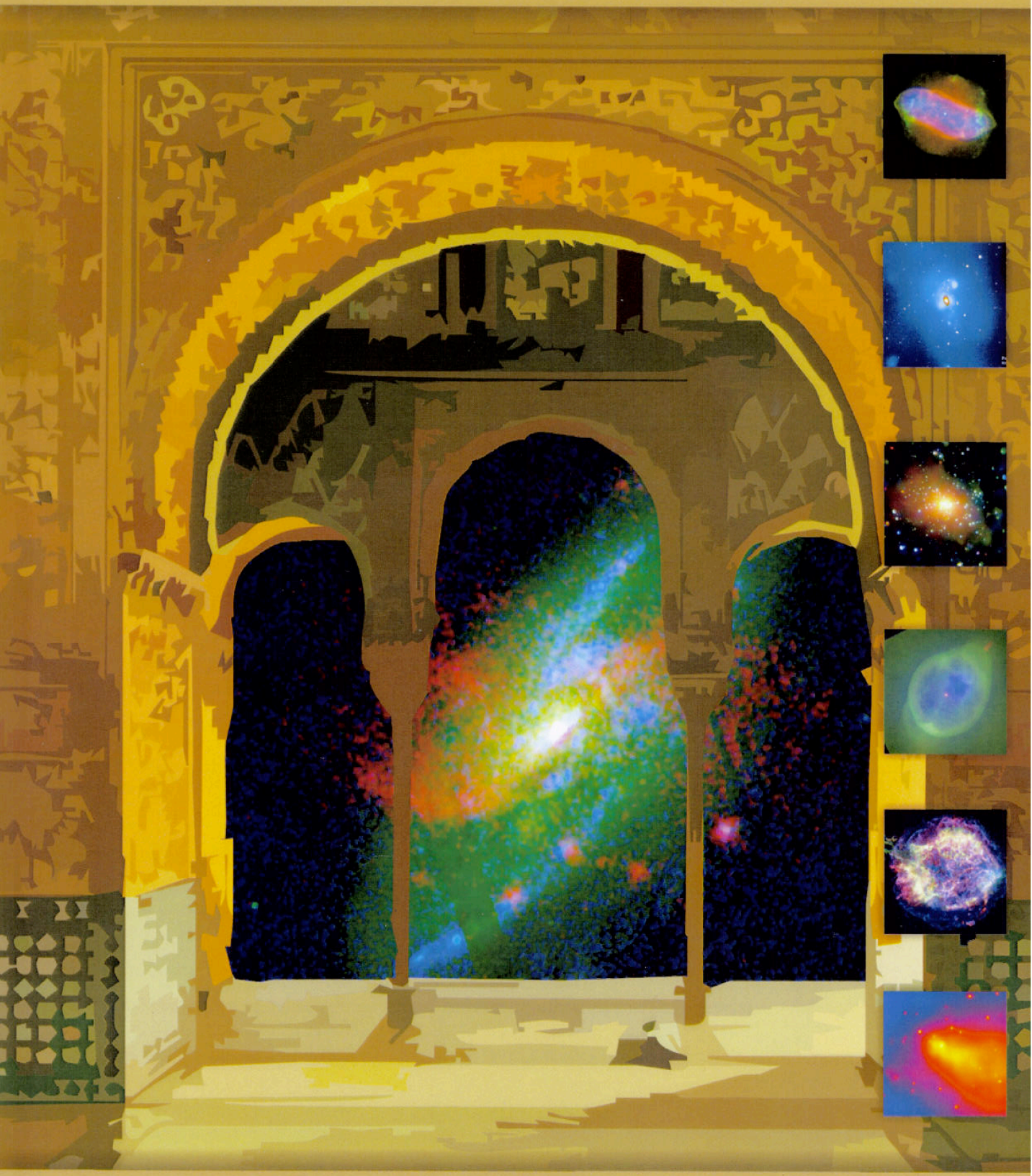
The X-ray Universe 2008

Granada, Spain, 27 - 30 May



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THE X-RAY UNIVERSE 2008

27 - 30 May 2008
Granada, Spain

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ABSTRACT BOOK

Oral Communications and Posters

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Chapter 1

Invited Speakers

High-redshift clusters and their evolution

Arnaud, M.
CEA Saclay, Service d' Astrophysique

The galaxy cluster population provide information on the physics of structure formation and can be used to constrain the cosmological parameters. I will review recent progresses made in this field from cluster evolution studies with XMM-Newton and Chandra.

Studies of the dark matter profiles are starting to probe the evolution of the concentration matter, a important test of theoretical scenario of the dark matter collapse. Observations of large sample of distant clusters have been used to assess the evolution of key properties of the gas, like metallicity, cooling core, structural properties and scaling relations. This provides new constraints on the complex physics, including non-gravitational processes, that governs the baryonic component in clusters. This also yield a better understanding of various mass proxies, and of the evolution of their relations to the mass, a key ingredient when using cluster abundance as cosmological probes. In parallel, significant progress has been made on the determination of the cosmological parameters, using the gas mass fraction in clusters, while XMM-Newton surveys are providing new distant cluster samples, including the most distant cluster ever known.

Future prospects in the field, with particular emphasis on the synergy between XMM-Newton and the forthcoming Planck mission, will also be discussed.

X-rays in late-type stars: From present challenges to future observations

Audard, M.
ISDC & Geneva Observatory

X-ray observations of stars have offered new insights into the physics of plasmas in late-type stars, from young stars in star forming regions to older, evolved stars. I will present a few science topics that challenged our view of X-ray stellar science and that next-generation missions such as XEUS will address in future observations.

Exploring the High-Redshift X-ray Universe: Snapshot to Ultradeep Surveys

Brandt, W.N.
Penn State University

X-ray studies of the high-redshift (z $\sim$ 2-6) universe have advanced dramatically over the past few years, largely due to complementary results from Chandra and XMM-Newton. These investigations probe the processes by which the first massive black holes and galaxies grew. I will review some of the recent X-ray results on high-redshift active (AGN) and non-active galaxies, derived from surveys ranging from shallow snapshots through to the Chandra Deep Fields.

Topics covered will include (1) new constraints on the cosmic evolution of AGN accretion processes out to the reionization epoch; (2) X-ray measurements of AGN outflows at high redshift; (3) the X-ray emission from high-redshift radio-loud quasars at pc-to-kpc scales; (4) the AGN content of forming galaxies at high redshift, such as submillimeter sources; and (5) the X-ray evolution of non-active late-type and early-type galaxies. I will also outline some future prospects, and I will describe how these studies are laying crucial observational groundwork for future missions such as Constellation-X, XEUS, WFXT, and Generation-X.

X-ray surveys of AGN : results and perspectives

Comastri, A.[1]; Gilli, R.[1]; Vignali, C.[2]
[1]*INAF-OABologna;* [2]*Astr. Dept. Bologna University*

Over the last few years, the existence of mutual feedback effects between accreting supermassive black holes powering AGN and star formation in their host galaxies has become evident. This means that the formation and the evolution of AGN and galaxies should be considered as one and the same problem. As a consequence, the search for, and the characterization of the evolutive and physical properties of AGN over a large redshift interval is a key topic of present research in the field of observational cosmology.

Significant advances have been obtained in the last few years thanks to the sizeable number of XMM-Newton and Chandra surveys, complemented by multiwavelength follow-up programs.

I will review some of the recent results and the ongoing efforts aimed at obtaining a complete census of accreting Black Holes in the Universe. In particular, I will cover the following topics:

1. The relative fraction of obscured AGN as a function of redshift and luminosity;
2. The multiwavelength searches for the most heavily obscured, Compton Thick, AGN;
3. The bolometric luminosity of Type 2 AGN;
4. The space density of high redshift (z $\sim$ 3-5) X-ray selected AGN and the quest for early (z $>$ 6) Black Holes

The perspectives for future observations with present (XMM-Newton and Chandra) and future missions (i.e. SimbolX and XEUS) will also be outlined.

Feedback at work: radio sources in clusters

Feretti, L.
Istituto di Radioastronomia

Recent results on the radio emission from galaxy clusters are presented, with emphasis on the diffuse radio sources associated with the intracluster medium: radio halos, mini-halos and relics. These radio sources demonstrate the existence of large scale cluster magnetic fields and of a population of relativistic particles in the cluster volume. There is a strong link between radio and X-ray emission, as it is deduced by several correlations. Moreover, there is evidence that the presence of large-scale diffuse radio emission is related to cluster merger processes. The details of this connection are discussed and a brief outline of current models of cluster radio halos and relics is presented.

Planetary Nebulae in X-rays

Guerrero, M.A.
Instituto de Astrofísica de Andalucía

Planetary nebulae (PNe) are formed by the interaction of the fast stellar wind emanating from their central stars with the circumstellar material ejected previously during the Asymptotic Giant Branch (AGB) phase. In the so-called interacting stellar wind model of PN formation, the fast stellar wind is shock-heated and should produce detectable X-ray emission within the PN interior. Fast collimated outflows, with velocities of up to 1,000 km s^{-1} have also been detected in PNe and their interaction with the circumstellar material can give rise to X-ray emission. *Einstein*, *EXOSAT*, *ROSAT*, and *ASCA*, the first generations of X-ray telescopes, detected the soft photospheric X-ray emission from the central stars of PNe, but their observations could not unambiguously detect the diffuse X-ray emission from shocked stellar winds or fast collimated outflows in PNe. *Chandra* and *XMM-Newton* have finally resolved the diffuse X-ray emission from shocked fast winds in PN interiors and from bow-shocks of fast collimated outflows impinging on the nebular envelopes. These observations have allowed us to study of the spatial distribution and physical properties of hot gas in PNe, but have also detected unexpected hard X-ray point-sources associated to their central stars.

In this talk, I will review the results of these new X-ray observations of PNe, with especial emphasis in the contribution made by *XMM-Newton* observations, and I will describe the theoretical progress motivated by these results.

X-ray emission from Isolated Neutron Stars

Haberl, F.
MPE Garching

X-ray observations unveiled new classes of isolated neutron stars for which it is presently unclear whether the different phenomenology we observe reflects different evolutionary stages and/or variations in intrinsic neutron star properties. Over the last years the outstanding capabilities of the X-ray observatories XMM-Newton and Chandra with respect to sensitivity and spectral resolution increased our knowledge in this field of neutron star research considerably. The analysis of thermal radiation from cooling isolated neutron stars has provided crucial insights on their surface temperature and magnetic field distributions. The results are essential to derive important information on the structure and chemical composition of the neutron star surface layers. Thermal emission with temperatures of about 0.3-1 Million K dominates the X-ray spectra of middle-aged pulsars. No non-thermal activity is seen from a group of nearby radio-quiet isolated neutron stars, which offers the unique opportunity to investigate their relatively undisturbed thermal emission in X-rays. XMM-Newton observations revealed broad absorption features in their X-ray spectra which are interpreted as cyclotron resonance absorption lines of protons or heavy ions and/or atomic transitions shifted to X-ray energies by strong magnetic fields of the order of 10^{13} G. Such strong magnetic fields may significantly influence the heat transport through the neutron star crust and the results from the X-ray investigations are crucial to constrain neutron star cooling models.

Recent X-ray Results on Supernova Remnants

Hughes, J.P.
Rutgers, The State University of New Jersey

Over the past few years, deep Chandra, XMM-Newton, and Suzaku observations coupled with theoretical investigations, have yielded anumber of important new insights into the nature of supernova remnants. We now have good evidence for diffusive shock acceleration of relativistic particles and magnetic field generation at the high speed shocks streaming out from the explosion sites. Nucleosynthesis studies, especially of the remnants of Type Ia supernovae, are offering constraints on progenitors and explosion mechanisms.

In this talk I will review a selection of topics chosen from recent investigations of supernova remnants.

Spatial Distribution of the GCDX and its Time Variability

Koyama, K.
Kyoto University

I report the Suzaku results of spatially resolved spectroscopy of the Galactic center diffuse X-rays (GCDX). The most pronounced features are K-shell transition lines from neutral and He-like irons at energies of the 6.4 keV and 6.7 keV. These lines are non-uniformly and asymmetrically distributed with respect to Sgr A*. Neither the 6.4 keV nor 6.7 keV line flux is proportional to the continuum flux (5–10 keV band). Instead, a combined flux of the 6.4 keV and 6.7 keV lines with the ratio of 1:2 is proportional to the continuum flux, hence the GCDX is composed of 6.7 keV and 6.4 keV associated continuums with the flux ratio of 2:1. This fact suggests that a large fraction of the GCDX is diffuse origin, not due to integration flux of the outputs of a large number of unresolved point sources. A few years of time variability of the 6.4 keV line from the Sgr B2 and Radio Arc complexes are found. Hence the origin of the 6.4 keV line is fluorescent irradiated by external X-rays. I infer that the GC black hole Sgr A* was X-ray bright in the past and exhibited a few years of time variability.

Outflows in AGNs: High-Resolution X-ray Spectroscopy

Krongold, Y.
UNAM

X-ray Ionized Outflows are seen in more than 50% of AGNs, and are therefore thought to be ubiquitous but observable only when our line of sight crosses the wind. The contribution of these winds to the energetic of AGNs and their host galaxy is still highly uncertain, due to the difficulty in assessing the mass outflow rate of such winds, which depends critically on their exact location. In this contribution I will review the current observational data and highlight the strength of time-resolved spectroscopy and modeling to strongly constrain the geometry, physics, and dynamics of ionized outflows in AGN.

The X-ray Foundation for AGN Feedback in the Radio Mode

McNamara, B.R.
Perimeter Institute for Theoretical Physics, University of Waterloo

The gaseous atmospheres of galaxies and clusters serve as gauges of the energy output from AGN over cosmic time. X-ray observations are showing that the mechanical energy emerging from the nuclei of giant elliptical galaxies and central cluster galaxies–even those with relatively feeble radio sources–often rivals the power output from quasars. AGN supply enough energy to suppress cooling of the dense cusps of X-ray emitting gas in clusters and galaxies, thus regulating the rate of black hole growth and star formation. How this and other heating mechanisms, such as conduction, cosmic rays, and star-burst winds, couple to and heat X-ray atmospheres is poorly understood.

I will discuss how modern X-ray observations have changed our understanding of galaxy formation and extragalactic radio sources.

The Equation of State of Neutron Stars

Méndez, M.
Kapteyn Astronomical Institute, University of Groningen

I will review the results of X-ray observations that have been used to constrain the equation of state of neutron stars. I will also discuss the advances that can be achieved in this topic with a future mission like Xeus.

Accretion in Galactic X-ray sources and AGN: constraints from X-ray observations

Miniutti, G.
Laboratoire APC

Active galaxies and Galactic black hole binaries are powered by accretion onto a central black hole. The environment of the two families of accreting black holes is clearly different, but the innermost regions of the accretion flow, where most of the energy is released, share a very large set of common properties. Here we review some of the information on the nature of the accretion/emission processes in both families gathered through X-ray observations in the past few years. Special attention is devoted to the properties of the relativistic X-ray reflection spectrum originating from the vicinity of the central black hole.

X-ray emission from hot stars

Nazé, Y.
Inst. of Astroph. & Geoph., Univ. of Liege

Massive, hot stars clearly dominate the stellar population: they are the main sources of ionizing radiation, mechanical energy and chemical enrichment in galaxies. High energies permit to probe the most important processes at work in these stars, and put constraints on their most peculiar feature: the stellar wind. Medium and high-resolution spectroscopy, provided by the most recent X-ray observatories, have shed new light on these objects. Here I shall review not only the emission from single O-type stars, but also the case of massive binaries, magnetic hot objects and evolved WR stars.

High resolution spectroscopy of novae and supersoft sources

Ness, J.-U.
Arizona State University

Classical Novae (CNe) and Super Soft X-ray binary Sources (SSS) are the only members of the class of Cataclysmic Variables in which the radiative output is powered by nuclear burning. In CNe nuclear burning occurs in a thermonuclear runaway explosion that is triggered after an episode of accretion. The emitted radiation comes from the optically thick, expanding, shell of gas. As the outer layers become optically thin the photosphere moves inward, but the source remains at constant bolometric luminosity so that the effective temperature gradually increases until the peak of the spectral energy distribution moves into the X-ray regime. Spectra taken at this time are classified as SSS spectra since they resemble those of systems like CAL 83. These are believed to be powered by quiescent nuclear burning that is fed via continuous accretion, a process that can lead to a SN Ia explosion. The X-ray spectra of both objects can be modeled with stellar atmosphere codes. For the early phases of CNe, the expansion may significantly distort the spectrum, and the surface gravity cannot be determined. Without high-resolution grating spectra the complex interplay between the atmosphere model parameters prevents adequate constraints of all model parameters except the temperature.

X-ray monitoring of SgrA*

Porquet, D.
Observatoire de Strasbourg;

The Galactic center harbors at its dynamical center Sgr A*, the closest supermassive black hole (SMBH). Surprisingly, the luminosity of SgrA* is found to be several orders of magnitude lower than the expected Eddington luminosity. The recent discovery of X-ray flares from Sgr A*, that are believed to originate within just a few Schwarzschild radii of the black hole event horizon, has provided new exciting perspectives for the understanding of the accretion and radiation mechanism at work in this peculiarly faint SMBH. I will review the results obtained during the past eight years thanks to XMM-Newton and Chandra monitorings of SgrA*.

Pulsar wind nebulae: The VHE - X-ray connection

Pühlhofer, G.
Landessternwarte Heidelberg

Pulsars convert their rotational energy into a wind of relativistic particles and magnetic fields. In usual scenarios, a large fraction of the energy is transformed into leptonic particles which are thermalized and accelerated to high energies near the pulsar. Such a pulsar wind nebula (PWN) is observable via synchrotron radiation in radio to X-rays, and Inverse Compton (IC) scattering in the very high energy (VHE) domain. High angular resolution X-ray imaging has revealed PWN jet and torus features as well as tails, reflecting the pulsar spin axis and motion. On the other hand, the large-scale particle flow and its possible interaction with the surrounding supernova remnant (SNR) shell can efficiently be studied in the VHE band, mainly because the corresponding IC emission is independent of the position-dependent magnetic field. VHE surveys of the Galactic plane have recently revealed new PWN candidates, some without an associated SNR shell, and at locations with very large (X-ray) absorption depths. The identification of the X-ray counterparts to these particle-dominated, relic VHE PWN candidates is a challenging task even for XMM-Newton and Suzaku, since these sources can exhibit X-ray fluxes an order of magnitude dimmer than in the VHE range. The current status of the VHE - X-ray PWN studies will be summarized.

Ultraluminous X-ray sources

Roberts, T.P.
Durham University

At the start of this decade ultraluminous X-ray sources (ULXs) were a relatively poorly studied novelty, the brightest off-nucleus X-ray sources found in some (but not all) nearby galaxies. However, over the course of the last 8 years *Chandra* and *XMM-Newton* have revolutionised our view of them. I will review the observational evidence from these missions that lent support to the idea that these sources might host large, $\sim 1000 M_{\odot}$ intermediate-mass black holes (IMBHs). I will also discuss the newer analyses, backed-up by multi-wavelength data, that contradict this view. In fact, our view is now tending towards the large majority of ULXs hosting comparatively ordinary stellar-mass black holes, albeit ones that might still be up to a few times more massive than those in our own Galaxy. In this case ULXs are probably better regarded as black holes in a **new, ultraluminous accretion state**. Despite this recent progress, the fundamental question of the black hole mass in ULXs will remain open to debate until dynamical evidence for their masses are obtained; I will highlight how close we are to achieving this.

XMM-Newton: status of the project

Schartel, N.
XMM-Newton SOC, ESA

An overview of the current status of the XMM-Newton mission will be provided. We will address the usage of the mission, its scientific community and the obtained scientific results. Operational as well as technical aspects and developments will be discussed. Special emphasis will be given to future mission extensions.

From X-ray binaries to AGN

Uttley, P.
University of Southampton

Even before the discovery of 'microquasars' in our Galaxy in the early 1990s, there was speculation that accreting stellar mass black holes may be microcosms of their supermassive counterparts in AGN, showing the same types of behaviour but over much shorter (and humanly-accessible) time-scales. The last ten years have revolutionised our view of the AGN-X-ray binary connection, mainly through X-ray observations. X-ray spectroscopy has enabled the detection of broad iron lines in both kinds of system, while monitoring on both long and short time-scales has allowed us to compare AGN and XRB variability properties to conclusively demonstrate that X-ray variability time-scales scale with black hole mass. More recently, X-ray spectral-timing studies have allowed us to compare inter-band time-lags in both types of system, throwing intriguing new light on the hidden structure of the X-ray emitting regions and the origins of variability. I will review some of these advances, focussing on the variability properties of AGN and X-ray binaries and how we can interpret them to shed light on the structure of black hole accretion flows and their behaviour over cosmologically relevant time-scales.

Chapter 2

Public Talk

Ver lo invisible: la Agencia Espacial Europea a la caza da agujeros negros en el Universo

Guainazzi, M.
XMM-Newton SOC, ESA

¿Qué sabemos sobre los agujeros negros? Sabemos que existen. Sabemos que son invisibles, porque no hay radiaciones capaces de escapar su horizonte. Sabemos que hay en cada galaxia. Sabemos que engullen gran cantidad de materia, gas, polvo y estrellas enteras. Sabemos que a su alrededor se manifiestan algunos de los fenómenos más violentos del universo. Uno de los métodos más eficaces para ver lo que no podemos ver es utilizar una radiación que nuestros ojos no pueden percibir: los rayos X y gamma. La Agencia Espacial Europea está a la vanguardia en la investigación del universo a través de esta radiación, y España tiene un papel fundamental en este campo. Esta charla resumirá algunos de los avances más importantes que hemos conseguido en nuestra comprensión de la naturaleza de los agujeros negros y de su entorno con experimentos y misiones europeas.

Chapter 3

Topic 1: Stars, Star-forming Regions, Planetary and Cometary Studies

The ChaMP Extended Stellar Survey: Photometric and Spectroscopic Properties

Agueros, M.[1]; Covey, K.[2]; Green, P.[2]; Haggard, D.[3]; Barkhouse, W.[4]; Drake, J.[2]; Evans, N.[2]; Kashyap, V.[2]; Kim, D.-W.[2]; Pease, D.[5]; Silverman, J.[6]
[1] *Columbia Astrophysics Lab;* [2] *Harvard-Smithsonian Center for Astrophysics;* [3] *University of Washington;* [4] *University of North Dakota;* [5] *Space Sciences Lab;* [6] *Max-Planck-Institut fur extraterrestrische Physik*

We present a catalog of ~ 350 X-ray emitting stars identified from correlations of the Extended Chandra Multiwavelength Project (ChaMP), a serendipitous survey based on archival X-ray images, with the Sloan Digital Sky Survey (SDSS). We use morphological star/galaxy separation, matching to an SDSS quasar catalog, an optical color-magnitude cut, and X-ray data quality tests to identify these stars. Fewer than 3% of the sources in our catalog are previously identified stellar X-ray emitters. We derive distances $\sim 10 - 2000$ pc for the stars in our catalog using photometric parallax relations and calculate their X-ray and bolometric luminosities. For 36 newly identified X-ray emitting M stars we calculate $L_{H\alpha}/L_{bol}$. $L_{H\alpha}/L_{bol}$ and L_X/L_{bol} are linearly related below $L_X/L_{bol} \sim 3 \times 10^{-4}$, while $L_{H\alpha}/L_{bol}$ appears to turn over at larger L_X/L_{bol} values. Stars with reliable SDSS photometry have an ~ 0.1 mag blue excess in $u - g$, likely due to increased chromospheric continuum emission. Photometric metallicity estimates suggest that the sample is evenly split between the young and old disk populations of the Galaxy; the lowest activity sources belong to the old disk population, a consequence of the decay of magnetic activity with age.

The Chandra view of the T Tau binary HDE 245059

Baldovin Saavedra, C.[1]; Audard, M.[1]; Duchene, G.[2]; Skinner, S.L.[3]; Paerels, F.B.S.[4]
[1] *ISDC & Geneva Observatory;* [2] *Laboratoire d'Astrophysique de l'Observatoire de Grenoble;* [3] *CASA, University of Colorado;* [4] *Columbia Astrophysics Laboratory*

Weak-lined T Tauri stars (WTTS) are pre-main sequence (PMS) stars showing little active accretion, but high levels of X-rays. Their study is, therefore, of strong interest, since accretion plays no role, and their X-ray flux directly impacts young planets. We present the Chandra HETGS observation of the WTTS HDE 245059, one of the X-ray brightest young stars (Log Lx $\sim$ 32 erg/s). Our target is part of the PMS group near the center of the lambda Ori star forming cloud, which may have been disrupted by a supernova 1-2 Myr ago. Our near-infrared Keck observations resolved for the first time HDE 245059 into a close binary separated by about 0.8 arcsec. The Chandra data also separated the binary in the zeroth order images as well as in the grating spectra. Variability was observed in both components, and a medium flare was detected in the southern component, which is weaker in quiescence. Our spectral analysis showed a wide range of plasma temperatures, from 4 to 50 MK, with a dominant component at 8 MK. Coronal abundances show an inverse FIP effect, except for Ca. Despite the low column density ($< 10^{19} cm^{-2}$), the OVII line triplet was not detected.

X-ray views of the solar sytem

Branduardi-Raymont, G.[1]; Bhardwaj, A.[2]; Elsner, R.F.[3]; Gladstone, G.R.[4]; Rodríguez, P.[5]; Cravens, T.E.[6]; Dennerl, K.[7]; Ford, P.[8]; Galand, M.[9]; Grodent, D.[10]; Waite, J.H. Jr[4]
[1] *University College London, Mullard Space Science Laboratory;* [2] *Space Physics Laboratory, Vikram Sarabhai Space Centre;* [3] *NASA Marshall Space Flight Center;* [4] *Southwest Research Institute;* [5] *XMM-Newton SOC;* [6] *University of Kansas;* [7] *MPI für extraterrestrische Physik;* [8] *Massachusetts Institute of Technology;* [9] *Imperial College London;* [10] *Université de Liege*

XMM-Newton and Chandra have provided an unprecedented wealth of information about solar system bodies: this presentation gives an up-to-date account of what we have discovered. XMM-Newton has demonstrated that Jupiter's X-ray aurorae are produced by energetic charged particles precipitating in its atmosphere: ions give off soft X-ray lines following charge exchange; above 2 keV, electron bremsstrahlung dominates. Chandra imaging provides evidence that the same electrons are also responsible for the auroral oval FUV emission. Jupiter's disk X-rays are mostly due to scattering of solar X-rays in the planet's upper atmosphere, so are controlled by the solar X-ray output. Saturn shows solar scattered, disk X-ray emission, with no evidence for X-ray aurorae. An oxygen line has been detected from its rings, which may be associated with fluorescent scattering of solar X-rays off the icy ring material. The Earth displays rapidly variable patches of soft X-ray auroral emission, as well as higher energy bremsstrahlung. Numerous signatures of charge exchange and solar X-ray scattering appear in the XMM-Newton RGS spectra of the exospheres and atmospheres of the unmagnetised planets, Venus and Mars. Cometary spectra bear proof of charge exchange by solar wind ions, thus reflecting the state of the solar wind in their surroundings.

Identifying solar wind charge exchange emission in XMM-Newton observations

Carter, J.A.; Sembay, S.
University of Leicester

The solar wind charge exchange (SWCX) process can be a significant source of background for space based X-ray telescopes such as XMM-Newton, dependent on specific alignment and observing conditions and the state and composition of the solar wind at the time of an observation. We describe a method for identifying XMM-Newton observations that have been affected by SWCX emission and present preliminary results of previously unidentified cases of such emission from a sample taken from the XMM-Newton Science Archive. We searched for variability in the diffuse X-ray background in an energy band containing the main indicators of geocoronal SWCX emission; emission lines from oxygen VII and VIII. This is compared to variability in a continuum band where no emission lines are expected to occur. Using a grade of high probability that variability in the line band has occurred, and along with indicators for any remaining background variability due to residual soft proton contamination, we are able to positively identify a set of observations that have been affected by SWCX emission. We use data from the ACE observatory to test for correlations between the solar wind proton flux and the enhancement observed by XMM-Newton.

X-ray activity and the YSO circumstellar environment: results from DROXO

Flaccomio, E.; Stelzer, B.; Sciortino, S.; Pillitteri, I.; Micela, G.
INAF-OAPA

The dynamic magnetospheres of Young Stellar Objects (YSOs) are instrumental for both their mass accretion and their intense X-ray activity. The interplay between activity and the circumstellar environment is a hot research topic. Disks might influence the coronae, as suggested by the long loops, possibly reaching out to the disk, implied by the modeling of intense X-ray flares. YSO's disks, on the other hand, are heated and ionized by X-rays from the central object, with implications for their structure, angular momentum transport, and planet formation. Observational signatures of this interaction can help constrain theoretical models. The Fe 6.4 keV Kα fluorescence line may be one of such signatures. Others are the Ne II (12.8 μm) and Ne III (15.55 μm) fine-structure lines due to the X-ray ionization of warm disk atmospheres. In this contribution we explore these issues using data from the Deep Rho Ophiuchi XMM-Newton Observation (DROXO). The analysis of flares confirms the existence of magnetic loops much longer than the stellar radius. We discuss the evidence from the Fe 6.4 keV fluorescent line and its time variability. Finally, using archival SPITZER infrared spectra we explore the relation between the Ne II line flux, X-ray activity, and other stellar and circumstellar characteristics.

Young A Stars: The softest Youngsters

Günther, H.M.; Schmitt, J.H.M.M.
Hamburger Sternwarte

The origin of X-rays from young accreting solar-like stars, the classical T Tauri stars, is now generally recognised as a combination of coronal emission, accretion shocks on the stellar surface and possibly hot jets. We present here RGS and EPIC data obtained by XMM-Newton on a more massive object (HD 163296), a Herbig Ae/Be star. This class is believed to host progenitors of (peculiar?) A and B stars. Conversely to their solar-mass brothers, the Herbig Ae/Be stars show a spectrum too steady and too soft to originate in flares, their line-ratios show no sign of radiative excitation as expected close to the star and - again contrary to T Tauri stars - there abundances show a pattern of significant iron enhancement. From optical observations there are very tight limits on the presence of a late-type companion to HD 163296, the standard explanation for X-rays from dynamoless A stars, but we want to specifically stress that the observational signatures are not at all alike to any observed late-type star. A possible source for the observed spectrum could be a magnetically confined wind as suggested by Babel & Montmerle (1997) for IQ Aur.

An XMM-Newton View of Westerlund 1 and the Surrounding Field

Kavanagh, P.J.[1]; Norci, L.[1]; Meurs, E.J.A.[2]
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We present the analysis of a 46 ks XMM-Newton observation of the young galactic super star cluster Westerlund 1 and the surrounding field. We detect 75 sources in total. Six of these 75 sources are associated with the cluster. We perform a spectral analysis on the 4 brightest cluster sources (including the well known magnetar) and the 10 brightest field sources. We produce hardness ratios for each source using the EPIC PN camera data and an analysis of the cluster diffuse emission. We find that the spectral analysis results of the cluster sources are in good agreement with previous Chandra studies. Of the field sources spectroscopically analyzed, 8 are found to be foreground sources (3 of which have optical counterparts) and 2 are found to be extragalactic. One of the field sources is seen to undergo a flaring phase during the observation. The results obtained for Westerlund 1 are subsequently discussed.

Resonance scattering in emission line profiles of ζ Puppis

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We present XMM-Newton Reflection Grating Spectrometer observations of pairs of X-ray emission line profiles from the O star ζ Pup that originate from the same He-like ion. The two profiles in each pair have different shapes and cannot both be consistently fit by models assuming the same wind parameters. We show that the differences in profile shape can be accounted for in a model including the effects of resonance scattering, which affects the resonance line in the pair but not the intercombination line. This implies that resonance scattering is also important in single resonance lines, where its effect is difficult to distinguish from a low effective continuum optical depth in the wind. Thus, resonance scattering may help reconcile X-ray line profile shapes with literature mass-loss rates.

Hard X-ray emission from Eta Carinae & other colliding-wind binaries

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Theoretical considerations predict that relativistic particle acceleration indeed takes place in colliding-wind binaries. As a result, hard X-rays and γ-rays are expected through inverse Compton emission, but to date they have never been unambiguously detected. In order to detect such an emission, observations performed with INTEGRAL were carefully analysed, capitalising on the latter's high spatial resolution. In particular, deep hard X-ray images of the region of Eta Carinae were constructed in several energy bands, leading to the very first detection of this source. The hard X-ray emission previously detected by BeppoSax around Eta Car originates in fact from at least 3 different point sources. The emission of Eta Car itself can now be isolated for the first time, and its spectrum unambiguously analyzed. The X-ray emission of Eta Car in the 22–100 keV energy range is very hard ($\Gamma \simeq 1 \pm 0.4$) and its luminosity is 7×10^{33} erg/s. This observed emission is in agreement with the predictions of inverse Compton scattering models, and corresponds to about 0.1% of the energy available in the wind collision. A systematic search for hard X-ray emission from other colliding-wind binaries and from massive stars is also being performed using the INTEGRAL data archive, and the first results will be presented.

Coronal properties of active M dwarfs

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We analyze the M3.5 and M4.5 components of the coeval EQ Peg binary system in comparison with YY Gem, AU Mic, EV Lac, AD Leo, and Proxima Cen, in order to probe the dependence of the coronal properties of active M dwarfs on spectral subclass. We compare the cumulative Chandra HETGS spectra of the seven stars and their coronal abundance ratios, based on emission-measure independent line ratios. The X-ray luminosity of EQ Peg A is by a factor of 6-10 brighter than that of EQ Peg B. All M dwarfs show an inverse FIP effect; in the EQ Peg system this bias tends to be less pronounced for the more inactive secondary, and also for the quiescent state of the primary compared to its flaring state. This trend is strengthened when the range of spectral types is extended to the other M dwarfs: As the X-ray luminosity decreases with later spectral type, so do coronal temperatures and flare rate. More active stars show a pronounced inverse FIP effect that turns into a solar-like coronal abundance level for less active stars, independent of the occurence of flares. The X-ray properties of active M dwarfs can thus be rated from their spectral subclass.

New deep XMM-Newton observations to the west of the sigma Orionis cluster

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Universidad Complutense de Madrid

We present the analysis of a deep XMM-Newton observation of the west region of the young ($\sim$ 3 Myr) stellar cluster σ Orionis. This is known to contain numerous Herbig Ae/Be and T Tau stars, brown dwarfs, and isolated planetary-mass objects within a radius of 30 arcmin of the central star, the Trapezium-like system σ Ori. Our field is centred on the brown dwarf S Ori 55, $\sim$ 20 arcmin to the west of σ Ori, slightly overlapped at the edge of the XMM-Newton observation of the cluster's centre. In this work we give details on the X-ray properties of the cluster stars in the field.

Accretion and Corona: HETG Chandra observations of TW Hya.

Luna, G.J.M.; Brickhouse, N.S.; Dupree, A.K.
SAO/CfA

We present results from an ongoing analysis of a 500 ks Chandra/HETG observation of the young accreting, possibly planet hosting star TW Hya. From emission measure distribution analysis we determine elemental abundances, temperature and density distributions from the quiescent and flare state. We also constrain the amount of absorption present in the system.

High-resolution X-ray spectroscopy of stellar winds from single O-type stars

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X-ray spectroscopy is a sensitive probe of massive star winds. X-rays originate from optically thin shock-heated plasma deep inside the wind and propagate outwards throughout absorbing cool material. Recent comprehensive analyses of the line ratios from He-like ions in the X-ray spectra of O-stars highlighted problems with this general paradigm: the measured line ratios of highest ions are consistent with the location of the hottest X-ray emitting plasma very close to the base of the wind, perhaps indicating the presence of a corona, while measurements from lower ions conform with the wind-embedded shock model. Nearly grey stellar wind opacity for the X-rays is deduced from the analyses of high-resolution X-ray spectra. This indicates that the stellar winds are strongly clumped. Furthermore, the nearly symmetric shape of X-ray emission line profiles can be explained if the wind clumps are radially compressed. The stellar wind clumping has drastic consequences for the stellar mass-loss rate estimates.

Temporal and spectral study of X-ray flares: Active G-K Dwarfs

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We present temporal and spectral characteristics of X-ray flares observed from six late-type G-K active dwarfs (V368 Cep, XI Boo, IM Vir, V471 Tau, CC Eri and EP Eri) using data from seventeen observations with the XMM-Newton observatory. All the stars were found to be flaring frequently and a total of seventeen flares were detected. The largest flare was observed in a low activity dwarf XI Boo with a decay time of 10 ks and ratio of peak flare luminosity to "quiescent" state luminosity of 2. The "quiescent" X-ray emission of these dwarfs varied from 0.5 to 8.3 x 10^{29} ergs/s though it was sometimes difficult to identify the quiescent state due to frequent flaring. We have studied the spectral changes during the flares by using colour-colour diagram and by detailed spectral analysis during the temporal evolution of the flares. The exponential decay of the X-ray light curves, and time evolution of the plasma temperature and emission measure are similar to those observed in compact solar flares. We have derived the semi-loop lengths of flares based on the hydrodynamic flare model. The size of the flaring loops is found to be less than the stellar radius. The hydrodynamic flare decay analysis indicates the presence of sustained heating during the decay of most flares.

X-ray properties of sources detected in the DROXO survey.

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DROXO is a XMM-Newton large program that explored the ρ Ophiuchi Cloud with a 500 ks observation. We presents the main properties of the 111 X-ray sources detected in DROXO. We achieved an average sensitivity of $\sim 10^{-15}$ erg s^{-1} cm^{-2} in flux and $\sim 10^{28}$ erg s^{-1} in luminosity. The rates of detection among Class I, II and III objects are 0.9, 0.68 and 0.46, respectively. Typically the source spectra are highly absorbed (NH $\sim 2.$ m^{-2}), with a mean plasma temperature of 2.5 keV. Some spectra show a soft excess that is best modeled with a double absorption. In six sources we detected the fluorescence line at 6.4 keV from neutral Fe. We found variability of this line in Elias 29 object during DROXO observation, as discussed in details in Giardino et al. (2007).

The periastron and X-ray eclipse of WR25, the most massive star in the Galaxy

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WR 25 is a WN6ha+O binary system whose Wolf-Rayet component is likely the most massive star in the Galaxy. The predicted rapid succession of periastron on 2008 February 11 and subsequent X-ray eclipse was successfully observed with Swift, allowing unique estimates of the orbital inclination and thus the stellar mass.

2XMM Cool-Star Variability Survey: the 2XMMp/Tycho Sample

Pye, J.P.; Fyfe, D.J.; Rosen, S.R.; Schroeder, A.C.
University of Leicester

We have used the XMM-Newton 2XMM Serendipitous Source Catalogue to search for flare events from cool (spectral type F M) stars in the Tycho (Hipparcos) catalogue. We have so far found 37 stars with flares (a total of 85 flare events); of these stars 24 are the target of the XMM observation and 13 are serendipitous observations. We present examples of the serendipitous discoveries most of these are previously little-studied objects and the distributions of measured flare parameters.

Analysis of the LETG spectrum of the hot star Delta Orionis

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We extend knowledge of the soft X-ray spectrum of the intrinsic wind emission from O stars with a 100ks Chandra LETG observation of the O9.5II star delta Orionis. This is first viable high-resolution long-wavelength X-ray spectrum of any hot star. The long wavelength lines provide a sensitive diagnostic of the velocity structure of the emitting material and the validity of equilibrium ionization models. Line features are measured.

The XMM-Newton view of the rich cluster Cyg OB2

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University of Liège

We present the results of an extensive observing campaign of the Cyg OB2 association with XMM-Newton. We analyse the spectra and the long-term variability of the brightest O-stars, some of which are interacting wind binaries displaying a non-thermal radio emission. We further discuss the properties of the population of faint X-ray sources associated with pre-main sequence stars of Cyg OB2.

X-rays from classical T Tauri stars - Accretion and wind signatures

Robrade, J.; Schmitt, J.H.M.M.
Hamburger Sternwarte

We study global X-ray spectra as well as density and temperature sensitive line ratios of classical T Tauri stars (CTTS) to investigate possible signatures of the accretion and outflow process. CTTS are young, pre-main sequence stars that still posses a circumstellar disk from which they actively accrete matter, presumably along magnetic field lines. Additionally, they drive strong, often collimated winds and also planet formation is thought to occur during these phase. While X-rays from magnetic activity (coronae) are clearly present in all CTTS, additional mechanisms involving star-disk interaction, accretion and outflows may generate or modify their X-ray emission. For example, the impact of accreted matter on the stellar surface leads to strong shocks that produce 'additional' soft X-ray emission while infalling and outflowing plasma leads to 'additional' X-ray absorption. We find that in all young accreting stars the properties of the cooler X-ray emitting plasma are influenced by the accretion process and suspect that individual characteristics of the system like magnetic field geometry, mass accretion rate, viewing angle and stellar parameters like mass and radius then naturally lead to the variety of observed phenomena.

Suzaku observations of the accreting stars TW Hya and Su Aur

Schmitt, J.H.M.M.; Robrade, J.
Hamburger Sternwarte

The role of accretion processes in classical T Tauri stars (CTTS) for X-ray emission of such objects is currently a hotly debated issue. In addition to the low f/i-ratios in the triplets of O VII and Ne IX, also a "cool excess" in CTTS shows up in the ratio between the O VIII and O VII resonance line strengths. With the – compared to XMM-Newton EPIC and Chandra ACIS – superior energy resolution of the Suzaku XIS a clear separation between the OVIII Ly_α line at 653 eV and the He-like r line at 572 eV is possible. We show that the Suzaku observations of TW Hya are consistent with the results derived from previous grating observations, and establish a new cool excess in the CTTS Su Aur. Therefore the new generation of X-ray CCDs to be flown on future missions such as eROSITA with the possibility to unambiguously separate OVII and OVIII emission open up a new powerful diagnostic window relevant for a wide range of thermal X-ray sources.

Carbon rich X-ray spectrum of a Wolf-Rayet binary θ Muscae

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We present *XMM-Newton* observations of the Wolf-Rayet binary θ Muscae (WC6+O6-7;WR48). The X-ray spectra, which have strong emission lines from highly ionized ions, are fitted by a multi-temperature thin-thermal plasma model. The emission lines indicated a Doppler shift of $\sim$ 600 km s^{-1}. The redshift is opossite sense from the prediction that the wind-wind collision layers are approaching toward us at the observational phase. To explain the redshit, we need another object, an optically identified O supergiant (Hartkopf et al. 1999) at $\sim$ 100 AU from θ Muscae, and a wind-wind interaction region between θ Muscae and the O supergiant companion. We also detected RRC (Radiative Recombination Continuum) structure from carbon around 0.49 keV, which shows similar red shift of $\sim$ 700 km s^{-1} as the emission lines. The RRC structure imply the existence of a cooler component with kT $\sim$ 5 eV. This might be the evidence that the hotter and a cooler components are located near the wind-wind collision layers between the wide binary.

A Survey of Orion A with XMM-Newton and Spitzer: SOXS

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We report on progress of an XMM-Newton survey of the L 1641 region, covering 3.5^o $times0.5^o$ just south of the Orion Nebular Cluster. We have observed 7 fields in this region and are augmenting the data with XMM-Newton archival data on the region surrounding the ONC including OMC 2/3, iota Ori, L1641N and V1118 Ori. The full survey plus archival data constitute an essentially complete XMM-Newton survey of the Orion A cloud. The final XMM Observations are being completed in March 2008. To date, about 1000 X-ray sources have been identified in L 1641. This exceeds the number of PMS stars found by Spitzer in the same region, despite X-ray luminosity limitations.

The X-ray data are in process of being combined with the Spitzer survey of Orion A. Wherein, Megeath et al. (2008) find ~ 700 young stars (Class 0/I/II) including > 150 protostars (Class 0/I) in the L 1641 region. Currently about 40% of the Class 0/I/II sources are detected by XMM. We estimate a total number of Class III objects as about 1000. Combined with the Spitzer identified sources we determine that there are nearly 1700 PMS stars south of the ONC.

Localizing a stellar X-ray flare using multi-wavelength observations

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We present an analysis of contemporaneous coronal, chromospheric and photospheric structures on the highly active, young K-dwarf star BO Mic ("Speedy Mic"), based on simultaneous observations with XMM-Newton and VLT/UVES. We study an X-ray flare with a total energy of the order of 10^{34} erg that we localize in the stellar atmosphere using its chromospheric emission at UV- and optical wavelengths. Comparison with our Doppler image shows that, regarding the photospheric spot pattern, the flare is located at a rather inconspicuous site. Using a model describing the dynamics of a flaring loop we determine the characteristic sizes of the X-ray emitting plasma and thus estimate the dimensions of the flaring regions. We find that these loop(s) are located far below the magnetically supported large prominences found about two stellar radii above the stellar surface.

Chapter 4

Topic 2: Interacting Binary Systems, (Galactic) Black Holes and Micro-quasars

A genuine new black hole candidate in the M31 globular cluster Bo 45

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The globular cluster X-ray source Bo 45 was included in the 2006 December 26 XMM-Newton observation of M31. Its hard emission spectrum and observed variability is characteristic of the Galactic low mass X-ray binaries (LMXBs) in the low-hard state, observed when accreting only small fraction of the Eddington limit ($< \sim$10% Eddington). However, its apparent 0.3–10 keV luminosity is $2.4 \pm 0.2 \times 10^{38}$ erg s^{-1}, i.e. $\sim$130% Eddington for a 1.4 M$_{\odot}$ neutron star. Hence we identify Bo 45 as a good black hole candidate. Our previous black hole candidates were misdiagnosed, due to an artefact introduced in the data extraction. However, Bo 45 is our first genuine black hole candidate to be identified with this method. Although no black hole LMXBs exist in Galactic globular clusters, at least one good candidate has been identified outside our galaxy. We find it unlikely that the X-ray emission of Bo 45 consists of the combined emission of several low state LMXBS in the globular cluster. However, the emission may be anisotropic and strongly beamed; in this case, Bo 45 could contain a neutron star accretor.

Characterization of BeX systems after 5 years of INTEGRAL

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We have analysed data from all the HMXB systems observed by INTEGRAL during the past 5 years. Our goal is to investigate whether the luminosity class of the optical companion plays a role in the accretion process and how it manisfests in terms of X-ray variability In this presentation we show the results of a very extensive spectral analysis. We find that the Be/X-ray binaries tend to exhibit harder spectra than those of Supergiant HMXRBs. We also discuss the spectral properties of peculiar systems, such as 4U 2206+54, IGR J16138-4848 and IGR J163204751, which clearly differ from the rest of HMXRBs.

INTEGRAL view of H 0115+634: detection of a QPO

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We present a detailed analysis of the BeX system H 0115+634 as seen by INTEGRAL/IBIS during the last 5 years. H 0115+634 was one of the first BeX systems discovered with UHURU data, and shows the typical transient behavior of BeX systems. INTEGRAL/IBIS spectra in the 20-200 keV energy range do not show important spectral changes. On the other hand, our timing analysis have been fruitful, resulting in a pulse period measurement of 3.616±0.002 s and the detection of a 2.3 mHz QPO.

The "Big Dipper" to probe the warm absorber in X-ray binaries

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Fe XXV and/or Fe XXVI absorption lines near 7 keV have now been reported in all the dipping X-ray binaries (systems viewed close to the disk plane) observed with XMM-Newton. This reveals the existence of a highly-ionized atmosphere in low-mass X-ray binaries comparable to the warm absorber in active galactic nuclei. We have demonstrated that the spectral changes during dips, both in the lines and in the continuum can be explained by variations of the ionization level and column density of this plasma. Here, we present new XMM-Newton observations covering several 4 h long dips of the so-called "Big Dipper", X 1624-490, providing us with the longest exposure ever obtained on its dips. These high-quality data enable us to study the spectral variations during dips with unprecedented detail and better constrain the disk structure and its highly-ionized atmosphere.

X-ray eclipse time delays in 4U 2129+47

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4U 2129+47 was discovered in the early 80's and classified as an accretion disk corona source due to its broad and partial X-ray eclipses. The 5.24 h binary orbital period was inferred from the X-ray and optical light curve modulation, implying a late K or M spectral type companion star. The source entered a low state in 1983, during which the optical modulation disappeared and an F8 IV star was revealed, suggesting that 4U 2129+47 might be part of a triple system. The nature of 4U 2129+47 has since been investigated, but no definitive conclusion has been reached. Here, we present timing and spectral analyses of two XMM-Newton observations of this source, carried out in May and June, 2005. We find evidence for a delay between two mid-eclipse epochs measured 22 days apart, and we show that this delay can be naturally explained as being due to the orbital motion of the binary 4U 2129+47 around the center of mass of a triple system. This result thus provides further support in favor of the triple nature of 4U 2129+47.

Multiwavelength Comparisons Between Microquasars XTE J1817-330 and XTE J1818-245

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We report high-energy results obtained with INTEGRAL, Rossi-XTE and ground based instruments (in radio, NIR and optical) on two black hole candidates situated in the Galactic Center: XTE J1817-330 and XTE J1818-245. We compare the results obtained on these X-ray binaries which were deeply observed thanks to several of our multiwavelength programs correlated with INTEGRAL. Broad-band spectra and fast time-variability properties are derived on these sources while in outburst together with radio, (N)IR and optical data. We build up spectral energy distributions of the sources and derive interesting constraints, showing spectral state variations.

The Scutum survey

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During the last couple of years, the γ-ray observatory INTEGRAL has been conducting a continuous monitoring of the Galactic Plane revealing large numbers of new X-ray sources. A substantial fraction of these sources are believed to be high mass X-ray binaries. The Scutum region has been proposed to be the site of vigorous formation of X–ray pulsars. Our main goal is to search for new HMXRB candidates most likely situated in this region of strong absorption, which still remain undetected. Preliminary imaging results of the Scutum survey performed by INTEGRAL suggest the presence of a few possible new sources. This is the first step of an on going project. The identification and follow up studies of the counterparts will be done in the IR bands.

Pulse profile study of the X-ray pulsar A 0535+26

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We present a detailed pulse profile study of the Be/X–ray binary pulsar A 0535+26 during two normal (type I) outbursts which took place in 2005–2006. Our main goal is to study the pulse shape evolution with luminosity, time and energy. Single peak pulse profiles were found at low luminosities. As luminosity increases two, three and four (a few cases even five) components become prominent features. An energy dependent pattern was also found. As the luminosity increases, low energy profiles are more complex, exhibiting the multiple components. High energy profiles evolve from double to single peaks. Changes in the pulse profile were found at energies around the 45 keV cyclotron line. The pre-outburst spike found in the August/September 2005 normal outburst shows a different pulse shape evolution.

X-rays from Quiescent Black Holes: Accretion or Jet Powered?

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We report results from a systematic study of X-ray emission from black hole transients in quiescence. In this state mass accretion is thought to follow the geometry of an outer thin disk and an inner advection-dominated accretion flow (ADAF), which is likely coupled to the jets that are also thought to be present in such systems. The goal of the study is to see whether the X-ray emission in the quiescent state is mainly powered by accretion or jets. Using data from deep *XMM-Newton* observations of three selected black hole transients, we have found that the quiescent X-ray spectra are, to a high precision, of power-law shape. The spectra deviate significantly from the expected X-ray spectrum of the ADAF for the quiescent state in the cases of GRO J1655-40 and V404 Cyg. On the other hand, they can naturally be explained by emission from the jets, if the emitting electrons follow a power-law spectral distribution (as is often assumed). The situation remains ambiguous in the case of XTE J1550-564, due to the relatively poorer quality of the data.

XMM-Newton observation of the Z-source GX 340+0

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I will present preliminary results from a recent XMM-Newton observation of the bright NS X-ray source GX 340+0. The spectral variability is followed in detail through the corresponding changes in the line profile of a broad emission line at 6.7 keV. We interpret the broadening of the line as due to a combination of relativistic and Doppler effects acting in an optically thick accretion disk, and fit the line profile with a diskline model. This model is statistically preferable over a simpler Gaussian profile and, thanks to a time-resolved spectral analysis, it is possible to derive the changes in the disk geometry and in the ionization state of the reflecting material in correlation with the changing X-ray luminosity of the source.

XMM-Newton Look on the Bright Atoll 4U 1735-44

D'Ai, A.; Di Salvo, T.; Iaria, R.; Robba, N.R.
DSFA - Palermo University

An important feature detected in several NS LMXBs is the iron emission line at energies between 6.4 and 6.7 keV, usually having a quite broad width (up to 1 keV FWHM). It has been proposed that the origin of the broad widths of these lines is due to the combined Doppler and relativistic effects that play a major role in the neighbourhood of the NS. The spectral shape of this line reveals the inner geometry of the accretion flow, and gives information also on the state of the reflecting matter and the corona and system geometry. We will show in this poster the results of a spectral analysis on XMM-Newton data of the bright atoll source 4U 1735-44, focused on the diagnostics possibilities offered by a relativistically smeared Fe line present in the spectrum.

Variations in the dip properties of the LMXB XB 1254-69 observed with XMM-Newton

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We present the results of the analysis from five XMM-Newton observations of XB 1254-69 which investigate the mechanism responsible for the highly variable dip durations and depths seen from this low-mass X-ray binary. Deep dips were present during two observations, shallow dips during one, while no dips were detected during the remaining two observations. We found that the folded V-band Optical Monitor light curves obtained when the source was undergoing deep, shallow and no detectable dipping exhibit sinusoid-like variations with significantly different amplitudes and phases. We fitted EPIC spectra obtained from persistent or dip-free intervals with a model consisting of disk blackbody and thermal comptonization components together with Gaussian emission features at 1 and 6.6 keV modified by absorption due to cold and photo-ionized material. None of the spectral parameters appears to be strongly correlated with the dip depth except for the temperature of the disk blackbody which is coolest (kT 1.7 keV) when deep dips are present and warmest (kT 2.2 keV) when no dips are detectable. We propose that the changes in both disk temperature and optical modulation can be explained by the presence of a precessing tilted accretion disk in the system.

Polarization of the thermal emission from the black-hole accretion discs

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Multicolour black-body emission from the accretion disc around the black hole can be polarized on its way through the atmosphere above the accretion disc. We model this effect by assuming Kerr metric for the black hole, a standard thin disc for the accretion flow and Rayleigh scattering in the atmosphere. We compute the expected polarization degree and the angle as they can be measured for different inclination of the observer, optical thickness of the atmosphere and different values of the black hole spin. All relativistic effects near a compact center are taken into account.

SS433 as an ultraluminous UV source

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We present optical spectral study of gas filaments located in the nebula W50 surrounding the famous galactic superaccretor SS433.The gas filaments are located in the direction of the jet propagation.We find high ionization emission lines of HeII and [OIII] in the filaments, the lines have to be produced in the gas photoionization by the SS433 accretion disk. The intrinsic face-on luminosity of the supercritical accretion disk in the far UV region is estimated to be $\sim 10^{40}$ erg/s. We compare the filament spectra with those of nebulae surrounding ultraluminous X-ray sources.

A new Comptonization model for low-magnetized accreting neutron stars in LMXBs

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We developed a new model for the X-ray spectral fitting XSPEC package which takes into account the effects of both thermal and dynamical (i.e. bulk) Comptonization.The model consists of two components: one is the direct blackbody-like emission due to seed photons which are not subjected to effective Compton scattering, while the other one is a convolution of the Green's function of the energy operator with a blackbody-like seed photon spectrum. When combined thermal and bulk effects are considered, the analytic form of the Green's function may be obtained as a solution of the diffusion Comptonization equation. Using data from the BeppoSAX, INTEGRAL and RXTE satellites, we test our model on the spectra of a sample of six persistently low magnetic field bright neutron star Low Mass X-ray Binaries, covering three different spectral states. Particular attention is given to the transient powerlaw-like hard X-ray (> 30 keV) tails that we interpret in the framework of the bulk motion Comptonization process. We show that the values of the best-fit δ-parameter, which represents the importance of bulk with respect to thermal Comptonization, can be physically meaningful and can at least qualitatively describe the physical conditions of the environment in the innermost part of the system. Moreover, we show that in fitting the thermal Comptonization spectra to the X-ray spectra of these systems, the best-fit parameters of our model are in excellent agreement with those of COMPTT, a broadly used and well established XSPEC model.

The Variable Source Content of the 2XMM Catalogue

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CESR

The 2XMM serendipitous source catalogue contains ∼2,000 unique sources that have been flagged as variable by the pipeline processing software. We have examined the products for each of these sources in the search for new X-ray binaries, CVs and related objects. We will present the results of these studies as well as follow-up analyses of the most promising serendipitous variable sources found in the catalogue, including new candidate neutron stars, CVs, and X-ray binaries. We will also present a summary of the remaining variable sources in the catalogue.

The accretion disc dynamics and nature of white dwarf binaries as X-ray sources

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Space Research Institute

As part of the family of X-ray sources, binary stars with white dwarf companion are also classified as CVs. White dwarfs are compact objects with high interior densities. In this paper we study models of disc dynamics and instability behaviour in this special class of accreting binaries. We stress features related to the X-ray emission. Mechanisms of hydrodynamics and appropriate model equations are used to examine the physical processes that excite the production of X-rays. We create synthetic light curves for selected binaries to visualize the radiation processes.

Models for Low-Mass X-Ray Binaries in the Elliptical galaxies NGC3379 and NGC427

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We present the first global population synthesis study of low-mass X-ray binaries (LMXB) in elliptical galaxies. The models are calculated with the recently updated *StarTrack* code (Belczynski et al., 2008), assuming only a primordial galactic field LMXB population. The simulations are targeted to modeling and understanding the origin of the X-ray luminosity functions (XLF) of point sources in the two ellipticals NGC 3379 and NGC 4278. For the first time we explore the XLF down to luminosities of $3 \times 10^{36}\,\mathrm{erg\,s^{-1}}$, as probed by the most recent observational results (Kim et al., 2006). We consider models for the formation and evolution of LMXBs in galactic fields with different CE efficiencies, stellar wind prescriptions, magnetic braking laws and IMFs. We identify models that produce XLFs consistent with the observations both in shape and absolute normalization, suggesting that a primordial galactic field LMXB population can have a significant contribution to the total population of an elliptical galaxy. We also find that the treatment of the outburst luminosity of transient systems remains a crucial factor for the determination of the XLF since the modeled populations are dominated by transient LMXBs.

Rapid optical/X-ray flux correlations in the low/hard state of GX 339-4

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We present the discovery of an interesting optical/X-ray flux correlation on rapid timescales of tens of milli-seconds in the low/hard state of the Galactic black hole GX 339-4 during June 2007. The optical (VLT) and X-ray (RXTE) data show a clear positive cross-correlation function (CCF) signal, with optical lagging X-rays by 150 ms, preceded by a shallow rise and followed by a steep decline with anti-correlation dips. Both optical and X-ray power density spectra are qualitatively similar with a break or QPO-like feature at timescales of 20 s. The CCF is narrow and the X-ray auto-correlation function (ACF) is broader than the optical ACF, arguing against reprocessing as the emission mechanism for the optical power. We discuss the observations in terms of cyclotron radiation from within a truncated disk, or as jet synchrotron. The complex CCF structure suggests similarities to another remarkable X-ray binary XTE J1118+480. Such rapid timing studies are opening up new parameter space for accretion studies in stellar sources.

X-ray spectral variability in the ULX population of NGC 4485 and NGC 4490

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University of Durham

The nearby Sd galaxy NGC 4490 is remarkable in that it hosts one of the most numerous ULX populations within 10 Mpc, only bettered by M51 and M82. Here, we examine the X-ray spectral and temporal variability of these sources over the course of four *Chandra* and *XMM-Newton* observations spanning the years 2000-2004. We detect all five previously identified ULXs in NGC 4490 and that in the tidal tail of NGC 4485. We also find one new transient ULX in the system. The spectral variability is generally characterised by a hardening of the source spectra as their luminosities increase. The sources show a variety of long-term light curves; however, short-term (intra-observational) temporal variability is conspicuous by its absence. We discuss the implication of our results for the nature of ULXs.

XMM-Newton's view of the eclipsing burster low-mass X-ray binary AX J1745.6-2901

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Observatoire Astronomique de Strasbourg

From 31 March to 4 April 2007, three observations were performed by XMM-Newton as part of a multi-wavelength observation campaign of SgrA* and its neighboring X-ray transient sources. Two bright transient sources in outburst were detected during these observations. We focus here on the transient source in outburst located about 1.5 arcmin South-West of SgrA*, which exhibited deep eclipses and type-I X-ray bursts. We identify this source with the eclipsing burster low-mass X-ray binary discovered by ASCA, AX J1745.6-2901. These XMM-Newton observations allows us to refine the period of the eclipse and the position of AX J1745.6-2901. Finally, we observed with XMM-Newton for the first time several dips. AX J1745.6-2901 is therefore the first dipper of the Galactic Center region.

A Jet Emitting Disc model for the microquasar broad band emission.

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LAOG

We have developed a unified picture to explain the spectral states of BH binaries as well as their spectral evolution during outbursts (Ferreira et al. 2006). The hard/soft transition is obtained by varying the relative contribution of an outer Standard Accretion Disk (SAD) and an inner Jet Emitting Disk (JED). We will focus on the most recent results : 1) The radial structure of the JED : it appears that the JED can exist either as a hot, optically thin, or a cold, optically thick disk, but that the optically thin solutions are still geometrically slim. The hot solution can be assimilated to the hard X-ray corona. 2) The hysteresis behavior can result from the combined evolution of the accretion rate and disc magnetization during the outburst ultimately driving the variation of the SAD-JED transition radius (Petrucci et al. 2008). 3) Correlation: we will compare our model predictions with the observed correlations between the radio and X-ray emission in hard states 4) SED: we will present the first SEDs from radio to X/gamma expected from our model.

A study of aperiodic time variation of Vela X-1

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We present the detailed study of the time variation of high mass X-ray binary pulsar, Vela X-1 observed with the Rossi X-ray Timing Explorer (RXTE). The iron K lines observed from X-ray pulsars is thought to be a re-processing matter around the neutron star. Thus the X-rays in the energy band containing the iron K lines is expected to have a certain delay from the higher continuum energy X-rays. We have analyzed the RXTE data to detect the temporal variation of iron-band emission is delayed as compared with that of the other energy X-rays from some of them. We have discovered that higher X-rays are advanced in comparison with the lower energy X-rays in Vela X-1. We will present our detail analysis and discuss the implications of our results.

The thermal emission component in low-luminosity binary pulsars

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INAF/IASF - Milano

In the latest years a clear excess, over the main power-law component, has been revealed below 10 keV in the spectrum of many X-ray binary pulsars. This component has been described with different models (both thermal and non-thermal) and various physical processes have been invoked to produce it. This feature has been detected also in faint sources and at low luminosity levels, suggesting that it is an ubiquitous phenomenon. In the most luminous pulsars this component is characterized by a low temperature and a large emission area, therefore it is referred to as a 'soft' excess. On the other hand, thanks to archival XMM-Newton observations, recently we have found a different feature in some persistent, low-luminosity ($L_X \sim 10^{34-35}$ erg s^{-1}) and long-period (P $>$ 100 s) Be pulsars; in these sources the observed excess can be modeled only with a rather hot (kT $>$ 1 keV) black-body component of small area (R $<$ 0.5 km), thus suggesting a different emission mechanism than in the high-luminosity pulsars. Here we present the spectral and timing characteristics of this component and argue about its possible origin; moreover, we also discuss of other interesting low-luminosity and long-period binary pulsars which could display the same type of feature.

Pulsed thermal emission and cyclotron lines from the HMXB XMMU J054134.7-682550

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The LMC source XMMU J054134.7-682550 has been observed by RXTE and XMM-Newton during an outburst in August 2007 lasting for 50 days and reaching $L_{0.2-10keV} \sim 10^{38}$ ergs s^{-1} and $L_{5-30keV} \sim 2.5 \times 10^{38}$ ergs s^{-1}. The source was detected before, during and after the ouburst. Cyclotron absorbing lines have been detected, corresponding to a magnetic field $\sim 10^{12}$ Gauss. The pulse period varies over the outbursts. A soft X-ray excess was detected below 1 keV. It features an independent pulsation when compared to that of the hard X-ray component. The soft excess provides constraints on the reprocessing geometry.

X-ray behaviour of the Supergiant Fast X-ray Transient: XTE J1739-302

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The data provided by the ESA INTEGRAL mission during the last five years prove that we are very far from knowing the size and distribution of the population of HMXRB in our Galaxy. Among them, an important fraction belong to the fastgrowing class of Supergiant Fast X-ray Transients (SFXT) (Negueruela et al. 2006, ApJ 638, 982; Smith et al. 2006, ApJ 638, 974). This new class of HMXBs is characterised by very short outbursts with very fast rise times (< 10 min) and typical durations of a few hours, staying in quiescence most of the time. XTE J1739-302, the prototype source of the SFXT class, will be presented in detail (Blay et al 2008, A&A, submitted). The source follows a more complex behaviour than expected. Far from presenting a regular variability pattern, XTE J1739-302 shows periods of high, intermediate, and low flaring activity. The X-ray behaviour of the source is analysed in the context of the cumply structure of the supergiant wind.

Evidences of the funnel radiation in X-ray spectra of SS433

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We have analysed XMM X-ray spectra of SS433. A model of the jet spectra was developed which satisfies the observed jet moving line fluxes. We find an additional component in the spectrum of SS433, the most probably the a reflected radiadion. The component may come from the deep inner regions of the supercrirical accretion disk funnel to be reflected in outer funnel walls (r$\sim 10^{11}$ cm). We have found a spectrum of the reflected component and estimated intrinsic X-ray luminosity, $L_x \geq 3x10^{38}$erg/s.

The INTEGRAL/IBIS view of IGR J16318-4848. Possible detection of spin period

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IGR J16318-4848 is the archetype of the new class of intrinsically obscured high-energy sources revealed by INTEGRAL. Many campaigns and multi-wavelength studies have been performed in order to understand its nature. Even having been the first system discovered by INTEGRAL, IGR J16318-4848 is still a source of many uncertainties, such as the knowledge of its orbital parameters, and its scenario is still not clear although some suggestions have been made so far. In this poster we report on a continuum spectral and a detailed timing analysis carried out with INTEGRAL/IBIS, from GPS and public observations up to date. Our goal is to characterize the source in the 20-100 keV regime. The main result of the study is the discovery of persistent modulations of around 9000 s throughout the light curve in the 20-40 keV energy range, which could constitute the spin period of the source. We also show the hard x-ray spectral results, which are consistent with previous studies.

Fast transient and persistent supergiant x-ray binaries as wind accretors

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The X-ray properties of Supergiant Fast X-ray Transients show that, in spite of their peculiarities, they are obviously related to persistent Supergiant X-ray Binaries. Any convincing explanation for their behaviour must consistently take into account all types of X-ray sources powered by wind accretion. Here we present a common framework for wind accreting sources, within the context of clumpy wind models, that allows a coherent interpretation of their different behaviours as an immediate consequence of diverse orbital geometries. SFXTs are systems with slightly wider orbits than persistent SGXBs, while systems with regular outbursts have more eccentric, longer-period orbits.

The globular cluster NGC 6388: XMM-Newton and Chandra observations

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By studying the optical brightness surface density of the globular cluster NGC 6388, it has been recently proposed that it harbors a central intermediate-mass black hole with mass $\simeq 5.7\times10^3$ $M_\odot$. We expect that the compact object in the center of NGC 6388 emits radiation in the X-ray band as a consequence of the accretion from the surrounding matter. We searched for XMM-Newton and *Chandra* observations towards NGC 6388 to test this hypothesis. The *Chandra* satellite disentangles several point-like X-ray sources, probably low mass X-ray binaries, well within the core radius of the globular cluster. However, three of them, coinciding with the cluster center of gravity, remain unresolved. Their total luminosity is $L_X^{Obs} \simeq 2.7 \times 10^{33}$ erg s^{-1}. If one of these sources is the X-ray counterpart of the intermediate-mass black hole in NGC 6388, the corresponding upper limit on the accretion efficiency, with respect to the Eddington luminosity, is 3×10^{-9}. This measurement could be tightened if moderately deep radio observations of the field were performed.

XMM observation of 1RXS J180431.1-273932: a new M-type X-ray binary with a 494s period

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Low-mass X-ray binaries are peculiar binary systems composed of a compact object and a low-mass star. Recently, a new class of these systems, known as symbiotic X-ray binaries (with a neutron star with a M-type giant companion), has been discovered. Here, we present long-duration *XMM* observations of the source 1RXS J180431.1-273932. Temporal and spectral analysis of the source was performed along with a search for an optical counterpart. We used a Lomb-Scargle periodogram analysis for the period search and evaluated the confidence level using Monte-Carlo simulations. The source is characterized by regular pulses so that it is most likely a neutron star. A modulation of $494.1 \pm 0.2\,\mathrm{s}$ (3σ error) was found with a confidence level of >99%. Evidence of variability is also present, since the data show a rate of change in the signal of $\sim -7.7 \times 10^{-4}$ counts s^{-1} hr^{-1}. A longer observation will be necessary in order to determine if the source shows any periodic behavior. The spectrum can be described by a power law with photon index $\Gamma \sim 1$ and a Gaussian line at 6.6 keV. The X-ray flux in the 0.2–10 keV energy band is 5.4×10^{-12} erg s^{-1} cm^{-2}. The identification of an optical counterpart (possibly an M6III red-giant star with an apparent visual magnitude of $\simeq 17.6$) allows a conservative distance of ~ 10 kpc to be estimated. Other possibilities are also discussed. Once the distance was estimated, we got an X-ray luminosity of $L_X < 6 \times 10^{34}$ erg s^{-1}, which is consistent with the typical X-ray luminosity of a symbiotic LMXB system.

Enlightening differences in AMSPs behaviour: XTE J1751-305 vs XTE J1814-338

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I will review the main rotational properties of Accreting Millisecond Pulsars resulting from the timing analysis of their coherent pulsations. In order to show the actual bimodality of the accretion torques acting on the rotating Neutron Stars, I will discuss and compare the cases of a spinning up source, XTE J1751-305, and a spinning down one, XTE J1814-338, showing how information on the mass accretion rate and the magnetic fields can be derived. A radically different behaviour between these two cases also arise if the phase response to variations of the accretion rate is considered. I will discuss these differences from the point of view of a newly developed model that can interpret them in terms of different inclination angles.

X-ray binaries and CXB

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We consider contribution of X-ray binaries to the Cosmic X-ray Background. We show that given the cosmic star formation history and L_X–SFR relation for high-mass X-ray binaries, their contribution to the CXB energy flux in the 2-10 keV band is $\sim 5-10\%$. This presents a significant contribution to the unresolved apart of the CXB in the 2–10 keV band, accounting for about a half of it, but is insufficient to explain it all. A similar estimate for low-mass X-ray binaries gives an upper limit of $\sim 1-2\%$ in the absence of cosmological evolution of the LMXB populations and luminoisty.

Are there atoll and Z sources in HMXBs?

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The definition of *source states* has been a very useful way to investigate the variability of X-ray binaries, particularly, of low-mass X-ray binaries (LMXB) and black holes (BH). In a given state, timing and spectral properties are found to be correlated, indicating that the physical processes associated with those properties have a common origin.
LMXBs contain low-magnetic field neutron stars and include two subtypes, named the Z and atoll sources, which can be distinguished by the different timing and spectral variability patterns of their states.
High-mass X-ray binaries (HMXB) contain high-magnetic field neutron stars and massive companions. All HMXBs but ahandful of systems show X-ray pulsations.
We have investigated the rapid aperiodic variability of Be/X-ray binaries in correlation with the spectral states (as defined by the position of the source in the colour-colour diagram (CD)) during giant outbursts. By investigating the power spectral shapes and the pattern traced in the CD, we find two types of sources. The similarities and differences between them and with their low-mass cousins are discussed.

A systematic look at the Very High and Low Hard state of GX 339-4

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We present a systematic study of GX 339-4 in both its very high and low hard states from simultaneous observations made with XMM-Newton and RXTE in 2004 and 2006. The X-ray spectra of both these extreme states exhibit strong reflection signatures, with a broad, skewed Fe-kalpha line clearly visible above the continuum. Using a newly developed, self-consistent reflection model which implicitly includes the blackbody radiation of the disc as well as the effect of Comptonisation, blurred with a relativistic line function, we were able to infer the spin parameter of GX 339-4 to be 0.92 ± 0.01 (statistical) ± 0.03 (systematic) at 90 per cent confidence. We find that both states are consistent with an ionised thin accretion disc extending to the innermost stable circular orbit around the rapidly spinning black hole.

Mass-loss rate estimation for the massive binary 4U 1538−52/QV Nor

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Universitat d'Alacant

We present an analysis of archival RXTE data of the X-ray binary source 4U 1538−52/QV Nor. The RXTE observatory made one complete binary cycle observation on January 1997 and 2001, respectively. The X-ray continuum data are well described by an absorbed Negative Positive power laws Exponentials (NPEX) component modified by an iron emission line at 6.4 keV and a cyclotron absorption line at 20 keV. Using a simple spherically symmetric wind model to describe the X-ray absorption variations as a function of orbital phase, we inferred a wind mass-loss rate from the companion star of $1.3 - 2.5 \times 10^{-6}$ $M_{\odot}$/year. Our results are consistent with those obtained by the Ginga X-ray observatory. We have also analyzed X-ray flux variations over the binary orbit and we have found an orbital modulation with two variable peaks.

Three black-hole binaries observed with XMM-Newton: XTE J1817-330, XTE J1856+053 and GRS 1915+105

Sala, G.; Greiner, J.
MPE

X-ray binaries are the brightest X-ray sources in the sky. They are powered by the accretion of material onto a compact object, a neutron star or a black hole. At present, around 20 X-ray binaries contain a dynamically confirmed black hole, and around another 20 are the so-called black hole candidates.

About half of the black hole binaries are transient sources with only one unique outburst observed. TOO observations of new X-ray transients are thus extremely important to identify new black-hole candidates. We report on XMM-Newton TOOs aimed to constrain the mass of the compact object in the X-ray transients XTE J1817-330 and XTE J1856+053.

Among the confirmed black hole binaries, GRS 1915+105 is the most prominent microquasar and the most energetic object known in our Galaxy. It has remained unique among its class for the large variety of temporal behaviours in different time scales. Multiwavelength observations showing radio, IR and X-ray oscillations, with time delays depending on the wavelength, have revealed in the past the intimate link between the accretion disc and the jet ejection. Here we will also present the first results of simultaneous XMM-Newton and VLT/ISAAC observations of GRS 1915+105 at high temporal resolution.

Modelling the RXTE and INTEGRAL Spectra of GX 9+9

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GX 9+9 is a persistently bright atoll-type Low-Mass X-ray Binary with a neutron star primary. The neutron star is assumed to have an accretion disc extending close to the surface, where it has a dynamic continuation in the form of either a simple, thin boundary layer or a spreading layer, i.e. a wider zone of matter settling towards the poles.

Both *RXTE* and *INTEGRAL* have observed GX 9+9 on numerous occasions. The spectra from 2002-2007 were fitted with a model consisting of two modified blackbodies, one representing the accretion disc and the other the spreading layer. We show how various parameters from the spectral fitting, such as the temperature of the spreading layer, depend on the luminosity of the components, as well as colours derived from model fluxes.

X-ray Absorption and Emission in Accretion Disks of bright LMXBs

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Compact binaries containing neutron stars and black holes emit luminous X-ray continua emanating from the central region of accretion. We traditionally model these X-ray spectra with radiative continuum processes added by some radiative reprocessing, in most cases Compton scattering and some additional isolated line features. High resolution X-ray spectrometers now enable us to recognize reprocessing in a much more sensitive fashion and we can use these X-ray continua to diagnose the conditions in the accretion disk through illumination and absorption. In many systems containing black holes powerful winds have been recognized through resonance line absorption and in a few X-ray binaries signatures of radiative heating of accretion disk atmospheres and coronae have been studied in some detail, some exhibiting warm absorbers as well. The bulk of sources, however, remained fairly devoid of such signatures, specifically the bright Z sources. This perception seems to be changing. A recent long exposed HETG observation of the prototype Z source Cyg X-2 not only shows lines from highly ionized ions, but also indicates a large dynamic range in line widths. We present analysis results from these spectra and compare them to previously obtained results from accretion disk coronal sources such as 4U 1822-37, Her X-1, EXO 0748-67, and Cir X-1 as well as the disk lines in compact binary pulsar 4U 1626-67.

Iron Lines and Precession Variability of the Unique Microquazar GRS 1915+105

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Based on INTEGRAL (2003-2007) and RXTE (1996-2008) data we studied X-ray variability of GRS1915+105 in the 10^{-8} - 10^{-1} Hz frequency range, aiming to detect features in their power density spectra associated with the long term periodicity. The 300-days periodicity was detected for the hard X-ray component of the GRS1915+105 flux (ISGRI/IBIS). Analyzis of low-ionized iron line evolution in the spectrum of GRS1915+105 is presented for different observations (XMM-Newton, Chandra, ASCA, BeppoSAX) carried out during 1994-2004. For all observations we fond tight correlation between the value of equivalent width and the precession phase. The long-term behaviour of the source together with variation of K_α iron line flux tends to indicate a precessional nature of this variability and could shed light on the nature of this peculiar microquazar. The future prospects are connected with a hight resolution X-ray spectroscopy (XMM-Newton, XEUS) of GRS1915+105. The investigation of K_α iron line profile in course of precession motion will offer the best opportunity to provide verification of origin of iron K emission in the spectrum of puzzling object GRS1915+105.

New observational insights into the Low/Hard State of Cygnus X-1 with Suzaku

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The black-hole binary Cygnus X-1 was observed with Suzaku for 17 ks in 2005 October, in the low/hard state with a 0.7–400 keV luminosity of 4.6×10^{37} erg s^{-1}. The high-quality XIS and HXD data, covering a broad energy band from 0.7 to 400 keV, have provided significant new insight into the accretion flow. The time-averaged spectrum was successfully reproduced invoking a cool accretion disk, and a hot Comptonizing corona surrounding it. The data require the Comptonizing corona to produce two distinct components, represented by y-parameters of ~ 1.2 and ~ 0.3. The cool disk manifest itself as a soft excess component with an innermost temperature of ~ 0.2 keV, a mild reflection hump, and a weakly broadened iron line. The disk is considered to protrude into the corona, but truncated at a radius ~ 3 times the last stable orbit. A comparison with the Suzaku data on GRO J1655−40 reveal several interesting spectral differences, which can be attributed to inclination effects. An intensity-sorted spectroscopy indicates that the continuum becomes less Comptonized when the source flares up on times scales of ~ 1 s, while the underlying disk remains unchanged.

The role of the disk irradiation in the outbursts of the Rapid Burster

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We analyze a specific group of intense outbursts with strong persistent emission (group A) in the unique low-mass X-ray binary Rapid Burster. We interpret them in terms of irradiation of the disk by X-rays strong enough to ionize all of the disk out to its outer edge without self-shadowing. We argue that the parameters of irradiation underwent a large and rapid change in the subsequent group B. We interpret the irradiation in terms of the slim accretion disk region. We find that the vertical dimension of the irradiating source, and hence its ability to irradiate the disk, decreases with the increasing luminosity of the outbursts with exponential decays in neutron star soft X-ray transients of a comparable orbital period length, and is exceptionally small in the Rapid Burster. The difference between the intensities and profiles of the group A and group B outbursts is not caused by a different absorption. The very rapid rise of outbursts in both groups speaks in favor of a small radius for the optically thin advection-dominated flow prior to an outside-in outburst. We argue against a significant role of the propeller effect in the Rapid Burster.

The strange 12 years long outburst with a series of echo outbursts in KS1731-260

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The thermal instability of accretion disk should appear when a quasipersistent low mass X-ray binary (LMXB) goes into quiescence. We analyze the complicated X-ray activity of one such case, KS1731-260. On the decline from a strange, 12 years long outburst, it went through a series of so-called echo outbursts with the properties similar to the 'ordinary' soft X-ray transients. We interpret the onset of echo outbursts as a decrease of the mass transfer rate which lead to a transition from a thermally stable to unstable disk. We show that the X-ray spectrum at the peak of the echo outburst is consistent with that in the high state/main outburst. These echo outbursts are of outside-in type. The disk did not get into real quiescence between most echo outbursts; a series of heating and cooling fronts thus formed and the disk just reached a steady-state at the outburst peak. We show that the individual echo outbursts are dependent on each other in KS1731-260. We put these events to the system incorporating cataclysmic variables and LMXBs. KS1731-260 provides a link between the persistent and transient systems.

Accretion discs in interacting compact binaries - X1822-371

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According to our current understanding, all the most luminous objects (quasars, AGNs) in the universe are accretion powered. In these systems, however, the accretion geometry and physics is very complicated and we hardly ever see the "central engine" directly. Thus X-ray binaries and cataclysmic variables provide a better laboratory for studying the accretion induced phenomena in the Galaxy. Despite the research of accretion induced phenomena over decades, there is still no satisfactory correspondence between the theory and observations. X1822-371 is a low-mass X-ray binary where a neutron star accretes mass from a low-mass normal star. In addition to the accretion disc around the neutron star, the system contains an accretion disc corona. This has made it maybe the strongest case for existence of thick (or warped) accretion discs as opposed to the standard, geometrically thin, Shakura-Sunyaev discs. We present results of modelling the accretion disc in the system by using high time and medium spectral resolution optical spectra over the orbital cycle of the target.

Long term monitoring of 4U 1722-30 with INTEGRAL: spectral state variations

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We report on the 2003-2007 INTEGRAL observations of the Neutron Star Low Mass X-ray Binary 4U 1722-30 (also known as GRS 1724-30) located in the Globular Cluster Terzan 2. The JEM-X and IBIS light curves show the source with a persistent but variable flux. The Hardness-Intensity diagrams evidence the behaviour of a typical Atoll source: 4U 1722-30 repeatedly moves in the diagrams from the Banana (Soft state) to the Island (Hard state). We report on the detailed spectral analysis of Soft and Hard states and for the first time also in an Intermediate state. The Hard spectra reveals a comptonised corona emission up to 200 keV with a high temperature of 40 keV and optical depth of 0.5. In the Soft state the main emission is from the accretion disk (with kTin$\sim$0.5 keV) whereas the comptonised emission decreases evidencing an optically thick and cold corona (tau $\sim$ 9, kTe $\sim$ 2 keV). During the hardening there is an increase of the inner radius of the accretion disk suggesting a system expansion during the spectral transition. This behaviour draws 4U 1722-30 near to the Soft X-ray transient sources though 4U 1722-30 doesn't never reach a real "quiescent" state.

INTEGRAL Observations Of Massive Stars Unveil Dynamics Of Stellar Winds

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INTEGRAL tripled the number of super-giant high-mass X-ray binaries known in the Galaxy by revealing absorbed and fast transient systems. INTEGRAL also unambiguously detected hard X-ray emission from few colliding wind binaries. These observations provide new insights and quantitative constraints on these binary systems. Wind clumping in massive stars could in particular be characterized observationally from the study of the hard X-ray variability of compact accreting objects. A large fraction of the hard X-ray emission is emitted in the form of flares with a typical duration of 3 ks, frequency of 7 days and luminosity of 10^{36} erg/s. Such flares are most probably emitted by the interaction of a compact object orbiting at about 10 R_* with wind clumps (10^{22-23} g) representing a large fraction of the stellar mass-loss rate. The density ratio between the clumps and the inter-clump medium is 10^{2-4} in SFXT systems. These parameters are in good agreement with macro-clumping scenario and line driven instability simulations. SFXT have probably a larger orbital radius than classical sgHMXB.

Mass estimates in Ultraluminous X-ray Sources

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In the last couple of years, X-ray and optical observations have significantly boosted our understanding of UltraLuminous X-ray Sources (ULXs). We are now confident that a large fraction of these sources (probably the majority) are X-ray binaries in external galaxies and that several have pretty massive binary companions. Yet, the most fundamental questions on ULXs remain still unanswered: Do they contain stellar (10 solar masses) or intermediate mass (100-1000 solar masses) black holes? Are they the high mass end of the X-ray luminosity function of X-ray binaries in galaxies? How do they form? Are they a good tracer of star formation in their host galaxies? In this talk I will present results of our recent work on the X-ray spectral/timing properties of ULXs and on the modelling of their binary systems. I will show the potential of a new method to estimate the mass of black holes in ULXs, based on the recently discovered "variability plane", populated by Galactic stellar-mass black holes and supermassive active galactic nuclei. I will also present a careful reanalysis of the black hole mass estimates obtained from X-ray spectral fits, including relativistic effects on the emergent spectrum. Finally, I will show how the evolutionary tracks of ULX binaries can be used to constrain the properties of these systems.

Chapter 5

Topic 3: Cataclysmic Variables and Novae

Chandra Spectroscopy of the Hot DA White Dwarf LB1919 and the PG1159 Star PG1

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We have performed soft X-ray spectroscopy of two hot white dwarfs with the *Chandra* observatory using the *Low Energy Transmission Grating*. The first target is the hot DA white dwarf LB1919 ($T_{\rm eff}$=69 000 K). This star is representative of a small group of hot DAs whose metallicities lie well below predictions from radiative levitation theory. The *Chandra* spectrum shows a rich absorption line spectrum which may allow to find the origin of the low-metallicity nature of these DAs. The second target is PG 1520+525, a very hot non-pulsating PG1159 star. We find that it is hotter ($T_{\rm eff}$=150 000 K) than the pulsating prototype PG 1159−035 ($T_{\rm eff}$ =140 000 K) and conclude that both stars confine the blue edge of the GW Vir instability strip.

RR Pictor (1925) : A Chandra X-ray View

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METU

We present the Chandra ACIS-S3 data of the old classical nova RR Pic (1925). We detect the orbital period of the underlying binary system in the X-ray wavelengths. We also find that the neutral Hydrogen column density differs for orbital minimum and orbital maximum spectra with values $0.25(+0.23-0.18)\ 10^{22}\ cm^2$ and $0.64(+0.13-0.14)\ 10^{22}\ cm^2$ at 3σ confidence level. The X-ray spectrum of RR Pic can be represented by a composite model of bremsstrahlung with a photoelectric absorption,two absorption lines centered around 1.1-1.4 keV and 5 Gaussian lines centered at emission lines around 0.3-1.1 keV. The bremsstrahlung temperature derived from the fits range from 0.99 to 1.60 keV and the unabsorbed X-ray flux is found to be 2.5 10^{-13} erg $cm^{-2}s^{-1}$ in the 0.3-5.0 keV range with a luminosity of $1.1 \pm 0.2\ 10^{31}$ erg s^{-1} at 600 pc. The emission lines correspond to various transitions of S, N, O, C, Ne and Fe ; and observation with better spectral resolution is needed to determine the exact emission and absorption features. The source spectrum is better fitted with a cooling flow model rather than photoionized plasma model. The fits with VMCFLOW and CEVMKL models show enhanced abundances of He, C, N, O and Ne in the X-ray emitting region indicating existence of diffusive mixing.

Magnetic accreting white dwarfs in the XMM-Newton era

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Among Cataclysmic Variables (CVs) the magnetic systems represent the brightest X-ray sources. Their X-ray emission is generally characterized by a hard optically thin component extending up to 90keV and soft optically thick component due to reprocessing of hard X-rays and cyclotron emission at the polar regions of the accreting white dwarf. The relative proportion of soft-to-hard X-ray emission strongly depends on the magnetic field strength of the compact object. While the high magnetic field (B>20MG) systems (the Polars) are well known to possess arelatively strong soft X-ray component, this component was known to be present in only 3 systems of the group of the Intermediate Polars, which are believed to possess low-field accreting white dwarf (B<10-20MG). XMM-Newton has instead changed this view revealing a soft X-ray component in an increasing number of systems of this group. We here outline the X-ray spectral and temporal properties as observed with XMM-Newton and their link with fundamental binary parameters with the aim to help in understanding this class of magnetic CVs that only recently have been identified as a potental important population of hard X-ray sources in our Galaxy.

The recovery of accretion in a classical nova seen in X-rays with XMM-Newton

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Nova Oph 1998 (V2487 Oph) was observed by XMM-Newton during 2001-2002, 2.7, 3.2, 3.7 and 4.3 years after outburst. The aim was to monitor the turn-off of the nova, i.e., the extinction of H nuclear burning on top of the white dwarf and thus the end of super soft X-ray emission from the whole hot photosphere. The nova was already extinguished when we observed it, but we detected thermal plasma emission with an Fe fluorescent Kα line at 6.4 keV, observed for the first time in a post nova. This is likely the signature of the reestablishment of accretion onto the white dwarf, but a longer exposure was needed to well define the properties of the cataclysmic binary and its magnetic character. A new and longer XMM-Newton observation was performed last year, allowing for a better energetic resolution spectral analysis as well as timing studies. We present our ongoing analysis, with a clear detection with RGS1, RGS2 and OM. The source is still bright in X-ray and optical bands 9 years after the explosion. New details on the accretion features will be shown, confirming the non-standard magnetic scenario for this classical nova.

V1223 Sgr: long term variability and periodic modulation of hard X-ray emission

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The intermediate polar V1223 Sgr is the most significantly detected cataclysmic variable by INTEGRAL/IBIS. Our analysis of all available observational data from INTEGRAL/IBIS showed that the fluxes of V1223 Sgr are long-term variable (by a factor 2), mainly in the(15-25) and (25-40) keV bands. Moreover this hard X-ray / soft gamma ray variability is correlated with changes in optical spectral band. We prepared unique method of folding particular phase interval on the base of proper time intervals from individual science windows. Our method is applying Good Time Intervals (GTIs) according to (orbital or other) phase bin and creating phase resolved mosaics (supposing sufficient exposure) of a periodic source. Using this method we showed that the flux of V1223 Sgr in the (15-25) keV band has sinusoidal variations with the orbital period (3.37 h).

INTEGRAL broadband X-ray spectra of the selected intermediate polars

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In total, 21 cataclysmic variables (CVs) have been detected by the INTEGRAL satellite in hard X-rays/soft gamma rays. Intermediate polars dominate the group of CVs seen by IBIS/ISGRI. In hard X-rays, these objects seem to be more luminous (up to the factor of 10) than polars. In the strongly magnetized polar systems, cyclotron cooling is probably an important mechanism to suppress the bremsstrahlung high temperature emission. We processed all available observational data from INTEGRAL/IBIS and INTEGRAL/JEM-X for selected intermediate polars and we constructed and analysed the composite IBIS + JEM-X spectra (3-100 keV). This composite spectra can be in most cases well fitted by a thermal bremsstrahlung model (kT = 15 - 25 keV) with reflection from an optically thick cold medium (the surface of the white dwarf).

The first supersoft X-ray sources in M31 globular clusters and optical novae

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We report the discovery of the two first transient supersoft X-ray sources (SSS) in M31 Globular Clusters (GCs), namely in the clusters Bol 111 and Bol 194. We present X-ray spectroscopy and outburst lightcurves for both sources based on observations with Chandra HRC-I, XMM-Newton and Swift XRT carried out from November 2007 until February 2008 in the context of the XMM-Newton/Chandra M31 nova monitoring collaboration. Using Swift and XMM-Newton spectra both sources were clearly identified as supersoft (blackbody spectra with kT $<$ 85eV). We identify the SSS in Bol 111 with the nova M31N 2007-06b, which had its optical outburst in June 2007 and was reported as member of this GC based on photometric and spectroscopic data (Shafter & Quimby 2007). This nova was the very first to be found in a M31 GC. For the second SSS in the GC Bol 194 no optical nova counterpart is known from the literature. We unsuccessfully searched for a nova outburst in Bol 194 in various archival M31 monitoring data. We give constrains on the maximum magnitude and outburst dates for an optical nova, which could have been missed by our monitoring.

The turn-off and recovery of accretion in classical novae as seen by XMM-Newton

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We have been monitoring post-outburst classical novae with XMM-Newton, (around 2 years after explosion), with the aim of understanding their turn-off as well as the reestablishment of accretion. These observations are very relevant to disentangle the controversy between theoretical predictions and previous observational data from ROSAT, which found only 3 novae emitting super soft X-rays (proving still active H-burning), from a sample of 30 galactic and 9 LMC novae observed up to 10 years after their explosion. It was clear that a larger sample of observed novae with more sensitive instruments, such as the EPIC cameras onboard XMM-Newton, was needed. A review of the results obtained will be presented, with a special emphasis on some particular cases, showing either clear features of reestablished accretion onto a magnetic white dwarf -which is not the standard scenario for nova explosions- or super soft emission related to hydrogen burning still active on their surface, with a puzzling temporal behavior. From our observations it is concluded that post explosive stages of classical novae are far from being uniform, but show instead a variety of behaviors not known prior to XMM-Newton era.

Cataclysmic variables as hard X-ray emitters seen by INTEGRAL

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The ESA INTEGRAL satellite is an efficient tool to detect X-ray active cataclysmic variables and related objects, particularly in their active and/or flaring states when the gamma-ray and hard X-ray emission increases. The fraction of cataclysmic variables and related objects in hard X-ray sources detected by the INTEGRAL satellite is surprisingly large and - including still unclassified sources - may represents up to 1/10 of all INTEGRAL IBIS sources. Some of the objects emit hard X-rays up to 80 keV. Results of INTEGRAL analyses of cataclysmic variables will be briefly presented and discussed.

Suzaku observations of the dwarf nova SS Cygni in quiescence and outburst

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Hard X-ray emission from dwarf novae is believed to emanate from the boundary layer formed between the innermost edge of the accretion disk and the white dwarf surface. It is, however, difficult to constrain physical parameters of the boundary layer, because the X-ray spectrum of the dwarf novae is composed of a multi-temperature optically thin thermal plasma emission being accompanied by reflection component from the white dwarf surface. In addition, the elemental abundances, imprinted as emission lines in the spectrum, deviate from those of the sun, and the absorber may be partially ionized. A wide energy band and moderate energy resolution of Suzaku enable us to disentangle these spectral complication. In this paper, we present the results from the Suzaku observations of the dwarf nova SS Cyg in full detail. We successfully derived physical parameters of the boundary layer of SS Cygni both in quiescence and outburst in unprecedented accuracy.

Hard X-ray Emitting White Dwarfs in Symbiotic Stars: a Progress Report

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Most symbiotic stars contain a white dwarf accreting from the wind of the red giant mass donor. Symbiotics are therefore closely related to cataclysmic variables. Four members of the class (RT Cru, T CrB, CH Cyg and CD -57 3057) are now known to be strong hard X-ray sources. We summarize the Swift BAT detection and XRT follow-up observations of these hard X-ray emitting systems. We also present pointed Suzaku observations of RT Cru and T CrB, and the results-to-date from our on-going long-term monitoring of CH Cyg and T CrB. We argue that the hard X-rays in these systems result from accretion onto non-magnetic white dwarfs, and that three of the white dwarfs are likely to massive enough (>1.3 Msun) to be considered Type Ia supernova progenitor candidates.

Novae in outburst and in quiescence: XMM constrains the parameters' space

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We will show an impressive sets of observations obtained with XMM-Newton and with Chandra, that help constrain the parameter's space of classical novae and better understand the evolution of hydrogen burning in an accreted shell on a white dwarf. We will describe observations in outburst and in quiescence, and we will especially show how the quiescent phase, observed with XMM-Newton, can yield very meaningful physical information and give indications on the possible paths of type Ia supernova progenitors.

Soft X-ray emission of polars

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Magnetic white dwarfs in accreting close binaries (polars) are among the brightest soft X-ray sources on the sky. The large number of systems discovered during the ROSAT All-Sky Survey has laid a basis for systematic follow-up studies of polars and their physical properties. We compare the main results obtained from our dedicated soft X-ray observations of polars with ROSAT, XMM-Newton, and Chandra over almost two decades and discuss their implications on the physical structure and parameters of the accretion region and the relevant radiation processes.

XMM-Newton observation of the supersoft classical nova V5116 Sgr 2005 No.2

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The Nova V5116 Sgr 2005 No. 2, discovered on 2005 July 4, was observed with XMM-Newton in March 2007, 20 months after the optical outburst. The X-ray spectrum shows that the nova had evolved to a pure supersoft X-ray source, indicative of residual H-burning on top of the white dwarf. The X-ray light-curve shows abrupt decreases and increases of the flux by a factor *sim*8 with a periodicity of 2.97 h, consistent with the possible orbital period of the system. The EPIC spectra are well fit with an ONe white dwarf atmosphere model, with the same temperature both in the low and the high flux periods. This rules out an intrinsic variation of the X-ray source as the origin of the flux changes, and points to a possible partial eclispe as the origin of the variable light curve. In addition to the EPIC spectra and light curves, we present here the RGS high resolution spectra, showing a number of absorption and emission features, some of them evolving between the low and the high states.

XMM observations of the asynchronous polar Paloma

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We present results from a 55 ksec XMM-Newton pointing of the asynchronous polar Paloma (RXJ0524+42). In this source the white dwarf spins 14% or 7% faster than then orbital period making it a transitional object between the fastly spinning IPs and the synchronized polars. The XMM light curve covers for the first time a large uninterupted fraction of the beat cycle, where substantial changes of the accretion geometry are supposed to occur. Throughout the beat cycle light curves are dominated by a self-eclipsing pole resembling the appearance of compact accretion regions seen in synchronized polars. Phasing and length of the bright phase changes along the beat cycle, which can be understood in terms of migration of the main accretion spot. Paloma is a hard X-ray source with only little evidence for a dedicated soft blackbody component. There is no indication for a systematic change of the X-ray hardness ratio.

Multiwavelength spectroscopy of high-accretion rate polars

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We present first results of our ongoing multiwavelength study targeting the brightest strongly magnetic CVs (polars). They escaped XMM-Newton in the early years of the XMM-Newton mission due to extended low states. In 2007 two of those systems, V834 Cen and VV Pup, could be covered in their high states following a ground-based trigger. Comprehensive data sets with simultaneous X-ray and optical spectroscopy and photometry were collected. We investigate the physics of the hard X-ray emitting shock by X-ray plasma diagnostics and optical cyclotron spectroscopy. We discuss the reprocessing efficiency of primary plasma radiation in the accretion region and the phase-dependent strength of absorption and reflection components in the X-ray spectrum. We perform line spectroscopy with the RGS searching for Doppler shifts and thus constrain the line emission region. Finally we derive phase-dependent spectral energy distributions comprising the X-ray, UV and optical spectral ranges to address the long-standing questions of accretion mode and energy balance of the accretion process.

Long-term activity and outbursts of the intermediate polar V1223 Sgr

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We analyze the character of long-term photometric activity of V1223 Sgr, with paying attention to the previously unresolved features. We detect cycles in both the high/low state transitions and oscillations in the high state. Usually, the high state displays the most stable and the most typical value of the mass transfer rate in this system. The Bamberg photographic data (1963-1970) represent an exception; the most probable value lies in a medium state. This state also underwent an excursion to a state of enormously high brightness which is not a simple continuation of the typical long-term variations. We argue that the viscosity alone keeps the disk in steady-state only in the high state, while in the medium state the disk consists of two zones - the inner one being kept in the hot state by irradiation by the white dwarf and the outer one being in the cold state. Burst of the mass outflow from the donor then can temporarily bring the outer zone to the hot state. This scenario is possible also for two smaller outbursts which occurred later. Our results confirm the scientific importance of astronomical plate archives.

X-Ray Spectral Study of the V458 Vulpeculae with Suzaku

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On 2007 August 8th, an optical nova was discovered by Japanese amateur astronomer Abe Hiroshi in the constellation Vulpecula (S. Nakano, IAUC 8861). Its visual magnitude was observed to increase from about 8th to 10th. It was named "V458 Vulpeculae" (N. N. Samus, IAUC 8863) and was suggested to be a "classical nova". Classical novae are known to be X-ray emitters at some stage of their evolution. The X-ray telescope onboard the Swift satellite monitored V458 Vulpeculae and detected X-rays on 2007 October 18th (70 days after the outburst; Drake et al. ATel.1246). We requested a follow-up observation with the Suzaku satellite under Director's discretionary time, and a 20 ksec observation was performed on 2007 November 4th (88 days after the outburst). This observation yielded a well-exposed X-ray spectrum, and we were able to identify emission lines from Ne, Mg, and Si. We fitted the spectrum with an isothermal optically-thin plasma model (apec) with interstellar extinction. The fitted model parameters indicate the plasma temperature, the abundance, and the interstellar extinction are about 0.6 keV, 0.3 solar, and 4×10^{21} H atoms cm^{-2}, respectively. We will present and discuss these results derived from the Suzaku observation in the context of the properties and evolution of the nova.

Suzaku Observation of a White Dwarf as a new Candidate of Cosmic-ray Origin

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Strongly magnetized white dwarfs have a potential to be a new particle acceleration site as a Cosmic-ray origin. Since white dwarfs exist everywhere, they should become a quiet but numerous accelerators giving important contributions of low-energy cosmic-rays. Suzaku observed one of the most promising objects as accelerators, AE Aquarii, which has magnetic field with 10^5 Gauss and a rapid spin period of 33 sec. The observations were done in 2005 and 2006 with exposures of 100 ksec in total. In the spin profile of the object, we discovered spiky pulsations like neutron star pulsars in the hard X-ray band of over 4 keV (both in the XIS and the HXD data), in addition to the well-known thermal modulation in the softer band. The X-ray spectrum requires an additional hard X-ray component on the well-known thermal emissions with temperatures of 0.5 and 2.9 keV, to account for the hard X-ray signals detected with the HXD. From time scale, spectral shapes and flux, we consider that the pulsations seen in the hard X-ray band should be a non-thermal origin, and the object is a white dwarf equivalent of a neutron star pulsar.

Intermediate high state observations of the soft polar QS Tel with XMM-Newton

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The magnetic cataclysmic variable QS Tel undergoes frequent changes in the accretion state and is supposed to switch between one-pole and two-pole geometry. With an orbital period of 2.33 hrs it is one of the few systems which settle the period gap of cataclysmic variables. During an intermediate high state of QS Tel, we have obtained 20 ksec of XMM-Newton data, corresponding to more than two orbital periods, accompanied by simultaneous optical photometry and phase-resolved spectroscopy. Soft emission at energies below 2 keV dominates the X-ray light curves. The complex double-peaked maxima are disrupted by a sharp dip in the very soft energy range (0.1-0.5 keV) with the count rate abruptly dropping to zero. The EPIC spectra are described by a nearly unabsorbed blackbody at 23 eV and multi-component plasma models with temperatures at several keV. The relatively cool plasma gives rise to rich metal lines, among them a prominent calcium emission feature, possibly indicating an overabundance in the accretion flow. The observations of QS Tel are part of a campaign to study the spectral components, their flux contributions, and the physical structure of the accretion regions of systems which have shown an extreme soft-to-hard X-ray flux ratio in the ROSAT All-Sky Survey.

Chapter 6

Topic 4: Magnetars, Isolated Neutron Stars and Pulsars

Broad-band Noise and Its Variations in Magnetars

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We have analyzed Rossi X-ray Timing Explorer (R-XTE), Chandra and XMM-Newton archival data and light curves for AXPs and SGRs (1E 2259+586, 1E 1048.1-5937, SGR 1900+14, 1E 1841-045, RXS J1708-40, 4U0142+61, SGR 1806-20, SGR 1627-41) in order to reveal their broad-band noise characteristics. We detect that AXP and SGR sources show band limited noise at low frequencies in the range 0.005-0.05 Hz varying from 2.5% to 70% integrated rms in time including quiescence and quiescence data following some burst/outburst. We find that this noise level and its changes is most likely associated with the characteristic of their burst activities. Flares and glitches may also contribute to the changes in the broad band noise levels. We discover band-limited red noise in 1E 2259+586 with R-XTE only for about two years after its outburst and the associated glitch. The system shows no broad-band noise otherwise. We detect a similar rise in the broad-band noise of 1E 1048.1-5937 after a long burst for about 1.95 years revealing a similar origin as the activity in 1E 2259+586. In general sources indicate a persistent band-limited noise at low levels in comparison. We favour that this broad-band noise is related to the Compton scattering of thermal photons in an existing magnetar corona and thus changes reveal coronal time scales and activity in these sources.

The X-ray Emission Properties of Rotation-Powered Pulsars

Becker, W.; Grünecker, B.; Hui, C.Y.
Max-Planck Institut für extraterr. Physik

In the past 8 1/2 years of their life time Chandra and XMM-Newton have measured spectra and/or pulse profiles from more than 80 rotation-powered pulsars. Back in 1997, at the end of the ROSAT mission, the number of detected pulsars was roughly only one third of that. Nevertheless, the ROSAT data allowed for the first time to investigate the spectral and temporal emission properties of pulsars for a larger sample. Becker & Trümper (1997) found the pulsars' X-ray efficiency in the 0.1-2.4 keV band to be $\sim 10^{-3}$ times their spin-down energy. Today, the sample of X-ray detected pulsars is much more complete than in 1997, including high S/N spectra from cooling neutron stars, million years old pulsars and recycled millisecond pulsars. We used the full sample of X-ray detected pulsars to determine the pulsars' X-ray efficiency in the soft and hard band and to search for a spectral evolution with the pulsars' spin-down age.

A search for X-ray counterparts of the ms-pulsars in the globular cluster M28

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A recent radio survey of globular clusters has increased the number of millisecond pulsars drastically. M28 is now the globular cluster with the third largest population of known pulsars, after Terzan 5 and 47Tuc. This prompted us to revisit the archival Chandra data on M28 to evaluate whether the newly discovered millisecond pulsars find a counterpart among the various X-ray sources detected in M28 previously. The radio position of J1824-2452H is found to be in agreement with the position of CXC 182431-245217 while some faint unresolved X-ray emission near to the center of M28 is found to be coincident with the millisecond pulsars PSR J1824-2452G, J1824-2452J, J1824-2452I and J1824-2452E.

Monitoring of intermediate long X-ray bursts with INTEGRAL

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Thermonuclear bursts on the surface of accreting neutron stars have been studied for many years and have in a few cases confirmed theoretical models of nuclear ignition and burning mechanisms. Of special interest are low luminosity bursting sources that exhibit X-ray bursts of very different durations, allowing to study the transition from a hydrogen-rich bursting regime to a pure helium regime and from helium burning to carbon burning. In the frame of the *INTEGRAL* observational Key Programmes over the Galactic Center a good number of the known X-ray bursters are frequently being monitored. An international collaboration led by the JEM-X instrument team at the Danish National Space Institute have exploited these observations to investigate the mechanisms up to high energies of exceptional burst events of which duration about a few tens of minutes is intermediate between usual short bursts and hour long superbursts. To date, a dozen such intermediate long bursts have been observed of which half of them by *INTEGRAL*. Depending on the composition of the accreted material, these bursts may be explained by either the unstable burning of a large pile of mixed hydrogen and helium or the ignition of a thick pure helium layer.

New XMM-Newton observations of radio pulsars

Gil, J.[1]; Haberl, F.[2]; Melikidze, G.[1]
[1] *J. Kepler Institute of Astronomy;* [2] *Max-Planck Institute for Extraterrestial Physics*

It is widely accepted that a phenomenon of drifting subpulses is associated with a number of sparks populating the polar cap surface and discharging an ultra strong accelerating potential drop above it. The non-corotating electric field in this region causes both heating of the polar cap surface due to intense back-flow bombardment and slow circulation of spark plasma around the polar cap boundary. A direct relationship between the polar cap heating rate and the subpulse drifting rate should exist, since both these phenomana are caused by the same electric field.This relationship can be verified by observing thermal X-ray radiation from hot polar cap in radio pulsars with drifting subpulses in which the so-called tertiary circulational periodicity is known. We analyse an existing sample of such pulsars, including our own radio and XMM-Newton observations, and conclude that their properties are highly consistent with the Partially Screend Gap model, in which the maximum available pure vacum gap potential drop is partially screened by the thermionic ions ejection at a rate close the the Goldreich-Julian charge density. The actual accelerating potential drop is less than 10% of the maximum available, which implicates both the thermal X-ray luminosity and the dirfting subpulse tertiary periodicity at an observed level.

Neutron Star Structure Constraints from Low-Resolution X-ray Spectroscopy

Heinke, C.O.
U. of Virginia

Observations of neutron stars in transient low-mass X-ray binaries during their quiescent periods constrain neutron star interior structure from two directions. The radius (and, to a lesser degree, mass) can be constrained by measuring the temperature and flux of NSs in globular clusters. Measuring the quiescent temperature of NSs with known outburst histories (such as SAX J1808.4-3658) constrains the rate of neutrino emission from the core, and thus its composition. I will discuss current constraints and future prospects.

Detailed study of Pulsar Wind Nebula and Jets of PSR B1509-58

Kawai, N.; Yatsu, Y.
Tokyo Tech

We have studied the spatial structure and its time variation of the pulsar wind nebula of the 150 ms young pulsar PSR B1509-58 with the long-exposure Chandra observations. The pulsar wind parameters (velocity and the magnetization parameters) have been derived from the detailed study of the vicinity of the pulsar. We also studied the proper motions and the Doppler shifts of the bright thermal knots of RCW 89 located at the end of the norther jet using the Chandra images spanning over five years and the XMM-Newton spectra. We find that the knots trace back to the position of the pulsar at the epoch consistent with the characteristic age of the pulsar. We will discuss the geometry and dynamics of the jets, rings/tori of this pulsar wind nebula based on these analyses.

Recent Suzaku Results on Strongly Magnetized Neutron Stars

Makishima, K.[1,2]; Enoto, T.[1]; Mihara, T.[2]; Nakajima, M.[3]; Nakazawa, K.[1]; Terada, Y.[4]
[1] *University of Tokyo;* [2] *RIKEN;* [3] *Nihon University;* [4] *Saitama University*

We present recent Suzaku results on strongly magnetized neutron stars. With its unprecedented hard X-ray sensitivity, the Hard X-ray Detector (HXD) onboard Suzaku accurately measured cyclotron resonance scattering features in three accreting pulsars, A0535+26, Her X-1, 4U 1626-67, and reconfirmed its evidence in the transient GRO J1008-57. From the first two objects, the signals were detected up to 3 times the resonance energy. This reinforced the presence of the 2nd harmonic resonance in these objects. We also found that the fundamental and 2nd harmonic resonance profiles deviate significantly from a simple Gaussian, but can be described successfully by the classical cyclotron resonance profile (of the form of Lorentzian times energy squared). We discuss possible origins of the rather broad resonance profiles. Yet another topic is anomalous X-ray pulsars. From 4U 0142+61, the extremely hard pulsing component, first discovered with INTEGRAL, was detected with the HXD at least up to 100 keV. The hard X-ray signals exhibited intensity variations on a time scale of a few hours. We present a new interpretation of this hard X-ray component, invoking non-thermal Bremsstrahlung from electron- positron pairs which are created in the extremely strong magnetic fields.

X-Ray emission from radio pulsars

Melikidze, G.I.; Gil, J.
J. Kepler Institute of Astronomy

We demonstrate that the features of the partially screened polar gap define properties of both X and radio emission of pulsars. The model implies that the temperature of the polar cap surface is almost equal to the co called critical temperature which is defined by the strength of the magnetic field at the stellar surface. Parameters of observed thermal X-ray emission derived from the blackbody fit usually imply the surface of the hot spot to be much smaller than the conventional polar cap area, which can be naturally explained by assuming that the geometry and strength of the magnetic field at the stellar surface differ essentially from the pure star centered dipole field. The model assumes that the source of the pulsar activity is associated with the Partially Screened Gap (PSG) operating in the inner acceleration region above the polar cap where the electric field has a component along the magnetic field lines.

Cyclotron Lines in Binary X-ray Pulsars

Nakajima, M.[1]; Makishima, K.[2,3]; Mihara, T.[3]; Terada, Y.[4]; Enoto, T.[2]; Nakazawa, K.[2]
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Cyclotron resonance scattering feature (CRSF) in the X-ray spectrum is good probe to determine the surface magnetic field of the binary X-ray pulsar. Using this spectral feature, the surface magnetic fields of ∼15 sources have been accurately measured by several X-ray observatories (e.g. RXTE, Suzaku, and Integral). According to recent studies, several pulsars show luminosity dependence changes in the cyclotron resonance energy. In the case of two transient pulsars, 4U 0115+63 and X0331+53, the cyclotron resonance energy has been found to correlate negatively with the source luminosity. On the other hand, the positive correlation is reported from the results of Her X-1. In this presentation, we report on the changes of the cyclotron parameters of all CRSF sources observed with RXTE, and discuss possible interpretations of the luminosity dependence behavior.

A search for new thermally emitting isolated neutron stars in the 2XMM catalogue

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Observatoire de Strasbourg

A small group of seven thermally emitting and radio-quiet isolated neutron stars (INSs) was discovered by ROSAT during the last decade. They are located at relatively short distances, have high surface magnetic fields and slow rotation periods distinct from those of most radio pulsars. They could well be locally as numerous as other groups of INSs. We selected in the 2XMM catalogue X-ray sources exhibiting properties similar to those of these ROSAT INSs, but seen at larger distance, thus fainter and more absorbed. Follow-up VLT and SOAR imaging of the brightest sources put constraints on the possible nature of their optical counterpart. We focus particularly on the X-ray brightest candidate of our sample, 2XMM J104608.7-594306. A lower limit on the X-ray to optical flux ratio of ~ 300 together with an apparently stable and soft X-ray spectrum make it the most promising new thermally emitting INS candidate.

XMM-Newton reveals magnetars' magnetospheric plasma densities

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University of Amsterdam

There is fairly evidence that "magnetars" are highly magnetic neutron stars, but their emission mechanism is still uncertain, although believed to be connected to their large magnetic fields. Recent theoretical works showed the possibility that our X-ray spectral view of magnetars might be distorted by a resonant cyclotron scattering of the surface thermal radiation by hot and dense magnetospheric plasma. I will report on the first successful observational evidence of this effect through detailed XMM-Newton spectral modeling of all the magnetars known up to date. This work led to the first observational estimate of the magnetospheric plasma density in magnetars, confirming the theoretical predictions of densities orders of magnitudes larger than in normal radio pulsars.

XMM-Newton discovery of X-ray pulsations and spectral features in RRAT J1819-1458

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Rotating RAdio transients (RRATs) are a recently discovered class of bursting radio sources thought to be related to the neutron star class. I report on a new XMM-Newton observation which finally confirms their neutron star nature through the discovery of X-ray pulsations on one RRAT, namely J1819-1458. Furthermore, the X-ray spectrum of this radio bursting neutron star showed a broad 1keV spectral feature, possibly due to resonant cyclotron scattering or absorption in its atmosphere.

Soft X-ray Sources in the 2XMM Catalogue

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CESR

We have mined the 2XMM serendipitous source catalogue for soft X-ray sources, with the aim of identifying new candidate stellar mass compact objects such as isolated neutron stars, cataclysmic variables, and super-soft sources. We will present the results of these studies, along with spectral and timing analyses of the most promising candidates. We will report the results obtained and discuss the possible nature of these sources.

Chandra Study of the High Magnetic Field PSR J1119-6127: Any Link to Magnetars?

Safi-Harb, S.; Kumar, H.S.
University of Manitoba

PSR J1119-6127 is a high magnetic field (B=4.1E13 Gauss), young ($\leq$1,700 year-old), and slow (P$\sim$408 ms) rotation-powered pulsar associated with the supernova remnant G292.2-0.5. In 2003, Chandra allowed the detection of the X-ray counterpart of the radio pulsar and provided the first evidence for a compact and faint pulsar wind nebula (PWN). We here present the results of a deep Chandra observation of the pulsar (combining the old and new Chandra observations) which allowed an imaging and spectroscopic study of the pulsar and PWN independently of each other. We discuss our results in the context of the X-ray manifestation of high-magnetic field pulsars in comparison with the rotation-powered pulsars and magnetars. In particular, we compare the properties of J1119-6127 to J1846-0258, a high magnetic field X-ray pulsar with spin properties remarkably similar to J1119-6127 and which recently revealed itself as a magnetar.

Suzaku Observation of HESS J 1825-137

Uchiyama, H.; Matsumoto, H.; Tsuru, T.G.; Koyama, K.
Kyoto University

HESS J1825-137 is a diffuse very high energy (VHE) gamma-ray source discovered by H.E.S.S telescope. PSR J 1826-1334 is thought to be the counterpart, however, the peak position of the VHE gamma-ray emission is located away from the pulsar by about 10 arcmin, and thus it has been a problem. XMM-Newton detected a pulsar wind nebular (PWN) extended toward the south but the size is at most 5 arcmin and could not detect X-ray emission from the peak position of the VHE gamma-ray emission. Recently, H.E.S.S. reported the photon index of the VHE gamma-ray softens along with the distance from the pulsar. It strongly suggests that HESS J 1825-137 is a PWN powered by PSR B 1823-13. We observed HESS J 1825-137 by the Suzakau satellite for 50 ksec. Thanks to the low particle background, our Suzaku observation detected diffuse component extended much more to reach the peak of the VHE gamma-ray emission. The size of X-ray emission we detected is about 14 arrcmin, which corresponds to 17 arcmin at 4 kpc. We will report the detail of our observation, and discuss the origin such a large structure and relationship with the VHE gamma-ray emission.

A Resonant cyclotron scattering model for the soft X-ray spectra of magnetars

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Soft gamma-ray repeaters (SGRs) and anomalous X-ray pulsars (AXPs) are peculiar X-ray sources which are believed to be magnetars: ultra-magnetized neutron stars with surface field in excess of 10^{14} G, i.e. well above the QED threshold. Spectral analysis is an important tool in magnetar astrophysics since it can provide key information on the emission mechanisms. The first attempts at modelling the soft X-ray (< 10 keV) spectra of AXPs proved that a model consisting of a blackbody ($kT \sim 0.3 - 0.6$ keV) plus a power-law (photon index $\sim 2 - 4$) could successfully reproduce the observed emission. However, despite this model has been largely applied to the X-ray spectra of magnetar candidates, a convincing physical interpretation of the two components is still missing. In this talk, I will present the application of synthetic model spectra, that we calculated with a new magnetic montecarlo radiative code. Our code accounts for resonant cyclotron upscattering of soft thermal photons (emitted by the star surface), by a population of relativistic electrons threated in the magnetosphere. Polarization and QED effects are consistently accounted for. The model is successfully applied to XMM-Newton data, and further applications to the modeling of the hard X-ray magnetar emission detected with Integral are discussed.

X-ray timing and spectral properties of the AXP 1RXS 170849-400910

Zane, S.[1]; Israel, G.L.[2]; Götz, D.[3]; Dall'Osso, S.[2]; Rea, N.[4]; Stella, L.[2]; Esposito, P.[5]; Gotthelf, E.[6]; Mereghetti, S.[7]; Tiengo, A.[7]; Turolla, R.[8]
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Previous studies of 1RXS J170849-400910 showed a long term hardness/intensity variability in the soft X-ray range (1-10keV) and a possible correlation with the spin glitches that occurred in 1999 and 2001. In this talk I will present a detailed timing analysis of archival Rossi-XTE data of 1RXS J170849-400910 (from January 2003 to June 2006), based on phase fitting techniques. We detected two large glitches (delta nu/nu of 1.2 and 2.1 10-6), occurred in January and June 2005. The occurrence times of these glitches are in agreement with the our past predictions, and strongly suggests a connection between the flux, spectral and timing properties. Besides, I will present a study the soft and hard X-ray spectral variability of the source, based on a new multi-band high-energy observing campaign carried out with Swift/XRT, INTEGRAL/IBIS and on the reanalysis of all the publicly available INTEGRAL data since 2002, and of the BeppoSAX, Chandra, XMM-Newton and Swift/XRT since 1999. We find a long-term variability of the hard X-ray flux, extending the hardness-intensity correlation proposed for this source over 2 orders of magnitude in energy.

Chapter 7

Topic 5: Planetary Nebulae, SN, SNR, Gamma-ray Bursts and Afterglows

Mapping RXJ1713.7-3946 with XMM-Newton

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The supernova remnant (SNR) RXJ1713.7-3946 (also known as G347.3-0.5) is one of the few shell-type SNRs observed at TeV energies. The comparison of the SNR in X-rays and in gamma-rays can help us improve our understanding the nature of the underlying emission mechanisms. Spatially resolved spectral studies done earlier in X- and gamma-rays (respectively with the XMM-Newton and the HESS telescopes) revealed an intrinsic scatter on photon index in X-rays but not in gamma-rays. However both studies did not use the same extraction regions.Using recent observations (Fall 2007) that complete the previous mosaic of the remnant, we present the first full coverage of RXJ1713.7-3946 with XMM-Newton. We compared in detail the results obtained at TeV energies and in X-rays using the same methods. We compared the radial profiles at both energies. Using the same extraction regions and same spatial resolution as in the gamma-ray study, we found no large variations of the photon index in the X-ray data. We also found a good correlation between the X and gamma-ray fluxes. We discuss the results in terms of leptonic and hadronic models of the TeV emission.

On the chemical abundance of mixed morphology supernova remnants

Bocchino, F.[1]; Orlando, S.[1]; Miceli, M.[2]; Troja, E.[3]
[1] *INAF-Osservatorio Astronomico di Palermo;* [2] *Consorzio Cometa;* [3] *INAF-IASF Palermo*

Mixed morphology supernova remnants (MMSNRs) are a sub-class of apparently evolved remnants showing an intriguing and peculiar morphology consisting of a radio shell and a centrally peaked X-ray emission. The origin of the differences in the two bands is not completely clear, and various models have been invoked to explain it. Recently, there have been some claims of high metal abundances in the X-ray emitting plasma of MMSNRs. These results challenge some of the proposed models and suggest that the CSM environment may play an important role in explaining the origin of the morphology. In this contribution, we present XMM-Newton observation of two MMSNRs, namely IC443 and VRO 42.05.01, and we briefly discuss our new proposed models we have developed for the metal rich MMSNRs.

X-ray and Radio Study of the Population of Supernova Remnants in NGC 6946

Espinoza, D.; Pérez Torres, M.A.; Guerrero, M.A.
Instituto de Astrofísica de Andalucía

The X-ray and radio emission from supernova remnants (SNR) offers the possibility to study the structure of the circumstellar medium and the evolution of the supernova shocks. We have used Chandra and XMM-Newton X-ray and VLA radio observations of the nearby (∼4 Mpc), face-on late type galaxy NGC 6946 to search for correlations between the X-ray and radio emission from the known population of SNR. We present preliminary results of our on-going study in this poster.

Cosmic ray acceleration by the supernova remnant RCW 86

Helder, E.A.; Vink, J.
Sterrekundig Instituut Utrecht

We present preliminary results of our research on the X-ray synchrotron and gamma-ray source RCW 86; a supernova remnant. Supernova remnants are the main candidates for accelerating cosmic rays, at least up to the so-called knee in the cosmic ray spectrum at 10^{15} eV.

X-ray synchrotron radiation is detected from the East side of the remnant, which already points towards fast shock acceleration. We took VLT spectra of the Balmer dominated shock on this side, in order to determine the shock velocity from thermal Doppler broadening. The Doppler broadening has a FWHM of 1000 km/s. This indicates either a shock velocity of 1000 km/s, in which case the electrons causing the X-ray synchrotron are accelerated in the past, or it indicates a reduced temperature, which may indicate that the internal energy is dominated by cosmic rays.

To solve this issue, we use deep XMM spectra of this region. Furthermore, we perform a morphological study on the East side, using Chandra data.

New X-ray supernova remnants in nearby galaxies

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We present the initial results from a study of the SNR population in a sample of six nearby galaxies (NGC 2403, NGC 4214, NGC 4449, NGC 5204, NGC 3077, NGC 4395) based on Chandra archival data. We discuss the analysis of the Chandra data and we present new SNRs based on their X–ray spectra as well as candidate SNR sources selected on the basis of their X–ray colours. Comparison of the X–ray results with new optical observations provides a more complete picture of the SNR population and allows us to address their X–ray emission.

Low angular momentum accretion in the collapsar: how long can be a long GRB?

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Within the collapsar scenario GRBs are believed to be powered by accretion through a rotationally supported torus or by fast rotation of a compact object. In both cases then, rotation of the progenitor star is one of the key properties because it must be high enough for the torus to form, the compact object to rotate very fast, or both. Here, we check what rotational properties a progenitor star must have in order to sustain torus accretion over relatively long activity periods as observed in most GRBs. We revise the simple estimates based on the total mass available for torus formation and consequently the duration of a GRB by taking into account the effect that as the compact object accretes the minimum specific angular momentum needed for torus formation increases. We demostrate that this effect can significantly affect the overall duration of a GRB event. We estimate the GRB duration times, by explicitly calculating the free fall time of the gas during the collapse. The calculations are done for both Schwarzschild and Kerr black hole.

The Slow X-Ray Expansion of the Northwestern Rim of the SNR RX J0852.0-4622

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The detection of radioactive decay line of ^{44}Ti provides a unique evidence that the γ-ray source is a young ($<$ 1,000 yr) supernova remnant because of its short lifetime of $\sim$90 yr. Only two Galactic remnants, Cassiopeia A and RX J0852.0-4622, are hitherto reported to be the ^{44}Ti line emitter, although the detection from the latter has been debated. Here we report on an expansion measurement of the northwestern rim of RX J0852.0-4622 obtained with X-ray observations separated by 6.5 yr. The expansion rate is derived to be 0.023$\pm$0.006 % that is about five times lower than those of young historical remnants. Such a slow expansion suggests that RX J0852.0-4622 is not a young remnant as has been expected. We estimate the age of 1,700-4,300 yr of this remnant depending on its evolutionary stage. Assuming a high shock speed of $\sim$3000 km sec^{-1}, which is suggested by the detection of non-thermal X-ray radiation, the distance of $\sim$750 pc to this remnant is also derived.

Examination of the XMM-Newton spectra of the SNR 0509-67.5

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[1] *Astronomical Institute Utrecht;* [2] *Institute for Theoretical and Experimental Physics*

We report on X-ray observations of the supernova remnant 0509-67.5 in the Large Magellanic Cloud with XMM-Newton X-ray observatory. We use the EPIC and RGS data to investigate properties of the remnant and its environment. The data analysis showed that reverse shock just recently reached iron layers of the ejecta and that the remnant has a high lines velocity broadening of 5000 km/s. We also constructed hydrodynamical models for the remnant which are in good agreement with the observations.

The nature of a cosmic-ray acclerator CTB37B observed with Suzaku and Chandra

Nakamura, R.[1]; Bamba, A.[1]; Ishida, M.[1]; Nakajima, H.[2]; Yamaguchi, H.[3]; Yamazaki, R.[4]; Terada, Y.[5]; Pühlhofer, G.[6]; Wagner, S.J.[6]
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CTB37B is one of the SNRs from which TeV γ-rays are detected with the H.E.S.S Cherenkov telescope. We carried out an 80 ksec Suzaku observation, and obtained a clear image of diffuse emission and high quality spectra. On the other hand, Chandra observation for 26 ksec discovered a bright point source located near the shell of CTB37B. The Suzaku high quality spectra revealed that the diffuse emission composes of thermal and non-thermal components. The thermal component can be represented by an NEI model with a temperature, an electron density and an age of 0.9 keV, 0.2 cm^{-3} and 1400 yr, respectively. The low electron density, together with a low abundance of Mg and Si ($<\sim 0.5 Z_{\odot}$), suggests that the explosion of CTB37B occurred in a cavity created by other preceding SNR(s). The non-thermal component was found from the south region of CTB37B. The photon index of 1.5 suggests efficient cosmic-ray acceleration. We also discuss the non-thermal X-ray emission in relation with the TeV γ-ray emissions. Comparing the Suzaku and Chandra data, we found the variability of the point source which spectrum can be represented a power-law model with a photon index of 3.0.

Mixing of hot 1 MK gas and cool electrons in planetary nebulae

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The planetary nebula BD+30 3969 has been observed by Chandra with the LETGS for a total exposure time of 300 ks. This is the first high resolution spectrum obtained from such an object. The nebula is composed of a WC star, a slow wind (v $<$ 50 km/s) cocoon of previously ejected material and a fast $\sim$700 km/s wind that hits the slow wind envelope and is shocked into X-ray emitting temperatures. We detect a narrow C VI radiative recombination continuum indicative of mixing between 1 MK hot gas and cool 20,000 K electrons. Mixing highly ionized carbon with cool electrons without intermediate temperatures, requires a very steep temperature gradient to be maintained at the contact discontinuity between the shocked gas and the cooler envelope. This can be explained by magnetic fields of order $\sim$1 μG.

Chandra Monitoring of X-Ray Evolution of SNR 1987A

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We present results from our continuing Chandra observations of SNR 1987A. The X-ray remnant of SN 1987A continues to brighten all around the X-ray ring. As of 2008-01 (day 7626), the observed fluxes are f(0.5-2 keV) = 4.1e-12 and f(3-10 keV) = 5.2e-13 ergs/cm^2/s (Lx = 2.7e36 and 1.6e35 ergs/s, respectively). The recent flux increase rates (for the last 2 yr) are, on average, $\sim$ 35% and $\sim$ 20% per yr in the soft (0.5-2 keV) and hard (3-10 keV) bands, respectively. The continuation of a rapid rise in the soft X-ray light curve indicates an on-going interaction of the blast wave with the denser portions of the inner circumstellar ring, as supported by the SNR's low radial expansion rate (1700 km/s) for the last $\sim$4 yr and by results from recent deep Chandra gratings observations. The hard X-ray light curve shows a steeper increase than that of low-frequency radio data, while being closer to high-frequency radio light curve. We discuss possible implications on the origin of the hard X-ray flux.

X-ray emission of the shock of SN1006. Constraints on electron kinetics

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The X-ray spectrum of the rim of non-thermal shells consists in general of thermal and non-thermal components. Such emission is therefore the most informative for analysis of the electron thermalization and acceleration processes. In this work, we present preliminary results on the analysis of 30 narrow regions covering the whole outer shock rim of the shell of SN1006, selected in the XMM-Newton archive observations of this remnant. Two different approaches to analysis of the spectra are applied that allows us to cross-check the best-fitted models. Our results will complement previous studies on the non-thermal component with information on the thermal emission and vice versa. The constraints which can be put on the level of electron-ion equipartition and on the electron injection efficiency with this kind of analysis are also discussed.

X-ray studies of Canadian Galactic Plane Survey (CGPS) Supernova Remnants (SNRs)

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[1] *University of Manitoba;* [2] *HIA-NRC/DRAO;* [3] *Brandon University*

X-ray studies of low-surface brightness SNRs are important in shaping our current understanding of pulsar and supernova evolution, since the population of SNRs in our Galaxy is likely dominated by faint objects. We present the XMM-Newton detection and detailed study and characterization of two such SNRs (G85.4+0.7 and G85.9-0.6), discovered in the radio with the CGPS. Additional Chandra observations of these SNRs have allowed us to resolve the point sources in their field and characterize their X-ray emission. CO and HI data from the CGPS were also used to determine the distances to these SNRs. We also present a preliminary XMM-Newton study of SNR G107.5-1.5, another faint SNR discovered with the CGPS, believed to be the most highly polarized SNR known to date, and harboring near its center a ROSAT unidentified source.

Gas-to-dust ratios in GRB host galaxies

Schady, P.; Page, M.; Oates, S.; Still, M.
MSSL-UCL

An understanding of GRB local environments is instrumental in determining the progenitors of GRBs and the properties of their host galaxies. The imprint left by dust and gas absorption on GRB X-ray and optical afterglows provides an effective probe to the immediate surroundings of GRBs, for which well sampled, multi-wavelength afterglow observations are imperative. Swift's capabilities to obtain simultaneous X-ray and UV/optical data make it ideal to study the dust and gas content in the local environment of GRBs. In this talk I present the results of analysis on the combined Swift and ground-based spectral energy distributions of 24 GRB afterglows; the largest sample of GRB afterglow spectral energy distributions thus far studied. A host galaxy absorption and extinction system is detected in the majority of cases, with a gas-to-dust ratio typically larger that that of the Milky Way or Magellanic Clouds. This is unlikely due to be the result of the GRB itself, suggesting that either GRB host galaxies have intrinsically large gas-to-dust ratios, or that selection effects are at play. Either way, these results have an important impact on our understanding of GRB host galaxies, which we investigate in this talk.

Investigation of the evolution of SN 2006aj/GRB060218 using the color indices

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We apply the method of color indices from multiband photometry on SN2006aj/ GRB060218. We show that this is a much better tool to analyze the evolution of supernovae (SNe) than the light curves themselves. For the first time, we show the color evolution of a Type Ic SN in the cosmic UV region. We find that the color indices of the early phase (t-To<2 d) are not consistent with those of the ensemble of 25 optical afterglows (OAs) of GRBs, but their time evolution is, and are suggestive of a similar physical nature of these events. We show a rapid and complicated evolution of SN2006aj from UV to the infrared. A stretching of the time evolution of the color indices of the group of 'ordinary' Type Ic SNe by a factor of 1.2 matches the evolution of SN2006aj over a broader spectral range than stretching of SN1998bw (the canonical SN of GRB) by a factor of 0.5. Our approach is important also for investigation of SNe in late phases of OAs for which obtaining spectra with good signal to noise ratio is often impossible.

X-ray observation of the Cygnus Loop with Suzaku and XMM-Newton

Tsunemi, H.[1]; Katsuda, S.[1]; Uchida, H.[1]; Kimura, M.[1]; Mori, K.[2]
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We observed the Cygnus Loop with Suzaku and XMM-Newton satellites. The Cygnus Loop is a nearby (540pc) middle-aged supernova remnant (SNR) and 2.7 deg in diameter. This is one of the brightest SNR in the X-ray sky. The observation is still on-going while half of the Loop has been covered by using X-ray CCDs. We confirmed that the spectrum of the Loop consists of two components. The low kT component forms a shell structure with non-uniform emission measure. It shows relatively low metal abundance. Most of the shell regions show about 0.1 solar while we found that there is some region in the NE portion of the Loop having about 0.5 solar that is a typical ISM abundance nearby. We have investigated whether or not an extra non-thermal component may explain the low metal abundance. The high kT component fills inside the Loop. It shows high metal abundance which is a fossil of the supernova explosion. We can estimate the progenitor mass to be around 15 Msun. The distribution of various metals suggests an onion skin structure and an asymmetric explosion. We will report the latest results in the symposium.

XMM-Newton Observation of the Southwestern Region of the Cygnus Loop

Uchida, H.; Katsuda, S.; Tsunemi, H.
Osaka University

We observed the southwestern region of the Cygnus Loop with the XMM-Newton satellite. The Cygnus Loop is a nearby (540pc) middle-aged supernova remnant (SNR) that is one of the brightest SNR in the X-ray sky. Recently, Tsunemi et al.(2007) studied the plasma structure along the diameter from the northeast to the southwest and showed that Si, S and Fe are concentrated in the inner region. Our observations were performed in two pointings that are in the south of the center towards the south blow-up. To investigate the radial structure, we divided our fields of view (FOV) into annular sectors. The spectra are well fitted by a two-component nonequilibrium ionization (NEI) model. Judging from metal abundances obtained, we concluded that high-kT_e-component ($\sim$0.4keV) originates from the ejecta while low-kT_e-component ($\sim$0.2keV) is derived from the swept-up interstellar medium (ISM). The flux of low-kT_e-component is much less than that of high-kT_e-component, suggesting the ISM component is very thin. Meanwhile, from the ejecta component we detected highly ionized strong Si-K line and Fe-L line almost everywhere in the FOV. These high metal abundances must come from the ejecta and we guess the ejecta plasma is blown out in the south blow-up region.

The possible detection of the progenitor of the type Ia supernova SN2007on

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We report the detection of an X-ray source at the position of the recent type Ia supernova (2007on) in archival Chandra observations prior to the explosion. This is the first direct observation of possible progenitor of a type Ia supernova, and if confirmed it can constraint the possible progenitors of such explosions, favoring the scenario where a white dwarf accretes from a non-degenerate companion star over the merging white dwarf scenario. The observed X-ray source had a luminosity of a few times 10^{37} erg/s, and a soft spectral shape, in agreement with expectations for an accreting white dwarf. While the probability of a chance co-alignment with an unrelated X-ray source is low, there is an non-negligible off-set between the two sources, decreasing the probability that the X-ray source is the supernova progenitor. Type Ia supernovae are not luminous X-ray sources after the explosion, and the observation of an X-ray source at the position of the supernova would prove that the two sources are unrelated. An initial follow-up observation with Chandra shows that the luminosity of the X-ray source has decreased with 90% probability but is inconclusive on whether the source is still active.

Supernova Remnants in M33: Results from the Chandra ACIS Survey of M33

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The Chandra ACIS Survey of M33 (ChASeM33) provides the deepest and highest resolution X-ray view to date of this, the closest face-on spiral galaxy. The 1.4 Ms survey covered the central portion of M33, out to a radius of 18 arcmin ($\approx$ 4 kpc), in seven overlapping fields. Our X-ray imaging shows a complex interstellar medium and a spectacularly rich population of both point and (slightly) resolved sources, including numerous supernova remnants (SNRs) and newly detected X-ray binaries. The survey region includes nearly one hundred SNRs identified in previous optical and radio surveys: we find ChASeM33 sources coincident (within 10 arcsec) with 31 of these. A number of the ChASeM33 sources are spatially resolved, showing X-ray emission clearly extending beyond the size of the point-spread function. We also find several soft, extended X-ray sources that are likely SNRs not yet identified in other bands. We will report on some of the most interesting cases, and initial results on statistical properties of the entire sample. In addition to the analysis of the new X-ray SNR candidates, we will also report on several candidate SNRs and larger supershells recently discovered in ground-based optical surveys. Support for this work was provided by NASA through Chandra Award Numbers G06-7073A and GO6-7073C.

Fe-rich ejecta in the northeast shell of RCW 86 revealed with Suzaku

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We present the results of the Suzaku observation of RCW86, one of the Galactic supernova remnants (SNRs). By the imaging analysis, we revealed the morphology of the Fe-K emission in the northwestern shell of this SNR, for the first time. The emission has no spatial correlation with the non-thermal X-ray filament, but is enhanced at the inward region with respect to the thermal emission from the blast-shocked dense interstellar medium. With the spectral analysis, we found that the Fe-K line ($E \sim 6.42$ keV) was reproduced by the thermal plasma with an extremely low ionization age of $n_e t \sim 2 \times 10^9$ cm^{-3} s. These results suggest that the origin of the Fe-K emission is Fe-rich ejecta heated by reverse shock very recently.

Chapter 8

Topic 6: Galaxies, Galaxy Surveys, Population Studies, ISM and Diffuse Galactic Emission

X-ray follow-ups of TeV unID sources using Suzaku

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H.E.S.S. TeV gamma-ray telescope discovered many new sources on the Galactic plane. They should be Galactic particle accelerators but their nature is still unknown since they have few informations in other wavelength. Jp-US X-ray telescope Suzaku has made follow-up observations for several TeV unID sources, using the low and stable background and the large effective area. The results are full of varieties; compact counterparts (HESS J1804-216, HESS J1837-609), diffuse counterparts (HESS J1614-518, HESS J1745-303), and no-detection even with long exposure (HESS J1616-508). In this talk, we consider the nature of these TeV unID sources.

Deep Chandra Observations of LMXB Populations in Normal Elliptical Galaxies

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Low mass X-ray binaries provide unique information on the formation and evolution of binary stars in elliptical galaxies. Here, we present the results of deep Chandra monitoring observations of the two nearby elliptical galaxies NGC 3379 and NGC 4278, which allow us to probe the LMXB populations to luminosities comparable to those of the majority of these sources, reaching to $<10^{36}$ erg s^{-1}. These observations reveal 98 sources in NGC 3379, and 180 in NGC 4278. From these sources we have characterized the properties of the LMXB populations (spatial distribution, spectra and X-ray colors, time variability and the X-ray luminosity function) and have used HST observations to identify GC correlations. Here we will discuss the properties of these populations from the two galaxies, highlighting their differences, which may be related to the different GC specific frequencies in these optically similar galaxies. In this discussion we will focus on the transient and variable behaviour that has been observed in both populations, providing important information that can constrain the nature of these LMXBs. We will also discuss the LMXB-GC connection which furthers our understanding of the relation of LMXBs to the underlying stellar population

The Spectral Properties of Galactic X-ray Sources at Faint Fluxes

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It has recently been argued that the integrated emission of low-luminosity sources, such as active binaries and CVs, contributes subtantially to the Galactic Ridge X-ray Emission (GRXE). One method of testing this hypothesis is to compare the typical spectral properties of sources detected in the Galactic Plane at intermediate to faint fluxes with the known energy spectrum of the GRXE. Here we construct a sample of relatively hard sources detected serendipitously in XMM-Newton Galactic Plane observations and investigate both their individual and summed spectral characteristics. On the basis of the results we consider the likely nature of the population and whether there is indeed a spectral match to the GRXE.

An X-ray Survey of WR Stars in the Magellanic Clouds

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Wolf-Rayet (WR) stars exhibit the most powerful stellar winds. X-ray emission can be produced by shocks within the WR wind (shocking winds), but also by to the interactions of the WR wind with the stellar wind of an O companion (colliding winds) or with the circumstellar medium (wind-blown bubbles). Therefore, X-ray observations of WR stars probe the opacity of their stellar winds, the orbital configuration of a WR+OB binary system, and the stellar mechanical energy injection into the interstellar medium. The study of the X-ray properties of Galactic WR stars is difficult because the high extinction in the Galactic plane hampers the detection itself, uncertain distances result in poorly determined luminosities, and the unknown existence of binary companions confuses the assessment of origin of X-ray emission. X-ray surveys of WR stars in the Large and Small Magellanic Clouds (LMC & SMC) benefit from the low foreground and internal extinctions in these galaxies and from their known distances. Furthermore, their lower metallicities allow us to probe abundance effects on the stellar winds. Therefore, we have used the ROSAT, Chandra, and XMM-Newton archives to search for and analyze X-ray sources associated with WR stars in the Magellanic Clouds (MCs). Here we analyze the X-ray survey of WR stars in the MCs and compare their properties with these of their Galactic counterparts.

The X-ray Morphology and Spectra of Galactic Disks

Owen, R.A.; Warwick, R.S.
University of Leicester

We use XMM-Newton observations to investigate the spectrum and morphology of the extended soft X-ray emission seen in a sample of nearby spiral galaxies after exclusion of the contamination arising from bright X-ray point sources. The spectrum of the diffuse X-ray emission is generally well modelled by a two-temperature thermal model with derived temperatures of kT ~ 0.2 keV and ~ 0.6 keV, with the higher temperature component enhanced in galaxies with starburst activity. This is typical of the diffuse components observed in normal and starburst galaxies. The soft X-ray morphology shows strong correlation with images from GALEX, with the X-ray to UV flux ratio observed to be consistent across the sample. We interpret these results in terms of a clumpy thin-disk component tracing the galactic spiral arms and suggest that diffuse X-ray emission observed in the galactic disk can be used as a tracer of star formation rate in the galaxy.

[PMH2004] 47: The second eclipsing high mass X-ray binary in M 33

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The transient M 33 X-ray binary candidate [PMH2004] 47 was in the field of view of several observations of the Chandra large project CHaSeM33 from November 2005 to September 2006. It varied strongly in brightness as during earlier XMM-Newton and Chandra observations from 2000 to 2003. During the bright state on 2006 September 18/19 we monitored a drop to an intensity consistent with zero for about 25 ks which we interpret as an eclipse of the X-ray source. During the bright state the spectrum of the source is hard and shows an intrinsic luminosity of 5 10^{37} erg s^{-1} at the distance of M 33. We detected several additional transitions from zero to high or intermediate intensity during other observations. In interpreting them as egresses from eclipse we derive a unique orbital period of 1.73248 d which also is consistent with other Chandra and also the much earlier XMM-Newton detections of the source. The position of the source coincides with a B star in M 33 which – in CFHT images – shows the typical ellipsoidal modulation at the X-ray period of a high mass optical companion. The optical light curves together with the X-ray eclipse can be modelled by a compact object with mass consistent with a neutron star in a high mass X-ray binary.

The Soft X-ray Spectrum of NGC 4151

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Recent models of the soft X-ray spectrum of NGC 4151 have required three components (of high, mid, and low ionization states). We point out that two different groups have derived mutually exclusive line fluxes from the same XMM-Newton observations, and we demonstrate that both groups used flawed methods in the process. We reanalyze the line fluxes and compare them with the previously reported values. Finally, we demonstrate that a single component can satisfactorily model all observed hydrogenic and helium-like emission lines.

Observations of Normal galaxies in the eROSITA all-sky survey

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We study statistical properties of normal galaxies in the eROSITA all-sky survey which will be conducted during the first 4 years of the future Spectrum-RG mission. We use luminosity functions of galaxies in radio, near-infrared and X-ray bands to predict log(N)-log(S) distributions of early and late type galaxies in the soft and standard X-ray bands and compare our results with source counts by Chandra and XMM-Newton. Based on these results we estimate that about $\sim$ 10,000–20,000 galaxies of each type will be detected by eROSITA in the course of the all-sky survey. We predict distance and luminosity distributions of the observed galaxies and estimate the number of Ultra Luminous X-ray sources (ULX) to be detected during the survey. Using Chandra observations of the Antennae galaxies, we simulate the eROSITA image of these galaxies and discuss the prospects for ULXs studies based on eROSITA data.

A deep X-ray observation of M82 with XMM-Newton

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We report on the analysis of a deep (100 ks) observation of the starburst galaxy M82 with the EPIC and RGS instruments on board the X-ray telescope XMM-Newton. The broad-band (0.5-10 keV) emission is due to at least three spectral components: i) continuum emission from point sources; ii) thermal plasma emission from hot gas; iii) charge exchange emission from neutral metals (Mg and Si). The plasma emission has a double-peaked differential emission measure, with the peaks at ~ 0.5 keV and ~ 7 keV. Spatially resolved spectroscopy has shown that the chemical absolute abundances are not uniformly distributed in the outflow, but are larger in the outskirts and smaller close to the galaxy centre. The abundance ratios also show spatial variations. The X-ray derived Oxygen abundance is lower than that measured in the atmospheres of red supergiant stars, leading to the hypothesis that a significant fraction of Oxygen ions have already cooled off and no longer emit at energies $>\sim 0.5$ keV. This work has been accepted for publication in MNRAS (astroph: 0802.2943).

Soft X-ray sources in the XMM-Newton survey of M 31

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The deep survey of the large local-group spiral galaxy M 31 is a milestone project for X-ray astronomy, as it allows a detailed X-ray inventory of an archetypal low-star-formation-rate galaxy like our own. Our goal is to study M 31 X-ray binaries and globular cluster sources, supersoft sources and supernova remnants and separate them from foreground stars and background objects. Here, we report on studies of the about 300 soft and supersoft source candidates in the field, selected by their hardness ratios. From cross correlations with optical and radio source catalogues the soft sources can be divided into foreground stars and supernova remnants. Foreground star classification can be strengthened if the source shows X-ray flares. In M 31 many supersoft sources have been identified as optical novae. With the new detections we find more correlations between supersoft sources and known optical novae.
We will compare the spatial distribution of the soft and supersoft sources with the spiral arm and bulge structure of the galaxy.

The XMM-Newton Serendipitous UV Source Survey

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During 8 years of operation, the XMM-Newton Optical Monitor has accumulated images over 50 deg^2 of the sky through 3 broad band UV filters. The majority of pointings are towards pre-planned science targets, but from our serendipitous viewpoint the exposure sequence randomly samples the sky with a small bias towards the Galactic plane. The serendipitous sample contains 500,000 UV sources, many with multiple exposures taken over hour-day timescales and many with repeat visits on year timescales. The catalogue will be publicly available shortly and will provide new resources for a broad sphere of researchers. We highlight both the congruence between the OM UV catalogue and source archives at similar or heterogeneous energies, and the unique qualities that the database can add to your science programs.

Surveying the Galactic Plane with XMM-Newton

Warwick, R.S.[1]; Pérez-Ramírez, D.[1,2]; Byckling, K.[1]
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We describe the results from a preliminary investigation of the serendipitous content of XMM-Newton pointings in the Galactic Plane within the central quadrant of the Galaxy. We spectrally classify the point sources observed at intermediate to faint fluxes on the basis of their spectral energy distribution in broad X-ray bands. For the hard source sample, we use the variation in the surface density as a function of X-ray flux and Galactic latitude/longitude to infer details of the underlying luminosity and spatial distribution of the parent populations. The question of whether the Galactic X-ray Ridge emission is entirely due to the integrated flux of relatively low-luminosity sources is revisited. We also investigate the incidence of relatively low surface brightness extended X-ray sources in low-latitude fields.

The origin of the 6.7 keV iron-line emission observed from the Galactic Centre

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University of Leicester

We use XMM-Newton observations to study the distribution of the 6.7 keV helium-like iron emission-line in the Galactic Centre region. After applying some corrections for the contribution of kT $<$ 2 keV plasma components, we find that the observed surface brightness distribution conforms quite well to circular symmetry with respect to Sgr A*, with a radial fall-off proportional to $r^{-0.87\pm0.06}$ over the range r= 3' to 12'. Of the competing explanations as to the nature of the 6.7 keV emission, namely an extensive hot (kT $>$ 5 keV) diffuse plasma or the summed emission of faint point sources, the observed distribution would appear to favour the latter. However, the strongest residuals in the modelled distribution coincide with the Radio Arc region, perhaps indicative of the fact more than one process is causing excitation of the 6.7 keV line, within the extreme environment of the Galactic Centre.

Hot gas in Cluster Spiral Galaxies

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We present XMM-Newton X-ray observations of the perturbed cluster spiral galaxies NGC 4254, NGC 4569, and NGC 4634. X-ray extended emission traces filaments of hot gas and is sensitive to the environmental effects exerted by cluster interactions like ram pressure stripping. Hence it is possible to examine disturbances in galactic disks and to trace the level of activity in central star forming regions. In NGC 4254 we observe enhanced soft X-ray emission in the regions of strong compression of the magnetic field, as well as in the central parts of this galaxy. NGC 4569 shows extended and asymmetric hot gas outflows, possibly evidence of a past starburst, as radio polarization data suggest, while an edge-on galaxy NGC 4634 is an interesting example of a non-starburst galaxy with vast extended soft X-ray halo. Together with radio polarization studies, X-ray observations enable us to trace back the violent history of cluster galaxies.

Chapter 9

Topic 7: Active Galactic Nuclei

X-ray Observations of Ultraluminous Infrared Galaxies from ASCA to Suzaku

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We present results from hard X-ray (> 2 keV) observations of ultraluminous infrared galaxies (ULIRGs) from ASCA to Suzaku. Since first detection of > 2 keV emission from UILRGs with ASCA, a lot of nearby ULIRGs have been observed by various X-ray observatories at least twice to date. While Chandra and XMM-Newton made progress understanding on the origin of X-ray emission from ULIRGs in these years, the power source of the infrared emission is still in debate. In particular, the possible presence of a heavily obscured active galactic nuclei (AGN) is indicated in some case, and it is hard to distinguish between a low-luminosity AGN and superposition of high mass X-ray binaries. Therefore, we review the origin of hard X-ray emission and the absorber from a viewpoint of the X-ray spectral changes. We also report results from X-ray observations of ULIRGs optically classified as Seyrert1 and 2, and discuss the difference of the AGN obscuring structure between ULIRGs and normal Seyfert galaxies/quasars.

The Warm Absorber of the Seyfert Galaxy NGC5548

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We present a spectral analysis of the Seyfert 1 Galaxy NGC 5548 data, which were obtained by CHANDRA with HEGT and LEGT, adding a total exposure time of 800 ks. The warm absorber of NGC 5548 was modeled with the code PHASE. We detected two different outflow velocity systems in the absorption lines present in the spectra of this source. One of the absorbing systems has outflow velocity of $-1091 \pm 63\ kms^{-1}$ and the other of $-568 \pm 49\ kms^{-1}$. Each system required two absorption components with different ionization level to fit the observed features. Each velocity system consist of a multi-phase medium.

The origin of the faintness in the X-ray weak QSOs: the case of PG 0043+039

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A fraction of QSOs, called soft X-ray weak QSOs, show unusually low emission in the hard X-rays. Although the nature of these sources as homogeneous class is not well assessed, their optical emission-line properties suggest that the primary physical parameters can be extreme. Several scenarios for the X-ray weakness have been proposed: the presence of absorbers (neutral or partially ionized), or strong variability of the intrinsic continuum and/or of the absorber. Recently, the light bending has been proposed as an alternative explanation. Finally, for at least some of these sources it can be an intrinsic property, calling for a different X-ray emission mechanism. We present the XMM-Newton observation of PG 0043+039, detected *for the first time* in the X-ray band. The observed flux is consistent with the non-detection in previous ROSAT and ASCA observations, and the EPIC spectra do not show any absorption features. Although a strong variability in the X-ray emission cannot be completely ruled out, the XMM-Newton data strongly suggest that PG 0043+039 can be numbered among the few source known to be intrinsically X-ray faint.

The Dichotomy of Seyfert Galaxies at Hardest X-rays

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It is commonly assumed that the central engines of Seyfert galaxies of type 1 and type 2 are intrinsically identical and that only absorption in the line of sight creates the different appearance of both groups. We challenge this view by studies based on hardest X-rays, where the absorption should not play a significant role. We present results from variability and spectral studies using data from INTEGRAL and Swift at energies above 20 keV, showing that Seyfert 2 have on average harder spectra than the type 1 objects. Probing different time scales, it appears that the absorbed AGN are more variable than the unabsorbed ones. As expected the blazars show stronger variability. 15% of the non-blazar AGN show variability of $> 20\%$ compared to the average flux on time scales of 20 days, and 30% show at least 10% flux variation. All the non-blazar AGN which show strong variability are low-luminosity objects with $L_X < 10^{44}$ erg s^{-1}. This tendency has also been previously observed in soft X-rays, in the UV, and in the optical domain. It is therefore important that the mass accretion rate of the massive black hole is considered when studying differences between the Seyfert classes. We discuss whether our findings can be explained in the simple unification model of AGN.

NGC 3147: a "true" type 2 Seyfert galaxy without the broad-line region

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We report on simultaneous optical and X-ray observations of the Seyfert galaxy, NGC 3147. The XMM-*Newton* spectrum shows that the source is unabsorbed in the X-rays ($N_H < 5 \times 10^{20}$ cm^{-2}). On the other hand, no broad lines are present in the optical spectrum. The origin of this optical/X-rays misclassification (with respect to the Unification Model) cannot be attributed to variability, since the observations in the two bands are simultaneous. Moreover, a Compton-thick nature of the object can be rejected on the basis of the low equivalent width of the iron Kα line ($\simeq$ 130 eV) and the large ratio between the 2-10 keV and the [OIII] fluxes. It seems therefore inescapable to conclude that NGC 3147 intrinsically lacks the Broad Line Region (BLR), making it the first "true" Seyfert 2.

The nature of X-ray selected Broad Absorption Line QSOs

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Significant absorption by the fast moving, high column density ionised winds in Broad Absorption Line QSOs (BALQSOs) is probably the reason why these AGN are notably X-ray weak with respect to their optical brightness. As a result, very few BALQSOs have been uncovered in X-ray surveys, and our knowledge of their X-ray properties is based upon a small number of extremely luminous optically-selected objects. We have now discovered five X-ray selected BALQSOs in deep X-ray surveys which have, contrarily, unexpectedly high X-ray to optical flux ratios. We use XMM-Newton X-ray spectroscopy, alongside ground-based optical spectroscopy and photometry, to demonstrate that this is not due to either low absorption from the wind, or high dust reddening suppressing the optical flux. We suggest that these sources have intrinsically X-ray dominated spectral energy distributions, and discuss the scenarios that this implies.

An inhomogeneous jet model for the rapid variability of TeV blazars

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We present a new time-dependent inhomogeneous jet model of non-thermal blazar emission, which reproduces the entire spectral energy distribution together with the rapid gamma-ray variability. Ultra-relativistic leptons are injected at the base of a jet and propagate along the jet structure. We assume continuous reacceleration and cooling, producing a relativistic quasi-maxwellian (or"pile-up") particle energy distribution. The synchrotron and Synchrotron-Self Compton jet emissivity are computed at each altitude. Time-dependent jet emission can be computed by assuming an "ad-hoc" time-dependent particle injection. We describe a new procedure to extract jet parameters from time-variable spectra, taking into account the fact that instantaneous spectra are not emitted by a single particle population. The stratification of the jet emission, together with a pile-up distribution, allows significantly lower bulk Lorentz factors, compared to the ones obtained with the commonly used one-zone models, in better agreement with observational and statistical constraints. Applying this model to the case of PKS 2155–304 and its big TeV flare observed in 2006, we can reproduce *simultaneously* the average broad band spectrum of this source as well as the TeV spectra and TeV light curve of the flare with bulk Lorentz factor compatible with 20.

Variability selected AGNs in the Chandra Deep Field South

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Variability is a fundamental property of active galactic nuclei (AGN) and it was adopted as a selection criterion using multi epoch surveys. Low Luminosity AGNs (LLAGNs) are contaminated by the light of the host galaxies, thus they cannot be detected by the usual color techniques. Their evolution in cosmic time is poorly known and consistency with the evolution derived from X-ray detected samples has not been clearly established so far. Another way to detect LLAGNs is through the nuclear optical variability of extended objects. Since several variability surveys are conducted for the detection of supernovae (SNe), we have re-analyzed the SN data sets with a variability criterion optimized for AGN detection in order to select a new AGN sample and study its properties. We have used images taken with the WFI at the 2.2m ESO/MPI telescope, in the framework of the STRESS supernova survey. We selected the AXAF field centered in the Chandra Deep Field South where, besides the deep X-ray survey also various optical catalogs exist. Our method has yielded 132 variable AGN candidates and most of them are X-ray sources. Recently we have conducted a spectroscopic campaign for part of our candidates, confirming their AGN nature.

The nature of the X-ray absorber in Seyfert Galaxies

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Recent X-ray observations of Seyfert 2 galaxies have shown that the distribution and ionization state of the circumnuclear absorbing material is more complex than the simple homogeneous and relatively cold torus predicted by the Unification Scheme of AGN. Hard X-ray observations above 10 keV represent a key to investigate the nature of this absorbing material, since they can make a precise measurement of the Compton reflection hump.

We present the first results for a sample of the local brightest nearby Compton-thin Seyferts2 observed with Suzaku. The sources were selected among the Swift/BAT high-latitude survey, with a flux in the 14-195 keV band of at least $\sim 10^{-10}$erg cm^{-2} s^{-1}. Suzaku's high sensitivity and broad bandpass allowed us to better constrain the primary X-ray continuum and investigate the nature of the reprocessing matter. Finally we present new Suzaku results on bright unconventional AGN, optically classified as unabsorbed but heavily obscured in the X-ray band.

Binary Black Holes in AGN

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Periodic phenomena observed in light-curves from the radio- to the gamma-regime as well as curved structures in pc-scale jets of AGN are thought to have their origin in a supermassive Binary Black Hole (SMBBH) in the center of theses objects. We report on a systematic search for further SMBBH-candidates in AGN and on recent results with regard to SMBBH modeling.

X-ray selected z> 3 quasars in the XMM-COSMOS field

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The characterization of the z> 3 quasars population is one of the main goal of the XMM-COSMOS survey. Making use of the information on spectroscopic and photometric redshifts available for the XMM-COSMOS sources, we extract from the XMM counterparts catalog a sample of 41 QSO at z> 3 at 0.5-2 keV fluxes larger than 10^{-15} cgs (> 1 deg^2 area). We present the optical (color-color diagrams) and average X-ray properties, the number counts and space densitities of the z> 3 quasars population in XMM-COSMOS and compare our findings with model predictions. Prospects for future, large and deep X-ray survesy are also discussed.

The coevolution of AGN and Galaxy clusters: new results from COSMOS

Cappelluti, N.[1] and the XMM-COSMOS team
[1] *MPE*

The XMM-COSMOS provides for the time a sample of ∼2000 AGN and 150 clusters with redshift information. This gives, for the first time the possibility of measuring the co-evolution and the correlation of AGN with Galaxy clusters down to the inner region of galaxy clusters. This has important consequences in understanding the physics of the ICM and AGN themselves. I will present results obtained in XMM+Chandra-COSMOS and their implication for future surveys.

Variable, ionized Fe emission and absorption line in the bright Seyfert 1 galaxy

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There are accumulating evidence of variable, sometimes transient, iron emission and absorption lines in the X-ray spectra of AGNs. I wish to show here the results obtained from multiple XMM-Newton observations of the bright Seyfert 1 galaxy Mrk509. The source does show variability and energy shifts, for both its emission and absorption Fe lines. These are most likely interpreted as being produced by highly ionized iron in the innermost regions of the accretion and ejection flows.

The complex structure of the absorption around Mrk 6

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We present here the results from the analysis of the most recent observations of the Seyfert radio galaxy Markarian 6. Spectroscopic observations were carried out simultaneously in the optical (2.2m CAHA) and X-ray (XMM-Newton) bands in order to prevent the source variability to confuse our study. Previous observations of this source have been performed along several years, revealing a very complex structure and variability, not completely understood so far. Making use of the large amount of archival data, especially the 3 available XMM-Newton observations, we were able to nail down the surrounding absorbing material around this galaxy. We find that a two-phase ionized absorber/emitter, likely coming form at outflow, can account for the observed source variability. The resulting constraints in the location and state of this absorber are in agreement with the values that can be inferred from the optical observations.

Average Fe K_α emission from distant AGN

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We present the results of a X-ray spectral stacking analysis of a large sample of type 1 and type 2 AGN in order to compute the mean Fe emission at high redshifts. We developed a new method to compute a high SNR X-ray average spectrum that takes into account all the possible contributions to the continuum and from which a significance for the detection of any feature can be derived. We find that the final type 1 AGN average spectrum shows a rather prominent narrow emission line corresponding to Fe emission from neutral (or weakly ionized) material with an Equivalent Width $\sim$ 90 eV. We also detect broad features around the narrow line that are best modeled by a modest reflection component. The possible broad component EW is constrained to be at most 400 eV at 3σ confidence level. Preliminary results for type 2 AGN also show a narrow emission line centered around 6.4 keV and broad emission residuals around it, but the smaller number of counts for this AGN type average spectrum does not allow us to distinguish between a relativistic line (EW $\sim$ 300 eV) and a neutral reflection component.

The contribution of the BLR to the iron Kα line in Mrk279

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We quantitatively test, using the "locally optimally emitting cloud" model, the contribution of the broad line region (BLR) to the iron Kα line using as a test case the Seyfert 1 Mrk279 observed by XMM-Newton. We make also use of the physical parameters of the BLR for this source that we obtained from a previous UV and soft X-rays study (Costantini et al. 2007). We find that the neutral iron line in this source is for the most part produced in regions far away from the ionizing source rather than in the BLR or in the accretion disk.

Shock heating in nearby active galaxies

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Shock heating by radio jets is potentially an important feedback process in a range of environments. Although this process is expected to occur in the most powerful radio-loud AGN, strong shocks have so far only been detected in nearby low-power radio galaxies. I will discuss X-ray detections of shock heating in nearby galaxies, including results from a new, deep observation of the nearest radio galaxy, Centaurus A, as part of a Chandra Very Large Program (VLP), and a possible example of AGN shock-heating in a spiral galaxy. I will discuss possible links between shock heating, AGN fuelling and galaxy mergers, and comment on the role of galaxy-scale shock heating in feedback models.

XMM-Newton observations of low-power radio-galaxy environments

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In order to understand the environmental impact of radio-loud AGN, it is essential to constrain their dynamics, energetics, and the properties of the group or cluster environments in which they occur. I will present a detailed study of the environments, particle content and impact of low-power radio galaxies, based on an XMM-Newton study of a representative sample of nearby FR-I radio galaxies. I will discuss evidence that entrainment may be energetically important for FR-I radio lobes, and will discuss evidence for heating of the surrounding group gas by the radio jets/lobes.

A Suzaku observation of Markarian 359

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SISSA

MRK 359 is one of the prototypical Narrow Line Seyfert 1 galaxies. I present the results of a new observation of MRK 359 taken by Suzaku, including variability studies and a comparison to previous XMM-Newton data. I apply relativistic and non-relativistic emission models.

Stability curve analysis for Warm Absorbers in AGN

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Signatures of warm absorbers are seen in soft X-ray spectra of about half of all Seyfert1 galaxies observed and in some quasars and blazars. We use the thermal equilibrium curve to study the influence of the shape of the ionizing continuum and the chemical composition of the absorbing gas on the existence and nature of the warm absorbers. We describe circumstances in which a stable warm absorber can exist as a multiphase medium or one with continuous variation in density. These results are also dependent on the atomic data bases to do the calculations. We find that the stability curves obtained under the same set of conditions, but using recently derived dielectronic recombination rates, give significantly different results, especially in the regions corresponding to warm absorbers, leading to different physical predictions. Using the current, more reliable rates we find a larger probability of having thermally stable warm absorber at 10^5 K than previous predictions and also a greater possibility for its multiphase nature.

High Velocity Outflows in Narrow Absorption Line Quasars

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High velocity and massive outflowing winds may be present in most quasars but only detected in those cases where our line of sight intersects the outflowing absorbing stream. We present results from XMM-Newton, Suzaku, and Chandra observations of Narrow Absorption Line (NAL) quasars with high velocity outflows. These observations have allowed us to place constraints on the intrinsic X-ray absorption in NAL quasars and on correlations between the amount of X-ray weakness and UV properties of the wind to better understand the acceleration mechanism of quasar winds. We find that the UV and X-ray properties of NAL quasars connect smoothly to those of BAL quasars. In contrast to what we find in BAL quasars the maximum outflow velocities of the UV absorbers of NAL quasars do not appear to be correlated with their X-ray weakness. Combing the results from X-ray observations of NAL and BAL quasars we present a unified picture to describe the outflow properties of both classes of objects.

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A hard X-ray view of IC 4329a: first results from Suzaku observations

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IC 4329a is the brightest Seyfert galaxy observed in X-ray. As such it's a wonderful laboratory to test the models for the production of X-rays close to super-massive black-holes. Here we present the first results obtained with five 25 Ks long Suzaku pointings. The main goal is to map the geometry of the disk-corona system tracing the time delays between the direct and reflected components.

FERO (Finding Extreme Relativistic Objects): Statistics of Relativistic Fe K alpha lines in XMM-Newton AGNs

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The detection of a broadened and skewed Fe K_α line in X-ray spectra of compact objects is generally interpreted as due to gravitational effects of the central black hole on the X-ray photons emitted in its vicinity. Works on sizable samples of AGNs converged to say that the broad Fe line is common in local bright sources, but there is no agreement on the average line intensity and on the fraction of objects with detected broad lines. Based on a large collection of 157 XMM-Newton archival data of unobscured AGNs, the FERO project is addressed to systematically study the properties of relativistic emission in type 1 active galaxies, both in individual objects and collectively as a sample. We will describe here the details of the analysis carried out and discuss briefly the main results and conclusions of the study.

Variability of the Fe K line complex in bright nearby AGNs

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The FeK line complex variability patterns can be used as powerful tools to map the innermost accretion flow in AGNs and to derive the physical conditions characterizing matter in the strong gravity regime of the supermassive black hole. We present a systematic study of a sample of 11 bright radio quiet AGN, observed with XMM-Newton, focused on the search for variable FeK emission lines. In order to identify them and to follow their temporal behaviour we mapped the emission in excess of the continuum in the time-energy plane, between 4-9 keV. Finally, using Monte Carlo simulations we estimated their variability significance.

We detected significant line variability in 5 out of 11 sources, between 5.4-7.2 keV. The brightest source of the sample, IC4329a, shows variable emission between E=5.4-6.1 keV characterized by intensity modulations on a time scale of 32.5 ks (at about 96% confidence level), and apparently lagging the 0.3-10 keV continuum emission by 15 ks (at about 97% confidence level). This work increases the number of variable Fe K emission lines detected with model independent methods, revealing complex variability patterns, whose origin will be a goal to be addressed by future X-ray missions like XEUS.

Seeking type 2 QSOs amongst bright X-ray selected EXOs

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X-ray surveys have revealed a population of objects with $f_{\rm X}/f_{\rm opt} > 10$, i. e. more than a factor 10 higher than typical X-ray selected AGN. The true nature of these extreme objects, called EXOs, is still not fully understood. A significant fraction of the EXO population has been found to exhibit very red optical-NIR colours ($R-K > 5$) and shows signatures of substantial absorption in X-rays. These objects are the best candidates to be the mostly elusive type 2 QSOs, required by synthesis models of the X-ray background.

Here we present the multi-wavelength properties of one of the largest samples of bright EXOs assembled so far (130 objects with $f_{\rm X} > 10^{-13}$ erg/cm^2/s, 0.2-12 keV), drawn from the cross-correlation between 2XMMp and SDSS-DR5 catalogues. Using detailed analysis of the XMM-Newton spectra and X-ray colours we are able to place limits on the size of the obscured population represented by our sample. UKIRT near-IR data, already obtained for ∼30% of our EXOs, show evidence of substantial reddening for most of them, supporting the classification of type 2 AGN. We have very recently obtained Subaru FOCAS optical spectroscopy for a substantial sub-sample of our EXOs and IR spectroscopy with Subaru MOIRCS is scheduled for the very near future. These new observations will allow us to throw new light on the nature of these objects.

XMM-Newton and INTEGRAL broad-band spectra of type 2 AGN

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The INTEGRAL/IBIS is surveying a large fraction of the sky above 20 keV with a sensitivity larger than a few mCrab, discovering a number of new extragalactic sources many of which now identified as nearby AGN. We have combined INTEGRAL data with XMM-Newton information to probe the broad-band spectral properties of a class of type 2 AGN representative of the population of absorbed AGN selected in hard X-ray. The high quality of data allow us a detailed study of the intrinsic and reflected continuum components. The high energy cutoff is measured in all sources of our sample and the range of values is in good agreement with that found in type 1 Seyfert galaxies. The Compton reflection components (Compton hump & iron line), are not immediately compatible with a scenario in which the absorbing and reflecting media are one and the same, i.e. the obscuring torus. The absorption is more effective than reflection; this evidence could be explained under the hypothesis that the absorbing/reflecting medium is not uniform, e.g. a clumpy torus. Preliminary analysis shows that, at the limiting flux of the INTEGRAL AGN catalogue, the fraction of obscured AGN is in good agreement with that expected by the CXRB model.

High-z INTEGRAL quasars and possible evidence of bulk Compton motion in 4C04.42

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We present the broad-band analysis of the powerful quasar 4C04.42 (z=0.965) observed by XMM-Newton and INTEGRAL. The 0.2-200 keV spectrum is well reproduced with a hard power-law component (photon index 1.2), augmented by a soft component below 2 keV (observer frame), which is described by a thermal blackbody with temperature kT 0.15 keV. We build with archival data the not-simultaneous Spectral Energy Distribution of the source from radio to gamma ray frequencies. The SED shows two main components: the low frequency one produced by Synchrotron radiation from the electrons moving in the jet and the high energy one produced through external Compton scattering of the electrons with the photons field of the Broad Line Region. Within this scenario the excess emission in the soft-X ray band can be interpreted as due to Bulk Compton radiation of cold electrons. We will also present preliminary results of the broad-band study of a class of high-z quasars (z=0.965-3.668) observed by INTEGRAL and XMM-Newton.

The best of both worlds: The warm absorber of Mrk 509 with XMM EPIC and RGS

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We present the results of a archive study of multiple observations of Mrk 509 taken with *XMM-Newton*. Mrk 509 is one of the brightest Seyfert 1 galaxies and clearly shows the presence of a warm absorber. By modelling the cross-calibration between EPIC-pn and RGS we can combine the sensitivity of the pn with the resolution of the RGS, to simultaneously measure the warm absorber. Using all five separate observations we can study the variability of the warm absorber in greater detail in order to put constraints on its location.

The Spatial Distribution of Quasars in the EDR of the SDSS Quasar Catalogue

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Abstract The Early Data Release (EDR) of the Sloan Digital Sky Survey (SDSS) Quasar Catalogue is analysed. It is shown that quasars are distributed with a periodicity of 5 hours along the ecliptic (i.e. 5 hour of quasar-populated region, followed by 5 hours of vacant region and so on). According to the catalog, quasars are crowded around the celestial equator in the interval , where is the declination. Quasars are also concentrated in the interval in the neighbourhood of the right ascension hours. Our investigation focuses on the Celestial Northern Hemisphere, as well as the ecliptic.

Tidal disruption events from the XMM-Newton slew survey

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The paradigm that the nuclei of non-active galaxies are occupied by black holes was predicted long ago by theory. This conjecture can be proved by the discovery of giant-amplitude, non-recurrent X-ray flares from non-active galaxies and explained in terms of outburst radiation from stars tidally disrupted by a dormant SMBH at their nuclei. Tidal disruption events could fuel the majority of LLAGN and might supply the fuel required for growing black holes to their present size. Two sources have been detected with XMM-Newton during slew observations showing properties consistent with the tidal disruption model. Optical and X-ray follow-up post-outburst observations have been performed on these objects in order to investigate their evolution. We show that the detected low-state emission must still be related to the flare. The X-ray luminosities of the objects are seen to be decreasing according to theoretical predictions for tidal disruption events. Both sources are seen to have hardened within three years from the slew detection near outburst, which may be interpreted as thermal Comptonization of photons from an accretion disk. In addition, our predicted tidal disruption rate as derived from slew observations lies in agreement with that from the theoretical approach, which further endorses the hypothesis that X-ray outbursts are the result of stellar tidal disruptions by a SMBH.

Extremely obscured AGN revealed through a new infrared diagnostic

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We propose a new infrared diagnostic to separate active galactic nuclei and star forming galaxies using mid-infrared and near-infrared colors. The difference with respect to previously proposed diagnostics is the usage of a broad mid-infrared band which encompasses at the same time the 9.7μm Silicate absorption and one of the main broad PAH features. In this way, the diagnostic is pretty insensitive to the spectral features in the 6-25μm range and it is able to make a clear distinction among different classes of galaxies with very low contamination with respect to previously proposed diagnostics. The diagnostic is perfectly suited to be used with archival data from the *ISO*, *Spitzer*, and *Akari* infrared missions. We applied the diagnostic to the GOODS and Lockman Hole fields. Roughly 70% of the galaxies classified as AGN on the basis of their X-ray flux are detected as AGN in the infrared. On the other hand, more than 80% of the galaxies classified as AGN in the infrared are not even detected in the X-rays. Using the proposed diagnostic, we estimate that AGN contribute the mid-infrared extra-galactic integrated emission less than 30%.

Multi-epoch X-ray observations of Seyfert 1s

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Seyfert 1s (S1s) and in particular Narrow-line Seyfert 1 galaxies (NLS1s) are recognised for extreme X-ray flux and spectral variability on all time scales. These fluctuations make it challenging to model single-epoch X-ray data in a meaningful manner. We have obtained multi-epoch observations of several S1s and NLS1s (e.g. I Zw 1, UGC 3973, Mrk 335, 1H0707-495) with XMM-Newton and Suzaku, spanning time scales from days to years, with the intension to model the data in a self-consistent manner. We demonstrate that by demanding the intrinsic continuum to vary modestly (or not at all) from epoch-to-epoch, many spectra can be modelled by modifying only non-continuum or line-of-sight parameters. It is now becoming possible to discriminate the different models (e.g. reflection and absorption) that successfully describe single-epoch observations.

On Hard X-ray AGN as Progenitors of Ultra-High Energy Cosmic Rays

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We measure the correlation between sky coordinates of the Swift BAT catalogue of active galactic nuclei with the arrival directions of the highest energy cosmic ray events detected by the Auger Observatory. The statistically complete, hard x-ray selected catalogue of AGN should help to distinguish between sources that follow the distribution of local large-scale structure. The positions of the full catalogue are marginally uncorrelated with the cosmic ray arrival directions, but various cuts on redshift and weighting by the source flux reveal a significant correlation. We discuss the implications for determining the mechanism which accelerates particles to these extreme energies in excess of 10^{20} eV.

The spatial clustering of X-ray selected AGN at $z \sim 1$

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We study the spatial clustering of ~ 550 AGN at a median redshift of $z \sim 1$ detected by XMM-Newton in the 2 deg^2 COSMOS field and spectroscopically identified to $I_{AB} < 23$. A strong clustering signal is detected at $\sim 17\sigma$ level, which is the most significant measurement obtained for clustering of X-ray selected AGN to date. By means of the projected correlation function $w(r_p)$, we derive a best fit comoving correlation length of $r_0 = 8.3 \pm 0.4\,h^{-1}$ Mpc (and slope of $\gamma = 1.89 \pm 0.07$; Poissonian errors). The large r_0 value is mainly due to a redshift structure at $z \sim 0.36$ which contains about 40 AGN: when removing this structure r_0 decreases to $\sim 6\,h^{-1}$ Mpc. The measured correlation length for XMM-COSMOS AGN is similar to that of ellipticals and of luminous infrared galaxies at the same redshifts, indicating that nuclear activity at $z \sim 1$ is preferentially hosted by massive galaxies.

We also investigate the clustering properties of obscured and unobscured AGN separately, providing for the first time a significant ($\sim 7\sigma$) clustering measurement for obscured AGN at $z \sim 1$. Within the statistical uncertainties, there is no evidence that obscured AGN cluster differently from unobscured AGN, suggesting that they inhabit similar environments.

The SDSS-2XMM BALQSO sample

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Broad Absorption Line Quasar (BALQSO) provide the most compelling evidence for the presence of massive outflows from the inner regions of AGN. X-ray spectral studies can probe the innermost, highly ionized part of the outflow, and can place strong contraints on the ejection flow properties, and on its impact on the surrounding medium. We cross-correlated the SDSS dr6 with the 2XMM catalog, obtaining a large ($N \sim 100$) sample of BALQSO at medium to high redshift ($z \sim 0.5-2.5$). We will present preliminary statistical results on these sources, which are drawn from the largest sample of this kind studied so far. Special emphasis will be posed on detailed spectral analysis of the brightest BALQSOs of the sample and/or to those with multiple observations.

The disk-jet link: X-ray and radio monitoring of PKS 0558-504

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Several studies of Galactic and extragalactic black hole systems have demonstrated that coordinated X-ray and radio observations represent one of the most effective tools to investigate of the link between accretion and ejection phenomena. Here we present the preliminary results of a 3-year long monitoring RXTE campaign of the radio-loud NLS1 PKS 0558-504, which has been recently monitored also in the radio band with the ATCA and VLBI. PKS 0558-504 is an extraordinary source under several aspects, most notably: 1) It is the radio-loud AGN with the highest accretion rate and the only narrow-lined radio galaxy bright enough to be regularly monitored in the X-ray. 2) The X-ray spectral variability properties of PKS 0558-504 are consistent with the behavior observed in Galactic Black Holes (GBHs) during their intermediate state. Therefore, the coordinated X-ray/radio investigation of PKS 0558-504 offers the possibility to to investigate the role played by accretion rate in the jet formation process, and to confirm/strengthen the link between AGN and GBHs.

An XMM view of Q2122-444: an AGN without Broad Line Region?

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Q2122-444 belongs to the class of naked AGN, also known as true type 2 AGN. Based on optical spectroscopic studies, these sources appear as classical type 2 (obscured) AGNs, with only narrow emission lines. However, long-term optical monitoring campaigns, carried out over more than two decades, show that the same sources are strongly variable, like type 1 (un-obscured) AGNs. Here, we present the preliminary results of a recent XMM-Newton observation of Q2122-444, complemented with radio data and Chandra observations. The source appears to be bright in the X-rays, with standard photon index and without significant intrinsic absorption, suggesting that some bright AGN may genuinely lack a broad line region.

Constant pressure absorption models contribution to the soft X-ray excess in AGN

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Many Active Galactic Nuclei (AGN) show a soft X-ray excess below 1 keV. This feature has been attributed either to reflection of the hard X-ray source by the accretion disk or to the presence of an additional Comptonizing medium. An alternative solution is that the soft X-ray excess is caused by relativistically smeared absorption. For the absorption hypothesis to hold, the plasma should be in total pressure equilibrium to constrain the spectral distribution, which otherwise would be too strongly variable in time and from one object to the other, as compared to observations. But constant pressure absorption models offer additional advantages: although computationally complex, they are characterized by a small number of free parameters and they are more physically robust than simple constant density models, previously used to compute relativistic wind models. Furthermore, they can account for the clumpy and stratified nature of the Warm Absorber, displaying a strong temperature, density, and ionization gradient. Encouraged by these results, we have built a grid of constant pressure models compatible with XSPEC and we have applied it to model XMM data of PG 1211+143. Results help understanding the role of absorption vs. reflection in modeling the soft X-ray excess in AGN.

An X-ray view of the Nature of LINERs

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LINERs are very common in the nearby universe. They can play a relevant role in the connection between normal galaxies and AGNs. However, there exists a strong ongoing debate on the origin of their energy source. Basically, either the ionizing energy source is a low luminosity AGN or this energy is of thermal origin from massive star formation or from shock heating mechanisms. The X-ray properties of the nucleus are among the most convincing evidence about their nature. We present the study achieved during my thesis work with the analysis of 83 LINERs observed with XMM-Newton (57) and Chandra data (68) from the Carrillo et al. (1999) catalog of 470 LINERs. We classify as AGN-candidates those objects showing a point-like source in the (4.5-8.0keV) band. The detection of the FeK(6.4keV) is another clue of the AGN nature. More than 60% of the LINERs show properties of AGNs, increasing when we study the Compton-Thickness. We find 14 cases with FeK line, with high EW in 7 cases. Some cases show FeXXV and FeXXVI emission lines, which are mainly hosted by ULIRGs. All together, a high percentage of LINERs harbor an AGN.

The contamination of high redshift X-ray clusters by AGN

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X-ray surveys for clusters of galaxies have been and are being used to constrain cosmological parameters. X-ray clusters at high redshift (near or greater than one) provide the lever arm for these cosmological measurements. AGN evolve rapidly with redshift and their X-ray emission will provide a source of systematic error in the measurement of the X-ray fluxes from distant clusters. The extent of this systematic error will be investigated, together with the impact on the measurement of cosmological parameters.

Particle acceleration in active galaxies – the X-ray view

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Observations of synchrotron radiation in the X-ray are crucial to an understanding of energy transport in radio-loud active galaxies because they trace the locations of high-energy particle acceleration; the electrons responsible for the X-ray emission lose essentially all of their energy on very short time/distance scales. Making use of this fact, we have shown that the standard picture of how and where particles are accelerated needs substantial revision. I will discuss particle acceleration both in jets in FRI radio galaxies (particularly the nearest, Centaurus A) and in the hotspots and lobes of more distant and powerful objects.

INTEGRAL results on blazars

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The ESA INTEGRAL satellite is an efficient tool to detect blazars in their flaring states when the hard X-ray and gamma-ray emission increases drastically. Summary of INTEGRAL analyses of blazars, both within the CP as well as AOs, will be presented and discussed. Several examples of successful INTEGRAL ToO observations (within accepted AO-proposals) of flaring blazars, based on multispectral monitoring of large sample of blazars and triggered by large brightening found, will be shown, confirming the scientific value of such approach. In addition, results of blazars in the Core Program will be also discussed.

Hydrodynamical simulations of the AGN Central Engine in 3D

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We consider hydrodynamics of inviscid accretion flows, assuming the spherically symmetric density distribution at the outer boundary, but brake the flow symmetry by introducing a small, either latitude-dependent, or both latitude- and azimuth dependent angular momentum. The material that has too much angular momentum to be accreted radially, forms a thick torus near the equator. Consequently, accretion proceeds only through the polar funnel, and the mass accretion rate through the funnel is constrained by the size and shape of the torus, not by the outer conditions. In 3-D simulations, we found that the torus precesses, even for axisymmetric conditions at large radii. For the latitude and azimuth-dependent angular momentum, the non-rotating gas near the equator can also significantly affect the evolution of the rotating gas. In particular, it may prevent the formation of a proper torus (i.e. its closing, in the azimuthal direction). In such models, the mass accretion rate is only slightly less than the corresponding Bondi rate.

The nature of the intranight variability of radio-quiet quasars

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We select a sample of 10 radio-quiet quasars with confirmed intranight variability and with available X-ray data. We compare the variability properties and the broad band spectral constraints to the predictions of microvariability by three models: (i) irradiation of accretion disk by variable X-ray flux (ii) accretion disk instability (iii) the presence of a weak blazar component. We concluded that the third model, i.e. the blazar component model, is the most promising if we adopt a cannonball model for the jet variable emission. In this case, the probability of detecting the microvariability is within 20-80%, depending on the ratio of the disk to the jet optical luminosity. Variable X-ray irradiation mechanism is also possible but only under additional requirement: either the source should have very narrow H-beta line or occasional extremely strong flares appear at very large disk radii.

Unifying accretion from X-ray binaries to AGN: explaining the quasar luminosity

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For X-ray binaries, a consistent picture has emerged of the coupling between the different states of the accretion disk and the presence or absence of radio jets. Theoretical arguments indicate that accretion onto supermassive black holes in active galactic nuclei (AGN) should show the same accretion states as observed in X-ray binaries, and hence obey the same disk/jet coupling as a function of Eddington-scaled accretion rate. We have been testing how far this analogy holds, in particular by introducing the "disk-fraction luminosity diagram" (DFLD) as a generalisation of the "hardness-intensity diagram" that is useful for understanding the behaviour of X-ray binaries. Indeed, the average radio-loudness of AGN as function of DFLD position shows exactly the behaviour expected if AGN have the same jet/disk coupling as X-ray binaries. We demonstrate that the unified accretion model simultaneously can reproduce the radio luminosity function (LF) and the quasar bolometric LF, with the break in the quasar LF arising from the onset of inefficient accretion. The model also allows us to determine the kinetic luminosity function of AGN jets, and hence the possible impact of AGN feedback on galaxy evolution.

Bubble heating in groups and clusters: the nature of ghost cavities

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We discuss energy injection in galaxy groups and clusters via both ghost and filled bubbles. We initially discuss a combined X-ray and radio study of the galaxy group NGC 741, in which we determine the energetics of the ghost cavity and the impact that a rising, subsonically expanding bubble can have on the energetics of intra-group medium (IGM), with particular regard to counteracting the effects of radiative cooling. Using a combination of X-ray and radio measurements we are able to place interesting limits on the fluid filling the ghost cavity which suggest that the fluid filling the bubble may not have evolved in the conventional way via expansion or synchrotron losses consistent with an evolving radio source. We discuss application of the same method used to determine the physical limits of the bubble fluid in NGC 741 to a sample of 'ghost cavities' in galaxy groups and clusters for which both radio and Chandra X-ray data are available.

X-ray properties of a sample of polar-scattered Seyfert galaxies

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We present the results on an XMM-Newton systematic analysis of a sample of nine Seyfert 1 galaxies. When observed in polarised light, the spectra of the selected sources are similar to those of Seyfert 2 galaxies. This peculiarity strongly suggests that these AGN are viewed with an inclination comparable with the torus opening angle. Our results are consistent with this scenario and, taking advant age of this favourable geometrical condition, we were able to investigate in detail the physical properties and the distribution of the circumnuclear gas in these sources.

The variable X-ray spectrum of PDS456

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Technion

The luminous quasar PDS456 is the brightest AGN in which a high velocity outflow has been claimed to be present in. We report on a new 180 ks XMM observation of this quasar which reveals its variable nature and reflects on the variable nature of the high velocity outflows phenomenon. In this object, as well as in a few others with high velocity outflows, repeated observation failed to reproduce the absorption spectrum seen before. This indicates that variability is common among the high velocity winds. We will discuss the timescale of these variations and the implications for the physical parameters of these outflows. We will also discuss the variable X-ray spectrum of PDS456 and the implications of this variability.

The X-ray - γ-ray connection of BL Lac objects

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The spectral energy distribution of BL Lac objects can be explained by synchrotron emission which peaks in the UV - X-ray regime and inverse Compton emission from a population of relativistic electrons which upscatter their own synchrotron photons into the Gev - TeV regime. Simultaneous observations in the X-ray and γ-ray bands can hence be used to quantify physical parameters of the emitting regions. From those it is possible to shed light on the processes of particle acceleration in the jets of active galactic nuclei. We present simultaneous X-ray and TeV observations to determine the synchrotron peak and spectral slope up to the peak during the recording of TeV spectra with HESS. This study doubles the list of sources for which such simultaneous data have been obtained.

An XMM-Newton Study of the Centaurus A Northern Middle Radio Lobe

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We present results from a 40 ks XMM-Newton observation of the X-ray filament associated with the Centaurus A Northern Middle Radio Lobe (NML). This filament is $\sim$20 kpc in length, centered $\sim$25kpc from the nucleus, and lies along the southeastern boundary of the NML in projection. We find that it is composed of five bright, spatially resolved knots with lower surface brightness emission connecting them. The emission from all the knots is thermal, non-thermal power law spectral models are excluded at high significance. Each knot is roughly 1 kpc in diameter, and the total X-ray luminosity of the filament is $\sim 5\times10^{39}$ ergs s^{-1}. The elemental abundance of the knots is low (less than 30% of the Solar value), suggesting that they did not originate in the central regions of the galaxy. Interestingly, the knots are overpressurized relative to the ambient medium. We discuss several scenarios for the origin of this filament including supersonic inflation of the NML, star formation and supernova blown bubbles, and entrainment of local hot ISM via Kelvin-Helmholtz instabilities.

The nature and density of Spitzer selected X-ray absorbed AGN

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We measure the density of X-ray absorbed AGN selected among a population of sources detected at 24 μm by *Spitzer* in the XMM/ELAIS-S1 field and showing large MIR/Optical (F(24 μm)/F(R)>20) flux ratios. We have carried out, for the first time, optical spectroscopic identification of 56 of such sources with R<24.2. The fraction of optical classified secure AGN result to be at least 45% at fluxes larger than 280 μJy, while the analysis of the X-ray properties, with XMM/Newton and *Chandra* telescopes, allows to classify all of them as (mostly absorbed) AGN. The space density of these sources will be compared with previous measures of the X-ray luminosity function of the AGN.

Discovery of a new radio galaxy with extremely rapid X-ray variability

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The radio galaxy 2XMM J134736+173404 has been serendipitously discovered in the 2XMMp catalogue due to its extremely rapid X-ray variability. During a 60 ksec XMM EPIC observation the light curve changed from a bright state with rapid ($\sim$ 100 sec) flares to a much fainter quiet state. We identified the X-ray source with a narrow line radio galaxy at a redshift of z=0.045. The X-ray spectrum is best fitted by a very soft power law. We therefore conclude that the X-ray emission corresponds to the high energy part of the jet synchrotron emission and compare the light curve with jet variability models.

Revealing X-ray obscured quasars in SWIRE sources with extreme MIR/O flux ratios

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Recent results indicate that IR color selection criteria can be used to build large samples of optically-obscured QSO candidates at z 1. We report X-ray spectroscopic study of 44 bright (F24>1.3 mJy) SWIRE sources with extreme mid-IR/Optical flux ratios (MIR/O¿2000). The aim of this project is to provide a direct measurement of the Nh of the absorber. We have spectroscopic redshift for 20% of the sources (0.22<zspec<2.54), for the remaining we derive photometric redshift (0.54<zphot<3.77). For 55% of sources we have constrained the Nh value: 95% objects are found to be obscured AGN (Nh>10^{22} cm^{-2}) and, remarkably, half of them show column densities larger than 10^{23} cm^{-2}. We also find that 50% of sources can be classified as type 2 QSOs on the basis of their Nh and X-ray luminosity.

X-ray spectral analysis of sources in SA57

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Several surveys in the Selected Area 57 were conducted since the 80's, to search for AGNs with various techniques including colours, variability and proper motions. Recently we have carried out a new survey with XMM-Newton (Trevese et al. 2007), which yelded 140 X-ray sources, 98 of which were identified in existing optical catalogues.New optical spectroscopy was also obtained for some X-ray- or variabiliyi-selected candidates (Trevese et al. 2008). Here we present the X-ray spectral analysis of the sample. The distribution of X-ray colours is analysed, taking into account the optical classification. Spectral fitting with absorbed power law models, indicate that 90 objects have a column density lower than log(NHI/cm^2)=22 while 17 are in the range 22 <log(NHI/cm^2)< 23 and 5 have log(NHI/cm^2)>23. Other 8 objects are fitted with thermal models.

FERO: statistics of relativistic Fe K alpha lines in XMM-Newton AGNs

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The detection of a broadened and skewed Fe K alpha line in X-ray spectra of compact objects is generally interpreted as due to gravitational effects of the central black hole on the X-ray photons emitted in its vicinity. Based on a large collection of 157 XMM-Newton archival radio quiet unobscured AGNs, the FERO project (Finding Extreme Relativistic Objects) is addressed to systematically study the broad Fe line properties by applying the fully relativistic code by Dovciak et al.(2004). The main results indicate that broad Fe lines are detected in 8% of the whole sample and that this percentage rises up to 65% when considering sources with good photons statistics. The mean intensity of the detected lines is around 100 eV. The sources with upper limits have been studied by using the technique of spectral stacking. The stacked Fe line profile is lower than 50 eV and no clear trend of the line intensity with 2-10 keV luminosity, black hole mass and Eddington ratio has been found.

The soft X-ray spectrum of NGC 4051 in its low state: a CLOUDY approach

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The physical properties of the line emitting material in AGNs can be derived from well known line ratio diagnostics related to H-like and He-like ion transitions. Here, we show how to get this information (size, location and geometry of the emitting clouds) by a fit procedure of the overall observed spectrum with theoretical models developed by using the photoionization code CLOUDY. Application to NGC 4051 in its low flux state is shown.

The Chandra 3C Snapshot Survey for Sources with z<0.3

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We report on our Chandra Cycle 9 program to observe half of the 60 as yet unobserved 3C radio sources at z<0.3 for 8 ksec each. We will propose for the remainder in cycle 10. Here we report on the preliminary analyses of about half of these first 30 AO-9 sources which have recently been observed. We show the first results about the emission of their active nuclei, with spectral fits to determine the excess (above galactic value) of the column density to the source. We also compare these observation with VLA radio maps and HST data to search for extended emission corresponding to jets and hotsposts. Amongst the first 15 sources already observed, we obtained detections of one jet and two hotspots. Finally, a comparison within X-rays flux maps in different energy range is presented. This allow us to study the absorption of nuclear regions and, when possible, to investigate the emission of their extended regions. The work at SAO is supported by NASA grant GO8-9114A.

The X-ray emission in the radio jet of 3C 17 and 3C 78

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The X-ray radiation observed from radio jets is generally interpreted to be from non-thermal processes, even if its nature is still unclear for any particular jet. It could be described in terms of synchrotron emission or in terms of several varieties of inverse Compton radiation. In this work, we investigated the X-ray emission of the radio jets in 3C 17 and in 3C 78 to understand the nature of their radiation. These two sources belong to the
chn snapshot program started last year to complete the sample of X-ray observations of the 3CR radio galaxies at redshift lower than 0.3. We compare the X-rays emission of 3C 17 and 3C 78 with the radio maps in the VLA and in the MERLIN archives and with the optical-IR archival images of the Hubble Space Telescope derived during the HST snapshot program of the 3CR sample. We found an X-ray detection of both radio jets in our two sources, both with optical-IR counterparts. We derived the spectral energy distribution for the nuclear emission and for the knots in the jets. We give source parameters required for the various X-ray emission models. The work at SAO is supported by NASA grant GO8-9114A.

Constraining the spectral energy distributions of AGN

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The bolometric luminosity of AGN is emitted over a very broad range of luminosities, from radio wavelengths to hard X-rays. The different components of the spectral energy distribution (SED) of these objects are believed to originate in the inner most regions of AGN and involving different physical processes. Mean SED of AGN have been available for many years, however these studies have revealed that there is a large dispersion in quasar SED around the mean. Accurate measurements of the SED of AGN are fundamental in order to fully understand the physics that takes place in these objects. We will present the preliminary results of a study of the SED of samples of AGN selected from several existing wide and deep multiwavelength surveys. The main goals of our study are to constrain the mean shape and dispersion of the SED for different classes of AGN as a function of luminosity, redshift, gas obscuration, X-ray absorption and host galaxy contribution. We also aim to investigate the correlation of different SED components, for example optical-UV reddening vs X-ray absorption. Finally we will use the results to quantify selections biases of samples of AGN selected at different wavelengths.

The origin of the soft X-ray excess in narrow line Seyfert 1's

Middleton, M.J.; Done, C.; Ward, M.J.; Gierlinski, M.; Mullaney, J.R.; Gelbord, J.M.
University of Durham

The X-ray spectra of high mass accretion rate AGN (predominantly NLS1s) typically show a strong, smooth rise below 1 keV, forming a 'soft excess'. The origin of this feature is much debated. Current models include a hot or Comptonised disc (slim disc), doppler smeared reflection, doppler smeared absorption and clumpy absorption. All these models can fit the smooth shape of the soft excess, but the slim disc has problems in reproducing the characteristic temperature of the soft excess across a range of sources, smeared reflection models fail on the physical grounds that a hydrostatic disc cannot produce a strong soft excess, and smeared absorption fails again on physical grounds that the terminal velocity of a line driven disc wind is not fast enough to smear the characteristic absorption features. This leaves only the clumpy wind models. We show that these can match both spectral and variability constraints from one of the strongest soft excess objects, REJ(KUG)1034+396. This more messy picture of the accretion flow may be physically expected for high mass accretion rate objects.

X-ray AGN-galaxy Cross Correlation and AGN Halo Occupation

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I will report the results from clustering studies of X-ray selected AGNs from the Extended Chandra Deep Field and COSMOS Field. In particular, I discuss cross-correlation of galaxies and X-ray selected AGNs and galaxies. In both fields, significant progresses have been made in identifying X-ray sources and a large fraction of the X-ray sources now have either photometric or spectroscopic redshifts. On the other hand, large optically selected galaxy catalogs with photometric redshifts with very high completeness have been developed. Having redshift information on both sides, we are now able to derive the cross-correlation without dilution by a projection effect. We probe the cross-correlation into a smaller non-linear scale, down to 0.1 Mpc, where the pairs within single dark matter halos dominate. By analyzing both the large (> 2 Mpc), where the linear theory can be applied, and smaller scale simultaneously, we infer the typical mass of the dark matter halo (DMH) occupied by AGNs in two ways: 1) by the bias paramter from large scale and 2) the number of galaxies in the same dark matter halo as the AGNs from small scales. Implications of the results on the AGN down-sizing will be also discussed.

Variability Analysis of the Seyfert 1 Galaxy MCG-6-30-15 observed by ASCA and Suzaku

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We analyzed long observations of the Seyfert 1 Galaxy MCG-6-30-15 in 1999 and 2006 using ASCA and Suzaku, respectively. We carried out the model independent RMS(Root Mean Square) variability analysis, and confirmed that the RMS variability spectrum in 1999 indicates a significant decrease at the Fe line energy band more rapidly than those in other energy bands, as the time scale increases from 10^4 to 10^5 sec, as already reported by Matsumoto et al. (2003). On the other hand, the RMS variability spectrum in 2006 does not show such a dramatic decrease at the Fe line energy band. Examining the structure function (variability time scale vs RMS variability), we found a common characteristic in 1999 and 2006 that RMS variability is most significant on a time scale of $\sim 10^3$ sec in all the energy bands. In addition, our results of differential spectral analysis are consistent with the results of the structure function analysis.

The Properties of a Complete Hard X-ray Selected Sample

Mushotzky, R.[1]; Winter, L.[2]; Tueller, J.[1]; Baumgartner, W.[1]; Ueda, Y.[3]
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We will present the x-ray, optical spectra and host galaxies properties of a complete hard x-ray selected sample of AGN. These properties are rather different from those of the SDSS selected low redshift AGN and the Chandra and XMM selected moderate z AGN. We will discuss the implications of these results for AGN evolution and the triggering of AGN activity.

An XMM-Newton Survey of Broad Lines in AGN

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We report the results of a comprehensive survey of the iron K-alpha line properties of a sample of Seyfert galaxies. We focus on the evidence for broad emission and the robustness of the interpretation that this emission comes from a relativistic accretion disk. Broad emission is found to in about around 70% of objects, but is required to be relativistic in only about the half the sample. Narrow emission only is seen in seen in many objects. Complex, ionized absorption is also common and while it affects the details of the broad line fits cannot account solely for the complexity seen at iron K. Evidence for shifted, narrow emission and absorption features is also reviewed.

GR Models of the X-ray Spectral Variability in MCG-6-30-15

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Several properties of the X-ray spectrum of MCG-6-30-15 are supposed to result from relativistic effects in the vicinity of black hole horizon, making this AGN the most important source for exploring GR in the strong field limit. We find that the properties revealed by XMM and Suzaku observations, including the relativistic Fe line with a pronounced red wing as well as reduced variability of the reflected radiation, independently indicate that the hard X-ray source must be located within 4 gravitational radii from a rotating black hole. We consider in details several models attributing spectral variability to GR effects and we find that the existing data favor a scenario involving a source with the radial distance varying around 2-3 gravitational radii. Alternative models, e.g. the light-bending model formulated by Miniutti & Fabian, do not reproduce the observed effects.

NLS1 galaxies in the eye of the X-ray excess variance method

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We estimate black hole masses in 21 Narrow Line Seyfert 1 (NLS1) galaxies and compare them to our previous sample of 14 Broad Line Seyfert 1 (BLS1) galaxies. In both cases the X-ray variance method was used to estimate those masses. NLS1s are generally more variable and for majority of those objects a black hole mass values are too small in comparison to values obtained from reverberation, stellar dispersion methods. A scaling coefficient is $\sim$ 10-30. In a small subset of NLS1s this approach failed and a scaling coefficient is the same as in BLS1s ($\sim$0.5-4). We discuss the issue whether the discrepancy reflects the additional dependence on source luminosity or the variability enhancement is due to the change in variability mechanism related to the change in the soft X-ray slope.

QSO winds and galaxy evolution (and XEUS too)

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A significant population of broad-line z=2 QSOs have heavily absorbed X-ray spectra. Submm observations show that these QSOs are embedded in ultraluminous starburst galaxies, unlike most unabsorbed QSOs at the same redshifts and luminosities. The radically different star formation properties between the absorbed and unabsorbed QSOs implies that the X-ray absorption is unrelated to the torus invoked in AGN unification schemes. Instead, these objects represent a transitional phase in an evolutionary sequence relating massive black holes and the formation of galaxies. Prior to this phase, the galaxy is rapidly forming its stars, and the growth of the black hole is obscured. After the X-ray absorbed phase, the naked QSO shines brightly, and its host elliptical galaxy is essentially fully formed. The most puzzling question about these objects has always been the nature of the X-ray absorber. I will present a study of the X-ray absorbers based on deep (50-100ks) XMM-Newton spectroscopy, and show that the absorption is due to a dense, ionised wind driven by the QSO, with a kinetic luminosity compatible with the theoretical requirements for producing the M-sigma relation. Finally, I discuss the potentially paradigm-changing capability of the XEUS cryogenic spectrometer for investigating the role that winds play in QSO and galaxy evolution.

XMM-Newton and INTEGRAL broad-band spectra of newly discovered broad line AGN

Panessa, F.[1]; Bassani, L.[2]; De Rosa, A.[1]; Malizia, A.[2]; Molina, M.[3]
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The INTEGRAL/IBIS is surveying a large fraction of the sky above 20 keV with a sensitivity larger than a few mCrab, discovering a number of new extragalactic sources many of which now identified as nearby AGN. We have combined INTEGRAL data with XMM-Newton information to probe the broad-band spectral properties of different AGN classes (radio-loud, type 1/2 Seyfert galaxies, NLSy1, etc.), representative of the population of AGN which are now being observed above 20 keV. Among broad line AGN, some were found to have very peculiar characteristics when compared with the INTEGRAL data, suggesting either extreme spectral and flux variability between the XMM-Newton and INTEGRAL observations, or a prominent reflection component dominating the hard X-ray data. In several cases, it is also possible that complex absorption could explain the differences between the two measurements. In some sources, cut-off energies have been constrained to be below 150 keV. Preliminary results on a complete sample of type 1 INTEGRAL AGN will also be presented.

Are strongly variable Seyfert 2 galaxies really AGN without a BLR?

Panessa, F.[1]; Carrera, F.J.[2]; Bianchi, S.[3]; Barcons, X.[2]; Bassani, L.[4]; Corral, A.[2]
[1]*INAF - Istituto di Astrofisica Spaziale e Fisica Cosmica - Roma;* [2]*Instituto de Física de Cantabria (CSIC-UC);* [3]*Dipartimento di Fisica, Universit degli Studi Roma Tr;* [4]*IASF-Bologna/INAF*

Strong amplitude optical brightness variability has been found in a sample of Seyfert 2 galaxies ("Naked AGN", Hawkins 2004). The variability suggests that the nuclear source is seen directly, contradicting the complete absence of broad emission lines as simple Unified Models for AGN would predict. Alternatively the Broad Line Region might be missing in these sources. Here we present the results obtained from XMM-Newton observations coordinated quasi-simultaneously with ground-based optical spectroscopy. This have offered a priviledged window into the central engine to understand the absorption properties of these objects and relate them to their optical appearance.

X-ray spectral properties of Type 2 Quasars observed by XMM-Newton

Piconcelli, E.; Fiore, F.
Osservatorio di Roma (INAF)

The current knowledge of the X-ray spectral properties of Type 2 quasars is still sparse with few notable exceptions. After reviewing the recent literature, we will discuss the results from XMM-Newton observations of two X-ray bright QSO2s (namely IRAS 09104+4109 and 3C 234) that enabled us to investigate in detail the physical and geometrical properties of the circumnuclear gas in these objects. We will also report on an X-ray spectroscopic study of a large sample of very bright mid-infrared sources with extreme mid-IR/Optical flux ratios (MIR/O>2000). Given the low surface density of these luminous sources, a sampling of a large area is necessarily required and, therefore, our sources have been selected from the 50 sqdeg SWIRE survey. Preliminary results are very promising and highlight the efficiency of the MIR selection in finding out a large number of QSO2s with respect to traditional optical/UV/soft X-ray surveys

A Survey of X-ray Variability in Seyfert 1 Galaxies with XMM-Newton

Ponti, G.
APC AstroParticule and Cosmologie

The nature of the soft excess and the presence of the broad Fe lines is still nowadays highly debated because the different absorption/emission models are degenerate. Spectral variability studies have the potential to break this degeneracy. I will present the results of a spectral variability RMS survey of the 36 brightest type 1 Seyfert galaxies observed by XMM-Newton for more than 30 ks. About half of the sample show lower variability in the soft energy band, indicating that the emission from the soft excess is more stable than the one of the continuum. While the other sources show a soft excess that is as variable as the continuum. About half of the sample do not show an excess of variability where the warm absorber component imprints its stronger features, suggesting that for these sources the soft excess is not produced by a relativistic absorbing wind. In a few bright and well exposed sources it has been possible to measure an excess of variability at the energy of the broad component of the Fe K line, in agreement with the broad emission line interpretation. For the sources where more than one observation was available the stability of the shape of the RMS spectrum has been investigated. Moreover, it will be presented the results of the computation of the excess variance of all the radio quiet type 1 AGN of the XMM-Newton database. The relations between variability, black hole mass, accretion rate and luminosity are investigated and their scatter measured.

AGNs in Groth: Analysis in X-rays and Optical

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We present the results from the study of the broadband BVRI optical and X-ray properties of a large sample of active galactic nuclei (AGN) detected in a deep (200ksec), small area (0.2 square degrees) Chandra/ACIS survey carried out in the Groth field. We obtained different structural parameters in aim to determine morphological classification of all objects and to look for the possible diagnostic diagrams which could allow us to separate between different nuclear types. We have seen that for the sample of very faint objects (R $<$ 24) with small isophotal area ($<$ 200 pixels) the most useful parameter for morphological classification is the concentration index combined with the asymmetry index. To get the separation between different nuclear types, as are broad and narrow line AGNs, we combined the X-ray-to-optical ratio with the hardness ratio in different ranges (soft, hard and very hard X rays). We didn't find any clear separation between BLAGNs or NLAGNs and morphology. We have seen that there is an anticorrelation between morphology type (concentration index) and X/O ratio, which seems to suggest more efficient accretion rate in the late type objects, compatible with the environment more rich in material for the central motor feeding.

XMM-Newton AO6 observations of NGC 1365: the long look

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We present the first results of a 5-day-long monitoring of the AGN in NGC 1365, known for its fast column density variability. The AGN was initially found in a Compton-thick, reflection dominated state. After 2 days the matter obscuring the central source was partially cleared, and after 10 more hours the system was back in the reflection-dominated state. This exceptional event allows a precise estimate of the dimension of the emitting region (of the order of a few 1013 cm, the first direct probe of such small scales around the central black hole), and of the distance from the center of the obscuring clouds (of the order of the BLR distance). Moreover, the high quality reflection-dominated spectrum shows three distinct iron narrow emission lines at 6.4, 6.7 and 6.9 keV, directly related to the analogous features seen in absorption in a previous XMM observation.

Deep U-band imaging of the XMM-Lockman field

Rovilos, E.; Burwitz, V.; MPE Lockman Hole group
MPI für extraterrestrische Physik, Garching

We are using the Large Binocular Telescope (LBT) to observe the XMM-Lockman area in the U-band. We will have obtained 24 hours of observations, which will allow us to reach 28 AB magnitude in U-band, the deepest image to date. Combining this with LBT, Subaru and Spitzer images of the same region in optical and infrared bands, we will obtain accurate photometric redshifts of the XMM sources too faint to be spectroscopically observed. We can also select high redshift AGN using the Lyman-break technique and identify Compton thick AGN candidates using selection criteria, based on emission ratios between different bands (eg. infrared/ultraviolet, infrared colours, infrared/radio). Getting accurate photometric redshifts for sources in the Lockman Hole will help us select targets at cosmologically interesting redshifts (z>1) to be observed with LUCIFER, a state of the art near infrared spectrograph to be mounted on the LBT late 2008, which will be able to study the properties of the redshifted Balmer lines.

Multiwavelength SEDs of Hyper-Luminous Infrared Galaxies

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The relationship between star formation and SMBH growth is central to our understanding of galaxy formation and evolution. Hyper-Luminous Infrared Galaxies (HLIRGs, $L_{IR} \geq 10^{13} L_{\odot}$) are powerful laboratories to investigate the AGN-starburst connection. They present extreme SFR ($\sim 1000 M_{\odot} yr^{-1}$) and most harbour an AGN.
We have done an intensive work with a sample of HLIRGs observed with XMM-Newton to unravel the relative contribution of AGNs and starbursts to their bolometric luminosity. Their X-ray emission is dominated by the AGN, often hidden behind Compton-Thick material. Their IR luminosity is also explained as an AGN origin, although the IR emission is systematically over-luminous with respect to a standard QSO with these X-ray luminosities.
We have also build the SEDs (from radio to X-rays) of these HLIRGs. Most are well fitted with type 1/2 AGN templates. We have seen that using a luminosity-dependent AGN template, the IR emission is no more over-luminous. The X-ray data in the SED are a severe constrain to an AGN component in the SED fit. These data can also reject some previous models of the emission of HLIRGs.

A 3D map of the AGN distribution and the relation to the zCOSMOS density field

Silverman, J.D.[1]; Brusa, M.[2]; Cappelluti, N.[2]; Comastri, A.[3]; Finoguenov, A.[2]; Gilli, R.[3]; Hasinger, G.[2]; Kovac, K.[1]; Mainieri, V.[4]; Lamareille, F.[5]; Lilly, S.[1]; Zamorani, G.[3]; XMM/COSMOS; zCOSMOS; COSMOS team
[1] *ETH-Zurich;* [2] *MPE;* [3] *INAF-OAbo;* [4] *ESO;* [5] *OMIP*

We trace the three-dimensional distribution of AGN identified by XMM-Newton observations of the COSMOS field up to z$\sim$1. Their relation to the underlying galaxy population is achieved using the zCOSMOS sample of 10k galaxies with spectroscopic redshifts. We present results based on these two inter-related samples to determine (1) the impact of environment on regulating AGN activity, and (2) if a direct relation between AGN accretion and star formation coexist. Our results show clear signs of evolution in terms of gas consumption by both Supermassive Black Holes and star formation.

Long term variability of AGN

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We present results on long term spectral variability of AGN. The main question is: are the variations intrinsic to the central engine of AGN or are they manifestations of changes in the AGN environment (e.g. absorption, reflection). We use all available RXTE data of 12 well studied AGN. We analyze more than 8600 pointed observations that span 10 years of RXTE monitoring. We are particularly interested in variations of the 2-10 keV X-ray photon index. We show that all the objects follow similar pattern on the photon index-accretion rate plane. We compare this AGN behavior to the behavior of Galactic black hole binaries. We also show that there is a correlation between the spectral and temporal variability of AGN. Our study has implications for the short term variability of AGN, and we plan to further explore this subject using XMM-Newton observations.

From radio to gamma-rays: 3C 273 reveals its multi-component structure

Soldi, S.; Tuerler, M.; Paltani, S.; Courvoisier, T.
ISDC

Long-term, multiwavelength studies are of fundamental importance to identify the different emitting components responsible for the broad-band radiation observed in AGN. The radio to gamma-ray observations of the bright quasar 3C 273 over 40 years allow us to study the amplitude and time-scales of the variability across the electromagnetic spectrum and to perform cross-correlations between the emission in different spectral domains. We find evidence that the variability properties of the hard X-rays above 20 keV are distinct from those at lower energies that are probably of Seyfert-like origin. The hard X-rays are most probably not due to electrons accelerated by the jet shock waves as their variability does not correlate with the flaring millimeter emission, but seem to be associated to long-timescale variations in the optical. This optical component is consistent with being optically thin synchrotron radiation from the base of the jet and the hard X-rays would be produced through inverse Compton processes (SSC and/or EC) by the same electron population. We show evidence that the synchrotron component extends from the optical to the near-infrared domain, where it is blended by emission of heated dust that we find to be located within about 1 light-year from the ultra-violet source.

The relic X-ray counterjet in Cygnus A

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We will present a deep (200 ks co-added) Chandra image of Cygnus A. We will focus on the detection of a counterjet, i.e. the jet receding from the observer. This counterjet, which does not follow the current counterjet observed through synchrotron radiation in the radio, is a relic from a previous episode of jet activity. Due to expansion losses, the original electron energy distribution is shifted towards lower ($\sim$ 1000) Lorentz factors. The emission mechanism is inverse-Compton scattering off the cosmic microwave background photons, yielding the observed X-ray emission. We explain the non-detection in X-rays of the relic approaching jet using well-understood light travel time effects, and constrain the timescale between successive episodes of jet activity to be of the order of a million years.

Time resolved X-ray spectroscopy on NGC 4051

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We will present 2, 100 ks, Chandra LETGS spectra of NGC 4051. During the 2nd observation the X-ray luminosity dropped by a factor of 5 and stayed at this low flux level for $\sim$20 ks. We extracted a spectrum for this low flux state and compared it with the preceding higher flux state. A significant change in the temperature of the soft excess modelled by a black body is detected between the high and low flux state. No significant change in the ionisation parameters of the different warm absorber components is detected. A linear change by a factor 5 is excluded for the best constrained warm absorber component. In the low flux state we do detect the radiative recombination continua of C VI and C V, and derive a temperature for the emitting gas. From the emission measure of these features and the minimum distance as determined from the maximum velocity broadening, we also derive an upper limit for the total column density. We will compare the emitting gas characteristics to those from the different absorber components.

Ultimate synchrotron cutoff in gamma-ray spectra of blazars

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There exists a fundamental upper limit on the energy of synchrotron radiation in high energy astrophysics: $\sim m_e c^2/\alpha$ where α=1/137 is the fine structure constant. It is implied that the upper limit refers to the reference frame of the fluid with frozen in magnetic field. This is the maximal energy of synchrotron photons which can be emitted by an electron with an arbitrarily high initial energy after it has been deflected by angle $\sim \pi$ in magnetic field. This upper limit can be naturally reached with the converter mechanism of jet radiation and should be observed by GLAST in spectra of blazars in GeV range. We investigate with numerical simulations the range of parameters of radiating jet where this feature can be observed and reproduce various spectra depending on the source luminosity and emission site. We also check EGRET data for presence of any hint on such feature and find a marginally significant indication.

The cosmic variance of 2XMM sources

Stewart, G.C.; Smith, R.
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The variation of sources detected in 2XMM fields is used to constrain the cosmic variance of X-ray selected sources. Constraints are placed on the bias paramater for these sources and the likely environemnt of active galaxies at z∼1-2

10 year monitoring of quasar 3C273

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The RLQ 3C273 is the closest and best observed member of its target class. We present the results of more than 850 RXTE observations performed between 1996 and 2007. Within the 10 years 3C273 showed count rate changes of more than factor five as well as changes in the spectral slope. The poster presents the first analysis of the long term variability of the "mother of all quasars".

The Space Density of Compton Thick AGN from an ultra-deep INTEGRAL Survey

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Most cosmic accretion onto super-massive black holes is obscured by gas and dust that absorbs all but the hardest X-ray photons. By performing deep observations at very high energies, E>10 keV, it is possible to obtain a complete sample of the AGN population, including the elusive Compton thick sources. In this talk I present the first results from our ultra-deep 3 Msec INTEGRAL survey of the XMM-LSS field, of which we have obtained and analyzed 2.1 Msec to date, detecting roughly a dozen AGN at high significance. Most are previously catalogued Seyfert galaxies and all are local (z<0.1). At most two are Compton thick AGN, significantly fewer than predicted by most models for the X-ray background. This can be explained by the strong degeneracy between the space density of Compton thick AGN and the normalization of the Compton reflection component. I will discuss how we can use hard X-ray surveys in order to break this degeneracy and its implications for an accurate census of the super-massive black holes in the nearby Universe. This work was made possible by support from ESO through the fellowship program and from NASA/INTEGRAL grant NNG05GM79G.

INTEGRAL Spectrum of the Cosmic X-ray Background from Occultation by the Earth

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Early 2006, INTEGRAL performed four observations of the diffuse extragalactic background occulted by the passage of the Earth in its field of view. Churasov et al. (2007) showed that the INTEGRAL measurements are consitent with the historic cosmic X-ray background (CXB) spectrum of HEAO-1 with a normalization about 10% higher. We present here a completely different analysis of the IBIS/ISGRI data with the improved energy calibration of the latest version of the analysis software. Our approach consists in fitting the observed detector lightcurves by the modulation expected from the Earth emission and from its occultation of the CXB, the galactic ridge emission and several point sources. By doing this in several energy bins, we derive a model-independent spectrum of the CXB in the 17-100 keV band, as well as strong constraints on the galactic ridge emission.

On the peculiar properties of the narrow-line quasar PG 1543+489 at z=0.40

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We present the analysis of four XMM-Newton observations of the narrow-line quasar PG 1543+489 at z=0.400 carried out over a time scale of about four years. The X-ray spectrum is characterized by a broad, relativistic iron K_α emission line and a steep photon index, which can be both explained by a ionized reflection model, where the source of X-ray photons is presumably located very close to the black hole. If this were the case, strong light-bending effects are expected, and actually they provide the most plausible explanation for the large equivalent width of the iron line. We also present an alternative explanation of the X-ray spectral properties of PG 1543+489 based on the presence of absorption partially covering the X-ray source.

Non-thermal hard X-ray emission from the radio halo of M87

Walter, R.; Neronov, A.
ISDC

The giant elliptical galaxy M87 hosts a variety of thermal and non-thermal phenomena.We report the first detection of M87 at hard X-rays achieved thanks to the INTEGRAL imager. Combining these data with observations obtained with XMM-Newton allows to constrain the nature of the observed hard X-ray emission. The only plausible site of the observed hard X-ray emission is the large, 10 kpc scale radio halo of M87. The high-energy electrons which produce the radio synchrotron emission in the halo are also emitting in the 20-60 keV band via inverse Compton scattering of the dense stellar radiation field in the cD galaxy.

High energy properties of PKS 1830-211

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We report on an analysis of hard-X-ray and gamma-ray observations of PKS 1830-211, based on the long-term campaigns carried out by INTEGRAL and COMPTEL. The source has 33sigma at 20-100 keV band and 5.2sigma at 1-3 MeV. The hard-X-ray observations show strong flux variability on timescales of months, while the gamma-rays show persistent emission over years. The hard X-ray spectrum is well represented by a power-law shape, with an spectral index of $1.29^{+0.16}_{-0.15}$ at 20-250 keV. The joint XMM/ISGRI spectrum is then fitted with a broken power law model. The results show the spectral index changes from 0.94 $^{+0.04}_{-0.03}$to 1.29 $^{+0.04}_{-0.03}$ at energy around 3.7 keV. At MeV energies, the spectrum softens to an index of $2.23^{+0.36}_{-0.27}$. These results, together with the EGRET measurement at $\geq$ 100 MeV, constitute a most updated broad-band spectrum containing the peak of the power output at MeV energies, similar to most γ-ray blazars.

Chapter 10

Topic 8: Clusters of Galaxies

Galaxy Clusters in the Swift/BAT era

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We report about the detection of 10 clusters of galaxies in the ongoing BAT all-sky survey. This sample was serendipitously detected in the 15–55 keV band. Most of the clusters show signature of past or recent merging events. The BAT sample can be used to investigate and to understand the role of non-thermal mechanisms. The BAT clusters do not show significant high-energy non-thermal emission. Using XMM, Swift/XRT and BAT data, we are able to put limits on the Inverse Compton emission mechanisms which are in disagreement with most of the previously claimed detection of non-thermal components. The coupling of the BAT and radio data allows to constrain the magnetic field in the 0.1 μG range for all the objects, implying that the intracluster medium is far from equipartition. Most of the clusters have hot (> 10 keV) regions which show shocks play an important role in heating the intracluster medium.

The most distant cluster of galaxies ever detected ?

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We investigate here the nature of an extended X-ray source serendipitously discovered by the XMM-Newton Telescope. Its X-ray emission is most likely due to an AGN, while the faint but extended X-ray morphology can be possibly interpreted as ICM. Based on the effective exposure 38 ks XMM-Newton observation, X-ray emission was studied in the 0.3-10 keV energy range. Spectrum shows a clear signature of the FeK$_\alpha$ [6.7 keV in rest frame] line emission, redshifted at the energy of 2.1 keV; i.e. $z \sim 2.15 \pm 0.08$. Unexpectedly, a double-peak FeK$_\alpha$ bump was found, which appears displaced from the maximum of the extended 0.3-10 keV emission. X-ray spectrum was extracted with a radius of 50 arcsec. X-ray spectrum was characterized by a mekal model of temperature kT$\sim$3.3$\pm$1.0 keV. The cluster unabsorbed X-ray flux is F_X[0.75-10 keV] = 2.4×10^{-14} ergs/s/cm^2, compatible with an X-ray luminosity of 6.6×10^{44} erg/s. If the accidental detection of this object is confirmed as a cluster, it would constitute the highest z detection of ICM, with the known impact for cosmology.

The X-ray cluster Abell 3376 and its giant radio structures

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In the current paradigm of large scale structure formation by hierarchical clustering of matter, an important role is played by megaparsec scale cosmic shock waves, arising either in major mergers of galaxy clusters or in gravity-driven supersonic flows of intergalactic matter onto dark matter dominated collapsing structures such as pancakes, filaments and clusters of galaxies. The structures that we have detected at radio wavelengths may be tracing such shock waves. The temperature and metallicity maps obtained from XMM-Newton archive data show that the X-ray gas has a very perturbed structure, revealing that it has undergone several major mergers, which we will attempt to characterize.

The Evolution History of Binary Cluster Abell 3705

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The nearby (z=0.0895), binary cluster of galaxy Abell 3705 is investigated. The cluster is composed of two main parts. A3705-NW has the temperature of 2.16 (+ 0.20/- 0.40) keV and A3705-SE has 2.71 (+ 0.10/- 0.12) keV. We also construct a wavelet map to study temperature variations over ICM. Temperature map also shows the same pattern as SE part of the binary cluster which has higher temperature value. The iso-temperature regions elongates in the same direction with the alignment of the binaries. This temperature structure is interpreted as SE and NW structures do not see each other for the first time. The epoch we observe should be at least their second passage. We try to understand the dynamical structure of this binary cluster by further analyzing the pressure and entropy maps.

A new method of structure analysis in the in Intra Cluster Medium

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Conventional structure detection algorithms in high energy astrophysics generally rely on dividing the spatial population into artificial bins. These methods suffer from identifying the dominant structures (point sources) while failing to detect the subtle structure. The method we present here is one which works on the data globally without introducing any artificial bias or structure. Voronoi Tessellation provides an estimate for the density distribution of photons on the detector. A series of Gaussian surface of varying size are then convolved with the density distribution. A Principal components analysis of the resulting surfaces then describes the data in terms of the differences between the various Gaussians (or any other 2D structure which is selected). This method excels in describing the data in terms of its components, for example cluster mergers that are otherwise undetected using conventional methods are identified clearly for further analysis. The application of a non-parametric method to the density distribution allows a quantitative analysis of the extended nature of the intra-cluster-medium in terms of its principal components, while removing the point sources which dominate the map through the components which describe them.

X-ray and lensing mass estimate of MS2137.3–2353

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We present a new mass reconstruction of the galaxy cluster MS2137.3-23, that takes advantage both of a strong lensing study -that yield a robust mass measurement of the cluster central regions- and of X-ray and weak lensing data, to extend our analysis to larger radii. Our aim is verify whether X-ray and strong lensing mass estimates are significantly different, as claimed for several objects in literature, and to check the consistency of the cluster mass profile with the NFW predictions. We analyse *Chandra* observations to recover the gas temperature and density profiles, through which we can estimate the cluster total mass by assuming spherical symmetry, hydrostatic equilibrium and a dark matter density model. Our X-ray analysis indicates $M_{200} \cong 3.7 \times 10^{14} M_{\odot}$. A parametric analysis of MS2137 strong lensing features allow to recover both the projected mass and the dark matter inner slope, disentangling the central galaxies mass; the extrapolated value of M_{200} is $\cong 3.4 \times 10^{14} M_{\odot}$. Finally, including weak lensing measurements, we will tightly constrain the NFW profile parameters by combining the probability distributions inferred from the cluster 2D (lensing) and 3D (X-ray) reconstructions.

Chemical Discriminators of Cold Fronts in Clusters of Galaxies

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Multiple mechanisms that generate cold fronts in galaxy clusters can be discriminated by the analysis of SN type enrichment of the metals in the intracluster gas. We present here the preliminary results of the analysis of the chemical discontinuities found across the "classic" cold front cluster Abell 3667 with the Chandra and XMM Satellites. Unlike the case for Abell 496 the results for A3667 suggest a discontinuity across the front corroborating the hypothesis of a merger-generated cold front. The variations of SN Type found for different elemental abundance ratios are discussed.

Non-Thermal X-ray Emission From Clusters Of Galaxies As Seen By INTEGRAL

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ISDC

The presence of relativistic electrons in some clusters of galaxies has been established for a long time through the detection of synchrotron emission in the radio domain. However, the inverse-Compton component which is predicted in the hard X-ray domain has been elusive for a long time. The detection of the hard X-ray component is important to measure the typical magnetic field in clusters, to understand the particle acceleration history of clusters, and to constrain the particle acceleration models which lead to the presence of relativistic electrons (primary, secondary electrons). In this presentation, I will present the results of observations of several clusters of galaxies with the IBIS/ISGRI and JEM-X instruments on board INTEGRAL. I will emphasize on the results obtained from observations of the Ophiuchus cluster, which led to the first statistically significant detection of non-thermal emission from a cluster of galaxies, and on the influence of these results on particle acceleration scenarios.

Dynamical history of six clusters of galaxies by XMM-Newton

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Recent studies with high-resolution cameras have extensively showed that clusters of galaxies are not as relaxed as we considered. With its advent technology XMM-Newton allows us to obtain temperature and metal abundance map in detail. In this study, we present our results on six (A194, A1056, A2638, A1674, A1882, A2690) nearby (z<0.14) clusters. These clusters have very poor X-ray atmosphere (ICM), therefore very efficient to study individual galaxies and their evolution within ICM. Based on the temperature maps and morphology of bright member galaxies, we try to understand perturbed galaxy emissions and dynamics of the clusters itself.

The cluster gas mass fraction as a cosmological probe: a revised study

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We present the analysis of the baryonic content of 70 X-ray luminous galaxy clusters observed with Chandra in the redshift range 0.059-1.273. Our study aims at resolving the gas mass fraction in these objects to put constraints on the cosmological parameters $\Omega_{\rm m}$, Ω_λ and the ratio between the pressure and density of the dark energy, w. We deproject the X-ray surface brightness profile to recover the gas mass profile and fit a single thermal component to measure the value of the gas temperature. By using these measured quantities, the gas fraction is evaluated and the fraction in stars is statistically estimated. By assuming that the galaxy clusters are representative of the cosmic baryon budget, the distribution of the cluster baryon fraction in the hottest ($kT_{\rm gas} > 5$keV) systems as function of redshift is used to constrain the cosmological parameters. We discuss how our constraints are affected from several systematics, namely the assumed baryon fraction in stars, the depletion parameter, the sample selection. By using just the cluster baryon fraction as proxy of the cosmological parameters, we obtain that $\Omega_{\rm m}$ is very well constrained at the value of 0.24 with a relative statistical uncertainty of 8% (1 sigma level; $w = -1$) and a further systematic error of about 25%. On the other hand, Ω_λ and w can only be limited in their upper ($\Omega_\lambda < 1.4$) and lower ($w > -2.3$) values, respectively.

X-ray bright galaxy groups with Chandra and XMM: mass, entropy and AGN heating

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We present mass, entropy and metal abundance radial profiles for a sample of 16 relaxed X-ray bright galaxy groups-poor clusters (kT range 1-3 keV, $M_{\rm vir}$ range 10^13 - 2×10^14 solar masses) selected for optimal mass constraints from the Chandra and XMM archives. After accounting for the mass of the hot gas, the resulting mass profiles are described well by a two-component model consisting of dark matter represented by an NFW model, and stars from the central galaxy. The mean gas fraction ($f_{\rm gas} = 0.05 \pm 0.01$) of the groups measured within an over-density of 2500 is lower than for hot, massive cluster with a larger scatter implying a greater impact of feedback processes on groups. This is reflected in the entropy profiles which show striking deviations from self-similarity, large object-to-object variations and characteristic broken-power-law behaviour, unlike more massive clusters. We also present the interesting cases of the cores of two objects in the sample: the relaxed poor cluster AWM 4, which is characterized by a unique combination of properties which defy the newly established paradigm for AGN heating and NGC 5044, which gives us hints about the cooling/heating of the X-ray emitting gas and the production of Hα emission.

A systematic study of the Nickel content in cool-cores

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The aim of our work is to estimate the nickel (Ni) abundance in the central regions of cool-core clusters and to use it to constrain the enrichment history of the ICM around the central galaxy and supernovae models. Starting from the flux-limited sample of Peres et al. (1998), we have analyzed the central regions (i.e. regions with physical radius equal to half the cooling radius) of all the cool-core clusters with available archival EPIC data. This resulted in a sample of 32 objects. Since the 8 keV spectral region, where the main Ni line is located, is subject to subtle systematic effects that can affect the abundance measures, we have made a considerable effort to study and correct all possible sources of errors (e.g. background subtraction effects and effective area differences between EPIC instruments). We show that none of the current SN models available in the literature can correctly account for the observed [Fe/Ni] ratio. Since cool cores are mainly enriched by SN type Ia we suggest that some revision of the theoretical Ni yields are needed.

Distant Galaxy Clusters and their Galaxy Populations

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We present results of our serendipitous XMM archive search for very distant X-ray luminous galaxy clusters for which we have analyzed more than 15 Msec of deep XMM data and identified 200 distant cluster candidates. Here we discuss X-ray characteristics and galaxy population properties of newly discovered z $\gtrsim$1 clusters.

A deep XMM-Newton observation of A496

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We present results from a long, 120 ks, XMM-Newton observation of the core and circum-core regions of Abell 496. We show detailed temperature, surface brightness, metal abundance, entropy and pressure maps. We also provide an in-depth analysis of the cold front, measuring amongst other things the metal abundance across the jump.

Detecting Sound Waves in Cluster Cores

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The "cooling flow problem" — the lack of cool gas in clusters with a central cooling time much less than the Hubble time — has been taken as evidence that some form of heating is needed to balance radiative losses. Mechanical energy injection by the central AGN is seen as one of the most promising sources of heating but, despite several studies showing that the total energy is likely sufficient to stem cooling, there is no consensus on how energy is distributed over whole cool-core region. One possible clue was provided by the detection by Fabian et al. (2003) of "sound waves" around the radio cavities of the Perseus cluster. However comparable features have not been detected in other clusters. We present an analysis of the observation time needed to detect comparable sound waves in other nearby clusters and find such detections are likely beyond the reach of the current generation of X-ray satellites but are easily achievable by future missions such as *Xeus*.

Cluster of galaxies at high redshift: $L_X - T$ relation and cool cores

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About a dozen x-ray selected galaxy clusters show a spectroscopically confirmed redshift above one. The abundance of those high-redshift clusters will be used in future x-ray surveys to constrain the nature of dark energy. For that purpose it is essential to know how the relation between luminosity, temperature and mass evolves with redshift. We analyse these properties for clusters in the XMM Newton Science Archive with emphasis on clusters with $z > 0.8$. We compare the number of luminous clusters to predictions from the *Mare Nostrum Universe* simulation. A few clusters significantly deviate from the mean $L_X - T$ relation, suggesting either a recent merger or a cool core. The simulation shows that merger were much more frequent at $z \sim 1$, however, we confirm for two observed clusters a cool core by the temperature profile, in particular for one of the most luminous high-redshift clusters.

Nature of X-ray sources in the outskirts of clusters of galaxies

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Three nearby (z<0.08) clusters of galaxies (A194, A1060, A2255) have been analyzed for the X-ray point source properties with XMM-Newton data. More than 100 sources are detected from cluster fields by a multi-band detection technique. The source properties are studied by individual spectral fitting and constructing a cumulative log(N)−log(S) for a flux limit of FX $\geq 110^{-14}$erg cm^{-2}s^{-1}. The results are compared with the properties of field galaxies from Lockman-Hole. About 3σ excess of X-ray sources was found from the cluster regions. The optical follow-up sources from A2255 field are further observed by TUG 1.5 m telescope of RTT-150. Considering the luminosity range of the sources in our study (LX >10E40 erg/s) the X-ray emission from accretion processes are taken into account rather than thermal processes of hot halo. Since cluster regions are highly populated with galaxies which are surrounded by high density ICM, clusters are the places with very high probability of galaxy collisions and close encounters. These physical conditions may disturb the equilibrium of individual galaxies with the surrounding gas of fuel and may trigger accretion onto LMXBs, fuel AGNs and awake black-holes. Regarding also the distribution of sources within the clusters, we notice that the brighter sources are likely to reside in the cluster outskirts. Based on our study results, infall induced AGN activities and quenching of point-like emissions by high dense cluster core are discussed.

Baseline expectations for X-ray galaxy cluster scaling relations.

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Using a sample of galaxy clusters spanning 2 decades in mass, extracted from high resolution numerical simulations, we present self-similar X-ray scaling relations and investigate their scatter. The simulations involve gravitational processes only, allowing us to establish baseline expectations and clarify evolution with redshift in the absence of complicated feedback processes. We investigate the M-T and M-Yx relations at redshifts of z=0–1.5 at a range of density contrasts, derived from both fixed density contrasts and from contrasts derived from the top-hat model, and determine how the choice of fiducial radius affects the evolution of and the dispersion around the scaling relations.

The chemical enrichment of clusters of galaxies

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Diffuse gas constitutes the bulk of the baryonic matter in the Universe. The hot gas in clusters of galaxies represents the largest sample available to study the chemical enrichment processes and history of the metallicity. All metals heavier than iron are primarily produced by type Ia or core collapse supernovae, while lighter elements such as C and N are also produced by intermediate mass stars. In this contribution we give an overview of the relative importance of these metal sources as deduced from deep XMM-Newton observations. We present both a few individual cases as well as the results from a larger sample of 20 clusters. We determine the typs Ia / core collapse ratio from the observed abundance patterns. We show how an apparent overabundance of Ca can be explained by adjusted SN Ia models; we present the first detection of trace elements like Cr; and we discuss the production mechanisms of C and N based on RGS observations of the cores of clusters. We also discuss the spatial distribution of different elements and show how we can constrain the enrichment processes using these observations.

Galaxy Merger Scenario for NGC 1550 from Metal Distributions in the Hot Gas

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NGC 1550 is an elliptical galaxy, identified with an extended X-ray source RX J0419+0225. From the *XMM-Newton* data and K-band data of Two Micron All Sky survay, we derive the spatial profiles of components constituting the NGC 1550 system; the gas mass, total mass, metal mass, and galaxy luminosity. The mass (1.6×10^{13} $M_\odot$) is typical of a galaxy group rather than of a single galaxy, and the metals are extended to $\sim$ 210 kpc from the center. The iron-mass-to-light ratio profile (silicon and oxygen as well) exhibits about two orders of magnitude decrease toward the center. Further studies which compare mass densities of metals with those of the other components reveal that the iron and silicon in the ICM traces very well the total gravitating mass, whereas the stellar component is significantly more concentrated around the NGC 1550 nucleus. Thus, in the central region, the amount of metals is significantly depleted for the luminous galaxy light. Among a few possible explanations of this effect, the most likely scenario is that galaxies in this system were initially much more extended than today, and gradually fell to the center and merged into NGC 1550.

Optical / near IR followup imaging of distant X-ray luminous clusters of galaxies

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We perform a large survey searching for distant X-ray luminous clusters of galaxies serendipitously found in archival XMM-Newton observations. We currently have observed 86 fields in R and z using the very red sensitive VLT FORS2 camera to optically verify the candidates and to derive a photometric redshift estimate. Our sample consists of 70 good candidates in a (photometric) redshift range $0.5<z<1.4$. We present the results of the optical/near IR followup observations and compare the constraints from the photometric analysis with those we derive from analyzing the available X-ray spectra.

The 2XMM-SDSS cluster sample

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We have correlated the 2XMMp catalogue of extended X-ray sources with clusters of galaxies in the SDSS. After visual screening of the serendipitous X-ray detections and removing multiple catalogue entries we find 411 extended XMM sources in the SDSS footprint. For 247 of these sources we were able to find cluster counterparts in the SDSS. In 116 cases a spectroscopic redshift is available, for 131 clusters a photometric redshift estimate was obtained. We present the redshift distribution as well as the X-ray and optical properies of this cluster sample.

Distant clusters of galaxies in a deep XMM-Newton field

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We present a catalogue of the extended sources in one of the deepest XMM-Newton fields and their cluster identifications based on deep imaging with the ESO VLT and from the CFHT legacy survey. We discovered a new X-ray luminous cluster of galaxies at $z_{phot} \simeq 1.0$. We also discuss the X-ray properties of the most distant cluster known so far at z=1.45.

Radial Profiles for a large Sample of Hot Intermediate Redshift Galaxy Clusters

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We select a representative sample of hot clusters at intermediate redshift, $0.1 < z < 0.3$, from the XMM-Newton archive and measure their radial properties. The sample is one of the largest considered so far, about 50 objects and includes both cool core and non cool core clusters. A detailed characterization of the background components, a new analysis technique, and extensive montecarlo simulations allow us to control systematics and to correct for errors afflicting many recent measures. We derive surface brightness, temperature, and metallicity profiles and compare them with those obtained from local samples ($z < 0.1$) and from cosmological simulations. Finally, we make combined use of the thermo-dynamic and chemical properties of the objects in our sample to assess the relative role of feedback and gravitational mechanisms in shaping clusters.

Stellar to gas ratio in rich clusters of galaxies

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The baryonic component in galaxy clusters may be divided in two main classes: the diffuse X-ray emitting intracluster gas and the stars, mainly in galaxies. In this work, we have analyzed 5 galaxy clusters using both XMM-Newton and optical SDSS and CFHT data in order to estimate the contribution of stars (in galaxies mainly, but also in the stars responsible for the diffuse intracluster light) to the total baryon mass and how this correlates to the physical properties of the cluster. We find that the stellar-to-gas mass ratio within r_{500}, is anti-correlated with the intra-cluster gas temperature, ranging from 14% to 6% while the temperature varies from 4.0 to 8.3 keV. This suggests that less massive, colder clusters are more prolific star forming environments than massive hot clusters.

The XMM Cluster Survey: First results for cluster scaling relations

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The XMM Cluster Survey (XCS) will exploit the entire XMM-Newton data archive to find clusters. XCS already covers 170 square degrees and has found more than 2000 cluster candidates. Of these, more than 400 have been optically confirmed so far; $z_{\rm max} = 1.45$. A companion presentation will give a general review of XCS methodology and present forecasts for cosmological parameter estimation (Romer et al.). Here we describe the XCS spectroscopy pipeline designed to measure X-ray temperatures and luminosities for a large catalogue in a highly automated fashion. We then present the first results for cluster X-ray scaling relations from an initial XCS sample and discuss their implication. Unlike most previous measurements of scaling relations, XCS will have a well characterised selection function, which will allow much more accurate inferences about the underlying cluster relations to be made from the measurements. To this end we also explore the effects of selection and measurement errors on our ability to measure scaling relations by folding clusters drawn from n-body/hydro simulations through the XCS selection function to infer selection and measurement biases.

Search for the WHIM in XMM-Newton data of nearby superclusters

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According to simulations around 30-40% of the barions in the universe reside in filaments connecting clusters of galaxies in the form of a low density warm-hot gas. We search for the emission from the dense regions of this warm-hot intergalactic medium near clusters of galaxies using a sample of 50 clusters observed with XMM-Newton with a total exposure time of 1.7 Ms. We analyze the X-ray images in two bands of 0.5-2.0 keV and 2.0-7.5 keV. For each cluster we determine the direction to its closest massive neighbour using a supercluster catalogue based on the ROSAT All Sky Survey. We scale the images by the cluster virial radii and stack them in the way that the expected filament connecting the observed cluster with its closest neighbour overlap in all images. In the final image we search for extended emission in the direction of the expected filament. Furthermore, we use the sample to investigate the alignment of the cluster emission with the large scale structure environment of the superclusters.

Gas sloshing behind the formation of radio corehalos and cold fronts in clusters

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We show an interesting correlation between the surface brightness and temperature structure of a number of relaxed clusters, hosting a pair of cold fronts, and their central core–halo radio source. We discuss the possibility that the origin of this diffuse radio emission may be strictly connected with the gas sloshing mechanism suggested to explain the formation of cold fronts in non major merging clusters. We show that the radiative lifetime of the relativistic electrons is much shorter than the timescale on which they can be transported from the central galaxy up to the radius of the outermost cold front. This strongly indicates that the observed diffuse radio emission is likely produced by electrons re–accelerated via some kind of turbulence generated within the cluster volume limited by the cold fronts during the gas sloshing.

Intermediate-Redshift Groups in the XBootes Survey: First Results

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Galaxy groups are key tracers of galaxy evolution, cluster evolution, and structure formation, yet they are difficult to study at even moderate redshift. We have undertaken a project to observe a flux-limited sample of intermediate-redshift ($0.1 < z < 0.5$) group candidates identified by the XBootes Chandra survey. By exploiting the unique multi-wavelength coverage of the XBootes/NOAO Deep Wide Field Survey (NDWFS) field, we aim to (1) understand the physical connection between the X-ray and optical properties of groups, and (2) constrain non-gravitational physics that alter the energetics of the intragroup medium. Here we present deep Suzaku/XIS and Chandra/ACIS follow-up observations of the first five targets in this project, spanning a redshift range of 0.19 to 0.34. All five are confirmed sources of diffuse, thermal emission with derived temperatures between 0.7 and 2.5 keV, abundances between 0.3 and 0.7 solar, and bolometric X-ray luminosities between 10^{43} and 10^{44} erg/s. The properties of these massive groups/poor clusters are consistent with observed cluster scaling relations. We will discuss these early results in the context of group and cluster evolution.

Non-thermal emission from clusters: results from Perseus and future prospects

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In the first part of this presentation I report results form a detailed analysis of a long XMM-Newton observation of the Perseus core: my main goal is the investigation of the non-thermal emission detected with Chandra. The second part of the presentation is devoted to a critical assesment of the prospects of non-thermal emission studies with future X-ray missions such as NuSTAR, Simbol-X, NeXT and XEUS.

Mapping the non-thermal component in Coma cluster

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We used all available XMM-Newton EPIC data on Coma cluster of galaxies in order to map the FeXXV/FeXXVI emission line ratio and thus the electron temperature structure in the cluster. We used this temperature diagnostics to separate the non-thermal emission component and we constrained the properties of the relativistic electrons. Combined with the radio observations, we derived the distribution of the magnetic field strength in Coma.

Properties of the intracluster medium in the REXCESS sample

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Using 31 clusters from the Representative XMM-Newton Cluster Structure Survey (REXCESS), we investigate the properties of the intracluster medium of a morphologically unbiased nearby galaxy cluster sample. Specifically, we examine the structural characteristics of the gas density profiles and the scaling properties of the gas mass, luminosity and Y_X over a decade in mass, using the representative nature of the sample to explore trends with dynamical state and the presence or absence of a cool core. Our results suggest that the internal structure of clusters becomes increasingly similar at large radii, irrespective of dynamical state, and that systematic variation of total gas content with mass appear to be the chief driver of the observed scaling relation behaviour.

Chandra and XMM-Newton Observations of Local Galaxy Groups and Clusters

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We show new results from the Chandra and XMM-Newton follow-up of a complete sample of the 64 X-ray brightest galaxy clusters in the sky (HIFLUGCS) as well as from the Chandra follow-up of an X-ray selected sample of 27 galaxy groups. Results include temperature and surface brightness/density profiles, scaling relations (L-T, M-T, L-M, Yx-M, fgas-T), and cooling core/radio properties.

The XMM Cluster Survey: Project summary and Cosmology Forecasts

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The XMM Cluster Survey (XCS) will exploit the entire XMM-Newton data archive to find clusters. XCS already covers 170 square degrees and has found more than 2000 cluster candidates. Of these, more than 400 have been optically confirmed so far; ($z_{\rm max} = 1.45$). A companion presentation will present preliminary XCS results on X-ray scaling relations (Lloyd Davies et al.). Here, we describe the mechanics of the survey, i.e. the X-ray reduction and source classification pipelines and our approach to optical follow-up. We will then present the survey selection function, constructed by placing synthetic clusters (including clusters taken from large n-body/hydro simulations) into real XMM observations. Next, by combining the selection function with state of the art forecasting techniques, we will show that XCS will deliver competitive, independent, constraints on cosmological parameters such as Ω-Matter and σ-8. Finally, we discuss the benefit of carrying out follow-up observations of XCS clusters using either XMM and/or XEUS. We will also comment on the potential added value of a large area contiguous cluster survey using XMM.

Cool Core vs Non Cool Core Objects with XMM-Newton

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Galaxy clusters are usually divided into two classes ("cool core" and "non cool core" objects) according to the surface brightness, temperature, cooling time and entropy profiles in their central regions. The origin of this dichotomy is still unclear.
The XMM-Newton public archive now allows to perform detailed high quality measurements of large representative samples, which can address this issue. We present surface brightness, temperature, cooling time, entropy, metal abundance profiles and thermodynamic maps of a nearly complete sample of 43 nearby galaxy clusters . Clusters in our sample show a variety of behaviors, which suggests that the observed bimodal distribution does not arise from a "primordial" dichotomy but is most likely due to a mechanism, such as mergers, that can produce substantial modifications to the thermodynamic and chemical structure of galaxy clusters.

A Direct Spectral Deprojection Method

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Deprojected temperature, density and abundance profiles of the hot ICM are important tools for studying the complex interactions of gravitational and feedback processes in the cores of galaxy clusters. Analysis of X-ray data has shown that methods such as projct can produce large and unphysical oscillating temperature profiles. Here we present and validate a new deprojection routine, Direct Spectral Deprojection (DSDeproj; Sanders & Fabian 2007), showing that it solves some of the issues inherent to projct. This is a model independent approach, assuming only spherical symmetry, which subtracts projected spectra from each successive annulus to produce a set of deprojected spectra.

RGS observations of cool X-ray emitting gas in cluster cores

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The temperature distribution of the intracluster medium in the cores of galaxy clusters can tell us a great deal about the feedback processes operating there. We present the results of a series of deep XMM-Newton RGS observations examining bright nearby clusters where individual emission lines can be spatially resolved. These include the Centaurus cluster, where we clearly detected Fe XVII emission. In this cluster the temperature decreases by more than a factor of ten to the core from the outskirts. The mean radiative cooling time of the coolest X-ray emitting gas is only around 10 million years.

Hard X-ray Emission and IC in Coma and Abell 3667 from Suzaku and XMM-Newton

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The X-ray bright, nearby galaxy clusters Coma and Abell 3667 host the brightest radio halo (Coma) and radio relic (A3667) known. These diffuse, Mpc-scale structures are due to synchrotron emission from relativistic electrons, which also produce hard X-ray inverse Compton (IC) emission. The high sensitivity and narrow FOV of the Suzaku PIN Hard X-ray Detector makes it an ideal instrument to search for IC. We present 180 ks and 95 ks Suzaku observations of the Coma and A3667 clusters, respectively, as well as mosaic XMM-Newton observations of the clusters. The XMM-Newton mosaics allow us to directly determine the thermal emission within the HXD-PIN FOV. While marginal nonthermal components are detected in both clusters, they are not robust to variations of the HXD-PIN background within the systematic error. We derive conservative upper limits for the nonthermal flux and corresponding lower limits for the average cluster magnetic field strength of both Coma and A3667. For A3667, the lower limit on the magnetic field is rather high given the large projected cluster radius of the relic. This suggests a substantial nonthermal contribution to the pressure in this region. Thermal X-ray emission is detected out to nearly the virial radius in A3667.

Metallicity in ICM of clusters and groups of galaxies observed with Suzaku

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We studied the properties of the intra-cluster medium (ICM) in clusters and groups with Suzaku. Based on spatially resolved energy spectra, we measured for the first time precise cumulative ICM metal masses and distributions for various elements, such as O, Ne, Mg, Si, S, Fe, to ~ 0.3 r_180. Because of the good XIS sensitivity to emission lines, especially below 1 keV, we directly measured O and Mg line intensities and obtained abundances. Observed spatial metal distribution supports the view that Fe and Si are produced by Type Ia supernovae (SNe Ia) with major contributions from the central galaxies, while galactic winds caused by Type II supernovae (SNe II) have caused wider distributions of Mg and O. Comparing our results with supernova nucleosynthesis models, the number ratio of SNe II to SNe Ia is estimated to be ~ 3.5, assuming the metal mass in the ICM is represented by the sum of products synthesized in SNe Ia and SNe II. We also calculated the Fe, O and Mg mass-to-light ratios (IMLR, OMLR, MMLR) with B-band and K-band for the ICM of the clusters and groups, and compared the values for the systems. We measured OMLR and MMLR to the outer region in the ICM for the first time with Suzaku, while IMLR were consistent with those with ASCA. Lager and richer systems have higher value of IMLR, OMLR, and MMLR with B-band, while those with K-band look similar.

AGN-driven shocks and metal transport in nearby cooling core clusters

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We present an in-depth investigation of the complex AGN-driven phenomena in cooling cluster cores. Using deep XMM-Newton exposures, we created temperature, pressure and entropy maps of nearby clusters showing some of the most spectacular signs of AGN-ICM interaction. We focus on M87 in the Virgo cluster and on Hydra A where we find the first two known classical AGN-driven shocks with spectroscopically confirmed temperature and pressure jumps corresponding to consistent Mach numbers. We ran 1D hydrodynamic simulations of the large-scale shock in Hydra A to estimate its Mach number and energy. We also present 3D simulations which show that a bulk flow of the ICM is needed to reproduce the observed shock front shape. Cool, metal-rich filaments associated with the radio lobes suggest moreover the crucial role of the AGN in uplifting the chemical elements produced by the central galaxy and transporting them into the ICM in both clusters. In the case of M87, we were able to determine the mass and metallicity of the gas uplifted by the AGN and show that this gas probably originates from the central parts of the X-ray halo, and was enriched by stellar mass loss and supernova products over 30-100 Myr.

Detection possibility of galaxy cluster merger in maximum core collapse

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Clusters of galaxies have been used for a long time as Cosmological tools. The hyd. Eq. is always a prerequisite for extracting the parameters of the so-called "Scaling Laws". But it is also known that clusters are still being formed and that the relaxation time scale could be longer than the interval between collisions. In this context, we present a precise study of "X-ray observed" hydro-NBody simulations of collapsing clusters around the maximum core collapse phase. From simulation data we obtained a "mock" XMM-observation data and we studied the cluster parameters and morphology and their possibility of detection for cluster merger around the maximum core collapse.

The X-ray-SZE cluster survey: Survey design and first results

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Detection and analysis of clusters of galaxies via the Sunyaev-Zel'dovich effect holds large potential to provide powerful tests of cosmological models and to study the nature of Dark Energy. In order to utilize this potential, it is necessary to have a deep understanding of the SZ selection function and calibration. To this end the three major SZ experiments, SPT, APEX and ACT, will focus their initial efforts into a common test region. The aim of the X-ray-SZE cluster survey is to observe a 6 $\deg^2$ field within the SZ test region with XMM Newton and thus allow for first calibration and provide X-ray physical parameters of the detected clusters for the SZ observations. We present the characterization of the survey and first results. The survey consists of 42 partially overlapping pointings with 10 ks exposures. The initial data reduction and cluster detection was carried out on the 41 currently available observations. We have detected $\sim$ 130 cluster candidates. The first cluster catalogue is going to be constructed during this year with expected $>\sim$ 50 clusters up to redshift $\sim$ 1.

Distribution of Real X-ray Clusters in the Universe and Model Clusters in Simulations

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We present the investigation of large-scale distribution of galaxy clusters from several X-ray catalogs. Our X-ray volume-limited (VL) cluster sample (which is all sky and complete for X-luminosities Lx>2.5 10^{43} (using H=100 Mpc/km/s) up to redshift z=0.09) is extracted from the recent compilation (Kopylov,2007). Different statistics of clustering like conditional correlation functon (CCF) and cluster analysis (minimal spanning tree (MST)), which supplement each other, as well as void statistics cumulative and differential void functions(VF)) were used. Clusters shows 3 distinct regimes of clustering: 1) on scales of superclusters that is represented as a power law density decline with distance up to scale of 35-40Mpc; 2) on larger scales a gradual transition to homogeneity is observed; 3) CCF from 100Mpc goes like plato - density does not decline with increasing of sphere radius. Fluctuations on scales > 100Mpc exist but here we have certain value of mean density of clusters (it is not defined on smaller scales). MST and void analysis give us a clue to outline the "skeleton" of structures represented by clusters and evidences for difference of cluster properties in different environments. We made a comparison of density contrasts of inhomogeneities in cluster and galaxy distributions in the SDSS region. We claim that a value of density contrast should be taken into account to reconcile the observed gradual transition to statistical homogeneity with the apparent presence of structures on corresponding scales and that observable bias is in accordance with theoretical prediction. Distribution of real clusters is compared to that of simulated (model) clusters (the MareNostrum Universe simulation, Gottlober et al., 2006) for WMAP3 cosmological parameters with a higher normalization of the initial power spectrum ($\sigma_8 = 0.8$). Application of different complementary statistics to samples of real and model clusters, chosen in a way to fit observed number density of VL real X-ray cluster sample, show general agreement in distribution of most massive virialised objects in the observable Universe and in cosmological simulations. Most exiting is that we've found the same scale (from 100Mpc) of statistical homogeneity (in a sense that we have well-defined mean density of objects on such scales) for real and model clusters found by CCF (note that this scale can be related to the comoving scale of largest wavelength of baryonic oscillation of photon-barionic plasma before recombination) if we take into account that homogeneity is imprinted in simulations. Very interesting is the coincidence of second (transitional) clustering regime (beyond characteristic scale of superclusters) shown by real and model CCF on scales 40-100Mpc. Shapley concentration strongly affects the value of CCF slope of real clusters on small scales and it is responsible for differences in distribution characteristics of real and model clusters: we see a luck of close massive cluster pairs in simulations. Larger simulation box is needed to find out such outstanding structures (like Shapley) in simulations. MST analysis show that real clusters are slightly more structured than model ones. Real and model VF fit each other quite good. On the whole, distribution of most massive model ΛCDM clusters of dark matter by the number of characteristics show reasonable agreement with distribution of most massive real X-ray clusters of galaxies.

Evolution in the thermodynamics and chemical properties of the ICM

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The capability of studying the chemical and thermodynamical properties of the ICM in high redshift clusters is an efficient tool to constrain the interaction processes between the cluster galaxies and the surrounding medium. We confirm that the ICM is already significantly enriched at a look-back time of 9 Gyr, and find that the Iron abundance change with redshift as $(1+z)^{-1.2}$, implying an increase of a factor of 2 with respect to z=1.3. This result can be explained by a prompt enrichment by star formation processes in massive ellipticals at z>2, followed by a slower release of enriched gas from disk galaxies into the ICM, associated to a morphological transition from disk to S0. We also discuss enrichment processes in relation to the formation and evolution of cool cores.

Observations of a z = 0.9 cluster of galaxies

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We carried out follow up observations of a cluster first discovered in X-rays with ROSAT. Follow up with Chandra XMM showed the ROSAT source flux was contaminated by 3 AGNs but never-the-less there is a detectable flux of X-rays in the XMM data. The XMM observation was badly contaminated by radiation such that the X-ray results in this abstract should be considered preliminary. The main interesting point from the X-ray data is that the cluster falls well off of the luminosity-temperature relationship curve for high redshift clusters. The cluster is much cooler (about 1.45 keV, $L_x \sim 2 \times 10^{44}$ ergs/sec) for its luminosity than previously cataloged X-ray detected clusters. This is consistent with the X-ray image that indicates the cluster is in the process of coalesce. The Spitzer and ground based data indicate there are several red but very young, dust filled galaxies in the cluster. The presence of red, dusty galaxies is also consistent with the cluster just being in the process of formation. Our work suggests that the epoch of X-ray "turn on" for at least some clusters is near z = 0.9. This is of interest both for cluster and galaxy evolution models as well as for cosmology related cluster surveys. Up-to-date results will be presented.

Abell S1136: A first look in X-rays

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We present a chance observation of the cluster of galaxies Abell S1136. This nearby cluster (red shift z = 0.05) was in the field of view of a gamma ray burst (GRB071028B) which was observed with the SWIFT satellite. This satellite uses three wavelengths for the observation of gamma ray bursts: gamma rays, X-rays and UV. We present the data from the X-ray camera (XRT) aboard this satellite,which is the first X-ray observation of this cluster. We are able to extract an image and also spectra from the data set. With the spectrum we calculate the metallicity and temperature of the whole cluster. A first look at the image shows a spherically cluster without any obviously seen structure. With the help of convolution combined with a prinicipal component analysis, we study the image in more detail. We here find that the cluster shows some substructure. This can be seen as a sign for recent or ongoing merger.

First detection of hot gas in filament connecting clusters of galaxies with XMM

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About half of the baryons in the local Universe are invisible and according to simulations their dominant fraction resides in filaments connecting clusters of galaxies in the form of low density gas with temperatures in the range of $10^5 < T < 10^7$ K. The existence of this warm-hot intergalactic medium was never unambiguously proven observationally in X-rays. We probe the low gas densities in the cosmic web by observing a filament connecting the massive clusters of galaxies A 222 and A 223 ($z = 0.21$), which has a favorable orientation along our line of sight. We present here observational evidence of the X-ray emission from the filament connecting the two clusters using a deep observation (144 ks) with XMM-Newton. We detect the filament in the wavelet decomposed soft band (0.5–2.0 keV) X-ray image with a 5σ significance. Following the emission down to 3σ significance, the observed filament is 1.2 Mpc wide. The temperature of the gas associated with the filament determined from the spectra is $kT = 0.91$ keV and its emission measure corresponds to a baryon density of $3.4 \times 10^{-5}(l/15\ \mathrm{Mpc})^{-1/2}\ \mathrm{cm}^{-3}$, where l is the length of the filament along the line of sight. This density corresponds to a baryon over-density of $\rho/\langle\rho_\mathrm{C}\rangle \approx 150$. The properties of the gas in the filament are consistent with the results of simulations for the densest and hottest parts of the warm-hot intergalactic medium.

Scaling Relations of Galaxy Clusters: X-ray and Lensing vs. Simulations

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The Local Cluster Substructure Survey (LoCuSS, Smith et al.) is a systematic multi-wavelength survey of more than 100 X-ray luminous galaxy clusters in the redshift range 0.14-0.3 selected from the ROSAT all sky survey. We used data on 37 LoCuSS clusters from the XMM-Newton archive. The scaling relations based solely on the X-ray data obey empirical self-similarity. The mean of the X-ray based mass to weak lensing mass ratio of these clusters is 1 with 31-51% scatter. The normalization of the M-Y_X relation using X-ray mass estimates is lower than the one from simulations by up to 18-24 per cent at 3 σ significance. This is in good agreement with the M-Y_X relation based on weak lensing masses, the normalization being 20 per cent lower than the one from simulations at 2 σ significance. The average of the X-ray based mass to weak lensing mass ratio is 1.09+/-0.08, setting the limit of the non-thermal pressure support to 9+/-8%. The XMM-Newton data of the flux-limited sample of more than 60 nearby clusters, HIFLUGCS, allow us to make a detailed investigation on the systematics of the cluster masses.

Chapter 11

Topic 9: Extragalactic Surveys and Population Studies, the Cosmic X-ray Background, WHIM and Cosmology

The Cosmic X-ray Background Spectrum with Swift/BAT

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We use the Swift/BAT instrument to derive an accurate measurement of the Cosmic X-ray Background (CXB) and of the Earth's albedo spectra in the 15-150 keV energy band. Our measurement takes advantage of several episodes of occultation of the BAT field of view caused by the Earth. The modulation of the CXB signal caused by the Earth passages can be used to measure the CXB spectrum. We use a limb-brightening rigidity-dependent Earth emission model to deconvolve the CXB and the albedo spectra without any assumption on their spectra. The main result is that both spectra are the most accurate measurements in this energy range. The BAT CXB spectrum confirms with great accuracy the HEAO-1 measurement, thus posing tight constraints on the space density of local Compton-thick AGN. The BAT albedo spectrum is the only high-significance measurement at these energies and it can be used by future mission to predict the level of the orbital photon background. Both spectra will be discussed in comparison with previous measurements. We will also discuss the most recent results from the BAT survey which are related to the generation and understanding of the CXB emission.

Constraints on decaying Dark Matter from XMM-Newton observations of M31

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We derive constraints on parameters of the radiatively decaying Dark Matter (DM) particles, using XMM-Newton EPIC spectra of the Andromeda galaxy (M31). Using the observations of the outer (5'-13') parts of M31 we improve the existing constraints. For the case of sterile neutrino DM, combining our constraints with the latest computation of abundances of sterile neutrino in the Dodelson-Widrow (DW) scenario, we obtain the lower mass limit $m_s < 4$ keV, which is stronger than the previous one $m_s < 6$ kev, obtained recently by Asaka et al. (2007) [hep-ph/0612182]. Comparing this limit with the most recent results on Lyman-alpha forest analysis of Viel et al. (2007) [arXiv:0709.0131] ($m_s > 5.6$ kev), we argue that the scenario in which all the DM is produced via DW mechanism is ruled out. We discuss however other production mechanisms and note that the sterile neutrino remains a viable candidate of Dark Matter, either warm or cold.

Optical identification of XMM-Newton detected sources in the Lockman Hole

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In surveys with low X-ray flux limits, low activity AGN and star forming galaxies begin to contitute a substantial fraction of the X-ray sources. These sources have a high optical to X-ray flux ratio and have not yet been studied in detail. We present the results of spectroscopic optical follow-up survey of faint X-ray sources detected with XMM-Newton. The spectroscopy of these R ¡ 22 mag sources has been obtained with the Low Resolution Resolution Spectrograph on the Hobby Eberly Telescope, Texas. This Survey allows us to determine redshifts as well as classify these sources. This work is important for the calibration of the photometric redshifts from a deep photometric survey of the Lockman hole that we are obtaining with the Large Binocular Telescope, Arizona. These results flow into the detailed catalogue of the inner 20 arcmin of Lockman Hole in order to improve the completeness of the sample.

Optical and X-ray colours of the X-ray sky at medium fluxes

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IFCA

X-ray sources at intermediate fluxes (1e-14 cgs) are responsible for a significant fraction of the X-ray background below 10keV. The XMM-Newton Survey (XMS) provides an unbiased and quantitative description of the X-ray source population at these fluxes in various energy bands. The XMS includes 319 sources in four overlapping samples in the soft (0.5-2keV), hard (2-10keV), XID (0.5-4.5keV) and ultra-hard (4.5-7.5keV) bands, identified spectroscopically to 85-95%.

We have studied the X-ray spectra, and the optical and IR colours of the XMS sources, to quantify the fraction of X-ray absorbed versus optically obscured objects, finding a small but significant number of mismatches between both classifications, including a number of "red QSOs". We have performed a clustering analysis in a multidimensional space including the optical colours, the X-ray-to-optical flux ratio, the amount of X-ray absorption from the X-ray spectra, and the optical extension of the sources, finding that different populations tend to occupy different regions of this space, but again with significant cross-contaminations.

Multiwavelength properties of Chandra-COSMOS X-ray Sources

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The Chandra-COSMOS survey is a recently completed 1.8 Ms Chandra program to image the center of the COSMOS field to a depth of 2×10^{-16} cgs (0.5-7 keV). The rich pre-existing multiwavelength data allows instant identification of over 85% of the Chandra sources in the optical, near-IR and IRAC identifications of the ∼1600 C-COSMOS X-ray sources above 5×10^{-16} cgs (0.5-7 keV). The SEDs of these sources can be rapidly determined by fully exploiting the unique COSMOS multiwavelength dataset (including HST, Spitzer, multiband optical and near-IR photometry, and deep IMACS and VLT optical spectroscopy). I will focus on a few examples of the most interesting classes of objects: obscured AGN, close pairs, and off- nuclear sources.

The physical and cosmological properties of AGN in the XMM Hard Bright Survey

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In the past years, we have built up a complete and representative sample of bright serendipitous XMM-Newton sources selected at high galactic latitude (>20deg), the XMM-NEWTON BRIGHT SERENDIPITOUS SURVEY (XBS). The XBS Survey consists of two flux-limited (> 7E-14 cgs) samples selected in the 0.5-4.5 keV (XMM-BSS, 389 sources; spectroscopic ID rate=87%) and 4.5-7.5 keV (XMM-HBS, 67 sources; spectroscopic ID rate=97%) energy bands. We discuss here the physical and cosmological properties of the AGN in the HBSS sample (which is now almost completely identified) and compare our results both with the unification schemes of AGN and with the predictions of the synthesis models of the X-ray background based on the combination of absorbed and unabsorbed AGN.

Cosmic evolution of AGN in several X-ray bands

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The X-ray luminosity function (XLF) is a key tool to understand the evolution of AGN and the variation in the accretion rate of matter onto the supermassive black hole accross cosmic time.

We have studied the comoving density of sources per unit luminosity in three X-ray bands: 0.5-2 keV, 2-10 keV and 4.5-7.5 keV, combining the XMS survey (a large and complete medium sensitivity survey) with other shallower (RBS, AMSS) and deeper (CDF) surveys, covering redshifts from ~ 0 to ~ 3. The XMS sample covers over 3 sq. degrees in the sky at medium fluxes, and its instrumental in mapping the history of cosmic accretion as the bulk of the cosmic X-ray background is emmitted at these fluxes.

We have found that the AGN detected in the 0.5-2 keV and 2-10 keV bands present evolution, showing a maximum in their comoving density at redshifts around ~ 1. Similarly, there are strong evidences of evolution in the AGN detected at very hard X-rays (4.5-7.5 keV), whose XLF has been modeled along with their intrinsic absorption (N_h function). The main conclusion is that the evolution of the X-ray luminosity along cosmic time is no way caused by changes in the absorption environment, but in intrinsic variation in the mass/accretion rate.

The Chandra survey of the COSMOS field

Fiore, F. on behalf of the Chandra-COSMOS team
INAF-OAR

COSMOS is a pan-chromatic survey of the extragalactic sky designed to be both large and deep enough to study galaxy and quasar evolution in typical environments with minimal 'cosmic bias'. The Chandra 1.8 Msec survey of the central 1 deg^2 of the COSMOS field joined in 2007 deep HST, Spitzer, GALEX, XMM, VLA, Subaru, CTIO, KPNO, CFHT, Magellan, VLT and LBT coverages. We present highlights from the Chandra survey, including: the catalog of 2000 point sources; the Chandra discovery or confirmation of large populations of elusive AGN like infrared bright, Compton thick AGN at z=0.7-2, high-z AGN, and low luminosity AGN; and the effect of the environment and of galaxy interactions on nuclear activity.

Compton thick AGN in the Chandra Deep Field North

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X-ray background population synthesis models predict a large number of Compton-thick objects at faint X-ray fluxes.We detect Compton-thick AGN sources in the Chandra Deep Field North using X-ray spectra, either directly finding sources with high column densities at high-z or indirectly finding flat spectrum sources at lower redshifts. In addition, we detect candidate Compton thick AGN, below the flux limit of the X-ray observations, using Spitzer mid-IR selection techniques. We show that samples of AGN candidates compiled on the basis of the mid-IR colours suffer from substantial contamination from galaxies. In contrast AGN selection methods that combine mid-IR with optical criteria are more successful in detecting obscured AGN (high 24 micron to R flux ratio, and red R-[3.6]micron colours). About 75% of these sources are not detected at X-ray wavelengths but X-ray stacking analysis reveals a flat mean spectrum ($\Gamma \sim 1.1$). The mid-IR colours and luminosities are consistent with ULIRGs at z$\approx$ 2 while HST/ACS images available for the optically brighter sources show disturbed optical morphologies.

Optical Counterparts of High-Energy Sources by ESA Gaia

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The ESA satellite in development Gaia to be launched in 2011 will focus on highly precise astrometry of stars and all objects down to limiting magnitude 20. Albeit focusing on astrometry related matters, the satellite will also provide photometric and spectral information and hence important inputs for various branches of astrophysics.

Within the Gaia Variability UnitCU7 and related work package Specific Object Studies there has been a sub-work package accepted for optical counterparts to celestial high-energy sources (including various categories of X-ray sources). Although the sampling of photometric data will not be optimal for this type of work, the strength of Gaia in such analyses is the fine spectral resolution (spectro-photometry) which will support the correct classification of many of high-energy sources. The possibilities to detect and to analyze optical counterparts of high-energy sources by Gaia will be presented and discussed.

Extended Chandra Multi-wavelength Project (ChaMPx)

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We present new results of the Extended Chandra Multi-wavelength Project (ChaMPx). In addition to our original ChaMP sample where we only used Chandra AO1-2 archival data, we extend to Chandra AO3-6 observations if they are also covered by the SDSS optical survey. We cross-correlated Chandra X-ray and SDSS optical sources and visually inspected both X-ray and optical images for each match. Our catalog consists of $\sim$ 16000 X-ray sources of which $\sim$ 6000 sources have SDSS optical counterparts. We developed sky coverage maps which provide limiting fluxes at every sky location covered in our X-ray dataset. We summarize recent results from ChaMP/SDSS samples of *sim*350 stars, $\sim$ 150 normal galaxies and $\sim$1000 QSOs serendipitously detected by Chandra.

X-ray absorption in distant type II QSOs

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We present the results of the X-ray spectral analysis of an XMM-Newton-selected type II QSO sample. We inspected 51 spectroscopically classified type II QSO candidates from the XMM-Newton Marano field survey, the XMM-Newton-2dF wide angle survey (XWAS), and the AXIS survey to set-up a well-defined sample with secure optical type II identifications. We classified 14 type II QSOs ($L_X > 10^4$4erg/sec) and analysed their X-ray spectra. We find only moderate absorption ($N_H = 2 - 10 \times 10^{22} cm^{-2}$) and no obvious trends with redshift and intrinsic X-ray luminosity. Two type II objects with no X-ray absorption were discovered. The stacked X-ray spectrum of our 14 type II QSOs shows no iron K-alpha line. On the other hand, the spectral stack of 8 less luminousous type II AGN reveals a very prominent iron K-alpha line at an energy of 6.6 keV and an EW $\sim$ 2 keV.

X-ray selected Type-2 QSOs: high luminosity in heavily obscured AGN

Mainieri, V.
ESO

Although the fraction of obscured AGN is found to decrease with luminosity from several studies, a non-negligible population of obscured QSOs is still required by the X-ray background synthesis models. We present a large sample (50 objects) of X-ray selected Type-2 QSOs from the XMM-COSMOS survey (2 sq. degs). The selection criteria are based on high X-ray luminosity (L_x>10^{44} erg s^{-1}) and heavy obscuration (NH>10^{22} cm^{-2}). These two physical quantities have been derived from a detailed X-ray spectral analysis of the 1800 X-ray point-like sources in this survey. Few (5%) of the Type-2 QSOs are best fitted with a pure reflection model, typical of Compton-thick sources. Around 10% of the Type-2 QSOs are radio loud, comparable to the AGN population as a whole. We have performed optical spectroscopy for half of the sample and for the remaining sources we have derived accurate photometric redshifts. The redshift range covered is wide, 0.5<z<3.0. We compare our X-ray selected sample with Type-2 QSOs selected from the optical (SDSS) and mid-IR and discuss different selection biases in order to derive a census of Type-2 QSOs. Using a morphological classification of the host galaxies based on five non-parametric diagnostics (asymmetry, concentration, Gini coefficient, M20, ellipticity) we found that half of the Type-2 QSOs are in elliptical galaxies while the other half has clear disk component. We will further compare the stellar masses and SFR distributions of these host galaxies with a comparison sample of non-active galaxies. We have studied their SED properties (radio to X-ray) and the majority of Type-2 QSOs are well reproduced by a composite SED of local Seyfert-2 galaxies.

High precision X-ray logN-logS distributions: implications for obscured AGN

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Source count distributions provide a rather direct method of investigating the cosmological and statistical properties of AGN. We present the main results of a study of the extragalactic source count distributions over a broad range of X-ray fluxes and in different energy bands. We selected 1129 XMM-*Newton* observations at $|b| > 20^{\circ}$ covering a total sky area of 132.3 deg^2 to compile the largest samples of X-ray selected objects to date in the 0.5-1 keV, 1-2 keV, 2-4.5 keV, 4.5-10 keV, 0.5-2 keV and 2-10 keV energy bands. Our survey spans more than 3 decades in flux (from $\sim 10^{-15} - 10^{-12}$ erg cm^{-2} s^{-1}) below ∼2 keV and more than 2 decades in flux (from $\sim 10^{-14} - 10^{-12}$ erg cm^{-2} s^{-1}) above 2 keV and includes in excess of 30,000 source detections. We investigate the dependence of the shape of the source counts on the energy band and the impact that non-AGN populations (mainly stars and clusters of galaxies) have on the observed shape of the source count distributions. Finally we have studied whether the synthesis models of the X-ray background are able to reproduce the new observational constrains provided by our analysis.

The Foreground to the Hot Universe

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We present the results of the analysis of the very deep RGS spectrum (1 Msec) of the blazar Mrk 421 obtained in 7 years of the operation of XMM-Newton. The superior photon statistics of this dataset allows us to study the weak absorption lines from the local hot absorbing medium. The origin of this absorbing gas is debated: it might be associated with the Galactic halo, with the Local Group, or it might have a multiphase nature being associated with several components. We clearly detect absorption from CVI, two OVII absorption lines, and we see a weak OVIII absorption feature. We find upper limits on the strongest n=2-3 transitions of Fe IX-XVII, putting joint constraints on the temperature and on the Fe/O abundance ratio in the absorbing gas. Furthermore, for the first time we detect 3 separate absorption lines (OI, OII, and NI) from the cold interstellar medium.

Swift-XRT measurement of the 1-7 keV cosmic X-ray background spectrum

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We present a new measurement of the Cosmic X-ray background (CXRB) spectrum in the 1-7 keV energy band, obtained by the exploitation of the archive of the X-ray telescope (XRT) on board the Swift satellite. The normalization of the CXRB is one of the most important open issues in the high-energy observational astrophysics. In fact, most of the measurements performed by imaging instruments, in the 1-10 keV band, although with the same slope, found a normalization significantly higher than the one measured by HEAO-1 and recently confirmed by the analysis of the SAX-PDS data archive. Following-up gamma ray burst afterglows, the Swift-XRT is providing us with a unprecedented serendipitous survey, deeply sampling the X-ray sky in randomly distributed positions. We will show the results of the cosmic variance study, together with the stacked analysis, performed on a survey of 140 different deep observations for a total sky-coverage of 15 square degrees. Our measurement is based on a full characterization of the different components of the XRT non cosmic background (instrumental, particle, stray-light) which is, at least, one order of magnitude lower than any previous X-ray telescope.

Deep XMM-Newton/ESO observations of the low-latitude area around 1E1207.4-5209

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The radio quiet neutron star 1E1207.4-5209 has been the target of several XMM-Newton observations, for a total of 350 ks. It is at low galactic latitude ($b \sim 10°$), in a sky region with an extremely interesting mix of both galactic and extragalactic sources. Therefore the analysis of the available EPIC data offers a unique opportunity to investigate such an interesting region. Here we report on the detection of about 150 serendipitous sources (above a limiting flux of 2×10^{-15} erg cm^{-2} sec^{-1} in the 0.3-8 keV energy range), whose log$N$–log$S$ distribution is presented and discussed. Moreover, thanks to the complete optical coverage of the same field performed by the 2.2 m ESO telescope, we also looked for the source optical counterparts down to a limiting magnitude V $\sim$ 25; in this way we could find a candidate counterpart for more than 50 X-ray sources. Finally, based on both the X-ray and optical results, we propose a tentative classification for most of the detected sources.

Cosmological implications from the XMM-LSS Class 1 cluster sample

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The XMM-LSS Class 1 sample consists of 29 galaxy clusters selected over a contiguous area of some 5 deg^2 out to a redshift of z = 1.05. It is to date the only large sample of XMM-detected clusters with a validated and published selection function. The sample clusters are all spectroscopically confirmed and temperatures could be measured for each of them. We demonstrate that including the selection effects is mandatory for a correct determination of the evolution of the L_X-T relation, which may explain the contradictory results from previous studies. The resulting L_X-$T(z)$ analysis points towards self-similar evolution, but does not exclude other physically plausible models. Detailed Constraints on intracluster medium models are however limited by our knowledge of the intrinsic dispersion of the L_X-T relation. Assuming that cluster scaling laws follow self-similar evolution, our number density estimates up to z = 1 are compatible with the predictions of the concordance cosmology and with the findings of previous ROSAT surveys. We finally emphasize how increasing the dispersion in the scaling laws tends to increase the number of detectable clusters, hence generating further degeneracy [in addition to σ_8, Ω_m, L_X-$M(z)$] in the cosmological interpretation of the cluster number counts.

Hard X-ray/Soft Gamma-ray Sources detected by INTEGRAL

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The X-ray/soft gamma-ray observatory INTEGRAL has recently celebrated its five year anniversary and the decision for an extension of the mission. More than four years of INTEGRAL data is now public. Based on this public dataset (roughly 12000 hours of good data), a survey of soft gamma-ray (E>200 keV) sources is presented using data from SPI and ISGRI. The sample includes approx. 20 sources which are mostly XRBs. The study includes a SPI/ISGRI cross-calibration.

Prospects for a large extragalactic survey with XMM

Pierre, M.
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Mid-April, an international workshop gathering some 60 participants will be held in Paris to examine the scientific arguments and technical issues for a large extragalactic survey ($\sim$ 100 deg2) with XMM, see http://www.astro.ulg.ac.be/RPub/Colloques/XXL/index.html .
We propose to present a summary of the outcome of the meeting:

- Science cases for galaxies, AGN, clusters of galaxies and X-ray background
- Optimal survey design
- Possible sky locations and associated multi-wavelength surveys
- The technical feasibility
- Points remaining to be worked out

Source distributions from the XMM slew survey

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Catalogued data from the XMM-Newton slew survey now covers 30% of the sky. Large numbers of sources have been detected and here we present luminosity functions in the soft (0.2-2 keV) and medium (2-10 keV) energy bands.

The quest for obscured quasars

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The long-standing quest for obscured (Type 2) quasars, the high-luminosity "big cousins" of local Seyfert 2 galaxies, has brought to significant results over the last few years, mainly thanks to the joint efforts of X-ray surveys and infrared observations with Spitzer. In order to provide a comprehensive picture of the Type 2 quasar population, we present the results recently obtained for a sample of hard X-ray selected AGN, providing estimates of their black hole mass, bolometric luminosity, and Eddington ratio. We also show how heavily obscured quasars may possibly hide among the population of SDSS quasars.

A New Sample Of "Normal" X-ray Emitting Galaxies

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We have selected a new sample of X-ray emitting galaxies from the 2XMM X-ray and the SDSS DR6 optical catalogues. Our selection criteria require low X-ray luminosity, low X-ray/optical flux ratios and galaxy morphology in the SDSS. We include only narrow emission and absorption line galaxies. These selection criteria exclude most luminous AGN and provide a large sample of galaxies expected to be dominated by "normal" galaxies. Our sample consists of 470 X-ray emitting galaxies. We use optical line ratios, optical colours and X-ray hardness ratios and other indicators to classify the galaxies and constrain the underlying X-ray emission mechanisms. We find that a surprisingly small fraction of the sample are consistent with non-AGN galaxy X-ray emission (eg integrated emission from X-ray binaries, starburst winds or hot gas halos of elliptical galaxies). The properties of a much larger fraction of the sample are in fact consistent with being AGN-powered, or having a significant AGN component. These results have implications for estimates of the luminosity function of normal galaxies. We also investigate the properties of the large new sample of Sy 2 galaxies and other types of low luminosity AGN provided by this work.

Chapter 12

Topic 10: X-ray Astronomy, Missions, Optics, Instrumentation, Data Analysis and Archiving

AHEAD: Integrated Activities for the High-Energy Astrophysics Domain

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The high-energy astrophysics community is strong in Europe. It could, however, benefit from better coordination across the continent and higher visibility on the science policy scene. A steering committee was created to prepare a proposal for bottom-up integrated activities for the high-energy astrophysics domain that would be funded through Europes seventh Framework Programme. The committee has defined a core structure for the proposal in the areas of networking, transnational/service, and joint research activities, structure that is bound to evolve as the proposal matures. The structure is described below. Suggestions will be requested from the community in Summer 2008 to modify and focus the planned activities. The steering committee will study the proposed work packages and will organize an open meeting to take place in January 2009 to further refine the proposals components and to obtain feedback from the community. The final proposal will be submitted for the Spring 2010 deadline of the next call released by the European Commission. The future board committee will evolve from the steering committee and will be enlarged by additional partners that will participate in the FP7 proposal.

The ISDC Data Centre for Astrophysics

Beckmann, V.; Tuerler, M.; Courvoisier, T.J.-L.
ISDC Data Centre for Astrophysics

The ISDC was originally founded as a ground segment and data center for ESA's INTEGRAL mission. By now it provides expertise in data handling, processing, and distribution as well as user support for several European space missions, such as Planck, Gaia, POLAR, and for the on-going INTEGRAL mission. Future activities will include for example XEUS and the Cherenkov Telescope Array (CTA). The ISDC is evolving towards becoming the science data centre for (mainly) high-energy astrophysics, and has worked successful in close collaboration with leading institutes in Europe and the US. The ISDC can function as a contact point in the future, providing services for ESA led and also for non-European missions.

Metallitic, Temperature and Density Determination with XEUS

Boller, Th.
MPE Garching

XEUS simulations are presented to contrain the metallicity determination as a function of z. The simulations are based on the XMM-Newton observation of NGC 6240. I further derive the density- and T-determinations in the BLR as a function of z and constrain GR effects at soft X-rays.

Modelling the relativistic features with the KY models in XSPEC

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The KY package of XSPEC models are suitable for fitting the X-ray sources where the effects of General Relativity cannot be neglected - the systems with a central black hole and thin accretion disc. The package contains models for the relativistically broadened line, continuum reflection of the primary powerlaw source above the disc as well as multicolour black-body emission. We present the recent developments of this package and plans for the future improvements. We also briefly compare these models with other currently available for XSPEC.

The Spektr-RG X-ray Calorimeter

den Herder, J.W[1]; Churazov, E.[2]; Kelley, R.[3]; McCammon, D.[4]; Mitsuda, K.[5]; Ezoe, Y.[6]; Fujimoto, R.[7]; Kaastra, J.[1]; Kilbourne, C.[3]; Ohashi, T.[8]; Pavlinsky, M.[9]; Porter, F.S.[3]; Sunyaev, R.[9]; Predehl, P.[10]; de Vries, C.[1]

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Spatially resolved X-ray spectroscopy with high spectral resolution allows the study of astrophysical processes in extended sources with unprecedented sensitivity. This includes the measurement of abundances, temperatures, densities, ionisation stages as well as turbulence and velocity structures in these sources. A X-ray calorimeter is planned for the Russian space mission Spectrum Rontgen-Gamma (launch 2011). During the first half year (pointed phase) it will study the dynamics and composition of Supernova Remnants (SNR) and of the hot gas in massive clusters of galaxies. During the survey phase it will produce the first all sky maps of line-rich spectra of the interstellar medium (ISM). Spectral analysis will be feasible for typically every 5o x 5o region on the sky. Considering the very short time-scale for the development of this instrument it consists of a combination of well developed systems. For the optics a spare unit of the eROSITA mirror, also part of the Spektr-RG payload, will be used. The detector will be based on spare parts of the detector flown on Suzaku and the cooler will be based on the design for the Japanse mission NeXT. In this paper we will focus on the science and give an overview of the instrument.

Monitoring of Galactic X-ray sources with SuperAGILE

Evangelista, Y. et al.
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SuperAGILE is the hard X-ray (18-60 keV) imager of the AGILE gamma-ray mission. With its four independent coded-mask detectors the instrument provides two orthogonal one-dimensional images of the sky, over a field of view of about 1 steradian, with an angular resolution of 6 arcmin and a source location accuracy of 1 arcmin. The one-day average sensitivity is approximately 15 mCrab. The main goal of SuperAGILE is the simultaneous monitoring of gamma ray-sources (e.g., gamma ray bursts, blazars, etc.) observed by the AGILE Gamma-Ray Imager Detector (GRID) operating in the energy band 30 MeV - 50 GeV. Thanks to its wide field of view, SuperAGILE acts also as an independent wide field monitor, simultaneously observing several sources during the typical 3-week long exposures of the satellite. In this paper we will present the results achieved by SuperAGILE during its first 9-10 months of nominal operation in orbit. The detected sources mostly lie over the Galactic plane (as a result of the AGILE pointing plan, driven by the scientific objectives of GRID, the primary experiment) and belong to the class of X-ray binaries. In particular, we will show images with arcmins resolution, light curves on different time scales and source variability analysis.

The Simbol-X mission

Ferrando, P. on behalf of the Simbol-X team
CEA/SAp & APC

The high energy astrophysics observatory Simbol-X, jointly developed by the French and Italian space agencies with a participation of Germany, just successfully completed its phase A study, and is entering in 2008 phase B development for launch in the middle of 2014. This observatory, operating in the 0.5-100 keV range, will have an angular resolution and a sensitivity in the hard X-ray range improved by several orders of magnitude over all instruments which have operated so far. This is obtained by using state-of-the-art grazing incidence optics and imaging detectors in a very long focal length telescope made possible thanks to the use of formation flying technology. This breakthrough in instrumentation power will open a new window in astrophysics and cosmology, and will offer a very large discovery space. Simbol-X will, in particular, provide crucial advancements in the two domains which define the core science objectives of the mission: that of black hole physics and census, and that of particle acceleration mechanisms. We give in this paper a general overview of the mission and of its development status at the beginning of phase B.

Active Galaxies from the 2XMM catalogue

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The 2XMM serendipitous catalogue contains $\sim 200,000$ unique X-ray sources in the energy band 0.2-12 keV, covering a total sky area of ~ 360 square degrees. We here present the extraordinary scientific potential of such a catalogue to investigate a number of types of high-energy astrophysical objects, especially focusing on the zoo of active galaxies. Since active galaxies are exceptionally bright in X-ray energies, information in this band is an invaluable tool in itself to infer when a particular galaxy might be active. Correlating the 2XMM sources with all available catalogues in NED, we identified a total of $\sim 4,000$ potential active galactic nuclei (AGN) with $z <\sim 6$. Half of these objects (~ 2100) are already classified as AGNs ($> 90\%$ type I AGNs). Their X-ray colour distribution has a peak at -0.55 and the redshift distribution a peak at $z \sim 1.8$. We find evidences from their X-ray properties to consider the other half of the sample (~ 1800 objects), previously classified as galaxies, to be AGNs, based on their luminosity and X-ray colour distributions. We show further investigations on the correlations between hardness ratios, intrinsic absorptions, luminosities and redshifts of the subclasses of objects of this large sample.

BiRD: Browsing RGS Spectra

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XMM-Newton SOC

As of March 2008, XMM-Newton has made more than 5000 observations of 2300 different astronomical objects. A substantial fraction of them have useful RGS data whose scientific potential is frequently overlooked. The goal of BiRD ("Browsing Interface for RGS Data") is to provide a tool for quick of evaluation of XMM-Newton RGS fluxed spectra. It has been designed as a user-friendly interface that allows the selection of spectra through a variety of parameters (e.g. date of observation, quality of the spectrum, type of object...) and also provides basic visualization utilities. This tool is available at http://xmm.esac.esa.int/BiRD/

Novel Technologies for Future Space X-ray Telescopes

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The future large space X-ray telescopes in study (such as the ESAs XEUS) require novel approaches and innovative lightweight technologies. Although there are several alternative possibilities, in general the shaped thin glass foils and shaped Si wafers are considered to belong to the most promising ones. We present and discuss the recent progress in these technologies, as well as properties of test mirrors produced and tested.

Astrophysics with LOBSTER

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We refer on the astrophysical aspects of the application of wide-field X-ray all-sky monitors based on Lobster Eye wide-field X-ray optics, with emphasis on investigations of Cataclysmic Variables and AGN. It is evident that the use of imaging wide-field X-ray optics increases the signal to noise ratio essentially resulting in superior sensitivity exceeding essentially those of recent X-ray all-sky monitors without use of optics.

MAXI: all-sky X-ray monitor with a milli-Crab sensitivity

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MAXI (Monitor of All-sky X-ray Image) is a Japanese X-ray all-sky monitor mission to be deployed on the International Space Station (ISS) in 2009. MAXI will scan almost all the sky every 90 minutes in the 0.5-30 keV band with two narrow fan-beamed (1.5 deg x 160 deg) fields of view. By integrating MAXIs scans, we will produce a weekly all-sky X-ray map with a milli-Crab sensitivity. We are planning to deliver X-ray transient alerts on various time scales to the world astronomy community to trigger follow-up observations in other wavebands. The light curves of 1000 pre-selected sources will be regularly published on the web to contribute to the multiwavelength studies of transient high-energy sources including accreting binaries and AGN. We will discuss the expected performance and scientific goals of MAXI based on simulations, and the plans for the data distribution.

Metods of identification of X-ray sources with small telescopes

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Goal of our thesis is to find optical counterparts of selected X-ray and gamma sources measured by INTEGRAL space mission using small telescopes. Our work provides basic measurement of short-term variations of sources in optical band, as well as its colour curve and light curve analysis.

Ground based robotic optical telescopes support of INTEGRAL and GAIA misions

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Astronomical Institute Academy of Sciences of the Czech Republic, v.v.i.

We refer about using robotic/automated telescopes, such as new D50 and BART telescopes in Astronomical Institute Ondrejov, to support INTEGRAL mission and future GAIA mission. These telescopes usually observe CVs, AGNsand error boxes of GRBs and are also capable to point at any necessary source in very short time (less than 10-30 secs).

News from the XMM-Newton Image Gallery

Loiseau, N.; Ehle, M.
XMM-Newton SOC, ESAC

The XMM-Newton Image Gallery, a web based repository for images submitted by the users' community, has now some new functionalities. Since August 2007 the collection of astronomical images and spectra taken with the XMM-Newton X-ray and optical instruments can be displayed in Google Sky in association with the corresponding celestial objects. It is now also possible to submit animations and videos. The images of the Gallery are intended to be used for educational or informational purposes. XMM-Newton images can be submitted by means of a PHP/MySQL user interface, adapted to X-ray astronomy and designed to allow a straightforward validation and maintenance procedure. In Dec 2003 the gallery was opened and scientists having remarkable and/or high quality images and results related to XMM-Newton were invited to submit them to the Gallery via the automatic interface. As a starting point we selected some interesting figures from published papers and also included several examples kindly provided by some scientists. A significant number of images have been since then submitted by external community members. The Gallery is frequently visited and images have been downloaded to be used for books, for highlighting conferences and talks on X-ray astronomy, for astronomical web pages, and for several other outreach and educational purposes. Presently we continue building a better sample of XMM-Newton results completing each category with more images, compensating the irregular distribution of the images that are being submitted by XMM-Newton users.

NuSTAR: the Nuclear Spectroscopic Telescope Array

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The Nuclear Spectroscopic Telescope Array will be the first highly-sensitive focusing telescope to image the hard X-ray (6 - 80 keV) sky. Using focusing optics with multilayer coating for enhanced reflectivity at high energies, NuSTAR will provide unprecedented sensitivity and angular resolution, surpassing current observatories in this band by orders of magnitude. This advance will allow it to carry out a compelling scientific program in its two year baseline mission beginning in August 2011, such as resolving the heavily obscured AGN population, surveys of the Galactic center, mapping Ti44 in young supernova remnants, Blazar jets physics, and studying the high-energy emissions from Pulsars and Magnetars. We will provide an overview of the NuSTAR observatory, it performance characteristics, and the science program.

X-ray spectral evolution of TeV HBLs with BeppoSAX, XMM-Newton and SWIFT

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Many of the extragalactic sources detected at TeV energies are BL Lac objects. The majority of these sources belong to the subclass of "high frequency peaked BL Lacs" (HBLs), as their spectral energy distributions (SEDs) exhibit a first peak in the X-ray band. At a closer look, their X-ray spectra appear to be generally curved into a log-parabolic shape. Investigating the X-ray emission of Mrk 421, two correlations were found between the spectral parameters. One involves the height S_p of the SED, that increases with the position E_p of the first peak; the other involves the curvature parameter b decreasing as E_p increases. The first has been interpreted as a signature of synchrotron radiation, and the second in terms of statistical/stochastic acceleration processes for the emitting electrons. Here we analyse X-ray spectra of several TeV HBLs to pinpoint their behaviours in the $E_p - S_p$ and $E_p - b$ planes and to compare them with Mrk 421. We report the whole set of observations obtained with the $BeppoSAX$, $XMM-Newton$ and $SWIFT$ satellites between 29/06/96 and 07/04/07 of all HBLs detected at TeV energies till May 2007. We focus on five sources (PKS 0548-322, 1H 1426+418, Mrk 501, 1ES 1959+650, PKS 2155-304) whose X-ray observations warrant detailed searching of correlations or trends. We found that four of our sources, namely PKS 0548-322, 1H 1426+418, Mrk 501 and 1ES 1959+650, follow similar trends as Mrk 421 in the $E_p - S_p$ plane, while PKS 2155-304 differs. As for the $E_p - b$ plane, all TeV HBLs follow a similar behaviour.

MagEX: Magnetosheath Explorer in X-rays

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MagEX, the "Magnetosheath Explorer in X-rays" is a proposed small X-ray telescope, its primary science goal being the study of the closest extraterrestrial emission in the X-ray Universe – the soft X-rays from the Solar Wind Charge Exchange (SWCX) process that occurs between the solar wind and the geocoronal neutrals concentrated in the Earth's magnetosheath. The telescope's compact, lightweight, micro-channel plate optics, offering a very wide field-of-view, combined with large-area CCD detectors with good soft X-ray (0.2–1.5 keV) spatial and spectral resolution, are able to provide a unique 3-dimensional view of the dynamic interaction of the solar wind with the Earth's magnetic field.

Though the design of MagEX is such that it could be placed onto a free-flyer, it is currently undergoing a funded study for a lunar location. There is renewed international interest in the Moon as a focus for scientific and technical exploration over the next few decades, and the Moon provides some advantages as a location for looking back at the Earth. In addition, a lunar-based MagEX would simultaneously observe the interaction of the solar wind with the tenuous lunar atmosphere.

MagEX is an international collaboration involving researchers in the USA (NASA) and the University of Leicester (UK).

An XMM-Newton Survey for X-ray Emission from Galactic Planetary Nebulae

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The shaping of Planetary Nebulae (PNe) is attributed to fast stellar winds emanating from their central stars or to fast collimated outflows discovered in a significant fraction of PNe. The interaction of either fast stellar winds or collimated outflows with the circumstellar envelope can produce hot gas that can be uniquely studied in the X-ray domain.
Chandra and XMM-Newton discovery of X-ray emission from a handful of PNe has allowed us to study the physical properties of hot gas in PNe. To assess the importance of hot gas in the evolution of PNe, the acquisition of X-ray observations of a large sample of PNe is mandatory, but this task would require huge amounts of observing time due to the low X-ray luminosity of PNe. Alternatively, the large field of view of the EPIC cameras on-board XMM-Newton is especially suited for serendipitous observations. We have searched the XMM-Newton archive for EPIC observations of Galactic Pne and found useful observations for 137 PNe, i.e., about the 5% of Galactic PNe have XMM-Newton observations. In this contribution, we report the frequency of occurrence of X-ray emission among the sample of Galactic PNe observed by XMM-Newton and draw the first relation-ships between X-ray occurrence and nebular properties.

The Constellation-X Mission

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Constellation-X is an broad bandpass (0.3-40 keV) X-ray observatory dedicated to high resolution X-ray spectroscopy. It will have 100 times the throughput for high resolution spectroscopy of previous X-ray observatories, a capability attained using 4 identical, coaligned, high-throughput X-ray telescopes on a single spacecraft. The observatory will have three coaligned instruments: (1) the X-ray Microcalorimeter Spectrometer (XMS) which provides high-resolution ($\Delta E \leq 2.5\,\mathrm{eV}$) spectral imaging capability; (2) the X-ray Grating Spectrometer (XGS), which will achieve $R \geq 1250$ between 0.3-1.0 keV, and (3) the Hard X-ray Telescope (HXT), which will enable hard X-ray imaging over the 7-40 keV band. Constellation-X will investigate black holes, galaxy formation, the evolution of the Universe on the largest scales, and the recycling of matter and energy in a range of systems, along with many other topics. I will give an overview of the mission science drivers and the implementation approach.

Image Deconvolution of XMM-Newton Data

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The on-axis point-spread function of each XMM-Newton mirror is around 5″ FWHM at 1.5 keV. The shape of the psf is complicated by shadowing caused by the support structure that holds the mirror shells and the electron deflector within each telescope, and distortions due to circular asymmetry. Recent advances in modelling the shape of the point-spread function by the EPIC Instrument Calibration Team have offered the possibility of improved results from image deconvolution techniques. We present examples of how spatial structure not visible in objects in raw XMM-Newton images can be recovered using image deconvolution with this model point-spread function. We compare our results with Chandra high-spatial resolution images of the same objects and discuss the advantages and disadvantages that image deconvolution could provide in the scientific exploitation of XMM-Newton data.

Efficiency of relativistic iron line models I. Fitting XMM-Newton data

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The analysis of the broad iron line profile in the X-ray spectra of active galactic nuclei and black hole X-ray binaries allows, in principle, to constrain the spin parameter of the black hole. We compare the constraints on the spin value for two X-ray sources with a broad iron line using three relativistic line models in XSPEC - laor, kyrline and kerrdisk. We investigate if the laor model still can be used for estimation of the spin with current data or if recently developed relativistic line models should be used instead. We also compare the speed of these models.

Efficiency of relativistic iron line models II. Fitting future data

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Currently, the spin of the black hole is constrained mainly by the upper and lower boundaries of the broad iron line, which depends also on the inner boundary of the disk emission. If the available data has a significant signal-to-noise ratio, this degeneracy can be removed by including also the spectral shape of the line profile in the analysis. We present simulated data from the future X-ray satellites Simbol-X and XEUS in the iron line band. The case of an active nucleus and a black hole X-ray binary are considered assuming a high count rate for both object types. Applying several available relativistic XSPEC models to the fake observations, we constrain the limitations of the individual models for a given signal-to-noise ratio of the data. A systematic comparison of the different models in terms of precision as well as fitting speed is conducted.

New VO capability to cross match 500+ LEDAS high energy catalogues in one go!

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We demonstrate new capability to quickly search, query, cross match and run python science scripts against over 500 high energy archives simultaneously in the Leicester high Energy Data Archive System (LEDAS) and any other Virtual Observatory (VO) enabled public archives using a robust new VO Desktop suite pioneered by AstroGrid for April 2008 public release. We illustrate this with a range of examples of new science samples derived in this way including searches for e.g. X-ray bright, highly reddened galaxies using XMM, 2MASS and UKIDSS and counterparts to transient events or X-ray extended sources. We illustrate the real benefits of a single entry point and remote execution over traditional methods. Finally we describe ambitious and ongoing efforts to investigate extracting upper flux limits for any position observed by a given mission where no catalogued source is recorded using the example of rare, optically selected BAL QSOs found in XMM observations.

Data Publishing and the European Virtual Observatory Data Centre Alliance

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The European Virtual Observatory Data Centre Alliance project (DCA, http://www.euro-vo.org/pub/dca/overview.html) is a Coordination Action funded by the European Commission within the Sixth Framework Program. It aims at assisting European astronomers and astronomical data centres to publish their datasets and services to the Virtual Observatory (VO), using standards defined by the International Virtual Observatory Alliance (IVOA). Single or multiple VO published datasets can be searched, queried, visualised and cross matched in one shot to improve visibility and enable wider science exploitation of your facility. AstroGrid is the UK partner in the European VO DCA (led by the University of Leicester). We are assisting both current and future missions to publish their datasets and services. We describe already published examples of key datasets using VO infrastructure, including the 2XMM catalogue and other high energy missions. We are providing both workshops and technical visits to enable planning for existing and future missions and a census is being compiled of European based data holdings and archives to enable us to focus assistance at both national and European level.

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