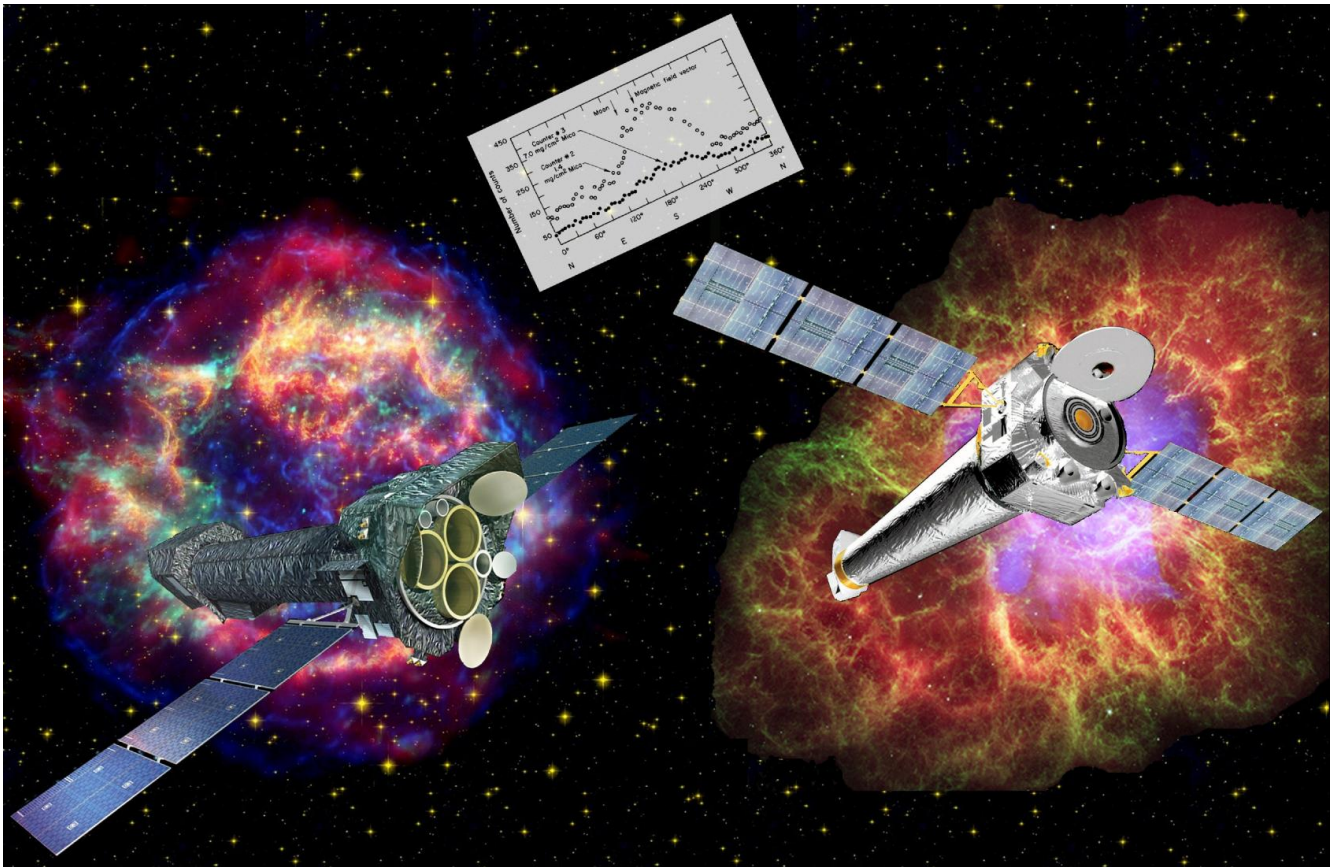

X-ray Astronomy: towards the next 50 years!

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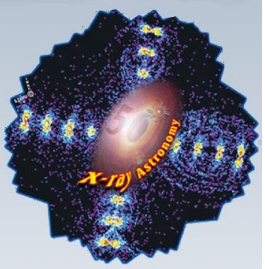

SUMMARY

Galactic Astronomy

Rob FENDER *I*
University of Southampton

Galactic black holes: accretion and ejection

In this review talk I will summarize the current state of the art in our empirical understanding of accretion and ejection in black hole binary systems. This is based upon the clear couplings observed between accretion flows, winds and relativistic jets in such systems. I will furthermore discuss how such coupled states might be applicable to active galactic nuclei, and how this scaling might be testable in the near future by long-term monitoring of tidal disruption events. I will conclude with some comments on whether or not there is any evidence for powering of relativistic jets by black hole spin.

Kazuo MAKISHIMA *I*
Department of Physics, University of Tokyo

From Sco X-1 to Magnetars -- past, present, and future of X-ray studies of neutron stars

50 years ago, X-ray astronomy started by the detection of Sco X-1, a mass accreting neutron star (NS). Since then, X-rays have been providing a unique window onto their basic parameters (particularly radii). In fact, the mass-radius relations of NSs provide vital constraints on the nuclear EOS. We propose some new ideas toward this goal, using the forthcoming ASTRO-H. X-ray observations of NSs with Tenma (Mitsuda+84) also verified the concept of standard accretion disk (Shakura & Sunyaev 73), and provided basis for understanding the accretion phenomena. The strong (1e12 G) magnetic fields of X-ray pulsars have been measured accurately using electron cyclotron resonances, with balloons (Truemper+78), Ginga (Makishima+99), BeppoSAX,and RXTE. We know that some NSs (magnetars) have even stronger MFs, where QED effects may appear. Based on the newest Suzaku results on various NSs, and prospects for ASTRO-H, we discuss the NS magnetism as a fascinating issue in fundamental physics.

Nanda REA *I*
Institute of Space Sciences (CSIC-IEEC), Facultat de Ciencies

Neutron stars with huge magnetic storms

The properties of matter under the influence of magnetic fields and the role of electromagnetism in physical processes are key areas of research in physics, biology, bioengineering, chemistry, geology and many other branches of science. However, despite decades of research, our ignorance of many physical processes related with strong magnetic fields is clear: we only need to note that the strongest steady magnetic field achieved in terrestrial labs is some hundreds of Tesla, only thousands of times stronger than a common refrigerator magnet. Among the many different classes of stellar objects, neutron stars provide a unique environment where we can test (at the same time) our understanding of matter with extreme density, temperature, and magnetic field. In this more general contest, I will review our current knowledge on the most magnetic objects in the Universe, a small sample of neutron stars called magnetars.

Jürgen SCHMITT ***I***
Hamburger Sternwarte

X-ray astronomy of stars

While our Sun has been the first recognized celestial X-ray source, it took the introduction of soft X-ray imaging to realize that X-ray emission is widespread among stars commonly placed in the HR-diagram. The X-ray output of stars can be very different from that observed from our Sun, which turned out to be a rather weak X-ray source in comparison to its stellar siblings. Especially young stars are copious producers of X-rays and thus X-ray observations have provided an entirely new view of the early stages of the solar system. I will give an overview over the basic and most important findings in stellar X-ray astronomy from the last three decades, and will try to identify some key problems for future research in this area.

Elisa COSTANTINI ***O***
SRON, Netherlands Institute for space research

Characterizing the chemistry of interstellar dust: the X-ray view

Interstellar dust (ID) plays a role at every distance-scale in the universe, from planets formation up to high-redshift galaxies. X-ray spectroscopy is a powerful tool to characterize the physical and chemical nature of interstellar dust. We will show how recent results, combining XMM-Newton and Chandra data, suggest that the chemical composition of ID can differ significantly from the traditional picture. Present and future missions will help characterizing O, Mg, Si and most of all iron in dust. The latter can be clearly detected only in the X-ray band.

Andreas ECKART ***O***
I.Physikalisches Institut

The broad band properties of X-ray flares from Sagittarius A*

The super-massive 4 million solar mass black hole (SMBH) SgrA* shows flare emission from the millimeter to the X-ray domain. An flare analysis in the framework of a Synchrotron Self Compton (SSC) mechanism shows that a scenario in which the infrared flares are explained by synchrotron emission and the associated X-ray flares are produced via SSC emission can also explain the variability spectrum observed in the sub-millimeter radio domain. The light curves suggest in many cases that the mm flare emission follows the NIR emission with a delay of 1.5 - 2 hours indicating that adiabatic expansion of a plasma of relativistic electrons is at work. A detailed analysis of the infrared light curves allow us to address the accretion phenomenon in a statistical way. The analysis shows that the NIR flare amplitudes are dominated by a SINGLE state power law. The structure functions in the X-ray to radio domain show different characteristic turnover points that can be interpreted as a consequence of the physical flare mechanisms at work. Differences in the NIR/X-ray flare profiles can be explained by a variation in the SSC scattering efficiency. Near-infrared polarimetry shows signatures of strong gravity that are statistically significant against randomly polarized red noise. This allows us to derive spin and inclination information of the SMBH.

Gian Luca ISRAEL ***O***
INAF - OA Roma

The multi-wavelength monitoring of magnetar outbursts

The results obtained through the monitoring and study of the transient phenomena displayed by a number of magnetars will be shown and discussed, with particular emphasis on the most recent results obtained. Among others are: the detection of long-term outbursts from transient Anomalous X-ray Pulsars (CXO J164710.2−455216, SGR0418+5729 and SwiftJ1822.3-1606) monitored through multi-wavelength observations, and the study of intermediate flares from SGR1900+14 and 1E1547.0-5408.

Martino MARELLI ***O***
INAF/IASF Milano

X-ray properties of the Fermi/LAT Pulsars

The Large Area Telescope (LAT) onboard the Fermi mission opened a new era for pulsar astronomy, detecting pulsations from more than 100 gamma-ray pulsars, 30% of which are not seen at radio wavelengths, yielding a new view of the Galactic population of isolated neutron stars. Using both archival and freshly acquired data from XMM-Newton, Chandra, Suzaku and Swift, we are investigating the X-ray phenomenology of gamma-ray pulsars. Based on the detection of ~70 X-ray counterparts, we will show the puzzling lack of correlation between gamma-ray and X-ray (non-thermal) emission, possibly stemming from vastly different geometrical configurations of the emitting regions at different wavelengths. We will also show that, on average, radio-quiet PSRs have higher (and less scattered) gamma-ray to X-ray flux ratios, pointing to a different and somewhat more constrained geometry for the radio-quiet objects with respect to the radio-loud ones.

Yujin NAKAGAWA ***O***
Waseda University

Wide-Band Spectra of Magnetar Burst and Persistent Emission

Soft gamma repeaters (SGRs) and anomalous X-ray pulsars (AXPs) are phenomenologically defined to be magnetars, highly magnetized neutron stars with field strengths greater than the quantum critical level 4.4*10^13 G, showing persistent X-ray emission and sporadic bursts. These energetic phenomena are presumably related to electron-positron plasmas in magnetosphere. The persistent emission spectra consist of thermal (10 keV) components. Using Suzaku and HETE-2 data, we discovered that the burst spectra consist of the same components. Luminosities of these components show a correlation over five orders of magnitude. These results suggest a possibility that the persistent emission may consist of numerous micro bursts. We observed recently activated AXP 4U 0142+614 on 7 September 2011 using Suzaku. The persistent emission spectrum in the active phase might be harder than that in the quiet phase. In this talk, we discuss wide-band spectra of magnetar emission.

Toshio NAKANO ***O***
University Tokyo

Solving Age Discrepancy between Magnetars and Associated Supernova Remnants

Magnetars are considered as neutron stars with strong magnetic fields. Of ~20 presently known magnetars, several are associated with supernova remnants (SNRs), and their X-ray diagnostics will provide clues to the formation of magnetars. Using Suzaku, we studied CTB109, one of such SNRs,hosting the magnetar 1E 2259+586. We found the SNR to have an explosion energy of (1.7-7.0)E+51 erg/s, together with an age of 1.3-1.7 kyr. While this SNR age agrees with a previous report (8.8 kyr; Sasaki + 2004), it is exceeded, by a factor of ~20,by the characteristic age of 1E 2259+586, 230 kyr. We hence suggest that the characteristic ages of magnetars are systematically overestimated, because the postulated (and observed) magnetic field decay is not properly considered. After Colpi+ (2000), we formulated this effect using a simple magnetic-field decay model. The results imply that magnetars are much younger than previously thought, and may provide the most dominant form of new-born neutron stars.

Martin WEISSKOPF ***O***
NASA/Marshall Space Flight Center

Monitoring of the Crab Nebula with Chandra and HST

Subsequent to the announcement by AGILE and Fermi-LAT of the discovery of gamma-ray flares from the Crab Nebula in the fall of 2010, this team has been monitoring the X-Ray emission from the Crab on a regular basis. X-Ray observations have taken place typically once per month when viewing constraints allow. A notable exception occurred in April of 2011, when we triggered a set of Chandra Target of opportunity observations in conjunction with the brightest gamma-ray flare from the system to date. Regular HST observations began in January of this year in conjunction with Chandra observations. The aim of this program to further characterize, in depth, the X-Ray and optical variations that take place in the nebula, and by so doing determine the regions which contribute to the harder X-ray variations and, if possible, determine much more precisely the location of the origin of the gamma-ray flares. We will briefly summarize the observations and the information we have gleaned to date.

Graziella BRANDUARDI-RAYMONT ***P***
University College London, Mullard Space Science Laboratory

X-ray Imaging of the Earth's Magnetosphere

Solar wind charge-exchange X-rays are produced in the Earth's magnetosphere and peak in the sub-solar magnetosheath and in the magnetospheric cusps, where solar wind and neutral exospheric densities are high. We propose a new approach to the study of the Sun-Earth relationships and the impact of the solar wind on the Earth's environment: remote X-ray imaging of the Earth's magnetosphere, providing the global view necessary to understand the overall behaviour and evolution of the plasma. We present a dedicated mission that can image the Earth's dayside magnetosphere, magnetosheath and bow shock in X-rays from a vantage point close to the Moon (AXIOM), or, alternatively, focuses on the cusps from a low-Earth orbit (AXIOM-C). Both missions address key outstanding questions concerning how the solar wind interacts with planetary magnetospheres. Their observations and the resulting models will also help understand this foreground emission all-important for Earth-orbiting X-ray observatories.

Sabrina CASANOVA ***P***
North West University, Potchefstroom & MPIK Heidelberg, Germany

Cosmic ray propagation in molecular clouds.

We solve the transport equations of cosmic rays inside a molecular cloud assuming an arbitrary energy and space dependent diffusion coefficient. Cosmic rays penetrating the cloud produce gamma-ray emission through pp collisions with the ambient gas. For small diffusion coefficients inside the cloud we expect the gamma-ray spectrum from the cloud to be harder than the Galactic diffuse emission spectrum, mainly due to the slower penetration of the low energy particles towards the core of the cloud. Moreover we study the influence of the gas density profile on the gamma-ray emission. Finally we present predictions for present and future telescopes to observe gamma-ray emission from molecular clouds and from their dense cores.

Andrea DE LUCA ***P***
INAF/IASF Milano

X-ray observations of “gamma-ray-only” pulsars unveil peculiar diffuse emission structures

The Large Area Telescope (LAT) onboard the Fermi mission opened a new era for pulsar astronomy, detecting pulsations from more than 100 gamma-ray pulsars, 30% of which are not seen at radio wavelengths, yielding a new view of the Galactic population of isolated neutron stars. Using data from XMM-Newton and Chandra, we are investigating the X-ray properties of Fermi PSRs. We will focus on the detection of very unusual diffuse emission structures surrounding a few radio-silent PSRs. We will discuss the case of PSR J0357+3205, which, in spite of its very low spin-down luminosity, is powering a parsec-long “tail” of diffuse emission with a weird morphology. We will also discuss the case of PSR J1135-6055, a Vela-like PSR powering a puzzling nebula, reminiscent of a pair of polar jets bent by the interaction with the interstellar medium. Understanding such features will teach us a lot about pulsar particle outflows.

Radhika DORAISWAMY ***P***
Isro Satellite Centre

Disk - Jet connection in outbursting Black Hole sources

We explored the `spectro - temporal' behaviour of outbursting Black Hole sources (e.g., XTE J1859+226, XTE J1748-228, H1743-322 etc.) in X-rays by analyzing the RXTE-PCA/HEXTE data, at the time of ejections as radio flares. While studying the energy dependent evolution of temporal and spectral properties over the energy band of 2 - 150 keV, it is found that during the ejections the QPO frequencies disappear as well as the power-law indices of the energy spectra increase suddenly, implying the soft nature of the spectrum. These results can be treated as observational signature to indicate that the inner part of the disk(i.e. Comptonized corona), which is responsible for the QPOs and for the non-thermal Comptonized component of the spectrum, is disrupted and the matter gets evacuated in the form of jet. We explain the nature of the disk-jet connection before, during and after the ejection events based on the Two Component Advective Flow (TCAF) paradigm, in presence of magnetic field.

Teruaki ENOTO ***P***
The Inst. of Physical and Chemical Research, Tamagawa high energy astrophysics laboratory, RIBF 4F

Broadband Suzaku Observations of Magnetars

There is accumulated evidence that Soft Gamma Repeaters (SGRs) and Anomalous X-ray Pulsars (AXPs) are ultra-strongly magnetized (B~1e+14-15 G) neutron stars, or called “magnetars” powered by dissipation of their huge magnetic energies. After the INTEGRAL discovery of the hard X-ray component above 10 keV, the Japan-US Suzaku observatory confirmed this hard X-rays from several magnetars. Since the soft and hard X-rays can be simultaneously observed using a wide energy coverage of Suzaku (0.3-600 keV), we recently found that a broad-band (0.8-70 keV) spectra of known magnetars systematically change depending on their characteristic age and magnetic field (Enoto et al., 2010 ApJL). The present result provides another support to the increasing evidence that SGRs and AXPs are intrinsically considered to be the same kinds of object. Together with recent discoveries of transient sources and their outbursts, magnetars will be fascinating objects in future GEMS and ASTRO-H missions.

Sergey GREBENEV ***P***
Space Research Institute, Russian Academy of Sciences

Supergiant Fast X-ray Transients discovered by INTEGRAL - a missing group of wind-fed X-ray binaries

We review observational properties of the Supergiant Fast X-ray Transients (SFXT) recently discovered with INTEGRAL. They likely represent a large missing group in the population of wind-fed X-ray binaries. It is known that persistently bright supergiant binaries and Be-systems occupy different regions in the Pspin-Porbit diagram (known as the Corbet diagram). The previous attempts to explain this diagram were not fully satisfactory. We propose a new explanation for the observed dependences which takes into account the fact that the accretting matter in such systems has smaller angular momentum than the Keplerian one. The location of SFXT in the Corbet diagram can be a key to understanding of the accretion mechanism responsible for their outbursts.

Yoshitaka HANABATA ***P***
Hiroshima University

Detailed X-Ray Study of the Supernova Remnant W51C with Suzaku

Efficient acceleration of cosmic rays occurs in young SNRs. However, it is still unclear how the acceleration process evolves in SNRs at the Sedov phase. Synchrotron X-ray emission from high energy electrons in SNRs is a powerful tool to study the evolution of cosmic-ray acceleration mechanism because of shortness of the cooling timescale. Plasma diagnostics of the X-ray emission from middle-aged SNRs also gives us the information of acceleration sites since an over ionized plasma can be generated by the interaction of the plasma with cosmic rays accelerated in the SNR. The SNR W51C is a middle-aged SNR associated with the GeV and TeV gamma-ray emission. We carried out X-ray observations of this remnant with superiror energy resolution and the large effective area of the XIS onboard Suzaku. We will discuss the plasma condition of the SNR and the origin of the extended hard X-ray emission near the molecular clouds interacting with the shell of W51C.

Hajime INOUE ***P***
Institute of Space and Astronautical Science, JAXA

Preccessions of accretion disks in close binaries

Preccessions of accretion disks in close binaries are suggested from the 35-day on-off cycle of Her-X-1 and also from the jet-preccession of SS433. We investigate properties of a preccessing motion of a ring, which is circularly rotating around a compact star under an influence of a tidal force from a companion star. By comparing predicted behaviors of the preccessing ring with observations, we find that several observational facts from Her X-1, SS433 and some other X-ray binaries can be explained with the tidal-force-induced precession scheme quite reasonably. We further examine energetics of the preccessing ring as a function of the tilting angle. Quantitative estimations show that the total energy of the ring has the minimum when it preccesses with a certain tilting angle, unless its thermal energy is insufficient. It is strongly suggested that preccessions of accretion disks are often realized in close binaries.

Naseer IQBAL ***P***
University of Kashmir

Study of correlated Ultra-violet and X-ray emission from X-Ray Binaries

X-ray binaries are luminous sources, which harbor neutron stars or black holes. Study of these sources will be a crucial step towards an understanding of the high-energy processes that are active in the Universe. These sources may also serve as a laboratory where the General theory of Relativity can be tested in the strong field limit. The X-ray emission arises from the inner most region of an accretion disk around the compact object. An important diagnostic of the system is their UV emission which could arise from the X-ray irradiated outer regions of the disk. This simple interpretation implies that the UV emission should be directly correlated with the X-ray one. However, earlier studies have indicated that the behavior of these systems is more complex. An obvious reason for this could be that the structure of the outer accretion disk is altered by the X-ray irradiation. We propose here to undertake a detailed theoretical analysis of the structure of an X-ray irradiated disk.

Satoru KATSUDA ***P***
RIKEN

Discovery of a Pulsar Wind Nebula Candidate in the Cygnus Loop

We report on a discovery of a diffuse nebula containing a point source in the southern blowout region of the Cygnus Loop supernova remnant, based on Suzaku and XMM-Newton observations. The X-ray spectra from the nebula and the point source are well represented by an absorbed power-law model with photon indices of 2.2+/-0.1 and 1.6+/-0.2, respectively. The photon indices as well as the flux ratio of F_nebula/F_point ~ 4 lead us to propose that the system is a pulsar wind nebula, although pulsations have not yet been detected. If we attribute its origin to the Cygnus Loop supernova, then the 0.5-8keV luminosity of the nebula is computed to be 2.1e31 (d/540pc)^{2} ergs/s, where d is the distance to the Loop. This implies a spin-down loss-energy of ~2.6e35 (d/540pc)^{2} ergs/s. The location of the neutron star candidate, ~2 degrees away from the geometric center of the Loop, implies a high transverse velocity of ~1850 km/s, assuming the currently accepted age of the Cygnus Loop.

Katsuji KOYAMA ***P***
Kyoto University

A New Evolutional Scenario for Mixed Morphology SNRs: Present and Astro-H era

Recombining plasma (RP) is a new feature found in some mixed morphology (MM) SNR. At present, 6 MM SNRs are known to exhibit RP, which are W49B, IC443, G359.1-0.5, W28, W44 and G346.6-0.2. Sawada and Koyama 2012 (PASJ 64, in press; 2012arXiv1202.3125S), Uchida et al. 2012 and Yamauchi et al. 2012 (both are submitted to PASJ) demonstrated that the RPs in MM-SNRs W28, W44 and G346.6-0.2 carry rich information (a new branch of SNR evolution). Including the other MM SNRs with RP, I will report on a new evolutional scenario for these MM SNRs. The high resolution spectroscopy of SXS/Astro-H may provide the first quantitative scenario on the new branch. The fluxes of fine structure lines are a powerful tool for quantitatively study for the production of a RP and following recombination (plasma relaxation) process. These data can be Rosetta Stone for a new branch of the SNR evolution.

Nicola LA PALOMBARA ***P***
INAF - IASF Milano

The hot-blackbody spectral excess as a common property of low-luminosity X-ray binaries

We report the main results obtained thanks to an observation campaign with XMM-Newton of persistent, low-luminosity (LX ~ 10^34 erg/s) and long-period (P > 100 s) Be accreting pulsars, which were previously poorly studied at soft X-ray energies. We found that in all sources the observed spectra show a hard excess that can be modeled with a rather hot (kT > 1 keV) blackbody component of small area (R < 0.5 km), which can be interpreted as emission from the NS polar caps. We show that not only this hot BB feature is a common property of several low-luminosity X-ray binaries, but also that for most sources its parameters (radius and temperature) are within a narrow range of values.

Ksenia LEVENFISH ***P***
Ioffe Physical Technical Institute

The lively X-ray nebula of Vela pulsar

We present animated dynamics of Vela PWN in X-rays using 11 images obtained by Chandra between July 2009 and September 2010. The improved X-rays astrometry reveals that finest structures of the lively PWN are variable on weeks to months timescales. The Vela's jet differs from its counter-jet both in morphology and variability, as do the jets of protostars and AGNs. Both jets tend to bent southward. Together with an overall asymmetry of the PWN, this hints on the presence of the flow from the North, supporting hypothesis that Vela's PWN was recently affected by the reverse shock wave propagating back into SNR interiors from the northern periphery of the remnant after the interaction with the interstellar medium. The jet overall shape changes on a timescale of months, while its internal structure varies much faster: the flow instabilities give rise to the bright diffuse blobs which propagate outward and brighten and fade on a timescale of weeks.

Vanessa MANGANO ***P***
INAF IASF Palermo

Swift monitoring of the candidate supergiant fast X-ray transient IGR J16418-4532

Supergiant Fast X-ray Transients (SFXTs) are a class of HMXBs with OB supergiant companions. The hallmark of SFXTs is the occurrence of short (a few hours) outbursts during which the luminosity can increase by 3-5 orders of magnitude (up to about 1E37 erg/s). Either the clumpy structure of the wind from the companion or a (centrifugal and/or magnetic) gating mechanism have been suggested to be responsible for the outbursts. After its discovery with INTEGRAL in 2003, IGR J16418-4532 has been tentatively classified as a SFXT. Both the orbital and spin periods of this source are known (3.7 d and 1.2 ks, respectively). In July 2011 Swift observed IGR J16418-4532 several times, covering three orbital periods. The data gathered in this monitoring allowed us to confirm the nature of the source as a SFXT. Moreover, we show that the X-ray emission from IGR J16418-4532 can be explained in terms of the accretion from a spherically symmetric clumpy wind, with clumps of masses from 1E16 to 1E21 g.

Vanessa MANGANO ***P***
INAF IASF Palermo

IGR J08408-4503 in outburst observed by Swift

Supergiant Fast X-ray Transients (SFXTs) are accreting HMXBs with OB supergiant companions showing outbursts in the soft/hard X-rays with an increase of 3-5 orders of magnitudes in the luminosity for a few hours followed by smaller amplitude flaring activity. We report on the analysis of the 2011 outburst of IGR J08408-4503 caught by Swift/BAT (15-150 keV) and followed up at softer energies (0.2-10 keV) with Swift/XRT. The spacecraft automatic slew and BAT/XRT simultaneous observations allowed us for the first time resolved broadband spectral analysis of the outburst emission for this source. We searched for spectral evolution with different spectral models, including the COMPMAG model (Farinelli et al. 2012) specifically dedicated to the physical framework of accretion at the polar cap of a neutron star with a high magnetic field (>= 1E12 G), expected to be typical of these accreting systems. We compare our results with those of IGR J16479-4514 time resolved spectral analysis.

Vanessa MANGANO ***P***
INAF IASF Palermo

Numerical Solution of the Radiative Transfer Problem for Accreting Matter onto Magnetized Compact Objects: Application to Supergiant Fast X-ray Transients

We have developed an algorithm based on relaxation techniques aimed at solving radiative transfer equations in Fokker-Planck (diffusion) approximation when both thermal and bulk Comptonization contribute to the spectral formation process. In particular, we applied the algorithm to the case of a cylindrical accretion column of matter falling onto the polar caps of a magnetised compact object. The algorithm is going to be implemented in the XSPEC package for X-ray spectral fitting as the contributed model COMPMAG. We show the results of the first application of this model to the two SFXT prototypes, XTE J1739-302 and IGR J17544-2619, which triggered the Swift/BAT on 2011 February 22 and March 24, respectively. We fitted the broad-band spectrum of those exceptionally bright outbursts comparing several phenomenological and physical models, including COMPMAG.

Masaru MATSUOKA ***P***
RIKEN, the Institute of Physical and Chemical Research

Possible contribution of stellar flares to GRXE based on the observation by MAXI/GSC

Using the results of MAXI/GSC the potential contribution of stellar flares including CVs to the Galactic ridge X-ray emission (GRXE) luminosity is estimated in the energy range of 2~10 keV. A promising result has been obtained extrapolating the number of stellar flares and that of CVs toward the Galactic ridge from those of the observed flares including CVs near the solar system although the MAXI/GSC data still lack sufficient statistics. The ionized emission lines of Si to Fe are also simulated by making the composite thermal spectrum which is based on the observational temperatures of stellar flares. The present evaluated result strongly supports a picture that the cumulative stellar flares contribute primarily to the GRXE. We also propose a possible contribution of 6.4 keV lines to the GRXE. Reference: http://arxiv.org/abs/1109.4814

Sandro MEREGHETTI ***P***
INAF - IASF Milano

X-rays from hot subdwarf stars with white dwarf and neutron star companions

There are only two hot subdwarfs detected in X-rays. Both show a fast periodicity demonstrating the presence of compact companions, as predicted in evolutionary models for these post common-envelope systems. The X-rays are likely powered by wind accretion onto a neutron star or white dwarf and can be used to study the weak winds of these peculiar stars. We showed that the companion of HD 49798 is the fastest spinning white dwarf (P=13.2 s) and one of the most massive with a dynamical mass measurement (M=1.28 Msun). We recently obtained new observations to study the X-ray emission during the white dwarf eclipse, probably originating from the sdO star itself or from reprocessing of the WD emission in the subdwarf's wind. BD+37 442 is a luminous He-rich sdO that was believed to be single, until our discovery of an X-ray periodicity of 19 s. I will review the properties of these systems, including our most recent results, and discuss them in the context of evolutionary models.

Ada NEBOT ***P***
Observatoire Astronomique de Strasbourg

XMM-Newton Survey Science Center Galactic Plane Survey

We report on the results from a Galactic survey conducted by the XMM-Newton Survey Science Centre at low Galactic latitudes (|b|<20 deg) and covering a wide range of Galactic longitudes. Among the 1319 serendipitously detected X-ray sources, we have classified 316 X-ray sources on the basis of optical spectra and helped by cross-correlation with optical and infrared catalogues. In the soft band (<2keV) most of the sources are identified with stars, with a surface density increasing towards the Galactic Plane. Although the hard band is dominated by the extragalactic background, we have evidence of a Galactic population with surface density increasing towards the Galactic Center.

Alida ODENDAAL ***P***
Department of Physics, University of the Free State

X-ray Periodicity in the Supersoft X-ray Sources CAL 83 and SMC 13

Supersoft X-ray Sources form a highly luminous class of objects that emit more than ~90% of their energy below 0.5 keV. They are believed to consist of a white dwarf (WD) accreting material from a binary companion at a rate high enough to drive nuclear burning on the WD surface. CAL 83 in the LMC is often considered to be the prototype of this class. We report the discovery of a ~67 s periodic modulation in some X-ray data sets of CAL 83 (up to ~8 sigma detection), usually during optically low stages. This is ascribed to the rotation period of a highly spun-up WD (cf. the WD spin periods of ~33 s in AE Aqr and ~64 s in V533 Her). This newly discovered spin period may indicate that the WD has a magnetosphere interacting with the disc, resulting in spin-up. The optical spectral line widths support the presence of an accretion disc. The orbital modulation in the X-ray flux of SMC 13 in the SMC has also been confirmed, and the X-ray period agrees with the known orbital period of ~4.1 h.

Adamantia PAIZIS ***P***
INAF IASF Milano

A Chandra ToO campaign to unveil the nature of new INTEGRAL sources

We present the results obtained from our Chandra Target of Opportunity campaign to unveil the nature of sources discovered by INTEGRAL. Our study, active since 2005, comprises Chandra 20ksec grating ToO observations of bright sources discovered by INTEGRAL. When possible, besides X-ray observations, near infrared and radio observations have been triggered and included as well. The current sample includes two accreting millisecond X-ray pulsars (IGRJ00291+5934, IGRJ17511-3057), two black hole candidate low mass X-ray binaries (IGRJ17497-2821, IGRJ17177-3656) and the recently discovered obscured X-ray pulsar (IGR J18179-1621).

Qiuhe PENG ***P***
Department of Astronomy, Nanjing University

A Physical mechanism of Emission for high x-ray luminosity of magnetars

we have found a mistake in the key formulae under strong magnetic field in popular textbooks on statistical physics. We correct the mistake and get a conclusion that the electron Fermi energy increases with magnetic field, which is contrary to the popular idea. result. It is found that the Fermi energy of electrons is higher than 60MeV in ultra-strong magnetic field B>> Bcr (=3.414*10**13 gauss), which is much higher than the Fermi energy of neutrons (~60MeV).Then the process of electron capture (EC) by protons around proton Femi surface will happen in a magnetars. The outgoing neutrons may easily destroy the P-Cooper pairs of neutrons.The energy of magnetic moment for the P-Cooper pairs is released and transformed into thermal energy, then it may be radiated as soft X-rays. According to the above ideas, we have calculated the theoretical luminosities of magnetars, and we have compared our results well with observations

Pierre-Olivier PETRUCCI ***P***
Institute of Planetology and Astrophysics of Grenoble

Disc apparent recession and jet reappearance: the turning back of GX 339-4 in the hard state at the end of its 2010-2011 outburst

We triggered our Suzaku ToO (5 × 20 ks spaced by a few days) at the very end of the 2010/2011 outburst of GX 339-4, when the source is turning back in the hard state. Quasi-simultaneous radio observation were also carried on. Although at almost the end of the transition, we had the opportunity to follow, in X-rays, the onset of the jet reappearance. The radio emission switches on between the first two Suzaku pointings. From an X-ray point of view, the first two observations show an excess at low energy well fitted by a multicolor disc extended down to the last stable orbit. Thus the disc could exist down to the last stable orbit until the very end of the transition, where the source begins to become very faint. Interestingly, the inner disc radius becomes larger than 10 Rg in the third observation suggesting the beginning of the disc recession, a few days after the switching on of the radio emission.

Fabio PIZZOLATO ***P***
IASF Milano

Stochastic accretion and the variability of super giant fast X-ray transients

We consider the variability of the luminosity of a compact object (CO) powered by the accretion of an extremely inhomogeneous (``clumpy'') stream of matter. The accretion of a single clump results in an X-ray flare: we adopt a simple model for the response of the CO to the accretion of a single clump, and derive a stochastic differential equation (SDE) for the accretion powered luminosity $L(t)$. We put the SDE in the equivalent form of an equation for the flares' luminosity distribution (FLD), and discuss its solution in the stationary case. As a case study, we apply our formalism to the analysis of the FLDs of Super-Giant Fast X-ray Transients (SFXTs), a peculiar sub-class of High Mass X--ray Binary Systems (HMXBs). We compare our theoretical FLDs to the distributions observed in the SFXTs $IGR~J16479-4514$, $IGR~J17544-2619$ and $XTE~J1739-302$. Despite its simplicity, our model fairly agrees with the observed distributions, and allows to predict some properties of the stellar wind. Finally, we discuss how our model may explain the difference between the broad FLD of SFXTs and the much narrower distribution of persistent HMXBs.

Gabriele PONTI ***P***
Max Planck Institute for Extraterrestrial Physics

Ubiquitous equatorial accretion disc winds in black hole soft states

High resolution X-ray spectroscopy has revealed the presence of highly ionised winds in Black Hole Binaries (BHB). We analysed all the HETG Chandra, XMM-Newton and Suzaku observations of every BH Low Mass X-ray Binary (LMXB) to investigate these winds. In GRS1915+105 we observe both a strong correlation between the presence of the wind and the source state and an anti-correlation with the jet. We show that all the dipping BH LMXB share this same behaviour, while the non-dipping LMXB never show any sign of FeK winds, regardless of the state. We interpret this as a strong evidence for flattened disc winds as an ubiquitous component of the jet-free soft states. The FeK winds are generally associated with large outflow velocities and mass loads, indicating mass outflow rates of the order or higher than the mass inflow rate. These winds are, thus, key components in our understanding of the accretion onto BH mechanism.

Alessandro RIGGIO ***P***
INAF - Oss. astronomico di Cagliari

From the past to the future: Moon occultation technique for present and future X-ray missions.

On 2010, the X-ray astronomical satellite Rossi XTE, during the observation of the newly discovered AXP IGR J17480-2446, detected a serendipitously lunar occultation of the source. From present knowledge of lunar topography and Earth, Moon, and spacecraft ephemeris, we determined the source position with an accuracy of 40 mas. For the first time, using a non-imaging X-ray observatory, the position of an X-ray source with a sub-arcsecond accuracy is derived. We will show how the Moon occultation technique can be fruitfully applied to current and future X-ray missions like XMM-Newton, NuSTAR and LOFT.

Patrizia ROMANO ***P***
INAF-IASF Palermo

From hours to years: Swift's revolutionary view of SFXTs

Bright hard-X-ray flares of Supergiant Fast X-ray Transients (SFXTs) have triggered the Swift/BAT since launch. To ensure simultaneous NFI data, the Swift team has enabled automatic rapid slews to these objects following a BAT detection of flares, as is done for GRBs. In order to investigate these transients, the Swift SFXT Project takes advantage of Swift's unique capabilities of automatic fast-slewing and broad-band energy coverage. Our strategy has tripled the available sets of broad-band data of SFXT outbursts. Furthermore, thanks to Swift's flexible scheduling, we investigated the long term properties of SFXTs through monitoring campaigns while outside the outbursts, where the very high sensitivity of XRT can be best exploited. We present a review of the Swift outburst follow-ups and monitoring campaigns, which has led us to a broad-band spectral characterization, an assessment of the fraction of the time these sources spend in each phase, and their duty cycle of inactivity.

Soki SAKURAI ***P***
The University of Tokyo

Luminosity-Dependent Changes in the Accretion Geometry in Aquila X-1

Low-Mass X-ray Binaries (LMXBs) reside either in the soft or hard states. While the soft state is relatively well understood, our knowledge is much poorer on their hard state. We analyzed archival Suzaku data of the transient LMXB Aql X-1, obtained on 7 occasions during an outburst in 2007. Except in the first observation, the source exhibited clear hard-state signature. On the 2nd to 4th ones, the broad-band spectra detected in 0.8-100 keV, with a luminosity of (2.6-3.4)e+36 erg/s, were reproduced by a Comptonized blackbody (BB) model, plus weaker signals from a truncated disk (Sakurai+2012). The BB radii supplying the seed photons were measured as 10 +/- 1 km, implying that the Comptonizing corona is flowing spherically onto the neutron star. The BB radius became smaller through the 5th to 7th observations, down to 3 km when the 0.8-100 keV luminosity decreased to 2e+34 erg/s. This suggests the emergence of a small magnetosphere, with the flow changing into magnetic-pole accretion.

David SALVETTI ***P***
INAF-IASF Milan

Completing the census of Fermi pulsars

The Large Area Telescope (LAT) onboard Fermi shed new light on the Galactic population of rotation-powered pulsars (PSRs), unveiling a large population of radio-quiet (Geminga-like) gamma-ray PSRs and one of gamma-ray-emitting millisecond PSRs. Moreover, among the ~2000 gamma-ray sources in the Fermi-LAT Second Source Catalog (2FGL), approximately 30% remained unidentified. An important fraction of these sources could be represented by gamma-ray PSRs. To complete the census of PSRs, we implemented a statistical method (logistic regression) to quantify the probability for each unidentified source to be a PSR, based solely on the observed gamma-ray properties of the source. We are performing X-ray follow-up observations of the most promising sources, which include good radio-quiet gamma-ray millisecond PSR candidates. Their discovery would have very important implications for our understanding of PSRs.

Nicola SARTORE ***P***
INAF - IASF Milano

Ten years of XMM-Newton observations of RX J1856.5-3754

RX J1856.5-3754 is the brightest and closest member of a small group of isolated neutron stars (INS) showing only thermal spectra, with temperatures of 50-100 eV. X-ray spectroscopic and timing studies, possibly coupled with polarization measurements, of this and other INS may reveal the physical conditions on their surface and thus give precious information on the structure and composition of NS interiors. We report on the spectral and timing analysis of a large set of XMM-Newton observations of RX J1856.5-3754 in the time interval from April 2002 to April 2012. Preliminary work showed that this object has a steady emission, with upper limits of 0.5% and 3%, respectively, on temperature and flux variations in the time span from March 2005 to present-day. A high-quality spectrum, obtained by summing homogeneous datasets, is best-fitted with a two blackbody model, which also accounts for the flux seen at optical wavelengths.

Angelica SARTORI ***P***
INAF-IASF Milano

A time-variable, phase-dependent emission line in the isolated neutron star RX J0822–4300

RXJ0822–4300 is the Central Compact Object in Puppis A SNR.Previous observations suggested RXJ0822–4300 to be a young neutron star with weak dipole field and peculiar surface temperature distribution (two antipodal spots with different temperatures and sizes), and the presence of an emission line at 0.8keV.We performed a 130ks XMM-Newton observation, which allowed detailed phase-resolved spectroscopy, confirming a narrow emission line only seen in the ‘Soft’ phase interval, when the cooler region is aligned to the line of sight. Surprisingly, comparison of our dataset to older ones yields evidence for a decrease in the central energy of the line from ~0.80keV in 2001 to ~0.73keV in 2009–2010. The line could be generated via cyclotron scattering of thermal photons in an optically thin layer of gas, or it could originate in low-rate accretion by a debris disk. This energy variation, pointing to a variation of the magnetic field in the line emitting region, cannot be easily accounted for.

Makoto SASANO ***P***
The university of Tokyo

Suzaku studies of 4U 0114+65 as a neutron star with possibly ~10^13 G magnetic fields

Magnetic field strengths of accreting neutron stars, typically B=10^12 G, have been measured using cyclotron resonances. At the same time, magnetars are known to have the strongest fields up to B~10^15 G. However, we know few neutron stars with B=10^13~14 G, which would bridge the typical neutron stars and magnetars. A candidate for this missing link is accreting pulsars with very long pulse periods, because their large co-rotation radii must be matched by rather large Alfven radii. Using Suzaku for 100 ks, we observed one such object, 4U0114+65. With the XIS and the HXD, its ~9400 s pulsations were clearly detected from 1 to 50 keV, together with two intense flares. Moreover, the obtained high-quality 1-100 keV spectra exhibited intriguing variations in the photoelectric absorption and Fe-K lines. Using these broad-band data and employing several different lines of argument, we estimate the Alfven radius of 4U0114+65, and discuss the possibility that this pulsar has B＞10^13.

Norbert S. SCHULZ ***P***
Massachusetts Institute of Technology

High Resolution X-ray Spectroscopy of Very Young Stellar Clusters

Since the first dectection of X-rays from young stars with EINSTEIN, X-ray observations of young stellar clusters have become an essential tool to study accretion, outflows, and specifically magnetic properties of young stellar objects. ROSAT in the past and XMM-Newton today suffer from sufficient spatial resolution to resolve cluster stars and majorly focus on spectroscopy of field stars. CHANDRA with its unique ability to fully resolve stellar clusters in X-rays opened the door to diagnose fundamental properties of very young cluster stars. We review results from highly resolved X-ray spectra obtained from nearby young clusters such as TW Hya, the Orion Nebula Cluster, and a variety of more distant clusters and discuss the challenges of future observations and possibilities with current and future missions.

Lara SIDOLI ***P***
INAF-IASF Milano

Supergiant Fast X-ray Transients: recent progress and challenging open issues in High Mass X-ray Binaries

Galactic X-ray binaries were discovered as the first cosmic X-ray sources. Since the early phases of X-ray astronomy, High Mass X-ray Binaries (most of which are accreting X-ray pulsars), have played a fundamental role in the study of accretion of matter onto a compact object. New surprises came thanks to the launch of INTEGRAL in 2002, which brought new attention to the HMXBs field, unveiling a new class of hard X-ray transients with short flaring activity, later recognized as a subclass of massive X-ray binaries: the Supergiant Fast X-ray Transients (SFXTs). A review of the main recent progress in the study of the puzzling properties of the SFXTs will be outlined, focusing on the new scenarios proposed to explain their bright flaring X-ray activity. We will also report on the latest results of a Suzaku observation of the SFXT with the shortest orbital period, IGRJ16479-4514, permitting the first orbital phase resolved investigation of the X-ray emission properties in a SFXT.

Yukikatsu TERADA ***P***
Saitama University

X-ray searches for new Galactic Particle-Acceleration sites with Suzaku

Origins of cosmic-rays are still mystery for just 100 years from the discovery. Neutron stars (NSs) and supernova remnants (SNRs) are considered as textbook cases of particle acceleration sites, but many unresolved problems remain numerically. Searches for new sites are crucial for astrophysics. We focus on two candidates those can contribute a few to ten % of Galactic cosmic-ray electrons: magnetic white dwarfs (MWDs) and runaway O-stars. The former has rotating magnetospheres like NSs, and the latter has termination shocks by fast stellar winds like SNRs. We performed six observations of MWDs in binaries and three single MWDs with Suzaku, and found some evidences of particle acceleration from three. We performed Suzaku observation of a runaway-star BD+43 3654, from where Synchrotron radio emission is reported. The upper limit in X-ray flux indicates low Lorentz factor of electrons, meaning low-turbulent magnetic field in shock. Prospects with near future missions are also discussed.

Shunsuke TORII ***P***
The University of Tokyo

Spectral and temporal studies of Cyg X-1 in the Soft State with Suzaku

Using Suzaku, we observed Cyg X-1 in the Soft State in October 2011. The obtained broadband (0.7-200 keV) spectra slightly deviated from a simple mixture of a multicolor disk emission and a power-law. In order to understand the overall spectral composition, we utilized exceptionally high variability (~50%) for the soft state, and tried to separate variable and stable components. We thus found a variable spectral component, which can be reproduced with an absorbed single power-law. Its photon index, ~2.7, was almost the same as the overall shape in the hard X-rays. After removing this component, we were left with a less variable spectral component in energies below 4 keV. It was expressed by another power-law with a steeper photon index of ~3.8 (with weak disk contribution). We interpret these spectral components as thermal/non-thermal hybrid plasma and diagnose geometry of accretion flows in the Soft State.

Panayiotis TZANAVARIS ***P***
NASA/Goddard Space Flight Center

Understanding X-ray Binary Formation and Evolution: Population Synthesis Modelins and Chandra Observations

We present the largest population synthesis study of X-ray binaries (XRBs) in nearby galaxies to date. We consider an extensive set of physically motivated models for formation and evolution of binaries with the population synthesis code StarTrack. We convolve them with star formation histories obtained with SED modeling (Noll et al. 2009) and construct theoretical X-ray binary luminosity functions (XLFs) for a subset of nearby galaxies in the Spitzer Infrared Nearby Galaxy Sample (SINGS). We also construct observational XRB-XLFs for these galaxies from X-SINGS, the extension of SINGS in the X-rays with Chandra. Using a likelihood approach, we identify models that produce XLFs consistent with the observations, providing robust constraints for XRB formation and evolution.

Hideki UCHIYAMA ***P***
University of Tokyo

The spatial profiles of K alpha line emissions from highly ionized S, Ar, Ca and Fe atoms in the Galactic ridge X-ray emission

The origin of the Galactic Ridge X-ray Emissions (GRXE) has been a mystery since the dawn of the X-ray astronomy. Recent Suzaku works show that the properties of Fe K alpha line emission in the GRXE, the intensity ratio of H-/He-like (Yamauchi+09) and emissivity per stellar mass (Uchiyama+11), are different between the Galactic center (|l|2 degree). These suggest that the origin of the GRXE might be different place by place. To confirm it, the positional difference of the GRXE spectra is important. Using all the Suzaku archival data of |b|< 5 degree, we have surveyed the spatial K alpha intensity profile of not only Fe but also S, Ar and Ca. The profiles of the H- and He-like Ar, Ca and Fe K alpha and He-like S K alpha have clear excess in the center compared to the plane. However, that of H-like S K alpha line has no significant excess. It means that multi-temperature plasma is required as the GRXE and the origins of Fe and S lines are probably different.

Hiroya YAMAGUCHI ***P***
Harvard-Smithsonian Center for Astrophysics

Spectroscopic studies of iron emissions from supernova remnants with Suzaku

We present X-ray spectroscopy of iron (Fe) emission from supernova remnants (SNRs) with Suzaku. Since production of Fe is significantly different between Type Ia and core-collapse (CC) supernovae, its emission provides a powerful probe of the SNR's progenitor and pre-explosion environment. In SN1006 we have detected an Fe emission line for the first time. Its abundance relative to other elements was found to be consistent with the predicted yields of Type Ia supernova models. Discovery of a radiative recombination continuum (RRC) of Fe from W49B is one of the most intriguing results from recent X-ray observations of SNRs. The presence of strong RRC indicates the plasma is overionized unlike most other SNRs, and has dramatically changed our knowledge of SNR evolution. We have also analyzed Suzaku data of more than 20 SNRs and found that the ionization degree of Fe ejecta tends to be lower in Type Ia SNRs than in CC SNRs. This may reflect the pre-explosion environment of the remnants.

Ping ZHAO ***P***
Harvard-Smithsonian Center for Astrophysics

Cataclysmic Variables discovered in the ChaMPlane Survey

We present the Cataclysmic Variables discovered in the Chandra Multi-wavelength Plane Survey (ChaMPlane). ChaMPlane is designed to survey the point X-ray sources discovered by the Chandra X-ray Observatory in the galactic plane in order to constrain the X-ray binary population in the Galaxy. We have been conducting the ChaMPlane survey since year 2000. The survey includes the data from the Chandra achieve, as well as the optical and infrared images and spectroscopes. CV candidates are first identified from the Chandra and optical imaging in the deep V, I, R, H-alpha bands. Then optical spectroscopic follow-ups are conducted to confirm their status. CVs are identified by their hydrogen Balmer and helium emission lines, often broadened and double peaked due to the accretion disk rotation around the primary. We present the spectra of 24 CVs obtained from the Magellan, CTIO-4m and WIYN telescopes.

Galaxies and ULX

Jeanette GLADSTONE ***I***
University of Alberta / Canada

New views of ultraluminous X-ray sources

Abstract: Ultraluminous X-ray sources (ULXs) were an enigma since their discovery. ASCA showed that they are accreting black holes (BHs), but the BHs mass remained unknown. Eddington scaling arguments and early XMM-Newton spectral analysis indicated that we may be observing intermediate mass BHs (IMBHs), providing a formation route for supermassive BHs. However, recent analysis shows that the majority of ULXs are more readily explained by extreme accretion onto (large) stellar mass BHs. While the majority of ULXs are now thought to be understood, an extreme subset of these sources has recently come to the fore. The discovery of hyperluminous X-ray sources (HLXs) has led to speculation that we may, once again, have found IMBHs. This talk will explore our current view of ULXs, discussing how the current, and next generation of, telescopes can be used to confirm their nature, while searching for more examples and a greater understanding of their new subclass, HLXs.

Sean FARRELL ***O***
The University of Sydney

Bridging the Gap Between Stellar Mass and Supermassive Black Holes

ULXs are extragalactic objects that are located outside the nuclei of their host galaxies with luminosities that exceed the Eddington limit for a 20 Msun black hole. These luminosities have been interpreted as evidence of a new class of intermediate mass black holes with masses between ~1E2 – 1E5 Msun. The brightest of these objects have luminosities above 1E41 erg/s that cannot be easily explained without intermediate mass black holes. However, the luminosities of the bulk of ULXs could be explained through a combination of mild super-Eddington accretion and beaming. I will present the latest results of observations of the candidate intermediate mass black hole ESO 243-49 HLX-1, as well as a recent study into long-term variability in ULXs that sheds new light on the nature of the rest of the population. Finally, I will outline predictions for the future direction of this field of study with a focus on the upcoming eROSITA all-sky X-ray survey.

Frank HABERL ***O***
Max Planck Institute for Extraterrestrial Physics

The XMM-Newton survey of the Small Magellanic Clouds - results and future prospects

Between May 2009 and March 2010 we carried out an XMM-Newton survey of the SMC, in order to obtain a complete coverage of both its bar and wing. Thirty-three observations with a total exposure of about one Ms together with the archival data cover the SMC down to a flux limit for point sources of ~10E−14 erg/cm2/s. This makes the XMM-Newton survey the deepest complete survey of the SMC in the 0.15--10.0 keV X-ray band. From a systematic processing of all available SMC data from the European Photon Imaging Camera we obtained a source catalogue which contains in total 5236 detections of 3053 individual X-ray sources. We find new interesting sources like Be/X-ray binaries and supersoft X-ray sources. In addition the images show extended X-ray sources like supernova remnants (SNRs) and clusters of galaxies. We propose new SNRs with low surface brightness of a few 10E-14 erg/cm2/s/arcmin2 and large extent. Also several known remnants appear larger than previously measured at other wavelengths, which extends the size distribution of SMC SNRs to larger values.

Michela MAPELLI ***O***
INAF-OAPd

X-ray binaries powered by massive stellar black holes

The mass of stellar black holes (SBHs) is currently thought to be in the 3-20 solar mass (Msun) range, but this is highly uncertain: recent observations indicate the existence of at least one SBH with mass >20 Msun. Stellar metallicity and dynamical processes are two key ingredients to shape the mass spectrum of SBHs. Dynamical interactions influence the mass of SBHs, as they trigger mass transfer and mergers between stars and between stars and SBHs. The metallicity of the progenitor star strongly influences the mass of the remnant, as only metal-poor stars can have final masses larger than ~40 Msun and are expected to directly collapse into SBHs with mass >25 Msun. In this talk, I discuss the formation and evolution of massive SBHs (MSBHs), with mass > 25 Msun. I study the effects of MSBHs on the population of X-ray sources and on the dynamics of star clusters.

Matthew MIDDLETON ***O***
University of Durham

X-ray/radio coupling revealing the presence of a stellar-mass black hole in a ULX

The extreme luminosities (>10^39 erg/s) of Ultraluminous X-ray sources (ULXs) have led to the suggestion of accretion onto 'intermediate mass black holes', bridging the gap between the supermassive black holes of AGN and stellar-mass black holes in X-ray binaries (XRBs). Alternatively, ULXs may represent a large population of XRBs with accretion rates approaching or exceeding the Eddington limit. However, determining the black hole mass in ULXs has been elusive due to the typically large distances involved, resulting in faint emission at all wavelengths, preventing rigorous diagnostic tests. Here we report that a new, transient ULX in M31, demonstrates clear X-ray state transitions as seen in XRBs and is associated with an extremely luminous radio source which varies on timescales as short as minutes, and must therefore originate in a compact jet. By comparison with the X-ray/radio coupling in XRBs, this invokes the presence of a stellar-mass black hole and ~Eddington accretion.

Ikuyuki MITSUISHI ***O***
Tokyo Metropolitan University

X-ray Properties of the Starburst-Driven Outflow in NGC 253

X-ray properties of hot gas for 3 regions in NGC 253 were investigated. We extracted abundance patterns and found that every abundance pattern in all regions is consistent with each other, suggesting that all of observed hot gas have the same origin. These abundance patterns are similar to those of type II supernova even in the halo and consistent with those of other starburst galaxy halos. This suggests that a chemical pollution mechanism is common. We also examined polytropic relationship between temperature and density and this indicates that the hot plasma expands adiabatically in the disk while it freely expands in the halo. Furthermore, the constant velocity of hot gas in the halo on the order of 100 km/s is needed to reproduce the observed temperature profile. This suggests that hot gas can escape from the host galaxy into intergalactic space as an outflow (Mitsuishi et al. in prep). Finally, we discuss the possibility of detecting outflowing hot gas using SXS on board Astro-H.

Piero RANALLI ***O***
National Observatory of Athens

X-ray gaseous emission in star forming galaxies

The understanding of the physical state of the X-ray emitting hot gas in star forming galaxies has been greatly improved thanks to high resolution X-ray spectroscopy. Observations of the prototype starburst galaxies M82 and NGC3256 with the EPIC and RGS instruments on XMM-Newton and with Suzaku have shown spatially dependent chemical abundances, possible non-thermal effects in X-ray plasma emission, and the first tentative discovery of charge-exchange emission in X-rays from an external galaxy. In this talk I will review these findings, and show the strong need of calorimeter instruments for the further advancement of this field.

Tim ROBERTS ***O***
Durham University

ULXs and accretion physics around the Eddington limit

It is now widely accepted that all but the most luminous ULXs are likely to be powered by accretion at or above the Eddington limit onto stellar remnant black holes. But what physical processes dominate this regime? And how does this new accretion regime relate to the familiar sub-Eddington states? Here we will present recent work from our group on several ULXs operating at around the Eddington limit for a 10 solar mass black hole (~10^39 erg/s), that show disc-like X-ray spectra. These spectra are too broad to be explained by standard accretion disc models, even when effects such as relativistic smearing are accounted for. Instead they appear to behave as a combination of an advection-dominated disc, and an emergent optically-thick corona. We will show how this behaviour is qualitatively similar to theoretical predictions of super-Eddington accretion, and how it should naturally evolve into the 'ultraluminous state' proposed for more luminous ULXs.

Maria D. CABALLERO-GARCIA ***P***
INAF-OAB (Merate, Italy)

Black Holes in Ultra-Luminous X-ray sources: the Spectral-Timing approach

Ultra-luminous X-ray sources are accreting black holes that might represent strong evidence of the Inter-Mediate Mass Black Holes (IMBH), proposed to exist by theoretical studies but with no firm detection (as a class) so far. In this talk I will present achievements that have been done in that direction and our new timing versus spectral results. I will discuss them in the framework of disc theory and provide some clues into the mass of these enigmatic objects.

Daniel DEWEY ***P***
MIT Kavli Institute for Astrophysics and Space Research

SN 1987A at High Resolution informs its Hydrodynamics

Handed the baton from ROSAT, early observations of SN 1987A with the Chandra HETG and the XMM-Newton RGS showed broad lines with FWHM ~ 10^4 km: the SN blast wave was continuing to shock the HII region around '87A. Since then, '87A's picturesque equatorial ring (ER) has been shocked, giving rise to a growing narrow-line emission. Even so, current HETG and RGS observations show that a broad component is still present and contributes ~20% of the 0.5-2 keV flux. SN 1987A's X-ray behavior can be modeled with a minimum of free parameters as the sum of two simple 1D hydrodynamic simulations: i) an on-going interaction with HII region material that produces the broad emission lines and most of the 3-10 keV flux, and ii) the shock interaction with dense, clumpy ER material that dominates the 0.5-2 keV flux. Toward the future, we predict a continued growth of the broad component but a drop in the 0.5-2 keV flux _once_ no new dense ER material is being shocked. Time, and new data, will tell.

Lorenzo DUCCI ***P***
Institut fuer Astronomie und Astrophysik, Universitaet Tuebingen

X-ray source population study of M83 with XMM-Newton

We present the results of three XMM-Newton observations of the starburst galaxy M83. 194 sources were detected down to a luminosity limit of ~1e37 erg/s (0.2-12keV) in the XMM-Newton field of view. We constrained the nature of the detected sources by means of hardness ratios, studies of the X-ray variability, and identification with sources in other wavelengths. We derived X-ray luminosity functions for the X-ray binaries within and outside the D25 ellipse, correcting for incompleteness and subtracting the AGN contribution. The possible interpretations of the results obtained from this comparison are discussed.

Andrea NEGRI ***P***
Dipartimento di Astronomia, Universita' di Bologna

Disk dynamics and the X-ray emission of S0 and flat early type galaxies

By using 2D hydro simulations performed with the ZEUS-MP2 code, we study the evolution of the hot gaseous halos of early type galaxies, focussing on the effects of galaxy rotation on the thermal and dynamical status of the ISM. The galaxy is modeled as a two-component axisymmetric system (stars and DM) with variable mount of azimuthal velocity dispersion and rotational support. We also investigate the ISM hydrodynamical evolution in the presence of a counter-rotating stellar disk. Preliminary results show that the X-ray emission is higher in velocity dispersion supported systems than in rotationally supported ones.

Silvia PELLEGRINI ***P***
Department of Astronomy, University of bologna

AGN activity and the extended hot interstellar medium in the compact radio elliptical NGC4278

A major field of current research, where X-ray astronomy provides fundamental information, is that of the connection between a galaxy and its central supermassive black hole (MBH). We present a deep (579 ks) Chandra ACIS pointing of the elliptical NGC4278, at a distance of 16.1 Mpc, representative of the less explored class of low/intermediate mass ellipticals. Hot gas is detected from the nucleus to a radius of 5 kpc, elongated and misaligned with the stellar distribution. The gas temperature shows a sharp increase at the center, an unusual feature discovered recently in few other galaxies. We investigate the origin of the very sub-Eddington nuclear emission, its relationship with the fuel available for the MBH, the partition in the accretion energy output between radiative and mechanical forms, and possible origins for the central temperature spike, including the action of a parsec-scale jet. A link seems also to be present between the hot, cold, and ionized gas phases.

Silvia POSACKI ***P***
Department of Astronomy, University of Bologna

The effects of flattening and rotation on the temperature of X-ray halos of elliptical galaxies

Elliptical galaxies have hot coronae with X-ray luminosities and mean gas temperatures that span over wide ranges. This variation can be partially due to the energy budget of the hot gas, that depends on the host galaxy structure and internal kinematics. With the aid of realistic axisymmetric galaxy models, we performed a preliminary diagnostic study focussed on the effects of galaxy flattening and rotational support. The two-integrals Jeans equations are solved, and the stellar density and velocity fields are projected along the line-of-sight. The circularized effective radius Re and the aperture velocity dispersion within Re are then computed. Using these quantities, the models are forced to follow the most important scaling laws of early-type galaxies (Faber-Jackson and Luminosity-Size). The expected gas temperature, and the energy required to extract the gas from the galaxy potential well, are finally computed for representative models.

Emanuele RIPAMONTI ***P***
Universita' di Milano-Bicocca - Dip. di Fisica "G. Occhialini"

Investigating the relation between ULXs and metallicity

One of the most promising models for ULXs predicts that they are powered by massive stellar black holes (MSBHs), i.e. stellar black holes with masses above ~25 Msun. Because of the dependence of stellar winds upon metallicity, MSBHs are expected to form only in environments with low-metallicity (even though dynamical interactions can slightly change this prediction). I will discuss whether observational evidences actually favour a link between ULXs and low metallicity.

Andrew SUTTON ***P***
University of Durham

Energy dependent variability as a diagnostic of the ultraluminous state

The nature of ultraluminous X-ray sources (ULXs) is still the subject of much debate. However, it seems increasingly likely that many are in a new super-Eddington accretion state, and there may be some spectral state progression with increasing Eddington ratio. Here, we present results from a sample of ULXs observed by XMM-Newton, composed of the highest count rate EPIC data. We use this to gain new physical insights, and break some of the degeneracies inherent in spectral studies, by systematically examining the short-term, energy dependent timing properties of ULXs. We show that the faintest ULXs typically have disc-like X-ray spectra, whilst the spectra of many brighter sources appear dominated by optically thick coronae, or a soft component consistent with a wind, with variability properties demonstrating this latter distinction may be due to viewing angle. Additionally, we present results from a multi-observatory study of the most luminous sample source, a ULX in NGC 5907.

Luca ZAMPIERI ***P***
INAF-Astronomical Observatory of Padova

Ultraluminous X-ray Sources: Looking ahead

Despite the impressive advancements occurred in recent years, the existence of Ultraluminous X-ray sources (ULXs) represents still a theoretical challenge in modern Astrophysics. Likely the majority of them are the most extreme version of an X-ray binary, with a Black Hole in a mass range or in an accretion regime so far unexplored. A handful of hyperluminous objects may provide the first unambiguous identification of an intermediate mass (100-10000 solar masses) black hole. Here I will review our present understanding of ULXs, discuss some potential pathways to their formation and summarize possible future theoretical and observational prospects, emphasizing what is the progress that can be expected from future X-ray missions.

Luca ZAMPIERI ***P***
INAF-Astronomical Observatory of Padova

A stellar-mass BH in a transient, low luminosity ULX in M31?

We report on a multi-wavelenght study of the recently discovered Ultra Luminous X-ray (ULX) transient XMMUJ004243.6+412519 in M31, based on data of Swift and the 1.8-m Copernico Telescope at Cima Ekar in Asiago (Italy). Undetected until January 2012, the source suddenly showed a powerful X-ray emission with a luminosity of 10^38 erg/s (at a distance of 780 kpc). In the following weeks, its luminosity overcame 10^39 erg/s, remaining fairly constant for at least 40 days and fading below 10^38 erg/s in the next 200 days. The spectrum can be well described by a multi-color disk blackbody model which progressively oftened during the decay (from kT= 0.9 keV to 0.4 keV). We do not find any variability nor QPOs up to 280 Hz. No emission from XMMUJ004243.6+412519 was detected down to 22 mag in the optical band and of 23–24 mag in the near ultraviolet. We compare its properties with those of other known ULXs and Galactic black hole transients, finding more similarities with the latter.

AGN, Jets and Feedback

Laura BRENNEMAN *I*
Harvard-Smithsonian Center for Astrophysics

NuSTAR's View of AGN

The launch of the Nuclear Spectroscopic Telescope Array (NuSTAR) in June 2012 has opened a new window onto the high-energy universe. The study of active galactic nuclei (AGN) and the supermassive black holes (SMBHs) within them stands to benefit greatly from this observatory. NuSTAR's unique combination of focusing X-ray optics, large effective area and low background over the 5-80 keV energy band allows us to unambiguously probe the nature of complex AGN environs. I will review the planned AGN physics science goals for the mission with a particular focus on joint XMM/NuSTAR and Suzaku/NuSTAR observing campaigns to constrain the properties of the SMBHs, inner accretion disks and coronae in six bright, nearby AGN. Obtaining high signal-to-noise spectra across a broad bandpass is crucial for this work, enabling degeneracies between the continuum, reflection and absorption signatures in the spectrum to be broken for the first time. I will show early results from the Suzaku/NuSTAR campaign on the bright Seyfert IC 4329A as a preview of the quality of results we can expect from these collaborations.

Gabriele GHISELLINI *I*
INAF/Osservatorio di Brera

High redshift blazar

High redshift extragalactic jetted sources are the most luminous persistent objects of the Universe, and can host black holes of a few billions of solar masses. Their study is important if we want to understand the physics of jets and their composition, hence the total power that they carry. I will review what we have learnt by the recent high energy missions, such as Swift/BAT and Fermi/LAT, and discuss the relation between the jet power and the accretion rate. The most extreme sources, found more efficiently through hard X-ray surveys rather than gamma-ray ones, are the objects hosting the largest black hole masses. Each detected blazars, whose jet is pointing at us, implies the existence of hundreds of similar sources whose jet is pointing in other directions: as a consequence, the search for high redshift blazars allows to put interesting constraints on the population of high redshift heavy black hole as a whole.

Roberto GILLI *I*
Osservatorio Astronomico di Bologna

The cosmic X-ray background: abundance and evolution of hidden black holes

The growth of each supermassive black hole across cosmic time leaves a radiative imprint which is recorded in the X-ray background (XRB). The XRB spectral shape suggests that a large population of distant, hidden nuclei must exist, which are now being revealed at higher and higher redshifts by the deepest surveys performed by Chandra and XMM. In this talk I will review our current understanding of the XRB emission in terms of AGN population synthesis models, and discuss the evolutionary path of nuclear accretion and obscuration which is emerging from leading X-ray surveys. The role of galaxy merging vs secular processes in triggering nuclear activity will be addressed in the framework of recent galaxy/black hole co-evolutionary scenarios. Finally, I will discuss the limits of current instrumentation in the detection of the most obscured and distant black holes, as well as some possible directions to overcome these limits.

James REEVES ***I***
UMBC

Iron lines and Outflows from Active Galactic Nuclei

I review the properties of the iron K lines observed in contemporary data from XMM-Newton, Chandra and Suzaku. In particular, the potential for measuring black hole spin from deep observations of AGN, such as from NGC 3783 or MCG -6-30-15, will be discussed, as well as the impact of X-ray absorption on the spectra. Evidence for highly ionised and potentially fast outflows, will also be discussed, including recent results from surveys of such outflows from XMM-Newton and Suzaku, as well as from deep follow-up observations. Finally the prosepcts for measuring iron line profiles at high resolution with Astro-H will be reviewed.

Alexander TCHEKHOVSKOY ***I***
Princeton University

GRMHD simulations of relativistic jets in AGN

Recent progress in computer simulations of black hole accretion allows studies of jet formation in active galactic nuclei (AGN) in unprecedented detail. For the first time, 3D general relativistic magnetohydrodynamic (GRMHD) numerical simulations allowed determination of the maximum efficiency with which radiatively inefficient accretion onto black holes can produce energy in the form of relativistic jets and winds. I will present the dependence of this maximum efficiency on black hole spin and accretion disk thickness and discuss the astrophysical implications.

Ezequiel TREISTER ***I***
Hawaii University

The Cosmic History of Black Hole Growth

In order to fully understand galaxy formation we need to know when in the cosmic history are black holes growing more intensively, in what type of galaxies this growth is happening and what fraction of these sources are invisible at most wavelengths due to obscuration. We take advantage of the rich multi-wavelength data available in the Chandra Deep Field South (CDF-S), including the 4 Msec Chandra observations (the deepest X-ray data to date), in order to measure the amount of black hole accretion as a function of cosmic history, from z~0 to z~6. We obtain stacked rest-frame X-ray spectra for samples of galaxies binned in terms of their IR luminosity, stellar mass and other galaxy properties. We find that the AGN fraction and their typical luminosities, and thus black hole accretion rates, increase with IR luminosity. The integrated intensity at high energies indicates that a significant fraction of the total black hole growth, 22%, occurs in heavily-obscured systems that are not individually detected in even the deepest X-ray observations. We further investigate the AGN triggering mechanism as a function of bolometric luminosity, finding evidence for a strong connection between significant black hole growth events and major galaxy mergers from z~0 to z~3, while less spectacular but longer accretion episodes are most likely due to other (stochastic) processes. AGN activity triggered by major galaxies is responsible for ~60% of the total black hole growth.

Massimo CAPPI ***O***
INAF/IASF-Bo

Ultra fast outflows (aka UFOs) from AGNs and QSOs

During the last decade, several observational evidences have accumulated for the existence of massive, high velocity winds/outflows (aka UFOs) in nearby AGNs and, possibly, distant quasars. I will present here such evidences and discuss their relevance for both understanding the physics of accretion/ejection flows on supermassive black holes, and for quantifying the total amount of AGN feedback.

Andrea COMASTRI ***O***
INAF-Osservatorio Astronomico di Bologna

Deep X-ray spectroscopy of obscured AGN in the ultra-deep XMM surveys of the Chandra Deep Field South (CDFS)

According to the recent models for the joint evolution of Super Massive Black Holes and their Host Galaxies, heavy obscuration represents a crucial phase and is expected to play a key role in the feedback mechanisms self regulating the SMBH growth. The smoking gun signature of heavy absorption is the presence of a low energy cut-off and/or reflection signatures (i.e. iron lines and edges) in the X-ray spectrum. Deep X-ray spectroscopy represents the most efficient method to uncover the most obscured sources at cosmological distances. After a brief description of the XMM ultra-deep (3 Ms) survey in the CDFS, I will present the results of a systematic search for heavily obscured and Compton thick AGN. I will also highlight the power of deep spectral spectroscopy to obtain redshift estimates, via the iron line, more accurate and reliable than available photo-z. Synergies between ultra-deep Chandra (4 Ms) and XMM observations and perspectives for future surveys will be also reported.

Agnese DEL MORO ***O***
Durham University

New insights on the distant AGN population

Current X-ray surveys have proved to be essential tools in order to identify and study AGNs across cosmic time. However, there is evidence that the most obscured AGNs are largely missing even in the deepest surveys. The search for these obscured AGNs is one of the most outstanding issues of extragalactic astronomy, since they are expected to make a major contribution to the high energy peak of the X-ray background (XRB) and might constitute a particularly active and dusty phase of black hole and galaxy evolution. I will present the whole AGN population identified in the Chandra deep fields using deep Chandra X-ray, Herschel infrared and/or VLA radio band data, highlighting the different properties of the different selections. I will also present the unprecedented NuSTAR view of these AGN, which will characterise, for the first time, the AGN population in the E=10-30 keV band, where the XRB peaks.

Barbara DE MARCO ***O***
Centro de Astrobiologia (CSIC-INTA)

Soft X-ray lags and the correlation with black hole mass in radio quiet AGN

Analysis of time lags between X-ray energy bands in AGN represents a powerful tool to study the causal connection between the different spectral components observed in time-averaged spectra, and to unveil the geometry of AGN inner regions. Recently, small-amplitude soft X-ray lags have been measured in a number of radio quiet AGN. The lags are observed in the energy band characterized by the presence of a soft-excess, giving important hints for understanding the physical origin of this component. We present results of a systematic analysis of X-ray lags in a sample of radio quiet AGN, with the aim of addressing the question of whether the detected soft lags can (all) be ascribed to a reverberation mechanism. This analysis led us to the discovery of a highly significant correlation of the soft lag characteristic time scales with the black hole mass, that points to the observed lags tracing a fundamental length scale of the system.

Ioannis GEORGANTOPOULOS ***O***
National Observatory of Athens

X-ray background synthesis models in the era of Nustar

We present a new model for the synthesis of the XRB which uses as input AGN X-ray spectra generated by Monte Carlo simulations. We identify a number of input parameters to the XRB synthesis code: the power-law index and high energy cut-off
of the X-ray spectra of AGN, the level of the reflection component and the fraction of Compton-thick (CT) AGN. We then map the range of parameters allowed by the XRB spectrum in the range 3-100 keV. One of the least constrained parameters is the fraction of Compton-thick AGN: acceptable fits to the XRB spectrum can be obtained for CT AGN fractions in the range 5-50% (1 sigma). This is because of degeneracies among input parameters to the XRB code. The safest route for constraining the fraction of CT is via their direct detection in high energy (>10 keV) surveys. The observed fraction of Compton-thick sources identied in the SWIFT/BAT survey, limits the fraction to 10-20%. Predictions for NUSTAR and eROSITA are presented.

Wako ISHIBASHI ***O***
Institute of Astronomy

The physical origin of the X-ray variability scaling in accreting black holes

Active galactic nuclei and black hole binaries are observed to follow the same X-ray variability 'fundamental plane', defined by the characteristic variability timescale, black hole mass, and accretion rate. The physical origin of this empirical scaling relationship, extending from super-massive to stellar-mass black holes, is however not definitively established. We suggest that the observed variability timescale is associated with the cooling timescale of electrons in the Comptonisation process at the origin of the hard X-ray emission. We obtain that the Compton cooling time remarkably reproduces the observed functional dependence on black hole mass and accretion rate. This result naturally arises from general properties of the emission process itself, and may provide a simple interpretation of the observed X-ray variability fundamental plane of accreting black holes.

Anne LOHFINK ***O***
University of Maryland, College Park

Tackling the soft X-ray excess in AGN with variability studies

Co-authors: REYNOLDS, Christopher (UMCP) MUSHOTZKY, Richard (UMCP) NOWAK, Michael (MIT) MILLER, Jon (U. of Michigan) The origin of the soft X-ray excess in AGN has been a mystery ever since its discovery. We present how the time variability of this spectral component can point towards its origin. Using the powerful technique of multi-epoch fitting, we study how the soft excess in a given object depends on other parameters of the continuum and the accretion disk possibly hinting at its nature. As an example, we present results from this technique applied to the Seyfert galaxy Mrk 841, the source in which the soft excess was originally discovered. We study all (5) XMM and all (4) Suzaku pointings available and find that the source displays an impressive variability in the soft X-ray band on the timescale of years. We several common soft excess models and their ability to physically consistently explain this spectral variability.

Andrea MERLONI ***O***
Max-Planck Institute for Extraterrestrial Physics

Accreting supermassive black holes in the COSMOS field and the connection to their host galaxies

Using the rich multi-band photometry in the COSMOS field we explore the host galaxy properties of a large, complete, sample of X-ray and spectroscopically selected AGN. Based on a two-components fit to their SED we derive rest-frame magnitudes, colors, stellar masses and star formation rates up to z~3. The probability for a galaxy to host a black hole growing at any given specific accretion rate (the ratio of X-ray luminosity to the host stellar mass) is independent of the galaxy mass and follows a power-law distribution in L_X/M. By looking at the normalization of such a probability distribution, we show how the incidence of AGN increases with redshift as rapidly as (1+z)^4.2, in close resemblance with the overall evolution of the specific star formation rate. Although AGN activity and star formation appear to have a common triggering mechanism, we do not find any 'smoking gun' signalling powerful AGN influence on the global properties of their host galaxies.

Lucerito MORALES TELLEZ ***O***
Universidad de Chile

AGN: Guilty or Innocent of Quenching Star Formation?

AGN host galaxies located at z~1 seem to be evenly divided into two groups: post-starburst galaxies or passively evolving galaxies, and actively star-forming dust-obscured galaxies. Previous work based on photometric data has given limited results to determine whether these two populations of AGN exist. Furthermore, the role that an AGN plays in galaxy formation and in the shutdown of star formation is not yet completely understood. Here, using spectra obtained with DEIMOS on the Keck II telescope, we performed a detailed analysis of the stellar populations of a representative sub-sample of ~30 AGN host galaxies selected in X-Rays in the ECDFS-S and COSMOS fields. Preliminary results on accurately age-date the stellar populations of the sample galaxies are presented in this work, giving a new insight into models of AGN feedback and the galaxy-black hole interaction.

Hirofumi NODA ***O***
The University of Tokyo

Model-Independent Decomposition of Broad-Band Suzaku Spectra of AGNs into Primary Continua and Secondary Components

X-ray signals from AGNs are relatively faint, and appear over a broad X-ray band. It has hence been difficult to uniquely separate their primary continua from various secondary components. Utilizing intensity correlations among different energies, instead of relying on spectral modeling, we developed a novel method to decompose the broad-band Suzaku spectra of AGNs. Applying this to many AGNs, we successfully extracted stable soft Compton components (Noda+11b), a variable new hard component (Noda+11a), and even the entire reflection feature with prominent Fe-K lines. These studies gave us two important implications. One is that the primary continua from the AGN central engines have concave shapes, rather than power-law like, due presumably to multi-zone Comptonization like in Cyg X-1 (Makishima+08). The other is that the cold materials producing the reflection and Fe-K line are mostly located at large distances from the central black holes, where the relativistic effect vanish.

Mathew PAGE ***O***
UCL Mullard Space Science Lab

X-ray and submillimetre observations of star-forming QSOs in the epoch of galaxy formation.

X-rays are the most efficient means to identify distant AGN, while submm observations expose star formation in their hosts. Prior to Herschel, X-ray surveys combined with ground based submm observations identified a subset of luminous, X-ray absorbed QSOs, as embedded in powerful star-forming galaxies. I will present evidence that the X-ray absorbers in these objects are highly-ionised winds, and discuss the evolutionary sequence suggested by these observations. I will then describe new results obtained from the Herschel HerMES observations of the Chandra Deep Fields, which pairs the deepest submm images with the deepest X-ray surveys (2012, Nature 485, 213). Remarkably, while submm emission from star formation is common in the hosts of 1<z< 10^44 ergs/s, none of the AGN with Lx > 10^44 are detected in the submm. This suppression of star formation at high Lx presents strong evidence that luminous AGN terminated the star formation in their hosts via powerful winds.

Abderahmen ZOGHBI ***O***
University of Maryland CP

Decoding black hole echoes

Studies of physical processes around black holes in active galactic nuclei has recently gained a great boost with the discovery of light reverberation on scales of a few gravitational radii. The initial detections where made in sources with bright so-called soft excess, where the delay was between the hard continuum and the 'reflected' soft excess. The ambiguous nature of the soft excess has however has limited a full understanding of the phenomena. In this work, I discuss the detection of light echoes in the iron K band in the bright AGN NGC 4151. The object not just shows delays between the iron line and the continuum, but also shows a delay between different parts of the line emitted at different radii in the black. I will discuss the result in this object and possible other sources and its implications.

Barbara BALMAVERDE ***P***
Osservatorio Astrofisico di Torino

Extended soft X-ray emission in 3CR radio galaxies at z < 0.3: High Excitation and Broad Line Galaxies.

We analyze the diffuse soft X-ray emission (0.5-2 keV) of the complete 3CR sample of radio galaxies at z< 0.3 recently observed by Chandra. We focus on the properties of the spectroscopic sub-classes of high excitation galaxies (HEGs) and broad line objects (BLOs). Among the 33 HEGs we detected extended (or possibly extended) emission in about 40% of the sources; the fraction is even higher (8/10) restricting the analysis to the objects with exposure times larger than 10 ks. In the 18 BLOs, extended emission is seen only in 2 objects; this lower detection rate can be ascribed to the presence of their bright X-ray nuclei that easily outshine any genuine diffuse emission. A very close correspondence between the soft X-ray and optical line morphology emerges. We also find that the ratio between [O III] and soft X-ray extended luminosity are confined within a factor of 2 around a median value of 5. Both results are reminiscent of what is seen in Seyfert galaxies.

Francisco J. CARRERA ***P***
Instituto de Fisica de Cantabria (CSIC-UC)

Star formation properties on the environments of high-redshift oscured quasars

We have assembled a sample of 5 X-ray and submm-luminous QSOs which are therefore both growing their central black holes through accretion and forming stars copiously. Hence, they are good laboratories to investigate the co-evolution of star formation and AGN. Our XMM-Newton observations reveal strong outflowing ionized winds from the QSOs which could terminate star formation. SCUBA maps have shown that they are also surrounded by submm source overdensities, placing them in the centres of high density peaks of the z~2 Universe. In one case we have already proved that the submm sources are indeed massive (but with undernourished black holes if any) star-forming galaxies associated to the QSO. We are studying an enlarged sample, using new larger-FOV wide-band X-ray-optical-IR-submm observations (including Herschel and SCUBA-2 data). We will appraise the relationship of the submm sources to the central quasars and their relevance for models of AGN-galaxy coevolution.

Ken EBISAWA ***P***
Japan Aerospace Exploration Agency(JAXA)/Institute of Space and Astronautical Science (ISAS)

Origin of the X-ray Variation and Seemingly Broad Iron Line Spectral Feature in Seyfert Galaxies

Significant X-ray variation of the AGN has been thought to originate in the X-ray production process taking place near the black holes. We show, contrary to the conventional picture, that the hard (2 - 40 keV) X-ray luminosities of the 21 Seyfert galaxies observed with the Suzaku satellite (including MCG-6-30-15) are rather invariable, and that the observed X-ray variations are explained by partial obscuration of the constant luminosity X-ray sources by the ionized clouds in the line of sight. The obscured spectral component has a significant ionized iron edge, which looks like a broad emission line. The geometrical covering fraction of the central X-ray source by the absorbing clouds is the only parameter required to explain apparently complicated X-ray intensity and spectral variations. This is considered to be the origin of the seemingly broad iron line spectral spectral feature and the small variations in the iron energy band, which are common properties of the Seyfert galaxies.

Luigi FOSCHINI ***P***
INAF Osservatorio Astronomico di Brera

Basic properties of Narrow-Line Seyfert 1 Galaxies with relativistic jets

The recent detection of high-energy gamma rays from Narrow-Line Seyfert 1 Galaxies (NLS1s) has drawn the attention on this peculiar class of AGN. I present here the preliminary results of a multiwavelength analysis of a sample of radio-loud NLS1s (including those detected at gamma rays) obtained from observations with Swift, Fermi, and ground-based radio telescopes.

Martin HUARTE-ESPINOSA ***P***
University of Rochester, Physics and Astronomy

Mass loading and knot formation in AGN jets by stellar winds

Jets from active galaxies propagate from the central black hole out to the radio lobes on scales of hundreds of kiloparsecs. The jets may encounter giant stars with strong stellar winds and produce observable signatures. For strong winds and a weak jet, the interaction may truncate the jet flow during its transit via the pass loading. For weaker jets, the interaction can produce knots in the jet. We present recent 3DMHD numerical simulations to model the evolution of this jet-wind interaction and the observational consequences. We explore: 1) the relative mechanical luminosity of the radio jets and the stellar winds 2) the impact parameter between the jets' axis and the stellar orbital path: 3) the relative magnetic field strength of the jets and the stellar winds. For our parameters we find that the otherwise smooth jet beam is considerably affected by stellar winds with mass losses ~5x10^-3 Mo/yr. Radio jet magnetic fields play some role in the dynamics and mixing of the interaction

Bidzina KAPANADZE ***P***
Ilia State University

Swift/XRT Observations of High-Energy Selected BL Lacertae Source PKS 2155-304

High-Energy Selected BL Lacertae Source PKS 2155-304 is one of the best studied sources in southern hemisphere. The Swift/XRT observed it more than 90 times during 2005-2011. We have reduced and analyzed these archived data which showed the extreme flux changes between 0.5 and 14 cts/sec through 0.3-10 keV band. The source varied erratically at different timescales from months down to about ten minutes. During the most dramatic flare (2006 July), the flux changed with factor of 6 , and decayed to the initial level in about 2 weeks. The spectrum was also variable with spectral slope \alpha=2.33 - 2.88 at 1 keV and SED peak energy \it{E}_{p}=1.82 – 2.68. The spectrum sometimes shows a significant curvature up to \it{b}=0.6. The spectral evolution in the hardness-ratio-flux plane shows both clockwise and counter-clockwise loops, revealing thus variable character of the acceleration processes occurring in this source.

Alexander KOLODZIG ***P***
MPA (Max-Planck-Institut für Astrophysik)

AGN in the eRosita All-Sky survey: Statistics and correlation properties

We study statistical properties of AGN to be detected in the all-sky survey by the eROSITA telescope aboard Spectrum-X Gamma observatory. Assuming that sensitivity of ~10^(-14) erg/s/cm^2 (soft band) will be achieved in the course of a 4 years survey, we estimate that ~3 million AGN will be detected. The redshift distribution of the detected AGN peaks at z~0.8, with 10% of objects located at z>2. A typical AGN detected in the survey will have the luminosity of ~10^44 erg/s. The ~10% of brightest objects will be detected with more than ~50 counts and their redshift distribution will peak at z~0.3. We also discuss prospects for studying large scale structure with the survey data.

Alberto MORETTI ***P***
INAF-O.A. Brera

The Cosmic X ray background: what's left unresolved 50 years since the discovery.

We present a study of the the unresolved X-ray background spectrum in the 1.5-7.0 keV energy band. Combining Swift and Chandra observations of the Chandra Deep Field South, we exploited the deepest observation ever performed and the lowest instrument background today available. This allowed us to measure the unresolved emission at the deepest level and with the best accuracy today available. We find that unresolved XRB emission can be modeled by a very hard power law (photon index ~ 0.1) with a flux corresponding to 20% of the total X-ray background in the 2-10 keV band, being 95% and 70% at 2 keV and 7 keV respectively. We show that this measurement can be effectively used in constraining the statistical properties of the elusive Compton Thick AGN population. Indeed, comparing our measurement with the output of AGN population synthesis models, we find evidence of a strong evolution with redshift of the luminosity function.

Andrzej NIEDZWIECKI ***P***
University of Lodz, Dept. of Astrophysics

X-ray emission from hot accretion flow

We present a model of optically thin, two-temperature accretion flows using an exact Monte Carlo treatment of global Comptonization, with a fully general relativistic description of both the radiative and hydrodynamic processes. The model also includes the description of the X-ray reflection from a surrounding cold matter. We compare predictions of our model, in particular, the luminosity vs. spectral index and the spectral index vs. reflection amplitude correlations, with observations of black hole binaries and active galactic nuclei.

Michael NOWAK ***P***
Massachusetts Institute of Technology

Hunting for the Variable Iron Line in NGC 4258 with Chandra-HETGS, XMM-Newton, and Suzaku

Aside from our own Galaxy, NGC 4258 hosts the supermasive black hole with the most precisely known mass and distance. Furthermore, we are viewing a nearly perfectly Keplerian, thin, warped accretion disk nearly edge-on, with our nuclear line of sight passing through the disk. The measured column in this source may be directly probing the disk's accretion rate. NGC 4258 is also important in that it is emitting at only a small fraction of the Eddington luminosity, lying in logarithmic steps half way between bright Seyferts and the extremely low luminosity of Sgr A*. The former exhibit well-formed disk spectra and relativistically broadened Fe lines. The latter, such as M81* (which lies at lower fractional Eddington luminosity than NCG 4258) shows line structure revealed by Chandra-HETG observations which may be indicative of an advective flow. Here we shall discuss the variable, narrow line Fe structure revealed by a series of observations with XMM, Suzaku, and Chandra-HETGS.

Stéphane PALTANI ***P***
ISDC, Observatory of the University of Geneva

Selection effects in the X-ray spectral indices of Seyfert galaxies

The rapid decrease of the fraction of X-ray absorbed Seyfert galaxies with X-ray luminosity may generate differences in observed average properties between Seyfert 1 and Seyfert 2 galaxies. One such difference that has been claimed is that the X-ray spectral index of Seyfert 2 galaxies is in average harder than that of Seyfert 1 galaxies. We explore here the possibility to obtain different spectral indices in a single population of Seyfert galaxies due to selection effects, based on the assumption that the spectral index is linked to the accretion rate. We estimate the amplitude of this effect using empirical determinations of the parameter distributions of Seyfert galaxies, like supermassive black-hole mass function, accretion rate distribution, etc., for surveys in different energy bands.

Pierre-Olivier PETRUCCI ***P***
Institute of Planetology and Astrophysics of Grenoble

Multiwavelength campaign on Mrk 509: testing realistic comptonization models

The simultaneous 1-month XMM/INTEGRAL monitoring of Mkn 509 provide a unique opportunity to test simultaneous UV to X/gamma rays data against physically motivated models. Each observation has been fitted with a realistic thermal comptonisation model for the primary continuum. In agreement with the observed UV/Soft X-ray correlation, we use a thermal comptonisation component for the soft X-ray excess. We also include a warm absorber and a reflection component, as required by the precise studies done by our consortium. The UV to X/gamma-rays emission of Mkn 509 is well fitted by these components and agrees with 1) a very hot optically-thin (kT~100 keV, tau~0.5) plasma for the primary continuum, and located in the inner accretion flow, and 2) a warm optically-thick (kT~1 keV, tau~10-20) plasma for the soft X-rays, that could be associated with the warm upper layer of the outer accretion disc. We discuss the direct constraints on and interconnections between these dfferent emitting regions

Gabriele PONTI ***P***
Max Planck Institute for Extraterrestrial Physics

Multiwavelength campaign on Mrk 509: Reverberation of the Fe Kalpha line

The origin and location of the Fe K emission in AGN is still highly debated. We will discuss the results of an extensive XMM-Newton monitoring campaign (10 pointing ~60 ks each, about once every four days) of the Fe K emission/absorption complex in the nearby, bright Seyfert 1 galaxy Mrk 509. Mrk 509 shows a clear (EW=58±4 eV) neutral Fe Kalpha emission line that can be decomposed into a narrow (sigma=0.027 keV) component (found in the Chandra HETG data) plus a resolved one (sigma=0.22 keV). We make the first reverberation measurement of the resolved component of the Fe Kalpha line (detecting a linear correlation, on time scales of few days-years, between the line intensity and the 3-10 keV flux variations), from which we can infer a location for the bulk of its emission at a distance of r~40-1000 rg from the BH. The Fe Kalpha emission could, thus, originate from the inner regions of the BLR, i.e. within the ~80 light days indicated by the Hbeta line measurements.

Agata ROZANSKA ***P***
N. Copernicus Astronomical Center

Radiative Transfer approach for X-ray astronomy

Interaction of radiation with matter in different astrophysical sources is observed in X-ray domain since the first satellite was lunched. Especially optically thick emission form neutron stars or accretion disks atmospheres in X-ray binaries is commonly observed. Furthermore, transmission of radiation through the diluted warm absorber is seen in above 50% of AGN. The data need to be compared with models. I overview recent methods of calculating the radiative transfer through the matter in various astrophysical objects i.a. neutron star atmospheres, accretion disks in X-ray binaries, and optically thin AGN outflows. The main differences between various methods will be present together with comparison to the observed spectra. Finally, I will emphasize what should be done in the future in this area.

Paola SEVERGNINI ***P***
INAF-Osservatorio Astronomico di Brera

Volume density of local Compton-thick AGN

We present a new efficient diagnostic method, based on mid-infrared and X-ray data, to select local (z<0.1) Compton-thick (CT) AGN with the aim of estimating their surface and space density. We define a region in the X-ray/IR vs. HR plane associated to CT AGN. We build up a sample of 43 CT AGN candidates using data from IRAS-PSC and 2XMM catalogue. In order to test the efficiency of the proposed method in selecting CT AGN we use the results of the X-ray spectral analysis performed on all the sources of our sample. After taking into account the different selection effects, we have estimated the number of CT AGN in the local Universe and their density down to the IRAS flux limit. We find that the diagnostic plot proposed here is an efficient method to select Compton-thick AGN in the nearby Universe. We find a large number of newly-discovered CT AGN. Finally, we estimated the co-moving space density of CT AGN with intrinsic LX>1e43 erg s-1 (0.004<z<0.06). The prediction for CT AGN based on the synthesis model of XRB in Gilli et al.(2007) is consistent with this value.

Stefano VERCELLONE ***P***
INAF-IASF Palermo

The Swiss knife: the unique Swift long-term monitoring program on 3C 454.3

The blazar 3C 454.3 is a well-known, extremely variable flat-spectrum radio quasar which exhibited the most intense gamma-ray flares detected up to now. Thanks to the Swift innovative and unique pointing strategy, it has been possible to monitor this source in the UV and X-ray energy bands on time-scales comparable to the ground-based optical and radio ones. The long-term multi-wavelength light-curves allowed us to obtain detailed information on time-lags between the flux emission in different energy bands, to investigate the properties of the jet during the most intense gamma-ray flares, and to study the radiation mechanisms responsible for the emission at different frequencies. We will review the results obtained so far on the above topics, highlighting the crucial role of Swift and its breakthrough in the X-ray studies of blazars.

Cristian VIGNALI ***P***
Universita' di Bologna, Dipartimento di Astronomia

Obscured accretion and star formation at z~1

Obscured accretion onto super-massive black holes at z~1 is one of the key ingredients in the current X-ray background (XRB) models. Here we present the properties of a sample of Type 2 AGN at z~1 selected by means of their [NeV]3426 emission line in the zCOSMOS bright survey. We use the 2-10 keV/[NeV] emission-line flux ratio as a diagnostic tool to discover heavily obscured, possibly Compton-thick AGN. While Compton-thick absorption is suggested in some objects directly from their Chandra spectra, average X-ray properties are derived for most of our sources via summed spectra and stacking analysis. The quest for obscured quasars at z~1 is relevant to place constraints on the number density of Compton-thick AGN in a redshift interval close to the predicted peak of the missing XRB population at 20-30 keV. We also present tentative evidence for enhanced star formation in our obscured quasars, which is consistent with current popular scenarios of BH-galaxy co-evolution.

Fabio VITO ***P***
Dipartimento di Astronomia - Universita' di Bologna, INAF-Osservatorio astronomico di Bologna

The high-redshift (z>3) AGN population in the 4 Ms Chandra Deep Field South

We present results from spectral analysis of a sample of high-redshift (z>3) X-ray selected AGN in the 4 Ms Chandra Deep Field South (CDF-S), the deepest X-ray survey to date. The sample is selected using the most recent spectroscopic and photometric information available in this field. It consists in 34 sources with median redshift z~4 and median net counts ~100. We assumed different spectral model to derive the distribution of column density and compared it with theoretical models. Moreover, we compute the LogN-LogS of the sample and compared it with data from other authors and models. Our results are consistent with a high-redshift decline of the AGN space density down to flux F(0.5-2 keV)~4x10^(-17) erg/s/cm^2 (i.e. rest-frame absorption-corrected luminosity down to L(2-10 keV)~10^43 erg/s and with no evolution of the AGN obscured fraction with redshift.

Xin-Lin ZHOU ***P***
National Astronomical Observatories, Chinese Academy of Sciences

A Comparison of Hard X-ray Photon Indices and Iron KαEmission Lines in X-ray Luminous Narrow- and Broad-line Seyfert 1 Galaxies

We use publicly available XMM-Newton data to systematically compare the hard X-ray photon indices, Γ2-10 keV , and the iron Kαemission lines of narrow- and broad-line Seyfert 1 (NLS1 and BLS1) galaxies. We compile a flux-limited (f 2-10 keV >= 1 × 10-12 erg s-1 cm-2) sample including 114 radio-quiet objects, with the 2-10 keV luminosity ranging from 1041 to 1045 erg s-1. Our main results are: (1) NLS1s and BLS1s show similar luminosity distributions; (2) the weighted means of Γ2-10 keV of NLS1s, BLS1s, and the total sample are 2.04 ± 0.04, 1.74 ± 0.02, and 1.84 ± 0.02, respectively; a significant anti-correlation between Γ2-10 keV and FWHMHβsuggests that Γ2-10 keV > 2.0 may be taken to indicate the X-ray luminous NLS1 type; (3) the 6.4 keV narrow iron Kαlines from NLS1s are generally weaker than that from BLS1s; this would indicate a smaller covering factor of the dusty tori in NLS1s if the line emission originates from the inner boundary region of the dusty torus in an active galactic nucleus; and (4) all the broadened iron Kαlines with intrinsic width σ>0.5 keV correspond to FWHMHβ<=4000 km s-1.

GRBs

Daniele FARGION ***P***
Physics Depart and INFN Rome 1

Are GRBs and SGRs thin collimated precessing gamma jets?

Gamma Ray Burst sources are apparently evolving around us in a harder and brighter samples at far and far redshift. The average output may range from a near Supernova (nearest events) output to a billion time that power for most distant events. Such a tuned evolution around us is not an anti-copernican signature. It is a clear imprint of a off-axis (nearest sources) beaming versus a rarest in-axis blazing (far redshift sources) by a thin relativistic beam (Lorentz factor up ten thousand or above, corresponding to micro-nano steradian solid angle). The main consequence is the rarer and rarer presences of hardest gamma events (hundreds MeV, GeVs, tens GeVs), nearly one over a twenty, partially opaque by IR-gamma cut-off, observed with difficulty at largest redshift inside their thinner beamed jets. Therefore cosmic GRBs born as beamed SN jet and their late decayed jet stages as SGRs in pulsars in our galactic volume are part of a single model. see arXiv:1108.0638v2

Agnieszka JANIUK ***P***
Center for Theoretial Physics

Accretion and outflow from a magnetized, neutrino cooled torus around the gamma ray burst central engine

We investigate the accretion flow evolution in the gamma ray burst central engine, using the 2-D MHD simulations in General Relativity. We compute the structure and evolution of the extremely hot and dense torus accreting onto the fast spinning black hole. We calculate the chemical structure of the disk and account for neutrino cooling. We estimate the neutrino luminosity of such an event for a given disk and central BH mass. Our models apply to the short GRB case (remnant torus accreted after NS-NS or NS-BH merger).

Makoto TASHIRO ***P***
Saitama University

Suzaku-WAM Observational Study of the Emission Mechanisms in Gamma-Ray Burst Exponential Decays

A Suzaku Wide-band All-sky Monitor (WAM) observational study is presented of the spectral evolution of gamma-ray burst (GRB) prompt emissions. We selected 6 bright GRBs exhibiting 7 well-separated fast-rise-exponential-decay (FRED) shaped light curves in order to investigate spectral changes by evaluating exponential decay time constants of the energy-resolved light curves. The time constants show a power-law like energy dependence with the energy index of –(0.3-0.5). In addition, we carried out time-resolved spectroscopy of two of them which were located with accuracy sufficient to evaluate the time-resolved spectra with precise energy response matrices. The two imply different emission mechanisms; the one is well reproduced with a cooling blackbody radiation model with a power-law component, while the other prefers non-thermal emission model with a decaying turn over energy.

Clusters of galaxies

Hans BÖHRINGER ***I***
Max-Planck-Institut fuer extraterrestrische Physik

Cosmology with X-ray Galaxy Clusters

Galaxy clusters form an integral part of the large-scale structure of the Universe. Therefore a census of clusters can provide quite precise insight into the cosmic large-scale structure and can be used to test cosmological models. X-ray observations provide us with the most detailed information on various physical parameters of clusters and they offer a very good means of their detection. Based on X-ray surveys of galaxy clusters and detailed follow-up observations I give a review on what we have learned on the structure of galaxy clusters and its statistics. I also show how the mass or X-ray luminosity function of clusters and their spatial distribution can be used to assess the large-scale structure of the dark matter distribution and how this assessment can be used to test cosmological models. Results from the cluster population detected in the ROSAT All-Sky Survey provide very good constraints on the matter density and the normalization of the power spectrum of the dark matter density fluctuations on large scales. It also provides a good measure of the power spectrum of the matter density fluctuations. The upcoming eROSITA mission will greatly improve the capabilities to use a large sample of up to 100 000 X-ray detected galaxy clusters for these test of cosmological models.

Maxim MARKEVITCH ***I***
NASA GSFC

Shocks and cold fronts in galaxy clusters

Galaxy clusters form and grow via a hierarchical process of merging of less massive systems. High angular resolution X-ray observations of cluster mergers performed by Chandra gave us unique insights into the physics of galaxy clusters. Observations of shock fronts provide information on the merger geometry and velocity, and for well-observed shocks, can constrain the microphysical properties of the intracluster plasma. A more frequently observed phenomenon, cluster cold fronts, may constrain viscosity of the intracluster medium and the structure and strength of the cluster magnetic fields. Combined with radio data, these observations also shed light on the production of ultrarelativistic particles that are known to coexist with the cluster thermal plasma. This talk will summarize the current X-ray observations of cluster mergers, as well as some recent radio data and high-resolution hydrodynamic simulations.

Etienne POINTECOUTEAU ***I***
IRAP

The Sunyaev-Zeldovich effect

The Sunyaev-Zel'dovich (SZ) effect provides an alternative to X-rays to characterise the hot gas within groups and clusters. The past years have seen a drastic increase of number of SZ measurements. Experiments such as the Planck satellite, the South Pole Telescope, the Atacalma Cosmology Telescope, the CARMA observatory, the Mustang/GBT instrument now allow precise SZ measurements over a wide range of spatial resolutions and frequencies. These SZ observations are covering huge volumes and providing detailed measurements of the intra-cluster gas, now able to compete with X-ray data. But even more important, combined SZ and X-ray analysis bear a tremendous scientific potential for clusters studies in the framework of structure formation and evolution, and cosmology. I will review the recent results obtained from SZ observations, and joint SZ and X-ray analysis.

Piero ROSATI ***I***
European Southern Observatory

Future X-ray surveys of clusters and multi-wavelength synergies

I will briefly review the current status of X-ray cluster surveys and recent remarkable progress in discovering clusters at z=1-2 in X-ray and other wavelengths with alternative methods. Multi-wavelengths observations are key to understand the formation and evolution of the baryonic content of clusters: much has been learnt recently on the formation of their galaxy populations, but very little on the early evolution of their intra-cluster gas due to the lack of X-ray surveys with adequate resolution and sensitivity. I will also briefly review recent progress in determining the cluster mass distribution (DM and baryons), which when compared with LCDM predictions on the structure of DM halos can be a powerful diagnostic of the current cosmological paradigm, besides the classic test on the abundance of clusters across cosmic time. I will also offer a forward look at the options the X-ray community has to make landmark progress in this field.

Fabio GASTALDELLLO ***O***
INAF-IASF Milano

X-ray groups from the core to the outskirts with Chandra, XMM and Suzaku

We present mass, entropy and metal abundance radial profiles for a sample of 50 galaxy groups-poor clusters (kT range 1-3 keV) with the best available data in the Chandra, XMM and Suzaku archives. The combination of data from these three satellites allows to constrain quantities in the core out to large radii. We will explore the concentration-mass relation in this important mass regime extending the results obtained with an earlier sample of 16 objects. We will investigate the entropy profile at large radii and compare it with the behavior of more massive clusters. We will systematically investigate with the better effective area of XMM the Chandra results of the Si/Fe radial profile in the group regime. We will present the results of a systematic search for sloshing cold fronts in groups and their implication for the influence of group tidal field on the optical appearance of disk galaxies.

Paolo TOZZI ***O***
INAF - Osservatorio Astronomico di Trieste

A scientific case for future X-ray astronomy: high-z galaxy clusters

We present recent results on distant (1<z10^{14} M_sun), high-z clusters is larger than previously thought, and this can put strong constraints on the standard LambdaCDM and Quintessence models, paving the way to possible new physics. Thanks to thes results, it is possible to find the optimal strategy to design future X-ray missions capable to create a breakthrough in this field.

Yu WANG ***O***
Shanghai Astronomical Observatory, Chinese Academy of Sciences

Central gas entropy excess as a direct evidence for AGN feedback in galaxy groups and clusters

I briefly review observations of X-ray jets and cavities in clusters of galaxies observed by {\it Chandra}. I then present my recent study on the excess of central gas entropy, which can be considered as direct evidence for AGN feedback in galaxy groups and clusters. An expanded account of this study has been presented in RAA (Wang et al. 2010).

Yuya SHIMODA ***P***
Saitama university

Metal abundances in the ICM associated with a medium-redshift cluster of galaxies MS 1512.4+3647 observed with Suzaku

We observed a medium redshift cluster of galaxies MS 1512.4+3647 (z = 0.37) with Suzaku for 230 ks. ASCA observation reported MS 1512.4+3647 is rather bright in X-ray and ICM temperature is low (2.85 keV) with high metal abundance (1.1 solar abundance). Therefore, MS 1512.4+3647 is one of the best target to detect metal abundances not only for Fe but also for alpha elements. Thanks to stable and low background level of Suzaku XIS, emission lines from highly ionized ions such as Ne, Mg, Si, S, Ar, Fe and Ni were significantly detected. Using a thin thermal plasma model, abundances of these elements are determined as 2.1, 1.0, 0.7, 0.5, 0.6, 0.7 and 2.6 solar, respectively, with uncertainty less than 50 %. This is one of the first result of abundance determination for alpha elements in the ICM associated with medium-redshift clusters. The abundance ratio to Fe is consistent with low-redshift clusters. Implication for metal enrichment history of this cluster will be discussed.

Current and Future Missions

Paul GORENSTEIN ***I***
Harvard-Smithsonian Center for Astrophysics

High Angular Resolution X-ray Astronomy In the Next 50 years

High angular resolution telescopes have made the importance of cosmic X-ray astronomy equal to optical and radio astronomy. However, the 0.5 arc second resolution of the Chandra X-Ray Observatory is near the limit of grazing incidence telescope technology. Future grazing incidence telescopes may have much larger effective area than Chandra but are not likely to have significantly better resolution. The most promising new technology is diffractive imaging with compensation over a significant bandwidth for chromatic aberration. Mili arc second resolution and better should be achievable. However, the optics require long distance formation flying between one spacecraft with optics and another with the detector. Focal lengths are hundreds or thousands of kilometers. The field of view is very small in practice because of limitations on the size of the detector. The area of the optics must be large in order to gather enough photons for the small angular bins to be statistically significant especially with a large cosmic ray background in large physical size pixels. The components are very light weight compared to grazing incidence optics so large areas are feasible. The prime targets would be the SMBH of an AGN, bright regions of jets, and coronas of nearby stars.

Robert PETRE ***I***
NASA / GSFC

AXSIO and the NASA X-ray Mission Concept Study

The Advanced X-ray Spectroscopy and Imaging Observatory (AXSIO) focuses on the IXO science objectives ranked highly by the Decadal Survey: tracing orbits near SMBH event horizons, measuring BH spin, characterizing outflows and the environment of AGN, observing SMBH to z=6, mapping gas motion in clusters, finding the missing baryons, and observing cosmic feedback. AXSIO's streamlining of IXO includes reduction in the instrument complement to a calorimeter and a grating spectrometer, and relaxation of the angular resolution to 10". With 0.9 m2 effective area at 1.25 keV, AXSIO delivers a 30-fold performance increase over current missions for high-resolution spectroscopy and spectroscopic timing. NASA has also undertaken a study of notional missions to determine lower cost approaches to accomplishing IXO objectives over the next decade. Three concepts were studied, which as a group encompass the full range of IXO science. The capabilities and architecture of these missions are summarized.

Peter PREDEHL ***I***
Max-Planck-Institut für extraterrestrische Physik

The eROSITA Mission

eROSITA (extended ROentgen Survey with an Imaging Telescope Array) is the core instrument on the Russian Spektrum-Roentgen-Gamma (SRG) mission which is current scheduled for launch in 2014. eROSITA will perform a deep survey of the entire X-ray sky. In the soft band (0.5-2 keV), it will be about 30 times more sensitive than ROSAT, while in the hard band (2-8 keV) it will provide the first ever true imaging survey of the sky. The design driving science is the detection of large samples of galaxy clusters to redshifts z > 1 in order to study the large scale structure in the Universe and test cosmological models including Dark Energy. In addition, eROSITA is expected to yield a sample of a few million AGN, including obscured objects, revolutionizing our view of the evolution of supermassive black holes. The survey will also provide new insights into a wide range of astrophysical phenomena, including X-ray binaries, active stars and diffuse emission within the Galaxy.

Luigi STELLA ***I***
INAF/Osservatorio di Roma

The Large Observatory for X-ray Timing (LOFT)

High-time-resolution X-ray observations of compact objects provide direct access to strong-field gravity, the equation of state of ultra-dense matter and black hole masses and spins. A 10 m^2-class instrument in combination with good spectral resolution is required to exploit the relevant diagnostics and answer two of the fundamental questions of the European Space Agency (ESA) Cosmic Vision Theme "Matter under extreme conditions", namely: does matter orbiting close to the event horizon follow the predictions of general relativity? What is the equation of state of matter in neutron stars? The Large Observatory For X-ray Timing (LOFT), selected by ESA as one of four Cosmic Vision M3 candidate missions to undergo an assessment phase, will revolutionise the study of collapsed objects in our galaxy and of the brightest supermassive black holes in active galactic nuclei. Thanks to an innovative design and the development of large-area monolithic Silicon Drift Detectors, the Large Area Detector (LAD) on board LOFT will achieve an effective area of ~10 m^2 (more than an order of magnitude larger than any spaceborne predecessor) in the 2-30 keV range (up to 50 keV in expanded mode), yet still fits a conventional platform and small/medium-class launcher. With this large area and a spectral resolution of ~200 eV, LOFT will yield unprecedented information on strongly curved spacetimes and matter under extreme conditions of density and magnetic field. Moroever, hundreds of galactic and extragalactic X-ray sources of different classes will be studied by LOFT with unprecedented throughput over about half of its 4-year operational lifetime.

Tadayuki TAKAHASHI ***I***
Institute of Space and Astronautical Science, JAXA

ASTRO-H, to Explore the High Energy Universe

ASTRO-H, the next Japanese X-ray Astronomy Satellite, is an interational X_ray mission planned for the launch in 2014. ASTRO-H is a combination of wide band X-ray spectroscopy (3 - 80 keV) provided by focusing hard X-ray mirrors and hard X-ray imaging detectors, and high energy-resolution soft X-ray spectroscopy (0.3 - 10 keV) provided by thin-foil X-ray optics and a micro-calorimeter array. The mission will also carry an X-ray CCD camera as a focal plane detector for a soft X-ray telescope and non-focusing soft gamma-ray detectors based on the concept of narrow-FOV semiconductor Compton Camera. With these instruments, ASTRO-H covers very wide energy range from 0.3 keV to 600 keV. The simultaneous broad band pass, coupled with high spectral resolution of <7 eV by the micro-calorimeter will enable a wide variety of important science themes to be pursued.
The ASTRO-H mission objectives are: to study the evolution of yet-unknown obscured supermassive black holes (SMBHs) in Active Galactic Nuclei (AGN); to trace the growth history of the largest structures in the Universe; to provide insights into the behavior of material in extreme gravitational fields; to determine the spin of black holes and the equation of state of neutron stars; to trace particle acceleration structures in clusters of galaxies and SNRs; and to investigate the detailed physics of astrophysical jets.
Imaging spectroscopy with the Soft X-ray Spectrometer (SXS) of extended sources can reveal line broadening and Doppler shifts due to turbulent or bulk velocities. This capability enables the determination of the level of turbulent pressure support in clusters, SNR ejecta dispersal patterns, the structure of AGN and starburst winds, and the spatially dependent abundance pattern in clusters and elliptical galaxies. On the other hand, the imaging capabilities at high X-ray energies open the completely new field of spatial studies of non-thermal emission above 10 keV. It will uniquely allow mapping of the spatial extent of the hard X-ray emission in diffuse sources, thus tracing the sites of particle acceleration in structures ranging in size from clusters of galaxies down to supernova remnants. Observing the hard X-ray synchrotron emission will allow a study of the most energetic particles, thus revealing the details of particle acceleration mechanisms in supernova remnants, while the high resolution SXS data on the gas kinematics of the remnant will constrain the energy input into the accelerators.

Alexey VIKHLININ ***I***
SRI Moscow and Harvard-Smithsonian CfA

SMART-X: square meter, arcsecond resolution X-ray telescope for the 2020's

SMART-X is a concept for a next-generation X-ray observatory with large-area, 0.5' resolution grazing incidence adjustable X-ray mirrors, high-throuput critical transmission gratings, and X-ray microcalorimeter and CMOS-based imager in the focal plane. High angular resolution is enabled by new technology based on controlling the shape of mirror segments using thin film piezo actuators deposited on the back surface. Science application include observations of growth of supermassive black holes sinse redshifts of ~10, ultra-deep surveys overs 10's of square degrees, galaxy assembly at z=2-3, as well as new opportunities in the high-resolution X-ray spectroscopy and time domain.

Mikhail PAVLINSKY ***O***
Space Research Institute

ART-XC/SRG

Spectrum Roentgen Gamma (SRG) is an X-ray astrophysical observatory, developed by Russia in collaboration with Germany. The mission will be launched in 2014 from Baikonur, by a Zenit rocket with a Fregat booster and placed in a 6-month-period halo orbit around L2. The scientific payload consists of two independent telescopes - a soft-x-ray survey instrument, eROSITA, being provided by Germany and a medium-x-ray-energy survey instrument ART-XC being developed by Russia. ART-XC will consist of seven independent, but co-aligned, telescope modules with seven corresponding cadmiumtelluride focal plane detectors. Each will operate over the approximate energy range of 6-30 keV, with an angular resolution of 1 arcmin, a field of view of ~30 arcmin and an energy resolution about 10% at 14 keV. The NASA Marshall Space Flight Center (MSFC) will fabricate some of the mirror modules, to complement others fabricated by VNIIEF in Russia.

Marco BARBERA ***P***
Dipartimento di Fisica - Universita' degli Studi di Palermo

Investigation on the status of the XMM-Newton EPIC thin and medium filters after more than 10 years of operation

After more than ten years of operation of the EPIC camera on board XMM-Newton we have started an investigation to review the status of the thin and medium filters by performing laboratory measurements on back-up filters, and on-board calibration measurements. The laboratory measurements will consist of: UV/VIS/IR transmission measurements, X-ray transmission measurements, and microscopic investigations. The on board calibration measurements will include: X-ray transmission measurements, based on the observation of the blazar PKS 2155-304, measurement of optical loading based on the observation of the AB Dor star, and measurement of the spatial homogeneity based on the observation of optical extended objects (e.g. Omega Cen). We present the plan of the activities and the preliminary results.

Stefano BORGANI ***P***
Univ. Trieste & INAF, Trieste

Cosmology with the next generation of wide-field X-ray surveys

In my talk I will present the potential that future wide area X-ray surveys have to constrain cosmological models and reveal signatures of deviations from the standard LambdaCDM paradigm. I will highlight that a critical aspect in the cosmological exploitation of such future surveys lies in the possibility of inferring cluster masses through the calibration of robust "mass proxies". I will finally discuss how a combination of high-quality observational data and advanced cosmological hydrodynamical simulations would contribute to the calibration of such mass proxies.

Jan-willem DEN HERDER ***P***
SRON, Netherlands Institute for Space Research

High spectral resolution imaging: a new window for X-rays

Combining high spectral resolution (eV) with good imaging capability opens new windows in astrophysics. It enables the study of the dynamics of hot plasmas (turbulences, bulk velocities) in point and extended sources. It will allow to track the formation, evolution dynamics of large scale structures of hot baryons in the Universe and their co-evolution with smaller scale structures. Similarly, it will enable to measure the kinetic power released by AGNs in the form of outflows, or finding the missing baryons in the Universe. Combined with timing for bright sources, it will also enable the physical state of the densest form of matter making up the core of neutron stars to be investigated. We will summarize the prospects of high throughput and high resolution X-ray spectroscopy and discuss the feasibility to achieve arrays for a future X-ray observatory mission like Athena (JW. Den Herder, X. Barcons, D. Barret, J. Kaastra, L. Piro)

Diego GöTZ ***P***
CEA Saclay - DSM/Irfu/Service d'Astrophysique

MXT : a light X-ray telescope for X-Gamma-Ray Burst afterglow observations

We present the Microchannel X-ray Telescope (MXT), a new telescope that will be flying on the sino-french SVOM mission dedicated to Gamma-Ray Burst science. MXT is based on sqaure micro-channel plates (MCP) optics, coupled with a low noise CCD. The MCP optic is based on the design of the MIXS-T telescope on board the ESA Bepi Colombo misson to Mercury, while the CCD is a pnsensor detector, similar to the one that will be at the focus of the eRosita telescopes. MXT is a compact and light (<30 kg) telescope with a 1 m focal length, and will provide an effective area of about 50 cmsq on axis. The MXT PSF is expected to be better than 3.7 arcmin (FWHM), and its sensitivity to be adequate to detect all the afterglows of the SVOM GRBs, and to localize them to better than 1 arc min (90%, no systematics) after 5 minutes of observation. These performances are fully adapted to the SVOM science goals, and prove that small and light telescopes can be used for future small X-ray missions.

Mikhail GUBAREV ***P***
Marshall Space Flight Center

Flight Programs and X-ray Optics Development at MSFC

The X-ray astronomy group at the Marshall Space Flight Center is developing electroformed nickel/cobalt x-ray optics for suborbital and orbital experiments. Suborbital instruments include the Focusing X-ray Solar Imager (FOXSI) and Micro-X sounding rocket experiments and the HERO balloon payload. Our current orbital program is the fabrication of a series of mirror modules for the Astronomical Roentgen Telescope (ART) to be launched on board the Russian-German Spectrum Roentgen Gamma Mission (SRG.) The details and status of these various programs will be presented. A second component of our work is the development of fabrication techniques and optical metrology to improve the angular resolution of thin-shell optics to the arcsecond-level. The status of these x-ray optics technology developments will also be presented.

Miranda JACKSON ***P***
KTH (Royal Institute of Technology)

Balloon-borne hard X-ray polarimetry with PoGOLite

The high-energy emission mechanisms postulated for compact astrophysical sources predict the production of polarised X-rays. The orientation of the polarisation plane is a powerful probe of the physical environment around the source. PoGOLite is a balloon-borne hard X-ray polarimeter operating in the 25-80 keV energy band. The polarisation of incoming photons is reconstructed using Compton scattering and photo-absorption in an array of phoswich detector cells comprising plastic scintillators, surrounded by a BGO anticoincidence shield and a polyethylene neutron shield. The maiden flight of PoGOLite took place from Esrange, Sweden, in July 2011, but was terminated prematurely. A second attempt will be made in July 2012. A circumpolar flight is foreseen, providing 15 days for observations of the primary science targets, the Crab and Cygnus X-1. The PoGOLite mission will be reviewed and the outcome of the 2012 flight will be discussed.

Roberto MIGNANI ***P***
MSSL-UCL

Multi-wavelength Timing of X-ray sources detected by LOFT

In the next decade, new optical survey facilities will become operational, like the LSST, which will scan large regions of the sky in deep, multi-epoch surveys. This will allow to search for variable sources on the day-to-years time scales and will provide a huge and unique observational data base to correlate with X-ray transients detected by the LOFT/WFM. On the other hand, the advent of the new generation of 30-40m class optical telescopes, like the E-ELT, coupled with instruments for high time resolution observations, will allow to search for variability on the ms time scales and will match the discovery potentials offered by the LOFT/LAD. In this talk, I describe the future optical/infrared facilities for variability studies and their synergy with the LOFT instruments.

Masanori OHNO ***P***
Hiroshima University

All sky observations by Suzaku Wide-band All-sky Monitor

In this presentation, we will summarize six years result of all-sky observations obtained by Suzaku Wide-band All-sky Monitor. The fifth Japanese X-ray satellite, Suzaku has also capability of all-sky observations. The Suzaku Wide-band All-sky Monitor (Suzaku-WAM) enables unique all-sky observations utilizing wide-band energy coverage between 50 keV to 5000 keV with very large effective area of 400 cm2 even at 1 MeV. After six years operation, Suzaku-WAM still continue to observe all-sky without any serious detector problems, and detect many gamma-ray sources. The number of GRB detection has reached almost 1000. Gamma-ray emission mechanism of GRBs has been discussed with by both time-resolved spectroscopy and time-series analysis. The WAM also detected many solar flares, including bright flares from recent high solar activity. We also investigate long-term variability in high energy band of Crab utilizing earth occultation technique.

Adamantia PAIZIS ***P***
INAF IASF Milano

Giant On-Line INTEGRAL Archive (GOLIA) @INAF-IASF Milano

We present the archive of the INTEGRAL data developed and maintained at INAF-IASF Milano. The archive comprises all the public data currently available (revolutions 0026-1045, i.e., December 2002 - May 2011). INTEGRAL data are downloaded from the ISDC, Geneva, on a regular basis as they become public and a customized analysis using the OSA 9.0 software package is routinely performed on the IBIS/ISGRI archive. The scientific products include individual pointing images and the associated detected source lists in the 17-30, 30-50, 17-50 and 50-100 keV energy bands, as well as light curves binned over 100 s in the 17-30 keV band for sources of interest. Documentation and ad-hoc tools to browse and visualize the results have also been developed. The whole database enables an easy access to the hard-X long-term behaviour of a vast sample of sources, be they Galactic (e.g., discovery of periodic outbursts from the SFXT IGR J11215-5952, and of hard tails from LMXBs) or extra-Galactic (AGNs).

John PYE ***P***
Space Research Centre, Department of Physics and Astronomy

3XMM: The Third XMM-Newton Serendipitous Source Catalogue

Preparation of 3XMM is in progress by the XMM Survey Science Centre and it is due to be released around the end of 2012. It will be based on a uniform reprocessing of all publicly available XMM EPIC data, with ~30% more observations than its immediate predecessor (2XMM-DR3) and nearly a factor two more than the original 2XMM (Watson et al 2009). We therefore expect ~460k detections associated with ~340k unique sources, maintaining the output of the XMM serendipitous source survey as the largest available catalogue of celestial X-ray sources. The data processing incorporates several additions and enhancements relative to the previous versions, including: S:N-optimised extraction of source spectra and timeseries, optimised removal of time periods of high background and several elements to reduce the number of spurious sources. We will outline these improvements, summarise the catalogue statistics, and give preliminary highlights of individual sources and of other associated analyses.

Patrizia ROMANO ***P***
INAF-IASF Palermo

Investigating Supergiant Fast X-ray Transients with LOFT

Supergiant Fast X-ray Transients are HMXBs with OB supergiant companions, known for X-ray outbursts during which their luminosity increases by 3--5 orders of magnitude. LOFT, with its coded mask Wide Field Monitor (WFM) and its 10-m^2 class collimated X-ray Large Area Detector (LAD) will provide simultaneous high S/N broad-band and time-resolved spectroscopy in several intensity states, long term monitoring that will yield new determinations of orbital periods, as well as spin periods. We present an extensive set of simulations based on the Swift broad-band and detailed XMM-Newton observations we collected. Our simulations describe the outbursts at several intensities (F(2-10 keV)=5.9E-9 to 5.5E-10 erg cm-2 s-1), the intermediate and most common state (1E-11 erg cm-2 s-1), and the low state (1.2E-12 to 5E-13 erg cm-2 s-1). We also considered large variations of NH and the presence of emission lines, as observed by Swift and XMM.

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CXBN: A Blueprint for an Improved Measurement of the Cosmological X-Ray Background

A precise measurement of the Cosmic X-Ray Background (CXB) is crucial for constraining models of the evolution and composition of the universe. While many large, expensive satellites have measured the CXB as a secondary mission, there is still disagreement about normalization of its spectrum. The Cosmic X-Ray Background NanoSat (CXBN) is a small, low-cost satellite whose primary goal is to measure the CXB over its two-year lifetime. Benefiting from a low instrument- induced background due to its small mass and size, CXBN will use a novel, pixelated Cadmium Zinc Telluride (CZT) detector with energy resolution < 1 keV over the range 1-60 keV to measure the CXBN with unprecedented accuracy. This paper describes CXBN and its science payload, including the GEANT4 model that has been used to predict overall performance and the backgrounds from secondary particles in Low Earth Orbit. It also addresses the strategy for scanning the sky and calibrating the data, and presents the expected result

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Development of four-reflection optics for future X-ray astronomy

Four-reflection optics for X-ray astronomy has never been applied due to low reflectivity for most frequently used energy band including several keV. However, for low-energy soft X-rays < 1 keV, practical reflectivity can be obtained even for four reflection. In this paper, we will show several advantages of four-reflection optics and examples of optics design. We will also report on the present status of the development of FXT (Four Stage X-ray Telescope) for DIOS (Diffuse Intergalactic Oxygen Surveyor) mission, which is planned to observe the warm-hot intergalactic medium (WHIM).

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