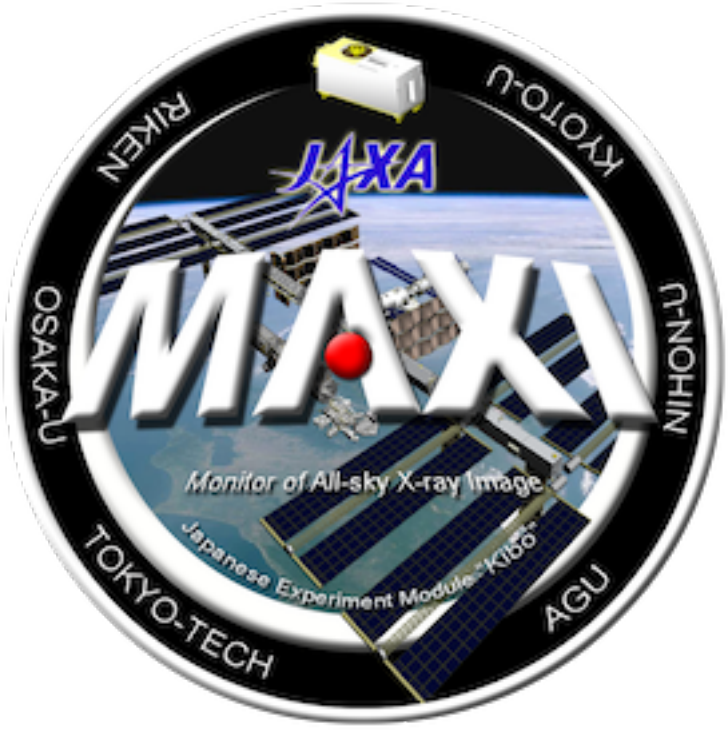
MAXI 15 Year Workshop for the Time Domain Astronomy

Tuesday 10 December 2024 - Thursday 12 December 2024

Nihon university



Book of Abstracts

Contents

Oral

10-1 / **57**

MAXI status and recent results

Author: Tatehiro Mihara[1]

[1] *RIKEN MAXI team*

MAXI has been working for 15 years and contributing to a part of the time-domain astronomy by the quick alerts of transients. The main instrument GSC of MAXI has been stable after some damage occurred in the first year. The other instrument SSC has damaged due to the radiation damage. The main system of the MAXI suffered abrupt shut down twice in 2022 June. Since then SSC was stopped to reduce the load of the power supply. MAXI discovered 35 sources in 15 years, including 14 black hole binaries. Since the previous 7 yr workshop, bright X-ray novae appeared, such as MAXI J1535-571, MAXI J1820+070, MAXI J1631-479, MAXI J1348-630, MAXI J1803-298, and 4U 1543-475. Two Be X-ray binary pulsars were discovered in the anti-galactic center direction, as MAXI J0709-159 and MAXI J0655-013.

10-1 / **58**

MAXI transients in 15 years

Author: Hitoshi Negoro[1]

[1] *Nihon University*

MAXI discovered 35 newly discovered X-ray novae or short transients, including 14 or more black hole candidates and the first Be/whit-dwarf nova MAXI J0158-744. The nature of some of them are still unknown. MAXI also detected a number of X-ray novae and X-ray or gamma bursts. I briefly summarize those transients sources MAXI discoverd/detected in 15 years.

10-1 / **60**

Swift and MAXI: 15 Years of Collaboration

Author: Jamie Kennea[1]

[1] *Penn State*

The Neil Gehrels Swift Observatory, which turns 20 years old in November 2024, is an epochal mission for TDAMM science thanks to it's rapid response capabilities, allowing for fast turn around observation of transients both discovered by Swift itself, and other observatories. It's combination of sensitive X-ray and UV/Optical telescopes allows for broadband follow-up of events discovered by MAXI and others. Before MAXI launched, it was recognized that Swift and MAXI are strongly complementary missions, and the two teams agreed to collaborate on transient discovery. This began a 15 year long collaboration between the two teams in which transients discovered by MAXI were regularly observed by Swift in order to accurately localize, categorize and follow-up these new events, which has resulted in ~100 publications on joint results from Swift and MAXI. In this talk I give a history of this collaboration and talk about selected scientific about highlights of this collaboration, including most recently the co-detection of GRB 221009A, AKA "The BOAT", the brightest Gamma-Ray burst ever seen and observations of GW events by Swift and MAXI. Finally I talk about the future of the collaboration, demonstrating new capabilities that Swift plans to bring online in the next 12 months which can further complement MAXI's discovery potential.

10-1 / **61**

NuSTAR and MAXI: capturing transient sources near the Sun

Author: Sean Pike[1]

[1] *UC, San Diego*

MAXI provides all-sky monitoring in the X-ray band, identifying multiple new sources each year, but a fraction of these transient sources falls too close to the Sun for most X-ray observatories to safely perform rapid follow-up observations. NuSTAR, however, is able to observe sources with much smaller angular separation from the Sun than other observatories, making it a uniquely capable tool for capturing X-ray transient data that would otherwise go unobserved. I will present recent results which have been achieved by performing rapid NuSTAR follow-up of X-ray transients discovered near the Sun by MAXI, including measurements of the spin and inclination of a faint black hole X-ray binary, and hints at an anomalously high magnetic field in a slow-spinning neutron star Be X-ray binary. I will also discuss the analysis challenges that come with observing near the Sun with NuSTAR, as well as the importance of monitoring newly discovered X-ray sources at multiple stages of their evolving outbursts.

10-2 / **62**

Status and preliminary results of Einstein Probe

Author: Weimin Yuan[1]

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The Einstein Probe (EP) is a space X-ray observatory designed to detect mainly high-energy transient and variable sources in the universe. It aims at detecting such sources at unprecedented sensitivity and spatial resolution in the soft X-ray band and performing quick onboard follow-up observations in X-rays. The Einstein Probe is a project led by the Chinese Academy of Sciences in collaboration with ESA, MPE and CNES. EP was launched on January 9, 2024. Till July, the satellite has completed the commissioning and in-orbit calibrations. Since then, EP has started the nominal science operations. This talk will introduce the mission status, the instrument performance and preliminary science results of the transient and variable sources detected.

10-2 / **79**

Transient search and multi-wavelength identification for the Einstein Probe mission

Author: Dongyue Li[1]

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Eintein Probe (EP) is a space X-ray observatory to monitor the soft X-ray sky with X-ray follow-up capability, and was lauched on January 9, 2024. It carried out a series of performance verification and calibration observation after launch and had begun scientific observations since late July. By now, EP has detected more than 30 fast X-ray transients, and long-term transients of different origin. Of which, some are very puzzling transients and their nature are still under investigation. In this talk, we will introduce the strategy we adopt to search for the transeints. For short term transients, like GRBs and stellar flares, that show high amplitude varibility during one single exposure, the Bayesian block algotithm is adopted to search for the variability signal. While for long-term, and relatively fainter transients, like TDEs, data stacking is used to increase the detection sensitivity. All these sources have been carefully identified following a series of cross-matches with astronomical data bases and multiwavelength catalogues, and also follow-up observations. In this talk, we will give a brief intriduction to the transient search and source identifications for EP, and also priliminary results of some peculiar EP transients.

10-2 / **63**

Development and Operation Status of X-Ray Imaging and Spectroscopy Mission (XRISM)

Author: Makoto Tashiro[1]

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The X-Ray Imaging and Spectroscopy Mission (XRISM) project was initiated in 2018. Following the development of onboard components, the proto-flight was conducted from 2021 to 2023 at JAXA Tsukuba Space Center. The spacecraft was launched from JAXA Tanegashima Space Center on September 7, 2023, and onboard components, including the observation instruments, were activated during the four months of the in-orbit commissioning phase. From February, the planned performance verification observations were conducted until the end of August, and the guest observations selected by JAXA, NASA, and ESA started in September. In this paper, we show initial results obtained in the performance verification phase, not only by the precise X-ray spectroscopy by the onboard X-ray micro-calorimeter but also by the wide field of view X-ray CCD camera.

10-3 / **64**

XRISM/Xtend Transient Search: Deep X-ray Transients

Author: Tomokage Yoneyama[1]

[1] *Chuo University*

X-ray Imaging and Spectroscopy Mission (XRISM) has two X-ray instruments. Resolve, an X-ray microcalorimeter, has an extreme energy resolution of 5 eV at 6 keV. Xtend, an X-ray CCD array, has a large field of view (FoV) of 38 arcmin square, which gives us opportunities to observe many serendipitous sources. We developed the XRISM/Xtend Transient Search (XTS), a project to quick search and fast report for X-ray transient detected by Xtend. XTS has ~ 3 orders of magnitude higher sensitivity than that of MAXI (with limited FoV). XTS is the first attempt to make the fast reports for transient sources with a pointing satellite (i.e., non-survey type mission). XTS started on Mar. 2024. We have reported 17 transients via the Astronomer's Telegram (ATel) so far (2024-09-30). Most of them are stellar flares with X-ray fluxes of 10^-13 – 10^-11 erg/s/cm^2. In this presentation, we report the development, operation and results during the "performance verification phase" of XRISM by Sep. 2024.

10-3 / 65

Followup and monitoring observations of MAXI flare stars in optical bands

Author: Yohko Tsuboi[1]

[1] *Chuo University*

Since MAXI's launch in 2009, we have continuously surveyed stellar flares. The flare sample now exceeds 200 and has been found to originate from about 30 active stars, including RS CVn systems, Algol systems, dMe stars, dKe stars, YSOs, and undefined-type stars. The observed parameters of these MAXI flares are: luminosity of 10^31-10^34 erg s-1 in the 2-20 keV band, emission of 10^54-10^57 cm-3, temperature of 1-16 keV, e-folding time of 6-360 ksec, radiation energy during the decay phase of 10^34-10^39 erg. These parameters indicate the upper limit of the stellar flare. The radiation energies are orders of magnitudes greater than the largest flares occurred at the Sun - the solar flare has a maximum of 10^32 erg. These differences raise the question of how such huge amounts of magnetic energy are stored and where these events originate. One of the keys to understanding this question may be multi-wavelength observations, since the flaring plasma will be essentially multi-temperature. With this idea, we have installed three optical telescopes on the rooftop of a building at Chuo University Korakuen campus, which is called CHAO (CHuo-university Astronomical Observatory). CAT (Chuo-university Astronomical Telescope) and SCAT (Spectroscopic Chuo-university Astronomical Telescope) have been executing photometry and low-dispersion spectroscopy, respectively, and PHAST (Photometric And Spectroscopic Telescope) can simultaneously perform photometry and high-dispersion spectroscopy, with very fast tracking capability for transient detected with MAXI at a world-class driving speed of 20 degrees per second. Despite that the Korakuen campus is located at a downtown Tokyo in Japan and the diameters of the three telescopes are just in the range of 26-41 cm, we have been accumulating good examples of the flares from MAXI stars. We will review the dynamics, the situation at the flare onset, and e-folding time, obtained with CHAO and the other large telescopes at the followup and monitoring observations of MAXI flare stars.

10-3 / 80

X-ray study of non-thermal plasma in stellar flares triggered by MAXI

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We detected a giant X-ray flare from the RS-CVn type binary star UX Ari using MAXI on 2020 August 17 and started a series of NICER observations 89 minutes later. For a week, the entire duration of the flare was covered with 32 snapshot observations including the rising phase. The X-ray luminosity reached 2×10^{33}~erg~s^{-1} and the entire energy release was $\sim 10^{38}$~erg in the 0.5–8.0~keV band. X-ray spectra characterized by continuum emission with lines of FeXXV Heα and FeXXVI Lyα were obtained. We found that the temperature peaks before that of the flux, which suggests that the period of plasma formation in the magnetic flare loop was captured. Using the continuum information (temperature, flux, and their delay time), we estimated the flare loop size to be $\sim 3 \times 10^{11}$~cm and the peak electron density to be $\sim 4 \times 10^{10}$~cm^{-3}. Furthermore, using the line ratio of FeXXV and FeXXVI, we investigated any potential indications of deviation from collisional ionization equilibrium (CIE). The X-ray spectra were consistent with CIE plasma throughout the flare, but the possibility of an ionizing plasma away from CIE was not rejected in the flux rising phase. In this talk, we also discuss the XRISM observation strategy for stellar flares using MAXI.

10-4 / 59

X-ray Polarization in the Variable Sky

Author: Roger Romani[1]

[1] *Stanford University*

The Imaging X-ray Polarimeter Explorer (IXPE) has opened up a new window on the X-ray sky, with observations of nearly 100 sources. In this talk I summarize IXPE's technical advances, the challenges of polarization measurements, our successes to date and the prospects for future discovery. IXPE has obtained polarization images of a number of X-ray nebulae, including pulsar wind nebulae and supernova remnants, that are probing the particle acceleration mechanisms. IXPE is also acquiring polarized light curves and spectra of accreting neutron star and black hole systems, in various outburst and quiescent states. These results provide new insights into the neutron star surface magnetization, black hole binary disk/corona structure and the particle energization in blazar jets. Polarization measurements require high photon counts and, with IXPE's modest aperture, MAXI alerts to transients and enhanced flux states of these highly variable sources have been integral to the mission's success.

10-4 / 66

MAXI and NICER collaboration for soft X-ray transients

Author: Wataru Iwakiri[1]

[1] *Chiba University*

MAXI provides us with a powerful tool for detecting soft X-ray transients, such as outbursts of LMXBs or HMXBs, long-duration X-ray bursts, and stellar flares. To investigate more detailed physical processes of these X-ray transients, it is important to obtain the precision timing and spectroscopy data by rapid follow-up observations with high-sensitivity X-ray detectors. The Neutron Star Interior Composition Explorer (NICER), which was installed on ISS in June 2017, has the capability of rapid response to the newly reported MAXI transients and high-sensitivity X-ray timing and spectral observations. Moreover, NICER enables short high cadence observations of these transients. We report on the results of successful collaboration between the MAXI and NICER teams so far.

10-4 / 70

Finding Relativistic Stellar Explosions as Fast Optical Transients

Author: Anna Ho[1]

[1] *Cornell University*

For the last half-century, relativistic outflows accompanying the final collapse of massive stars have predominantly been detected via high-energy emission, as long-duration gamma-ray bursts (GRBs). Yet, it has long been hypothesized that GRBs are the tip of the iceberg of relativistic stellar explosions, because the conditions required to produce and detect a GRB are contrived. I will present results from a search for relativistic stellar explosions using optical time-domain surveys. The emerging zoo includes afterglows at cosmological distances with no detected GRB, supernovae with luminous X-ray and radio emission, and a mysterious class of "fast blue optical transients" with minute-timescale optical flares at supernova-like luminosities. An understanding of the origin of these events and their relation to GRBs will be enabled by upcoming time-domain surveys in other bands, including X-ray, UV, and submillimeter.

11-1 / **67**

INTEGRAL contributions to time domain astronomy

Author: Erik Kuulkers[1]

[1] *ESA*

This presentation will review the main, unique, contributions of the INTErnational Gamma-Ray Astrophysics Laboratory, INTEGRAL, to time domain astronomy.

11-1 / **68**

Orbital phase resolved and Intensity resolved spectroscopy of HMXBs with MAXI

Author: Biswajit Paul[1]

[1] *Raman Research Institute*

Orbital phase-resolved spectroscopy of High Mass X-ray Binaries (HMXBs) allow detailed probe of the X-ray reprocessing environment and line of sight absorption of the X-rays by the stellar wind through different lines of sights in the binary. Same study, when carried out at different intensity levels of a given binary system allows probes of the changes in the reprocessing/absorption agents which may also be responsible for the X-ray intensity variations. We have investigated several HMXBs, including GX 301-2, Cen X-3, and Vela X-1 for their orbital phase dependence of the spectral parameters and intensity dependence of the same using long term data from MAXI-GSC onboard the ISS. Insights gained from the MAXI results for these individual systems to understand their stellar wind characteristics will be presented.

11-1 / **81**

A new mechanism for state transition in Be X-ray binaries

Author: Atsuo Okazaki[1]

[1] *Hokkai-Gakuen University*

Be X-ray binaries (BeXRBs) consist of a Be star (a massive star with a circumstellar disk) and a neutron star. They constitute a prominent subclass within the category of high-mass X-ray binaries, characterized by their transient nature. These binaries intermittently exhibit X-ray outbursts, whereas the rest of the time they remain quiescent. On the transition between these two X-ray activity states, it is believed that a BeXRB enters a quiescent state when accretion onto the neutron star is impeded by its rapidly rotating magnetosphere. However, the observational support for this centrifugal inhibition of accretion, often referred to as the propeller mechanism, comes only from a couple of systems with a neutron star with a relatively short spin period. The applicability of this mechanism in other BeXRBs, particularly those housing slowly rotating neutron stars, remains uncertain. In this presentation, we explore a possibility that in misaligned BeXRBs, the wind of the Be star can strongly suppress accretion, dispersing the accreting gas by its large ram pressure. Employing analytical models for both the wind and accretion disk, we compare the wind ram pressure with the gas pressures of the accretion flow for a number of systems with well determined/constrained parameters. We find that in some systems the state transition from the X-ray outburst to the quiescence is likely attributed to the inhibition of accretion by the stellar wind. In order to better understand how this mechanism works, we discuss the interaction between the stellar wind and the accretion flow in more detail, on the basis of the results from 3D hydrodynamic simulations.

11-1 / **82**

Novel Paradigms of Magnetars Opened by Advanced Timing Studies

Author: Kazuo Makishima[1]

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Advanced timing studies of archival data from ASCA, Suzaku, NuSTAR, and XMM-Newton are opening several novel aspects of magnetars. (1a) Representative 7 magnetars were found to be axially deformed to 10^{-4}, and performs free precession. (1b) The deformation is due to internal magnetic pressure, with the internal (toroidal) magnetic fields reaching 10^{16} G (Makishima+24a, 24b). (2a) The toroidal (Bt) to dipole (Bd) magnetic-field ratios of the 7 magnetars increase towards older objects; their Bt lasts longer than their Bd (Makishima+24a). (2b) Considering the Bd decay, magnetars could dominate new-born neutron stars (Nakano+15). (2d) There may be a large population of old magnetars with weak Bd but strong Bt. (2e) The very long periods (e.g., 6.7 hours) of some Central Compact Objects in supernova remnants are not their rotational periods, but are the slip periods of their free precession. Their true rotation period may reside at about 1 second. (3a) Magnetars are also found in binaries, such as X-Persei (via MAXI observations; Yatabe+18) and the gamma-ray binary LS 5039 (Yoneda+20, Makishima+23). (3b) As in LS 5039, magnetars can steadily accelerate particles up to TeV energies, probably via induced electric fields. (3c) The magnetars in binaries allow first measurements of the mass of magnetars. As indicated by X-Persei and LS 5039, magnetars could have a higher mass (~2.0 Msun) than the ordinary neutron stars.

11-2 / **69**

Overview of the Scientific Results from the Insight-HXMT Space Mission over 7 Years in Orbit

Author: Lian Tao[1]

[1] *Institute of High Energy Physics, Chinese Academy of Sciences*

The Insight-HXMT space mission is China's first X-ray astronomical satellite, which has been in orbit for over 7 years. Its main scientific objectives include searching and monitoring transients in the disk of the Milky Way, observing X-ray binaries to study the motion and radiation mechanisms in strong gravitational or magnetic fields, and monitoring and studying gamma-ray bursts and electromagnetic counterparts of gravitational waves. Insight-HXMT has achieved a number of important results in these research areas. In this report, I will present the most important results and discuss the potential for collaboration with time-domain astronomical satellites such as MAXI.

11-2 / 71

MAXI X-ray monitoring of transient high-mass X-ray binary pulsars

Author: Mutsumi Sugizaki[1]

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We report on the results of MAXI monitoring of X-ray binary pulsars (XBPs), which are mostly high-mass X-ray binaries hosted by Be stars or OB supergiants. So far, about a hundred of XBPs have been known in our Galaxy. More than a half of them appear as X-ray transients whose activity are limited within their short (< several months) outburst periods. The MAXI all-sky survey for 15 years discovered several new XBPs including MAXI J1409-619, MAXI J0903-531, and MAXI J0655-013, and revealed their comprehensive outburst behaviours. Be XBPs usually exhibit outbursts lasting a few weeks to several months, according to the mass accretion on to a neutron star from a Be circumstellar disk. We investigated correlations between X-ray intensity variations observed by MAXI/GSC and pulse-period changes observed be Fermi/GBM for all clearly detected Be-XBP outbursts, and found that all of them reasonably agree with those predicted by theoretical models about the mass accretion along the pulsar magnetosphere. The model-fit results suggest that some Be XBPs with a long pulse period, X Persei, MAXI J0655-013, and LS V +44 17 would have strong magnetic fields of > 10^13 G, higher than the typical ~10^12 G. On the other hand, that of the ultra-luminous X-ray pulsar, Swift J0243.6+6124 was estimated to be typical ~10^12 G. We also examined the validity of these model predictions by comparing the results of all (~15) Be-XBP sample.

11-2 / 83

Monitoring SMC X-1's Spin and Superorbital Modulation using MAXI and NinjaSat

Author: Chin-Ping Hu[1]

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SMC X-1 is a high-mass X-ray binary exhibiting superorbital modulation with an unstable period. Monitoring carried out by RXTE/ASM, Swift/BAT, and MAXI revealed excursion events in 1996–1998, 2005–2007, and 2014–2016, during which the superorbital period drifted from ~60 days to ~40 days. These events occurred at intervals of about 3,200 days. However, recent observations suggest that a new excursion occurred in 2020–2021, and the overall superorbital period shows a long-term decreasing trend. We further trace the spin-period evolution of SMC X-1 using MAXI and find that the spin-up rate accelerated one year before the onset of this new excursion, suggesting a possible inside-out process connecting the spin-up acceleration and the superorbital excursion. Further analysis of the pulse profile evolution reveals that the pulsed fraction exhibits long-term changes that may be connected to the superorbital excursion. These discoveries deepen the mystery of SMC X-1, as they cannot be solely interpreted by the warped-disc model. In 2024, we carried out a series of NinjaSat observations monitoring the spin frequency evolution. This regular monitoring reveals detailed spin-period evolution within a single superorbital cycle and may enhance our understanding of the underlying accretion mechanisms.

11-2 / **84**

Dust scattering echo around MAXI J1421-613 observed by Suzaku and Swift follow-up observations

Author: Kumiko Nobukawa[1]

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MAXI J1421-613 is an X-ray burster discovered by MAXI on 9 January 2014 and is considered to be a low-mass X-ray binary. We report the discovery of an annular emission around MAXI J1421-613 in Suzaku and Swift follow-up observations. The Swift follow-up observation which was conducted by the photon counting mode on 18 January 2014 found an annular emission at 2.5'−4.5' whereas the Suzaku observation on 31 January to 3 February 2014 detected an annular emission of 3'−9' radius around the transient source. The spectra of the annular emission were represented by an absorbed power law, and the photon index was higher than that of MAXI J1421−613 itself by delta Gamma ~ 2. The flux and radius of the annular emission observed by Suzaku and Swift are well explained by dust scattering of the same outburst of the transient. We estimate the distance to MAXI J1421-613 to be ~3 kpc assuming that the dust layer is at the same location as the CO cloud in front of MAXI J1421-613.

11-3 / **72**

MAXI detections and follow-up observations of outbursts from X-ray binaries

Author: Megumi Shidatsu[1]

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Since the start of the operation in 2009, MAXI has detected many outbursts from newly discovered and known Galactic black hole and neutron star X-ray binaries. They were promptly reported to the astronomical community over the world, which stimulated follow-up observations at various wavelengths. MAXI itself also provided unique long-term X-ray data covering their entire outburst periods, which gave us the overall picture of the spectral evolution during outbursts. In this talk, we showcase the MAXI detections and long-term monitoring of X-ray binaries and present the results of follow-up observations that we conducted with other observatories.

11-3 / **85**

The puzzling black hole candidate MAXI J1810-222

Author: Melania Del Santo[1]

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The X-ray transient MAXI J1810-222 was discovered by MAXI in 2018 and has been active ever since. A long, combined radio and X-ray monitoring campaign was performed with ATCA and Swift, respectively. It gas been identified as a black hole candidate, even though the highly unusual outburst behaviour and the absence of information regarding the distance or the donor leaves the nature of the compact object open to ongoing debate. We detected a strong spectral absorption feature at ~1 keV with NICER which was described with a physical photoionization model. Through a deep scan of the parameters space, we found evidence for a spectral-state dependent outflow, with mildly relativistic speeds at 0.05-0.15 c. This finding would make MAXI J1810-222 the first X-ray binary where ultra-fast outflows have been detected at such high speeds. This is unlikely from classical thermal winds in Galactic X-ray binary and must involve either strong radiation or (most likely) a magnetically-driven wind. Motivated by this findings, we obtained a high quality XMM-Newton observation in 2023, in order to deeply investigate the nature of this absorption feature. I will present preliminary results of this observation.

11-3 / **86**

Exploring the broadband spectral and timing characteristics of GRS 1915+105 with AstroSat and NICER

Author: Ruchika Dhaka[1]

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In this study, we undertake a spectral-timing analysis of the black hole X-ray binary source GRS 1915+105 using simultaneous observations carried out by AstroSat and NICER. The source showed two flux levels (high and low), whose energy spectra can be described by the thermal comptonization of disk photons. The spectral parameters obtained by the joint fitting of SXT/LAXPC and NICER/LAXPC were consistent. The power density spectra from LAXPC and NICER revealed a broad, prominent feature at ~2 Hz. The energy dependence of the fractional r.m.s and time lag of this feature cannot be explained by only variations of coronal spectral parameters. Instead, a model where the coronal heating rate varies first and induces a change in the disk temperature and inner radius can explain the variation.

11-3 / **73**

Relativistic jets and MAXI sources

Author: Stéphane Corbel[1]

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Since the launch of MAXI 15 years ago, several considerable achievements have been reached in the field of Galactic accreting binary systems, especially in light of the extreme variability of their relativistic jets. These jets have now been recognized as vital component for energy transfer and angular momentum in black holes. Although the phenomenology is now rather well established, their emission and contribution to the total energy budget and the connection to the accretion disk are still the subject of active debates. In this review, I will present the most relevant observations concerning our understanding of relativistic jets in accreting systems and their coupling to the accretion disk, discussing in particular the key sources discovered by MAXI.

11-4 / **74**

Optical and X-ray monitoring of the early rise of the black hole X-ray binary, Swift J1753.5-0127

Author: David Russell[1]

[1] *New York University Abu Dhabi (NYUAD)*

Despite decades of research, predicting outbursts of X-ray transients, and witnessing their beginning stages, remains very challenging. The cause of these X-ray brightenings is thought to be the sudden increase of accretion of matter onto a black hole or neutron star, initiated by the ionization of hydrogen in the accretion disc. I present recent observational advances in our understanding of how X-ray transients first brighten, focussing on the best case, optical and X-ray monitoring of the early rise of the black hole X-ray binary, Swift J1753.5-0127 in 2023. A delay of ~4 days is measured between a thermal instability developing in the accretion disc, causing heating fronts to begin propagating through the disc (seen by an optical brightening), and the onset of accretion onto the black hole (X-ray brightening). We witness the propagation of the heating wave, as a steady increase in the flux and surface area of the disc, and we constrain the disc viscosity. I demonstrate the ability of optical monitoring to be able to provide a few days (sometimes weeks) lead time to the rise of X-ray transient outbursts. This can help to inform X-ray missions, including possibly reducing the time needed to spot new outbursts in MAXI data.

11-4 / 87

You snooze, you lose: catching the early rise of outbursts in LMXBs with XB-NEWS

Author: Kevin Alabarta[1]

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Usually, X-ray binary (XRB) outbursts are first detected by X-ray all-sky monitors like MAXI. Only after this are observations with more sensitive multi-wavelength telescopes triggered. This causes a gap in the coverage of the rise of the outbursts, limiting our knowledge of their early stages. Therefore, the best approach to better understand the accretion process in XRBs is to combine X-ray observations with regular optical band monitoring. According to the disc-instability model (DIM), XRBs experience an earlier optical brightening than in X-rays at the beginning of the outburst. In this talk, we show that, with our regular monitoring of ~50 XRBs with the Faulkes Telescopes/Las Cumbres Observatory (LCO), we are detecting the optical brightening of XRBs typically ~11 days before the outbursts are detected in X-rays with MAXI. In addition, we show that outbursts rise at shorter optical wavelengths before rising at longer wavelengths. This seems to occur as the ionizing heating wave propagates through the disk at the onset of the outburst. In addition, we present our real-time data analysis pipeline, the "X-ray Binary New Early Warning System" (XB-NEWS), which we use to detect and announce new XRB outbursts within days of their first optical detection. This allows the community to trigger multi-wavelength campaigns at the very beginning of outbursts, constraining the physical mechanisms triggering them.

11-4 / 88

The delayed radio emission in the black hole X-ray binary MAXI J1348–630

Author: Shuaikang Yang[1]

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Multi-wavelength observations are essential to understand the coupling between the accretion flow and the jet in black hole X-ray binary (BHXRB). We investigate the X-ray and radio emissions in MAXI J1348-630 during its 2019 outburst. For the first time, we find that the radio emission lags behind the X-ray Comptonization emission by about 3 days during the rising phase covering the rising hard state and the following soft state. Such a long radio delay indicates that, in this source, the Comptonization emission most likely originates from the advection-dominated accretion flow (ADAF) rather than the jet during the rising phase. Further, we study the correlation between the X-ray Comptonization and radio emissions in a broad X-ray energy band 0.1-100 keV. During the rising phase, considering the radio delay of ~ 3 days, we obtain a slope $\beta = 3.04 \pm 0.93$, which is much steeper than the previously reported $\beta = 0.6$ or 1.40 using the total luminosity in the limited band (e.g., 1-10 keV). During the mini-outburst, the radio-Compton correlation becomes shallow with the correlation slope $\beta = 1.11 \pm 0.15$. These indicate an intrinsic difference in the accretion-jet coupling physics between the main outburst and the mini-outburst.

11-5 / **75**

The radio view of MAXI transients

Author: Alexandra Tetarenko[1]

[1] *University of Lethbridge*

The most powerful cosmic engines in our universe are fueled by compact objects such as black holes and neutron stars. These cosmic engines accrete large amounts of material and eject matter in the form of jets traveling at near the speed of light. Recent groundbreaking discoveries of gravitational waves from systems harbouring compact objects and the direct imaging of the black hole shadows with the Event Horizon Telescope, represent major steps forward in our understanding of such systems. However, there exists a huge population of stellar-mass compact objects in our own Galaxy, present in transient X-ray binaries, which provide much more ideal laboratories by providing a real-time view of the behaviour of these objects and their dynamic environments. In this talk, I will review the key role that MAXI has played in identifying these explosive galactic transients, highlighting how we can leverage radio observations of these systems to track the path of material from inflow to outflow and gain unique insights into the accretion/jet ejection process.

11-5 / **89**

Geometrical and dynamic evolution of the accretion flow during the 2018 outburst of MAXI J1820+070

Author: Bei You[1]

[1] *Wuhan University*

A black hole X-ray binary produces hard X-ray radiation from its corona and disk when the accreting matter heats up. During an outburst, the disk and corona co-evolve with each other. MAXI J1820 + 070 (ASASSN-18ey) is a low-mass BH X-ray binary, discovered in X-rays with MAXI on 11 March 2018. During the 2018 outburst, this source underwent the rising hard state, the soft state, and then the decaying hard state. In this talk, I will review the recent studies on this source, mainly concentrating on the geometrical and dynamic evolutions of the disk and corona. In the rising hard state, the outflowing corona and its evolution will be discussed by presenting the X-ray spectral analysis of HXMT-Insight observation. And, in the decaying hard state, the disk is found to recede over time, and the corona reaches the Magnetically Arrested Disk (MAD) state, with the radio/optical/X-ray high-cadence observations.

12-1 / **76**

Understanding accretion from Black Hole Binaries

Author: Chris Done[1]

[1] *university of durham*

The transient X-ray outbursts of galactic binaries give some of the most spectacular lightcurves seen by MAXI and other monitoring instruments. I will review what these reveal about the accretion flow, and how it links to the transient radio jets. The luminous accretion flow also powers winds, now revealed in exquisite detail in XRISM, and I will speculate on how these relate to the accretion flow, and how we can piece all of this behaviour together into a physically motivated picture.

12-1 / 90

Important roles of accretion rings in X-ray binaries

Author: Hajime Inoue[1]

[1] *ISAS/JAXA*

In a steady mass flow from a companion star to a compact object in an X-ray binary, the inflowing matter from the companion star is expected to carry a certain amount of specific angular momentum and to first form a geometrically thick ring tube along the Keplerian circular orbit, which is called the accretion ring. A study of the accretion ring by Inoue (2021, PASJ, 73, 795) showed that a pair of inward (accretion) and outward (excretion) flows emerges as the result of angular momentum transfer from the inner side to the outer side of the ring and that each of the oppositely directed flows has a two-layer structure in which a thin disk is sandwiched by a thick flow. Here, we present several observational phenomena in which the accretion ring can be considered to play important roles: 1) The two-layer accretion flows can well explain the overall properties of long term variabilities of black hole X-ray binaries in the high/soft state and the low/hard state. 2) The thick excretion flow can be an origin of the disk winds often observed from X-ray binaries. 3) The periodic precsssing motion can be excited for the accretion ring, inducing the cyclic obscuration of the central X-ray source, observed as a variable source with the super-orbital period. 4) The two-layer excretion flows and the precessing motion can interpret several properties of SS433. 5) In addition, the broad line region in AGNs is possible to be regarded as the accretion ring around the super-massive black hole.

12-1 / 91

Magnetic Heating as the Origin of Bright Hard State in Black Hole Candidates

Author: Ryoji Matsumoto[1]

[1] *Chiba University*

We present the results of three-dimensional global radiation magnetohydrodynamic simulations of state transitions in black hole candidates. During the hard-to-soft state transition, accretion flow near the black hole tends to be in optically thin hot state even when the accretion rate exceeds the upper limit for RIAF in the outer region. In such state, RIAF near the black hole co-exists with the outer radiatively cooled disk. We found that the temperature of the radiatively cooled disk is higher than the standard disk because the magnetic energy enhanced around the interface between RIAF and the cooled disk is transported radially outward around the equatorial region and heats the disk by releasing the magnetic energy through magnetic reconnection. This non-local heating keeps the disk temperature around 10KeV in stellar mass black holes and 1KeV in super-massive black holes. This mechanism explains the hard X-ray emission in bright hard state and the soft X-ray excess during changing look phenomena in active galactic nuclei,

12-1 / 92

20 years of Winds in 4U 1630-47

Author: Maxime Parra[1]

[1] *Ehime University*

Despite having one of the most detailed outburst coverage among BHLMXBs, the long term behavior of the wind in 4U 1630-47 remains poorly known. We thus performed an exhaustive study of archival X-ray observations of the source, combining Chandra, NICER, NuSTAR, Suzaku and XMM-Newton, for more than 200 epochs spanned over 9 separate outbursts and two decades, complemented by Swift-BAT and INTEGRAL. I will present our results for the long term evolution of the lines and wind, including new diagnostics made possible by the high energy coverage.

12-1 / **93**

Tests of driving mechanisms of the accretion disk winds in X-ray binaries

Author: Ryota Tomaru[1]

[1] *Osaka University*

Accretion disk winds in compact objects in low-mass X-ray binaries, suggested by the blue-shifted absorption lines in spectroscopic data, are important phenomena to address the understanding of the physics of AGN feedback. However, the driving mechanisms of the winds are unclear. To tackle this, we build a comprehensive model for X-ray spectra, where the detail line profiles are simulated by Monte-Carlo radiation transfer (MCRT), whose input density/velocity fields are done by the radiation hydrodynamics code. Our models show that the observed spectra are well described by the winds launched at a larger radius driven by radiative heating/acceleration. We also show the new result of high-resolution spectroscopy by microcalorimeters onboard XRISM.

12-2 / **94**

Dust reverberation mapping on type-2 AGN realized by MAXI and WISE monitor

Author: Hirofumi Noda[1]

[1] *Tohoku University*

According to the unified model of active galactic nuclei (AGNs), a dusty torus is formed around a broad-line region, accretion disk, and corona near a supermassive black hole (SMBH), and these structures produce multi-wavelength radiation. Studying the structures in not only type-1 but also type-2 AGNs is important to understand e.g., the growth of a SMBH via mass accretion and the AGN feedback to a host galaxy. The dust reverberation mapping is one of the most powerful methods to determine especially an innermost region of a dusty torus, and it has been performed on a few tens type-1 AGNs by optical and infrared monitors. However, no clear results have been reported on type-2 AGNs so far because strong optical extinction completely hides their disk emission. We therefore focus on an X-ray-bright type-2 AGN NGC 2110, and utilize 2–20 keV variation monitored by MAXI to trace the disk emission, instead of optical variation. Comparing it with 3–5 μm infrared variation observed by WISE, we successfully found a dust reverberation time lag of ~130 days (Noda et al. 2020, MNRAS, 495, 2921). In this presentation, we introduce these results comparing with those in type-1 AGNs, and discuss future studies by the dust reverberation mapping on type-2 AGNs with simultaneous X-ray and infrared monitors.

12-2 / **95**

Early Discovery of TDE Candidates by the Einstein Probe Mission

Author: Chichuan Jin[1]

[1] *National Astronomical Observatories, Chinese Academy of Sciences*

The Einstein Probe (EP) is a newly launched space mission dedicated to the X-ray all-sky survey and characterization of all kinds of high-energy transients. During the first few months of in-orbit operation, EP has discovered dozens of new X-ray transients with intriguing properties. In this talk, I will present a few typical examples of TDE candidates discovered by EP since its launch, including the first case of TDE spectroscopically confirmed to be located in the outskirts of a galaxy. Its rising, peak, plateau and decay phases have all been observed, supporting it in hosting an IMBH of tens of thousands of solar masses. Then I will introduce some puzzling TDE candidates discovered by EP, which are still being monitored and under investigation. Finally, I will provide some prospects for future discoveries and joint observations of EP with other facilities on TDE sciences.

12-2 / 96

Investigation on the broad-band emission and variability of radio-quiet AGN

Author: Huaqing Cheng[1]

[1] *National Astronomical Observatories, Chinese Academy of Sciences*

The broad-band emission (optical/UV to X-ray) of luminous active galactic nuclei (AGNs) is believed to be powered by accretion onto central supermassive black holes, with the optical/UV emission generally explained as from the standard accretion disc, and the X-ray emission often explained as the inverse Compton scattering of the soft photons from the accretion disc in a hot corona above. This talk contains mainly two topics. Firstly, we performed a detailed study on the physical origin of the optical/UV-to-X-ray emission of luminous AGNs based on a sample composed of 23 type I Seyfert galaxies. Our work reveal that the optical/UV emission can be well fitted by a modified disc model with the radial temperature profile Teff(R) ∝ R^{-p} (with p~0.5-0.75, and a median of 0.63), deviating from the predication of the standard disk model of p=0.75 (2) the simultaneous optical/UV-to-X-ray emission can be well fitted by our refined disc-corona model with the corona heated by the magnetic reconnection. Secondly, we will present a recent study on a highly variable low-luminosity AGN NGC 7589, which showed a very strong X-ray variability with flux varied by a factor of over 100 within several months. Multi-epoch optical spectroscopic observations reveal no signs of Seyfert type change, however. The physical origin of the extreme variability remains mysterious and requires further, in-depth investigations.

12-2 / 77

NinjaSAT observation of SRGA J144459.2-604207

Author: Tomoshi Takeda[1]

[1] *RIKEN/Tokyo university of Science*

NinjaSat is the RIKEN's 6U-size X-ray CubeSat launched on 2023 November 11. The main instrument is Xe-based proportional counter covering the energy range of 2–50~keV. Just after we finished the satellite commissioning in 2024 February, the new X-ray transient SRGA J144459.2-604207 appeared. NinjaSat observed SRGA J1444 from 2024 from February 21 to March 18. Meanwhile, NinjaSat detected 12 Type-I X-ray bursts. The recurrence time of X-ray bursts became longer from 2 hour to 8 hour as the source flux decreased. The recurrent time was found to be almost inversely proportional to the accumulated flux.

12-2 / 97

Status of MAXI observations of EM counterparts of GW events

Author: Satoshi Sugita[1]

[1] *AoyamaGakuin University*

MAXI scans about 85% of the whole sky in its orbital period (92 min) by sweeping the sky with a slit-shaped field-of-view (FOV). It can cover a large localized area of a GW event detected by GW detectors and search for an emission from the area before the time of the GW trigger. From the start of LIGO's operation, MAXI has searched for X-ray counterparts of GW events and reported on upper limits of X-ray flux in the localized areas starting with GW 150914. In GW 170817, MAXI did not observe GW 170817 at the trigger time because during the high-voltage-off operation. The first observation of the position of GW 170817 was eventually performed 4.6 hours after the trigger, though it was the earliest X-ray observation of the EM counterpart of GW 170817. From LIGO's Observing Runs 3, we performed the operation carefully expanding HV-on area so that all-sky coverage is achieved. In O4, we have been reporting to GCN the observations of the GW events that satisfied the criteria of False Alert Rate smaller than 20 per year and probability of neutron star merger larger than 5%. We report the observations and the operations for GW EM counterparts by MAXI.

12-3 / **78**

First results of SVOM/ECLAIRs

Author: Jean-Luc Atteia[1]

[1] *IRAP - Toulouse*

This talk will start with a presentation of the SVOM mission and the homonymous satellite, which was successfully launched on June 22nd 2024, with a special focus on the ECLAIRs hard X-ray imager. Then, the operations performed during the commissioning and early science phases will be described, along with the tuning of some crucial parameters. This will lead to the description of ECLAIRs in-flight performance and first transient detections. A short conclusion will address the perspectives offered by SVOM for the study of the transient high-energy sky.

12-3 / **98**

Overview of GRBs observed by MAXI

Author: Hiroki Hiramatsu[1]

[1] *Aoyama Gakuin University*

The Monitor of All-sky X-ray Image (MAXI) has been observing the X-ray sky and has detected 164 GRBs since its launch in 2009. MAXI is suitable for detecting transient events such as GRB due to its unique scanning observation. Recently, Low luminosity GRBs (LL GRBs) have become a key in multi-messenger astronomy. However, only a few of these events have been observed by all detectors so far. MAXI has the potential to detect LL GRB with sensitivity in lower energy range. In this study, we performed spectral analysis and estimated the Luminosity Function of GRBs observed by MAXI. Our results show that MAXI is capable of observing LL GRB, as shown by the logN-logS distribution and the derived Luminosity Function.

12-3 / **99**

Some Preliminary Results of LEIA - the Pathfinder of Einstein Probe

Author: Heyang Liu[1]

[1] *National Astronomical Observatories, Chinese Academy of Sciences*

Lobster Eye Imager for Astronomy (LEIA) is a pathfinder of the wide-field X-ray telescope of the Einstein Probe (EP) mission. The piggyback imager, launched in 2022 July, has a mostly unvignetted field of view of 18°. 6 × 18°.6. Its spatial resolution is in the range of 4–7 arcmin in FWHM and the focal spot effective area is 2–3 square centimeter, both showing only mild fluctuations across the field of view. LEIA has started its regular scientific surveys since Nov. 2022, and has finished its first all sky survey. In this talk, we report on the results from its all sky survey. By now LEIA has detected more than 300 sources, of which more than 60 show high variabilities (more than a factor of 10). These sources have been carefully identified following a series of cross-matches with astronomical data bases and multiwavelength catalogues. It has also caught several fast X-ray transients, including GRB 230307A and two novae.

12-3 / 100

Magnetar emergence in a peculiar gamma-ray burst from a compact star merger

Author: Hui Sun[1]

[1] *National Astronomical Observatories, Chinese Academy of Sciences*

The central engine that powers gamma-ray bursts (GRBs) is still not identified. Besides hyper- accreting black holes, rapidly spinning and highly magnetized neutron stars, known as millisec- ond magnetars, have been suggested to power both long and short GRBs. Indirect indications of a magnetar engine in these merger sources have been observed in the form of plateau fea- tures present in the X-ray afterglow light curves of some short GRBs. Nevertheless, smoking gun evidence is still lacking for a magnetar engine in short GRBs. Here we present a com- prehensive analysis of the broad-band prompt emission data of a peculiar, very bright GRB 230307A. Despite its apparently long duration, the prompt emission and host galaxy properties are consistent with a compact star merger origin, as suggested by its association with a kilo- nova. More intriguingly, an extended X-ray emission component shows up as the γ-ray emission dies out, signifying the emergence of a magnetar central engine. The magnetar-powered X-ray emission is regared as one of the promising EM counterparts of gravitational wave events from compact binary mergers, and would be crucial for identifying the merger remnants. Future multi-messenger observations of similar events hold the promise of unveiling the identity of the progenitor of the peculiar systems such as GRB 230307A.

12-3 / 101

Exploring New Opportunities in Time Domain Astronomy with the CATCH Space Mission

Author: Qianqing Yin[1]

[1] *Institute of High Energy Physics, CAS*

The Chasing All Transients Constellation Hunters (CATCH) space mission, proposed in 2019, is an AI-controlled astronomical constellation dedicated to monitoring X-ray emissions from tran-sients across the entire sky. The mission aims to enhance our understanding of the extreme uni-verse through X-ray imaging, spectral, timing, and polarization measurements. Plans are also in place to introduce microsatellites in various wavelengths, including optical, ultraviolet, infrared, and gamma-ray, to provide a comprehensive view of dynamic events in the universe. The initial pathfinder, CATCH-1, launched in June 2024 alongside SVOM, is designed to validate X-ray timing technologies with Micro Pore Optics (MPO) and a 4-pixel Silicon Drift Detector (SDD) array. Future plans include developing several pathfinders, such as CATCH-3, equipped with MPO and CMOS for simultaneous multi-wavelength observations in collaboration with ground-based optical telescopes like WFST ("Mozi") and Mephisto. Furthermore, recognizing the significance of X-ray polarization, CATCH has designed a polarization pathfinder with lightweight Wolter-I focusing mirrors and Gas Micro Plate Detector (GMPD) system to con-duct rapid, high-sensitivity polarization measurements in the 2-10 keV energy range with a re-sponse time of 5-10 minutes. This pathfinder will also collaborate with missions like EP and SVOM to enhance its observational capabilities for transients in polarization.

Poster

10-1 - Board: 01 / **151**

Status of the MAXI Data Archive at DARTS and HEASARC

Author: Ken Ebisawa[1]

[1] *ISAS/JAXA*

At DARTS (JAXA) and HEASARC (NASA), we maintain the permanent MAXI data archive, which keeps calibrated GSC event files on a daily basis. Any kind of data analysis is available using MAXI FTOOLS (mxproduct etc) and CALDB provided by HEASARC. Still, it is reported that there are minor discrepancies between the results obtained by DARTS/HEASRC archive and those by the public light curves and on-demand analysis supported by RIKEN. We are developing a new FTOOL "mxpipeline" which gives identical results to the on-demand analysis. Background and PSF simulations will be also made possible in mxpipeline; this will be useful for crowded regions where the BGD is difficult to obtain in the FOV and the PSF is contaminated by nearby sources. It is planned to reproduce RIKEN public light curves using mxpipeline. In this manner, the DARTS/HEASARC archive, RIKEN public light curve, and on-demand analysis will fully agree.

10-1 - Board: 02 / **154**

MAXI observation of reflected X-ray by the moon

Author: Shino Sugawara[1]

[1] *Rikkyo univ. and RIKEN*

A strong solar flare of X6.3 class occurred on February 22, 2024. X-rays from the solar flare are reflected by the moon, MAXI captured the fluorescent X-rays. MAXI detected emission lines of three elements, Si, Ca, and Fe. Those were consistent with the main elements of the moon surface. We considered a model of the reflected X-rays by the moon and compared the intensities of the calculated and the observed emission lines.

10-1 - Board: 03 / **155**

Development of FTOOLS-based software for MAXI/GSC light curves using image fits with point spread function

Author: Mikio Morii[1]

[1] *Japan Aerospace Exploration Agency*

We, Science Satellite Operation and Data Archive Unit (C-SODA) in JAXA, have developed FTOOLS-based software (mxsim_psf and mxsim_bgd), which can make simulations of point spread function (PSF) and non X-ray background (NXB) of MAXI/GSC. These tools will be released from HEASARC, soon. By using these tools, we start to develop a tool to make MAXI/GSC light curves obtained by image-fits using the PSF and NXB. We aim to make the PSF-fit tool used for the search of soft X-ray flashes of novae (Morii et al. 2016) available by this development.

10-1 - Board: 04 / **156**

Non-bias survey of the cluster of galaxies with MAXI

Author: Yuki Taki[1]

[1] *Rikkyo University and RIKEN*

We analyzed 186 cluster of galaxies with MAXI and obtained luminosity, temperature, and abundance. Significant abundance was obtained from 32 clusters, whose average was 0.29 +- 0.06. It is consistent with the previous works. The temperature was obtained from 179 clusters, from which the relation between the luminosity and temperature was obtained as L is proportional to T^4.01. This value was not consistent with the previous works with the index 2.53+-0.15.

10-1 - Board: 05 / **165**

An improved image fit method to create MAXI/GSC light curves and the search for embedded transient sources using more than 15 years MAXI data

Author: Yuno Kudo[1]

[1] *Nihon University*

MAXI has discovered 35 new X-ray transients since 2009. Sources in source-crowded regions such as the Galactic bulge regions, however, have not been investigated intensively because of relatively low spatial resolution (~ 1 deg) X-ray cameras. We are therefore trying to discover X-ray novae and other transient objects by creating light curves at regions around the Galactic bulge at equal intervals using more than 15 years MAXI data. We are also developing the system to produce light curves based on an image fit method by Morii, M., et al. (2016, PASJ, 68, S11). The new system takes account of an asymmetric point spread function of the Gas-Slit Cameras for oblique incident X-rays. As a result, we can obtain 10-20 keV light curves in addition to improved 2-4 keV and 4-10 keV ones. We will show some examples of the best MAXI light curves ever obtained, and some results of new source findings.

10-1 - Board: 06 / **174**

Origin of Pink Noise in MAXI X-ray Sources

Author: Masahiro Morikawa[1]

[1] *Riken*

A fair number of MAXI X-ray sources show pink noise (power index -0.8 to -1.2) in their power spectral density toward the lowest frequency, the inverse of 15 years. This pink noise is quite robust and reappears after thresholding, inverse-thresholding, and even after removing the energy information, leaving only the timing data. We explore the origin of this robust pink noise in MAXI sources. The system of a black hole and the surrounding rotating plasma/disk generates multiple vortices tend to align with the rotation axis. The winding electric currents on these vortices form multiple local dynamos, whose dynamics can be described by the Macro Spin Model. This model has successfully explained the dynamics of geomagnetism and solar magnetism. Through stochastic resonance, the bipolar magnetic field undergoes intermittent sudden reversals. This model generally yields 1/f fluctuations by the synchronization of the spins through the systematic accumulation of frequencies and their wave beat. We further explore possible verifications of this model and compare the similar pink noise in solar flares and earthquakes.

10-2 - Board: 07 / **150**

Science operations and space-ground information/data flow of the Einstein Probe

Author: Congying Bao[1]

[1] *NAOC*

The time-domain X-ray space mission Einstein Probe (EP) was launched on January 9, 2024. Since then, EP had been undergoing extensive in-orbit tests and calibration until July 2024. EP is aimed for the detection of cosmic high-energy transients in soft X-rays and quick X-ray follow-up characterization. For this, there are two instruments onboard: a wide-field X-ray telescope (WXT) for transient search and a follow-up X-ray telescope (FXT) for follow-ups and precise source localization. EP makes use of the X-band communication route for the science and house-keeping data telemetry, which are received by the ground stations provided by the CAS and ESA. The T&C is achieved by the S-band link. As soon as a transient is detected onboard, an alert message containing the basic information of the sources will be downlinked quickly to the EP science center (EPSC) via the Chinese Beidou system and the VHF system provided by CNES. Quick follow-up or ToO observations can be performed once a fast transient is detected, either on board (automated follow-up) or on ground and by uplink command (via the Beidou system). The information of transients is issued publicly to the global community to trigger more follow-up observations. The data flow and science operations of EP are thus complicated, involving two-way information/data exchanges between space and ground. Here we present the scientific operations scheme of EP, particularly on the space-ground data and information flow. The functions of EPSC will also be briefly introduced.

10-2 - Board: 08 / **182**

Image deconvolution of the Crab Nebula observed by Hitomi/HXT

Author: Mikio Morii[1]

[1] *Japan Aerospace Exploration Agency*

We develop a new deconvolution method to recover the Crab Nebula image taken by the Hitomi HXT. To suppress the artifact due to the bright Crab pulsar located at the center of the Crab Nebula, we extend the Richardson-Lucy method. Here, we introduce two components corresponding to the nebula and pulsar with regularization for smoothness and flux, respectively, and we perform simultaneous deconvolution of multi-pulse-phase images. At 3.6-15 keV band, we successfully recover the torus and jets, as seen in the Chandra X-ray image. Above 15 keV, we confirm the NuSTAR's findings that the nebula size decreases in higher energy bands.

10-3 - Board: 09 / **103**

A Most-Energetic-Ever-Detected X-ray Stellar Flare Discovered by Lobster Eye Imager for Astronomy

Author: Xuan Mao[1]

[1] *National Astronomical Observatories, Chinese Academy of Sciences*

LEIA (Lobster Eye Imager for Astronomy) detected a new X-ray transient on November 7, 2022, identified as a superflare event occurring on a nearby RS CVn-type binary HD 251108. The flux increase was also detected in follow-up observations at X-ray, UV and optical wavelengths. The flare lasted for about forty days in soft X-ray observations, reaching a peak luminosity of ~ 1.1 × 10^34 erg s^−1 in 0.5–4.0 keV, which is roughly 60 times the quiescent luminosity. Optical brightening was observed for only one night. The X-ray light curve is well described by a double "FRED" (fast rise and exponential decay) model, attributed to the cooling process of a loop arcade structure formed subsequent to the initial large loop with a half-length of ~ 1.8 R*. Time-resolved X-ray spectra were fitted with a two-temperature apec model, showing significant evolution of plasma temperature, emission measure, and metal abundance over time. The estimated energy released in the LEIA band is ~ 3 × 10^39 erg, suggesting this is likely the most energetic X-ray stellar flare detected to date.

10-3 - Board: 10 / **162**

An Application of XRISM/Xtend Transient Search Developed for Gravitational Wave Events

Author: Tomohiro Yanagi[1]

[1] *Chuo University*

The X-ray Imaging Spectroscopy Mission (XRISM) was launched on September 7th 2023, and the onboard Xtend is now performing spectral imaging in the 0.4-13 keV band with a wide field of view of 38 arcminutes. "XRISM/Xtend Transient Search (XTS)" is a system to conduct a transient search by utilizing the wide field of view of Xtend once per a day. With the high sensitivity of about 10^-14 ergs^-1 cm^-2 for a one-day observation, XTS has been able to detect orders of magnitude fainter objects than those obtained with all-sky survey satellites (e.g. MAXI and Einstein probe), i.e. as faint objects as those obtained with Swift's XRT and SRG's eROSITA. In recent years, technology for detecting signals (messengers) other than electromagnetic waves, such as cosmic rays, neutrinos and gravitational waves, has also improved dramatically. Multi-messenger observations, the simultaneous observation of electromagnetic waves along with other messengers, are now being carried out, and the groundwork is being laid for a multifaceted understanding of transient astronomical events, to obtain a complete understanding of their nature. It is still challenging to explore transient events in multiple bands. XTS joins the exploration with the high sensitivity in the X-ray band . We will present our application of XTS for the exploration.

10-3 - Board: 11 / **163**

XRISM and CHAO observations of HR 1099

Author: Nagisa Nagashima[1]

[1] *Chuo univ.*

HR 1099 (V711 Tau) is one of the most active RS Canum Venaticorum binaries with an orbital period of 2.8377 days and has been extensively studied at various wavelengths. It is a non-eclipsing, double-lined spectroscopic binary with a K0 - K1 subgiant primary and a G5 dwarf secondary in a nearly circular orbit (Fekel 1983). We observed this object from March 6 to 10 (UT) with XRISM as one of the calibration targets. We performed simultaneous optical observations with CAT and SCAT at CHAO (CHuo-university Astronomical Observatory) on the Korakuen campus of Chuo University on March 9 and 10 (UT) . We detected a flare during the XRISM observations. The X-ray flux increased from the 7th, peaked on the 8th, and finally decayed to the pre-flare level within 50000 s from the peak. The peak flux in the 0.4-10 keV band is 1×10^-10 erg s^-1 cm^-2, which corresponds to a luminosity of 1×10^31 erg s^-1 at 29 pc (Perryman et al. 1997). We found that the X-ray flare occurred around phase 0.0, i.e. when the K supergiant is in front of us, by extrapolating the radial velocity curve in Frasca & Lanza (2005). From the Resolve and Xtend light curves we found an X-ray enhancement after the flare, at the opposite phase (the phase ~0.5), and also another weak enhancement before the flare, again at the opposite phase (the phase ~0.5). In the X-ray enhancement after the flare, we detected a possible redshift of the Fe K alpha line with a velocity of about 600 km/s with Xtend, and also a redshift of the H alpha line with a velocity of about 300 km/s with SCAT. We will discuss the nature of the large redshift.

10-3 - Board: 12 / **173**

X-ray Source Population of the Wide-field X-ray Telescope on board the Einstein Probe

Author: Jingwei Hu[1]

[1] *National Astronomical Observatories, Chinese Academy of Sciences*

The Einstein Probe (EP) is an interdisciplinary mission of time-domain and X-ray astronomy. It was launched into orbit from the Xichang satellite launch centre on January 9, 2024. From 2024 July the commissioning and calibration phase was successfully completed and the nominal operations phase has started. The Wide-field X-ray Telescope (WXT), one of the two main payloads on board EP, is to monitor the sky with on-board triggering capability. Some of the WXT performances have also been demonstrated by the EP/WXT pathfinder LEIA (Lobster-Eye Imager for Astronomy) in orbit, launched in July 2022. In this talk, I will introduce the latest X-ray source population of the WXT on board the EP and the first source catalog of the LEIA.

10-3 - Board: 13 / **180**

XRISM/Xtend Study of CXOU J174610.8-290019

Author: Anje Yoshimoto[1]

[1] *Nara Women's University*

XRISM PV observation of the Galactic Center detected an interesting transient source named CXOU J174610.8-290019 within the Xtend FoV. The spectrum shows an intensity ratio of Fe-XXVI and Fe-XXV corresponding to kT>20 keV in comparison with a moderate bremsstrahlung continuum of kT~5 keV. We present the results of spectral and timing analyses.

10-3 - Board: 14 / **183**

X-ray transient Cl Collinder 228 113 detected with XRISM/Xtend

Author: Yukiko Ishihara[1]

[1] *Chuo University*

XRISM/Xtend Transient Search (XTS) detected an X-ray flare from a Chandra X-ray source CXOGNC J104457.51-595429.5, which was identified with a Gaia source, DR2 5350302509372303744 or Cl Collinder 228 113 (ATel #16652). From the SED and the distance of ~1.3 kpc, we found that Cl Collinder 228 113 has the spectrum type of K7 giant. The X-ray spectrum of this source has a strong Fe-K line at the flare phase, and it requires a large abundance of 2 solar, when we fit it with a thermal plasma (APEC) model. The other derived parameters are plasma temperature of kT ~4 keV and Emission Measure of 1 x 10^54 cm^-3. The flux in the 0.4–10.0 keV band is 1 x 10^-12 ergs/cm^2/s and the corresponding X-ray luminosity is 3 x 10^32 ergs/s. The e-folding time of the decay phase is derived to be 1 x 10^4 sec from the light curve, and then the total released energy in the 0.4–10.0 keV band is 3.4 × 10^36 erg. These parameters are not inconsistent with the correlations of the Emission Measure vs. kT and X-ray luminosity vs. e-folding time, which are shown in Shibata and Yokoyama (1999 ApJ) and Tsuboi et al. (2016 PASJ).

10-4 - Board: 15 / **178**

Polarization properties of Microquasars as seen by INTEGRAL

Author: Tristan Bouchet[1]

[1] *CEA Saclay*

Microquasars are known to produce strong hard X-ray emission during their outbursts, which is thought to be either inverse Compton emission, synchrotron emission or a mix of both. Although challenging to measure properly, polarization is a critical tool to distinguish between them. For this task, the IBIS telescope onboard the INTEGRAL satellite can be used to probe the polarization of bright sources above 200 keV, thanks to the Compton scattering of photons between its two detectors: ISGRI (30 – 500 keV) and PICsIT (170 keV – 10 MeV). The transient nature of most microquasars makes MAXI continuous monitoring of the sky an essential instrument: once a bright enough Microquasars is detected, the outburst evolution (flux and hardness-ratio) can be tracked by MAXI and polarization measurement can be made through the different states by the INTEGRAL/IBIS Compton mode. We will give a review of the previous polarization results, where some sources were found to be highly polarized (>50%) during their Hard State while some showed weaker or no polarization. We will also present recent results from the very bright outburst of the Microquasar Swift J1727.8-1613, which allowed us to measure polarization in both the Hard and Soft Intermediate states (SIMS). Interestingly the polarization angle was found to be aligned with the jet axis in the SIMS, and the same jet alignment was found after reanalyzing data of the source MAXI J1348-630. We therefore argue that this behavior may be more generic than first thought. Finally, we interpret the possible orientation of the polarization angle and magnetic field compared to the gamma-ray emitting jet during the outburst, and we suggest a way to constrain the inclination of the jet using the polarization fraction and photon index.

11-1 - Board: 16 / **166**

Supergiant Fast X-ray Transient from the Slowest X-ray Pulsar AX J1910.7+0917 with XRISM/Xtend

Author: Marina Yoshimoto[1]

[1] *Osaka University*

XRISM/Xtend has a large Field of View (FOV; 38′×38′) and can detect serendipitous transient X-ray phenomena in the FOV. XRISM/Xtend detected a supergiant fast X-ray transient from AX J1910.7+0917 during observation of PV target W49B. The AX J1910.7+0917 is the slowest X-ray pulsar with a rotation period of ~ 10 hours. In the spectral analysis, the time average spectrum is reproduced with an absorbed power-law model resulting in luminosity of 1.8_(−0.1)^(+0.1) × 10^35 erg s^(−1) (1–10 keV). We divided the light curves into 5 phases to investigate time variability. The Fe emission line(s) is(/are) detected in bright phase. Assuming the line width as Doppler broadening, the Keplerian radius is consistent with Alfvén radius with magnetic field of 1012 G. We detected pulsation period of 3.6–3.9×104 s. Possibly, there is a positive correlation between flux and rotation period. The AX J1910.7+0917 may be a key object to investigate the SFXT and related accretion phenomena.

11-1 - Board: 17 / **177**

Possible anti-correlations between pulsations and the disk growth of giant-outbursting Be X-ray binaries

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[1] *Tokyo Tech*

The mechanism of X-ray outbursts in Be X-ray binaries remains a mystery, and understanding their circumstellar disks is crucial for a solution of the mass-transfer problem. In particular, it is important to identify the Be star activities (e.g., pulsations) that cause mass ejection and, hence, disk formation. Therefore, we investigated the relationship between optical flux oscillations and the infrared (IR) excess in a sample of five Be X-ray binaries. Applying the Lomb-Scargle technique to high-cadence optical light curves from the Transiting Exoplanet Survey Satellite (TESS), we detected several significant oscillation modes in the 3 to 24 hour period range for each source. We also measured the IR excess (a proxy for disk growth) of those five sources, using J-band light curves from Palomar Gattini-IR. In four of the five sources, we found anti-correlations between the IR excess and the amplitude of the main flux oscillation modes. This result is inconsistent with the conventional idea that non-radial pulsations drive mass ejections. We propose an alternative scenario where internal temperature variations in the Be star cause transitions between pulsation-active and mass-ejection-active states.

11-2 - Board: 18 / **157**

New correlation between normal outburst profiles and binary orbital parameters in Be/X-ray binary pulsars

Author: Motoki Nakajima[1]

[1] *Nihon University*

We present the analysis results of normal outbursts (NOBs) from Be/X-ray binary pulsars (BeXBPs) observed by the MAXI/GSC. Since August 2009, over 200 X-ray outbursts were detected over a period of 15 years. Using the data obtained by the MAXI/GSC, we investigated the NOB profiles of BeXBPs from onset to end. The ascent phases of the NOBs are approximated by a linear function, from which we derived the average flux increase rate for each NOB. The relation between the flux increase rate of NOBs and their peak flux can be characterized by a power-law function. Furthermore, we find that the power-law indexes correlate with the eccentricities of the binary orbits of BeXBPs. Utilizing this relation, the orbital eccentricity can be estimated from the NOB profiles of the BeXBP with unknown orbital parameters.

11-2 - Board: 19 / **158**

Application of the Ghosh and Lamb Accretion Torque Model to the Relation between the Luminosity and Period-derivative of the X-ray Binary Pulsar A 0535+262

Author: Yuki Niida[1]

[1] *Ehime University*

We studied accretion torque induced change in the pulse period derivative of the X-ray binary pulsar A 0535+262 using the long-term light curve from the MAXI/GSC and the time variation of the pulse period from the Fermi/GBM. We found a clear anti-correlation between the bolometric luminosity and the period derivative. We applied the accretion torque model proposed by Ghosh and Lamb (1979) to the observed anti-correlation. This model predicts the relation between the luminosity and the period derivative considering the fundamental parameters of the system including the mass and radius of the neutron star, and hence the application of the model to the data enables us to constrain these parameters. From the A 0535+262 data, we obtained a neutron star mass of 1.1-1.2 solar mass. In this presentation, we will present the details of the analysis and results and discuss possible uncertainties in the results produced by the model and the data.

11-2 - Board: 20 / **159**

Urca Pair ^{63}Fe$-^{63}$Mn and its Impact on the Thermal Evolution of Neutron Star Crust

Author: Hao Huang[1]

[1] *Institute of Modern Physics, Chinese Academy of Sciences*

The cooling effect of ^{63}Fe$-^{63}$Mn Urca pair on the neutron star surface has been evaluated based on the state-of-the-art shell model calculations which reproduced the experimental spectroscopy results in the neutron-rich N $\sim$ 40 region. It is concluded that ^{63}Fe$-^{63}$Mn could be among the strongest Urca pairs in the neutron star crust. This pair has been identified as the primary contributor to the cooling of neutron stars after type-I X-ray bursts, as demonstrated by crust cooling models. When considering this pair, carbon ignition is expected to occur at a deeper shell, potentially facilitating superburst ignition with X-ray burst residues. Consideration of ^{63}Fe$-^{63}$Mn also improves the constraints that can be made on past surface nuclear burning on accreting neutron stars with observed quiescent cooling light curves of MAXI J0556-332.

11-2 - Board: 21 / **168**

THE PECULIAR PULSED FRACTION SPECTRA OF V0332+53: HINTS FOR A COMPLEX CYCLOTRON LINE SHAPE

Author: Giancarlo Cusumano[1]

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Pulse profiles of X-ray pulsars are invaluable tools for understanding emission mechanisms, system geometry, and radiation transfer under extreme conditions. By extracting energy-dependent pulse profiles Ferrigno (2023) showed how the changes in the pulse shape at energies corresponding to the cyclotron resonance scattering features, provide a quantitative way of determining the feature main properties (e.g. position and spectral width) with the same relative uncertainty given by the usual tools of spectral analysis. In this contribution, I will show how the application of the same method to the accreting source V0332+53 yields surprising results regarding the shape of its broad cyclotron feature. We studied the pulsed fraction spectra for all the available NuSTAR observations, thus sampling source luminosities different by a factor more than 30. We found some common key characteristics: a two-hump continuum with a local minimum around 10 keV, a double-peaked feature at the fundamental cyclotron energy, and a clear lag discontinuity at the same energies. The interpretation of such results leads to new clues for the spectral modelling of cyclotron features by using physical models to better constrain the plasma conditions of the emergent cyclotron feature.

11-3 - Board: 22 / **104**

Evolution of X-ray and optical rapid variability during the low/hard state in the 2018 outburst of MAXI J1820+070

Author: Mariko Kimura[1]

[1] *Kanazawa univ.*

MAXI J1820+070 is a low-mass X-ray binary harboring a black hole. It entered a very bright outburst in 2018. We performed shot analyses of X-ray and optical sub-second flares observed during the low/hard state of that outbursts. The advantage of shot analyses is that the average flare shape can be preserved. We found that the timescale of shots was about 0.2 s and that optical shots were less spread than X-ray shots. The amplitude of X-ray shots was the highest at the onset of the outburst, and they faded at the transition to the intermediate state. We also detected the abrupt spectral hardening synchronized with this steep flaring event, which was not found in previous shot analyses for another black-hole binary Cyg X-1. The time evolution of optical shots was not similar to that of X-ray shots. These results suggest that accreting gas blobs triggered a series of magnetic reconnections at the hot inner accretion flow in the vicinity of the black hole, which enhanced X-ray emission and generated flaring events. The rapid X-ray spectral hardening would be caused by this kind of magnetic activity. Also, the synchrotron emission not only at the hot flow but also at the jet plasma would contribute to the optical rapid variability. We also found that the low/hard state exhibited six different phases in the hardness-intensity diagram and the correlation plot between the optical flux and the X-ray hardness. The amplitude and duration of X-ray shots varied in synchrony with these phases. This time variation may provide key information about the evolution of the hot flow, the low-temperature outer disk, and the jet-emitting plasma.

11-3 - Board: 23 / **148**

The Detailed View of LFQPO in the Broadband 0.2–200keV with Insight-HXMT and NICER

Author: Xiang Ma[1]

[1] *Institute of High Energy Physics, CAS*

We report the X-ray timing results of the black hole candidate MAXI J1820+070 during its 2018 outburst using the Hard X-ray Modulation Telescope (Insight-HXMT) and Neutron Star Interior Composition Explorer Mission (NICER) observations. Low-frequency quasi-periodic oscillations (LFQPOs) are detected in the low/hard state and the hard intermediate state, which lasted for ~90 days. Thanks to the large effective area of Insight-HXMT at high energies and NICER at low energies, we are able to present the energy dependence of the LFQPO characteristics and phase lags from 0.2 to 200 keV, which has never been explored by previous missions. We find that the centroid frequency of the LFQPOs does not change significantly with energy, while the full width at half maximum and fractional rms show a complex evolution with energy. The LFQPO phase lags at high energies and low energies show consistent energy-dependence relations taking the ~2 keV as reference. Our results suggest that the LFQPOs from high energy come from the LT precession of the relativistic jet, while the low-energy radiation is mainly from the perpendicular innermost regions of the accretion disk.

11-3 - Board: 24 / **152**

Investigation of X-ray Spectral Variations in the Black Hole Candidate Swift J1727.8-1613

Author: Taichi Nakamoto[1]

[1] *Ehime University*

We report the results of X-ray spectral analysis of the Galactic black hole X-ray binary Swift J1727.8-1613 during its outburst. It showed one of the largest outbursts ever observed in black hole X-ray binaries and was monitored by many X-ray observatories. Using the NICER spectra obtained at various epochs in the outburst, we investigated the accretion disk structure and its evolution. We applied a model consisting of a multi-temperature blackbody component from the accretion disk and a power-law component (which represents Comptonization of the disk photons) to the spectra and found that the model reproduced the data well across different X-ray luminosities. The results revealed that the system made a transition from the low/hard state in the early stages of the outburst to the very high state near the peak luminosity, and then to the high/soft state. Equating the inner disk radius obtained in the high/soft state with the innermost stable circular orbit of the black hole, we estimated the black hole mass to be ~3.4 (D/2.7 kpc) (cos i/cos 0 deg)^(-1/2) M_sun for a non-spinning black hole, and ~20 (D/2.7 kpc) (cos i/cos 0 deg)^(-1/2) M_sun for a maximally spinning black hole.

11-3 - Board: 25 / **164**

Discovery of the black hole X-ray nova MAXI J1631-479 and understanding its peculiar properties

Author: Kohei Kobayashi[1]

[1] *Nihon University (Current Affiliation: MAMEZOU CO., LTD)*

MAXI J1631-479 was discovered on 2018 December 21 by MAXI, and exhibited a fast rise and exponential decay type of the outburst. After the low/hard state at the beginning of the outburst, the source underwent a variety of state transitions. The source, however, had been mostly in the high/soft state after about 100 days from the discovery until the X-ray flux decreased by about four orders of magnitude from a peak flux of about 2.5 Crab in the 2-10 keV band. A hardness-intensity diagram of count ratios at the energy bands, (4-10 keV)/(2-4 keV), and 2-10 keV flux does not show a typical 'q'-shape but an inverted 'Y' just like observed in XTE J1550-564 and some other black hole X-ray nova. It is naturally explained by increase and decrease in mass accretion rates and corresponding various solutions in accretion disk theories. A dust-scattered X-ray halo was observed with the X-ray telescope of the Neil Gehrels Swift Observatory. Our dust-echo analysis to the direction of MAXI J1631-479 shows that two or three dust layers are present, and the source distance is estimated at about 8 kpc and 12 kpc, respectively. If the source distance is 12 kpc, the mass is the largest among X-ray binary discovered in the Milky Way.

11-3 - Board: 26 / **170**

A Review on Properties of MAXI discovered 7 Black Hole Candidates: Analysis with TCAF model

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MAXI is one of the most successful astronomy mission satellites which discovered 14 Galactic X-ray binaries to date. We studied the accretion flow properties of 7 black hole candidates (BHCs; such as MAXI J1659-152, MAXI J1836-194, MAXI J1543-564, MAXI J1535-571, MAXI J1348-630, MAXI J1813-095, MAXI J1910-057) using one of the generalized physical accretion flow models, namely Two-component advective flow (TCAF) model. One can directly extract information about two types of accretion (Keplerian disk and sub-Keplerian halo) rates, and shock parameters(location and strength) from spectral analysis with this model in XSPEC. The variation of these physical flow parameters along with temporal properties such as variation of hardness-ratios, and the nature of observed quasi-periodic oscillations (QPOs) provided us with a clear picture of flow dynamics of the transient BHCs during the outbursts. It also allows us to understand the evolution of the spectral states during the outbursts. Estimation of intrinsic source parameters of these newly discovered BHCs is done from our detailed study. From our spectral study, estimation of X-ray fluxes contributed by jets/outflows in some of the above BHCs is also done after introduction of an innovative method. The nature of the jet is also studied.

11-3 - Board: 27 / **171**

Disk receding during state transitions in black hole X-ray binaries: a sample study using RXTE observations

Author: Saien Xu[1]

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Black hole X-ray binaries (BHXRBs) undergo hard-soft-hard state during their outbursts. In the soft state, the energy spectrum is dominated by thermal emission from the accretion disk, which is thought to extend down to the innermost stable circular orbit. In contrast, during the hard state, the disk is truncated at a larger radius, and the spectrum is dominated by a comptonization component from a corona. Recent observations of the 2018 outburst of MAXI J1820+070 provide evidence for the formation of a magnetically arrested disk. A key indicator of this phenomenon is the observed deviation from the exponential decay of disk luminosity, which suggests the disk is receding. In this work, we analyze RXTE data from 16 BHXRBs, fitting their X-ray spectra to separately determine the luminosities of the disk and the corona. We find that the disk luminosity in the soft state generally follows an exponential decay. Although some sources lack data for the soft-hard state transition and others exhibit more complex light curves during their decay phases, seven sources show evidence of disk receding during the soft-hard state transition, accompanied by a flare in the comptonization component. Our results demonstrate that the disk receding during the soft-hard state transition is a common feature in BHXRBs.

11-3 - Board: 28 / **181**

X-ray Spectral and Timing Properties of the Black Hole Binary XTE J1859+226 and their Relation to Jets

Author: Kazutaka Yamaoka[1]

[1] *Nagoya Univ.*

We compiled the X-ray and soft gamma-ray observations of the Galactic black hole binary XTE J1859+226 in the 1999–2000 outburst from RXTE, ASCA, BeppoSAX and CGRO. Throughout systematic spectral analysis using a two-component model consisting of a multi-temperature accretion disk plus a fraction of its flux convolved with a phenomenological cutoff powerlaw component resembling Comptonizaion, we found that the innermost radius (rin) and temperature (Tin) of the disk are very variable with time in the rising phase of X-ray flux below 20 keV where several types of low-frequency quasi-periodic oscillations (QPOs) were found. After this phase, rin remains constant at around 60 km assuming a distance of 8 kpc and inclination angle of 67◦, and Tin is smoothly decayed with time. Based on these results, the constant rin is probably due to a presence of the innermost stable circular orbit (ISCO), and rin repeats moving closer and farther away from the ISCO in the rising phase. Both disk parameters are also remarkably correlated with independently analyzed timing properties such as QPO central frequency and fractional rms variability amplitude. We found that the Type-A and -B QPOs are seen only when rin is close to the ISCO, while Type-C are seen when rin is truncated and the frequency changes with a relation of rin^-1.0 . This fact supports that Type-C QPOs occurs at the inner edge of the truncated disk. For at least three of five jet ejections, we suggest that relativistic jet productions occur when rin rapidly approaches from far side to the ISCO, and disk flux, and hardness ratio also rapidly changes.

11-3 - Board: 29 / **184**

Understanding unusual flux drops in the 2012 outburst of 4U 1630-472

Author: Chulsoo Kang[1]

[1] *Ehime University*

The black hole X-ray binary 4U 1630-472 shows outbursts repeatedly with an interval of 600 days. We studied the 2012 outburst, which was one of the biggest outbursts of the source. We found unusual X-ray flux drops by ~50% with a duration of ~1 day at its brightest phase, which is much shorter than the timescale of accretion but longer than the dynamical timescale in the inner region of the accretion disk. To understand the cause of the drops, we compared the MAXI and Swift spectra obtained during and outside the drops. We found that, during the drops, the source decreased its flux without significantly changing the spectral shape below 10 keV. We consider two possible interpretations for the observed spectral variation: (1) fully ionized, Compton-thick gas passed through our line of sight and reduced the apparent X-ray flux, and (2) the Comptonized corona developed with the decrease of the inner disk temperature and the disk luminosity and the spectral hardening by strong Comptonization compensated the spectral softening.

11-4 - Board: 30 / **146**

The formation and dissipation of the resolved jet of a black hole X-ray transient Swift J1727.8-1613 by the radio monitoring with the Yamaguchi Interferometer and the Japanese VLBI Network

Author: Masanori Akimoto[1]

[1] *Yamaguchi university*

Swift/BAT first reported the detection of the X-ray transient Swift J1727.8-1613 on 2023 August 24 (Page+2023). Optical observations revealed that Swift J1727.8-1613 has a black hole candidate larger than 3.2 Msun and a K4V donor (Mata Sanchez+2023). Black hole X-ray binaries have an accretion state responsible for the ejection of large-scale or compact jets. The formation process of these jets is one of the open questions in astronomy. Swift J1727.8-1613 has the resolved continuous jets reaching 20–40 mas in the north-south direction observed by the Very Long Baseline Array during the hard/hard-intermediate state (Wood+2024). However, the variabilities of the intensity and the spatial structure of the observed jets have not been revealed. We therefore carried out the flux density monitoring at 6/8 GHz of a jet of Swift J1727.8-1613 with the Yamaguchi Interferometer (YI) and the Japanese VLBI Network (JVN) simultaneously from September 19 to October 1 in 2023. A radio interferometer such as the YI and the JVN can not detect a jet component larger than their spatial resolutions, which are 1'1 arcmin and 8 mas at 8 GHz. This means that the observed flux density of the JVN is less than that of YI. As a result, we observed the variabilities increasing 35 and 40 mJy in the JVN and the YI at 8 GHz in an hour, respectively. The difference of 5 mJy represents a component spread to a few mas which the JVN can resolve. Another component showed the radio variabilities that the short radio flares and the persistent components exist together. The former is that the variability amplitude of the YI is equal to that of JVN for two hours so it represents that the size of the radio flare component is smaller than a few mas. The latter represents a steady component larger than a few mas for several hours.

12-2 - Board: 31 / **102**

Current operational status of Insight-HXMT

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As China's first X-ray astronomy satellite, the Hard X-ray Modulation Telescope (HXMT) has been successfully operational in orbit for about 7 years. It is equipped with three payloads, covering band ranging from 1 to 250 keV. This poster aims to provide a comprehensive overview of HXMT's operational status, with a focus on its scientific proposals, data products, the performance of its three payloads and data analysis procedures.

12-2 - Board: 32 / **149**

A Systematic Search of X-ray Eclipse Events of Active Galactic Nuclei Observed by Swift/XRT

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The core of active galactic nuclei (AGN) may be surrounded by numerous clouds in diverse physical states. These clumpy clouds can randomly obscure the central X-ray source, leading to eclipse events. Recent studies indicated that such events are likely common in AGN. However, the complete eclipse events are rarely discovered, because they require extensive X-ray monitoring spanning years. In this study, we conduct a systematic search of eclipse events in 40 AGNs with a total of 11486 observations by Swift X-ray telescope (XRT). Our selection is based on unusual variation of X-ray flux and hardness ratio. We discover 3 eclipse events in 3 sources, as well as 7 candidate events in 5 sources, all of which are identified in type I AGN. Compared to pervious studies, 5 events are newly discovered. The ionization parameter (logξ) derived by fitting the average spectrum during the eclipse time ranging from -0.547 to 2.443 with the column densities spanning 0.16 - 31.15 x 10^22 cm^-2. The timescales of these events vary from a few days to years. We estimate the distance of these events to the central black hole, ranging from 0.31 - 107.79 x 10^4 Rg. 6 out of 10 events have cloud locations consistent with the dust sublimation zone (DSZ) while 2 events have clouds outside the DSZ, and the remaining 2 events resided at broad line regions (BLR). The X-ray all-sky monitoring of Einstein Probe (EP) may provide a much stronger constraints on the rate of such events in the local universe.

12-2 - Board: 33 / **153**

Development of The Multi-Messenger Observation Database and Viewer

Author: Yuta Kawakubo[1]

[1] *Aoyama Gakuin University*

In the past two decades, multi-wavelength observations of astronomical objects and phenomena using electromagnetic waves have become commonplace. Furthermore, multi-messenger astronomy, which includes messengers beyond electromagnetic waves, such as gravitational waves and neutrinos, is emerging as the new standard. The Multi-Messenger Observation Database and Viewer compile and visualize various types of observation data, enhancing the ability to identify potential targets for multi-messenger astronomy. In particular, the viewer quickly provides information to assist in deciding whether to follow up on transients. We will introduce the Multi-Messenger Observation Database and Viewer and provide a development status.

12-2 - Board: 34 / **161**

Upper limit estimation of X-ray flux for gravitational wave counterparts with MAXI

Author: Yuta Kondo[1]

[1] *Aoyamagakuin University*

In the O4a period of gravitational wave observation, only two LIGO observatories were available, and thus, a 90% credible region was typically several percent to several tens of percent of the whole sky. Therefore, we need instruments with a wide field of views. Monitor of All-sky X-ray Image (MAXI) is an X-ray detector aboard the International Space Station (ISS). MAXI is sensitive to X-rays in 2-20 keV and has a field of view of 3° x 160°. MAXI can observe 85% of the all-sky in 92 minutes (orbital period of the ISS) and almost 100% in two weeks. The ability to observe X-rays over a wide area is advantageous for searching for X-ray counterparts of gravitational wave sources. Because it is estimated that the electromagnetic emissions generated by gravitational wave events decay rapidly over time, the ability to observe X-rays over a wide area is advantageous for searching for gravitational wave sources. From the data analyses of MAXI, we can obtain the observation time and X-ray fluxes or upper limits for each region of the all-sky. The predicted flux of most events is an upper limit due to MAXI's insufficient sensitivity. However, it could be a severe constraint on the radiation model if the region was observed just after the gravitational wave event. In this study, we analyzed gravitational wave events with FAR < 20 per year (6.34 x 10^{-7} Hz) and have Prob NS > 5%, which may include neutron stars. 13 events met these two criteria. We confirmed that none of the events had bright X-ray sources that MAXI could detect. In these 13 events, the average coverage of LIGO's 90% credible region of gravitational wave in one scan (92 minutes) of MAXI was 80%. Next, we obtained the upper limit of the X-ray flux by analyzing the MAXI data. First, we adjusted the resolution of the probability map of LIGO to the MAXI's point spread function. Then the number of photons in each region was counted in the pixels in the 90% credible region. Finally, the numbers of the photons were divided by the MAXI exposure (effective area x time) to obtain the flux upper limit of each position. This method was applied to 13 events, and we obtained the upper limits. For example, the upper limit of S230615az was the average was 1.3 x 10^{-10} to 5.4 x 10^{-9} erg cm^{-2} s^{-1}, the average was 9 x 10^{-10} erg cm^{-2} s^$^{-1}$.

12-2 - Board: 35 / **169**

Evaluation of the Time Correlation between X-rays and Neutrinos from a Seyfert Galaxy

Author: Yu Miyazato[1]

[1] *Chiba University*

In recent years, magnetic turbulence in the hot coronae of Seyfert galaxies has been proposed as a potential source for high-energy neutrino production. This model predicts that the signal strength of neutrinos originating from the coronae correlates with X-ray intensity, and experimentally constraining this correlation could provide a deeper understanding of high-energy neutrino and cosmic ray production models. In this study, we developed and tested a method to evaluate the time correlation between X-ray and neutrino observational data from a Seyfert galaxy, using approximately 10 years of continuous observations from MAXI and IceCube. First, we assumed a correlation function with several parameters between X-rays and neutrinos. Then, focusing on nearby, X-ray-bright Seyfert galaxy, we used MAXI's observational results and this correlation function to generate neutrino data corresponding to the X-rays. We optimized the parameters through simulations based on pseudo-observational data. By defining correlation detection confidence as the percentile position of the median of the parameter histogram fitted under a correlation assumption, relative to the histogram of parameters under the assumption of no correlation, we were able to impose constraints on the number of neutrino detections by IceCube necessary to identify the correlation. Specifically, we found that if 34 or more neutrinos are detected from NGC 4151 over 3,804 days, the correlation between X-rays and neutrinos from the galaxy could be analyzed with over 90% confidence using this method, representing a stricter constraint than previous limits.

12-2 - Board: 36 / **172**

The Catalog of Extragalactic Fast X-ray Transients Discovered by Einstein Probe during its Commissioning Phase

Author: Qinyu Wu[1]

[1] *National Astronomical Observatories, Chinese Academy of Sciences*

Extragalactic Fast X-ray Transients (eFXTs) are defined as short flares in X ray with cosmological origins. But the nature of eFXT is still uncertain due to the lack of timely follow up observations. The possible physical mechanisms include the shock breakout of a supernova, the fireball phase of a nova, the magnetar powered X-ray emission after the mergers of binary neutron stars, off-axis GRBs and other unexplored objects. Benefiting from its unprecedentedly large field of view and high sensitivity in the soft X-ray band, the Wide field X-ray Telescope (WXT) on board Einstein Probe (EP) satellite has detected a few dozens of eFXTs during its commissioning phase. The near real time alert and quick autonomous follow up observations of Follow up X ray (FXT) enable the timely multi wavelength detection in some cases (e.g. EP240315a and EP240414a). These eFXTs show diverse temporal shapes and multi wavelength associations. A significant fraction (more than two thirds) of these eFXTs have no corresponding gamma ray counterparts indicating potential distinct origins from GRBs. In this talk, I will introduce the statistical studies of these eFXTs' properties, aiming to obtain a comprehensive understanding of their possible physical origins.

12-2 - Board: 37 / **175**

X-ray Variability and Quasi Periodic Oscillations (QPOs) in AGNs

Author: Alok Gupta[1]

[1] *ARIES, Nainital*

It is a well established fact that AGNs show large amplitude flux and occasional quasi periodic oscillations (QPOs) in their X-ray light curves. For the last 1.5 decades, my group has extensively worked on searching for X-ray variations in two subclasses of active galactic nuclei (AGNs) namely narrow line Seyfert 1 (NLSy1) and blazars. We have used various X-ray missions e.g. MAXI, XMM-Newton, Chandra, Suzaku, NuStar, etc. In the present talk, I will summarize key results of our work, and possible theoretical explanations.

12-2 - Board: 38 / **179**

Modeling a New Clocked X-ray Burster SRGA J144459.2-604207

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Recently, (Type-I) X-ray bursts have been observed in a neutron star SRGA J144459.2-604207 by various X-ray satellites, firstly INTEGRAL and NinjaSat (Atel: 16485, 16495). To summarize their observations shortly, in the early phase, they show very regular behavior, i.e., Clocked bursters, but in the latter phase, they become irregular. From such a Clocked burster with various properties, we can probe the nature of low-mass X-ray binaries through the comparison of theoretical X-ray burst models. In this work, we report the modeling SRGA J144459.2-604207 for multi-X-ray observations, focusing on the composition of accreted matter. We will also mention the relation between persistent flux and recurrence time observed by the NinjaSat and its implication to neutron-star mass.

12-3 - Board: 39 / **147**

The maximum-likelihood estimation method for X-ray spectra with low counts

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For X-ray spectra with low counts, traditional statistics such as ⊠2 statistic and Poisson (C) statistic cannot well enough evaluate the goodness-of-fit during model fitting, because the binning process is usually arbitrary and would result in the loss of channel information. The maximum-likelihood estimation method is an ideal alternative method that does not require any binning procedures. We establish the maximum-likelihood estimation method and test it with fake spectra with low counts. We also test other methods such as XSPEC fitting, MCMC method and BXA method for comparison, and we found that the results obtained by the maximum-likelihood estimation method are better than those obtained by XSPEC fitting. Both the maximum-likelihood estimation method and MCMC method can obtain pretty good results, however, the running time of MCMC can be much longer than that of the maximum-likelihood estimator. Besides, we also look into the effect that the parameter values have on the results. We further apply the method to the LEIA observational data and attain some satisfactory results. In a word, we have established the unbinned maximum-likelihood estimation method especially for low-count data and proved its practicability by applying to the real data.

12-3 - Board: 40 / **167**

Observations of MAXI Unidentified Short Soft Transients

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Short X-ray transients are observed by various X-ray missions. Origins of these transients are both galactic (X-ray bursts, stellar flares, soft gamma-ray repeaters, etc.) and extra-galactic (Gamma-ray bursts, tidal disruption events, AGNs, etc.). Among them MAXI observed short soft transients which were not observed by other instruments including X-ray follow-up observations. We summarize the observations of these transients and discuss possible origins of them.

12-3 - Board: 41 / **176**

Exploring the Landscape of Shock Breakout Spectra

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The first detectable light of a supernova explosion is the shock breakout emission, which is produced as the supernova shock wave breaches the star's surface and which acts as a powerful diagnostic for the pre-explosion state of the progenitor system. I will discuss a novel way of categorizing the possible spectra observed immediately after breakout, and the recent advances in shock breakout theory underpinning this. We find that there are three important timescales controlling the spectral behavior: the light crossing time of the system, the initial diffusion time, and the time when the observer starts to see ejecta in thermal equilibrium. There are five allowed orderings of these timescales, each of which result in a different spectral evolution. Among these possibilities is a hitherto unexplored scenario, relevant to fast shocks breaking out from an extended envelope or circumstellar material, where thermalized ejecta are revealed in less than a light crossing time, resulting in a spectrum in which distinct blackbody and free-free emission components are blended together by light travel time effects. We apply this non-standard breakout scenario to explain the peculiar low-luminosity GRB 060218.

12-3 - Board: 42 / **185**

Radiation tolerance test with 10 MeV protons and performance evaluation of pnCCD for future satellite mission HiZ-GUNDAM

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Wide-field soft X-ray surveys are important for future gamma-ray burst observations. The HiZ-GUNDAM satellite will use lobster-eye optics and pnCCDs to observe soft X-ray transients such as gamma-ray bursts. In this study, the radiation tolerance of a small pnCCD with a pixel size of 75 μm and a depletion thickness of 450 μm was evaluated. In this test, radiation damage due to orbital total dose effect was given by 10 MeV proton beams as representative. As a result of performance evaluation after the test, the operating temperature and framerate range of the pnCCD required to meet the HiZ-GUNDAM mission requirement of 0.4 keV lower detectable energy was calculated.