

NATIONAL TARAS SHEVCHENKO UNIVERSITY OF KYIV  
DEPARTMENT OF ASTRONOMY AND SPACE PHYSICS

16th Young Scientists' Conference  
on Astronomy and Space Physics  
Abstracts

Kyiv, 2009



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**Preface**

This year Young Scientists' Conference on Astronomy and Space Physics is held for the sixteenth time. We all have been looking forward to the annual meeting of astronomers at National Taras Shevchenko 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 National Taras Shevchenko University of Kyiv as a students' conference in 1994. Since 1996 our conference has welcomed young researchers from other universities and scientific institutions. During 1994-2008 participants from Ukraine, Russia, Poland, France, Germany, Spain, Sweden, Libya, Egypt, Japan, Finland, Turkey, China, Slovakia, Armenia, USA and other countries participated in Young Scientists' Conference.

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

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

*Grygorii Polinovskyi and  
Local Organizing Committee*

# PROGRAMME

**Monday, April, 27**

10.00-14.00 - Registration  
14.15-14.35 - Official opening.

**Section 'Interstellar Medium'**

- 14.35-15.20 Bogdan Wszolek. *We Do Not Forget Johannes Kepler* (invited)
- 15.20-15.50 Tea-break
- 15.50-16.05 Iurii Sushch, B.I. Hnatyk, A. Neronov. *Modelling of the Vela Complex Including Vela Supernova Remnant, Gum Nebula and Binary System  $\gamma^2$  Velorum*
- 16.05-16.20 Grygorii Polinovskyi, B.I. Hnatyk. *Generation of TeV  $\gamma$ -rays in the SNRs*
- 16.20-16.35 Anna Karnausenko, E.Yu. Bannikova, V.M. Kontorovich, V.M. Shulga. *Interaction of the Supernova Remnant with Molecular Cloud*
- 16.35-16.50 Ruslana Kozel, B.Ya. Melekh. *Photoionization Modelling of HII Regions with Stellar Wind Bubble Inside*
- 16.50-17.05 Maryana Sokil, B.Ya. Melekh. *Photoionization Modelling of the HII Regions with Inhomogeneous Spatial Distribution of the Chemical Composition*
- 17.05-17.10 Sergey Polushkin, I.E. Val'tts, S.V. Kalenskii. *Class I Methanol Maser Emission in DR21(OH) Environments* (poster)
- 18.30-21.00 Excursion to the Main Astronomical Observatory of NAS of Ukraine

Tuesday, April, 28

Section 'High-Energy Astrophysics'

- 09.30-10.15** Marcus Kirsch. *XMM-Newton - ESAs X-ray Observatory, Ready for the Next Decade* (invited)
- 10.15-10.30** Rudolf Galis, S. Paltani, D. Eckert, F. Munz, M. Kocka. *X-ray Emission of Cataclysmic Variables Observed by INTEGRAL*
- 10.30-10.45** Dmytro Iakubovskiy, M. Miceli, F. Bocchino, S. Orlando, I. Tezhinsky, M. Kirsch, O. Petruk, G. Dubner, G. Castelletti. *Thermal and Non-thermal X-ray Emission from SN 1006*
- 10.45-11.15** Tea-break
- 11.15-11.30** Ievgen Vovk, A. Neronov, B.I. Hnatyk. *XMM-Newton Observations of SN G353.6-0.7 Remnant*
- 11.30-11.45** Violetta Sagun, O.V. Fedorova. *XMM-Newton and Swift X-Ray Observations of Active Galactic Nucleus of NGC 4945*
- 11.45-12.00** Vasyl Beshley, O.L. Petruk. *Very-High Energy Gamma-Ray Images of Supernova Remnants due to Inverse-Compton Scattering*
- 12.00-12.15** Volodymyr Masliukh, B.I. Hnatyk. *High Energy Cosmic Rays from SNIa and Hypernovae*
- 12.15-12.30** Volodymyr Marchenko, D. Pekur. *Neutrino from Hypernova Explosion*
- 12.30-12.45** Demid Pekur, V. Marchenko. *Acceleration of Cosmic Rays during the Hypernova Explosion*
- 12.45-13.00** Oleg Kobzar, T. Bogdan, V. Marchenko. *Cosmic Rays Propagation in the Galactic Magnetic Field*
- 13.00-13.05** Darja Dobrycheva, J. Solomennyk, V. Marchenko. *The Acceleration of Cosmic Rays in the Active Galactic Nuclei* (poster)
- 13.05-13.10** Anatoliy Vasylenko, A.V. Tugay. *Geometrical Model of X-ray Pulsar Cen X-3* (poster)
- 15.00-18.00** City tour (by bus)
- 18.00-22.00** Kyiv by night (walking tour)

Wednesday, April, 29

Section 'Stellar Astrophysics'

- 09.30-10.15 Siegfried Franck. *Extrasolar Planetary Systems: the Search for a Second Earth* (invited)
- 10.15-10.45 Tea-break
- 10.45-11.00 Oleksiy Ivanyuk, Ya.V. Pavlenko. *Chemical Composition of Solar-Twin Wide Binaries*
- 11.00-11.15 Przemyslaw Jagodzinski. *Mode Identification of Beta Cephei Star SY Equ*
- 11.15-11.30 Vladimir Yushchenko, S. Hubrig, F. MUSAEV. *The Abundance Patterns of Chemically Peculiar Stars HD91375 and HD25354*
- 11.30-11.45 Marek Gorski, K. Sobon. *Red Clump Stars and Tip of Red Giant Branch as a Distance Indicator*
- 11.45-12.00 Daria Teplykh, V.M. Malofeev, S.V. Logvinenko. *Radio Emission from RRAT J1819-14 at Low Frequencies*
- 12.00-12.05 Daria Teplykh, V.M. Malofeev, O.I. Malov, A.E. Rodin. *Detection of Radio Emission from AXP 4U 0142+61* (poster)
- 12.05-12.10 Anna Tatarnikova, A.M. Tatarnikov. *UV-Observations of the Symbiotic Nova PU Vul during Its Nebular Phase* (poster)

Section 'Variable Stars'

- 14.00-14.45 Alexey Berezhnoj. *Chemistry of the Solar System* (invited)
- 14.45-15.00 Fedir Chekhonadskikh, V.V. Kovtyukh. *Spectral Luminosity Indicators for FGK Supergiants and Classical Cepheids*
- 15.00-15.25 Tea-break
- 15.25-15.40 Stefan Parimucha, T. Pribulla, M. Vanko, P. Dubovsky. *VW LMi – Tighest Known Close Quadruple System*
- 15.40-15.55 Alla Kozhevnikova, I.Yu. Alekseev. *Long-Term Starspot Activity of RS CVn-type Stars from Photometric Observations*
- 15.55-16.10 Olga Maryeva. *Spectral Variability of the LBV Star V532 in M33*
- 16.10-16.25 L'ubomír Urbančok. *Observations of Cataclysmic Variables in Amateur Conditions – Results from Cataclysmic Stars Observations at Šíd Astronomical Observatory*
- 16.25-16.30 Stefan Parimucha, P. Dubovsky, I. Kudzej. *Monitoring of Cataclysmic Variables at Astronomical Observatory in Kolonica Saddle* (poster)
- 16.30-16.35 Stefan Parimucha, P. Dubovsky, I. Kudzej. *Intermediate Polars Campaign at Astronomical Observatory in Kolonica Saddle* (poster)
- 16.35-16.40 Rudolf Galis, L. Hric, E. Kundra. *RS Oph: Flickering Study for 3 Years after the Outburst*
- 18.30-22.00 Organ hall / opera hall / etc.

Thursday, April, 30

**Section 'Extragalactic Astrophysics'**

- 09.30-09.45** Roman Uklein. *3D Structure of the Canes Venatici Cloud*
- 09.45-10.00** Agnieszka Rys. *Starbursts in the Local Universe: HST WFPC2 Observations of NGC 1569 and NGC 4449*
- 10.00-10.15** Olga Kashibadze. *Total Mass of the Virgo Cluster Derived from the Infall Effect of Galaxies within 30 Mpc*
- 10.15-10.30** Ivan Khatko, B.I. Hnatyk, A.O. Simon. *Observations of Active Galactic Nucleus OJ287, 3c273, Mrk501 in March – August 2008*
- 10.30-10.45** Katerina Agienko, Y.I. Izotov, N.G. Guseva. *Spectral Investigation of Blue Compact Dwarf Galaxy IC4662*
- 10.45-11.00** Julia Solomennyk, D. Dobrycheva, O. Melnyk. *Morphological Content of Galaxy Pairs and Isolated Galaxies*
- 11.00-11.05** Agnieszka Kuźmicz, M. Jamroz. *Host Galaxies of Giant Radio Sources and Their Optical Spectra* (poster)
- 11.05-11.10** Roman Korytko, B.Ya. Melekh. *Nebular Diagnostics and Lyman Continuum Spectra Determination of HII Regions in Spiral Galaxies* (poster)
- 11.10-11.15** Vitaliy Gritsyuk, B.I. Hnatyk. *Binary Active Galactic Nucleus: Correlation in the Optics and X-ray Bands* (poster)
- 11.15-11.45** Tea-break

**Section 'Cosmology'**

- 11.45-12.00** Dmytro Iakubovskiy, A. Boyarsky, O. Ruchayskiy, V. Savchenko, D. Malyshev. *Constraints on Sterile Neutrino Dark Matter and the Possibility of Its "Direct" Astrophysical Search*
- 12.00-12.15** Olga Sergijenko, B. Novosyadlyj. *Scalar Field as Dark Energy: Classical Field versus Tachyon*
- 12.15-12.30** Bohdana Venhlovskaja, B. Novosyadlyj. *Evolution of Ionization Fractions at Early Universe*
- 12.30-12.45** Pavel Nakaznoy. *The Modeling of Circular Velocities of Spiral Galaxies in the Thin Unconditioned Disc Model within the Frame of Einstein Equations with the Cosmological Term Which Linearly Depends on Ricci-Scalar*
- 12.45-12.50** Lidiia Zadorozhna, B.I. Hnatyk. *Nonthermal Radiation of Superconducting Cosmic String in Magnetized Intergalactic Medium* (poster)

**Section 'Solar System'**

- 14.00-14.45** Oleg Ugolnikov. *Lunar Eclipses: The History and Science* (invited)
- 14.45-15.15** Tea-break
- 15.15-15.30** Maria Gritsevich. *New Aspects and Modern State of Research in Meteor Physics*
- 15.30-15.45** Remigiusz Pospieszyński. *Cometary Environment – Different Operating Modes of the Rosetta's Ion Composition Analyzer and Its Virtual Counterpart*
- 15.45-15.50** Sergiy Kharchuk. *The Striae Features in the Dust Tail of Comet C/2006 P1 (McNaught)* (poster)
- 15.50-15.55** Artur Durajski, R. Szczęśniak, M.M. Jarosik, M. Szczęśniak. *The Cold Free-Floating Giant Planets* (poster)
- 18.00-22.00** Conference dinner

**Friday, May, 1**

**Section 'Space Geophysics'**

- 09.30-10.15** Gennady Milinevsky. *Ozone Hole and Climate Change* (invited)
- 10.15-10.45** Tea-break
- 10.45-11.00** Oleksandr Shuyenko, L.V. Kozak. *Basic Physical Concepts and Numerical Modeling of Sprites*
- 11.00-11.15** Andrii Bovchaliuk, L.V. Kozak, S.P. Savin. *Statistical Features of the Magnetic Field Fluctuations from Satellite Interball Data* (poster)
- 11.15-11.20** Daniil Kozlov, A.S. Leonovich. *Alfven and Magnetosonic Resonances in an Inhomogeneous Plasma* (poster)
- 11.20-11.25** Sergii Pylypenko, L.V. Kozak. *Simulation of Spread and Dissipation of Atmospheric Waves* (poster)

**Section 'Methods of Astronomy'**

- 11.25-11.40** Ozgur Basturk, S.O. Selam, B. Albayrak. *Comparative Analysis of the High Resolution Spectra of Deneb (Alpha Cygni) Obtained with the Coude Echelle Spectrograph (CES) Attached on the RTT-150 Telescope*
- 11.40-11.55** Vladimir Akhmetov, P.N. Fedorov. *The XPM Catalogue. Absolute Proper Motions of 280 Millions Stars*
- 11.55-12.00** Anooshiravan Roozrokh, Hiva Pazira. *Reducing Abell 226 Optical Data Using THELI Pipeline*
- 12.00-12.05** Ivan Khatko, A.O. Simon, V.V. Kleshchonok. *The Photometrical System and Positional Accuracy of the CCD Camera ST8 of Lisnyky Observational Station*
- 12.05-12.10** Michał Gochna, M. Górski. *Wide Field Low-Resolution Spectrograph for ASAS*
- 12.10-12.05** Mikayel Arzakantsyan, V.A. Gevorkyan, A.E. Reymers, M.N. Nersesyan. *Investigation of Physical Characteristics of Nano-Structured Thin Films of Cu<sub>2</sub>O for Solar Cells Application*
- 12.00-12.05** Karina Baczek. *Space Tourism*

**Section 'Solar Physics'**

- 14.00-14.15** Olexandra Baran, M.I. Stodilka. *Large-scale Horizontal Flows in the Solar Atmosphere*
- 14.15-14.30** Ievgeniia Sadovenko, M.I. Pishkalo. *Calculation and Visualisation of Coronal Magnetic Field during the 2006 and 2008 Total Solar Eclipses*
- 14.30-14.45** Olena Andriets, V.G. Lozitsky. *Magnetic Fields Nonuniformity in Solar Flares*
- 14.45-15.00** Michael Tchernikov, V.N. Raskhozhev. *Observation and Photometry of Total Solar Eclipse of August 1 2008*
- 15.00-15.15** Ümit Deniz Göker, E.R. Pekünlü. *A Different and New Point of View to the Collisionless Plasma on Shock Waves in the Current Sheet Region in Solar Corona*
- 15.15-15.20** Olga Botygina, V.G. Lozitsky. *Observed Peculiarities of the Stokes Profiles of D<sub>3</sub> Line in a Solar Prominence (poster)*
- 15.20-16.00** Poster Section + Tea-break
- 16.00-16.30** Official closure

# INVITED LECTURES

**We Do Not Forget Johannes Kepler**

Bogdan Wszolek

*Jan Długosz Academy, Institute of Physics, Częstochowa, Poland*

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Year 2009 was announced as the International Year of Astronomy. This was to mark 400th anniversary of the first astronomical observation through a telescope by Galileo. On the other hand, this year marks 400th anniversary of *Astronomia Nova*, the famous work by Kepler published in Prag in 1609. Two laws of planetary motions opened human efforts to understand gravitational force; so, the overall cosmic space conquest, with its great importance not only for astronomy, was developed thankful to Kepler's work. This lecture is thought to show the most inspiring ideas of Johannes Kepler, published in *Astronomia Nova* and in his other writings.

**XMM-Newton – ESAs X-ray Observatory, Ready for the Next Decade**

Marcus Kirsch

*European Space Operations Centre, European Space Agency, Darmstadt, Germany*

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ESAs XMM-Newton space observatory is the flagship of European X-ray astronomy. After launch from Kourou, French Guiana on 10 December 1999, it is the most powerful X-ray telescope ever placed in orbit. The mission is solving many cosmic mysteries of the hot X-ray universe observing objects like neutron stars, black holes or active galaxies.

The mission was originally designed for a 10 years life time, however since space craft and instruments are operating admirably without major degradation it is planned to operate the observatory long into the next decade, our only limitation being the hydrazine resources.

In 2008 due to an antennae switch problem contact was lost to the satellite. However after a major recovery XMM-Newton was back online only some days later to serve the X-ray community.

I will describe the health status of space craft and instruments in combination with the 2008 recovery. To round up I will present major discoveries from XMM from the last 10 years.

**Extrasolar Planetary Systems: the Search for a Second Earth**

Siegfried Franck

*Potsdam Institute for Climate Impact Research &  
Institute for Physics and Astronomy of Potsdam University, Postdam, Germany*

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Is there life beyond planet Earth? This is one of the grand enigmas which humankind tries to solve through scientific research. Recent progress in astronomical measurement techniques has confirmed the existence of a multitude of extra-solar planets. On the other hand, enormous efforts are being made to assess the possibility of life on Mars. All these activities have stimulated several investigations about the habitability of cosmic bodies. The habitable zone (HZ) around a given central star is defined as the region within which an

Earth-like planet might enjoy the moderate surface temperatures required for advanced life forms. Super-Earths are rocky planets from one to ten Earth masses with the same chemical and mineral composition as the Earth. We use scaling laws to obtain the total radius, mantle thickness and average density as a function of planetary mass. The HZ around Gl 581 for super-Earths with five and eight Earth masses has been calculated.

Our results can be used to determine the average number of planets per planetary system that are within the HZ. With the help of a segment of the Drake equation, the number of "Gaia's" (i.e. extra-solar terrestrial planets with a globally acting biosphere) is estimated. This leads to the thoroughly educated guess that there should exist half a million Gaia's in the Milky Way.

### **Chemistry of the Solar System**

Alexey Berezhnoy

*Sternberg Astronomical Institute, Moscow, Russia*

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A study of chemical and isotopic composition of planetary bodies is important for better understanding of early history of the Solar system. Chemical processes during collisions between planets and impactors are considered on the example of the comet Shoemaker-Levy 9 – Jupiter collision and meteoroid bombardment of the Moon and Mercury. Hypothesis of delivery of lunar polar volatile by impacts of comets is considered. Properties of lunar and Hermean exospheres are discussed. Main mechanisms of isotopic fractionation in planetary atmospheres are shown. Prebiotic chemistry on planetary surfaces is described.

### **Lunar Eclipses: The History and Science**

Oleg Ugolnikov

*Space Research Institute, Russian Academy of Sciences, Moscow, Russia*

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The lecture contains the review of the history of lunar eclipse observations, the major historical events related with these phenomena and the basic scientific problems that were solved and are being solved now by the analysis of the lunar eclipses.

From the ancient times, the lunar eclipses observations were the base of lunar motion theory and the celestial mechanics in general. Another part of lunar eclipses science, the optical one, was too difficult to be improved for many centuries. The relation between the properties of eclipsed Moon and the atmosphere refraction was established by Johannes Kepler.

The geometry of lunar eclipse is similar to the one of space mission for atmospheric research, and the role of spacecraft is played by the Moon. Until the start of cosmic era the lunar eclipses observations were the only way for atmospheric remote sounding at different altitudes and distances of many thousands of kilometers. Rapid variations of eclipse brightness were related with clouds in the atmosphere, solar activity, meteor storms and many other factors.

The results of 5 recent eclipses observations in 2004-2008 are also presented. The surface photometry of the Moon is used to determine the latitude and altitude distributions of atmospheric aerosol and water vapor with account of regional properties of the Earth's limb for each eclipse. The correlation with total ozone amount in southern hemisphere is also investigated.

**Ozone Hole and Climate Change**

Gennadi Milinevsky

*National Taras Shevchenko University of Kyiv, Kyiv, Ukraine*

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Who discovered the ozone hole? Is that really a "hole"? Formation of the Antarctic ozone hole. Planetary waves in total ozone. Changes in ozone layer: impact on ecosystem, influence on regional climate. What is the future of the ozone hole? What is the connection of Antarctic Peninsula regional climate warming to changes in ozone layer and ozone hole development? Our research of troposphere-stratosphere coupling is based on the idea of energy and mass exchange between turbulent atmosphere and "calm" stratosphere, study of the troposphere energy sources: strong weather fronts, cyclones, planetary waves. Characteristics of a zonal asymmetry in the total ozone content distribution caused by the ozone hole and planetary waves are analyzed using the TOMS measurements in 1979-2007. The monthly averaged values for the southern spring shows: (1) zonal ozone minimum exhibits a long-term eastward shift in the longitudinal sector 60W – 0E; (2) a strong asymmetry in the ozone distribution. The influence of a long-term ozone distribution changes and its possible influence on the troposphere warming are discussed.

# INTERSTELLAR MEDIUM

**Modelling of the Vela Complex Including Vela Supernova Remnant, Gum Nebula and Binary System  $\gamma^2$  Velorum**

Iurii Sushch<sup>1,2</sup>, B. Hnatyk<sup>3</sup>, A. Neronov<sup>4</sup>

<sup>1</sup> *National Taras Shevchenko University of Kyiv, Kyiv, Ukraine*

<sup>2</sup> *Hubboldt-Universität zu Berlin, Berlin, Germany*

<sup>3</sup> *Astronomical Observatory of National Taras Shevchenko University of Kyiv, Kyiv, Ukraine*

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We study the geometry of the Vela complex including Vela supernova remnant (SNR), Gum nebula and a binary system  $\gamma^2$  Velorum. We argue that the asymmetry between North-East and South-West parts of Vela SNR could be explained by the presence of a stellar wind bubble blown by the nearest to the Earth Wolf-Rayet star in the  $\gamma^2$  Velorum system. Detection of the boundary of the stellar wind bubble of  $\gamma^2$  Velorum enables us to derive the initial mass of the WR star  $M_{\text{initial}} \sim (40 - 54)M_{\odot}$ . Low initial mass of the WR star implies that luminosity of a nuclear line of  $^{26}\text{Al}$ , produced by the  $\gamma^2$  Velorum is below the detection limit of the existing telescopes.

**Generation of TeV  $\gamma$ -rays in the SNRs**

Grygorii Polinovskyi<sup>1</sup>, B.I. Hnatyk<sup>2</sup>

<sup>1</sup> *National Taras Shevchenko University of Kyiv, Kyiv, Ukraine*

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Supernova remnants (SNRs) are believed to be the sites of the production of galaxy cosmic rays (CR). Strong shocks in SNRs can cause acceleration of electrons, protons and nuclei. Some shell-type SNRs have been detected at TeV energies, as expected if they indeed are the sources of CRs. TeV gamma-rays can originate from the neutral pions decay, produced due to interactions between the accelerated CRs, interstellar medium, or/and gas swept up by the SNR shock. In the present work we examine a model of interaction of the ultrarelativistic particles produced in the SNR IC 443 with a possible nearby molecular cloud. We present the results which depend on different conditions assumed in the model and show that the resulting gamma-ray flux is consistent with the observational data.

**Interaction of the Supernova Remnant with Molecular Cloud**

Anna Karnaushenko<sup>1</sup>, E.Yu. Bannikova<sup>1,2</sup>, V.M. Kontorovich<sup>1,2</sup>, V.M. Shulga<sup>1,2</sup>

<sup>1</sup> *Institute of Radio Astronomy of NAS of Ukraine, Kharkiv, Ukraine*

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The solution of Kompaneets equation for a shock front (see review [1]) in a plane stratified medium with density changing by the law of a hyperbolic tangent from a more rarefied (interstellar) medium to a more dense (cloud) was obtained. The law of motion for a leading point of a front in case of disappearing small density of the interstellar medium was found. Dynamics of a leading point of a front extending towards a small density of the medium was investigated analytically in details. Under this condition a "Kompaneets break" of a shock front on the infinitely large distance for a finite time appears. At finite, but small density of ISM there is a period of acceleration of the shock front at times of the order of the break time. This period is replaced by the front delay on large-scale times. On the scales of the break the front gets extended barrel-like form observed in a number of supernova remnants. On large-scale times the front gets a spherical-like form. Motion of a leading point towards the molecular cloud occurs with delay. This component of the shock front is of an interest in connection with the new possibilities of detection of interaction between supernova remnants and molecular clouds by observing the line of 1720 MHz hydroxyl maser emission [2]. In this region maser emission of methanol at 95 GHz was also observed [3].

1. Bisnovatyi-Kogan, G.S., Silich, S.A., *Revs. Mod. Phys.*, V. 67, 3, p. 661 (1995)
2. Koralesky, B., et al. *Astron. J.*, V. 116, p. 1323 (1998)
3. Zubrin, S.Yu., Shulga, V.M., YSC'15 Proc. of Contributed Papers. Eds.: V.Ya. Choliy, G. Ivashchenko, 'Logos', Kyiv, p. 41 (2008)

### **Photoionization Modelling of HII Regions with Stellar Wind Bubble Inside**

Ruslana Kozel, B.Ya. Melekh

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For the photoionization modeling of region around starburst Lyman continuum spectra must be given. The last results obtained from optimized photoionization modeling show a gap of Lyman continuum quanta in a wavelength range  $\lambda = 912 - 504 \text{ \AA}$ . It could be explained as the ionizing radiation penetrates a thin and dense envelope of nebular plasma with high density. Presence of such an envelope in HII region surrounding a starburst could be explained by a superwind bubble formation. For detailed analysis multicomponent grid of photoionization models were calculated. ISM grains were also included in modelling. Each model has three components

1. The first component represents low density hot gas, like a stellar wind cavity.
2. The second one is a thin envelope of high density gas, compressed by a superwind's shockwave.
3. The third one represents an "ordinary" HII region.

In this talk comparative analysis of the emission line spectra of the models with presence of second component vs. models without one is going to be presented.

### **Photoionization Modelling of the HII Regions with Inhomogeneous Spatial Distribution of the Chemical Composition**

Maryana Sokil, B.Ya. Melekh

*Ivan Franko National University of Lviv, Ukraine*

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Most real giant HII regions show spatial inhomogeneity of the chemical compositions, because of enrichment by heavy elements due to supernova explosions and stellar superwind. But at present most photoionization models of HII regions are based on the assumption of spatial homogeneity of the chemical abundances. That is why a task of verification of authenticity of such models appears. On this purpose we calculated several multicomponent photoionization models with the different distributions of the chemical compositions along the line of sight: from a smooth change to a random fluctuations. ISM grains physics was also included into our models. A comparative analysis of the predicted emission line spectra from models with inhomogeneous chemical compositions and without ones respectively was done.

**Class I Methanol Maser Emission in DR21(OH) Environments**

Sergey Polushkin, I.E. Valts, S.V. Kalenskii

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The results of two cycles of observations of Class I methanol maser emission are presented. The observations of DR21(OH) vicinity were carried out at Onsala Space Observatory (Sweden) using 20-m telescope. The first set of observations (2007) was aimed at searching ( $4_{-1} - 3_0E$ ) 36 GHz masers and ( $7_0 - 6_1A^+$ ) 44 GHz masers towards clumps of vibrational  $H_2$  1-0S(1) transition tracing filaments of postshocked gas. Methanol emission was detected in all searched points. The second set of observations was conducted in 2008. DR21(OH) environments were mapped at 44 GHz in order to confirm or disprove the possible association of methanol maser emission with  $H_2$  mosaics and peaks: detailed analysis of the map is suggested. The existence of a maser source northwards of DR21(OH) detected in the first row of observations was confirmed.

HIGH-ENERGY  
ASTROPHYSICS

**X-ray Emission of Cataclysmic Variables Observed by INTEGRAL**

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Cataclysmic variables and especially intermediate polars represent significant fraction of all INTEGRAL detections in hard X-ray / soft gamma ray. We processed all available observational data from INTEGRAL/IBIS and INTEGRAL/JEM-X for selected IPs and we analysed long-term variability as well as the composite spectra (3–100 KeV) of these sources. Our analysis showed that the fluxes of some IPs are long-term variable, mainly in 15 – 25 and 25 – 40 keV bands. Moreover this hard X-ray / soft gamma ray variability is correlated with the changes in optical spectral band. The broad-band spectra of surveyed IPs can be well fitted by a thermal bremsstrahlung model ( $kT \sim 20 - 25$  keV), with reflection from an optically thick cold medium (the surface of the white dwarf) in some cases.

**Thermal and Non-thermal X-ray Emission from SN 1006**

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A number of important processes taking place around strong shocks in supernova remnants (SNRs) depend on the shock obliquity – the angle between the shock normal and the interstellar magnetic field (ISMF). To study these processes, we select SN 1006 – the first SNR with recognized non-thermal emission. Its rather simple morphology, the exact knowledge of its age, and its evolution in low interstellar medium densities (due to high galactic latitude) make it an ideal laboratory to study these processes. We investigate the spatial distribution of X-ray and radio emission, observed with XMM-Newton and VLA/Parkes, respectively. Analyzing the radio map we conclude about the possible direction of ISMF depending on shock acceleration (aspect angle). When combining X-ray and radio data together, we model the emission from regions close to the shock as the sum of thermal and non-thermal components. By subtracting the properly scaled non-thermal emission, we produce the “purely thermal” image which indicates the separation between purely thermal and non-thermal emission. The possible implications of these results are discussed.

**XMM-Newton Observations of SN G353.6-0.7 Remnant**

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We investigated recently discovered object HESS J1731-347 using X-ray observations carried by XMM-Newton satellite. We confirm previously made conclusion (Tian et.al. 2008) that this object is a supernova remnant. We also estimated its X-ray luminosity and performed hydrodynamic modeling that had shown, that this remnant is likely to be an old one, far beyond the adiabatic (Sedov) stage.

**XMM-Newton and Swift X-Ray Observations of Active Galactic Nucleus of NGC 4945**

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We present the X-Ray spectrum of active galactic nucleus of NGC 4945 ( $z = 0.0019$ ) observed with the XMM-Newton and Swift X-Ray observatories. Thermal emission associated with the nuclear starburst and plume is dominated in the spectrum. Nevertheless the signature of the AGN is present in the form of a neutral Compton reflection component and 6.4 keV fluorescent iron  $K\alpha$  line. We obtained and modeled spectra from three cameras and two independent observations of the XMM-Newton satellite. Proper values of reflection coefficient, the temperature of the plasma and absorption along the line of sight were also calculated as a result of modeling. Processing of Swift satellite has not given any result since the number of the registered photons was not enough.

**Very-High Energy Gamma-Ray Images of Supernova Remnants due to Inverse-Compton Scattering**

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The synchrotron radio maps of supernova remnants (SNRs) in uniform interstellar medium and interstellar magnetic field are analysed, allowing different 'sensitivity' of injection efficiency to the shock obliquity. The very-high energy gamma-rays images due to inverse-Compton process of the same SNRs are also synthesized. The properties of images in these different wavelength bands are compared, with particular emphasis on the location of the bright limbs in bilateral SNRs. Recent H.E.S.S. observations of SN 1006 show that the radio and IC gamma-ray limbs coincide, and we found that this may happen if: i) injection is

isotropic but the variation of the maximum energy of electrons is rather quick to compensate for differences in magnetic field; ii) obliquity dependence of injection (either quasi-parallel or quasi-perpendicular) and the electron maximum energy is strong enough to dominate magnetic field variation. In the last case, the obliquity dependence of the injection and the maximum energy should not be opposite. We argue that the position of the limbs alone and even their coincidence in radio, X-rays and gamma-rays, as it is discovered by H.E.S.S. in SN 1006, cannot be conclusive about the dependence of the electron injection efficiency, the compression amplification of ISMF and the electron maximum energy on the obliquity angle.

### **High Energy Cosmic Rays from SNIa and Hypernovae**

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There is a wide consensus that the sources of cosmic rays of energy below the first “knee” are Galactic supernovae remnants, and that the sources of cosmic rays above the “ankle” are extra-Galactic. But there is no consensus regarding the sources of cosmic rays in the energy range between the knee and the “ankle”. In our work we investigate acceleration of cosmic rays during the transition deceleration stage of expansion shock wave in surrounding medium (stage between reaching the surface of presupernova / prehypernova star and beginning of Sedov-Taylor regime by shock wave) in SN Ia and Hypernovae explosion.

### **Neutrino from Hypernova Explosion**

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The generation of neutrino during the Hypernova explosion is considered. The parameters of neutrino flash that appears from pions decay as a result of inelastic collisions between accelerated particles and circumstellar environment are estimated. The detectability of neutrino flash are calculated.

### **Acceleration of Cosmic Rays during the Hypernova Explosion**

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The acceleration of cosmic rays during Hypernova explosion is considered. The characteristics of hydrodynamically accelerated external layers of star (energy spectrum of accelerated particles, total energy etc.) are estimated. The observational signatures of accelerated particles are investigated.

### **Cosmic Rays Propagation in the Galactic Magnetic Field**

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We consider the propagation of cosmic rays in the Galactic magnetic field. The differences in propagation depending on the energy of cosmic rays are investigated. The different models of Galactic magnetic field are used.

### **The Acceleration of Cosmic Rays in the Active Galactic Nuclei**

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The acceleration of cosmic rays in the active galactic nuclei is considered. The characteristics of accelerated (energy spectrum of accelerated particles, total energy etc.) are estimated. The observational signatures of accelerated particles are investigated.

### **Geometrical Model of X-ray Pulsar Cen X-3**

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We continue the analysis of XMM-Newton observation of X-ray pulsar Cen X-3. We used the PN camera observations which was carried out on 27.01.2001 during 68 kiloseconds. We tried to apply geometric diskline model (A.C. Fabian et al, 1989) for Fe emission lines – Fe I  $K\alpha$ , Fe XXV and Fe XXVI in 6.4 – 7.0 keV region. We obtained parameters of disc inclination, inner and outer radii of disc and mass of central compact object (neutron star).

Maybe the most interesting feature of Cen X-3 spectrum is Fe XXV triplet which was reported by R. Iaria et al. (2005). In our study we searched for this triplet and had not founded it. We explained the absence of triplet by the insufficient energy resolution of XMM instruments. But we found out that Chandra instruments also can not resolve this triplet. Thus reported results of Chandra's group (R. Iaria et al, 2005) lie within the errors level. Respectively, we cannot yet determine such parameters as temperature and density in Cen X-3 emission line region. Probably the future X-ray observations will significantly resolve Fe XXV triplet.

# STELLAR ASTROPHYSICS

### Chemical Composition of Solar-Twin Wide Binaries

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We have latest observational data on 14 pairs solar-twin binaries for studying their chemical composition and comparison it with Solar's elements abundances. We have processed all spectras and as we expected didn't find any significant differences between stars in single pair. Results of comparison with Solar chemical composition were much more interesting. By modeling atmospheres of examined stars we tried to find out the exact causes of such differences. The causes that we expect are variations in surface temperature, gravity, preliminary chemical conditions of star. Modeling will help us to find out the exact abundances of each element that indicate divisions in the spectra.

### Mode Identification of Beta Cephei Star SY Equ

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SY Equ is supposed to be one of the fastest rotating beta Cephei type star. I present mode identification of SY Equ from the multicolour photometric and high resolution spectroscopic observations for the dominant pulsation frequency at  $6.029 \text{ d}^{-1}$ .

### The Abundance Patterns of Chemically Peculiar Stars HD91375 and HD25354

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The high resolution spectra of chemically peculiar stars HD91375 and HD25354 were obtained at 8.2 meters ESO VLT telescope and 2.0 meters Terskol observatory telescope respectively. We found the effective temperatures and surface gravities in the atmospheres of these stars using the analysis of equivalent widths of iron lines:  $T_{eff} = 9100 \text{ K}$ ,  $\log g = 3.8$  for HD91375, and  $T_{eff} = 13000 \text{ K}$ ,  $\log g = 4$  for HD25354. The value of effective temperature for HD25354 is significantly higher than the previous determinations. The comparison of observed and synthetic spectra allow us to identify the clean lines of chemical elements, which were used for calculation of the abundances of these elements. The overabundances of heavy elements can reach 2 and 6 orders for HD91375 and HD25354 respectively.

**Red Clump Stars and Tip of Red Giant Branch as a Distance Indicator**

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We present distance determinations for Large Magellan Cloud and Small Magellan Cloud based on magnitude of the red clump stars, and distance determination for Carina, Fornax and Sculptor dwarf spheroidal galaxies, based on Sobel filter detection of the tip of the red giant branch. The distances obtained from near-infrared observations, and presented here, are in good agreement with those obtained from optical calibration of TRGB, RR Lyrae and Cepheid variables.

**Radio Emission from RRAT J1819-14 at Low Frequencies**

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Rotation Radio Transients (RRATs) are a new type of sources. These are transient radio bursts from rotating neutron stars. For today the eleven sources are known. These objects are characterized by single, dispersed bursts having durations between 2 and 30 ms. The average time intervals between bursts range from 4 min to 3 h. We reported detection of one of RRATs J1819-14 at low frequencies. The observations were performed using two sensitive transit radio telescopes of the Pushchino (Russia) at frequencies: 111 and 41 MHz. The main characteristics of pulsar are presented.

**Detection of Radio Emission from AXP 4U 0142+61**

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Anomalous X-ray pulsars – AXPs are a group of 7-8 X-ray sources showing periodical pulsations at periods in the narrow 6-12 s range and generally exhibiting steady and large spin-down. None of the AXPs shows the evidence of a binary companion and the main problem is the source of their energies, because their X-ray luminosities much higher than can be provided by the rotational kinetic energy losses. The most popular magnetar model of Thompson and Duncan (1996), which proposes the enormous surface magnetic fields 1014-1015 G and the absence of radio emission from these objects. The first detection of periodical pulsations from the AXP 1E2259+586 have been made at the frequency 111 MHz by Malofeev et al. (2001, 2005, 2007). The second transient AXP XTE J1810-197 (Camilo et al. 2006) has been detected as the strong pulsar in the large frequency band 0.69-42 GHz. In this report we present briefly data on the radio emission detection of the AXP 4U 0142+61 at low radio frequencies. The flux densities, mean pulse profiles, period and period derivative as well as, the estimation of the dispersion measures, distances and integrated radio luminosities are presented. Comparison with X-ray data shows large differences in the mean pulse widths and the flux variations.

**UV-Observations of the Symbiotic Nova PU Vul during Its Nebular Phase**

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We analyze IUE-spectra of the symbiotic Nova PU Vul, obtained in 1991-1996 (nebular phase). We show that in 1991-1996 the spectral energy distribution of the PU Vul can be reproduced in the standard model, which consists of hot component's radiation and nebular radiation unlike previous "supergiant phase" (1978-1987). The temperature of the hot component increased from 74000 K (1991) to 100000 K (1996) and the hot component's track on the H-R diagram resembles theoretical track for a degenerate dwarf during hydrogen shell flash. On the base of the UV-observations of the eclipse in 1993-1994 we estimate the cool component's radius  $R_{cool} \geq 285R_{\odot}$ . Asymmetry of the Rayleigh scattering of the hot component's radiation on the neutral hydrogen in the cool component's atmosphere make it possible to suppose that mass loss rate of the cool component of PU Vul is variable.

# VARIABLE STARS

### Spectral Luminosity Indicators for FGK Supergiants and Classical Cepheids

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In our presentation we would like to suggest a new method to determine luminosities of FGK supergiants and classical Cepheids from line depth ratios. We have determined 80 relations between  $M_V$ ,  $T_{\text{eff}}$  and line depth's ratios. These relations have been used for the estimation of the absolute magnitudes of 56 supergiants with an error 0.05 – 0.20. The application range is F0-K0, luminosity classes I and II.

### VW LMi – Tighest Known Close Quadruple System

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Tightest known quadruple system VW LMi consists of contact eclipsing binary with  $P_{12} = 0.477551\text{d}$  and detached binary with  $P_{34} = 7.93063\text{d}$  revolving in rather tight, 355.0d orbit. We presents new photometric and spectroscopic observations yielding 69 times of minima and 36 disentangled radial velocities for the component stars. All available radial velocities and minima times are combined to better characterize the orbits and to derive absolute parameters of components.

### Long-Term Starspot Activity of RS CVn-type Stars from Photometric Observations

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We present the results of starspot analyses of seventeen RS CVn-type binary stars for 421 data sets on the basis of our new photometric observations, as well as published elsewhere photometric data spanning almost 40 years. The zonal starspot model was used. Spotted regions were concentrated at middle and low latitudes up to 58 degrees. Spots covered from 1 to 55 % of the stellar surface, and were cooler than the unspotted photosphere by 600 – 2300 K. It is found that spot temperatures and spot latitudes grow as the star spectral classes become earlier. Note that temperatures and latitudes of spots on the Sun are in good agreement with the obtained dependencies. We found that variations of mean brightness and spottedness of the five stars are cyclic with periods of 7 – 23 years, resembling the solar 11-year cycle. The long-term evolution of spotted regions was analyzed as well.

### Spectral Variability of the LBV Star V532 in M33

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We present the results of spectral monitoring of the LBV star V532 (Romano star) in the M33 galaxy. Spectroscopic data cover 15 years of observations (from 1992 to 2007) during which V532 evolved from 16 mag to 18.5. Spectral data were compared with photometrical data in V band. We show that the object in maximum of brightness behaves as an emission line supergiant while in minimum V532 moves along the sequence of late WNH stars. We identify about 100 spectral lines in  $3700 \div 7300 \text{ \AA}$  wavelength range. For today, our spectroscopy is the fullest for this object. The velocity of the wind was derived using HeI lines ( $360 \pm 30 \text{ km s}^{-1}$ ). This value is consistent with the wind velocities of late WN. Physical parameters of the nebula around V532 are estimated.

### Observations of Cataclysmic Variables in Amateur Conditions – Results from Cataclysmic Stars Observations at Šíd Astronomical Observatory

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The results of observations of cataclysmic variable stars with cheap observational methods are presented. The observations were prepared by small 25cm Newtonian telescope equipped at EQ6 robotized equatorial mount on Šíd astronomical observatory – Slovakia. This instrument is equipped with uncooled Meade DSI CCD. For data processing the Maxim DL and data reduction the Cmunipack softwares were used and the Peranso for data processing respectively.

The observed stars are V466 And, OT\_J0814 and TY Psc. V466 And is well characterised from our observations as WZ Sge type cataclysmic variables. TY Psc and OT\_J0814 are well observable SU Uma cataclysmic, which is differently from WZ Sge with longer period of ordinary superhumps and only ordinary superhumps are observable. In V466 And system is the best period of the early-superhumps 0.0538d. The Best periods of OT\_J0814 and TY Psc are 0.07285d and 0.07024d respectively. Our research show, that only 9 stars of WZ Sge type including V466 And which were observed by us during 6 nights are well observed in history and take it to very interesting and expensive subject of modern astrophysical research.

SU Uma stars are more known star systems, unfortunately not the OT\_J0814 which was observed only from 2 observatories in Slovakia and some observatories in Japan during 3 nights. We calculated the inclination of V466 And about  $60^\circ$  and the period exceeds about 1.2%.

Note: Šíd astronomical observatory is the private observatory of L'ubomír Urbančok – secondary grammar school student at Gymnázium Fiakovo secondary grammar school. This research were supported by Slovnaft oil company and central European foundation support for talented young students and by Gymnázium Fiakovo, cities of Fiakovo and Šíd and Banská bystrica county government.

### Monitoring of Cataclysmic Variables at Astronomical Observatory in Kolonica Saddle

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Our systematic observations of cataclysmic variables at Kolonica Observatory began in 2006 and still continue. Up to now, we have observed almost 30 dwarf novae of SU UMa type in superoutbursts, where superhumps were detected. The part of our measurements were already analyzed and results were published. Here we present our observations and preliminary analysis of 5 SU UMa type dwarf novae MR UMa, UV Per, RXJ053234, CSS080505 and NSV1485. We performed period analysis of the superhumps using ANOVA method and analyzed variations of their period using O-C diagram. Our observations demonstrate that also the small telescopes with low cost CCD camera could be used for a serious observations, which give interesting and useful results.

### **Intermediate Polars Campaign at Astronomical Observatory in Kolonica Saddle**

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We presents the new observing program and sample of new results obtained by 1m telescope at Astronomical Observatory in Kolonica Saddle. Instalation of the CCD camera in the Nasmyth give us the opportunity to perform fast multicolor photometry of relatively faint objects. We decided to join the "Inter-Longitude Astronomy" project of regular monitoring of cataclysmic variables with different degree of influence of the magnetic field onto accretion. We have finished the winter 2007/2008 campaign on several intermediate polars. Until now we have observed and successfully determined the spin periods in the following targets: RXJ2133.7+5107, MU Cam, BG CMi, PQ Gem, 1RXS J063631.9+353537, 1RXS J070407.9+262501. Additionally we had the chance to observe two objects during outbursts: DO Dra and HT Cam. The summer campaign contains the following targets: V795 Her, RXJ180340+401214, V603 Aql, FO Aqr and AO Psc.

### **RS Oph: Flickering Study for 3 Years after the Outburst**

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A long-term photometric study of the recurrent nova RS Oph is presented. The basic physical characteristics have been obtained using the statistical calibrations and the light curves secured in four colours since the outburst. Moreover, the flickering activity study is discussed. The monitoring of flickering activity has covered the period since the evolution of the light curve of the RN with no flickering variability up today when very marked flickering variations are observed. The possible source of the flickering is discussed. The wavelet analysis was used for better understanding of the flickering behaviour. Three detected periods can be explained by orbital motion, rotation of the white dwarf and by flickering activity.

EXTRAGALACTIC  
ASTROPHYSICS

### 3D Structure of the Canes Venatici Cloud

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We present the improved distance moduli of 34 galaxies in the Canes Venatici cloud using advanced Tip of Red Giant Branch (TRGB) method (Makarov et al. 2006). The method was determined for accurate estimation of the distances even if TRGB situated near photometric limit. The data were taken from the Archive of the Hubble Space Telescope (HST). Based on ACS and WFPC2 images of the HST we construct the color-magnitude diagrams of the resolved stellar population of the galaxies using Dolphot and HSTPhot packages. New refined method of the distance determination allows us to clarify the 3D structure of the Canes Venatici cloud. It is divided on central group of the galaxies around M94 and the outskirts which is situated in gravitational field of the "nucleus". The mass and mass-to-light ratio of the CVn cloud have been estimated.

### Starbursts in the Local Universe: HST WFPC2 Observations of NGC 1569 and NGC 4449

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In the hierarchical scenario of galaxy formation dwarf irregular galaxies are known as "building blocks" of the universe. Observing such systems at high redshift could help shed some light on galaxy formation and evolution on a cosmological timescale, however, only the local analogs of such primeval galaxies can be studied in detail. Nearby starbursting systems display a number of similarities to their distant counterparts, such as: unusually high star formation rate, low metallicity and high gas abundance, but they are also much rarer. NGC 1569 and NGC 4449 are the two closest (post)starburst galaxies, at a distance of 3.36 Mpc and 3.82 Mpc, respectively. The results of new Hubble Space Telescope Wide Field and Planetary Camera 2 observations of the two galaxies will be presented.

### Total Mass of the Virgo Cluster Derived from the Infall Effect of Galaxies within 30 Mpc

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We use recent data on distances and velocities of galaxies in the wide proximity of the Virgo Cluster in order to derive its total mass from the effect of gravitational deceleration of the surrounding Hubble expansion. A decelerating influence of the Virgo on nearby galaxies causes the Hubble regression  $V(D)$  to cross the line of zero velocity at a non-zero distance  $R_0$ . The total mass of the cluster can then be expressed via  $R_0$  and the age of the Universe  $T_0$  by the simple relation  $M_T = K \cdot R_0^3 \cdot T_0^{-2}$ , where  $K$  is a model-dependent factor.

The observational data include 6 samples numbering 1376 galaxies with accurate distances (standart errors vary from 5% for SN Ia distances to 20% for infrared Tully-Fisher distances). The median estimate of the zero velocity surface radius yields  $R_0 = (6.7 \pm 0.6)$  pc which corresponds (in the standard flat cosmological model with  $\Lambda$ -term and  $\Omega_m$  as a matter component) to the total mass of the Virgo Cluster  $M_T = (6.4 \pm 1.7) \cdot 10^{14} M_\odot$ .

**Observations of Active Galactic Nucleus OJ287, 3c273, Mrk501 in March – August 2008**

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We present our results of observations of several active galactic nuclei. They were executed at observation station Lisnyki. OJ287 was observed from March to May 2008, 3c273 from March to June 2008 and Mkr501 from May to August 2008. These differences were caused by conditions of observations of this objects.

**Spectral Investigation of Blue Compact Dwarf Galaxy IC4662**

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The investigations of HII regions optical spectra of the BCD galaxy IC4662 is presented in this paper. Spectral data were obtained at ESO VLT. This spectra includes such bright emission lines as H $\beta$  4861, OIII 4363, 4959, 5007 etc. During the research we derived O and N chemical abundances and obtained the number of WR-stars in the most bright areas of HII region. Also we studied kinematics of ionized gas of HII region of the galaxy.

**Morphological Content of Galaxy Pairs and Isolated Galaxies**

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We made morphological classification of galaxies from SDSS DR5 sample of pairs and isolated galaxies by eye and with the help of two-dimensional distributions absolute magnitude - color index and inverse concentration index - color index. It was shown that in average the sample of isolated galaxies has smaller part of early-type galaxies than samples of galaxies in pairs. We also compared these two methods of morphological classification of galaxies in SDSS.

### Host Galaxies of Giant Radio Sources and Their Optical Spectra

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Giant radio sources are the largest single objects in the universe. Their projected linear sizes are greater than 0.7 [Mpc] ( $H_0 = 71 \text{ km s}^{-1} \text{ Mpc}^{-1}$ ,  $\Omega_M = 0.27$ ,  $\Omega_\Lambda = 0.73$ ). Currently, the largest known "giant" has a size about 4.7 Mpc (which is comparable to a size of a cluster of galaxies). Up to now, there are no unambiguous answers what are the reasons of the extremely large size of a small fraction of radio galaxies. It might be, for example, possible that giant radio sources have very powerful AGN. In addition, they might evolve in low-density cluster environment and/or their nuclear activity have recurrent character. Some can expect, that the behavior of the central AGN should influence intensities of the optical spectral lines of their host galaxy. We study correlations between ratios of the lines intensities, the total radio luminosity and the projected linear size of "giants". It seems, that the dominant ionization mechanism in "giants" host galaxies is photo-ionization by the central AGN.

### Nebular Diagnostics and Lyman Continuum Spectra Determination of HII Regions in Spiral Galaxies

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The chemical compositions of Orion nebula (used 12 emission lines spectra from different aperture positions), M8 and NGC5457 (13 regions) were determined using nebular diagnostic method DIAGN. The Lyman continuum spectra of ionizing sources in above objects were calculated using method NLEHII, which is independent of assumptions about nature of ionizing source and based on thermal equilibrium, and equations of photons balance in the nebular gas.

### Binary Active Galactic Nucleus: Correlation between the Optics and X-ray Bands

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It is believed that most galaxies have supermassive black holes at their centers. Since large galaxies are result of frequent mergers, supermassive binary black holes (BBHs) with a sub-parsec scale separation are inevitably formed in the Universe. The robust signature of BBH in the AGN is the periodic synchronous flux variations in different bands – from radio to X- and gamma-ray range. As example, the blazar OJ 287 – candidate for a supermassive BBH shows periodic light variations on a timescale of 1112 yrs. In our work we investigate the two candidates for supermassive BBH: 3C273 OJ287 and analyze the existing observational data in optic and X-ray band in order to estimate possible correlations between light curves in both bands.

# COSMOLOGY

### Constraints on Sterile Neutrino Dark Matter and the Possibility of Its "Direct" Astrophysical Search

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The fact that the Dark Matter cannot be explained in terms of particles inside the Standard Model leads to building the numerous extensions of Standard Model including the "Dark Matter particles". One of these models, the nuMSM, could explain the Dark Matter together with neutrino oscillations and baryon asymmetry. Here we give the overview of the existing constraints on such Dark matter particles (the so-called "sterile", or right-handed, massive neutrinos), and propose the method for "direct" astrophysical search of these particles.

### Scalar Field as Dark Energy: Classical Field versus Tachyon

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The evolution of scalar linear perturbations is studied in gauge-invariant approach for models with minimally coupled scalar fields, the potentials of which were constructed for either constant dark energy equation of state (EoS) parameter  $w$  or its adiabatic sound speed  $c_a^2$  equal to zero. The numerical solutions show that such fields are almost smoothed out on subhorizon scales. However they cause the scale dependent suppression of the nonrelativistic matter density perturbations and the decay of gravitational potential, which can be used for choice of the dark energy model. We discuss 2 types of the Lagrangian: classical and tachyonic ones. As our results show, the fields with  $w = const$  are almost indistinguishable, while for fields with  $c_a^2 = 0$  the caused by Lagrangian shape difference of dark energy effective sound speed  $c_s^2$  affects the perturbations evolution significantly. We present also the transfer functions for both nonrelativistic and repulsive components.

### Evolution of Ionization Fractions at Early Universe

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We study the evolution of the ionization fractions (relative number densities) of atoms and ions before and after decoupling of matter and radiation. The influence of adiabatic density perturbations on the number densities of ionized fraction is analyzed. At decoupling epoch the amplitude of relative perturbations of electron number density is 4-5 times higher

than amplitude of relative perturbations of total baryon density. And this effect for adiabatic perturbations on different scales at region of acoustic peaks was more detailed to compare the power spectra of number density perturbations of different components at decoupling epoch.

**The Modeling of Circular Velocities of Spiral Galaxies in the Thin Unconditioned Disc Model within the Frame of Einstein Equations with the Cosmological Term Which Linearly Depends on Ricci-Scalar**

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Within the frame of Einstein equations with cosmological term, which linearly depends on Ricci-scalar, the modeling of circular velocities for spiral galaxies in the thin unconditioned disc model are considered. It is shown that such model makes it possible to describe the rotation curves of galaxies without invoking the dark matter hypothesis. The results of calculations for different galaxies in comparison with observed data are discussed.

**Nonthermal Radiation of Superconducting Cosmic String in Magnetized Intergalactic Medium**

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Cosmic strings are topologically stable, one-dimensional defects in the vacuum, which can appear during appropriate phase transition in an adiabatically expanding early Universe, which cools down from a very hot initial state. According to realistic particle-physics models, cosmic string posses a properties of developing tremendous electric currents, thus they effectively becoming electrically superconducting wires of astrophysical dimensions, at a certain stage of string evolution. It is shown that superconducting cosmic strings can serve as powerful sources of nonthermal radiation in wide energy range - from radio- up to X- and gamma-ray radiation. The mechanism of radiation is synchrotron and inverse Compton radiation of bow shock wave, created by magnetosphere of relativistically moving string in intergalactic medium (IGM). The calculations of expected flux of radiation show that for typical parameters of strings (loops) and IGM existing detectors can see dozens of sources in radio and X-range.

# SOLAR SYSTEM

**New Aspects and Modern State of Research in Meteor Physics**

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Research in meteor physics are of current importance because of their implications for gaining information on cosmic-matter influx onto planets, for the studying of composition and structure of cometary nuclei, for calculating the orbital evolution timescale and the peak temperature reached on atmospheric entry. Majority of the existing conclusions in these applications are quite sensitive to assumed meteoroids masses and bulk densities values. In turn these values received by means of various approaches sometimes differ from each other by more than on order. Some approaches are very inefficient if applied to studying large bodies for which the major part of the luminous segment of the trajectory corresponds to conditions of continuous-medium flow around the meteoroid. That is why the detailed review of the existing models for evaluating parameters of meteor bodies is strongly required.

Obviously our preference should be based on the correct physical models and the accessible experimental data, which allow avoiding rough assumptions and uncertainties in the explanation. As a first step in the present study the original mathematical technique to find basic dynamic parameters of the theoretical relationship between the height and the velocity of the meteor body motion that help to fit observations along the luminous part of the trajectories in the best way is suggested. The basic difference from previous studies is that the given observations are approximated using the analytical solution of the equations of meteor physics. The model is successfully applied to a number of bright meteors observed by the Canadian camera network and by the US Prairie network. The proposed general approach helps in understanding the extensive observational data of the deceleration of meteors and bolides.

**Cometary Environment – Different Operating Modes of the Rosetta's Ion Composition Analyzer and Its Virtual Counterpart**

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Ion Composition Analyzer (ICA) is a part of the Rosetta Plasma Consortium (RPC) which is on board the Rosetta space probe heading for the comet 67/P Churyumov-Gerasimenko. It is scheduled to reach the comet in year 2014. In order to reduce telemetry the ICA instrument has a number of data reduction modes (sampling modes). The effects of these different modes are investigated and a plan on how to best operate the instrument when in orbit around the comet will be prepared. In order to investigate all of the cases a virtual instrument is being prepared. The virtual instrument can be operated in different modes just as the 'real' one. The work with sampling will be to calculate what particles are coming from each direction we are looking in, based on the ISSI Comet Model, and then see how much information we loose by too sparse sampling and incomplete spatial coverage.

**Review of Radio Observations of the Moon**

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One of the possible methods for recognition of precursors of moonquakes is the investigation of the electromagnetic radiation of the seismic origin (Grimalsky et al., 2005). Massive impactors may significantly increase seismic activity on the Moon. In this article we review the results of search for lunar radio emission caused by the meteoroid bombardment. Soon after the collision between the Lunar Prospector spacecraft and the Moon variations of the lunar radio flux at 13 and 21 cm were detected on 30 July – 2 August 1999 (Khavroshkin et al., 2001). Flashes of radio emission at 3.6 cm during optical flashes caused by 1999 Leonids impacts onto the Moon were not detected (Osaki et al., 2001). Study of fluctuations of the lunar radio flux carried out also at 1.3 cm, 6 cm, and 18 cm on April 16-20, 2001 (Berezhnoy et al., 2002). Additional observations performed during November 29-30, 2001 show increasing of the amplitude of fluctuations near the terminator and edges of the lunar disk. Observations of the Moon at 6.2 cm during 2001 Leonid meteor shower do not give support to the lunar origin of previously detected variations (Volvach et al., 2005). During lunar eclipse on November 8-9, 2003 the simultaneous observations of the Moon were carried out in Pushchino and in Simeiz (Volvach et al., 2005). The correlation between variations of the lunar radio flux registered at both telescopes was not detected. Variations of the lunar radio flux at 3.6 cm detected soon after the collision between SMART-1 spacecraft and the Moon on September 3, 2006 can be explained by vibrations of the radio telescope (Berezhnoy et al., 2007).

### **The Striae Features in the Dust Tail of Comet C/2006 P1 (McNaught)**

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The results of dynamic modelling of the dust tail formation of comet C/2006 P1 (McNaught) are presented. The clear transversal striae in its tail are characteristic features of the comet during near perihelion observations. The presence of local active areas on the surface of the rotating nucleus can be a possible explanation of this phenomenon. The bright striae are resulted from crossing the sunlit side of the cometary nucleus by the active areas. The tail of comet McNaught was fitted under assumption that there is not only the uniform outflow of matter from the nucleus but also the considerable fraction of matter streams out from three active local sources. According to our model experiments the period of comet C/2006 P1 (McNaught) is 21 hours.

### **The Cold Free-Floating Giant Planets**

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In the paper, we have calculated the values of the surface temperature of *cold* planets. In the *cold* planets some part of the solid metallic hydrogen is in the superconducting state. We have shown that the *cold* planets represent the final states of the thermal evolution of the free-floating giant planets.

# SPACE GEOPHYSICS

**Basic Physical Concepts and Numerical Modeling of Sprites**

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During the past several years, a wealth of new experimental evidence has surfaced which indicates strong electrodynamic coupling between phenomena occurring in the troposphere at altitudes of 10-15 km and the mesosphere (lower ionosphere) ranging in altitude up to 100 km. This experimental evidence includes early and fast perturbations of subionospherically propagating VLF signals associated with lightning discharges in underlying thunderstorms and optical emissions in clear air above thunderstorms associated with sprites, blue jets, blue starters and airglow enhancements. The latter are believed to be closely associated with recently discovered rapid ( $< 1$  ms) optical emissions at 80-95 km altitudes with lateral extents up to 300 km preceding sprites and referred to as "elves". In this work the basic mechanisms, which produce sprites and was modeled the dynamic of the electric fields in atmosphere, were considered.

**Statistical Features of the Magnetic Field Fluctuations from Satellite Interball Data**

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Investigation of statistical features of the magnetic field fluctuations in different regions of Earth magnetosphere and the solar wind plasma at different timescales from satellite Interball data has been carried out. Changes of shape and parameters of the probability distribution function for periods of the satellite position in different magnetosphere regions were examined. As a characteristic of evolution at different timescales the changes of probability of return  $P(0)$  and kurtosis values were used. Two asymptotic modes for  $P(0)$  characterized by different power laws have been found. In addition, for the analysis of turbulent processes the structure functions of different orders were investigated, and comparison of the obtained results with log-Poisson cascade model and Iroshnikov-Kraichnan model was made.

**Alfven and Magnetosonic Resonances in an Inhomogeneous Plasma**

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The process of resonant excitation of guided MHD modes by a monochromatic fast magnetosonic wave was studied in a 1D-inhomogeneous plasma model. It was shown that absorption of incident wave energy increases considerably when there is a resonant surface for slow magnetosonic oscillations. In the neighborhood of this resonant surface, the energy of an incident wave is totally absorbed, resulting in additional plasma heating. There is a range of

frequencies and wavelengths for which the absorption coefficient is 100 %. Numerical calculations showed that the energy absorption coefficient for an incident fast magnetosonic wave in plasma with  $\beta \sim 1$  exceeds its counterpart in "cold" plasma and in plasma configuration with one resonant surface, for Alfvén waves only.

### **Simulation of Spread and Dissipation of Atmospheric Waves**

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The atmosphere gravity waves (AGW) is one of the mechanisms responsible for the transportation of disturbances upward from the Earth surface. In spite of these waves are investigated for more than a half of century, the discussions about the spread altitudes, amplitudes and spatial characteristics do not stop. It is conditioned by the fact that in non-uniform atmosphere the acoustic gravity waves dissipate their energy by means of self-fading, or redistribution of the energy with other dissipative processes.

In the frame of this work we have carried out the spatial analysis of the AGW spread in the windless, non-isothermal, stratificated by density and concentration of the main components atmosphere, taking into account the viscosity and heat conductivity. For the modeling of AGW characteristics in the atmosphere the multi-layer method for the solution of Navies-Stocks equations was used as a base. The dependence of both vertical and horizontal profiles of AGW on different input parameters is considered. In addition, the dependence of AGW characteristics on the wave period has been analyzed.

# METHODS OF ASTRONOMY

**Comparative Analysis of the High Resolution Spectra of Deneb (Alpha Cygni)  
Obtained with the Coude Echelle Spectrograph (CES) Attached on the  
RTT-150 Telescope**

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In this study equivalent widths in the spectra of a spectroscopically well-studied star Deneb (Alpha Cygni) have been measured and compared with the results of former studies by other authors (Zverko (1970), Albayrak (2003), Schiller and Przybilla (2008)) in order to have an idea on the quality of the spectra obtained with the Coude Echelle Spectrograph (CES) attached on the 150 cm Russian-Turkish Telescope (RTT-1150) at the TÜBİTAK National Observatory (TUG). Analyses were based on the high S/N ratio (larger than 100) and high resolution spectra in the visual band. Quality of the spectra showed that the CES can be used for quantitative analyses.

**The XPM Catalogue. Absolute Proper Motions of 280 Millions Stars**

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We combined the data from 2MASS (Two Micron All Sky Survey) and USNO-A2.0 catalogues in order to derive the absolute proper motions of about 280 million stars distributed all over the sky in the magnitude range  $12 < B < 21$ . The proper motions were derived from 2MASS Point Sources and USNO-A2.0 catalogues positions, with the mean epoch difference of about 45 years for the northern hemisphere, and about 17 years for the south one. The zero-pointing of proper-motion frame (the absolutization) was specified with the use of about 1.45 million galaxies from 2MASS. Most of the systematic zonal errors inherent in the USNO-A2.0 catalogue were eliminated before calculation of proper motions. The mean formal error of absolute calibration is less than 1 mas/yr. The generated catalogue contains the ICRS positions of stars for the J2000 epoch, original absolute proper motions, as well as B, R, J, H and K magnitudes. A comparison of the proper motions obtained in this work with the data of other recent catalogues of quasars was fulfilled.

**Reducing Abell 226 Optical Data Using THELI Pipeline**

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In astronomy, raw images from CCD detectors are not immediately usable for scientific exploitation but are instead contaminated by several instrumental effects. Generally speaking, data reduction is the transformation of raw data into a more applicable form. Thus, this involves: (1) Removal of instrumental signatures, like dark current and field curvature; (2) Masking of unwanted signals, like cosmic ray; (3) Stellar halos and satellite tracks; (4) Photometric and Astrometric Calibration; (5) Coaddition of individual frames.

**The Photometrical System and Positional Accuracy of the CCD Camera ST8  
of Lisnyky Observational Station**

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The results of testing of CCD ST-8 camera mounted on the AZT-8 telescope of the Lisnyky Observational Station are reported. Correspondence between instrumental photometrical system and V, R bands of Johnson photometrical system was found with the help of M67 open cluster observations. Magnitude determination accuracy is 0.05m for 15m – 16m stars, 0.02m – 0.04m for 12m – 15m stars; positional accuracy is about 0.18 arcsec.

**Wide Field Low-Resolution Spectrograph for ASAS**

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More than one hundred years ago Henry Drapper made first catalogue of low resolution star spectra, which consists of more than 5000 stars. His work has contributed to general knowledge of star classification. Nowadays, modern observational techniques allow us to repeat his work with extended brightness range and better quality. We consider few possible configurations of spectrograph with their advantages and disadvantages: Littrow configuration, aperture diffraction grating, aperture prism and aperture grism. Synthetic spectra analysis shows that desired resolution of 10nm/pix will allow us to distinguish stars between main spectral types and also find anomalous spectra. This data will be useful as a supplement to data gathered by ASAS telescopes. As an extension of this project our spectrograph will be able to work in follow-up mode and make spectra of anomalous objects like nova etc.

**Investigation of Physical Characteristics of Nano-Structured Thin Films of  
Cu<sub>2</sub>O for Solar Cells Application**

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Solar energy is of the main types of renewable energy. Developing low cost technology for solar cell production is one of the most interesting nowadays problems of renewable energy physics. Among the potential thin film solar cells based on semiconductor oxides as active layer is cuprous oxide (Cu<sub>2</sub>O). The theoretical energy conversion efficiency of Cu<sub>2</sub>O solar cell is about 20%. This oxide semiconductor shows many interesting characteristics useful for solar cells production such as low cost, non-toxicity, fairly high minority carrier diffusion length, high absorption coefficient and direct energy gap. Although the theoretical limit of Cu<sub>2</sub>O solar cell efficiency is about 20%, the highest efficiency obtained up to now is only 2%. This is due to a very limited amount of work devoted to this semiconductor and only during

last a few years this material has been investigated for solar cells applications. The optimization of Cu<sub>2</sub>O solar cell is slowed down by the lack of clear understanding of the electrical and crystalline structure properties of this material and defects arising on hetero-junction, as well as limited technological methods applied up to now. Here we report on some results of optical and structural investigations of Cu<sub>2</sub>O thin films prepared by optimized thermal evaporation technique. The films of Cu<sub>2</sub>O have a nanometer size grain structure. The films of Cu<sub>2</sub>O were deposited on sapphire substrate by thermal evaporation of CuO powder with the average dimensions of powder grains 100 micrometer. The effects of substrate temperature on structural and optical properties of Cu<sub>2</sub>O thin films were investigated.

### **Space Tourism**

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The cosmos is no longer the exclusive domain of scientists and astronauts. In the recent years it's also becoming an attraction for regular people. This new form of entertainment is called space tourism. It is at the same time a new branch of astronautics. It can be divided into several categories. Payed orbital flights to the International Space Station constitute the highest category. At the moment only the Russian space infrastructure is used for this. It's organized by an american company: Space Adventures. The participation fee is 45 milion US dollars. The second category includes Middle Eastern cooperation. It is a suborbital flights category. The participant doesn't complete a full orbit but rather reaches the edge of space at 100 km above the ground. The flight includes a few minutes of free fall and it is possible to see the curvature of the Earth as well as the black sky without atmosphere. All people taking part in these adventures are described as 'space tourists'. So far, the flight between Earth and the spacecraft ISS and back on board the Russian spacecraft "Sojuz" took 6 people.

# SOLAR PHYSICS

**Large-scale Horizontal Flows in the Solar Atmosphere**

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Convection is the main form of energy transport in the subsurface layers of the sun and other cool stars. The imprint of cellular convection can be directly observed on the solar surface. One of the most striking properties of solar velocity fields is the existence of distinct cellular scales observed at the surface of the Sun. The focus of this study was the large-scale of horizontal velocity flow field, i.e. mesogranulation and supergranulation. We investigated the properties of the convective motions on the Sun using neutral iron line  $\lambda = 532.42$  nm profiles obtained at the solar limb with high spatial resolution. Space-time variations of horizontal velocity were reproduced by method of  $\lambda$ -metre. Acoustic waves were removed by  $k - \omega$  filtration. The structure of convective motions, the range of convective cell sizes, and the overshooting depths of convection are discussed. The amplitude of horizontal velocities of the mesogranules decreases with the height whereas horizontal velocities of the supergranules are sufficient for the whole range of altitudes.

**Calculation and Visualisation of Coronal Magnetic Field during the 2006 and 2008 Total Solar Eclipses**

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The coronal magnetic field is obtained by a potential field extrapolation using a Potential Source Surface (PSS) model. Wilcox Solar Observatory photospheric magnetic field data for Carrington rotations 2042 and 2073 were used. Coronal magnetic field charts at the source-surface distance were plotted. We used the radial and classical approaches to calculate spherical harmonic coefficients and constructed the lines of magnetic field in the Sun's corona. Three-dimensional structure of the solar corona and calculated coronal magnetic field were compared and analyzed.

**Magnetic Fields Nonuniformity in Solar Flares**

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The solar flare of July 28, 2004 and flare of July 18, 2000 were investigated using spectral data obtained with Echelle spectrograph of horizontal solar telescope of Astronomical Observatory of Kyiv Taras Shevchenko National University.

The C4 solar flare of July 28, 2004 arose in AR NOAA 652. The flare projected on sunspot of N polarity with magnetic field strength 2700 G. Magnetic field measurements were made using  $I \pm V$  profiles of  $H_{\alpha}$ , Fe 6301.5, Fe 6302.5, FeI 5250.2, FeI 5250.6, FeI 5247.1,

Cr 5247.6 lines. Comparison of data for lines of green region give the evidence for two-component structure in flare. Likely, two magnetic field modes were in a flare, with field strength of 2500-2700 G, 5500-6000 G. The first mode appertained to background field, whereas the second one – to small-scale structures. During 12 min of flare evolution, synchronous changes of flare emission in  $H_{\alpha}$  and magnetic field variation in line Fe 6301.5 were detected. New observational evidences of practically zero vertical gradient of magnetic field in range “photosphere-chromosphere“ was found.

In the time of study of solar flare of July 18, 2000, we used  $I \pm V$  profiles of  $H_{\alpha}$ , Fe 5247.1, Fe 5247.6, Fe 5250.2, Fe 5250.6, Fe 5233, Fe 5234.6, Fe 5237.3, Fe 5239.8, FeII 42 4923.921. Relations of bisector splitting vs. distance from line centre were parsed. For both flares the best data correlation exists when we consider reduced distance from line centre, that is  $\Delta\lambda/g$ , where  $g$  is lines Lande factor. This data indicate the spatial inhomogeneity and multicomponent structure of magnetic field (minimum two-component structure). Common splitting maximum was found and it corresponds to magnetic field about 3 kG. Such strong magnetic fields existed in spatially unresolved structures of flare area.

#### **Observation and Photometry of Total Solar Eclipse of August 1 2008**

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In the article the results of photometry of solar totality are given. An original adapter circuit between a photometer and a computer in field conditions is provided. The possibility of coronal structure photometry over digital photographs is demonstrated. A technique of determination of illumination alteration over a series of Sun photographs was applied in thirty seconds before the second contact.

#### **A Different and New Point of View to the Collisionless Plasma on Shock Waves in the Current Sheet Region in Solar Corona**

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The Structure of the current sheet is related with collisionless plasma. In spite of this it cannot denied that a small number of collisions will occur. We found where these collisions were evaluated and analysed the effect of these collisions on shock waves. In addition to this we made a comparison between two different structures for shock waves by presenting the changes of the plasma and different effects of the collisional and collisionless behaviour in the current sheet.

#### **Observed Peculiarities of the Stokes Profiles of D3 Line in a Solar Prominence**

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The Zeeman-spectrograms of July 12, 2004 prominence are investigated. Spectral observations of the prominence were carried out with the Echelle spectrograph of horizontal solar telescope of Astronomical Observatory of Kyiv Taras Shevchenko National University. The photometrical analysis shows that splitting of bisectors of the Stokes  $I \pm V$  profiles of  $D_3$  HeI line are different on various distances from lines center. As a rule, values of bisector splitting are maximum in lines core, and practically zero – in line wings. The maximum splitting of bisectors correspond to magnetic field strength of 400-600 Gauss. Likely, these values present a low limit of real magnetic field strengthes. As it is follows from comparison of Stokes V profiles and gradient intensity  $dI/d\lambda$ , the values of local magnetic fields in the prominence were greater. It is interesting to note, that spectral splitting of V peaks was three times lower, than splitting of  $dI/d\lambda$  parameters peaks. This indicates, at least, two-component magnetic field structure, including weak background field and small-scale strong field. We can conclude that spatially unresolved elements of the prominence placed on height of 10 Mm above photosphere had very strong field of about 4 kG, and very low temperature, about 330 K only. Similar parameters of subtelescopic structures were found earlier by Lozitsky et al. (1999) on the photospheric level of a solar flare.

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