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

26th Young Scientists' Conference on Astronomy and Space Physics

Abstracts

Kyiv, 2019

26th Young Scientists' Conference on Astronomy and Space Physics

April 22 – 27, 2019
Kyiv, Ukraine

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Preface

This year Young Scientists' Conference on Astronomy and Space Physics is held for the twenty fifth time. We all have been looking forward to the annual meeting of astronomers at the Taras Shevchenko National University of Kyiv (KNU). 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 Faculty of Physics of KNU as a students' conference in 1994. Since 1996 our conference has welcomed young researchers from other universities and scientific institutions. During 1994-2017 participants from Ukraine, Russia, Poland, France, Germany, Spain, Sweden, Libya, Egypt, Japan, Finland, Turkey, China, Slovakia, Armenia, USA, Romania, Iran, Armenia, Georgia, Morocco, South Africa and other countries participated in Young Scientists' Conference.

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

We would like to express our gratitude to the invited lecturers and participants for contributing lectures and reports, and to Prof. V. M. Ivchenko for the help in conference organization.

We are especially grateful to Prof. Viktor Khalack (Université de Moncton, Moncton, Canada) and also the following former students of the Astronomy and Space Physics of KNU whose contribution made it possible to provide personal grants for several participants from Ukraine: Kateryna Frantseva (Netherlands Institute for Space Research, Groningen, The Netherlands), Dr. Ievgen Vovk (Max-Planck Institut für Physik, Munich, Germany), Olena Torbaniuk (University Federico II in Naples, Italy). Also we would like to thank the deputy head of the Taras Shevchenko National University of Kyiv Students' Parliament Borys Topol for his support in the conference organization.

Maksym Mohorian and
the Local Organizing Committee

PROGRAMME

Monday, April, 22

09.00-13.00 - Registration
13.00-13.30 - Official opening

Section 'Solar Physics & Heliosphere'

13.30-14.15 V. G. Lozitsky *(Astronomical Observatory of the Taras Shevchenko National University of Kyiv, Kyiv, Ukraine)* Essential features of solar activity: new data and some problems **(invited)**

14.15-14.30 Andrii Prysiazhnyi, M. I. Stodilka *(Astronomical Observatory of Ivan Franko National University of Lviv, Lviv, Ukraine)* The influence of magnetic field on photospheric convection in solar facular region **(12+3)**

14.230-14.35 Oleksandra Baran, M. I. Stodilka *(Astronomical Observatory of Ivan Franko National University of Lviv, Lviv, Ukraine)* Role of the pressure variations in the formation of granular structures in the solar photosphere **(poster)**

14.35-14.40 Anna Pankivska, S. Osipov *(Taras Shevchenko National University of Kyiv, Kyiv, Ukraine)* Spectral analysis and comparison of solar activity indices **(poster)**

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

Tuesday, April, 23

Section 'Extragalactic Astrophysics & Cosmology'

09.00-10.00 morning coffee

10.00-10.45 Sergei Parnovsky *(Astronomical Observatory of Taras Shevchenko National University of Kyiv, Kyiv, Ukraine)* Dark side of the Universe **(invited)**

10.45-11.00 Anatoliy Tugay *(Taras Shevchenko National University of Kyiv, Kyiv, Ukraine)* Space telescopes **(12+3)**

11.00-11.15 Vladislav Khramtsov, V. S. Akhmetov *(Insitute of Astronomy, V. N. Karazin Kharkiv National University, Kharkiv, Ukraine)* Classification model to identify extragalactic objects within WISExPanSTARRS1 catalogue **(12+3)**

11.15-11.30 Iurii Babyk *(Main Astronomical Observatory of the National Academy of Science of Ukraine, Kyiv, Ukraine; Department of Physics and Astronomy, University of Waterloo, Waterloo, Canada)* The distribution of cold molecular gas in groups and early-type galaxies **(12+3)**

11.30-11.45 Andrii Maliuk, I. A. Zinchenko *(Main Astronomical Observatory of National Academy of Sciences of Ukraine, Kyiv, Ukraine)* Investigation of the chemical composition of interacting galaxies from the MaNGA review **(12+3)**

11.45-12.00 Olha Ponomarenko, A. V. Tugay *(Natural Scientific Lyceum №145, Kyiv, Ukraine)* New galaxy cluster around NGC 3216 **(12+3)**

12.00-12.15 Vadym Voytsekhovskiy, A. V. Tugay *(Taras Shevchenko National University of Kyiv, Kyiv, Ukraine)* Two-dimensional simulation of galaxy distribution with Gaussian random fields **(12+3)**

12.15-12.30 Olena Kompaniiets, P. Berczik, V. Marchenko, M. Sobolenko, E. Fedorova *(Taras Shevchenko National University of Kyiv, Kyiv, Ukraine)* Dynamical Evolution of Supermassive Binary Black Hole at the Center of NGC 6240 Based on Chandra Observation **(12+3)**

12.30-12.35 Inna Izviekova, A. O. Simon *(Taras Shevchenko National University of Kyiv, Kyiv, Ukraine)* Optical monitoring of the BL Lac object OJ 287 at the Lisnyky observational station from 2010 till 2018 **(poster)**

13.00-14.00 lunch

Section 'High Energy Astrophysics'

14.00-14.15 Anton Dmytriiev, H. Sol, A. Zech, O. Le Blanc, J-M. Huet, L. Dangeon, J. Gironnet *(Laboratory Universe and Theories, Paris Observatory, Meudon, France)* Simulation of the optical performance of the Gamma-ray Cherenkov Telescope (GCT) and its prototype using ROBAST ray tracing software **(12+3)**

14.15-14.30 Roman Gnatyk *(Astronomical Observatory of Taras Shevchenko National University of Kyiv, Kyiv, Ukraine)* Gamma-ray emission of the Supernova remnant associated with the magnetar SGR1900+14 **(12+3)**

14.30-14.45 Kateryna Vynokurova, B. I. Hnatyk *(Taras Shevchenko National University of Kyiv, Kyiv, Ukraine)* TeV gamma-ray emission from the Vela Supernova Remnant **(12+3)**

14.45-15.00 Pavlo Plotko, B. I. Hnatyk *(Taras Shevchenko National University of Kyiv, Kyiv, Ukraine)* Vela Supernova Remnant and its Pulsar Wind Nebula: Physical Characteristics and Radio Emission **(12+3)**

15.00-15.15 Taras Kuzyo, O. Petruk *(Pidstryhach Institute for Applied Problems of Mechanics and Mathematics, Lviv, Ukraine)* MHD Simulations of Early SNR Evolution **(12+3)**

15.15-15.30 Mariana Patrii, O. Petruk, T. Kuzyo *(Ivan Franko National University of Lviv, Lviv, Ukraine)* MHD simulations of interaction of the strong shock with accretion disk **(12+3)**

15.30-15.45 Vadym Voytsekhovskiy, B. Hnatyk, Yu. Kudrya *(Taras Shevchenko National University of Kyiv, Kyiv, Ukraine)* Magnetic Fields in the Local Filament and Their Influence on the Propagation of Ultra High Energy Cosmic Rays **(12+3)**

15.45-15.50 Valeriia Slipak, V. Aushev *(Taras Shevchenko National University of Kyiv, Kyiv, Ukraine)* Prospects for neutrino studies of supernovae in DUNE experiment **(poster)**

15.50-15.55 Lidiia Zadorozhna *(Taras Shevchenko National University of Kyiv, Kyiv, Ukraine)* Repeated bursts of FRB 121102 as a radiation from cusps on superconducting cosmic string loop **(poster)**

16.00-20.00 City tour (walking tour)

Wednesday, April, 24

Section 'Solar System & Exoplanets'

09.00-10.00 morning coffee

10.00-10.45 Oleksiy Golubov *(Institute of Astronomy of V. N. Karazin Kharkiv National University, School of Physics and Technology of V. N. Karazin Kharkiv National University, Kharkiv, Ukraine)* Origin and evolution of asteroids **(invited)**

10.45-11.00 Tetiana Hromakina, D. Perna, N. Bott, E. Mazzotta Epifani, E. Dotto, A. Doressoundiram *(V. N. Karazin Kharkiv National University, Kharkiv, Ukraine)* Surface properties of Jupiter Trojans (624) Hektor and (911) Agamemnon **(12+3)**

11.00-11.15 Olena Shubina, O. Ivanova, V. Rozenbush, N. Kiselev, V. Afanasiev, N. Borisov *(Main Astronomical Observatory of National Academy of Sciences of Ukraine, Kyiv, Ukraine)* Optical spectra of the short-period comet 2P/Encke in 2003 and 2017 appearances **(12+3)**

11.15-11.30 Daniella Glezina, I. G. Slyusarev *(V. N. Karazin Kharkiv National University, Kharkiv, Ukraine)* Results of observation of 4 exoplanets in search of inflated atmosphere evidence **(12+3)**

11.30-11.45 Daniella Glezina, I. G. Slyusarev *(V. N. Karazin Kharkiv National University, Kharkiv, Ukraine)* Towards the search of the difference in physical and dynamical properties between the L4 and L5 swarms of Jupiter Trojans **(12+3)**

11.45-11.50 Volodymyr Troianskyi, A. O. Simon, V. I. Kashuba *(Astronomical Observatory, Odessa I. I. Mechnikov National University, Odessa, Ukraine)* Discovery of the small Solar system bodies with OMT-800 and AZT-8 telescope **(poster)**

11.50-11.55 Yuliia Kalinina, V. M. Reshetnyk *(Taras Shevchenko National University of Kyiv, Kyiv, Ukraine)* Rotational periods of the selected near-Earth asteroids **(poster)**

11.55-12.00 Elena Musiichuk, S. A. Borysenko *(Taras Shevchenko National University of Kyiv, Kyiv, Ukraine)* Heliocentric distribution of activity for the main-belt and quasi-Hilda comets during of last 20 years **(poster)**

12.00-13.00 tea-break

13.30-14.30 lunch

18.00-22.00 Organ hall / opera hall / etc.

Thursday, April, 25

Section 'Stellar Astrophysics and Interstellar Medium'

09.00-10.00 morning coffee

10.00-10.15 Vitalii Breus, I. L. Andronov, P. Dubovsky, K. Petrik, S. Zola, T. Hegedus *(Odessa National Maritime University, Odessa, Ukraine)* Photometric analysis and improved parameters of newly discovered short-period binaries **(12+3)**

10.15-10.30 Jaime Andrés Rosales Guzmán, R. E. Mennickent, A. A. Senhadji *(University of Concepción, Concepción, Chile)* Evolutionary process of the Double Periodic Variable: V495 Centauri **(12+3)**

10.30-10.45 Jaime Andrés Rosales Guzmán, R. E. Mennickent, G. Djurasevic, I. Araya, M. Curé *(University of Concepción, Concepción, Chile)* Analyzing the long term variability of the Double Periodic Variable HD 50526 **(12+3)**

10.45-11.00 Artem Dmytrenko, V. S. Akhmetov *(V. N. Karazin Kharkiv National University, Kharkiv, Ukraine)* The search of the globular clusters by catalogue data **(12+3)**

11.00-11.15 Khrystyna Kobyrynka *(Ivan Franko National University of Lviv, Lviv, Ukraine)* On the possible constraints on dark energy using compact objects **(12+3)**

11.15-11.30 Maksym Mohorian, Y. V. Pavlenko, A. Suarez Mascareno, R. Rebolo, N. Lodieu, V. J. S. Bejar, J. I. Gonzalez Hernandez *(Taras Shevchenko National University of Kyiv, Kyiv, Ukraine)* Spectroscopic manifestations of activity processes in the atmosphere of Proxima Centauri **(12+3)**

11.30-11.45 Dmytro Melekh, J. Krelowski, S. Smerechynskyi, B. Melekh *(Ivan Franko National University of Lviv, Lviv, Ukraine)* Variability of interstellar absorption lines and emission line [O III] 5007 Å in direction to η Carinae association **(12+3)**

11.45-12.00 Fedir Karasenko, B. Ya. Melekh *(Ivan Franko National University of Lviv, Lviv, Ukraine)* Search of the optimal photoionization models of nebular environments using Markov chains method **(12+3)**

12.00-12.30 tea-break

12.30-12.45 Yevhen Vasylkivskyi, S. V. Stepkin, O. O. Konovalenko *(Institute of Radio Astronomy of the National Academy of Sciences of Ukraine, Kharkiv, Ukraine)* New objects and methods of the low-frequency radio spectroscopy using decametric radio recombination lines **(12+3)**

12.45-13.00 Ihor Koshmak, B. Ya. Melekh *(Ivan Franko National University of Lviv, Lviv, Ukraine)* The primordial helium abundance determined using multicomponent photoionization modelling **(12+3)**

13.00-13.15 Oleh Buhajenko, B. Ya. Melekh *(Ivan Franko National University of Lviv, Lviv, Ukraine)* On the reliability of the diagnostic methods in the investigation of the inhomogeneous nebular component of dwarf star-forming galaxies **(12+3)**

13.15-13.30 Myroslav Kasheba, B. Ya. Melekh *(Ivan Franko National University of Lviv, Lviv, Ukraine)* Determining the distribution of the nebular matter in PNe envelopes using their emission line spectra **(12+3)**

13.30-13.35 Katerina Bovkun, A. O. Simon, V. M. Reshetnyk, O. R. Baransky *(Taras Shevchenko National University of Kyiv, Kyiv, Ukraine)* Photometric system for telescope AZT-8 **(poster)**

13.35-13.40 Yana Markus, V. M. Reshetnyk *(Taras Shevchenko National University of Kyiv, Kyiv, Ukraine)* Data processing of Gaia alerts **(poster)**

13.40-13.45 Sergii Pokhvala, B. E. Zhilyaev *(Main Astronomical Observatory of the National Academy of Sciences of Ukraine, Kyiv, Ukraine)* Studying the spectroscopic short time-scale variability of the hot supergiant ζ Orionis **(poster)**

13.45-13.50 Volodymyr Vasylenko, A. O. Simon, N. V. Metlova *(Taras Shevchenko National University of Kyiv, Kyiv, Ukraine)* Optical observations of the 1H1936+541 from 2008 till 2018 **(poster)**

14.00-15.00 lunch

17.45-20.00 Excursion to Pinchuk Art Center

Friday, April, 26

Section 'Atmospheric studies and space geophysics'

09.00-10.00 morning coffee

10.00-10.45 Gennadi Milinevsky *(Taras Shevchenko National University of Kyiv, Kyiv, Ukraine)* Ukraine Aerosol-UA space mission for atmospheric aerosol study: tasks, state-of-art and prospects **(invited)**

10.45-11.00 Andrew Prokhorenkov, L. Kozak, E. Kronberg, E. Grigorenko, A. T. Y. Lui *(Taras Shevchenko National University of Kyiv, Kyiv, Ukraine)* Power spectrum manifestation of Kelvin-Helmholtz instability by Cluster II mission measurements **(12+3)**

11.00-11.15 Elena Belyaeva, V. Ya. Choliy *(Taras Shevchenko National University of Kyiv, Kyiv, Ukraine)* On building the targets of any possible shapes in DDscat.C++ software **(12+3)**

11.15-11.30 Bohdan Petrenko, L. Kozak, E. Kronberg, E. Grigorenko, A. Lui *(Taras Shevchenko National University of Kyiv, Kyiv, Ukraine)* Turbulence spectra in region of magnetic dipolarization **(12+3)**

11.30-11.45 Maksym Vasiuta, M. M. Medvedskyy *(Taras Shevchenko National University of Kyiv, Kyiv, Ukraine)* In-sky safety system using ADS-B radar receiver **(12+3)**

11.45-11.50 Orkhan Hajiyev, S. R. Hajiyeva, M. V. Frontasyeva, A. I. Madadzada, Z. T. Veliyeva, M. S. Shvetsova, A. A. Samadova *(Baku State University, Baku, Azerbaijan)* Active biomonitoring of air pollution in Baku, the capital of Azerbaijan **(poster)**

11.50-11.55 Sergii Cheremnykh *(Space Research Institute National Academy of Sciences of Ukraine and State Space Agency of Ukraine, Kyiv, Ukraine)* Kelvin-Helmholtz instability at the boundary of the geomagnetic tail **(poster)**

11.55-12.40 Poster section + tea-break

12.40-13.00 Official closure

13.00-14.00 lunch

Saturday, April, 27

09.00-13.00 Museum of Folk Architecture and Life of Ukraine

INVITED LECTURES

Origin and evolution of asteroids

Oleksiy Golubov

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School of Physics and Technology of V. N. Karazin Kharkiv National University, Kharkiv, Ukraine

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In my talk, I will give an overview of evolution of asteroids, stating at their coalescence from dust grains in the protoplanetary disk and following them trough partial melting, collisions, gravitational interactions with planets, all the way to the present structure of the asteroid belt. I'll discuss Kirkwood gaps, asteroid families, binary and multiple asteroids.

A special attention will be paid to my own research devoted to the light pressure torques acting upon asteroids, to how these torques form the observed distribution of asteroids over rotation rates, how asteroids are split into binaries by their fast rotation, or on the contrary, find a stable equilibrium in which their evolution stalls

I will try to share with the audience my persuasion, that asteroids are a fascinating world on their own, with diverse and beautiful physics and with multiple links to all other parts of the Solar System.

Ukraine Aerosol-UA space mission for atmospheric aerosol study: tasks, state-of-art and prospects

Gennadi Milinevsky

Taras Shevchenko National University of Kyiv, Kyiv, Ukraine
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The tasks and progress in development of Ukrainian space project Aerosol-UA are discussed. The mission aims in providing information on the terrestrial atmospheric aerosol spatial distribution and microphysics to quantify the aerosol contribution to the climate change and planet energy budget modeling. The aerosol

remote sensing concept of the project is based on precise orbital measurements of the intensity and polarization of sunlight scattered by the atmospheric aerosols and the surface. The scanning polarimeter ScanPol will be accompanied by the wide-angle multispectral imager-polarimeter MSIP. The ScanPol is designed for remote sensing of aerosol and cloud properties and will allow to measure Stokes parameters I, Q, U within the spectral range from the near-UV to the SWIR spectral bands in a wide range of phase angles (Milinevsky et al. 2016). The expected ScanPol polarimetric accuracy is 0.15%. The ScanPol will estimate the tropospheric aerosol absorption capacity, the aerosol over the ocean and the land surface, will also record the signals from cirrus clouds, stratospheric aerosols caused by major volcanic eruptions, and the contribution of the Earth's surface. The second instrument of the mission is the multispectral wide-angle imager–polarimeter MSIP. That instrument will be collecting images on the atmosphere and surface state in the area, where the ScanPol polarimeter will scan. The MSIP will retrieve aerosol optical depth and polarization properties of aerosol by simultaneous registration of three Stokes parameters in three spectral channels. Two intensity channels of the MSIP will serve to obtain images in eight spectral wavebands to retrieve the aerosol optical depth. The main feature of the MSIP channels is the splitting of the image by a special prism-splitter for four images on the same CCD image detector in each channel. In that way we will simultaneously measure four polarization components 0°, 45°, 90° and 135° as images in each of three polarization channels and eight images in eight spectral bands in the intensity channels. One of the special features of ScanPol/MSIP concept is calibration of the MSIP using ScanPol data in the same field-of-view. Expected advantages of the project are: accurate retrieval of polarization because it is a relative measurement; polarimetric ScanPol measurements can stably calibrated on the orbit and the MSIP data will be intercalibrated by ScanPol observation; changes of polarization with scattering angle and wavelength gives information on size, refractive index and shape of aerosol; synergy of scanner and imager should provide additional quality of data on aerosol properties.

The new satellite platform YuzhSat is planned to launch the project Aerosol-UA mission, which is under development in Yuzhnoye SDO in Dniepr.

SOLAR PHYSICS & HELIOSPHERE

The influence of magnetic field on photospheric convection in solar facular region

Andrii Prysiazhnyi, M. I. Stodilka

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The relationship between temperature, velocity of convective motions and magnetic field strength was investigated.

The data of observations of solar facular region near the center of solar disk were used. This observations were carried out at the wavelengths of Ba II λ4554 Å and Fe I λ15648 Å spectral lines using German Vacuum Tower telescope (VTT) of the Teide observatory (Canary Islands, Spain).

The height dependence of physical parameters for each column of observational region were obtained by solving the inverse radiative transfer problem for Ba II λ4554 Å line.

Magnetic field strength was determined by measuring the distance between positions of Stokes V peaks of Fe I λ15648 Å line. To reduce the influence of noise and to obtain more reliable values of magnetic field strength, a modified method was used – each V-profile was approximated by curve, described by the modified wavelet function $f(x) = x \exp(-\frac{1}{2}x^2)$. In this approach, the magnetic field strength is measured by the distance between positions of maxima of the approximation curve.

We divided observed region into four parts with different mean values of the magnetic field strength, which made it possible to investigate the influence of the magnetic field on averaged variations of temperature and averaged field of line-of-sight velocities. It was found that the magnetic field stimulates convection (the transport of matter into the upper layers increases, and the temperature is lowered). The greatest influence of the magnetic field on convection account for the layers of lower photosphere.

Role of the pressure variations in the formation of granular structures in the solar photosphere

Oleksandra Baran, M. I. Stodilka

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Spatio-temporal variations of pressure of the photospheric convection are reproduced by the solution the inverse nonequilibrium radiative transfer problem using high quality data from VTT observations. The pressure variations are positive within granular flows and they become maximal during their fragmentation: in the lower photosphere such variations in fragmenting granules are larger by 1.5–2 times than in dissolving ones; within all granular structures the pressure variations decrease significantly in the upper layers of the photosphere, but within fragmenting granules they predominate. The results of the study indicate that the high values of the positive variations of pressure lead to the separation of granular flows into two or more fragments.

Spectral analysis and comparison of solar activity indices

Anna Pankivska[1], S. Osipov[2]

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Since the Sun is a variable star, in this study a comparison of solar activity indices of more than a few cycles is presented. Such as Wolf numbers, the measured magnetic field, the area of sunspots and solar flux measurements in the range of 10.7 cm. The constructed power spectra with the help of Fourier analysis and their analysis in the periodicity range. In the work we used data from The Wilcox Solar Observatory and also WDC-SILSO, Royal Observatory of Belgium.

EXTRAGALACTIC ASTROPHYSICS & COSMOLOGY

Space telescopes

Anatoliy Tugay

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Recent astronomical observations includes wide range of electromagnetic spectrum (from radio to gamma waves), cosmic rays, neutrino and gravitational waves. All types of observations has advantages of using space observatories and some of them are impossible from Earth. Major past and present space telescopes are described in this report. Some future projects will be discussed including E-ASTROGAM, Athena, WSO-UV and James Webb Space Telescope. Current possibilities of designing of Moon-based astronomical observatory also will revealed.

Classification model to identify extragalactic objects within WISExPanSTARRS1 catalogue

Vladislav Khramtsov, V. S. Akhmetov

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We present new classification model (CM) to create a catalogue of extragalactic objects in the optical-infrared range. Our CM is used to separate galaxies and quasars from the stars on the colour-diagram with using W1–W4 (WISE) and g, r, i, z, y (PS1) bands and without any morphological criteria.

We define CM as a set of feature space and separating function within it. According that, any object with observed features have to be classified by separating function as extragalactic or galactic object. The simplest CM is a (W1–J) colour diagram with W1–J < -1.7 separation: objects with W1–J < -1.7 colour are mostly galaxies. But this model is incomplete and yields only 80–90% of classification accuracy depending on W1 limit; also J magnitude is available for the relatively small portion of observed objects. We introduce a new CM, based on Neural Network feature extraction (to build feature space) and SVM classification (to build separating surface), which allows us to get $\sim$99.95% of classification accuracy with

using 5 'neural' features. We trained neural network with using ∼2 000 000 spectroscopically classified objects from SDSS DR14; SVM was trained with 300 000 stars and 300 000 extragalactic objects from the same sample. In result, we got fully-automatic method to transform original colours of object into feature space plus separating surface within built feature space. In the near feature, we will apply our CM to the WISE-PanSTARRS1 catalogue to get one of the deepest and the purest sample of extragalactic objects in optical-infrared range.

The distribution of cold molecular gas in groups and early-type galaxies

Iurii Babyk

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Department of Physics and Astronomy, University of Waterloo, Waterloo, Canada

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We present measurements of cold molecular gas using archival *ALMA* data for several groups and early-type galaxies. We use the obtained X-ray thermodynamic properties of these galaxies to investigate the origin of molecular gas located within the center of these low-mass systems. We find strong correlations between the mass of cold gas against temperature and electron density of hot X-ray gas. The correlation between molecular gas mass against X-ray gas mass follows a simple power law model as $M_{mol} \propto M_X^{1.6\pm0.2}$. Our results indicate that hot gas plays an important role in molecular gas cooling. The obtained similarity of thermodynamic properties of sampled galaxies argues in favor theory according to which a relativistic jet, produced by the accretion onto the black hole, heats the surrounding gas at a similar rate producing energetic balance where cooling and heating are in equilibrium.

Investigation of the chemical composition of interacting galaxies from the MaNGA review

Andrii Maliuk[1], I. A. Zinchenko[2]

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[2] *Main Astronomical Observatory of the National Academy of Sciences of Ukraine, Kyiv, Ukraine*

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The oxygen abundances for galaxies with satellites from Mapping Nearby Galaxies at APO (MaNGA) Survey were determined. Values of oxygen abundance were

calculated using N2, O3N2, R and S calibration ratios. Two-dimensional maps of metallicity were build for each galaxy. Interacting galaxies usually show lower oxygen abundance then single galaxies.

New galaxy cluster around NGC 3216

Olha Ponomarenko[1], A. Tugay[2]

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[2]*Taras Shevchenko National University of Kyiv, Kyiv, Ukraine*

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NGC 3216 is one of the least explored galaxies of New General Catalog. It is identified in SIMBAD as elliptical galaxy with no special features. We analyzed X-ray XMM-Newtone observation of this galaxy with SAS software. We find extended X-ray halo around the galaxy four time larger than optical image. This halo should correspond to hot extragalactic gas in galaxy cluster. We build X-ray spectrum of the halo and find that its blackbody temperature is 300 eV. In the following work we will estimate the mass of baryon and dark matter in the mentioned cluster.

Two-dimensional simulation of galaxy distribution with Gaussian random fields

Vadym Voytsekhovskiy, A. V. Tugay

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We simulated galaxy distribution using Gaussian fields in wide range of initial parameters such as filament length, cluster richness, number of isolated galaxies, etc.
Radial velocity range from 3 000 to 10 000 km/sec was considered as the most representative view of the large scale structure.

Changing above parameters has led to similarity with SDSS distribution. We calculated two-points angular correlation function, and compare it with real distribution based on SDSS survey. We show that observed distribution of galaxies in the sky, can be imitated by simple random distribution.

Dynamical Evolution of Supermassive Binary Black Hole at the Center of NGC 6240 Based on Chandra Observation

Olena Kompaniiets[1], P. Berczik[2], V. Marchenko[3], M. Sobolenko[2], E. Fedorova[4]

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NGC 6240 is a interacting galaxy with redshift $z = 0.0243$ and dual nuclei. It is assumed that each nucleus have Supermassive Black Hole which form Supermassive Black Hole binaries (SMBHBs). Dynamic evolution of the candidate to binary supermassive black hole (BSMBHs) depends on the characteristics of the environment and also on the parameters of the interacting Supermassive Black Hole binaries.We performed direct N-body simulations with Newtonian and Post-Newtonian dynamics. Since NGC 6240 is the result of the merging of two galaxies to describe initial state our system we use distribution of Plummer density for each galaxy.The physical parameters such as black hole mass, dynamical mass and separation distance we found using the X-ray observation data from Chandra Data Archive. In the X-ray spectra from nuclei narrow component of the Fe K_α emission line are present. We described the spectra of the North and the South nuclei using physical models from XSPEC and find the rest-frame line energy. To estimate the black hole mass and dynamical mass for the region within 1 kpc scale we calculate Doppler effect and suppose that nuclei rotate around the center of mass on a circular orbit. For our physical parameters we obtained the timescale of merger for SMBH in the NGC 6240 at the level of $\sim$10 Myr.

Optical monitoring of the BL Lac object OJ 287 at the Lisnyky observational station from 2010 till 2018

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We present the results of optical UBVRI monitoring of the blazar OJ 287 during 2010–2018. OJ 287 at redshift $z = 0.306$ is one of the most active and most studied objects of BL Lac. All observations were obtained at the Lisnyky observational station of Taras Shevchenko National University of Kyiv. Light curves from our observations were plotted. Also color indexes were analyzed.

HIGH-ENERGY ASTROPHYSICS

Simulation of the optical performance of the Gamma-ray Cherenkov Telescope (GCT) and its prototype using ROBAST ray tracing software

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The Cherenkov Telescope Array (CTA) is an international project to construct a new generation ground-based gamma-ray instrument that will operate in the energy range from some tens of GeV to about 300 TeV. CTA will be composed of three classes of telescopes to enable coverage of the full energy range: Large-Sized Telescopes (LST), Medium-Sized Telescopes (MST) and Small-Sized Telescopes (SST). The SSTs (diameter of about 4 m) will cover the high energy part of CTA range of sensitivity (above $\sim$1 TeV) and will open a new window in the Very High Energy gamma-ray sky.

Three solutions for the SST design are currently proposed to CTA. The aim is to combine a large field of view (around 9 degrees) with a good imaging resolution and reduced costs. The Gamma-ray Cherenkov Telescope (GCT), one of the three considered SST designs, is based on a Schwarzschild-Couder optics, that comprises aspherical primary and secondary mirrors. In order to test this design never used in Cherenkov astronomy before and to evaluate its performance, a prototype of the GCT was constructed at the Paris Observatory in Meudon, France. The primary mirror of GCT is segmented into six petals with a complex hexagonal contour shape, while the prototype's primary mirror is at the moment equipped with only two petals with a circular contour shape.

We present the results of our simulations which we performed to assess the optical performance of the GCT telescope and its prototype. Using ROBAST (ROOT Based Simulator for Ray Tracing), we calculated the effective area, the shape and the 80% containment radius of the point spread function (PSF) of the prototype, as well as of the GCT itself. Also, we estimated shadowing induced by various telescope components such as the support masts and trusses. In addition, we have investigated the impact of various imperfections (such as tip, tilt and micro-roughness of the primary mirror petals) on the PSF shape and size. Such a study is necessary for retrieving the actual values of the imperfections of a telescope by measuring its PSF.

Gamma-ray emission of the Supernova remnant associated with the magnetar SGR1900+14

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Magnetar SGR1900+14 was formed 1000-6000 years ago as a result of Supernova outburst in a massive stellar cluster at the distance of 12.5 kpc. This magnetar can be a source of ultra-high energy cosmic rays, in particular the cosmic rays triplet ($E > 10^{20}$ eV) located in the Galactic plane near the Galactic center ($l = 35°$, $b = -4°$). Still, the signatures of the Supernova remnant, the progenitor of the magnetar, in radio, optical and X-ray range were not detected. In the recent Fermi LAT telescope 8-years survey (FL8Y) in the vicinity of the SGR1900+14 an unidentified source FL8Y J1907.3+0920 of multi-TeV emission was found. In our work we show that this emission can be generated due to p-p interactions of the Supernova remnant shock accelerated cosmic rays with target particles within the Supernova remnant.

TeV gamma-ray emission from the Vela Supernova Remnant

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We present an analysis of physical conditions of the Vela Supernova Remnant and it's emission in TeV gamma-ray band. We calculated the expected TeV gamma-ray total flux and spectrum as a result of cosmic ray proton interactions with the proton and nuclear targets in the whole remnant as well as in it's north-eastern and south-western parts. We compare the obtained results with the differential sensitivity curves of the future CTA South telescope and estimate the detection capability of the TeV gamma-ray emission from the Vela Supernova Remnant.

Vela Supernova Remnant and its Pulsar Wind Nebula: Physical Characteristics and Radio Emission

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Vela Supernova Remnant is a result of Supernova outburst at the boundary of the stellar wind bubble created by binary (WR11 and O-star) star $\gamma 2$ Velorum.

Due to the different densities inside and outside the stellar wind bubble, NE and SW parts of Remnant have different physical characteristics. Once more, pulsar wind nebula created by Vela pulsar is deformed and shifted by anisotropic reverse shock wave of Vela Supernova remnant. We analyse the physical conditions in the Vela Supernova Remnants and Vela pulsar wind nebula on the basis of their radio maps and recover the magnetic field and cosmic ray parameters from radio (synchrotron) and gamma-ray (Inverse Compton) emission data.

MHD Simulations of Early SNR Evolution

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A typical SNR evolution is described by the free expansion followed by the adiabatic stage, which in turn changes into the radiative stage. Yet, it was shown that the transition time between adiabatic and radiative stages is comparable with the duration of the adiabatic stage. Naturally, one can expect the transition to the adiabatic stage to be sufficiently long as well. In order to verify this supposition, we study the properties of SNR shocks starting from the very early evolutionary stages up to the well established adiabatic stage by means of high-resolution MHD simulations allowing us to capture all essential features of the post-shock flow. We are particularly interested in factors affecting the shock dynamics and conditions which facilitate the development of the adiabatic shock.

MHD simulations of interaction of the strong shock with accretion disk

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Supernovae and their remnants play a significant role in the modern astronomy. SNe type Ia have a key role in the number of important questions in cosmology, neutrino astrophysics and high-energy astrophysics. In our talk we present results related to one of the SN Ia model (the binary system with a white dwarf and giant star). Namely, we perform the two-dimensional time-dependent magneto-hydrodynamic simulations of interaction of strong shock wave with an accretion disk. We use the numerical code PLUTO in order to model the system and to analyze the role of magnetic field in such interactions.

Magnetic Fields in the Local Filament and Their Influence on the Propagation of Ultra High Energy Cosmic Rays

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Cosmological density distribution in Local Universe up to ~ 100 Mpc, especially in Virgo Supercluster region (~ 20 Mpc) is strongly nonuniform. Local Group of galaxies and its neighbors Cen A group and M81 group reside in Local Sheet (LS), which is a part of Local Filament (LF), connecting LS with Virgo cluster (VC) at a distance of 16.5 Mpc. Meantime, VC resides in another large filament, connecting Great Attractor mass concentration and Perseus-Pisces Supercluster. Extragalactic magnetic field (EGMF) distribution is expected to follow the barionic matter density distribution, with typical values of 10^{-6} G in central regions of clusters, 10^{-8} G in filaments and $\leqslant 10^{-9}$ G in voids. Ultra high energy cosmic rays (UHECRs) from extragalactic sources should be considerably deflected in EGMF. In this work we estimate the influence of EGMF in LS and LF on the propagation of UHECRs from sources in Local Universe, especially, from radiogalaxies Cen A, Virgo A, and from starburst galaxy M82.

Prospects for neutrino studies of supernovae in DUNE experiment

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The development of neutrino astronomy let us to investigate cosmic objects by analyzing their neutrino emission.

DUNE (the Deep Underground Neutrino Experiment) — is a multinational effort to address the biggest questions in neutrino physics as well as neutrino astronomy. It's currently the largest particle physics project being undertaken anywhere in the world since the Large Hadron Collider at the European laboratory CERN. The experiment will be hosted in the United States by Fermi National Accelerator Laboratory. DUNE envisages to deploy up to four 10 kt LAr TPC modules in a mine in South Dakota (USA). CERN is playing a very active role in LAr-TPC prototyping for DUNE.

This work is devoted to determining detector requirements for detection of supernova neutrinos in DUNE by using MC simulation in the LArSoft software framework. Also presented first looks at the 3D reconstructed data for the $3 \times 1 \times 1$ prototype LAr-TPC at CERN.

Repeated bursts of FRB 121102 as a radiation from cusps on superconducting cosmic string loop

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A new class of objects, that received the name fast radio bursts (FRBs), were discovered by Parkes radio telescope, Arecibo observatory, ASKAP, UTMOST and Green Bank Telescope during the last few years. There are 30 observed FRBs now. All of them have the similar characteristics: the frequency of detecting are 1.3 GHz, 1.4 GHz, 843 MHz, 700–900 MHz, 5–8 GHz the duration is near a few milliseconds and the peak of observed flow is near a few Jy. Various theories exist attempting to explain this phenomenon. FRB 121102 known as repeating burst, the total received bursts from this location are 32. Repeated bursts of FRBs have initiated multiple origin hypotheses.

Cosmic strings are one of the types of topological defects which could be formed during phase transitions of fields with spontaneous breaking symmetry in an adiabatically expanding early Universe, which cools down from a very hot initial state. There also exists a special class of cosmic strings – superconducting cosmic strings, inside of which the massless charge carriers, so-called zero modes, are presented and can move along the string without any resistance. Superconducting cosmic strings could be a powerful source of electromagnetic radiation. Loops of cosmic strings oscillate periodically, different segments of the string move with different relativistic velocities, so that cusps-sharp bends-holds are formed on string each period. The radiation from cusps on superconducting strings is highly beamed and has the nature of bursts.

We propose to consider fast radio bursts as an electromagnetic emission from cusps on superconducting cosmic string loops, that moves with the large Lorentz-factor through magnetic field, frozen into cosmic plasma. The observed duration, flow and event rate are in a good agreement with proposed model. Within the framework of our model, a repeated fast radio burst FRB 121102 was also investigated. It was shown, that each of the radiated bursts from FRB 121102 could be emitted by the same source. For each event, discovered till now, the energy parameter α, which characterizes the radiation source - the loop of cosmic string, was obtained. The values of this parameter are very similar for each event. In our assumption, that agrees well with the observational data, the radiation source could be a superconducting cosmic string loop that moves and oscillates over a implex anharmonic law and on which cusps arise from time to time.

SOLAR SYSTEM & EXOPLANETS

Surface properties of Jupiter Trojans (624) Hektor and (911) Agamemnon

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We present the first-ever rotationally resolved spectroscopic investigation of (624) Hektor and (911) Agamemnon, the two largest Jupiter Trojans. The visible and near-infrared spectra that we have obtained at the TNG telescope (La Palma, Spain) do not show any feature or hints of heterogeneity. In particular, we found no hints of water-related absorptions. We modelled complete visible and near-infrared spectra of our targets using the Shkuratov formalism to define the upper limit to the presence of water ice and to constrain their surface composition. For both objects, successful models include amorphous carbon, magnesium-rich pyroxene, and kerogen, with an upper limit to the amount of water ice of a few percent.

Optical spectra of the short-period comet 2P/Encke in 2003 and 2017 appearances

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We present results of pre-perihelion spectral observations of the short-period comet 2P/Encke in 2003 and 2017 apparitions. The spectra were obtained with the 1-m telescope Zeiss-1000 (November 2003) and the 6-m telescope BTA (January 2017) of the Special Astrophysical Observatory (Russia), when the comet was at heliocentric distance of 1.03–0.91 au and 1.06 au, respectively. The spectral regions were 410–720 nm in the 2003 apparition and 380-680 nm in the 2017 apparition. Emission features of molecules C2, CN, NH2, C3, CH, and CO+ were identified in the cometary spectra. Using the Haser model we calculated the gas production rates of molecules C2 ($\Delta\nu$=+1; $\Delta\nu$=0), CN (0–0), NH2 (10–0; 7–0), and C3. We found slightly less gas activity of the Comet 2P/Encke in 2003 passage. The dust productivity was estimated within the BC, GC, and RC bands at both observational periods. The normalized gradient of reflectivity was also computed.

Results of observation of 4 exoplanets in search of inflated atmosphere evidence

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We want to present the results of observation of transits of 4 exoplanets CoRoT-2b, Gliese 1214b, HAT-P-5b, WASP-10b. Observations were accomplished at Chuguev observational station of the Institute of astronomy of V N Karazin Kharkiv National University on 70 cm reflector telescope. These exoplanets are classified as hot jupiters, gas giants which are located les than 0.05 AU from their parent star. Several papers indicate that all of the observed exoplanets have different types of atmospheric dissipation: HAT-P-5b and WASP-10 have classic or thermal dissipation, while hydrodynamic regime of dissipation prevail on Gliese-1214b. Our lightcurves in B and R filters of Johnson-Cousins system of HAT-P-5 b have differenties that can be an evidence of the inflation of planet's atmosphere.

Towards the search of the difference in physical and dynamical properties between the L4 and L5 swarms of Jupiter Trojans

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From the beginning of the study of Jupiter Trojans, there is a well-known difference in number of objects between L4 and L5 groups. For a long time, this difference has been attributed to the observational selection effect. However, as the number of discovered Trojans increase, L4 Trojans the difference become even more noticeable. At present, there are 4599 objects known in L4 and 2433 in L5 population, i.e. L4 Trojans are more numerous than L5 in 1.9 times. We found that the shape of the orbital inclinations distribution in the L4 and L5 swarms are also different (Slyusarev 2013). The L5 population shows significantly wider distribution with a plateau in the range from 5Âř to 17Âř and a weak maximum at 27Âř. The distribution of the L4 population demonstrates a sharp maximum at 7Âř, after which the number of Trojans with specified inclinations decreases exponentially. These two manifestations of asymmetry in the L4 and L5 swarms weren't explaned yet. The asymmetry of L4 and L5 swarms is difficult to explain basing on dynamical models. We search for possible differences in physical parameters between Trojans belonging to the L4 swarm and to that belonging to L5 swarm using our own observations and literature data.

Discovery of the small Solar system bodies with OMT-800 and AZT-8 telescope

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Observing for 2017 year on a Odessa Multifunctional Telescope (OMT-800) in Astronomical Observatory, Odessa I.I. Mechnikov National University and Astronomical Mirror Telescope (AZT-8) in Astronomical Observatory, Taras Shevchenko National University. We discovery four small Solar system bodies: 2017 BC94, 2017 QX33, 2017 RV12, 2017 QJ36, 2017 ST39, 2017 SV39, and 2017 TS7. More than fifty objects were rediscovered.

Primary processing of FITS.* frames, produced by software CoLiTec and Astrometrica. Soft has created specifically to search for new objects in the Solar system.

To calculate the ephemeris, the Väisälä method was used (implemented by the authors), used in "Find_Orb" orbit determination software – Project Pluto. It allows us to determine the primary orbit on a short arc from two observations. This allowed us to calculate the search ephemeris, for unknown objects. All measurements are sent to the Minor Planet Center (MPC).

Rotational periods of the selected near-Earth asteroids

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In this work, rotation period of the selected near-Earth asteroids were found. The selected asteroids were observed on Terskol observatory. There were found light curves in white light or R filter. We used phase dispersion minimization (PDM) and Lomb Normalized Periodogram (LNP) data analysis techniques for period determination.

Heliocentric distribution of activity for the main-belt and quasi-Hilda comets during of last 20 years

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We present an analysis of heliocentric distribution of activity for the main-belt and quasi-Hilda comets during of last 20 years. Flares with amplitudes 2^m or more were selected to avoid variations of brightness caused by rotation or observational errors. The main-belt and quasi-Hilda comets are quite different in behaviour of activity. Flares of quasi-Hilda comets are located homogeneously along the whole orbits. While most of flares for main-belt comets are located in the sector 0 – 60 degrees of heliocentric longitude.

We compared moments of cometary flares with results of Geostationary Operational Environmental Satellite (GOES) observations for X-ray solar fluxes at the Earth. Flares of some main-belt and quasi-Hilda comets show correlations with Solar fluxes (M and X types). Possibility of impact with hypothetical asteroid stream is discussed.

STELLAR ASTROPHYSICS & INTERSTELLAR MEDIUM

Photometric analysis and improved parameters of newly discovered short-period binaries

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We present results of photometric observations of short-period variable stars discovered during recent decade in the field of view of intermediate polars (V2832 Cyg, V2833 Cyg, 2MASS J21330148+5101105, 2MASS J21323285+5107316, 2MASS J21334629+5112088, 2MASS J21341620+5107382, 2MASS J21342297+5115544, 2MASS J21344894+5112116, VSX J213351.1+510633, VSXJ212326.6+422115, VSXJ195753.6+322815, VSXJ195810.3+323350, VSXJ195826.2+323717). Most of variables belong to eclipsing binary systems. Data were obtained with different instruments in 2009–2017.

During analysis of (O-C) diagrams of some objects we found significant linear trends which indicate necessity of improvement of the orbital period values (that usually obtained using relatively short period of observations). Particularly, for the EW-type system V2833 Cyg the value of the orbital period is 0.37177351(19) days which is statistically different from published earlier value of 0.371782(12) days. For some objects we improved the value of the period and determined the parameters of the light curves. Using time series of other objects we confirm previously published values of the period. Modelling for some objects is planned.

Evolutionary process of the Double Periodic Variable: V495 Centauri

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We presented a simple model for the Double Periodic Variable (DPV) V495 Cen, which evolve a binary system of intermediate mass, including an accretion disc. The theoretical model begins at the zero-age main sequence with rotation for both stars. We started the model using parameters obtained from Rosales et al. (2018), adopting an initial orbital period 4.0 d and and initial mass for the primary component (donor) $m_{i,d} = 3.45\ m_{\odot}$ and $m_{i,g} = 3.25\ m_{\odot}$ for the gainer, with a metallicity associated to this type of DPV of $z = 0.02$. For this purpose we use the evolutionary code MESA, developed to calculate evolution of stars in a wide range of environments. We described each evolutionary stage of both components until that the donor reaches the core Helium depletion (X_{He_c}) as stop criterion. Also we offer a complementary analysis for understand how the second period is linked to mechanism based of cycles on magnetic dynamo into of the donor star called Applegate mechanism, that was proposed as an explanation for the DPV long cycles. Currently, the theoretical model is consistent with published results for V495 Cen and we discuss how our predictions can help to develop efficients theoretical models for DPV stars.

Analyzing the long term variability of the Double Periodic Variable HD 50526

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HD 50526 is a Double Periodic Variable (DPV) characterized by an long photometric cycle of 190.584±0.089 d that lasting on average of 28 time the orbital period. We have determined an improved orbital period of 6.701 ± 0.001 d using the ASAS light curve. Also we performed a second photometric analysis with PanSTARRS-1 shown a new short period 22.096 ± 0.1 d and a long period 137 ± 10 d, possibly related to highly activity on the surface of the star caused by great changes into of stellar dynamo. We present a detailed spectroscopic study of the DPV HD 50526 Cen based on high-resolution with different spectrograph from years 2008 to 2015. The spectra of each component were disentangled with a method that is quite good for separating the absorption-lines widths of both stellar components. The features

of the donor star were modeled using the SPECTRUM code, and we found a little evolved donor star of $T = 9500 \pm 250$ K, $\log g = 2.5 \pm 0.5$, $V_{turb} = 0.0$ km s^{-1}, $V \sin i = 60.5$ km s^{-1}. We classified the donor star as spectral type A0I, while that for the companion we estimated a $m_g \sim 5.78 m_\odot$, $T_g \sim 14000$ K with a concave and geometrically thick disc and the system is seen under inclination 63.5°. We must emphasize that the research is not complete and we must continue for obtain the fundamental parameters and constraint the nature of the long cycle.

The search of the globular clusters by catalogue data

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The problem of cataloguing star clusters and nebulas remains is unresolved in astrometry. One of the main reasons that contribute to this is their search and selection of observational data. Modern astrometric data has enough information to expand current catalogues of globular star clusters.

This paper presents an independent comprehensive method for processing catalogue data (PMA, GAIA, etc.) with the aim of identifying new objects under investigation. Also, this method allows specifying the coordinates and proper motion of already known star clusters due to the re-analysis of the stars which they contain. The result of the work represents a new catalogue of stellar globular clusters based on PMA catalogue data.

On the possible constraints on dark energy using compact objects

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Dark energy is believed to be responsible for accelerated expansion of the Universe, but its nature is poorly understood. In our work we aimed to constrain one of the parameters of equation of state for dark energy, namely effective speed of sound c_s, using compact objects (white dwarfs and neutron stars). We have investigated the impact of dark energy inside compact object on its structure and derived

the minimal value of c_s which corresponds to the onset of instability of an object. It was shown that influence of dark energy is stronger for neutron stars, however, obtained constraints are weak for both types of compact objects.

Spectroscopic manifestations of activity processes in the atmosphere of Proxima Centauri

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We study the behavior of some emission spectral lines formed during the flare processes in the atmosphere of Proxima Cen (M5.5V). We analyze the archived time series of observations obtained on HARPS telescope. The temporal changes of the emission lines of H, He and other elements are studied.

On the reliability of the diagnostic methods in the investigation of the inhomogeneous nebular component of dwarf star-forming galaxies

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To determine the electron density and temperature in nebular environments so called diagnostic methods are usually used. During diagnostics the nebular object is divided into so-called ionization zones that represent the different parts of the nebula characterized by different ionization fractions, and in each of them the ratios (so-called diagnostic ratios) between line intensities of the same element are used to determine the electron temperature and density as well as ionic abundances. However, usage of these methods can be subject to severe uncertainties and even errors in the case of low density nebulae with strong inhomogeneities of density, temperature, and chemical composition. To investigate the reliability of diagnostic methods in the case of low-density nebular gas in star-forming galaxies (such as NGC1569) we used the emissivities map, obtained by us during multicomponent photoionization modelling (MPhM) at various abundances of dust grains.

The results of chemodynamical simulations (ChDS) of such galaxies were used as input data for MPhM. We calculated the predicted emission line spectra for various position of synthetic aperture. Such kind of objects can be devided into two main components: 1) the hot, low density superwind region (SWR), where physical conditions are defined mainly by hydrodynamic processes; 2) the outer nebular component, where physical conditions are determined mainly by photoionization processes. Thus, the spatial distributions of chemical elements over all galaxy volume as well as electron temperature in SWR were obtained from ChDS, while ionization structure of nebular component was calculated using MPhM.

Oxygen abundances, averaged over mass along central sight line of each of apertures, were compared to the ones determined by popular diagnostic T_e- and R_{23}-methods from the corresponding synthetic emission line spectra. As a result, the reliability of the diagnostic methods for investigation on low density nebular component in star-forming galaxies was analysed. Also, we plan to perform such analyzis for HII regions in blue compact dwarf galaxies that are very important in the task of the primordial helium abundance determination.

Search of the optimal photoionization models of nebular environments using Markov chains method

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To determine the chemical composition of H II regions and planetary nebulae the ionization-correction factors (ICFs) obtained from the photoionization models grid of these objects are usually used.

Melekh, Holovatyy and Izotov (2008) have proposed to determine the chemical abundances of H II regions in blue compact dwarf galaxies (BCDG) using optimized photoionization modelling that does not require ICFs. For this purpose they used Peter van Hoof's method *Phymir* for optimization and Gary Freland's code *Cloudy* – for photoionization modelling. The search of the optimal photoionization model (OPhM) requires the calculation of thousend photoionization models. In order to reduce the CPU time during such modelling we propose to use Markov chains (MC) method.

We implemented this method in code *Cloudy* and used it to search the OPhM in diagnostics mode (one-zone optimization modelling with propose to determine the electron temperature and density in various ionization zones by reproducing of diagnostics ratios between emission line intensities). The efficiency of MC-Cloudy method in comparison with Phymir-Cloudy one was discussed.

We plan to use MC-Cloudy method for search of OPhM for low-metallicity H II regions in BCDGs with purpose to redetermine the chemical composition of these objects and, correspondingly, to obtain more precisely the primordial helium abundance and its enrichment during chemical stellar evolution of matter.

New objects and methods of the low-frequency radio spectroscopy using decametric radio recombination lines

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Observations of the low-frequency radio recombination lines (RRLs) provide a powerful method of the cold low density interstellar plasma diagnostic. This branch of radio astronomy is now actively developed at different observatories including the European LOFAR system. Nevertheless, severe terrestrial interferences and low intensity of the studied features make such investigations rather difficult for the most galactic objects with one exception – observations of the medium lying against Cassiopeia A in the Perseus Arm are comparatively favourable to researchers. In order to improve effectiveness of the low-frequency radio spectroscopy we need to develop new methods of hindering signal mitigations and experiment sensitivity improvement. Such new approaches to the low-frequency RRLs investigations have been developed at the UTR-2 observatory. This expands the number of objects that could be effectively studied by RRLs observations. Also it is necessary to point out that UTR-2 remains to be the biggest decameter wave radio telescope and a large number of spectroscopic observations have been carried out during last years with this instrument. Here we report the new results of the carbon RRLs

studies in the medium lying on the line of sight towards several galactic objects such as DR-21, S140, L1407 and other. These results illustrate the new opportunities in the low-frequency radio spectroscopy that are opened with new methods and equipments.

The primordial helium abundance determined using multicomponent photoionization modelling

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The method for the multicomponent photoionization modelling (MPhM) of low-metalicity H II regions surrounding the starburst region was developed. The internal structure of the H II region has been determined using the evolutionary modelling of the superwind bubble surrounding the star-forming region. Models of Chevalier and Clegg (1985) and Weaver et al. (1977) have been used to determine the radial distribution of the gas density, the velocity of gas layers, and the temperature within internal components (the region of the superwind free expansion and the cavity, respectively). The chemical abundances in region of the superwind free expansion were obtained from the evolutionary population synthesis with including of rotating stars. The chemical abundances within cavity were defined by averaging over mass the chemical compositions of mixture of the abundances of gas from superwind and ones within outer component, because of gas evaporation from external component into the cavity. External components of our models describe a high-density, thin shell of gas formed by superwind shock and a typical undisturbed hydrodynamically H II region, respectively. Evolutionary grids of multicomponent low-metallicity models are calculated. A comparative analysis of the results of their calculation with the observed data has been carried out. The ionic abundances averaged over modelling volume as well as chemical composition assumed in models were used to derive the new expressions for ionization-correction factors that were used to redetermine the chemical compositions of 88 H II regions in blue compact dwarf galaxies. It must be noticed that we used for this propose the ionic abundances obtained by Izotov et al. (2007). In result the primordial helium abundance and its enrichment during stellar chemical evolution of matter were determined.

Variability of interstellar absorption lines and emission line [O III] 5007 Å in direction to η Carinae association

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We have analysed the variability of Ca I, Ca II, Na I and K I absorption lines as well as forbidden strong emission line [O III] 5007 Å. Usually the absorption lines originate in cool dense interstellar environments, while forbidden emission lines – in hot nebular gas. The correlation between variations of profiles and intensities of the mentioned above absorption lines and emission one was investigated. It was concluded that the variability of these lines is caused by dynamics of the compact clumps that are dense enough to originating the absorption lines. To determine the localization of such clumps (inside nebular gas or beyond the ionization front) the approach based on the photoionization modelling of inerstellar gas was proposed.

Determining the distribution of the nebular matter in PNe envelopes using their emission line spectra

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The photoionization models grid of planetary nebulae (PNe) envelopes along the evolutionary tracks of their nuclei for two types of dust grains (carbonates and silicates) and various masses of progenitor stars was calculated using Gary Ferland's code Cloudy 08.00. Two types of the chemical abundances averaged over ones of PNe in Large Magellanic Clouds and Milky Way correspondingly were adopted. The radial density distribution of matter in models was defined using Golovatyi-Malkov semi-empirical law. The predicted spectra of models were used for search of the correlations between emission line ratios that depend on the parameters of this distribution as well as for nebular diagnostics using two independent codes – Diagn and Neatter. Code Cloudy in optimization one-zone mode was also used with diagnostic purpose. In result the electron densities and temperatures in various 8-12 ionization zones were obtained. The reliability of the diagnostic methods was analyzed and new method for determination of density distribution using emission

line spectra was developed. This method was used for the determination of gas density distributions in real PNe envelopes.

Photometric system for telescope AZT-8

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The processing of observations requires the construction of a photometric system. The construction of a photometric system for a telescope requires a photometry of a large number of stars.

Usually in such situation stellar clusters are observed. Here we calculate the photometric system for telescope AZT-8 (Astronomical Mirror Telescope 8, 1968 year). The telescope is located in an observational base in Lisnyky.

The optical parameters: telescope diameter $D = 70$ cm, focal length $F = 2.8$ m, CCD-camera FLI PL47-10 with filters UBVRI. Observations were conducted from 2014 to 2017.

We consider 8 star clusters (date of observation is pointed in the brackets): PG 2213 (17.09.2014), M 34 (31.10.2015), NGC 6712 (30.08.2016), NGC 6779 (30.08.2016), NGC 6791 (30.08.2016), L 112 (28.09.2017), L 113 (28.09.2017), NGC 103 (26.12.2017).

The photometric system allows to take into account the majority of errors in optics, atmosphere and extinction. We also presenting observed star magnitude in the standard filter bands.

Data processing of Gaia alerts

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I present the results of photometric studies of Gaia alerts. I processed images that taken at the Terskol Observatory in 2017 and received a light curve of objects: Gaia16asm, Gaia16blg, Gaia17bqo and some others.

Studying the spectroscopic short time-scale variability of the hot supergiant ζ Orionis

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We present results of observations of short time-scale variability of the O9.2Ib supergiant ζ Ori. Massive stars play a significant role in the chemical and dynamical evolution of galaxies. However, much of their variability, particularly during their evolved supergiant stage, is poorly understood. ζ Ori is only currently confirmed supergiant to host a magnetic field. Spectral observations were carried out with low-resolution slitless spectrograph ($R \sim 200$) installed on the 60 cm Carl Zeiss telescope in the Andrushivka Observatory, Ukraine. Also, part of observations were carried with help of small Maksutov-Cassegrain telescope ($D = 6''$). Spectra were obtained with a time resolution in the sub-second and second range. It has been found that the supergiant ζ Ori shows rapid variations in the hydrogen lines H_β, H_γ, H_δ, H_ε, H_ζ and helium lines He I (4472 Å), He I (5016 Å) He I (5876 Å). We perform a detailed frequency analysis to detect and characterize the star's periodic variability. We detect the variability with 600 s periodicity. Variability of the O9.2Ib supergiant ζ Ori can be interpreted that their variations are non-radial pulsations and strong stellar wind.

Optical observations of 1H1936+541 from 2008 till 2018

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We report the results of observations of the Be/X-ray binary system 1H1936+541. Be/X-ray binaries are systems with Be star as a main component and, usually, neutron star as a compact object. Be star is a star of spectral class B which at least one time show emission line in its spectrum for the all time of its observations. Our observations conducted in U, B, V, R and I bands from 2008 until 2018. During this time, photometrical variability occurred in all bands, however the most significant changes were present in U and I bands. Variability in this star, as we think, related with changes in the decretion disc structure, because variabilities in U and I bands anti-correlate among ourselves. So, photometrical variability indicates about changes in decretion disk structure. Our observations cover more than one period of variability.

ATMOSPHERIC STUDIES & SPACE GEOPHYSICS

Power spectrum manifestation of Kelvin-Helmholtz instability by Cluster II mission measurements

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In near-Earth space, Kelvin-Helmholtz instability (KHI) occur at the boundary of two regions: solar wind and magnetosphere. The manifestation of this instability can be found with different methods and in this work we used wavelet analysis and power spectrum analysis.

From the analysis of power spectrum and it's characteric property: intermittency; direct and inverse cascade processes caused by Kelvin-Helmholtz instability found from the wavelet analysis and vortex nature of induces electro-magnetic field the Kelvin-Helmholtz instability can be identified with high accuracy.

We present our results on identification of Kelvin-Helmholtz instability for multiple events in magnetopause with measurements of Cluster II space mission.

The work is done in the frame of the grant Az. 90 312 from the Volkswagen Foundation ("VW-Stiftung").

On building the targets of any possible shapes in DDscat.C++ software

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DDscat.C++ is a freely available open-source C++ software package applying the "discrete dipole approximation" (DDA) to calculate scattering and absorption of electromagnetic waves by targets with arbitrary geometries and a complex refractive index. DDscat.C++ was created by Vasyl Choliy as a clone of the DDSCAT product

written in Fortran-90. However, C++ code uses a new methodology of target creating. A new version of DDscat.C++ is going to be released and now the user can create and manipulate targets of any possible shapes.

There are two methods to build a target in DDscat.C++. The user creates targets by inserting the creating instruction for a new target into the parameter file. A target could be created as a combination of items from the library of elementary targets. List of targets includes prisms (incl. cylinders and starlike objects), pyramids (incl. cones and starlike variants), Plato bodies, ellipsoids, paraboloids, bricks etc. Not very trivial are springs, torus, knots, Cassini bodies, caps and lenses. The targets with absolute orientation are Line, Plane, Grating, Arc, Circle, Bezier arc, Bezier surface, Graphics. The user also can create a calculable target. With the new release, it is possible to create targets given by the parametric equations. There are new pretty targets like Moebius sheet and even Klein bottle among the built-in targets. Any targets may be manipulated by boolean logic operators and affine transformations.

Sometimes the targets cannot be represented with the library of elementary targets. For the targets of this kind we use Monte Carlo method and Cauchy integral formula. The random point z_0 belongs to the figure G if contour integral taken around the boundary Γ of the figure G equals 2π. Unfortunately with this method one can build only prismatic targets. The way for solving this problem is the use of the three-dimensional analogue of the Cauchy integral formula. This method allows to construct targets of any form in 3D, but it is quite slow, since for each point it is necessary to calculate the double integral. There is a quaternion version of Cauchy integral formula. We have a plan to use it for the targets of any possible form represented implicitly in 3D.

Turbulence spectra in region of magnetic dipolarization

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The Earth's magnetotail is a self-consistent large-scale current structure, the parameters of which are governed both by the solar wind plasma and by internal processes. During substorm expansion phase the horizontal component of the magnetic field decreases in the magnetotail lobes while the vertical component increases, that is, namely, phenomenon of magnetic dipolarization. In order to determine the

features of turbulent processes before and during the dipolarization, the fluctuations of the magnetic field of the 4 spacecraft of the Cluster-2 mission for September 21, 2005 event were examined. We carried out the following: determination of kurtosis; spectral power density analysis; amplitude analysis and wavelet power spectral of the signal.

In the wavelet analysis, we used the Morley wavelet, consisting of a plane wave modulated by a Gaussian.

In the frame of the investigations the features of the turbulent processes on the different time scales were obtained. Wavelet analysis showed the presence of both direct and reverse cascade processes and Pc4 and Pc5 pulsations.

The work was conducted in the frame of complex program of National Academy of Science of Ukraine on scientific cosmic researches; with support of education program of Ministry of Education and Science of Ukraine №2201250 "Education, Training of students, PhD students, scientific and pedagogical staff abroad"; the grant Az. 90 312 from the Volkswagen Foundation ("VW- Stiftung") and International Institution of Space Research (ISSI-BJ).

In-sky safety system using ADS-B radar receiver

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The purpose of this work is to develop and assemble the real-time in-sky safety system for SLR (Satellite Laser Ranging) system. It bases on receiving ADS-B protocol aircraft data. This solution represents an asynchronous service in the SLR laser control system. It instantly inhibits SLR laser pulses in order to prevent illumination of aircraft. The service is preparing for implementation at the SLR station "Golosiiv, Ukraine" (EUROLAS Data Center ID — 1824).

Active biomonitoring of air pollution in Baku, the capital of Azerbaijan

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Devitalized Sphagnum girgensohnii Russow (in moss-bags) as a biomonitor species for the first time were used to characterize different pollution sources at a local scale and long-range transport of air pollutants in the capital of the Republic of Azerbaijan. Two complementary analytical techniques were used: neutron activation analysis and atomic absorption spectrometry. A total of 39 elements were determined: Na, Mg, Al, Cl, K, Ca, Sc, V, Cr, Mn, Ni, Co, Fe, Zn, As, Br, Sr, Rb, Mo, Sb, I, Ba, Cs, La, Sm, Hf, W, Au, Th, U, Cu, Cd, and Pb. Multivariate Statistical Analysis (Factor Analysis) allowed characterization of potential pollution sources.

Atmospheric pollutants has a severe adverse effect on human health. About half of the urban population being monitored is exposed to air pollution that is at least 2.5 times higher than the levels World Health Organization recommends (WHO, 2014). Industrial emissions in Azerbaijan are mostly concentrated in Baku and Sumgayit, and associated with the oil industry. The long history of oil exploitation in the country has left Azerbaijan with a massive legacy of oil and other chemical pollution, both land-based and offshore. The Absheron Peninsula (which includes Baku and Sumqayit) and the Caspian Sea are considered to be one of the ecologically most devastated areas in the world because of severe air, soil and water pollution.

Moss bag technique is the most commonly reported method of active biomonitoring with terrestrial mosses. The technique is a simple and cost-effective way of evaluating air quality. For the first NAA was used to determine large set of elements, previously not assessed in air pollution of the study area.

Kelvin-Helmholtz instability at the boundary of the geomagnetic tail

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The Kelvin-Helmholtz instability at the boundary of the geomagnetic tail is considered to be one of the main mechanisms for generating turbulent pulsations. A dispersion equation is obtained for this instability in the approximations of an incompressible and a compressible medium. Longitudinal ($\vec{k} \parallel \vec{v}$) and oblique

$$\left(0 < \cos\varphi \leqslant 1,\ \varphi = \arccos\left[\frac{(\vec{k}\cdot\vec{v})}{k\cdot v}\right]\right)$$

perturbations are considered. Expressions for increments are obtained. Dependences of increments on the Mach number are analyzed.

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