

Astrophysics with All-Sky X-Ray Observations

-- 3rd International MAXI Workshop --

RIKEN Symposium, June 10–12 2008
Suzuki Umetaro Hall, RIKEN, Wako, Saitama, Japan

Tuesday, June 10

- 9:00 Registration
- 10:00 **Session 1 -- Opening; Black-hole binaries**
- 10:00 [0-01] M. Matsuoka (12) Welcome to the third MAXI Workshop
- 10:15 [0-02] K. Makishima (30) Suzaku Observations of Black-Hole Binaries and ULXs
- 10:50 Coffee Break / Poster Viewing
- 11:20 **Session 2 -- Accretion variability**
- 11:20 [0-03] A. Zdziarski (30) Long-term and super-orbital variability of X-ray binaries
- 11:55 [0-04] R. Matsumoto (30) Variability Science in Accretion Disk Theory
- 12:30 Lunch / Poster Viewing
- 14:00 **Session 3 -- MAXI mission; Galactic sources**
- 14:00 [0-05] S. Ueno (15) MAXI Mission Overview and Schedule
- 14:20 [0-06] H. Tomida (15) The X-ray cameras of MAXI mission : Gas Slit Camera (GSC) and Solid-state Slit Camera (SSC)
- 14:40 [0-07] M. Sugizaki (12) Response Functions of X-ray Slit Cameras Onboard MAXI and Simulator
- 14:55 [0-08] H. Negoro (30) MAXI nova alert system and black hole transients
- 15:30 [0-32] D. J. Thompson (30) Science of compact X- and gamma-ray sources: MAXI and GLAST
- 16:05 Coffee Break / Poster Viewing
- 16:35 **Session 4 -- Galactic sources; MAXI data**
- 16:35 [0-10] R. Fender (30) Relativistic jets from X-ray binaries
- 17:10 [0-11] K. Ebisawa (30) Galactic Transient Sources with MAXI
- 17:45 [0-12] R. Wijnands (12) Discovering and monitoring sub-luminous X-ray binaries using MAXI
- 18:00 [0-13] S. Trushkin (12) Active flaring states of GRS 1915+105 and Cyg X-3 in radio/X-ray monitoring
- 18:15 [0-14] M. Kohama (12) MAXI data distribution and the archive System

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Thursday, June 12

- 9:30 **Session 9 -- Compact hard X-ray/gamma-ray sources**
- 9:30 [0-30] L. Kuiper (30) Hard X-ray/soft γ -ray characteristics of magnetars
- 10:05 [0-31] M. Morii (12) Suzaku observation of the AXP 1E 1841-045 and the future observation in the MAXI era
- 10:20 [0-21] S. Kulkarni (30) New Transients in the Optical and Radio Sky
- 10:55 Coffee Break / Poster Viewing
- 11:25 **Session 10 -- Compact hard X-ray/gamma-ray sources**
- 11:25 [0-33] P. Ubertini (30) The Hard X-ray sources observed by INTEGRAL/IBIS and their science
- 12:00 [0-34] N. Gehrels (30) Non-GRB X-ray and Hard X-ray Sources Observed with Swift
- 12:35 Lunch / Poster Viewing
- 14:00 **Session 11 -- Source population; Diffuse emission**
- 14:00 [0-35] M. Sakano (12) The 2XMM catalogue and variability of X-ray sources
- 14:15 [0-36] Y. Ueda (15) Extragalactic survey with MAXI
- 14:35 [0-37] D. McCammon (30) Diffuse soft X-ray sky
- 15:10 [0-38] E. Miyata (30) Diffuse Source Mapping with MAXI
- 15:45 Coffee Break / Poster Viewing
- 16:00 **Session 12 -- Future missions; Closing**
- 16:00 [0-39] T. Takahashi (15) NeXT
- 16:20 [0-40] B. Paul (12) ASTROSAT observations of variable X-ray sources: together with MAXI
- 16:35 [0-41] S. Zhang (12) Introduction to the Hard X-ray modulation Telescope (HXMT)
- 16:50 [0-42] N. Kawai (12) Concluding Remarks

Friday, June 13

9:30–15:30

MAXI Tour to Tsukuba Space Center

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Poster Session,

June 10 – June 11

9:00 – 18:30

June 12

9:00 – 16:30

- | | | |
|------|--------------|---|
| P-01 | Eguchi, S. | MAXI Simulator: A Framework of Satellite Simulators |
| P-02 | Ishikawa, M. | On-board and Ground Data processing System of MAXI |
| P-03 | Ishikawa, M. | Ground Software System for MAXI data |
| P-04 | Kawasaki, K. | Overview of JEM-EF on ISS |
| P-05 | Kohama, M. | MAXI data distribution system |
| P-06 | Mihara, T | The Gas slit camera, GSC, onboard MAXI |
| P-07 | Miyata, E. | Solite-state slit camera, SSC, onboard MAXI |
| P-08 | Negoro, H. | MAXI alert system |
| P-09 | Sugizaki, M. | Response Builder of MAXI X-ray Cameras for Analyses of Spatially Complex Source Region |
| P-10 | Suzuki, M. | GRB observations with MAXI |
| P-11 | Arimoto, M. | Spectral lag analysis of GRBs detected by HETE-2 |
| P-12 | Fujimoto, S. | Soft X-ray Emission And Lithium Production in Cen X-4 in Quiescence |
| P-13 | Fukazawa, Y. | Hard X-ray mapping of galaxy clusters |
| P-14 | Gandhi, P. | Light bending and the hard X-ray background |
| P-15 | Gendreau, K. | The Neutron star Interior Composition Explorer |
| P-16 | Hayasaki, K. | Probing the supermassive binary black holes with MAXI |
| P-17 | HIROI, K. | MAXI Catalog: Source Detection and Sensitivity |
| P-18 | Horike, N. | The on-board Attitude Determination System for MAXI |
| P-19 | Inoue, Y. | The Blazar Sequence and The Cosmic Gamma-Ray Background Radiation |
| P-20 | Kato, Y. | Quasi-Periodic Oscillations and Variable Emissions in Magnetohydrodynamic Accretion Flows |
| P-21 | Kawanaka, N. | X-ray Emissions from Three-dimensional Magnetohydrodynamic Coronal Accretion Flows |
| P-22 | Kinugasa, K. | Optical Follow-up Observations of Transient Sources at Gunma Astronomical Observatory |
| P-23 | Kira, C. | Suzaku-WAM soft gamma-ray all-sky monitor by the earth occultation technique |
| P-24 | Kishimoto Y. | Observation of Polarization in Hard X-Ray Region with PHENEX Polarimeter |
| P-25 | Kotani, T. | Multi-Wavelength Observations of the Microquasar SS~433 |
| P-26 | Kudo, Y. | Development of MITSuME telescope and observations of afterglows |
| P-27 | Kurita, K. | Recent Development Status of PoGOLite |
| P-28 | Machida, M. | Magneto-hydrodynamic Simulations of Excitation of Low-Frequency QPOs in Black Hole Candidates |
| P-29 | Mizobuchi S. | The development of the MAXI system monitor |

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Poster Session,

June 10 – June 11

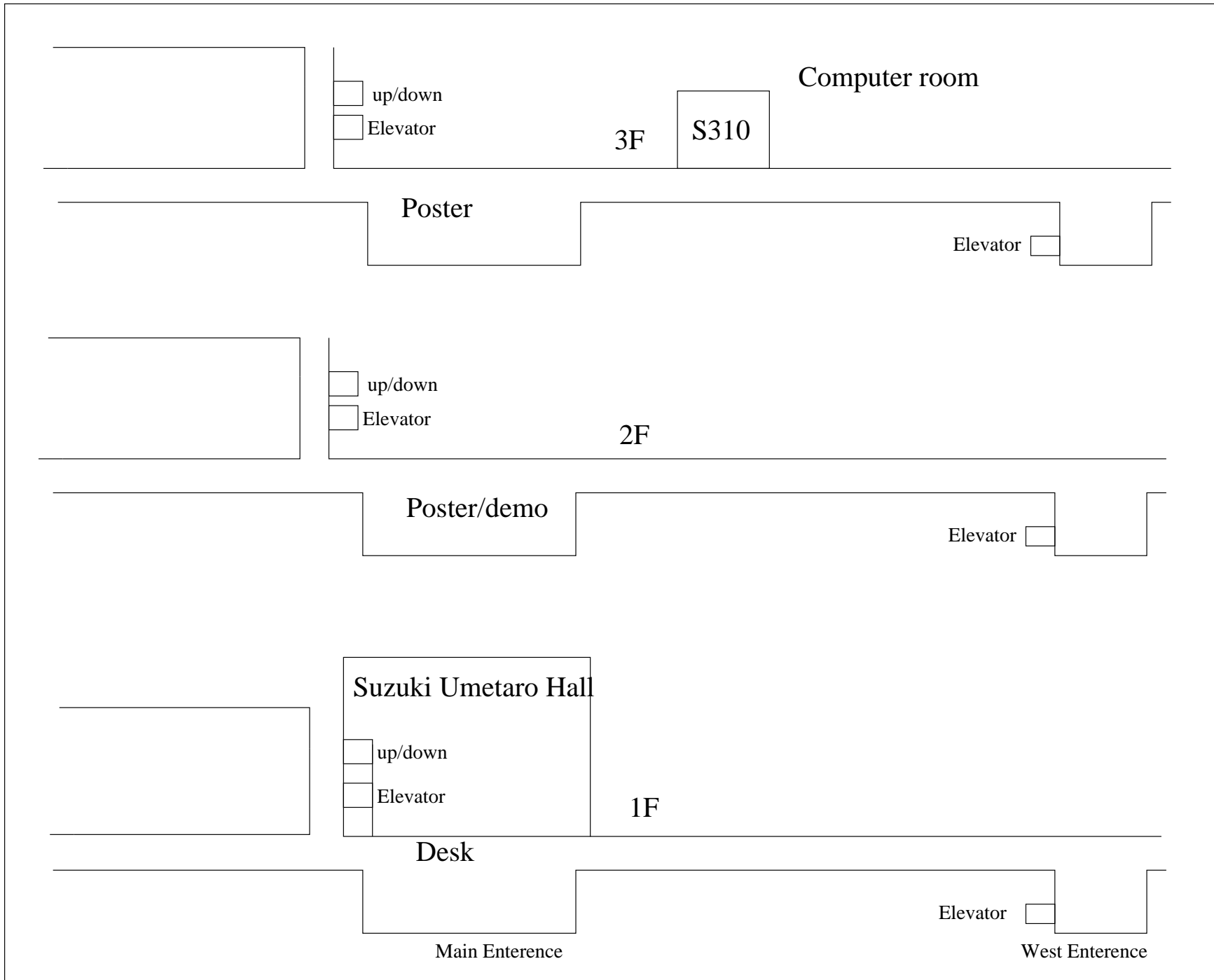
9:00 – 18:30

June 12

9:00 – 16:30

- P-30 Mori, M. CANGAROO-III Search for TeV Gamma-rays from Two Clusters of Galaxies
- P-31 Mori, Y.A. Multiwavelength simultaneous observation of Blazar 3C454.3 at the gamma rays flare in November 2008
- P-32 Nakagawa Y. E. New Magnetar Frontiers with MAXI Survey
- P-33 Nakahira S. Wide-band gamma-ray burst detector: GRB monitor for the CALET mission
- P-34 Ohsuga, K. Global Radiative Magnetohydrodynamic Simulations of Black-hole Accretion Disks
- P-35 Paul, B. Long term intensity variations of Cen X-3
- P-36 Takahashi, I. Possible coordinate observations by MAXI and the AROMA wide-field optical monitor
- P-37 Takahashi, R. Eclipsing light curves for accretion flows around a rotating black hole and atmospheric effects of the companion star
- P-38 Takei, D. Evolutionary Studies of the Classical Nova with V458 Vulpeculae
- P-39 Toizumi, T. X-ray polarimetry small satellite TSUBAME
- P-40 Yamaguchi, H. Study of the Ejecta Distribution in the Vela SNR with MAXI
- P-41 Yoshida, K. The CALET Project for All-Sky Gamma-Ray and Electron Observations on JEM-EF of ISS

Suzuki Umetaro Hall



ORAL PAPERS

Welcome to the third MAXI Workshop

Masaru Matsuoka

ISS Science Project Office, JAXA/ISAS 2-1-1, Sengen, Tsukuba, Ibaraki 305-8505, Japan Mail: matsuoka.masaru@jaxa.jp

MAXI is the first payload to be installed on Japanese Experiment Module "Kibo"- Exposed Facility (JEM-EF), a component of the International Space Station (ISS). It provides an all-sky X-ray image every ISS orbit. By scanning the sky for a few weeks, MAXI will be able to make a milli-Crab X-ray all-sky map, excluding the bright region around the Sun. MAXI will report X-ray novae or transient phenomena rapidly to astronomers worldwide and observe long-term variability of Galactic and extra-Galactic X-ray sources. MAXI also provides catalogues of all-sky X-ray sources with diffuse cosmic X-ray background every month and/or year.

MAXI has a long history from 1997 when MAXI project was approved by NASDA (previous agency of JAXA). MAXI development has been advanced so much since 1997. X-ray astronomy has also progressed excitingly with several X-ray astronomy satellites. Most satellites have performed pointing observations with narrow field of views; a few of them have wide field of views. Nevertheless, we can still expect interesting results from nova-like or transient X-ray objects, especially for weaker sources. Non-bias all sky survey is also interesting in future. Concept of MAXI project is alive and useful to achieve these requests.

Now, MAXI is scheduled to be launched by Space Shuttle Endeavour (STS-127) in early 2009. After MAXI is mounted on JEM-EF of ISS, we will adjust software systems and carry out various observational performances for several months. We welcome you to participate in MAXI science and utilize its observation data.

We would appreciate you if you could provide recent scientific results and useful comments to MAXI.

Thank you very much for your attendance at this workshop.

Suzaku Observations of Black-Hole Binaries and ULXsKazuo Makishima^{1,2}

1 Cosmic Radiation Laboratory, RIKEN, Wako, Saitama, Japan

2 Department of Physics, University of Tokyo, Tokyo, Japan

We review *Suzaku* observations of black-hole binaries (BHBs) and ultra-luminous X-ray sources (ULXs). The broad energy band of *Suzaku* has allowed us to construct a unified double-Compton modeling of the low/hard state spectra of Cyg X-1 and GRO J1655-40. The scenario has been extended to provide a possible interpretation of the fast hard X-ray flickering. We have detected clear inclination effects, that flat-disk related spectral components (Fe-K line, a cool disk emission, and a Compton reflection hump) are systematically weaker in GRO J1655-40, which has a higher inclination than Cyg X-1.

Observations with *Suzaku* and other X-ray missions indicate that ULXs are just more luminous version of BHBs, because both show similar transitions among the low/hard state, the very-high state, and the slim-disk state. We hence conclude that ULXs are genuine intermediate-mass BHs. As a result, ULXs could be considered as building blocks from which massive BHs at the galactic centers are formed via repeated mergers. Further supposing that a small fraction of active galaxies may be in a state of final mergers of the two constituent BHs, we expect stable X-ray periodicities from such objects. Evidently, the MAXI data will provide the best mean to search for the expected periodic signals.

O-03

Long-term and super-orbital variability of X-ray binaries

Andrzej A. Zdziarski

N. Copernicus Astronomical Center, Warsaw, Poland

I will discuss long-term periodic, quasiperiodic, and aperiodic variability of X-ray binaries, and the related physical models.

Variability Science in Accretion Disk Theory

Matsumoto, R.

Chiba University, Inage-ku, Chiba, Japan

Black hole candidates show complex time variabilities such as $1/f$ noise-like fluctuations, quasi-periodic oscillations (QPOs), state transitions, and plasmoid ejections. Three-dimensional global magnetohydrodynamic (MHD) simulations of black hole accretion disks indicate that X-ray fluctuations are produced by magnetic energy release in turbulent accretion disks. We also found that sawtooth-like oscillations of magnetic energy are excited when an inner torus is formed near the black hole. They produce X-ray QPOs with period about 0.1sec in stellar mass black holes and $10^5 - 10^7$ sec in AGNs with black hole mass $10^7 - 10^9 M_\odot$. X-ray Monitoring of AGNs in bright hard state should detect these QPOs.

By carrying out global 3D MHD simulations including radiative cooling, we found that a magnetically supported disk is formed when the disk shrinks in the vertical direction by the cooling instability. Such an instability takes place at the beginning of the hard-to-soft transition. When the magnetic energy stored in the disk is released, relativistic outflows will be launched. Such ejections are observed in a galactic microquasar GRS1915 105. In AGNs with black hole mass $10^7 - 10^8 M_\odot$, MAXI covers the time scale of the cooling instability ($10^7 - 10^8$ sec) in black hole accretion disks.

MAXI Mission Overview and Schedule

Ueno S.¹, and the MAXI team

¹JAXA/TKSC, Tsukuba, Ibaraki, Japan

Monitor of All-sky X-ray Image (MAXI) is an X-ray all-sky monitor, covering photon energy of 2 to 30 keV using position sensitive proportional counters in Gas Slit Camera (GSC), and also covering 0.5 to 15 keV using cooled X-ray CCD chips in Solid-state Slit Camera (SSC). MAXI will be delivered to the International Space Station (ISS) by the Space Shuttle flight planned for April of 2009. MAXI scans almost the whole sky once every orbit (or every ninety minutes) for mission life of two to five years. GSC and SSC have long and narrow fields of view with 1-dimensional imaging capability. While MAXI completes each orbit around the Earth, it produces a 2-dimensional X-ray color image of all sky with a typical point spread function of 1.5 degrees at FWHM. Attitude data from MAXI's Visual Star Camera (VSC) and Ring Laser Gyro (RLG) enable us to determine X-ray source positions as accurately as 0.1 degree or better. For GSC, we estimate $5\text{-}\sigma$ detection limits to be 5 mCrab (for 1-day MAXI operation), 2 mCrab (1 week), 1 mCrab (1 month), and the source confusion limit of 0.2 mCrab (2 years). MAXI will scan the X-ray sky continuously except for interruptions caused by intense solar X-rays, South Atlantic Anomaly backgrounds, and the interference of ISS solar paddles. On detection of significant changes of X-ray flux, the MAXI ground system will transmit their sky position, time, and flux information (or X-ray nova alerts) to registered users through the Internet. X-ray photon event data are archived in the MAXI database. Public users can access the database through a web interface to receive processed products: spectra, light curves, and images for pre-selected X-ray sources or any sky regions specified by the users.

The X-ray cameras of MAXI mission : Gas Slit Camera (GSC) and
Solid-state Slit Camera (SSC)

Tomida H.¹, Matsuoka M.¹, Kawasaki K.¹, Ueno S.¹, Adachi Y.¹, Suzuki M.¹,
Ishikawa M.¹, Katayama H.¹, Kohama M.^{1,2}, Mihara T.², Isobe N.², Sugizaki
M.², Tsunemi H.³, Miyata E.³, Kawai N.⁴, Kataoka J.⁴, Yoshida A.⁵, Yamaoka
K.⁵, Negoro H.⁶, Nakajima M.⁶, Morii M.⁷

¹JAXA/TKSC, Tsukuba, Ibaraki, Japan

²RIKEN, Wako, Saitama, Japan

³Osaka University, Toyonaka, Osaka, Japan

⁴Tokyo Institute of Technology, Meguro, Tokyo, Japan

⁵Aoyama Gakuin University, Sagamihara, Kanagawa, Japan

⁶Nihon University, Chiyada, Tokyo, Japan

⁷Rikkyo University, Toshima, Tokyo, Japan

We report on the two types of X-ray camera onboard MAXI. The cameras are GSC (Gas Slit Camera) and SSC (Solid State-slit camera). The GSC utilizes large area one-dimensional proportional counter, which has Xenon(99%) and CO₂(1%) gas, and 6 carbon wires of 10 μm diameter as anode. The total X-ray detection area is 5350 cm², and the energy range is 2~30 keV. The high sensitivity as an all-sky monitor enables us to detect 1mCrab sources in one month observation. SSC is CCD camera. SSC consists of 32 CCD chips fabricated by Hamamatsu Photonics. The size of CCD is 25 \times 25mm, and the pixel number is 1024 \times 1024. The thickness of depletion layer is \sim 70 μm . The detection energy range is 0.5~12 keV. We use the CCD as one dimensional position detector. CCDs are cooled by Peltier cooler and the camera body is also cooled by utilizing passive radiator and heat pipe. The operation temperature of CCD is less than -60°C . The energy resolution of CCD 150eV in average at -60°C . We can determine the position of bright sources in the accuracy of 0.1 $^{\circ}$ by GSC and SSC. These slit-cameras enable us to detect diffuse X-ray sources.

Response Functions of X-ray Slit Cameras onboard MAXI and Simulator

Mutsumi Sugizaki on behalf of MAXI Software Team

RIKEN, Wako, Saitama, Japan

MAXI carries two kinds of X-ray cameras: GSC (Gas Slit Camera) and SSC (Solid-state Slit Camera). Both X-ray cameras are scanning imagers combining position-sensitive detectors and slit collimators. They covers the whole sky every 90 minutes of the ISS (International Space Station) orbital period. The response functions of these cameras for any celestial X-ray sources depends on the ISS attitude, which always changes according to the ISS motion. We are developing a MAXI observation simulator in ISS orbit and a software to build response functions for a target at a given sky position from the instrument calibration data and the ISS attitude data. We describe the schemes of the simulator and the standard analysis of MAXI data using the response functions.

MAXI nova alert system and black hole transients**Negoro, H.¹, Saito, H.^{1,2}, Miyoshi, S.¹, and MAXI team.**¹ Nihon University, Chiyoda, Tokyo, Japan² present address: Toshiba Medical Systems Corp.

Black hole transients such as X-ray novae have provided us new insight into the black-hole accretion disks. GS 1124-684 discovered with *Ginga* ASM, showed various short-term temporal and spectral variations, which were really useful for understanding state transitions of the accretion disk. A superluminal jet source GRS 1915 105 and high frequency QPO sources, for instance, XTE J1550-564 and GRO J1655-40 are also black hole transients relatively recently discovered. The discovery of such transient objects is one of the top priorities for the MAXI mission. We have developed a nova search system which find transient objects as fast as possible and send an alert to all over the world with GCN (Gamma-ray bursts Coordinates Network) for GRBs and/or E-mail. I will talk about the present status of the development of the nova search system, and show some capabilities of the system to find not only black hole transients but also GRBs.

Science of compact X- and gamma-ray sources: MAXI and GLAST**Thompson, D. J.¹**¹NASA Goddard Space Flight Center, Greenbelt, MD 20771 USA

MAXI and GLAST will be surveying the sky simultaneously. Compact objects that may show variability will be excellent targets for coordinated multiwavelength studies. Gamma-ray bursts (and afterglows), pulsars, high-mass X-ray binaries, microquasars, and active galactic nuclei are all objects whose X- and gamma-ray relationship can be explored by such observations. Of particular interest will be variable unidentified gamma-ray sources, whose contemporaneous observations by MAXI may prove decisive in identifying the source of the high-energy emission.

Relativistic jets from X-ray binaries

Fender R.¹

¹ University of Southampton, UK

In this talk I will review the latest observations of black hole X-ray binaries, focussing on the relation between accretion 'state' as observed in the X-ray band, and jet-like outflows, as observed in the radio, and sometimes infrared, bands. In particular I will discuss the relation between X-ray state changes, as observed in both X-ray energy spectra and power spectra, and major relativistic ejection events. Finally I will discuss how the observed disc-jet coupling relates to that observed in AGN, as well as in neutron star and white dwarf systems.

Galactic Transient Sources with MAXI**Ken EBISAWA**

JAXA/ISAS, Sagamihara, Kanagawa, Japan

Since the beginning of X-ray astronomy, Galactic transient sources have been in the central arena of the interests. All sky X-ray monitors on-board various spacecrafts have played a critical role to understand characteristics of such binary transient sources. However, our current understanding is limited by rather moderate sensitivity of the conventional all-sky detectors, so that transient behaviors under lower activities (< 10 mCrab) are hardly known. Now, MAXI is for the first time able to study daily transient phenomena of the binary sources at such low activities. This will enhance our understanding of X-ray binary sources at low mass accretion rates. Also, MAXI will help us better understand spectral variations of bright X-ray binaries in moderate time-scales between hours to days thanks to frequent monitoring.

Discovering and monitoring sub-luminous X-ray binaries using MAXI**Wijnands, R.¹**

¹ Astronomical Institute 'Anton Pannekoek', University of Amsterdam, Kruislaan 403, Amsterdam, The Netherlands

Most studies of accreting neutron stars and black holes in X-ray binaries focus on those systems which are accreting at relatively high mass accretion rates and therefore have high associated X-ray luminosities ($> 10^{36}$ erg s⁻¹). Although the existence of very faint, sub-luminous systems is well known, the study of these systems is inhibited by the difficulties in finding them (both the persistent as well as the transient systems) in large numbers using currently available all-sky monitoring instruments. These systems are usually found serendipitously in pointed observations with small field-of-view instruments which have the needed sensitivity to detect them. I will briefly review our current knowledge and understanding about these enigmatically faint systems and how they can be used to probe the extreme physical processes associated with accreting neutron stars and black holes in ways which cannot be done for their brighter cousins. I will also discuss the problems in finding these systems and how MAXI will significantly improve on this situation. The 1 mCrab sensitivity of MAXI within a week (about 10^{35} erg s⁻¹ at a distance of 8 kpc) will be extremely useful in finding and monitoring these sub-luminous X-ray binaries.

Active flaring states of GRS 1915105 and Cyg X-3 in radio/X-ray monitoring**Trushkin S.A.¹ and Nizhelskij N.A.¹, Kotani T.² and Kawai N.², Tsuboi M.³, Namiki M.⁴**¹ Special astrophysical Observatory RAS, Nizhnij Arkhyz, Russia² Tokyo Institute of Technology, O-okayama, Tokyo, Japan³ ISAS/JAEA , Sagamihara, Kanagawa, Japan⁴ Osaka University, Toyonaka, Osaka, Japan

In multi-wavelength collaboration we studied the variability of the microquasars GRS1915105 and CygX-3 during 2005 to May 2008 with the RATAN-600 radio telescope of SAO RAS.

We detected clear correlation of the flaring radio fluxes and X-rays 'spikes' at 2-12 keV emission detected in RXTE ASM from GRS1915105 during eight relatively bright (200-600 mJy) radio flares in October 2005. Spectra of these flares in maximum were optically thick at frequencies lower 2.3 GHz and optically thin at the higher frequencies. During the radio flares the spectra of the X-ray spikes become softer than those of the quiescent phase. Thus these data indicated the transitions from very high/hard states to high/soft ones during which massive ejections are probably happened. These ejections are detected as radio flares. Such X-ray/radio events correlation detected later in 2006-2008.

After of the 4-year quiescent radio state (100-200 mJy) in December 2005 Cyg X-3 entered in the softer X-ray state with low level of hard (15-50 keV) X-rays and high (~ 0.5 crab) in the soft band (1-10keV). Then during 500 days we have detected more 10 bright (> 1 Jy) flaring events correlated with rising phases of ASM-Swift-BAT intensity of Cyg X-3. A first 1Jy-flare was detected on 3 February 2006 after 18 days of the quenched radio emission (< 20 mJy). The daily spectra of the flare in the maximum were flat from 1 to 100 GHz, using the quasi-simultaneous observations at 109 GHz with RT45m telescope and millimeter array (NMA) of Nobeyama Radio Observatory.

MAXI data distribution and the archive system

Kohama M.^{1,2}, Mihara T.¹, Sugizaki M.¹, Negoro H.³, Nakajima M.³, Eguchi S.⁴, Tomida H.², Ueno S.², Suzuki M.², Kawasaki K.², Matsuoka M.², Ishikawa M.², Adachi Y.², Kawai N.⁵, Yoshida A.⁶, Miyata E.⁷, Tsunemi H.⁷, Ueda Y.⁴ and MAXI team

¹RIKEN, Wako, Saitama, Japan

²JAXA(TKSC), Tsukuba, Ibaraki, Japan

³Nihon Univ., Chiyoda-Ku, Tokyo Japan

⁴Kyoto Univ., Sakyo, Kyoto, Japan

⁵Tokyo Tech, Meguro, Tokyo, Japan

⁶Aoyama Gakuin Univ., Sagami-hara, Kanagawa, Japan

⁷Osaka Univ., Toyonaka, Osaka, Japan

MAXI is designed for monitoring all-sky in the X-ray band by scanning with slit collimators and slit apertures. The sensitivity of MAXI will reach into about 5m crab with 1 day survey, 1 m crab with 1 month observation. We plan to make most of the MAXI data products public in a timely manner. MAXI data will be distributed by the Web Interface (from RIKEN site, URL is <http://www.maxi.riken.jp>). MAXI will provide about 1000 catalogued objects every day (e.g. light curves, spectra, images). We will start the data distribution from about 3 month after the launch. In this paper, we will talk about the data distribution system and we will explain the policy of the data distribution and the instruction of Web Interface.

All-Sky Observations with BATSE and GBM: X-ray Sources and GRB

Colleen A. Wilson-Hodge

NASA/MSFC

I will review highlights of observations with the Burst and Transient Source Experiment (BATSE) and planned observations with the GLAST Burst Monitor (GBM). BATSE flew on-board the Compton Gamma Ray Observatory (CGRO) from 1991-2000. BATSE is probably best known for its observations of 2704 gamma ray bursts. However, BATSE also was used as an all-sky monitor, using Earth occultation measurements to monitor a catalog of almost 200 sources.

Further, BATSE was used as an X-ray timing mission, monitoring long-term pulse frequency and pulsed flux variations in accretion powered pulsars. The Gamma Ray Large Area Space Telescope (GLAST) on which GBM is the secondary instrument, is currently scheduled for launch on June 3, 2008.

The primary scientific objective of GBM is to observe gamma ray bursts and extend observed spectra from the Large Area Telescope (LAT) down to the better studied BATSE energy range and to provide real-time burst locations sufficient to repoint the GLAST spacecraft. Guest investigations are planned to use GBM as an all-sky monitor using Earth occultation and to use it as a timing experiment to measure pulse frequencies and pulsed flux for accreting pulsars. I will discuss GBM's capabilities compared to BATSE and plans for the mission.

GRB Catalog : Bursts from Vela to Swift

Lorella Angelini¹

¹ GSFC/NASA , Code 661, Greenbelt 20771, MD USA

Gamma ray burst (GRB) astronomy started when the first event was recorded on July 2, 1967, by Vela 4a and 4b (see figure on the left). Since then many missions have flown experiments capable of detecting GRBs. The events collected by these older experiments are mostly available in paper copy, each containing a few ten to a few hundreds bursts. No systematic effort in cataloging of these bursts has been available. In some cases the information is unpublished and in others difficult to retrieve. The first major GRB catalog was obtained by GRO with the BATSE experiment. It contains more than 2000 bursts and includes homogeneous information for each of the burst. With the launch of Swift, the first Gamma X-ray mission dedicated to the study of the GRBs and their afterglows, a wealthy of information is collecting by the Swift instruments as well as from ground based telescopes. This talked will describe the effort to create a comprehensive GRBCAT, its current status and future prospects.

X-ray flashes

Luigi Piro

Istituto Astrofisica Spaziale Fisica Cosmica, Roma, INAF

After their discovery with BeppoSAX and vigorous follow up programs with HETE2 and, more recently, with SWIFT, X-ray flashes are still puzzling phenomena. They are a very numerous class of soft GRB, making up about 40% of the total population. In this talk I will review the status of observations and discuss about different scenarios proposed to explain their origin. These include the off-axis jet scenario or sub-energetic GRBs. With its soft X-ray response and wide sky capability, we expect that MAXI will provide important observations to improve our understanding on these elusive phenomena

Recent results of GRB X-ray afterglows

David N. Burrows¹

¹ Dept. of Astronomy & Astrophysics, Penn State University, University Park, PA 16802 USA

I will review recent results on GRB X-ray afterglows measured by the Swift X-ray Telescope (XRT). The XRT has observed over 280 X-ray afterglows of GRBs, obtaining > 80% of the world total of X-ray afterglows and > 70% of the world total of GRBs with redshifts. I will discuss general characteristics of X-ray afterglows as observed by Swift, and will then focus on a few of our most interesting discoveries. One of the most exciting of these was the “naked-eye” burst, GRB 080319B, with the brightest optical counterpart ever seen and one of the best-observed X-ray and optical light curves ever obtained.

Suzaku Wide-band All-sky Monitor (WAM) Observations of High Energy Transients

K.Yamaoka¹, Y.E.Nakagawa¹, S.Sugita¹, M.Tashiro², Y.Terada², Y.Urata², K.Onda², A.Endo², N.Kodata², K.Morigami², Y.Fukazawa³, T.Takahashi³, T.Uehara³, C.Kira³, Y.Hanabata³, K.Makishima⁴, K.Nakazawa⁴, R.Miyawaki⁴, T.Enoto⁴, T.Takahashi⁵, M.Kokubun⁵, M.Ohno⁵, M.Suzuki⁶, S.Hong⁷, T.Tamagawa⁸, M.Yamauchi⁹, E.Sonoda⁹, R.Hara⁹, Y.Tanaka⁹, T.Murakami¹⁰, H.Tajima¹¹

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The wide-band all-sky monitor (WAM) is the secondary function of large BGO shields of the Hard X-ray Detector (HXD) onboard the Suzaku mission. Owing to its large geometrical area of 800 cm² per side and wide field of view, the WAM is very powerful to study soft gamma-ray transients in the energy range of 50–5000 keV. The main scientific objectives are gamma-ray bursts (GRB), soft gamma-ray repeaters (SGR), solar flares, and black-hole binaries. 317 GRBs, 68 SGRs, and 166 solar flares confirmed by other satellites were detected during the first two-years operation (August 2005 to October 2007). The GRB detection rate is more than 140 per year, which shows one of the highest in current GRB missions. High quality spectra and light curves can be obtained for bright GRBs, which enable us to investigate the time variability and the time resolved spectroscopy even for the short duration GRBs. Furthermore, the WAM detected a large flare from the black-hole binary Cygnus X-1 corresponding to TeV gamma-ray detections with MAGIC telescope on September 2006. In this paper, we will review the results obtained from the WAM, and report on the current status of the WAM observations of these high energy transients.

GRB observations with MAXI

Suzuki, M.¹, and MAXI team

¹JAXA/TKSC, Tsukuba, Ibaraki, Japan

MAXI has an ability to distribute gamma-ray burst (GRB) alert promptly. For the prompt emissions, bursts in the MAXI field of view ($1.5\text{deg} \times 160\text{deg} \times 2\text{ways}$) will be observed. Based on latest results of observations, we simulate various bursts including short GRBs and X-ray flashes. From the results of simulations we estimate sensitivity to these bursts. X-ray afterglows of GRBs are also detectable with MAXI. The positions of the bursts (excluding bursts with the distance to the sun < 30) will be scanned by MAXI within about 70 minutes of the prompt emissions. GRB prompt emissions and X-ray afterglows will be searched by MAXI Nova Search system placed at Tsukuba Space Center. When Nova Search system finds the bursts, the results will be distributed to the world through the MAXI mailing list and Gamma-ray Burst Coordination Network.

The summary of 1) the number of observable bursts and X-ray afterglows, 2) the availability and the number of MAXI alert on bursts, and 3) quality of spectra of MAXI bursts will be presented at the oral session. Details will be described in a poster.

The challenge of identifying Galactic TeV sources

Olaf Reimer

W.W.Hansen Experimental Physics Lab & Kavli Institute for Particle Astrophysics and Cosmology,
Stanford University, CA 94305, USA

With VHE gamma-ray observations made during the H.E.S.S. Galactic Plane Survey, revealing for the first time the existence of dozens of extreme particle accelerators in our Galaxy, source identification became a crucial aspect in high-energy gamma-ray astronomy at TeV wavelengths. Whereas the general problem resembles that of the unidentified EGRET sources, a low-threshold imaging Cherenkov telescope array's superior angular resolution and resulting morphological imaging capabilities against a drastically reduced diffuse component enables different identification techniques. Given that IC photons at TeV energies originate from seed photons at keV energies, the wide field X-ray imaging capabilities and high duty cycle of the MAXI mission will provide the needed X-ray observations to effectively establish counterparts of VHE gamma-ray sources, and will ultimately help to characterize the underlying particle population of these extreme Galactic gamma-ray emitters.

Target of Opportunity Observations with the MAGIC telescope

E.J. Lindfors, D. Mazin and A. Stamerra on behalf of the MAGIC Collaboration

Tuorla Observatory, University of Turku, FIN-21500 Piikkiö, Finland

MAGIC is the largest Imaging Air Cherenkov Telescope (IACT) in the world. Due to its large collection area and uniquely designed camera MAGIC has reached a lower energy threshold for cosmic gamma-ray emission than any existing terrestrial gamma-ray telescope. The MAGIC collaboration has been performing Target of Opportunity (ToO) observations whenever alerted that known or potential very high energy gamma-ray emitting extragalactic sources were in a high flux state in the optical, X-ray band or/and in the TeV energy range. Here we discuss the MAGIC observations performed after such triggers and future prospects of ToO observations.

Multiwavelength observations of Blazars**Wagner, Stefan J.**

Landessternwarte Heidelberg

Blazars exhibit very broad spectral energy distributions, extending over up to 20 orders of magnitude in photon energy. Blazars also vary on a wide range of time scales with power density spectra that have been measured over as many as 9 orders of magnitude in time for the best studied objects. Given these characteristics, coordinated multiwavelength observations are required to understand the physical processes in Blazars. Apart from detailed studies of a very small number of prominent targets, statistical investigations of homogenous observations are important, but difficult to assemble due to technical constraints. The current status of multiwavelength investigations will be reviewed with a special emphasis on future opportunities.

X-Ray Variability of AGN**Ian McHardy**

School of Physics and Astronomy, University of Southampton, Southampton, UK

Long term X-ray monitoring observations over the last decade have revolutionised our understanding of AGN. Here I give an overview of the present observations and show how we can now understand the variability properties of black hole systems of all masses as a simple continuum, dependent only on the ratio of mass to accretion rate. However the present observations are mainly of high accretion rate AGN, ie the equivalent of X-ray binaries in the high/soft state, and there is a great need to determine how low accretion rate (low/hard state) AGN behave. Also, until recently the origin of optical variability in AGN was largely unknown. However following a number of long timescale coordinated X-ray and optical monitoring campaigns we are starting to understand what drives the optical variations and I will present some relevant observations. I will also consider the relationship between X-ray and radio variability. I will discuss how MAXI will be able to help us improve our understanding of AGN.

**Optical—Infrared Observation of Astronomical Transients with the
"KANATA" 1.5-m Telescope**

**Uemura, M.¹, Ohsugi, T.¹, Yamashita, T.¹, Kawabata, K. S.¹, Isogai, M.¹,
Arai, A.¹, Nagae, O.¹, Yamanaka, M.¹, Uehara, T.¹, Sasada, M.¹, Tanaka, H.¹,
Matsui, R.¹, Miyamoto, H.¹, Sato, S.², Kino, M.², on behalf of the KANATA
team**

¹Hiroshima University, Higashi-Hiroshima, Japan

²Nagoya University, Nagoya, Japan

Owing to the development of the Internet service, studies of astronomical transient phenomena have entered a new era, in which we can promptly receive and send the information about transients and variables. On the other hand, a sudden requirement for dense and long monitorings for them is still difficult for large telescopes. Here, we introduce our new observatory and telescope, which are developed exclusively for studies of various kinds of transients. Our 1.5-m telescope "KANATA" was installed at Higashi-Hiroshima Observatory on May 2006. Using unique instruments attached to KANATA, we can study transients in near-infrared wavelengths, with polarimetry, and with high-speed photometry. These observation modes have revealed totally new features of our targets, such as gamma-ray bursts, blazars, X-ray binaries, supernovae, novae, dwarf novae, and T Tau stars.

MAXI and GLAST studies of jets in active galaxies

G. Madejski¹

¹Stanford Linear Accelerator Center and KIPAC, Menlo Park, CA, USA

The next 12 months will bring the launch of GLAST, and anticipated deployment of the all-sky monitor MAXI, to be installed on the International Space Station. This will provide a unique opportunity for broad-band simultaneous observations of jet-dominated active galaxies known as blazars. Such simultaneous observations, when coupled with monitoring in other bands such as radio, IR and optical, are likely to answer many pressing questions regarding the radiation mechanisms, structure and content of blazar jets. This presentation will highlight anticipated results from such joint monitoring campaigns for blazars.

**A search for large amplitude X-ray variables with the XMM-Newton
Serendipitous Survey**

Yuan, W.¹

¹ Yunnan Astronomical Observatory, Chinese Academy of Sciences, PO Box 110, Kunming, Yunnan, 650011 China

I report an ongoing programme to search for X-ray sources with long-term, large amplitude X-ray variability. The method is to compare the fluxes of X-ray sources from the XMM-Newton Serendipitous Survey with those from previous ROSAT pointed observations and the ROSAT All-sky Survey. In this talk I present some of the preliminary results. The prospects of detecting some of these X-ray variables by MAXI are also discussed.

Relation between BH Mass and X-ray Variability: Expectations to the MAXI**Hayashida K.¹**¹Osaka University, Toyonaka, Osaka, Japan

Irregular X-ray variability is a common feature of black hole (BH) system from stellar mass ones to super massive ones, at least in some states. Although its origin is not clear, the variability must reflect the size and physical process near the BHs. In fact, the time scale of the X-ray variability of AGNs is much longer than that for the stellar mass BH binaries. Several attempts have been made to employ that point to estimate the BH mass, including the one we proposed. We shortly review those attempts and current status of the calibration to other BH mass estimation. We then explore our expectation to the MAXI, filling the gap in the time scale of the observations, corresponding BH mass range. We emphasize the importance of wide coverage in the time scale.

Near-Infrared Intraday Variations in AGN

Minezaki, T.¹, Yoshii, Y.^{1,2}, Kobayashi, Y.³, Enya, K.⁴, Suganuma, M.³, Tomita, H.¹, Koshida, S.⁵, Yamauchi, M.⁵ and Aoki, T.¹

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² Research Center for the Early Universe, University of Tokyo, Hongo, Tokyo, Japan

³ National Astronomical Observatory Japan, Mitaka, Tokyo, Japan

⁴ Institute of Space and Astronautical Science, JAXA, Yoshinodai, Kanagawa, Japan

⁵ Department of Astronomy, University of Tokyo, Hongo, Tokyo, Japan

We carried out a one-night optical V and near-infrared JHK monitoring observation of the least luminous Seyfert 1 galaxy, NGC 4395, on 2004 May 1, and detected intraday flux variations in the V, J and H bands. The near-infrared intraday flux variations are almost synchronized with the flux variation in the V band. It indicates that the intraday-variable component of near-infrared continuum emission of the NGC 4395 nucleus is an extension of UV-optical power-law continuum emission and originates in an outer region of the central accretion disk. In addition, possible time-lag about ~ 7 minutes between the V-band and the infrared variations is found by the cross-correlation analysis. These results can be explained by the X-ray reprocessing model that the X-ray flux variation propagates with the light velocity and drives the flux variation in optical and near-infrared wavelengths.

Hard X-ray/soft γ -ray characteristics of magnetars**Kuiper L.¹**¹SRON, Utrecht, The Netherlands

During the last \sim five years surprisingly new discoveries at soft γ -rays have been made with the INTEGRAL and RXTE observatories in the magnetar research field. In this presentation the current observational status of the persistent hard X-ray/soft γ -ray characteristics of anomalous X-ray pulsars and soft γ -ray repeaters will be reviewed. In particular, new results on AXPs 1RXS J1708-4009 and 4U 0142 61 are presented based on multi-year INTEGRAL, RXTE and XMM-Newton observations.

Suzaku observation of the AXP 1E 1841-045 and the future observation in the MAXI era**Morii M.¹**¹Rikkyo University, Nishi-ikebukuro, Tokyo, Japan

We report results of the Suzaku observation of the anomalous X-ray pulsar (AXP) 1E 1841–045 at the center of the supernova remnant Kes 73. We obtained the spectrum from 0.4 keV to ~ 70 keV simultaneously. The model consisting of a blackbody and two power-law functions could simulate the spectrum well. We also found that the power-law function at the higher energy can be replaced with a thermal bremsstrahlung. This replacement is also possible for every pulse phase. The fact that the hard X-ray emission can be interpreted as a thermal bremsstrahlung would support the theoretical emission model proposed by Thompson & Beloborodov (2005). Emission mechanism of the hard X-ray component can be understood by detecting the variability of the photon index and cutoff energy. In this reason, the MAXI monitoring of AXPs are extremely important. The monitoring of the pulse frequency and pulse profiles of AXPs are also important as well as that of the flux. Nonetheless, this is hard task for the detector team, because the pulse profiles are sensitive to the triangle response of the collimator of GSC/MAXI. We would estimate the detectability of the AXPs and their pulsation by MAXI, using the simulator of MAXI.

New Transients in the Optical and Radio Sky**S. R. Kulkarni¹**¹California Institute of Technology, Pasadena, CA 91125, USA

Explosive events have played a major role in astronomy both in elucidating astrophysical processes and in the use of transients as probes. Novae were recognized in the beginning of the previous century. Over time the distinction between novae and supernovae and the recognition of two major families of supernovae became clear. We now know that that gamma-ray bursts (discoveries in the sixties) arise from the deaths of massive stars or from coalescence of compact stars.

The speaker will review our current state of catastrophic cosmic explosions. In the radio a number of events with luminosity between novae and supernovae have now been seen. At radio wavelengths, millisecond bursts of arguably extragalactic origin and mysterious slow transients have been uncovered. These discoveries auger well for the future. Synoptic optical (e.g. PanSTARRS, SkyMapper and Palomar Transient Factory) and radio (EVLA, SKA pathfinders) telescopes will likely discover entirely new classes of explosions. The speaker will summarize the phase space opened up by these projects and end with some speculation of future discoveries.

The Hard X-ray sources observed by INTEGRAL/IBIS and their science**P. Ubertini et al. on behalf of the IBIS survey team**

IASF-Rome/INAF, Italy

Following more than 5 years of successful operations, INTEGRAL has significantly changed our vision of the Universe through its observations of the gamma-ray sky. The telescopes aboard the satellite have revealed hundreds of sources of different types and new classes of objects. INTEGRAL is providing surveys of the hard X-ray and soft gamma-ray sky (18 keV-1 MeV), with a census of the source populations and first-ever all sky maps in this so far unexplored energy range. The talk will focus on the new vision of the high energy sky as painted by INTEGRAL observatory. In particular the talk will outline the main INTEGRAL instruments characteristics and report on the main results of the 3rd survey, with particular light on Supergiant High Mass X-ray Binaries (SGXBs), Active Galactic Nuclei (AGN), Pulsar Wind Nebulae and Very High Energy (VHE) TeV sources.

Non-GRB X-ray and Hard X-ray Sources Observed with Swift**Neil Gehrels**

NASA/GSFC

The Swift mission was designed for rapid observations of GRBs and other transients. It is made up of the BAT wide-field hard X-ray instrument and the XRT and UVOT focusing narrow-field X-ray and UV-optical telescopes. A large amount of data is obtained on non-GRB sources by XRT and UVOT both during GRB pointings and during times when no afterglows are visible. The BAT is continuously observing the hard X-ray sky performing a sensitive survey in the 15 - 350 keV range. It is nearly uniform across the sky and is not effected by absorption for Compton-thin sources. At a sensitivity of 10^{-11} ergs $\text{cm}^{-2} \text{s}^{-1}$, it is has detected 450 AGN in 36 months. The XRT performs moderately deep observations in the 0.2 - 10 keV range of select source fields during GRB and non-GRB pointings. Sensitivities achieved are in the 10^{-15} to 10^{-14} erg cm^{-2} range. There are also valuable data from Target of Opportunity observations of transients. To date more that 500 such TOOs have been performed. This talk will summarize the non-GRB X-ray and hard X-ray observations of Swift.

The 2XMM catalogue and variability of X-ray sources**Sakano M.¹, Fyfe D.¹, Mateos S.¹, Osborne J.¹, Page C.¹, Pye J.¹, Schröder A.¹, Stewart I.², Tedds J.¹, Watson M.G.¹**¹Univ. Leicester, Leicester, UK²Jodrell Bank Observatory, Manchester, UK

We have released the 2XMM catalogue, the largest ever X-ray source catalogue. It contains $\approx 247,000$ detections drawn from 3491 public XMM-*Newton* observations, which relate to $\approx 192,000$ unique sources. The time variability, as well as spectrum, has been studied for the sources that have reasonable statistics, numbering 38,320 detections. Among those, we have found 2307 detections are considered variable at a probability of 10^{-5} , based on the null-hypothesis that the source is constant. Here we present the highlight of the 2XMM catalogue, and discuss the potential future study with the X-ray monitoring instrument, MAXI.

Extragalactic Survey with MAXI**Yoshihiro Ueda¹ and the MAXI team**¹Department of Astronomy, Kyoto University, Kyoto 606-8502, Japan

We summarize the prospects for extragalactic survey with the MAXI mission. By integrating all the data taken over 2 years, we estimate that about 1,300 Active Galactic Nuclei (AGNs) will be detected in the 3–20 keV band with the GSC detector from extragalactic sky at Galactic latitudes higher than 15° . The MAXI survey will achieve the best sensitivity for populations of moderately absorbed AGNs among any all sky X-ray missions, and is complementary to ROSAT all sky survey and hard X-ray (>10 keV) surveys by the Swift and INTEGRAL satellites. Many “transient” AGNs will be newly detected with MAXI. In this paper, we discuss the scientific significance of the MAXI survey for AGN evolution and physics of accretion onto black holes.

Diffuse soft X-ray sky

McCammon, D.

University of Wisconsin,

Forty years after its discovery, we still have a very incomplete understanding of the diffuse X-ray background at energies less than about 1 keV. I will give a brief review of the current status, open questions, and possibilities for progress.

Diffuse Source Mapping with MAXI**Emi Miyata¹**¹Osaka University, Japan

The X-ray CCD camera onboard MAXI, SSC, has a unique capability to map the all sky with emission lines of heavy elements from oxygen to iron. Large $S \times \Omega$ ($44 \text{ cm}^2 \text{ deg}^2$ for oxygen and $390 \text{ cm}^2 \text{ deg}^2$ for iron) together with the good energy resolving power (12% at oxygen and 2% at iron) enables us to investigate the origins of the soft X-ray background, the galactic X-ray ridge emission, the large-scale structure such as north polar spur and so on.

NeXT Mission

Tadayuki Takahashi

Institute of Space and Astronautical Science (ISAS/JAXA), Sagamihara, Kanagawa, Japan

The NeXT (New exploration X-ray Telescope) mission has been studied as the next key X-ray astronomy mission of Japan, which will be developed under international collaboration. NeXT is now in phase A and the planned launch year is 2013. NeXT has two major mission goals, one is to study the high-energy non-thermal universe by utilizing the technology of focusing optics above 10 keV and the second is to recover the science which should have been achieved by the XRS of Suzaku. The design of the NeXT satellite is optimized to satisfy the science requirements we defined: namely, to achieve two orders of magnitudes of improvement in the energy range from 10 keV up to 80 keV, to give high resolution spectroscopy with an energy resolution better than 7 eV at iron, together with the capability to measure broad-band spectra from 0.5 keV up to 600 keV. NeXT will carry two hard X-ray telescopes (HXTs) for the hard X-ray imager (HXI), and two soft X-ray telescopes (SXT), one with a micro-calorimeter spectrometer array (SXS) with excellent energy resolution of ~ 7 eV, and the other with a CCD. In order to extend the energy coverage up to 600 keV, a Si/CdTe Compton Telescope as a soft γ -ray detector (SGD) will also be carried. In this presentation, the mission concept and expected performance will be summarized.

ASTROSAT observations of variable X-ray sources: together with MAXI**B. Paul**

Raman Research Institute, Bangalore 566080, India

ASTROSAT is an astronomy satellite proposed to be launched in 2009. It is designed for simultaneous multi-wavelength studies with five payloads in the optical/UV and a broad X-ray energy range. One of the instruments, a set of three large area xenon proportional counters (LAXPC) will enable high time resolution X-ray measurements in the 2-80 keV band with moderate energy resolution. There are two imaging X-ray spectrometers, one in the soft and one in the hard X-ray band. Two telescopes will provide multi-band imaging in three optical/UV channels. An X-ray sky monitor onboard ASTROSAT, that is similar in concept to the RXTE ASM will be used to study long term intensity variations of bright X-ray sources. This instrument will also facilitate X-ray observations with the LAXPC and other payloads. We will give a brief summary of the design and characteristics of the scientific payloads, their expected sensitivities and present status of ASTROSAT. We will also discuss some of the science topics related to variable and transient X-ray sources that can be suitably addressed together with ASTORSAT and MAXI.

O-41

Introduction to the Hard X-ray modulation Telescope (HXMT)

Shu Zhang

Institute of High Energy Physics

We present a brief introduction to the development of the HXMT on its configuration, scientific targets and current status. This talk is aimed at making a sufficiently prospective context of the hard X-ray domain, in the observational point of view, before the era of MAXI.

Concluding Remarks

Nobuyuki Kawai

Tokyo Tech, Meguro-ku, Tokyo, Japan
and RIKEN, Wako, Saitama, Japan

I plan to give a brief overview of the papers presented in this workshop highlighting the science topics and data products most expected for MAXI. I then will try to itemize the activities that the MAXI team should perform to maximize the scientific outputs and enhance the collaboration with the rest of the community.

POSTER PAPERS

MAXI Simulator: A Framework of Satellite Simulators

Eguchi Satoshi¹, Kazuo Hiroi¹, Yoshihiro Ueda¹, Mutsumi Sugizaki², Hiroshi Tomida³, Motoko Suzuki³, and the MAXI team

¹Kyoto University, Kyoto, Japan

²Riken, Wako, Saitama, Japan

³JAXA/TKSC, Tsukuba, Ibaraki, Japan

We are developing the MAXI simulator, a software program that produces fully simulated data of the MAXI instruments in space. The MAXI simulator is utilized for the development and tests of various software supporting the MAXI mission, including the “nova search” program (Negoro et al., this conference). To generate realistic data, the simulator can take into account detailed conditions on the ISS, such as the occultation of the sky by the sun panel, the particle background, and the response function of the instruments. We code the program in C by introducing “classes” that have hierarchical and expandable structure. With this design, it provides a framework for general satellite simulators. In this poster, we present the design and current performance of the MAXI simulator, and discuss the possibility of its application to other space missions.

On-board and Ground Data processing System of MAXI

Masaki Ishikawa¹, Daiki Takahashi¹, Masaru Matsuoka¹, Shiro Ueno¹, Hiroshi Tomida¹, Haruyoshi Katayama¹, Kazuyoshi Kawasaki¹, Mitsuhiko Kohama¹, Motoko Suzuki¹, Yasuki Adachi¹, Tatehiro Mihara², Naoki Isobe², Hiroshi Tsunemi³, Emi Miyata³, Atsumasa Yoshida⁴, Kazutaka Yamaoka⁴, Nobuyuki Kawai⁵, Jun Kataoka⁵, Motoki Nakajima⁶, Hiroshi Negoro⁶ and Mikio Morii⁷

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MAXI (Monitor of All sky X-ray Image) is the first X-ray observation payload to be installed to EF (Exposed Facility) of Kibo (JEM: Japanese Experiment Module) on ISS (International Space Station). The communication system of MAXI has the characteristic feature which is different from ordinary payloads on free flyers (satellites), because it is one of the payloads of ISS. Since JEM and ISS provide their resources to keep the function of each payload, almost volume of MAXI can be used for the observation, data processing and supporting systems. All payload data are sent to the ground system of each payload team through the data transmission system of JEM and ISS. The ground system of MAXI is built by MAXI project team. To satisfy the requirement of JAXA security rule, MAXI ground system has special structure. We describes the process for the data transmission in each stage such as MAXI, the ISS communication links to connect between onboard and ground, and MAXI ground system.

MAXI Data processing at MAXI ground system

Masaki Ishikawa¹, Yasuki Adachi¹, Daiki Takahashi¹, Masaru Matsuoka¹, Shiro Ueno¹, Hiroshi Tomida¹, Haruyoshi Katayama¹, Kazuyoshi Kawasaki¹, Mitsuhiro Kohama¹, Motoko Suzuki¹, Tatehiro Mihara², Naoki Isobe², Hiroshi Tsunemi³, Emi Miyata³, Atsumasa Yoshida⁴, Kazutaka Yamaoka⁴, Nobuyuki Kawai⁵, Jun Kataoka⁵, Motoki Nakajima⁶, Hiroshi Negoro⁶ and Mikio Morii⁷

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⁵Department of Physics, Tokyo Institute of Technology,

⁶Department of Physics, Nihon University,

⁷ Research Center for Measurement in Advanced Science, Rikkyo University

MAXI (Monitor of All sky X-ray Image) is the first X-ray observation payload to be installed to EF (Exposed Facility) of Kibo (JEM: Japanese Experiment Module) on ISS (International Space Station). MAXI data are sent to MAXI ground system in TKSC (TsuKuba Space Center). MAXI ground system at TKSC sends the sorted data to RIKEN. MAXI ground system at RIKEN provides the data of X-ray sources from the result of detail analysis to astronomical community on their home page. We describe MAXI ground system in TKSC, and the system in RIKEN will be introduced, being reported by Kohama et al, in this conference. MAXI ground system in TKSC receives and stores data from MAXI. This system also sends a quasi-real time if for X-ray transient information obtained. Another important role of this system plays to plan MAXI operation and produce commands for operation by analyzing the data. We describe the function of each software of MAXI ground system which provide these functions.

Overview of JEM-EF on ISS

Kazuyoshi Kawasaki¹

¹JAXA/TKSC, Tsukuba, Ibaraki, Japan

Kibo Exposed Facility (JEM-EF) is a multipurpose experiment space where various activities such as scientific experiments, Earth observation, engineering experiments. Those can be conducted by utilizing environment which is exposed to space characterized with microgravity, high level vacuum and vast area. MAXI will be attached to the JEM-EF ram side port (EFU#1). On ISS, JEM-EF, the Truss sites are the main facilities that allow experiments those being exposed to space environment, which many researchers are interested in.

The JEM-EF with its size of 6m × 5m × 4m (20ft × 16.7ft × 13.3ft) weighs approximately 4000kg (8890lb) at time of launch. Experiment payloads of EF can be exchanged. EF will be operated for ten years on orbit supporting exposed experiments. It will supply electric power, circulates coolant for cooling the experiment devices or collects experiment data. Standard payload envelope is assumed to be of 1.85m × 1.0m × 0.8m (6.2ft × 3.3ft × 2.7ft) and weighs 500kg (1110lb). In this poster, further detail of the JEM-EF will be presented.

MAXI data distribution system

Kohama M.^{1,2}, Mihara T.¹, Sugizaki M.¹, Negoro H.³, Nakajima M.³, Eguchi S.⁴, Tomida H.², Ueno S.², Suzuki M.², Kawasaki K.², Matsuoka M.², Ishikawa M.², Adachi Y.², Kawai N.⁵, Yoshida A.⁶, Miyata E.⁷, Tsunemi H.⁷, Ueda Y.⁴ and MAXI team

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MAXI is designed for monitoring all-sky in the X-ray band by scanning with slit collimators and slit apertures. The sensitivity of MAXI will reach into about 5m crab with 1 day servay, 1 m crab with 1 month observation. We plan to make most of the MAXI data products public in a timely manner. MAXI data will be distributed by the Web Interface (from RIKEN site, URL is <http://www.maxi.riken.jp>). MAXI will provide about 1000 catalogued objects every day (e.g. light curves, spectra, images). We will start the data distribution from about 3 month after the lunch. In this paper, we will talk about the data distribuion system and we will explain the policy of the data distrbution and the instruction of Web Interface.

The Gas slit camera, GSC, onboard MAXI**Tatehiro Mihara¹ and the MAXI GSC team**¹RIKEN, Wako, Saitama, Japan

The Gas Slit Camera (GSC) consists of 12 cameras. Each camera utilizes slat collimator, a slit and a proportional counter. The slat collimator limits the FOV into an arc of 1.5×80 degrees. The slit makes one-dimensional image on the proportional counter within the FOV. The one-dimensional position-sensitive proportional counter is filled with Xe gas, and thin ($10 \mu\text{m}$ in diameter) carbon fibers are used as the resistive anodes, which enables position resolution of 1 mm. Six anode cells are surrounded by the veto layers, which achieves a low background rate by anti-coincidence. Six cameras are set to cover an arc of 1.5×160 degrees of forward direction, and other six cameras are set to zenith direction. The total area of the twelve proportional counters are 5350 cm^2 . The energy range is 2–30 keV. The sensitivity of one scan is 7 mCrab (5σ), which reaches 1 mCrab when the data is accumulated in one week.

Solite-state slit camera, SSC, onboard MAXI

Emi Miyata¹ and the MAXI SSC team

¹Osaka University, Japan

MAXI carries two solid-state slit cameras (SSCs). Each SSC carries 16 X-ray charge-coupled-devices (CCDs), each of which has $2.4 \times 2.4 \text{ cm}^2$, resulting in the total area of 200 cm^2 . The field of view is $1.5^\circ \times 85^\circ$ and energy range is 0.5–15 keV. The nominal operating temperature is -60°C which can be achieved by the passive cooling system (radiator panel with loop heat pipe) together with the active cooling system (peltier cooler directly attached to each CCD).

MAXI alert system

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MAXI always monitors a part of the X-ray sky, and downloads the data through the ISS network. It takes about 5 seconds to send the data from MAXI to the UOA (User Operations Area) in Tsukuba, where the telemetry data are processed to find transient objects, such as X/ γ -ray bursts, flares and novae. Performing the data processing and the timing analysis every second enables us to find a burst or flare in several seconds after MAXI detects X-rays on the ISS. We are planning to provide alert information of such a transient object to the world through 1) GCN (Gamma-ray bursts Coordinates Network) for GRBs or very short-term events, 2) E-mail for X-ray novae, for instance, and 3) web (see Kohama et al. in this volume).

**Response Builder of MAXI X-ray Cameras for Analyses of Spatially
Complex Source Region**

Mutsumi Sugizaki on behalf of MAXI Software Team

RIKEN, Wako, Saitama, Japan

X-ray cameras on-board MAXI, GSC (Gas Slit Camera) and SSC (Solid-state Slit Camera), are scanning imagers combining position-sensitive detectors and slit collimators. The PSFs (Point-Spread Functions) of these cameras are roughly approximated by a triangular peak with a FWHM of about 2 degrees. However, the details are fairly complicated. The precise response function depends on the off-axis angle from the detector normal direction and the scanning direction due to the rotation of the ISS (International Space Station). We are developing a software to calculate the response function for a source at a given sky position from the instrument calibration data and the ISS attitude data. We show PSF samples obtained by the developing response builder. We then apply the PSFs to analysis of simulated images for spatially complex source region and estimate the feasibility.

GRB observations with MAXI

Suzuki, M.¹, and MAXI team

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MAXI has an ability to distribute gamma-ray burst (GRB) alert promptly. For the prompt emissions, bursts in the MAXI field of view ($1.5\text{deg} \times 160\text{deg} \times 2\text{ways}$) will be observed. Based on latest results of observations, we simulate various bursts including short GRBs and X-ray flashes. From the results of simulations we estimate sensitivity to these bursts. X-ray afterglows of GRBs are also detectable with MAXI. The positions of the bursts (excluding bursts with the distance to the sun < 30) will be scanned by MAXI within about 70 minutes of the prompt emissions. GRB prompt emissions and X-ray afterglows will be searched by MAXI Nova Search system placed at Tsukuba Space Center. When Nova Search system finds the bursts, the results will be distributed to the world through the MAXI mailing list and Gamma-ray Burst Coordination Network.

The summary of 1) the number of observable bursts and X-ray afterglows, 2) the availability and the number of MAXI alert on bursts, and 3) quality of spectra of MAXI bursts will be presented at the oral session. Details will be described in a poster.

Spectral lag analysis of GRBs detected by HETE-2**Makoto Arimoto¹, Nicolas Vasquez Pazmino¹, Nobuyuki Kawai¹, and HETE2 members**¹Tokyo Institute of Technology, Meguro, Tokyo, Japan

Prompt emission of gamma-ray bursts (GRBs) must be carrying the key to clarifying the emission mechanism and origin of the GRBs, and yet it still remains enigmatic.

One of the characteristics of GRB prompt emission is the spectral lag. It is the delay of the photons light curve in the soft energy band with respect to the higher energy band. From the theoretical point of view, the spectral lag is important because it could be an indicator of the jet opening angle and of the Lorentz factor. Empirically from analyses of GRBs detected by BATSE, the spectral lags show correlation with both GRB peak luminosity and time history morphology; GRBs with shorter lags have higher variability and greater luminosities than long-lag, smooth bursts. Thus they can be potentially used for redshift indicator.

Here we present the analysis of the spectral lags in the GRBs detected by HETE-2. Using WXM and FREGATE on HETE-2, we can study the lags between the traditional gamma-ray band (30-400 keV) and the X-ray band (2-25 keV), which was not possible with BATSE. We examine if the correlations found in the BATSE gamma-ray bands also hold for the lower-energy bands.

Soft X-ray Emission And Lithium Production in Cen X-4 in Quiescence

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We investigate emission mechanism of soft X-ray radiation from a neutron star soft X-ray transient (NSSXT), Cen X-4 and unusually high abundances of Li on a low-mass secondary in Cen X-4 during a quiescent state. An accretion flow in NSSXTs is thought to be an advection-dominated one and truncated by magneto-centrifugal forces due to the magnetic field of a neutron star. The advection dominated accretion flow (ADAF) is very hot (> 1 MeV) enough to synthesize abundant neutrons through the spallation of ^4He via protons in the flow. Although almost all charged nuclei in the ADAF are outflowed by the magneto-centrifugal forces, the neutrons accrete onto the neutron star because of no influence of the magnetic field on the neutrons. Consequently, the accretion flow is composed of neutrons near the neutron star. The accretion energy of the neutrons liberated on the surface of the star is a possible energy budget for soft X-ray radiation in a NSSXT in quiescence. Moreover, Li is abundantly synthesized in the ADAF through $\alpha-\alpha$ reactions and is transferred to the surface of the secondary by the magneto-centrifugal forces. We find that for reasonable values of the mass accretion rate and the magnetic field of the neutron star, the estimated soft X-ray luminosity and abundance of Li on the secondary are comparable to those observed in Cen X-4.

Hard X-ray mapping of galaxy clusters

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Clusters of galaxies are the largest gravitationally bound systems in the universe, and believed to release a large amount of energy. Some part of energy might be converted into nonthermal particles accelerated in the intracluster space. Diffuse radio emission is evidence of existence of accelerated electrons in the intracluster space. Recent hard X-ray observations, including ASCA, BeppoSAX, RXTE, INTEGRAL, and Suzaku, reported some evidences of nonthermal hard X-ray from clusters. Therefore, hard X-ray scanning of nearby galaxy clusters with MAXI is also important to localize the nonthermal emission, in order to study the correlation with radio emissions, together with sensitive GLAST gamma-ray survey.

Light bending and the hard X-ray background

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Light bending due to strong gravity has recently been invoked to explain variability and flux correlations between different bands in some accreting black holes. A characteristic feature of light bending is reflection-dominated spectra, especially if photon sources lie in the deepest parts of the gravitational potential within a few gravitational radii of the event horizon. We use the spectrum of the hard X-ray background in order to constrain the prevalence of such reflection-dominated sources. We first emphasize the need for reflection and explore the broad-band properties of realistic spectra that incorporate light bending. We then use these spectra, in conjunction with the observed 2–10 keV AGN luminosity functions in order to predict the hard X-ray background spectrum over 3–100 keV, and provide limits on the fraction of reflection-dominated sources, dependent on the flare height. Our results allow for a cosmologically-significant fraction of sources that incorporate strong light bending. The luminosity function based on intrinsic flare luminosities is derived. We discuss prospects for missions such as NeXT and Simbol-X that can image such sources as well as confirm the precise spectral shape of the background near its peak, important for constraining the universal relevance of light bending.

Poster presentation may be more appropriate, since our results are relevant to hard X-ray surveys in general, but not to MAXI in particular.

The Neutron star Interior Composition Explorer

Keith Gendreau¹, Zaven Arzoumanian,^{1,2} and the NICE Team

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The Neutron star Interior Composition Explorer (NICE) will be a Mission of Opportunity dedicated to the study of neutron stars, the only places in the universe where all four fundamental forces of nature are simultaneously in play. NICE will explore the exotic states of matter within neutron stars, revealing their interior and surface compositions through rotation resolved X-ray spectroscopy. Absolute time-referenced data will allow NICE to probe the extreme physical environments associated with neutron stars, leveraging observations across the electromagnetic spectrum to answer decades-old questions about one of the most powerful cosmic accelerators known. Finally, NICE will definitively measure stabilities of pulsars as clocks, with implications for navigation, a pulsar-based timescale, and gravitational-wave detection. NICE will fly on the International Space Station, while GLAST is on orbit and post-RXTE, and will allow for the discovery of new high-energy pulsars and provide continuity in X-ray timing astrophysics.

Probing the supermassive binary black holes with MAXI**Hayasaki K.¹, Isobe N.², Sudou H.³, Seta H.² and Mineshige S.^{1,4}**¹YITP, Kyoto University, Kyoto, Japan²RIKEN, Wako, Saitama, Japan³Faculty of Engineering, Gifu University, Gifu, Japan⁴Department of Astronomy, Kyoto University, Kyoto, Japan

Supermassive black holes (BHs) are considered to have been coevolved with their host galaxies. This strongly suggests that BH growth is mainly caused by BH mergers and subsequent accretion of gas in the course of the galaxy merger. If so, supermassive binary black holes (BBHs) with a sub-parsec scale separation are inevitably formed before the BHs merge by emitting gravitational radiation. However, there is yet no definitive observational evidence for supermassive BBHs in spite of some claims (e.g. quasi-periodic light variations from OJ287).

In this paper, we study the smoothed particle hydrodynamics simulations of accretion flows around the supermassive BBHs with a moderate orbital eccentricity and the observable period by MAXI. In the simulations we consider a triple-disk system composing of two accretion disks around BHs and one circumbinary disk surrounding the two. Here, the circumbinary disk works as a mass reservoir. We confirm that X-ray luminosity from accretion disks significantly depends on the orbital phase because of the eccentric orbit of the BBHs. Note also that the X-ray luminosity exhibits the double peaks every binary orbit in the case of BBHs with low mass ratios. Such properties could not only explain a basic feature of light variations from OJ287 but also provide a potentially important observational signature of the sub-parsec BBHs in active galactic nuclei with MAXI.

MAXI Catalog: Source Detection and Sensitivity

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The MAXI source catalog will become a unique database of X-ray populations covering the 0.5–30 keV band in all sky. It will contain more than 1,300 AGNs (Ueda's talk), including many new sources. Using the MAXI simulator by Eguchi et al. (this conference), we develop a software program of source detection of faint sources from MAXI/GSC data, where maximum likelihood fit is performed to a projected image by taking into account the image response and background. In this poster, we present our study to estimate realistic sensitivities of MAXI based on the simulation, and summarize the expected properties of the MAXI catalog in the extragalactic sky.

The on-board Attitude Determination System for MAXI

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ADS (Attitude Determination System) is the three-axes(X-Y-Z) strap-down type on-board attitude determination system using a Star sensor(VSC) and Inertial systems(RLG).

The purpose of ADS is rapidly providing accurate attitude determination results through the MAXI alert ground system. It 's required that the accuracy of the occurrence of X-ray events must be less than 0.1degree in direction in any situation of data downlink and getting VSC data.

In this report, ADS function, operational condition, attitude determination algorithm and the result of tests will be introduced. Especially the design for the complexity of MAXI-DP system and the disturbance on orbit environment(SAA, day side Erath and Sun interference for VSC).

ADS algorithm is modified based on the on-board attitude determination systems will be focused, mainly used in Astronomy Missions of JAXA/ISAS. MAXI-ADS Features are the followings.

(1)ADS is the embedded function in MAXI on-board Application Software in the MAXI-DP master CPU, to avoid to use ISS-JEM data interface directly.

(2) To improve the VSC data noise characteristics the logics use rejecting noise, generated by several reasons, in VSC data.

(3)ADS consists of one Star sensor(VSC) and one RLG(Ring Leaser Gyro) only. This is much simple in comparison with common attitude determination sensor systems. RLG has a characteristic of large readout noise. And the attitude disturbance around 8Hz will be expected due to ergometers used by astronauts. So RLG output data above 20Hz will be cut-off by low-pass filter.

The Blazar Sequence and The Cosmic Gamma-Ray Background Radiation**Yoshiyuki Inoue¹, Tomonori Totani¹, and Takuro Narumoto¹**¹Department of Astronomy, Kyoto University, Japan

We present a study of the blazar gamma-ray luminosity function (GLF) and their contribution to EGRB radiation based on the unified blazar SED sequence studies. Previously the power-law or broken power-law SED is simply assumed to construct GLF and calculate EGRB spectrum. The blazar SED, however, has a unique sequence feature that synchrotron and Compton peak energy increase as the blazar jet emission power decreases. Using such SED sequence, we reconstruct the blazar GLF with the luminosity dependent density evolution model, which is favored by the X-ray luminosity function of active galactic nuclei (AGNs). We then find that 50% – 70% of the EGRB spectrum above 100 MeV can be explained by blazars. Furthermore, the origin of cosmic MeV gamma-ray background has recently been explained by Seyfert class of AGNs, which compose the cosmic X-ray background, with the expected non-thermal tail in AGN spectrum model. From these results, we also find that the cosmic X-ray to gamma-ray background up to 1GeV will be composed of the emission from Seyfert and blazar type of AGNs.

Quasi-Periodic Oscillations and Variable Emissions in Magnetohydrodynamic Accretion Flows

Yoshiaki Kato

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We present our study of oscillations and emissions in three-dimensional (3-D) magnetohydrodynamic (MHD) accretion flows around black holes. It is found that a pair of persistent quasi-periodic oscillations (twin QPOs) is excited at the resonant radius, where the ratio of Keplerian frequency to epicyclic frequency is close to 2:1. The PSD shows that the lower peak frequency corresponds to the Keplerian frequency, while the upper peak frequency corresponds to the sum of Keplerian frequency and epicyclic frequency. The results provide the first direct evidence for the excitation of resonant disk oscillation in MHD accretion flows.

Additionally, in order to examine to what extent the simulated MHD flows can account for the observed spectral energy density distribution (SED), we calculate the emergent spectra from 3-D MHD flows in wide range of wavelengths (from radio to Gamma-ray) by solving 3-D radiative transfer equations. We calculated time-dependent spectral changes, finding that the fluxes fluctuate in a wide range of frequency and the flux at each wavelength does not always vary coherently. We describe our attempt to explore the spectral variation due to the dynamics involving accretion flows and jets.

X-ray Emissions from Three-dimensional Magnetohydrodynamic Coronal Accretion Flows

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We calculate the radiation spectrum and its time variability of the black hole accretion disk-corona system based on the three-dimensional magnetohydrodynamic simulation. In explaining the spectral properties of active galactic nuclei (AGNs) or X-ray binaries in their low/hard state, it is often assumed that they consist of a geometrically thin, optically thick disk and hot, optically thin corona surrounding the thin disk. As for a model of the corona, we adopt the simulation data of three-dimensional, non-radiative MHD accretion flows calculated by Kato and coworkers, while for a thin disk we assume a standard type disk. We perform Monte Carlo radiative transfer simulations in the corona, taking into account the Compton scattering of soft photons from the thin disk by hot thermal electrons and coronal irradiation heating of the thin disk, which emits blackbody radiation. By adjusting the density parameter of the MHD coronal flow, we can produce the emergent spectra which are consistent with those of typical Seyfert galaxies. Moreover, we find rapid time variability in X-ray emission spectra, originating from the density fluctuation produced by the magnetorotational instability in the MHD corona.

Optical Follow-up Observations of Transient Sources at Gunma Astronomical Observatory

**Kinugasa K.¹, Hashimoto O.¹, Honda S.¹, Takahashi H.¹,
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Gunma Astronomical Observatory (GAO) is a public observational facility founded in 1999 by Gunma Prefecture local government. GAO has a 150 cm reflector, a 65 cm reflector, and other small telescopes. Moreover, there are some powerful instruments prepared for the 150 cm telescope such as a near infrared camera/spectrograph, a high resolution spectrograph and a low resolution spectrograph and imager. The observatory is designed for both astronomical research and public use. We can flexibly operate it as a public observatory, allowing us to observe time-limited transient sources. We proceeded with optical follow-up observations of gamma-ray bursts, supernovae, and other variable objects and join some multi-wavelength campaign observations of SS433, GRS1915 105 and so on. We introduce some GAO facilities and some scientific results from the optical follow-up observations of transient sources. We can proceed with follow-up observations of new transient sources with MAXI.

**Suzaku-WAM soft gamma-ray all-sky monitor by the earth occultation
technique**

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Suzaku-WAM has detected many gamma-ray bursts and solar flares. In addition, thanks to its large field of view, WAM is able to monitor the bright soft gamma-ray sources by the earth occultation technique, as CGRO-BATSE. We have constructed the analysis system of the WAM earth occultation, calibrated the obtained spectra and the flux by the Crab nebula, and then found that the response uncertainty is around 10–20%. Therefore, WAM is an important all-sky monitor in 50keV–1MeV band. This is unique against the RXTE/ASM (1–10keV) and Swift/BAT (10–100keV). Here, we introduce the analysis process, Crab calibration, and preliminary results on the Galactic black hole binaries and AGNs.

Observation of Polarization in Hard X-Ray Region with PHENEX Polarimeter

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In X-ray astronomy, the information on spectroscopy, timing and imaging have been utilized to understand the nature of stellar objects. Left out of these measurements to date is polarimetry, yet the observation of polarization brings us invaluable information such as space-time curvature near black holes, radiation mechanisms in pulsars, and the magnetic structure of supernova remnants. Further, it is also useful for understanding the radiation emission mechanism in gamma-ray bursts.

We have been developing an instrument named “PHENEX(Polarimetry for High ENergy X rays)” to measure polarization in the hard X-ray region. We carried out a preliminary observation of the Crab Nebula on Jun. 13th 2006 with balloon-borne experiment, constructing the prototype polarimeter. From the data, we confirmed that PHENEX polarimeter detected hard X rays from the Crab with a significance of 8σ . By the analysis of the polarization, the degree and the direction of polarization were $33\pm 26\%$ and $154\pm 43^\circ$, respectively.

Now we are improving the detector to realize the observation of the Crab Nebula with higher accuracy in the next balloon-borne experiment. In this presentation, we will present the summary of the experiment and the current status of the PHENEX project.

Multi-Wavelength Observations of the Microquasar SS 433

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SS 433 is the unique microquasar known for the very stable continuous jet emanating at a quarter of the speed of light. Multi-wavelength observation campaigns are necessary to understand SS 433 consisting of a synchrotron jet, an optically-thick accretion disk, and a high-energy jet engine. A radio-IR-optical-X-ray observation campaign for SS 433 has been performed in 2006 April, when the jet axis is almost perpendicular to the line of sight. The participating observatories include Suzaku, BTA (SAO RAS), 150-cm Telescope (Gunma), Nayuta (Nishi-Harima), KGB-38 (Crimean), MITSuME-Okayama (OAO), MITSuME-Akeno (Tokyo Tech), VSOLJ, 1.4-m Telescope (SAAO), RATAN-600 (SAO RAS), and NMA (Nobeyama). Five flares have been detected during the campaign by radio monitoring observation with RATAN-600. Suzaku observed the source in and out of eclipse. The source seems to be in the active state during the campaign.

Development of MITSuME telescope and observations of afterglows

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MITSuME (Multicolor imaging telescopes for survey and monstrous explosions, or three-eyed monster) consists of three robotic telescopes designed for gamma-ray burst afterglow observations. Two 50 cm optical telescopes, located in Okayama (OAQ/NAOJ) and in Yamanashi (Akeno Observatory/ICRR) are equipped with tri-color CCD cameras that perform simultaneous imaging in the g' , Rc and Ic bands. We performed follow-up observations of 28 GRBs in a year since April 2007 with the MITSuME Akeno Telescope, and detected five afterglows.

The telescope is automatically pointed to the GRB coordinates when a GCN notice is received. The images are automatically reduced, co-added, and analyzed to detect uncatalogued objects in the field.

While waiting for GRB alerts, the telescopes perform patrol of pre-selected objects, such as variable AGNs. The photometry of these patrolled objects is also performed automatically.

In this paper, we report the results of the GRB afterglow observations at Okayama / Akeno MITSuME Telescopes. We also present the automatic observation and analysis system.

Recent Development Status of PoGOLite

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The light-weight Polarized Gamma-ray Observer (PoGOLite) experiment is designed to measure the linear polarization of celestial soft gamma rays in the 25 keV – 80 keV energy range. Polarized gamma rays are expected from a wide variety of sources including rotation-powered pulsars, accreting black holes and neutron stars, and jet-dominated active galaxies. Polarization has never been measured at soft gamma-ray energies where non-thermal processes are likely to produce high degrees of polarization. The polarization is derived from the azimuthal distribution of Compton scattering angles in the sensitive volume of the instrument. The scattering angle will be measured by detecting coincident Compton scattering and photo-absorption sites in an array of 217 phoswich detectors. The PoGOLite experiment is being developed by groups in USA, Sweden, France and Japan.

We present the status of recent PoGOLite developments, including results from a polarized X-ray beam test performed at the KEK Photon Factory in February 2008.

Magneto-hydrodynamic Simulations of Excitation of Low-Frequency QPOs in Black Hole Candidates

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We present the results of global three-dimensional magneto-hydrodynamic simulations of black hole accretion flows. We focus on the excitation mechanism of low frequency quasi-periodic oscillations observed during the state transition of black hole candidates. When a cool gas is supplied, a constant angular momentum inner torus is formed around $4 - 8r_s$ where r_s is the Schwartzchild radius. This inner torus deforms itself from circle to crescent quasi-periodically. The origin of the torus deformation from circle to crescent is the Papaloizou & Pringle instability. The magnetic energy release by the magnetic reconnection is the reason why the torus deformed to the crescent shape returns to the circle shape. The time interval of these deformation is about 1 day when we assumed the $10^7 M_\odot$ black hole. In this presentation, we show the dependence of numerical results on the gas temperature supplied from the outer region.

The development of the MAXI monitoring system

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Our company, SEC, is software company that is specialized for real-time system and involved in space exploration also. We provide control systems of rocket launch, on-board systems and ground-base systems of satellites, taking advantage of our skills in developing real-time systems. We have developed many satellite systems so far, starting from N-I rocket. In this presentation, we present the development of the MAXI monitoring system. We have to monitor and control MAXI through the telemetry data while observing for the stable MAXI operation. Therefore, the MAXI telemetry data include not only observation data for scientific purpose, but also the ancillary data as system status. Basically, the monitoring system is required to receive and to display telemetry data continuously in real-time without loss. We have developed the real-time monitoring system to satisfy these requirements. And also, our monitoring system has good look-and-feel and flexibility of the display design, display format and monitored telemetry data. We will report the characteristic of the present monitoring system and the future plan.

CANGAROO-III Search for TeV Gamma-rays from Two Clusters of Galaxies

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Accretion and merger shocks in clusters of galaxies may accelerate particles to high energies, and those clusters are good candidate sites for the origin of ultra-high-energy (UHE) cosmic-rays. Recently, a prediction of gamma-ray emission from a cluster of galaxies at a detectable level with modern imaging atmospheric Cherenkov telescopes was presented in which gamma-rays are produced via inverse Compton upscattering of cosmic microwave background (CMB) photons by electron-positron pairs generated by collisions of UHE cosmic rays in a cluster with CMB. We observed two clusters of galaxies, Abell 3667 and Abell 4038, searching for very-high-energy gamma-ray emission with the CANGAROO-III atmospheric Cherenkov telescope system in 2006. The analysis showed no significant excess around these clusters, thus giving upper limits on gamma-ray emission. By comparing the upper limit for the north-west radio relic region of Abell 3667 with the model prediction, we can derive the lower limit of the magnetic field of the region as $\sim 0.1\mu\text{G}$. This shows the potential of gamma-ray observations in studies of the cluster environment. We also discuss the upper limit from cluster center regions with a model of gamma-ray emission from neutral pion produced in hadronic collisions of cosmic-ray protons with the intra-cluster medium (ICM). The derived upper limit of the cosmic-ray energy density within this framework was 1 order higher than that of our Galaxy.

Multiwavelength simultaneous observation of Blazar 3C454.3 at the gamma rays flare in November 2007

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The spectrum of blazars span over 20 decades from radio to gamma rays. To clarify a variety of physical phenomena of the blazar jets, a blazar must be monitored *in multiwavelengths* and *simultaneously*.

We succeeded in simultaneous multiwavelength observation of a blazar 3C 454.3, a QHB (quasar-hosted blazar) at $z=0.859$. It also belongs to the brightest quasar class, with its luminosity reaching 10^{48} erg/s. A huge gamma-ray flare of 3C 454.3 was reported by the AGILE satellite on November 2nd through December 1st, 2007. We proposed a ToO observation with the Suzaku satellite, which was approved and performed on Dec 5, 6. At the same time, we were monitoring its optical magnitudes in three colors (g', Rc, Ic) using the MITSuME Telescope at the ICRR Akeno Observatory, Yamanashi, Japan. Its R band magnitude increased from R=16 up to R=13.4 on December 1. We present the spectral energy distribution based on this multiwavelength observation, and discuss the emission models.

New Magnetar Frontiers with MAXI Survey

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There has been great discussion about magnetars which may be neutron stars with a super strong magnetic fields $\sim 10^{15}$ G. Several studies have claimed that there are 11 X-ray candidates in the galactic plane. Over the past three decades, the candidates were observed by many satellites. However, some important issues such as a birth rate, a nature of a super strong magnetic field and an emission mechanism still remain unclear. What seems lacking is statistical spectral and temporal studies. Munro et al. (2007) reported that a birth rate of the X-ray candidates could range between 0.003 and 0.06 yr⁻¹ based on the XMM-Newton and *Chandra* archive data for the galactic plane ($|b| \leq 5$). Let us look at an important fact, namely that their survey region covers just $\sim 4\%$ of the galactic plane. Thus a survey of entire region of the galactic plane should be the first prioritized issue. The main objective of our study is to survey the new X-ray magnetar candidates and to give their accurate birth rate using the GSC/MAXI which has the best sensitivity in near future. Considering a flux of known candidates lies around $\sim 10^{-12}$ erg cm⁻² s⁻¹, the GSC can survey the most sky with just 1 week observation.

Wide-band gamma-ray burst detector: GRB monitor for the CALET mission**S. Nakahira¹, A. Yoshida¹, K. Yamaoka¹, T. Kotani¹, T. Doshida¹, K. Suzuki¹, S. Sugita¹, T. Oyama¹, S. Torii², H. Tomida³, Y. E. Nakagawa⁴**¹Department of Physics and Mathematics, Aoyama Gakuin University, Japan²Research Institute for Science and Engineering, Waseda University Japan³ISS Science Project Team, Japan Aerospace Exploration Agency (JAXA), Japan⁴RIKEN, Japan

We propose to provide a gamma-ray burst monitor for the CALET mission. CALET mission is proposed for the Japanese Experiment Module Exposure Facility of the ISS targeting the launch of 2013. The major purpose is to derive a wide-band energy spectrum of GRB over an unprecedented 9 decades of energy (from a few keV to a few TeV) in combination with the CALET Imaging Calorimeter(IMC) detector and Toral Absorption Calorimeter(TASC) detector. Hence it is desirable to have the CALET-GBM covering an energy range from a few keV to about 20 MeV to avoid a gap in observational energy band. The design of GBM is underway to fulfill this requirement. The current detector candidate is BGO, and LaBr(Ce) scintillator which has a superior energy resolution to that of NaI(Tl). LaBr3(Ce) is very attractive material, but has not been used in space yet. For study of it's radiation hardness and possible induced background on the radiation environment of ISS orbit, we carried out proton beam and gamma-ray irradiation test. In this paper, design and expected performance of the CALET-GBM are shown.

Global Radiative Magnetohydrodynamic Simulations of Black-hole Accretion Disks

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We perform global radiative magneto-hydrodynamic (RMHD) simulations of accretion disks around black holes. These are first global simulations, in which radiative transfer and magneto-hydrodynamics are solved in multi-dimensional space.

It is widely believed that accretion flow onto black holes drives major activities of astrophysical black holes, such as active galactic nuclei (AGNs), Galactic black hole candidates (BHCs), and possibly gamma-ray bursts (GRBs). Although one-dimensional disk models (e.g., Standard-disk model, RIAF, and slim-disk model) has been believed to be solutions of the accretion disks, these models don't correctly solve the magnetic fields, radiation fields, and multi-dimensional effects.

By performing two-dimensional RMHD simulations of disks, we investigate the dynamics and structure of the accretion disks. When the mass-accretion rate, \dot{M} , exceeds the critical rate, L_E/c^2 , the radiatively-supported thick disks as well as the radiatively driven jets form, where L_E is the Eddington luminosity. In contrast, the disks become cool and thin by the effective radiative cooling, in the case of mildly sub-Eddington accretion, $\dot{M} \sim 10^{-3}L_E/c^2$. In the case that the mass-accretion rate is much smaller than the critical value, $\dot{M} \sim 10^{-7}L_E/c^2$, hot and thick disks appear, since radiative cooling and radiative pressure don't play important role. The disks intermittently produce magnetized jets.

Long term intensity variations of Cen X-3**B. Paul and H. Raichur**

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As the long term flux variations of Cen X-3 are strongly aperiodic in nature, it is natural to assume that the flux variations are due to a changing mass accretion rate. However, we have found a strong dependence of the orbital modulation on the X-ray flux state of Cen X-3. In the low flux state, instead of sharp eclipse ingress and egress, the light curve has a smooth flux variation showing that the X-ray emission observed in this state is from an extended object. The flux-dependent orbital modulations and the pulsed fraction in different flux states is consistent with a scenario in which the X-ray flux variation of Cen X-3 is due to change in obscuration by an aperiodically precessing warped accretion disk. We found that the X-ray emission of Cen X-3 has one highly varying component with a constant pulsed fraction and an unpulsed component and in the low state, the unpulsed component becomes dominant. The observed X-ray emission in the low state is likely to be due to scattering of X-rays from the stellar wind of the companion star. We provide further support to this hypothesis from measurements of quasi periodic oscillations in different flux states.

Possible coordinate observations by MAXI and the AROMA wide-field
optical monitor

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In order to observe the early optical afterglows of GRBs, we have developed and operated the automatic telescope Aoyama Gakuin University Robotic Optical Monitor for Astrophysical objects (AROMA). It currently consists of amateur-oriented astronomical instruments to conduct immediate and automatic follow-up observations and analyses of the GRB optical afterglows. Then, to expand AROMA, a development of an observation system using multiple digital single-lens reflex cameras (AROMA-W) is underway. The new function of AROMA can achieve simultaneous observations in multiple optical bands with a wide field of view. The program which analyzes massive amounts of imaging data automatically was also under development. Finally we aim at discoveries of the optical transients by monitoring all the stars which are visible in a AROMA-W view. In this paper, we report a developmental status of AROMA-W and a possibility of the simultaneous observation to the X-ray transients (e.g. X-ray nova, Supernova, GRBs) discovered with MAXI.

Eclipsing light curves for accretion flows around a rotating black hole and atmospheric effects of the companion star**Rohta Takahashi¹**¹RIKEN, Wako, Saitama, Japan

We calculate eclipsing light curves for accretion flows around a rotating black hole taking into account the atmospheric effects of the companion star such as the atmospheric absorption and scattering effects. By using the solar-type atmospheric model, we have taken into account the atmospheric effects of the companion star, such as the photoionization by HI and HeI. We found that the eclipsing light curves observed at 1 keV possibly contain the information of the black hole spin. However, in our atmospheric model, the effects of the atmosphere are much larger than the effects of the black hole spin. Therefore, even in the case that the light curves contain the information of the black hole spin, it may be difficult to extract the information of the black hole spin if we do not have the realistic atmospheric profiles, such as the temperature, and the number densities for several elements (Takahashi & Watarai, 2007, MNRAS, 374, 1515). If the light curves of the occultation events of the black hole binaries are detected by MAXI, the light curves contain the information of the atmosphere of the companion star and, possibly, a black hole's spin.

Evolutionary Studies of the Classical Nova with V458 Vulpeculae

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On 2007 August 8th, an optical nova was discovered by Japanese amateur astronomer Abe Hiroshi in the constellation Vulpecula (S. Nakano, IAUC 8861). Its visual magnitude was observed to increase from about 8th to 10th. It was named "V458 Vulpeculae" (N. N. Samus, IAUC 8863) and was suggested to be a "classical nova".

Classical novae are known to be X-ray emitters at some stage of their evolution. The X-ray telescope onboard the Swift satellite monitored V458 Vulpeculae and detected X-rays on 2007 October 18th (70 days after the outburst; Drake et al. ATel.1246).

We requested a follow-up observation with the Suzaku satellite under Director's discretionary time, and a 20 ksec observation was performed on 2007 November 4th (88 days after the outburst). This observation yielded a well-exposed X-ray spectrum, and we were able to identify emission lines from Ne, Mg, and Si. We fitted the spectrum with an isothermal optically-thin plasma model (apec) with interstellar extinction. The fitted model parameters indicate the plasma temperature, the abundance, and the interstellar extinction are about 0.6 keV, 0.3 solar, and 4×10^{21} H atoms cm^{-2} , respectively. We will present these results, and discuss further possibilities for evolutionary studies of the classical nova with MAXI.

X-ray polarimetry small satellite TSUBAME

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TSUBAME is a university-built small satellite mission to measure polarization of hard X-ray photons (30-100keV) from Gamma-ray bursts (GRBs) using azimuthal angle anisotropy of Compton-scattered photons. Polarimetry in the hard X-ray and soft γ -ray band plays a crucial role in the understanding of high energy emission mechanisms and the distribution of magnetic fields and radiation fields. TSUBAME has two instruments: the Wide-field Burst Monitor (WBM) and the Hard X-ray Compton Polarimeter (HXCP). The WBM determines on board the direction of the burst occurrence with an accuracy of 10 degrees, then using a high speed attitude control device, the HXCP is pointed to the GRB within 15 seconds after the burst occurrence to promptly detect polarized X-ray photons from the GRB.

We present a TSUBAME mission overview, number of GRB we can observe with the WBM, results of a Monte Carlo simulation of the X-ray polarization measurement, and development of multi anode photo multi tube which uses an ultra bi-alkali photo cathode.

Study of the Ejecta Distribution in the Vela SNR with MAXI

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The informations of global ejecta distributions in supernova remnants (SNRs) are essentially important to understand the mechanism of the supernova explosions. Since the Vela SNR, whose progenitor is a massive star, has the largest angular diameter ($\sim 8^\circ$), it is a very ideal target for studying the detailed structure. ROSAT observed the entire Vela SNR and discovered several “shrapnels” which protrude beyond the primary blast-shock front (Aschenbach et al. 1995). Some of the shrapnels were confirmed to be associated with the fragments of the ejecta by the XMM-Newton observations (Katsuda & Tsunemi 2005; 2006). However, the most part of the SNR has not yet been observed by XMM-Newton and the other recent satellites, because the SNR is too large to be covered with their limited exposure times. MAXI will be the first X-ray mission allowing us to search other ejecta fragments hiding inside the shell by the projection effect and to study the ejecta distribution in the entire SNR.

**The CALET Project for All-Sky Gamma-Ray and Electron Observations on
JEM-EF of ISS**

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The CALorimetric Electron Telescope, CALET, is a new all-sky gamma-ray and electron observatory being developed for the Exposure Facility of Japanese Experiment Module on the International Space Station. The mission goal is to investigate high-energy universe by observing cosmic-ray electrons in 1 GEV – 10 TeV, gamma rays in 20 MeV – 10 TeV, and protons in 10 GeV – 1 PeV. CALET has a unique capability to observe electrons and gamma rays over 1 TeV with a hadron rejection power better than 10^6 and an energy resolution better than a few % above 100 GeV. This capability enables us to search for nearby cosmic-ray sources, dark matter and so on. The main instrument consists of an imaging calorimeter of scintillating fibers, IMC, and a total absorption calorimeter of BGO, TASC. With auxiliary detectors, CALET will also monitor solar activity and study gamma-ray bursts. We will discuss the science, technique, observation and current status of the CALET project.

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