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Bhavya A K (Indian Institute of Astrophysics, University of Calicut)

Search for High-Resolution BAL Outflow Observations in HST and Their Variability Studies

Active Galactic Nuclei (AGN) have long been key objects in studying extragalactic phenomena due to their dynamic nature. Among the various transient phenomena observed in AGN, Broad Absorption Line (BAL) outflows stand out for their variability and potential to shed light on the processes occurring near supermassive black holes. This research focuses on the variability of BAL features in AGN and their implications for understanding the interaction between AGNs and their host galaxies. By analyzing light curves and spectral data from the Zwicky Transient Facility (ZTF) and Hubble Space Telescope (HST) archival data, we aim to examine the temporal evolution of ionic column densities and fine-structure lines in response to changes in the AGN continuum. This study will contribute to our understanding of the mechanisms driving AGN variability and the feedback processes (outflows) influencing galactic evolution.

Tagir Abdulmyanov (Kazan State Power Engineering University)

On methods for solving classical problems of the initial formation of celestial bodies using modern computer modeling tools

Analytical and numerical methods for solving classical problems of celestial mechanics using modern computer modeling tools acquire new forms and provide new opportunities in solving these problems. For analytical solution of problems, the computing resources and graphical capabilities of analytical computing systems (ACS) are currently used. Modern analytical methods are based on classical methods of celestial mechanics and the use of computer methods eliminates possible errors when performing complex analytical calculations. Despite the fact that it is impossible to solve complex differential equations and systems of differential equations using CAS, CAS are indispensable as auxiliary tools in preparing problems for their solution by numerical methods. To substantiate this statement, the resources of the MAPLE CAS, as well as the capabilities and limitations of the ANSYS computer system, are considered. The main tasks of modeling the initial stage of formation and evolution of orbits of celestial bodies, the origin and evolution of the Solar System were discussed at the conferences “Activity of stars and the Sun at different stages of their evolution”, St. Petersburg (Vityazev, Pechernikova, 2010), “Planet Formation and Evolution”, 2017, Jena, “European Planetary Science Congress 2017, Berlin. To solve evolutionary problems, it is necessary to integrate the main equations over long time intervals. It may seem

that this problem can be solved by increasing the integration step. However, in this case, as a result of “averaging”, the details of the process of formation of bodies will be excluded. Reducing the integration step also cannot be infinite, and requires the use of super-powerful computers. In this paper, it is proposed to consider a compromise solution to the problem using the MAPLE CAB and the ANSYS computer system.

Bhavya Ailawadhi (Aryabhatta Research Institute of observational sciencES)

TBD

The metallicity of a host galaxy plays a crucial role in the occurrence and characteristics of supernovae (SNe), as it influences the formation and evolution of progenitor stars. This study investigates whether the plateau length in Type II SNe can serve as an indicator of the metallicity. By analyzing both long and short plateau SNe, we explore potential correlations between the duration of the plateau phase and the host metallicity. Detailed spectral analysis throughout the plateau phase is conducted, with a focus on the emergence of specific spectral lines as the plateau ends. These lines may provide critical insights into the physical conditions within the supernova and their variations. The aim of this research is to assess whether the length of the plateau phase reliably reflects the host galaxy's metallicity, thereby offering new perspectives on the relationship between stellar composition and supernova behavior in transient astrophysics.

Toushif Alam (Indian Institute of Technology Kanpur)

Simulating Blast Wave Scenario in Astrophysical Phenomena and Multiwavelength Analysis of ESO 137-006 Galaxy

Shockwave generation in Supernova explosions or in Active Galactic Nuclei (AGN) various jet activities or in gamma ray bursts are common phenomena and the shock front propagates away from its origin. As time passes by depending on the velocity of the shock, input energy and ambient medium density it retains some shape and forms gigantic bubbles, similar to ones seen in our own Milky Way galaxy. For AGN it forms a cocoon with the plasma material due to the forward and sideways velocity of jet propagation. We try to simulate the shape of the shock front from various initial surfaces and evolve it with time. It is done in python and takes very less time compared to the hydrodynamical simulations.

As time passes by eventually the gigantic bubbles could form some thread or filamentary like structures, ones seen in a Radio galaxy called ESO 137-006 in the A3627 cluster. The collimated yet seen as connected with the bipolar jets are called Collimated Synchrotron Thread (CST). We explored that and analyzed its associated multiwavelength data, which could tell us its total flux, synchrotron power and spectral index. Spectral index gives valuable information about the age of the materials having the cosmic ray electron energy density and the magnetic field. Precise measurement is very much important in order to calculate the X-ray photon counts in each section of the galaxy and the region where our CSTs are. This X-ray analysis over the source region with Radio contour will be discussed in detail. The corresponding fraction of cosmic ray electron energy and the magnetic field energy is varied to match the synchrotron power obtained from observation. The simulation that governs this, the procedure and examples for other different cases will also be discussed in the following.

Getinet Ayane (Kotebe University of Education)

TBD

In Ethiopia, the indigenous astronomy is among the least investigated. Even though modern astronomy in Ethiopia is a recent history, astronomy cannot be entirely new in the country. Ancient agricultural practices, myths, calendars, alphabets, etc. are quiet rich in astronomy. In the distant past the knowledge of astronomy was abundant. Ethiopian Ancient Books such as the book of Enoch are devoted to this knowledge. The country has its own calendar, which is a witness for the existence of indigenous knowledge in astronomy.

There is a need to unearth indigenous astronomy in the country and to bridge the gap between cultural and modern astronomy to secure sustainable development. This abstract highlights the current status of indigenous knowledge of astronomy in Ethiopia, specifically some of the work I did which includes publishing books on Ethiopian indigenous astronomy, the effort I did to reach the community through different media including continuous television program and the need for incorporating it in the modern curriculum. Finally, I present the experiences I have in astro-tourism in conjunction with indigenous knowledge which helped us to reach the community through astronomy.

Nhlengani J. Baloyi (University of South Africa)

TBD

We use a popular clustering algorithm, HDBSCAN, to conduct a new blind search for galactic globular clusters (GCs), in 4 regions described by $l \in$

(0◦, 40◦) ∪ (180◦, 220◦), and 20◦ < |b| < 60◦. The search makes use of Gaia DR3's high precision 5-D astrometric data. The search also utilizes a convolutional neural network (CNN), trained on color-magnitudes diagrams, to distinguish true clusters from the statistical overdensities retrieved via HDBSCAN. The 4 search regions contain 18 known GCs in total, and 1 known GC candidate (Sagittarius II). Our machine learning framework was able to detect 15 of the 18 known GCs, as well as Sagittarius II. We also fortuitously detected 2 known open clusters in the regions, Alessi 10 and Messier 67. Finally, we detected 59 possible GC candidates, 29 of which were deemed credible due to them passing a statistical density contrast test. This test involved comparing the nearest neighbor distance distribution of the members of the candidates, with the surrounding nearby background sources. These findings show that there is still scope for the investigation of GCs in the Milky Way and beyond.

Alexey Berezhnoy (Sternberg Astronomical Institute; Kazan Federal University)

Meteoroid bombardment as a source of exospheres of the Moon and Mercury

An advanced model of physic-chemical processes during collisions between meteoroids and the Moon was developed. In this model condensation of refractory elements in the form of minerals is considered and variable adiabatic index during expansion of impact-produced clouds is taken into account. Quenched chemical composition of impact-produced clouds is estimated. In accordance with this model relative fraction of atoms delivered to the lunar exosphere by impacts of meteoroids is significantly higher than that estimated with usage of the previous model with constant adiabatic index and without considering condensation. This model is also applied for studies of collisions between meteoroids and Mercury.

Ilfan Bikmaev (Kazan Federal University)

Optical identifications of SRG X-Ray transient sources by RTT-150

In this report I will discuss main results (2020-2024) of the program of optical identifications (using 1.5-meter KFU optical telescope RTT-150, installed in Turkey) of the new X-Ray sources (AGNs, QSOs, close binary systems, etc.), discovered by X-Ray space observatory Spectrum-Roentgen-Gamma.

Shraddha Biswas (Indian Centre for Space Physics, Kolkata)

TBD

Transit timing variations (TTVs) have proven to be a valuable tool in exoplanetary detection. Currently, WASP-4 and WASP-12 are among the most promising candidates exhibiting TTVs. In this study, we present an analysis of the transit timing variations for the exoplanet WASP-19b, one of the first detected ultrashort period gas giants. Our analysis includes a total of 250 complete transits, comprising 116 light curves from the Transiting Exoplanet Survey Satellite (TESS), 62 light curves from the Exoplanet Transit Database, and 72 from the literature, spanning a 13-year period.

We observed a TTV with an amplitude of 66.83 seconds and investigated its possible origins. To evaluate short-term TTVs, we computed the false alarm probability (FAP) for the highest power peak using the generalized Lomb-Scargle periodogram. The FAP value was found to be 15%, which is above the significance thresholds of 5% and 1%. Due to the lack of significant periodicity, we excluded short-term TTVs and focused on long-term variations. Orbital decay appears to be the most plausible explanation for the observed TTV. To confirm these findings, further high-precision transit observations of the system would be beneficial.

David Buckley (South African Astronomical Observatory)

Transient Followup Opportunities within BRICS

In this talk I will outline the plans within the BRICS consortium and also within Africa to network observatories and telescopes for autonomous optical follow-up observations of objects discovered by the up-coming large survey missions. I will review the pioneering SALT transient program, which since 2018 has been actively engaged in the observing transients across the electromagnetic spectrum. This has included discoveries from the eROSITA X-ray surveys and the Gaia missions. In preparation for the Rubin Observatory's 10-year Legacy Survey of Space and Time (LSST), due to start in 2025, it will be crucial to have automated networks optical telescopes to characterize the nature of new transient and variable object discoveries from the LSST. I will review the aims of a global flagship project, namely the BRICS Intelligent Telescope and Data Network (BITDN), whose aim is to co-ordinate robotic observations utilizing the various facilities available to the BRICS partnership. A similar African initiative – the African Integrated Observation System (AIOS) – will also be described.

Nikolay Budnev (Irkutsk State University)

Multi-messenger studies of the high-energy Universe at a unique facility in Eastern Siberia

In recent years, the most significant results in astronomy have been obtained by joint observation of electromagnetic radiation from radio waves to ultrahigh-energy gamma-quanta, neutrinos, charged particles and gravitational waves by both ground-based and space-based installations. Such studies are called multi-messenger astronomy.

Since 2015, Baikal-GVD underwater neutrino telescope, has been deployed on Lake Baikal. At the moment, its effective volume is 0.7 cubic kilometers. New installation clusters are deployed annually, and in 2024, during the ice expedition, for the first time, 12 Chinese-made optical modules were installed on one of the telescope's string together with scientists from the High Energy Institute (Beijing). The possibility of increasing the size of the installation to 30 cubic kilometers is being considered, which is not possible without close cooperation with the BRICS countries.

In 2022, in the Tunka Valley, 50 km from the southwestern tip of Lake Baikal, the creation of a complex of TAIGA-1 with a hybrid detector system on an area of 1.1 km 2 for the study of very high energy gamma and cosmic rays fluxes was completed. The approach used in the project, in which the Cherenkov radiation of Earth atmospheric showers is detected by both a network of wide-angle detectors and Imaging Atmospheric Cherenkov Telescopes, is the most cost-effective way for creating of gamma observatory with an area of tens of square kilometers. Currently, the development of a project and detectors for a full-scale complex of TAIGA-100 with area of about 100 km 2 for PeV gamma-astronomy has begun. International cooperation is also extremely important for the implementation of this ambitious project.

The report presents the current status of the Baikal-GVD and TAIGA projects, plans for their development, possible areas of cooperation with the BRICS countries, as well as some scientific results already obtained.

Dmitry Chulkov (Institute of Astronomy of RAS)

Pleiades multiplicity hidden in Gaia data.

Open clusters represent a population of stars with a common origin, united in age and chemical composition, grouped relatively compactly in space. This makes them useful for developing evolution models or as markers of galactic structure. Multiplicity is an essential, yet often poorly known, characteristic of a stellar population. Known since prehistoric times, the Pleiades cluster is the largest within 400 pc of the Sun, representing an important benchmark for astronomers. In recent years, the Gaia mission by the European Space Agency has produced one of, if not the, most demanded

data products in modern astronomy. These data are implemented to produce an accurate, high-completeness census of Pleiades stars with masses larger than half that of the Sun, based on available proper motion, parallax, and radial velocity information. Gaia DR3 data are complemented by auxiliary datasets whenever necessary to ensure the inclusion of sources with unreliable or incomplete astrometric solutions. Subsequently, an artifact in Gaia data induced by different pipelines used for its multicolor photometric data is exploited to reveal previously unknown binary stars with subarcsecond angular resolution. Overall, 24 ± 3 cluster members with angular separations between 0.1 and 1 arcsec (13.5 to 135 AU projected distance) and mass ratios of components q > 0.5 are deemed binary; for 6 of them, binarity was previously unknown. The overall binarity fraction in the considered parameter space is estimated to be 6 ± 1%. The findings are confirmed with follow-up high-angular-resolution observations using the 2.5-meter telescope of the Caucasian Observatory of the Sternberg Astronomical Institute, Lomonosov Moscow State University. The observational survey for the whole sample of cluster members is ongoing.

Ilkham Galiullin (Kazan Federal University)

TBD

Cataclysmic variables (CVs) are compact binary systems in which a white dwarf accretes matter from a Roche-lobe-filling companion star. Many CVs appear as periodic sources in optical light curves. Furthermore, accretion can lead to outbursts, which can also be observed in their optical light curves, particularly in non-magnetic CVs. We present a modern multiwavelength approach to classifying new CVs among stellar objects based on an "X-ray Main Sequence," a phase space of X-ray-to-optical flux ratio, and a Gaia optical BP–RP color. With our method, we identified a dozen new CV candidates in a cross match of different X-ray catalogs, Gaia proper motion data, and the optical ZTF database. We searched for variability in our objects based on ZTF optical photometry. To confirm the nature of our objects, we undertook optical spectroscopic follow-up observations with the Keck and Palomar Observatories. We discovered a handful of new magnetic and non-magnetic CVs, including an eclipsing AM CVn and the period-bouncer CV. These results show that a joint X-ray and optical analysis can be a powerful tool for finding new CVs in large X-ray and optical catalogs.

Ayush Garg (Indian Institute of Technology, Indore)

Time & Flux-Resolved Spectroscopic Study of Ultra-Long GRB 220627A

The ultra-relativistic, highly collimated jets generated by Gamma-Ray Bursts (GRBs) provide crucial insights into particle emission. These jets also reveal the physical mechanisms driving the rapid release of high-energy gamma-ray photons. This presentation will discuss time-resolved and flux-resolved spectroscopy for the ultra-long GRB 220627A. The analysis spans a duration exceeding 1200 seconds using Fermi telescope data. Two prompt emission episodes observed by Fermi-GBM, separated by more than 500 s, were analyzed. Due to its unique characteristics, GRB 220627A serves as an excellent source for studying particle emission processes, small-scale variability, and central engine properties. To investigate gravitational lensing, the time bins of the first episode were correlated with those of the second episode. A coherent relationship was observed between flux and photon spectral distribution. This relationship was modelled using power law and exponentially cut-off power law models for both episodes. The hardness ratio was inconsistent across both episodes. LAT detected high-energy gamma-ray photons only for up to 700 seconds, thus ruling out gravitational lensing. These results suggest that GRB 220627A is an ultra-long GRB with two episodes rather than a lensed GRB. Our findings from spectral analysis reveal characteristics most consistent with those of an ultra-long GRB. Parameters such as isotropic energy, jet velocity, and burst duration align with the established limits for a blue supergiant progenitor, as the literature describes.

Mansur Ibrahimov (Institute of astronomy of RAS)

Asteroid in exoplanet systems as transient objects: an exotic red flares as their observational manifestation

Optic/IR photometry of available published data on exotic red flares (RFs) was compiled and discussed. So far, RFs have been observed: a) in IR space missions (1-2 yr-long IR-flares observed using WISE/NEOWISE and Spitzer in NGC2547 ID-8, HD 166191, WD 0145+234, and some other objects); b) in 5 optical system with normal stars (UU CrB, AZ Ori, FF Ori, IX Oph, CU Cnc; 3 of 5 systems are binary; 7 single flares were observed in 1980-2009 having a 1-hour average duration, an amplitude up to 2 mag, and an energy up to 10^39 erg/sec); c) in 3 optical/hi-energy system with a compact object (V404 Cyg, MAXI J1820+070, Swift J1858.6-0814; all systems are binary hosting a black hole or neutron star as a component, a ""forest"" of tens of flares were observed having a sub-second duration, an amplitude up to 1.6 mag, and an energy of order of 10^36 erg/sec); d) in near-IR on 2MASS-stars (hundreds of flares were found on the base of statistical study of more than 1300 2MASS M dwarfs). RFs are assumed to be produced by a collisional impact and distraction of asteroid-like bodies in exosystems. All above data independently supports an idea that an exotic red flare is a real and well-distributed

phenomenon. The data also suggests that RFs look like a transient event in optic/IR. Undoubtedly, RFs serve deeper and wider investigation including BITDN facilities and keeping in mind their connection to the asteroid in exosystems.

Narusha Isaacs-Klein (University of the Western Cape)

TBD

The impact of visualization and technology on understanding Astrophysical concepts. The difference between accessibility and trained accessibility with technology and visualization tools.

Anna Kartashova (Institute of astronomy of RAS)

Meteor Optical Observations for Solving Various Tasks

Observations of various types are necessary to solve a wide range of tasks of meteor astronomy, including the study of the influx of meteor matter to Earth, the study of meteor shower parameters, the registrations of new meteor showers, obtaining estimates of the mass and density of meteor particles in each stream and sporadic background, monitoring the distribution of meteor matter in the Solar System, both to ensure the safety of space flights and to reduce the threat of "asteroid hazard". To study meteor matter and its flux (including to identify new and study the main parameters of known meteor showers) and the sporadic background (which contributes most of the influx of the meteor matter), observations from different geographical locations are necessary. Obtaining observational data at various longitudes, without interruptions, allows us to study the fine structure of meteoroid streams. With this approach, it is possible to register various inhomogeneities in the stream, differing both in the density of the particle distribution in the flow and in the mass distribution. In recent years, the most popular method has been the television (optical) observation method. The number of meteor systems used by professional meteor groups in collaboration with amateur astronomers located around the world is constantly increasing. This presentation discusses the features of optical observations and the research results obtained with their help. Various properties of selected fluxes (radiant, orbital parameters, etc.) are considered. The mass distribution of meteor matter is often estimated using a special parameter - the mass index (s). The paper presents estimations of s for selected meteor showers, while the masses of meteor particles were estimated using different methods based on observational data (photometric mass, empirical dependence estimate).

Pavel Kaygorodov (Institute of Astronomy of RAS)

Tomo-V - a new instrument for Doppler tomography

I want to present a new tool for Doppler tomography - Tomo-V (https://tomo-v.inasan.ru). This tool was developed using the Algebraic Reconstruction Technique (ART), which was not widely used before in tomography, since its direct implementation had high computational complexity. I have developed a fast version of this algorithm, which made it possible to implement it as a web application that runs at an acceptable speed in a browser on a personal computer. Using this method, it is possible to obtain sharp tomographic images from blurred profiles; in addition, the method has shown good results in restoring images from noisy data, from a small number of profiles, as well as from profiles contaminated with absorption lines and emission of the expanding envelopes. Tomo-V also includes tools for analyzing the obtained tomograms, allowing to display accretion disks and Roche lobes on the tomogram, as well as the back projection of the tomographic image onto flow elements in spatial coordinates. With Tomo-V it is possible now to make Doppler tomograms for data, which was not acceptable before for Doppler tomography.

Irek Khamitov (Kazan Federal University)

Extragalactic X-ray sources with anomalously high proper motions discovered with the SRG/eROSITA

Extragalactic X-ray sources with anomalously high proper motions discovered with the SRG/eROSITA. By comparing the SRG/eROSITA X-ray catalog of stars with X-ray activity and the GAIA DR3 optical catalog, we obtained a sample of about 500 objects with properties of extragalactic sources, but with statistically significant values of proper motions. About half of the sources are confirmed AGNs and galaxies with spectrally measured redshifts. To explain the observed proper motion of these objects, the apparent velocities of the components must be superluminal. The imitation of significant proper motions can be explained by the well-known VIM-effect (variability induced motion). Presence of the long-term transient events on the line of sight in the vicinity of AGNs and quasars (within the Gaia optical resolution element) can produce the photocenter shift measured with GAIA. In our view, the most typical of the known astrophysical manifestations of this kind of transient events are the following: supernova outbursts, tidal disruption events in binary SMBHs, the presence of stellar OB associations against the background of AGNs with a variable brightness high-amplitude

long-term changes (increases) in the brightness of massive supergiants with outflowing envelopes and stellar winds like eta Carinae. For the remaining half of discovered peculiar objects the additional spectroscopic observations are needed to identify their nature. Such a work, as an ongoing observational project, is performed by us on the 1.5-m optical Russian–Turkish telescope RTT-150.

Nikolai Kiselev (Institute of Astronomy of RAS; Crimean Astrophysical Observatory of RAS), M. Shcherbina (Institute of Astronomy of RAS), E. Zhuzhulina (Crimean Astrophysical Observatory of RAS), N. V. Karpov (Institute of Astronomy of RAS)

Results of Polarimetric Monitoring of Selected Atmosphereless Solar System Bodies and Comets in 2019–2024

The interest in studying small bodies, such as asteroids and comets from different dynamic groups, as well as planetary satellites, is due to their important role in the formation and evolution of the Solar System and the origin of life on Earth.

We present the results of new polarimetric observations of near-Earth asteroids (NEAs), large satellites of Jupiter and Saturn, and both long- and short-period comets. These observations were conducted using identical two-channel photoelectric polarimeters with the 2.6 m telescope of the Crimean Astrophysical Observatory and the 2 m telescope at the Peak Terskol Observatory from 2019 to 2024. The following results were obtained and will be discussed:

1. The phase-angle dependence of polarization for 19 NEAs, including the rare high-albedo E-type asteroid 2010 XC15 with low polarization, and the low-albedo C-type asteroid 25330 (1999 KV4) with extremely high polarization. We determined the geometric albedo and sizes of some NEAs.
2. The precise shape of the negative branch of polarization for Jupiter’s moons Europa, Io, and Ganymede, as well as Saturn’s moons Dione, Rhea, and Enceladus, was established. The longitude variations of polarization for some planetary satellites were detected. Notably, temporal changes in Io's longitude polarization suggest long-term changes in the satellite's local or global volcanic activity.
3. The phase-angle dependence of polarization for 18 short-period and 25 long-period comets were obtained. Using all available data, small but systematic differences in polarization of long-period and short-period comets were found.

Toktarkhan Komesh (Nazarbayev University)

Measurements of Early-Time Spectral Shapes of GRBs Using NUTTelA-TAO

Instruments such as the ROTSE, TORTORA, Pi of the Sky, MASTER-net, and others have recorded single-band optical flux measurements of gamma-ray bursts starting as early as ~ 10 seconds after gamma-ray trigger. The earliest measurements of optical spectral shape have been made only much later, typically on hour time scales, never starting less than a minute after trigger, until now. We designed and built a unique instrument, the Burst Simultaneous Three-channel Imager, mounted on the 700 mm aperture Nazarbayev University Transient Telescope at Assy-Turgen Astrophysical Observatory (NUTTelA-TAO), to make these measurements. The system can point and track any celestial target above 15◦ altitude in ≤ 8 s, responding automatically to Swift and other real-time GRB alerts, with time resolution down to ~ 0.1 seconds. We observed GRB 201015A and GRB 200925B starting only 58 and 129 seconds, respectively, after the BAT trigger, measuring in three Sloan filter bands, g', r', and i'. We did not find evidence for a two-component jet structure or a transition from reverse to forward shock or a prompt emission component that would explain this change in slope. We find that the majority of the optical spectral slope evolution is consistent with a monotonic decay of extinction, evidence of dust destruction. Our work shows that significant information about the early emission phase is being missed without such early observations with simultaneous multi-band instruments.

Dmitry Korotyshkin (Kazan Federal University), Sherstyukov O.N., Valiullin F.S. (Kazan Federal University)

Perspectives on the Development of the Meteor Radar at Kazan Federal University

The meteor radar at Kazan Federal University (KFU) is a unique instrument in Russia for the research of micrometeors. The smallest particles of matter entering the Earth's atmosphere burn in the upper mesosphere to lower thermosphere (70-110 kilometers), leaving ionized trails that are detected by the meteor radar.

Radiometeor research at KFU has been conducted for more than 70 years. In 2015, a meteor radar of the common SKiYMET model (produced in Australia and Canada) was installed at the radio station of the Problematic Radio Astronomy Observatory. The measuring baselines of the phase interferometer were 45x45 meters. In 2020, the hardware and software of the meteor radar were upgraded: the measuring baselines increased to 220x160 meters, and the number of receiving channels increased from 5 to 12. This

allowed the number of recorded meteors to double (up to 60,000 per day) and improved the angular resolution of meteor reflections by four times (with a resolution no worse than 0.3 degrees).

The report will present the main astronomical capabilities of the updated all-weather meteor radar at KFU, along with a number of results from 24-hour radio meteor observations conducted between 2015 and 2024.

In addition, the presentation will include future perspectives for the development of the radiometeor method.

Vitaly Kozinets (Kazan Federal University), Maria Sergienko (Kazan Federal University), Nefedyev Yu.A. (Kazan Federal University), Andreev A.O. (Kazan Federal University; Kazan Power Engineering University)

Study of the dynamics and evolutionary processes of near-Sun asteroids

We consider near-Sun and near-Earth asteroids as well as dust rings existing in the inner part of the Solar System. Their distributions for orbital parameters and color indices are examined. The results obtained will allow to understand the physics of dynamic processes in both the Solar System and, as a consequence, the evolution of exoplanet systems. Keywords: near-Sun asteroids, near-Earth asteroids, dust rings.

Gaurav Kumar (Fergusson College (Autonomous), Pune)

Understanding the Redshift of Recombination in the Universe

Cosmology, the study of the universe's origins, evolution, and ultimate fate, relies on mathematical frameworks to understand cosmic dynamics. Central to this field are the Friedmann equations, which describe the universe's expansion by accounting for the roles of matter, radiation, and dark energy. This talk explores these fundamental equations, beginning with the necessary background to derive and interpret them, and establishing a foundation for understanding their implications.

In the project on which talk is based, I used numerical integration in Python to model various types of universes, each characterized by different proportions of matter, radiation, and dark energy. These models illustrate how each component influences the universe's early conditions, expansion rate, and long-term evolution. The findings highlight the critical role of dark energy in driving accelerated expansion, while matter and radiation shape the universe's behavior during different epochs.

Additionally, I delve into the concept of fractional ionization, emphasizing its crucial role in the early universe, particularly in the formation of cosmic structures. The analysis also examines the cosmic microwave background (CMB), a relic radiation that provides vital insights into the universe's early state and subsequent development.

Ultimately, my talk underscores the importance of the Friedmann equations in uncovering the universe's past and predicting its future, seamlessly integrating theoretical concepts with practical computational techniques.

Misra Kuntal (Aryabhatta Research Institute of observational sciencES), Dimple, K. G. Arun

Understanding the GRB classification conundrum

GRBs are traditionally classified into two categories based on the T_{90} duration. GRBs with $T_{90} > 2$ sec are classified as long, and those with $T_{90} < 2$ sec are classified as short GRBs. This also indicates two different progenitor channels for the two classes. However, the recent discoveries of GRBs have challenged this classification. In this talk, I will discuss the GRB classification conundrum and the application of machine learning to classify GRBs and their progenitors. I will discuss the possible progenitors of GRBs with the kilonovae association.

Eduard Kuznetsov (Ural Federal University), M. I. Galiullin, D. V. Glamazda, Yu. S. Wiebe (Ural Federal University)

Dynamic and physical parameters of near-Earth asteroids from SBG telescope observations

Observations of near-Earth objects (NEOs) have a few features that distinguish them from main belt asteroids. The periods of visibility during which NEOs are accessible to small and medium-sized ground-based telescopes are irregular. The smaller the size of an NEO, the longer the time intervals between its appearances on average, and the shorter the time intervals that allow observations to be made. In the case of close approaches of asteroids to the Earth, it becomes possible to observe small objects with diameters of a few tens or hundreds of meters, but the area of the Earth's surface from which observations can be made is reduced. Each occurrence of NEOs becomes a unique transient phenomenon that provides new information characterizing the dynamic and physical properties of the asteroid. We performed astrometric and multicolor photometric observations of near-Earth asteroids at the SBG telescope of the Kourovka Astronomical Observatory of the Ural Federal University in 2023-2024. We improved orbital elements for 26

asteroids from astrometric observations, including potential hazardous asteroid (439437) 2013 NK4 and seven NEOs with diameter more than 1 km. Furthermore, we estimated the axial rotation periods of the asteroids (154029) 2002 CY46 and (154244) 2002 KL6 from photometric observations. We obtained color indices for 15 asteroids from multicolor photometric observations in filters V, R, and I. Also, we estimated the Tolen's taxonomic classes for three asteroids, using the color indices V-R and V-I. The most reliable results are obtained for two asteroids: (1685) Toro is classified as a class S asteroid and (25330) 1999 KV4 is a class B. The work was supported by the Ministry of Science and Higher Education of the Russian Federation, topic FEUZ-2023-0019.

Vladimir Lukin (VE Zuev Institute of Atmospheric Optics SB RAS), Konyaev P.A., Bolbasova L.A., Borzilov A.G. (VE Zuev Institute of Atmospheric Optics SB RAS), Kolobov D.Yu., Kovadlo P.G., Shikhovtsev A.Yu. (Institute of Solar-Terrestrial Physics SB RAS)

Transition from multi-loop adaptive optics systems for solar telescopes to multi-conjugation ones

Atmospheric turbulence is known to limit the resolution of ground-based optical telescopes and cause image jitter and scintillation. To improve image quality, ground-based solar telescopes are equipped with adaptive optics (AO) systems. Classic AO systems use one tilt corrector and one deformable mirror coupled to the telescope aperture plane, as well as a wavefront sensor. Therefore, achieving diffraction-limited images using the first generation of AO systems for large-aperture telescopes turned out to be practically impossible, as a result, the next generation AO systems are currently being developed, which use several deformable mirrors and/or wavefront sensors - a multi-conjugate adaptive optical system. AO systems for solar telescopes use a multi-conjugation AO system, in which each deformable mirror adjusts its conjugate layer in the atmosphere. As a result, each mirror is optically coupled to a different height in the atmosphere, namely the one where phase distortion occurs. A study of the world literature allows us to conclude that the authors of the most modern developments on AO systems are inclined to believe that the construction of a multi-mirror system can be approached only after a thorough analysis of the vertical profile of the turbulence level, which makes it possible to install wavefront correctors in planes associated with the strongest layers of atmospheric turbulence. For Russia's one of the largest solar telescope, Large Solar Vacuum Telescope (LSVT), approaches were developed to determine the characteristics of turbulence in different layers of the troposphere. These investigations were carried out with the financial support of the Russian Science Foundation (Grant No. 23-42-00043).

Aleksander Lutovinov (Space Research Institute of RAS)

Hard X-ray sky with SRG/ART-XC: steady-state and transient

An overview of highlights and discoveries from Mikhail Pavlinsky ART-XC telescope on board the SRG observatory is presented. Since 2019 SRG/ART-XC has conducted several full all sky surveys, a deep survey of our Galaxy, as well as observations of a significant number of regions and objects in the sky, including observations of unique transient events. As a result, we obtained the catalogue of hard X-ray sources detected at the all sky, which includes more than one and a half thousand objects, as well as the catalogue of sources in the Galactic Center region. Hundreds of new objects have been detected, including new microquasars, slowly rotating neutron stars, dwarf novae flares, Swift J1727.8-1613 -- the brightest object in the X-ray sky of 2023. In February 2024 SRG/ART-XC discovered a new accreting millisecond pulsar demonstrating quasi regular X-ray bursts and effects of the GR in its pulse profile. We also obtained a unique X-ray light curve of the most powerful gamma-ray burst GRB221009A and estimated its luminosity and total energy release. At this moment SRG/ART-XC continues the all sky surveys.

Oleg Malkov (Institute of Astronomy of RAS)

Binary star database update based on Gaia data.

Binary and multiple systems are very numerous and constitute an important parts of the stellar population. Depending on the observational method, they might have various sets of observational parameters, identification systems and designations in different catalogues/databases. Thus, it is necessary to identify an object in different datasets. This could be done with a unified dataset containing all binary and multiple systems with proper cross-identification of systems and components. This dataset is Binary star DataBase (BDB, bdb.inasan.ru) together with its index catalogue: Identification List of Binaries (ILB). There remains the necessity of updating the catalogue, in particular, the results of the Gaia mission could significantly augment its data. In this work we report new data in BDB obtained by the Gaia mission.

Alexander Meshcheryakov (Space Research Institute of RAS)

Machine learning models for SRG/eRosita extragalactic sky survey: challenges, results and perspectives.

During the 2.5 years in 2019-2022 the eROSITA telescope onboard the SRG space observatory produced a deep all-sky survey in soft X-rays. The competitive analysis of this unique data requires an intensive application of modern machine learning techniques together with massive usage of available sky surveys data in the broad spectral range from Radio to UV, which is the main task for SRGz system. I will describe the current status of SRGz models and their results in identification, classification and photo-z determination for X-ray sources in the eROSITA X-ray sky survey in the eastern extragalactic hemisphere (|b|>20deg, 0<180deg).

Papers:

«SRGz: Machine Learning Methods and Properties of the Catalog of SRG/eROSITA Point X-ray Source Optical Counterparts in the DESI Legacy Imaging Surveys Footprint», 2023, DOI: 10.1134/S1063773723070022

«SRGz: Classification of eROSITA Point X-ray Sources in the 1%DESI Region and Calibration of Photometric Redshifts», 2024, DOI: 10.1134/S1063773723110129

Pavel Minaev (Space Research Institute of RAS), Pozanenko A.S. (Space Research Institute of RAS)

EHD method of gamma-ray transients classification

Fast gamma-ray transients could be caused by various progenitors. Type I (short) gamma-ray bursts (GRB) are believed to be connected with a merger of two neutron stars while type II (long) gamma-ray bursts are associated with the type Ic core collapse supernovae. Unfortunately, anomalies in the correlation between the duration of the gamma-ray bursts and the type of their progenitors complicate the classification. For example, some type I bursts are accompanied by an additional long duration component - extended emission. Moreover, short hard emission is typical for both short GRBs and giant flares of soft gamma repeaters observed from Galaxy and nearby galaxies. Nevertheless, the correct classification of gamma-ray transients is crucial for studying their progenitors. We present one of the most reliable methods of gamma-ray transients classification, using correlations between energetics ('E'), spectral hardness ('H') and duration ('D') parameters of each transient and its type of progenitor - the EHD method.

Arkady Mkrtchyan (Moscow Institute of Physics and Technology, Space Research Institute of RAS), Pozanenko A.S., Minaev P.Yu. (Space Research Institute of RAS)

Segmented gamma-ray spectrometer for polarization registration of transient gamma-ray sources

When observing astrophysical objects, insufficient attention is still paid to measuring the polarization of gamma-ray sources. Examples of such sources are cosmic gamma-ray bursts, the mechanism of radiation of which is not fully understood. The principle of registration of linear polarization of gamma radiation is based on the anisotropy of Compton scattering. This property is used in the development of polarimeters, which are segmented scintillation detectors. An additional advantage of segmented detectors is a significantly lower susceptibility to dead time effects when registering very bright events, such as, for example, GRB 221009A and the possibility of localizing point sources.

The Space Research Institute Russian Academy of Sciences is developing a segmented gamma-ray spectrometer (SGS), which is part of the payload of the Chibis-AI spacecraft. One of the tasks of the SGS is to register the polarization of gamma-ray bursts and the most powerful terrestrial gamma-ray flashes. A similar detector is being developed for the International Lunar Research Station.

The SGS detector was simulated and calibrated using the Geant4 software package. The accuracy of measuring the degree of linear polarization depending on the flow and the possibility of autonomous localization of point sources are investigated.

Igor Nikolenko (Institute of Astronomy of RAS)

Observation of Supernova SN2023ixf within a year after its outbreak

In May 2023, a polarimeter was commissioned on the Zeiss-1000 telescope (Simeiz INASAN Observatory) to observe extended objects (mainly comets). With this polarimeter, we conducted a series of observations of the Supernova SN2023ixf from July 2023, to July 2024, In addition, we made several measurements of this Supernova using the infrared photometer of the Crimean Astronomical Station GAISH (CAS MSU). Here are the results of measurements of the brightness of the Supernova in the spectral bands UBVRI JHKLM and estimates of the magnitude of linear polarization for the spectral bands BVRI, both the Supernova itself and the region of the galaxy M101 located next to it. In September 2023, the supernova turned noticeably red,

and in May-July 2024, it weakened to a level comparable to neighboring sources in the galaxy.

Devendra K. Ojha (Tata Institute of Fundamental Research (TIFR), Mumbai)

Disk-mediated accretion bursts in low- and high-mass young stellar objects and infrared instrumentation.

Understanding how stars form within the Universe is one of the fundamental questions in modern astrophysics and is central to many other fields. In this talk, I will briefly describe the current astrophysical understanding of the formation of low-mass (Sun-like) and high-mass (> 8 M_{Sun}) stars out of the interstellar medium in the Milky Way, based on our long-term monitoring observations of a few rare type of eruptive young low-mass young stellar objects (e.g., FUors, EXors, etc.) and from our ongoing investigation of high-mass star formation at the periphery of Galactic H II regions. In the second part of my talk, I will give a brief description of the activities of the Infrared Astronomy Group of TIFR with special emphasis on the ground-based near-infrared and balloon-borne Instrumentation for star formation studies.

Nicolai Pankov (National Research Institute Higher School of Economics), A. Pozanenko (Space Research Institute of RAS), E. Schekotikhin (National Research Institute Higher School of Economics), P. Minaev, S. Belkin, E. Mazaeva, A. Volnova (Space Research Institute of RAS)

Automatic Observation Planning and Image Processing in the Search for Optical Transients

The automation of optical surveys in the era of investigations of transient phenomena in multiwavelength (Gamma-, X-rays, UV/Optical/IR, Radio-waves), and multichannel (electromagnetic, gravitational wave) is important in many ways. First off, observations of large localization areas of transients, which can reach hundreds of square degrees, must be carried out optimally from point of view of an airmass and localization probability. Secondly, lots of images ingested during observations are have to be reduced to obtain lists of candidate transients. Finally, both these processes must be performed as close to real-time as it can be in order to follow up and measure fast decaying transients. We present software approaches for the automatic observation

scheduling AWARE and astronomical image processing (Starfall, APEX). The AWARE, Starfall, and APEX flow charts, and main capabilities are demonstrated. Thus, AWARE processes alert messages on transients, and performs scheduling for the network of telescopes. APEX reduces series of raw images to retrieve lists of candidate transients. Starfall runs APEX pipelines on newly ingested survey images automatically. We display current results obtained with mentioned software.

Natalia Petrova (Kazan Federal University; Kazan Power Engineering University), Nefedyev Yu.A., Zagidullin A.A., Andreev A.O. (Kazan Federal University; Kazan Power Engineering University)

Study of the influence of the Earth's flattening on the physical libration of the Moon

At the Department of Astronomy and Space Geodesy of the Kazan Federal University, the construction of a numerical and analytical theory of the physical libration of the Moon has been implemented for several years. The task that is relevant today is to achieve the accuracy of the theory of 1 ms of arc in determining the libration angles. The dynamic factors considered in the theory being developed are the potential energy of interaction of the lunar body with the point-like Earth up to the 4th order inclusive in the expansion of the selenopotential, as well as the direct and indirect influence of Jupiter and Venus, and finally the influence of tidal deformation of the lunar body by the averaged potential method.

At present, the analytical theory is consistent with similar theories with an accuracy of 50 ms, the numerical theory – with an accuracy of 20 ms over a time interval of 800 years. In the presented study, we considered the effect of the Earth's flattening. For this, we used the expression for the quadrupole-quadrupole potential obtained in the works of V. V. Beletsky and his colleague V. A. Sarychev. The libration equations were obtained by the Hamilton method, and we obtained their solution by both analytical and numerical methods. According to calculations, the contribution of the quadrupole-quadrupole potential is a million times less than the contribution of the 2nd-order harmonic. Nevertheless, our calculations showed that its inclusion led to the appearance of an additional contribution to the values of the physical libration angles of about 5-10 ms, i.e., within the required accuracy, this effect must be taken into account. The analytical solution allowing us to identify at what frequencies the influence of the Earth's flattening effect is most noticeable.

Jinsong Ping (National Astronomical Observatories of CAS)

TBD

In BRIC members, the China and Russia space agencies are jointly promoting the International Lunar Research Station, the ILRS. Astronomical study is a key part for this joint station project. Among the objectives, we are suggesting a joint study as Dynamics of Lunar Rotation & Frame Tie of Astronomy. The joint team likes to suggest a mission by means of sitting the lunar surface radio beacons, new lunar laser retro-reflectors, and GNSS receiving systems on the Moon, to strength the observation studies for the lunar dynamics, inner structure, and for linking the celestial reference frames of VLBI radio sources, GNSS and Earth-Moon ephemeris. All BRIC members are welcome to join the ground observation and to promote the lunar surface instruments.

Alexei Pozanenko (Space Research Institute of RAS), IKI GRB-FuN team

Transient observations with the IKI GRB Follow up Network

We consider observations of various transients in gamma rays, optical and radio frequencies using the Space Research Institute Follow up Network (IKI GRB-FuN). We describe the facilities used for transient search and observation, the pipelines used for planning, data processing and transient search. The facilities and software packages can be used in BRICS collaborative research. In particular, we present the results of the most interesting discoveries and observations, such as GW 170717 / GRB 170817, GW 190425 / GRB 190425, GRB 221009A and others.

Anna Romanovskaya (Institute of astronomy of RAS), Yu. Pakhomov, I. Potravnov, T. Ryabchikova (Institute of Astronomy of RAS), A. Kniazev (South African Astronomical Observatory), N. Piskunov (Department of Physics and Astronomy, Division of Astronomy and Space Physics, Uppsala University)

The perspectives of southern magnetic peculiar stars study with SALT telescope

A self-consistent extended spectroscopic analysis of the southern star MX TrA was performed based on the high-resolution spectra obtained with spectrograph mounted on the SALT telescope of the South African

Astronomical Observatory. Spectrum variability together with the derived chemical abundances and atmospheric parameters show that MX TrA is a typical member of silicon subgroup of Ap stars with spotted surface structure. Maps of Si, He, Fe, Mg, O, and Cr were constructed by Doppler Imaging technique and then used for modelling of the light curves in different photometric bands. The modelled light curve in TESS photometric band fits the observed photometry better than 0.001 mag, confirming again that the photometric variability of magnetic stars is caused by inhomogeneous surface abundance distribution. The abundances analysis of Fe and Si in different ionization stages indicate the presence of vertical abundance stratification, however, the rapid axial rotation (vsini = 69 km/s) prevent to study abundance vertical structure directly. A possible abundance gradients were estimated using spectra of sharp-lined twin Si-star BD +00 1659 (vsini = 7 km/s) with the same atmospheric parameters and abundances as MX TrA. The presence of abundance stratification increases the emergent flux, and this effect is very sensitive to the position of abundance jump in stellar atmosphere. This research was funded by Russian Science Foundation (project No 24-22-00237).

Mikhail Sachkov (Institute of Astronomy of RAS)

TBD

The Spektr-UF (WSO-UV) project is an efficient multipurpose orbital observatory for high and low resolution spectroscopy, high sensitivity imaging and slitless spectroscopy in the ultraviolet. The project has a high scientific relevance. After 2029, the project will be the only observatory in the world for high-resolution spectroscopy in UV. There are no critical technical problems. Key systems are at the Technology Readiness Level of at least 7. Individual components of the Scientific Equipment Complex have passed design and finishing tests or are at the stage of preparation for them. Readiness is above 50%. The readiness of the on-board module of the service systems of the Spektr-UV spacecraft is estimated at 70%. Here we present a current status of the project.

Nail Sakhibullin (Kazan Federal University)

History of Astronomy in Kazan University

In this report I plan to give brief information about astronomical education and scientific studies in Kazan University from beginning in 1810 till present, including important persons in Kazan Astronomy - Lobachevsky, Simonov, Khabibullin, etc.

Vladimir Samodurov (P.N. Lebedev Physical Institute of RAS, Astro Space Center, Pushchino Radio Astronomy Observatory)

Stream processing of data from the monitoring radio survey of the northern hemisphere for a frequency of 110 MHz at the BSA FIAN radio telescope

Since July 2012, the BSA radio telescope of the Lebedev Physical Institute has been conducting 24/7 monitoring, currently covering about 48% of the celestial sphere per day at declinations between –8° and +55°. The two observation modes are recorded in 6 and 32 frequency channels and with a time constant of 100 and 12.5 milliseconds using the 128-beam diagram of the BSA. At present, more than 350 TB of data have been accumulated. A data processing pipeline has been developed, consisting of the following stages:

- by calibrating and initially processing the data, we convert them into metadata with a step of 10 seconds for all observed frequencies and beams of the radio telescope;

- from the metadata, the output of information on transients up to events (to search for pulsars, lightning discharges, EAS from cosmic rays, FRB) has been previously developed, the results have been and are being published;

- this paper describes a pipeline for identifying common radio sources (the time scale is the size of the BSA diagram in R.A. - from 6 to 10 minutes) and monitoring their brightness and scintillation index for more than 10 years with a step from several days to a year. The pipeline includes: first, assembling reference metadata templates in intervals from 9 days to 1 year with the rejection of outlier observations and averaging the remaining ones. Second, data convolution according to the BSA diagram for subtracting the reference data template in order to better identify possible variable radio sources on scales from days to years. Third, radio sources are identified by mathematical data filtering, monthly catalogs are formed from about 15-30 thousand sources, then mass monitoring of their fluxes and scintillation indices is carried out. The first results have been obtained and will be presented.

Sergei Schmalz (Keldysh Institute of Applied Mathematics of RAS), E. Pavlova, V. Voropaev, A. Mokhnatkin, A. Novichonok, M. Tereshina (Keldysh Institute of Applied Mathematics of RAS)

Observations of astronomical transients, space debris and minor planets by KIAM/ISON optical telescopes

ISON (International Scientific Optical Network) is the only full-fledged initiative of its kind involving multiple BRICS countries to coordinate international observing campaigns with optical telescopes. ISON, spearheaded by the KIAM RAS (Keldysh Institute of Applied Mathematics of the Russian Academy of Sciences), focuses primarily on space debris, near-Earth objects and transients. The network encompasses roughly twenty operational and planned sites where electro-optical facilities of varying designs associated with different institutions can efficiently conduct regular joint observing campaigns. This decentralized framework, based on scientific and technical cooperation agreements, represents a unique example of mutually beneficial cooperation between nations at different levels of development in space science and technology.

In the scope of space debris tracking and survey observations ISON engages optical telescopes with diameters ranging from 19 to 100 cm in both astrometry and photometry. KIAM RAS performs daily conjunction analysis for high-altitude objects. An open photometry database is under construction. The software for autonomous planning and performing of observations in its present state of improvement already allows ISON to acquire position measurements of more than 600 different space objects with a single wide-field survey telescope on a fully clear winter night.

Currently, a sub-network of ten observatories performs photometric observations of stellar transients, astro- and photometric observations of minor bodies of the Solar System. Numerous results of these observations have been published in the NASA Gamma-ray Coordination Network Circulars, the Minor Planet Electronic Circulars of the IAU Minor Planet Center and the Minor Planet Bulletin.

Andrei Semena (Space Research Institute of RAS)

TBD

A review on the near real time analysis pipeline for the Mikhail Pavlinskiy SRG/ART-XC telescope.

Maria Sergienko (Kazan Federal University), Nefedyev Yu.A. (Kazan Federal University), Andreev A.O. (Kazan Federal University; Kazan Power Engineering University)

Analysis of the dynamic parameters of the Cancrids meteor shower and its drift motion

We consider the Cancrids meteor shower and analyze its dynamical parameters. For each branch of the shower we determined radiants, their displacements, and radiation areas. The dependences of the semi-major axis

and eccentricity on magnitude were studied. Resonances from Jupiter were determined for the meteor shower. It is concluded that the branches of the shower have different evolutionary mechanisms of origin. Keywords: meteor shower, radiants, meteor complex, resonances.

Marina Shcherbina (Institute of Astronomy of RAS), Busarev V. (Sternberg Astronomical Institute of MSU), Kiselev N. (Institute of Astronomy of RAS; Crimean Astrophysical Observatory of RAS)

Active Asteroids: Relevance, Research Methods, Results

Active asteroids (AAs) are a unique class of objects with asteroid-like orbits that exhibit comet-like characteristics, such as tails and comae. The discovery of objects classified as both asteroids and comets has led to the concept of an asteroid-comet continuum, which suggests blurred boundaries between asteroids and comets that may share common origins and evolutionary paths. The activity of asteroids can be caused by various mechanisms, the primary distinction between which is the periodicity of the phenomena, identified through regular observations.

The study of the physico-chemical properties of surface materials, as well as the presence and composition of a tenuous exosphere of AAs, is conducted using three methods: spectrophotometry, UBVRI-photometry, and polarimetry. Research is carried out at the INASAN in collaboration with the SAI MSU, and the CrAO.

Changes in the reflection spectrum obtained through spectrophotometry, such as peaks in reflectance, can indicate light scattering on dust particles or molecules in the exosphere, aiding in the identification of objects with sublimation-dust activity. UBVRI-photometry, especially in the U-band, is sensitive to such changes and allows for the rapid study of many asteroids. About 30 AAs have been identified using these two methods.

Polarimetry provides information about the size and structure of particles. Observations at large phase angles and analysis of phase-angle dependence of polarization help identify candidates for AAs.

Although AAs are of great interest, there is still insufficient data for comprehensive statistical analysis and identification of influencing factors. Therefore, international collaboration between scientific institutions is crucial for the effective study of these objects.

Eugene Shekotihin (National Research Institute Higher School of Economics), Nicolai Pankov (National Research Institute Higher School of Economics), A. Pozanenko, S. Belkin, A. Volnova, P. Minaev (Space Research Institute of RAS)

Application of neural networks to image subtraction for optical transient source detection

With the beginning of a new gravitational-wave era in astronomy and astrophysics, the problem of identification of gamma-ray bursts optical counterparts is becoming more relevant than ever before. The application of existing methods for identifying transients, in particular image subtraction, is complicated by several factors; the main ones are the variability of observation conditions and the variability of other sources not related to the desired counterpart, as well as the possible absence of reference images from the observatory at which the search is being conducted. This paper examines the results of using Deep Image Prior neural network to translation images from the Pan-STARRS survey to images from the AS-32 telescope of the Abastumani Astrophysical Observatory for the purpose of their subsequent subtraction for the identification and photometry of optical transients. Using examples of fragments of images of the M82 galaxy, the potential of the Deep Prior approach is demonstrated for both detection of transient events in M82 and for their flux estimation.

Andrey Shugarov (Institute of Astronomy of RAS), Shustov B. (Institute of Astronomy of RAS)

On ground-based and space-born network to detect decameter class asteroids in the near-Earth space

As was demonstrated by the Chelyabinsk event on February 15, 2013, collisions of the small (decameter class) Near-Earth objects (NEOs) with the Earth can pose a danger to the inhabitants of our planet. Such bodies are faint and can be systematically detected only in near-Earth space. Moreover, half of them approach the Earth from the side of the day-time sky and they can only be detected with special space-born facilities.

A civil space safety program "Milky Way" is being developed in Russia. Solution of the NEO problem (asteroid/comet hazard) is a part of the program. BRICS countries were recently invited by the head of ROSCOSMOS for international collaboration on the asteroid hazard problem.

We propose to build two segments regarding the problem under discussion:

- ground-based network: a network of small/moderate aperture wide-field optical telescopes to search for asteroids in the night-time hemisphere. This may be part of the BITDN Project.

- space-based segment: a spacecraft in L1 point of the Sun-Earth system to search for asteroids in the day-time hemisphere which are unobservable with ground-based telescopes.

For years we have worked on the SODA Project (System of Observation Day-time Asteroids). The payload SODA consists of a set of wide-field telescopes with an aperture of 30 cm. It is under development at INASAN. Detection will be carried out using a barrier technique.

The efficiency of asteroid detection from L1 can be significantly increased using triangulation tracking mode if two spacecraft are operated simultaneously. Cooperation within BRICS countries is welcome to build the second spacecraft to operate in L1.

A combination of space-based (SODA) and ground-based projects like BITDN is a proper way to provide a realistic real-time warning system against decameter-size impactors.

Boris Shustov (Institute of Astronomy of RAS)

TBD

In some cases, optical transients as objects of basic science are directly linked to practical needs of humanity. This is certainly true for small bodies of the Solar System. In particular, small bodies are source of danger for all mankind (asteroid-comet hazard aka NEO problem) and for states engaged in space activities (the problem of the meteoroidal situation in the near-Earth space).

The report briefly discusses two scientific problems, the solution of which is closely related to practical tasks. These are:

1. Inventory and statistics of NEOs. We still have little information about the number and properties of NEOs less than ~100 m in size (which most often collide with the Earth and are therefore the most dangerous on a reasonable time scale.)
2. Origin and evolution of meteoroid flows. Of particular interest are active NEOs and asteroidal origin of meteoroid flows. Understanding of these processes is required to build a reliable dynamic model for forecasting the meteoroid situation in the OKP.

The problems are of global nature and are natural subject of international cooperation. A brief overview of ongoing multilateral cooperation to study and parry them is presented. Particular attention is paid to the prospects of cooperation within the framework of BRICS on prospects of the BITDN on both space and ground systems aimed at detection of small bodies (NEOs and meteoroids) and big data processing.

Satish Sonkamble (Centre for Space Research, North - West University, Potchefstroom (SA))

MGCLS DR1 field: A multiwavelength study of WISE mid-infrared galaxies

We developed a pipeline to compile an X-ray catalog of galaxies identified through the MeerKAT Galaxy Cluster Legacy Survey (MGCLS) by cross-matching data from the Dark Energy Camera Legacy Survey (DECaLS), Mid-IR WISE survey, and LoTSS 144 MHz radio survey. Numerous mid-IR galaxies were detected. The key statistical characteristics of these sources were examined in their X-ray spectral analysis and a spectral-energy-distribution (SED) fitting using MAGPHYS and X-CIGALE to investigate the AGN and host-galaxy physical properties - such as stellar mass, star-formation rate (SFR), infrared (IR) luminosity, X-ray luminosity, and hydrogen column density of our detected mid-IR galaxies and active galactic nuclei (AGN) at redshift < 4. We also studied different correlations among these physical properties.

Jing Sun (National Astronomical Observatories of CAS)

TBD

Radar astronomy observations provide information on surface characteristics, orbits, rotations, and polar ices for a wide variety of solar system objects. Based on Chinese VLBI network (CVN), Russian VLBI Network (Quasar) and the telescopes in the South Africa, we propose the possible joint radar observations based on the current and future radar instruments.

Dmitriy Tagaev (Ural Federal University), Seleznev A.F. (Ural Federal University)

Possible open clusters members with `bad' astrometric solutions of Gaia

Data from the Gaia catalogs (today it is Gaia DR3) are the basis for selection of probable members of open clusters (OSCs). To do this, various statistical methods are applied to multidimensional spaces of star parameters from the Gaia catalogs: coordinates, parallaxes, proper motions, stellar magnitudes and color indices. As a result, one immediately excludes stars with two-parameter solutions (19% of Gaia DR3). In addition, to obtain samples of probable OSC members, stars with `good' astrometric solutions are selected, with a restriction on the errors of trigonometric parallaxes and/or on the RUWE parameter. We estimate how many stars with `bad' Gaia astrometric solutions or with two-parameter solutions can be members of OSCs. As an

example, we study cluster NGC 3532. First, we counted stars with 5- and 6-parameter solutions. As a result, we estimated the cluster radius to be 178±3 arcminutes and obtained a preliminary estimate of the number of stars to be 2,210 (G≤18 mag). Then, we constructed a Hess diagram in the (G, BP-RP) plane for stars from the Hunt & Reffert (2023) sample and selected stars from the Gaia DR3 catalog that have either 2-parameter solutions, or relative parallax errors ≥0.2, or RUWE>1.4 values falling into the region occupied by the cluster at the Hess diagram. As a result, we selected 11,123 stars within a circle of the cluster radius. These stars noticeably concentrate towards the cluster center. Using this fact, we estimated that 2,100 such stars could be cluster members. Thus, the number of `lost' stars is close to the number of cluster stars determined in the usual way. It is especially important, that numerous unresolved binary systems could be among the `lost' stars.

Zheng-Hong Tang (Shanghai Astronomical Observatory, Chinese Academy of Sciences)

Digitization of historical photographic plates and its application on long-term time domain astronomy

Long-term time domain astronomy relies on observational data covering large time span. Photography technology was invented in the 1850s and quickly was used to record information of celestial objects. About 3 million astronomical plates had been taken worldwide before 2000, each of them is the only observation record of the sky region at that time that cannot be reproduced by modern telescopes.

Astronomical plates can only be applied to scientific research after being digitized into digital data precisely. Due to technical limitations, by now only small part of plates were locally digitized. In 2000 and 2018, the IAU GA twice called on astronomical community to work together and cooperate on digitizing astronomical plates. With the support of the Ministry of Science and Technology of China, the Shanghai Astronomical Observatory of the Chinese Academy of Sciences (SHAO) has established an advanced laboratory for plate digitization since 2009. In 2016, one high-precision and fast astronomical plate digitizing machines was successfully developed. In 2017, about 30,000 Chinese astronomical plates spanning nearly a century had been digitized and can be used by astronomers worldwide through Chinese Virtual Observatory. Considering the wide use of technology of precise digitization in other research fields, such as remote sensing, surveying and mapping, medicine, biology and so on, four new generation high-precision digitizing machines have been developed under the support of the Shanghai Municipal Science and Technology Commission during 2019-2023. All of them can be used to digitize astronomical plates. Since there are plenty of historical plates in many

Observtories of BRICS, SHAO would like to cooperate all Observatories in this field. After digitizing all plates, we can cooperate on image analysis and do research on long-term time domain astronomy jointly.

Alexander Tarasenkov (Institute of Astronomy of RAS; Sternberg Astronomical Institute of MSU)

Investigation of different types of variable objects with TESS data

TESS spacecraft obtained a large amount of high-precision photometric data, which can be used to solve a huge number of astronomical problems. But the accuracy and completeness of the data provided by the TESS open data archive is not always enough to solve them. So we present simple but powerful pipeline based on Lightkurve and Astrobase, for raw TESS data reduction and analysis.

We also present a short overview of our research in which we use TESS data, analysed using this pipeline. We are conducting a program to search and confirm variable stars using archives of frames from small photometric telescopes SAI and INASAN, in which we use high-precision photometry TESS and ZTF. We are also conduct mapping chromospherically active stars using on light curves extracted from raw TESS data by our pipeline.

We also present photometry of dwarf novae and other transient astronomical objects based on our processing of TESS data.

Vladimir Usanin (Kazan Federal University)

Concerning the existence of the Uranus comet family

The Radzievskij-Tisserand criterion is applied to 27P/Crommelin, 38P/Stephan-Oterma, and 55P/Tempel-Tuttle for the evaluation of the hypothesis that they belong to the Uranus family. No dynamical relation of these comets to Uranus is revealed.

Valery Vlasyuk (Special Astrophysical Observatory of RAS)

Multi-band studies of some blazars with optical and radio telescopes of SAO RAS

TBD.

Alina Volnova (Space Research Institute of RAS), Pozanenko A., Belkin S. (Space Research Institute of RAS)

Gamma-ray bursts and Supernovae Connection

Past two decades of researches established well the observational connection between long gamma-ray bursts (GRBs) and type Ic supernovae (SNe). Since the first observational association between the long GRB 980425 and coincident low-luminous SN Ic 1998bw and up till now several dozens of spectroscopically confirmed GRB-SNe were discovered. However, the amount of light curves suitable for good modelling of GRB-SNe physical properties is still low. In this talk we review the history of GRB-SNe discovery, including the evolution of methods of the physical parameters modelling. We present optical light curves of GRB-SNe observed by the Space Research Institute GRB Follow-up Network (IKI GRB FuN) and discuss several outstanding examples of well-sampled light curves and their numerical modelling. We also present several cases of GRBs, which do not follow the usual behavior of regular GRB-SNe despite of the resemblance of their observational properties.

Svetlana Voskresenskaia (National Research Institute Higher School of Economics)

ComPACT: Combined ACT+Planck galaxy cluster catalogue

Galaxy clusters are the most massive gravitationally bound systems consisting of dark matter, hot baryonic gas and stars. They play an important role in observational cosmology and galaxy evolution studies. We develop a deep learning model for segmentation of Sunyaev-Zeldovich (SZ) signal on ACT+Planck intensity maps and construct a pipeline for microwave cluster detection in the ACT footprint. The proposed model allows us to identify previously unknown galaxy clusters, i.e. it is capable of detecting SZ sources below the detection threshold adopted in the published galaxy clusters catalogues (such as ACT DR5 and PSZ2). In this paper, we use the derived SZ signal map to considerably improve a cluster purity in the extended catalogue of Sunyaev-Zeldovich objects from Planck data (SZcat) in the ACT footprint. From SZcat, we create a new microwave galaxy cluster catalogue (ComPACT), which includes 2,962 SZ objects with cluster purity conservatively estimated as ~ 74-84 per cent. We categorise objects in the catalogue into 3 categories, based on their cluster reliability. Within the ComPACT catalogue, there are >~977 new clusters with respect to the ACT DR5 and PSZ2 catalogues.

NASA.ads:
https://ui.adsabs.harvard.edu/abs/2024MNRAS.tmp.1272V/abstract

Samuel Bogale Worku (Ural Federal University)

TBD

We analyzed a sample of 1472 X-ray detected AGN in the COSMOS field, extending our study to the green valley (GV), blue cloud (BC), and red sequence (RS) AGN, selected via U-B rest-frame color criteria. Previous research indicated that GV-selected far-infrared (FIR) AGN exhibit enhanced star formation rates (SFR) compared to non-AGN sources, contrary to earlier optical and X-ray studies. Our multiwavelength study encompassed optical, X-ray, and radio data to further investigate this phenomenon. In the X-ray band, we examined various properties such as X-ray-to-optical flux ratio, hardness ratios, X-ray luminosities, and the positioning of sources on the X/O-hardness ratio plane, the X-ray luminosity-redshift plane, and the X-ray luminosity-stellar mass plane. In the radio band, we analyzed the distribution of BC, GV, and RS AGN concerning their radio luminosities at 1.4 GHz and 3 GHz, X-ray to radio luminosity ratio, accretion rates, jet luminosity, and radio classification. Additionally, we assessed the SFR and black hole mass distributions of these AGN categories and their positioning relative to the main sequence of star formation. Our results reveal that BC, GV, and RS active galaxies exhibit very similar properties in X-rays and radio, spanning a relatively narrow range of the parameters analyzed. We confirmed that not only GV AGN but also BC and RS FIR AGN show enhanced SFRs, reaffirming the complex role of AGN in star formation quenching. This contradicts previous optical studies and underscores the necessity of multiwavelength data for understanding AGN influence on star formation. Further studies are essential to elucidate these complex scenarios.

Carlos Alexandre Wuensche (Instituto Nacional de Pesquisas Espaciais)

TBD

We intend to present the BINGO capabilities to detect transients, particularly Fast Radio Bursts.

Igor Zinchenko (Federal Research Center A.V. Gaponov-Grekhov Institute of Applied Physics of the RAS)

Accretion bursts in massive young stellar objects

There are still several competing scenarios of high mass star formation. A key question is whether this process is a scaled-up version of the low-mass star formation or is significantly different. Observations at various scales and regular monitoring in various bands are essential for selection between

different scenarios. The accretion flow can be irregular due to disk fragmentation. Such a behavior in low-mass (proto)stars is confirmed by luminosity outbursts, which have been observed in these objects for decades (FUor and EXor outbursts). In recent years several similar events have been detected in high-mass young stellar objects (YSO). One of the first such events was registered towards the 20 M⊙ YSO S255 NIRS 3 as IR and methanol maser flares. In our ALMA observations of this area we detected a burst in the submillimeter continuum and a new, never predicted methanol maser line. This object belongs to the well-known star-forming complex sandwiched between the evolved H II regions S255 and S257. We have observed this area with several single-dish radio telescopes (IRAM-30m, OSO-29m, MPIfR 100-m) and with radio interferometers (ALMA, GMRT, SMA, VLA). These observations include imaging in continuum and in many molecular lines. The frequency coverage was from ~600 MHz (GMRT) to ~350 GHz (ALMA). The angular resolution achieves ~15 milliarcseconds (for ALMA observations), which corresponds to ~25 au at the distance to S255. In addition, we combine our radio data with our and other available data in other bands. In general, these observations confirm the scenario of episodic disk accretion as a formation mechanism for ~20 M⊙ stars. Further studies of its evolution after the recent accretion burst would be very important. The work is supported by the Russian Science Foundation grant 24-12-00153.

Roman Zolotarev (Institute of Astronomy of RAS), B. Shustov (Institute of Astronomy of RAS)

On the distribution of NEO encounter parameters

In this talk we present the results of statistical modeling of the entry of near-Earth objects (NEOs) into the near-Earth space. The distributions of asteroids with respect to the direction and velocity of approaching to the Earth are constructed. The NEO population was modeled using the NEOMOD package and integrated for 110 years using the REBOUND package. The main results are: 1) the number of asteroids larger than 10 m in size entering to near-Earth space is approximately 1000 per year; 2) up to half of the asteroids can enter the near-Earth space from the side of the day-time-hemisphere; 3) there is anisotropy in the flux density of incoming asteroids. Typical velocity of approach to the Earth at the entrance to the near-Earth space is approximately 7.5 km/s (maximum speed can reach up to 30 km/s). The results can be useful in the design of a System of Observation of Day-time Asteroids (SODA).