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

PROGRAM AND ABSTRACTS

August 21-25, 2023
Odesa, Ukraine

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

August 21-25, 2023, Odesa, Ukraine

Monday, 21.08.2023

OPENING OF THE CONFERENCE AND GREETING TALKS

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

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*

MEMORIAL SESSION

– The 155th anniversary of Prof. K.D.Pokrovsky – Director of the Astronomical Observatory of Odessa I.I.Mechnikov State University from 1934 to 1944 *(M.I.Ryabov)***;**

– Prof. K.D. Pokrovsky – Odessa period of the life of Professor K.D.Pokrovsky *(I.E.Rikun)***;**

– "Heavenly Physics" by Isaac Newton (the 380th anniversary of Isaac Newton) *(O.A.Bazyey)***;**

– To the 85th anniversary of Professor Nikolay Komarov *(T.V.Mishenina)***;**

– The memory of Academician V.M.Shulga, the chair of SOC of the Gamow conferences from 2012 to 2022 *(V.V.Zakharenko)***.**

PLENARY SESSION

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

John Ellis **(**King's College London, UK and CERN, Switzerland)
"Atom interferometry to search for gravitational waves and dark matter"

Alexander Vikman **(**CEICO, Institute of Physics of the Czech Academy of Sciences, Czech Republic)
"Gravitational Waves and Dark Matter from Melting Domain Walls"

Massimo Capaccioli (Naples University Federico II, Italy)
"The birth of modern cosmology"

Alexander Zhuk (ONU, Odesa, Ukraine and CASUS, Görlitz, Germany)
"N-body simulation of the cosmic screening effect"

Serge Parnovsky (KNU, Kyiv, Ukraine and University of Geneva, Switzerland)
"Do astronomical observations rule out the possibility of an anisotropic Big Bang?"

Viatcheslav Mukhanov (Ludwig Maximilian University of Munich, Germany)
"How predictive are the cosmological theories?"

Roman Konoplya (Silesian University in Opava, Opava, Czech Republic)
"The sound of the event horizon"

Jutta Kunz (University of Oldenburg, Oldenburg, Germany)
"Scalarized black holes in alternative gravities"

Valery Zhdanov, Yuri Shtanov, Oleksandr Stashko (KNU, Kyiv, Ukraine; Bogolyubov Institute for Theoretical Physics, Kyiv, Ukraine; Goethe Universitat, Frankfurt am Main, Germany; Princeton University, Princeton, USA)
"Scalar fields and $f(R)$ gravity in isolated spherically symmetric configurations"

Tuesday, 22.08.2023

Congratulations to Professor V.G.Karetnikov on his 85th birthday!

PLENARY SESSION

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

Roberto Ragazzoni (Astronomical observatory of Padova, Italy)
"Telescopes from the ground and from space to discover and characterize alien worlds"

Enrichetta Iodice (Capodimonte Astronomical Observatory in Naples, Italy)
"The assembly history of galaxies in a cluster environment"

Ilya Usoskin (University of Oulu, Finland)
"Extreme solar eruptive events: rare and dangerous"

Maria Madjarska (Max Planck Institutes for Solar System Research, Germany)
"Small-scale loop systems and their associated dynamic activity"

Alexandr Yushchenko, Jeong Y., Yushchenko V., Demessinova A., Jeong K.S. (Astrocamp Contents Research Institute, Korea; Astronomical Observatory, Odesa National University, Ukraine; Department of History, Sejong University, Korea; Main Astronomical Observatory of National Academy of Sciences of Ukraine; Physico-Technical Department, Al Farabi Kazakh National University, Almaty, Kazakhstan: Institute of Liberal Education, Incheon National University, Incheon, Korea)
"New telescopes and our understanding of the Universe"

PLENARY SESSION

*(Convener **I.L.Andronov**)*

Jordanka Semkova (Space Research and Technology Institute, Bulgaria)
"Space radiation weather at Mars"

Anatoly Miroshnichenko (University of North Carolina at Greensboro, USA)
"Nature and Processes in Circumstellar Disks of Stars with Be and B[e] Phenomena"

Nataliia Shchukina (Main Astronomical Observatory National Academy of Sciences of Ukraine)
"Magnetometry of the solar corona"

Ivan Andronov, Lidiia Chinarova, Larysa Kudashkina **(**Odesa National Maritime University, Odesa, Ukraine)
"Statistically Optimal Mathematical Modeling of Physical Variability of Irregularly Spaced Signals"

CLOSING OF THE PLENARY SESSION.
Announcement of the 2024 conference dedicated to the 120th anniversary of George Gamow!

SECTION SESSIONS

August, 23 – 25

1. **Cosmology, gravitation, astroparticle physics, high energy physics**
   (Chair – *A.I.Zhuk*)
   August, 23

2. **Astrophysics** (Chairs – *I.L.Andronov, T.V.Mishenina*)
   August, 24

3. **Solar system and space environment** (Chair – *N.I.Koshkin*)
   August, 23

4. **Sun, Solar activity, Solar-terrestrial relations and Astrobiology**
   (Chairs – *V.M.Efimenko, M.I.Ryabov*)
   August, 24

5. **Radio Astronomy** (Chairs – *O.M.Ulyanov, O.A.Litvinenko*)
   August, 25

6. **Astronomical Education and Outreach**
   (Chair – *I.L.Andronov*)
   August, 25

7. Biology section **"The Importance of G. Gamow's Ideas for Biology of the 21st Century"** (Chair – *S.V.Chebotar*)
   August, 23

Program and abstracts will be posted on the web page of the Conference:
www.gamow.odessa.ua

SECTION SESSIONS

COSMOLOGY, GRAVITATION, ASTROPARTICLE PHYSICS, HIGH ENERGY PHYSICS

Wednesday, 23.08.2023

*Convener – **A.I.Zhuk***

Cosmology and extragalactic astronomy

1. *Yu.Kulinich, B.Novosyadlyj* DARK AGES GLOBAL SIGNAL IN THE ROVIBRATIONAL LINES OF THE FIRST MOLECULES
2. *Błażej Mrzygłód, Włodzimierz Godłowski* A NEW METHOD OF INVESTIGATION OF THE ORIENTATION OF GALAXIES IN CLUSTERS IN LACK OF INFORMATION ABOUT THEIR MORPHOLOGICAL TYPES
3. *Włodzimierz Godłowski, Błażej Mrzygłód* APPLICATION OF THE NEW METHOD OF INVESTIGATION THE ALIGNMENT OF GALAXIES IN CLUSTERS IN THE ABSENCE OF INFORMATION ON THEIR MORPHOLOGICAL TYPES
4. *O.I.Gerasymov, L.S.Kudashkina* TOWARDS THEORETICAL MODELLING OF DISTRIBUTION OF MATTER AT UNIVERSE
5. *M.Vasylenko, I.Vavilova, D.Dobrycheva, A.Elyiv, O.Melnyk, V.Khramtsov* THE PROBLEM POINTS OF GALAXY CLASSIFICATION WITH MACHINE LEARNING TECHNIGUES
6. *O.Kompaniiets* MULTIWAVELENGTH PROPERTIES OF THE ISOLATED AGNs at z<0.0.05
7. *M.Berkovskyi, E.Panko, N.Miroshnik* GALAXY CLUSTER MERGERS: COMPUTER MODELING
8. *O.Hetmantsev, D.Dobrycheva, I.Vavilova* POLAR RING GALAXIES IN THE SDSS: VISUAL INSPECTION AND AUGMENTATION

Gravitation

9. *Serhiy Skolota, Elena Bannikova, Massimo Capaccioli* EXTERNAL GRAVITATIONAL POTENTIAL OF AN INHOMOGENEOUS TORUS

High energy physics and astroparticle physics

10. *Yu.I.Fedorov* THE HELIOSPHERIC MODULATION OF GALACTIC COSMIC RAYS DURING SOLAR ACTIVITY MINIMUM
11. *A.Tugay, Y.Sahai, O.Prikhodko, L.Zadorozhna, N.Pulatova, D.Malyshev, D.Savchenko* THE STUDY OF X-RAY SPECTRUM OF COMA GALAXY CLUSTER
12. *D.N.Doikov, M.D.Doikov* FLASHING IN THE ATMOSPHERES OF PLANETS OF THE SOLAR SYSTEM AND EXOPLANETS
13. *M.D. Doikov* MULTICHANNEL SPECTROGRAPH IN γ-OPTICAL AND NIR SPECTRA WITH SIMULTANEOUS REGISTRATION OF THE LOCAL MAGNETIC FIELD FROM LIGHTING

ASTROPHYSICS
(stellar atmospheres, interacting binary systems, variable stars)

Thursday, 24.08.2023

Astrophysics I *Convener –* ***T.V.Mishenina***

1. *V.S.Akhmetov, B.Bucciarelli, M.Crosta, M.G.Lattanzi, A.Spagna, P. Re Fiorentin, E.Yu.Bannikova* NEW KINEMATIC MODEL OF THE GALAXY: ANALYSIS OF THE STELLAR VELOCITY FIELD FROM GAIADR3
2. *N.Britavskiy* TOWARDS AN UNDERSTANDING OF THE NATURE OF MASSIVE FAST-ROTATORS
3. *T.Mishenina, I.Usenko, A.Kniazev, T.Gorbaneva* MANIFESTATION OF STELLAR EVOLUTION IN METAL-DEFICIENT STARS
4. *I.A.Gabitova, A.S.Miroshnichenko, S.V.Zharikov, A.Amantayeva, S.A.Khokhlov* DOPPLER TOMOGRAPHY OF THE CIRCUMSTELLAR DISK OF THE BE STAR K DRACONIS
5. *Kh.M.Mikailov, A.H.Alili, K.I.Alisheva* DETERMINATION OF TEMPERATURE OF CENTRAL STARS' OF CHOSEN PLANETARY NEBULAE
6. *E.Paunzen, M.Piecka, J.Supíková* TWO TOOLS FOR ESTIMATING STAR CLUSTER PARAMETERS
7. *B.N.Rustamov, Kh.M.Mikailov, K.I.Alisheva, S.O.Mammadova, Sh.A.Agayeva, O.Maryeva* SPECTRAL OBSERVATIONS OF THE ALGOL – TYPE BINARY STAR δ LIBRAE
8. *Z.A.Samedov, U.R.Rustem, G.M.Hajiyeva, Z.F.Aliyeva* FUNDAMENTAL PARAMETERS OF SUPERGİANT STAR HD40589(A0IAB)
9. *V.Yushchenko, V.Gopka, A.Yushchenko, A.Shavrina, Ja.Pavlenko, F.Musaev, S.Vasil'eva, Y.Jeong, K.S.Jeong* RADIOACTIVE ELEMENTS IN STELLAR ATMOSPHERES. A QUANTITATIVE INVESTIGATION OF PROMETHIUM ABUNDANCE.
10. *I.Usenko, A.S.Miroshnichenko, S.Denford, D.Turner, D.Majaess, D.Balam* SPECTROSCOPIC STUDIES OF STARS IN THE FIELD OF THE POLARIS
11. *O.P.Shereta* SUBSTRUCTURES IN PROFILES OF DIFFUSE INTERSTELLAR BANDS

Astrophysics II *Convener –* ***I.L.Andronov***

1. *Kh.M.Mikailov, B.N.Rustamov, A.B.Rustamova, A.J.Orujova* THE Hα AND Hβ LINES IN THE SPECTRUM OF CH CYG IN 2016
2. *V.Marsakova, S.Shugarov, I.Andronov* MULTIWAVELENGTH RESEARCH OF THE FAST AND SLOW VARIABILITY OF SYMBIOTIC VARIABLES PU VUL, RT SER AND CH CYG
3. *V.O.Borshchenko, I.L.Andronov* A NOVEL RUNNING SINE APPROXIMATION PROGRAM VOB WITH ENHANCED ACCURACY AND TREND ANALYSIS. APPLICATION TO SEMI-REGULAR DISCRETE SIGNALS
4. *V.Breus, I.L.Andronov, P.Dubovsky, K.Petrik* VARIABILITY OF THE INTERMEDIATE POLARS V405 AUR AND RX J2133.7+5107
5. *M.Yu.Pyatnytskyy* TESS SURVEY AND THE MYSTERY OF AN ELUSIVE ECLIPSING VARIABLE STAR NQ HERCULIS
6. *L.E.Keir* THE NEW APPROACH TO THE LIGHT CURVE ANALYSIS OF RR LYR TYPE PULSATING STARS WITH BLAZHKO EFFECT
7. *V.Andruk* COMPARISON OF PHOTOGRAPHIC V MAGNITUDES OF STARS OBTAINED FROM THE PROCESSING OF SCANS FROM THE ARCHIVES OF THE SCHMIDT TELESCOPES IN BALDONE AND TAUTENBURG
8. *A.Dzygunenko, A.Baransky* PERIOD ANALYSIS OF THE SEMIREGULAR VARIABLE STAR RX LEPORIS?
9. *O.Pyshna, A.Baransky* STUDY OF GRB 221009A AFTERGLOW AT THE LISNYKY OBSERVATIONAL STATION
10. *I.L.Andronov, S.V.Kolesnikov, L.L.Chinarova* BZ CAM: VARIABILITY OF THE NOVA-LIKE VY SCL-TYPE CATACLYSMIC VARIABLE FROM MINUTES TO DECADES
11. *S.I.Iovchev, I.L.Andronov, L.L.Chinarova, N.V.Savchuk, H.M.Akopian* CATALOGUE OF THE PARAMETERS OF POORLY STUDIED BINARY SYSTEMS: EW:
12. *N.V.Savchuk, I.L.Andronov, L.L.Chinarova, S.I.Iovchev, H.M.Akopian* CATALOGUE OF THE PARAMETERS OF POORLY STUDIED BINARY SYSTEMS: EA
13. *H.M.Akopian, I.L.Andronov, L.L.Chinarova, S.I.Iovchev, N.V.Savchuk* CATALOGUE OF THE PARAMETERS OF POORLY STUDIED BINARY SYSTEMS: EB
14. *L.L.Chinarova, I.L.Andronov* CATALOGUE OF MAIN CHARACTERISTICS OF PULSATIONS OF 173 SEMI-REGULAR STARS. II
15. *I.L.Andronov, L.S.Kudashkina, L.L.Chinarova* STUDYING THE VARIABILITY OF PULSATING STARS USING STATISTICALLY OPTIMAL MATHEMATICAL MODELING

SOLAR SYSTEM AND SPACE ENVIRONMENT

Wednesday, 23.08.2023

*Convener – **N.I.Koshkin***

1. *V.G.Chiorny, V.G.Shevchenko, I.G.Slyusarev, O.I.Mikhalchenko, Yu.N.Krugly, D.Oszkiewicz* PHOTOMETRY OF SMALL ASTEROIDS OF DIFFERENT FAMILIES AND DYNAMICAL GROUPS WITH A SHORT ROTATION PERIODS
2. *O.Ivanova, J.Licandro, F.Moreno, I.Luk'yanyk, J.Markkanen, D.Tomko, M.Husárik, A.Cabrera-Lavers, M.Popescu, E.Shablovinskaya, O.Shubina* RESULTS OF OBSERVATIONS OF ASTEROID (248370) 2005 QN173
3. *I.Eglitis, K.Nagainis, A.Sokolova, G.Campbell* LIGHT CURVE ANALYSIS OF MAIN BELT ASTEROIDS WITH EARTH MOID LESS THAN 1AU
4. *O.Kozhukhov, M.Medina* NOAP – SCRIPT PACKAGE FOR PLANNING AND ANALYSIS OF NEO OBSERVATIONS
5. *A.Golubaev, A.Mozgova* THERMAL DESORPTION OF THE DUST PARTICLES MATTER NEAR THE SUN. DATA ANALYSIS OF METEOR OBSERVATIONS AND THEIR INTERPRETATION
6. *D.Chechotkina, Ye.Surkov, Yu.Shkuratov, V.Kaydash* ON ASSESSMENT OF LUNAR SURFACE TEMPERATURE
7. *V.Kaydash, Ye.Surkov, Yu.Shkuratov* LUNAR OPPOSITION EFFECT EXPLORATION USING LROC NAC DATA
8. *A.V.Golubaev, A.P.Zheleznyak, V.G.Kaydash* ASSESSMENT OF THE ASTROCLIMATIC CONDITIONS OF THE OBSERVATION COMPLEX AT THE INSTITUTE OF ASTRONOMY OF KHARKIV NATIONAL UNIVERSITY

*Convener – **O.A.Bazyey***

9. *L.Shakun, K.Kaminski, O.Kozhukhov, O.Briukhovetskyi, E.Wnuk, Ju.Golebiewska, M.Kaminska, M.Kruzynski, N.Koshkin* CALIBRATING OPTICAL ASTROMETRIC MEASUREMENTS OF RESIDENT SPACE OBJECTS IN EARTH ORBIT AND TELESCOPE LOCATIONS OF THE UKRAINIAN-POLISH TELESCOPE NETWORK
10. *O.Kozhukhov, Yu.Omelchenko, D.Kozhukhov, M.Kulichenko, O.Shulga, Ye.Kozyrev, N.Maigurova* TEST OPTICAL OBSERVATIONS OF THE COSMOS 1408 FRAGMENTS
11. *O.Shulga, M.Kaliuzhnyi, F.Bushuev, M.Kulichenko, N.Maigurova* LEO SATELLITES RADIO OBSERVATIONS IN THE RESEARCH INSTITUTE "MAO" USING THE DOPPLER EFFECT
12. *N.Koshkin, L.Shakun, O.Kozhukhov, A.Bilinsky, O.Briukhovetskyi, V.Dragomiretsky, O.Dzyhadlo, T.Golubovskaya, E.Korobeinikova, V.Kudak, S.Melikyants, Y.Omelchenko, V.Omelchenko, V.Perig, A.Ryabov, S.Strakhova, S.Terpan, S.Tsvihun, O.Vasiltsun, Ye.Vovchyk, S.Zolotov* DETERMINATION OF THE RSO ROTATION AXIS
13. *M.Kulichenko, Y.Kozyryev, N.Maigurova, O.Shulga* COLOR-INDEX DETERMINATION OF LEO SATELLITES USING COLOR IP-CAMERAS
14. *O.M.Yizhakevych, S.V.Shatokhina, V.M.Andruk* SOME Asteroid positions OF THE TAUTENBURG DIGITIZED ASTROPLATES
15. *S.V.Shatokhina, H.Relke, O.M.Yizhakevych, V.M.Andruk, A.Sh.Mullo-Abdolov* ASTEROID POSITIONS BASED ON THE DUSHANBE PART OF THE FON PROJECT OBSERVATIONS

SUN, SOLAR ACTIVITY, SOLAR-TERRESTRIAL RELATIONS AND ASTROBIOLOGY

Thursday, 24.08.2023

*Conveners – **V.M.Efimenko, M.I.Ryabov***

1. *V.M. Efimenko, V.G. Lozitsky* THE OPTIMAL INTERVAL FOR DETERMINING THE GROWTH RATE OF SOLAR ACTIVITY FOR THE PREDICTION OF THE MAXIMUM AMPLITUDE OF THE 25th CYCLE
2. *N.M. Kondrashova,V.N.Krivodubskij* ANOMALOUS MAGNETIC REGIONS ON THE SUN
3. *N.I.Lozitska, I.I.Yakovkin, V.G.Lozitsky* COMPARISON OF MAGNETIC FIELDS BY D1, D2 AND NII LINES MEASURED IN THE AREAS OF THE SEISMIC SOURCE OF A POWERFUL SOLAR FLARE AND IN A SUNSPOT WITHOUT FLARES
4. *V.G.Lozitsky, S.M.Osipov* TRIAL SPECTRAL-POLARIZATION OBSERVATIONS IN THE H-ALPHA LINE FOR THE SEARCH FOR SUPER-STRONG MAGNETIC FIELDS IN SUNSPOTS AT THE CHROMOSPHERE LEVEL
5. *S.Osipov* SCATTERED LIGHT IN THE SPECTROGRAPH OF ERNEST GURTOVENKO SOLAR TELESCOPE
6. *M.M.Pasechnik* SPECTRAL STUDY LOWER SOLAR ATMOSPHERE OF THE ACTIVE REGION SITE WITH THE ELLERMAN BOMB AND ACCOMPANYING Hα-EJECTIONS
7. *N.G.Shchukina, Javier Trujillo Bueno* EUV CORONAL SPECTROPOLARIMETRY
8. *R.Kostik* BRIGHTNESS IN THE SOLAR FACULA
9. *M.Pishkalo* FLATTENING INDEX OF THE SOLAR CORONA IN THE SOLAR CYCLE AND ITS RELATION WITH PARAMETERS OF MAGNETIC FIELD OF THE SUN
10. *E.A.Isaeva* THE RALATIONSHIP OF THE PROTON FLUX OF SCR WITH THE PARAMETERS OF TYPE II RADIO BURSTS
11. *M.I.Ryabov, A.L.Sukharev* ON THE ANOMALOUS RISE OF CYCLE 25 AS A RESULT OF THE MANIFESTATION ACTIVITY OF THE NORTHERN AND SOUTHERN HEMISPHERES OF THE SUN
12. *T.Sumaruk, P.Sumaruk, M.Neska* SOLAR AND GEOMAGNETIC ACTIVITY IN 19-24 CYCLES
13. *M.I.Orlyuk, A.A.Romenets* THE EARTH'S MAGNETIC FIELD AND THE LARGE-SCALE MAGNETIC FIELD OF THE SUN: THE SOLAR-TERRESTRIAL CONNECTION
14. *M.I.Ryabov, A.L.Sukharev, M.I.Orlyuk, D.M.Ryabov, Yu.P.Sumaruk, L.I.Sobitniak, A.O.Romenets* ASSESSMENT OF THE POSSIBILITY OF USING NEURAL NETWORKS AND WAVELET ANALYSIS FOR PROCESSING THE DATA OF MONITORING OBSERVATIONS OF GEOMAGNETIC VARIATIONS FOR INVESTIGATION SPACE WEATHER
15. *L.I Sobitnyak, M.I.Ryabov, A.L.Sukharev, M.I.Orlyuk, D.M.Ryabov, A.Romenets, Yu.Sumaruk* COMPARATIVE ANALYSIS OF THE CATALOGS OF PLANETARY MAGNETIC AND IONOSPHERIC STORMS WITH THE CATALOG OF MAGNETIC STORMS FOR THE ZONE OF THE ODESSA MAGNETIC ANOMALY
16. *M.I.Orlyuk, A.A.Romenets, I.M.Orliuk* SARS-CoV-2 VIRUS SPREADING IN RELATION TO THE EARTH'S MAGNETIC FIELD
17. *O.V.Dudnik, A.Wawrzaszek, A.Képa, M.Karlický, A.Awasthi, T.Mrozek, J.Sylwester* SOLAR FLARES IN MAY 2021 AND THEIR MANIFESTATIONS IN THE INTERPLANETARY SPACE AS DETECTED WITH STIX, EPD, MAG, AND SWA INSTRUMENTS ONBOARD THE SOLAR ORBITER

RADIO ASTRONOMY

Friday, 25.08.2023

Convener – ***Oleg Ulyanov***

1. *V.N.Melnik, A.I.Brazhenko, A.V.Frantsuzenko, V.V.Dorovskyy, M.V.Shevchuk* DECAMETER TYPE IV BURST WITH HIGH POLARIZATION ON 13 JULY 2022
2. *V.V.Dorovskyy, V.N.Melnik, A.I.Brazhenko* GROUND BASED SUPPORT OF THE SPACE MISSION PARKER PERFORMED WITH UKRAINIAN LOW FREQUENCY RADIO TELESCOPES
3. *Koval A., Stanislavsky A., Karlicky M., Wang B., Yerin S., Konovalenko A., Barta M., Bubnov I.* MORPHOLOGY OF SOLAR TYPE II BURSTS CAUSED BY SHOCK PROPAGATION THROUGH TURBULENT AND INHOMOGENEOUS CORONAL PLASMA
4. *O.Ulyanov, C.Tiburzi, A.Shevtsova, V.Zakharenko, A.Konovalenko, P.Zarka, J-M.Grießmeier, S.Yerin, I.Kravtsov, A.Brazhenko, A.Frantsuzenko* THE USE OF PULSAR PULSES FOR COSMIC MAGNETOACTIVE PLASMA DIAGNOSING
5. *Vladislavs Bezrukovs* RECENT RADIO ASTRONOMICAL ACTIVITIES AT THE VENTSPILS INTERNATIONAL RADIO ASTRONOMY CENTRE
6. *Ye.Vasylkivskyi, O.Konovalenko, S.Stepkin* LARGE-SCALE STUDIES OF DECAMETER CARBON RADIO RECOMBINATION LINES IN GALAXY
7. *L.O.Stanislavsky, I.M.Bubnov, O.O.Stanislavsky, S.M.Yerin* EVOLUTION OF FREE-FREE ABSORPTION PARAMETERS IN CASSIOPEIA A
8. *V.Shepelev, R.Vashchishin, V.Dorovskyy, V.Melnik, M.Shevchuk* INTERFEROMETRIC OBSERVATIONS OF THE QUIET SUN AT DECAMETER WAVELENGTHS UNDER STRONG RADIO FREQUENCY INTERFERENCE
9. *R.V.Vashchishyn, V.A.Shepelev, O.A.Litvinenko, G.S.Podgorny, A.V.Lozinsky* ANGULAR STRUCTURE OF THE RADIO GALAXY 3C280 AT DECAMETER WAVELENGTHS
10. *A.Lozynskyy, O.Ivantyshyn, B.Rusyn, O.Ulyanov* THE “INTERFEROVISION” PROJECT : WHAT WE WANT, WHAT WE HAVE AND WHAT WE ARE WORKING HARD ON NOW

Convener – ***Oleg Litvinenko***

11. *A.Konovalenko, V.Zakharenko, O.Ulyanov, P.Tokarsky, M.Sidorchuck, S.Stepkin, P.Zarka, J.Girard, J-M.Grießmeier, M.Tagger, R.Vermeulen, L.Gurvits, H.O.Rucker, A.Lecacheuh, N.Kalinichenko, A.Stanislavsky, V.Melnik, V.Dorovsky, N.Shevchuk, V.Shepelev, Y.Vasilkovsky, A.Brazhenko, A.Frantsuzenko, O.Ivantyshin, A.Lozinsky, I.Bubnov, M.Ryabov, O.Litvinenko, A.Reznichenko, V.Bortsov, S.Yerin* PERSPECTIVES OF LOW-FREQUENCY RADIO ASTRONOMY IN UKRAINE
12. *A.L.Sukharev, M.I.Ryabov,* *V.V.Galanin* ABOUT RESEARCH PROGRAMS AT THE RADIO TELESCOPE "URAN-4" OF THE RADIO ASTRONOMY INSTITUTE OF THE NATIONAL ACADEMY OF SCIENCES OF UKRAINE (MONITORING OF FLUXES OF POWERFUL RADIO SOURCES, STUDY OF THE SUN'S SUPERCORONA BY PASSAGE OF THE CRAB NEBULA, OBSERVATIONS OF SOLAR ECLIPSE)
13. *N.O.Tsvyk* THE DICHOTOMY OF THE MECHANISMS OF DECAMETER RADIO EMISSION FROM JUPITER: THE INFLUENCE OF STREAMER INHOMOGENEITIES AND MHD PERTURBATIONS IN THE SOURCE
14. *D.Zabora, M.Ryabov, A.Sukharev, V.Bezrukovs, O.Bazyey* MOTION KINEMATIC OF COMPONENTS IN AGN’S JETS ACCORDING TO VLBI MOJAVE MONITORING DATA
15. V.V.Orlov, O.A.Lytvynenko, V.G.Derevyagin MODELING OF AN ADAPTIVE INTERFERENCE SUPPRESSION SYSTEM IN LONGWAVE RADIO ASTRONOMY
16. *O.A.Lytvynenko, S.K.Panishko, V.G.Derevyagin* SEPARATION OF DIURNAL AND SEASONAL EFFECTS IN THE RADIO ASTRONOMICAL METHOD OF THE IONOSPHERE SOUNDING
17. *O.A.Lytvynenko, S.K.Panishko, V.G.Derevyagin* THE LONG-TERM OBSERVATIONS OF THE POWER COSMIC RADIO SOURCES ON THE RADIO TELESCOPE URAN-4 AT THE DECAMETER WAVELENGTH RANGE
18. *Miroshnichenko A.P.* THE JET KINETIC LUMINOSITIES FOR THE UTR-2 SOURCES WITH THE STEEP LOW-FREQUENCY SPECTRA

ASTRONOMICAL EDUCATION AND OUTREACH

Friday, 25.08.2023

Convener – ***Ivan Andronov***

1. *I.B.Vavilova, B.Ya.Melekh* ASTRONOMICAL TEXTBOOKS AND MONOGRAPHS FOR THE HIGHER EDUCATION
2. *V.Ivchenko, V.Marsakova, B.Melekh, B.Novosyadlyj, V.Reshetnyk, A.Simon, O.Vernydub.* ASTRONOMY OLYMPIAD ACTIVITY IN UKRAINE
3. *O.Golubov* ASTRONOMY IN UKRAINIAN WIKIPEDIA
4. *I.L.Andronov* ASTRONOMY OUTREACH IN UKRAINE
5. *V.V.Marsakova* ASTRONOMICAL ACTIVITY IN CENTER OF STEM-EDUCATION OF ODESA REGION
6. *M.Yu.Pyatnytskyy* OBSERVING VARIABLE STARS AT THE "OSOKORKY" OBSERVATORY
7. *T.Karasova* ASTROSANDBOX PROJECT

BIOLOGICAL SESSION **“THE IMPORTANCE OF G. GAMOW'S IDEAS FOR BIOLOGY OF THE 21ST CENTURY”**

*Convener – **S.V.Chebotar***

1. *J.Kumlehn* CAS ENDONUCLEASE TECHNOLOGY IN CEREALS: FROM SITE-DIRECTED MUTAGENESIS TOWARDS MORE PRECISE GENOME EDITING
2. *S.Griffiths* THE RHT8 SEESAW
3. *M.Nagel* CHANGES OF SEED METABOLITE AFTER 40 YEARS OF LONG-TERM COLD STORAGE IN WHEAT AND BARLEY
4. *M.Schierenbeck, A.M.Alqudah, S.G.Thabet, E.G.Avogadro, U.Lohwasser, M.R.Simón, A.Börner* GENETIC DISSECTION FOR SEEDLING DROUGHT STRESS TOLERANCE IN A WINTER WHEAT PANEL
5. *G.Chebotar, A.Börner, M.Nagel* HOW TO FIND CANDIDATE GENE – GWAS – WITH SPECIAL EMPHASIS ON BARLEY LONGEVITY
6. *Yu.A.Popovych, O.M.Blagodarova, S.V.Chebotar* PREFERENCES OF MOLECULAR MARKERS FOR DETECTING OF ALLELIC VARIANTS OF GLIADINS
7. *S.Okoń, T.Ociepa, A.Nucia, K.Kowalczyk* IDENTIFICATION AND CHROMOSOMAL LOCALIZATION OF *PM11* AND *PM12* POWDERY MILDEW RESISTANCE GENES IN OAT (*AVENA SATIVA* L.)
8. *E.Bucher* PLANT GENOME AND EPIGENOME DYNAMICS IN THE CONTEXT OF CLIMATE CHANGE
9. *O.Yushchuk, F.Marinelli, V.Fedorenko* GLYCOPEPTIDE ANTIBIOTIC RESISTANCE GENES: AN UPDATED POINT OF VIEW
10. *A.Kachor, O.M.Gromyko* GENOMIC CHARACTERIZATION OF ACTINOMYCETE STRAIN MUMIA SP. PV 4-285 ISOLATED FROM PHYLLOSTACHYS VIRIDIGLAUCESCENS RHIZOSPHERE
11. *Y.O.Tynkevich, I.I.Moysiyenko, I.I.Panchuk, R.A.Volkov* 5S RIBOSOMAL DNA IN THE TRIBE LIMONIEAE (PLUMBAGINACEAE): MOLECULAR ORGANIZATION, POLYMORPHISM, AND TAXONOMIC APPLICATION
12. *D.Sirokha, V.Kalynovskyi, N.Zelinska, O.Gorodna, L.Livshits* THE OLIGOGENIC IMPACT OF KIAA1210 & CFAP47 MUTATIONS ON THE DEVELOPMENT OF DSD FEATURES IN A PATIENT WITH A C.34G>C GATA4 MUTATION
13. *Yu.Monczak* MOLECULAR DNA TRACKING OF CORD BLOOD STEM CELL TRANSPLANTATION WITH MULTI-DONOR POOLS: WHEN ONE DONOR IS NOT ENOUGH
14. *G.Segre* GEORGE GAMOW’S FRIEND MAX DELBRUCK, THE FOUNDER OF MODERN VIRUS STUDIE

ABSTRACTS

MEMORIAL SESSION

«HEAVENLY PHYSICS» BY ISAAC NEWTON

O.Bazyey
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Odesa National Maritime University, Ukraine

Nicolaus Copernicus stood at the beginning of the scientific revolution in the 16th century. The most revolutionary is his idea of the unity of the world: "Heaven is governed by the same laws as the Earth". This is the first impulse towards the creation of modern science.

At the beginning of the 17th century, Johannes Kepler formulated the laws of planetary motion. The orbits calculated according to these laws were ideally confirmed by observations. Now it was necessary to explain what makes the planets move around the Sun.

Aristotle's physics is being replaced by Galileo's quantitative dynamics: "The Great Book of the Universe is written in the language of mathematics ... Without it, we wander in vain in a dark labyrinth". The scientific world was prepared for Newton's discoveries.

In 1673, Christian Huygens obtained a formula for the acceleration of a body in a circular motion. He called it "centrifugal force". Using Kepler's third law, Newton discovered that the "centrifugal forces" generated by the planets vary inversely with the square of their distance from the Sun.

In 1682, a comet appeared, later called Halley's comet. Newton first suggested that comets are also attracted by the Sun. Two years later, he sent Halley the treatise "Movement of Bodies in Orbit". Three years later, the famous essay "Mathematical Principles of Natural Philosophy" grew out of this work.

In the first book, Newton formulated the three laws of dynamics, introduced the concept of centripetal force, and formulated the concept of mass.

The second book is a treatise on mechanics. Newton proved that space is free from friction and that there are forces capable of acting at a distance.

In the third book, Newton argued that the cause of the motion of celestial bodies is the force of gravity and formulated the law of universal gravitation.

This discovery of Newton had the consequence that the Earth must be compressed at the poles. The polar contraction of the Earth for the first time allowed Newton to explain the phenomenon of precession.

For two centuries after Newton's discoveries, there were heated discussions about the absurdity of the action of gravity through the void. Newton insisted that he was not interested in the essence of attraction, but in its effects. The equations of motion based on the law of universal gravitation made it possible to make very impressive predictions.

Newton's theory of gravitation has gained indisputable authority. However, in the early twentieth century, Einstein's theory of relativity showed that the universe is more complex than Newton imagined.

TO THE 85th ANNIVERSARY OF PROFESSOR NIKOLAY KOMAROV

T.Mishenina
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The biography and scientific achievements of Professor Nikolay Sergeevich Komarov, the founder of modern spectroscopy at the Astronomical Observatory Odesa National University, are briefly presented.

THE 155th ANNIVERSARY OF PROF. K.D.POKROVSKY – DIRECTOR OF THE ASTRONOMICAL OBSERVATORY OF ODESSA I.I.MECHNIKOV STATE UNIVERSITY FROM 1934 TO 1944

M.I.Ryabov[1], I.E.Rikun[2]
[1] Odessa Astronomical Society
[2] Odessa House of Scientists

Professor Konstantin Dorimedontovich Pokrovsky is a prominent representative of "classical" directors of the Odessa Observatory for its more than 150 years of history.

Among them were: Professor A.K.Kononovich (1881–1910), Professor and Academician of the Academy of Sciences of Ukraine A.Y.Orlov (1912–1934), Professor and Member of the USSR Academy of Sciences K.D.Pokrovsky (1934–1944), Professor and Member of the Academy of Sciences of Ukraine V.P.Tsesevich (1944–1983).

All of them were characterized by a high international level of scientific research, outstanding organizational skills, active teaching and successful training of scientific personnel, publication of monographs and educational literature on astronomy.

Professor K.D.Pokrovsky happened to be the director of the observatory in the most difficult period of the observatory's history from 1934 to 1944, which included the time of repression and the Second World War.

K.D.Pokrovsky became the director of the Odessa Observatory in the year of the restoration of Odessa University, already being a world-famous scientist.

During the period before the Second World War, Professor K.D.Pokrovsky managed to restore the Department of Astronomy and postgraduate studies, expanded the subject of scientific research of the observatory and streamlined its

activities, was the dean of the Faculty of Physics and showed extremely high social activity.

At this time, he headed the Odessa branch of VAGO. In 1940, K.D.Pokrovsky was appointed by the Academy of Sciences as chairman of the commission for the construction of planetariums in Ukraine.

At the beginning of the Second World War, due to old age, K.D.Pokrovsky remained in Odessa and continued to be the director of the observatory throughout the occupation.

At the same time, he managed to keep the observatory and its equipment safe and sound. After the liberation of Odessa, K.D.Pokrovsky was accused of collaborating with the occupiers and died during the investigation in Kiev.

In 1993, K.D.Pokrovsky was rehabilitated. The tragic fate and outstanding role of K.D.Pokrovsky in the preservation of the observatory will remain in history as the highest example of selfless service to science. In conclusion, it should be noted that in 1939–1944, Pokrovsky was the Chairman and member of the board of the Odessa House of Scientists, and carried out great public, educational and popularization activities there. Unfortunately, the House of Scientists, the former palace of the Counts Tolstoy, architectural monument, received significant damage during the rocket attack on Odessa on July 23, 2023. The House of Scientists is in need of restoration and hopes for the help of everyone who cares about the history of science in Odessa.

THE MEMORY OF ACADEMICIAN V.M.SHULGA, THE CHAIR OF SOC OF THE GAMOW CONFERENCES FROM 2012 TO 2022

V.V.Zakharenko
Institute of Radio Astronomy, NAS of Ukraine

Academician V.M. Shulga was one of the most active co-organizers of the Gamow International Conference. From 2012 he was the chair of Scientific Organizing Committee of the Gamow conferences from 2012 to 2022.

V.M. Shulga was born on August 16, 1944 in the city of Krasnograd, Kharkiv region, Ukraine. In 1966, he graduated with honors from the Kharkiv State University (now –V.N. Karazin Kharkiv National University) in the specialty “radiophysics and electronics” and continued his studies at the graduate school of this university. After completing his postgraduate studies, he worked at the Institute of Radiophysics and Electronics of the National Academy of Sciences (NAS) of Ukraine and lectured at the Kharkiv State University since 1972.

From 1986 until the end of his life, V.M. Shulga worked at the Institute of Radio Astronomy of the NAS of Ukraine.

On December 4, 1997, Valery Shulga was elected a corresponding member of the NAS of Ukraine, and on May 6, 2006, he was elected a member of the NAS of Ukraine.

With the participation of V.M. Shulga, the most high-frequency quantum amplifiers (masers) at frequencies of 45 GHz and 95 GHz with record characteristics were developed. In 1989, this work by V.M. Shulga and his colleagues were recognized and awarded the State Prize of Ukraine in the field of science and technology. Since 1990-ies, V.M. Shulga initiated in Ukraine the spectral studies of the Galaxy in the millimeter wavelength range. In recent years, his scientific interests have spread to cosmological problems: the formation of the large-scale structure of the Universe, the existence of dark matter and dark energy. V.M. Shulga also began a new field of research regarding the seasonal changes in the state of the Earth's atmosphere at the heights of the stratosphere and mesosphere using the molecular radiation analysis in the millimeter range.

In 2001, Valery Shulga was awarded the M.P. Barabashov Prize of the NAS of Ukraine for a series of works entitled "Study of spectra and variability of cosmic radio radiation in the millimeter range using the RT-22 radio telescope”. In 2008, he was awarded the State Order of Merit, III degree.

V.M. Shulga headed the Scientific Astronomical Council of the NAS of Ukraine, was a member of the Expert Council of the Ministry for Education and Science of Ukraine on the issues of expertise of dissertation works in physics and astronomy. As an official representative of the NAS of Ukraine at the International Center for Future Science of the Jilin University (People's Republic of China), he developed a fruitful scientific cooperation.

V.M. Shulga combined intensive scientific work with organizational and pedagogical activities. For more than 30 years, he headed the Department of Millimeter Radio Astronomy at the Institute of Radio Astronomy of the NAS of Ukraine, during 17 years he was the Deputy-director for scientific work of this institute.

Valery Mykhailovych Shulga devoted his life to the faithful service of science. With his creative output, Prof. Valery Shulga enriched world and national science in the field of radio physics and radio astronomy.

PLENARY SPEAKERS

STATISTICALLLY OPTIMAL MATHEMATICAL MODELING OF PHYSICAL VARIABILITY OF IRREGULARLY SPACED SIGNALS

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A variety of types of natural and artificial signals has initiated elaboration of corresponding algorithms and an expert system of programs for statistically optimal mathematical modelling of such data. We review "main trends" of the data analysis, and make a "crucial" review of achievements of these methods, as well as possible types of "fake discoveries", when applying "good" methods to the signals, which do not satisfy conditions allowing oversimplified formulae.

For these methods, we apply "crash tests" to estimate conditions, which begin to produce "bad" (bias) results.

Although the methods may be used for "simple" cases of regularly spaced observations (in time or any other argument), our main direction is to improve existing algorithms to a case of signals with generally irregular spacing. This is a common case for e.g. photometric surveys – the visual, photographic or recent CCD ones, which are made either in the ground-based, or space observatories.

More than 70 main types are listed in the catalogs of variable stars (e.g. GCVS, VSX), and hundreds of combined ("hybrid") ones.

Such time series (the light curves) may be subdivided in a smaller number of classes – periodic, multi-periodic, multi-harmonic, quasi-periodic, transient periodic, regular aperiodic (like regular outbursts with variable intervals between them), or outbursts "once in a lifetime".

Results for all methods will produce the same results, as the formulae of the classical Fourier Transform, only in the case of regularly spaced data and discrete set of frequencies,. In other cases, such oversimplified methods, which use preliminary "mean removal", "trend removal" or "pre-whitening" (removal of a periodic (typically, sinusoidal) variation) before further modeling, may produce a significant bias of the determined parameters, and so wrong conclusions and even "fake discoveries". We review mathematical models – either the popular "oversimplified" ones (and show cases with extremely wrong results), or the improved methods with complete mathematical models.

The algorithms are devoted to:

Periodogram analysis. Obviously, the best case is to have long regular time series and to see distance between the characteristic points (e.g. minima of the eclipsing systems or maxima of pulsating variables).

More accurate is to use a complete light curve and to look for possible variations of the shape of the light curve with time, which may be caused by additional physical mechanisms of variability. However, long series of observations (like that from the KEPLER or TESS space missions) exist, but they are available in the selected fields of the stellar sky. To get most accurate ToM (Time of Minima/Maxima, according to the AAVSO terminology), it is recommended to use the software MAVKA (http://uavso.org.ua/mavka), see there references also to previous algorithms.

The absolute majority of the data are sparse, mainly in one filter or without any one.

The methods are based on the analysis based on computation of so-called periodograms for a large number (often to a million trial periods P, or frequencies f=1/P). To estimate the quality of the periodogram, a test-function is computed $Q(f,x,t,T_0)$, which numerically shows a "quality" of the phase curve.

Possible period corresponds to the extremum (in some methods, the maximum, in others – the minimum).

There are many methods, which may be split into groups – either "non-parametric" (or "point-point"), or "parametric" (or "point-curve"). For the "parametric" methods, the coefficients may be determined using the method of the Least Squares (LSq), which is statistically correct. However, there are "oversimplified" methods like that of Lomb popularized by Scargle, where, in fact, the part of the matrix of normal equations is voluntary set to zero. Formally, the first coefficient C_1 is set to a sample mean value x_{mean}, and this model is $x(t)-x_{mean} = C_2\cos(\omega t)+C_3\sin(\omega t)$ contains two unknown coefficients, and often it is refereed as "the Fourier Transform" (FT). This simplification may lead to systematic errors in the period value up to two (!!!) times, thus a complete mathematical model is needed. The software MCV (http://uavso.org.ua/mcv/MCV.zip , "Multi – Column View") has many features, particularly, allows to make a periodogram analysis using a periodic trigonometric polynomial superimposed on an algebraic trend. The period is determined using differential corrections. Also it is possible to determine coefficients of a multi-periodic multi-harmonic model with a polynomial trend. For eclipsing systems, the algorithm NAV ("New Algol Variable" was proposed.

Another class of models is based on so-called "local" approximations, where only the central point is used, whereas the data are taken in the interval $[t_0-\Delta t, t_0+\Delta t]$. Here Δt is a "filter half-width", which is determined to be optimal by minimizing the r.m.s. accuracy of the approximation at times of observations. This method is also effective for studies of flickering and quasi-periodic oscillations.

The wavelet analysis was described using different test-functions WWZ, WWT, WWA and WWS.

For e.g. semi-regular stars the method of the "Running sines" is more effective. It was recently improved for taking into account a possible trend and non-rectangular weight functions in the program VOB (presented separately at the section AstroInformatics).

The principal components of variability may be computed either for simultaneous multi-channel signals, or for the monochrome data with shift,

The expressions for statistical properties of the auto-correlation functions for the detrended data were summarized.

These methods have been used for the analysis of 2000+ stars based on own observations and that published in the international databases.

A recent review was published in 2020dson.book....3A.

THE BIRTH OF MODERN COSMOLOGY

Massimo Capaccioli [1,2,3]

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[2]*Capodimonte Astronomical Observatory, National Institute of Astronomy, Naples, Italy*
[3]*Foreign member, National Academy of Sciences of Ukraine*

The first quarter of the 20th century saw two fundamental steps forward in the understanding of the nature of gravity and the large-scale structure of the universe, with the formulation of the theory of general relativity and the first solutions of the field equations, and with the final establishment of the empirical model of a homogeneous and isotropic cosmos. Looking at both the facts and the actors, this contribution reconstructs and discusses the fundamental steps and the inevitable errors and mistakes of an epic that, together with the early developments of quantum mechanics, represented a *unicum* in the timeline of modern science and whose consequences we still make full use of today.

N-BODY SIMULATION OF THE COSMIC SCREENING EFFECT

M.Eingorn [1], ***E.Yilmaz*** [2,3], ***A.E.Yükselci*** [4], ***A.Zhuk*** [2,3,5]

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[5]*Astronomical Observatory, Odessa I.I.Mechnikov National University, Odessa, Ukraine*

We consider the large-scale structure formation within the cosmic screening approach. The main feature of this approach is that a careful analysis of the perturbed Einstein equations leads to the conclusion that there is an exponential cutoff of the gravitational interaction on large (of the order of 2–3 Gpc) cosmological scales. This is a purely relativistic effect associated with the non-linearity of Einstein's equations. Consequently, the gravitational potential is described by an equation of Helmholtz-type and not of Poisson-type and it has the form of the Yukawa potential, and not the Newton potential familiar to us from school days. To confirm this effect numerically, we perform the N-body simulation in a box with a comoving size of 5.632 Gps/h employing the relativistic code “gevolution” modified to our approach. We calculate the power spectra of the mass density contrast and find that these spectra cease to depend on time for scales beyond the cosmic screening length. This is a clear manifestation of the cosmic screening effect.

ATOM INTERFEROMETRY TO SEARCH FOR GRAVITATIONAL WAVES AND DARK MATTER

John Ellis
King’s College London, UK and CERN, Switzerland

The discovery of gravitational waves (GWs) by the LIGO and Virgo Collaborations opened a new window on the Universe. They observed the mergers of stellar-mass black holes and neutron stars. The NANOGrav and other pulsar timing array (PTA) Collaborations have recently presented evidence for GWs with frequencies in the nanoHz range. I will discuss their possible astrophysical and cosmological origins and the prospects for other experiments to observe GWs in the range of frequencies between the PTAs and LIGO/Virgo, and detect the mergers of supermassive black holes, networks of cosmic strings or cosmological phase transitions. I will stress the potential of atom interferometers to complement laser interferometer experiments.

THE ASSEMBLY HISTORY OF GALAXIES IN A CLUSTER ENVIRONMENT

E. Iodice
INAF-Astronomical Observatory of Capodimonte, via Moiariello 16, 80131 Napoli

In this talk I would like to present the study of the Hydra I cluster, at z~0.012, based on deep images and integral-field (IF) spectroscopy. Deep images, obtained with VST, allowed to map the galaxy structure out the regions of the stellar halos, to detect the diffuse intra-cluster light components and the population of low-surface brightness (LSB) galaxies (*i.e.*, dwarfs and ultra-diffuse galaxies). In particular, we studied how the LSB galaxies are distributed in the cluster, in order to map the mass assembly of the Hydra I cluster. We discovered that galaxies are grouped in substructures in different regions of the covered cluster area. The non-uniform spatial distribution of galaxies supports the idea that several small galaxies are falling through the cluster core, feeding the cluster mass assembly process. This study motivated a spectroscopic follow-up with MUSE@VLT, entitled "Looking into the faintEst WIth muSe (LEWIS)". With LEWIS we obtained the first homogeneous IF spectroscopic survey of LSB and ultra-diffuse galaxies. This project will be also presented in my talk.

THE SOUND OF THE EVENT HORIZON

Roman Konoplya
Silesian University in Opava, Opava, Czech Republic

It is broadly believed that quasinormal modes (QNMs) cannot tell the black-hole near-horizon geometry, because usually the low-lying modes are determined by the scattering of perturbations around the peak of the effective potential. Using the general parametrization of the black-hole spacetimes respecting the generic post-Newtonian asymptotic, we will show that tiny modifications of the Schwarzschild/Kerr geometry in a relatively small region near the event horizon lead to almost the same Schwarzschild/Kerr fundamental mode, but totally different first few overtones. Having in mind that the first several overtones affect the quasinormal (QN) ringing at its early and intermediate stage [M. Giesler, M. Isi, M. Scheel, and S. Teukolsky, Phys. Rev. X 9, 041060 (2019)], we argue that the near-horizon geometry could in principle be studied via the first few overtones of the QN spectrum, which is important because corrections to the Einstein theory must modify precisely the near-horizon geometry, keeping the known weak field regime. We discuss the connection of this observation with the so called "overtones' instability" recently studied in [J. Jaramillo et. al. Phys. Rev. Lett. 128, 211102 (2022)].

SCALARIZED BLACK HOLES IN ALTERNATIVE GRAVITIES

Jutta Kunz
University of Oldenburg, Oldenburg, Germany

Black holes represent excellent laboratories for testing Einstein's theory of general relativity as well as alternative gravities. The latter typically introduce additional degrees of freedom, where the simplest and most prominent one is an additional scalar field. The resulting black holes may then possibly carry scalar hair, leading to significant deviations of their properties from those of their counterparts in general relativity.

SMALL-SCALE LOOP SYSTEMS AND THEIR ASSOCIATED DYNAMIC ACTIVITY

Maria Madjarska
Max Planck Institutes for Solar System Research, Germany

Small-scale magnetic loops are the main magnetic skeleton of the solar atmosphere outside active regions. Some appear bright and are referred to as coronal bright points for historical reasons. Others are fainter, building up the background corona of the so-called quiet Sun. Thus, these small-scale loops dominate the solar corona seen in images that record the emission from plasmas heated to approximately 1 million degrees, especially during the minimum of the solar activity cycle. Their role in heating the upper solar atmosphere is still under intense debate, being a subject of numerous observational and theoretical studies. I will briefly review the morphological, magnetic, and plasma properties reported in studies spanning more than five decades. I will present a series of our observational and modelling studies on eruptions (mini coronal mass ejections and jets) associated with these loop systems. I will discuss the possibility of whether these mini eruptions could be the source of magnetic switchbacks (sudden deflections of the magnetic field) that prevail in the inner heliosphere.

NATURE AND PROCESSES IN CIRCUMSTELLAR DISKS OF STARS WITH Be AND B[e] PHENOMENA

Anatoly Miroshnichenko
University of North Carolina at Greensboro, USA

Stars with initial masses of 3-20 $M_{\odot}$ spend most of their main-sequence lifetime are classified as stars with the spectral type B. Although many of them show only absorption-line spectra, there are two groups, called objects with the Be and B[e] phenomenon, that exhibit emission-line spectra. The line emission comes from circumstellar envelopes, which are usually disk-shaped. The Be stars are typically fast-rotating and contain only gas in their disks, while the B[e] stars have a strong excess of infrared radiation that manifests the presence of dusty particles in addition to the gas. The origin of both phenomena is still under debate, but recent results of their investigation strongly suggest that the presence of a second star in the system may play an important role in triggering the circumstellar material accumulation. Current views on these phenomena will be introduced, and examples of objects showing them will be presented.

HOW PREDICTIVE ARE THE COSMOLOGICAL THEORIES?

Viatcheslav Mukhanov
Ludwig Maximilian University of Munich, Germany

I will discuss how much did we learn during last 25 years from CMB observations about the early universe and will raise several questions about future observations.

DO ASTRONOMICAL OBSERVATIONS RULE OUT THE POSSIBILITY OF AN ANISOTROPIC BIG BANG?

S.L. Parnovsky
Taras Shevchenko National University of Kyiv, Astronomical observatory, Kyiv, Ukraine

We investigate possible astronomical manifestations of space-time anisotropy. The homogeneous vacuum Kasner solution was chosen as a reference anisotropic cosmological model. The study of its geodesic structure

made it possible to clarify the properties of this space-time. It showed that the degree of manifestation of anisotropy varies significantly depending on the time after which the light from the observed object reaches the observer. For nearby objects, for which it does not exceed half the age of the universe, the manifestations of anisotropy are very small.

Distant objects show more pronounced manifestations, for example, in the distribution of objects over the sky and over photometric distances. These effects for each of the individual objects decrease with time, but in general, the manifestations of anisotropy in the Kasner space-time remain constant due to the fact that new sources emerging from beyond the cosmological horizon. These effects were not found in astronomical observations, including the study of the CMB. We can assume that the Universe has always been isotropic or almost isotropic since the recombination era. This does not exclude the possibility of its significant anisotropy at the moment of the Big Bang followed by rapid isotropization during the inflationary epoch. The corresponding metrics are obtained from the general solution of the GR equations for homogeneous models.

TELESCOPES FROM THE GROUND AND FROM SPACE TO DISCOVER AND CHARACTERIZE ALIEN WORLDS

***R.Ragazzoni*[1,2]**
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[2]*INAF-Astronomical Observatory of Padova, Italy*

From the first, Nobel class, discovery of an extrasolar planet around a normal star, an increasing number of alien worlds revolving stars different than our own Sun has been discovered and, to a partial extent, characterizes. This has been achieved by a combination of different techniques exploring partially the parameter's space where the signature of an exoplanet can be recognized.

While in some case this has been achieved by the exploitation or the development of existing classes of instruments, in other cases brand new instruments or telescopes have been designed and put in operations, both from the ground and from space.

I will try to review critically this development in order to assess which could be the next steps both in terms of technological development needed and in terms of how much scientific outcome we should expect, provided that nature, till this moment and from certain points of view, proved to exhibits more phantasy than science fiction's writers.

SPACE RADIATION WEATHER AT MARS

Jordanka Semkova
Space Research and Technology Institute, Bulgarian Academy of Sciences, Bulgaria

Potential deleterious health effects to astronauts induced by space radiation is one of the most important long-term risks for human space missions, especially future planetary missions to Mars. Therefore, the assessment of such radiation and the evaluation of its biological consequences have been given a high priority in the field of space exploration.

In the last two decades the radiation environment during the transit to Mars, on Mars orbit and surface has been investigated by several instruments aboard different missions. The most extensive radiation investigations have been provided by RAD instrument aboard Mars Science Laboratory and by Liulin-MO instrument aboard ExoMars Trace Gas Orbiter.

In this paper the main results from the investigation of the galactic cosmic rays (GCR) and solar energetic particle (SEP) events contribution to the radiation conditions in the interplanetary space and in Mars vicinity during 24th and the current 25th solar cycles are presented. Compared are measurements of different instruments on different space missions. Compared are also the measurement and modelled results for the radiation doses and particle fluxes during the transit to Mars and in Mars orbit/surface. The results show that in the case of a Hohmann transfer with up to 500 days of transit time and about 500 days of surface stay, the mission dose equivalent from GCR during solar minimum is higher than the current allowed career dose limits for astronauts, during solar maximum it is below these limits. However, large SEP events with more probability occurrence during solar maximum can be very dangerous, even lethal, although they are rare. The main part of the GCR dose will be accumulated during the transit to Mars. In the future, with advanced nuclear thrusters via a fast transfer the total GCR dose equivalent can be reduced.

MAGNETOMETRY OF THE SOLAR CORONA

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The first goal of the talk is to review the advancements in coronal magnetometry provided by the upcoming and future ground-based and space solar telescopes. We focus on the new largest solar ground-based telescopes with the highest spatial, spectral, temporal resolution and polarimetric sensitivity one can achieve from the ground. They are the National Science Foundation's 4.24-m Daniel K. Inouye Solar Telescope (DKIST) launched recently and the future 4-m European Solar Telescope (EST).

Secondly, we discuss the current state-of-the-art of coronal magnetometry, based on using coronagraphically observed forbidden optical and near-infrared lines of highly ionized atoms. They enable a range of coronal plasma diagnostics for the magnetic field direction via linear polarization generated by anisotropic photoexcitation and the longitudinal magnetic field amplitude.

Thirdly, we present advancements in coronal spectropolarimetry based on using permitted EUV lines. We show that the atomic polarization generated in the lower levels of these ions by scattering in the forbidden

visible, red or IR lines can be transferred by electronic collisions to the highly-excited upper levels of the permitted EUV lines. As a result, the measurable linear polarization signals in the latter lines would be sensitive to the coronal magnetic fields.

Finally, we focus on the Solar Research project POLMAG launched in 2018 within the framework of the Advanced Grant of the European Research Council under the European Union's Horizon 2020 research and innovation programme. It aims at exploring the magnetic fields of the chromosphere, transition region and corona of the Sun via the interpretation of the Stokes profiles of the optical, near-infrared and EUV coronal lines of highly ionized atoms.

EXTREME SOLAR ERUPTIVE EVENTS: RARE AND DANGEROUS

Ilya Usoskin
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Solar energetic eruptive processes, such as flares and coronal mass ejections, are relatively well-studied during the past decades of direct observations. Although their maximum strength/energy is not constrained by direct data because of a too-short period of observations, we know that extreme events do occur rarely on the Sun over the last millennia. This is known from both the multi-millennial data of extreme solar activity using cosmogenic-proxy data, and also a several-year survey of thousands of sun-like stars, thanks to high-precision stellar photometry. From these datasets, we can estimate the occurrence probability of extreme solar events and even reconstruct their energy spectra and assess the dramatic terrestrial and societal impacts. The consistency of different datasets on the average flux of solar energetic particles at the Earth's orbit can be assessed.

GRAVITATIONAL WAVES AND DARK MATTER FROM MELTING DOMAIN WALLS

Alexander Vikman
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I will discuss cosmic domain walls which are described by tension red-shifting with the expansion of the Universe so that this network eventually fades away completely. These melting domain walls emit gravitational waves with the low-frequency spectral shape corresponding to the spectral index $\gamma=3$ favoured by the recent NANOGrav 15 yrs data. This scenario involves a feebly coupled scalar field, which can serve as a promising dark matter candidate. This ultra-light dark matter has mass below 0.01 neV which is accessible through planned observations thanks to the effects of superradiance of rotating black holes. This talk is based on recent works: arXiv:2104.13722, arXiv:2112.12608 and arXiv:2307.04582.

NEW TELESCOPES AND OUR UNDERSTANDING OF THE UNIVERSE

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We report the short overview of new discoveries in astronomy, which becomes possible due to the new telescopes: from the Galileo's telescope to recent Gaia, James Webb Space Telescope and Euclid.

We discuss in more details the old and recent results on the structure of clusters of galaxies. In recent decades the infall regions were discovered in many clusters. The velocites of galaxies in these regions are significantly higher than it can be expected from Newtonian dynamics.

SPHERICALLY SYMMETRIC CONFIGURATIONS IN $F(R)$ GRAVITY IN THE EINSTEIN FRAME

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We study isolated compact configurations in the quadratic f(R) gravity. The field equations are reduced to the Einstein frame, in which the extra gravitational degree of freedom is represented by a minimally coupled scalar field (the scalaron). This enables one to use the results from the theories with a non-linear scalar field. A static spherically symmetric configuration with a non-trivial scalar field but without ordinary matter exhibits a naked singularity at the center. We study the limits of weak scalar field for static configurations with singularity or with regular matter distribution. Approximate and numerical solutions in the region of strong gravitational and scalar field are obtained with the aim of looking for observational effects. We show that, for viable values of the scalaron mass, the space-time metric remains practically unaffected by the scalar filed outside the Schwarzschild sphere. However, arbitrarily small scalar fields drastically change the space-time properties in the inner region.

COSMOLOGY, GRAVITATION, HIGH ENERGY PHYSICS, ASTROPARTICLE PHYSICS

GALAXY CLUSTER MERGERS: COMPUTER MODELING

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We show the possibilities of the methods of computer modelling of the galaxy cluster merger process with different initial parameters for the investigation the features of the clusters after colliding.

Galaxy clusters are among the biggest virialised components of the Universe's large-scale structure. We consider the galaxy clusters as evolving objects including through collisions. Computer modelling of galaxy cluster mergers and comparison of its results with observational data makes it possible to determine the evolutionary status of real clusters with a complex internal structures.

Our study is based on the catalogue prepared by ZuHone (2011). Within the study, we analyzed in detail a series of models of the galaxy clusters' merger consequences under different initial conditions like mass ratio, initial collision parameter, or plasma coefficient β at time intervals from 0 to 4.8 billion years, from 0 to 6 billion years, and from 0 to 10 billion years, depending on the initial conditions. Based on the images of the simulated galaxy clusters, maps of the distribution of the total mass density and X-ray radiation were created and compared with observations.

We showed a good perspective to use this catalogue for studying galaxy clusters having compound inner structure.

FLASHING IN THE ATMOSPHERES OF PLANETS OF THE SOLAR SYSTEM AND EXOPLANETS

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Planets of the Solar System or exoplanets with atmospheres are complicated to investigate by the absence of sufficiently intense own energy fluxes reflected by their atmospheres. At a sufficiently high brightness of the neighboring star, the atmosphere of the exoplanet gives the absorption spectra of some molecules with a high dissociation potential. If the star's surface temperature is low enough and its activity is low, then the presence of thunderstorm activity in the planet's atmosphere can make it possible to identify it. We show the processes that lead to the formation of flare spectra in the γ- and optical ranges and ways to identify them. It is important to note that current discharges initiate intense thermonuclear transformations with the formation of proton-rich C11, N13, and O15 nuclei. The spectrum of such a medium is specific and different from the spectra formed by the neighboring star. The statistical irregularity of the frequency of thunderstorms and the variety of conditions in the atmospheres of planets makes it possible to study them due to their illumination in the optical part of the spectrum. It is shown that the integrated optical flow and the detailed γ-spectrum make it possible to trace the time evolution of the lightning head current cord and obtain quantitative values of the current strength. Such fluctuations of the current give changes in the magnetic field of the filament, comparable with the value and even greater than the intrinsic magnetic fields of the planets. To carry out the proposed research, M. Doikov developed a multichannel spectrograph consisting of a γ- and optical spectrometer, a highly sensitive magnetometer, and a radio wave recorder. Its design is discussed in his report. We also note here that the calculations make it possible to determine the statistical parameter of time signals, the operating modes of the equipment, and the selection of the necessary nodes for designing the final working layout of the multichannel spectrometer. The value of the choice of observation site is indicated. In mountainous areas, these are heights of the order of a kilometer. In this case, the devices are near lightning.

MULTICHANNEL SPECTROGRAPH IN γ-, OPTICAL AND NIR SPECTRA WITH SIMULTANEOUS REGISTRATION OF THE LOCAL MAGNETIC FIELD FROM LIGHTING

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One of the objects that make it possible to test the developed high-speed spectrographic equipment is lightning discharges in the atmospheres of planets, including the Earth. The spectra of γ-bursts discovered during thunderstorms showed their thermonuclear nature. The paper shows the role of the corresponding channels

involving high-energy protons and α-particles, leading to the formation of C11, N13, and O15 isotopes. Registration of the γ-spectrum of lightning and its evolution made it possible to estimate the character and energy and time scales of the processes necessary for the design and manufacture of multi-purpose measuring complexes by us. The inclusion of γ-spectra in the consideration made it possible to estimate the correlation between the maximum currents of particles and the productivity of γ-rays. In the experiments planned by us, magnetic field disturbances created by currents are simultaneously recorded by highly sensitive magnetic field detectors. The height of the building of the Faculty of Physics in Smolyan, Bulgaria is 900 meters above sea level, making it possible to place the measuring complex as close as possible to sources of hard radiation and to carry out measurements in the immediate vicinity. Unlike distant space objects, the peroxide detector registers the positions themselves. This makes it possible to use the methods of positron γ-spectroscopy and determine exactly the parameters of local currents. The technological parameters of the equipment are determined. A simulation model was created in Simulink MATLAB with synchronization of the operation of the listed spectrographs. The characteristic shape of the signal formed by individual γ-quanta with the parameters of the Gaussian function and the total number of these quanta are calculated. The degree of mathematical blinding of neighboring Gaussian functions and its influence on the structure of the final spectrogram in the form of an autocorrelation function is estimated.

The similarity of the time scales of thermonuclear explosive processes on white dwarfs (WD) and the processes of synthesis of C11, N13, and O15 isotopes in the head of lightning is determined. It is concluded that it is expedient to create a robotic network of lightning observation stations similar to the meteor patrol at the I. I. Mechnikov National University in Ukraine.

THE HELIOSPHERIC MODULATION OF GALACTIC COSMIC RAYS DURING SOLAR ACTIVITY MINIMUM

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The energetic charged particle propagation in the heliosphere is considered on the base of cosmic ray transport equation. The solution of transport equation is reached in the approximation of small anisotropy of particle angular distribution. The galactic cosmic ray energetic distribution on the heliopause is supposed to be known due to results of prominent space missions (Voyager, PAMELA, AMS-02 et al.). The density of galactic cosmic ray streaming is calculated during periods of various solar magnetic field polarities. It is shown that cosmic ray heliolatitude distribution has minimum in helioequator region during periods of positive magnetic polarity. In the case of negative interplanetary magnetic field polarity the galactic cosmic ray intensity on the contrary decreases under heliolatitude increase.

TOWARDS THEORETICAL MODELLING OF DISTRIBUTION OF MATTER AT UNIVERSE

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The description of the distribution of matter (substance) in the Universe requires not only precise observations, but also adequate approaches to their theoretical interpretation.

In this paper, we propose a method for parametrizing distributions with a morphologically complex topology using structural invariants (for example, Euler), on the basis of which it is possible to distinguish clusters with different topologies (in the observation plane).

On the basis of observations, a scale scaling is established in the distribution of observed masses, which makes it possible to estimate the distribution of matter, for example, in the framework of the mean field model.

APPLICATION OF THE NEW METHOD OF INVESTIGATION THE ALIGNMENT OF GALAXIES IN CLUSTERS IN THE ABSENCE OF INFORMATION ON THEIR MORPHOLOGICAL TYPES

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The analysis of the distribution position angles of the galaxy major axes, as well as two angles describing the spatial orientation of galaxy plane gives information about orientation of galaxies in space and galaxy angular momenta. Such investigations give us a standard test of the scenarios of galaxies formation because various scenarios make different predictions concerning orientation of galaxies in structures, distribution of spins of galaxies and alignment between the brightest galaxy and the major axis of the structure. The method of analysis of the alignment of galaxies in clusters originally proposed in our previous papers was now greatly improved. The analysis the spatial orientation of the galaxies from deprojection of their images required, in classical form, knowledge of morphological types of galaxies, which is rare with modern Kilo-Degree Survey. The new version of the method makes it possible to carry out such an analysis also in the case of the absence of information on their morphological types. We present practical application of new variant of our method as well as implications of the results with reference to theories of galaxy formation.

POLAR RING GALAXIES IN THE SDSS: VISUAL INSPECTION AND AUGMENTATION

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This study focuses on the development of a training sample of galaxies with polar rings. Given the limited

number of objects available in the current sample (only 114), we propose to augment it using the GALFIT package to model the galaxies. By leveraging deep learning techniques, we aim to identify galaxies with polar rings in the SDSS dataset. We hope that our findings hold significant potential for advancing the understanding of galaxy formation and evolution.

MULTIWAVELENGTH PROPERTIES OF THE ISOLATED AGNS AT Z<0.0.05

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We present the preliminary results of a multiwavelength analysis of 2MIG isolated galaxies with AGN. 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, we estimate the contribution of different galaxy components to total emission and their mass.

DARK AGES GLOBAL SIGNAL IN THE ROVIBRATIONAL LINES OF THE FIRST MOLECULES

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The only sources of signals in the Dark Ages before the appearance of the first stars were neutral hydrogen atoms and the first molecules, which give rise to the CMB spectral distortions by emitting, absorbing and scattering in the 21 cm line and in the lines of rovibrational transitions, respectively. Signals from the first molecules are important sources of information about the ionization and thermal history of the post-recombination Universe. In our research, we aim to find out whether it will be possible to detect the CMB spectral distortions caused by the first molecules during the implementation of the proposed spectrometer concepts for space-based (PIXIE, PRISM, PRISTINE, SuperPIXIE and Voyage2050), balloon-based (BISOU) or ground-based (APSERa and Cosmo at Dome-C, TMS at Teide Observatory) missions in the near future. To do this, we calculate the contents of the first molecules by integrating the equations of the kinetics of chemical reactions in the weakly ionized plasma of the early Universe, as well as the population of rovibrational levels of these molecules for standard cosmology, as well as for cosmology with decaying dark matter particles or primordial magnetic fields that are additional sources of ionization and heating. We show that in standard cosmology the signal from the first molecules has the character of an absorption profile against the background of relic radiation, while the presence of the additional sources of ionization and heating lead to the emission of the first molecules (mainly H2). The calculated signal from the first molecules is several orders of magnitude smaller than other sources of relic spectrum distortion (e.g., μ and y distortions), but its detection is still possible due to the different angular distribution.

A NEW METHOD OF INVESTIGATION OF THE ORIENTATION OF GALAXIES IN CLUSTERS IN LACK OF INFORMATION ABOUT THEIR MORPHOLOGICAL TYPES

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The problem of the formation of structures in the universe is one of the most important issues of modern extragalactic astronomy and cosmology. The tool enabling the verification of a particular formation scenario is analysis the spatial orientation of the galaxies from deprojection of their images. Obtaining correct analysis results obliges to take into account the fact that galaxies are oblate spheroids with the real axis ratio depending on the morphological type, which, however, is not given in most of the currently available astronomical data. According to the approach used in the new method of investigation, on the basis of estimated frequencies of occurrence of given morphological types, obtained using sufficiently numerous observational data, simulations are performed, which enable to recognize new angle distributions used in orientation studies. These distributions already contain information on the frequency of the appearance of galaxies of particular morphological types in clusters, allowing for more accurate results of the statistical tests carried out during the analysis. The method is an extension of results developed in Godłowski 2012 and Pajowska et al. 2019.

EXTERNAL GRAVITATIONAL POTENTIAL OF AN INHOMOGENEOUS TORUS

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Toroidal/ring structures are present in a wide variety of astrophysical objects: dusty tori in AGNs, rings in galaxies, protoplanetary disks, etc. In this talk we present the more general case of the gravitational potential of an inhomogeneous torus with an elliptical cross section. We first show that the external potential of a homogeneous elliptical torus is well matched by that of two circles with

masses equal to half the total mass of the torus. The intriguing property is that these circles are placed at half the distance from the foci of the elliptical cross section, independent of the other parameters of the torus. The result holds for both oblate and prolate geometry. We also analyse the case of an inhomogeneous torus and find that the external potential of a torus with a confocal density distribution in its cross section is independent of the density distribution law. This implies that even for the inhomogeneous confocal case, the external potential can be represented by just two massive circles. The obtained approximation is robust as proven by the maps of residuals. This approach allows us to simplify the problems of dynamics and to more easily analyse the result of N-body simulations for the systems consisting of a toroidal structure.

THE STUDY OF X-RAY SPECTRUM OF COMA GALAXY CLUSTER

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The X-ray spectrum of the Coma galaxy cluster was studied using the data from the XMM-Newton observatory. We combined 7 overlapping observations made with XMM/MOS in region of 40′ × 40′. 196 kiloseconds of observations span scattered from 2000 to 2005 were used for the purpose of our analysis. The MOS camera spectrum was chosen due to its lower influence on instrumental lines. Background contributions of the Solar system, Milky Way, and cosmic rays were accounted to build up the spectrum. The spectrum was derived from the central region of the Coma cluster. The observed spectrum exhibits a thermal nature with a possible power-law contribution from the synchrotron emission of relativistic electrons on a turbulent magnetic field close to the central object. The spectrum was fitted with two models: a two-temperature thermal spectrum and a one-temperature thermal plasma model adjusted with nonthermal-correction. We compared the results with previous works by other authors and spectra obtained from other telescopes that operate in the same range of 1-10 keV. Careful and detailed spectrum analysis shall be a necessary contribution to our future work – searching for axion-like dark matter particles' manifestations in the Coma cluster.

THE PROBLEM POINTS OF GALAXY CLASSIFICATION WITH MACHINE LEARNING TECHNIQUES

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We present the results of our study on galaxy classification techniques using different methods including human labelling, multi-photometry diagrams, naive Bayes, logistic regression, support-vector machine, random forest, k-nearest neighbors, and deep learning. We have achieved a high accuracy above 95% for morphological classification of SDSS_ galaxies using photometrical parameters and images. However, we have observed spread errors in our machine learning methods, which have resulted in incomplete classification. In this talk, we will discuss the problem points of supervised machine learning and labelling bias that contribute to these errors. Our findings have significant implications for improving the accuracy of galaxy classification and understanding the limitations of machine learning methods for this task.

ASTROPHYSICS

(stellar atmospheres, interacting binary systems, variable stars)

NEW KINEMATIC MODEL OF THE GALAXY: ANALYSIS OF THE STELLAR VELOCITY FIELD FROM GAIADR3

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This work presents the results of a kinematic analysis of the Galaxy that uses a new model as applied to the newest available Gaia data. We carry out the Taylor decomposition of the velocity field up to second order for 18 million high luminosity stars (i.e., young OB, giants and subgiants) from the Gaia DR3 data. We determine the components of mean stellar velocities and their first and second partial derivatives (relative to cylindrical coordinates) for more than 28 thousand points in the plane of our Galaxy. We estimate Oort's constants A, B, C, and K and other kinematics parameters and map them as a function of Galactocentric coordinates. The values found confirm the results of our previous works and are in excellent agreement with those obtained by other authors. In addition, the introduction of second order partial derivatives of the stellar velocity field allows us to determine the values of the vertical gradient of the Galaxy azimuthal, radial and vertical velocities. Also, we determine the mean of the Galaxy rotation curve for Galactocentric distances from 4 kpc to 18 kpc by averaging Galactic azimuths in the range $-30^\circ < \theta < +30^\circ$ about the direction Galactic Centre – Sun – Galactic anticentre. Maps of the velocity components and of their partial derivatives with respect to coordinates within 10 kpc of the Sun reveal complex substructures, which provide clear evidence of non-axisymmetric features of the Galaxy. Finally, we show evidence of differences in the Northern and Southern hemispheres stellar velocity fields.

CATALOGUE OF THE PARAMETERS OF POORLY STUDIED BINARY SYSTEMS: EB

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The β Lyrae eclipsing binary systems are excellent natural space laboratories with a variety of physical processes taking place in them. They exhibit periodical (primary and secondary) eclipses due to the orbital motion. Phenomenological parameters from the analysis of phase curves are important for further physical modeling, statistical studies and test of structure and evolution of these fascinating objects. Besides, some stars exhibit evidence for additional physical mechanisms like solar-like giant spots or period variations due to a presence of the third body, or the mass transfer from more evolved star to another.

We have analysed observations of 50 stars of this type, using published open databases of the photometrical observations from ground-based (AAVSO, ASAS-SN, ZTF, NSVS, SuperWASP) and space (TESS) observatories, whenever available. For many of these stars, the photometrical elements (period, initial epoch, brightness at both minima and maxima, duration of eclipse) are still incomplete or even absent in the "General Catalogue of Variable Stars".

The analysis was made using few algorithms:

a) the periodogram using a trigonometric polynomial (1994OAP.....7...49A, 2003ASPC..292..391A) of intermediate order s=4 (sometimes, for narrower eclipses, s=6) to determine the period; b) the NAV algorithm (2012Ap.....55..536A, 2016JPhSt..20.4902T) for a "global" approximation and corresponding parameters; c) the MAVKA software (http://uavso.org.ua/mavka) for the determination of "ToM" (Times of Minima) for "continuous" parts of the data, or, its improved version, for seasonal phase curves.

STUDYING THE VARIABILITY OF PULSATING STARS USING STATISTICALLY OPTIMAL MATHEMATICAL MODELING

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A set of algorithms and programs was used to study changes in the brightness of semi-regular variable stars. The most efficient approximation is by a trigonometric polynomial of a statistically optimal order. For quasi-periodic variations, one can use wavelet analysis with adaptive determination of the effective width or scale-gram analysis followed by local weighted approximation with optimal width. For stars with multicomponent variability (such as RV Tauri), the periodograms were calculated using the least squares approximation of the signal by a sinusoid. For stars of the SR type, the "Running parabolas" approximation was also carried out. The mean light curves were plotted and analyzed for the period values that correspond to the peaks in the periodograms.

BZ CAM: VARIABILITY OF THE NOVA-LIKE VY SCL-TYPE CATACLYSMIC VARIABLE FROM MINUTES TO DECADES

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BZ Cam is one of the brightest cataclysmic variables, and thus is well observed. It exhibits variability at different time scales of seconds, minutes, hours and months.

For the analysis, we have used the observations obtained by S.V.Kolesnikov at the 2.6m telescope ZTSh (named after Prof. G.A.Shain) of the Crimean

Astrophysical Observatory, Ukraine, using the fast photometer-polarimeter. BZ Cam was one of a sample of cataclysmic variables, which were studied for a fast variability. At this survey, the fractal-type variability of another star, a polar AM Her, was detected, which ranges in a wide time-scale from 3 seconds to 30 years (1997OAP....10...15A). For this and other other stars, including BZ Cam, the "sigma-scalegram" analysis (1997A&AS..125..207A) was made.

All of them showed flickering, or the "red noise" at a periodogram. These data were re-analysed.

To study long-term variability, we have used the multi-color CCD observations from the international AAVSO database (http://aavso.org). The most numerous data are in V (*n*=8934). We have used the following methods: the periodogram analysis using the "sine+zero level" approximation (1994OAP.....7...49A, 2003ASPC..292..391A); the "sigma" (1997A&AS..125..207A) and "Lambda" (2003ASPC..292..391A) scalegram analysis. The software MCV (http://uavso.org.ua/mcv/MCV.zip) and MAVKA (http://uavso.org.ua/mavka) was used, respectively. The object has a monthly-scale weakening to ~14mag.

The photometric period significantly differs from the spectroscopis (orbital) one arguing for the model of the "negative superhumps" often seen in nova-like cataclysmic binary systems, e.g. 2009A&A...496..765K.

COMPARISON OF PHOTOGRAPHIC V MAGNITUDES OF STARS OBTAINED FROM THE PROCESSING OF SCANS FROM THE ARCHIVES OF THE SCHMIDT TELESCOPES IN BALDONE AND TAUTENBURG

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This work was performed in order to evaluate the accuracy of two methods for photometric processing of scans of digitized astronegatives. Each of the methods was developed for different arrays of observations that were performed in the V Johnson photometric system. In the first method, an empirical characteristic curve is used to construct the characteristic curve of the astronegative. This curve changes its contrast and zero point for each specific astronegative in the process of reducing the instrumental stellar magnitudes m to the V Johnson system. The first method was used to process an array of 2,200 astronegatives that were exposed in the V band at the 1.2m Schmidt telescope of the Baldone Observatory. Another reduction method was used for the array of observations that were made in the V band on the 2m Schmidt telescope of the Tautenburg observatory. For its application, the g magnitudes of the GAIA DR2 catalog of the GAIA space mission were first transformed into the V magnitudes of the Johnson system, and only then were they used to construct the characteristic curve. According to the second method, an array of scans of 500 digitized photographic plates was processed. Based on the processing of two arrays of observations, two catalogs of equatorial coordinates and V magnitudes of stars and galaxies were created. The first and second catalogs contain information on 21.5 million and 2.7 million objects, respectively. The paper compares the magnitudes of common objects that were registered on processed scans of astronegatives of two glass film archives. The comparison of V magnitudes for 332,227 common objects gave the following result: the root mean square error of the differences of stellar V magnitudes reaches the value $\sigma V = 0.46$m.

A NOVEL RUNNING SINE APPROXIMATION PROGRAM VOB WITH ENHANCED ACCURACY AND TREND ANALYSIS. APPLICATION TO SEMI-REGULAR DISCRETE SIGNALS

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We present "VOB": a program, that introduces a dynamic running sine approximation technique paired with linear trend analysis. At the heart of VOB lies a sophisticated algorithm leveraging the meticulously calibrated filter half width (Δt) to achieve best accuracy in central point estimation. Building upon the established "Running sines" (RS) algorithm scrutinized in 2013CKA....10..171A, VOB brings forth three significant advancements: 1) incorporation of the versatile weight function *p(z)*, drawing from the extensive expression library in 1997A%26AS..125..207A; 2) determination of a statistically optimized Δt; and 3) integration of linear trends into the sine approximation process.

VOB's methodology centers on localized intervals $[t_0-\Delta t,\ t_0+\Delta t]$ for approximation, aided by the additional weight function p(z) governing data point influence. The dimensionless parameter $z=(t-t_0)/\Delta t$ goverrns *p(z)*, ensuring robust representation while disregarding contributions beyond $|z|>1$. Diverse *p(z)* profiles, from rectangular to intricate forms like $(1-|z|^{\alpha})^{\beta}$, are harnessed, with "tri-cubic" ($\alpha=3$, $\beta=3$) and "quadro-square" ($\alpha=4$, $\beta=2$) functions newly added to an usual “bi-square” ($\alpha=2$, $\beta=2$). These variants prevent infinite second derivative jumps inherent in the "running" approximation with a rectangular window ($\alpha\to\infty$).

Central to VOB are comprehensive output parameters: 1) Δt, the filter half-width; 2) three sinusoid parameters; 3) trend slope; and 4) error estimates for optimal Δt-based coefficients. Rigorous testing probes various *p(z)* functions, enhancing insights into their effectiveness.

VOB excels in scenarios with pronounced trends and limited variability cycles. In shorter observation intervals, increased scatter unveils intriguing elusive trends.

VOB's testing encompasses two signal types extracted from unevenly spaced data: 1) sine waves with constant and variable periods alongside noise; and 2) a curated Mira-type star R Ori subset from the AAVSO database. VOB's robustness extends its applicability to other stars in photometric surveys.

In conclusion, VOB introduces an era of accurate, trend-aware approximation through its refined algorithm and weight function integration. With meticulous methodology and insightful analysis, VOB promises to uncover hidden patterns and open new dimensions in astronomical research.

VARIABILITY OF THE INTERMEDIATE POLARS V405 AUR AND RX J2133.7+5107

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We report the results of long-term CCD photometry of the magnetic cataclysmic variables V405 Aurigae and RX J2133.7+5107 obtained using different instruments. We analysed variability of the spin period of the white dwarf in V405 Aur. We confirmed one of the 2 hypotheses of the spin period variability of this system published earlier. This system shows us a spin period increase and decrease during a couple decades of observations thus belongs to the list of the intermediate polars with complicated changes of spin period. On RX J2133.7+5107 using data taken during 2007-2022 (15 yr), 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 $1.511(3)\cdot 10^5$ yr. The observed rate of spin-up is even faster then reported by de Miguel et al. (2017) and one of the fastest of all known intermediate polars. We confirm the presence of superhumps and studied the changes of superhump period. Also we report a presence of complicated changes of (O-C) with a period of about 7 years, that may be interpreted either as fluctuations around the equilibrium period.

TOWARDS AN UNDERSTANDING OF THE NATURE OF MASSIVE FAST-ROTATORS

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The origin of fast rotation in massive stars remains debated, although binary interactions are now often advocated as a cause. In our work, we examine this question from different angles. First, we analyze a large population of Galactic fast rotators, weighting the overall need for binary interactions (by using Gaia, TESS, and multi-epoch spectroscopic data). Second, we report on the discovery of further short-period binaries containing fast rotators, using photometry and spectroscopy. The nature of these systems is then constrained, which provides additional information on the origin of fast rotation. Finally, we model these systems and other previously known cases using MESA with different initial conditions in order to evaluate possible evolutionary paths that can explain their present appearance and unveil the role of a common envelope phase in their lives.

CATALOGUE OF MAIN CHARACTERISTICS OF PULSATIONS OF 173 SEMI-REGULAR STARS. II

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We report on the continuation of the Catalogue of Main Characteristics of Pulsations of 173 Semi-Regular Stars published in 2000 in the “Odessa Astronomical Publications” (2000OAP....13..116C) based on new data obtained during these two dozens years either visually (the aavso.org international database), or at ground-based (ASAS-SN, ZTF, NSVS) or space (TESS) observatories. Observations of some previously neglected stars were included.

Various methods of the analysis were used using own software: the periodogram analysis using the complete “sine + zero level” approximation (1994OAP.....7...49A), “running sine” (RS, 2013CKA....10..171A) and “running parabola” scalegrams and optimal fit (1997A&AS..125..207A). The characteristics of the individual extrema were determined using the software MAVKA (2020JPhSt..24.1902A). All algorithms were reviewed in 2020kdbd.book..191A .

This work is a part of the “Inter-Longitude Astronomy” (ILA, 2003A&AT...22..793A, 2014AASP....4....3A), “Ukrainian Virtual Observatory” (2012KPCB...28...85V) and “AstroInformatics” (2017IAUS..325..361V).

PERIOD ANALYSIS OF THE SEMIREGULAR VARIABLE STAR RX LEPORIS?

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In this work, we present the periodogram and wavelet analysis of the semiregular variable star RX Leporis based on AAVSO database and photometry data analysis from TESS space telescope The object of our research, RX Lep, is an oxygen-rich semiregular pulsating variable star of the SRB type, spectral class M6III, in the early phase of the asymptotic giant branch.

In the first part of the work, we performed periodogram and wavelet analysis from the data of the AAVSO database. In total, we analyzed 75 years of observations of RX Lep from the AAVSO database using the VStar program. Utilizing the Fourier series method, we managed to find different periods of RX Lep oscillations.

In past studies of RX Lep shorter period was previously determined. A period of 79.54 days is specified in the AAVSO database, and two additional periods of 90.1 and 101.7 days are mentioned in the article "Long-term photometry and periods for 261 nearby pulsating M giants". However, based on periodogram analysis, we found that there is one common period that can vary from ~80 to 100 days. Moreover, according to processing and analysis data from the AAVSO database, we detected a longer period that was unknown in earlier studies. We also determined that this period varies from ~500 to 780 days. We constructed phase curves and calculated an error for each of the periods.

In the last part of the study, we analyzed the photometric data of RX Lep from the observations of the TESS space observatory. Using the Makulsky archive for space telescopes, we downloaded data from sectors 5 and 32. Due to the fact that TESS has quite accurate data, we

discovered chaotic pulsations with a small amplitude. In addition, we found periodic flashes with a period of 3 days based on the photometric data of the TESS telescope.

DOPPLER TOMOGRAPHY OF THE CIRCUMSTELLAR DISK OF THE BE STAR K DRACONIS

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κ Dra is a binary system and a classical Be star. It exhibits strong emission lines, notably a double-peaked Hα line with radial velocity (RV) and peak intensity (V/R) ratio variations phase-locked with the orbital period P = 61.55 days. Among binaries demonstrating the Be phenomenon, κ Dra stands out as one of the few systems with a discernible mass for its secondary component.

Abundant spectroscopic data collected in 2013-2023 enabled us to extract physical parameters of the system. Based on those and the mass function we employed Doppler tomography method to investigate regions emitting Hα line in the circumstellar disk of the system. The results show non-uniform ring form of the disk with a prominent hot spot at Vy ≈ 100 km·s^{-1} and Vx ≈ -50 km·s^{-1} that corresponds to a dense cloud-like source of the double-peaked Hα line. We argue that this spot's motion is the source of Hα V/R ratio periodic variations that are syn-phased with the RV of absorption lines from the atmosphere of the main component, but counter-phased to the RV of the Hα line itself, indicating that from a central mass perspective, the circumstellar disk's hot spot moves in opposition to the primary star's direction, while aligning with the motion of the secondary star.

CATALOGUE OF THE PARAMETERS OF POORLY STUDIED BINARY SYSTEMS: EW:

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We have analysed 47 binary systems of the suggested type EW: i.e. the W UMa – type stars with yet doubtful classification in the recent electronic "General Catalogue of Variable Stars" (GCVS).

Physically, these are gravitationally coupled binary stars, which are close enough to be not only gravitationally distorted, but to form a "dumbbell-like" structure, which corresponds to an equipotential surface exceeding the famous Roche lobe. Such systems often show physical variability due to the O'Connell effect (presence of magnetically driven spots) and exhibit period variations due to a mass transfer from one component to another.

However, For the systems we have chosen, even the main phenomenological and physical parameter – the orbital period is still not known. The preliminary periodogram analysis was made using a trigonometric polynomial (1994OAP.....7...49A, 2003ASPC..292..391A) of low order s=2 with a subsequent correction either the period, or the form, using more harmonics and the NAV algorithm (2012Ap.....55..536A).

The obtained parameters will fill the gaps in the catalogues of variable stars on these stars.

THE NEW APPROACH TO THE LIGHT CURVE ANALYSIS OF RR LYR TYPE PULSATING STARS WITH BLAZHKO EFFECT

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We discuss the results of the new approach for the analysis of the long-term dense series of observations of RR Lyr type pulsating stars with Blazhko effect. The standard way, namely the frequency analysis of the O–C values for the times of maxima does not allow for to detection of the complex nature of the periodic changes in the shape of the light curves, including bi-cyclicity. We have shown the perspectives of a new approach on the example of the analysis of FI Sge observations containing total of 55 observational nights during a period of five years. (AZT-3 Telescope, Mayaki Observational Station, SRI "Astronomical Observatory", I.I. Mechnikov ONU)

Our results show that in order to understand the features in the shape of the light curve variations for RR Lyr type pulsating stars with Blazhko effect, it is necessary to have data for full cycles of variability over a long time, and not just the moments of maxima.

MULTIWAVELENGTH RESEARCH OF THE FAST AND SLOW VARIABILITY OF SYMBIOTIC VARIABLES PU VUL, RT SER AND CH CYG

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We analyzed the UBVRI observations made in Astronomical Institute of Slovak Academy of Sciences as well as AAVSO multicolor observations and other archival data for symbiotical variables PU Vul, RT Ser and CH Cyg.

For symbiotic nova RT Ser, the orbital period of 4520□50 days was clarified and the cycles of the variability of 160, 306, 766-68 were found, some of them could be due to pulsation variability of red giant.

For symbiotic nova PU Vul we have found for the first time, that the pulsational period of red giant increase from about 210 to 222 days during the 50-year period of observations. We also found that the pulsational variability breaks its regularity in some time interval with non-stable cyclicity which can be correlated with orbital motion. We also analyzed parameters of the eclipses in this system was analyzed. We identified long-period brightness wave (especially iin R-band and R-I color index) with a cycle close to the orbital period and we suggested that it is being caused by varying visibility conditions (during orbital motion) of partially optically thick nebula ionized by the hard radiation from the white dwarf.

For symbiotic variable CH Cyg we searched for variability on timescale of hours and analyzed flickering properties by using long series of observations during several dozens of nights.

DETERMINATION OF TEMPERATURE OF CENTRAL STARS' OF CHOSEN PLANETARY NEBULAE

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Some spectra obtained for planetary nebulae on the European Southern Observatory's Extremely Large Telescope were selected, the processing was accomplished using the DECH30 program and the flux was determined in the Hβ emission line. Then, on the basis of F(Hβ) the temperatures of the central stars of these nebulae were calculated by the Zanstra method. During the calculation, the extinction was taken into account for F(Hβ) in the interstellar medium. The obtained results were compared with the temperatures calculated by other researchers, and it was determined that the values of temperature differed very little.

THE Hα AND Hβ LINES IN THE SPECTRUM OF CH CYG IN 2016

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We present the results of spectral observations of the symbiotic star CH Cyg, carried out at the Cassegrain focus of the 2-m telescope of the ShAO named after N.Tusi, by using the Shamakhy Fiber Echelle Spectrograph (ShAFES). The spectra of star CH Cyg were obtained with the spectral resolution of R = 28000, between June and November 2016. We also present the results of the comparative analysis of the brightness curve of the star with the main parameters of Hα and Hβ emission lines. During the observation period, both lines exhibited changing profiles characterized by complex structures, predominantly with double peaks. The ratio of the intensities of the blue and red components was typically V/R < 1 for the Hα line and V/R ≥ 1 for the Hβ line. A quasi-period of 241 days was found in the variation of the equivalent widths of Hα and Hβ emission lines as well as in the intensities of their components.

MANIFESTATION OF STELLAR EVOLUTION IN METAL-DEFICIENT STARS

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Metal-poor stars allow us to establish the early history of the Milky Way, but the stars on advanced evolution stage (e.g. giants, AGB stars etc) allow us study of peculiarities of stellar evolution at low metallicity. On the base of spectra obtained using echelle-spectrograph fibre-fed HRS by Southern African Large Telescope (SALT, 11 m) in 2018 - 2020, the atmospheric parameters and elemental abundances of four metal-poor star HE 1523-0901, HD 6268, HD 121135, and HD 195636 ([Fe/H] ~ -1.5 – -3.0) have been studied. The iron abundance was determined based on the equivalent widths of lines. The carbon abundance was obtained by the molecular synthesis fitting for the region of CH (4300-4330 ÅÅ). The relationship between the chemical enrichment of stars and their stellar evolution was considered. It may be associated with the processes of mixing inside the stars, the mechanisms of matter transfer during the course of stellar evolution.

TWO TOOLS FOR ESTIMATING STAR CLUSTER PARAMETERS

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A star cluster is a composition of stars held together by the overall gravitational field of the whole cluster. The stars of a given cluster are born in a giant molecular cloud, and as such, can be regarded as objects with almost equal ages. Furthermore, assuming that the initial material in the cloud is perfectly mixed, we may also say that the metallicity of all cluster members is the same.

Four parameters (distance, extinction or reddening, age, and metallicity) are standardly used to describe star clusters. Their knowledge is essential for studying galaxies' local and global properties (especially our own Galaxy). However, deriving these parameters may take time and effort. Thanks to the Gaia mission\'s parallax measurements, we can determine the distances of stars (and clusters) within our Galaxy with unprecedented precision. Therefore, we can remove the distance from the list of free parameters.

We developed two different tools for estimating cluster parameters:

– Metalcode (https://github.com/mpiecka/metalcode): an automatic tool focused on deriving metallicities of open clusters.

– Stellar Isochrone Fitting Tool (StIFT, https://github.com/Johaney-s/StIFT): a tool for fitting a grid of isochrones for any photometric system available.

We present both tools with examples of star clusters and Galactic field stars.

TESS SURVEY AND THE MYSTERY OF AN ELUSIVE ECLIPSING VARIABLE STAR NQ HERCULIS

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The star NQ Her = HD 166801 was claimed to be a variable of Algol type in 1936 by C. Hoffmeister. Since then, however, the evidence of its variability has been contradictory. Currently, the star is listed as a CST (non-variable star) in GCVS. However, a light curve for NQ Her from the Transiting Exoplanet Survey Satellite (TESS) shows one well-defined minimum, which undoubtedly indicates that the star is indeed an eclipsing binary.

Combining the TESS data with the data from other surveys and visual observations from the AAVSO International Database, the author approved the nature of the star's variability and defined the light curve elements. In December 2020, the updated star's characteristics were published in the AAVSO International Variable Star Index (VSX).

STUDY OF GRB 221009A AFTERGLOW AT THE LISNYKY OBSERVATIONAL STATION

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GRB 221009A – hyper-luminous, long-duration gamma-ray burst (GRB) detected by Neil Gehrels Swift Observatory on October 9, 2022 and classified as the brightest GRB ever detected. In this work, we are presenting the results of our observations and photometric analysis of GRB 221009A at the Lisnyky observational station, as a part of international GRANDMA network (Global Rapid Advanced Network Devoted to the Multi-messenger Addicts). We observed the optical afterglow of GRB 221009A on AZT-8 with Moravian-C4 16000 CCD camera, in Johnson-Cousins R and I filter. Our first observation was obtained on 2022-10-10: 1.223 days after the trigger of Gamma Ray Burst Monitor and the Large Area Telescope of the Fermi observatory. Overall, we obtained 371 images in R filter and 165 images in I filter. During this time, the brightness of GRB 221009A afterglow decreased from 18.31^m to 20.48^m in the R filter and from 18.14^m to 20.13^m in the I filter. The photometric error varies from 0.03^m to 0.46^m (R filter) and from 0.01^m to 0.98^m (I filter). We estimated physical parameters of GRB 221009A based on empirical correlations for long-durational gamma-ray bursts, using peak energy value: Ep = 1060 keV, reported by GCN CIRCULAR 32668. Based on obtaining best fit parameters for the light curve approximations in X-ray and optical band, using afterglowpy top-hat, gaussian core, gaussian, power law, smooth power law and cocoon jet models and redback code for MCMC (Markov Chain Monte Carlo) modelling, we obtained values of parameters connected to structured jet and cocoon, as well as microphysical parameters. Now we are working on a different method of modelling, which is going to improve our results and allow us to use a wider range of models. Additionally, we calculated some parameters connected to the possible progenitor and central engine of this gamma-ray burst.

SPECTRAL OBSERVATIONS OF THE ALGOL – TYPE BINARY STAR δ LIBRAE

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The results of spectral observations of the Algol-type binary star δ Lib are presented. The behavior of Hα and Hβ lines in the star's spectrum during the orbital period phase is described. Based on our measurements of the radial velocities of the Hα and Hβ lines and using published data, the radial velocity curves of both components of the δ Lib system were constructed. In some phases of the orbital period, an absorption component was detected in the blue, or red, part of the Hα and Hβ line profiles. The observed Hα and Hβ absorption lines are attributed to the main component of the binary system δ Lib. It is assumed that the appearance of absorption components at these lines is associated either with suspicion of a third component in the system, or at these phases of the Hα and Hβ lines, the primary and secondary components of the δ Lib system are observed simultaneously.

FUNDAMENTAL PARAMETERS OF SUPERGİANT STAR HD40589(A0IAB)

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The atmosphere of HD40589(A0Iab) supergiant star of A spectral class was studied using the model and parallax methods. The effective temperatures T_{eff} and surface of gravity g of star was determined based on a comparison of the observed and theoretically calculated values of the photometric quantities [c_1], Q and the equivalent widths of the spectral lines of the hydrogen Balmer series and the using of parallax:

T_{eff}=10750±150, logg=1.65±0.2.

Based on the FeII lines the microturbulence ξ_t and the metallicity [Fe/H] were determined: $\xi_t = 4.4 \pm 0.5$ km/s, [Fe/H]= – 0.10.

In the atmospheres of the star HD40589(A0Iab), the metallicity is close to the metalicity in the Sun. This result is important from the point of view of the chemical evolution theory of the stars.

CATALOGUE OF THE PARAMETERS OF POORLY STUDIED BINARY SYSTEMS: EA

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Eclipsing binary systems are the main sources of the physical characteristics of stars. The Algol-type objects (EA) are physically characterised by smaller relative radii of the stars, At this stage of evolution, the mutual gravitational influence is relatively small, so the parameters do not differ significantly from that of single stats of the same mass and chemical composition.

For our analysis, we have chosen 69 objects.

The data are based on the electronically published databases ASAS-SN, ZTF, et al,

Because of the suggested narrow minimum, the preliminary periodogram analysis was made using a

trigonometric polynomial (1994OAP.....7...49A, 2003ASPC..292..391A) of high order s=8 with a subsequent correction either the period, or the form, using more harmonics and the NAV algorithm (2012Ap.....55..536A). For more accurate determination of the parameters, the "New Algol Variable" (NAV) algorithm (2012Ap.....55..536A) was applied.

Some of the objects were confirmed as the EA, some show periods like 1d, 4d and narrow eclipses, what prevented previous authors to catch the minimum. The preliminary periodogram analysis was made using a trigonometric polynomial (1994OAP.....7...49A, 2003ASPC..292..391A) of high order s=8.

One of the stars, GU Lup, was re-classificated as a pulsating variable of the RR Lyrae – type, namely, RRab. The period was found to be P=0.71497d, ranging from 15.07 to 16.29 mag. The phase light curve is highly asymmetric (M-m=0.15). The light curve is best approximated by a trigonometrical polynomial of intermediate order s=4.

SUBSTRUCTURES IN PROFILES OF DIFFUSE INTERSTELLAR BANDS

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Diffuse interstellar bands discovered by Heger (1922) in the spectra of stars remain a mystery to researchers today. Despite attempts to identify carriers of DIBs, the nature of their origin is generally not known for certain. An important role in the search for a carrier is played by the determination of laboratory wavelengths of DIB. However, the issue of determining the wavelength of DIB, as well as applicable to stellar lines, is not at all a trivial task due to the complexity of the band shape. Here we are faced with the question – what is considered the center of the band? And is it generally correct to single out the only center of the band? Profiles of band often represent a complex structure consisting of apparently several separate components more or less separated in the spectrum.

Naturally, with this approach, we must have high-quality spectral material with high resolution in order to be able to separate the components. And also with a high S/N, since sometimes the noise fluctuations become commensurate with the magnitude of the substructure.

We focus solely on star spectra passing through a single molecular cloud to negate Doppler splitting effects. Additionally, the spectrum used to determine the band's laboratory wavelenght is adjusted to the rest wavelength velocity scale to prevent extra shifts due to cloud motion-related Doppler shifts. For this, atomic interstellar lines or lines of simple molecules are used, the wavelengths of which we know exactly. In this case it is Na I 5797 Å.

Several spectra of stars (HD 145502, HD 147889, HD 147933, HD 179406) were selected that fit us according to listed above criteria, and for one of these stars HD 147933, the wavelengths of substructures were determined for several known 5797 Å6196 Å, 6379 Å, 6613 Å.

SPECTROSCOPIC STUDIES OF STARS IN THE POLARIS FIELD

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The results of spectroscopic studies of 17 stars in the Polaris field are presented here. The obtained data on the radial velocities and the atmosphere parameters of these stars in combination with the data on their distances from the Gaia DR3 catalog make it possible to determine which of these objects can belong to the so-called "Polaris open cluster" and which can belong to field stars.

RADIOACTIVE ELEMENTS IN STELLAR ATMOSPHERES. A QUANTITATIVE INVESTIGATION OF PROMETHIUM ABUNDANCE.

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All known 34 promethium isotopes are radioactive with short decay times. The longest half-life time has the isotope 145. It is 17.3 years. The studies of promethium absorption lines in stellar spectra showed that the detection of promethium is possible in red supergiants (PMMR23, PMMR46, PMMR144) and in hot magnetic peculiar stars (HR465, HD25354).

The existence of promethium in red supergiants that have undergone a certain path of evolution can be explained by nuclear processes in these stars.

We report the identification of promethium lines and the calculation of promethium abundances in the atmospheres of red supergiant in Magellanic Clouds and in hot peculiar stars of our Galaxy.

SOLAR SYSTEM AND SPACE ENVIRONMENT

ON ASSESSMENT OF LUNAR SURFACE TEMPERATURE

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Thermal correction of spectra is an essential step in the reduction of spectrophotometric observations of the lunar surface at wavelengths > 2.5 μm. This requires an assessment of the surface temperature. Shkuratov et al. (Planet. Space Sci. 2011, 59, 1326) proposed determination of the equilibrium temperature of the Moon\'s surface, taking into account the dependence of emissivity on the emergence angle and wavelength. We applied this technique to estimates of the surface temperature of the Aristarchus crater area using data from the Chandrayaan-1 M3 spectrometer. The albedo and angle between the local surface normal and the direction to the Sun were used for the modeling. The original photometric correction of the M3 data was preserved. Comparisons were made with the temperature map assessed with the model used by Clark et al. (Science 2009, 326, 562), which is based on the assumption that the emissivity of the Moon equals 1 (the black body approximation). The results show systematically lower temperature (in 2-7oK) that is more expressed for the regions with larger incidence angles and higher albedo for Shkuratov's approach. In the model used, the equilibrium temperature depends primarily on the angle of incidence of the Sun\'s rays. While the model of Clark et al. (2009) shows a more pronounced dependence on the surface albedo, probably due to the effect of uncompensated albedo. The resulting difference is important for reconstruction of reflectance spectra in the 2.6–3.0 μm region, where the H2O/OH absorption bands are located.

PHOTOMETRY OF SMALL ASTEROIDS OF DIFFERENT FAMILIES AND DYNAMICAL GROUPS WITH A SHORT ROTATION PERIODS

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We present photometric observations of 25 small asteroids belonging to different families and dynamical groups. From the observed lightcurves we obtained rotation periods, and lightcurve amplitudes for each asteroid, as well as their V-R color index, absolute magnitudes, and revised albedo based on newly determined absolute magnitudes. For three of these objects, our determinations provide new results. Additionally, we estimated the diameters of four of the asteroids. The short rotation period and small amplitude of the observed lightcurves suggest the possibility of further searches for binarity and more detailed studies of rotation properties within these families. By analyzing the observed parameters, color indices, absolute magnitude, and revised albedo values, along with color indices of asteroid data obtained from SDSS and Sky-Mapper surveys, we can effectively classify taxonomically members of asteroid families and background asteroids.

LIGHT CURVE ANALYSIS OF MAIN BELT ASTEROIDS WITH EARTH MOID LESS THAN 1AU

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The main belt asteroids with Earth MOID less than 1AU were studied at the Baldone Astrophysical Observatory in the time span range 1999-2023. The obtained light curve data together with published MPCs data are analyzed with Fourier series, Lomb-Scargle periodogram, and Phase dispersion minimization methods. A plan of analysis is given. The results computed from different observatories' data are compared and mean-weighted periods are obtained.

THERMAL DESORPTION OF THE DUST PARTICLES MATTER NEAR THE SUN. DATA ANALYSIS OF METEOR OBSERVATIONS AND THEIR INTERPRETATION

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The main aim of the researches is to identify the effects of the Sun's thermal influence on the physical and chemical properties of meteoroids with perihelion distances q < 0.1 AU.

A statistical and quantitative analysis of the meteors observations database with brightnesses from -5^m to $+5^m$ that corresponds to the range of meteoroid masses from 0.001 g to 10 g was carried out. We compared the masses of meteor bodies recorded in the Earth's atmosphere in the sections of their trajectories before and after passing through the near-solar region. This makes it possible to evaluate the effect of the Sun's thermal influence on the physical and chemical properties of meteoroids.

It was found that the masses of meteor bodies that registered after passing perihelion in the Earth's

atmosphere are systematically ~ 1 – 6 g smaller than the masses of particles that were just moving towards the Sun. This is confirmed by the model calculations according to the kinetic theory of dust evaporation near the Sun.

Observations of meteors show a significant decrease in the number of meteor bodies at the heliocentric distances q < 0.087 AU (~19 $R_\odot$) and there are almost no meteoroids in the statistical sample at the distances less than 4 $R_\odot$. This result is completely consistent with the conclusions of the researches using the NASA Parker Solar Probe (PSP) spacecraft about the existence of a zone of dust concentration reduction between 19 $R_\odot$ and 3 $R_\odot$.

The model calculations according to the kinetic theory of dust evaporation showed that the main number of meteor bodies partially or completely sublimes in the interval of the heliocentric distances of 0.03 – 0.07 AU. Thermal desorption of meteoroids as they approach the Sun is a selective evaporation of matter.

ASSESSMENT OF THE ASTROCLIMATIC CONDITIONS OF THE OBSERVATION COMPLEX AT THE INSTITUTE OF ASTRONOMY OF KHARKIV NATIONAL UNIVERSITY

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The article is devoted to the comparison of modern astroclimatic conditions (light pollution and the number of cloudless nights) of 14 Ukrainian astronomical observatories. The aim of the work is to assess the prospects for further development of the observational complex of the Chuhuiv Observational Station (COS) at the Institute of Astronomy of Kharkiv National University (IA KNU). The level of light pollution at the selected observation stations is studied using the Global Light Pollution Map databank. The Weather Archive database is used to analyze the statistics of cloudless skies at these locations. An independent measurement of the integral brightness of the sky background is carried out using a portable integrated photometer. It is found that, in terms of light pollution, the COS of the Institute of Astronomy has the most favorable conditions for astronomical observations among other observatories in Ukraine. The results of measurements of the integrated brightness of the sky background at the COS of the Institute of Astronomy using a portable integrated photometer showed a rather dark sky background for a plain observatory; the levels of indicators are similar to the Crimean Astrophysical Observatory. A selective analysis of the weather archive database for the period 2017–2019 for the southern, western, eastern, and central regions of Ukraine showed that, on average, the statistical indicators of cloudless skies in these locations differ little. Taking into account the results of astroclimatic studies and the absence of sources of significant light pollution at distances of 15…20 km from the COS (and the low probability of their appearance in the near future), it can be concluded that it is advisable to modernize the observatory complex of the IA KNU, in particular, to build a modern telescope of 1…2-m class on its territory.

RESULTS OF OBSERVATIONS OF ASTEROID (248370) 2005 QN173

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The results of observations of asteroid (248370) QN173 obtained during July 2021 – January 2022 are presented. The direct images of the asteroid were obtained with broad-band filters with the help of three telescopes. The spectrum of the asteroid closely matched that of a C-type asteroid. The asteroid demonstrated a redder color compared to the Sun. The changes in dust productivity were not detected. The $g - r$ color changes from 0.2^m to 0.7^m over the coma, and the linear polarization degree varies from about 1.2% to 0.2% and from −0.2% to −1.5% at the phase angle of 23.2◦ and 8.16◦. The total dust mass ejected until the latest observation on October 10 is 4.2×10^7 kg, with a maximum rate of 2.6 kg s^{-1} based on the Monte Carlo modeling of the dust tail. The estimated asteroid nucleus size is 1.3 km. The evolution of (248370) QN173 orbit and the orbits of the sample of the 464 short-periodic comets were followed.

LUNAR OPPOSITION EFFECT EXPLORATION USING LROC NAC DATA

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The lunar opposition effect (LOE) reveals itself by the sharp increasing of surface brightness as the phase angle tends to 0°. Two light scattering phenomena as potential physical mechanisms of LOE are discussed as most probable: (1) shadow – hiding effect at microtopography scale as the result of incoherent multiply scattering, and (2) the coherent backscattering enhancement. The wider

surge is controlled by shadow-hiding effect, whereas narrow one is caused by coherent backscattering. Direct observations of the LOE are complicated by the phase curve flattening due to the large angular radius of the Sun. The recovery of such phase function is ill – posed problem. We explored opposition surges for different sites using the LROC NAC data focusing on magnitudes of phase curves and their dependences on surface albedo.

The phase ratio technique was utilized by division the zero-phase image and image at bigger phase angle. After albedo pattern suppression obtained values were averaged over zones of equal phase to obtain relative phase curves normalized on brightness at some phase angle.

Lunar opposition surge effect has been explored using LROC NAC data for nine sites with different albedo ranged from 0.1 to 0.25. It has been shown that the phase curves reveal significantly nonlinear behavior at phase angles less 0.3o for the bright surfaces. The estimated magnitude does not depend on albedo for dark surfaces but show nonlinear growth for the brightest ones. The width of opposition spike also depends on surface albedo and inversely correlates with the magnitude. Increasing of phase function slope with surface albedo at zero phase angle supports the conclusion of coherent backscattering may play important role in the formation of the LOE at least for very bright surfaces.

DETERMINATION OF THE RSO ROTATION AXIS

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The spatial density of Near-Earth artificial space bodies is growing rapidly, especially in low earth orbits, also due to miniaturization of spacecrafts and the deployment of large constellations. Active debris removal (ADR) and on-orbit maintenance missions can present a real opportunity to reduce orbital risks. However, working with a target body with a large and unknown angular momentum in order to capture can lead to various problems, including the risk of collision with the service spacecraft and the further formation of new fragments. Thus, synchronization with the movement of the target and docking with a rotating uncooperative body are complex stages of the ADR mission. These considerations show that predicting the rotational state of a target is critical to success.

Currently, a variety of observations of resident space objects (RSOs) are used to study of the state of its rotation. They include active methods such as satellite laser ranging (SLR), inverse synthetic aperture radar (ISAR) imaging, or Doppler radar measurements. However, the most promising and inexpensive way to get more information about the RSO rotation rate and the evolution of the rotation axis' direction over time is photometry, that is light curves obtained using optical telescopes.

This paper reports on the successful use of a photometric technique for analyzing the rotation of an RSO with unknown shape and estimation of the its rotation axis attitude. We use and analyze the photometric data obtained as a result of the 2020 campaign for synchronous observations of the defunct RSO Topex (COSPAR ID 1992-052A) with the participation of the observatories of Odessa, Lviv and Uzhgorod universities, as well as the light curves of the destroyed RSO Cosmos-1408 (COSPAR ID 1982-092A), obtained in June-July 2023 by the optical sensors of the NSFCTC of SSAU.

NOAP – SCRIPT PACKAGE FOR PLANNING AND ANALYSIS OF NEO OBSERVATIONS

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We present a package of Python scripts NOAP (NEO Observations Analyzer and Planner) designed for automatic planning of NEO observations, as well as analysis of already existing observations in the NEODyS-2 database. The package is divided into two parts: analyzer and planner. The analyzer automatically downloads data from the NEODyS-2 database, converts them by adding additional information, including the apparent speed of objects and observation errors along and across the track, and also provides a large amount of statistical data and graphs for the selected period. It can be done for several observatories at once. The planner also selects the objects of observation for the upcoming night and calculates their ephemeris with a given step in a fully automatic mode. The output data format of the scheduler allows its use both on semi-automatic telescopes and for fully robotic observations. NOAP has been successfully used for more than a year for planning and analysis of NEO observations by optical sensors of the National Space Facilities Control and Test Center of the State Space Agency of Ukraine.

TEST OPTICAL OBSERVATIONS OF THE COSMOS 1408 FRAGMENTS

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The non-functioning spacecraft COSMOS 1408 (NSSDCA/COSPAR ID: 1982-092A) was destroyed as a result of tests of Russian anti-satellite weapons. The huge

cloud of debris that poses a threat to other LEO objects in close orbits was generated. More than 1500 pieces of them had trackable size. Such events require rapid and immediate monitoring using all available all available means of ground tracking, both radar and optical. The results of optical test observations of some fragments of COSMOS 1408 are presented. The observations were carried out by two telescopes: OES30 of the National Space Facilities Control and Test Center of the State Space Agency of Ukraine and the FRT of the Research Institute "Mykolaiv Astronomical Observatory" in February 2022. The observations are shown that Ukrainian optical sensors are able to observe LEO space debris objects with RCS less than 0.1 sq. m. in the presence of relatively accurate ephemeris.

COLOR-INDEX DETERMINATION OF LEO SATELLITES USING COLOR IP-CAMERAS

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The study is devoted to determining the colorimetric characteristics of the structural surfaces of artificial satellites and the changes of these characteristics over time with an assessment of possible causes of a natural nature, functional state, leading to destructive phenomena in the spacecraft structure.

The satellite observations equipment consists of Canon EF 85mm f/1.8 USM photographic lens and professional VIVOTEK IP816A-HP network camera, which provides a shooting speed of up to 60 frames per second, a field size of 2 megapixels (1920x1080), a sensitivity of 0.03 lux (Color mode), 3D noise suppression in low light conditions, RBF (Radial Basis Function) system for precise focus adjustment, EIS (electronic image stabilization) to control image stability. The camera is directed to the zenith and has a field of view (4.9ºx2.8º).

Observations of satellites 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. Color-index determination based on catalogue of synthetic RGB magnitudes calibrated by high-quality photometric G, GBP, and GRP magnitudes provided by the Gaia EDR3. The stars of the reference system are in the range of 5-13 mag. Values of obtained color-index for 1 LEO satellite has accuracy about 0.3 mag.

CALIBRATING OPTICAL ASTROMETRIC MEASUREMENTS OF RESIDENT SPACE OBJECTS IN EARTH ORBIT AND TELESCOPE LOCATIONS OF THE UKRAINIAN-POLISH TELESCOPE NETWORK

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During the last ten years, the number of resident space objects (RSOs) around Earth has doubled, leading to an increased risk of collisions and also an increased number of satellite trails affecting astronomical images. The motion of RSOs is influenced by various forces, including those unrelated to gravity, making their orbit complex and variable. Regular observations of RSOs, determining their orbit, and orbital maneuvers to avoid hazardous close passes are crucial to prevent collisions between space debris and active satellites. Improving the accuracy of orbit determination and observations is essential in predicting and avoiding potential RSO collisions.

The astrometric observations in the optical range are one type of RSO observations. To verify observation accuracy, these measurements are compared to orbital products provided by International Laser Ranging System (ILRS), Doppler Orbitography and Radiopositioning Integrated by Satellite (DORIS), and International GNSS Service (IGS) services. In the analysis of residuals between the measurements and accurate orbital propagation, it is often found that the standard deviation of one measurement is comparable with the amplitude of systematic trends in residuals. This means that systematic measurement deviation is the main factor limiting observation accuracy and, as a result, limits the determination accuracy of the object's orbit.

In this presentation, we will discuss potential sources of systematic deviation trends that can affect the accuracy of measurements. We will show that not everyone's orbital ILRS prediction can be used to estimate observation accuracy. We will demonstrate that regular GPS coordinates for telescopes can cause systematic trends in measurement residuals. To address this issue, we will present an original method for deriving telescope location coordinates based on observations themselves. Finally, we will showcase a small Ukrainian-Polish telescope network example and how adjusting the telescope coordinates can lead to increased orbit determination accuracy.

ASTEROID POSITIONS BASED ON THE DUSHANBE PART OF THE FON PROJECT OBSERVATIONS

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Asteroid images identification and creation the positional catalogs based on digitized photographic observations of previous years were continued. Namely, the cooperation between Ukrainian Virtual Observatory and the Institute of Astrophysics of the Academy of Sciences of Tajikistan make it possible to expand this work by involving numerous additional archives of digitized observations and processing services and thus obtaining new original data about the Universe.

The Dushanbe part of the Northern Sky Survey (FON project) is represented by about 1570 photographic plates obtained in 1985-1992 at the Gissar Astronomical Observatory of the Institute of Astrophysics of the Academy of Sciences of Tajikistan. At present, their digitization and further scanning processing have been completed, and a catalog of equatorial coordinates and stellar magnitudes for all registered objects on the plates has been obtained.

In parallel with solving the main task of the project to create a catalog of stars and galaxies, we analyzed the results of processing the plates to search for images of asteroids and comets and create a catalog of their coordinates and values. About 2200 positions of asteroids and comets were obtained with visual magnitudes from 7 to 16.5. All positions of the asteroids were compared with the ephemeris. A preliminary analysis of the O-C differences and their comparison with similar results obtained from the digitized observations of the Kyiv and Kitab parts of the FON project are conducted.

LEO SATELLITES RADIO OBSERVATIONS IN THE RESEARCH INSTITUTE "MAO" USING THE DOPPLER EFFECT

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A ground-based Doppler station has been developed and tested at the RI "MAO". The station is used to observe LEO satellites by receiving the signals of their radio beacons in the 430-440 MHz frequency band. Orbital elements of the satellites are clarified using the Doppler frequency shift of the radio beacon signals.

Satellite radio beacon signals are received by SDR based on a USB receiver of terrestrial digital TV and FM radio. The frequency of the local oscillator of the receiver is stabilized using a sinusoidal signal of 10 MHz generated by the GPS receiver.

The Doppler station hardware and software allow tracking in azimuth one satellite that is above the horizon and has a minimum range from the station among other given satellites.

A pilot signal is used to accurately determine the frequency and time. The pilot signal is synchronized in phase and in time with signals generated by the GPS receiver and is fed to the receiver input simultaneously with the payload signal.

The Doppler station performs automatic detection of the radio beacon signal, determination of its frequency, and Doppler shift. Satellite orbit elements are clarified based on measured frequency values using the WinMNK program, developed by the Kharkiv scientist V.A.Yamnitsky.

The report presents an estimation of the internal error in determining the Doppler frequency shift and an external comparison of clarified orbit elements with NORAD data.

Doppler stations developed at the RI "MAO" could be used for creating an international network of monitoring of the orbital positions of low Earth orbit satellites based on downlink signals emitted by those satellites.

SOME ASTEROID POSITIONS OF THE TAUTENBURG DIGITIZED ASTROPLATES

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We present about 100 positions of asteroids obtained as a result of searching for their images on the V-plates of the Tautenburg Schmidt telescope. They were obtained as a supplement to the main task of processing the plates and compiling the star catalog. The plates were taken with the Tautenburg 2m Schmidt telescope between 1963 and 1989 and digitized with the Tautenburg Plate Scanner. Based on the results of processing scans of 500 plates, a catalog of equatorial coordinates and V magnitudes for 2 673 686 stars and galaxies up to $V \leq 20$m for the epoch 1974.5 was created a little earlier. Coordinates are obtained in the Gaia DR2 catalog system, V-values in the Johnson system. The internal accuracy of the catalog for all stellar objects is $\sigma\alpha\delta = \pm 0.14"$ and $\sigma V = \pm 0.12$m.

The asteroid positions obtained by us were compared with similar Tautenburg positions from the MPC database (code 033). Analysis of the O-C differences shows similarities and differences in position changes. New early positions are also obtained for some asteroids discovered later.

SOLAR ACTIVITY, SOLAR-TERRESTRIAL RELATIONS, ASTROBIOLOGY

SOLAR FLARES IN MAY 2021 AND THEIR MANIFESTATIONS IN THE INTERPLANETARY SPACE AS DETECTED WITH STIX, EPD, MAG, AND SWA INSTRUMENTS ONBOARD THE SOLAR ORBITER

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Outbursts from the Sun increase rapidly since the onset of the 25th activity cycle. More frequently are seen large flares, prominences, eruptions, coronal mass ejections. The X-ray emission of the solar corona, which provides information on the processes that generate high-energy charged particles, is measured by the STIX telescope onboard the Solar Orbiter mission. X-ray spectroscopy of thermal and non-thermal emissions is provided by the STIX up to the energy of 150 keV. The Solar Orbiter provides also observations of different manifestations of solar flares in the interplanetary space such as high energy charged particles of various species (EPD suite), solar wind parameters (SWA), and components of the interplanetary magnetic field (MAG). An additional marker of the solar energetic particle ejection states the ground-based registration of the solar radio bursts in a wide frequency band up to a range of up to the GHz one.

In this work, we study the time evolution of coronal X-ray emission, ejected and accelerated high energy electrons, protons and ions, solar wind plasma parameters, and magnetic field fluctuations. For this purpose, the C4 and C6 GOES class solar flares on May, 9 and 22 of 2021 have been selected for detailed investigation. Specific features in energetic electron flow in the 22 May flare event, such as the narrowness of beams in energy and time, their anisotropy in a velocity, the presence of accelerated ions in a wide range of atomic mass are being discussed. We also carry out the analysis of X-ray emission, radio bursts observed by the Ondřejov (Czech Republic) and ORFEES (France) ground-based radio spectrographs, and high energy electron fluxes in the range from 30 to 400 keV as seen by the Electron Proton Telescope (EPT) of EPD suite.

THE OPTIMAL INTERVAL FOR DETERMINING THE GROWTH RATE OF SOLAR ACTIVITY FOR THE PREDICTION OF THE MAXIMUM AMPLITUDE OF THE 25TH CYCLE

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Based on data on 24 previous solar cycles, the statistical relationship between the rate of increase in the number of sunspots in the initial phase of the growth curve (up to the 35th month from the beginning of the cycle) and the amplitude of the cycle was considered. It was found that the maximum smoothed number of sunspots for the 25th cycle depends on the interval used to determine the rate of increase in the number of sunspots during the growth phase of the cycle and is within Wmax (25) ≈ 140-170 units.

At the same time, the statistical estimate of the deviation of the points from the linear dependence (Pearson's test) is r = 0.35-0.91 (the maximum value of r = 0.91 for the interval 11-35 months). The amplitude of the 25th cycle of activity was also evaluated, taking into account the rate of decline of the activity of the previous cycle, which is equal to 148 units (r = 0.73) and is within the limits of the obtained amplitude for the growing phase of the cycle.

The obtained statistical dependence of the duration of the growth phase of the cycle on the rate of increase in the number of sunspots. The maximum of the cycle is expected between November 2024 and January 2025.

THE RALATIONSHIP OF THE PROTON FLUX OF SCR WITH THE PARAMETERS OF TYPE II RADIO BURSTS

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112 solar proton events were processed for the period from November 24, 2000 to December 20, 2014, which were accompanied by type II radio bursts. The relationship between the intensity of the SCR proton flux I_p with the drift velocity V_{II} and the intensity of bursts II type I_{II} is studied according to original data from the Solar Radio Spectrograph in the range of 25-180 MHz. Detailed studies have shown that the intensity of type II burst I_{II}, as well as drift velocity V_{II}, varies monotonically along the harmonics of type II bursts. Comparative analysis showed that the relationship between the intensity of the SCR proton flux I_p and the intensity of type I_{II} bursts is much stronger than with the drift velocity V_{II}, where the correlation coefficient r is 0.82 and 0.67, respectively. It was also shown that the strongest coupling of I_{II} and V_{II} with I_p is observed with medium relativistic SCR protons in the range E_p > 30-100 MeV.

ANOMALOUS MAGNETIC REGIONS ON THE SUN

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We investigated the anomalous magnetic regions observed near the minima of solar cycles 24 and 25. The peculiarity of these regions consisted in the deviation of its configuration from Hale's law of the magnetic polarity

and Joy's law of the inclination of the axes of bipolar groups to the latitudinal direction. Therefore, they belong to the class of anti-Hale active regions. Possible mechanisms of their formation are discussed. An urgent problem today is the search for observed evidence of the existence of the theoretically proposed by Brandenburg A. et al. (2012) of a new physical entity – a small-scale magnetic field hidden in the solar depths, excited by two qualitatively different mechanisms of a small-scale dynamo (SSD).The first mechanism is the SSD of macroscopic MHD (SSD1), while the second is the diffusion SSD of classical MHD (SSD2). However, the small contributions of these sources are very difficult to distinguish observationally.To solve this complication, Sokoloff D. et al. (2015) proposed a test for separating the contributions of two sources based on a statistical probabilistic model.Such an important feature of the differences between of the two SSD is the behavior of the percentage of anti-Hail groups of sunspots (in relation to the total number of spots) in the minima of solar cycles. According to statistical studies of long series of observations Sokoloff D. et al. (2015) found that the percentage of anti-Haile groups of spots increases during minima of the solar cycles, suggesting in favor of SSD2. We believe that the detected magnetic anomalies of the regions studies may be caused by the influence of a SSD2 in the depths of the convective zone of the Sun, since this source gives the most noticeable contribution to the surface magnetism near cycle minima.

BRIGHTNESS IN THE SOLAR FACULA

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We used observations of the facula region near the solar disk center. These are: spectropolarimetric observations of the Stokes parameters of the Fe I 1564.3 nm an 1565.8 nm lines (lower photosphere); filter observations in different parts of the Ba II 455.4 nm line profile (photosphere); ilter observations at the Ca II H 396.8 nm line core (chromosphere).

It is found that in bright areas with a strong magnetic field, upward waves predominate, while downward waves are more often observed in less bright areas with a weak field. It is shown that the facular contrast measured at the center of the Ca II H line correlates with the power of wave velocity oscillations. In bright areas, it increases with the power regardless of the direction in which the waves propagate. In facular regions with decreased brightness, the opposite dependence is observed. The power of wave velocity oscillations is sensitive to the field strength magnitude. In the magnetic elements of the facula with increased brightness, the stronger the field, the higher the power of oscillations. In areas with decreased brightness, the inverse dependence is observed.

The facular brightness strongly depends on the propagation direction of sound waves. The regions of the facula,where the upward propagating wave are observed, look brighter than the regions in which the waves propagate in the opposite direction from the chromosphere to the photosphere. Dependence of the facular brightness on the wave propagation direction is caused by the fact that upward sound waves, for some reason, prefer to propagate in those regions of the solar facula where the magnetic field strength is above the average value. On the contrary, downward waves are observed in areas where the magnetic field is below average.

COMPARISON OF MAGNETIC FIELDS BY D1, D2 AND NII LINES MEASURED IN THE AREAS OF THE SEISMIC SOURCE OF A POWERFUL SOLAR FLARE AND IN A SUNSPOT WITHOUT FLARES

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The results of magnetic field measurements by the D1, D2 NaI and NiI 5892.883 lines are presented for area of the seismic source of the powerful solar flare on October 28, 2003 of X17.2/4B class. For comparison, similar data are presented for a large sunspot of AR NOAA 3379 on July 24, 2023, where at the time of observations no flares were observed. For D1 and D2 lines, the magnetic fields in the flare on October 28, 2003 were measured by the splitting of emission peaks, and in the sunspot on July 24, 2023 – by the splitting of Fraunhofer profiles. For the NiI line, magnetic fields were measured by the splitting of Fraunhofer profiles only. The magnetic fields measured by direct method were in the range of 900–1400 G for the flare and 500–1700 G for the sunspot without flares. It is interesting to note that magnetic field ratio by D2 and D1 lines, B(D2)/B(D1), was 1.6 for the flare and 1.7–1.8 for the sunspot without flares. Since the Lande factors of these lines are 0.75 and 1.33, respectively, these data in frame of the \"line ratio\" method indicate a spatially unresolved magnetic field structure in the picture plane with even stronger local magnetic fields. Estimation of the lower limit of local fields at the level of the chromosphere by this method leads to magnetic fields in the range of 3500–5200 G, that is, several times stronger than according to direct measurements. The significant heterogeneity of the magnetic field in the vertical direction of the flare is evidenced by the fact that an almost zero magnetic field was measured by the NiI line, while in the sunspot without flares – approximately the same magnetic field as by the D1 and D2 lines.

TRIAL SPECTRAL-POLARIZATION OBSERVATIONS IN THE H-ALPHA LINE FOR THE SEARCH FOR SUPER-STRONG MAGNETIC FIELDS IN SUNSPOTS AT THE CHROMOSPHERE LEVEL

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We analyze the spectral-polarization observations of sunspots in H-alpha line carried out on the Ernest Gurtovenko (ATsU-5) telescope of MAO NAS of

Ukraine. In order to study of $I \pm V$ profiles of the line, a circular polarization analyzer and spectra registration with the SBIG ST-8300 CCD camera was used. Observations were made in May 25, 2023 and related to the largest sunspot in AR NOAA 3310. The profiles of the H-alpha line and its far wings were obtained within 20 angstroms, more precisely from -10 to +10 angstroms. We find that the bisectors of the $I \pm V$ line profiles split, as a rule, the most in the core of the line, with a gradual decrease in the splitting in its wings. However, in the far wings of the line, corresponding to distances of 2-3 angstroms from the center, an increase in the splitting of bisectors was also sometimes found. If you do not take into account that such an effect is strongly stolen by the blending of other lines, then you can say that this is equivalent to the appearance of secondary Stokes V peaks at such distances that change their sign when passing through the center of the line. A similar effect was found earlier in the limb solar flare (Advances in Space Research, 2022. Vol. 69, Iss. 12, P. 4408; DOI: https://doi.org/10.1016/j.asr.2022.04.012). If this effect in the sunspot to interpret as a manifestation of the presence of particularly strong magnetic fields, then their magnitude should be close to 100 kG, and the magnetic polarity should be opposite to the polarity of the weaker "background" field with an intensity of several kilogauss.

THE EARTH'S MAGNETIC FIELD AND THE LARGE-SCALE MAGNETIC FIELD OF THE SUN: THE SOLAR-TERRESTRIAL CONNECTION

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The report presents the results of a joint analysis of the Earth's main magnetic field (core field) B_{IGRF} and the large-scale magnetic field (LSMF) of the Sun.

The connection between the temporal change of the geomagnetic field [1] and variations of the velocity of the Earth rotation[2] with solar activity and the large-scale magnetic field of the Sun has been revealed [3,4].

The maximum temporal change of the B_{IGRF} field and the Earth's rotation speed fall on odd Hale cycles, when the Sun's magnetic field has a direction opposite to that of the Earth's magnetic field. Paired Hale cycles (the directions of the Sun's and Earth's magnetic fields coincide) are characterized by weak changes in the geomagnetic field and velocity variations and high solar activity. According to the results of the latest research a negative correlation has been found between the magnitude of the large-scale magnetic field and the angular rotation rate of the Sun [5]. The main rotation period (about 27-day period) of the two-sector structure of IMF varied with about 22-year cycle. An analysis of the spectrums of the whole cycles showed that during the 18th–19th cycles the rotation period of IMF was greater during odd cycle and smaller during even cycle and during the 20th–23rd cycles the rotation period of IMF was greater in even cycles and smaller in odd cycles [6].

The study of the dynamics of the main magnetic field of the Earth and the large-scale magnetic field of the Sun indicates their essential connection. Their rotation mode can be a mechanism of connection between the dynamics of the magnetic fields of the Sun and the Earth.

References:

1. Orlyuk M.I., Romenets A.A. Spatial-temporal change of the geomagnetic field: environmental aspect//Geophys. Journ. – 2020. – т.42, № 4. – С.18-38. DOI: https://doi.org/10.24028/gzh.0203-3100.v42i4.2020.210670
2. Stephenson F.R., Morrison L.V., Hohenkerk C.Y. Measurement of the Earth's rotation: 720 BC to AD 2015. Proc. of the Royal Society A. 2016, v. 472, pp. 2196-2208. DOI: 10.1098/rspa.2016.0404
3. Matsakis D**.,** Mccarthy D**.** Will We Have a Negative Leap Second? //Inside GNSS, March 19, 2023.
4. Orlyuk M.I., Romenet A.O. On the relationship of temporary changes in the Earth's magnetic field with solar activity 19-24 cycles// ISSN 1025-6415. Dopov. Nac. akad. nauk Ukr. 2022. № 1. https://doi.org/10.15407/dopovidi2022.01.072.
5. Obridko V N, Pipin V V, Sokoloff D, Shibalova A S. Solar large-scale magnetic field and cycle patterns in solar dynamo// *Monthly Notices of the Royal Astronomical Society*, Volume 504, Issue 4, July 2021, https://doi.org/10.1093/mnras/stab1062
6. Leiko U. M. Large-scale magnetic fields of Sun-heliosphere magnetic system // Кинематика и физика небесных тел. 2005, Т. 21,С. 187-188.

SARS-CoV-2 VIRUS SPREADING IN RELATION TO THE EARTH'S MAGNETIC FIELD

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According to numerous studies, the geomagnetic field is one of environmental factors and has a significant impact on living organisms, in general, and on human activities, in particular [1, 2]. In the work [3] the value of geomagnetic field "ecological" norm of a permanent field in the range of 35-55 μT was proposed considering the fact that the geomagnetic field on the Earth's surface varies within very wide limits. In relation to the permanent magnetic field, not only its limit values, but also the maximum of possible staying time in such fields have been introduced in connection with the analysis of people working and living conditions at the present time [4].

The results of a study on the possible connection between the spread of the SARS-CoV-2 virus and the Earth's magnetic field based on the analysis of a large array digital data for 95 countries of the world are presented. The dependence of the spatial SARS-CoV-2 virus spread on the magnitude of the B_{IGRF} Earth's main magnetic field modular induction values was established [5]. The maximum diseases number occurs in countries that are located in regions with reduced (25.0-30.0 μT) and increased (48.0-55.0 μT) values, with a higher correlation for the first case. The spatial dependence of the SARS-CoV-2 virus spreading on geomagnetic field dynamics over the past 70 years was revealed. The maximum diseases number refers to the areas with maximum changes in it, both in decrease direction (up to -6500 nT) and increase (up to 2500 nT), with a more significant correlation for countries located in regions with increased geomagnetic field.

References:
1. Connie, X. Wang, Isaac, A. Hilburn, Daw-An Wu, Mizuhara,Y.,Christopher, P. Cousté, Jacob N. H. Abrahams, Sam E. Bernstein, Ayumu Matani, Shinsuke Shimojo, and Joseph L. Kirschvink. (2019) Transduction of the Geomagnetic Field as Evidenced from alpha-Band Activity in the Human Brain// *eNeuro March*, 6(2) e0483-18.2019 1–23 https://doi.org/10.1523/ENEURO.0483-18.2019.
2. Orlyuk, M.I., Romenets, A.A. (2020) Spatial-temporal change of the geomagnetic field: environmental aspect // *Geophysical journal.* – V.42, № 4. – 18-38. https://doi.org/10.24028/gzh.0203-3100.v42i4.2020.210670.
3. Orlyuk, M., Romenets, A., Orliuk, I. (2016) Natural and technogenic components of megalopolis magnetic field. *Geophysical journal.* 38, № 1. 78-86.
4. Standard-2015 Randbedingungen: SBM-2015. Institut fur Baubiologie + Nachhaltinkeit. IBN. p.18 www.baubiologie.de.
5. Orlyuk, M.I., Romenets, A.O. SARS-CoV-2 virus spreading in depending of the Earth's magnetic field (in ukrainian)// *Geophysical journal*, 2022, № 4, T. 44, C.74-94. DOI: https://doi.org/10.24028/gj.v44i4.264842.

SCATTERED LIGHT IN THE SPECTROGRAPH OF ERNEST GURTOVENKO SOLAR TELESCOPE

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Reductions due to the influence of scattered light in the spectrograph are a mandatory procedure for spectral observations. But there are no generally accepted standard methods for determining the levels of scattered light. The method of half diaphragms, which was developed and is used for observations on the spectrograph of the Ernest Gurtovenko solar telescope of the MAO of the National Academy of Sciences of Ukraine, is presented. Scattered light is modeled by the sum of the flat and diffuse components. The methodology is being tested on observations of saturated telluric lines. The results of changes in scattered light over a long period of time are presented.

SPECTRAL STUDY LOWER SOLAR ATMOSPHERE OF THE ACTIVE REGION SITE WITH THE ELLERMAN BOMB AND ACCOMPANYING Hα-EJECTIONS

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Among the many manifestations of solar activity, such fine scale, short and impulsive events as Ellerman bombs (EBs) and chromospheric ejections (surges) play an important role. Small-scale magnetic reconnections can effectively help inject dense plasma into the upper atmosphere.

We present the results of studying the features formation and development of EB and accompanying Hα-ejections arose on the NOAA 11024 active region site. This site was in the region of emerging magnetic flux. As a result its interaction with the magnetic field already existing, a pore was formed, an EB developed at a distance of about 7.2 Mm from it and Hα-ejections occurred. Spectral data with high spatial and temporal resolution were obtained with the French–Italian THEMIS telescope. We used spectra were obtained in the Hα-line and in the photospheric lines: FeI λ 630.15, 630.25, 630.35 and TiI λ 630.38 nm. Stokes I profiles were obtained with an interval corresponding to 160 km on the Sun surface.

The Hα line profiles obtained for different periods of EB development were asymmetric with an excess of emission in the short-wavelength wing. The temporal variations of intensity in the Hα line wings at distances ±0.1 and ±0.16 nm from its center showed that two periods can be distinguished in EB evolution: the preheating phase (the first 8 min) and the flaring phase (6 min), during which the gradual and pulse energy release occurred. In all spectra surges were visible in the absorption. The serge profile component was projected onto the blue or red Hα line wing. Its Doppler shifts were used to calculate the line-of-sight velocities (Vlos) of chromospheric matter in surges. The velocity distribution in the surges indicates their multi-flow structure. One of the surges showed signs of plasma vortex motions. Most surges occurred at a high velocity – Vlos up reached -110 km/s, and down – 90 km/s.

In the photosphere, predominantly upward motions were found. Vlos varying from -2.1 km/s upflows to 0.5 km/s downflows. An increase the core intensity of all photospheric lines was correlated in time with an increase of the intensity in the Ha line wings.

The obtained results can be used in the verification of existing and creation of new theoretical models of EBs and Hα-ejections.

FLATTENING INDEX OF THE SOLAR CORONA IN THE SOLAR CYCLE AND ITS RELATION WITH PARAMETERS OF MAGNETIC FIELD OF THE SUN

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The flattening index of the solar corona observed during total solar eclipses is a quantitative characteristic of the shape of the white-light corona. It was introduced by Hans Ludendorff in the 1930s. We collected the flattening index values for 69 total solar eclipses in 1851–2020 and investigated their relationship with the parameters of the solar cycle. The value of the flattening index varies from approximately 0.3–0.4 at the cycle minimum to 0.0–0.1 at the cycle maximum. The flattening index correlates with the international sunspot numbers and the phase of the solar cycle. The correlation coefficients between the flattening index and the daily, monthly and monthly smoothed sunspot number are -0.577, -0.595 and -0.598, respectively. The correlation coefficients between the flattening index and the phase Φ of the solar cycle for the rising and declining branches of the cycle are -0.759 and 0.660, respectively. Flattening index values for eclipses in 1967–2020 were additionally compared with parameters of magnetic field of the Sun as observed and calculated at the Wilcox Solar Observatory for corresponding dates or Carrington rotations. It is found that among all the harmonic terms of solar magnetic field the flattening index best correlates with the axial dipole term (c.c. = 0.700). Besides, it is found that the flattening index also strong correlates with observed polar magnetic field

strength (c.c. = 0.797) and is in strong anti-correlation with heliospheric current sheet tilts (c.c. equals to -0.814 and -0.829 for classic and radial tilts, respectively). The flattening index is also in moderate negative correlation with the total magnetic flux in the photosphere and tends to be higher in the minimum of a stronger solar cycle. We concluded that the observed shape of the white-light solar corona, in particular the value of the flattening index, is determined by the global magnetic field of the Sun, mainly by its dipole component.

ON THE ANOMALOUS RISE OF CYCLE 25 AS A RESULT OF THE MANIFESTATION ACTIVITY OF THE NORTHERN AND SOUTHERN HEMISPHERES OF THE SUN

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The development of the current 25-th cycle of solar activity demonstrates its obvious difference from previous solar cycles by the nature of the rise values of Wolf numbers for the entire solar disk. At the same time, the results of processing data from previous solar cycles by the nature of changes in sunspot areas and Wolf numbers separately for the Northern and Southern hemispheres show the presence of different cycles of manifestation of their activity.

The cycles of the Northern and Southern hemispheres show their start, maximum, and minimum times. At the same time, the development data of the current 25th cycle show a completely different picture of the quasi-synchronous rise of the activity of the two hemispheres. At the same time, each of the hemispheres has not yet demonstrated extreme manifestations of spotted activity, but in total they exceed the indicators of previous cycles of solar activity in the phase of its rise . To what extent this trend will continue, observations will show. This 25th cycle in the manifestation of its activity is unusual, but at the moment it cannot be attributed to extreme.

ASSESSMENT OF THE POSSIBILITY OF USING NEURAL NETWORKS AND WAVELET ANALYSIS FOR PROCESSING THE DATA OF MONITORING OBSERVATIONS OF GEOMAGNETIC VARIATIONS FOR INVESTIGATION SPACE WEATHER

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The study of solar-terrestrial relations based on the results of observations at the URAN-4 radio telescope and the Odesa magnetic observatory requires modern methods of analysis and interpretation of the initial data, in particular variations of the geomagnetic field. Usually, to characterize the magnetic field, its calm and disturbed intervals with different discretization (1 hour, 3 hours, 24 hours) were distinguished. Magnetic storms, based on observations at magnetic observatories, were calculated on the basis of 1-hour or 3-hour K-indexes, based on the analysis of which the time of their onset, duration, classification, etc., were determined.

At present, using digital registration with a second resolution, such a procedure is cumbersome and does not allow taking into account short-term variations. The paper evaluates the feasibility of two approaches to this problem. The application of neural networks is based on "training" the detection of magnetic storms on continuous records of geomagnetic variations. The second method is based on the calculation of wavelet spectra and determination of the time of occurrence of short-term variations. The preliminary results of the application of the above methods and the degree of their agreement and mutual complementation in determining the time and nature of the magnetic storm manifestation are shown.

EUV CORONAL SPECTROPOLARIMETRY

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A major challenge in solar physics is to obtain empirical information on the magnetic field of the million-degree plasma of the solar corona. To this end, we need observables of the solar electromagnetic radiation sensitive to the magnetic field in the solar corona. The most familiar observables are the polarization signals in forbidden coronal lines, which can only be observed during total solar eclipses or using a coronagraph. To this end, great expectations are nowadays put on DKIST, which has been designed to be able to observe several coronal forbidden lines in the IR. While the forbidden line radiation can only be detected for off-limb line of sights, the spectral line radiation from permitted EUV lines can be observed also when pointing to the solar disk. EUV lines are mainly collisionally excited, but in 2009 Manso Sainz and Trujillo Bueno (2009; ASP Conf. Ser. Vol. 405, 423) pointed out that some permitted EUV lines can actually be linearly polarized, and that their polarization is sensitive to the orientation of the coronal magnetic field. Here we theoretically investigate in depth the linear polarization in permitted EUV lines of a variety of highly ionized atoms.

COMPARATIVE ANALYSIS OF THE CATALOGS OF PLANETARY MAGNETIC AND IONOSPHERIC STORMS WITH THE CATALOG OF MAGNETIC STORMS FOR THE ZONE OF THE ODESSA MAGNETIC ANOMALY

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On magnetic observatory "Odessa" since 1948 measurements of a magnetic field of Earth, with a time frame – are conducted 1 hour. At the same time measurements of K-index and three elements of a magnetic field (horizontal component (H), vertical component (Z) and inducement (D)) are registered. Basis of these data the catalog of magnetic storms in the 22nd and 23rd cycles of solar activity was compiled. The catalog for 1987-1994 and 2000-2009 indicates the date and time of the beginning and end of the storm, the duration of the storm, the amplitude for three elements of the magnetic field: H, Z, D, the characteristics of magnetic storms with indication of active periods. In this edition of the catalog, daily average measurements of the K-index have been added.

The magnetic station "Odessa" is located near a zone of a magnetic anomaly. To identify changes in geomagnetic activity due to the presence of a magnetic anomaly, a comparative analysis of the catalogs of magnetic storms was carried out. The catalog of magnetic storms for the magnetic anomaly zone was compared with the catalogs of planetary magnetic and ionospheric storms.

From the beginning of observations in 1987 year at a radio telescope "URAN-4" the fluxes monitoring of high-power galactic and extragalactic radio sources is carried out. A comparative analysis of the catalogs is carried out in order to reveal the contribution of geomagnetic activity to the change in the flux of radio sources.

SOLAR AND GEOMAGNETIC ACTIVITY IN 19-24 CYCLES

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The paper presents the results of the analysis of changes solar and geomagnetic activity in 19-25 Wolf cycles. A forecast of the maximum geomagnetic activity cycle 25 is made.

Solar activity is presented by solar number Rz, geomagnetic activity is expressed by the energetic index ∑(H-Sq), calculated from the data of the "Lviv" and "Belsk" geomagnetic observatories.

By annual averages Rz values, the 11-year window was used to obtain the solar activity minimum (around 1711, 1810, 1901, and 2009).The minimum of 2009 was one of the smallest in the observed data, and we took it as the beginning of the 24th cycle and the 100-year solar activity cycle. The maximum of the 24th cycle occurred in 2014 for Rz and in 2015 for ∑(H-Sq).

Cycle 25 began in 2019 according to Rz, and in 2020 according to ∑(H-Sq). For cycles 19-25, solar activity is 1-2 years ahead of magnetic activity. The identified quasi-biennial variations over the studied period and the lag of geomagnetic activity from solar activity allow us to predict the magnitude of geomagnetic activity and its maximum in cycle 25.

According to our calculations, the maximum of geomagnetic activity will occur around 2026 and its magnitude will be 1.5-2 times higher than the maximum of the 24th cycle.

RADIO ASTRONOMY

RECENT RADIO ASTRONOMICAL ACTIVITIES AT THE VENTSPILS INTERNATIONAL RADIO ASTRONOMY CENTRE

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Ventspils International Radio Astronomy Centre (VIRAC) of Ventspils University of Applied Sciences (VUAS) was established in 1994. The most important instrumental base for the centre comprised two fully steerable parabolic antennas, RT-16 and RT-32 with the mirror diameter of 16 m and 32 m and LOFAR-LATVIA station. RT-16 and RT-32 were instrumented with two channel cryogenic broad band receivers with frequency coverage of 4.5 – 8.8 GHz with system noise temperatures of 30 to 50 K. A secondary receiver is available at RT-32 for observations at 1.40 to 1.72 GHz. It is an uncooled receiver with RCP and LCP polarization channels and system temperatures of 60 to 100 K. Additionally, radio telescope RT-32 performs routine spectral polarimetric observations of the Sun by the multi-channel spectral polarimeter, capable to observe circular polarization of the solar emission in 4.1 – 14.3 GHz bandwidth, divided into 12 frequency bands. Each telescope has VLBI equipment available. The LOFAR-Latvia is a part of an international LOFAR consortium.

In March 2022 radio telescope RT-32 was stopped for modernization. Currently, a new vertex room is installed. Enhanced vertex room, located in the secondary focus, will allow simultaneous installation of several cryogenic receivers in offset positions. In the new vertex room, the space for future developments such as cryogenic L-S and 22 GHz band receivers are allocated. In parallel with vertex room modernization, the secondary mirror was equipped with a movable automatic positioning system.

In January 2023 VIRAC started two new three-years research projects: "Multi-Wavelength Study of Quasi-Periodic Pulsations in Solar and Stellar Flares" and „A single-baseline radio interferometer in a new age of transient astrophysics" lead by guest leading researchers prof. Valeri Nakariakov and PhD. Ross Alexander Burns.

GROUND BASED SUPPORT OF THE SPACE MISSION PARKER PERFORMED WITH UKRAINIAN LOW FREQUENCY RADIO TELESCOPES

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The purpose of this work is to demonstrate the effectiveness of ground-based support for space missions, primarily PSP, using large Ukrainian decameter radio telescopes. Another goal of the work is to carry out cross-calibration of the radiometers onboard spacecraft using the calibrated data of the ground-based radio telescopes.

One of the most common methods of remote diagnostics of the solar corona is the study of radio emission, the sources of which are located in the solar corona at different heliocentric altitudes. The technique of joint space-terrestrial observations consists in the simultaneous observation of individual events and their analysis in the widest possible frequency band during the maximum approach of the PSP vehicle to the Sun. At the same time, observation in the common frequency band is proposed to be used for calibration of the on-board radio receivers.

The methods of planning joint space-terrestrial observations are substantiated. Using the data of the UTR-2, URAN-2 radio telescopes and the PSP probe, the dynamic and polarization spectra of the simultaneously observed bursts on June 9, 2020 were obtained. The identification and comparison of individual bursts was carried out. A common dynamic spectrum of the bursts in the frequency band 0.5 – 32 MHz was obtained. Cross-calibration of the HFR receiver of the FIELDS-PSP module in the frequency band 10-18 MHz was made using the calibrated data of terrestrial radio telescopes.

The effectiveness of ground-based support of the PSP mission by the large Ukrainian radio telescopes is shown. Examples of joint observations are given, and the method of cross-calibration of the FIELD-PSP module receivers is demonstrated. Prospects for further ground-based support for solar space missions are presented.

MORPHOLOGY OF SOLAR TYPE II BURSTS CAUSED BY SHOCK PROPAGATION THROUGH TURBULENT AND INHOMOGENEOUS CORONAL PLASMA

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Type II solar bursts are radio signatures of shock waves in the solar corona driven by solar flares or coronal mass ejections (CMEs). Therefore, these bursts present complex spectral morphologies in solar dynamic spectra. Here, we report about meter-decameter radio observations of the type II burst on 2014 July 25th with Ukrainian radio

telescopes UTR-2 (8.25-33 MHz) and GURT (8.25-78 MHz). The burst demonstrates fundamental-harmonic components, band-splitting, herringbone structure, and spectral break. These specific spectral features, observed jointly in a single type II burst, are rarely detected. To contribute to understanding of such puzzling type II events, we have carried out a profound analysis of the recorded type II dynamic spectrum.

PERSPECTIVES OF LOW-FREQUENCY RADIO ASTRONOMY IN UKRAINE

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There is a rapid world progress in low-frequency radio astronomy at present. New generation radio telescopes (LOFAR, NenuFar, LWA, MWA, SKA-Low, GURT) in the frequency band of 10-300 MHz are being created on all continents. At the same time, for 90 years of radio astronomy development, several dozens of radio telescopes of various configurations were created. Among them, let us recall the UTR-2 radio telescope (8-40 MHz) existing in Ukraine, to which this report is devoted.

The creation of UTR-2 was a revolutionary event. It was the world's largest low-frequency radio telescope with unique parameters. In the 70s, a deep modernization of the instrument began. As a result, at the beginning of 2022, the practically new UTR-2 not only continued to function, but also remained among the leading telescopes of world low-frequency radio astronomy. In recent years, it has been shown that not all the reserves in the modernization and improvement of the efficiency of the UTR-2 have been used. The new modernization plan for UTR-2 was developed.

Unfortunately, the military aggression by the neighboring country against Ukraine, which began on February 24, 2022, did not allow these plans to be realized. The observatory named academicion S. Ya. Braude hosting UTR-2 was occupied and destroyed, and much of the equipment was looted. At the same time, radio astronomy in Ukraine continues. After the undoubted victory of Ukraine in this war, it is planned to restore the UTR-2 radio telescope using new modern technologies. This recovery can be carried out jointly with the leading astronomical institutions of Europe.

THE "INTERFEROVISION" PROJECT : WHAT WE WANT, WHAT WE HAVE AND WHAT WE ARE WORKING HARD ON NOW

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The Ukrainian VLBI system of decameter radio telescopes URAN successfully solves many scientific problems, but implementing aperture synthesis technology has a number of difficulties. One of them is significant phase distortions in this range caused by an inhomogeneous propagation environment. Therefore, the task arose to develop an alternative technology with the conventional name "Interferovision", which would allow us to restore radio images with a limited number of antennas, operate with broadband signals, not require flatness of the objects scene, and have an extended field of view. A method of direct image reconstruction when observing objects in space, using a multi-element interferometer, is proposed. This method is based on a physically based principle that is similar to holography. The wave front is registered by the antennas of the interferometer, and further processing is equivalent to its playback in reverse and registration of the resulting spatial interference image. There are no special requirements for the radiation of individual points of the source, except for its delta correlation. A finite frequency band is considered, and each point can be characterized by its own spectrum. A theoretical justification of the method for spaces of different dimensions has been obtained. It is shown that all interferometric systems of the same rank with many antennas are reduced to a same canonical form with fixed number of virtual antennas placed at the origin of the coordinates and at unit distances on the coordinate axes. The ambiguity of the obtained solution is eliminated by using an additional antenna. A simulation of the proposed method of direct image reconstruction for two-dimensional space was carried out. Despite the low conditionality of the system for estimating the distance, when it increases, the angular characteristics are preserved. Therefore, the method is promising for restoring radio images of space radio sources.

SEPARATION OF DIURNAL AND SEASONAL EFFECTS IN THE RADIO ASTRONOMICAL METHOD OF THE IONOSPHERE SOUNDING

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Our report concerns the method of processing ionospheric monitoring data, which is carried out on the URAN-4 radio telescope. The used radio astronomical sounding method is based on the transillumination of the medium under study by radio emission from compact space radio sources. The application of this method for monitoring ionospheric scintillations characterizing ionospheric turbulence has its own peculiarities. One of them is related to the fact that when observing celestial bodies, it is not possible to directly separate the influence of seasonal and daily factors on the parameters under study. The study of the separate influence of seasonal and diurnal factors on ionospheric turbulence is of independent importance. In addition, when processing ionospheric sounding records by the radio astronomical method, separate consideration of these effects will increase the probability of detecting the ionospheric response to single transient events. In this communication, we consider our proposed method for separating the diurnal and seasonal effects in processing data on ionospheric scintillations.

THE LONG-TERM OBSERVATIONS OF THE POWER COSMIC RADIO SOURCES ON THE RADIO TELESCOPE URAN-4 AT THE DECAMETER WAVELENGTH RANGE

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The radio telescope (RT) URAN-4, located near the city of Odessa, started to work in 1987 as a component of the radio interferometric system URAN, which operates in the decameter range of radio waves and whose elements are located in several points throughout Ukraine. The first successful VLBI observations of compact cosmic radio sources in the URAN system were carried out on the RT URAN-4 – UTR-2 interferometer at the end of 1987. In the same period, a program was launched for regular observations of powerful cosmic radio sources 3C 144, 3C 274, 3C 405, 3C 461 at frequencies of 20 and 25 MHz in the radiometric mode. Later, several stages of modernization of radiometric equipment and systems for automation of observations took place. This made it possible by 2000 to switch to practically continuous radiometric monitoring of a group of these radio sources. Method of measuring and processing of the records of the radio sources passage through RT direction pattern, statistics of the observation records on time periods in dependence from the registration systems of the data obtained during more 35 years observations on the RT URAN-4 are considered in this report. Some results are given which related to the study of the flux densities of the observing radio sources and ionospheric scintillation effect which is essential at the decameter wavelength range**.**

DECAMETER TYPE IV BURST WITH HIGH POLARIZATION ON 13 JULY 2022

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We discuss properties of Type IV burst observed by radio telescopes URAN-2 (Ukrainian Radio Interferometer of NASU-2) and NDA (Nançay Decameter Array) on 13 July 2022. This burst was registered at frequencies of 26-70 MHz and lasted from 07:00 to 12:00 UT. It had the fine structure in the form of sub-bursts similar to decameter Type III-like bursts, with negative frequency drift rates from -5MHz/s to -21MHZ/s and sometimes with positive drifts. Their durations were from 1 s to 2.6 s in most cases and maximum fluxes were up to 700 s.f.u. At the same time maximum polarization of Type IV burst was 100%. It is very unusual for decameter Type IV bursts because as a rule this value is about 40%.

This Type IV burst can be associated with a very weak CME. We discuss properties of this Type IV burst in the plasma model of radio emission.

THE JET KINETIC LUMINOSITIES FOR THE UTR-2 SOURCES WITH THE STEEP LOW-FREQUENCY SPECTRA

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Earlier we have determined that the UTR-2 radio sources with steep linear spectra possess greater jet propagation velocity and lesser characteristic age than the UTR-2 radio sources with steep break spectrum.Since the source jets are connected with the accretion disk of the source, it is important to examine relations of their physical characteristics. With this purpose we obtain estimates of the jet kinetic luminosity for the UTR-2 steep-spectrum sources on the assumption of the equality of the corresponding mass accretion rate and the jet matter flux. Using our calculated values of the jet propagation velocity and the mass accretion rate for the UTR-2 steep-spectrum galaxies and quasars, we estimate their jet kinetic luminosities. The obtained values of the jet kinetic luminosities are ~ 10E45 erg/s, pointing out the great power of jets of the examined steep-spectrum sources. It is essential that the examined objects display the relation of their kinetic luminosity and corresponding redshift.

MODELING OF AN ADAPTIVE INTERFERENCE SUPPRESSION SYSTEM IN LONGWAVE RADIO ASTRONOMY

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In longwave radio astronomy, signal processing in a wide frequency band is associated with the problem of

eliminating various radio interference of terrestrial origin. The aim of the work is to build effective noise protection by modeling an adaptive system for compensating stationary and short-term interference in radiometry and radio interferometry systems.

Based on the analysis of experimental data of long-wave radio astronomy, a method for mathematical modeling of space signals and interference of terrestrial origin is proposed. An adaptive Bayesian approach is applied for the statistical synthesis of adaptive noise compensation systems. It is shown that the problem is reduced to mathematical modeling of the processing of a broadband random signal under conditions of narrowband interference with an unknown spectrum shape. The methodology is based on improving the principle of two-channel spatial correlation processing by applying estimates of the correlation properties of interference to compensate for them.

An adaptive system for temporal interference compensation based on the estimation of the correlation parameters of interference in each of the spatial channels has been developed. The requirements for the size of the training sample during the adaptation of systems for a number of interference models are determined. In order to reduce the computational costs associated with the inversion of the noise covariance matrix, an implementation of time processing on adaptive lattice filters is proposed.

The proposed adaptive systems do not require a significant increase in hardware costs in comparison with traditional systems of radiometry and radio interferometry and provide an efficiency of signal extraction against the background of short-term interference that is close to potentially achievable.

INTERFEROMETRIC OBSERVATIONS OF THE QUIET SUN AT DECAMETER WAVELENGTHS UNDER STRONG RADIO FREQUENCY INTERFERENCE

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Studies of the quiet Sun radio emission were carried out in a wide range of wavelengths from extremely short up to decameter ones. At the longest wavelengths, the measurements of angular sizes of the solar corona were previously carried out using the UTR-2 radio telescope in the scanning mode. We have developed a simple interferometric technique for measuring the angular diameter of an extended radio source. It uses a set of interferometers formed from the antenna sections of the north-south and west-east arms of the UTR-2 radio telescope to measure the size of the quiet Sun in the equatorial and polar directions. The first interferometric observations with this approach were carried out using the receivers and software of the URAN interferometers back in 2014. That study allowed us to determine equatorial and polar solar sizes at the fixed frequencies of 20 and 25 MHz. To expand the frequency range of the studies in the following observations, we used broadband digital DSPZ receivers in the correlation mode. However, in the daytime, broadband observations are complicated by radio frequency interference of various types, which often significantly exceed the level of wanted signals. To limit the effect of RFI, software has been developed that automatically detects and mitigates narrowband and impulse interference in a recorded signal. The paper describes the methods of RFI mitigation and criteria for the degree of signal clearing, which are used in this software. We also present the measurement results of the angular parameters of the quiet Sun radio emission, which were obtained by the interferometric method in the frequency range of 10 – 30 MHz. The observations were carried out during the minimum of solar activity in 2018-2020.

EVOLUTION OF FREE-FREE ABSORPTION PARAMETERS IN CASSIOPEIA A

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Active study of Cassiopeia A (Cas A) as a radio source began immediately after the end of the Second World War, and the first spectrum of Cas A was obtained in 1947 by Martin Ryle and Francis Graham-Smith at the Cambridge Telescope. The interest in studying this supernova remnant (SNR) isn`t only due to the fact that Cas A is one of the brightest radio sources available for observation, but also because this SNR is one of the few supernova remnants that show unshaken ejecta during radio observations. The spectrum of Cas A is affected by absorption from cold non-impact ejections inside the shell of Cas A, as well as interstellar free-free absorption. Recent studies from May 17 to October 11 2019, by using interferometric observations of the GURT in correlation mode at frequencies of 16-72 MHz have shown that measurements of the absolute integral spectrum of Cas A at these frequencies allow us to determine the values of the emission measure, the electron temperature and the average number of ion charges as for internal and external absorbing ionized gas towards Cas A. This method was developed and applied for the first time. In this paper, we considered not only the obtained values of seven free-free absorption parameters inside and outside Cassiopeia A, but also analyzed these parameters for the presence of a monotonic trend in them by using the Mann-Kendal trend test.

The obtained results on the presence of a monotonic trend in the free -free absorption parameters are encouraging from the point of view of expanding information on the evolution of Cas A, but require refinement of the results with the help of further observations at the GURT and NenuFAR radio telescopes.

ABOUT RESEARCH PROGRAMS AT THE RADIO TELESCOPE "URAN-4" OF THE RADIOASTRONOMY INSTITUTE OF THE NATIONAL ACADEMY OF SCIENCES OF UKRAINE (MONITORING OF FLUXES OF POWERFUL RADIO SOURCES, STUDY OF THE SUN'S SUPERCORONA BY PASSAGE OF THE CRAB NEBULA, OBSERVATIONS OF SOLAR ECLIPSE)

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During 2020 – 2023, an initiative series of observation programs was carried out on a radiometer designed and manufactured by V.V. Galanin. Unfortunately, he passed away in 2023. Among them are observations of ionospheric scintillations of powerful radio sources Cas A, Cyg A, Virg A, Tau A, Pers A, on the URAN-4 radio telescope (IRA NASU) at frequencies of 20 and 25 MHz. The observations were carried out at various states of solar and geomagnetic activity and allow us to analyze the response of the ionosphere in the region of the Odessa Magnetic Anomaly to disturbing events.

It was found that the radio source 3C 84 (Perseus A) is the least noisy at the location of the URAN-4 antenna and is well suited for studying the ionospheric response during magnetic storms.

The recorded scintillation periods of the studied radio sources, on "calm" days, are in the range of 1-2 minutes. During magnetic storms, the periods of scintillations are reduced to 10 – 30 seconds. The report considers the features of the response of scintillations of different radio sources to a magnetic storm, since they shine through different spatial regions of the ionosphere.

Of particular interest are observations of the radio source Taurus A (3C 144), which annually, in June, shines through the Solar Supercorona. Processing scans of such observations of the 3C 144 source shows an increase flux variations with an average "period" of about 5-10 seconds.

Observations were also made to record the features of radio background variations during partial Solar eclipses. It is shown that during a Solar eclipse, the level of background radio noise increases significantly. At the same time, the background level on the next day after the eclipse was still quite high. A more detailed analysis of this effect is planned and, if possible, repeated observations.

THE DICHOTOMY OF THE MECHANISMS OF DECAMETER RADIO EMISSION FROM JUPITER: THE INFLUENCE OF STREAMER INHOMOGENEITIES AND MHD PERTURBATIONS IN THE SOURCE

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There are analyzed a model of the source of DAM radiation bursts that activate under MHD waves excitation in the lower magnetosphere of Jupiter in the presence of ionized streamer-like inhomogeneities of limited thickness (10-100 km).

There was studied the formation of an anisotropic kinetic distribution of electrons, which leads to the generation of DAM bursts of Jupiter radiation under the various scenarios. It was investigated the influence of gas-dust flows in the Io-Jupiter tube, the ionization processes and the effects of ambipolar diffusion of the streamer plasma on the creation of the cone-type kinetic distribution of electrons. On the other hand, it has been shown that Alfven waves, due to the fluctuations of electric fields, are to form of both “cone-bunched” electron distribution (at "medium" speeds, primarily on the streamer periphery) and beams of accelerated electrons (at speeds of about 0.1 c, primarily inside the streamer), which further run along the streamers and they are modulated by a "longitudinal" MHD wave with a length of about 1000 km and a period of about 1 second.

Oscillations of streamers in the direction tangential to the streamer lead to the excitation of fast magnetic sound (at ion cyclotron resonance frequencies). The beams of accelerated electrons of along the magnetic field lines generate the plasma waves in the same direction (at about the electron cyclotron resonance frequency). At the same time, plasma perturbations create an stratification of the steamer-tube structure into ultrafine threads of ionized plasma, and its contribute to the ultrafine modulation of bursts of DAM radiation with millisecond periods.

Finally, it is shown how all these processes lead to the activation of bursts of Jupiter’s DAM radiation in that source at the frequency of electron cyclotron resonance by different generation mechanisms and with different bursts properties.

THE USE OF PULSAR PULSES FOR COSMIC MAGNETOACTIVE PLASMA DIAGNOSING

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It is shown that pulsar pulses can be used to probe magnetically active cosmic plasma. This may be the plasma of the Solar corona, the Jupiter-Io magnetic tube or similar tubes of the other Galilean satellites of Jupiter, as well as possible magnetosphere of exoplanets and/or planets of the Solar system. The influence of the magnetic field and plasma temperature on the group/phase velocities of electromagnetic

waves is considered. It is shown that such integral parameters as the dispersion measure and the rotation measure become frequency dependent in the presence of a strong magnetic field. At the same time, a moderate increase in the plasma temperature, which is characterized by non-relativistic electron velocities, does not change the dispersion measure value in the first approximation. The additional contribution of the Solar corona to the dispersion measure as a function of elongation is estimated for different models of the distribution of free electrons in the Solar corona.

ANGULAR STRUCTURE OF THE RADIO GALAXY 3C280 AT DECAMETER WAVELENGTHS

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The image of the 3C280 radio galaxy at decimeter wavelengths consists of two emission regions, the centers of which are separated by about 13 arc seconds. These regions are lobes of the radio galaxy with bright compact components or hot spots embedded in them. We present the results of a study of the source structure in the decameter wavelength range, carried out with the URAN-1 – URAN-4 radio interferometers using an especially technique developed. We show, that at the decameter wavelengths, the source model contains two extended components with the size and position as the lobes have in the decimeter range and a compact detail corresponding to one of the hot spots. The radio emission of other hot spots is not detected at the decameter waves due to their low flux density. The spectra of the radio galaxy components and their variation in the range from decameter to decimeter wavelengths are determined in this study. It is found, that extended lobes provide about 70% of 3C280 flux at low frequencies in contrast to the high-frequency image of the radio galaxy, where compact hot spots predominate in the source radiation.

LARGE-SCALE STUDIES OF DECAMETER CARBON RADIO RECOMBINATION LINES IN GALAXY

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Understanding of spatial distribution of ionized matter in Galaxy has the great importance in studying of many processes occurring in interstellar medium (ISM). The carbon radio recombination lines (CRRLs) are one of the most effective probes of ionized medium. Studying of CRRLs at decameter wavelengths has the great importance. Results of many years of multifrequency CRRLs studies have shown that ionized carbon regions (CII-regions) most likely coexist with HI clouds, where almost all hydrogen is in neutral state and carbon is ionized by ultraviolet quanta with wavelengths of 912 Å < λ < 1100 Å.

However, almost all observations to date have been made for directions lying within the Galactic plane. There are only a few successful detections with $|b| = 1^o \div 2^o$. Based on available theoretical concepts, it can be assumed that if CII-regions and widespread HI clouds in Galaxy are associated, then therefore it can be assumed that CII-regions also can be a widespread component of Galaxy. This can be confirmed by detection of decameter CRRLs at high galactic latitudes and comparison of obtained results with HI data for the same medium regions.

In this report the results of large-scale survey at UTR-2 in decameter CRRLs will be presented. Observations have been made by continuous scanning of UTR-2 beam pointed to zenith position. Due to the daily Earth rotation, the beam covers various areas of Galaxy and also crosses the Galactic plane to twice a day. Decameter CRRLs have been clearly detected up to $|b| > 10^o$. A gradual decreasing in CRRLs relative intensity with galactic latitude increasing is observed.

Comparison of obtained results with HI data indicates the possible association of CII-regions with HI clouds which are widespread in Galaxy.

MOTION KINEMATIC OF COMPONENTS IN AGN'S JETS ACCORDING TO VLBI MOJAVE MONITORING DATA

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A system of 10 radio telescopes VLBA (Very Large Baseline Array) with a maximum base of 8,600 km length of National Radio Astronomical Observatory USA (NRAO) systematically performs monitoring observations of about 500-ed active galactic nuclei (AGN), which are represented in the MOJAVE database. The resulting angular resolution (~0.12 mas at the frequency of 15.4 GHz) is enough to resolve the jet's close surroundings and to study their structure.

In the MOJAVE database are represented AGN's flux density, radio images at each epoch at the frequency of 15.4 GHz and the Separation Jet diagrams (which shows the angular separation of the jet features in time). Such information allows to find the moving features of jets and study their motion. In the existing MOJAVE papers, such analysis wasn't published for all jet's features.

In this work, the general analysis of patterns of motions of jet components (features) was performed for 3C 120, 3C 273, 3C 345, 3C 454.3, 3C 446, CTA 102, BL Lac, OJ 287 quasars, blazars and radio galaxies. As additional data, the data of University of Michigan Radio Astronomical Observatory (UMRAO, USA) was applied.

Such an approach allows to compare their movement with processes of activity in the active galactic nuclei and study the space structure of the jets.

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.

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 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". There are also individual FB pages (including my own) with, particularly, astronomical posts and reposts.

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.

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 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.

A non-profit organization "New Ukrainian Astronomy Renaissance" (http://nuaar.com, head is Dmytro Tvardovskyi, ex-YAS winner from Odesa) initiates various project related to popularization of Astronomy, takes an active part in writing papers in the WikiPedia. They have organized a scientific conference "CATS! (Comets, Asteroids, Transition, Stars, where there were lectures by scientists, as well as presentations of young astronomers on variable stars based on the TESS observations.

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.

ASTRONOMY IN UKRAINIAN WIKIPEDIA

Oleksiy Golubov
V. N. Karazin Kharkiv National University

Wikipedia is not merely the most popular internet encyclopaedia. It is an important platform for science

outreach, a quick-and-dirty source of knowledge for students, and even a convenient tool for scientists to find some basic information outside their field of expertise. For many languages, it systematises the scientific terminology, it teaches science in the native language, and popularises the language among foreigners. Success of Wikipedia on a national language strongly correlates with the nation\'s economical and political success, and to some small but noticeable degree the former can even contribute to the latter.

Now, in time of war, promoting Ukrainian Wikipedia turns into an important instrument of establishing self-sufficiency of our language and securing our informational independence. Although the readership of Ukrainian Wikipedia is constantly growing, it still marginally loses to Russian Wikipedia by the number of views from Ukraine. To speed up this process, we need to do ur best to improve the quality and quantity of articles in Ukrainian Wikipedia. Astronomy-related articles represent only one aspect of this big work, but the aspect to which we all can most productively contribute.

In my talk, I will briefly outline the principles of Ukrainian Wikipedia and the scope of astronomical articles in it, tell about some of its successes and problems, explain some basics of editing Wikipedia, and gladly answer your questions. The presentation will be based on my background as an administrator of Ukrainian Wikipedia and author of over 900 Wikipedia articles, most of them on astronomical topics. I am cordially inviting everyone to share with me your experience with Wikipedia: mistakes that you find, important articles that are missing, or anything you want to improve in Wikipedia but maybe do not know how.

ASTRONOMY OLYMPIAD ACTIVITY IN UKRAINE

V.Ivchenko [1], V.Marsakova [2], B.Melekh [3], B.Novosyadlyj [3], V.Reshetnyk [1], A.Simon [4], O.Vernydub [5]

[1] *Taras Shevchenko National University of Kyiv*
[2] *Richelieu Scientific Lyceum*
[3] *Ivan Franko National University of Lviv*
[4] *Junior Academy of Science of Ukraine*
[5] *Institute of education content modernization*

Astronomy Olympiad global activity in Ukraine began in 2007, since the participation of Ukrainian teams in international astronomy olympiads (IOA and IOAA). Since that time, the annual student Olympiad on Astronomy and Astrophysics is held by representatives of classical universities (https://space.univ.kiev.ua/vseukrayinska-olimpiada-z-as/).

The National Astronomy Olympiad for schoolchildren was started in 2011 and is held every year for high school students. It was interrupted only in 2020-2022 due to the Covid-19 quarantine. The Olympiad on Astronomy and Astrophysics was online in those years.

In 2022 the Internet Olympiad in Astronomy (https://astrointernolymp.lnu.edu.ua/) for middle and high school students was launched but the 1st stage of the Olympiad was only held, the 2nd stage did not take place because russian invasion. In 2023 a full cycle of all the Olympiads was held.

Ukraine was represented at all international Olympiads in Astronomy and Astrophysics which took place every year except for 2020 when the Global E-Competition in Astronomy and Astrophysics was held by Estonia in online format. During the participation of Ukrainian teams in international astronomy olympiads, the participants won 3 gold, 13 silver and 24 bronze medals.

In 2022 the 15th International Astronomy and Astrophysics Olympiad was supposed to be held in Ukraine but due to the full-scale Russian invasion of Ukraine the Olympiad was moved to Georgia.

By 2020, students interested in astronomy, former and current Olympians led by Taisia Karasova, formed the Astrosandbox (https://www.astrosandbox.com/) which is an open community of students, teachers and astronomy enthusiasts, which organize webinars, astronomy Olympiads, command competition AstroBattles (where the olympiad-level and non-trivial astronomical tasks are solved) and collects an archive of materials for studying astronomy.

The Ukrainian Astronomical Olympic Community invites students, teachers, scientists and all those interested in learning the secrets of the Universe to participate in our various events.

ASTROSANDBOX PROJECT

Taisiia Karasova
MIT, USA

AstroSandbox is a non-profit project founded in January 2020 to provide Ukrainian school students access to advanced astronomical education and form a community of astronomical learners and teachers. Our primary methods of achieving the former are online course with webinars (60 so far) on diverse astronomical topics and a well-structured multi-level archive of previous olympiads\' tasks (from district to international level). We hold two study groups: one for high school and university students cooperating with the Institute of Aerospace Technologies of NTUU KPI and another for 5-9 grades with the Kvanta Mathematics and Computer Science club. For the latter, we organize the annual Astronomy Battles Tournament nationally and have a Telegram community where students and teachers can discuss space sciences-related problems. We also use this community to widespread information about astronomical opportunities and updates of AstroSandbox. We inform our readers about each upcoming competition.

We also serve as the contact point for Ukrainian educational institutions with foreign volunteers. This summer, we helped fundraise for purchasing and delivering three telescopes from Astronomy for Equity organization to Ukrainian schools. In addition, we found four universities willing to receive modern telescopes donated by the Unistellar organization.

Our plans include a Tournament of Young Astronomers and an adjustment of Astronomy Battles to the current educational situation in Ukraine.

ASTRONOMICAL ACTIVITY IN CENTER OF STEM-EDUCATION OF ODESA REGION

Marsakova V.
Richelieu Scientific Lyceum, Odesa, Ukraine

„Center of STEM-education of Odesa region“ is open at the Richelieu Scientific Lyceum since 2018. It has many different departments, including astronomy. The pupils-astronomers attend theoretical and practical classes in astronomy, before the large-scale invasion they regularly visited the observation station of the Scientific Research Institute \"Astronomic Observatory\" in the village of Mayaki. They also participate in astronomy Olympiads of various levels, often taking prize even in international competitions. They also prepare their research for the competition of the Junior Academy of Science.

Also, the Richelieu Scientific Lyceum cooperates with several educational institutions in Poland and Slovakia, such as the Vyhorlat Observatory and Planetarium in Humenny (Slovakia), the Youth Astronomical Observatory named after K. Kordylevskyi in Nepolomice (Poland), the Virtual Academy of Astronomy and the Opole Society of Friends of Science (Poland). We take part and organize together with them the astrocamps and other meetings.

OBSERVING VARIABLE STARS AT THE "OSOKORKY" OBSERVATORY

M. Yu. Pyatnytskyy
Private Observatory “Osokorky,” Kyiv, Ukraine, www.osokorky-observatory.com

Since 2017, the author has observed variable stars with a small Newtonian telescope in his backyard. The first setup consisted of the 150 mm Newtonian telescope on the tracking equatorial mount and Canon 600 DSLR. With this setup, the author not only conducted observations of some well-known variables but also discovered 31 new variable stars, which are now listed in the AAVSO International Variable Star Index (VSX) under the names PMAK V1 .. PMAK V31.

Since then, the setup has been improved; currently, it includes a monochrome CMOS camera with a cooled sensor and auto-guiding facility.

The author's observations can be found in the AAVSO International Database (observer code PMAK). Some of them were used in research papers and were presented at scientific conferences.

In 2022, the American Association of Variable Star Observers awarded the author and his colleagues from Ukraine “for their bravery and determination in continuing the valuable and important work of observing variable stars despite the most difficult and hazardous conditions due to the war occurring in their country.”

ASTRONOMICAL TEXTBOOKS AND MONOGRAPHS FOR THE HIGHER EDUCATION

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[2] Ivan Franko National University of Lviv, Lviv, Ukraine

We discuss the current state of formation of the database of the astronomical textbooks and monographs, which were prepared by the Ukrainian authors since 1990-ies. These books can be used by students, post-gradient students, and lecturers in the higher educational process, see, https://mao.kiev.ua/index.php/ua/education-in-astronomy.

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PROGRAM AND ABSTRACTS