XXIV Gamow International Astronomical Conference "ASTRONOMY AND BEYOND: ASTROPHYSICS, COSMOLOGY AND GRAVITATION, ASTROPARTICLE PHYSICS, RADIO ASTRONOMY, ASTROBIOLOGY AND GENETICS"

PROGRAM AND ABSTRACTS

August 19-23, 2024
Odesa, Ukraine

XXIV GAMOW INTERNATIONAL ASTRONOMICAL CONFERENCE: "ASTRONOMY AND BEYOND: ASTROPHYSICS, COSMOLOGY AND GRAVITATION, ASTROPARTICLE PHYSICS, RADIO ASTRONOMY, ASTROBIOLOGY AND GENETICS"

August 19 - 23, 2024, Odesa, Ukraine

(The program indicates the time in Ukraine, that is the Central European Time +1)

Monday, 19.08.2024

09.30 – 10.00 OPENING OF THE CONFERENCE AND GREETING TALKS

Greetings of the Rector of the Odessa I.I.Mechnikov National University ***V.I.Truba***

Greetings of the President of the Ukrainian Astronomical Association ***Ya.S.Yatskiv***

10.00 – 12.50 MEMORIAL SESSION

*(Convener **O.M.Ulyanov**)*

10.00 – 10.30 ***Massimo Capaccioli*** (Università di Napoli Federico II**,** Italy)
A Fil Rouge of Genius: from Galilei to Gamow

10.30 – 11.10 ***Alessandro Bettini*** (University of Padua, Department of Physics and Astronomy "Galileo Galilei", Italy)
Four-hundred years of Relativity Principle

11.10 – 11.30 ***O.A.Bazyey*** (ONU, Odesa, Ukraine)
Kant and Laplace - in search of the root cause (to the 300th anniversary of the birth of I. Kant and the 275th anniversary of the birth of P. Laplace)

11.30 – 11.50 ***M.I.Ryabov*** (IRA NANU, Ukraine)
Gamow conference in Washington University and 30-th anniversary Gamow's Conference in Odesa University

11.50 – 12.10 ***I.L.Andronov*** (ONMU, Odesa, Ukraine)
A.M.Shulberg (27.05.1914-01.09.1994) and the modeling of eclipsing binary systems with spherical components

12.10 – 12.30 ***O.Y.Karpenko*** (ONU, Odesa, Ukraine), ***M.I.Ryabov*** (IRA NANU, Ukraine)
Onomastics and names of the Starry Sky (to the 95th anniversary of Professor, Corresponding Member of the Academy of Sciences of Ukraine Y.A. Karpenko - author of the book "Names of the Starry Sky")

12.30 – 12.50 **Memorial Prof. V.G.Karetnikov**

14.00 – 18.00 PLENARY SESSION (35 +5 minutes for the report and questions)

*(Convener **A.I.Zhuk**)*

14.00 – 14.40 ***S.Parnovsky*** (Taras Shevchenko National University of Kyiv, Observatory, Ukraine)
The Einstein-Podolsky-Rosen paper: history and false instantaneous information transfer paradox

14.40 – 15.20 ***R.Ragazzoni*** (President of the Italian National Institute for Astrophysics (INAF), Italy)
How large a telescope can be?

15.20 – 16.00 ***Ö.Akarsu*** (Department of Physics, Istanbul Technical University, Turkey) **Λ_sCDM cosmology: A promising paradigm free of cosmological tensions**

16.00 – 16.40 ***E.Bannikova*** (INAF - Astronomical Observatory of Capodimonte, Naples, Italy; IRA NASU, Kharkiv, Ukraine)
Active Galactic Nuclei: evolution of observations and models

16.40 – 17.20 ***V.Zhdanov, O.Stashko, Yu.Shtanov*** (Taras Shevchenko Nat. Univ. of Kyiv, Ukraine; Princeton University, USA; Bogolyubov Inst. for Theor. Phys., Kyiv, Ukraine)
Cosmic censorship and naked singularities in the quadratic f(R) gravity

17.20 – 18.00 ***A.Linde*** (Stanford Institute for Theoretical Physics and Department of Physics, Stanford University, USA)
Present status of inflationary cosmology

Tuesday, 20.08.2024

10.00 – 12.40 PLENARY SESSION (35 +5 minutes for the report and questions)
*(Convener **I.L.Andronov**)*

10.00 – 10.40 ***R.Ruffini*** (Director of ICRANet, Italy)
The role of Fermi in the discussion of Gamow cosmology: an international implication

10.40 – 11.20 ***N.Gopalswamy*** (NASA Goddard Space Flight Center, USA)
The backreaction of the reduced heliospheric pressure and its implications for the strength of solar cycle 25.

11.20 – 12.00 ***B.Novosyadly*** **(Astronomical Observatory of Lviv University, Ukraine)**
Signal in the redshifted hydrogen 21 cm line from Dark Ages and Cosmic Dawn as a new cosmological test.

12.00 – 12.40 ***V.Zakharenko***, ***O.Konovalenko*** (IRA NASU, Kharkiv, Ukraine), et al.
On the possibility of detecting a signal in the 21 cm hydrogen line from the Dark Ages at a decameter wavelength.

12.40 – 14.00 ***Lunch***

14.00 – 16.00 PLENARY SESSION (30 +5 minutes for the report and questions**)**
*(Convener **B.Novosyadlyi**)*

14.00 – 14.40 ***I.Usoskin*** (Oulu University, Finland)
Cosmic rays in the Earth's atmosphere: Shall we care?

14.40 – 15.20 ***M.Lattanzi*** **(**Italian National Institute for Astrophysics (INAF), Italy) **The Gaia mission and beyond: present and future of Gravitational Astronomy.**

15.20 – 16.00 ***I.Andronov*** *et al.* (Odesa National Maritime University, Odesa, Ukraine)
Variable stars: Clues from the multi-component variability.

16.00 – 16.30 CLOSING OF THE PLENARY SESSION

SECTION SESSIONS

August, 21 – 23

SECTIONS:

1. **Cosmology, gravitation, astroparticle physics, high energy physics (Chair *A.I.Zhuk*)**
   August 21 (Wednesday) (10.00 – 12.20, 13.20 – 15.00)
2. **Astrophysics: nucleosynthesis, stellar atmospheres, kinematics, structure and chemical evolution of the Galaxy (Chair *T.V.Mishenina*)**
   August 21 (Wednesday) (10.00 – 13.00)
3. **Astrophysics: Interacting Binary Systems and Variable Stars (Chair *I.L.Andronov*)**
   August 21 (Wednesday) (14.00 – 18.00)
4. **Astrophysics: Extragalactic astronomy and Astroinformatics (Chair *I.B.Vavilova*)**
   August 22 (Thursday) (10.00 – 13.40)
5. **Solar System, Exoplanets and Near-Earth astronomy (Chair *N.I.Koshkin*)**
   August 22 (Thursday) (10.00 – 13.00, 14.00 – 18.20)
6. **Radio Astronomy (Chairs *O.M.Ulyanov, O.A.Litvinenko*)**
   August 23 (Friday) (09.30 – 13.30, 14.30 – 17.35)
7. **Sun, solar activity, solar-terrestrial relations and astrobiology (Chairs *V.M.Efimenko, M.I.Ryabov*)**
   August 22 (Thursday) (09.30 – 13.10, 14.00 – 15.45)
8. **Biologic section «Gamow's ideas in 21st century biology» (Chair *S.V.Chebotar*)**
   August 23 (Friday) (10.00 – 14.00, 15.00 – 17.00)
9. **Astronomical education and** Astronomy Outreach (Chair *I.L.Andronov)*
   August 22 (Thursday) (10.00 – 12.00)

Program and abstracts will be posted on the web page of the Conference:
www.gamow.odessa.ua
In case of problems with uploading abstract texts, please send them to
S.L.Strakhova: okioao26@gmail.com

For more details regarding the Conference, please contact us:
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SECTION SESSIONS

COSMOLOGY, GRAVITATION, ASTROPARTICLE PHYSICS, HIGH ENERGY PHYSICS

Wednesday, 21.08.2024
(10.00 – 12.20, 13.20 – 15.00)

(*Chair* – ***A.I.Zhuk***)
(15 + 5 minutes for the report)

10.00-10.20 *Y.V.Taistra, V.O.Pelykh* ELECTROVAC EQUATIONS IN THE CASE OF OUTGOING ONE-WAY NULL FIELDS

10.20-10.40 *Olexandr Gugnin, Vadym Voitsekhovskyi, Bohdan Hnatyk* BACKPROPAGATING EHECR IN THE DIRECTION OF THE LOCAL VOID

10.40-11.00 *V.M.Babur, B.I.Hnatyk* PROBING GAMMA-RAY EMISSION IN THE SHAPLEY SUPERCLUSTER

11.00-11.20 *M.Stepanov, L.Zadorozhna, B.Hnatyk* GAMMA-RAY SIGNATURES OF DARK MATTER IN GALAXY CLUSTERS: ANNIHILATION AND DECAY SCENARIOS

11.20-11.40 *Serhii Skolota, Elena Bannikova, Volodymyr Akhmetov, Peter Berczik, Maryna Ishchenko, Massimo Capaccioli* ORBITAL-VORTEX RESONANCE OF A GRAVITATING TORUS IN THE FIELD OF A CENTRAL MASS: APPLICATION TO AGNs

11.40-12.00 *Denys Ilchenko, Elena Bannikova, Albert Kotvytskiy GRAVITATIONAL LENSING EFFECTS ON AN INHOMOGENEOUS TORUS WITH A CENTRAL MASS*

12.00-12.20 *Albert Kotvytskiy, Štefan Parimucha* IMAGE CONSTRUCTION IN GRAVITATIONAL LENSES USING THE ELIMINATION METHOD IN AXIALLY SYMMETRIC CASES

12.20 – 13.20 ***Lunch***

13.20-13.40 *Maksym Tsizh, Franco Vazza COSMIC WEB EVOLUTION IN TERMS OF NETWORK METRICS*

13.40-14.00 *Y.Sahai, L.Zadorozhna, O.Prikhodko, A.Tugay, D.Malyshev, N.Pulatova* IMPLICATIONS OF PHOTON–AXION OSCILLATIONS ON X-RAY OBSERVATIONS OF THE COMA CLUSTER

14.00-14.20 *O.I.Gerasymov, L.S.Kudashkina* TOWARDS THE PARAMETERIZATION OF STRUCTURATION IN DISCRETE MULTISCALE MASS-CONGLOMERATIONS

14.20-14.40 *D.N.Doykov,M.D.Doykov A FEATURES OF LIGHNING SPECTRA IN "TRANSPERENCY WINDOWS" OF SOFT X-ray RADIATION*

14.40-15.00 *Marko D. Doikov* THE DESIGN AND MODELING OF HARD-RADIATION SPECTROGRAPHS FOR RECORDING FAST-FLOWING PROCESSES

ASTROPHYSICS 1
(nucleosynthesis, stellar atmospheres, kinematics, structure and chemical evolution of the galaxy)

Wednesday, 21.08.2024
(10.00 – 13.00)

(*Chair* – ***T.V.Mishenina***)

10.00-10.20 *V.S.Akhmetov, B.Bucciarelli, M.G.Lattanzi, M.Crosta, E.Yu.Bannikova, A.Spagna, P. Re Fiorentin* ANALYSIS OF THE GAIA DR3 ASTROMETRIC SOLUTION WITH VECTOR SPHERICAL HARMONICS

10.20-10.40 *A.H.Alili, K.I.Alisheva* DETERMINATION OF ZASTRA TEMPERATURES OF CENTRAL STARS OF NGC 246 AND NGC 7293 PLANETARY NEBULAE

10.40-11.00 *A.M.Dmytrenko, P.M.Fedorov, V.S.Akhmetov, A.B.Velichko, S.I.Denyshchenko, V.P.Khramtsov, I.B.Vavilova, D.V.Dobrycheva, A.A.Vasylenko, O.M.Sergijenko, O.V.Kompaniiets* 3D KINEMATICS OF GIANTS AND SUBGIANTS FROM THE GAIA DR3 DATA

11.00-11.20 *T.Mishenina, T.Gorbaneva, A.Dmytrenko, M.Pignatari, F.-K.Thielemann* SPECIFIC FEATURES OF THE ENRICHMENT OF METAL-POOR STARS WITH NEUTRON-CAPTURE (R-PROCESS) ELEMENTS

11.20-11.40 *D.Odynets, V.Akhmetov, P.Fedorov* BOTTLINGER'S FORMULAS FOR ESTIMATING THE DISTANCE FROM THE SUN TO THE GALACTIC CENTRE

11.40-12.00 *Tahereh Ramezani, Ernst Paunzen* OBSERVATIONS OF UNSTUDIED OPEN CLUSTERS IN THE UV

12.00-12.20 *A.B.Hasanova, A.Sh.Baloglanov, N.Z.Ismailov* SPECTRAL VARIABILITY OF THE Hβ, Hγ, Hδ LINES FOR THE SUPERGINAT HD 187982

12.20-12.40 *Usenko I.A., Miroshnichenko A.S., Danford S., Aarnio A.N., Vaidman N., Turner D., Majaess D.* SPECTROSCOPIC STUDIES OF POLARIS: GETTING BACK TO NORMAL LIFE OF A CEPHEID?

12.40-13.00 *Yushchenko V.A., Gopka V.F., Yushchenko A.V., Pavlenko Ya.V., Shavrina A.V., Musaev F., Demessinova A., Vasil'eva S.* THE ANALYSIS OF PM AND AC ABUNDANCE IN THE ATMOSPHERES OF MAGNETIC-PECULIARITY STARS HD25354

ASTROPHYSICS 2
(Interacting Binary Systems and Variable Stars)

Wednesday, 21.08.2024
(14.00 – 18.00)

(*Chair* – ***I.L.Andronov***)

14.00-14.20 *V.Breus, I.L.Andronov, P.Dubovsky, K.Petrik* THE INTERMEDIATE POLAR RX J2133.7+5107: SPIN, SUPERHUMP VARIABILITY AND THE NEW UNKNOWN PERIOD

14.20-14.40 *A.Dzygunenko, A.Baransky* CORRELATION ANALYSIS OF LIGHT CURVES AND ORBITAL PARAMETERS IN DWARF NOVAE

14.40-15.00 *N.Britavskiy* LET'S SHAPE UP THE INITIAL ROTATION DISTRIBUTION IN THE MASSIVE STAR DOMAIN

15.00-15.20 *B.N.Rustamov, Kh.M.Mikailov, S.O.Mammadova, K.I.Alisheva, V.İ.Aliyeva* THIRD COMPONENT IN ALGOL TYPE ECLIPSING BINARY SYSTEMS.

15.20-15.40 *I.L.Andronov, N.V.Savchuk, L.L.Chinarova, H.M.Akopian, S.I.Iovchev* DETERMINATION OF PHENOMENOLOGICAL CHARACTERISTICS OF A GROUP OF ECLIPSING STARS

15.40-16.00 *Marsakova V., Borshchenko V., Dubovsky V., Garbazhii-Romanchenko I., Lashkova A., Kreminska S., Andronov I., Dubovsky P.* INVESTIGATION OF POORLY STUDIED ECLIPSING VARIABLES

16.00-16.20 *Kh.M.Mikailov, A.B.Rustamova, I.A.Alekberov, B.N.Rustamov* ACTIVE STAGE OF THE SYMBIOTIC STAR CH CYG IN 2015

16.20-16.40 *Marsakova V., Shugarov S., Andronov I., Chinarova L.* RED GIANT PULSATIONS IN SYMBIOTIC VARIABLES RT SER AND UV AUR

16.40-17.00 *M.Yu.Pyatnytskyy, I.L.Andronov* ADDITIONAL PULSATION FREQUENCIES OF THE HADS STAR V965 CEP

17.00-17.20 *L.Keir, S.Udovichenko* THE R-BAND OBSERVATIONS AND COMPARISON WITH RESULTS IN THE V-BAND OF FI SGE

17.20-17.40 *L.Kudashkina, V.Marsakova, S.Shugarov, I.Andronov, L.Chinarova* THE PHOTOMETRIC BEHAVIOR OF A SYMBIOTIC STAR V919 Sgr

17.40-18.00 **General Discussion**

EXTRAGALACTIC ASTRONOMY AND ASTROINFORMATICS

Thursday, 22.08.2024
(10.00 – 13.40)

(*Chair* – ***I.B.Vavilova***)

10.00-10.20 *Oleksandra Pyshna, Vladislav Morozov, Alexander Baransky* LNM-SNCLASS - LARGE NUMBER OF MODELS SUPERNOVA CLASSIFIER

10.20-10.40 *Dobrycheva D., Vavilova I., Khramtsov V., Hetmantsev O., Vasylenko M., Melnyk O.* POST-PROCESSING AFTER MACHINE LEARNING LASSIFICATION: VISUAL INSPECTION OF SDSS GALAXIES AT Z<0.1

10.40-11.00 *Hetmantsev O., Dobrycheva D., Vavilova I., Gugnin O., Shportko A.* DEEP LEARNING APPROACHES FOR DETECTING POLAR RING GALAXIES

11.00-11.20 *Godłowski W., Popiela J., Mrzygłód B.* REMARKS ON THE LUMINOSITY FUNCTION OF GALAXY CLUSTERS

11.20-11.40 *Sviatoslav Yemelianov, Elena Panko* CLUSTER CARTOGRAPHY ON THE NEW PLATFORM AND ITS NEW POSSIBILITIES

11.40-12.00 ***Coffee break***

12.00-12.20 *Olena Kompaniiets, Iryna Vavilova, Małek Katarzyna, Agnieszka Pollo* MULTIWAVELENGTH PROPERTIES OF THE ISOLATED GALAXIES WITH ACTIVE NUCLEI AT Z < 0.05

12.20-12.40 *Vavilova I.B., Fedorov P.N., Dobrycheva D.V., Kompaniiets O.V., Sergijenko O., Vasylenko A.A., Dmytrenko A.M., Khramtsov V.P., Vasylkivskyi E.V.* AN ADVANCED APPROACH FOR DEFINITION OF THE "MILKY WAY GALAXIES-ANALOGUES"

12.40-13.00 *Pastoven O., Kompaniiets O., Vavilova I., Vasylkivskyi Ye.* ULTIWAVELENGTH ANALYSIS OF THE GALAXY NGC 3521

13.00-13.20 *Panko E.* THE INNER STRUCTURE OF GALAXY CLUSTERS IN THE TRIPLETS

13.20-13.40 *Karasova T., Masterson M.* EXPLORING THE HOST GALAXIES' CENTRAL CONCETRATION LEVEL OF A NEW POPULATION OF IR-SELECTED TIDAL DISRUPTION EVENTS

SOLAR SYSTEM, EXOPLANETS AND NEAR-EARTH ASTRONOMY

Thursday, 22.08.2024
(10.00 – 13.00, 14.00 – 18.20)

10.00 – 13.00 Section session (15 + 5 min)

*Convener – **N.I.Koshkin***

10.00-10.20 *Vadym Kaydash, Sergey Velichko, Yuriy Velikodsky, Viktor Korokhin, Yuriy Shkuratov*. LUNAR DISK FUNCTION EXPLORATION USING LROC NAC DATA

10.20-10.40 *S.Velichko, V.Korokhin, Yu.Velikodsky, V.Kaydash, Yu.Shkuratov, Y.Surkov.* MULTIPHASE PHOTOCLINOMETRY AS APPLIED TO THE LUNAR PHOTOMETRY WITH LROC NAC DATA

10.40-11.00 *Vasilij Chiorny, Yurij Krugly, Vasilij Shevchenko, Ivan Slyusarev, Olga Mikhalchenko.* ABSOLUTE PHOTOMETRY OF SMALL MAIN-BELT BINARY ASTEROIDS: THE PHYSICAL PROPERTIES

11.00-11.20 *D.Svincicka, I.Eglitis.* DETERMINATION OF THE ROTATION PERIOD OF ASTEROIDS FROM A SHORT SERIES OF BRIGHTNESS OBSERVATIONS UNEVENLY SPREAD OVER A LONG TIME INTERVAL

11.20-11.40 *Valeriia Rychahova, Ivan Slyusarev, Vadym Kaydash, Irina Belskaya, Vasilij Shevchenko.* REFINED CLASSIFICATION OF ORANGE MATERIAL DEPOSITS ON ASTEROID VESTA

11.40-12.00 *A.Aleksandrov, O.Golubov*. FORMATION AND DESTRUCTION OF BINARY ASTEROIDS

12.00-12.20 *Andrii Panasiuk, Oleksiy Golubov, Ihor Kyrylenko*. SIMULATION OF DEFLECTION OF HAZARDOUS ASTEROIDS

12.20-12.40 *Oleksiy Golubov, Olga Mikhalchenko, Veronika Lipatova.* NON-LINEAR THERMAL MODEL OF THE YARKOVSKY EFFECT

12.40-13.00 *V.V.Kleshchonok*. INCREASE IN ACTIVITY OF COMET 67P/CHURYUMOV–GERASIMENKO ON AUGUST 22–23, 2015, AS OBSERVED BY THE OSIRIS INSTRUMENT ON THE ROSETTA MISSION

13.00 – 14.00 *Lunch*

14.00 – 18.20 Section session (15 + 5 min)

*Convener – **O.A.Bazyey***

14.00-14.20 *A.S.Kasianchuk, V.M.Reshetnyk*. THE SEARCH FOR NEOS AS POTENTIAL CANDIDATES FOR USE IN SPACE MISSIONS TO VENUS AND MARS

14.20-14.40 *I.Luk'yanyk, O.Ivanova, V.Rosenbush, C.Snodgrass, D.Gardener*. A COMPREHENSIVE STUDY OF COMET 67P/CHURYUMOV-GERASIMENKO IN THE 2021-2022 APPARITION: I. OBSERVATIONS AND PRELIMINARY RESULTS

14.40-15.00 *A.Golubaev, A.Mozgova*. METEOR BODIES PHYSICAL PARAMETERS ESTIMATION TAKING INTO ACCOUNT THEIR CHEMICAL COMPOSITION DETERMINED FROM SPECTRAL OBSERVATIONS

15.00-15.20 *M.Kulichenko, N.Maigurova, O.Shulga.* COLOR-INDEX DETERMINATION OF METEORS USING TV CCD CAMERAS

15.20-15.40 *O.Kozhukhov, M.Medina*. NOAP PLANNER 0.6.5 – FEATURES OF PLANNING NEO OBSERVATIONS WITH ONE BUTTON

15.40-16.00 *O.Bryukhovetskyi, O.Kozhukhov, A.Ozerian, D.Kozhukhov, I.Kononchuk, S.Khlamov*. RESULTS OF USING A NEW ASTRONOMICAL IMAGE PROCESSING PROGRAM AT NSFCTC

*Convener – **O.M.Kozhukhov***

16.00-16.20 *Viktor Kudak, Vasyl Perig*. MODELING OF RESIDENT SPACE OBJECT LIGHTCURVES WITH BLENDER SOFTWARE

16.20-16.40 *L.Shakun, N.Koshkin, E.Korobeynikova, S.Melikyants, S.Strakhova, S.Terpan, T.Golubovskaya, V.Dragomiretsky, A.Ryabov.* DETERMINATION OF THE SPIN AXIS ATTITUDE OF AJISAI SATELLITE BY PHOTOMETRIC PATTERNS METHOD

16.40-17.00 *N.Koshkin, L.Shakun, O.Kozhukhov, O.Briukhovetskyi, V.Dragomiretsky, E.Korobeinikova, V.Kudak, S.Melikyants, V.Perig, A.Ryabov, I.Salnikov, S.Strakhova, Ye.Vovchyk.* ON THE POSSIBILITY OF USING THE "PHOTOMETRIC PATTERNS" METHOD TO DETERMINE THE ROTATION AXIS OF RSOs THAT REFLECT SUNLIGHT ALMOST DIFFUSELY

17.00-17.20 *P.M.Kozak.* ESTIMATION OF THE PROBABILITY FOR DAMAGING AN ARTIFICIAL SATELLITE FROM STREAM AND SPORADIC METEOROIDS

17.20-17.40 *P.M.Kozak, I.V.Luk'yanyk, S.V.Stariy, LV.Kozak, O.B.Stelya*. THE EXPERIENCE OF DOUBLE-STATION METEOR OBSERVATIONS FOR DEVELOPMENT OF VIDEO OBSERVATION NETWORKS FOR MONITORING LOCAL ZONES IN AIRSPACE

17.40-18.00 *A.A.Strautman, O.A.Bazyey.* MODELING SPACE DEBRIS IN NEAR-EARTH SPACE

18.00-18.20 *V.Psaryov, Yu.Velikodsky, V.Konichek, I.Sinelnikov.* PHOTOMETROLOGICAL PROPERTIES OF CANON EOS 6D MARK II

RADIO ASTRONOMY

Friday, 23.08.2024

(09.30 – 13.30, 14.30 – 17.35)

(*Chairs – **O.M.Ulyanov, O.A.Litvinenko***)

09.30-09.45 *R.V.Vashchishin, V.O.Shepelev, O.O.Litvinenko, A.B.Lozinsky* ANGULAR BRIGHTNESS DISTRIBUTION OF QUASAR 3C268.4 AT DECAMETER WAVELENGTHS

09.50-10.05 *V.N.Melnik, V.A.Shepelev, V.V.Dorovskyy, A.I.Brazhenko, A.V.Frantsuzenko* INTERFEROMETER OBSERVATIONS OF TYPE IV BURST AT 20 AND 25 MHZ ON 29 MAY 2014

10.10-10.25 *Shepeliev V.O., Vashchishyn R.V., Litvinenko O.O., Lozynskyi A.V.* STUDY OF RADIO GALAXIES 3C268.1 AND 3C268.3 WITH URAN INTERFEROMETERS

10.30-10.45 *Ivar Shmeld, Vladislavs Bezrukovs* IRBENE SINGLE BASELINE RADIO INTERFEROMETER

10.50-11.05 *Vladislavs Bezrukovs, Ivar Shmeld* MULTI-WAVELENGTH VLBI POLARISATION ANALYSIS OF SELECTED BL LAC OBJECTS

11.10-11.30 ***Coffee break***

11.30-11.45 *A.A.Stanislavsky, A.A.Konovalenko, I.M.Bubnov, L.A.Stanislavsky, P.Zarka, A.Loh, C.Viou, R.V.Vaschishyn, A.V.Frantsuzenko, V.I.Myrhorod* TYCHO'S SUPERNOVA REMNANT AT LOW FREQUENCIES

11.50-12.05 *Yevhen Vasylkivskyi, Oleksandr Konovalenko, Iryna Vavilova* DETECTION OF RADIO EMISSION FROM WEAK RADIO SOURCES IN DIURNAL SPECTRA OF UTR-2 RADIO TELESCOPE

12.10-12.25 *Yevhen Vasylkivskyi, Oleksandr Konovalenko, Sergiy Stepkin* FIRST RESULTS OF UTR-2 LARGE-SCALE SURVEY OF IONIZED CARBON IN THE GALAXY

12.30-12.45 *O.Ulyanov, C.Tiburzi, A.Shevtsova, V.Zakharenko, A.Konovalenko, P.Zarka, J-M.Grießmeier, S.Yerin, I.Kravtsov, A.Brazhenko, A.Frantsuzenko, M.Skoryk, A.Skoryk, I.Bubnov* USE OF PULSAR PULSES FOR PROBING SPACE MAGNETOACTIVE PLASMA

12.50-13.05 *Shevchuk M., Melnik V., Dorovskyy V., Konovalenko A.* DETERMINATION OF THE CME CORE PARAMETERS BY THE RADIO ASTRONOMICAL METHODS

13.10-13.25 *O.L.Ivantyshyn, B.P.Rusyn, A.B.Lozynskyy, D.O.Ivantyshyn* INVESTIGATION OF SOLAR COSMIC RAYS INFLUENCE ON ATMOSPHERIC INFRASOUND

13.30-14.30 ***Lunch***

14.30-14.45 *D.A.Zabora, M.I.Ryabov, A.L.Sukharev* PROCESSES IN JETS OF AGNS ACCORDING TO RADIO ASTRONOMICAL MONITORING ON MOJAVE VLBI SYSTEM

14.50-15.05 *Taisiia Karasova, Dillon Dong* STOKES V SURVEY WITH VLASS3.2 DATA

15.10-15.25 *N.O.Tsvyk* S-BURSTS OF JOVIAN DECAMETER RADIO EMISSION STORMS UNDER THE INFLUENCE OF LOW AND HIGH FREQUENCY MHD DISTURBANCES IN STREAMER-LIKE SOURCES

15.30-15.45 *A.P.Miroshnichenko* EVOLUTION OF THE JET EMISSION OF RADIO SOURCES WITH STEEP LOW-FREQUENCY SPECTRA

15.50-16.10 ***Coffee break***

POSTER REPORTS

16.10-16.20 *I.M.Bubnov, L.A.Stanislavsky, A.A.Konovalenko, A.A.Stanislavsky, V.V.Zakharenko, O.M.Ulyanov, A.V.Ilyushin, A.S.Belov, V.V.Shevchenko, V.Yu.Selin, A.M.Reznichenko, V.V.Bortsov, M.V.Shevchuk, M.A.Sidorchuk, A.I.Miasoied, P.A.Makovecky, S.D.Velichko* THE START OF RESTORATION OF THE GURT RADIO TELESCOPE

16.25-16.30 *Dmytro Chechotkin, Oleksiy Dudnik, Oleksandr Yakovlev* UTILIZATION OF THE TRIGGER MODE IN THE RPW/SOLAR ORBITER WORK REGIME TO DETECT COMPRESSION REGIONS IN THE SOLAR WIND STREAM

16.35-16.40 *O.Reznichenko, V.Bortsov, M.Bortsova, O.Ulyanov, I.Bubnov, E.Vasylkivskyi* THE NEW GENERATION DIGITAL RADIO ASTRONOMY RECORDER. DEVELOPMENT AND LABORATORY TESTS RESULTS

16.45-16.50 *V.V.Orlov, O.A.Lytvynenko, V.G.Derevyagin* MODELING OF AN ANTENNA ARRAY FOR THE TASKS OF INCREASING THE RESOLUTION IN LONG-WAVE RADIO ASTRONOMY

16.55-17.00 *V.G.Derevyagin, O.A.Lytvynenko, V.V.Yasynskyi* MULTI-FUNCTIONAL RADIOMETER BASED ON THE STM32F446 MICRO CONTROLLER FOR URAN-4 RADIO TELESCOPE

17.05-17.35 **Discussion and closing of the Radio Astronomy section**

SUN, SOLAR ACTIVITY, SOLAR-TERRESTRIAL RELATIONS AND ASTROBIOLOGY

Thursday, 22.08.2024

(09.30 – 13.10, 14.00 – 15.45)

(*Chairs – **V.M.Efimenko, M.I.Ryabov***)

09.30-09.45 *O.V.Yakovlev, O.V.Dudnik, A.Wawrzaszek* STATISTICAL ANALYSIS OF THE SOLAR WIND AND INTERPLANETARY MAGNETIC FIELD PARAMETERS DURING SHOCK WAVE EVENTS DETECTED WITH SOLAR ORBITER MISSION IN 2023

09.45-10.00 *Kyzyurov Yu., Malovichko P.* SMALL-SCALE PLASMA FLUCTUATIONS IN TURBULENT FLOWS OF ACTIVE REGIONS AT THE SOLAR PHOTOSPHERE

10.00-10.15 *Dorovskyy V.V., Melnik V.N., Brazhenko A.I., Shevchuk M.V.* ON THE PROPERTIES OF INDIVIDUAL DECAMETER S-BURSTS OBSERVED IN A DENSE STORM

10.15-10.30 *V.M. Efimenko, V.G. Lozitsky* ABOUT CHANGES IN THE SPEED OF THE NUMBER OF SUNSPOTS DURING THE CYCLE GROWTH PHASE AND CLARIFICATION OF THE AMPLITUDE OF THE 25TH SOLAR CYCLE

10.30-10.45 *N.M.Kondrashova, M.M.Pasechnik, S.M.Osipov, M.I.Pishkalo* EVOLUTION AND FLARE ACTIVITY OF CARRINGTON-CLASS SOLAR ACTIVE REGION NOAA 13664 AND ITS IMPACT ON THE EARTH

10.45-11.00 *Krivodubskij V.N.* MACROSCOPIC TURBULENT DIAMAGNETISM OF SOLAR PLASMA

11.00 – 11.30 ***Coffee break***

11.30-11.50 *O.V.Dudnik R.F.Wimmer-Schweingruber, O.V.Yakovlev, G.M.Mason, B.O.Dudnik, F.Espinosa Lara G.C.Ho, J.Rodríguez-Pacheco M., R.Gómez Herrero, N.Dresing, A.Képa, A.Kouloumvakos* ACCELERATION OF SEPS DURING THE SOLAR BACKSIDE EVENT AND THE HALO-TYPE ICME ON MARCH 13-14, 2023

11.50-12.05 *N.I.Lozitska, M.A.Hromov I.I.Yakovkin, V.G.Lozitsky* COMPARISON OF MAGNETIC FIELD MEASUREMENTS IN A SUNSPOT USING SPECTRAL LINES WITH DIFFERENT LANDE FACTORS AND FORMATION HEIGHT IN ATMOSPHERE

12.05-12.20 *O.Bilokon* COMPARATIVE ANALYSIS OF PULSATIONS AT VARIOUS PHASES F FLARE BY THERMAL AND NON-THERMAL RADIATION OF PLASMA

12.20-12.35 *M.I.Ryabov, A.L.Sukharev, Ye.M.Strakhov, N.Didenko* WHAT ARE THE UNUSUAL PROPERTIES OF THE 25th CYCLE OF SOLAR ACTIVITY

12.35-12.50 *Orlyuk M., Romenets A., Marchenko A., Orliuk I.* SPATIO-TEMPORAL PERTURBATION OF THE EARTH'S MAGNETIC FIELD ALONG THE "STRUVE GEODETIC ARC"

12.50-13.05 *T.Sumaruk, J.Reda* DIAGNOSTICS OF THE SOURCES OF GEOMAGNETIC VARIATIONS FOR THE SUPERSTORM OF MAY 10-13, 2024

13.10 – 14.00 ***Lunch***

14.00-14.15 *Shepeliev V.O., Lytvynenko O.O., Panishko S.K., Derevyagin V.G., Pidgornyi G.S.* IONOSPHERIC SCINTILLATIONS AT DECAMETER WAVELENGTHS DURING THE EXTREME GEOMAGNETIC STORM IN MAY 2024

14.15-14.30 *A.L.Sukharev, M.I.Ryabov, M.I.Orlyuk, Yu.Sumaruk, D.Zabora, V.Derevyagin, Ye.Strakhov, M.Didenko* EFFECTS OF THE EXTREME MAGNETIC STORM ON MAY 10-11, 2024 AND ITS MANIFESTATION IN THE AREA OF THE ODESSA MAGNETIC ANOMALY

14.30-14.45 *A.L.Sukharev, M.I.Ryabov, V.V.Galanin* ABOUT THE MANIFESTATION OF IONOSPHERIC AND GEOMAGNETIC STORMS ACCORDING TO THE MONITORING DATA OF HIGH-POWER RADIO SOURCES AT THE URAN-4 RADIO TELESCOPE OF THE IRA NASU

14.45-15.00 *Doikov D.M., Doikova E.M., Zherdev M*. THE EXISTENCE OF SIMPLEST BIOLOGICAL STRUCTURES IN THE FIELD OF HARD RADIATIONS

15.00-15.15 *T.Sumaruk, N.Stryamets, P.Prydka* INFLUENCE OF THE EARTH'S MAGNETIC FIELD ON THE BIOPOTENTIAL OF THE TREES OF THE UKRAINIAN ROZTOCHYA

15.15-15.30 *V.Bezrukovs, I.Usoskin, M.Ryabov, M.Orlyuk, A.Sukharev, J.Steinbergs* COMPLEX ANALYSIS OF SPACE WEATHER MANIFESTATION IN THE "STRUVE GEODETIC ARC" AREA BY USING OF RADIO ASTRONOMICAL OBSERVATIONS, GEOMAGNETIC MEASUREMENTS AND COSMIC RAYS VARIATIONS

15.30-15.45 *Isaeva E.A.* DIAGNOSTICS OF SOLAR PROTON EVENTS, AS WELL AS CORONAL SHOCK WAVES, USING THE PARAMETERS OF TYPE II AND IV SOLAR RADIO BURSTS

ASTRONOMICAL EDUCATION AND ASTRONOMY OUTREACH

Thursday, 22.08.2024

(10.00 – 12.00)

(*Chair* – ***I.L.Andronov***)
(15 + 5 minutes for the report)

10.00-10.20 *E.Panko, O.Sergienko, S.Guziy* EDUCATION AND SCIENTIFIC CENTER KALINENKOV ASTRONOMICAL OBSERVATORY. ON THE CENTENARY OF PROFESSOR KALINENKOV

10.20-10.40 *I.L.Andronov* ASTRONOMY OUTREACH IN UKRAINE

10.40-11.00 *O.Kompaniets* SCIENCE KIDS: INSPIRING THE NEXT GENERATION OF CURIOUS MINDS

11.00-11.20 *L.S.Kudashkina* THE EDUCATIONAL PROGRAM OF 'ASTROTOURISM'

11.20-11.40 *L.L.Chinarova, I.L.Andronov* THE TEXTBOOK “ELEMENTS OF THEORY OF PROBABILITY ANS MATHEMATICAL STATISTICS”

BIOLOGIC SECTION

"THE IMPORTANCE OF G. GAMOW'S IDEAS FOR BIOLOGY OF THE 21st CENTURY"

Friday, 22.08.2024 (10.00 – 14.00, 15.00 – 17.00)

10.00-17.00 **Section session** (25 or 15 min for report and 5 min for discussion)

(*Convener* – ***S.V. Chebotar***)

10.00-10.10 OPENING OF THE BIOLOGICAL SESSION *S.Chebotar*

10.10-10.40 *N.Borisjuk, A.Stepanenko, G.Chen, T.Michael, E.Lam, V.Schubert, I.Schubert* FIRST NUCLEOTIDE LEVEL STRUCTURE of 5S and 35S rDNA LOCI FOR PLANTS

10.40-11.10 *Yu.O.Tynkevich, I.I.Panchuk, R.A.Volkov* CONSERVED SEQUENCE ELEMENTS IN THE 5S RDNA INTERGENIC SPACER ARE PRESENT IN THE GENOMES OF DISTANTLY RELATED ANGIOSPERMS

11.10-11.25 *P.Satpathy, M.Mirzakhmedov, H.Büchner, S.Chamas, I.Hoffie, D.S. Daghma, J. Kumlehn* GENERATION OF HAPLOIDY INDUCERS IN BARLEY BY CAS9-MEDIATED KNOCKOUT OF PHOSPHOLIPASE A1.

11.25-11.40 *Yu.A.Popovych, O.M.Blagodarova, S.V.Chebotar* APPLICATION OF NEW MOLECULAR MARKERS FOR DETECTING OF GENETIC POLIMORPHISM OF UKRAINIAN CULTIVARS OF TRITICUM DURUM L.

11.40-12.00 *G.Chebotar* ENSURING DATA ACCESSIBILITY AND REUSABILITY: THE FAIR APPROACH TO RESEARCH DATA MANAGEMENT

12.00-12.10 ***Coffee break***

12.10-12.40 *O.Yushchuk, A.Barkhatova, A.Chyzh, Y.Mast, F.Marinelli, V.Fedorenko* DEVELOPING A GENETIC TOOLKIT TO MANIPULATE THE RARE ACTINOBACTERIUM UMEZAWAEA ENDOPHYTICA DSM 103496

12.40-13.00 *S.Melnyk, M.Stierhof, D.Bratiichu, Yu.Rebets, A.Luzhetskyy, B.Ostash* EXPLORING THE GENOMIC POTENTIAL OF STREPTOMYCES ROSEOCHROMOGENES NRRL 3504 FOR SPECIALIZED METABOLITE PRODUCTION

13.00-13.20 *V.-M.Tseduliak, O.Koshla, B.Ostash, A.Luzhetskyy, S.Matsumoto, Y.Ohtsubo, Y.Nagata* EFFECTS OF MUTATED RIBOSOMAL PROTEIN S12 ON STREPTOMYCES ALBIDOFLAVUS J1074

13.20-13.40 *I.Roman, V.Fedorenko, O.Gromyko* THE IMPACT OF BIOINFORMATICS TOOLS IN THE CLASSIFICATION OF PROKARYOTES, THE CASE OF THE GENUS ACTINOPLANES

13.40-14.00 *D.O.Zharikova* THE UNEXPLORED RELATIONSHIP BETWEEN THE EPIGENOME AND THE ROOT MICROBIOME OF ZEA MAISE

14.00-15.00 ***Lunch***

15.00-15.30 *K.Snape* CANCER GENOMICS: CLINICAL INTERROGATION OF THE TWO GENOMES OF CANCER PATIENTS

15.30-16.00 *R.Sydor, N.Senchenko, N.Shenderovska, M.Heichenko , I.Starenka, I.Savinova, D.Semeniuk, N.Hrubiian, R.Vietrov, S.Novosolov, S.Panashchuk, A.Olkhovska, M.Trokoz, O.Hubar* MULTIFACTORIAL ENGINEERING OF CAP-LESS mRNAs FOR ENHANCED *IN VITRO* POTENCIES

16.00-16.20 *Yu.Monczak* MEASURABLE RESIDUAL DISEASE (MRD) IN LYMPHOID MALIGNANCIES: THE HAYSTACK, THE NEEDLE, AND HOW TO FIND IT

16.20-16.40 *Xianran Li* GRAPHING LARGE INDEL-BASED HAPLOTYPES FROM PAN-GENOME FACILITATES GENE DISCOVERY

16.40-17.00 CLOSING OF THE BIOLOGICAL SESSION

XXIV Gamow International Astronomical Conference

"ASTRONOMY AND BEYOND: ASTROPHYSICS, COSMOLOGY AND GRAVITATION, ASTROPARTICLE PHYSICS, RADIO ASTRONOMY, ASTROBIOLOGY AND GENETICS"

(August 19-23, 2024, Odesa, Ukraine)

MEMORIAL SESSIONS

A.M.SHULBERG (27.05.1914 – 01.09.1994) AND THE MODELING OF ECLIPSING BINARY SYSTEMS WITH SPHERICAL COMPONENTS (to the 100th anniversary of the birth of Aleksandr Mikhailovich Shulberg)

Andronov I.L
Odesa National Maritime University, Odesa, Ukraine

In 2024, occurs the 110th anniversary of the birth of A.M.Shulberg (also written as Shul'berg and Schulberg) and 30 years after his death, who teached few generations of astronomers in Odesa at the Department of Astronomy Of the Odesa Mechnikov State (now National) University. He was a brilliant lecturer, and a very kind person. The detailed brilliant essay on his Life and various activities was published after his death by Prof. Valentin G., Karetnikov (22.08.2038-07.05.2024) who passed away this year. This essay is available at http://www.astro-observ-odessa0.1gb.ua/dat/History/shulberg.pdf, The life trajectory of A.M.Shulberg was complicated. After the school, A.M. Shulberg continued his studies at the railway technical school, where he worked as an assistant driver on a steam locomotive. Then he entered the evening department of the Odessa Institute of Public Education, from which Odessa University was restored in 4 years. He successfully graduated from the Faculty of Physics and Mathematics of Odessa University in 1937, and was recommended for postgraduate studies. Professor K.D.Pokrovsky, the head of the Department of Astronomy and Geodesy and famous scientist, initiated A.M.Shulberg to work in Astrophysics (concretely, spectroscopy of close binary stars) and his supervisor was the great astrophysicist V.A.Krat. At this time, a huge observational material on photometry of eclipsing binary stars was collected, and spectral observations were extremely important for more complete study of these objects. Even now, 87 years after this, the CALEB https://caleb.eastern.edu/ contains information of only 227 systems with spectral observations in 55 constellations (out of 88), whereas the number of photomerically discovered binary stars is hundreds thousand.

A.M.Shulberg has to work not only in the Odessa University (all his further carrier), but also lectured in other organizations and even a school. During the Word War II, he fought in the army from a soldier to a captain, and had two wounds and a contusion. After the war, he continued lecturing. The publications were in the Soviet journals, the majority of them are still not digitized and are absent in the Internet. Even his monograph Close binary systems with spherical components https://ui.adsabs.harvard.edu/abs/1971cbsw.book.....S is available officially only in the "paper" libraries.

One may say that this book "ends the era of pre-computer" modeling of the light curves of the eclipsing binary stars, also marked by famous monographs by V.P.Tsesevich (1907-1983), a head of Astronomy in Odessa in 1944-1983 (https://ui.adsabs.harvard.edu/abs/1971isme.conf.....T) and Z.Kopal (1914-1993) (https://ui.adsabs.harvard.edu/abs/1959cbs..book.....K), despite, A.M.Shulberg started to use computers, when available. Further mainstream started on the Wilson-Devinney (https://ui.adsabs.harvard.edu/abs/1972ApJ...171..413W) "WS" model and its numerous realizations and improvements. The 50-year history of the WD method was reviewed in https://ui.adsabs.harvard.edu/abs/2022Galax..10...17K.

A.M.Shulberg was a supervisor of the PhD thesis of V.G.Karetnikov (1938-2024), who was the head of the Department of Astronomy (1983-2006) and also the director of the Astronomical Observatory (1989-2006). He actively studied binary stars at the first stage of evolution. Under his supervision, the PhDs defended S.M.Andrievskii, K.A.Antoniuk, L.V.Glazunova, E.V.Menchenkova, F.V.Sirotkin, G.V.Volkova. For more than two decades, the eclipsing binary stars, the scientific direction of A.M.Shulberg, are a part of studies in our group.

KANT AND LAPLACE – IN SEARCH OF THE ROOT CAUSE
(to the 300th anniversary of the birth of I.Kant and the 275th anniversary of the birth of P.Laplace)

Bazyey O.A. [1,2]***, Tomina A.-M.V.*** [3]
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2024 marks the 300th anniversary of the birth of the German philosopher Immanuel Kant and the 275th anniversary of the birth of the French astronomer and mathematician Pierre Laplace. For the first time in history, they made an attempt to create hypotheses of the formation of the Solar System from a primordial gas-dust nebula.

In his work "General Natural History and Theory of Heaven" (1755), Kant is simultaneously a philosopher, an artist and a scientist. Based on Newton's laws, he makes an attempt to explain the origin of the Solar System and even the entire universe. According to Kant, the first cause of the existence of the Universe is God, the forces of attraction and the forces of repulsion. From the primary rarefied chaotic state, the substance begins to move and forms a condensation. Condensations grow and unite, stars and planets around them are formed.

Pierre Laplace made many advances in applied mathematics and astronomy, and their effects are still felt today. He applied his mathematical abilities to the problems of celestial mechanics. In 1796, Laplace published the nebular hypothesis, which posited that the Solar System formed from the gravitational compression of an initially large, diffuse, and slowly rotating cloud of interstellar gas. Laplace relies on astronomical data, believes that the orderliness of the movements of the celestial bodies of the Solar System is determined by the law of universal gravitation. He considers only the natural causes of the formation and movement of the planets. Laplace considers his hypothesis as one possible explanation. And this explanation needs evidence.

Elements of Kant's and Laplace's hypotheses have been preserved in modern cosmogonic ideas, such as the idea of the joint formation of the Sun and the planets from a single primordial nebula and the rotational instability of the protoplanetary disk. One of the nebular hypotheses is generally accepted nowadays.

400 YEARS OF RELATIVITY PRINCIPLE

Alessandro Bettini
University of Padova and INFN

Four hundred years ago, in 1624, G. Galilei gave the first experimental proof of the fundamental physical law that we now call Relativity Principle (RP), launching a key high in the air sitting in a fast moving boat. In the same year he wrote the famous page on the “Gran Naviglio” (Great Vessel) experiment, declaring the universal validity of the RP.

Newton in the Principia showed the RP to be a consequence of the Laws of motion. Doubts on its validity outside mechanics arose with the introduction of the luminiferous ether, once the wave nature of light was established.

One hundred twenty years ago, in 1904, H. A. Lorentz discovered the space-time transformations and H. Poincaré re-established the universal validity of the Galilei law, giving it the name of Relativity Principle.

I will finally recall how in 1911 V. S. von Ignatowsy showed that the Lorentz transformations – the other pillar of the entire physics - are consequence of basic properties of space-time, and of the inertia law, independently of the electromagnetism.

A FIL ROUGE OF GENIUS: FROM GALILEI TO GAMOW

Massimo Capaccioli
Università di Napoli Federico II, Italy

Anniversaries are occasions to reread the past, to rejoice or to mourn, as the case may be. It is in this sense that this year's commemoration of a formidable trio of scientists, Galileo Galilei, Dmitri Mendeleev, and George Gamow, who were born 460, 190 and 120 years ago respectively, should be understood. A coincidence without any substantial value and not even too elitist (it recurs identically every 10 years). However, it allows us to reflect on the history of modern cosmology, since so many milestones in the path of this science are linked to the three characters.

ONOMASTICS AND NAMES OF THE STARRY SKY
(to the 95th anniversary of Professor, Corresponding Member of the Academy of Sciences of Ukraine Y.O.Karpenko – author of the book "Names of the Starry Sky")

O.Y.Karpenko [1]***, M.I.Ryabov*** [2]
[1] *ONU, Odesa, Ukraine*
[2] *IRA NASU, Odesa, Ukraine*

Yuriy Oleksandrovych Karpenko would have turned 95 this year. He was born in 1929 and lived a full and mostly happy life despite the hardships of his wartime childhood. He got his master’s degree from Lviv University, completed his PhD and doctoral programs in Chernivtsy University, many years taught students in Odesa University, was elected member of the National Academy of Sciences of Ukraine.

The scientific contributions of Yuriy Karpenko are impressive: he is the author of about 500 works (http://karpenko.in.ua), and under his supervision, 62 PhD and 5 doctoral dissertations have been defended. He initiated the publication of many scientific collections, including the annual collection of onomastic papers *Opera in onomastica* (http://zzo.onu.edu.ua). The Odesa Onomastic School, founded by Yuriy Oleksandrovych, continues to actively develop.

Onomastics gradually became the main interest of Yuriy Karpenko’s scientific research. Yu. O. Karpenko developed the concept of the toponymic system, the ratio

of proper and common names; the methodology of the futurological study of proper names, the theory of literary onomastics, the typology of literary proper names. He was drawn to humorous onomastics. He was the author of the concept of Ukrainian ethnology, including the origin of the Ukrainian language, developed the theory of general phonology and the phonology of the Ukrainian language.

Possessing outstanding knowledge in the field of onomastics, he wrote a unique book *Names of the Starry Sky*, which has no analogues to this day. According to the author, "the cosmos is not only other physical states and other worlds. From galaxies and constellations to minor planets and even meteorites, man-made space objects have their own names. The human path of knowledge has always been accompanied by words. Man denoted all his discoveries and victories by means of language – he named them. Without this, without such names, there would be no point in thinking about the accumulation of knowledge, about passing it on to subsequent generations". The coverage of topics reflected in the book is enormous: star names, galaxies, constellations, asterisms, stars, planets, satellites of planets, asteroids, comets, the surface of the Moon. The time has come to publish an edition of this book in Ukrainian and English.

GAMOW CONFERENCE IN WASHINGTON UNIVERSITY AND 30-TH ANNIVERSARY GAMOW'S CONFERENCE IN ODESA UNIVERSITY

M.I. Ryabov
IRA NASU, Ukraine

2024 is the year of the 120th anniversary of the birth of George Gamow. George Gamow was one of the most influential physicists and cosmologists of the 20th century. He made significant and decisive contributions to modern physics, cosmology, and biology. His three most notable contributions include:

1. Discovery of the quantum nature of alpha decay in nuclear physics (1928).
2. Proposal of the Hot Universe theory (1946-1953).
3. Deciphering the genetic code in biology (1954).

George Gamow was born in Odesa on March 4, 1904. He completed his secondary education there and was a student at the Odesa (Novorossiysk) University for two years. Gamow studied at Odesa University from 1921 to 1922, during which he worked as an evaluator at the astronomical observatory. In his book *My World Line*, Gamow outlined his journey in science, which began in Odesa. His academic pursuits and the start of his scientific career continued in Leningrad. Later, his work and travels took him across Europe, including to world-renowned centers of theoretical physics such as Copenhagen and Cambridge. A significant part of his "world line" took place in the United States, where he arrived in 1934 and remained until the end of his life.

When George Gamow was offered a position at George Washington University in 1934, he set one condition for accepting the offer: the establishment of an annual physics conference at the university, co-sponsored by the Carnegie Institution. At that time, Foggy Bottom, the Washington neighborhood where GWU is located, was not particularly known for physics. However, Gamow aimed to bring the "spirit of Copenhagen" to this location and to attract an international group of theorists. The Washington Conference on Theoretical Physics first convened in 1935 and was held annually until 1947. After the tenth meeting in 1947, Gamow's focus shifted from nuclear physics to cosmology, and he began working more closely with graduate students and local collaborators. As a result of diminished interest, the conference was no longer held.

Topics of the Gamow Conferences:

- 1935: First Washington Conference on Theoretical Physics: Nuclear Physics.
- 1936: Second - Molecular Physics.
- 1937: Third - Problems of Elementary Particles and Nuclear Physics.
- 1938: Fourth: Stellar Energy and Nuclear Processes.
- 1939: Fifth - Low Temperature Physics and Superconductivity.
- 1940: Sixth - Geophysics and the Interior of the Earth.
- 1941: Seventh - Elementary Particles.
- 1946: Ninth - Physics of Living Matter.
- 1947: Tenth - Gravitation and Electromagnetism.

This year marks the 7th Gamow Memorial Conference in Odesa, following those held in 1994, 1999, 2004, 2009, 2014, and 2019. These conferences are held every five years. Since 2000, annual Gamow conferences have also been held. In 2024, this will be the 24th Gamow Conference. Our goal is to bring together experts in modern astrophysics, cosmology, high-energy physics, and biology, along with interested scientists and students, to discuss the latest developments and challenges related to these topics, exchange ideas, and review major experimental and theoretical efforts.

It appears that we were inspired by the "spirit of the Gamow Conferences" at George Washington University, as the topics of the Odesa Gamow Conferences are also very broad. On the wall of the main building of the university, there is a memorial plaque dedicated to Gamow. Following the appeal of participants of the First Gamow Conference in 1994 and the rector of Odesa University to the Mayor of Odesa, a decision was made to name one of the city's beautiful squares after Gamow. As a result of the work of the Gamow Conferences, the Jubilee Gamow Medal and scholarships for students of physics and astronomy were established at Odesa University.

Gamow Conferences in Odesa have been held for 30 years (without interruption!) thanks to the dedicated efforts of the members of the Scientific and Local Organizing Committee, representing the Astronomical Observatory of Odesa I.I. Mechnikov National University, the Institute of Radio Astronomy of the National Academy of Sciences of Ukraine, with the unwavering support of the Ukrainian Astronomical Association, and the active participation of the Odesa Astronomical Society.

PLENARY SPEAKERS

Λ_sCDM COSMOLOGY: A PROMISING PARADIGM FREE OF COSMOLOGICAL TENSIONS

Ö. Akarsu
Department of Physics, Istanbul Technical University, Turkey

The Λ_sCDM cosmology has emerged as a compelling new paradigm, demonstrating unprecedented success in aligning with observational data from various datasets and effectively resolving major cosmological tensions. This model is characterized by a minimal deviation from the standard ΛCDM model, proposing a rapid Anti-de Sitter (AdS) to de Sitter (dS) transition in the late universe ($z \sim 1.7$), inspired by the graduated dark energy (gDE) model. In this talk, we will provide a concise introduction to major cosmological tensions and the Λ_sCDM cosmology, followed by a discussion of the latest theoretical and observational developments that underscore Λ_sCDM as a promising candidate and/or guide for a new concordance cosmological model of the Universe.

VARIABLE STARS: CLUES FROM THE MULTI-COMPONENT VARIABILITY

I.L. Andronov[1], L.L. Chinarova[1], L.S. Kudashkina[1], H.M. Akopian[1], V.O. Borshchenko[1], V.V. Breus[1], S.I.Iovchev[1], S.V. Kolesnikov[1], N.V. Savchuk[1], V.I. Marsakova[2], M.Yu. Pyatnytskyy[3]
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We review some highlights on phenomenological modeling of variability of stars of different types based on the data obtained using ground-base and space telescopes and published in photometric surveys. The need of a net of different phenomenological models is justified by the diversity of types variability of stars and stellar systems. Currently, there are 70+main types and hundreds of mixes, especially if the object is a binary (or multiple) system instead of a single star. The study is formally organized as temporarily working groups oriented to study concrete groups of variable stars with a title "Inter-longitude Astronomy" (ILA). The current group of co-authors continues the scientific school of variable star research in Odesa, Ukraine, which was created by the eminent astronomer Vladimir Platonovich Tsesevich (11.10.1907 – 28.10.1983) [2017OAP....30..252A, 2017OAP....30..256V], This direction is also related to the "AstroInformatics" and "UkrVO" projects going on under the supervision of Prof. Irina B. Vavilova [2017IAUS..325..361V]. Totally, 450+ papers have been published on a study of 2500+ stars. It is based on own observations (photometric, polarimetric) made by our group, foreign co-authors (also spectral),

An unprecedented series of photopolarimetric observations of classical polars (AM Her, QQ Vul), series on synchronous polars (BY Cam, V1432 Aql), eclipsing polar V808 Aur, intermediate polars (MU Cam and PQ Gem) and some related objects have been obtained at the 2.6m telescope ZTSh of the Crimean Astrophysical Observatory since 1989 for more than a quarter of century by Drs S.V. Kolesnikov and N.M. Shakhovskoy. Since 2004, intensive observations were made for studies of rotational evolution of intermediate polars by V.V.Breus in Slovakia and Poland and colleagues from Korea and other countries. Other types of variability of studied stars range (for pulsating variables) as RR – HADS – δ Cep – RV – SR – ZA, and interacting binary stars – cataclysmic, symbiotic and "heart-beat" ones, as well as the "Direct Impactors" (V361 Lyr, V0549 Cam). Special study is for the newly discovered, suspected or neglected systems of EA, EB and EW types – determination of the (often unknown) parameters, confirmation of the type, or re-classification.

The set of algorithms and software was developed, which improve simplified algorithms adequate for the regularly spaced data, but make bias results (and fake discoveries) for a real case of sparce "sky patrol" (photometric survey) monitoring and/or rare time series e.g. during some nights with natural gaps in between.

We focus on the multi-component variability caused by a few physical mechanisms. For newly discovered and/or poorly known stars, we conduct a basic analysis to determine both minimal and advanced sets of parameters and to confirm or correct their classification.

To achieve this, we have developed a set of statistically optimal algorithms/programs designed for regular and irregular time series, with or without additional trends, harmonics, periods, outbursts/flares, quasi-periods, or transit periodic oscillations. These methods include global (all-data) and local (running, non-polynomial spline, special shapes/patterns/templates) approximations with additional weight functions. Following a recent review of these methods [2020kdbd.book…191A], some new algorithms are currently in the testing phase and are being prepared for publication. These algorithms can be applied to signals of any nature, such as those from AGNs, asteroids, exoplanets, solar activity, etc. Some of the programs and references are available at http://uavso.org.ua/mavka.

ACTIVE GALACTIC NUCLEI: EVOLUTION OF OBSERVATIONS AND MODELS

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Active galactic nuclei (AGNs) are the most powerful objects in the Universe. Their structure is so complex that each component of an AGN is a separate object of study

(accretion disk, jets, dusty torus, outflows). Processes in the vicinity of a supermassive black hole (SMBH) lead to the formation of jets whose scales exceed the limits of the parent galaxy. The study of jets allows us to infer the radiation mechanisms and particle acceleration processes in extreme conditions. An important role in the activity of such galaxies is played by the dusty torus, which is a reservoir of matter that feeds the accretion disc and supports the high luminosity of AGNs. The dynamics of the matter in the torus, its interaction with the accretion disk, its formation and evolution are still under discussion. This in turn is important for constructions of the Unified Model, in which the differences between AGNs are explained by different orientations of the torus with respect to the observer. A major breakthrough in AGN observations has been achieved thanks to the largest ground-based interferometers and space telescopes, which provide us with the data in different wavelength bands (from radio- to gamma rays). On the other hand, advances in computational techniques have made it possible to simulate complex systems taking into account many factors, leading to more realistic models that can best explain the observational data. In my talk I will briefly review the evolution of observations and modeling of AGNs over the last decades.

THE BACKREACTION OF THE REDUCED HELIOSPHERIC PRESSURE AND ITS IMPLICATIONS FOR THE STRENGTH OF SOLAR CYCLE 25

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The effect of the heliospheric pressure on the properties of coronal mass ejections (CMEs) was first recognized as the anomalous expansion of CMEs in the beginning of solar cycle 24 (Gopalswamy et al. 2014, GRL 41, 2673). The reduced heliospheric total pressure, whose backreaction on CMEs allows them to expand more, resulted in a larger CME width in cycle 24 than in cycle 23 for a given speed. The backreaction of the reduced heliospheric pressure manifests in many ways, including (i) enhanced halo CME abundance, (ii) halo formation closer to the Sun at lower CMEs speeds, (iii) wider longitudinal distribution of halo CMEs, (iv) change in slope of the CME expansion speed – CME radial speed relationship, and (v) larger pressure balance distance for CME flux ropes. The current solar cycle 25 is in its maximum phase and has witnessed a significant number of CMEs in the first 4 years since it started in December 2019.

We use limb CMEs associated with solar flares of X-ray intensity $\geq$ C3.0 in solar cycles 23-25 to revisit the CME speed–width relationship. We find that the slope of the speed-width relationship is significantly larger in cycle 25 than in cycle 23 but only slightly smaller than that in cycle 24.

These results imply that cycle 25 is weaker than cycle 23 but similar in strength to cycle 24.

THE GAIA MISSION AND BEYOND: PRESENT AND FUTURE OF GRAVITATIONAL ASTRONOMY

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How can 21st Astrometry contribute to providing Humanity with the answers to the key questions: how did the Universe form and evolve? What is our place in it?

One way is to look for, and measure, the effects of Gravitation all scales within The Milky Way (hence, Gravitational Astronomy), and then compare them to the predictions of current gravity theories and cosmological formation scenarios including stellar and planetary formation.

The talk will present some of the recent results in this area from the Gaia mission, and what can be anticipated of its coming deliveries.

Finally, I will also address what are the next technological challenges Astrometry faces to remain at the forefront of research in Physics and Astronomy in this century and beyond.

PRESENT STATUS OF INFLATIONARY COSMOLOGY

A. Linde
Stanford Institute for Theoretical Physics and Department of Physics, Stanford University, USA

I will describe basic principles of inflationary cosmology, its history and its present status. Some of its most unexpected results include the possibility that our universe was born from less than one milligram of matter, that galaxies are children of quantum fluctuations, and that our universe can be a self-reproducing fractal, a multiverse consisting of exponentially large parts with different properties. I will describe a large set of observational results testing various predictions of inflationary theory. I will also introduce a large class of inflationary models which can describe all presently available inflation-related observational data using a single parameter.

SIGNAL IN THE REDSHIFTED HYDROGEN 21 CM LINE FROM DARK AGES AND COSMIC DAWN AS A NEW COSMOLOGICAL TEST

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We estimate the global signal in the redshifted hyperfine structure line 21 cm of hydrogen atom during Dark Ages and Cosmic Dawn epochs. The evolution of

the brightness temperature in this line was computed to study its dependence on the values of cosmological parameters and physical conditions in the intergalactic medium. Variations of the depth of absorption line formed in the Dark Ages epoch at z∼80 with variations of the cosmological parameters Ωb, Ωcdm, ΩΛ, ΩK and H0 are studied. The standard ΛCDM model with Planck Space Observatory parameters predicts a value of the brightness temperature in the center of the absorption line ∼35 mK at ~16 MHz. It is independent on the correlated variations of ΩΛ and ΩK parameters, slightly depends on Ωcdm, moderately on Ωb and noticeable on H0. For example, increasing the H0 from 67.4 km/s/Mpc to 74 km/s/Mpc increases the depth of absorption line to ~45 mK. Therefore, precise measurements of this line at decameter wavelengths can help to solve the Hubble tension problem. The profile of this line can be quite another in the non-standard cosmological models, which include the annihilating or decaying dark matter, a primordial stochastic magnetic field, etc. It can be shallower or be an emission bump instead of an absorption trough. It is also shown that the position and depth of the Cosmic Dawn absorption line formed at 10<z<30, are due to the Wouthuysen-Field effect, and are mainly defined by the spectral energy distribution of the first sources of light. The redshifted 21 cm line from Cosmic Dawn epoch to meter wavelength is sensitive also to cosmological parameters, nature of dark matter particles and primordial magnetic fields. Therefore, tomography of the Dark Ages and Cosmic Dawn epochs in the redshifted 21 cm line of neutral hydrogen can be a new cosmological test.

THE EINSTEIN-PODOLSKY-ROSEN PAPER: HISTORY AND FALSE INSTANTANEOUS INFORMATION TRANSFER PARADOX

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Taras Shevchenko National University of Kyiv

The paradox about the supposedly instantaneous transfer of information associated with the determination of the parameters of one of the particles included in a quantum entangled pair is considered. It is shown that this conclusion is drawn on the basis of not quite correctly formulated conditions of the thought experiment underlying the imaginary paradox.

The existence of quantum entanglement has been confirmed in numerous experiments and is not questioned. I want to discuss some aspects related to the paradox usually associated with this concept, limiting myself to a discussion of simple thought (gedanken) experiments. It is connected with the fact that a measurement of a parameter of one particle is accompanied by an instantaneous termination of the entangled state of the other. In the simplest example, a pair of entangled photons is born somewhere in space. One of them arrives on Earth, where physicists measure its helicity. This makes it possible to know the helicity of the second photon, which is somewhere in the Andromeda Nebula at that moment. Is this a transmission of information at faster than the speed of light in a vacuum forbidden by the special theory of relativity?

This conclusion was made on the basis of not quite correctly formulated conditions of the gedanken experiment that underlay the imaginary paradox. An essential detail of the analysis is the well-known statement of quantum mechanics about the influence of the process of measurement on the state of the observed system.

In addition to discussing the paradox, the report recounts the publication of the paper underlying it. This is due to the fact that two of the three authors worked in Ukraine in Kharkiv and Kyiv in the 1930s.

HOW LARGE A TELESCOPE CAN BE?

Roberto Ragazzoni
INAF & University of Padova

I will explore how the capability of a telescope can be described by a single quantity, ranging from conventional (e.g. diameter) to unconventional (like the "etenude" or the product of the aperture times

the collected Field of View. I will point out how these figures translates directly into the capability to detect unresolved sources but are not enough descriptive for a number of particular science cases or for particular kind of telescopes. Examining some kind of "secondary" telescopes, like the Cherenkov ones or the one involved in external occulting coronograph, shows that the size of the telesope or other exact figures are not necessarily meant to express the scope capability. I will use all these as a pretest in order to try to sketch out a review of which kind of instrumentation could be available in the 2030 panorama.

THE ROLE OF FERMI IN THE DISCUSSION OF GAMOW COSMOLOGY: AN INTERNATIONAL IMPLICATION

R. Ruffini
Director of ICRANet, Italy

We recall the work of Fermi in completing the cosmological nucleosynthesis and evidencing first the role of formation of the light element in cosmology, opening a new era in Relativistic Astrophysics of the Big Bang.

COSMIC RAYS IN THE EARTH'S ATMOSPHERE: SHALL WE CARE?

I. Usoskin
Oulu University, Finland

Cosmic rays are energetic particles (nuclei of fully ionized atoms ranging from hydrogen up to iron and beyond) of extra-terrestrial origin. Galactic cosmic rays (GCR) are omnipresent near Earth with the flux being slightly variable due to solar activity. Additionally, sporadic solar energetic particle (SEP) events are formed

by the Sun and are characterised by soft energy spectra and very high particle fluxes. These energetic particles induce physical and chemical changes in the Earth's atmosphere in particular ionising the ambient air and also producing some rare cosmogenic radionuclides. On top of that, cosmic rays impose important hazards for modern technological devices beyond the protective atmosphere and magnetosphere. Here, a brief overview of the cosmic-ray-induced effects is presented.

ON THE POSSIBILITY OF DETECTING A SIGNAL IN THE 21 CM HYDROGEN LINE FROM THE DARK AGES AT A DECAMETER WAVELENGTH

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The report provides an overview of the possibilities of detecting a signal in the hydrogen 21 cm line, which was formed in the early universe during the Dark Ages and due to cosmological expansion is shifted to the decameter range of wavelengths (~18 m, ~16 MHz). It is in this range that the large Ukrainian decameter radio telescopes work: the world's largest UTR-2, the URAN radio interferometer system and a new one – GURT. However, the reliable detection of this very weak redshifted line (hundredths of a fraction of K compared to the background of the Galaxy at tens of thousands of degrees) requires a sensitivity of about 10^{-7} and a careful setting of the base line. The ideal conditions would be the location of a decameter radio telescope on the farside of the Moon due to effective shielding electromagnetic interference and noises from the Earth, but this is associated with great technical difficulties and costs. The alternative way – detection of the Dark Ages hydrogen line from the Earth's surface – is complicated by many powerful interfering factors, starting from radio frequency interference (RFI), the influence of the ionosphere, etc. This review is devoted to the development of means of receiving extremely low-frequency radio astronomical signals, increasing sensitivity, and software methods of RFI mitigation in order to reliably detect the signal in the 21 cm line, which can become an important source of information both about the environment in which the first stars and galaxies were born, and about the nature of dark matter particles and the magnitude of primordial magnetic fields.

COSMIC CENSORSHIP AND NAKED SINGULARITIES IN THE QUADRATIC $F(R)$ GRAVITY

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Penrose's cosmic censorship hypothesis, which states that naked singularities cannot exist in the real Universe, is closely related to the predictive power of the gravitational theory. This hypothesis has never been proved, and there are several counterexamples that can, however, be questioned for physical reasons. It is also widely believed that a naked singularity, if it can form, is unstable, although the answer may depend on the specific situation. We study this issue in the case of spherically symmetric (SS) configurations of the quadratic *f(R)* gravity. In case of a purely gravitational system, we study global qualitative behavior of the metric and the scalaron field in the Einstein frame for all static SS solutions satisfying the conditions of asymptotic flatness. The solutions are proved to be regular everywhere except for a naked singularity at the center; they are uniquely determined by two parameters: total mass M and "scalar charge" Q characterizing the strength of the scalaron field at spatial infinity. The case $Q = 0$ (zero scalaron) yields the usual Schwarzschild solution. Then we numerically investigate the linear stability of these solutions with respect to the time-dependent SS perturbations. The results show that naked singularities with a sufficiently small but non-zero scalaron field are linearly unstable.

COSMOLOGY, GRAVITATION, HIGH ENERGY PHYSICS, ASTROPARTICLE PHYSICS

PROBING GAMMA-RAY EMISSION IN THE SHAPLEY SUPERCLUSTER

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The Shapley Supercluster, the largest and most massive concentration of matter in the nearby Universe, is about 200 Mpc away in the Centaurus constellation . According to the latest X-ray observations presented in the eROSITA/eRASS1 first catalog of superclusters in the western Galactic hemisphere, the Shapley Supercluster contains 45 X-ray galaxy clusters.

Galaxy clusters are expected to be reservoirs of cosmic rays accelerated by structure formation processes, active galactic nuclei, etc. While the detection of diffuse synchrotron radio emission in several clusters confirms the presence of cosmic-ray electrons and magnetic fields permeating the intraclustar medium (ICM), the direct detection of gamma-rays from proton-proton collisions in galaxy clusters has not yet been achieved. However, multi-GeV gamma-rays can serve as indirect evidence of hadronic (protons and nuclei) cosmic rays in ICM since cosmic-ray protons and havier nuclei yield high-energy gamma-ray emission through neutral pion decay.

In our research, we consider the Shapley Supercluster and its separate regions as potential sources of gamma-ray emission, which could be detected by the Cherenkov Telescope Array Observatory (CTAO), a next-generation gamma-ray observatory. This study aims to model and investigate maps of the surface brightness and spectra of gamma-ray emission from the Shapley Supercluster. The results obtained will provide essential information for planning future CTAO-observations of this structure.

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THE DESIGN AND MODELING OF HARD-RADIATION SPECTROGRAPHS FOR RECORDING FAST-FLOWING PROCESSES

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The growing need to record the spectra of hard radiation associated with fast-flowing thermonuclear processes leads to the need to develop and model a new generation of semiconductor detectors. Their main difference from classical recording devices is the presence in their composition of chemical elements with large atomic numbers In particular, the inclusions of Pb and Lu atoms that are part of CsPbBr3 and LuSiO5 crystals are considered. The proposed problem was solved within the framework of the Giant4-DNA project version 11.2 in the form of using an integrated engineering-physics constructor. The optimal energy and structure for modeling spectrographs were chosen in the energy range of (0.001 – 10) MeV. Affordability in acquiring, minimizing the size and operation structure of detection systems is taken into account. Detailed tracks of particles and quanta, values of energy losses, their relation to amplitudes of current pulses supplied to the high-voltage preamplifier were obtained. On the basis of the obtained results the selection of a suitable electronic interface was carried out. The whole detector-spectrograph design is operated under normal conditions and does not require deep cooling. We modeled the detector, which consists of 10 layers, in Geant4 software. The whole detector has dimensions of 1cm by 1cm by 1cm by 1cm. All basic elementary processes are taken into account based on the Monte Carlo method. For certainty, we limited the energy of the beam entering the detector from 50KeV to 1MeV. At given time intervals, elementary scattering acts were visualized and tracks within a given detector were plotted using this method. This method allowed us to construct a detailed relationship between the absorbed energy and current pulse of a given detector layer. Visualization of all processes and their spectra was implemented within the framework of the Giant4-DNA project.

A FEATURES OF LIGHNING SPECTRA IN "TRANSPERENCY WINDOWS" OF SOFT X-RAY RADIATION

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Appearances of lightning in the Earth's atmosphere during storms and volcanic phenomena make it possible to study the state of atmospheric plasma, including various aerosols in order to determine their chemical composition. by characteristic lines in soft X-ray The present work takes water vapor as the main aerosol component. Between the clouds pure water together with atmospheric gas are in a strong electric field with potential difference $\Delta\varphi\approx(10^6\text{-}10^8)$V. It has been shown that the hard radiation flux generated by lightning is the result of transforming the initial braking spectrum of relativistic electrons and collisions of protons, ions of C, N, and O elements with resting atoms of the medium. Both currents consisting of ions and electrons are directed in opposite directions.

The gamma and X-ray radiation of lightning reaches the detectors with strongly attenuated long-wave part. At

energies less than 1 KeV, practically all energy of long-wavelength X-ray quanta is spent in photo-ionization of surrounding water vapor. However, in the wavelength range 2 - 4 nm. there is a transparency window with characteristic K-lines of C, N O atoms. We propose a method and compose a model for registration of radiation fluxes in the window of water transparency. This allows us to study the plasma in which intensive ionization processes occur by the joint action of photons and impact ionization of atoms by electrons and protons. The protons and electrons experience collisions with target atoms - C, N, O - of elements. It was obtained that at sufficiently high saturation with water vapor around the lightning, its long-wave part is cut off in the X-ray spectrum. The relationship between water vapor content and radiation intensity at the receiver is described. The concurrence of the processes of scattering, absorption of X-ray quanta and formation of induced secondary quanta (characteristic emission of C, N, O elements) is responsible for the formation of the observed diffuse (bulk) X-ray fluorescence [1,3].

The simulation of the process of nucleation of electron and hadronic (p, α-particles + C, N, O - ions) currents was carried out in the framework of the Geant4 - DNA project [2]. Concurrently, the formation of X-ray and UV fluorescence was monitored. All necessary spectroscopic constants for the media in which the processes under consideration took place were used using the service macro commands of this project according to the scheme Geant4 – DNA→NIST→ Geant4 -DNA [3].

All the above described processes took place in a strong electric field with a potential difference of $\Delta\varphi=(10^6\text{-}10^8)$V, which leads to the intensity $E=(10^3\text{-}10^5)$V/m. A comparison with the laboratory experiments in [ ] has been made. On the basis of modeling of various types of lightning using the Geant4-DNA version 11.2 project, spectra of lightning in the X-ray range are constructed and conclusions are drawn concerning the application of this method in the study of explosive processes on the surface of polars.

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TOWARDS THE PARAMETERIZATION OF STRUCTURATION IN DISCRETE MULTISCALE MASS-CONGLOMERATIONS

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This summarizes the study which explores analogies in the distribution of matter density across differently scaled physical systems, such as the Universe and micro-mechanical (granular) materials. Both systems face the initial challenge of insufficiently defined local density fields. We develop and apply a method for parameterizing distributions with morphologically complex topologies using structural invariants (e.g., Euler characteristics), enabling the identification of clusters with varying topologies. By introducing classification and appropriate scaling, we can estimate the matter distribution within the framework of the mean-field model. To study the kinetics of matter distribution evolution, an ordering parameter based on Euler-Poincaré invariants is introduced. This approach allows the construction of phase diagrams and the investigation of the temporal hierarchy of relaxation times of intermediate states.

The proposed method can be used to parameterize matter distribution in the Universe, treating the visible distribution of super-galaxies (voids and filaments) as a "microstructure".

We also show that by utilizing the Dirichlet problem combined with the Mises transform in the context of multi-level structural analysis, it is possible to relate surface characteristics to volumetric structures in various physical systems. This applies to both the large-scale structure of the Universe and the mesoscale structure of granular materials. Sequentially solving relevant boundary value problems at each scale allows for estimating mass distribution and its correlation across different observational levels. The method also includes using characteristics obtained at smaller scales as input data for larger scales.

Overall, this analysis and methodology deepen our understanding of the nature of matter distribution in the Universe, offering an alternative to other methods of parameterizing structurally complex systems, such as Voronoi methods and graph theory.

BACKPROPAGATING EHECR IN THE DIRECTION OF THE LOCAL VOID

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Determining the origins of extremely high-energy cosmic rays (EHECRs) is a fundamental challenge in high-energy astrophysics, as their immense energies push the limits of current particle acceleration theories. Identifying the sources and understanding the propagation characteristics of EHECRs with different compositions can shed light on some of the most extreme and energetic processes in the Universe, potentially involving environments around magnetars or other exotic astrophysical phenomena. In this study, we employed numerical simulations using the CRPropa library to investigate the propagation of EHECRs with various chemical compositions–protons, helium nuclei, carbon nuclei, and iron nuclei–in the region around the local void. Our methodology included tracking the three-dimensional trajectories of these EHECRs within the Milky Way. To explore potential connections between EHECRs and sources in the local void, we conducted a statistical analysis and created two-dimensional visualizations of the particle trajectories, helping to identify possible source candidates along their paths.

GRAVITATIONAL LENSING EFFECTS ON A INHOMOGENEOUS TORUS WITH A CENTRAL MASS

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Gravitational lensing has become a powerful tool in extragalactic astronomy and cosmology, providing important information about the distribution of matter. In this talk, we present the new results on the strong gravitational lensing effects that arise in a system where a lens consists of a central mass and a toroidal distribution of matter around it.

Such a system mimics astrophysical objects with the toroidal/ring structures, such as for example, ring galaxies or dusty tori in active galactic nuclei (AGNs).We divide the problem into three cases, where the torus in projection on a picture plane is modeled as an annular infinitely thin disk with different surface density distributions in it. The density law in this disk is the following: i) homogeneous disk; ii) inhomogeneous distribution, modeling the torus with the constant density; iii) a Gaussian distribution of surface density corresponding to the more realistic case of the toroidal distribution of the matter.We obtained the new lens equations for the last two cases, those expressed by of elementary (ii case) or special (iii case) functions. We carried out a series of the numerical simulations using a ray-tracing algorithm for all these cases of the lens system. We found that the homogeneous annular disk model can be used as a good approximation for the investigation of the gravitational lensing effects on the toroidal structure in the outer region. We found new effects that related to the gravitational lensing on an inhomogeneous disk: the formation of additional images and Einstein rings in the inner region. We have also developed software to generate images and animate gravitational lensing effects using a ray-tracing algorithm for these systems, which can be a useful tool for visualizing the results and creating a training database for machine learning.

IMAGE CONSTRUCTION IN GRAVITATIONAL LENSES USING THE ELIMINATION METHOD IN AXIALLY SYMMETRIC CASES

Albert Kotvytskiy [1,2], Štefan Parimucha[1]
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The presented work proposes a general approach to constructing images in axially symmetric gravitational lenses using the elimination method. An arbitrarily located elliptical source is considered. To apply the elimination method, a rational parameterization is introduced to describe the source. General formulas for an implicit description of images in any axially symmetric case are then derived. Specific examples of both formulas and images are provided for the cases of a single-point gravitational lens and a gravitational lens in the form of a homogeneous disk. It is shown that in simple cases, these general formulas reduce to known expressions.

THE FORMATION OF THE FIRST MOLECULES IN THE COSMIC DARK AGES AND THEIR INFLUENCE ON THE CMB SPECTRUM

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Primordial chemistry begins in the epoch of recombination with the appearance of neutrals and continues in the post-recombination universe due to residual free electrons and ions. The presence of these ingredients in the almost neutral gas of the post-recombination universe triggers a cascade of chemical reactions, which leads to the formation of the first diatomic compounds, among which the most common are molecules H2 and HD, as well as the helium hydride ion HeH+. They are thought to have played a crucial role in forming the first stars by allowing protostellar gas clouds to cool and collapse. We calculate the abundance of the first H2, HD, and HeH+molecules by integrating the equations for the kinetics of chemical reactions in the weakly ionized plasma of the early universe, as well as the population of the rovibrational levels of these molecules for the standard cosmology as well as for cosmologies with annihilating dark matter particles and primordial magnetic fields as additional sources of ionization and heating. We show that the absorption/emission of the first molecules during the dark ages contributes to the spectral distortion of the CMB. In standard cosmology, the sky-averaged signal from the first molecules is an absorption profile against the CMB spectrum, and the presence of additional sources of ionization and heating turns it into an emission profile. The calculated sky-averaged signal from the first molecules is a few orders of magnitude smaller than other sources of relic spectrum distortion (e.g. μ- and y-distortion). However, its detection is still possible in the presence of primary magnetic fields of ~nG or due to its characteristic angular distribution. We show that signals from the first molecules can become important sources of information about the ionization, thermal, and chemical history of the post-recombination universe, providing additional evidence in favor of the standard cosmological model or helping to reveal new, not yet accounted for-phenomena in the evolution of the early universe.

IMPLICATIONS OF PHOTON–AXION OSCILLATIONS ON X-RAY OBSERVATIONS OF THE COMA CLUSTER

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Axion-like particles (ALPs) emerge as predictions from various extensions of the Standard Model, standing out as plausible candidates for dark matter. Axions are thought to be produced when light passes through regions of magnetic fields. This positions astrophysical environments as prime sites for their production and subsequent detection. However, establishing precise constraints on axion parameters remains challenging, primarily due to the limited understanding of astrophysical magnetic fields.

The Coma cluster is notable for being the sole cluster where the profile of magnetic field strength has been relatively accurately determined using Faraday Rotation Measures. We examined the X-ray spectrum of the Coma galaxy cluster by using data from the XMM-Newton observatory. We combined data from eight XMM-Newton observations conducted between 2000 and 2005, spanning a 40′x40′ area centered on the Coma cluster, totalling 343.8 ks. The X-ray spectrum of the intracluster medium was characterized by modelling it with emissions from a single-temperature hot plasma. Furthermore, we explored the potential impact of photon-axion conversion on the spectrum of the Coma cluster.

Our investigation encompassed a range of parameters – the coupling constant and the axion mass, focusing on regions that have not yet been excluded. For the selected axion parameters, the primary impact on the spectrum could occur at high energies exceeding 5 keV.

Analysis of the limited statistics gathered in this study indicates that the unexcluded parameter space for axions, based on X-ray observations of the Coma cluster, lies below the following values: $g_{a\gamma} \lesssim 5 \cdot 10^{-13}$ GeV^{-1}, $m_a \lesssim 5 \cdot 10^{-12}$ eV.

ORBITAL-VORTEX RESONANCE OF A GRAVITATING TORUS IN THE FIELD OF A CENTRAL MASS: APPLICATION TO AGNS

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Recent observations show a complex structure and non-trivial dynamics in active galactic nuclei (AGNs), which may be a consequence of the torus self-gravity. Indeed, the dusty tori in AGNs have masses that are a few percent of the mass of a supermassive black hole (SMBH). The doughnut shape of the dusty torus has been confirmed by observations in different wavelength bands and is consistent with the unified scheme. In this talk, we present our results from N-body simulations of the clumpy torus rotating around the SMBH. We have performed a series of numerical experiments for the weight range of torus to SMBH masses and the different initial cloud distributions corresponding to the state in AGNs. The simulations were performed using a high-order hermit integrator (phi-GPU). We found that in such a system there are SMBH oscillations whose amplitude and frequency depend on the torus mass. These oscillations have a larger amplitude in the vertical direction and they correlate with the torus barycentre oscillations. This means that the torus and the SMBH oscillate in opposite directions. The nature of this behaviour is related to the presence of a vortex motion in the torus, appearing under the mutual role of its self-gravity and the presence of the central mass. This effect may be important for the interpretation of observational data of AGNs.

GAMMA-RAY SIGNATURES OF DARK MATTER IN GALAXY CLUSTERS: ANNIHILATION AND DECAY SCENARIOS

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We present a comprehensive analysis of gamma-ray emission from dark matter (DM) annihilation and decay in galaxy clusters, focusing on the four central clusters of the Shapley Supercluster and the Perseus Cluster. Our study emphasizes Weakly Interacting Massive Particles (WIMPs) as DM candidates, which naturally arise from Standard Model extensions addressing the gauge hierarchy problem. Using the CLUMPY code, we compute astrophysical J- and D-factors for smooth DM distributions, excluding substructures. Our calculations reveal that while annihilation signals scale with the square of DM density, decay signals

correlate directly with total DM mass, leading to enhanced decay signatures in more massive objects. We evaluate the gamma-ray fluxes for various DM particle models and assess detection prospects using next-generation gamma-ray telescopes such as the Cherenkov Telescope Array Observatory. Our results highlight the importance of considering both annihilation and decay scenarios in indirect DM searches and provide a framework for future observational strategies targeting massive cosmic structures.

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ELECTROVAC EQUATIONS IN THE CASE OF OUTGOING ONE-WAY NULL FIELDS

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Electromagnetic fields that are generating near black holes, neutron stars, quasars etc. have strong enough energy-momentum quantities and according to general relativity theory influence the gravitational field. Proper mathematical model for such consideration are the Einstein-Maxwell equations. When the Maxwell field have no sources, such model is called electrovac. Additional assumptions on electromagnetic or gravitational field yield more simple models that may be qualitatively analyzed and often have exact solutions. One of them is the well-known Kerr-Newman solution of the Einstein-Maxwell equations.

We consider electrovac equations with outgoing one-way null condition on the Weyl and the Maxwell spinors. We have found that corresponding null congruence is geodesic, shearfree and non-diverging. Additional conditions on the Newman-Penrose scalars are obtained from the Newman-Penrose field equations. The question of integrability for the Maxwell equations and Bianchi identities is investigated. Such systems are compatible and no additional conditions rise.

COSMIC WEB EVOLUTION IN TERMS OF NETWORK METRICS

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In my work, I study the evolution of network characteristics (metrics) of the Cosmic web of cosmological simulation. For this, I use halo catalogs of dark matter-only simulation Multidark. The halos of dark matter are considered vertices (nodes) of the graph, they are considered connected if the distance between them is smaller than a certain value, called the linking length of this network. I consider several values of linking lengths between 2 and 4 Mpc/h. The studied network metrics include global ones, such as maximum node degree, largest connected coefficient, density, and the transitivity of the network, and the local ones, such as clustering coefficient, degree, closeness, betweenness, and other types of node centralities. I explore the evolution of each metric with cosmic time. The considered redshifts lie in the range between 4 and 0. The behavior is of metrics is studied for halo subpopulations of certain ranges, to take into account the topological bias effect. The discovered features of the evolution show that the Cosmic web exhibits complex behavior, each mass range has its own trajectory in terms of network metrics. Finding the correlation between the metrics and physical characteristics of halos, as well as cross-correlation between the network metrics can help understand the sophisticated multilevel structure of the Cosmic web.

ASTROPHYSICS 1
(nucleosynthesis, stellar atmospheres, kinematics, structure and chemical evolution of the galaxy)

ANALYSIS OF THE GAIA DR3 ASTROMETRIC SOLUTION WITH VECTOR SPHERICAL HARMONICS

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The Gaia mission has provided astronomers with an unprecedented amount of data on the positions, proper motions, and parallaxes of stars in our Galaxy. However, the accuracy of these measurements is not uniform across the sky, and it is important to assess the quality of the data and correct for any systematic errors. One promising approach to this problem is to use extragalactic objects, such as quasars, as a reference frame to calibrate the proper motions and parallaxes of the Gaia catalogue. In this work, we use a powerful mathematical method to decompose the formal proper motions (and parallaxes) of extragalactic objects into Vector Spherical Harmonics (VSH). Using data from 1.6 million extragalactic objects from the GaiaCRF3 catalogue, the values of spheroidal and toroidal harmonics have been estimated up to the 15th order. The values of these harmonics show good agreement with similar data obtained by other researchers and do not exceed 20 μas/year. For the first time, we have also performed a decomposition of the parallaxes of extragalactic objects into the orthogonal basis of the spherical functions. Analysis of the results shows a correlation between the harmonic values computed from the proper motions and the parallaxes. In this way, we have estimated the correction values of the parallax and proper motion as a function of the spherical coordinates for the Gaia DR3 catalogue.

DETERMINATION OF ZASTRA TEMPERATURES OF CENTRAL STARS OF NGC 246 AND NGC 7293 PLANETARY NEBULAE

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In this scientific work has determined the fluxes in the HI and HeII radiation lines from processed spectra of the NGC 246 and NGC 7293 planetary nebulae. Spectra of these planetary nebulae have taken from the archive of European Southern Observatory. Based on the assigned fluxes, the Zanstra temperatures of the central stars of these planetary nebulae were calculated according to the HI and HeII lines. According to the temperatures of 53723.14 K and 100871.43K were found for the central stars of NGC 246, and the temperatures of 51072K and 89073.4K were found for the central stars of NGC 7293. Achieved scientific results were also compared with other authors' works' results.

3D KINEMATICS OF GIANTS AND SUBGIANTS FROM THE GAIA DR3 DATA

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Previously, we presented the results of the kinematic analysis of giants and subgiants whose centroids we placed in the Galactic midplane. In this paper, we present the results of 3D kinematics of stars whose centroids are located at all points in the Galactic space where giants and subgiants with known positions, parallaxes, proper motions and radial velocities are available, based on the Gaia DR3 catalogue. In this work, we use a sample of giants and subgiants for which we take into account the corrections to the parallaxes according to Lindegren (2021), and also correct the proper motions of stars from 6 to 13 magnitudes (Fedorov, 2018; Lindegren, 2018; Brandt, 2018). Taking into account additional criteria for the accuracy of the astrometric parameter determination (Lindegren, 2018), the resulting sample contains 14 million stars. The region under study in the rectangular Galactic coordinate system is within the following ranges: $-8 \le X \le 8$, $-8 \le Y \le 8$ and $-4 \le Z \le 4$ kpc. We have experimentally chosen the radius of each sub-sample to be equal to 1 kpc. We have built a coordinate grid with the step of 100 pc. As a result, we have formed over 1 million spherical regions for which we determine 12 kinematic parameters of the Ogorodnikov-Milne model. We provide in the form of gif animations the detailed maps of the obtained

parameters in the XY, XZ and YZ planes, as well as their dependence on the Galactocentric coordinates R, θ, Z.

SPECTRAL VARIABILITY OF THE Hβ, Hγ, Hδ LINES FOR THE SUPERGINAT HD 187982

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In this report we have presented the results of spectral observations of the supergiant star HD 187982 (SpA1 Iab) for 2016-2020. Our measurements showed that variability for hydrogen lines higher than the other spectral lines. In this report we have presented results of studies of the time variability of the Hβ, Hγ, Hδ lines parameters. Hydrogen lines show variability with a characteristic time of 24-29 days and an amplitude of 6-8 km/s. Since the value of this velocity is smaller than the first cosmic velocity of the star, the material ejected by the stellar wind from the upper layers of the star's surface falls back to the star's surface after a short time. Therefore, the circumstellar gas disk and, therefore, the radiation lines in the spectrum change.

A comparison of the average value of the radial velocity of the hydrogen lines formed in different specific layers of the star's atmosphere with the radial velocity of the center of mass of the star shows that this velocity difference approaches zero as the quantum number of the line increases. All independently observed processes unambiguously indicate that the stellar wind near the supergiant sometimes throws out portions, i.e. outflow of the matter does not always occurred as stationary.

SPECIFIC FEATURES OF THE ENRICHMENT OF METAL-POOR STARS WITH NEUTRON-CAPTURE (R-PROCESS) ELEMENTS

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In contrast to stars with near-solar metallicity (Galactic disc stars), metal-deficient stars show an abundance scatter of up to 3 dex in the enrichment with neutron-capture elements, in particular the r-process elements. The reasons of such a large variation in the in the r-process nucleosynthesis is currently matter of debate. Possible scenarios could be the presence of various r-process stellar and mechanisms in the early unevenly mixed Galaxy, as well as different stellar origin, either galactic or extragalactic, that reflect entering the Galaxy after the capture or coalescence of both individual stars and more complex stellar associations and star formations. In order to study differences in the enrichment with the r-process elements, we selected 20 metal-deficient stars, the spectra of which were collected in the UVES/VLT archive. We employed earlier determined atmospheric parameters to calculate the abundances of about 20 neutron-capture elements via the synthetic spectrum method, taking into account the hyperfine structure for a number of elements. We performed an analysis of the enrichment with the r-process elements grounded on multiple levels of enrichment intensity – namely, limited r-process, r-I and r-II – and the arrangement of stars by their belonging to different populations of the Galaxy, based on the stars' spatial velocity components.

BOTTLINGER'S FORMULAS FOR ESTIMATING THE DISTANCE FROM THE SUN TO THE GALACTIC CENTRE

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Our work is devoted to estimating the distance to the centre of the Galaxy using the Bottinger formulas based on the Gaia DR3 catalogue. The positions, parallaxes, proper motions and radial velocities from the Gaia DR3 catalogue were used. First, a sample of the brightest objects with absolute magnitude MG<4 was created. We used the Levenberg-Marquardt least squares optimization method to solve Bottlinger's nonlinear system equations. We have also extended Bottlinger's formulas by adding the first and second derivatives of the rotational velocity of the stellar system from the galactocentric and vertical directions. The kinematic parameters of the Galaxy and the distance from the Sun to the Galactic centre R0 have been estimated for different stellar samples. A detailed analysis of the kinematic parameters obtained using different stellar distances based on corrected parallaxes, geometric and photogeometric distances is also performed. It is found that the use of Bottliger's formulas allows us to obtain estimates of the components of the solar velocity, the kinematic parameters for the stellar system, and the galactocentric distance of the Sun with high accuracy.

OBSERVATIONS OF UNSTUDIED OPEN CLUSTERS IN THE UV

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Our research focuses on observing unstudied Galactic open clusters in the Ultraviolet (UV) wavelength range

and analyzing their photometric data. Gaia Data Release 3 (DR3) enables us to precisely study known Galactic open clusters. We have collected available photometric and astrometric data for these clusters. We conducted observations using the 1.54-meter Danish Telescope (DK1.54) in Chile and the 2.15-meter telescope at the Complejo Astronómico El Leoncito (CASLEO) in Argentina, employing UV filters. This wavelength range is particularly useful for studying interstellar reddening, which is independent of the age and metallicity of the clusters. After the observations, we performed Point Spread Function (PSF) photometry on 205 cluster fields. We then matched the stars with the Gaia Data Release 3 catalog. Next, we plotted color-color diagrams using Gaia magnitudes and our UV magnitudes. We fitted isochrones to all 205 cluster sequences to determine their membership, utilizing the Hunt & Reffert (2023) catalog as a reference. Currently, we are calculating the reddening laws for each cluster. With these data, a first homogeneous census of unstudied open clusters in the Milky Way using Ultraviolet photometry can be derived and compared to the literature.

SPECTROSCOPIC STUDIES OF POLARIS: GETTING BACK TO NORMAL LIFE OF A CEPHEID?

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Radial velocities of Polaris were measured in 404 new spectra taken between mid-2020 to mid-2024 at the 0.81-m telescope of the Three College Observatory (North Carolina, USA). Analysis of their variations shows that the pulsation amplitude increased during this time period and reached ~4 km/s by mid-2024. This amplitude is close to that detected in the middle of the 1960s, when it began gradually decreasing. Therefore, the Cepheid's pulsational activity got back to normal. The amplitude variation might be due to the orbital motion of the system's secondary companion Polaris Ab, which completed nearly two 30-year long orbital periods.

THE ANALYSIS OF PM AND AC ABUNDANCE IN THE ATMOSPHERES OF MAGNETIC-PECULIARITY STARS HD25354

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We investigate absorption lines of Pm and Ac, a radioactive elements with a short half-life, in the spectra of magnetic chemically peculiar (MCP) A0Vp star HD 25354 and determine abundances in the star's atmosphere. We used an ELODIE archive spectrum of HD 25354 dated 1996 with the wavelength range of 400.0–680.0 nm and the resolving power R = 42,000 obtained with the 1.9-meter telescope at the Haute-Provence Observatory, as well as spectral material with the wavelength range of 370.0-940.0 nm, signal-to-noise ratio up to S/N = 200 for the summed spectrum and the resolving power R = 60,000 obtained by F. Musaev in 2006 with the 2-meter telescope at the Terskol Peak Observatory.

ASTROPHYSICS 2
(interacting binary systems and variable stars)

DETERMINATION OF PHENOMENOLOGICAL CHARACTERISTICS OF A GROUP OF ECLIPSING STARS

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For the analysis, we have chosen objects from the General Catalogue of Variable Stars (GCVS), which are classified as eclipsing binaries with a remark "insure (":"), or which did not have such remarks, but necessary parameters (e.g. the period, duration of eclipses, amplitudes are absent in the GCVS). For the analysis, we have used all databases of photometric surveys, which are available in the Internet. Some stars were observed by TESS, what makes possible an easy preliminary determination of the period just by computing the time interval between the subsequent minima. However, a huge amount of stars have been observed and studied in the pre-TESS (and pre-KEPLER) era, and observations of them are sparse.

For such stars, we have used the following algorithm. At first, we make a periodogram analysis using the trigonometric polynomial fit of an (integer) order s, which is dependent on the expected type of variability and may be preliminary estimated from a histogram of brightness. Typically, s=2 for the EW-type systems with a typical "double wave". Taking into account the declared similarity of the depths of both minima, some authors even use s=1 (a sine function), and then double the derived period. However, for EB and (especially) EA type with narrow minima, the s=1 approximation is an absurd. The recommended value is s≈100/D, where D – is a total duration of the eclipse (in per cent, as defined in the GCVS). As we do not know D yet (this is one of the parameters to be determined), it may be estimated (for EA) roughly as ~2N/N[eclipse]. Anyway, these estimates are very rough. In our practice, one may often use "rough" value of s≈8. This preliminary "underfitting" value is typically much smaller than the "statistically optimal one" according to the Fischer's criterion. Some stars show s=21 with a number of parameters 2s+2=44. For such an analysis, we use the program MCV (https://ui.adsabs.harvard.edu/abs/2004AstSR...5..264A, http://uavso.org.ua/mcv/MCV/zip).

The next step is to use the "New Algol Variable" (NAV) algorithm (https://ui.adsabs.harvard.edu/abs/2012Ap.....55..536A). Despite the name, this algorithm is effective also for EB and even EW systems (https://ui.adsabs.harvard.edu/abs/2016JPhSt..20.4902T), Results on the profiles of the minima are compared with that obtained with the MAVKA software (http://uavso.org.ua/mavka).

In this work, we present some highlights of the studies of 160 eclipsing variables of the (preliminary) EA, EB, EW types. Some of the systems are confirmed, some reclassified not only between these types, but as the pulsating RR – type. Some objects were not confirmed as variables.

We review some highlights on phenomenological modeling of variability of stars of different types based on the data obtained using ground-base and space telescopes and published in photometric surveys. The need of a net of different phenomenological models is justified by the diversity of types variability of stars and stellar systems. Currently, there are 70+main types and hundreds of mixes, especially if the object is a binary (or multiple) system instead of a single star. The study is formally organized as temporarily working groups oriented to study concrete groups of variable stars with a title "Inter-longitude Astronomy" (ILA). The current group of co-authors continues the scientific school of variable star research in Odesa, Ukraine, which was created by the eminent astronomer Vladimir Platonovich Tsesevich (11.10.1907 – 28.10.1983) [2017OAP....30..252A, 2017OAP....30..256V], This direction is also related to the "AstroInformatics" and "UkrVO" projects going on under the supervision of Prof. Irina B. Vavilova [2017IAUS..325..361V]. Totally, 450+ papers have been published on a study of 2500+ stars. It is based on own observations (photometric, polarimetric) made by our group, foreign co-authors (also spectral).

An unprecedented series of photopolarimetric observations of classical polars (AM Her, QQ Vul), series on synchronous polars (BY Cam, V1432 Aql), eclipsing polar V808 Aur, intermediate polars (MU Cam and PQ Gem) and some related objects have been obtained at the 2.6m telescope ZTSh of the Crimean Astrophysical Observatory since 1989 for more than a quarter of century by Drs S.V. Kolesnikov and N.M. Shakhovskoy. Since 2004, intensive observations were made for studies of rotational evolution of intermediate polars by V.V.Breus in Slovakia and Poland and colleagues from Korea and other countries. Other types of variability of studied stars range (for pulsating variables) as RR – HADS – δ Cep – RV – SR – ZA, and interacting binary stars – cataclysmic, symbiotic and "heart-beat" ones, as well as the "Direct Impactors" (V361 Lyr, V0549 Cam). Special study is for the newly discovered, suspected or neglected systems of EA, EB and EW types – determination of the (often unknown) parameters, confirmation of the type, or re-classification.

The set of algorithms and software was developed, which improve simplified algorithms adequate for the regularly spaced data, but make bias results (and fake discoveries) for a real case of sparce "sky patrol" (photometric survey) monitoring and/or rare time series e.g. during some nights with natural gaps in between.

We focus on the multi-component variability caused by a few physical mechanisms. For newly discovered and/or poorly known stars, we conduct a basic analysis to

determine both minimal and advanced sets of parameters and to confirm or correct their classification.

To achieve this, we have developed a set of statistically optimal algorithms/programs designed for regular and irregular time series, with or without additional trends, harmonics, periods, outbursts/flares, quasi-periods, or transit periodic oscillations. These methods include global (all-data) and local (running, non-polynomial spline, special shapes/patterns/templates) approximations with additional weight functions. Following a recent review of these methods [2020kdbd.book…191A], some new algorithms are currently in the testing phase and are being prepared for publication. These algorithms can be applied to signals of any nature, such as those from AGNs, asteroids, exoplanets, solar activity, etc. Some of the programs and references are available at http://uavso.org.ua/mavka.

THE INTERMEDIATE POLAR RX J2133.7+5107: SPIN, SUPERHUMP VARIABILITY AND THE NEW UNKNOWN PERIOD

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We report the results of long-term time series photometry on RX J2133.7+5107. We confirmed and improved the results obtained by de Miguel et al. (2017). Due to longer time-base we obtained more accurate value of the spin-up time-scale 1.483(1) x 10^5 yr. The observed rate of spin-up is even faster then reported by previous authors and one of the fastest of all known intermediate polars. We report a presence of complicated changes of (O-C) with a period of about 7 years, that may be interpreted as fluctuations around the equilibrium period. Superhump maxima timings is changing from season to season. These irregular changes of the superhump maxima timings cause large scatter on the O-C diagram. Using TESS photometry that contains 6 runs in 2019, 2022 and 2024 we detected new, previously unknown period of 4.85 days that changes from run to run. The values of the best period and semiamplitude (in flux) of two-periodic trigonometric polynomial fit were determined. The origin of this period should be discussed.

LET'S SHAPE UP THE INITIAL ROTATION DISTRIBUTION IN THE MASSIVE STAR DOMAIN

N. Britavskiy

ROB

The initial distribution of rotational velocities of stars is still poorly known, and how the stellar spin evolves from birth to the various endpoints of stellar evolution is an actively debated topic. Binary interactions are often invoked to explain the existence of extremely fast-rotating stars (vsini > 300 km/s). Nevertheless, the recent detections of pre-interacting binaries with primaries as fast rotators are puzzling our understanding of the initial stellar rotation distribution in the OB-type domain. Thus, it is important to understand what is the "true" original rotation distribution of stars that have not passed any binary interaction yet. To do so, I will introduce the population of fast-rotating Galactic OB-type stars, and we will look at how exactly we can approach them in terms of revealing their origin. The ultimate goal is to shape up the resulting morphology of the vsini distribution that different stellar environments can have.

CORRELATION ANALYSIS OF LIGHT CURVES AND ORBITAL PARAMETERS IN DWARF NOVAE

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We present our research on the correlation analysis of light curves, orbital, and physical parameters of cataclysmic variable stars (CVs), with a focus on dwarf novae. Dwarf novae are a subclass of CVs characterized by periodic outbursts due to mass transfer from a companion star onto a white dwarf. Our study analyzed five previously unexplored CVs and conducted parameter correlations using data from other sources, performing a statistical analysis of 650 additional CVs from the Dwarf Novae Catalog.

The Thermal-Tidal Instability (TTI) model explains the cyclical brightenings in CVs through thermal and tidal effects within the accretion disk. We analyzed data from the Dwarf Novae Catalog, comprising 653 dwarf novae and 26 parameters, to investigate correlations between superoutburst duration (DSO), plateau phase duration (DP), drop duration (DD), rise duration (DR), and periodicity (Ps, Ps max, Psc, Psc max). For UGSU-type variables, we found correlations between DSO and DP (0.753) and between DD and DSO (0.638).

Using MCMC linear regression, a Bayesian statistical method, we derived empirical equations for the six strongest correlations identified. We selected a subset of dwarf novae, specifically Gaia21djh, Gaia19bwr, Gaia21akq, Gaia21enu, and Gaia18cjn, and calculated their parameters using data from AAVSO, TESS, and ASAS-SN databases, along with Python libraries Lightkurve and astropy. Orbital periods for Gaia21djh, Gaia19bwr, and Gaia21akq were approximately 0.0844, 0.072, and 0.09217 days, respectively. We also determined period excess (ε+/−) and mass ratio (q) for these systems.

Furthermore, we calculated outburst and superoutburst parameters using VStar software and compared our results with existing correlations from the Dwarf Novae Catalog.

Our findings were consistent with established data, validating our research.

In conclusion, our research explores correlations among various parameters in CVs and provides essential calculations of physical and orbital parameters for select dwarf novae. Our findings offer a fresh perspective on these relationships, potentially advancing the understanding of cataclysmic variable evolution and the thermal-tidal instability model.

THE R-BAND OBSERVATIONS AND COMPARISON WITH RESULTS IN THE V-BAND OF FI SGE

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We present the result of the processing of our observations of the FI Sge, the pulsating RR-type variable with the Blazhko effect in the R-band. The data were obtained during 36 nights in 2018 as well as during 13 nights in 2021. We used the period and initial epoch obtained from our observations in V-band. We confirmed the presence of the Blazhko effect, the bi-cyclicity effect, and also the effect of discrete displacement of the light curved along the phase curve detected firstly in the V-band. We detect some differences in the dynamic of the light curve variability in different photometrical bands, possibly related to the Blazhko effect.

THE PHOTOMETRIC BEHAVIOR OF A SYMBIOTIC STAR V919 SGR

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We collected data on the symbiotic star V919 Sgr from the AAVSO and ASAS-SN databases, as well as UBVRI observations obtained at the Astronomical Institute of the Slovak Academy of Sciences. This symbiotic binary star is of the Z And type. It has been largely ignored by observers. The first outburst was observed in 1991. We found an earlier outburst in 1932 from the Sonnenberg Observatory plates. In total, we found seven outbursts of V919 Sgr. In particular, the star has recently shown significant activity, including a new active phase starting in 2022 and a re-brightening in 2023 that exceeded the previous year's outburst by about 0.4 V magnitudes.

To analyze the activity of V919 Sgr on short time scales, we used a "pattern scaling analysis" with a weighted "running parabola" (RP) approximation and additional "bi-square" weights. An optimal window half-width of 63 days minimized the rms statistical errors, and the B-V, V-R, and R-I color indices were determined. The B-V color index ranged from 0.53 at brightness maxima (10.15-10.76 in V) to 1.20 at magnitude 13.8. A periodogram analysis was also performed. However, due to the limited number of observations between outbursts, the period estimates are highly uncertain.

RED GIANT PULSATIONS IN SYMBIOTIC VARIABLES RT SER AND UV AUR

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We analyzed the photometric observations made in the Astronomical Institute of Slovak Academy of Sciences as well as AAVSO multicolor observations, as well as many sources of archival data for the symbiotic variables.

Using the multicolor observations or two or more frequency approximations we correct the long waves (about 4400-7000 days) parameters and suggested that they are caused by varying visibility conditions (during orbital motion) of partially optically thick nebula ionized by the hard radiation from the white dwarf. RT Ser is a symbiotic nova (with the outburst approximately in 1910-1920), but our analysis of observations of UV Aur in more than 100-years interval did not reveal the outbursts.

For UV Aur we analyzed pulsations with a cycle of about 394 days and suspect a slow increase in the cycle length with the rate of about 0.8 days per cycle on average. Such long-term period changes may be similar to ones that Miras show on the helium shell flash stage (e.g. R Aql, R Hya, W Dra и T Umi).

For RT Ser, we found the multiperiodc behavior, particularly on a short time scale with cycles from 90 to 160 days, most likely caused by pulsations.

INVESTIGATION OF POORLY STUDIED ECLIPSING VARIABLES

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A group of poorly studied eclipsing variables has been studied with the using of the photometric observations of TESS, GAIA, ZTF, and NSVS as well as those obtained by our group by using the telescopes at Astronomické observatórium na Kolonickom sedle and Observatory and Planetarium in Hlohovec (Slovakia) during "Variable-2024" astrocamp. The periods and classification were corrected, and the depths and durations of the eclipses were

estimated. For some variables our moments of minima and ones found in the literature were used for O-C curves.

ACTIVE STAGE OF THE SYMBIOTIC STAR CH CYG IN 2015

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Symbiotic star CH Cyg is very different from other members of this group by the behavior of its photometric and spectral parameters. CH Cyg also belongs to a minor subgroup of symbiotic stars in spectra where the high velocity absorption components have been observed – so called "Jet Absorption Structures" in the Hydrogen lines from the Balmer series. In this paper, the behavior of these jet absorption structures in H alpha and H beta lines in the spectrum of the symbiotic star CH Cyg during 18 nights from July to September of the year 2015 is described. Spectra has been obtained at the Cassegrain focus of the 2-meter telescope at Shamakhy Astrophysical Observatory with the help of echelle spectrograph with spectral resolution of R = 14,000. This paper also provides the profiles of the H alpha and H beta lines with absorption components on the blue wing. Based on the depth and the appearance, the absorption components have changed significantly and the short wavelength boundary reaches velocities of near 2500 km/s. The depth of absorption component on Hα is considerably less than the one at Hβ.

ADDITIONAL PULSATION FREQUENCIES OF THE HADS STAR V965 CEP

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We revealed additional pulsation frequencies for the High-Amplitude Delta Scuti star V965 Cep. The pulsations on these additional frequencies may explain quite a big scatter in the star's O-C diagram: their existence causes an effect similar to the Blazhko effect observed for RR Lyrae-type variables, i.e., modulation of the timing and amplitude of the maxima of brightness.

One of these discovered frequencies, F, has an F0/F ratio of 0.80, where F0 is the primary pulsation frequency. This ratio is close to the commonly observed ratio of the fundamental frequency to the first radial overtone for HADS stars (0.77) yet exceeds it.

Other frequencies are close to the main one but lower than it. These close-to-the-main frequencies mainly determine the observed fluctuations of the moments and amplitude of the star's maxima of brightness.

THIRD COMPONENT IN ALGOL TYPE ECLIPSING BINARY SYSTEMS

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After the application of the echelle spectrograph in combinations with high sensitivity radiation receivers during the observations of short period Algol type binary star systems, in some cases there is a special feature observed in their spectrum which could indicate the presence of the potential third component. Currently the subclass of the star is distinguished among the Algol type stars in spectra of which similar features have been observed. The results of the spectral observations of two Algol type stars that belong to the subclass delta Lib and U Sge are also included. In both stars, there is an absorption detail that appears during the phases of the orbit (0,1 – 0,4) in red and (0.6 – 0.8) in blue wings of the H alpha line. These phase intervals correspond to eclipse period of the secondary component. Preliminarily, we are suggesting that this observational fact could indicate the presence of the third component in the system and also provides alternative hypotheses that leads to similar physical conditions

EXTRAGALACTIC ASTRONOMY AND ASTROINFORMATICS

POST-PROCESSING AFTER MACHINE LEARNING CLASSIFICATION: VISUAL INSPECTION OF SDSS GALAXIES AT Z<0.1

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Our work aims to study the evolutionary properties of galaxies at redshifts z<0.1. We have created catalogs of galaxies at z<0.1 with specific morphological features, alongside estimations of the basic evolutionary parameters of the galaxies contained within these catalogs (Vavilova+, 2022). We developed this catalog using photometry- and image-based machine learning for classification. This catalog provides information on 32 features, such as bar, ring, merger, dust lane, edge-on, and irregular etc. It also includes attributes related to CNN accuracy in identifying these features.

To ensure higher CNN accuracy in estimating the evolutionary properties of galaxies, we conducted a thorough visual inspection of the galaxy catalogs to remove misclassified objects. This meticulous process enhances the reliability and precision of our evolutionary analyses. We present the results of this visual inspection and identify the leading machine learning errors uncovered during the review.

REMARKS ON THE LUMINOSITY FUNCTION OF GALAXY CLUSTERS

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The main idea of our project is constructing the luminosity function of galaxy clusters. This important astrophysical problem was analyzed many times for individual objects as a optical galaxy or a radio galaxy, however the problem of determining the luminosity function for the clusters themselves has not been popular among researchers and has not yet been solved. It is mostly because of lack of appropriate data necessary for investigate the problem of constructing luminosity function for galaxy clusters. Even where the authors noted that they investigated luminosity function for galaxy clusters, in fact they analyzed luminosity function for galaxies belonging to clusters, not total brightness of the clusters.

It is the reason that we decided to construct the luminosity function of total brightness of galaxy cluster which was performed by counting brightness of galaxies belonging to 6160 clusters from Panko-Flin Catalogue. Our study has shown that the brightness function for galaxy clusters is significantly different from that obtained for optical galaxies and for radio galaxies.

The dependence of luminosity function on Bautz-Morgan morphological types has also been investigated. We discuss implication of this result for the theories of the structure formation.

DEEP LEARNING APPROACHES FOR DETECTING POLAR RING GALAXIES

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Polar ring galaxies (PRGs) are unique and rare objects. We compiled a catalog from all known literature and found 356 of these galaxies available in the SDSS, of which only 75 are suitable for our task. They are important for understanding galaxy evolution. We used deep learning to search for PRGs in the SDSS dataset. Given the limited number of objects in the current sample (only 75 PRG), we generated the training sample using two different approaches.

In the first approach, as part of the work, a convolutional neural network (CNN) model was developed and trained on an augmented dataset where the classified objects underwent segmentation and smoothing. The model achieved high validation accuracy, reaching approximately 90%. However, when evaluated on a representative sample from the SDSS, the model exhibited poor generalization performance.

In the second approach, we tried using a deep learning method called transfer learning, which would allow us to train a neural network on a smaller dataset given that some pre-trained model exists. First, we generated a dataset of synthetic images of PRGs and non-PRGs, 1000 and 3000 images, respectively. Then, the InceptionResNet_V2 model was trained on this synthetic dataset. Then, using transfer-learning we applied this model to our original dataset of real images (75 PRG). And lastly, the final model was applied to a sample of more than 300k galaxies from SDSS.

Although the search failed to produce strong PRG-candidates, it is apparent that our CNN has successfully learned important features of such objects. A significant number of objects that scored the highest appear similar to objects that could be related to or reasonably confused with PRGs. The neural network seems to be assigning the highest score to late type spiral galaxies and irregular galaxies, notably to those which resemble some kind of a ring-like structure.

EXPLORING THE HOST GALAXIES' CENTRAL CONCETRATION LEVEL OF A NEW POPULATION OF IR-SELECTED TIDAL DISRUPTION EVENTS

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A tidal disruption event (TDE) is a burst of emission across the electromagnetic spectrum caused by a star being ripped apart by the tidal forces of the black hole. TDEs were first discovered in the late 1990s in the X-ray band, but with recent time-domain optical surveys, hundreds of TDEs were found in the 2010s, allowing for demographic studies of their host galaxies. Optical TDEs tend to be found in a relatively rare type of galaxies - the ones that have recently undergone an active period of rapid stellar formation. Our research aims at understanding whether the optical TDEs found mostly in post-starburst galaxies due to some intrinsic property of those galaxies or a selection effect of the surveys.

Recently, the group of Megan Masterson found a new population of TDEs using infrared (IR) data from the WISE satellite. This new population is sensitive to TDEs in dusty galaxies, which may be missed by optical surveys and hence addresses the question of selection effects above. We analyzed the Sersic profiles of 15 host galaxies of IR TDEs and found that they tend to be less centrally concentrated compared to those hosting optical TDEs, with a broader range of Sersic indices. Despite one possible explanation being the closer location of the IR TDEs' hosts, no correlation was found between the Sersic index and the distance. We used Kolmogorov-Smirnov test to compare the distributions of Sersic indices of optical and IR TDEs' hosts which resulted in probability of samples being drawn from different distributions to be 17%. Therefore, it is likely that the Sercic indices of IR and optical TDEs' hosts' are initially distributed differently.

MULTIWAVELENGTH PROPERTIES OF THE ISOLATED GALAXIES WITH ACTIVE NUCLEI AT Z < 0.05

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We present the preliminary results of a multiwavelength analysis of eighteen 2MIG isolated galaxies with active nuclei by CIGALE softweare. These host galaxies have remained free from mergers for at least 3 billion years, making them a unique laboratory for exploring their internal properties and the physical parameters. Moreover, studying isolated galaxies with AGNs can provide valuable insights into the evolution and activity of galaxies within the larger context of the Cosmic Web. By investigating the properties of isolated galaxies with AGNs, we aim to shed light on several vital aspects. Firstly, we seek to understand how the environment affects the internal properties and physical processes associated with accretion into supermassive black holes in these galaxies. Secondly, we aim to gain insights into the broader picture of galaxy evolution and activity within the context of the Cosmic Web. By examining galaxies that are not subject to the immediate influence of nearby companions, we can better discern the role of the environment itself. These galaxies, in particular, are a unique laboratory to study the interplay between different astrophysical processes without the complicating factors of interactions with other galaxies or the effects of a dense cluster environment. Using observable fluxes from UV to the radio ranges from archival databases (GALEX, SDSS, 2MASS, Spitzer, Hershel, IRAS, WISE, VLA), we estimated the contribution from the emission of an active nucleus to the galaxy's total emission, the stellar mass, and the star formation rate. The mass of the stellar component falls from 1010 MSun and 1011 MSun. The star formation rate for most galaxies (except UGC 10120) does not exceed 3 MSun per year.

THE INNER STRUCTURE OF GALAXY CLUSTERS IN THE TRIPLETS

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We analyzed the inner structure of galaxy clusters included in the cluster triplets detected in the PF Catalogue of Galaxy Clusters and Groups by Panko and Flin. The shapes of cluster triplets varied from practically regular triangle to straight chain, i.e., the ellipticity of the best-fitted ellipse of the triplets are in the range from 0.12 to 0.92. We suppose the substructures in the galaxy clusters must be connected with the influence of other triplet members. We have detected different types of substructures in our data set. The results are discussed.

MULTIWAVELENGTH ANALYSIS OF THE GALAXY NGC 3521

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We present the UV to radio SED analysis of the Milky Way twin, NGC 3521 using CIGALE software. The baseline model describing the emission from gas and stars, considering dust attenuation and dust emission. It is allowed us to estimate stellar mass M_{star} = 2.54 x 10^{10} $M_{\odot}$; dust mass, M_{dust} = 8.36 x 10^{7} $M_{\odot}$; and the star formation rate, SFR = 1.26 $M_{\odot}^{year}$, with a corresponding statistical value of χ^2/d.o.f = 2.

Based on radio data, we also estimated the mass of neutral hydrogen, M_{HI} = 1.3 x 10^{10} $M_{\odot}$. Additionally, using the BPT diagram, we classified the emission from the nucleus of NGC 3521 as originating from an active galactic nucleus (AGN) of the LINER type. However, adding the AGN module to the basic model did not improve the χ^2/d.o.f, which may indicate a weak contribution from the AGN to the total emission.

LNM-SNCLASS - LARGE NUMBER OF MODELS SUPERNOVA CLASSIFIER

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Photometric classification of transients is a dynamically progressing field in astronomy, developed to find a way to classify transient objects based on photometric data. Currently, the most used approach to photometric classification involves machine learning, however, in this work, we propose our method for classifying supernovae, involving Bayesian inference model fitting. The method is called: LNM-SNClass - Large Number of Models Supernova Classifier, which can be used to classify confirmed supernovae by types and can detect SN Ia from samples of different transients. LNM-SNClass uses 180 supernovae models implemented in the SNCosmo package for SN Ia, Ib/c, Ib, Ic, Ic-BL, II, IIP, IIL, IIn, IIb types. Most of the models use three parameters to describe a light-curve shape – time offset, amplitude, and redshift. At the end of the fit of all models to the object with a nested sampler, the code provides the values of three scores: log_likelihood, log_evidence, and AIC for each analyzed model. Consequently, exponentiated model scores are summed into three main types: Ia, Ib/c, and II resulting in a softmax probability for each. As of now, tests are being made on objects with assumed known redshift and objects with calculated photometric redshift by our code, using ZTF r and g photometry of spectroscopically confirmed supernovae with known types to determine the accuracy of the proposed classifier. Our tests on around 2800 objects with different amounts of data points per object starting from 10 data points demonstrated >86% general accuracy, with completeness: 88%, 84%, 65%, purity: 81%, 77%, 79% with spectroscopic redshift, and >85% general accuracy, with completeness: 87%, 83%, 60%, purity: 83%, 71%, 78% with photometric redshift for type Ia, II and Ib/c respectively. In addition, classifier can spot SN Ia giving >10 datapoints with 94% confidence, from any ZTF transient data.

AN ADVANCED APPROACH FOR DEFINITION OF THE "MILKY WAY GALAXIES-ANALOGUES"

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Our Galaxy – the Milky Way – has characteristic features of evolution, including the low oxygen content on the periphery, low activity of the nucleus, small mass of a black hole, and the lack of significant mergings over the past 10 Gyrs.

We propose a project on searching and studying the Milky Way analogues. The parameters of the Milky Way analogues will be examined using the results of own observations, data from the literature and archives of ground-based/space telescopes. This will allow us to analyze and optimize the necessary and sufficient conditions for revealing galaxies-analogues based on the overall MW parameters. The cosmological simulations will make it possible to clarify whether the evolution of the Galaxy is the only reason for its existing characteristics. We will use machine learning and the obtained multiwavelength radiation parameters of galaxies-analogues as well as 3-D kinematics of the Milky Way to establish the appearance of the Galaxy from the outside.

CLUSTER CARTOGRAPHY ON THE NEW PLATFORM AND ITS NEW POSSIBILITIES

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Based on the summarization of our previous experience in analyzing the internal structure of galaxy clusters using the Cluster Cartography set we have created the web version of the Cluster Cartography. We used SVG (Scalable Vector Graphics) and JavaScript to implement dynamic data visualization in a web environment. The web version of the code includes functions for processing data, calculating statistics, and plotting maps, histograms, and graphics, which are built using different parameters, such as the radii and widths of the rings in determining the degree of the concentration to the center, the widths of the bands in determining of the degree of the concentration in the linear substructures, etc. We also added a new kind of analysis. We discuss the possibilities of the new version of Cluster Cartography.

SOLAR SYSTEM, EXOPLANETS AND NEAR-EARTH ASTRONOMY

FORMATION AND DESTRUCTION OF BINARY ASTEROIDS

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This report investigates the evolution of binary asteroid systems and asteroid pairs within the inner region of the main asteroid belt. Through statistical analysis, typical satellite sizes in binary systems and the lifetimes of both single and binary asteroids under the YORP effect are determined. The study models the formation of binary systems from single asteroids reaching critical rotation speeds due to the YORP effect, leading to their fragmentation into binary systems. The subsequent orbital evolution of these binaries is driven by the BYORP (binary YORP) effect, which increases their orbital radii and can eventually result in their disintegration into separate asteroid pairs.

Findings reveal that asteroids exist in a binary state for approximately 7% of their lifespan, closely matching the observed 15% fraction of binary asteroids. This indicates that the YORP and BYORP effects are significant in shaping the life cycles of asteroids, complementing the traditionally recognized role of collisions in asteroid disruption. This comprehensive examination of binary asteroid formation and destruction underscores the complex and dynamic processes governing asteroid evolution, contributing to our broader understanding of small body dynamics in the solar system.

RESULTS OF USING A NEW ASTRONOMICAL IMAGE PROCESSING PROGRAM AT NSFCTC

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A unified system named the Centralized Processing of Optical Sensors Data (CPOSD), was installed at the NSFCTC, based on the client-server technology. Implementation of the system made it possible to obtain measurements in a "pseudo-real" time scale, i.e. 15-30 minutes (at some "average night quality") after receiving the last image of a separate sequences of frames from the telescope.

With this software the NSFCTC is capable of processing both observations of artificial Earth satellites and Near-Earth Objects.

According to the authors of the report, when processing large amounts of optical observation data, it is often desirable not to overload the observer with processing details, because his main task is to organize and conduct observations (selection of objects and observation modes). This approach was used in the creation of the CPOSD.

Currently, an update is being prepared to add a function for generating ultra-precise light curves and visual control of data accuracy, with convenient display of graphs, the ability to delete measurements with large errors, and save measurements in various formats.

The report will present the main features of using the CPOSD.

ABSOLUTE PHOTOMETRY OF SMALL MAIN-BELT BINARY ASTEROIDS: THE PHYSICAL PROPERTIES

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For a long time since 2006 at the Chuguiv observation station of the Institute of Astronomy of the V.N. Karazin Kharkiv National University the photometric observations of small main-belt asteroids with a diameter of less than 15 km were carried out in support of the international program for a discovery of binary/multiple systems among these asteroids. During this time 45 binary and ternary asteroids were discovered and their parameters were determined with our participation.

The aim of this study is to obtain physical characteristics small binary asteroids based on photometric lightcurves observations obtained in the standard spectral bands B, V and R. Here we presents the results of BVR photometry of 24 newly discovered and 2 probable binary asteroids at the inner main belt. The main results of the observations are the obtained lightcurves of each main component of binary systems with determination of the rotation period and amplitude, as well as determination of the color indices V – R and B – V, and the absolute magnitudes HV of the studied objects. The values of the absolute magnitudes HV that we have obtained allows us to revise the previously determined albedo of these asteroids.

Analysis of our observed data V – R and B – V color indices data, revised albedo, color indices obtained from the SDSS and Sky-Mapper surveys, as well as recently published spectral characteristics in the visible and infrared wavelength ranges, allows us to effectively make a taxonomy of the observed asteroids. We have determined that the most of these main components of the binary main-belt asteroids belong to the moderate-albedo S-type with albedo 0.24 ±0.07. Also in this sample there are moderate-albedo objects of the K, L, M, Q, and V-types as well as high-albedo E-type asteroids. It should be noted that asteroids with low albedo are absent in this sample of binary asteroids.

METEOR BODIES PHYSICAL PARAMETERS ESTIMATION TAKING INTO ACCOUNT THEIR CHEMICAL COMPOSITION DETERMINED FROM SPECTRAL OBSERVATIONS

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Modern methods and technical equipment of multi-stations observations of meteors make it possible to reliably obtain the kinematic and orbital parameters of meteoroids but the physical characteristics of meteoroids are not determined reliably enough, in particular their masses. At the same time, the catalogs of meteors do not indicate the chemical composition, since spectral observations are absent in most cases. The classical method of estimating the mass, average density and porosity of a meteor body is derived from the equations of inhibition, mass loss (ablation) and luminosity of a meteor. In this case, the simulation is based only on the energy balance equation, which lacks information about the chemical composition of meteoroids. The system of basic equations is multiparametric and the values of the most of these parameters are unknown. Significant possibilities are achieved on the basis of multi-stations observations of meteors combined with the simultaneous registration of their spectra. In this case, kinetic equations are added to the classical system of basic equations of meteor physics for those substances that are observed in the meteor spectrum. The proposed method involves the using of theoretical and experimental data on the evaporation of metals and meteorites. Such an integrated approach using spectral data makes it possible to assess the physical parameters of meteoroids more unambiguously, in contrast to classical methods.

The meteor data analyzed in this work were obtained from observations using the Automated Video Spectral Meteor Patrol (AVSMP) of the Institute of Astronomy of V.N.Karazin Kharkiv National University. We present the results of research of selected meteors brighter than 0^m that were recorded by the multi-stations method and for which spectral observations were obtained.

NON-LINEAR THERMAL MODEL OF THE YARKOVSKY EFFECT

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The Yarkovsky effect is a light pressure force originating from the asymmetric remission of the absorbed solar energy by a rotating asteroid. This effect is an important factor of orbital evolution of small asteroids, an essential ingredient for predicting asteroid hazard, and a powerful tool for measurement of asteroid masses.

Historically, the Yarkovsky effect was first proposed and studied for meteoroids that rotate much faster than asteroids, and thus have a much higher value of the thermal parameter θ. As a rudiment of this historical twist, the Yarkovsky effect for asteroids is still routinely studied in the limit of high thermal parameters, although most asteroids have thermal parameters of the order or less than unity. We analytically consider the opposite limiting case of small thermal parameters, numerically simulate the heat conduction problem for arbitrary thermal parameters, and combine all these different approaches to construct a unified analytic function describing the Yarkovsky effect for any value of the thermal parameter θ at the accuracy of a few per cent.

For small thermal inertias, we have to correct the classical linear model of the Yarkovsky effect by the factor of about 0.5, implying that the Yarkovsky drift rate for most asteroids gets significantly smaller, and the estimated asteroid densities get significantly lower.

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THE SEARCH FOR NEOS AS POTENTIAL CANDIDATES FOR USE IN SPACE MISSIONS TO VENUS AND MARS

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In this work, we analyzed the orbits of more than 35,000 (for 2024) near-Earth objects (NEOs) for the possibility of successive approaches to all pairs of planets: Earth, Venus, and Mars in the time range from 2020 to 2120. We have selected 120 candidates for Earth-Mars, Earth-Venus, Mars-Earth, Mars-Venus, Venus-Earth, and Venus-Mars fast transfers (within 180 days); 2 candidates for double transfers (consecutive approaches with three planets); 10 candidates for multiple transfers, when an asteroid has several consecutive paired approaches to planets in a hundred years.

LUNAR DISK FUNCTION EXPLORATION USING LROC NAC DATA

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The brightness distribution over the lunar disk (disk function) at arbitrary phase angle is a result of a combination of the inherent brightness pattern caused by the composition and microstructure, as well as the local

topography and the global brightness trend due to the sphericity of the Moon. Until now the global latitudinal brightness trend of the Moon has not been studied sufficiently. One can exploit disk functions deduced from theoretical models or find such functions empirically. We here use two formulations of disk functions, proposed by Akimov: an empirical one, generalizing the Minnaert law; and semiempirical one, which was derived for utterly rough surfaces.

The orbital photometric survey by high-resolution Lunar Reconnaissance Orbiter Camera (LROC) gives a possibility to study the lunar disk function with high angular and spatial resolution. For this aim we use LROC NAC images of several 2-3 km sized craters located at low- and mid selenographic latitudes. These data allow variations of photometric latitude and longitude in the ~ 0-50 deg range over the steep crater slopes. We accounted the local observation geometry using topography models obtained with orbital stereophotogrammetry and photoclinometry. We eliminated albedo pattern using phase-ratio method and then performed a fitting of Akimov's models with phase-ratio data. Our results reveal that parameter of semi-empirical disk function vary a little for different craters being rather close to unity which correspond to the Akimov model of lightscattering for utterly rough surfaces and for Shkuratov's model of fractal-like surfaces.

Fitting of semiempirical Akimov's model gives the value of parameter ~0.45 which is greater than it was estimated earlier with telescopic measurements (0.16-0.31). We note that using high-resolution space photometry data we deal with higher optical roughness as compared to Earth-based photometry thus space-derived data should be photometrically normalized with updated values of disk function parameters.

INCREASE IN ACTIVITY OF COMET 67P/CHURYUMOV–GERASIMENKO ON AUGUST 22–23, 2015, AS OBSERVED BY THE OSIRIS INSTRUMENT ON THE ROSETTA MISSION

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The Wide Angle Camera (WAC) of the OSIRIS instrument on board the Rosetta spacecraft monitored the coma of comet 67P/Churyumov–Gerasimenko. On August 22, the comet experienced a mini-outburst, resulting in the ejection of a significant number of icy particles. The behavior of the primary cometary emissions was studied, and the distribution patterns of CN, OH, NH, NH2, and OI emissions did not show significant changes compared to other dates. Unlike other emissions, which displayed a strong maximum in the solar direction, the surface brightness of the CN emission exhibited a weak dependence on the position angle and distance from the nucleus.

The coma continuum color experienced a blue shift, attributed to the presence of a large number of icy particles. Additionally, the study demonstrated the potential for determining the volume density of dust particles through photometry of the nucleus's shadow. This method revealed two subsystems of dust particles: large particles near the nucleus and smaller particles in the free expansion region. In the free expansion region, the volume density dependence on distance significantly deviated from the -2 index expected for the stationary expansion of stable particles, indicating rapid fragmentation of dust due to the evaporation of ice particles.

ON THE POSSIBILITY OF USING THE "PHOTOMETRIC PATTERNS" METHOD TO DETERMINE THE ROTATION AXIS OF RSOs THAT REFLECT SUNLIGHT ALMOST DIFFUSELY

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Determining the rotation state of non-cooperative space objects is one of the tasks of the SSA. Estimation of their rotation rate and the spatial orientation of the rotation axis is necessary to predict their attitude, which is of great importance for both the success of active large space debris removal (ADR) missions and the improved propagation of RSO orbits on LEO. Monitoring the state of RSO can be carried out by various means, including using ground-based optical sensors to collect photometric data, processing it and analyzing light curves. This paper discusses a technique for estimating the orientation of the RSO rotation axis in space, which is based on a structural analysis of RSO light curves and the search for similar fragments ("photometric patterns") in observations obtained from one or several sites synchronously, or sequentially over a short period of time. This method does not require prior knowledge of the object's shape. Therefore, it was used to determine the orientation of the rotation axis of RSO 18340 (87074G or R/B SL-14). Photometric observations were obtained during the IADC's international campaign from 2020 to 2024 at several observatories in Ukraine and other countries. The results of the estimation of the rotation period's value and evolution, as well as the orientations of the RSO rotation axis, were obtained for time intervals with the greatest closeness of the observation series, are presented.

ESTIMATION OF THE PROBABILITY FOR DAMAGING AN ARTIFICIAL SATELLITE FROM STREAM AND SPORADIC METEOROIDS

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At present the meteor substance distribution along the earth orbit is generally known. There is a large amount of radar and video observations of the meteor sporadic background, which give the information about the space particle influx into earth atmosphere during a year. The coefficient of meteoroid mass distribution is also calculated from the observational results. In general, the mass distribution of space particles is described by a power low, namely by Pareto distribution. The situation with meteoroids belonging to meteor streams is more difficult since the points of earth and a meteor stream intersection allow observing only a small part of a meteor stream each year. Nevertheless, some statistics has been already collected. Namely, some mean values of meteoroid bulk density, coefficients of mass distribution, etc. are determined for each meteor shower presented in MDC IAU. This fact allows using the meteor showers data together with the meteor sporadic background.

This work is devoted to estimate the probability for the collision of a meteor particle with a near earth space vehicle. In order to calculate the frequency of meteor-to-vehicle collision two main factors are used: the value of influx of sporadic and shower meteors into earth atmosphere (earth orbit space), and the effective 'target' area of the space vehicle. The area depends on the satellite orientation in space in geocentric and heliocentric coordinate systems, and the time of screening the vehicle by earth for the given meteor stream. The ability for calculating this effective area with the help of 3-dimension geometric primitive elements is proposed. The physical factor of potential damage level due to the meteoroid velocity and attack angle is considered. Collision frequency is transformed into probability of meteor-to-vehicle collision, which is described by Poisson distribution. The example of such calculation is given for the International Space Station.

THE EXPERIENCE OF DOUBLE-STATION METEOR OBSERVATIONS FOR DEVELOPMENT OF VIDEO OBSERVATION NETWORKS FOR MONITORING LOCAL ZONES IN AIRSPACE

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The double-station simultaneous TV-, and later video observations allowed to obtain all kinematic characteristics of meteor particles, including parameters of their trajectories in earth's atmosphere and the elements of heliocentric orbits of the meteoroids. Besides, the photometry of meteors along their trajectories allowed plotting their light curves on altitude, and to calculate the initial masses of the space particles. Taking into account modern scientific-technical and geopolitical problems, especially during war conditions, we can declare that the problem of the observation (or the continuous monitoring) of some selected zones of airspace, or fixed parts of atmosphere, is very important. In this conditions the experience of meteor video observations may serve as a base for methodology of the observations, and for methods for data processing to be obtained from the local observation networks.

The goal of this work is the selection of technical characteristics of video cameras for monitoring local zones in airspace, and optimization of the observation points disposition and video camera optical axes orientation for providing the best control of the zones. Requirements to the observation cameras are based on the estimated linear sizes of the observed objects (storm discharges, birds, artificial objects – helicopters, cruise missiles, UAVs etc.), distances to them from the observation point, and velocities of their motion. From these data the minimal size of the camera detector, its spatial and temporal resolution, focal distance of the photo lens, and size of the observed object image in pixels are calculated. Optimization of the camera series disposition (at list two) and their optic axes orientation is more difficult task, which allows a range of solutions of the problem. Formulae for calculating the common horizontal area for two basis video cameras view fields at fixed heights, and the common observable integral volume of atmosphere are derived, examples are presented.

NOAP PLANNER 0.6.5 – FEATURES OF PLANNING NEO OBSERVATIONS WITH ONE BUTTON

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At the last Gamow conference, a package of Python scripts NOAP (NEO Observation Analyzer and Planner) was presented. It designed for automatic planning of NEO observations, as well as analysis of existing observations. The package continues to evolve and over the past year significant changes have been made primarily to the Planner. They concerned, first of all, the maximum automation of planning operations and increasing the accuracy of the selection of objects for observation. The report outlines the main changes. which were included in the Planner, and also discusses some features of automatic planning of NEO observations for telescopes with small apertures.

MODELING OF RESIDENT SPACE OBJECT LIGHTCURVES WITH BLENDER SOFTWARE

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Modelling the behaviour and shape of space objects is widely used in modern astrophysical research methods. Such studies are often used to determine the shape and physical parameters of variable stars and asteroids.

Therefore, based on the database of photometric observations of resident space objects (RSO) available in the Laboratory of Space Research of Uzhhorod National University, was decided to find a means for modelling light curves to confirm the shape of objects and determine the parameters of their rotation, by analogy with objects in deep space. We attempted to use Blender software to model the RSO synthetic light curves (LCs). While Blender has been a popular open-source software among animators and visual effects artists, in recent years it has also become a tool for researchers for example it is used for visualizing astrophysical datasets and generating asteroid light curves.

In the process of modelling, we used all the advantages of Blender software such as Python scripting, and the use of GPU. We made synthetic light curves selected RSO objects (TOPEX/Poseidon, COSMOS-2502 and COSMOS-2528). A 3D model for Topex/Poseidon was available on the NASA website. Still, after research of official datasheets, we figured out that the available 3D model requires corrections in the dimensions of the RSO body and solar panel. A 3D model of COSMOS-2502 and COSMOS-2528 was made according to available information from the internet. A manual modelling process was performed according to well-known RSO's self-rotation parameters. We also show the results of LC modelling using the Markov chain Monte Carlo (MCMC) method. All synthetic LCs obtained in the research process are well correlated with real observed LCs.

COLOR-INDEX DETERMINATION OF METEORS USING TV CCD CAMERAS

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The study is devoted to determining the photometric characteristics of meteors: light curves in different spectral bands and color-indices. The meteor observations equipment consists of two telescopes with wide field lens (f=50 mm, f/1.2, field of view 5.4ºx7.2º) and WAT-902H2 cameras. These telescopes are equipped with broadband filters at red and blue ranges. The pass bands of our filters are close to Gaia BP/RP photometric system, which was chosen as standard system. Observations of meteors are carried out in automatic mode using motion detection software developed at RI "MAO". Coordinate and photometric processing of saved images is carried out using SExtractor and Astrometry.net software along with additional Python scripts. The mean standard errors of the photometric solution are about (0.2-0.3)mag for RP and BP ranges. The stars of the reference system are in the range of (5-13)mag. From simultaneous observations, light curves in red and blue filters were obtained for 205 meteors.

A COMPREHENSIVE STUDY OF COMET 67P/CHURYUMOV-GERASIMENKO IN THE 2021-2022 APPARITION: I. OBSERVATIONS AND PRELIMINARY RESULTS

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Results of pre- and post-perihelion sets of quasi-simultaneous photometric, spectroscopic, and polarimetric observations of comet 67P/Churyumov–Gerasimenko during the 2021–2022 apparition are presented. The pre-perihelion observations were acquired at four epochs (October 6 and 8, August 18, and September 9, 2021), and the post-perihelion at two epochs (February 6, 2022). These observations cover a range of heliocentric distances from 1.248 to 1.836 au, geocentric distances from 0.468 to 0.950 au, and phase angles from 10.5 to 48.2°. We compare the results of the present comprehensive investigation of the comet with those obtained during a previous perihelion passage in November 2015 – April 2016. The stable jet, which corresponds to one of jets observed in the 2015 apparition, and a dust tail were observed throughout the observation period. We discuss our results in context with the previous findings and in situ measurements of dust particles obtained within the Rosetta s mission.

SIMULATION OF DEFLECTION OF HAZARDOUS ASTEROIDS

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There are more than 2000 potentially hazardous asteroids that have a minimum intersection distance with the Earth orbit of less than 0.05 au. It is estimated that such asteroids collide with the Earth, causing local catastrophes every 1000 years and continental-scale cataclysms every 100,000 years. To prevent such disasters, we study the methods of deflecting hazardous asteroids by applying small perturbations to their velocities.

We create a synthetic asteroid with given collision parameters and integrate its orbital evolution into the past

using the Rebound N-body integrator. Then, we create a sample of clones of this asteroid by applying some small perturbation magnitude Δv distributed by angles to get the most effective direction for such perturbation. Utilizing the bisection method, we estimate the minimal value of additional velocity required to deflect the asteroid from the Earth for each moment in time.

We investigate the obtained time dependence of the necessary perturbation magnitude Δv, and compare the results with the theoretical prediction. We find out that in the regular case, Δv is proportional to the radius R of the Earth and inversely proportional to the time t before the impact. We expect that in the case of multiple close flybys of the asteroid near the Earth, they can be used to decrease the necessary Δv far below the R/t rule, but this method may be extremely sensitive to the accuracy of the orbit integration.

PHOTOMETROLOGICAL PROPERTIES OF CANON EOS 6D MARK II

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Full-format (24mm × 36mm, 6264 × 4180 px) digital camera Canon EOS 6D Mark II has being used as a measure and registrate device in photometric studies of Kharkov astronomers. Limit levels of its CMOS matrix output signal are 0.01 and 14250 DN. Photosensor solarization occurs when the output signal reaches 14250 – 14350 DN. Dynamic range of the photosensor output signal in linear response regime is 24.5 dB (ΔS=45-12913 DN, ΔTexp=0.04-10.4 sec). When using the photosensor radiometric transfer function presented in logarithmic scale, the range of its linear response increases to 40 dB (ΔS=1.4-12913 DN, ΔTexp=0.0013-10.4 sec). Dependence of the sensor output signal on its γ-correction level S(ISO) under integration duration Texp=5.2 sec remains linear within the entire range of ISO values from ISO 100 to ISO 102400 when using the logarithmic radiometric transfer function lg Se(lg ISO).

Research of the photosensor response linearity to changes in acting light signal provides the relative photometry on base of linear interpolation methods to record experimental data. It has become necessary also because this metodics is used to absolutize photometric results, which have wide range of values [1].

To carry out photometrologic analysis a series of frames were obtained with exposure durations from 32 sec to 0.00024 sec and γ-correction of ISO 100, ISO 12800, ISO 40000 as well as a series for all ISO values from 100 to 102400 under integration duration of 5.2 sec.

If the noise of a signal is considered as its standard deviation [2], so the sensor signal-to-noise ratio depends mainly on the sensor output level and ISO. SNR changes in range from 1 to 100, when sensor output signal increases from 1 up to 13000 DN.

Taking into account the results of conducted analysis, the use of digital cameras with a CMOS sensor in photometric studies can be considered acceptable.

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REFINED CLASSIFICATION OF ORANGE MATERIAL DEPOSITS ON ASTEROID VESTA

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Asteroid 4 Vesta stands out among other members of the main belt due to its large size, preservation from the earliest epoch of the solar system formation as a possible intact protoplanet and connection to large eponymous asteroid family as well as commonly found HED meteorites as their parent body. Vesta's surface exhibit a high level of heterogeneity according to global mosaics obtained by Dawn spacecraft. One of the most prominent features with unusual spectral behavior is orange material, which occurs commonly among vestan surface as irregular-shaped patches or deposits. As described in previous works (LeCorre et al. 2013, Garry et al. 2014), these deposits are considered to be a result of regular surficial material interaction with melts excavated during the formation of Rheasilvia impact basin.

In this work we provide a detailed analysis of orange material patches population using color-ratio imagery as applied to data obtained by Dawn spacecraft onboard instrument Framing Camera (FC). We used images obtained during HAMO orbital phase in all available color filters to built color-ratio distribution maps for regions described in LeCorre et al. 2013 as bearing orange material. Two color ratios C(438nm/917nm) and C(749nm/917nm) were used as referent to get information about the spectral slope and depth of pyroxene band, respectively. Other color ratios provides us additional constraints to perform more accurate classification.

Patches share several common features in spectral behavior as (1) stronger absorption at 438 nm, (2) deeper pyroxene band at 0.9 μm and (3) higher albedo than surroundings. But we found according to color ratio C(438nm/917nm) distribution maps analysis that the population of the orange material patches is non-homogenious in terms of shapes and sizes as well as sharpness of spots' edges. Additionally, several spots,

previously classified as orange material, show quite distinct spectral characteristics to traditional. Our results seem to contradict with impact melt hypothesis of orange material origin.

DETERMINATION OF THE SPIN AXIS ATTITUDE OF AJISAI SATELLITE BY PHOTOMETRIC PATTERNS METHOD

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The growing number of space objects (SOs) in Earth's orbit is raising the risk of collisions. To prevent collisions, it's important to accurately track SO positions and actively de-orbit large space debris. Both tasks require the ability to track orbital motion and determine the attitude of SOs. Our research provides a practical solution to this problem by introducing a method to remotely determine a space object's attitude through the analysis of its photometric light curves.

When estimating a spacecraft's orientation, we need to determine its spin period and the direction of the spin axis. Usually, we can evaluate the apparent spin period by analyzing just a single light curve. However, finding the direction of the spin axis is much more complex. Currently, we only know the spin axis direction for a few objects. The main challenge in determining the spin axis direction is accurately modeling the spacecraft's brightness, which is difficult because we often lack accurate information about the spacecraft's shape and surface properties.

We have recently introduced a novel method known as the photometric pattern method to determine the orientation of the spacecraft's spin axis. Its primary advantage is that it does not need knowledge of the SO's shape and surface properties.

In this study, we use the photometric patterns method to determine the spin axis orientation of the geodetic satellite Ajisai, using it as a representative example. We illustrate how the photometric patterns can be identified on the light curves and how their moments of occurrence on the light curve can be utilized to estimate the direction of the spin axis.

As a result, we demonstrate that the spin axis undergoes both precession and nutation motion over time. We also provide the methodology and assessment results of Ajisai spin axis precession and nutation characteristics.

MODELING SPACE DEBRIS IN NEAR-EARTH SPACE

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The problem of the growing pollution of the Earth's space is under consideration. The difficulty of predicting movement in near-Earth space lies in the complexity of active disturbances of various physical nature. There are various methods of reproducing the Earth's environment using mathematical and physical models. One of them is deterministic. It consists in "artificial" prediction of the movement of each object with known initial conditions. But for small objects, the initial state vector is completely unknown. Using an exclusively deterministic method becomes impossible. Therefore, statistical modeling is used. In this case, objects whose perigee height is less than 2000 km are considered. It is believed that only the height of the perigee has a significant effect on the evolution of the distribution of cosmic dust by height. The cost of computer time with this approach is reduced by 3 orders of magnitude.

In near-Earth space, a cascading process of formation of new fragments of space debris due to their collision with each other is observed. The cascading process maintains itself, it cannot be affected by reducing the number of starts.

Due to the inhomogeneities of the Earth's gravitational field, we expect to detect areas of concentration of space debris resulting from the evolution of orbits over time. In addition to the gravitational field, a significant influence of other disturbances is possible. This issue is still poorly researched. Based on the given task, we plan to create a deterministic model of the object's movement in near-Earth space.

DETERMINATION OF THE ROTATION PERIOD OF ASTEROIDS FROM A SHORT SERIES OF BRIGHTNESS OBSERVATIONS UNEVENLY SPREAD OVER A LONG TIME INTERVAL

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In the present study, the Lomb–Scargle method was employed for the analysis of brightness measurements from multiple observatories to determine the periods of asteroids. The results revealed the potential for this approach to be used in the subsequent identification of yet-unknown periods of asteroids. This was demonstrated by the confirmation of periods for four of the five asteroids with known periods from the ALCDEF database, namely 1951, 2128, 2134, and 2150. As has been evidenced, the use of the L-S method in conjunction with multiple observatories is a suitable approach even for a relatively limited series of brightness observations, a determination that was previously more challenging to ascertain. Furthermore, this approach is effective even when there are significant intervals between measurements, which is not the case with the classical Fourier method. Additionally, the exclusion of observations that deviate significantly from the linear relationship of the phase diagram, following the three-sigma criterion, markedly enhanced the efficacy and precision of the method. As a result, periods were determined for the first time for asteroids 1205, 1779, 1818, 1963, 2174, 2313, 2497, 2503, 2538, 2539, and 2583.

MULTIPHASE PHOTOCLINOMETRY AS APPLIED TO THE LUNAR PHOTOMETRY WITH LROC NAC DATA

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We has been developed new method for photometric and geometric correction of LROC NAC data with high resolution (up to 0.5 m/pix). The technique is based on photogrammetry and multiphase photoclinometry and realized as software library for our program complex xIRIS. The use of the technique allows us to obtain digital elevation model (DEM) with the resolution of LROC NAC CDR input images as well as to map parameters of model phase function. Obtained DEMs, requiring only LROC NAC images and LRO SPICE-kernels, exhibit significantly fewer defects and artifacts compared to existing DEMs. The method implements the principle of self-ortho-correction of data too.

This method was used to study areas with photometric anomalies, including the Irregular Mare Patch (IMP) formation Ina. The high-quality DEM of the Ina formation and surrounding area with a resolution of 0.5 m/pixel was constructed. A zoning map of the correlation diagram of phase ratio vs. equigonal albedo shows significant differences in the optical (photometric) properties of the regolith for hummocky and blocky formations of the IMP Ina, compared to the surrounding areas, which indicates the different nature of their formation, age, and surface roughness, contradicting some models of the IMP formation.

Our phase-ratio analysis supports a “collapsing” scenario of crater Ina’s formation. First, an ancient basalt eruption from the vent of proto-Ina created the shield volcano. Next, the lava lake in the vent was cooled and hardened from the upper layer inward and roofed over to form a void, as the lake simultaneously drained in the background through its own voids and cracks. Then, all traces of the event were hidden by long regolith-formation processes. Collapses of the old roof was triggered recently by tectonic or moonquake stimulated movements. The hummocky areas can be formed from the blocks and debris of the fallen roof.

RADIO ASTRONOMY

MULTI-WAVELENGTH VLBI POLARISATION ANALYSIS OF SELECTED BL LAC OBJECTS

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Even though Active Galactic Nuclei (AGNs) were discovered in the mid-twentieth century, a number of their physical characteristics still remain unknown. At present there is a more or less generally accepted picture of what is happening inside the AGN, however details regarding the central engine properties and jet launching mechanism remain unclear. Since the emission properties of AGN jets vary greatly with the distance from the central engine, and also moving outwards from the jet axis, observations which provide high angular resolutions of milliarcseconds (or several parsecs in the AGN rest frame) play an important role in determination of the jet parameters.

This study is devoted to multi-frequency polarisation properties of a type of highly variable AGN known as BL Lac objects on parsec scales obtained by VLBI methods, focusing primarily on the core regions of these objects. The objects analysed are from the radio sample of Northern sky BL Lac objects compiled in 1990 by Kühr & Schmidt (1990). Objects from this sample were observed with the VLBA at frequencies 15, 8.4 and 5 GHz and at 43, 22 and 15 GHz with full polarization information.

THE START OF RESTORATION OF THE GURT RADIO TELESCOPE

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The Giant Ukrainian Radio Telescope (GURT) is a new-generation radio astronomy telescope designed for the study of both continuous and sporadic radiation from various cosmic objects, including the Sun, Jupiter, pulsars, the Galaxy, supernova remnants (SNRs), and radio galaxies. This impressive radio telescope aims to enhance our understanding of the Universe by observing radio waves at low frequencies.

As a result of the full-scale invasion by the Russian Federation, a large part of the GURT telescope was either destroyed or stolen. The antenna system of the telescope was the most affected - more than 80% of the technical equipment in the antenna sections was destroyed. However, thanks to the dedicated work of the employees at the Institute of Radio Astronomy of the National Academy of Sciences of Ukraine, it was possible to partially salvage the phasing system, amplification system, and control and registration components of the GURT radio telescope. Diagnostic and repair work was carried out using the salvaged elements and systems. Implementation of these repairs began after August 23, 2023, when a solar power plant was installed at the Radio Astronomical Observatory named after S.Ya Braude. The antenna system of the first section was restored on September 28, and the first observations were made on October 12.

As of now, two subarrays of GURT have been fully restored. These restored sections are used for periodic observations of the Sun and SNR Cassiopeia A.

UTILIZATION OF THE TRIGGER MODE IN THE RPW/SOLAR ORBITER WORK REGIME TO DETECT COMPRESSION REGIONS IN THE SOLAR WIND STREAM

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Application of trigger modes of spacecraft equipment allow us to automate the detection process of events such as shock waves, discontinuities in solar wind (SW) streams, the occurrence of Langmuir waves, etc. Such modes allow us to reduce the forecasting time of some space weather parameters and automate collecting scientific information.

Similar modes were applied in the payload of Helios-1 and Helios-2 spacecraft to detect interplanetary shock waves (IPS). In STEREO-A and -B mission, the trigger mode is implemented combining eight indicators from different instruments with different weighted coefficients for each.

The SBM1 trigger mode of the Radio and Plasma Waves (RPW) instrument onboard the Solar Orbiter (SolO) mission allows us to detect main types of IPS and other discontinuities in the SW streams in the interplanetary space. We assume SBM1 trigger mode can respond to intensive changes in the SW and interplanetary magnetic field parameters when the spacecraft is in the compression region at the boundary of slow and fast SW streams.

To exam this hypothesis, a comparative analysis of the registration moments and frequency of the occurrence of the SBM1/RPW trigger events with solar wind and magnetic field parameters is carried out. For the analysis, we used the data derived from the Solar Wind Analyzer (SWA) and Magnetometer (MAG) instruments. In this work, we selected several events when high-speed streams were observed in the SW.

Based on the relative location of the SolO between the Earth and the Sun, for the events under consideration, a

search for coronal holes as potential sources of high-speed solar wind streams was performed. For this purpose, the SDO/AIA instrument observations were used. Recommendations on the usage of SBM1/RPW trigger events as markers of the SolO location in the compression region of the solar wind streams were proposed.

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MULTIFUNCTIONAL RADIOMETER BASED ON THE STM32F446 MICROCONTROLLER FOR URAN-4 RADIO TELESCOPE

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Even at the design stage of the URAN radio telescopes, it was envisaged to divide the rectangular antenna array of the telescope into two parts, eastern and western, having a common phasing system, but independent receiving paths. This made it possible to use the antenna in two modes: in the summation mode, when both halves of the antenna array were combined into one whole, and in the short-base interferometer mode, when the signals of the two halves of the antenna were multiplied. In the second case, galactic noise was suppressed and it became possible to measure the signal power of compact space radio sources using a correlation or modulation radiometer.

The analog-digital radiometers used for a long time on the URAN-4 RT have begun to lose their efficiency in recent years due to a significant deterioration in the radio interference environment in the short-wave radio range. This is due to the relatively low dynamic range of the radiometers used and the impossibility of implementing adaptive suppression of radio interference.

To overcome the problems associated with the deterioration of the interference environment and to expand the scope of application, a multifunctional radiometer based on the STM32F446 microcontroller was developed. The dynamic range has been increased, and it has become possible to filter narrow-band and pulsed radio interference. New functions can be implemented: operation in the riometer and polarimeter mode, use in VLBI.

INVESTIGATION OF SOLAR COSMIC RAYS INFLUENCE ON ATMOSPHERIC INFRASOUND

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The report presents the results of the influence of solar cosmic rays on atmospheric infrasound during the solar energetic particle event on 2013 May 22.

We used the experimental data of the atmospheric infrasound obtained at the Karpenko Physico-Mechanical Institute of the NAS of Ukraine and Lviv Centre of the Institute of Space Research of the NAS of Ukraine and the SSA of Ukraine and the data of the flux density of high-energy particles measured by the GOES satellite.

According to NOAA GOES, the maximum flow of high-energy particles has increased to 1660 cm^{-2} s^{-1} sr^{-1}. About 5 hours later, we registered the beginning of a daily cycle disturbance of natural atmospheric infrasound, increased of the it's frequency spectrum width and an increase of atmospheric infrasound magnitude by ~3÷4 times.

Oscillations with a period of T~300 sec are dominated at the signal spectrum before the disturbance of atmospheric infrasound, and the oscillations with periods T~100÷230 sec became dominant after the atmospheric infrasound disturbance.

STOKES V SURVEY WITH VLASS3.2 DATA

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Despite the rich information contained in circularly polarized (Stokes V) radio emission, there has been no wide-field Stokes V survey performed in high resolution at GHz frequencies. We are using the Very Large Array Sky Survey (VLASS) epoch 3.2 to perform such survey. VLASS is the largest radio sky survey ever performed. It covers 33885 square degrees, which is 80% of the sky. Epoch 3.2 is in run from May to October 2024 and covers 17000 square degrees.

Our goal is to establish an approach to perform such a survey with VLASS3.2 data. We investigated the influence of different Stokes V imaging parameters on the runtime, developed an algorithm of source finding and artifact rejection in Stokes V imaging, as well as experimentally calculated the influence of Stokes V primary beam on the measured level of circular polarization. To date, we have created initial images of approximately 6500 square degrees in Stokes V, with more than 50,000 source candidates. About 2000 of them passed the preliminary filtering algorithm. However, additional filtering based on the intricate form of the Stokes V primary beam is still to be applied to these 2000 sources.

INTERFEROMETER OBSERVATIONS OF TYPE IV BURST AT 20 AND 25 MHZ ON 29 MAY 2014

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Results of interferometer observations of Type IV durst by the UTR-2 radio telescope at frequencies 20 and 25 MHz on 29 May 2014 are discussed. For interferometer observations we used 4 sections of west-east arm of UTR-2 the radio telescope. These observations were supported by the URAN-2 radio telescope observations in the usual spectrographic regime.

Type IV burst was observed from 9:06 till 11:15 UT on 29 May 2014. It was initiated by coronal mass ejection (CME) which moved behind the eastern limb with

longitude - λ. The source of Type IV burst was situated at the distance of 25-35` during about 50 minutes at both frequencies 20 and 25 MHz and we conclude that this Type IV burst was a stationary. The sizes of Type IV source were practically unchanged and equal 27' and 37' at frequencies 25 and 20 MHz correspondingly.

EVOLUTION OF THE JET EMISSION OF RADIO SOURCES WITH STEEP LOW-FREQUENCY SPECTRA

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We suppose the relation of source emission at the decameter and infrared band as the estimate of the jet structure contribution relatively the central region of the source.This relation is examined for the sample of galaxies and quasars with steep low-frequency spectra from the UTR-2 catalogue.We have derived the relations of corresponding flux densities (at 25 MHz and at the near-infrared band) and their connection with source's redshifts, characteristic ages, jet propagation velosities.At the separate value of the jet emission relation the examined galaxies and quasars with steep linear spectrum and steep break spectrum have positive correlation for corresponding redshifts, jet propagation velocity.The sources with steep linear spectrum display smaller characteristic age (10E7 years) than ones with steep break spectrum (10E8 years). At that time the examined parameters are very close for the sample's galaxies and quasars with the same type of radio spestra. This may evidence for their same evolution.

MODELING OF AN ANTENNA ARRAY FOR THE TASKS OF INCREASING THE RESOLUTION IN LONG-WAVE RADIO ASTRONOMY

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In long-wave radio astronomy, signal processing is often associated with the problem of increasing the resolution of closely located cosmic radio sources under the interference of various sources of radio signals of terrestrial origin.

Modern spatial signal processing methods provide super-resolution compared to the traditional periodogram method. They use the inversion of the correlation matrix, which consists of estimates of the signal correlations between all pairs of antenna array elements. However, super-resolution methods are not applicable to the existing URAN equipment since there are no analog-to-digital signal converters on each of the elements of the antenna array. The advantage of the URAN equipment is the ability to process periodogram records after reviewing the entire angular space.

An algorithm for signal processing is proposed to increase the resolution of signal sources based on periodograms measured after the angular space survey. The algorithm is based on forming an estimate of the covariance matrix based on the results of the constructed periodograms and applying this estimate to super-resolution methods. The algorithm can be simplified for an equidistant antenna array, for which the covariance matrix has the Toeplitz property. In this case, the number of different elements of the covariance matrix is minimal and equal to the number of elements of the antenna array. The algorithm consists of 4 stages: calculating the angular spectrum using the periodogram method after the angular space survey; forming a system of equations for calculating the coefficients of the covariance matrix; inverting the covariance matrix; calculating the angular spectrum using the super-resolution method.

A method for modeling a signal recording processing system has been developed that allows for a significant increase in the resolution of antennas in radiometry and radio interferometry systems.

THE NEW GENERATION DIGITAL RADIO ASTRONOMY RECORDER. DEVELOPMENT AND LABORATORY TESTS RESULTS

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The digital radio astronomy recorder (DRR) a new generation was designed over the past few years. It is intended for use on UTR-2 and URAN-1,...,4 radio telescopes. The created device has parameters that significantly (in some cases by ten times) exceed the parameters of previous generation recorders. The DRR includes a digital receiver and a computer-recorder with special software and GPU.

The digital receiver has two identical channels of digital processing of radio astronomical signals, external inputs for clocking and synchronization. The receiver is built using high-speed ADCs, ALTERA FPGA (Field Programmable Gate Arrays) and a USB 3.0 interface controller.

The combined method of data processing is used in the DRR with the ALTERA FPGA and video card with the digital graphics processor of the CUDA architecture, which ensures high technical parameters of the DRR. The DRR has undergone preliminary testing in laboratory and at the URAN-2 radio telescope.

STUDY OF RADIO GALAXIES 3C268.1 AND 3C268.3 WITH URAN INTERFEROMETERS

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A study of extragalactic radio sources at decameter wavelengths with the URAN interferometers has revealed significant changes in their angular structure compared with

high-frequency images of the sources. One of the reasons is the difference in spectra of source components that change the ratio of their fluxes with frequency decreasing and modifying source brightness distribution. A synchrotron self-absorption in a source core or hot spots can decrease their prominence up to the disappearance of the most compact components at the lowest frequencies. An increase in the angular size of source lobes is another detail of brightness distribution observed at low frequencies. The most interesting feature is an extended structure with a steep spectrum detected at low frequencies in some radio sources. The size of such components often exceeded the source dimensions measured at decimeter wavelength significantly. They are not prominent at higher frequencies due to high spectral indexes and low surface brightness but provide a considerable part of the total source flux at the decameter wavelengths.

Using the URAN interferometers we observed two radio galaxies that have FRII structures according to their high-frequency maps. The radio galaxy 3C268.1 has dimensions of several hundred kiloparsecs, while another one 3C268.3 is a CSS (compact steep spectrum) radio source with a parsec-scale size. The goal of the study was to obtain the angular brightness distributions of these objects at decameter wavelengths, to find a difference from their high-frequency images, and also to compare the low-frequency radio structures of these radio galaxies with significantly different sizes, powers, and ages. An extended structure was found in the radio source 3C268.1, supplying more than half of its flux density in the decameter range. The radio galaxy 3C268.3 retains its compact structure, though its visible brightness distribution is influenced by interstellar scattering, and the shape of its total spectrum at low frequencies is determined by synchrotron self-absorption in compact parts of the source.

DETERMINATION OF THE CME CORE PARAMETERS BY THE RADIO ASTRONOMICAL METHODS

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In the work the possible method of the determination of the CME core parameters is presented. The analyzed CME and associated type IV burst were observed on 22 August 2015 in the optical range by the SOHO and SDO satellites and in the radio range (8 - 80 MHz) with the radio telescopes UTR-2 and NDA. Analyzing spikes against the background of Type IV burst we reconstruct the temperature T(r) and magnetic field B(r) profiles in the CME core assuming that the density follows the exponential law – $n(r) \sim \exp f_0(-\alpha r)$ (r is the distance from the core center to its periphery). We also evaluated the CME core mass that equaled 〚10〛^{15} g and 〚10〛^{16} g assuming that its sizes equaled 1 and 2 solar radius respectively.

IRBENE SINGLE BASELINE RADIO INTERFEROMETER

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The technique of radio interferometry has significantly enhanced the research capabilities of radio astronomy, particularly for studying distant objects with high resolution. In the early stages of radio interferometry, single-baseline interferometers with lengths of no more than a few kilometers were widely used. Today, these have been largely replaced by Very Long Baseline Interferometry (VLBI) networks, which offer much greater capabilities, such as obtaining radio images of remote radio sources. As a result, single small-baseline radio interferometers are now used very rarely. However, they can be extremely useful in situations where high resolution is not required, but there is a need to study rapidly transient processes with short characteristic timescales, requiring sensitivity comparable to or even exceeding that of the world's largest radio telescopes. These large radio telescopes are usually overbooked, making it practically impossible to conduct high-cadence radio observations with them. Therefore, small-baseline radio interferometers, implemented using several closely spaced radio telescopes, can prove to be very beneficial in such cases.

The two radio telescopes, with diameters of 32 meters and 16 meters, operated by the Ventspils International Radio Astronomy Centre (VIRAC) of Ventspils University of Applied Sciences (VUAS), are positioned 800 meters apart and have been used to create such an interferometer. Currently, two projects are being carried out at VIRAC, which, alongside improving this interferometer, are studying high-mass protostar systems and searching for stellar flares.

TYCHO'S SUPERNOVA REMNANT AT LOW FREQUENCIES

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Low-frequency radio observations of supernova remnants (SNRs) are a promising means of detecting and investigating free-free absorption inside and outside SNRs along the lines of sight. In this context, we present new radio observations of Tycho's SNR (3C10) using a multi-baseline interferometer

based on the low-frequency radio telescope NenuFAR in France. This SNR is a result of a core-collapse explosion in 1572. We investigate its emission at low frequencies as applied to free–free absorption, which consists of two parts. One part is external, resulting from ionization in the surrounding environment of the SNR, while the other part is internal, occurring within Tycho's SNR due to cold ionized gas. The investigations took place between May and August 2024. The radio observations using NenuFAR allow us to determine the absorption properties from Tycho's radio spectrum. For this purpose we measured the integrated radio spectrum of Tycho's SNR in the frequency range of 15–66 MHz. The radio flux density of Tycho' SNR was determined with respect to the radio galaxy Cygnus A as a calibration source, while pairs of NenuFAR mini-arrays were used as correlation interferometers with different baselines to improve both sensitivity and accuracy of observations. With the absolute measurements of the flux-density spectrum of Tycho's SNR we estimate the values of free-free absorption parameters. Additionally, during that time, we also observed Cassiopeia A (3C461) to determine the magnitudes of emission measure, electron temperature, and the average number of charges of ions related to both internal and external absorbing ionized gas in the direction of this SNR.

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S-BURSTS OF JOVIAN DECAMETER RADIO EMISSION STORMS UNDER THE INFLUENCE OF LOW AND HIGH FREQUENCY MHD DISTURBANCES IN STREAMER-LIKE SOURCES

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There are analyzed a model for the DAM-bursts radiation by maser-cyclotron generation mechanism in the streamer-like sources that have been activated on ionization processes and MHD waves of high and low frequencies in Jupiter magnetosphere.

It was accounted that the ion-atom collision processes in the low-ionized magnetosphere change the velocities and decay times of MHD waves at ultralow frequencies, because of the high and low MHD plasma disturbances have different properties and functions in the magnetosphere. Thus, it is shown that the typical periodicities of high frequency (HF) S-burst-storm, about 0.5 kHz and 1 Hz, may be associated with HF A/MS-waves, which activate the processes of DAM burst radiations. On the other hand, the typical low-frequency (LF) periodicities of S-storm radiation, about 300s and 20 min time-scales, may be associated with LF A/MS-waves, which activate the processes of plasma ionization and its streamer-like fragmentation.

There was studied the propagation process of HF and LF MHD waves in Jupiter magnetosphere, in the time when plasma flux is streaming inside the Io-Jupiter tube. Then, the process of maser generation of DAM bursts in the presence of HF MHD-waves is investigated. We show that HF-Alfven waves perturb the electron plasma density and its velocity distribution, which give us the conditions for generation of DAM radiation effectively.

Finally, we discussed the particular properties of HF A/MS-waves in the plasma streamers, and the specific properties of the DAM burst formation, and how that corresponded to observation data, and the other plasma processes that may works in this source model.

USE OF PULSAR PULSES FOR PROBING SPACE MAGNETOACTIVE PLASMA

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Investigating space magnetoactive plasma, especially in the solar corona, using pulsar radio pulses is a highly promising scientific approach. The broadband, pulsed nature of pulsar radiation, free from interference effects, enables accurate estimation of additional components in the integral parameters of dispersion measure (DM) and rotation measure (RM) due to plasma effects.

The time delay of pulses at different frequencies depends on the polarization modes of the waves forming the pulse and the angle between the wave and magnetic field vectors. For a mixture of ordinary and extraordinary waves with equal probability distribution at frequencies above the cyclotron resonance frequency, DM estimates derived from cold anisotropic plasma equations are consistently greater at lower frequencies compared to higher frequencies.

By separating ordinary and extraordinary wave modes and analyzing pulsar pulse scattering in space magnetoactive plasma, particularly in the solar corona, it is possible to determine conditions for quasi-longitudinal and quasi-transversal propagation of radio emissions in various types of magnetoactive plasma with high precision. Future studies of the solar corona or other extended radio sources

containing magnetoactive plasma should utilize both low-frequency and high-frequency radio telescopes.

ANGULAR BRIGHTNESS DISTRIBUTION OF QUASAR 3C268.4 AT DECAMETER WAVELENGTHS

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Using the URAN VLBI network, we studied an angular structure of the 3C268.4 quasar at the decameter wavelengths. It is shown, that the brightness distribution of the source in the decameter range differs significantly from the decimeter image of the quasar. At low frequencies, the source model consists of two extended components and a compact feature, whose sizes and positions coincide with the parameters of lobes and one of the hot spots of 3C268.4 observed in the decimeter range. The radio emission of the second hot spot at decameter wavelengths is quite weak and does not significantly affect interferometer response. The probable spectra of the quasar components and their changes in the range from decameter to decimeter wavelengths are determined in the study as well. It is noted that, in contrast to the high-frequency image of 3C268.4, where compact hot spots predominate in the source radiation, at decameter wavelengths about 65% of the source flux density is provided by its more extended lobes. We have also shown that the change in the slope of the full spectrum of the quasar at 325 MHz is caused by synchrotron losses in its lobes.

DETECTION OF RADIO EMISSION FROM WEAK RADIO SOURCES IN DIURNAL SPECTRA OF UTR-2 RADIO TELESCOPE

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Decameter surveys of the Northern sky have been performed at the Ukrainian UTR-2 radio telescope for more than 50 years. During this period the radio astronomical receivers and observational methods underwent a radical development. In this regard the possibilities to extract the astrophysical information at the higher qualitative and quantitative levels through the sky surveys performing have been increased in many times.

By using the UTR-2 radio telescope with the multi-channel DSP-Z spectrum analyzers there are the possibilities to obtain the power spectra from "North – South" and "East – West" arms as well as amplitude and phase cross-spectra from arms of T-shape UTR-2 radio telescope. These spectra will clearly display the beam response both to crossing the Galactic plane twice a day and to a large number of discrete radio sources of different power. There is also a possibility of hardware implementation of synthesized pencil beam with a size of $0.5° \times 0.5°$. Then, it will be possible to determine and investigate the characteristics of discrete radio sources, including rather weak ones. Among them we can notice the NGC 3521 galaxy, which according to certain criteria can be considered as a galaxy-twin of Milky Way. Detection of signal from NGC 3521 and the analysis of its flux density and spectral index at different frequencies within the UTR-2 analysis band will allow us to make the necessary refinements for the further multiparametric modeling.

In this report, we will present the preliminary results obtained in 2021 – 2022 with use of the diurnal spectra at different averaging frequency bands (from 1 to 16 MHz) and integration times (from 0.1 to 30 seconds). The application of proposed observational methods and data processing for various problems of astrophysics will be also discussed.

FIRST RESULTS OF UTR-2 LARGE-SCALE SURVEY OF IONIZED CARBON IN THE GALAXY

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Carbon atoms play an important role in many physical and chemical processes occurring in interstellar medium (ISM). This element serves as the main supplier of electrons and ions in cold ISM regions lying aside from powerful stars and other sources of intensive ionization. Carbon has a lower ionization potential than hydrogen and due to this fact it is almost completely ionized in such medium regions. Carbon atoms are part of many interstellar molecules and their importance for many branches of astrophysical research (including astrobiology) is difficult to exaggerate.

Carbon ions corresponding to extremely rarefied interstellar plasma ($Ne < 0.1$ cm^{-3}, $Te < 100$ K) were detected for the first time in 1978 at Ukrainian UTR-2 radio telescope through observations of carbon radio recombination lines (RRLs) near the frequency 26 MHz (principal quantum numbers more than 600). At the same time, during 2015 – 2022 a new hardware, methodical as well as observational capabilities for radio spectroscopy were implemented for the first time at the world's largest domestic decameter waves radio telescope. For the first ultra-sensitive search studies the zenith orientation of UTR-2 beam was chosen (Dec ~ 50º, RA = 0h – 24h, the scanning of Galaxy is provided by the daily Earth rotation), which gives the highest observational parameters of radio

telescope. In addition, the five-beam observation mode and broadband simultaneous registration of RRLs by using DSP-Z digital recorders (frequencies of about 300 RRLs falls into the 8 – 32 MHz band) give a record relative sensitivity of the line search at 10^{-5} level. Corresponding carbon RRLs are detected in a large part of Northern Sky. Their parameters correlate well with distribution of neutral hydrogen in Galaxy.

PROCESSES IN JETS OF AGNS ACCORDING TO RADIO ASTRONOMICAL MONITORING ON MOJAVE VLBI SYSTEM

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MOJAVE is one of the most effective VLBI monitoring programs to observe Active Galactic Nuclei (AGN) jets angular structure in the radio band. MOJAVE are using the radio interferometric network of 10 radio telescopes of the National Radio Astronomy Observatory (NRAO, USA).

Observation results are available in the MOJAVE Database (MOJAVE/2cm Survey Data Archive). With the largest baseline of about 8600 km, the system allows to map AGN's close surroundings at ~0.12 mas resolution on ~15.4 GHz frequency.

For approximately 30 years of MOJAVE AGN monitoring observations, the Survey Data Archive accumulated a huge amount of observational data. Especially interesting ones are data about the locations of bright features (components) in jets and their changes in time. This data is presented in image format (Separation vs. time plot). And their presence allows to analyze motion patterns of components in jets, which represent AGN's activity, as well as the jet's structure itself.

In this work analysis of components motion in the Seyfert I galaxy 3C 120 (1995.6 – 2020 yy, 54 components), Quasars 3C 273 (1995.6 – 2020 yy, 31 components) and 3C 454.3 (1995.4 – 2019 yy, 9 components), BL Lac (1995.3 – 2020 yy, 37 components) was performed. These objects demonstrate presence both of moving and quasi-stationary components, which slowly change their locations in time. Based on the moving components, the average velocities and accelerations in the jets were estimated in projection onto the picture plane. Also, the distribution of velocities of the components in the jets was constructed and assumptions were made about the structure of the jets based on existing publications on them.

The discussed components demonstrate inhomogeneities in their movement up to quasi-harmonic oscillations of their positions relative to the average movement direction trend. Especially interesting are the oscillations of quasi-stationary components close to nuclei, which can be a result of the propagation of shock waves in jets.

SOLAR ACTIVITY, SOLAR-TERRESTRIAL RELATIONS, ASTROBIOLOGY

COMPLEX ANALYSIS OF SPACE WEATHER MANIFESTATION IN THE "STRUVE GEODETIC ARC" AREA BY USING OF RADIO ASTRONOMICAL OBSERVATIONS, GEOMAGNETIC MEASUREMENTS AND COSMIC RAYS VARIATIONS

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The international "Struve Geodetic Arc" project was conducted from 1816 to 1855 and was designed to determine the shape of the Earth. Ten countries took part in the project. 265 triangulation points stretched over 2,820 kilometers from Hammerfest city in Norway to the Black Sea coast. The accuracy of the "Struve Arc" measurements was so high that its verification by satellite methods in the 20th century showed an error of only 12 meters. In 1993, Finland proposed to give the Arc status of a UNESCO World Heritage Site. In the countries through which the "Struve Arc" passed, there are areas with different soil conductivity, positive and negative magnetic anomalies. Because of this, the regional effects of the magnetosphere-ionosphere system's response to solar activity and disturbances in the solar wind often differ from planetary effects. So, despite the work of many services monitoring "space weather" on a planetary scale, regional effects, their properties and features, are still not fully understood and leave many questions. Considering that the current 25th solar cycle is almost at the maximum of activity, this topic is especially relevant now. This report describes a project for a detailed study of regional features of ionospheric activity (by registering radio scintillations of powerful space sources) and the geomagnetic field (according to magnetometers data), as a response to solar activity (using variations in the intensity of cosmic rays as an indirect indicator of disturbances in the solar wind), in the "Struve Arc" sector - Latvia, Finland, Ukraine.

COMPARATIVE ANALYSIS OF PULSATIONS AT VARIOUS PHASES OF FLARE BY THERMAL AND NON-THERMAL RADIATION OF PLASMA

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Context. Large X-ray flares of X class are very often accompanied by quasi-periodic pulsations (QPPs) at different phases of the flare. It is known that quasi-periodic pulsations of an X-ray flare are an effective tool for diagnosing flare processes and parameters of thermal plasma and accelerated particles. But forever, all pulsations belong to one active region, and this aspect presents researchers with the task of identifying the affiliation of pulsations to active regions.

Aims. A comparative analysis of the impulse coincidences of the time parameters of the temperature and the emission measure in different phases of the flare is conducted on the data recorded by STIX SO to determine whether the pulsations belong to the same active region

Methods. We use X-ray flare data captured by STIX SO. SPEX and OSPEX SPECTROSCOPY procedures are used to estimate temperature parameters and emission measure. In the process of assigning different pulses to different active regions, a common method is the presence of pulse coincidences in the time parameters of light curve pulsations, temperature, and emission measure. Furthermore, a further quantitative evaluation is conducted using the mathematical model of the empirical Neupert effect (ENE) to evaluate pulsations across many parameters.

As a result, obtained X-ray flare curves signal frequencies are visualized on the spectrogram. Curves of temperature dynamics and emission measure are obtained and compared. A mathematical model of the Neupert effect for estimating energy release was obtained. The relative yield of SXR and HXR - emission during the flare is calculated.

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Keywords: STIX, Solar Orbiter, X-ray flare, Pulse Observations, empirical Neupert effect (ENE).

THE EXISTENCE OF SIMPLEST BIOLOGICAL STRUCTURES IN THE FIELD OF HARD RADIATIONS

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Annotation. In recent decades, work in the field of radiation biology. This is has been gained practical interest in terms of spaceflight safety and, in doing so, the survival of various life forms located inside various spacecraft. In other words, the interaction of different

types of cosmic rays (**CR**) with biological structures has been considered. The structure of various biological objects is stored in the form of elemental composition in particular in National Institute of Standard and Technologies, USA (**NIST)**. It should be noted that with his scientific biography G. Gamow united nuclear physics, astrophysics and biology. The present work is devoted to this unification.

Astrobiology. By the mid of1970-s, a number of papers by Hoyle et al. [1,2,3] and Herbst et al. with therein reference in [4] had raised the question of surface reactions for the synthesis of complex molecules on ultracold particles within gas-dust conglomerates. Typical reaction times of macromolecule synthesis τ_{reac} are much shorter than the lifetime of gas-dust nebulae τ_{cloud}. In 1970s, radio astronomy began the pursuit of recording complex molecules down to sugars, amino acids, etc. At the same time, even small doses of hard radiations cause the appearance of surface charge of dust particles, which further reduces the values of the τ_{reac} On the other hand, the survival of macromolecules strongly depends on the spectrum of cosmic rays crossing these conglomerates. The question about the cross sections of cosmic ray interactions with macromolecules is reduced to their interactions with the atoms composing the molecule. The high-energy part of the **CR** distribution mainly penetrates into gas-dust nebulae. And the interaction of these particles gives very small cross sections in the interaction with atomic electron shells of the considered molecules and do not significantly affect the formation of macromolecules. Moreover, when solving such a class of problems and the energy ratio, we can consider these molecules with their constituent electrons as quiescent. To solve the above problem, it is necessary to calculate the total energy losses for dust particles and molecular atoms separately.

Nuclear Medicine. Calculations of macromolecule survival in the field of harsh radiation are necessary in nuclear medicine when using RFPs and directed beams of heavy particles in oncology. As part of the Giant4-DNA 11.2 project, model studies of protozoan bacteria in media filled with radiopharmaceuticals (hereinafter RFP)-Fluorodeoxyglucose (hereinafter FDG), a biological analog of glucose, were carried out. Its full name is 2-fluoro-2-deoxy-D-glucose. When 18F atom is introduced into the preparation, the names are supplemented with its mention, e.g. 18F-FDG. For the model experiment the medium conventionally called "living environment" (hereinafter referred to as LE) is chosen. The LE experiences the direct effect of positrons and gamma-quanta formed by decay in the RFP.

Bacteria are placed inside the LE. Having the results of measurements of hard radiation fluxes on the PET CT, we set the field of gamma rays and diffusely moving particles - decay products in the form of positrons and recoil nuclei as a result of reactions: ${}^{18}_{9}F \rightarrow {}^{18}_{8}O + e^{+}$ and $e^{+} + e^{-} \rightarrow 2\gamma$

The general scheme of the hard-radiation interaction processes was consistent with the solutions adopted in Giant4-DNA 11.2. Taking into account characteristic times, we divide the chain of processes into stages: ionization → radiolysis + free radicals → reactions between free radicals and bacterial membranes and organelles [4,5 and them references]. The given scheme was necessary for comparative characterization of prediction of bacteria existence in biological environment and without it. The second case is applied to space conditions. Here the field of harsh radiations interacts directly with the microorganism. The participation of RFP - Glucose Fluorine in the processes of metabolism and synthesis was considered in the form of different variants of their placement in space.

Calculations. The effects of the decay products of the isotope ${}^{18}_{9}F$ in RFP on protozoan organisms and cells are considered in the following cases:

– Free radicals during radiolysis arise in the bio-solution around the bacterium and enter the intracellular space [4,5].

– Decaying within the bacterium.

– Direct interaction of the cell membrane, organelle and macromolecule with radioactive decay products.

The role of the RFP decay product ${}^{18}_{8}O$ inside the bacterium as a result of ionization and direct destruction of components of the internal structure of the bacterium was considered. The consequences of the presence of ${}^{18}_{8}O$ as a decay product of ${}^{18}_{9}F \rightarrow {}^{18}_{8}O + e^{+}$ were calculated.

The results of the calculations are presented in the form of 3D images of biological structures involved in the noted interactions.

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ON THE PROPERTIES OF INDIVIDUAL DECAMETER S-BURSTS OBSERVED IN A DENSE STORM

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The properties of the S-bursts observed during the dense storm on 20-21 June by the radio telescope URAN-2 are discussed.

The discussed storm appeared to be very dense, reaching 60 bursts per minute. We concluded that by the mean durations, drift rates, frequency extend and the polarization all observed S-bursts can be divided into two separate groups, the short and the long S-bursts. The former had durations of less than 100ms, drift rates of about 0.75 MHz/s at frequency of 14 MHz, frequency extent of 1-2 MHz and the polarization of up to 90% while the parameters of the latter were ~1s, 0.4MHz/s, 10 MHz and 30%, respectively.

Some long S-bursts covered the whole frequency band of the URAN-2 radio telescope from 10 to 32 MHz. Such extended bursts were recorded for the first time. The tracks of such bursts could be used for diagnostics of the instant as well as of long-term state of the coronal plasma at heliocentric heights range from 1.7 to 3Rs, where Rs is the solar radius. 50 extended S-bursts were selected for

the analysis. The index of the drift rate-frequency dependence averaged over all 50 selected bursts was found to be 1.7. This value appeared to be close to the index of the well-known Type III bursts dependence. It was shown that sources of both the Type III and S-bursts most likely move through the Newkirk corona.

Assuming that irregularities of individual S-bursts tracks reflect small-scale short-term coronal inhomogeneities, the sizes and the amplitudes of the latter were estimated.

The dependence of the long S-bursts durations on frequency was obtained. Its index equal -0.61 appeared to be very close to that for Type III bursts. From this dependence the longitudinal size of the electron beam and the electron velocity dispersion in the beam were found.

ACCELERATION OF SEPS DURING THE SOLAR BACKSIDE EVENT AND THE HALO-TYPE ICME ON MARCH 13-14, 2023

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The acceleration of energetic particles in solar flares and at ICME-driven shocks are important physical processes being studied by the ESA-NASA Solar Orbiter mission. It is of great interest when powerful solar flares occur on the Sun's backside (as seen by observers on Earth) but the massive CME nevertheless reaches interplanetary space at the opposite side of the CME's origin. Such occasions are fascinating because of their near-global impact on the inner heliosphere including Earth's magnetosphere.

In our study, we conduct a cross-analysis of the data derived from the Solar Wind Analyzer Proton-Alpha Sensor (SWA-PAS), the Magnetometer (MAG), and the Energetic Particle Detector (EPD) suite aboard Solar Orbiter for the period of 13-14 March 2023, when a high-speed halo-type CME launched from nearly 180° from Earth manifested itself as a very sharp and strong fast forward shock wave. Almost isotropic fluxes of all particle species which were accelerated at the shock front, from electrons to heavy ions, were detected by EPD's sensors. In detail, we'll present the main parameters of the IP shock such as magnetic and density compression ratios, plasma beta, as well as magnetosonic and Alfvénic Mach numbers. In the analysis, we involve data from the Suprathermal Ion Spectrograph (SIS), the SupraThermal Electrons and Protons (STEP) sensor, and the Electron Proton Telescope (EPT) of the EPD suite.

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ABOUT CHANGES IN THE SPEED OF THE NUMBER OF SUNSPOTS DURING THE CYCLE GROWTH PHASE AND CLARIFICATION OF THE AMPLITUDE OF THE 25TH SOLAR CYCLE

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As of June 2024, 55 months have passed since the beginning of the 25th cycle of solar activity. In the previous 24 cycles, the maximum for this time passed in 67% of cycles. This allows us to state that the 25th cycle of solar activity for July 2024 is close to its maximum. Previously, we proposed a prediction of the amplitude of the 25th cycle of solar activity based on the analysis of data from previous solar cycles (https://doi.org/10/1016/j.asr.2023.04.006). For this, the dependence of the amplitude of 24 previous cycles on the rate of change in the number of sunspots during the growing phase of 11-year cycles was constructed. When determining the rate of change in the number of sunspots, the duration of the growth phase interval used for this was varied. The optimal interval obtained in the study was equal to 35 months, and the amplitude of the 25th cycle was expected at the level of Wmax (25) = 150 units, which corresponds to the average power of the solar cycle, with a good implementation of the Hnievyshev-Ohl rule. We considered changes in the speed of the number of spots during the growth phase of solar cycles. It was found that part of the cycles has a monotonic dependence of the rate of change in the number of spots over time (2/3 of the cycles), the other part is characterized by a significant change in rate. The current 25th cycle, as it turned out recently, is a cycle with a non-monotonic growth curve. This requires making changes to previously obtained results. Our corrected analysis confirms the previous values of the forecast of cycle 25 within the range of Wmax (25) = 130-150 units of smoothed Wolf's numbers.

DIAGNOSTICS OF SOLAR PROTON EVENTS, AS WELL AS CORONAL SHOCK WAVES, USING THE PARAMETERS OF TYPE II AND IV SOLAR RADIO BURSTS

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This paper presents the results of a study of the relationship between solar cosmic rays (SCRs) and

coronal shock waves (CSWs) with the parameters of solar microwave continuum radio bursts of type IV (μ-bursts), as well as with the parameters of radio bursts of type II. A total of 349 solar proton events (SPEs) were analyzed for the period from 02-03-1986 to 02-12-2018. For the analysis, we used original records of solar radio emission at 8 fixed frequencies in the range 245-15400 MHz according to data from RSTN (Radio Solar Telescope Network), original records of dynamic spectra from SRS (Solar Radio Spectrograph) in the range 25-180 MHz, tabular data for speed coronal shock waves, as well as original records of the intensity of the SCR proton flux with proton energies in the range >1-100 MeV according to data from the GOES series devices.

It was previously shown that for most proton events there is a strong connection between the SCR proton flux and the parameters of type IV continuum microwave bursts, which indicates the dominant role of the SCR acceleration process in the flare region. However, as a result of recent detailed studies of the fine structure of type II radio bursts, a strong connection was discovered between the intensity of the flux of moderately relativistic SCR protons and certain parameters of type II radio bursts in the range of 25-180 MHz. The presence of a strong connection between the flux of SCR protons and the parameters of type II radio bursts indicates the important role of the acceleration of SCR protons at the fronts of coronal shock waves. A fairly strong relationship was also found between the speed of coronal shocks and the parameters of Type IV microwave bursts, which clearly indicates that coronal shocks are associated with solar flares.

EVOLUTION AND FLARE ACTIVITY OF CARRINGTON-CLASS SOLAR ACTIVE REGION NOAA 13664 AND ITS IMPACT ON THE EARTH

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We have analyzed the temporal and spatial evolution and the flare activity of the active region (AR) 13664 and its impact on the Earth. The magnetograms, continuum images and EUV-images were provided by the Solar Dynamics Observatory (SDO) the Helioseismic and Magnetic Imager (HMI) and the Atmospheric Imaging Assembly (AIA). The X-ray data were obtained at Geostationary Operational Environmental Satellite (GOES). The spectrograms were recorded on 2024 May 9 with the Ernest Gurtovenko solar horizontal telescope at the Main Astronomical Observatory in Kyiv. The Hα line profiles were obtained for X2.3-class flare.

The region appeared in the southern hemisphere of the solar disk on 2024 May 1 and was observed on the solar disk until May 14. The number of sunspots was growing rapidly. The sunspot area increased from 40 to 2400 millionths of the solar hemisphere. The active region had a complex multipolar configuration of the magnetic field beginning on May 7. On May 8, solar flares of intensity X1.0, M8.7 and M9.9 took place in the active region, which caused coronal mass ejections (CMEs). These CMEs reached the Earth on May 10, causing strong and extreme geomagnetic storms with bright and very long-lasting auroras. The event was classified as a G5 geomagnetic storm, making it the most intense storm since 2003. On May 9-11, flares of intensity X2.2, X1.1, X4, and X5.8 occurred, each of which caused a CME. The radiation from the X5.8 flare caused a deep shortwave radio blackout over the Pacific Ocean. On May 14, AR produced an X8.7-class flare, the most powerful in solar cycle 25 to that point. The flare caused a CME and a shortwave radio blackout over the Americas. Overall, AR 13664 produced 65 M- and X-class flares.

The active region AR 13664 has returned on May 29 and has been renumbered as NOAA 13697. It produced three X-flares – X1.1, X1.4, and X1.0 on May 31 and June 1. Each caused a radio blackout on the day side of the Earth, reducing the power of shortwave transmissions at all frequencies below 30 MHz. Radiation from M9.7-class flare on June 8 ionized the upper part of the Earth's atmosphere, causing a deep shortwave radio blackout in the western Pacific Ocean. On June 10, the AR produced an X1.6-class flare, the explosion occurred just behind the western limb of the Sun and as a result, it was not very geoeffective.

AR 13664 returned on June 24 again. This was its 3rd trip across the solar disk. It was renamed as NOAA 13723. On June 29, the magnetic field configuration of the region has been significantly simplified. The number and area of sunspots have decreased sharply.

AR 13664 belonged to the Carrington class. It was not only one of the largest sunspot groups rivaled Carrington's sunspot of 1859, it turned out to be one of the most powerful among all those observed on the Sun in recent years, was the source of the strongest flares that triggered largest CMEs and associated geomagnetic storms which were very geoeffective and created bright auroras at much lower latitudes than usual, both in the northern and southern hemispheres.

MACROSCOPIC TURBULENT DIAMAGNETISM OF SOLAR PLASMA

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Turbulent motions and convection, which are ubiquitous in cosmic plasma, play a key role in the processes of magnetic fields reconstruction in astrophysical conditions. Involvement of turbulent motions in the consideration, when studying the reconstruction of magnetic fields, ended with the creation of the theory of magnetohydrodynamics of mean turbulent magnetic fields, which in the literature was called macroscopic MHD. Macroscopic MHD has become widely used in studies of the reconstruction of the Sun's magnetic fields, since the conditions required by the theory of mean fields are created in the solar convective zone (SCZ). One of the important effects of macroscopic MHD is called turbulent diamagnetism. The physical essence of the effect of macroscopic turbulent

diamagnetism consists in the displacement of global (mean) magnetic fields from areas of increased intensity of turbulent pulsations to places with less developed turbulence along the gradient of turbulent viscosity gradient ν_T with an effective macroscopic velocity $\mathbf{U}_\mu = -\nabla\nu_T/2$ ($\nu_T \approx (1/3)ul$, (u and l are the effective velocity and the characteristic pulsation scale of the velocity). We considered the role of macroscopic turbulent diamagnetism in the formation of the magnetic field layer in the lower part of the SCZ. We calculated the radial distribution of the turbulent viscosity νT along the depth z for the SCZ model of Stix (2002). It was found that the radial distribution of this parameter has the form of a convex function νT(z) with a maximum approximately in the middle of the SCZ ($z \approx$ 140,000 km). Noticeable positive radial gradient of the turbulent viscosity $\nabla\nu_T$, which is found in the lower part of the SCZ, causes a downward intense diamagnetic displacement of the toroidal magnetic field, the velocity of which reaches the value $U_\mu \approx 4x10^3$ cm/s near the lower base of the SCZ ($z \approx$ 180,000 km). Therefore, macroscopic turbulent diamagnetism in deep layers plays the role of **negative magnetic buoyancy**. Macroscopic diamagnetism acts against magnetic buoyancy, the velocity of which is $U_B(B) = B/(4\pi\rho)^{1/2}$ (B is the magnetic induction, ρ is the density of plasma), and contributes to the formation of a magnetic layer of a steady state toroidal magnetic field with a strength of $B_S = (4\pi\rho)^{1/2}\ \nu_T/2 \approx$ 3000–4000 G.

SMALL-SCALE PLASMA FLUCTUATIONS IN TURBULENT FLOWS OF ACTIVE REGIONS AT THE SOLAR PHOTOSPHERE

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Good ground for study of small-scale processes in the solar photosphere is provided by results of high-resolution ground-based and spacecraft observations. In this report we consider generation of small-scale fluctuations in plasma density of turbulent flows in active regions (plages) of the photosphere and dependence of their characteristics on the magnetic field strength. The process was described in the framework of three-fluid approach. Taking into account a low degree of ionisation of the gas in the photosphere, we assumed that ion-electron plasma is embedded in the flow of gas and has no influence on its motion. According to data of observations the statistics of random velocity field of gas corresponds to the Kolmogorov turbulence. For analysis of the effect of magnetic field on the plasma density fluctuations, analytic expressions describing their spatial spectrum and rms level were derived. Estimations of the spectral shape and the fluctuation level were made for the photosphere near 300 km altitude under the magnetic field strength from 100 to 1000 G. It was shown that the rms amplitude of fluctuations (with length-scales smaller than 100 km) around the mean plasma density has to increase with strength of magnetic field. The spatial spectrum of plasma fluctuations can be approximated by a power law and the power index has to increase too.

COMPARISON OF MAGNETIC FIELD MEASUREMENTS IN A SUNSPOT USING SPECTRAL LINES WITH DIFFERENT LANDE FACTORS AND FORMATION HEIGHT IN ATMOSPHERE

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Direct measurements of magnetic fields in sunspots by different spectral lines are important for elucidating the true magnitude and structure of the magnetic field at different levels of the solar atmosphere. Today, magnetographic measurements are the most popular, but such measurements mainly represent the longitudinal component of the magnetic field. In the sunspot umbra, such measurements give unreliable information and do not allow to determine the true module (absolute value) of the magnetic field. Such data can be obtained from spectral-polarization observations, thanks to which the Zeeman splitting can be determined directly, and not as calibrated polarization in the line profiles. In the presented work, we investigate the magnetic fields in the sunspot on July 17, 2023, using the Echelle Zeeman spectrogram obtained at the horizontal solar telescope of the Astronomical Observatory of Taras Shevchenko Kyiv National University. The I ± V profiles of the FeI 6291.0, 6297.8, 6301.5, 6302.5, 6311.5 and TiI 6303.8, 6312.2 lines were analyzed in detail. The studied areas included the penumbra and umbra of the sunspot, as well as the surrounding photosphere. The expected increase in the magnitude of the magnetic field during the transition from the penumbra to the umbra of the spot was found, but the ratio of intensities along different spectral lines turned out to be atypical in some places. Probably, the obtained data indicate a combination of at least two effects: the dependence on the heights of the formation of lines in the solar atmosphere and the increase in the potential of the lower therm. It was also found that the shadow lines of TiI 6303.8 and 6312.2 do not exhibit stronger magnetic fields in accordance with the non-shadow lines. The obtained data are planned to be used to clarify the general picture of the magnetic field by means of simulation.

SPATIO-TEMPORAL PERTURBATION OF THE EARTH'S MAGNETIC FIELD ALONG THE "STRUVE GEODETIC ARC"

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The report presents the spatio-temporal perturbation of the geomagnetic field in connection with the assessment of its role in solar-terrestrial connections and its potential impact on the specifics of the flow of a magnetic storm. For the planet Earth, the dependence of spatio-temporal changes of the magnetic field on its rotation mode was revealed. This regularity plays an important role in understanding the

mechanism of the connection between the Earth's magnetic field and the large-scale magnetic field of the Sun due to the coherence of their rotational modes. The details of the relationship between the geomagnetic field and the Sun's magnetic field and solar activity are shown on the example of a study of a strong magnetic storm on May 10-14, 2024 in the area of the Struve arc. The main magnetic field (BIGRF) in the 2024 epoch varies from 49,500 nT in the south of the territory to 54,500 nT in the north along the "Struve Geodetic Arc". Regional magnetic anomalies on the Earth's surface are characterized by an intensity of ±(300÷700) nT. According to calculations, these anomalies are well manifested at altitudes of 100-200 km and can affect ionospheric flows and the formation of inhomogeneities. The analysis of magnetic storms in 7 magnetic observatories located near the Struve arc shows their fundamentally different nature depending on the main magnetic field of the Earth and regional anomalies. In particular, there is a general decrease in the intensity of the variation of the geomagnetic field from north to south (from 2400 nT in Sodankyla (SOD, 67.37N) to 265 nT in Surlari (SUR, 44.68N)). A fundamental change in the nature of the magnetic storm occurs at the latitude of the Nurmijarvi observatory (NUR, 60.51N, 24.66E), south of which the trend component of the variation changes its sign to the opposite. Certain differences in the course of the magnetic storm were also observed in the areas of regional magnetic anomalies.

WHAT ARE THE UNUSUAL PROPERTIES OF THE 25TH CYCLE OF SOLAR ACTIVITY?

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First of all, it should be noted the special nature of the manifestation of activity in the 25th cycle, which distinguishes it from the previous ones. The observed features are primarily associated with the manifestation of the N-S activity of the Sun's hemispheres. The universally used Wolf index for the entire hemisphere is a statistical result of the addition of the activity of the northern and southern hemispheres. At the very beginning of the 25th cycle, there was a slight predominance of activity in the northern hemisphere, and starting in April 2024, the southern hemisphere became more active. At the same time, in general, the activity of both hemispheres was mainly quasi-synchronous.

As a result, this led to the fact that the values of the Wolf numbers for the entire disk of the Sun were at the level of 23 cycles of activity and exceeded the indicators of 24 cycles. Wavelet analysis methods obtained data on the main periods of activity separately for the northern and southern hemispheres of the Sun, which demonstrates their significant difference.

A distinctive feature of the current solar cycle is also a significant number of M and X-class flares, many of which were quasi-synchronous even in different hemispheres. All this indicates the presence of complexes of activity that unite groups of sunspots in different hemispheres of the Sun.

IONOSPHERIC SCINTILLATIONS AT DECAMETER WAVELENGTHS DURING THE EXTREME GEOMAGNETIC STORM IN MAY 2024

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The Earth's ionosphere significantly affects radio astronomy observations at decameter wavelengths. When radio waves propagate through the inhomogeneous medium of the ionosphere, scattering of radio waves occurs, which leads to fluctuations in the amplitude and phase of the signal. When we studied ionospheric scintillations at decameter wavelengths with the URAN-1 and URAN-4 radio telescopes, a significant connection was established between mid-latitude scintillations in this range and space weather. It was shown that the ionospheric scintillation index of radiation received from cosmic radio sources increases under the influence of shock waves in the interplanetary medium generated by coronal mass ejections (CMEs) or corotating interaction regions (CIR) of the fast and slow solar wind.

In May 2024, some powerful X-class solar flares occurred accompanied by coronal mass ejections in the Earth's direction. After the interaction of the CMEs with the Earth's magnetosphere, an extreme geomagnetic storm with Dst≈-400 nt was observed. We used the URAN-4 and URAN-1 radio telescopes to observe ionospheric scintillations of signals from powerful radio sources at frequencies of 20 and 25 MHz before and during this storm. The report presents the measured power of signals, and scintillation indices and considers their correlation with the parameters of the solar wind, ionosphere, and magnetosphere of the Earth.

EFFECTS OF THE EXTREME MAGNETIC STORM ON MAY 10-11, 2024 AND ITS MANIFESTATION IN THE AREA OF THE ODESSA MAGNETIC ANOMALY

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The report considers regional effects of extreme manifestation of solar and geomagnetic activity during the extreme magnetic storm of May 10-11, which was

observed at magnetic observatories in the area of the Odessa Regional Magnetic Anomaly (ORMA). As regional effects of their manifestation in the “Struve Arc” area, the data of geomagnetic field and cosmic rays variations from the Sodankyla observatory (Finland) and other geomagnetic observatories located in places of significantly different "geomagnetic relief" of the Earth's surface (which is reflected on the form of digital spectra of geomagnetic variations and evolution of their "periods"), magnetometer data in the area of the URAN-4 radio telescope (IRA NASU) and the Odessa and Lviv magnetic observatories of the Institute of Geophysics of the NASU were used. A comparison was made with other appearance of extreme solar and geomagnetic activity in another solar cycles, based on observation data from the URAN-4 and magnetometric measurements from the Odessa magnetic station.

ABOUT THE MANIFESTATION OF IONOSPHERIC AND GEOMAGNETIC STORMS ACCORDING TO THE MONITORING DATA OF HIGH-POWER RADIO SOURCES AT THE URAN-4 RADIO TELESCOPE OF THE IRA NASU

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The URAN-4 low-frequency radio telescope (frequency range 10-30 MHz) is located on the territory of the Odessa Regional Magnetic Anomaly (ORMA). This provides a unique opportunity to study the features and properties of ionospheric response to magnetic and ionospheric storms by recording ionospheric scintillations of powerful cosmic radio sources, whose radio emission passes through the layer of ionospheric plasma. The report discusses some results of the study of radio sources 3C 405, 3C 123, 3C 274 scintillations and monitoring sessions lasting 2-3 days, which were obtained in 2013 and 2020. It is shown that magnetic and ionospheric storms caused by various active events on the Sun significantly change the shape of ionospheric scintillations spectrograms for different radio sources, and the main scintillation “periods” of about 1 minute and 20 seconds, observed on URAN-4, often coincide with the “periods” of rapid geomagnetic variations during magnetic storms and disturbances.

DIAGNOSTICS OF THE SOURCES OF GEOMAGNETIC VARIATIONS FOR THE SUPERSTORM OF MAY 10-13, 2024

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The X1.0 solar flare, which peaked at 05:09 UT, and the M8.6 solar flare, which peaked at 12:03 UT on May 8, 2024, caused coronal mass ejections (CME). These events caused a large geomagnetic storm on May 20-13, 2024 with (SSC) (Dst = - 412 nT and Kp = 9).

To diagnose the sources of the magnetospheric-ionospheric current system, we used one-minute data of the horizontal component H(X) of the Earth's magnetic field induction vector (B) from the Ukrainian and Polish INTERMAGNET observatories.

The irregular variation of the geomagnetic field caused by the magnetospheric-ionospheric current system is calculated. The contribution of magnetospheric sources (DR, DT, DRP) was calculated using the Dst-index of magnetic activity. The variation of DP from the ionospheric currents in the aurora zone and their return currents to the middle latitudes was calculated. The magnitude of the variation from the currents at the DCF magnetopause was calculated using model calculations. In this work, we used the Mead model.

We have diagnosed the sources of geomagnetic variations and calculated the contribution to the variation of each source. It is shown that for the superstorm of May 10-13, 2024, magnetospheric sources of variations (ring magnetospheric current, magnetospheric tail current, and magnetopause current) during a magnetic storm give the largest contribution to the field variation of ~70 - 80 %, and the contribution of ionospheric sources (auroral electric currents and their return currents) to the field variation at midlatitudes is ~20 - 30 %.

INFLUENCE OF THE EARTH’S MAGNETIC FIELD ON THE BIOPOTENTIAL OF THE TREES OF THE UKRAINIAN ROZTOCHYA

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The measurements of bioelectric potential of plants and their response on solar activity and changes of magnetic field is timing and important task, for better understanding of biological activity of plants.

The paper aims to examines the effect of changes in the Earth's magnetic field on the bioelectric potential of oak (Quercus robur), pine (Pinus sylvestris), beech (Fagus sylvatica), which form the stands of the Ukrainian Roztochya region and experimental plantation of Korean cedar (Pinus koraiensis).

Electrophysiological parameters, such as bioelectric potentials, impedance, polarization capacity, are indicators that reflect the intensity and peculiarities of physiological-biochemical processes in daily, seasonal, and ontogenetic aspects and characterize the general condition of plants and its growth.

A high-precision voltmeter and non-polarizing silver chloride electrodes were used to measure biopotentials. Electrodes were inserted into the trunks at a height of 0 m and 2.40 m. Measurements were carried out continuously

during the days in June - July on magnetically stable and magnetically disturbed days. Data on changes in the Earth's magnetic field were obtained from the data of the Lviv geomagnetic observatory.

The obtained results indicate high correlations of changes in the Earth's magnetic field caused by the activity of the Sun, which proves the influence of solar (geomagnetic) activity on the intensity of tree growth at different stages of the development of plantations, the phytomass of needles and leaves, etc. This results might be used for prognoses of influence of damage to trees by pests and diseases, etc.

STATISTICAL ANALYSIS OF THE SOLAR WIND AND INTERPLANETARY MAGNETIC FIELD PARAMETERS DURING SHOCK WAVE EVENTS DETECTED WITH SOLAR ORBITER MISSION IN 2023

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In this study, we perform a statistical analysis of the solar wind (SW) and interplanetary magnetic field (IMF) parameters measured with the Proton-Alpha Sensor of the Solar Wind Analyzer (SWA-PAS) and the Magnetometer (MAG) instruments onboard the Solar Orbiter mission in 2023. During the measurement period, the distance between the spacecraft and the Sun varied from 0.29 to 0.95 a.u., and the longitudinal separation of the spacecraft to Earth varied from -232.9 to 174.8 degrees.

To execute analysis, an algorithm for the automated definition of the interplanetary (IP) shock wave front arrival time to the spacecraft location and a method for calculating the SW and the IMF parameters in the upstream and downstream zones of the IP shocks have been developed. Using the statistical analysis, the criteria for identifying events as IP shocks were developed keeping in mind event quality parameters. The 44 shock waves were identified in 2023 using the developed algorithm. All of them associate well with the shock waves registered independently by other sources. The types of detected shock waves and basic parameters, in particular magnetic and density compression ratios, and plasma beta values were determined too. Thus, among all registered IP shocks, 40 events were classified as fast forward shocks, two as fast reverse, one as slow forward, and one as slow reverse shock.

We also established a correlation between the temporal course of the IP shock quantity and the amounts of coronal mass ejections (CMEs) and solar flares.

This work is supported by the “Long-term program of support of the Ukrainian research teams at the Polish Academy of Sciences carried out in collaboration with the U.S. National Academy of Sciences with the financial support of external partners”.

ASTRONOMICAL EDUCATION AND OUTREACH

ASTRONOMY OUTREACH IN UKRAINE

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We review various directions of popularizing astronomy at different levels of public interest for recent years. The Isite of the AU (International Astronomical Union) office for Astronomy Outreach is https://www.iau.org/public/oao/. There are representatives ("National Outreach" coordinators") in countries, including Ukraine.

There are two astronomical calendars published in Ukraine – one in the Main Astronomical observatory of the National Academy of Sciences of Ukraine (www.mao.kiev.ua), and another one – in the Astronomical Observatory of the Odesa I.I.Mechnikov National University (http://lib.onu.edu.ua/odeskyj-astronomichnyj-kalendar/). Also there were popular journals "Nashe Nebo" ("Our Sky") and "Univesre. Space Time", the last of which transferred to the FaceBook group "The Universe Space Tech".

Other popular groups in the Facebook are "Odessa Astronomical club for children"," "Екскурсія до телескопу" (Excursion to the telescope". "Alpha Centauri", "TerAstro: Territory of Astronomy" (FB name: astroTernopil), "Українська астрономія та космонавтика" (Ukrainian Astronomy and Cosmonautics), "Science In UA - Все про Всесвіт" (All about the Universe"), Всесвіт (Universe, FB:vsesvitua), et.al. There are also individual FB pages (including my own (FB: Ivan.L.Andronov) with, particularly, astronomical posts and reposts.

There also Ukrainian Telegram channels for popularizing Astronomy like astron_kharkiv_ua, ustmagazine, universeinthepocket et al.

On 26-28.08.2024, there is a summmer school "Through Milky Way to the Universerse". A seies of summer scools was orgenized bi the scientific lyceum named on the famous Klim Ivanovych Churyumov (FB code: ScientificLiceumCIGS).

A lot of astronomical videos in Ukrainian may be found at Youtube with a search link "бесіди про Всесвіт".

There are planetaria in Odesa, Kyiv, Kharkiv, Vinnytsia, Dnipro and some other cities. Unfortunately, the Planetarium in Kherson was rubbered and destroyed by the Russian army, but, it was very effectively working for decades. Particularly, the FB group of the Odesa Planetarium is "planetarium.odessa". At this Gamow conference, there is a separate section on "Planetaria".

Another type of activity is so-called "Youth Academy of Sciences" (YAS). This is a state-supported activity in different regions, where there is an astronomical circle and a stage of the astronomical contest for schoolars, the winners of which take part at the all-Ukrainian contest. The section of Astronomy contains two subsections "Astrophysics" and "Aerophysics and Space Studies". The jury are the professional astronomers. In 2024, Oleksandr Parsolov from Odesa has win the all-Ukrainian contest.

Particularly, in Odesa, we are proud that many active students started their carrier at YAS, some of them presented their winner's YAS works at the Gmaow conference and published them in the "Odessa Astronomical Publications" and other scientific journals (V.V.Breus, K.D.Andrych, M.V.Mogorean/Mogorian, D.E.Tvardovskyi). Other YSC winners (V.V.Troianski, V.O.Yushchenko, L.A.Sobitniak take part in this conference). Especially active supervisors of YSC projects are Drs. V.I.Marsakova (also an ex-winner of the YAS) and O.O.Bazei.

The schoolars present their works not only based on their own observations (previously, on the photographic plates of the Odessa "7-camera astrograph", currently or processing CCD observations obtained during summer schools abroad or from other professional observers), but also Web-sites with the astronomical contents, or even own computer programs (in De;phi, VBA, C, Python et al.) to realize new algorithms. Many of ex-YAS members are now PhDs or DrSci.

Another "Public Outreach" direction is a "Pro-Am" (professional-amateur) collaboration is on variable stars – the branch of astronomy, where well-experienced astronomers may pay a tribute to studies of variable stars. The Associations of the observers of variable stars exist in all developed countries (USA, France, UK, Germany, Japan, Poland, Czechia, Slovakia, Hungary etc.). In 2003, such a public organization UAVSO was declared, as a part of the "Ukrainian Organization of Amateur Astronomers" (UTAA), and the famous astronomer Klim Ivanovych Churyumov was elected as a President. To avoid duplication, UTAA has become a part of "Astronomy Outreach" direction of activity of the Ukrainian Astronomical Association with corresponding Vice-Presidents (K.I.Chyryumov, V.A.Zakhozhai and currently I.L.Andronov).

The owners/heads/observers of private observatories with studies of variable stars, most active during a recent dozen years, are Maxim Pyatnytskyy (has a separate talk in this section), Nick Myshevskyi and Valerii Tsekhmeistrenko. All of them have international scientific publications in different groups, particularly, within the "Inter-Longitude Astronomy" (ILA) project.

The activity of Ukrainian "amateur" astronomers was mentioned by the awards of the American Association of Variable Star Observers" (AAVSO) for Maxim Pyatnytskyy (2023) and Oleksandr Baranskyi (2003). In fact, these "amateurs" are PhDs, but not in Astronomy, but Physics and Biology.

In Odes, there is a very active society "AstrOdes" (head Oleksand Angelskyi), which is oriented to AstroPhotography and meteor streams.

Other directions of the Education and Public Outreach activity are presented at this section as separate presentation – on astronomical literature, international Astronomical Olympiads, WikiPedia, STEM education in the Richelieu Scientific Lyceum and on the "AstroSandBox" with solving practical astronomical tasks and series of lectures.

THE TEXTBOOK "ELEMENTS OF THEORY OF PROBABILITY AND MATHEMATICAL STATISTICS

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Primary textbook (in Ukrainian) for the educational component "Theory of Probability and Mathematical Statistics". The lecture material is presented on basic axioms,

theorems and formulas of statistical distributions and characteristics, which are illustrated by a detailed the solution of numerous specific tasks. Calculations can be made using a calculator, programming languages or electronic table.

It contains the following contents:

RANDOM EVENTS (Relative frequency of an event and probability of an event. Basic definitions of concepts; Dependent and independent events; Combinations of events. Opposite events. Probability of an event. Concept of probability theory. Incompatible events. Addition of probabilities. Dependent and independent events. Multiplication of probabilities. Statistical and classical definition of probability. Geometric definition of probability);.

ELEMENTS OF COMBINATORICS (Permutations. Arrangements. Combinations);

BASIC THEOREMS AND FORMULAS OF PROBABILITY THEORY (Theorems of addition and multiplication of probabilities.Formula of total probability.Bayes' formulas. Bernoulli's formula. Local theorem of Moivre-Laplace. Integral theorem of Moivre-Laplace. Approximate Poisson formula for repeated trials);

RANDOM VARIABLES (Discrete random variables. Basic distribution laws of discrete random variables. Continuous random variables. Numerical characteristics of random variables. Mathematical expectation of a random variable. Variance of a random variable. Initial and central moments of a random variable X. Basic distribution laws of discrete random variables, their main numerical characteristics);

FUNDAMENTALS OF MATHEMATICAL STATISTICS (Statistical distribution series. Sample. Types of samples. Statistical series. Empirical distribution function. Numerical characteristics of the sample. Example of statistical study of a sample. Example of a study of a sample presented as an interval statistical series).

The textbook is available via the ADS link https://ui.adsabs.harvard.edu/abs/2024etpm.book.....C, or http://rp.onmu.org.ua/handle/123456789/3828 (the repository of ONMU).

SCIENCE KIDS: INSPIRING THE NEXT GENERATION OF CURIOUS MINDS

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Science Kids – popular science lecture series for children aged 7-13 years old, which helps participants discover the exciting world of science.

This is a great opportunity to get free Ukrainian-language content, communicate with scientists, as well as find new hobbies and like-minded people. With over 200 videos featuring scientists on the INSCIENCE and Science Kids UA YouTube channels, the project continues to expand its reach. We organize online events twice a week via Zoom and hold weekly in-person events in our offices in Prague and Warsaw. This autumn, we are excited to resume activities in Odesa, Kharkiv, and Mykolaiv, while also launching new branches in Kherson and Zaporizhzhia.

The project partners are the Visegrad Fund, UNICEF, SQUAD, MGID, RIA.com, and Grammarly.

THE EDUCATIONAL PROGRAM OF 'ASTROTOURISM'

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Tourism, including observations of stars and astronomical phenomena, not only contributes to the economic development of regions, but also popularizes astronomy and increases public education. This work is aimed at developing an educational program aimed at popularizing astronomical observations and visiting tourist sites related to astronomy. The goal of the educational course is a comprehensive understanding of astronomy and the skills of organizing trips on an astronomical theme, including observations and visiting places related to astronomical activities. The course includes the basics of astronomy, the history of astronomy and modern popularization of astronomical knowledge, as well as the ability to recognize and explain the main astronomical phenomena and organize astronomical events and excursions. The main components of the program include lectures, practical classes, and observation sessions. The program can be integrated into educational institutions, tourist organizations and local communities.

EDUCATION AND SCIENTIFIC CENTER KALINENKOV ASTRONOMICAL OBSERVATORY. ON THE CENTENARY OF PROFESSOR KALINENKOV

Elena Panko, Olga Sergienko, Sergey Guziy
I.I. Mechnikov Odessa National University, Physics and Astronomy Department. V.O.Sukhomlynskyi Mykolaiv National University, Physics, Astronomy and IT department. Petro Mohyla Black Sea National University, Physics and Mathematics Department

We summarize Nikifor Dmitrievish Kalinenkov's activity during his work at the Nikolaev State Pedagogical Institute. He was a unique specialist in astrophysics and a great teacher. His students work in astronomy in different countries. During Kalinenkov's work in Nikolaev, starting in 1968, the educational astronomical laboratory of the pedagogical institute with the 200-mm AVR-2 telescope turned into a full-fledged educational and scientific center "astronomical observatory", equipped with 700-mm and 400-mm telescopes, which were developed and created under his direct supervision. The observatory also obtained 2 astrographs: Industar-51 and URAN 16, and other equipment: spectrographs, photometers, spectrophotometer, coordinate measuring machines, mechanical and optical workshops, the library, etc. At the observatory, under the leadership of Professor Kalinenkov, serious scientific work was carried out, including "The Astronomical Observations of Halley's Comet in 1985-86" and "Development and Production of a Submillimeter and Infrared Telescope." A representative of the observatory participated in 1991 in a meeting of Ukrainian astronomers, at which the Ukrainian Astronomical Association was created. Since 1996, the educational and scientific center has been named after Kalinenkov.

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