacuum of the quantized massive scalar field. We considered a GUT scale cosmic string in the vacuum of pseudoscalar matter consisting of charged pions. We study the interaction between the magnetic flux tube, surrounding the string, – the magnetosphere of the string – with cosmic plasma in the early Universe. The possibility of magnetization of cosmic plasma as a result of its interaction with the magnetic field of the string is analyzed.

Fractal model of the Universe's large-scale structure

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The analysis of SDSS DR7 and WMAP-7 data reveals the following properties of the large-scale structure. (1) The dependence of a quasar number in a sphere on its radius is described by a power-law: $N(<r) \sim r^{d_c}$, where the correlation dimension $d_c = 2.17$ characterizes difference of a distribution from a homogenous and isotropic one (when $d_c = 3$). (2) An analogous relation arises for two-dimensional distribution on the celestial sphere between a number of quasars with angular distances less than ϑ and $\sin(\vartheta/2)$: $N(<\vartheta) \sim \left(\sin\frac{\vartheta}{2}\right)^{\beta}$, where $\beta = 1.49 \div 1.56$ for different redshift layers. (3) The angular correlation function of the quasar distribution on the celestial sphere and the angular power spectrum for its expansion in spherical functions series for different redshift-layers approximate to power-laws at the average: $\omega(\vartheta) \sim \vartheta^{-1.08}$ and $u_l \sim l^{-1.08}$ respectively. (4) Large-scale quasar clumps are discovered in the SDSS-quasar distribution. The relation between a number of clumps $N(\vartheta_c)$ and their angular size ϑ_c is characterised by a power-law: $N_c \sim {\vartheta_c}^{-2.02}$. (5) The angular power spectrum of the CMB temperature fluctuations approximates to a power-law at the average: $C_l \sim l^{-1.74}$. These power-laws are evidences of fractality because they may be interpreted through a conception of the Universe as an assembly of self-similar space domains. These large quasar groups mark the domains. For physical explanation of these properties we consider three main hypotheses. (1) The matter of the Universe is described by the charged scalar meson field (complex field) ψ which possesses the rotary symmetry: $\psi\psi^* = \Psi^2 = \text{const}$. (2) The Universe is composed of self-similar space-time domains which are related to each other by the discrete scale transformation: $\psi\ leftrightarrow e^{i\alpha}\tilde{\psi}$. (3) These fractal properties are consequences of fractal properties of initial matter density perturbations which further led to the large-scale structure formation due to gravitational instability. For this, we have to find a scale-invariant solution of the GR equation. Basing on this, we construct the fractal cosmological model with scale-invariant ψ-field equation and Einstein's equation providing a physical explanation of the observable fractal properties. The general solution of the equations is derived. The space-time intervals and other parameters of different space-time domains differ in a constant factor only. Therefore, they are geometrically similar and evolve similarly. The fractal properties of the initial density perturbations remain and lead to presence of the fractal properties of the Universe's large-scale structure. The partial solution of the equations in homogeneous and isotropic case has been obtained. The cosmological model is nonsingular, compacted, pulsating and doubly-connected. The anisotropy of a background radiation is considered. The power spectrum of the brightness anisotropy is calculated and revealed to be close to the observed angular power spectrum of the SDSS-quasar

distribution on the celestial sphere. Only qualitatively it conforms to the angular power spectrum of CMB.

Conformally flat V Bianchi magnetized tilted cosmological model

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Conformally flat Bianchi type V magnetized tilted cosmological model is investigated. To determine the complete solution we have assumed that the condition $A = B$, where A and B are metric potentials. Special model is also investigated in the absence of magnetic field. The physical and geometrical aspects of the model in the presence and absence of magnetic field are also discussed.

Spherically symmetric solutions of General Relativity with a scalar field within the Dark Energy model that mimics ΛCDM

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It is well known that the scalar field drastically changes the geometry around collapsing body; in particular introduction of a scalar field can disrupt the event horizon leading to emergence of a naked singularity. On the other hand, a number of cosmological models deal with the scalar fields. In this view we consider the scalar field that provides exactly the same evolution of a cosmological scale factor as the standard ΛCDM cosmological model. The scalar field potential has a simple analytical form yielding exactly the same dependence of the Hubble parameter on the redshift as in the ΛCDM cosmological model. We study spherically symmetrical solutions of the Einstein equations with this scalar field under different asymptotic conditions at spatial infinity (asymptotically flat and asymptotically Kottler).

OBSERVATIONAL COSMOLOGY

Dynamical dark energy with barotropic equation of state: observational constraints from Planck data

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We present the observational constraints on cosmological models with dynamical dark energy in the form of classical scalar field with barotropic equation of state, derived from the latest Planck data on CMB anisotropy. We compare the precision of determination of dark energy parameters from WMAP7, WMAP9 and Planck. We also compare the error bars, obtained from real Planck data, with the forecasted ones, obtained from mock Planck data.

Galaxy clusters' substructures in optics and X-Rays

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In our days the observable large sponge-like structure of the Universe is quite successfully described within the framework of the standard ΛCDM model. Dark matter hypothetically consisted of nonbaryonic particles acts like collisionless gas tending to form low-dimensional structures. Superclusters, voids, walls, filaments and nodes naturally arise in N-body simulations. Within this picture rich galaxy clusters considered to be the nodes of the cosmic web. Several decades ago such structures regarded as substantially isolated gravitationally-bounded systems attaining a stage of dynamical relaxation. Nevertheless, since late 1970s a complete nonequilibrium structure of clusters was discovered in X-rays and optics. Recent studies (Einasto M. et al A&A 540, A123, 2012) showed, that there exist a strong correlation between cluster's multimodality and its supercluster morphology. It indicates the genetic relationship between clusters and their environment. High energy collisions of cluster with accreting external groups of galaxies influence on phase distribution of galaxies within the cluster and may result in errors in cluster's mass estimations and cluster-based cosmological tests. Analysing nonequilibrium structure of clusters one can establish the current status of cluster-environment interaction. In this contribution we develop a wavelet-based approach for analysis of optical (astrometric and spectroscopic) and X-ray data on galaxy clusters. We use data about 35 richest clusters (with richness $N_{gal} > 100$) from Tempel's catalog of groups and clusters of galaxies in the SDSS-DR8 (Tempel at al A&A 540, A106, 2012). The X-ray data about these clusters was executed from ROSAT All Sky Survey archive. We implement 3D-wavelet analysis to the optical galaxy distribution in projected phase space (celestial coordinates + redshifts) using the 3D 'Mexican Hat' wavelet, and 2D-wavelet cross-correlation method for the comparison of optical and X-ray fields. The identified substructures are in a good agreement with the results of Einasto et al. We thank the FCPK grant 16.740.11.0465 for support of our work.

Bright X-ray galaxies in SDSS filaments

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Clusters of galaxies and extragalactic filaments are the main elements of the large-scale structure of Universe. Sloan Digital Sky Survey is appropriate for the studying the cosmic structures at redshifts $z < 0.2$. Different methods of filament detection are discussed in this work. Recent catalogue of 53 SDSS filaments (Smith et al, 2012) is criticised. New simple method of filament detection is proposed. Galaxy clusters are well known as bright X-ray sources. The shape of large-scale structure in X-rays should be traced not only by clusters but also by X-ray emitting galaxies in filaments. A new sample of X-ray galaxies in SDSS region is presented in this work. This sample can be used in future works to describe X-ray development of large-scale structure.

Redshift dependence of the β parameter describing non-Hubble motions of quasars

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Non-Hubble motions of extragalactic objects in the so-called linear regime can be used to test cosmological models of structure formation. In the present work we study the redshift dependence of the β-parameter describing the flattening of the two-point correlation function (2pCF) along the line of sight in redshift space, which is caused by infall of galaxies onto mass overdensities. For this purpose a sample of quasars was compiled from the 7th Data Release of the Sloan Digital Sky Survey, and the 2pCF in real and redshift space was calculated for three redshift bins.

Cross-correlation function of SDSS quasars and WiggleZ galaxies: parameters of non-Hubble motions

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Statistical studies of quasar distribution at low redshifts ($z < 1$) is complicated because of small number density of quasars. This problem can be solved with the cross-correlation analysis of quasar samples with much larger samples of galaxies in the same volume. We present our results of the cross-correlation analysis of the sample of 1379 quasars from the SDSS DR7 and 66970 galaxies from the first data release of the WiggleZ survey, which is a deep optical survey of the blue emission line galaxies seen by GALEX. Both samples contain objects with redshift within $0.1 < z < 1.1$ range with the mean $z \approx 0.6$. The two-point cross-correlation function was

calculated in real and redshift space and the parameters of non-Hubble motions are estimated from the redshift-space distortions. The β-parameter describing describing infall of galaxies onto mass overdensities is found to be 0.63 ± 0.11, the dispersion of relative velocity in quasar-galaxy pairs is estimated to be ≈ 410 km/s.

Redshift dependence of the mean transmission in the Lyα-forest: effects of the continuum fitting technique

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The Lyα forest in spectra of distant quasars traces the thermal and radiative history of the Universe, as well as the evolution of underlying matter distribution over a wide range of scales and redshifts. It is possible due to relation of the Lyα opacity of the intergalactic neutral hydrogen H I to its density and other physical parameters. As a measure of opacity the value F, named the transmission and defined as a ratio of observed (transmitted) and emitted fluxes, is used. One of the main problems in these studies is related to determination of emitted flux, i. e. the continuum level in quasar spectra. In the present study we summarise the current results on redshift dependence of the mean transmission obtained from spectra of different resolution with different techniques of continuum fitting. We found that both results obtained with manual continuum fitting and continuum extrapolation are consistent for redshifts up to ~ 3, but at $z \sim 4.5$ the value of F obtained with manual fitting is about 1.4 times smaller than that obtained with extrapolation. We compared them to our results obtained from the sample of 33 high-resolution (R=5 300–45 000) spectra from the public available archive of the European Southern Observatory, and found that they are consistent within errors with both results obtained with manual continuum fitting and continuum extrapolation. However the more precise analysis of disadvantages of continuum fitting techniques requires much larger sample.

Nitrogen abundance estimation in WR galaxies of SDSS DR7

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We have examined all the galaxies in the Sloan Digital Sky Survey (SDSS) Data Release 7 (DR7) to select out those with a detected [O III] λ4363 emission line, which allows, in principle, a direct element abundance determination based on the electron temperature. We have selected two sub-samples of galaxies: with apparent WR features in integrated spectra and with nebular emission of HeII λ4686 line. We confirm the apparent increase in N/O with decreasing EW(Hβ), already shown in previous studies, and explain it as the signature of gradual nitrogen ejection by massive stars from the most recent starburst.

The relation between star formation rate and local density

for the Virgo galaxy cluster

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Galaxies emit electromagnetic radiation over the full possible frequency/wavelength range. Analysis of this radiation is the main means through which astronomers study distant galaxies and thus learn about their formation and evolution. The distribution of energy over wavelength/frequency is called the Spectral Energy Distribution (SED). In this project, we measure the star formation rate of each galaxies in Virgo galaxy cluster using SED fitting method and compare the results with local density of each galaxy to understand the effects of them on each other.

HIGH-ENERGY ASTROPHYSICS

Search for a radiative dark matter decay signatures using combination archival XMM-Newton observations of galaxies

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The search for decaying dark matter is an important scientific goal. It can provide valuable constraints on the parameter space of extensions to the Standard Model, and may even lead to the discovery of a signal from dark matter particles. Unlike the search for annihilating dark matter (where the WIMP hypothesis limits the range of masses to the GeV energy range), there is no a priori preferred energy range for the searches of decaying dark matter signal. If the dark matter particles are fermions, there is a very robust bound on their mass. Namely, due to the Pauli exclusion principle, there exists the densest "packing" of the fermions in a given region of the phase space. Decreasing the mass of the dark matter particles, one increases their number (and, hence, phase-space density) in any dark matter-dominated object. The requirement that this phase-space density did not exceed that of the degenerate Fermi gas thus leads to the lower mass bound. Using recent results of the mass modeling of dwarf spheroidal galaxies and paying special attention to systematic uncertainties in relevant parameters, it is shown that the mass of dark matter fermion should exceed $\sim$0.4 keV, and therefore the dark matter decay signal should be searched in X-ray and gamma-ray energy ranges. As the decay width increases with the mass of the particle, we conclude that the X-ray range is the preferred range of searches for fermionic decaying dark matter. The existing bounds on decaying dark matter lifetime in the keV energy range are obtained from the analysis of medium exposure (about 100 kilo-seconds) observations of individual objects of different types. We argue that with the current generation of X-ray telescopes there are two possible ways to further improve the existing bounds and probe the theoretically interesting regions of particle physics models: (a) Deep (few mega-seconds) observations of the most X-ray quiet objects. "Classical" dwarf spheroidal galaxies (Ursa Minor, Draco, Sculptor, Fornax), where the dark matter content can be determined robustly are the preferred targets. The problem with this approach is the limited visibility of some of these objects and large investment (about 10%) of the annual observational time of the satellite (total observational time available each year for XMM-Newton and Chandra satellites is about half of the calendar year, i.e. 14–15 Msec). Allocating time for such an observation in the absence of a candidate line is hardly possible. On the other hand, observations of these objects would provide an important confirmation of the signal, detected with some other means. (b) Total exposure of all observations of dark matter-dominated objects with the X-ray satellites is several orders of magnitude longer than any possible single observation. Therefore a possible way to advance with the existing X-ray instruments is to combine a large number of X-ray observations of different dark matter-dominated objects. The idea is that the spectral position of the dark matter decay line is the same for all these observations, while the astrophysical backgrounds in the combined spectrum would "average out", producing a smooth continuum against which a small line would become visible. Naively, such a dataset, uniformly processed, should allow to improve the existing bounds by at least an order of magnitude and study spatial dependence of each candidate line. During this talk, we discuss our analysis of a large dataset of archival XMM-Newton observations of galaxies. Extremely large combined exposure of this dataset (two orders of magnitude longer than a typical single observation) presents several new challenges. Indeed,

large number of counts in each energy bin mean that the statistical errors become very small (sub-% level). To extract meaningful bounds one needs therefore to control systematic errors at the comparable level. The level of systematics of the XMM-Newton is considered to be much higher (5-10%) due to the instrument's degradation with time, variability of the instrumental background, imperfect knowledge of the instrument's response functions, etc. To tackle these problems, a novel method of data analysis has been developed that delivers the required control over the level of systematics. We demonstrate the sensitivity of this method and search for the presence of lines in the 2.5–11 keV energy range. We find several new line candidates. After careful analysis, all these candidates are quantified as faint instrumental lines which have not been observed previously. Finally, we construct strongest todate upper bounds on decaying dark matter parameters probing significant part of the parameter space of the corresponding particle physics models.

Spectral and spatial variations of the diffuse gamma-ray background in the vicinity of the Galactic plane and possible nature of the feature at 130 GeV

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We study the properties of the diffuse gamma-ray background around the Galactic plane at energies 20–200 GeV. We find that the spectrum of this emission possesses significant spacial variations with respect to the average smooth component. The positions and shapes of these spectral features change with the direction on the sky. We therefore argue, that the spectral feature around 130 GeV, found in several regions around the Galactic Centre and in the Galactic plane in [1203.1312, 1204.2797, 1205.1045, 1206.1616], can not be interpreted with confidence as a gamma-ray line, but may be a component of the diffuse background and can be of instrumental or astrophysical origin. Therefore, the dark matter origin of this spectral feature becomes dubious.

Stochastic acceleration of charged particles in turbulent magnetic fields

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AGN are regarded as the most possible UHECR sources. Relativistic jets can generate shock waves which effectively accelerate the charged particles via Fermi mechanism of type I. Still FR II galaxies with the powerful shock-wave features are located too far to provide the registered UHECR flux. Therefore great efforts are applied towards studying CR acceleration in FR I galaxies which are situated close enough to the Earth but have less powerful jets which decelerate gradually. Deceleration region has to be strong turbulent and fulfil conditions favourable for CR

acceleration via Fermi mechanism of type II with turbulent fluctuations and MHD waves as centrers of scatter. We discuss the results of direct numerical modelling of CR acceleration process under the conditions of strongly excited weak relativistic turbulence where QLT is non-applicable. It is shown that in the case of strong turbulence acceleration efficiency increases drastically as compared to the quasi-linear case of the weak turbulence. This result can sufficiently amplify the possibility of FR I radiogalaxies to be UHECR accelerators. Nearby galaxies Cen A and Virgo A also are related to that galaxy type, so CR acceleration under the conditions respecting the jet deceleration regions in these objects is to be analysed.

Investigation of gamma/electron separation methods for CTA

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The future ground-based gamma-ray astronomy experiments, like CTA, will possess very high sensitivity due to the high quality of gamma-hadron separation. For energies below ≈ 500 GeV cosmic electrons significantly contribute to the background. Cosmic electrons produce extensive air showers very similar to gamma-induced showers and differing mostly by first-interaction point. This could be used for gamma-electron separation in future experiments.

Synchrotron self-Compton and inverse Compton radiation of the superconducting cosmic strings

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According to the most of current quantum field theories different phase transitions might have happened in the early Universe. They are considered to have led to the formation of some topological defects, one of which could be cosmic strings. At the same time it is assumed existence of superconducting cosmic strings inside which the massless carriers of charge can move without any resistance. When such type of string moves in the galactic or intergalactic magnetic fields it causes to generation of electric current inside the string and magnetosphere around it. Interaction of the moving magnetosphere with ambient plasma produces a relativistic shock wave. This shock wave can accelerate electrons to relativistic velocities and they may appear via different types of non-thermal radiation. In our paper spectral fluxes of self-Compton and inverse Compton emission from the shocked plasma around superconducting cosmic strings are calculated for strings with various tensions and for different cases of their location. Also possibilities of strings detection by existing facilities are estimated.

Suzaku observations of the relativistic pulsar wind in PSR B1259/SS2883 system

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We have used the observations of Suzaku satellite to observe the PSR B1259-63, a young pulsar orbiting around Be star SS2883. The X-ray emission from system characterizes the interaction between outflows from Be star and relativistic wind from pulsar. The X-ray spectra demonstrated a featureless continuum for 0.5-10.0 keV, and modelled using a simple absorbed power law in a wide range of photon index 1.4-1.7. Combining the XIS (0.1-10.0 keV) and HXD (15.0-50.0 keV) X-ray spectra we found the break at $\sim$ 4.2 keV for one observation only. Such break can be explained by low-energy cutoff of the synchrotron emission associated with the relativistic pulsar wind which has Lorentz factor equal $\gamma \sim 10^4$. The PSR B1259-63/SS2883 gives us a great possibility to study the fundamental properties of the pulsar wind and pulsar wind nebulae.

Transition from galactic to extragalactic cosmic rays

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The sources and chemical composition (mass numbers) of Ultra High Energy Cosmic Rays (UHECRs) are still unknown. Once more, there are no robust signatures of transition from Galactic to extragalactic component in all-particle energy spectrum of UHECRs. We analyse the recent observational results of KASCADE-Grande and IceTop/IceCube detectors and show, that electron rich sample (proton and light elements) in KASCADE-Grande energy spectrum at $\lg E(\mathrm{eV}) = 17 - 18$ can be explained as extragalactic proton component in this energy range. It has the spectral slope 2.6–2.7 and, taking into account the modification factor for protons, very well coincides with AUGER-TA spectra at higher energy. In our model, transition from Galactic to extragalactic component (crossing of spectra) takes place at $\lg E(\mathrm{eV}) = 17.5$.

ACTIVE GALACTIC NUCLEI

On the question of the breaks in the GeV spectra of blazars

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The question of the breaks in the GeV spectra of blazars became intriguing over the last couple of years. Some authors claimed that these breaks provide an evidence for the gamma ray absorption within the Broad Line Region of these sources, putting the blazar gamma ray emission site close to the central black hole, as opposed to the models predicting gamma-ray emission in more distant regions of the jet. This evidence is based on the very specific feature of the spectral breaks — their suitable energy and its apparent stability. Here I will review the previous findings on the subject and present my own findings on this matter, where I show that a careful treatment of the uncertainties in the source spectra make this kind of analysis far less promising than one may think.

Search of giant radio sources in the 102.5 MHz Nothern Sky Survey

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Giant radio sources are the largest objects in the universe known to date. Typical giant radio sources have projected size of hundreds of kiloparsecs, part of the radio source are far beyond the host galaxy. They usually have large angular size. Indeed, the projected size of 500 kpc at $z = 0.1$ corresponds to an angular size of about $5'$. Individual giant radio sources have angular sizes greater than 1° for example, the radio sources 3C236 and NGC6251. Radio-clouds of giant radio-sources directly interact with the intergalactic gas, which allows us to study the physical conditions in it. Extended structures at distances of hundreds of kpc from the nucleus of interest in the evolution of radio sources. There are uncertainties associated with the lifetime of the giant radio sources, their formation, the process of pumping radio-clouds electrons, the lifetime of the relativistic electrons to the complete exhaustion of energy, the physical conditions in some detail the sources to help understand the conditions of their birth. Obviously, for an extended source flux density in the surveys made with radiotelescopes with high angular resolution will be too low, and the estimate of the spectral index is too high. In this work we carried out the identification of sources of Pushchino survey observed at a frequency of 102 MHz (NSS 102 catalog) with sources in catalogues with much greater angular resolution. For all sources of the catalogue NSS at frequency 102 MHz we measured two-point spectral indices. If the spectral index was greater than some fixed value, the source was investigated as source with large angular sizes. When selecting candidates for the giant radio galaxy, we followed these rules: (1) the flux density of the source in more than 5 Jan in NSS; 2) the source must be extragalactic (galactic latitude > 15 degrees); (3) Within the area of identification (the size of the site 20 arcminutes) for all used catalogues there must be only one candidate for identification. We have found 17 such sources, 10 of the 17 sources of candidates were previously known extended sources. Of the 7 remaining

sources 4 show clear signs of length, 1 is a good candidate for giant radio sources, 1 is the likely source of confusion case and 1 a case of false detection source.

The transverse and longitudinal structure of 3C 273 X-ray jet

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In the present report we extensively analyse X-ray structure of the 3C 273 quasar jet using the newly processed Chandra data. We attempt to resolve the perpendicular jet structure, analyse morphological and spectral longitudinal jet structure, study the inner jet not discussed in detail till now. In the analysis we use UV and radio data for comparison and/or reference. In particular we compare X-ray and radio knots positions to reveal that it increases with a distance from the central source.

Studying Fe Kα line profile in Sy2 galaxy NGC 4388

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We present results of our study of iron emission line profiles in Compton-thin HBLR Seyfert 2 galaxy NGC 4388, based on three XMM-Newton and several Swift-XRT observations. Parameters of the continuum are determined. Significant photoelectric absorption at energies below 1 keV is observed due to the fact that this galaxy is seen nearly edge-on. Two lines at 6.4 keV (Fe Kα), 6.9 keV (Fe Kβ) were clearly detected in the total exposure time in 0.1-12 keV XMM-Newton spectrum of this object. The flux level and equivalent width of the emission lines were determined by spectral fitting. Also we calculated the ratio between fluxes in these two lines. We simulated the line profile using the gaussian model, zgauss model, and three different relativistic models for line emission from accretion disk (kerrdisk, diskline, laor) that include general relativistic effects. Within the models, we estimated the parameters of accretion disk and black hole. The results of kerrdisk fitting show that the black hole at the centre of the disc has a non-zero spin. The lower limit of the dimensionless spin is expected to be 0.1. The best fit to the overall 0.1-12 keV spectrum is total model by power law with absorption (both with redshift) plus two zgauss (more simple case) or kerrdisk models (relativistic case). The behavior of the spectrum at low energies is not well described by these two models. The shape of the iron emission line shows that it was not formed in very close proximity to the black hole, but some of the effects could still affect the formation of some details in the Fe Kα line profile.

An image of diffuse emission for Centaurus A

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The present work is devoted to study of Centaurus A – the nearest and one of the fascinating active galaxies. Centaurus A has been observed frequently within the last 150 years in all accessible wavelength bands and thus a wealth of data exist over a wide range in frequencies. In this study the diffuse X-ray emission and morphology of the extended X-ray sources of Centaurus A are analyzed. The results are compared to observational data from different wavebands.

Analysis of spatial and temporal properties of active galaxies' relativistic jets

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In the present paper we consider the internal structure of active galaxies' jets using X-ray and radio observational data and investigate their spatial and temporal properties. It is shown that activity of active galaxies is mostly associated with its core and relativistic jets which are generated in the core and cover distances up to hundreds of Mpc. 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.

Observations of AGN in Sy2 galaxy NGC3281 by XMM-Newton and INTEGRAL satellites

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We analyse new XMM-Newton and INTEGRAL observations of active galactic nuclei NGC 3281 of type Sy 2. The data of all three EPIC XMM cameras in the energy range 0.3-12 keV have been used. The INTEGRAL data involved allowed us to extend the spectral range up to 300 keV. We determined parameters of the continuum part of the spectrum. There are two-components of absorption existing in the spectrum – from warm and neutral environment. A soft excess is present below 3 keV, which corresponds to the emission of the diffuse hot gas. Also, we found moderately narrow (FWHM=110 eV) emission line of neutral iron Fe Kα at 6.4 keV energy which possibly originates in an outer part of the broad line region or the inside of the gas/dust torus.

EXOPLANETS

Observations of transiting exoplanets in Toruń Centre for Astronomy

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Number of newly discovered extrasolar planets is still increasing. One of the most promising methods of searching for exoplanets is an attempt to observe their transits. If a planet crosses in front of its parent star's disk, then the observed visual brightness of the star drops a very small value. We can notice it as a characteristic light curve making photometric observations. Analyzing it we can determine the radius of the planet, to estimate its density, and even examine the chemical composition of the atmosphere. Further, detailed observations of transits of already known exoplanets can lead to much more accurate determination of their astrophysical parameters and even provide new discoveries of further planets in the same planetary systems. In my presentation, I would like to present the results carried out for several months observing exoplanet transits using 60-cm telescope at Piwnice near Toruń, what is related with my thesis. As one of the first, were observed transits of exoplanets XO-2b, TrES-5b and Qatar-1b. I hope to introduce also new data from this springtime. Will be presented detailed information about preparation for the observations, used instruments, reduction and analysis of data, received light curves and designated from them astrophysical parameters of planets.

Two transiting exoplanet candidates in Cygnus from the MASTER-Net project

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We present two transiting exoplanet candidates in Cygnus discovered during a small photometric survey performed at the Kourovka Astronomical Observatory of Ural Federal University in the summer of 2012. The MASTER-1 b candidate (host star 2MASS 20260213+5006032, R=12.4^m) has a period of 0.847^d, transit depth of 0.015^m, and transit duration of 1.6^h. The MASTER-2 b candidate (host star 2MASS 20341625+5015427, R=13.8^m) has a period of 0.983^d, transit depth of 0.017^m, and transit duration of 1.7^h. We believe that these transit-like signals might be caused by Hot Jupiters. Observations, data reduction, transit search tools, and detected candidates are described. Follow-up photometric and spectroscopic observations are needed to clarify the nature of the candidates. This work was partly supported by the Federal Task Program "Research and Operations on Priority Directions of Development of the Science and Technology Complex of Russia for 2007-2013" (contract 14.518.11.7064), by Russian Foundation for Basic Research grant 12-02-31095, and by a grant in the form of a subsidy from Ministry of Education of the Russian Federation (the Agreement No. 8415 of August 27, 2012).

Analysis of the light curve of exoplanet transit systems TrES-3 and WASP-3

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High-accuracy light curves of transit systems TrES-1 and WASP-3 were analyzed. Physical parameters for transit system components were calculated. Light curve analysis includes simulation of transit curve shape using the analytic theory of the light curve. Simulation was performed using the IDL environment. We apply the chi-square test with Markov Chain Monte Carlo (MCMC) techniques to fitting light curves and assessing the uncertainties in orbital elements using the model of Giménez (2006). Making of light curve and calculations of transit system parameters were carried out with the star limb-darkening low. The model includes such parameters as fractional radii of exoplanet and host star, inclination of the orbit, orbital eccentricity and periastron position. Photometric data of transit systems were obtained using Zeiss-600 telescope (peak Terskol Observatory) and Cassegrain K-380 (Crimean Astrophysical Observatory).

Spectral studies of exoplanet transit system WASP-33 during some transit phenomena

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Analysis of some spectra of exoplanet transit system WASP-33 was done. Observations were carried out for three successive transit phenomena. Variability of parameters for some spectral lines during each transit were obtained. We used spectral data obtained at the 2-meter telescope Zeiss-2000 with spectral resolution $R = 45000$ (Peak Terskol Observatory).

Searching for TTV signal in HAT-P-16 system

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Numerous projects are involved in searching for exoplanets, both on Earth, such as HAT, WASP, XO or TrES and space missions, among which lead the probe COROT and Kepler space telescope. Detailed analysis of transits of known exoplanets have even lead to further discoveries of exoplanets that are in the same planetary system. Very promising seems to be the method of transit timing variations. I would like to present the results of my astronomical practice, carried out under the supervision of Dr. Gracjan Maciejewski, related with reduction and analysis of photometric data from different observatories in Germany, Bulgaria and the United States. There were observed eight transits of exoplanet HAT-P-16b in 2010-2012. For each we managed to get transit light curve, and then use the best of them for further analysis to determine the astrophysical parameters of the planet. Will be presented basic information for the reduction and analysis of the collected material, as well as the corresponding light curves will be presented and the first scientific data.

STELLAR ASTROPHYSICS

One-dimensional radiative transfer modelling of the polarization of the continuous spectrum of the late-type stars

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We present the results of one-dimensional modelling of the polarization of the continuous spectrum of the late-type stars. Simulations are performed in a range of wavelengths from 3000 Å to 9000 Å. We considered metallicity ([M/H]) values -0.5, 0, 0.5, and built mesh models with different values of $\log g$ and T_{eff} (effective temperature) which corresponds to spectral classes G, K and M.

Spectrophotometry of flares on EV Lac in 2010-2011

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We present low-resolution spectroscopic observations of star EV Lac. Data were obtained during May, June, August 2010 and May 2011 using the 60-cm Cassegrain telescope at Terskol Peak (North Caucasus, 3100 m a.s.l.). Algorithms and special software were developed for comfortable and quickly processing a large array data because of the lack of suitable software. We processed and analysed 14800 images with spectra in range from 330 nm to 900 nm with resolution $R = 50 - 100$. The temperature and the size of the flare were estimated. Also statistics of the stellar flares were received for pointed above observation period.

Overcontact binaries in the Kepler mission: migration of the dark spots

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Since the data from Kepler Mission were released into public, we are capable of tracing short-time scale changes in the light curves of the overcontact binaries. This has led to the studies of the constant and dynamic changes of the O'Connell Effect, detailed shape of the minima and dense O-C diagrams, which constitutes our tracing of the dark region migrations throughout the star's surface. We presented how the existence of the dark spot influence the shape of the minima and the O-C diagrams. Studies conclude that Kepler's photometry allow to investigate the location of small dark spots and the given object KIC 2159783 is a very chromospherically active system.

Spectroscopic properties of the 107 stars from the CHEPS sample

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We report results of the high resolution spectral analysis of the 107 potential host stars from the Calan-Hertfordshire Planet Search Program (CHEPS). We used synthetic spectra approach to estimate effective photosphere temperatures, surface gravities, and the abundances of some light elements. The effective temperature-surface gravity dependencies estimated using optical and near-infrared photometry data were clarified spectroscopically. Our approach also allows us to estimate projected rotational velocity and lower and higher limit for the microturbulent velocity, which is reflected in the uncertainty values.

MgH lines in spectrum of Arcturus

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Theoretical spectra of red giant Arcturus (K2II) in the region covered by the MgH A-X band system were calculated. We used chemical composition determined in the PDK work. Model atmospheres were calculated with account of the known opacity sources. Calculation of synthetic spectra was carried out in WITA6 program. We identified MgH lines in Arcturus spectrum and determined their sensitivity on the input parameters, i. e. effective temperature, acceleration of gravity, abundance of Mg and microturbulet velocity.

Dynamically enhanced mass-loss on the Red Giant Branch: a solution to the second-parameter problem?

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Red Giant Branch (RGB) stars are large in size and surrounded by a loosely bound envelope. They are thought to shed a significant part of it before moving on to become Horizontal Branch (HB) stars. However, how exactly this mass-loss takes place is currently unclear. The physics of mass-loss is poorly constrained by direct observations. However, the amount and the overall distribution of mass lost have a strong impact on the temperature distribution of the resulting HB stars as observed, for example, in Globular Clusters (GCs). The temperature distribution of HB stars is readily observed as a color distribution in the color-magnitude diagram. The quest for parameters that determine the HB color/temperature distribution (besides stellar metallicity) is know as "the second parameter problem" and is a long-standing unsolved issue of stellar physics. A possible solution is that mass in the RGB phase is lost dynamically, due to stellar encounters in dense environment such as GCs. This would result in a dynamical solution to the second-parameter problem. In my talk I will illustrate the modelling efforts by my group to quantitatively estimate the mass-loss distribution in this scenario.

Optical study of RX J0440.9+4431 in 2010-2012

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We have carried optical study of the Be/X-ray binary RX J0440.9+4431 for a three years since 2010. During this time U and B magnitudes of the system were constant and V magnitude decreased on 0.1 magnitude. Such behaviour cant be explained by slow destruction of decretion disk. This conclusion is supported by spectral data in which we can find decrease of EW of the double-peaked H-alpha line and increase of its peak separation.

SOLAR SYSTEM

Analysis of astrometric measurements of selected asteroids for determination of Yarkovsky effect

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In order to identify and determine the Yarkovsky effect, a small non-gravitational force which causes secular changes of semi-major axis of the orbits of small asteroids and meteoroids, a list of asteroids was prepared for observations. This force arises due to radiative recoil of the anisotropic thermal re-emission from surfaces of the body. It is considered that the Yarkovsky effect has a great influence on the motion of the small asteroids, the size of which is less than 100 km. The changes of semi-major axis due to Yarkovsky effect has a value of $\sim 10^{-3}$ AU/Myr. The detection of such small deviations of the orbit requires a long series of observations and the high accuracy of the positions. This report presents the results of the observations of 10 asteroids for 2009–2012 and their analysis. The asteroids were selected based on the available list of asteroids with relatively large deviations from the unperturbed semi-major axis of the orbit. The observations were made on RTT-150 (NO TUBITAK, Turkey) and Mobitel (RI NAO, Ukraine). We computed the difference between the observed (O) and the calculated (C) positions as well as the standard deviation (RMS) of measurement. For the telescope RTT150 RMS is less than $0.1''$ in both coordinates, for the telescope Mobitel – $0.10''$ and $0.11''$ in right ascension and declination, respectively. High positional accuracy of the observational data gives us suggest that these observations, together with other observations from Minor Planet Center (MPC) can be used to identify and determine the value of the Yarkovsky effect.

Photometry of the distant active comet C/2010 S1 (LINEAR)

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Dynamically new comet C/2010 S1 (LINEAR) was observed at Lisnyky observational station (585) of the Taras Shevchenko National University. Kyiv Internet telescope Celestron CGE-1400 equipped with broadband UBVRI filters was used in the observations. During the observations the comet moved to the distances of 6.35 AU and 6.53 from the Sun and Earth, respectively. The comet demonstrated considerable level of physical activity therefore the images obtained in V and R bands were used to investigate the dust component of the cometary coma as well as to study the image morphology. Comet brightness was at level of 14.85±0.06 and 14.54±0.04 magnitudes in V and R bands respectively. The brightness distribution was found to be inverse proportion to the projected distance from the nucleus with a slope of about -1. Therefore the calculated $Af\rho$, 8373.2 sm for V filter and 8207.7 sm for R filter, parameter was used to estimate the dust production rate. Assuming the steady outflow from the nucleus, the dust production rate was estimated to be about 600 kg/s. Comparison of the V-R color indices obtained from the inner coma region with solar ones does not point out reddening of reflected solar radiation in the spectral region of 540-683 nm.

Database of polarimetry of planetary satellites

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We present the electronic database (EAR-SA-COMPIL-3-SATPOL-V1.0, NASA Planetary Data System) which contains 2355 published and 105 unpublished results in planetary satellite polarimetry. The database contains 2460 measurements of linear polarization of planetary satellites including 15 measurements of polarization for the Martian satellites (Phobos and Deimos), 2318 measurements for 5 Jovian satellites (Io, Europa, Ganymede, Callisto, and Himalia), 127 measurements for 2 Saturnian satellites (Titan and Iapetus). The broad-band measurements within the spectral region 233-850 nm are presented. The range of phase angles is 0.1-154 deg. The geometric conditions of observations (phase angle, planetographic longitude and latitude of the target disk centre seen by the observer, and position angle of the scattering plane) are calculated for given moments of time according to the JPL Horizons ephemeris system. We have compiled 19 references to the published papers and some unpublished sources. The data are provided in a tabular ASCII format. The database can be used as the observational basis for detailed theoretical modelling, interpretation of the phase-angle and spectral dependence of polarization, and for selecting future space-mission targets.

The spectrum of a meteor of 9/10 August 1965

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Each spectrum of meteor has a great scientific value because it gives information about the chemical composition of the cosmic body that invaded into the Earth's atmosphere and the nature of the glow of its substance. For this purpose, the photographic images of meteor spectra obtained during 1953–1965 years are processed. These spectrograms are digitizated. There are more than 50 spectrograms of meteors obtained in Odesa, Simferopol and Ashgabat and they will be used for processing. First, we would like to note the meteor spectrum obtained 9/10 August 1965 at the Odesa Observatory station in Kryzhanivka by Vladimir Smirnov. The spectrum was obtained by meteor patrol, which consists of three cameras NAFA 3s/25 with lenses of "Uranium-9". Two cameras were equipped with replicas of diffraction gratings 300 str./mm, and one is equipped with a 17-degree objective prism. The meteor observed at 1^h15^m, local time. Exposure was 0^h50^m – 2^h11^m. The meteor belongs to flow of Perseid. The photometric standards for the further processing of the meteor spectra obtained by meteor spectrosensitometer, designed by V. A. Smirnov. The spectrum was partially processed by the observer. The relative intensities obtained with using the scale of the meteor spectrosensitometer and the characteristic curve of the star, the total radiation of the corresponding plot of the meteor spectrum and the number of atoms that emit were defined for this meteor. A digital processing of the photo in order to obtain and compare the results and determine the chemical composition of the meteor was performed. It is supposed to study all available pictures of meteor spectra. The spectrograms of meteors and photometric standards were digitized by Epson Expression 10000XL scanner with a resolution of 1200dpi at the Main Astronomical Observatory of Ukraine. These images are processed at the Astronomical Observatory of the Taras Shevchenko National University of Kyiv.

Peculiarities of the dynamics and the origin of retrograde satellites of planets

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The retrograde moons of the giant planets revolve around planets in opposite direction on orbits with large angles of inclination and eccentricity. By this time there is no universally accepted concept of their origin. Studies of orbital parameters of retrograde satellites of planets during their evolution can give us information about their formation after the formation of planets and direct satellite systems. This work is an overview of retrograde satellites according to their orbital parameters and considered different hypotheses of their formation, in particular in certain groups.

Photometry and polarimetry of asteroid 4 Vesta

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Photometry and polarimetry of one of the largest Main Belt asteroid 4 Vesta were carried out from September 2 to December 18, 2012. Asteroid was observed with 0.7m telescope at Astronomical Institute of Kharkiv University and with 1.0m telescope at Crimean Astrophysical Observatory (Simeiz). The telescopes were equipped with CCD camera ML 4710 and by single-channel photoelectric polarimeter, respectively. Standard set of BVRI filters was used. We obtained a full lightcurve in BVRI spectral bands with amplitude of 0.16 mag at phase angle a little more than 23 deg. Lightcurve has a standard form with one maximum and one minimum for the period of asteroid rotation (5.342 hr). Colour indices B-V and R-I are bluer and redder at lightcurve minimum with amplitudes of 0.02 mag and 0.06 mag, respectively. At the same time, colour index V-R shows variation with amplitude about of 0.06 mag. It is bluer at two parts of asteroid rotation phase as follows: in minimum and near the beginning of wide maximum of brightness lightcurve. Our results qualitatively coincide with DAWN data. Polarimetry of the asteroid 4 Vesta have been obtained within the range of phase angle 1.99-22.99 deg. Phase-angle dependence of linear polarization in V spectral band demonstrates a good agreement with the known one. The measured data of circular polarization in the range of phase angle 1.99-4.92 deg show that it is close to zero to an approximation of our observations.

2P/Enke, 4P/Faye, 6P/d'Arrest, 21P/Giacobini-Zinner and 27P/Crommelin comets' disintegration study

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The secular disintegration of absolute magnitude for 5 short-period comets (2P/Enke, 4P/Faye, 6P/d'Arrest, 21P/Giacobini-Zinner, 27P/Crommelin) is studied. For the whole period of observations (232 years) comet 2P disintegrated by 3^m, comet 4P (163 years) – by 1.5^m, comet 27P (554 years) – by 6^m. For comet 6P (156 years) and

comet 21P (112 years) the apparent disintegration is not found. So, two groups of comets with the apparent disintegration (decrease of absolute magnitude for 100-200 years is 1-4^m) and implicit disintegration (decrease of absolute magnitude is less then 0.1^m) was established. The first group includes comets 2P, 4P, 27P, second - 6P, 21P. The connection of the disintegration of comets with secular variations in solar activity was revealed.

Changes in the spectrum of the star HIP 54721 during its coverage by comet C/2009 P1 (Garradd)

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We present the results of studies of the covering of star $HIP54721$ by comet $C/2009\ P1$ (Garradd) with medium resolution spectra. The observations were carried out on March 18, 2012 at the Lisnyky station of the Taras Shevchenko National University of Kyiv (MPC code 585). The spectra were obtained before, during and after the covering of the star $HIP54721$ by comet $C/2009\ P1$ ($Garradd$) with reflecting telescope AZT-14 ($D = 4.8\ m$, $F = 7.7\ m$) and suspended spectrograph ASP-9 ($\lambda/\Delta\lambda \approx$1000 Å). Star $HIP\ 54721$ (spectral class $A2$) has an integral magnitude $T = 6.4^m$. The comet $C/2009\ P1(Garradd)$ has the following parameters: heliocentric distance $r = 1.9$ A.U., geocentric distance $\Delta = 1.3$ A.U., integral magnitude $T = 7.5^m$, phase angle $S - T - O = 28.5°$ and elongation angle $S - O - T = 112°$. The minimum distance from the comet to the star was ≈ 6 arcsec. Several features were discovered during the coverage of the star. The luminous flux from the star essentially has not changed, except of the range ($5850 < \lambda < 5980$), there was an absorption line with decrease of intensity by 5%. There is only one main comet emission in this spectral range – atomic sodium doublet ($D1 = 5890$, $D2 = 5896$). We computed equivalent width of the absorption band and amount of sodium atoms along the line of vision to the unit area. Possibility of registration of sodium at spectral supervision of stars coverings of early spectral classes is discussed.

Titan's influence on Hyperion's rotational dynamics

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The rotation of Saturn's moon, Hyperion, is known to be chaotic from numerical simulations as well as from astronomical observations. A simplified model assumes that because of the tidal torque the rotation axis should align with the axis perpendicular to the orbit's plane. Although the gravitational interaction with Titan is negligible compared to the one with Saturn, the two moons remain in an orbital 4:3 resonance, which justifies the hypothesis of Titan's influence on Hyperion's rotational dynamics. A comparison of numerical solutions of equation of motion with and without taking into account Hyperion's interaction with Titan shows that a significant part of the phase space is characterized by different types of motion, switching from chaotic to quasiperiodic, yet preserving the dynamical and fractal properties of the chaotic zone.

POSITIONAL ASTRONOMY & ASTRONOMICAL EQUIPMENT

Processing of VLBI data of MAO NASU analysis centre with new SteelBreeze software

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We present the review of the activities of International VLBI Servise (IVS). Main goal of IVS is to coordinate the observations of distant radio sources by designated observatories. Another valuable task is to rule the efforts of analysis centres to the best combined solution. Analysis centre of the Main Astronomical Observatory of NASU owns the SteelBreeze software to process the observations. Now we present the newest version of SteelBreeze and the first results of our processing efforts.

Tests of commercial color CMOS cameras in astronomical applications

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We present some results of testing of commercial color CMOS cameras for astronomical applications. CMOS sensors allow to perform photometry in three filters simultaneously that gives a great advantage compared with monochrome CCD detectors. The Bayer BGR colour system realised in CMOS sensors is close to the Johnson BVR system. We demonstrate transformation from the Bayer color system to the Johnson one. Our photometric measurements with color CMOS cameras coupled to small telescopes (11–30 inch) reveal that the precision of about 0.01 mag can be achieved for stars up to V$\sim$14. In video mode stars up to V$\sim$10 can be shot at 24 frames per second. We show that for urban observations near the big cities the limit amplitude depends on sky background (mag/sec^2) and seeing (arc-secs). We present the basic camera characteristics: read noise (e/pix), thermal noise (e/pix) for the commercial digital cameras Nikon D90, Canon 350D, Canon 5D Mark III.

Comparison of two methods for processing images of spectropolarimetric echelle spectrograph on the example of a magnetic star B CrB

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We present the results of comparison of two methods of processing spectra-polarimetric images of magnetic star CrB. One is the method of high-precision measurements of a longitudinal component of magnetic fields of stars with the help stokesometr in the Crimean astrophysical observatory. The second one is measurements of circular polarization in the spectral line.

Registration a rapidly changing electromagnetic waves using a modern electronic equipment

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Complex multichannel recording weak alternating electromagnetic radiation by the method of photon counting was designed. The equipment is designed with use of a microcontrollers and programmable logic (FPGA). The receiving-recording part was developed and experimental models of equipment was created. The software for Embedded Systems and control programs for the PC was written. Equipment is relevant for astronomical observations of rapidly changing and/or very weak signals.

INTERSTELLAR MEDIUM

Modelling of low-metallicity HII region emission with bubble-like structure inside

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We investigated the influence of bubble-like structures, around starbursts inside low-metallicity HII regions, on the ionization spectrum shape changing and on the emission lines forming using multicomponent photoionization modelling. Radial distribution of density values and other physical parameters of bubble-like structures were given from Weaver et al. in 1977. The first and second inner components of such models describe the free expansion zone of superwind from the central starburst region and rarefied hot gas of the cavity, thermalized by inverse shock wave, correspondingly. The gas density and electron temperature distributions in these components are obtained from solution of equations system of continuity and energy transfer including heat conductivity. The third component is a thin shell of high density gas formed by direct shock wave of stellar wind from the gas which surround bubble. The gas density in this component was obtained from isobaric condition at contact discontinuity between second and third components. Input spectra of the ionizing radiation were obtained from the starburst evolution models calculated by us. The evolution grid of the multicomponent low-metallicity photoionization models with free parameters, which determined physical conditions inside "bubble", was calculated. The influence of stellar wind "bubble" on the ionization spectrum shape changing and on the forming of fluxes in important emission lines in low-metallicity case was analysed.

Optimization of the integration step in calculation procedure of the nebular diffuse radiation

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The calculation procedure of the nebular diffuse radiation selecting the optimal integration step over 3D volume with given emissivity and opacity, calculated previously with Cloudy code was developed. We compared those optimal steps for planetary nebula and HII region. For this purpose we have developed the code, that solves radiative transfer equation in 3D case. Using this procedure the radial dependence of integral diffuse radiation flux for the different kinds of the nebular environments was obtained. We plain to implement this procedure in Clody code for precise photoionization modelling.

On the search of optimal photoionization models of planetary nebulae

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The data on the hydrogen radial density distribution, obtained previously by V. Golovatyi and Yu. Mal'kov (1992) from Hβ isophote maps of 12 planetary nebulae (PNe) envelopes, were used to the search of their optimal photoionization models

(OPhM). This distribution is characterised by presence the clearly defined maximum. Three stages optimisation method, developed previously by B. Melekh was used for this purpose. At the first optimisation stage the ionization structure of above PNe envelopes and the energy distribution in the spectrum of the ionizing radiation from their nuclei were determined using mainly diagnostic ratios between emission lines. At the second stage the chemical composition was refined using fluxes in emission lines. At the third stage all free parameters were employed in modelling, and the final optimal ionization structure and chemical composition of the above PNe envelopes were obtained. The hydrogen density distributions in PNe envelopes were also optimised in the range of error bars, obtained previously from mentioned above data. The dust presence was also taken into account during OPhM search and the optimal grains mixture as well as dust abundance in modelled PNe were obtained. It is shown that considered method to OPhM search allows to obtain the physical characteristics and chemical composition in PNe envelopes more correctly.

Magnetic field in dynamics of post-adiabatic supernova remnants

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The whole evolution of supernova remnants (SNR's) is commonly divided in 3 stages: free expansion, adiabatic expansion and radiative cooling. It can be shown that the period of time between the one where adiabatic solutions are not longer valid and the one where radiative shock is formed lasts about 80% of the duration of the adiabatic stage. The behaviour of the shock essentially changes during this time. Therefore one has to consider an additional, post-adiabatic, stage in the evolution of SNR's. We investigate the physics of the post-adiabatic shock performing numerical simulations including the cooling of the optically thin plasma. In particular, we study the role of the magnetic field in the dynamics and temporal evolution of the shock. We have shown than magnetic field doesn't affect the flow dynamics during the adiabatic stage. On the post-adiabatic stage, the transverse magnetic field considerably suppresses the shock compression comparing to the model without magnetic field. In contrast, the presence of a parallel component of the magnetic field almost does not affect the overall shock dynamics.

Long-term scintillation observations of PSR B0823+26

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We present the results of the analysis of interstellar scintillation in PSR B0823+26. The observations were conducted at the frequency of 1.7 GHz using the 32-meter Torun Centre of Astronomy radiotelescope. More than 50 observing sessions, that lasted of average of 10 hours, where conducted between 2003–2006. We found interstellar scintillation parameters, by the means of the dynamic spectrum analysis as well as structure function analysis of the flux density variations. We identified two distinctive timescales, which we believe to be the timescales of diffractive and refractive scintillation. Our results show that at the given frequency, the diffractive timescales in PSR B0823+26 is 17.6 minutes, the refractive timescale is 170 minutes, and the decorrelation bandwidth is 80.7 MHz.

SOLAR PHYSICS

Structure of the solar corona during total solar eclipses in solar cycle 23 and modelling of coronal magnetic field in the potential approach

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Magnetic field in the solar corona during the total solar eclipses in solar cycle 23 was calculated using classical approach of the PFSS model. Source surface radius was equal to 2.5 solar radii. Sinoptical photospheric magnetic field data from Wilcox Solar Observatory with adding of polar field corrections from 0 to 1500 μT proportional to $\cos 8\theta$ were used. Magnetic field lines configurations were compared with observed coronal structures during total solar eclipses. Polar field corrections were determined from comparison of modelled and calculated coronal structures. It was found that polar field correction changed from 500 μT in minimum to 500 μT in maximum of solar cycle.

Magnetic fields in limb solar flares

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Two limb solar flares, of 14 July 2005 and 19 July 2012, of type $X1.2$ and $M7.7$, are analysed at present work. Magnetic field strengths in named flares are investigated by Stokes $I \pm V$ profiles of $H\alpha$ and $D3$ HeI lines. There are direct evidences for the magnetic field inhomogeneity in flares, in particular, non-parallelism of bisectors in $I+V$ and $I-V$ profiles. In some flare places, the local maximums of bisectors splitting were found in both lines. If these bisectors splittings to interpret as Zeeman effect manifestation, the following magnetic field strengths reach up to 2200 G in $H\alpha$ and 1300 G in $D3$. According to calculations, observed peculiarities of line profiles may indicate the existence of optically thick emissive small-scale elements with strong magnetic fields and lowered temperature.

Fast-growing sunspot groups AR 1618, AR 1619, AR 1620, AR 1640 and their features

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The present work discusses the evolutionary features of fast-growing sunspot groups AR 1618, AR 1619, AR 1620 and AR 1640. Magnetic fields, the movements at different levels of the solar atmosphere, and other data are analyzed. In order to obtain maximum information about the groups we used data from several sources, terrestrial (Kanzelhoehe Solar Observatory, Crimean Astrophysical Observatory), and space (SOHO, SDO, etc.).

TST Spectra View application

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We present a web service for the visualisation and analysis of solar data from the TST-2 (Tower Solar Telescope) of Crimean Astrophysical Observatory. This application allows you to work with an online database of original observations obtained in different spectral regions. It is implemented as a tool of International Virtual Observatory.

Power spectra of convective motions in the solar photosphere

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We reproduced the convective velocity field in the solar photosphere using neutral iron line $\lambda \approx 639.3$ nm profiles from the observations with high spatial resolution. We obtained power spectra of vertical velocity fluctuations at different photospheric levels in order to separate and study convective motions on different spatial scales. In the lower photosphere the main power is localised on the granular scales with a pick at a scale of about $2.5 \div 3$ Mm. A separate regime of mesogranulaton ($\lambda = 5 \div 10$ Mm) distinguished from granulation by a power gap has not been found. Mesostructures appear as a part of an extended distribution of granular sizes without further distinction from granulation. In the higher levels of the solar photosphere power of vertical velocity fluctuations decreases on the granular scales and stays almost stable on the supergranular scales ($\lambda = 20 \div 30$ Mm): the variations of the vertical velocity of granulation decrease with heights but the velocity variations of supergranulation reach much higher layers.

The macroscopic turbulent diamagnetism and stability of sunspots

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We considered the difference in turbulent pulsation intensities between the sunspot umbra (where turbulent pulsations are suppressed by a strong magnetic field) and the surrounded plasma without magnetic fields (photosphere and convection zone, where suppression of turbulized convection due to magnetic field is absent). This approach enabled us to reveal the effect of macroscopic diamagnetic expulsion of magnetic field from photosphere or convective zone to sunspot (transverse diamagnetism), which can play an essential role in supporting the long-term stability and equilibrium state of vertical magnetic flux tubes in sunspots.

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