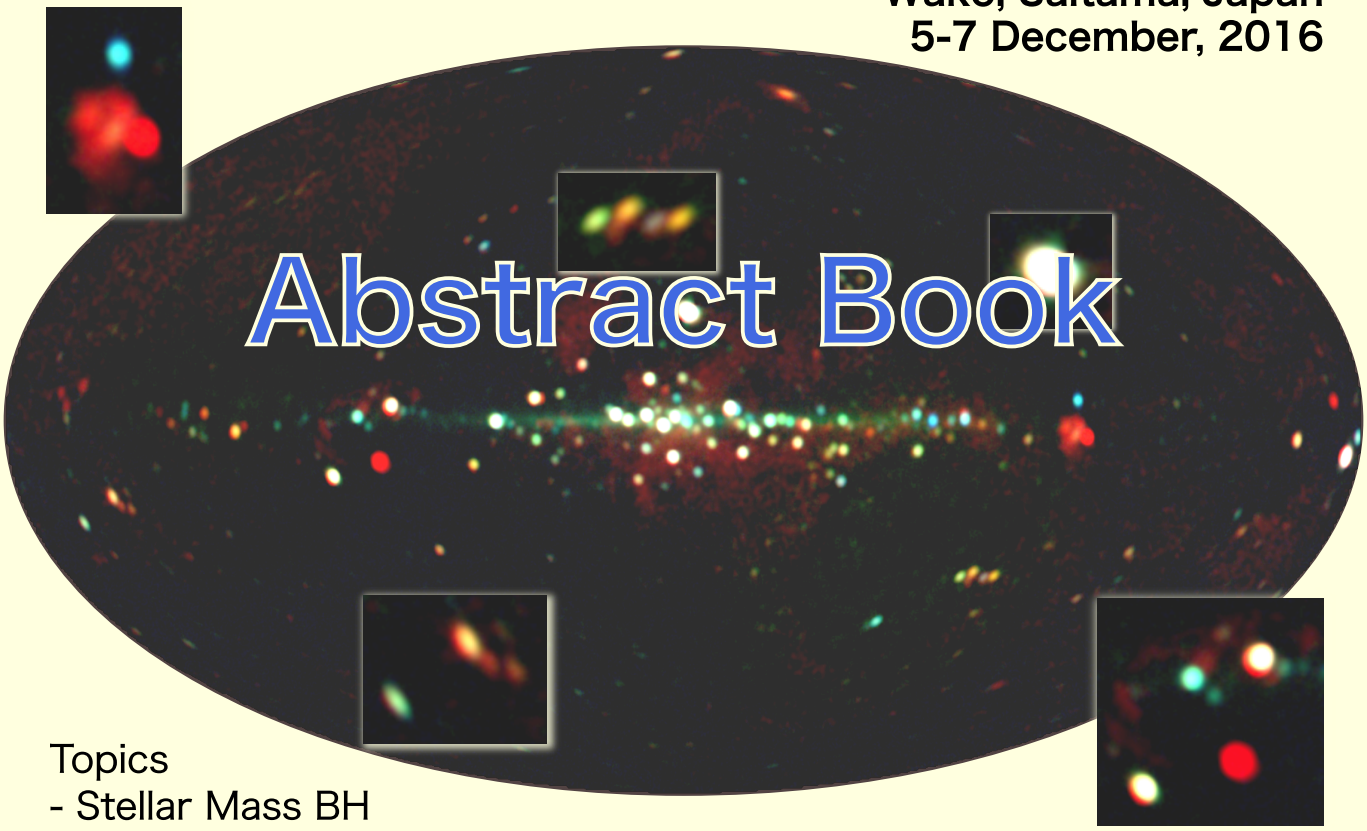
RIKEN symposium

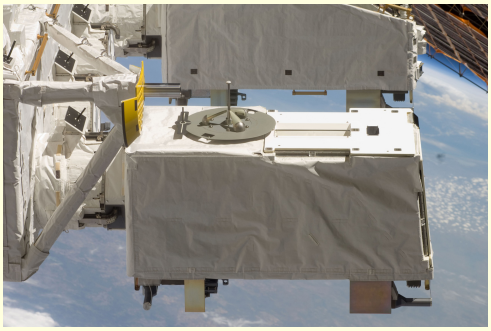
7 years of MAXI
Monitoring X-ray Transients

Suzuki Umetaro Hall, RIKEN
Wako, Saitama, Japan
5-7 December, 2016



Abstract Book

Topics
- Stellar Mass BH
- Low Mass X-ray Binaries
- GRB
- MAXI Transients
- Superbursts
- Stellar Flares
- AGN
- Hitomi Results
- Binary X-ray Pulsars
- Gravitational Wave Sources



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PROGRAM

Monday 05 December 2016

Tuesday 06 December 2016

Wednesday 07 December 2016

7 years of MAXI : monitoring X-ray transients

Monday 05 December 2016

Registration - (09:30-10:00)

Opening remarks - (10:00-10:10)

- **Presenters: Prof. MATSUOKA, Masaru**

Session 1 : Highlights - (10:10-11:30)

Chair : Prof. KAWAI, Nobuyuki

time	title	presenter
10:10	MAXI 7 years highlights	Dr. MIHARA, Tatehiro
10:40	MAXI-SSC results in 7 years	Prof. TSUNEMI, Hiroshi
11:00	Discovery of 17 X-ray transients with MAXI/GSC and their nature	Prof. NEGORO, Hitoshi

Lunch & Poster - (11:30-13:30)

Session 2 : Stellar Mass Black Hole - (13:30-15:00)

Chair : Prof. UEDA, Yoshihiro

time	title	presenter
13:30	Progress Galactic black hole binaries over the past 7 years: a selection of recent results	Dr. RODRIGUEZ, Jerome
14:00	Violent optical variations and correlation with X-ray variability in the 2015 outbursts in V404 Cygni	Ms. KIMURA, Mariko
14:15	Two optical emission components with different variability in V404 Cygni	Mr. TACHIBANA, Yutaro
14:30	Observation of the long-term variability of Cygnus X-1 with MAXI	Ms. SUGIMOTO, Juri
14:45	Accretion flow properties of three MAXI Black Hole candiadtes: analysis with TCAF solution	Dr. DEBNATH, Dipak

Coffee & Poster - (15:00-15:30)

Session 3 : Low Mass X-ray Binaries - (15:30-17:05)

Chair : Prof. MATSUOKA, Masaru

time	title	presenter
15:30	Black holes and neutron stars in Low Mass X-ray binaries	Prof. DONE, Chris
16:00	Spectral states in NS-LMXBs observed with MAXI/GSC and Swift/BAT	Dr. ASAI, Kazumi

16:20	Overview of spectral change in NS-LMXB	Dr. TAKAHASHI, Hiromitsu
16:50	Unveiling the spectral transition of Aql X-1 from the hard to soft state	Mr. ONO, Ko

Session 4 : GRB - (17:05-18:10)

Chair : Dr. SAKAMOTO, Takanori

time	title	presenter
17:05	Short-GRB rate from Yonetoku relation for SGRB and the detectability of GW in O2 of aLIGO/aVirgo	Prof. NAKAMURA, Takashi
17:20	GRB radio view from all angles	Dr. VAN DER HORST, Alexander
17:40	GRBs with MAXI and CALET	Dr. NAKAHIRA, Satoshi
17:55	POLAR - The gamma-ray burst polarimetry experiment onboard China's TG-2 spacelab	Prof. ZHANG, Shuang-Nan

Note : 30 min talk = 25 + 5 min discussion / 25 min talk = 20 + 5 min discussion / 20 min talk = 15 + 5 min discussion / 15 min talk = 12 + 3 min discussion

Tuesday 06 December 2016

Session 5 : MAXI Transients - (09:00-10:35)

Chair : Prof. NEGORO, Hitoshi

time	title	presenter
09:00	Quick review of X-ray transients	Prof. NEGORO, Hitoshi
09:05	Swift/MAXI transient collaboration: 7 years of success	Dr. KENNEA, Jamie
09:35	On the orbital period of MAXI J1305-704	Dr. SHAW, Aarran
09:50	A multi-wavelength view of jets in accreting binaries	Prof. CORBEL, Stephane
10:20	Novae with super-Eddington luminosities	Prof. SHIGEYAMA, Toshikazu

Session 6 : Superbursts - (10:35-11:25)

Chair : Dr. IWAKIRI, Wataru

time	title	presenter
10:35	Understanding superbursts	Dr. IN 'T ZAND, Jean
11:05	MAXI detections of superbursts	Dr. SERINO, Motoko

Session 7 : MAXI Archive - (11:25-11:40)

Chair : Dr. IWAKIRI, Wataru

time	title	presenter
11:25	MAXI data archive plan	Prof. EBISAWA, Ken

Lunch & Poster - (11:40-13:30)

Session 8 : Steller Flares - (13:30-14:40)

Chair : Dr. SUGAWARA, Yasuharu

time	title	presenter
13:30	X-ray study of stellar flares	Prof. TSUBOI, Yohko
13:55	Superflares on Sun-like stars	Prof. SHIBATA, Kazunari
14:25	Transient magnetars and magnetic field evolution of neutron stars	Dr. ENOTO, Teruaki

Coffee & Poster - (14:40-15:10)

Session 9 : AGN - (15:10-16:30)

Chair : Dr. ISOBE, Naoki

time	title	presenter
15:10	Hard X-ray luminosity function of tidal disruption events: first results from MAXI extragalactic survey	Mr. KAWAMURO, Taiki
15:25	First statistical tests for clumpy-torus models: constraints from RXTE monitoring of Seyfert AGN	Dr. MARKOWITZ, Alex
15:55	A Novel view of AGN accretion flows revealed by X-ray and optical monitoring	Prof. MAKISHIMA, Kazuo
16:15	An X-ray spectral variability of fast disk winds in AGN	Dr. HAGINO, Kouichi

Session 10 : Science from Hitomi - (16:30-18:00)

Chair : Prof. MAKISHIMA, Kazuo

time	title	presenter
16:30	Science from Hitomi: Introduction	Prof. OHASHI, Takaya
16:35	Hitomi observation of the Perseus cluster - gas motions and resonant scattering -	Dr. SATO, Kosuke
16:59	Hitomi observation of the Perseus cluster - temperature and elemental abundances -	Dr. NAKASHIMA, Shinya
17:23	Hitomi results of NGC 1275: the origin of Fe-K alpha Line	Dr. NODA, Hirofumi
17:41	Hitomi observation of the supernova remnant N132D in the Large Magellanic Cloud	Dr. KATSUDA, Satoru

Banquet - Hirosawa Club (18:15-20:30)

Note : 30 min talk = 25 + 5 min discussion / 25 min talk = 20 + 5 min discussion / 20 min talk = 15 + 5 min discussion / 15 min talk = 12 + 3 min discussion

Wednesday 07 December 2016

Session 11 : Binary X-ray pulsars - (09:00-11:55)

Chair : Dr. MIHARA, Tatehiro

time	title	presenter
09:00	Monitoring activities of X-ray binary pulsars with Fermi/GBM	Dr. JENKE, Peter
09:30	Luminosity and spin-up relation in X-ray binary pulsars with MAXI/GSC and Fermi/GBM	Dr. SUGIZAKI, Mutsumi
10:00	Monitoring Supergiant Fast X-ray Transients with Swift and XMM-Newton	Dr. BOZZO, Enrico
10:15	MAXI/GSC observation of X-ray outbursts from Be/X-ray binary pulsars	Dr. NAKAJIMA, Motoki
10:40	Cyclotron absorption lines in the era of Suzaku and NuSTAR	Mr. GAURAVA K., Jaisawal
10:55	Indian Astro-sat : results in the first year	Prof. PAUL, Biswajit
11:25	The Hard X-ray Modulation Telescope mission	Prof. ZHANG, Shuang-Nan
11:40	X-ray polarimetry mission PRAXyS	Dr. TORU, Tamagawa

Lunch & Poster Session - (11:55-13:50)

Session 12 : Gravitational wave sources - (13:50-15:40)

Chair : Dr. SERINO, Motoko

time	title	presenter
13:50	Advanced LIGO first light: multimessenger astrophysics at the birth of gravitational-wave observatory	Dr. SINGER, Leo
14:20	Binary black hole remnants of first stars for the gravitational wave source	Dr. KINUGAWA,, Tomoya
14:35	Search for X-ray counterparts of gravitational wave events	Prof. KAWAI, Nobuyuki
14:55	X-ray Transient Localization Experiment aboard a micro-satellite for multi-messenger counterpart search	Mr. SAWANO, Tatsuya
15:10	Einstein Probe -- a small mission to explore the transient X-ray sky	Dr. YUAN, Weimin

Closing remarks - (15:40-15:50)

- Presenters: Prof. MAKISHIMA, Kazuo

Note : 30 min talk = 25 + 5 min discussion / 25 min talk = 20 + 5 min discussion / 20 min talk = 15 + 5 min discussion / 15 min talk = 12 + 3 min discussion

ORAL PAPERS

Oct. 5, 10:10-

MIHARA, Tatehiro (RIKEN)

MAXI 7 Years highlights

MAXI started observation on August 15, 2009. Since then MAXI is monitoring the X-ray sky for more than 7 years. The light curves of about 350 sources are updated in every 4 hours or 1 day and open through MAXI homepage (`http://maxi.riken.jp`). MAXI' s alert on new X-ray transients are sent to subscribers in the MAXI alert mailing lists in 12 seconds as the earliest case. Most of them were followed up by the Swift/XRT revealing the nature of the source. Seventeen new sources were found by MAXI. Six of them were new black holes. Soft X-ray flash at an ignition of a nova was detected for the first time in November 11, 2011. Tidal disruption events have formed a new category after the discovery of Swift J1644+57.

MAXI catalogs of both GSC and SSC were issued revealing new members of X-ray emitters in the 21st century. Fluxes of X-ray binaries are monitored continuously recording histories of activities of the neutron stars. Monitoring is used for detailed observations with Suzaku, Chandra and XMM-Newton. Data with uniform quality are used for power-spectrum-density analysis in AGNs and study of accretion disk instabilities in NS-LMXB and black hole binaries. Normal and giant outbursts of Be X-ray binaries are monitored enabling a detailed discussion on the Be stellar disk together with optical emission-line profile. MAXI detected large flares from blazars as well as those from active stars, and one-hour lasting superbursts from NS-LMXB. Gamma-ray bursts have been detected steadily, whose number reached 85. Still, we have 7 MAXI unidentified short soft transients (MUSST).

Last year LIGO started operation and found the gravitational wave sources. NICER, an X-ray telescope on the ISS, will be mounted in several months. Together with these new instruments, MAXI will open new windows to understand the universe further.

Oct. 5, 10:40-

TSUNEMI, Hiroshi (Osaka university)

MAXI-SSC results in 7 years

MAXI-SSC consists of two sets of CCD camera having a fan-beam collimator to scan the sky. Its effective energy range is 0.7–7 keV that covers the lower energy band than that of MAXI-GSC. So far, we discovered the novae, flares and GRBs. The SSC source catalog in 2016 contains 170 point-sources. Other than them, we detected extended sources and a large scale structure in the sky. The North Polar Spur is one of the most prominent soft X-ray features in the sky. This seems to be a part of a large scale structure in the northern sky in galactic coordinate. We confirmed its spectrum originated from a thin thermal emission. Although we cannot measure the distance to the plasma, we measure its intensity, structure and temperature. We will report the summary of the MAXI-SSC results in this 7 years.

Oct. 5, 11:00-

NEGORO, Hitoshi (Nihon University)

Discovery of 17 X-ray Transients with MAXI/GSC and their Nature

MAXI newly discovered 15 uncatalogued, and 2 unidentified X-ray novae since 2009 in terms of the MAXI/GSC nova-alert system (Negoro et al. 2016). By MAXI and followup observations, especially thanks to rapid Swift/XRT followup observations, those transients are found to be 6 black hole candidates, 6 neutron stars including 1 pulsar, and 1 white dwarf. The nature of 4 transients is still unclear.

In this talk, I review the characteristics and statistics of these X-ray novae by comparison with transients discovered by other all-sky-monitors or X-ray detectors with a wide field of view. For instance, except for MAXI J1659−152 and MAXI J1910−057, peak fluxes of the MAXI novae are relatively low and about 100 mCrab. Does this indicate that MAXI observes distant area in our Galaxy as is expected before the launch? I try to estimate the distance to the sources using various methods, and answer the above question.

Possible nature of the unknown/unidentified 4 sources are also discussed. Finally, I summarize what we have learnt from 7 years transient search by MAXI, and future expectation.

Oct. 5, 13:30-

RODRIGUEZ, Jerome (CEA - Astrophysics division)

Progress on Galactic black hole binaries over the past 7 years: a selection of recent results

The RXTE era have revolutionized our understanding of X-ray Binaries and Galactic accreting black holes in general by providing systematics survey and monitoring of sources during outbursts. Generic patterns, and global phenomenology of outburst evolution, coupled with multi-wavelength approach and study of the fast temporal variability have allowed us to discover tight connections between accretion, ejection, and the presence of variable features with quasi periodicities.

After the end of the RXTE mission, one could have feared a dark age for microquasars. In particular since 2010, and thanks to survey of the X-ray sky with Maxi, Swift, and some specific programs with INTEGRAL, black hole binaries have continued to be followed in a rather systematic way. By pointing these sources in specific states with more sensitive instrument such as XMM-Newton, Chandra and more recently Nustar, several new results of high importance have been obtained over the past 6–7 years.

In this review I will present a selection of some of these results and will in particular focus on those that have implied multi-instrumental and/or multi-wavelength observations, and campaigns that usually started with alerts given by large fields of view X-ray telescopes.

Oct. 5, 14:00-

KIMURA, Mariko (Kyoto University)

Violent Optical Variations and Correlation with X-ray Variability in the 2015 Outbursts in V404 Cygni

V404 Cyg is one of transient black-hole (BH) low-mass X-ray binaries (LMXBs). This system underwent outbursts in June and December in 2015 and showed large-amplitude and short-term variations in optical wavelengths and X-rays. We performed the optical photometry of the two outbursts and compared them with the X-ray light curves from Swift/XRT, Swift/BAT and INTEGRAL IBIS/ISGRI. Analyzing the simultaneous optical and X-ray data, we found large-amplitude optical variations with repetitive patterns (the period: 30 min – 2.5 hours, the amplitude: about 2 mag) at low luminosity (even at one hundredth of the Eddington luminosity) in the June outburst for the first time among BH LMXBs. Although repetitive variations in BH LMXBs had been observed only at high luminosity (e.g., GRS 1915+105) and the existing theories were developing to explain these observations before the outburst, they overturned the conventional idea. The correlation between them and the X-ray variations was good. With the time lag between them and our multi-wavelengths SED analysis, we demonstrated that the repetitive optical variability was mainly dominated by reprocessing of X-ray irradiation in the disk (Kimura et al. 2016). Also in the December outburst, the repetitive optical variations were detected in one term. In addition, we found that the optical variability was positively correlated with the X-ray one in another two terms. The time lag between them was very small and the relation between the optical and X-ray luminosity was inconsistent with canonical disk reprocessing. The results suggest that there is a possibility that the origin of the optical variations was different from that of the repetitive optical variations (Kimura et al. submitted). In this presentation, I report the analysis of the simultaneous optical and X-ray light curves and discuss the various origins of the optical variations in outbursts in V404 Cyg.

Oct. 5, 14:15-

TACHIBANA, Yutaro (Tokyo Institute of Technology)

Two optical emission components with different variability in V404 Cygni

The nearest black hole binary V404 Cygni (=GS 2023+338) went into an outburst again on June 15, 2015 after 26 years of quietness. Soon after the notifications by MAXI and Swift, we started intense observation campaign of this source using the MITSuME 50cm telescope in Akeno, Yamanashi, and MURIKABUSHI 1.0m Telescope in Ishigakijima Astronomical Observatory.

The spectral variation in the optical band was quite mysterious. The spectral index between R_c-band and I_c-band was stable over the outburst, whereas that between g'-band and R_c-band varied violently. With the time domain analysis of the multi-color optical light curves, however, we successfully decomposed optical variations into three components: highly-variable component (HVC), little-variable component (LVC), and stable component. The loci of the LVC in the color-color diagram is consistent with that of a multi-color blackbody radiation from a standard accretion disk, while those of the HVC trace that of power-law spectra, possibly represents synchrotron emission from the jet. The observed spectral energy distribution (SED) from NIR to UV is also naturally well reproduced by a model consisting of a power-law component with a spectral index $\alpha \sim 0.5$ and a multi-color standard accretion disk emission.

Additionally, we found the correlated flux decay in optical and X-ray bands at a highly variable phase in MJD 57193. At that time, the extrapolation of the SED of the optical HVC is roughly agrees with the observed X-ray flux. In the variation, the amplitude in optical and X-ray was quite different; ~ 10 times in optical and ~ 1000 times in X-ray, as reported by previous works (e.g., Kimura et al. 2016). The result of our analysis naturally explains this situation, since only the HVC is strongly correlating with the X-ray emission while the LVC and the stable component provide uncorrelated baseline.

Oct. 5, 14:30-

SUGIMOTO, Juri (RIKEN / Rikkyo university)

Observation of the long-term variability of Cygnus X-1 with MAXI

We studied the long-term X-ray variability of the black hole binary, Cygnus X-1, using about 6 years of MAXI data from 2009 to 2016, in a high/soft state (HSS) and a low/hard state (LHS).

We analyzed an aperiodic long-term variation, using Normalized Power Spectrum Densities (NPSDs), in the frequency range from 10^{-7} to 10^{-4} Hz, with 2–4 keV, 4–10 keV and 10–20 keV data. From the comparison with previous works in the frequency region above 10^{-3} Hz, it was shown that the NPSD extends with a single index from 10^{-3} to 10^{-7} Hz in both the LHS and HSS. Such the long-term variation is mostly caused by power-law component in the energy spectrum. In the LHS, the variability slightly decreased towards higher energies, and in the HSS, it was found to increase significantly with energy.

We also studied the 5.6-day orbital modulation in the LHS and HSS. In both states, the orbital modulations were seen in the light curves with roughly 4%, except for the 2–4 keV band in the LHS. It is interpreted as the modulation of the power-law component and can be explained by a scattering by the stellar wind, implying that the stellar wind is almost ionized in both states. In 2–4 keV of the LHS, the modulation was larger than those in other bands. At the superior conjunction of the black hole, we see the gas, which is not fully ionized. These conditions can be explained by an inhomogeneous stellar wind.

From our results, we propose a new large-scale disk structure, which can explain the long-term aperiodic variation. In our model, an optically-thin and geometrically-thick accretion flow coexists with an optically-thick and geometrically-thin, standard accretion disk, which is extending up to a large radius of sim 10^{12} cm, in both states.

Oct. 5, 14:45-

DEBNATH, Dipak (Indian Centre for Space Physics)

Accretion Flow Properties of Three MAXI Black Hole Candidates: Analysis with TCAF Solution

Recently after the implementation of Chakrabarti and his collaborators Two-component advective flow (TCAF) model into HEASARC's spectral analysis software package XSPEC as an additive table model, we found that it is quite capable to describe the underlying accretion flow dynamics around BHs with spectral fitted physical parameters. Properties of different spectral states and their transitions during an outburst of a transient BHC are more clear. One can even predict frequency of the dominating quasi-periodic oscillation (QPO) from TCAF model fitted shock parameters and even predict the most probable mass range of an unknown BHC from TCAF fits. This gives us a confidence that the description of accretion process is more clear than ever before. Recently we studied three Galactic transient black hole candidates (BHCs), such as, MAXI J1659−152, MAXI J1836−194, MAXI J1543−564 with the TCAF solution to study accretion flow properties of these compact objects during their very first outbursts. We classified entire outbursts of these sources into different spectral states on the basis of nature of variations of TCAF model fitted physical flow parameters and observed QPOs. Probable mass ranges of these BHCs are also estimated from our study. Estimation of X-ray jet fluxes during the 2011 outburst of MAXI J1836−194 are also done.

Oct. 5, 15:30-

DONE, Chris (ISAS/JAXA and University of Durham, UK)

Black holes and Neutron stars in Low Mass X-ray binaries

Black holes and neutron stars both show dramatic spectral and timing evolution as a function of mass accretion rate. This is seen most clearly in the transient outbursts of these systems, which can be followed with MAXI and other all sky monitors. I will discuss the similarities and differences between the neutron stars and black holes, showing how to fit this together in a picture of a very similar accretion flow with a very different boundary condition - an event horizon in black holes, versus a surface in neutron stars.

Oct. 5, 16:00-

ASAI, Kazumi (RIKEN)

Spectral states in NS-LMXBs observed with MAXI/GSC and Swift/BAT

The NS-LMXBs show two kinds of X-ray spectra depending on their X-ray luminosities. In the high luminosity(10^{37} erg/s) it is dominated by blackbody components, and called the soft state. On the other hand, in the low luminosity(5×10^{36} erg/s) it is dominated by a Comptonized component, and called the hard state. The transitions between the two states were seen in the NS-LMXB transients. This was caused by the instability in a standard accretion disk.

We define the spectral state with MAXI/GSC (2–10 keV) and Swift/BAT (15–50 keV). Sensitive observations with GSC-BAT showed outbursts even with small peak luminosities and shorter durations. Such "mini-outburst" were observed in four sources; 4U 1636−536, 4U 1705−44, 4U 1608−52, and GS 1826−238 (Asai+ 2015). We understand it as a "purr-type" of disk instability predicted by Mineshige and Osaki (1985). (The large normal outburst is named as a roar-type.)

There are several atoll NS-LMXBs which are persistent and always in the soft state. Although the hardness ratio (HR) in GSC-BAT observations is always low, the HR distributed in two (higher/lower) groups. The higher group contains 4U 1820−30 and 4U 1735−44, while the lower group contains GX 3+1, GX 9+1, GX 13+1, and GX 9+9. We interpreted the difference to come from the size of the Comptonized cloud. The high HR was resulted from a large Comptonized cloud, which might be dammed at the Alfven radius by rather high magnetic fields (Asai+ 2016).

In the brightest NS-LMXB (Z sources), there are three branches; Horizontal Branch (HB), Normal Branch (NB) and Flaring Branch (FB). Although the differences of HB and NB in the spectral and timing properties indicated some changes in the geometrical structure, the physical understanding is still controversial. We suggest that the difference of HB and NB might be explained by the disk evaporation (Asai+ in preparation).

Oct. 5, 16:20-

TAKAHASHI, Hiromitsu (Hiroshima University)

Overview of spectral change in NS-LMXB

Neutron Star (NS)-Low Mass X-ray Binaries (LMXBs) are historically divided into two classes called Z and atoll sources, according to the shape of their color-color diagrams. Z sources (including Sco X-1, Cyg X-2, etc.) are always very bright close to Eddington luminosity, and show three distinct states named as Horizontal, Normal and Flaring branches (HB, NB and FB). Atoll sources are transient and sometimes switch the states between low/hard and high/soft states. After the discovery of the bright transient NS-LMXB XTE J1701−462, which followed the spectral states of both Z and atoll sources, it is clear these two types of NS-LMXBs are determined mainly by the mass accretion rate. However, the physical origins are still unclear how Z sources change the three branches. In this presentation, I review the current observational results of NS-LMXB high/soft state, including Z and atoll sources, and explain the detail behaviors of physical parameters obtained from the spectral analyses.

Oct. 5, 16:50-

ONO, Ko (The University of Tokyo)

Unveiling the spectral transition of Aql X-1 from the hard to soft state

A ToO observation of the recurrent transient Aquila X-1 was carried out during an initial rising phase of an outburst on 2011 October 21. It fortunately captured a clear spectral transition from the hard to the soft state, on a time scale of only 30 ks. During the transition, spectrum changed from a power-low like shape with a high-energy cutoff, to that typical in the soft state with more convex shape, resulting in an increase of the 0.8–10 keV XIS 0 count rate by a factor of 3 and an decrease of the 15–60 keV HXD count rate by about the same factor. All the wide-band spectra during the transition were successfully reproduced with a model consisting of a multi-color blackbody and a Comptonized blackbody, which increased and decreased during the transition, respectively. The model parameters changed continuously from those typical in the hard state to those typical in the soft state. In particular, the inner disk radius and the blackbody radius decreased from $\sim$ 31 km to 18 km and 12 km to 7 km, respectively, accompanied by a decrease in the coronal temperature from 10 keV to 3 keV. This implies that the corona shrank towards a closer vicinity of the neutron star. Indeed, by utilizing the measured coronal optical depth, the corona was confirmed to shrink toward the soft state, and/or its motion becomes more Keplerian. These results establish the unified view of LMXBs in the soft and hard states.

Oct. 5, 17:05-

NAKAMURA, Takashi (Kyoto Univ.)

SGRB rate from Yonetoku relation for SGRB and the detectability of GW in O2 of aLIGO/aVirgo

Using 8 SGRB with Ep, z and Lp, Tsutsui et al. (2013) obtained Yonetoku relation for SGRB. Applying this relation to bright BATSE SGRBs, the minimum event rate of SGRB is $6.3(^{+3.1}_{-3.9}) \times 10^{-10}$events/Mpc^3/yr. Under the assumption of beaming factor of 100 and 4 times dimmer SGRBs, if 10% of SGRB is NS-BH or 100% is NS-NS, there is a good chance to observe a few GW events in O2 of aLIGO/aVirgo so that MAXI might see something at the same time.

Oct. 5, 17:20-

VAN DER HORST, Alexander (George Washington University)

GRB radio view from all angles

Gamma-ray bursts are among the most extreme objects in the Universe in terms of the energetics and the physics needed to describe the observed phenomena. They are detected across the entire electromagnetic spectrum, from low-frequency radio waves to high-energy gamma rays. Our current understanding of gamma-ray bursts is based on multi-wavelength and multi-timescale observations. In this talk I will show the role that radio observations have played, and will play in the future, in putting together a picture of the physics behind the observed emission, the progenitors, and their environment. I will highlight the unique role that radio observations can play in detecting gamma-ray bursts for which the initial high-energy emission is beamed away from us, so-called orphan afterglows, and the possibilities that several new and upgraded radio observatories offer to obtain a better understanding of these enigmatic phenomena.

Oct. 5, 17:40-

NAKAHIRA, Satoshi (Japan Aerospace eXploration Agency)

GRBs with MAXI and CALET

MAXI and CALET (CALorimetric Electron Telescope) are wide-field monitors currently operated in the exposed facility of ISS/Japanese Experiment Module (Kibo). About one-third of the MAXI field of view is simultaneously covered by both HXM (Hard X-ray monitor) and SGM (Soft Gamma-ray monitor) scintillation detectors of the CALET Gamma-ray Burst monitor (CGBM). They have overlapped energy range with five scientific instruments; MAXI/SSC (0.7–7 keV), GSC(2–30 keV), CALET/HXM (7–1000 MeV), SGM (50 keV–20 MeV) and CAL (CALorimeter; 1 GeV–10 TeV). Therefore, MAXI and CALET has a unique capability to observe GRBs with wide energy range from sub-keV to TeV.

So far, MAXI observed more than 90 GRBs or short X-ray transients in the seven years. CGBM detected 38 GRBs in the first year, six GRBs (151225A, 160307A, 160408A, 160709A, 160726A and 160804B) were short burst and another four (160101A, 160107A, 160625B and 160814A) were also detected by MAXI/GSC. In this paper, we will report systematic analysis of CGBM GRB samples and highlight several events including simultaneously detected GRBs and a Soft Gamma-ray repeater.

Oct. 5, 17:55-

ZHANG, Shuang-Nan (Institute of High Energy Physics, China)

POLAR - The gamma-ray burst polarimetry experiment onboard China's TG-2 spacelab

On 2016-09-15, the gamma-ray burst polarimetry experiment, POLAR, onboard China's Tiangong-2 spacelab has been launched. The main scientific goal of the experiment is to measure the polarization of gamma-rays from gamma-ray bursts between 50–200 keV. POLAR will be able to detect about 50 gamma-ray bursts per year and can measure the polarization with precision of about 10% for the brightest gamma-ray bursts. POLAR can also detect solar flares and the Crab pulsar and measurement their polarization. In this talk I will describe the POLAR instrument and report some early results.

Oct. 6, 9:05-

KENNEA, Jamie (Penn State)

Swift/MAXI transient collaboration: 7 years of success

JAXA's "Monitor of All-sky X-ray Image" (MAXI) part of the Japanese Experiment Module on the International Space Station, provides a powerful tool for the discovery of new X-ray transients in our Galaxy. The localization accuracy of MAXI does not however allow for identification of sources in crowded fields, or for optical counterparts. NASA's Swift is uniquely capable of performing rapid (within hours) observations of newly reported MAXI transients. In addition Swift's X-ray Telescope provides a well matched field of view of $\sim$0.2 degrees, similar to that of the localization accuracy of MAXI in most cases, allowing for easy localization of bright transients. The UV/Optical telescope provides both detection of optical counterparts of these transients, and reduces the astrometry error on XRT positions to as little as 1.5 arc-seconds. Swift's low overhead observations also allow for short (1 ks) high cadency (every 1–2 days) observations of these transients in order to sensitively monitor outburst light-curves and spectral evolution of these transients. We report on 7 years of successful collaboration between the Swift and MAXI teams on Galactic Transient discovery, and discuss new initiatives underway at Swift that will improve transient discovery both independently by Swift, and in collaboration with MAXI.

SHAW, Aarran (University of Alberta)

On the orbital period of MAXI J1305−704

MAXI J1305−704 is a candidate black hole X-ray binary discovered by MAXI in 2012. The system parameters are relatively unknown, with no dynamical determination of the mass of the compact object measured. There have also been several conflicting measurements of the source's orbital period, the most recent of which is P=9.74 hours, based on the observation of deep X-ray dips in the X-ray light curve. We reanalyse a 40 ks Suzaku observation of MAXI J1305−704 in order to disentangle the multiple periodicities previously reported. Using a number of timing analysis techniques, we suggest that the orbital period is instead ∼5 hours. We also present optical spectroscopy of the source in outburst and attempt to place a limit on the mass of the compact object.

Oct. 6, 9:50-

CORBEL, Stephane (Univ. Paris Diderot & CEA Saclay & Observatoire de Paris)

A panchromatic overview of accreting binary systems and their associated relativistic jets

In the past decade, 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 moved from being considered exotic and rare abnormalities to being recognized as integral and vital components in the transfer of energy and angular momentum.

Although their phenomenology is now rather well established, their emission and contribution to the total energy budget of microquasars at large (and connexion to the supermassive black holes) is still the subject of active debates. I will present the most relevant observations concerning our understanding of relativistic jets in accreting systems, discussing in particular some open issues.

Oct. 6, 10:20-

SHIGEYAMA, Toshikazu (University of Tokyo)

Novae with super-Eddington luminosities

We are trying to construct a theoretical model describing novae with super-Eddington luminosities in the context of a steady wind model emanating from the surface of a white dwarf. The motivation of this work originates from the discovery of a bright transient event MAXI J0158−744 in the Small Magellanic Cloud by MAXI. We succeeded in reproducing the peculiar spectrum showing a strong Ne IX emission line at 0.92 keV with a large equivalent width We are trying to construct a theoretical model describing novae with super-Eddington luminosities in the context of a steady wind model emanating from the surface of a white dwarf. The motivation of this work originates from the discovery of a bright transient event MAXI J0158−744 in the Small Magellanic Cloud by MAXI. We succeeded in reproducing the peculiar spectrum showing a strong Ne IX emission line at 0.92 keV with a large equivalent width and the absence of Ne X line at 1.02 keV by assuming a very fast wind accelerated out side the photosphere by a given luminosity estimated by the MAXI observations (Ohtani et al. 2014). This is in contrast with the existing nova wind model which assumes acceleration in the photosphere. Thus we have extended the previous model to include the optically thin region by utilizing a flux-limited diffusion approximation (Wada & Shigeyama 2016). Though we can obtain solutions in which the wind is accelerated outside the photosphere and the resultant luminosities significantly exceed the Eddington limit, the luminosity cannot be so high as observed. We will discuss possibilities to obtain more luminous solutions compatible with observed bright events including MAXI J0158−744.

Oct. 6, 10:35-

IN 'T ZAND, Jean (SRON)

Understanding superbursts

Superbursts were discovered in 2000 with the BeppoSAX Wide Field Cameras. Since then, several tens of cases have been detected, for instance with MAXI. Superbursts are carbon copies of ordinary thermonuclear ($'$type-$'$) 1-min long X-ray bursts that are found in many low-mass X-ray binaries, representing unstable thermonuclear burning of accreted hydrogen and helium on neutron stars, except that they are thousand times longer, more energetic and deeper into the neutron star. Several questions are unresolved regarding superbursts, for instance: 1) where does the carbon come from that is thought to fuel them (and related to that: could it not be another fuel?); 2) why are they seen at low mass accretion rates; 3) what constraint can be inferred about the neutron star crust? Observational and theoretical studies will be discussed, as well as future observational requirements and prospects.

Oct. 6, 11:05-

SERINO, Motoko (RIKEN)

MAXI detections of Superbursts

MAXI observed eleven long X-ray bursts, which were observed at least two consecutive scans, in seven years. We divided them into two classes according to their e-folding decay time: the bursts with longer e-folding time ($>$ 1 hour) are superbursts, and the others are intermediate duration bursts. We found possible anti-correlation between the decay time and the peak flux. Superbursts have low peak fluxes (10–50% of the Eddington limit) and intermediate duration bursts have the peak fluxes of about the Eddington limit. MAXI detected superbursts from 1) a bright persistent source (Ser X-1), 2) a dim persistent source (4U 0614+091), and 3) four transient sources (Aql X-1, SAX J1747.0−2853, EXO 1745−248, and SAX J1828.5−1037). Two of the superbursts from transient sources occurred at the time of very low accretion rate, which may be before the outbursts. Four out of five intermediate duration bursts had low ($<$ 2% of the Eddington limit) persistent flux. Four intermediate duration bursts are from ultracompact X-ray binary. These characteristics are common to the intermediate duration bursts which were observed before the MAXI era.

Oct. 6, 11:25-

EBISAWA, Ken (JAXA/ISAS)

MAXI data archive plan

We will describe the MAXI data archive plan.

Currently, daily light curves are created for major known sources, and released from RIKEN (`http://maxi.riken.jp`). In addition, the web-based "on-demand" analysis tool is available at RIKEN (`http://maxi.riken.jp/mxondem`), with which MAXI users can retrieve images, light-curves, spectra and responses for a given region and time-period.

At DARTS (`http://darts.isas.jaxa.jp`), interactive all-sky images will be available in the JUDO2 system (`http://darts.isas.jaxa.jp/astro/judo2`), not only for the entire MAXI mission period, but also, yearly, monthly, weekly and daily periods. Users can superpose MAXI images with other astronomical images and catalogs, and also easily jump from JUDO2 to the RIKEN on-demand system.

Also, we are developing the full MAXI data archive system, where all the MAXI events are stored in the standard FITS formats commonly used in high energy astrophysics. The sky is divided into 768 HEALPIX regions, and daily events from each region is kept in a single event FITS file. Data analysis can be carried out MAXI specific ftool-like tools, with which users will have full access to the entire MAXI data. We will provide simple user-friendly scripts which enable users to easily download only the required event and auxiliary data from DARTS for a given position and time-period, and to handle the data-sets to extract the data products for further analysis.

The full archive system will be made available from DARTS by the end of 2016. It is also planned that the full archive system be released from HEASARC, and the MAXI analysis tools included in HEAsoft.

After the MAXI project is over, the daily light-curves and the on-demand system will be ported to DARTS. At DARTS, the MAXI data will be permanently archived as well as JAXA's other science satellite data.

Oct. 6, 13:30-

TSUBOI, Yohko (Chuo University)

X-ray study of stellar flares

Since the launch in 2009 August, with the unprecedentedly high sensitivity as an all-sky X-ray monitor, MAXI have caught more than a hundred of huge flares from stars. Most of them are from cool, active stars (RS CVn systems, an Algol system, dMe systems, a dKe system, Young Stellar Objects). With the total radiative energy of 10^{34-39} ergs, the MAXI detections have broken the record of the largest flaring magnitudes in each stellar categories (e.g. "RS CVn" and so on). The enlarged sample of intense flares have enabled us to do systematic studies in various viewpoints. One of the studies is our discovery of a universal correlation between the flare duration and the intrinsic X-ray luminosity, which holds for 5 and 12 orders of magnitude in the duration and L_X, respectively. In this talk, we will review recent studies for flares we obtained with MAXI and/or the other X-ray astronomical satellites.

The talk also includes the topic of the MAXI detection of a historically brightest X-ray flares on the massive star system, Eta Carinae.

Oct. 6, 13:55-

SHIBATA, Kazunari (Kwasan and Hida Observatories)

superflares on Sun-like stars

Many stars show flares similar to solar flares, and often such stellar flares are much more energetic than solar flares. The total energy of a solar flare is typically 10^{29}–10^{32} erg. There are much more energetic flares (10^{33}–10^{38} erg) in stars, especially in young stars with rapid rotation. These are called superflares. We propose that these stellar superflares can be understood in a unified way based on the reconnection mechanism which has been developed to explain solar flares. Recently, it has been revealed that superflares with energy of 10^{34}–10^{35} erg (100–1000 times of the largest solar flares) occur with frequency of once in 800–5000 years on Sun-like stars with slow rotation, which are similar to our Sun. These superflares are usually associated with large spots with area A = 10^3–10^5 in unit of one millionth of solar hemisphere, much larger than normal sunspots (with area A = 100–1000) on the Sun. It has become clear that superflares can occur on slowly rotating Sun-like stars because very large star spots can be generated in these slowly rotating stars, though frequency is very small. Hence, the problem of superflare occurrence becomes dynamo problem; why can a very large star spot be generated in slowly rotating stars like our Sun?

Oct. 6, 14:25-

ENOTO, Teruaki (Kyoto University)

Transient Magnetars and Magnetic Field Evolution of Neutron Stars

An increasing number of X-ray outbursts from transient magnetars has changed our perception about the magnetic field evolution of highly magnetised isolated neutron stars. Magnetar activities, such as short bursts and activated persistent X-ray emission during outbursts, have been also discovered from high-B rotation powered pulsars (e.g., PSR J1119−6127), low-field magnetars (e.g., SGR 0418+5729), and a Compact Central Object (CCO) 1E 161348−5055 at the centre of the supernova remnant RCW 103. All these sources exhibited not only a soft-thermal surface emission but also a hard power-law component extending above 10 keV, suggesting an unified view of the magnetar (and related) classes. Recent observational review will be presented from Swift, INTEGRAL, Suzaku, and NuSTAR observations with future prospects of the NICER project launched in 2017.

Oct. 6, 15:10-

KAWAMURO, Taiki (KyotoUniversity)

Hard X-ray Luminosity Function of Tidal Disruption Events: First Results from *MAXI* Extragalactic Survey

We derive the first hard X-ray luminosity function (XLF) of stellar tidal disruption events (TDEs) by supermassive black holes (SMBHs), which gives an occurrence rate of TDEs per unit volume as a function of peak luminosity and redshift, utilizing an unbiased sample observed by the Monitor of All-sky X-ray Image (*MAXI*). On the basis of the light curves characterized by a power-law decay with an index of $-5/3$, a systematic search using the *MAXI* data in the first 37 months detected four TDEs, all of which have been found in the literature. To formulate the TDE XLF, we consider the mass function of SMBHs, that of disrupted stars, the specific TDE rate as a function of SMBH mass, and the fraction of TDEs with relativistic jets. We perform an unbinned maximum likelihood fit to the *MAXI* TDE list and check the consistency with the observed TDE rate in the *ROSAT* all sky survey. The results suggest that the intrinsic fraction of the jet-accompanying events is 0.0007%–34%. We confirm that at $z \lesssim 1.5$ the contamination by TDEs to the hard X-ray luminosity functions of active galactic nuclei is not significant and hence that their contribution to the growth of SMBHs is negligible at the redshifts.

Oct. 6, 15:25-

MARKOWITZ, Alex (Univ. of California, San Diego, Center for Astrophysics and Space Sciences)

First Statistical Tests for Clumpy-Torus Models: Constraints from RXTE monitoring of Seyfert AGN

We present an analysis of multi-timescale variability in line-of-sight X-ray absorbing gas as a function of optical classification in AGN to derive the first statistical constraints for recent _clumpy_ absorbing torus models. Such models represent the paradigm shift away from the classical "solid donut" morphology.

Such advances come courtesy of sustained long-term X-ray monitoring; we use the vast archive of Rossi X-ray Timing Explorer multi-timescale monitoring of dozens of type I and Compton-thin type II Seyfert AGN. We search for discrete absorption events due to clouds transiting the line of sight; most of our twelve detected clouds are Compton-thin and are located in the outer BLR or inner dusty torus. We discuss the resulting implications for cloud distributions in the context of the clumpy-torus models. We discuss cloud sizes, stability, and radial distribution across a wide range of distances, and explore the exhibited range in density profiles for the highest-quality eclipse events. We discuss possible connections to the mechanisms that form and launch clouds (e.g. disk fragmentation). In addition, all observed clouds are sub-critical with respect to tidal disruption; self-gravity alone cannot contain them. External forces, such as magnetic fields or ambient pressure, are needed to contain them. Otherwise, clouds must be short-lived. Finally, we infer that the radial cloud density distribution behaves as $\sim 1/r^{0.7}$, compatible with VLTI observations.

Our results apply to both dusty and non-dusty clumpy media, and probe model parameter space complementary to that for short-term eclipses observed with XMM-Newton, Suzaku, and Chandra.

Oct. 6, 15:55-

MAKISHIMA, Kazuo (RIKEN, Global Research Cluster)

A Novel View of AGN Accretion Flows Revealed by X-ray and Optical Monitoring

In spite of long studies, the accrete flows in AGNs are not yet well understood, even in the simplest Type I objects. Big debates continues whether they are similar to the High/Soft state of BHBs, where the accretion disk continuing to ISCO is illuminated by a "lamppost"-type corona (e.g., Uttely+ 2014), or they are closer to the Low/Hard state of BHBs wherein the disk is truncated and transforms into a hot coronal flow (e.g., Yuan & Narayan 2014).

To settle the above controversy, we performed 1-year X-ray/optical monitoring of the Seyfert NGC 3516, using Suzaku and 5 Japanese telescopes (Pirka, Kiso Schmidt, MITSuME, Nayuta, Kanata). The source was in a very faint phase with the Eddington ratio of < 0.01, and showed tight X-ray vs. optical correlation. Furthermore, X-rays preceded the optical by $\sim$2 days, implying that the optical variation is produced when the X-rays illuminate the accretion disk at a distance of $\sim$2-light days. This rules out the High/Soft-state analogy, because an accretion disk with such a low Eddington ratio would be too cool to emit optical at such a large distance. In contrast, the Low/hard-state analogy can successfully explain the results (Noda et al. 2016, ApJ, 828, 78),

More generally, we have shown, for the first time, that Type I Seyferts have two distinct X-ray continua (Noda, Makishima+ 14, 13a, 13b, 11). One is a slowly-varying absorbed hard (photon index$\sim$1.5) power-law, which carried the tight correlation to the optical in NGC 3516. The other is a fast-varying softer (index $\sim$2.2) power-law with low absorption, which emerges at higher Eddington ratios and does not correlate with optical signals.

Thus, X-ray and optical reverberation can be one of the most powerful methods to clarify the long-sought nature of the AGN engine. This encourages the promotion of a high-sensitivity X-ray all-sky monitor.

Oct. 6, 16:15-

HAGINO, Kouichi (ISAS/JAXA)

An X-ray spectral variability of fast disk winds in AGN

Recent X-ray observations of blue-shifted absorption lines revealed an existence of the extremely fast disk winds with outflow velocities of ∼0.1-0.3c. Such fast outflows would have a large impact on the coevolution of black holes and host galaxies since they are expected to carry a large amount of kinetic energy. One of the common characteristics of these fast winds is a strong time variability of the absorption feature. To investigate this variability, we have developed a new X-ray spectral model of the disk winds, which is generated by 3-dimensional Monte Carlo radiation transfer simulations on the assumption of the realistic wind geometry. By applying our wind model to the multi-epoch X-ray data of an archetypal wind source PDS 456, we find the variability in the absorption line is explained by a change of the wind outflowing angle without any large variability in the mass outflow rate of the wind. This result indicates that the fast disk winds are stable and that local hydrodynamic instabilities produce a large time variability of the absorption line.

Oct. 6, 16:30-

OHASHI, Takaya (Tokyo Metropolitan University)

Science from Hitomi: Introduction

I will give a short introduction of the science from Hitomi. Overview of results obtained from 6 targets observed in the orbit will be presented, and detailed reports on individual sources will follow this presentation.

Oct. 6, 16:35-

SATO, Kosuke (Tokyo university of Science)

Hitomi observation of the Perseus cluster - gas motions and resonant scattering -

Hitomi (ASTRO-H) SXS first allow us to investigate fine structures of emission lines from highly ionized ions with its high energy resolution of $\sim$5 eV at 6 keV. The line diagnostics make it possible to measure streaming and turbulent gas motions, which play key roles for understanding the basic physical properties of the intra-cluster medium (ICM) in galaxy clusters, such as the thermal conductivity and viscosity. Particularly in the cluster core, resonance scattering should be taken into account when inferring physical properties from line intensities.

Hitomi SXS finds a extremely quiescent atmosphere in the ICM of the Perseus cluster core where the gas has a line-of-sight velocity dispersion below 200 km/sec (Hitomi collaboration, Nature, 2016). Also, the line-of-sight velocity map across the 60 kpc image of the cluster core shows a relative gradient of 150 ± 70 km/sec. These suggest that the cluster mass measurement under the assumption of hydrostatic equilibrium would be little affected by turbulent pressure. On the other hand, the observed line flux ratio of Fe XXV He alpha resonant to forbidden lines is found to be lower in the cluster core when compared to the outer region, consistent with resonant scattering of the resonant line and also in support of the low turbulent velocity.

Oct. 6, 16:59-

NAKASHIMA, Shinya (JAXA/ISAS)

Hitomi observation of the Perseus cluster - Temperature and Elemental Abundances -

The unprecedented energy resolution of the Soft X-ray Spectrometer (SXS) aboard Hitomi has opened up a new frontier for temperature and abundance measurements of the intracluster medium. We successfully resolve emission lines which are degenerate in CCD spectra, including Ni XXVII Kα and Fe XXV Kβ lines, from the spectrum of the Perseus cluster. We also detect Cr Kα, Mn Kα, and Fe K-shell lines from quantum numbers of $n > 3$. These emission lines provide new insights as follows: (1) We find that the abundance ratio of Ni/Fe is $\sim$1 solar and is significantly smaller than previous results ($\sim$2 solar). The abundance ratios of Cr/Fe and Mn/Fe are also found to be $\sim$1 solar. This measurement suggests that both single-degenerate and double-degenerate channels have contributed to past Type Ia supernovae in this cluster. (2) The observed fluxes of Fe XXV K-shell and Fe XXVI K-shell lines are inconsistent with single-temperature collisional ionization equilibrium plasma, suggesting a multi-temperature structure. We find no prominent features of radiative recombination edges or high-n transition lines, indicating little contribution of out-of-equilibrium atomic processes (including charge exchange) to the observed Fe emission. The detailed analysis method and discussion will be presented.

Oct. 6, 17:23-

NODA, Hirofumi (Tohoku University)

Hitomi Results of NGC 1275: The Origin of Fe-Kα? Line

NGC 1275 is a bright radio galaxy at a center of the Perseus cluster of galaxies, and its radio lobes formed by past jet activity are known to deeply affect the intracluster medium. Hence, the AGN has been regarded as a promising candidate to study important topics such as the cooling flow problem and how AGN feedback influences clusters of galaxies. In 2016 February and March, Hitomi observed the AGN with the Soft X-ray Spectrometer (SXS) and Soft X-ray Imager (SXI). We are analyzing the Hitomi data and archival data of other X-ray satellites, aiming to understand the X-ray emission mechanism and the structure of the central region in NGC 1275. One of the most important topics related to NGC 1275 is the source of the Fe-Kα? emission line at 6.4 keV. Possible sites of origin include the broad line region, dusty torus, and molecular clouds outside the AGN. Thanks to the unprecedented energy resolution of $\sim$5 eV at 6 keV achieved by the SXS, we significantly detected the Fe-Kα? line with an equivalent width of $\sim$10 eV, limiting its velocity width to $\sim$500-1400 km/s (FWHM) for the first time ever. Because the velocity width is too narrow to be emitted by the inner part of the AGN, we can exclude a large contribution of the broad line region. Furthermore, we performed Monte Carlo simulations calculating the Fe-Kα? intensity from molecular clouds, and found that their contribution is also too small. Thus, the origin of the Fe-Kα? line from NGC 1275 is likely the dusty torus, possibly showing that the AGN structure in NGC 1275 is different from those in typical Seyfert galaxies, which have Fe-Kα? velocity widths of $\sim$2000 km/s.

Oct. 6, 17:41-

KATSUDA, Satoru (Chuo University)

Hitomi Observation of the Supernova Remnant N132D in the Large Magellanic Cloud

N132D is one of the brightest supernova remnants (SNRs) in the Large Magellanic Cloud, and has been served as a standard calibration source for modern X-ray astronomy satellites. Like other satellites, Hitomi observed this SNR to calibrate the soft X-ray spectrometer (SXS) and the soft X-ray imager (SXI). Unfortunately, just after pointing to this remnant, an STT anomaly happened, causing an unstable satellite attitude. Therefore, the SXS was able to catch it in its field of view for only an hour, allowing us to detect only about 250 counts in the entire energy range. Of these, 16 photons are identified as Fe He-α lines. After a careful data reduction and calibration, the energies of the Fe He-α lines are found to be shifted redward by roughly 2000 km/s, suggesting an asymmetric SN explosion. This result clearly demonstrates the power of the SXS, and provides us with a good pathfinder for future high-resolution X-ray spectroscopy of extra-galactic and low-surface-brightness SNe with Athena. On the other hand, the SXI succeeded in observing N132D even after the STT anomaly, thanks to its large field of view. Therefore, we obtained a statistically-rich SXI spectrum, from which we see several emission lines including Fe He-α and Ly-α. The SXI spectrum can be used to constrain the plasma state of the X-ray emitting gas. We will present the current status of our analyses and interpretations of the Hitomi observation of N132D.

Oct. 7, 9:00-

JENKE, Peter (University of Alabama in Huntsville)

Monitoring activities of X-ray binary pulsars with Fermi/GBM

The Fermi Gamma ray Burst Monitor (GBM) is a unique instrument that offers the largest instantaneous field of view of any hard X-ray instrument currently in operation. This capability along with excellent timing resolution, makes it very successful at detecting rare transient events as well as providing long integration times for pulsed signal extraction. Even though GBM has a relatively modest size, we are able to observe a typical accreting pulsar for over 40,000 seconds each day allowing us to make precise measurements of the source frequency and pulsed flux for sources with a spin frequency between 0.001 and 2 Hz. These frequency measurements along with GBM's excellent timing capabilities have given us the capability to determine/update orbital ephemerides for many sources as well as monitor rare torque reversals in persistent (semi-persistent) sources such as EXO 2030+375. Continuous Time Tagged Event data, available since November 2012, allows the GBM pulsar monitor to track the frequency of even higher frequency sources and we plan to make these histories available later this year.

The GBM pulsar monitor consists of two parts: A daily blind search which looks for excess power in the Fourier spectrum from 15 equally spaced directions along the Galactic plane plus the directions to the SMC and LMC and a dedicated monitoring program for 39 sources, in which 36 have been detected including SMC X-3. The results of the dedicated monitoring program are available online (`http://gammaray.msfc.nasa.gov/gbm/science/pulsars.html`) and updated twice a week.

We will present 8 years of accreting pulsar monitoring with Fermi/GBM and show how Maxi has been an invaluable tool in making the GBM pulsar monitoring program and its sister programs (i.e. the XRB monitoring program) a success.

Oct. 7, 9:30-

SUGIZAKI, Mutsumi (RIKEN)

Luminosity and spin-up relation in X-ray binary pulsars with MAXI/GSC and Fermi/GBM

To observationally study spin-period changes of accreting pulsars caused by the accretion torque, X-ray light curves of 12 Be binary pulsars obtained by the MAXI/GSC all-sky survey and pulse periods measured by the Fermi/GBM pulsar project, both covering 6 years from 2009 to 2015, were analyzed. For this purpose, we selected 12 Be binary pulsars whose stellar companion is certainly identified by optical observations and surface magnetic field is determined from the cyclotron resonance scattering feature in X-ray spectra. The obtained luminosity, L, and the spin-frequency derivatives, fdot, during the large outbursts, clearly shows the positive correlation following the theoretical relation represented by $\dot{f} = KL^{6/7}$, in all the 12 sources. The relative factor K, derived for each target, is found to agree with that of the disk-accretion model proposed by Ghosh & Lamb (1979) within a factor of $\sim$3 if the typical neutron-star mass of 1.4 solar mass and radius of 10 km are assumed. The dispersion of the ratios of the coefficient K to the model, which range from $\sim$0.3 to $\sim$3, is largely explained by the errors on the distance estimate. We discuss the implication of the discrepancy in the coefficient K between the number observationally determined and that calculated from the canonical neutron-star parameter.

Oct. 7, 10:00-

BOZZO, Enrico (ISDC - University of Geneva)

Monitoring Supergiant Fast X-ray Transients with Swift and XMM-Newton

In this contribution, I will present the current status of our long term monitoring program of the Supergiant Fast X-ray transients with Swift/XRT, including an exhaustive summary of the main findings on this class of extremely variable sources in the X-ray domain. I will also report on the most recent results obtained through a combined XMM and NuSTAR long observational campaign on the SFXT prototype IGRJ17544−2619, highlighting all challenges that do not currently allow us to theoretically interpret the SFXT phenomenology in a satisfiable way.

Oct. 7, 10:15-

NAKAJIMA, Motoki (Nihon University)

MAXI/GSC observation of X-ray outbursts from Be/X-ray binary pulsars

MAXI/GSC has been monitoring the X-ray activities of Be/X-ray binary pulsars for 7 years since the MAXI operation started. During this period, over the hundred outbursts were observed, and ∼50 Atels were issued based on the MAXI/GSC observation data. So far, two types of the X-ray outbursts (normal and giant) have been observed. The reports of the onset of the giant outbursts from two sources (GX 304−1 and GRO J1008−57) led the discovery of the cyclotron resonance features by the Suzaku ToO observations. The observations of the consecutive X-ray outbursts from A 0535+26 and GX 304−1 found the systematic shift of the outburst peaks. This systematic shift can be explained by the precessed Be disk model. Comparing with the previous results, we find that these outburst phase shift rate might depend on the orbital parameters.

Oct. 7, 10:40-

JAISAWAL, Gaurava Kumar (Physical Research Laboratory)

Cyclotron absorption lines in the era of Suzaku and NuSTAR

Cyclotron resonance scattering features or cyclotron absorption lines are unique features observed in hard X-ray spectra of accretion powered X-ray pulsars with magnetic field of the order of 10^{12} G. Detection of these features is a powerful tool and the only direct method to estimate the magnetic field strength close to the surface of neutron stars. Corresponding to magnetic field of $\sim 10^{12}$ G, the fundamental lines are expected in 10–100 keV energy range with harmonics expected at multiples of fundamental line energy. However, we detected first harmonics of cyclotron line at less than twice of the fundamental line energy ($\sim$1.7 times the fundamental line energy) in Be/X-ray binary pulsar Cep X-4. With the broadband spectral capability of Suzaku and NuSTAR observatories, we have investigated several X-ray pulsars to understand line shape, width, magnetic field mapping, anharmonicity in the line energies, and luminosity-dependent properties of cyclotron lines. The results obtained from these works and new detection of cyclotron line in unknown/ poorly studied sources will be discussed in detail.

Oct. 7, 10:55-

PAUL, Biswajit (Raman Research Institute)

Some early results from Astrosat

Astrosat covers a wide energy band in X-rays from 0.2–150.0 keV and it also has two UV telescopes. We will show some early results from Astrosat on a variety of objects and discuss further science prospects with Astrosat and a small satellite mission with a Thomson X-ray polarimeter POLIX.

Oct. 7, 11:25-

ZHANG, Shuang-Nan (Institute of High Energy Physics, China)

The Hard X-ray Modulation Telescope Mission

A dedicated X-ray astronomy satellite, the Hard X-ray Modulation Telescope (HXMT) will be launched in the spring 2017. HXMT is composed of three sets of collimated instruments in 1–10 keV (about 400 cm^2), 5–30 keV (about 1000 cm^2) and 20–250 keV (about 5000 cm^2) respectively. The anti-coincidence detector of HXMT can also be used as a sensitive gamma-ray burst detector between 300 keV to 3 MeV. In this talk, I will describe the instrumentation and scientific program of HXMT, including the Galactic plane scanning survey and monitoring as well as pointed observations of X-ray binaries and pulsars.

Oct. 7, 11:40-

TAMAGAWA, Toru (RIKEN)

X-ray polarimetry mission PRAXyS

Polarimeter for Relativistic Astrophysical X-ray Sources (PRAXyS) led by NASA's Goddard Space Flight Center is the highly sensitive X-ray polarimetry satellite, recently proposed as a NASA's small explorer mission. NASA selected the PRAXyS project for the Phase A study in July, 2015, together with another polarimetry mission Imaging X-ray Polarimetry Explorer (IXPE) led by NASA's Marshall Space Flight Center. PRAXyS will observe about 30 stellar objects such as stellar or massive black holes, highly magnetized neutron stars, supernova remnants, etc. in the first 9 months after launch with a detectable polarization of down to 1% for a 2 mCrab source with 3.4×10^6 seconds observation in the 2–10 keV energy band. Japanese contribution to the PRAXyS mission was approved as a JAXA's small project in 2016, and NASA's final decision will be made in February 2017 for a launch in 2020. At the conference we are presenting the science cases explored by the PRAXyS mission and readiness of flight instrumentations, as well as how all-sky X-ray monitoring missions impact to PRAXyS.

Oct. 7, 13:50-

SINGER, Leo (NASA Goddard Space Flight Center)

Advanced LIGO First Light: Multimessenger Astrophysics at the Birth of Gravitational-Wave Observatory

Advanced LIGO's direct observation of gravitational radiation from a binary black hole merger has sent quakes through the physics and astronomy community. In a few short years, the search for gravitational waves will complete its transformation from an experimental effort into a new discipline of observational astronomy as we rapidly build a sample of merging compact binaries. A particularly tantalizing goal is to combine our new GW observatories with existing electromagnetic ones—uncovering the host environments and formation channels of compact binaries, exposing the mechanism behind short GRBs, explaining the cosmic inventory of r-process elements, and even testing if stellar-mass black hole binaries are truly barren of matter and magnetic fields. I will describe results from LIGO's first observing run with a special focus on the electromagnetic follow-up program, which brings together real-time GW data analysis and 63 groups who are searching for counterparts of LIGO so urces using ground- and space-based partner facilities spanning gamma ray, x-ray, optical, infrared, and radio wavelengths, as well as neutrinos. I will discuss the anticipated trajectory of the worldwide GW detector network from the standpoint of multimessenger observations, and I will conclude with some ideas for the future.

Oct. 7, 14:20-

KINUGAWA, Tomoya (Institute for Cosmic Ray Research)

Binary black hole remnants of First stars for the gravitational wave source

Using our population synthesis code, we found that the typical chirp mass of binary black holes (BH-BHs) whose origin is the first star (Pop III) is $\sim$30 $M_\odot$ with the total mass of $\sim$60 Msun so that the inspiral chirp signal as well as quasi normal mode (QNM) of the merging black hole are interesting targets of LIGO,VIRGO and KAGRA (Kinugawa et al. 2014 and 2016). The detection rate of the coalescing Pop III BH-BHs is $\sim$ 180 events/yr ($SFR_p/(10^{-2.5}$ $M_\odot$ /yr/Mpc^3))*([f_b/(1+f_b)]/0.33)*Err_{sys} in our standard model where SFR_p, f_b and Err_{sys} are the peak value of the Pop III star formation rate, the binary fraction and the systematic error with Err_{sys} =1 for our standard model, respectively. Furthermore, We found that the chirp mass has a peak at $\sim$30 $M_\odot$ in most of parameters and distribution functions (Kinugawa et al. 2016). This result predicted the gravitational wave events like GW150914 and LIGO paper said 'recently predicted BBH total masses agree astonishingly well with GW150914 and can have sufficiently long merger times to occur in the nearby universe (Kinugawa et al. 2014)' (Abbot et al. ApJL 818, 22 (2016)). Nakano, Tanaka & Nakamura 2015 show that if S/N of QNM is larger than 35, we can confirm or refute the General Relativity more than 5 sigma level. In our standard model, the detection rate of Pop III BH-BHs whose S/N is larger than 35 is 3.2 events/yr ($SFR_p/(10^{-2.5}M_\odot$/yr/Mpc^3))*([f_b/(1+f_b)]/0.33)* Err_{sys}. Thus, there is a good chance to confirm the existence of Pop III stars and to check whether GR is correct or not in the strong gravity region.

Oct. 7, 14:35-

KAWAI, Nobuyuki (Tokyo Institute of Technology)

Search for X-ray Counterparts of Gravitational Wave Events

The Gas Slit Camera (GSC) of Monitor of All-sky X-ray Image (MAXI) on the ISS scans most of the sky in the 2–20 keV X-ray band every 92 minutes with the orbital revolution of the ISS. Thus it can be used to search for an X-ray counterpart without prompt precise location of the GW event if the emission lasts for tens of minutes. We examined the MAXI/GSC all-sky X-ray images (2–20 keV) obtained in the orbits preceding and following the gravitational wave event GW150914. In each of the 92-min orbits, MAXI/GSC scanned more than 90% of the localization (90% confidence) regions of the GW skymap. No significant new source was found in these scans with typical upper limit of about 1×10^{-9} erg/s/cm^2 in 2–20 keV. Based on this sensitivity, we argue that MAXI may be able to detect afterglows of short GRBs within the LIGO/Virgo/KAGRA range for neutron star merger.

Oct. 7, 14:55-

SAWANO, Tatsuya (Kanazawa University)

X-ray Transient Localization Experiment aboard a micro-satellite for multi-messenger counterpart search

Short gamma-ray bursts (SGRBs) are likely caused by the coalescence of double neutron star binary and/or neutron star and black hole binary, and therefore they are expected to be promising electromagnetic counterparts of GW sources. The joint observation of SGRB and GW, and the identification of the host galaxy and distance of such events will provide not only the definitive observational evidence for the origins of SGRBs but also the insights to the compact object merger model and the explosion mechanism. However, GW sky location is uncertain by tens or hundreds of square degrees, which is not well constrained for the efficient follow-up observation with optical/NIR telescopes. Thus, we are developing X-ray imaging detector that has both fine localization accuracy and wide field-of-view, named Transient Localization Experiment (T-LEX). The energy range, field-of-view, localization accuracy of T-LEX are designed to be 1 – 20 keV, 1 steradian, and 15 arcminutes, respectively. To achieve such capability, we adopted two sets of 1-dimensional coded aperture imaging system, which consists of tungsten mask with random pattern of 1-dimensional strip-like apertures and silicon strip detector with an active area of 50 cm^2 for each dimension. T-LEX is plan to be launched onboard a microsatellite in 2018 – 2019, which are being developed at Kanazawa University named as Kanazawa-SAT^3, with a designed mission life of more than 1 year. The objective of the satellite mission is to localize X-ray transients including GW sources and to send real time alerts of X-ray transient information about the position and the burst trigger time. In this talk, we report the objective, design, and current performance of an engineering model of T-LEX.

Oct. 7, 15:10-

YUAN, Weimin (National Astronomical Observatories, CAS)

Einstein Probe – a small mission to explore the transient X-ray sky

The Einstein Probe is a small satellite dedicated to time-domain astronomy to monitor the sky in the soft X-ray band, pursued within the space science programme of the Chinese Academy of Sciences. It will enable systematic survey and characterisation of high-energy transients at unprecedented sensitivity, spatial resolution, Grasp and monitoring cadence. Its wide-field imaging capability is achieved by using established technology of micro-pore lobster-eye X-ray focusing optics. Complementary to this is deep X-ray followup capability enabled by a narrow-field X-ray telescope. It is also capable of fast transient alerts triggering and downlink, aiming at multi-wavelength followup observations by world-wide community. Its scientific goals are concerned with discovering new or rare types of transients, including tidal disruption events, supernova shock breakouts, high-redshift GRBs, and of particular interest, electromagnetic sources of gravitational wave events.

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AXELSSON, Magnus (Tokyo Metropolitan University)

The broad-band X-ray power spectrum in black hole binaries: from months to milliseconds

The X-ray emission from black hole binaries shows variability on timescales from milliseconds to years. While the power spectrum has been well characterised above $\sim$0.01 Hz for a number of sources, the frequency range below 10^{-5} Hz is much less studied. The monitoring capabilities of MAXI make it a unique tool in such studies. Combined with RXTE observations, we compare the low and high frequency power spectrum in hard and soft states of bright sources such as GX 339$-$4 and Cygnus X-1. We find the broad-band variability to be more stable across states at low frequencies, and discuss our results in the context of propagating fluctuation models.

P-02

YAMAOKA, Kazutaka (Nagoya University)

X-ray monitering of the Galactic microquasar V4641 Sgr

V4641 Sgr is the black hole (BH) candidate which exhibits a giant outburst with an X-ray intensity up to 12 Crab on September 1999. Since then, several small outbursts with 1–100 mCrab level have been observed almost every year. However, it remains unclear whether this source has typical spectral states such low/hard and high/soft states seen in BH candidates and what X-ray emission mechanisms are. Large-scale radio jets have also been observed from this source, hence it is very important source to study the relation between jets and accretion flows. Since 2008, we have monitored this source in an outburst with MAXI/GSC and Swift/XRT, and carried out detailed observations with Suzaku and NuSTAR in 2014. The observed X-ray flux ranges up to 40 mCrab. The spectra of this source look like high/soft state, and can be well explained by multi-color disk model with an innermost temperature of 1.0–1.5 keV, but the innermost radii, 8–21% of Schwarzchild radii, are too small to explain its emission region and does not keep constant. We also detected iron emission lines at 6.8 keV due to highly ionized irons from Swift/XRT, NuSTAR, and Suzaku spectra, and first revealed the presence of photo-ionized plasma in this source. In this paper, we will discuss the origin of X-ray continuum and iron emission lines, and similarity to the peculiar microquasar V404 Cyg.

P-03

JANA, ARGHA JIT (INDIAN CENTRE FOR SPACE PHYSICS)

Inflow-Outflow Properties of Accretion Disk around MAXI J1836−194 with TCAF Solution during its 2011 Outburst

Galactic black hole candidate (BHC) MAXI J1836−194 was discovered by MAXI/GSC on 29th August, 2011 at the sky location RA= 18h 35m 43s, DEC= −19deg 19m 12.1s. We study this BHC during its 2011 outburst using 2.5-25 keV RXTE/PCA archival data with Two Component Advective Flow (TCAF) solution. From spectral fit with the TCAF solution, we extracted physical accretion flow parameters, such as, Keplerian disk rate, sub-Keplerian halo rate, shock location, and compression ratio, etc. Low frequency quasi-periodic oscillations (QPOs) are observed sporadically during entire phase of the outburst. TCAF model normalization values throughout the outburst are not observed with in a constant narrow range, a higher values are required to fit spectra, specially in observations when prominent jets are present. From our spectral study, we estimated X-ray fluxes from jets. From the nature of variations of accretion rate ratio (ratio of halo to disk rates) and QPOs (if observed), we have been able to classify entire epoch of the outburst into two harder spectral state, such as, hard (HS), hard-intermediate (HIMS). These states are observed in the sequence of HS (Ris.) → HIMS (Ris.) → HIMS (Dec.) → HS (Dec.). This particular outburst of MAXI J1836−194 could be termed as 'failed' outburst, since no observation of soft (SS) and soft-intermediate (SIMS) spectral state are found during the entire outburst. The reason for that could be the accretion disk is immersed in the excretion disk of the companion which is a B[e] star.

KAWASE, Tomofumi (Nihon University)

Improvements of power spectrum analysis of short-term X-ray variability using MAXI/GSC data

We performed a feasibility study for the detection of short-term X-ray variability of black hole candidates using MAXI/GSC data. Power spectrum densities (PSDs) of bright black hole candidates and neutron star X-ray binaries must provide the information about, for instance, state transitions and quasi-periodic oscillations. There are two reasons for using MAXI/GSC data. Firstly, MAXI scans the whole sky every 92 minutes, so the probability that GSC can observe new bright transients is higher than other observatories. Secondly, in case extremely bright sources appear, MAXI can observe these sources because GSC doesn't have mirrors to focus X-rays. In contrast other observatories having mirrors can't do that for detector saturation. Therefore, the preparations to analyze short-term variability using MAXI data are needed for upcoming new bright transients as well as black hole candidates. Light curves of individual sources are, however, much affected by a triangular window function of the effective area due to the scanning observation. Suzuki (2015) established the method of evaluating resultant PSDs correctly, and showed its usefulness for short-term X-ray variability of black hole candidates. We packaged those programs to analyze data more efficiently and improved those to evaluate PSDs more correctly. Although scan duration in the previous method was fixed to 40 seconds to analyze the minimum duration, we modified those programs to use data as long as possible ($\lesssim$200 s). In addition, we also modified those to adapt to not so bright sources by cutting the edges of window function to remove low S/N ratio data, and evaluated its effects in the PSDs analytically. Since the programs are improved, we must confirm the credibility of these again. Here we present results of some simulations to verify this improved method, and some examples of the PSDs observed with GSC.

P-05

MASUMITSU, Takahiro (Nihon University)

Reinvestigation of the relation between the state transition and the mass accretion rate in the black hole candidates.

The state transitions observed in the black hole candidates (BHCs) are thought to result from changes in the mass accretion rate. Yu et al. (2007) showed that the peak flux during the low/hard state (LHS) at the beginning of an outburst and the time since the flux peak of the LHS in the decay phase in the previous outburst were linearly related, and that the peak luminosities of the LHS and those of the following high/soft state (HSS) were also linearly related. Maccarone (2003) demonstrated that the HSS-to-LHS transition luminosities were 1–4% of the Eddington luminosities.

To verify these relations and to estimate the distance to 6 BHCs discovered by MAXI, we analyzed MAXI/GSC, RXTE/ASM, and Swift/BAT data of the BHCs GX339−4 and H1743−322 which often exhibited outbursts previously. For MAXI/GSC data, we reevaluated light curves by using the image fit method that takes into account the point spread function of the detectors (Morii et al. 2016). As a result, we obtained more continuous and more reliable light curves, especially for the data of H1743−322 near the Galactic center, influenced by X-ray emission from the Galactic plane.

We could confirm the relation in the HSS-to-LHS transition, but the flux and time-interval relation and the relation between the peak fluxes in the LHS and the HSS were not confirmed in both BHCs.

P-06

QIAO, Erlin (National Astronomical Observatories,CAS)

The Coupling of a disk corona and a jet for the radio/X-ray correlation in black hole X-ray binaries

We interpret the radio/X-ray correlation of $L_{\rm R} \propto L_{\rm X}^{\sim 1.4}$ for $L_{\rm X}/L_{\rm Edd} \gtrsim 10^{-3}$ within the framework of a disk corona-jet model, in which the matter in the accretion flow and the matter in the jet are connected by a parameter, 'η', describing the fraction of the matter in the accretion flow ejected outward to form the jet. We calculate $L_{\rm R}$ and $L_{\rm X}$ for different $\dot{M}$, adjusting η to fit the observed radio/X-ray correlation of the black hole X-ray transient H1743−322 for $L_{\rm X}/L_{\rm Edd} > 10^{-3}$. It is found that the value of η for this radio/X-ray correlation for $L_{\rm X}/L_{\rm Edd} > 10^{-3}$, is systematically less than that of the case for $L_{\rm X}/L_{\rm Edd} < 10^{-3}$, which is consistent with the general idea that the jet is often relatively suppressed at the high luminosity phase in black hole X-ray binaries.

P-07

UCHIYAMA, Hideki (Shizuoka University)

Suzaku Observation of a Diffuse X-ray Lobe in the East Side of SS433

Using Suzaku, we observed of a diffuse X-ray lobe in the east side of SS433. The pointing is far away from SS433 by about 35 arcmin and the effective exposure time is 107 ks.

Thanks to the low and stable non-X-ray background of XIS, we obtained a good spectrum in the 0.5–10 keV band. The spectrum consists of thermal and non-thermal components. We found that the non-thermal component is not a simple power-law as it was reported before but it has a cutoff around 8 keV. In addition, the cutoff energy becomes smaller with the distance from SS433. Probably, this shows synchrotron-cooling process of relativistic electrons that were accelerated by the SS433 jet.

From the spatial change of the cutoff energy, we limited that the magnetic filed around the lobe is less than 20 μG assuming the synchrotron cooling. If the magnetic field is 10 μG, our result indicated that the relativistic electrons move with the bulk velocity of 5% of the light speed.

The details of the analysis and discussion will be shown in our poster.

EBISAWA, Ken (JAXA/ISAS)

Classification of Hard X-ray Light Curves of Black Hole Binary Transients

Black hole binaries emit strong X-rays by releasing gravitational energies through mass accretion from companions to the black holes. When the mass accretion increases abruptly, they are observed as black hole transients, which exhibit varieties of durations, amplitudes and time-variations etc., presumably reflecting various aspects of the accretion processes. However, our understanding of the physical mechanisms behind such X-ray light-curve morphology is very limited.

Today, MAXI and Swift, two hard X-ray all sky monitors are operational, and a large amount of high quality X-ray light-curve data of bright sources are being accumulated. We have systematically analyzed these hard X-ray light curves of transient black hole binaries taken by Swift/BAT (15–50 keV) and MAXI (3–20 keV), searching for common properties among different outbursts. To that end, we have applied a technique commonly used in the data analysis, such that "distance" between two light-curves is defined to quantify their similarities, "tree diagram" is made to classify all the observed light-curves. Consequently, we found the light-curves in 15–50 keV are classified into major four groups based on their morphologies, while such a classification is not clear in the 3–20 keV light curves. This suggests that the hard X-ray light-curves are more likely to reflect distinct mechanisms of the accretion processes than the soft X-ray light-curves. In particular, we have found several intriguing, statistically significant resemblances among in hard X-ray light-curves of two or more outbursts from the same sources or different sources. This suggests that common accretion processes are taking place in different out-bursts even from different sources.

P-09

KITAOKA, Yoshiki (Aoyama Gakuinn University)

Optical monitoring of the MAXI sources by the optical telescope AROMA-N

MAXI is constantly monitoring variable X-ray sources and measuring the fluxes in the X-ray bands. Aoyama Gakuin University(AGU) has a small optical telescope called AROMA-N(AGU robotic monitor for astrophysical objects-narrow field) which is detected to perform follow-up and coordinated observations of high energy source. AROMA-N is located on the roof of the building of AGU. This telescope is Schmidt-Cassegrain type and 30cm in diameter. The German-type equatorial mount, the auto-focuser and the filter wheel with the Johnson UBVRI filters are equipped. The typical limiting magnitude of AROMA-N is 16–17 mag in 60 second exposures. The operation of AROMA-N is fully automated. Since AROMA-N constantly observes the MAXI sources, we can track the flux variations of the sources both in X-ray and optical bands. In this paper, we will introduce the importance of simultaneous observations with X-ray and optical using the MAXI and the AROMA-N data. We will report the analysis results and consider the prospects for the future.

SAKAMOTO, Takanori (Aoyama Gakuin University)

The MAXI/GSC X-ray Burst Catalog

We present the X-ray burst (XRB) catalog based on the MAXI/GSC observations. Between August 15, 2009 and November 30, 2015 (six years and three months), we identified 329 XRBs from 24 sources. The majorities of XRBs were detected from H 1636−536 (79 XRBs) and GS 1826−238 (139 XRBs). We compared burst durations, radiation energies and burst frequencies of those XRBs with the persistent fluxes near the burst, and found relationships among them. We discuss the general picture of XRBs based on the MAXI/GSC observations.

OKADA, Chiho (Hiroshima university)

Hard X-ray study of low mass X-ray binary Sco X-1 with Suzaku

Low-mass X-ray binaries, whose luminosity is close to Eddington limit (10^{38} erg/s), are called a Z source. It is known that Z sources transit among three states on the color-color diagram; Horizontal branch (HB), Normal branch (NB), and Flaring branch (FB). Apart from the thermal emission, the hard X-ray tail in >50 keV from Sco X-1 has been reported by BoppoSAX, RXTE, INTEGRAL satellites. However, detection of the hard emission relies on the time variability and instrument calibration uncertainties, and thus the origin of the hard tail is not understood well. We think that clarifying this phenomenon leads to understanding a physical picture of neutron stars and their neighboring accretion disk. Since Sco X-1 is the most brightest object in the X-ray band, it is suitable to examine time variation of the hard tail with three state transitions.

Therefore we performed an observation of Sco X-1 by Suzaku and on March 9–12, 2015. We confirmed that Sco X-1 transited among three states (HB, NB, FB) of Z sources during the Suzaku observation by making a color-color diagram using XIS and PIN data. Reproducibility of the background model of PIN is not good because the background observation was limited due to the electricity shortage of Suzaku around the observation epoch of Sco X-1. Therefore we studied and corrected the background model carefully by ourselves. As a result, we found that inverse Compton scattering of black body seed photons from the neutron star surface can reproduce only less than 50 keV. The hard-tail was more likely to exist above 50 keV with a flux of $\sim 10^{-10}$ erg/cm^2/s in 20–200 keV at average. In this paper, we will report the relation between each state and strength of the hard tail.

TANAKA, Koji (Hiroshima University)

Localization of Gamma-ray Bursts with BGO Active Shield of the Soft Gamma-ray Detector and Hard X-ray Imager onboard Hitomi

Gamma-ray bursts (GRBs) are the brightest explosions in the universe. The origin and emission mechanism of bursts whose duration of shorter than 2 seconds are not known well. The merger of compact objects such as neutron star and black hole is the candidate of the origin of those short GRBs and such compact mergers are known to be a source of gravitational waves. Therefore, it is important to observe short GRBs in gamma-ray energy band and localize it to investigate the association between short GRBs and gravitational waves. Soft Gamma-ray Detector (SGD) and Hard X-ray Imager (HXI) onboard Hitomi are surrounded by large and thick $Bi_4Ge_3O_{12}$(BGO) crystal scintillators to reduce background. These BGO scintillators act as not only active shield but also all-sky monitor, especially for GRBs. Therefore, we estimated the capability of localization of GRBs with SGD and HXI BGO active shield by using geant4 based Monte Carlo simulation. We developed simulator of SGD and HXI BGO active shield including mass model of Hitomi and detector parameters which are obtained ground calibration test using flight model sensors. We made database of detection efficiency of GRBs for all 68 BGO units utilizing this simulator. Utilizing this database, we established two localization methods. One is by utilizing photon counts ratio using only brightest 4 units from different shape of crystal, and the other is finding best fit incident angle by comparing observed photon counts of all 68 units and calculated database. By applying these methods to actually observed by HXI/SGD BGO active shield, GRB 160324A, we successfully constrained incident photon direction within 10 degrees uncertainty.

OHNO, Masanori (Hiroshima University)

Suzaku Wide-band All-sky Monitor view of soft gamma-ray transients

We review results of soft gamma-ray transients observed by the Wide-band All-sky Monitor (WAM) onboard Suzaku satellite. The WAM had been operated for about 10 years from 2005 to 2015, and observed various types of transients and bright gamma-ray sources, such as gamma-ray bursts (GRBs), solar flares, soft gamma repeaters (SGRs), gamma-ray emission from Crab nebula ..etc. Thanks to its very large effective area up to soft gamma-ray energy band ($\sim$400 cm^2 even at 1 MeV), we can detect soft gamma-ray photons from many objects with good statistics. Especially, detected number of GRBs is more than 1400, which is comparable detection rate to other GRB instruments. With those large number of samples, we can discuss many kinds of science topics. For example, the duration distribution of observed GRBs, timing and spectral properties for short GRBs, weak GRBs with high redshifts, time-resolved pulses for long GRBs, spectral properties of solar flares in hard X-ray energy band, and emission mechanism of bright bursts from SGRs. In addition to transient observations, the WAM has the capability to monitor the bright gamma-ray sources utilizing earth occultation technique. We successfully monitored some sources such as Crab, Cyg X-1 from 150 to 500 keV energy band and we can trace the broad-band spectral variability.

YAMADA, Yusuke (Aoyama Gakuin University)

Energy response function of CALET Gamma ray Burst Monitor

CALorimetric Electron Telescope (CALET) was successfully launched and attached to the exposed facility of the Japanese Experimental Module called Kibo at the International Space Station (ISS) on August, 2015. CALET started its regular operation on October 2015. CALET has two scientific instruments: CALorimetor (CAL) and CALET Gamma-ray Burst Monitor (CGBM). CGBM is specifically designed to observe gamma-ray bursts (GRBs). CGBM has two kinds of scintillation detectors: Hard X-ray Monitor (HXM) and Soft Gamma-ray Monitor (SGM). The HXM which utilizes LaBr3(Ce) crystal has the energy range of 7 keV–1 MeV. The SGM uses BGO crystal and covers 50 keV–20 MeV. We calibrate the energy response function of the CGBM using the ground and the flight data. The well calibrated energy response function is crucial for the spectral analysis of GRBs. We constructed the mass model of CALET using the GEANT4 simulation package. This mass module is used to construct the energy response function of CGBM. In this paper, we present the current status of the energy response function of the CGBM. We will explain the development of the CGBM energy response function. We will also show the spectral analysis results of CGBM for simultaneously detected bright GRBs by other GRB detectors using our developed energy response function.

KAWAKUBO, Yuta (Aoyama Gakuin University)

Overview and the first year observation of CALET Gamma-ray Burst Monitor

CALorimetric Electron Telescope (CALET) was launched by H-IIB/HTV-5 in August 19, 2015. CALET Gamma-ray Burst Monitor (CGBM) is the scientific instrument and designed to observe a prompt emission of a gamma-ray burst (GRB). CGBM has two kinds of scintillation detectors; Hard X-ray Monitor (HXM; 7 keV–1 MeV) and Soft Gamma ray Monitor (SGM; 40 keV–20 MeV).

So far, CGBM has been detected 44 GRBs since October 2015. The GRB detection rate of CGBM is about 4 GRBs per month. CGBM can detect both long and short GRBs. Since MAXI and CALET are located at the same platform of International Space Station, 4 CGBM-detected GRBs were also observed by MAXI (GRB 160101A, GRB 160107A, GRB 160509A and GRB 160814A). For those GRBs, the MAXI data provide the X-ray part of the emission. Whereas, the CGBM data cover the hard X-ray and the soft gamma-ray range of the spectrum. We will report the overview of CGBM and systematic analysis including temporal and spectral characteristics of the GRBs detected by CGBM.

URATA, Yuji (IANCU)

Extremely Soft X-ray Flash as the indicator of off-axis orphan GRB afterglow

We verified the off-axis jet model of X-ray flashes (XRFs) and examined a discovery of off-axis orphan gamma-ray burst (GRBs) afterglows. The XRF sample was selected on the basis of the following three factors: (1) a constraint on the lower peak energy of the prompt spectrum $E_{\rm src}$, (2) redshift measurements, obs and (3) multi-color observations of an earlier (or brightening) phase. XRF020903 was the only sample selected basis of these criteria. A complete optical multi-color afterglow light curve of XRF020903 obtained from archived data and photometric results in literature showed an achromatic brightening around 0.7 days. An off-axis jet model with a large observing angle (0.21 rad, which is twice the jet opening half-angle, $\theta_{\rm jet}$) can naturally describe the achromatic brightening and the prompt X-ray spectral properties. This result indicates the existence of off-axis orphan GRB afterglow light curves. Events with a larger viewing angle ($\gtrsim 2\theta_{\rm jet}$) could be discovered using an 8-m class telescope with wide field imagers such as Subaru Hyper-Suprime-Cam and the Large Synoptic Survey Telescope.

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FUJIWARA, Taichi (Tokyo institute of technology)

Gamma-ray burst observation for eight and half year by Akeno MITSuME telescope

We report on the observations of early GRB afterglows at Akeno MITSuME Telescope in 2008–2016. We had 29 detections and about 120 upper limits in this period. For discuss their timing properties and correlations with gamma/X-ray light curves.

OHMORI, Norisuke (University of Miyazaki)

The first Suzaku/WAM Gamma-ray Burst catalog

The gamma-ray bursts (GRBs) are one of the most powerful explosion phenomena. Many GRB catalogs have been published to study the origin of the prompt emission so far, but the physical mechanisms remain unresolved. In order to investigate systematic properties of GRBs, we are constructing the GRB catalog for GRBs observed by the wide-band all-sky monitor (WAM) onboard the Suzaku satellite. The WAM energy range is 50–5000 keV, and its on-axis effective area is large in comparison with other GRB instruments: 800 cm^2 at 100 keV and 400 cm^2 at 1 MeV. In the first catalog, we will summarize results from 1464 GRBs detected between August 4, 2005 and December 29, 2010. Ohmori et al. (2016) already reported the duration distributions with two distinct peaks at 0.38 sec and 19 sec, which confirms the presence of short/hard and long/soft GRBs. As a next step, we are performing spectral analysis with the three models (power-law, power-law with an exponential cutoff, and the Band function) using 412 GRBs localized by Swift/BAT, Fermi/GBM and interplanetary network (IPN).

In this paper, we report on the status of the catalog project, focusing on distributions of spectral parameters, fluence, and 1-s peak flux.

IWAKIRI, Wataru (RIKEN)

MAXI/GSC observation of new superburst from Ser X-1

A new candidate of superburst was detected by MAXI/GSC data of Ser X-1. Three superbursts have been observed from this source previously (Cornelisse et al. 2002, Kuulkers 2009). The new long duration burst occurred on 2011 Dec 6 (MJD 55901). It rose from persistent flux of 0.15 Crab in 2–10 keV to the observed peak flux of 0.33 Crab. The burst lightcurve shows that the e-folding decay time is 2.3 hours. Since the duration is consistent with superbursts previously observed, we concluded that this is the fourth superburst from Ser X-1. The recurrence time between the third burst (MJD 54753) and fourth burst is 1148 day. We estimate the alpha of these superbursts (which is ratio of average persistent flux times recurrence time and burst fluence) and the result is 1000–10000. From fits of cooling models to superburst lightcurve (Cumming & Macbeth 2004), we found the energy release per unit mass is (1.4–6.5) $\times$ 10^{17} erg/g and the ignition column depth is (1.7–2.5) $\times 10^{12}$ g/cm^2. These results are consistent with the the results from the first superburst studied in Cumming et al. 2006. Comparing these results with previous superbursts from Ser X-1, it suggests that the e-folding time is negatively correlated with the superburst alpha although there is possibility of missing superbursts.

YABE, Seiya (Sitama university)

Suzaku/WAM Hard X-ray Observations of Solar Flares —from 2005 to 2014

Solar flare is the largest explosive phenomenon in the solar system, which suddenly releases magnetic energy built up in the solar atmosphere through reconnection. The rate of solar flare is correlated with the solar activity whose 11-year period is well known. Solar flare is observed in entire band that we observe. In particular, hard X-ray radiation is produced by non-thermal electrons accelerated at the magnetic field reconnection, although the detailed mechanism of particle acceleration is still in debate. The Suzaku Wideband All-sky Monitor (WAM) had observed over 700 solar flares in 50 keV to over MeV band through the life of the hard X-ray detector (HXD) from 2005 to 2015. The first catalog was published by Endo et al. (2010). They showed the hard X-ray properties of flares in the solar minimum from 2005 to 2009. Following their study, we carried out systematic spectral analysis of solar flares observed with WAM during the solar maximum from 2010 to 2014. We recognized no significant difference between the solar maximum and minimum in the hard X-ray spectrum, and found following "common" characteristics. First, the hard X-ray flux of each event is well correlated with the thermal soft X-ray flux. Second, the spectral slope of the non-thermal hard X-ray component shows clear correlation neither with event duration nor hard X-ray flux of each event. In this presentation, we discuss hard X-ray emission mechanism suggested by these observed properties.

YABUKI, Ken (Chuo university)

An investigation of the X-ray luminosity in quiescent phase for superflare stars.

Flares which occur on stellar surfaces are caused by the release of magnetic energy. There are flares with more than 10^{33} ergs of energy, i.e. at least 10 times larger than the maximum solar flare. These flares are called "superflare". Maehara et al. (2012) has searched for superflares on G-type dwarfs using Keplar data in optical band. They found that slowly rotating stars, with spin period of about 20 days, like the Sun, can show superflares. They also derived total bolometric energy of superflares and found the largest values of those for each objects do not show any clear correlation with the period of stellar rotation. These results indicate different trend from that obtained in X-ray band; Pizzolato et al. (2003) indicates the X-ray luminosity in quiescent phase declines with increasing rotation periods for the stars with rotation periods of more than 7 days. With the above background, we have searched for $L_{\rm xq}$ of superflare stars, using available X-ray archived data. As the result, we found that 11 stars are in the fields of view of XMM-Newton and 7 of them are detected. In addition, we confirmed that each of 3 stars is identified with a source in the ROSAT All-Sky Survey catalog. In consequence, for the stars of which the rotational periods are more than 10 days, each $L_{\rm xq}$ is larger than the predicted value from the relation by about an order of magnitude. This is consistent with the result in optical band (Maehara et al. 2012). We further investigated the correlation between $L_{\rm xq}$ and $E_{\rm max}$, and found positive correlation ($E_{\rm max} \propto L_{\rm xq}^{1.2}$). This relation is roughly consistent with that between $L_{\rm xq}$ and the largest flare luminosity for each objects in X-ray band (see the poster by Sasaki et al. at this international conference).

SASAKI, Ryo (Chuo University)

Statistical research of hyper X-ray flares detected with MAXI: a correlation between the quiescent luminosity and the largest flare luminosity.

Stellar flares are unpredictable phenomena. It is adequate to survey all-sky for detection of large stellar flares. MAXI is mounted on the Japanese Experiment Module Exposed Facility of International Space Station. It is designed for monitoring all-sky in the X-ray band. It observes an area in the sky once per 92 min orbital cycle. MAXI employs two types of X-ray camera. These are Gas Slit Camera and Solid-state Slit Camera which cover the 2–30 keV and the 0.5–12 keV energy band, respectively. MAXI started its operation in 2009 August. Owing to its unprecedentedly high sensitivity as an all-sky X-ray monitor and its capability of real-time data transfer, we have detected 105 strong flares from 27 active stars (fourteen RS CVn systems, one Algol system, nine dMe systems, one dKe system, one Young Stellar Object, one T-Tauri Star). These flares have large X-ray luminosity of 2e30–7e33 erg s^{-1} in the 2–20 keV band, which can be high ends of among their own categories. We compared the largest X-ray luminosity for each objects ($L_{\rm x,f}$) and quiescent state X-ray luminosity ($L_{\rm x,q}$). Each $L_{\rm x,q}$ was extracted from the ROSAT all-sky survey bright source catalogue (Voges et al. 1999). Such a statistical study has never been done. As a result, we obtained the correlation of $L_{\rm x,f} \propto L_{\rm x,q}^{0.7}$. With the correlation, we can predict the largest luminosity for each stars from the $L_{\rm x,q}$. In this poster, we will report the interpretation of this statistical result.

NAKAMURA, Yumiko (Department of Physics, Chuo University,)

Superflare star candidates detected by XMM-Newton

While superflare surveys on main-sequence stars have been well performed with Kepler satellite in the optical band (e.g. Maehara et al. 2012), there are few reports in the X-ray band. Hence necessity of statistical study in the X-ray band has been enhanced recently.

We found 23 objects in 2XMMi-DR3 catalog (Dacheng et al. 2012) have the light curves which resemble those of stellar flares. Among them, we have identified 22 objects with the stars listed in available optical and infrared catalogs. We made SEDs from the optical and infrared data, and derived temperatures and spectral types (M type:18, K type:3, F type:1).

One of the 22 objects is concluded to be a new member of AB Dor moving group, from the coordinate and proper motion. The young age of AB Dor (50–120 Myr; Malo et al. 2013) also supports the membership, with the fact that YSOs originate flares frequently (e.g. Imanishi et al. 2003). Assuming that it is in the main sequence phase, we derived the lower limit of the distance to the star as 77 pc from the apparent magnitude and the color. With the lower limit and the estimation by Malo et al. (2013) of 7–77 pc, distance to the star is determined to be 77 pc, and then $L_{\rm X}$ is derived as 10^{29} ergs s^{-1}, well in the range of superflare class.

The lower limits of the distance and Lx for the other 21 objects are also derived with the same assumption, 10–500 pc and 10^{26}–10^{31} ergs s^{-1}, respectively. Among them, 15 objects have the lower limit of $L_{\rm X}$ of 10^{28} ergs s^{-1}, well in the superflare class. Since a detection of a superflare originated on the main sequence phase is quite rare, at least in the X-ray band, our sample gives valuable candidates for them.

TODA, Koyo (Hiroshima University)

Revisiting the cosmological evolution of X-ray selected blazars with the Swift/BAT 70-month all sky survey data

Blazars constitute the most extreme class of active galactic nuclei. Recent multi-wavelength observations allow us to understand the emission processes in blazars. In contrast, the cosmic history of blazars is still veiled in mystery. The keys to understand their evolution is the cumulative source count distribution and the luminosity function with which we are able to obtain the trend of evolution and the peak of blazar formation epoch in the universe. In this talk, we report our study on the cosmological evolution of blazars utilizing the 70-month data from the Swift/Burst Alert Telescope (BAT) survey. Our sample comprises 41 flat-spectrum radio quasars (FSRQs) and 27 BL Lacertae (BL Lac) objects. Our sample size is a factor of $\sim$2 bigger than that of the previous study with the 22-month Swift/BAT survey data (Ajello et al. 2009). Although Ajello et al. 2009 reported the peak of the FSRQ density at z$\sim$5, we find that the FSRQ density has a peak around z$\sim$2–3 which is nearly consistent with the study based on gamma-ray selected FSRQs (Ajello et al. 2012). Furthermore, we will discuss prospects for blazar detectability by future X-ray survey missions such as iWF-MAXI.

CONNOLLY, Sam (University of Southampton)

Testing Accretion Disc Theory in AGN - X-Ray/Optical Interband Lags in NGC 4395

Measuring time lags between the X-ray and UV/optical variations in AGN is a powerful tool in determining both the emission mechanisms in these bands and the geometry of the environment close to the black hole. Previous observations suggest that UV/optical variability usually lags X-ray variability, implying that the UV/optical variations result from reprocessing of the X-rays by the accretion disc. Recent Swift observations of the $4 \times 10^7 M_\odot$ AGN NGC 5548 confirm definite UV/optical lags which are consistent with reprocessing in a disc, however the lag is larger than expected from a standard Shakura-Sunyaev disc model. In order to properly test our understanding of disc models, it is vital to make similar lag observations of AGN of different masses. Here, we report XMM-Newton and ground-based optical observations of the low mass ($3 \times 10^5 M_\odot$) AGN NGC 4395. We find UVW1 and g-band lags with respect to the X-rays of $\sim$450 s and 800 s. We report the results of physical modelling of the lags according to the standard Shakura-Sunyaev disc model, which imply that, unlike NGC 5548, the reprocessing in NGC 4395 appears to be consistent with this model.

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FATIMA, Siti (Department of Astronomy, Institut Teknologi Bandung)

Variability Analysis of X-ray spectrum of Blazar OJ 287 from Suzaku/XIS and Swift/XRT (2005–2016)

Blazar OJ 287 is known to exhibit periodic outburst from optical observations. A model of Binary Supermassive Black Holes (SMBHs) in the center of OJ 287 is used to explain the phenomenon of 12 years periodic optic outburst. X-ray observations also confirmed outbursts of OJ 287 in the X-ray band. X-ray spectra of OJ 287 from X-ray observation in 2005 to 2016 were analyzed to determine the variability in X-ray. Spectral data are obtained from X-ray Imaging Spectrometers (XIS) from Suzaku mission in observation years of 2007 and 2015. Also obtained from X-ray Telescope (XRT) mission from Swift in observation period since May 2005 to March 2016. Energy interval of the X-ray spectrum is 0.4 – 10 keV for Suzaku/XIS and 0.3 – 7 keV for Swift/XRT. The data are divided into several non-outburst and outburst data groups. In general power law model is the best model and it is also confirmed that the X-ray spectra of OJ 287 during that period exhibit fluctuation in photon index value, Γ. Variability of the value of Γ indicates that there is evolution of the X-ray spectrum of OJ 287 during non-outbursts time and also during transition between non-outburst and outburst phase and vice versa. Different values of Γ are also found during different outburst phases. In general the derived values of Γ are in agreement with the inverse compton model ($\Gamma \sim 1 - 2$) in contrast with the synchrotron model ($\Gamma \sim 2 - 3$). We also found that Γ increases as the flux increases as opposed to that of synchrotron model. In addition, X-ray luminosity of OJ 287 shows fluctuation within $\sim 1 \times 10^{11} \leq L_{\odot} \leq 1 \times 10^{12}$.

MATSUMOTO, Jin (RIKEN)

Synergetic Growth of the Rayleigh-Taylor and Richtmyer-Meshkov Instabilities in the Relativistic Jet

The relativistic jet is ubiquitous phenomenon among astrophysical systems consisting of a compact object surrounded by an accretion disk, e.g., active galactic nuclei, microquasars, and the central engine of gamma-ray bursts. The dynamics and stability of the relativistic jet is important in order to understand the emission properties of the jet. The radial oscillating motion of the jet is naturally excited due to the pressure mismatch between the jet and surrounding medium, that is, cocoon when the jet propagates through an ambient medium. In the rest frame of the decelerating jet interface that expands radially, an effective inertia force acts on the interface and is directed outward. Therefore the jet medium is on top of the cocoon medium in the effective gravity in this frame and the Rayleigh-Taylor instability is expected to grow at the interface. We investigate the growth of the Rayleigh-Taylor instability at the interface of the jet using three-dimensional hydrodynamic simulations. The propagation of the relativistic jet that is continuously injected from the boundary of the calculation domain into a uniform ambient medium is solved. We find that the interface of the jet is deformed by a synergetic growth of the Rayleigh-Taylor and Richtmyer-Meshkov instabilities regardless of the launching condition, such as the specific enthalpy of the jet or the effective inertia ratio between the jet and ambient medium. The material mixing between the jet and external medium due to these instabilities causes the deceleration of the jet.

ITOH, Ryosuke (Tokyo Institute of technology)

Mulit-wavelength observation of blazar Mrk 421 in extreme X-ray flare

Blazars are highly variable active galactic nuclei that can be detected for all wavelengths and thought to have relativistic jets. Blazar Mrk 421 exhibited extreme X-ray flares in 2010. We performed optical photopolarimetric follow-up observations using the Kanata telescope. In 2010, the variability in the X-ray band was significant, while the optical and ultraviolet (UV) flux decreased gradually. Polarization properties also exhibited unique variability in 2010, suggesting the presence of systematic component of polarization and magnetic field alignment for the emergence of a new polarized emission region. The results revealed different behaviors in terms of spectral evolution and suggested different variability mechanisms between 2010 and 2011. In 2010, the radiation was likely the result of energy injection into the emitting regions with an aligned magnetic field. In contrast, in 2011 the superposition of different emission regions may have contributed to the low degree of observed polarization. It also implies that high-energy electron which were not accelerated to ultra-relativistic velocities were injected in 2011.

ISOBE, Naoki (Tokyo Institute of Technology)

MAXI and AKARI investigation of nearby active galactic nuclei

X-ray and infrared properties of nearby active galactic nuclei were studied with MAXI and the Japanese infrared observatory AKARI, respectively. In the second release of the MAXI all-sky X-ray source catalog, 100 non-blazar-type active galactic nuclei, including 95 Seyfert galaxies and 5 quasars, are listed. They are composed of 73 type-1 and 27 type-2 objects. The AKARI all-sky survey point source catalog was searched for their mid- and far-infrared counterparts at 9, 18, and 90 micron. As a result, 69 Seyfert galaxies in the MAXI catalog (48 type-1 and 21 type-2 ones) were found to be detected with AKARI. The X-ray and infrared luminosities of these objects and their color information were investigated. When the canonical photon index, 1.9, of the intrinsic X-ray spectrum of the Seyfert galaxies was adopted, the absorption column density was estimated from the X-ray hardness ratio between the 3–4 and 4–10 keV ranges obtained with MAXI. After the absorption correction based on the estimated column density, the well-known X-ray-to-infrared luminosity correlation was confirmed in the Compton-thin regime. In contrast, NGC 1365, only one Compton-thick object in the MAXI catalog, was found not to follow the correlation in the sense that this object exhibits a significantly lower X-ray luminosity by nearly an order of magnitude. It was verified that Compton-thick objects are effectively picked up by using the relation between the X-ray hardness below 10 keV and X-ray-to-infrared color. The difference in the infrared colors between the type-1 and type-2 Seyfert galaxies were briefly investigated from the point of view of the unified picture of active galactic nuclei.

SHIKI, Kensei (Hiroshima University)

Kanata optical monitoring of radio galaxy NGC 1275

NGC 1275 is a radio galaxy, located at the center of Perseus cluster. The multi-wavelength spectrum from radio to gamma-ray of NGC 1275 is similar to that of blazars, and it shows a variable gamma-ray activity. NGC 1275 showed broad emission lines in optical band and a Fe-K line in X-ray band which are similar to Seyfert galaxies. Therefore emission of accretion disk dominates in optical and X-ray bands. In previous works (e.g., Yamazaki et al. 2013), there was no evidence about time variability in the optical bands from 2010 to 2011, and X-ray bands from 2006 to 2011. On the other hand, Aleksic et al. (2014) showed a variability in gamma-ray and optical bands by the data of MAGIC between October 2009 and February 2010, Fermi-LAT and KVA in between and August 2010 and February 2011. In their paper, optical variability was also reported. Fukazawa et al. 2016 (astrp-ph) has reported gradually brightening of NGC 1275 in X-ray correlated with gamma-ray activity from 2013 to 2014. Based on these results, we expect a jet origin brightening in optical band during the same time period. We performed optical and near-infrared photometry using HONIR installed on the 1.5 m Kanata telescope since February 2015. Furthermore, we analyzed X-ray archival public data of XRT onboard the Swift satellite, and also investigated time variability correlation between X-ray and optical bands.

SEINO, Manami (the University of Tokyo)

X-Ray Spectral Variability of the Narrow-Line Seyfert 1 Galaxy NGC 4051 Observed with Suzaku

Time resolved X-ray spectra study of Seyfert 1 galaxies have shown that it consists of a highly time variable (∼10 ks) soft (photon index $\Gamma \sim 2.2$) power-law (PL) component, a less variable (∼months) reflection component with Iron K-line and Compton hump, and another hard PL component, presumably originating from another hot corona (e.g. Noda+ 2013). In this work, we investigated if the three-components view can be applied also to narrow-line Sayfert 1 galaxies (NLS1s), whose black holes (BHs) are less massive, and have higher Eddington ratio and fast (∼100 s) time variability.

NGC 4051 is a near-by (redshift of 0.0024; Brinkmann+ 1995) NLS1. It has a $1.7 \times 10^6 M_\odot$ BH (Denney+ 2009) and high X-ray flux of $\sim 2 \times 10^{-11}$ erg cm^{-2} s^{-1} at 2–10 keV, and the intensity varied by a factor of 2 within 500 s. Therefore, it is one of the best targets for our study. we observed the source two times with Suzaku in 2008 November, with a two-weeks interval.

Based on 500 s bin light curve at 2–10 keV made from the XIS, we obtained two spectra of higher-/lower-than-average count rate periods, and generated a difference spectrum representing the fast-time-variable component. Both observations show soft PL-like spectra with $\Gamma \sim 2.2$. On the other hand, a difference spectrum between the two observations, which are 2 weeks apart, shows a hard X-ray hump in addition to the PL continuum below 10 keV.

These properties can be understood well in the three-spectral-components view. We investigated three candidates as the additional hard component: another primary component, partial covering absorption of the $\Gamma \sim 2.2$ primary component, and relativistically smeared reflection. While all three models explained the time-averaged spectra well, lack/existence of the hard X-ray hump in difference spectra of 500 s / 2 weeks, respectively, suggests that the idea of slowly variable another PL is preferable.

MIYAKE, Katsuma (The University of Tokyo)

The new primary X-ray spectral component of IC4329A confirmed with Suzaku and NuSTAR

X-ray spectra of active galactic nuclei (AGNs) were so far considered to consist of a single power-law (PL) like primary continuum, and its reflection component accompanied by an FeKα line. However, this assumption was model-dependent, and was subject to ambiguities of how to model their relatively featureless spectra. Noda et al. (2011, 2013, 2014) developed a method that can decompose AGN spectra model-independently using time-variability, and discovered that two diiferent primary components coexist in spectra of some Seyfert 1 AGNs. We applied the spectral decomposition method to the bright and highly-variable Seyfert 1 AGN, IC4329A. This AGN was observed in 2012 August simultaneously with Suzaku and NuSTAR. The source was detected in 2–70 keV with 2–10 keV flux of 1e$-$10 erg cm^{-2} s^{-1}, and the source intensity changed by a factor of 1.5 within the observation. Using the Noda's method, the time-averaged Suzaku and NuSTAR spectra (3–70 keV) were consistently decomposed into a fast variable continuum and another slowly-varying component. While the former can be modeled as a PL with photon index $\Gamma = 2.1$, the latter was reproduced only when a strongly-absorbed hard ($\Gamma = 1.4$) PL was added to the reflection.

In terms of its variability and spectral shape, the harder PL cannot be a partially-absorbed part of the $\Gamma = 2.1$ PL, nor relativistic reflection. Instead, it is considered as an additional primary X-ray component from this AGN. By combining Suzaku and NuSTAR, the presence of this new PL component and its interpretation as a new primary emission have been reinforced than in the case of using only the Suzaku data (Miyake et al. 2016). Considering similar results on other Seyfert 1 AGNs (Noda et al. 2011, 2013, 2014), we conclude that Seyfert 1 AGNs have multiple Comptonized X-ray radiation, in contrast to the previous popular view.

SAWADA, Makoto (Aoyama Gakuin University)

Atomic data and spectral modeling constraints from high-resolution X-ray spectroscopic observations of the Perseus cluster with Hitomi

High-resolution X-ray spectroscopy is a key to understand nature of cosmic plasmas, as it provides direct measurements of temperature and velocity structures, chemical abundances, and charge-state distributions. It also opens a window for new spectral features that reflect non-equilibrium phenomena or interactions with environments. Plasma codes are indispensable to carry out high-resolution spectroscopy as any spectral analysis uses a plasma code to derive physical parameters. Thus, accurate atomic database and emission models, and appropriate numerical and statistical treatments are needed to minimize systematic errors originating from plasma codes. The first high-resolution X-ray spectrum of the Perseus cluster has been obtained with the Soft X-ray Spectrometer on the Hitomi X-ray satellite. It covers major spectral features in 2–9 keV, including K-shell emission lines of abundant elements Si through Ni. The Hitomi spectrum can be used for the first practical benchmark of plasma codes.

The atomic team in the Hitomi science working group is working on this with a close collaboration with other teams analyzing the Perseus data. One of our purposes is to evaluate systematic uncertainties in calculations of spectra and their impacts on deriving physical parameters. Even with the relatively simple plasma condition of the Perseus cluster, roughly a 4-keV plasma at collisional ionization equilibrium, many differences have been identified between codes developed by different groups. This clearly shows the need of further developments on plasma codes, including feedbacks from ground plasma experiments, for existing Hitomi data and future high-resolution X-ray spectroscopy missions. Another purpose is to investigate possibilities to detect new spectral features, for instance charge-exchange emissions or characteristic emission line ratios due to interactions with non-thermal electrons. In this presentation, a current status of our activity will be reported.

NAKAJIMA, Hiroshi (Osaka University)

Hitomi Observation of the Highly Obscured High-Mass X-ray Binary IGR J16318−4848

IGR J16318−4848 is a highly absorbed X-ray source discovered by INTEGRAL. The X-ray spectrum is characterized by a strong Fe absorption edge and is dominated by Fe Kα, Kβ, and Ni Kα fluorescence emission lines. The lines as well as the continuum vary on time scales of thousands of seconds, corresponding to an emitting region of about 10^{13} cm. The optical/near-infrared (NIR) counterpart exhibits less absorption than that measured in the X-ray band, which implies that the absorbing material is concentrated around the compact object. The NIR spectrum also suggests the counter part is a supergiant B[e] star. The source is thus classified as a high-mass X-ray binary system. It was observed by Hitomi from March 10th to 14th, just after the startup of the Soft X-ray Spectrometer (SXS), the Soft X-ray Imager (SXI), and the Hard X-ray Imager (HXI). Because the observation was performed before optimizing the attitude matrices of the star trackers, the source was outside of the field of view (FoV) of the SXS for most of the observation and only the outskirts of the point spread function of the Hard X-ray Telescopes were within the FoV of the HXI. On the other hand, thanks to the large FoV of the SXI, we successfully obtained a CCD spectrum with an effective exposure time of 147 ks. The X-ray emission exhibits time variability in terms of flux and spectral shape as seen in the previous observations by XMM-Newton and Suzaku. We report the characteristics of the long-term variability of this source since its discovery. We also show the possible X-ray events from this source detected by the SXS and HXI.

ISHIDA, Manabu (Institute of Space and Astronautical Science)

Calibration status of Hitomi with the Crab

The X-ray astronomy satellite Hitomi observed the Crab on March 26, 2016. All the scientific instruments had been started up, and we successfully carried out a wide band observation in the band 0.5–300 keV. We present results from this observation primarily focusing on instrument calibration.

NAKAZAWA, Kazuhiro (the University of Tokyo)

In-flight performance of the Hard X-ray Imager onboard Hitomi

The Hitomi (ASTRO-H) mission is the sixth Japanese X-ray astronomy satellite developed by a large international collaboration. Its one month of operation in orbit demonstrated that many of the new technologies introduced to the Hitomi mission worked well. The hard X-ray imaging spectroscopy system of Hitomi composed of 2 sets of hard X-ray telescopes (HXT, a super-mirror with a focal length of 12 m) and hard X-ray imagers (HXI). It provides 1.7–1.9 arcmin (HPD) imaging in 5–80 keV band with 9×9 arcmin^2 field of view. The HXI is designed to provide low background, utilizing the deep-well shaped BGO active shield, made of 9 BGO units read-out via avalanche photo diode. In the bottom of the well, a camera made of 4 layers of 32×32 mm^2 double-sided Si strip detectors and 1 CdTe double-sided strip detector beneath are located. The HXI saw 13 days of successful operation in orbit. We observed two pulsar wind nebula, and some blank sky fields. No malfunction nor degradation was seen after launch, and temperature control also worked well. The imaging spectroscopy was performed well. Energy resolution was 1.0 keV (FWHM) at 14 keV. After proper screening, in-orbit background was about $(1-3)\times10^{-4}$ cts/s/cm^2 and relatively stable thanks to tight active shielding as well as comprehensive CXB baffling.

FUKAZAWA, Yasushi (Hiroshima University)

In-flight performance of the Soft Gamma-ray Detector (SGD) onboard Hitomi

The Soft Gamma-ray Detector (SGD) is one of observational instruments onboard the Hitomi (ASTRO-H), and will provide better sensitivity in 60–600 keV than the past observatories. The SGD utilizes similar technologies to the Hard X-ray Imager (HXI) onboard the ASTRO-H. The SGD achieves low background by constraining gamma-ray events within a narrow field-of-view by Compton kinematics, in addition to the BGO active shield. SGD was successfully turned on and observed the Crab nebula. All the instrumental components, including 6 Compton cameras and 50 BGO active shields, were worked well without significant problems. Noise performance was <2 keV (FWHM) at 100 keV, as well as expected, and the pulse profle from the Crab neutron star was obtained. Polarization studies of the Crab nebula is going on. In this paper, we will report the in-flight operation, calibration, and performance of SGD.

OHNO, Masanori (Hiroshima University)

Development and in-orbit performance of all-sky monitoring function of BGO active shield of the soft gamma-ray detector onboard Hitomi

BGO active shields of the Soft Gamma-ray Detector (SGD) onboard Hitomi satellite can also act as an all-sky monitor with very large effective area up to soft gamma-ray energy band. We have developed the hardware and signal processing system of BGO active shield so that we can perform effective all-sky observations with limited resources.

The data processing system accumulates high-time resolution (16 ms) spectral data (32 channels) once the onboard hardware trigger is activated for 5.376 sec duration. Therefore, this trigger data is dedicated to short transients such as short gamma-ray bursts or terrestrial gamma-ray flashes. We also added the autonomous data accumulation system with moderate time resolution (4 s) spectral data (128 channels) during about 512 seconds after the trigger to cover the long-duration transients such as long gamma-ray bursts and solar flares. The recorded data is transferred to the digital electronics soon after the data accumulation is finished and make ready for the next trigger so that we can maximize the trigger efficiency.

We confirmed that above data accumulation system of BGO active shield works well at on-ground calibration tests. After the launch, we activated the all-sky monitoring function after the commissioning phase of SGD finished. Unfortunately, we could not optimize the trigger judgement parameters during the observation and we had no trigger data from astronomical origin. However, we confirmed that our developed signal processing system itself worked well in the orbit. We will present about the detail of development and in-orbit performance of all-sky monitoring function of SGD and discuss possible synergy with MAXI and such large area all-sky monitor as the future perspective.

HORI, Takafumi (Kyoto University)

The MAXI/GSC catalog in the low Galactic-latitude sky

Complete X-ray source catalogs in our Galaxy are the basis to study the demography of Galactic X-ray populations. Since MAXI/Gas Slit Camera (GSC) covers the 2–10 keV band with the highest sensitivity as an all-sky mission, its Galactic source catalog will be complementary to those of hard X-ray (>10 keV) missions. Here we present the latest X-ray source catalog of MAXI/GSC in the low Galactic-latitude sky ($|b| < 10$ degrees) based on the first 74 month data. We utilize the same image fitting method as that in Hiroi et al. (2013), who constructed the 37-month MAXI/GSC catalog at high Galactic latitudes ($|b| < 10$ degrees). To overcome source confusion in crowded regions, we have accurately calibrated the position-dependent shape of the point spread function of MAXI/GSC by utilizing the onboard data. We also take into account the Galactic ridge X-ray emission in the background, utilizing the model by Revnivtsev et al. (2006). With a preliminary analysis, we detect at least 150 sources with significance above 8 sigma, among which about 70% have counterparts in the Swift/BAT 70-month catalog. Updated results will be presented.

SHIDATSU, Megumi (RIKEN)

MAXI/GSC 7-year all-sky map and studies of large-scale diffuse structures

We present MAXI/GSC all-sky maps in the soft (3–4 keV), medium (4–10 keV), and hard (10–20 keV) X-ray bands constructed from the whole 7-year data. To realize maximum sensitivity, we have developed a model of the non X-ray background (NXB) with high accuracy, by using the rate of the coincident events between a signal anode and a veto anode, as a tracer of the intensity and energy distribution of the NXB. The model has enabled us to obtain the high-quality all-sky maps and to analyse X-ray sources all over the sky. We report our studies of extended structures, including the spatial distribution of the Galactic ridge X-ray background and constraints on the strength of the Fermi bubbles in the X-ray band.

SUGIZAKI, Mutsumi (RIKEN)

Operation and calibration of MAXI Gas Slit Camera (GSC) on the International Space Station for over 7 years

GSC (Gas Slit Camera) is the main X-ray instrument of the MAXI mission carried out on the International Space Station (ISS). Utilizing 6 identical camera units, each of which consists of two Xe-gas counters and a slit mask with one-dimensional field of view, it scans the almost entire sky every ISS orbital cycle of 92 minutes. The Xe-gas counters employ resistive carbon anodes to archive the position sensitivity. Passing through the in-orbit operation for over 7 years since 2009, some gas counters are now found to expose significant performance degradation. Three out of the 12 counters are considered to have a broken anode wires, which is thought to be caused by repeated heavy particle irradiation and discharge. We operate these counters carefully by activating only their alive segments. Another counter showed a sudden gain increase on 2013 June. From the diagnostic data analysis, it is suggested that the gas pressure began to decrease at that time with the exponential decay time of $\sim$1.5 year. We operate the counter by tuning the anode voltage so that the gas gain keep constant. The paper summarizes the in-orbit performance of the GSC for over 7 years and the response calibration.

TOMIDA, Hiroshi (ISAS/JAXA)

The current status of Solid-state Slit Camera aboard MAXI

We will report the current performance-status of the CCD camera aboard MAXI (Solid-state Slit Camera: SSC). After the 7-years operation in orbit, the performance of the MAXI/SSC has been guradually decreasing. The incrasing dark current and the charge transfer inefficiency led to the degradation of the energy resolution. In the poster, we will summarize the history of the SSC perfomances.

FURUSHO, Tae (ISAS/JAXA)

Energy spectra of bright clusters of galaxies obtained from the MAXI data archive

In order to enhance use of the MAXI data by scientists all over the world, we are developing the MAXI data archive. The archival data and tools will be released from DARTS at ISAS/JAXA by the end of 2016. Also, it is planned that the data and tools be available from HEASARC at NASA/GSFC. Although MAXI data analysis procedure is complicated, we offer simple analysis tools that enable end-users to easily create standard images, energy spectra and responses, and light curves. We describe design of the MAXI data archive system and how to use the analysis tools for end-users. To demonstrate performance of the MAXI archive, we present energy spectra of the Perseus cluster and other clusters of galaxies accumulated over the seven-year MAXI life-period. Thanks to MAXI's sensitivity to largely extended emission and wide energy band, we are able to create high-quality spectra in 0.7–30 keV from the entire clusters of galaxies.

KAWAI, Nobuyuki (Tokyo Institute of Technology)

iWF-MAXI: Soft X-ray Transient Monitor on the ISS

iWF-MAXI is an X-ray transient monitor mission proposed as an experiment payload on the JEM/EF (Japanese Experiment Module Exposed Facility) of the International Space Station. Its main scientific goals are monitor the large part of the sky in X-ray band to find and localize astrophysical transient events. Prompt X-ray emission associated with gravitational wave events is its prime target. Other targets include gamma-ray bursts, tidal disruption events, stellar flares, nova ignitions, supernova shock breakouts, black hole/neutron star binaries, and active galactic nuclei (AGN). Its main scientific instrument is the Soft X-ray Large Solid Angle Camera (SLC) with a localization accuracy of 0.1 degrees.

Its overview and current status are presented.

SUGITA, Satoshi (Tokyo Institute of Technology)

Development of the Hard X-ray Monitor onboard WF-MAXI

Wide-Field MAXI (WF-MAXI) is a mission to detect and localize X-ray transients with short-term variability including EM counterparts of gravitational-wave events such as gamma-ray bursts and supernovae etc. WF-MAXI consists of two main instruments, Soft X-ray Large Solid Angle Camera (SLC) for localization of the events with few arc-minutes error in soft X-ray band and Hard X-ray Monitor (HXM) to measure the spectrum and the lightcurves in hard X-ray band. The field of view of WF-MAXI is 20% of all sky at any given time and the energy band is covered from 0.7 keV to 1 MeV. We have developed the HXM components which consists of 24 channel arrays of Ce:GAGG scintillators coupled with APDs covering the hard X-ray band with effective area of above 120 cm^2. To read out signals from the censor arrays, we designed a new LSI dedicated with the readout of 32 APDs' signals using 0.35 μm CMOS technology. We will report the integration and the end-to-end test of the components of HXM BBM.

NAKANO, Toshio (RIKEN)

End-to-End test of the mirror and polarimeter of PRAXyS

The Polarimeter for Relativistic Astrophysical X-ray Sources (PRAXyS), NASA's small explore mission, will allow us to measure the polarization of the X-ray in the 2–10 keV energy band. We carried out an end-to-end test of the X-ray optics combining a grazing incident X-ray mirror and a Time Projection Chamber Polarimeter for PRAXyS at the NASA Goddard Spacecraft Center 100m X-ray beamline in June and July 2016. To simulate the spacecraft rotation canceling out instrumental fake polarizations, the X-ray tube, mirror and polarimeter in the test were designed to rotate around beamline axis independently. The optics was tested with 2.7 keV, 4.5 keV and 6.4 keV X-rays (and bremsstrahlung X-rays) at several combinations of angles. We verified uniformity of the mirror and performance of the polarimetry.

SANTANGELO, Andrea (University of Tübingen)

The enhanced X-ray Timing and Polarimetry mission

I present here the enhanced X-ray Timing and Polarimetry (eXTP) mission concept, currently developed by an international Consortium led by the IHEP of CAS. The science goals aim at studying matter under the extreme conditions of density (equation of state and QCD), gravity (strong field gravity and GR) and magnetism (strong and extreme magnetic fields and QED). The mission will also monitor the X-ray sky in the 2–50 keV range. The scientific payload includes a suite of instruments devoted to large-area and high-sensitivity spectral, timing and polarimetric studies:
- The Spectroscopy Focusing Array (SFA, 0.5–10 keV)
- The Large Area Detector (LAD, 2–30 keV)
- The Polarimetry Focusing Array (PFA, 2–10 keV)
- The Wide Field Monitor (WFM, 2–50 keV)

After presenting the science case of the mission, I will then describe the current mission configuration, and its capability as All sky monitor.

MORI, Koji (University of Miyazaki)

A broadband X-ray imaging spectroscopy with high-angular resolution: the FORCE mission

We present our concept of future Japan-lead medium-class mission, FORCE (Focusing On Relativistic universe and Cosmic Evolution), to be launched in the mid 2020s. FORCE is the direct successor to the broadband X-ray imaging spectroscopy aspect of Hitomi (ASTRO-H) with significantly higher angular resolution. The current design of FORCE defines energy band pass of 1–80 keV with angular resolution of < 15" in half-power diameter, achieving a 10 times higher sensitivity above 10 keV compared to any previous missions with simultaneous soft X-ray coverage. Our primary scientific objective is to trace the cosmic formation history by searching for "missing black holes" in various mass-scales: "buried supermassive black holes (SMBHs)" residing in the center of galaxies in a cosmological distance, "intermediate-mass black holes" acting as the possible seeds from which SMBHs grow, and "orphan stellar-mass black holes" without companion in our Galaxy. In addition to these missing BHs, hunting for the nature of relativistic particles at various astrophysical shocks is also in our scope, utilizing the broadband X-ray coverage with high angular-resolution. FORCE are going to open a new era in these fields. The satellite is proposed to be launched with the Epsilon vehicle that is a Japanese current solid-fuel rocket. FORCE carries three identical pairs of Super-mirror and wide-band X-ray detector. The focal length is currently planned to be 10 m. The silicon mirror with multi-layer coating is our primary choice to achieve lightweight, good angular optics. The detector is a descendant of hard X-ray imager onboard Hitomi (ASTRO-H) replacing its silicon strip detector with SOI-CMOS silicon pixel detector, allowing an extension of the low energy threshold down to 1 keV or even less.

HAYASHI, Hideki (Kyoto University)

Development of X-ray SOI pixel sensors for future X-ray wide filed cameras

MAXI has opened up the all-sky monitor and time-domain astronomy in the soft X-ray band below 10 keV. In order to push out the frontiers, we develop X-ray wide field cameras using two-dimensional coded masks with XRPIX. XRPIX is a monolithic active pixel sensor based on the silicon-on-insulator (SOI) pixel technology. XRPIX contains a comparator circuit in each pixel for hit trigger (timing) and two-dimensional hit-pattern (position) outputs in addition to the imaging and spectroscopic capabilities comparable to those of an X-ray CCD. The function allows us to read out analog signals of only hit pixels, which is referred to as the event-driven readout mode. Thus, XRPIX offers a good time resolution better than 10 microsecond and a high throughput reaching >1 kHz in the event-driven readout mode. The pixel size of XRPIX is 36 micron $\times$ 36 micron. Thus, the angular resolution reaches 2.5 arcmin in principle by adopting the same pitch size for the coded mask and the distance between XRPIX and the mask of 10 cm. We can also reduce the non-X-ray background by applying the anti-coincidence technique because XRPIX has the high time resolution. In our previous studies, we have successfully demonstrated the X-ray detection by the event-driven readout. Recently, we successfully processed XRPIX with an imaging area of 24.6 mm $\times$ 15.3 mm and the format of 608 $\times$ 384 pixels. In this poster, we report the evaluation results of the new device together with the concept of the wide field camera using XRPIX.

HARITA, Shohei (TokyoTech)

Micro-satellite for astrometry and photometry of gravitational wave sources

We are planning a micro-satellite for astrometry and UV photometry of gravitational wave sources. Humankind had detected three gravitational waves arise from BH-BH mergers that were totally unexpected. Another candidates of gravitational wave source are NS-NS or NS-BH mergers. Short Gamma-ray Bursts (sGRB) have been believed to be related to the NS mergers. If it is the case, gravitational waves may be accompanied by sGRBs and their optical afterglows. Furthermore, recent theoretical study predicts that the NS merger may radiate strong UV light caused by free neutron beta-decay. To detect these phenomena we propose a wide-field UV surveying observation mission in space utilizing micro-satellite.

In the strictly limited mission payload we packed an UV telescope, two wide field optical monitors, and gamma-ray scintillation detectors to detect and localize sGRBs. The diameter of the UV telescope is 200mm to achieve the limiting magnitude of 22 mag in u'-band for 1000s exposure. In the current design the FoV of the UV telescope amounts to $4^\circ \times 4^\circ$. While the optical wide field monitor have $10^\circ \times 10^\circ$ FoV and achieve the limiting magnitude of 20 mag at optical band for 1000s exposure.

Based on a brief estimation, these detector system can detect several supernovae per month. Therefore this may be capable with detecting not only the GW sources but also the other transient sources, like supernova shock breakouts.

Those telescope system mounted on 50 kg class micro-satellite with brand-new attitude control system, namely "variable shape attitude control (VSAC)" system which satisfies both maneuver speed and stability. We plans tiling observation utilizing for surveying GW sources by using the agile satellite bus and follow-up observation based on the GW alert sent by LIGO/Virgo/KAGRA. This project is just started but we aim to launch within 2020.

YAMAOKA, Kazutaka (ISEE, Nagoya University)

Development of the Solar Neutron Monitor on the ChubuSat-2 Satellite

The solar neutron observation is a key in understanding of the ion acceleration mechanisms at the Sun surface since neutrons are not affected by the magnetic field around the Sun and interstellar mediums. However, there have only been a few tens of detection so far since its discovery in 1982. ChubuSat is a series of 50-kg class microsatellites jointly developed by Nagoya university, Daido university, and aerospace industrial companies in the Chubu area of central Japan. ChubuSat-2 was selected as one of the four piggyback payloads of the X-ray astronomy satellite ASTRO-H in 2014 summer, and was successfully launched by the H-IIA launch vehicles from the JAXA Tanegashima Space Center (TNSC) on February 17, 2016. ChubuSat-2 carries two mission instruments, the radiation detector (RD) and the infrared camera. The main mission of ChubuSat-2 is devoted to monitoring neutrons and gamma-rays which can be background sources for ASTRO-H celestial observations. The mission also involves solar neutron observations which were originally proposed by graduate students who join the leadership development program for space exploration and research, a program for the leading graduate schools (LGS) at Nagoya University. The RD has a similar detection area and efficiency to those of the neuron detector, SEDA-AP FIB on the International Space Station (ISS), but is expected to have a lower background than the SEDA-AP FIB thanks to a much smaller mass of the micro-satellite. In this paper, we will describe development of the ChubuSat-2 satellite and the RD, and the current status in orbit.

UCHIDA, Nagomi (Hiroshima University)

Development of an in-orbit radiation environment monitor CUBES onboard a small satellite MIST

Gamma-ray Bursts (GRBs) are the brightest explosions in the universe, and some of GRBs could be a candidate of gravitational wave sources. However, the emission mechanism and physical environment of GRBs are not understood well. To investigate them, we are planning to observe gamma-ray polarization of GRBs, using the Segmented Polarimeter for High eNergy X-rays (SPHiNX) launched in 2020. Since the gamma-ray polarization information has been measured from a few sources, SPHiNX will observe polarization properties of 30 GRBs in 2 years and accumulate the statistics. If the emission is produced in photospheric through the thermal process, polarization degree is expected to be weaker. On the other hand, if the emission is produced far from the progenitor through the synchrotron process, the polarization degree is expected to be higher.

The main detector of SPHiNX is the Compton-based hard X-ray polarimeter which consists of plastic scintillators as the scatterer, and $Bi_4Ge_3O_{12}$ (BGO) or $Gd_3Al_2Ga_3O_{12}$ (GAGG) as the absorber. Compared to BGO, GAGG is a new material with high light yield and good energy resolution, however it has not been used much in space. We are investigating which scintillators are suitable for SPHiNX. This satellite will move around the low earth orbit and thus will be exposed to primary cosmic rays, and secondary charged particles, gamma-rays, and neutrons which are sources of background.

CUBES is a detector jointly developed by Hiroshima University and KTH in Sweden and launched by the MIST satellite in 2018. The aims of CUBES are to study the behavior of these scintillators and radiation environment in the SPHiNX orbit. CUBES loads the three candidates of scintillators for SPHiNX which are read by Si-Phtomultiplier. We present sciences of SPHiNX, current development of the analog readout circuit for CUBES and test of radiation tolerance of GAGG against ^{60}Co gamma-rays.

ONO, Yuki (Tokyo Tech)

X-ray emission of the Be star/pulsar system PSR B1259−63 at non-periastron phase

PSR B1259−63/SS 2883 is a binary system in which a pulsar orbits around a Be star with a long orbital period of about 3.4 yr. It is argued that the system is non-accreting and a shock is formed between the pulsar wind and the Be star wind, resulting in particle acceleration and non-thermal emission near periastron up to TeV gamma-ray bands. In the five years MAXI observation of the field of PSR B1259−63, X-ray flares have been observed at orbital phases far from the periastron. The resolution of MAXI GSC is typically on the order of 1.5°, while a nearly transient source IGR J13020−6359 is located at 0.16° from PSR B1259−63, making it difficult to identify the sources of the flares. In this study, we fit the X-ray images with the Point Spread Function of MAXI GSC to determine the position of the X-ray flares accurately. As a result, we can distinguish the flares of PSR B1259−63 from those of IGR J13020−6359; three flares out of five flares are likely to be from PSR B1259−63. We suggest that the Be star temporarily releases the large amount of gas in a direction other than the circumstellar disk, resulting in increases of the stellar wind density around the pulsar at phases far from the periastron.

RODES ROCA, Jose Joaquin (University of Alicante)

Long term variability of Cen X-3 with MAXI

Cen X-3 is an O-type donor Supergiant X-ray Binary with a neutron star as a compact object and a prime benchmark to study disk fed accreting systems. The aim of this work is to study both the light curve and orbital phase spectroscopy of this system in the long term. Here we estimate the orbital period from the light curve and then we derive the good time interval to extract the spectrum from different orbital phases. We obtain orbital phase-averaged and phase-resolved spectra and we analyse the variability of the model parameters to infer properties of the circumstellar environment of Cen X-3 and possible dependences of the spectral parameters. The MAXI spectra in the 2–20 keV energy range were fitted with typical models used in X-ray accreting systems. Then we used the best one to discuss the orbital phase variability of the parameters.

ISLAM, Nazma (Raman Research Institute)

Orbital phase resolved spectroscopy of GX 301−2 with MAXI

GX 301−2, a bright high-mass X-ray binary with an orbital period of 41.5 d, exhibits stable periodic orbital intensity modulations with a strong pre-periastron X-ray flare. Several models have been proposed to explain the accretion at different orbital phases, invoking accretion via stellar wind, equatorial disc, and accretion stream from the companion star. We present results from exhaustive orbital phase resolved spectroscopic measurements of GX 301−2 using data from the Gas Slit Camera onboard MAXI. Using spectroscopic analysis of the MAXI data with unprecedented orbital coverage for many orbits continuously, we have found a strong orbital dependence of the absorption column density and equivalent width of the iron emission line. A very large equivalent width of the iron line along with a small value of the column density in the orbital phase range 0.10–0.30 after the periastron passage indicates the presence of high density absorbing matter behind the neutron star in this orbital phase range. A low energy excess is also found in the spectrum at orbital phases around the pre-periastron X-ray flare. The orbital dependence of these parameters are then used to examine the various models about mode of accretion on to the neutron star in GX 301−2.

PRADHAN, Pragati (University Of North Bengal & Raman Research Institute)

A COMPARATIVE STUDY OF SG-HMXBS AND SFXTS USING IRON K-ALPHA LINE AS A TRACER

We present a comparative study of classical supergiant HMXB and SFXT systems by making a detailed study of the variation of the equivalent width of iron K-alpha line with the absorption column density using out-of-eclipse observations from Suzaku, XMM, and Chandra (and taking care not to mix observations in different spectral states). Analysis of the entire archival Suzaku observations of these systems show that the equivalent width of SFXTs is significantly smaller compared to those of classical supergiant HMXBs even when the hydrogen column density of both are comparable. We discuss the results of the analysis in the light of two theories on SFXTS: the clumpy wind and the magnetic gating model. The findings are also used to make a comparison between these two systems as a class.

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INOUE, Hajime (Meisei University)

Precessions of accretion rings and super-orbital periods

I show that X-ray light curves of three X-ray pulsars, Her X-1, LMC X-4 and SMC X-1, folded with their respective super-orbital periods, can well be reproduced by a model that X-rays from a compact object towards us are periodically obscured by a precessing ring at the outermost part of an accretion disk around the central object.

LAPLACE, Eva (University of Tübingen)

Possible regular phenomena in EXO 2030+375

The X-ray source EXO 2030+375 (spin period: 42 s; orbital period: 46.021 d) is known for being the Be X-ray binary system showing the largest number of recurring low-luminosity X-ray outbursts (type I) every orbital period. Recently, however, its behaviour started to change: the X-ray flux decreased significantly and some expected type I outbursts were not detected, while the spin frequency reached a plateau (Fuerst et al. 2016). We report a striking similarity with events which occurred 20 years ago, just before the source showed a sudden shift of the orbital phase of the outburst peak (orbital phase jump) in 1995 (Wilson et al. 2002). Moreover, we investigate the relation between these events and the long high-luminosity outbursts (type II), which were observed in 1985 (Parmar et al. 1985) and 2006 (Corbet & Levine 2006). The existence of an underlying periodicity between an orbital phase jump and/or type II outbursts is considered. We discuss possible models explaining the observed changes such as Kozai-Lidov oscillations of the circumstellar disk. If our view is correct, we should experience another orbital phase jump in December 2016/January 2017.

SAKAMAKI, Ai (Nihon University)

MAXI Observations of Supergiant Fast X-ray Transients

MAXI has often detected short X-ray flares or outbursts possibly from supergiant fast X-ray transients (SFXTs), for instance, IGR J18483−0311, AX J1841.0−0536, and IGR J08408−4503. Peak X-ray fluxes from those sources are just around the detection limit in a single (80∼100 mCrab) or a few (30–50 mCrab) scanning observations. Here, we briefly summarize MAXI observations of SFXTs: detection frequencies, (peak) fluxes, and average orbital X-ray light curves.

OHUCHI, Haruka (Tokyo Institute of Technology)

Gamma-ray observation for PSR J2022+3842

The Fermi Gamma-ray Space Telescope has observed more than 200 pulsars and about half of them are young pulsars (`http://tinyurl.com/fermipulsars`). About 1/3 of them are also known as radio pulsars. On the other hand, there some pulsars which have not been detected in the gamma-rays in spite of radio observations. It is important to investigate how many pulsars can be observed in radio and/or gamma-ray (Romani et al. 1995).

PSR J2022+3842 was discovered in SNR G76.9+1.0 as an energetic rotation-powered young pulsar and has period of 48 ms (Arzoumanian et al. 2011, Arumugasamy et al. 2014). It is a Vela-like pulsar due to its spin down energy rate of 3.0×10^{37} erg/s and the characteristic age of 8.9 kyr. Though radio and X-ray pulse emission were observed, the pulsar has not been detected in gamma-rays due to its location on the galactic plane resulting in high background levels.

We report that we observed the gamma-ray pulsation of PSR J2022+3842 and its anomalous behavior.

YONEYAMA, Tomokage (Osaka University Graduate School of Science)

Discovery of keV excess emission in the isolated neutron star RX J1856.5−3754

RX J1856.5−3754 is the brightest and nearest (∼120 pc) thermally emitting isolated neutron star, a prototype of X-ray dim neutron stars (XDINS). After its discovery with ROSAT, the source was observed many times with various X-ray satellites. Observations with XMM-Newton and Chandra satellites indicate that the X-ray spectrum is well reproduced with a combination of blackbody models, one with $kT \sim 32$ eV and the other with $kT \sim 63$ eV. In addition, the X-ray spectrum and intensity are found to be fairly stable over the time. Therefore, the source was employed as a calibration target of the soft X-ray detectors, which are sensitive to contamination of material onto detectors or filters inside the satellites. Suzaku observed this source 10 times during its lifetime primarily for the calibration purpose. The X-ray spectra below 0.8 keV are well fitted with the two blackbody model determined with XMM-Newton and Chandra. Nevertheless, we notice systematic excess of the observed spectra over the two blackbody model. The excess is about 20% in the integrated counts in 0.8–1.2 keV band, and is found both in the spectra of BI-CCD (XIS1) and FI-CCD(XIS0+XIS3). We further analyze the XMM-Newton EPIC-PN spectra of this source and find similar excess. We call this keV excess, discovered 1st time for this source and for the XDINS class. We examine possible causes of this excess, including uncertainty in background subtraction, pileup of photons below 0.8 keV, and contamination of other sources. We show qualitative difficulties in explaining the keV excess with these causes. We then conclude the keV excess is originated in the source RX J1856.5−3754, or its neighbor within the radius of 0.2 arcmin. The keV excess component is fitted either with a blackbody model ($kT \sim 140$ eV) or a power law model ($\Gamma \sim 4.5$), though it is hard to constrain considering the systematic uncertainty. We shortly discuss possible origin of this keV excess.

MORII, Mikio (Institute of Statistical Mathematics)

Search for soft X-ray flashes at the ignition phase of optical novae using GSC data

We searched for soft X-ray flashes associated with optically discovered classical or recurrent novae in 5-yr MAXI/GSC data in 2–4 keV band. For this purpose, we developed a tool to make the light curves of a point source by fitting the event distribution with point spread functions (PSF-fit tool). We applied the PSF-fit tool to 40 classical/recurrent novae that were discovered in optical observations from 2009 August to 2014 August. We found no precursive soft X-ray flashes with significance above the 3-sigma level between T − 10 day and T (T = discovery date). We obtained the upper limits for the bolometric luminosity of soft X-ray flashes, and compared them with the theoretical prediction and that observed for MAXI J0158−744.

SUGAWARA, Yasuharu (JAXA/ISAS)

X-ray spectral variability of the colliding wind binary WR140: the origin of the cool plasma component

We present the results from the X-ray spectral analysis of the colliding wind binary WR140 (WC7pd+O5.5fc) using archival XMM-Newton, Suzaku and Chandra data. The long period binary WR140 (P=7.94 yr) is considered as the textbook example of an episodic dust-making colliding wind binary and a good natural laboratory for the study of shock physics, because the orbital parameters have well determined. Recently we reported that a cool plasma component in a recombining phase was discovered from the WR140 X-ray spectrum at near periastron (Sugawara et al. 2015). In order to uncover the origin of the cool plasma component, we performed the spectral analysis using XMM-Newton, Suzaku and Chandra data at near periastron. These observations cover four different epochs from 2008 December 26 to 2009 January 25 for a total exposure of about 184 ks. The spectra of the cool plasma component were well-fitted by a single-absorbed non-equilibrium ionization collisional plasma model. It is found for the first time that the emission measure of the cool plasma component decreased at approximately fifty percent per month. This variation indicates that the plasma was cooled down by radiation and/or was expanded. As one interpretation, the cool component may be a relic of the wind-wind collision plasma, and may represent a transitional phase from the compressed hot gas to dust formation.

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