SPECIAL ASTROPHYSICAL OBSERVATORY RUSSIAN ACADEMY OF SCIENCES

ACTIVE GALAXIES AT DIFFERENT SCALES AND WAVELENGTHS — 2024

ABSTRACT BOOK

Nizhnij Arkhyz (Russia)

14-17 Octomber 2024

The Conference Website:`https://www.sao.ru/hq/saoagn24/`

Welcome

A leading center of the Russian ground-based observational astronomy, Special Astrophysical Observatory of the Russian Academy of Sciences, is organising an international conference "Active galaxies at different scales and wavelengths". The main purpose of the conference is the discussions of observation manifestations of the Active Galactic Nucleus (AGN) phenomenon on different spatial and time scales: from the central engine in the internal parsec — to the feedback processes in the host galaxy disk and beyond, from the interday flux variability — to the AGN duty cycle and cosmological evolution. The Conference is planned to be held in an in-person format.

The conference will focus on the following main topics:

- Physics of AGN Broad Line Regions, including Changing-look phenomenon, AGN monitoring from radio to X-ray.
- AGN evolution and feedback processes revealed from multiwavelength and 3D spectroscopic surveys.
- Large-scale emission line structures in AGN hosts and intergalactic medium.

Scientific Organizing Committee:

- Balashev Sergei (Ioffe Institute, Russia)
- Chen Yanmei (Nanjing University, China)
- Dodonov Sergei (Special Astrophysical Observatory, Russia)
- Ilic Dragana (Belgrade Observatory, Serbia)
- Moiseev Alexei (Special Astrophysical Observatory, Russia) — co-chair
- Popovich Luka (Belgrade Observatory, Serbia) — co-chair
- Sanchez Sebastian (UNAM, Mexico)
- Sazonov Sergei (Space Research Institute, Russia)
- Sotnikova Yulia (Special Astrophysical Observatory, Russia)

Local Organizing Committee:

- Chazov Maxim
- Korchagina Elena
- Kotov Sergei
- Kudriasheva Anastasia
- Maricheva Margarita
- Moiseev Alexei — chair
- Oparin Dmitry
- Perepelitsyna Yulia
- Smirnova Aleksandrina
- Tepliakova Arina
- Uklein Roman
- Zhelenkova Olga

Confirmed invited speakers:

- An Tao (Shanghai Astronomical Observatory, China)
- Chen Yanmei (Nanjing University, China)
- Ilic Dragana (Belgrade Observatory, Serbia)

SAO RAS Telescopes

The Special Astrophysical Observatory of the Russian Academy of Sciences was founded in 1966. At present this is the Russian center for ground-based astronomical observations. The main instruments are: the optical telescope BTA and the radio telescope RATAN-600. The telescopes have the status of national instruments. The observatory has a branch in SaintPetersburg.

BTA – the Big Telescope Azimuthal – is the Eurasia's largest optical telescope with a main mirror diameter of 6 meters. This is the first large telescope on alt-azimuth mounting.

The telescope height is 42 m, the weight is about 600 tons. The dome is 52 m high. The focal distance of the primary focus is 24 m, that of Nasmyth focuses is 180 m.

Spectral and photometric observations of stars and galaxies are conducted with the BTA including observations with high angular, temporal, or spectral resolution.

RATAN–600 is the only radio telescope in the world with a ring main mirror with a diameter of 600 m, which consists of 895 elements — flat metallic panels 11.5 m high.

The wavelength range is from 1 to 50 cm. Radio observations of the Sun, the nearest planets, the interstellar medium, active objects of the Universe, and the microwave background are carried out in three focuses.

1. Program

Sunday, October 13

Reception and opening registration desk.

Monday, October 14

- 08:00 - 09:30 Breakfast.
- 09:30 - 09:40 **Gennady Valyavin** (SAO RAS director).
  Opening talk.

- 09:40 - 10:20 **Dragana Ilic**.
  Optical time-domain analysis of AGN and the potential to study their extreme variability (invited talk).
- 10:20 - 10:50 **Sergey Sazonov**.
  X-ray variability of SDSS quasars based on the SRG/eROSITA all-sky survey.

- 10:50 - 11:20 Coffee-break

- 11:20 - 11:50 **Vineet Ojha**.
  Unveiling the Temporal and Spectral Variability in Nearby and Distant Gamma-NLS1 Galaxies.
- 11:50 - 12:20 **Luka Popovic** (online).
  Unusual broad line profiles of AGNs and sub-pc supermassive binary black holes.
- 12:20 - 12:50 **Ruancun Li** (online).
  The Transient Slim Disk of the Changing-look Active Galactic Nucleus 1ES 1927+654.

- 13:00 - 14:00 Lunch

- 14:00 - 14:30 **Yulia Sotnikova**.

  Radio variability of high-redshift quasars.

- 14:30 - 15:00 **Valery Vlasyuk**.

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

- 15:00 - 15:30 **Marina Butuzova**.

  Correlation and evolution of the blazar S5 1803+784 short-term variability properties during 01.2022 – 01.2023.

- 15:30 - 16:00 Coffee-break.

- 16:00 - 16:20 **Dmitrii Zagorulia** (online).

  Morphological Classification of Jets in Active Galactic Nuclei.

- 16:20 - 16:40 **Arina Arshinova**.

  Polarization of active galactic nuclei with significant VLBI-Gaia displacements.

- 16:40 - 17:00 **Ekaterina Shishkina**.

  Searching for rotations of the polarization position angle of quasars.

- 17:00 - 17:20 **Vladimir Amirkhanyan**.

  S5 0716 + 713: linear polarization oscillation.

- 17:20 - 17:30 Poster session.

- 19:00 Welcome cocktail.

Tuesday, October 15

- 09:00 - 09:40 **Luis Ho** (online).

  Black Holes at Cosmic Dawn.

- 09:40 - 10:10 **Wei-Jian Guo** (online).

  Changing-look AGN in DESI.

- 10:10 - 10:40 **Alexei Moiseev**.

  The supermassive black holes merging in Tick-Tock AGN (SDSS J1430+2303): Pro and Contra.

- 10:40 - 11:20 Coffee-break.

- 11:20 - 11:50 **Meicun Hou**.
  An X-Ray Census of Active Galactic Nuclei in the Virgo and Fornax Clusters of Galaxies with SRG/eROSITA.
- 11:50 - 12:20 **Sergey Sazonov**.
  SRG/ART-XC all-sky X-ray survey: Catalog of sources detected during the first five scans.
- 12:20 - 12:50 **Igor Zaznobin**.
  Optical identification of active galactic nuclei from the SRG/ART-XC all-sky X-ray survey.

- 13:00 - 14:00 Lunch.

- 14:00 - 14:30 **Georgii Khorunzhev**.
  A problem of classification the eROSITA Tidal disruption events among another X-ray variable sources.
- 14:30 - 15:00 **Maxim Barkov**.
  Ultrafast VHE Gamma-Ray Flares of AGN.

- Excursion to the 6-m telescope.
- 19:00 - 20:00 Dinner.

Wednesday, October 16

- 09:00 - 09:50 **Marko Micic** (online).
  Low-mass galaxy interactions trigger AGN activity.
- 09:30 - 10:10 **Yan-Mei Chen**.
  Galactic scale outflows in MaNGA survey.
- 10:10 - 10:40 **Sergei Balashev**.
  The view on quasar nearby environment through the proximate absorption systems.

- 10:40 - 11:20 Coffee-break.

- 11:20 - 11:50 **Alexander Meshcheryakov**.
  Search for distant X-ray quasars with machine learning techniques.
- 11:50 - 12:20 **Sergei Dodonov**.
  Optical identification of X-ray ROSAT sources in the field HS47.5/22.
- 12:20 - 12:50 **Sergey Kotov**.
  Searching for galaxies with active nuclei.

- 13:00 - 14:00 Lunch.

- Excursion to RATAN-600 and RT-32 radiotelescopes.
- 19:00 Conference dinner.

Thursday, October 17

- 09:00 - 09:40 **Tao An** (online, invited). AGNs in the early Universe.
- 09:40 - 10:10 **Irina Proshina** (online). Star-forming ring in the galaxy with AGN NGC 5347.
- 10:10 - 10:40 **Sergei Khrapov**. Accretion of intergalactic matter onto S-galaxies: formation mechanisms of polar rings.

- 10:40 - 11:20 Coffee-break.

- 11:20 - 11:50 **Olga Zhelenkova**. State of the steep spectrum sample of the experiment Cold according to modern sky surveys in the optical and radio ranges.
- 11:50 - 12:20 **Alexander Mikhailov**. Broadband radio properties of the FR0 radio galaxies.
- 12:20 - 12:40 **Milica Andjelić**. Extragalactic search for supernova remnants.
- 12:40 - 13:00 **Dejan Urošević**. Particle acceleration on strong shocks of supernova remnants.

- 12:30 - 13:00 Close of the conference.
- 13:00 - 14:00 Lunch.
- 12:30 - 13:00 Close of the conference.
- 13:00 - 14:00 Lunch.
- 14:00 Excursion to the archaeological museum.

2. List of abstracts

2.1 Invited talks

AGNs in the early Universe

Tao An (Shanghai Astronomical Observatory, China), Yulia Sotnikova, Shaoguang Guo, Yuanqi Liu, Ailing Wang, Yingkang Zhang, Mikhailov Alexander, Mufakharov Timur et al.

Abstract:

TBD

Galactic scale outflows in MaNGA survey

Yanmei Chen (Nanjing University, China), Yan-Mei Chen, Zhi-Jie Zhou, Xiao Cao, Alexei Moiseev, Dmitry Bizyaev, Min Bao, Yong Shi, Qiu-Sheng Gu.

Abstract:

We select 142 galactic scale outflow candidates with enhanced [OIII]λ5007 equivalent width (EQW) along photometric minor axis from MaNGA Survey, including 81 star-forming galaxies, 31 composite galaxies, and 30 AGNs according to the [N II]-BPT diagram. We analyse the morphologies of the outflows, the primary driven mechanisms, as well as their influences on host galaxy properties. In addition, detailed studies on gas kinematics of outflow galaxies find several interesting cases, such as a dual active black hole system with mass ratio 10 in a regular disk galaxy; galaxies with different [OIII]λ5007 and $H\alpha$ kinematics.

Black Holes at Cosmic Dawn

Luis Ho (Kavli Institute for Astronomy and Astrophysics, Peking University).

Abstract:

I will discuss the discovery, based on JWST observations, of a new class of sources called ”Little Red Dots” at redshifts 5 to 11, which are the progenitors of quasars and AGNs at lower redshifts. These sources have remarkable and unexpected properties that are both puzzling and fascinating, offering

new clues on the formation mechanism of supermassive black holes, AGN evolution, AGN-galaxy coevolution, and AGN feedback.

Optical time-domain analysis of AGN and the potential to study their extreme variability

Dragana Ilic (Belgrade Observatory, Serbia), Luka Č. Popović, Andjelka Kovačević.

Abstract:

Optical time-domain astronomy is particularly effective for investigating active galactic nuclei (AGNs) due to their significant optical variability, which is considered a universal intrinsic characteristic of all AGNs. Studies of optical variability may provide crucial insights into the accretion disk and its interaction with the supermassive black hole (SMBH) and other surrounding emitting and absorbing regions. Cases of extreme variability, such as "changing-look" transitions, are especially intriguing and are increasingly being discovered through current and upcoming ground- and space-based time-domain surveys. These transients could offer valuable insights into the origins of AGN activity. For instance, one type of transient event, known as a Tidal Disruption Event (TDE), occurs when a star is partially or completely destroyed by an SMBH. TDEs can also take place in AGNs, although they are difficult to detect. They have been proposed as a possible scenario for extreme AGN variability and changing-look transitions, potentially offering clues to the triggers of AGN activity. Moreover, the population of changing-look AGNs is now large enough that they can be divided into sub-classes of changing-obscuration and changing-state AGNs. In this talk, we will introduce the extremely variable AGNs and provide a brief (and likely not comprehensive) overview of the current status of time-domain studies of AGNs and their extreme variability, with a focus on the upcoming largest time-domain survey by the Vera C. Rubin Observatory - the Legacy Survey of Space and Time (LSST).

2.2 Talks

S5 0716 + 713: linear polarization oscillation

Vladimir Amirkhanyan (SAO RAS).

Abstract:

Linear polarization observation's of S6 0716 + 714 in filter R was carried out by Zeiss-600 SAO RAS: 4419 exposures in 2019-2022. The author claims that oscillations of the polarization degree's have

a harmonic component as a function of the flow of the object. Oscillation period is 3 - 8 mJy in the range of flux density 5 - 55 mJy.

Extragalactic search for supernova remnants

Milica Andjelić (University of Belgrade).

Abstract:

TBD

Polarization of active galactic nuclei with significant VLBI-Gaia displacements

Arina Arshinova (SAO RAS), Dmitry Blinov.

Abstract:

We conducted optical polarimetric observations of 157 AGN using three telescopes. These observations are complemented by other publicly available polarimetric measurements of AGN. We cross-matched the public astrometric data from VLBI and Gaia experiments, obtained the corresponding positional displacements, and join this catalog with the polarimetric and jet directions data. Additionally, we cross-matched the catalog of polarization measurements at 44 GHz by the Planck observatory with the the catalog of AGN with significant VGD. As a result, AGN with downstream VGD are confirmed to have significantly higher optical fractional polarization than the upstream sample. Meanwhile, the mm-wavelength polarization of both samples shows very similar distributions. Our results support the hypothesis that the VLBI-to-Gaia displacements pointing down the radio jet are likely caused by a component in the jet emitting highly polarized synchrotron radiation and dominating in the overall optical emission. The upstreamoriented VGD are likely to be produced by the low-polarized emission of the central engine sub-components dominating in the optical.

The view on quasar nearby environment through the proximate absorption systems

Sergei Balashev (Ioffe Institute).

Abstract:

In this talk I will present results from our ongoing follow-up studies of the high-redshift quasars selected through the molecular hydrogen (H2) proximate absorption systems. Recently using we found that

the H2 detection rate is significantly enhanced in the proximate quasar absorbers in comparison with intervening ones. We initiated follow-up studies of the H2 absorption candidates selected using SDSS catalog in the optical and mm domain, using VLT, NOEMA and ALMA. These observations indicate that identified proximate H2 absorption systems have different origin, including the nearby galaxies in the groups, outflowing AGN gas and the gas of the galaxy from the major merger. Moreover, an associated Damped Lyman Alpha (DLA) system acts as a natural coronagraph that may completely remove quasar continuum emission at particular wavelengths that facilitate the studies of the AGN nearby gas in emission using IFU facilities. NOEMA observations reveal a large reservoir of the molecular gas in the AGN host galaxies and/or its environment, with in some cases enhanced velocity dispersion. The most recent ALMA observations of one particular target confirmed the ongoing major merger. The optical spectra towards the bright AGN allow us to analyse H2 lines in details and derive the physical conditions (UV field and number density) in the cold (T 100K) gas through the modelling of H2 excitation diagram. Consequently, an estimate on the distance between absorber and AGN central engine can be obtained. This provides an important input for the simulation of the gas in the close vicinity of AGN and its impact of the nearby environment. The work is supported by RSF grant 23-12-00166.

Ultrafast VHE Gamma-Ray Flares of AGN

Maxim Barkov (INASAN).

Abstract:

We analyze three scenarios to address the challenge of ultrafast gamma-ray variability reported from active galactic nuclei. We focus on the energy requirements imposed by these scenarios: (I) external cloud in the jet, (II) relativistic blob propagating through the jet material, and (III) production of high-energy gamma-rays in the magnetosphere gaps. We show that while the first two scenarios are not constrained by the flare luminosity, there is a robust upper limit on the luminosity of flares generated in the black hole magnetosphere. This limit depends weakly on the mass of the central black hole and is determined by the accretion disk magnetization, viewing angle, and the pair multiplicity. For the most favorable values of these parameters, the luminosity for 5-minute flares is limited by $2 \times 10^{43} ergs - 1$, which excludes a black hole magnetosphere origin of the flare detected from IC 310. In the scopes of scenarios (I) and (II), the jet power, which is required to explain the IC 310 flare, exceeds the jet power estimated based on the radio data. To resolve this discrepancy in the framework of scenario (II), it is sufficient to assume that the relativistic blobs are not distributed isotropically in the jet reference frame. A realization of scenario (I) demands that the jet power during the flare exceeds by a factor 1^2

the power of the radio jet relevant to a timescale of 10^8 years.

Blazar S5 1803+784 short-term variability properties during 01.2022 – 01.2023

Marina Butuzova (Crimean Astrophysical Observatory), Gorbachev M.A., Guseva V.A., Zhovtan A.V., Nazarov S.V., Baida G.V. and Krivenko A.S.

Abstract:

The TESS satellite provides a unique opportunity to track the variability of objects with high temporal resolution over a single set of observations (27 days). For objects located near the ecliptic pole, the TESS data series covers almost 12-13 months continuously. Using TESS data for S5 1803+784 for the period 01.2022 to 01.2023, and supplementing them with multi-band photometric observations from the ZTF survey and the AZT-8 telescope of the Crimean Astrophysical Observatory, we investigate for the first time the relation between the shortest characteristic times and the spectral properties of the variability. For this purpose, firstly, we obtained the light curve by summarizing each 10-20 TESS cuts. This allowed us to remove the false signal possibly present in SAP fluxes and preserved the true long-term trend often eliminated in PDCSAP fluxes. Secondly, a new method for identify the shortest times of variability was applied by applying a structure function to successive sections of a light curve. Thirdly, to unify the ZTF and AZT-8 data, the emission spectral index was determined assuming a power law spectrum. At the final stage, the evolution of temporal and spectral properties of variability and their mutual correlation were investigated. As a result, we registered sharp changes in the characteristic time of variability for successive intervals of the light curve and found no significant dependence of the characteristic time of variability on the spectral index. We interpret it in the assumption of development and evolution sub-component in the jet flow, characterized by different volume and Doppler factor, radiation of which creates variability on the short time scale. At the same time, the detected correlation between the mean amplitude and the characteristic time of variability indicates a possible relation between the Doppler factor and the sub-component volume, which allows us to infer conclusions about the structure of the jet flow. (This work was partly supported by the Russian Science Foundation, No.24-22-00343).

Optical identification of X-ray ROSAT sources in the field HS47.5/22

Sergei Dodonov (IAA RAS, SAO RAS), Kotov S.S.

Abstract:

We present optical identification for 144 X-ray sources detected by the ROSAT observatory in a

field of 2.38 square degrees. These candidates are selected using multicolor images obtained for the HS47.5/22 field with the 1-m Schmidt telescope of the Byurakan Observatory in 16 medium-band and 4 broad-band filters covering the wavelength range 3500-8000 Å. These X-ray sources are relatively weak (CR << $0.2s^{-1}$) and thus are mostly not included in the RBS catalog, a significant fraction of the sources have no previous optical identification. Almost all X-ray sources have one or more optical candidates within their coordinate error boxes. In the process of identification we found 5 "empty fields" and 449 objects into the error boxes of the X-ray source coordinates. We classified 449 detected optical candidates up to $m_r = 22.5^m$. Among them are 85 QSOs, 126 stars of different spectral classes and 238 galaxies. In addition, 4 radio sources from the FIRST catalog were detected. For all 449 objects we determined their type and photometric redshifts. The accuracy of determining the photometric redshifts for galaxies was $\sigma_{NMAD} = 0.0043$ with the number of errors greater than 5σ about 8% and for quasars $\sigma_{NMAD} = 0.0136$ with the number of errors greater than 5σ about 3%.

Changing-look AGN in DESI

Wei-Jian Guo (National Astronomical Observatories, Chinese Academy of Sciences).

Abstract:

AGNs undergoing Changing-Look (CL) phases present formidable challenges to both the traditional accretion disk model and the orientation-based AGN unified model. We present the identification of CL-AGNs from the Dark Energy Spectroscopic Instrument First Data Release and Sloan Digital Sky Survey Data Release 16 at z¡0.9. . This intricate process allows us to compile a statistical catalog of 561 CL-AGNs. We find 1)A consistent 283:278 ratio of turn-on to turn-off CL-AGNs, with no indication of evolution with redshift. 2) The Baldwin–Phillips–Terlevich diagram for CL-AGNs shows no distinct difference from the general AGN populations. 3) A strong correlation between the change in the luminosity of broad emission lines (BELs) and continuum luminosity change, with MgII responses akin to Hb during CL phases. 4)The critical value for CL events is established around 1% Eddington ratio. 5) Five CL-AGNs are associated with asymmetrical mid-infrared flares, possibly linked to Tidal Disruption Events. Given the quantity of CL-AGNs and the stochastic sampling of spectra, we propose that some CL events are inherently due to typical AGN variability during low accretion rates, particularly for singular BEL CL.

An X-Ray Census of Active Galactic Nuclei in the Virgo and Fornax Clusters of Galaxies with SRG/eROSITA

Meicun Hou (Nanjing University), Zhensong Hu, Zhiyuan Li.

Abstract:

We present a uniform and sensitive X-ray census of active galactic nuclei (AGNs) in the two nearest galaxy clusters, Virgo and Fornax, utilizing the newly released X-ray source catalogs from the first all-sky scan of Spectrum-Roentgen-Gamma/eROSITA. A total of 50 and 10 X-ray sources are found positionally coincident with the nuclei of member galaxies in Virgo and Fornax, respectively, down to a 0.2-2.3keV luminosity of $\sim 10^{39} erg/s$ and reaching out to a projected distance well beyond the virial radius of both clusters. The majority of the nuclear X-ray sources are newly identified. Several hosts are dwarf galaxies. We find that contamination by nonnuclear X-ray emission can be neglected in most cases, indicating the dominance of a genuine AGN. In the meantime, no nuclear X-ray source exhibits a luminosity higher than a few times 10^{41} erg/s, which might be owing to a steep intrinsic luminosity function. The X-ray AGN occupation rate is only ~3% in both clusters, apparently much lower than that in field galaxies inferred from previous X-ray studies. Both aspects suggest that the cluster environment effectively suppresses AGN activity. The findings of this census have important implications for the interplay between galaxies and their central massive black holes in cluster environments.

A problem of classification the eROSITA Tidal disruption events among another X-ray variable sources

Georgii Khorunzhev (Space Research Institute, Moscow), Gilfanov M.R., Mescheryakov A.V., Sazonov S.Yu.

Abstract:

The four completed SRG Observatory half-year all-sky surveys have yielded a significant number of variable X-ray sources. The SRG/eROSITA telescope has discovered a rich population of tidal disruption events (TDE) that exhibit strong X-ray variability. A search for TDE in the X-ray band offers certain advantages over a selection in the optical range. In X-rays, the background flux of the host galaxy is negligible, allowing us to detect X-ray TDEs with lower luminosity and at greater distances, compared to optical TDE sample. We present study concerns a sample of TDEs selected on the basis of the X-ray flux variability factor (R¿10) between surveys. This corresponds to TDEs

with peak X-ray luminosity in excess of 5e43 erg/s at a typical redshift of z=0.2 of the eROSITA X-ray TDEs. Unfortunatelly, a significant number of AGN displame similar X-ray flux variability on a half-year scale, thus contaminating the list of TDE candidates. Furthermore, a considerable number of TDE candidates lack spectroscopic redshift and classification. A constellation of optical telescopes observes variable SRG sources to obtain a complete spectroscopic sample of TDE. We present the complex method of spectroscopic classification helps to rule out the most AGN. The key relationship between X-ray luminosity and luminosity O[III] (5007A) can be used to confirm the TDE candidate even for an optical spectrum of moderate quality. That permits to study archive X-ray TDE with lower variability factor (R 5) and extend X-ray TDE sample to lower luminosities. Only extremely rare - one might even say unique - variable AGN (Sy2 or LINERS) with soft X-ray spectrum can be misclassified according to this criterion.

Accretion of intergalactic matter onto S-galaxies: formation mechanisms of polar rings

Sergei Khrapov (Volgograd State University), Khoperskov A.V., Khrapov N.S.

Abstract:

The interaction of a gas-rich spiral galaxy with an intergalactic flow can be the cause of some observed phenomena. We model such interaction by a non-uniform gas flow together with a dark mass. The mechanisms of formation of gas rings around the disk of the galaxy are investigated both due to the gas-dynamic effect of the infalling flow on the gas disk and due to the redistribution of angular momentum between the accreting and galactic components. Retrograde accretion of a gas flow without dark matter provides the formation of an outer gas ring. The angle of inclination of the ring to the plane of the galaxy is always greater than the initial angle of incidence of the intergalactic gas. This is due to the peculiarities of gas-dynamic interaction and the redistribution of angular momentum in the system with the occurrence of counter precession of the galactic disk and the plane of the gas ring. The result of the prograde fall of the intergalactic gas is a decrease in the angle between the plane of the gas ring and the galactic disk due to the co-precession of these components. Prograde models with an angle of incidence less than 30 degrees do not produce a long-lived gas ring, since it merges with the gas disk of the galaxy. We also study the consequences of the combined infall of dark matter and intergalactic gas to reveal the role of the dark component in the flow on the conditions for the formation of polar rings and active galactic nuclei. This work supported by the Russian Science Foundation (grant no. 23-71- 00016, https://rscf.ru/project/23-71-00016/). The research is carried

out using the equipment of the shared research facilities of HPC computing resources at Lomonosov Moscow State University.

Searching for galaxies with active nuclei

Sergey Kotov (IAA RAS), Dodonov, S.N.

Abstract:

In a multidimensional color space, the color excesses of distant galaxies form groups defined by their classification, redshift, and the presence and activity of an active nucleus. Using broadband photometry data from the COSMOS survey (Weaver et al. 2021), we developed a method to categorize galaxies into groups based on the k-nearest neighbors algorithm. For each galaxy, the average distance to its nearest n neighbors in color space is calculated, where n is determined by the total number of objects, photometric errors, and the number of photometric bands. The gradient descent method is then used to locate each galaxy's closest density clump: among its nearest neighbors in color space, the galaxy with the highest surrounding density is identified. If this galaxy's nearest k neighbors have a lower surrounding density, it is considered the center of the clump. If not, the next nearest neighbor with the highest surrounding density is determined. This process is repeated in several iterations to find the center of the cluster. We examined these density clumps for the presence of X-ray sources using data from the Chandra telescope. A significant variation in the number of X-ray sources across the groups was observed, ranging from 0% to approximately 20%. A morphological study using HST data revealed that groups with a higher number of X-ray sources predominantly consist of galaxies with nuclear structures. Furthermore, most of the spectra from galaxies within these groups showed signs of active nuclei.

Search for distant X-ray quasars with machine learning techniques

Alexander Meshcheryakov (Space Research Institute, Moscow),

Abstract:

TBD

Low-mass galaxy interactions trigger AGN activity

Marko Micic (University of Oklahoma), Jimmy Irwin, Preethi Nair, Olivia Holmes, Brenna Wells, Jackson Eames.

Abstract:

Recent discoveries of supermassive black holes existing less than 500 million years after the Big Bang represent a major puzzle. How did these black holes grow so much in such a short period of time? In this talk, I will discuss how the early Universe environmental conditions could have led to an accelerated black hole growth. The prevailing wisdom suggests that the early Universe is dominated by dwarf galaxies that are undergoing concurrent and consecutive interactions with other dwarfs. I constructed the largest sample of low-z dwarf-dwarf pairs and groups using the 3D-HST survey, which can be used as local analogs of high-z interacting dwarfs. Then, I used Chandra to discover 6 AGN in these systems, increasing the number of known dwarf-dwarf merger-related AGN from 1 to 7. I constructed a sample of isolated dwarfs, with the same redshift-stellar mass distribution as interacting dwarfs, and found that interacting dwarfs are 6-10 times more likely to host AGN. This discovery demonstrates that low-mass galaxy interactions are very efficient in triggering black hole activity, and opens new avenues in studying the growth mechanisms of the first supermassive black holes.

Broadband radio properties of the FR0 radio galaxies

Alexander Mikhailov (SAO RAS), Yulia Sotnikova, Vlad Stolyarov.

Abstract:

The modern radio sky surveys have shown that compact radio sources, so named FR0 radio galaxies, are the majority among radio loud active galactic nuclei of the local Universe. The numerous FR0 population have to make a significant contribution to cosmic background emissions. These sources have mildly relativistic jets at parsec scales despite lack of prominent extended kpc radio structures. At the same time FR0s are a gamma-ray emitting population as it was established recently. The issue about FR0s nature and their evolution status is open. There is a deficit of radio continuum measurements FR0s until recently. We present the study of 34 FR0s properties at the centimeter range based on monitoring data RATAN-600 in 2020-2024. We show that most of these objects have flat and convex radio spectra with peaks in the GHz range. The spectral modeling of broadband radio spectra shows that a convex spectrum shape can be determined by synchrotron self absorption (SSA) processes with a contribution of the inhomogeneous free-free absorption (FFA) effects in some sources. The FR0s variability doesn't exceed 20% mostly, although there are sources with variability up 40%. We discuss different reasons for observed FR0s variability. The analysis of the light curves at 5, 8 and 11 GHz allows us to determine characteristic time scales 100-900 days and to get constraints of emitting regions sizes about 0.1-0.7 pc.

The supermassive black holes merging in Tick-Tock AGN (SDSS J1430+2303): Pro and Contra.

Alexei Moiseev (SAO RAS),

Abstract:

Since 2022, the galaxy SDSS J1430+2303 is considered as a potential candidate for supermassive black holes imminent merging thanks to its unusual light curve in the optical and X-ray ranges, as well as a significant change in Balmer lines shape in the comparison to the archive data. This report discusses the results of SDSS J1430+2303 new observations obtained at the 6-m telescope, Hubble Space telescope and Mikhail Pavlinsky ART-XC telescope on board the Spektr-RG space observatory. We consider arguments for and against the central black hole duality in SDSS J1430+2303.

Unveiling the Temporal and Spectral Variability in Nearby and Distant Gamma-NLS1 Galaxies

Vineet Ojha (Kavli Institute for Astronomy and Astrophysics at Peking University), Wu, Xue-Bing; Singh, Veeresh.

Abstract:

The variability in intensity across the electromagnetic spectrum is a defining feature of active galactic nuclei (AGNs), providing crucial insights into their emission mechanisms at scales that remain beyond the reach of current imaging technologies. Such variability serves as a potent diagnostic tool for elucidating the underlying physics and properties of AGNs, offering valuable information on the spatial and temporal distribution of emitting regions, the structure and dynamics of accretion disks, and the characteristics of the central supermassive black hole. In this study, we present a comprehensive analysis of flux and color variability in the optical and infrared wavelengths for two gamma-ray detected Narrow-line Seyfert 1 galaxies (gamma-NLS1s), representing the extreme ends of redshift. The selected sources are 1H 0323+342 (z = 0.06), the nearest known gamma-NLS1, and TXS 1206+549 (z = 1.344), the farthest detected to date. Both galaxies exhibit optical flux variability on timescales ranging from minutes to years, as observed with 1-4 meter class ground-based telescopes. Notably, a rapid optical flare was detected from 1H 0323+342, with a magnitude change of 0.07 within 20 minutes during an intra-night observation. In the infrared regime, data from the Wide-field Infrared Survey Explorer (WISE) reveal variability on daily timescales for both gamma-NLS1s. Additionally, a high-cadence color variability analysis using data from the Zwicky Transient Facility (ZTF) indicates

that neither galaxy follows the typical "bluer when brighter" (BWB) or "redder when brighter" (RWB) trends in the optical domain. However, a BWB trend is observed in the infrared data from WISE. We will discuss potential physical mechanisms driving the observed flux and color variability in both optical and infrared wavelengths.

Unusual broad line profiles of AGNs and sub-pc supermassive binary black holes

Luka Popovic (Astronomical Observatory, Belgrade).

Abstract:

TBD

Star-forming ring in the galaxy with AGN NGC 5347

Irina Proshina (Sternberg Astronomical Institute of the Moscow State University), Oparin D.

Abstract:

We obtained a narrowband images of the galaxy NGC 5347 in the $H\alpha$, [NII]λ6583, and [OIII]λ5007 emission lines by using MaNGaL – a mapper with a tunable filter – on the 2.5-meter telescope of the Caucasus Mountain Observatory of the Sternberg Astronomical Institute of the Moscow State University, which showed the presence of ionized gas in the form of a knot about 1.9 arcseconds (300 pc) at size at the center of the galaxy, in the form of a clump about 3.4 arcseconds (540 pc) at size at a distance of 3.7 arcseconds (600 pc) in the northeast of the center and in a ring-like region at a distance of 21 to 44 arcseconds (3.4 - 7.1 kpc) from the center of the galaxy, coinciding with the ring visible in the optical and UV ranges. Analysis of the identified emission regions by using the BPT diagram showed that in the first two locations the gas is ionized by radiation from the active galactic nucleus; in the ring-like region, the gas is ionized by the light of young stars. The ionized gas is distributed unevenly throughout the ring: in the form of separate clumps of different sizes (200 – 1000 pc) and shapes, often conjugate with each other, and there is an absence of star formation clumps along the direction of the minor axis of the ring, onto which the ionization cone of the jet from the AGN is projected. In addition, there are several separated weak clumps of current star formation outside the outer boundary of the ring and two weak clumps of current star formation inside the ring, projected onto the dusty spiral arms that appear in the color index (g-r) map. The metallicity of gas in star-forming clumps ranges from 8.42 ± 0.04 to 8.59 ± 0.03 dex with an average value of 8.50 ± 0.03 dex, demonstrating a correlation with the surface density of the current rates of star formation in these clumps. Moreover, with distance from the center of the galaxy, both the metallicity of the gas and the

surface density of the rate of star formation decrease. The integral rate of star formation in the ring on a time scale of 200 Myr, estimated from the flux in the NUV range by using GALEX images, is equal to 1 M⊙/year, which is typical for spiral galaxies. A comparison of star formation rates on three time scales (10, 100 and 200 million years ago, estimated from fluxes in the $H\alpha$ emission line, FUV and NUV ranges, respectively) indicates the decaying nature of modern star formation throughout the ring as a whole.

The Transient Slim Disk of the Changing-look Active Galactic Nucleus 1ES 1927+654

Ruancun Li (Pekin University), Luis C. Ho, Claudio Ricci, Benny Trakhtenbrot, Erin Kara, Megan Masterson.

Abstract:

In changing-look active galactic nucleus (AGN) the optical-to-X-ray continuum flux typically increases significantly as broad emission lines appear. The changing-look AGN 1ES 1927+654, hosting already a highly accretion black hole, displays peculiar X-ray properties after its optical changing-look events in early 2018. We carried out a follow-up campaign to probe its extreme accretion physics, using 34 optical spectra, 800 NICER and 14 Swift/XRT observations, as well as 7 simultaneous XMM-Newton/NuSTAR exposures. Detailed spectral energy distribution analysis suggests that the black hole was accreting super-critically, with $t^{-5/3}$ declining mass accretion rate. The bolometric luminosity was logarithmically dependent on the mass accretion rate, suggesting the existence of a slim disk. Photon trapping in the slim disk triggered by the high initial $\dot{M}$ was characterized by a low radiation efficiency(3%), which later more than doubled (8%) after 0.55 solar masses of material was consumed. The evolution of the radiation efficiency and disk temperature suggest that the accretion flow finally returned to a thin disk. During the transient slim disk phase, the X-ray corona tightly correlated with the properties of the inner accretion flow, suggesting that the corona plasma originated from the disk itself. Additionally, the UV-X-ray spectral index and bolometric correction follow completely different branch during the slim disk phase. Our work presents compelling observational evidence for the existence of slim accretion disks and elucidates the key parameters governing their behavior, paving the way for further exploration in this area.

”1) SRG/ART-XC all-sky X-ray survey: Catalog of sources detected during the first five scans 2) X-ray variability of SDSS quasars based on the SRG/eROSITA all-sky survey”

Sergey Sazonov (Space Research Institute, Moscow).

Abstract:

TBD

Searching for rotations of the polarization position angle of quasars

Ekaterina Shishkina (St Petersburg University), S. S. Savchenko, D. A. Morozova, S. G. Jorstad, D. A. Blinov, G. A. Borman, A. A. Vasilyev, T. S. Grishina, A. V. Zhovtan, E. N. Kopatskaya, E. G. Larionova, P. A. Novikova, I. S. Troitskiy, Yu. V. Troitskaya, E. A. Shkodkina.

Abstract:

The distinctive features of blazars in the optical range include strong variability in flux density as well as high and variable polarization. Polarimetric observations of blazars have shown that at certain times the position angle of the plane of polarization (EVPA) of the incoming radiation from them exhibits smooth, ordered changes, so-called rotations. Sometimes these events can occur in chains and coincide with blazar activity in other spectral ranges. Since the direction of the EVPA is related to the magnetic field, a detailed study of its rotations will provide information about the fine structure of the blazar jet. We analyzed optical polarization degree and angle curves for 31 objects included in the monitoring program of the observational astrophysics laboratory at St. Petersburg State University, and obtained a sample of more than 600 EVPA rotations. Rotations were detected in all types of blazars, and five sources exhibit a dominant direction of rotations.

Radio variability of high-redshift quasars

Yulia Sotnikova (SAO RAS), Mufakharov T., Mikhailov A., Stolyarov V., Khabibullina M., Mingaliev M., Vlasyuk V., Kudryavtsev D., Kovalev Yu., Semenova T., Volvach A., Kharinov M., Erkenov A., Kudryashova A.

Abstract:

We present a study of the radio variability of radio-loud high-redshift quasars at z¿3 based on the radio data covering a time period of up to 30–40 yrs. The quasi-simultaneous measurements are

represented by the 1-22 GHz measurements from the SAO RAS RATAN-600 radio telescope, the 5 and 8 GHz data from the IAA RAS RT-32 telescopes, and the 37 GHz data from the RT-22 telescope of CrAO RAS. A comprehensive analysis of radio continuum spectra of the quasars found that only 24% showed the flat spectra typical of blazars and nearly half of quasars exhibit peaked spectra that indicates a significant population of young evolving radio AGN. The average radio variability 25-50% is comparable to the variability of AGNs at intermediate redshifts. We have not found a correlation between the radio variability and redshift or the spectral index. However, several source groups with distinctive variability characteristics were found using the cluster analysis of quasars. The most interesting is a small highly variable group of quasars located at redshifts of 4.3–5.3, notable by a shorter time scale of radio monitoring. Radio variability and individual properties of several blazars are discussed, including at extreme redshifts z=5-6.

Particle acceleration on strong shocks of supernova remnants

Dejan Urošević (Department of Astronomy, Faculty of Mathematics, University of Belgrade).

Abstract:

TBD

Unraveling galactic molecular high-velocity outflows

Evgenii Vasiliev (ASC LPI), Igor Novikov Jn., Yuri Shchekinov, Biman Nath.

Abstract:

In numerous galaxies and active galactic nuclei molecular high-velocity outflows are observed. The masses of molecular gas reach hundreds of millions of solar masses, while their velocities (more exactly, their widths of molecular lines) exceed several hundred km/s. This leads us to a puzzle of how dust particles needed for molecule formation survive in such high-velocity gas. Using three-dimensional modelling of initiating outflow in regions of high star formation rate typical for starbursts galaxies, we analyze a possibility of dust survival and molecule reformation in gaseous flows driven by high-velocity shock waves.

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

Valery Vlasyuk (SAO RAS), Yu.Sotnikova, T.Mufaharov, A. Volvach, O.Spiridonova, A.Mikhailov, Yu.A.Kovalev, V.Stolyarov, D.Kudryavtsev.

Abstract:

We present a study of the multiwavelength (MW) variability of the blazars S4 0954+658, AO 0235+164, Ton599 and others, based on the radio-to-γ-ray data covering a period of last two decades. The radio data are represented by the measurements from the SAO RAS, IAA RAS and CrAO RAS telescopes. The optical measurements were collected with the SAO RAS 1-m and 0.5-m reflectors. The archive data at 230 GHz from the Submillimeter Array and the γ-ray data from the Fermi-LAT mission were used too. A significant correlation between different spectral bands is found for some of blazars. Object AO 0235+164 shows a total variability quasi-periods of ~6 yrs for all wavelength bands, and 1.4–2.3 yrs during the low state, which may reflect its general properties. The blazar S4 0954+658 demonstrate very complex structure of flares in optical, radio-bands and gamma-rays. Some new results presented for blazar 1616+051, taken with RATAN-600 and BTA.

Morphological Classification of Jets in Active Galactic Nuclei

Dmitrii Zagorulia (Moscow Institute of Physics and Technology), M.M. Lisakov.

Abstract:

This work explores the application of machine learning techniques to classifying jetted active galactic nuclei (AGN) based on Very-Long-Baseline Interferometry (VLBI) observations at frequencies 1–90 GHz. Building upon previous work by Fanaroff and Riley, who classified relativistic jets in radio galaxies on kiloparsec scales, we extend this classification to parsec scales, closer to the central supermassive black hole. This approach enables detailed study of jet spatial structures and can help enhance accuracy in global positioning systems. We define four morphological classes: single Gaussian source, double Gaussian source, and sources with single or double-sided jets. Synthetic models of AGN jets were generated to create a training dataset for a convolutional neural network (CNN). The CNN was trained on these synthetic data and subsequently applied to classify 130 thousand AGN jet images from the Astrogeo database. The distribution of images into designated classes, predicted by CNN, qualitatively matches the expected outcome.

Optical identification of active galactic nuclei from the SRG/ART-XC all-sky X-ray survey

Igor Zaznobin (Space Research Institute, Moscow), G. Uskov, S. Sazonov, R. Burenin, M. Gilfanov, P. Medvedev, R. Sunyaev, R. Krivonos, E. Filippova, A. Lutovinov, G. Khorunzhev, M. Eselevich.

Abstract:

We presents the results of optical identification of 50 active galactic nuclei detected by the SRG/ART-XC telescope during all-sky surveys in the hard X-ray (4-12 keV) energy band. Of these, 17 AGNs were discovered in X-rays for the first time and the rest were already known earlier, but their nature remained unknown. For sources in the eastern galactic hemisphere we obtained spectra from the SRG/eROSITA all-sky surveys in the energy band 0.2-8 keV. The analysis of X-ray spectra revealed significant internal absorption in 14 AGNs (NH $> 10^{22} cm^{-2}$). Using the 1.6-m AZT-33IK telescope of the Sayan Observatory of ISTP SB RAS and the 1.5-m Russian-Turkish telescope (RTT150) of the TÜBİTAK National Observatory, we obtained optical spectra of 38 sources located in the northern sky ($\delta > -25^{\circ}$).

State of the steep spectrum sample of the experiment Cold according to modern sky surveys in the optical and radio ranges

Olga Zhelenkova (SAO RAS), Yu. Parijskij, N. Soboleva, A. Temirova.

Abstract:

The Big Trio program was aimed at searching for distant radio galaxies for the purpose of cosmological research. From the radio sources discovered in a series of surveys of the Cold Experiment, which was carried out on the RATAN-600 radio telescope, a selection of sources with steep and ultra-steep spectra was prepared. The results of the studies of 113 sources in this sample were the optical identification of almost the entire sample, spectral studies of the majority of objects (70%), spectral redshifts were determined for half of them, and three unique radio galaxies with a redshift z¿3 and extremely high radio luminosity were discovered. New radio sky surveys of high sensitivity and angular resolution have now become available, which has made it possible to conduct additional studies of the radio sources of the sample. With their help, the continuous spectra of the sources and their radiomorphology, as well as the evolutionary status and environment of the radio galaxies, were refined. Spectral indices determined from new radio survey data turned out to be flatter than from old data. Based on the spectral curvature parameter and the morphological structure of the sources in the

SS sample, 10%-15% are likely to be young, 40%-50% are in an active state, 10% are in the fading phase, and most likely 20%-25% are in the restart phase.

2.3 Posters

The orientation of galaxy spins relative to filaments of the large-scale structure of the Universe.

Aleksandra Antipova (SAO RAS), Makarov D.I.

Abstract:

The theory of galaxy formation posits a clear correlation between the spin of galaxies and the directions on the elements of the large-scale structure of the Universe, in particular on filaments. A substantial number of observational and modelling studies have been conducted with the objective of identifying the dependence of the spin position on the elements of the large-scale structure. However, the results of these studies are contradictory. This paper presents a study of the orientation of the spins of 4513 galaxies with respect to 3494 filaments of the large-scale structure of the Universe. In our sample, all galaxies have an inclination angle to the observer greater than 85 degrees, which allows us to unambiguously determine the direction of the spin axis of the galaxy in space, as they are seen almost they are seen very close from the edge. The results demonstrate a tendency for galaxy spins to align along the filament axes of the large-scale structure, with a statistically significant outcome. This work was carried out with the financial support of the Russian science foundation (project No. 24-72-10084 Edge-on galaxies: a laboratory for exploring the Universe).

The extended ionized blob in the merging group of galaxies NGC1143/44

Aleksandrina Smirnova (SAO RAS), Alexei V. Moiseev.

Abstract:

Arp118 is a spectacular collisional system comprising of a distorted disk galaxy NGC1144 and an elliptical galaxy NGC1143 located at the 40 "" to the NW of NGC 1144. In order to better understand the physics of processes occurring in this pair of galaxies, we have mapped collisional system Arp118 in the Ha and forbidden emission lines using observations obtained at the 2.5-m telescope of the Caucasus Mountain Observatory (CMO) of Sternberg Astronomical Institute of Moscow State University (SAI MSU) and performed long-slit spectroscopy at the 6-m telescope of

the Special Astrophysical Observatory of the Russian Academy of Sciences (SAO RAS).

MAGIC: a focal reducer for the study of active galactic nuclei

Roman Uklein (SAO RAS), Eugene Malygin, Elena Shablovinskaya, Vladimir Amirkhanyan, Alexander Perepelitsyn, Irina Afanasieva and [Victor Afanasiev].

Abstract:

TBD