

# Five Years of INTEGRAL

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## Abstract Collection

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*(alphabetic by first author)*

## **Swift/BAT measurement of the X-ray background and Earth's albedo spectra**

*Marco Ajello, D. Willis, J. Greiner, G. Kanbach, A. W. Strong, R. Diehl, and on behalf of the BAT team*

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 focusing in particular on the INTEGRAL one. We will also discuss the most recent results from the BAT survey which are related to the generation and understanding of the CXB emission.

## **Gamma-Ray Bursts: recent advances and open issues**

*Lorenzo Amati*

I present a short review of the current status of Gamma-Ray Bursts studies, including recent discoveries by Swift, standard scenarios, open issues and the future perspectives of this very intriguing field of modern astrophysics.

## **Spectrum-energy correlations in GRB: observational status and main implications**

*Lorenzo Amati*

The correlation between the photon energy at which the redshift corrected  $\nu F_{\nu}$  spectrum peaks (hence called "peak energy",  $E_{p,i}$ ) and the isotropic equivalent radiated energy (Eiso), is one of the most intriguing and debated observational evidences in Gamma-Ray Bursts (GRB) astrophysics. I present the updated  $E_{p,i}$  - Eiso correlation and discuss its main implications for the physics and geometry of the GRB emission, with particular emphasis on the properties of Swift GRBs and the location in the  $E_{p,i}$ -Eiso plane of sub-energetic long GRBs (including the peculiar INTEGRAL GRB 031203), GRB/SN events, short GRBs and the recently discovered sub-class of long GRBs without association with a hypernova.

## **Compton Upscattering Modeling of the Hard X-ray Tail Emission of Anomalous X-ray Pulsars**

*Matthew G. Baring and Alice K. Harding*

The paradigm for Anomalous X-ray Pulsars (AXPs) has evolved recently with the discovery by INTEGRAL and RXTE of flat, hard X-ray components in three AXPs. These non-thermal spectral components differ dramatically from the steeper quasi-power-law tails seen in the classic X-ray band in these sources, and can naturally be attributed to activity in the magnetosphere. Resonant, magnetic Compton upscattering is a candidate mechanism for generating this new component, since it is very efficient in the strong fields present near AXP surfaces. In this paper, results from an inner magnetospheric model for upscattering of surface thermal X-rays in AXPs are presented, using a kinetic equation formalism. Electron cooling due to the scattering is treated. Strongly polarized and characteristically flat emission spectra are produced by non-thermal electrons injected in the emission region. Non-resonant contributions from less relativistic electrons tend to steepen the spectra to slopes more commensurate with the hard X-ray observations. A relativistic QED scattering cross section is employed so that Klein-Nishina reductions are influential in determining the photon spectra and fluxes. Spectral results depend strongly on the magnetospheric locale of the scattering and the observer's orientation, which couple directly to the angular distributions of photons sampled. Constraints imposed by the Comptel upper bounds for these AXPs are discussed.

## **Highlights of MAGIC Results**

*Denis Bastieri*

MAGIC is the largest Cherenkov telescope and is fully operating since September 2004. Since then, it is providing a full wealth of exciting new physics results from its observations in the VHE region of galactic and extragalactic locations. Among the main results that will be presented, the discoveries of new sources and even of entire new classes of sources and the observation of fast variability down to an unprecedented level of precision.

## **Hard X-ray variability of AGN"**

*V. Beckmann, S. Soldi, J. Wendt, et al.*

INTEGRAL and Swift offer for the first time the opportunity to do long term variability studies of a large number of AGN in the 20-100 keV energy range. We use data of the 40 brightest AGN seen by INTEGRAL IBIS/ISGRI and Swift/BAT. Two methods are applied in order to determine the strength and type of variability: a maximum-likelihood estimator and the structure function. Preliminary results show that the blazars are the most variable objects among the AGN. For the Seyfert type objects it appears that the absorbed sources and Seyfert 2 are more variable than the unabsorbed/Seyfert 1 type objects. This observed trend does not seem to depend on the brightness of the source.

## **Synergy and Complexity in the Milk Way's Central Molecular Zone**

*Guillaume Belanger*

The Central Molecular Zone (CMZ) is totally unique in our Galaxy. It is located at the very centre of the Galaxy and extends over approximately 400 by 150 pc ( $\sim 3 \times 1$  degrees). This is a tiny fraction of the Galaxy, and yet it contains about 10% of the Galaxy's molecular mass, most of it concentrated in the form of dense, giant molecular clouds, it is responsible for about 10% of the Galaxy's infra-red luminosity, has a density of stars about 1 million times higher than the Galactic average, and is the home of a 3.5 million solar mass black hole, Sgr A\*, that resides at its core. The CMZ is also contains several supernova remnants, thermal and non-thermal filaments and a large number of stellar mass black holes and neutron star systems, including micro-quasars. In this presentation, I will introduce this complex and interesting region of our Galaxy and then present preliminary results from the studies we have carried out using the public and Key Programme INTEGRAL data we have been granted in AO4, as well as with XMM archive data.

## **State transitions of black-hole binaries: the high-energy view**

*T. Belloni*

In the past years, it has become clear that state transitions in black-hole binaries are rather complex and can take place on very short time scales. Although marked changes can be seen in the timing properties, the spectral evolution measured below 10 keV appears to be minor. With coordinated INTEGRAL/RXTE observations, we are for the first time able to follow these transitions at high energies. Despite the fact that the transitions are rare, only moderately predictable and fast, we have caught two such events in GX 339-4. I will present the results of these two campaigns, one of which is still on-going.

## **The IBIS Survey - Latest status and results**

*A J Bird, on behalf of the IBIS survey team.*

The IBIS survey team recently published the third catalogue of IBIS sources, containing over 400 persistent and transient sources detected during approximately 4 years of INTEGRAL science operations. I will review the latest status of the survey processing and the data products generated by the survey team. I will also outline, quantify and characterise the source populations uncovered, and briefly review some of the science highlights coming from the survey so far.

## Characterization of BeX systems after 5 years of INTEGRAL

*Blay P., Miralles D., Reig P., Martinez-Nuñez S., Camero A., Reglero V.*

We have analysed data from all the BeX systems observed by INTEGRAL. In addition, public data from other types of HMXRBs was analyzed, with the goal to compare the temporal and spectral behaviour of the BeX systems when compared to other types of HMXRBs. As a result we show a very extensive spectral characterization work. Interesting conclusions about the different spectral behaviour of BeX systems when compared to other HMXRBs will be shown and discussed. We find in the BeX systems a tendency to show softer spectra than those of Supergiant HMXRBs. Peculiar systems (i.e. 4U 2206+54, IGR J16138-4848, and IGR J16320-4751) clearly differ from the rest of HMXRBs.

## SPI/INTEGRAL all sky survey

*Bouchet L., Jourdain E., Roques J.P on behalf SPI/INTEGRAL team*

Using 4 years of data, we have derived an all sky census from 20 keV to 8 MeV. In this energy range, various components play a role: the source population, the galactic ridge emission and the annihilation process.

The spectra of these components have been derived and will be discussed. In addition, the spatial distributions versus the energy have been studied.

## Spin and Orbital Evolution of Accreting Millisecond Pulsars

*L. Burderi, T. Di Salvo, A. Riggio, M.T. Menna, A. Papitto*

We review recent results from the X-ray timing of accreting millisecond pulsars in LMXBs. This is the first time a timing analysis is performed on accreting millisecond pulsars, and for the first time we can obtain information on the behavior of a very fast pulsar subject to accretion torques. We find both spin-up and spin-down behaviors, from which, using available models for the accretion torques, we derive information on the mass accretion rate and magnetic field of the neutron star in these systems. We also find that the phase delays behavior as a function of time in these sources is sometimes quite complex and difficult to interpret, since phase shifts, most probably driven by variations of the X-ray flux, are sometimes present. Nevertheless, we are able to derive very precise spin and orbital parameters for these sources. In particular we report here for the first time the orbital period derivative for an accreting millisecond pulsar ( $dP/dt = 3.4 \times 10^{-12}$  s/s for SAX J1808.4-3658). The result is surprising, since the measured derivative is one order of magnitude larger than expected, and we interpret this as caused by a strong non-conservative mass transfer.

## **A 0535+26 in outburst: change in the cyclotron line energy**

*Caballero, I., Santangelo, A., Kretschmar, P., Finger, M.H., Klochkov, D., Kreykenbohm, I., Wilms, J., Staubert, R.*

The analysis of the INTEGRAL and RXTE observations of the Be/X-ray binary A 0535+26 during a normal (type I) outburst in August/September 2005 is presented. The X-ray flux at the maximum of the outburst reached a value of 400mCrab in the 5-100 keV range. The X-ray spectrum of the source shows cyclotron absorption features at ~45keV (fundamental) and ~100keV (1st harmonic), implying a magnetic field strength of  $\sim 4 \times 10^{12}$  G. The light curve of the outburst presents a sharp spike preceding the main outburst. The energy of the fundamental cyclotron line during the spike is measured to be ~7keV higher than during the rest of the outburst. The pulse period is measured to be constant during the initial spike followed by a spin-up. A possible interpretation of the observed behaviour of the cyclotron line energy (reported here for the first time) is discussed.

## **A deep view into the black holes high energy emission.**

*Dolores Caballero García*

Deep ToO observations with INTEGRAL (3-1000 keV) and XMM (0.5-10 keV) of the known black hole transients in our galaxy during their outbursts are key in the understanding of the continuum underlying the X-ray and gamma-ray emission of these objects. XMM-Newton observations simultaneous with INTEGRAL provide the broad energy coverage necessary in order to determine both the properties of the accretion flow of the medium (<10 keV), namely Fe K $\alpha$  relativistic emission line plus the absorption lines and edges and the behaviour of the scattered light. The photons coming from the inner region of the accretion disk interact with the existing corona (i.e. neutral plasma consisted of electrons and protons) providing the high energy emission seen with INTEGRAL ( $E > 20$  keV). This high energy emission can serve us to disentangle the nature of the particle distribution of these plasmas (coronae or jets?), which can be both thermal and non-thermal. Also noticeable is the high energy emission coming from the reflected photons from a high energy source, which could be variable (jets?). With GRO J1655-40 we learnt about the changing of the accretion flow properties and the absence of any break in the high-energy emission during the low-hard state. The last is an unexpected issue as inferred from the previous studies (Caballero-García et al., 2007a). With GX 339-4 we have noticed that the high-energy emission is highly variable (Caballero-García et al., 2007b, in prep.), in the form of breaks in the high-energy emission that appear and disappear. Undoubtedly XMM and INTEGRAL observatories provide us a unique insight into the understanding of the physical mechanisms that power the X-rays and gamma-rays already seen in black hole transients.

## **The two INTEGRAL X-ray transients IGR J17091-3624 and IGR J17098-3628**

A longterm campaign.

*Fiamma Capitanio*

IGR J17091-3624 and IGR J17098-3628 are two X-ray transient 9.6 arcmin away each other discovered by INTEGRAL respectively in 2003 and 2005 and classified as possible BHC. IGR J17098-3624 has been regularly detected by INTEGRAL and RXTE from 2005 until now and it was also observed with pointed observations by XMM and XRT in 2005. IGR J17091-3624 was detectable along 1 year period starting from April 2004 and was observed by INTEGRAL and RXTE/PCA. During a SWIFT ToO on the 9th July 2007, pointed on IGR J17098-3624, another source was detected in the field of view of XRT. The new source has been identified as IGR J17091-3624 that is again in outburst. We show here the preliminary results on both sources obtained from the new data collected with different instruments from 2005 until now.

## **INTEGRAL Science and the GLAST Mission**

*Patrizia Caraveo*

The current high-energy gamma-ray source catalogue lists 271 sources, 172 of which have no identification (neither certain nor probable). To make matters worse, the 99 identified sources belong to just two classes of celestial objects: pulsars (6 objects) and active galactic nuclei (all the remaining IDs), both classes having been recognized by virtue of their variability. High-energy gamma-ray astronomy lacks the variety of source classes found by Integral. The current generation of high-energy gamma-ray instruments is expected to change dramatically the observational panorama both by increasing the source number and by improving their positioning. Unveiling the nature of a vast number of unidentified sources (hopefully belonging to different source classes) will be the most compelling problem Agile and Glast will have to face. Multiwavelength studies, involving Integral and Swift to cover the soft-to-hard X-ray domain, and Magic and Hess, to cover the higher energies, are considered the most promising tool to crack the mystery of the unidentified gamma-ray sources.

## **High Energy Emissions from Two Component Advective disk models**

*Sandip K. Chakrabarti*

Accretion processes on black holes being necessarily transonic, the flow cannot be Keplerian close to the black hole. The deviation of the main Keplerian component, together with supply of winds and sub-Keplerian flows make the geometry of the disk a bit complicated. We argue that the flow indeed separates into two components, Keplerian and sub-Keplerian. The latter flow is capable of formation of standing, oscillating and propagating shocks, and also winds and outflows. We compute the spectral properties of the flow and show that non-thermal electrons produced at the shocks are capable of producing power-law photons till  $\sim 20$  MeV even in spectrally soft states of the black holes. This process is independent of the mass of the black hole.

## **Obscured high mass X-ray binaries and Supergiant Fast X-ray transients**

Multi-wavelength observations of INTEGRAL sources.

*S. Chaty.*

The INTEGRAL satellite has revealed a major population of supergiant High Mass X-ray Binaries in our Galaxy, which separates in two classes, both exhibiting unusual properties: obscured sources and Supergiant Fast X-ray Transients. The first sources seem to hide behind a cocoon of gas and dust, while the others exhibit unusually fast X-ray transient flares. I will describe multi-wavelength observations (high-energy with INTEGRAL, XMM, Chandra to optical, near- and mid-infrared with ESO/NTT, VLT) allowing us to study their nature and reveal their mysterious properties. I will finally show how these sources revolutionize our view on binary systems and their evolution.

## **Search for new X-ray bursters with weak persistent flux and fast X-ray transients in IBIS/ISGRI data"**

*Ivan Chelovekov*

Our work is dedicated to a search for new X-ray bursters and fast X-ray transients through the analysis of IBIS/ISGRI detector lightcurves. So far we have discovered one new X-ray burster IGR J17380-3749, one new  $\gamma$ -ray burst GRB060428C and revealed an X-ray burster nature of the source AX J1754.2-2754. As a byproduct of this research we are creating a catalog of hard X-ray bursts from known X-ray bursters, registered by IBIS/ISGRI detector. Most of the bursts in this catalog are due to GX354-0 activity, so we are doing some statistical analysis of it's burst properties.

## **Long X-ray burst monitoring with INTEGRAL**

*J. Chenevez*

In the frame of the INTEGRAL Key Programmes a good number of the known X-ray bursters are frequently being monitored. An international collaboration lead by the JEM-X team has proposed to exploit the improved sensitivity of the INTEGRAL instruments to investigate the observational properties and physics up to high energies of exceptional burst events with intermediate duration about a few tens of minutes. Depending on the composition of the accreted material, such long 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.

## **Preliminary results of the Suzaku, XMM-Newton and Chandra observations of PSR B1259-63 during the 2007 periastron passage.**

*M. Chernyakova, Y. Uchiyama, T. Takahashi, F. Aharonian, J. Hinton, M.*

*Kerschhaggl, D. Khangulyan, A. Neronov, E. Nichelli, H. Odaka*

PSR B1259-63 is a unique system in which 48 ms radio pulsar is in a highly eccentric, 3.4 year orbit with a Be star. Collision of the pulsar wind with the wind of the Be star lead to the highly variable along the orbit broadband (from radio to TeV) emission. Timing analysis of the PSR B1259-63 system show that the disk of Be star is highly tilted with respect to the orbital plane, thus the pulsar crosses the disk twice per orbit, before and after the periastron. 2007 periastron passage along with both periods of disk crossing was observed in unprecedented details with Suzaku, XMM-Newton and Chandra. In this talk we present the first results of this campaign, compare them with the previous data and discuss the physics implications.

## **Annihilation emission from the supermassive black hole in the Galactic center.**

*K.S.Cheng, D.O.Chernyshov, V.A.Dogiel*

We suggest that the energy source of the observed annihilation emission from the direction of the Galactic Center is the Galactic black hole Sgr A\*, which becomes active when a star is captured in a rate of  $10^{-5}$  yr<sup>-1</sup>. Subsequently the star is tidally disrupted and its matter is accreted into the black hole. During the active phase relativistic protons with a characteristic energy  $\sim 6 \cdot 10^{52}$  erg per capture are ejected. Over 90% of these relativistic protons will disappear due to proton-proton collisions in a time scale  $\sim 10^4$  years in the small central bulge region with radius  $\sim 50$  pc within Sgr A\*, where the density is  $>10^3$  cm<sup>-3</sup>. The gamma-ray intensity, which results from the decay of neutral pions produced by proton-proton collisions, will rapidly decrease. Less than 5% of relativistic protons escaped from the central bulge region can survive and maintain their energies for  $>10^7$  years due to much lower gas density outside, where the gas density can drop to  $\sim 1$  cm<sup>-3</sup>. These protons as well as secondary positrons can diffuse to  $\sim 500$  pc region before disappear due to proton-proton collisions and annihilation. The observed diffuse annihilation emission as well as the GeV gamma-ray flux resulting from the decay of pions produced via p-p collisions is expected to be insensitive to time in the multi-injection model with the characteristic injection rate of  $10^{-5}$ /yr. Our model calculated GeV and 511keV gamma-ray intensities are consistent with the observed results of EGRET and INTEGRAL, however, our calculated inflight annihilation rate cannot produce sufficient intensity to explain the COMPTEL data in MeV energy range.

## **An X-ray view of absorbed AGN**

*A. De Rosa, L. Bassani, A. Malizia, F. Panessa on behalf of the INTEGRAL AGN/survey team*

We present a broad-band study of absorbed AGN observed with INTEGRAL, XMM and Chandra. The column density of the absorbing gas suggests that these objects all are Compton thin. This result is also confirmed by the ratios FX/OIII. The Compton reflection we measure is not immediately compatible with a scenario in which the absorbing and reflecting media are one and the same, while the (neutral) iron line detected in the spectra is narrow and consistent with being produced in the absorbing gas. At lower energies there is clear evidence of a soft component (reproduced with a thermal and/or scattering component). The high energy cut-off (a lower limit in two cases) is found in all sources of our sample and the range of values are in good agreement with that found in other type 1 Seyfert galaxies

## **Gamma Ray Polarisation studies of Cosmic Sources with SPI**

*Dean A.J.*

The spectrometer on board INTEGRAL, SPI, has the capability to detect the signature of polarised emission from bright gamma-ray sources. Gamma-ray polarimetric observations have the diagnostic potential to discriminate between different compact source models and offer a unique insight into the geometrical nature of the emission zone. Recent polarisation measurements made on gamma-ray bursts including GRB 041219a, which have been detected in the field of view of SPI are presented, together with gamma-ray polarization measurements made on the Crab pulsar and its associated Pulsar Wind Nebula.

## **Pulsar Wind Nebulae as seen by INTEGRAL**

*Dean A.J.*

INTEGRAL has discovered that Pulsar Wind Nebulae (PWN) are powerful soft gamma-ray sources that emit typically 1% of the pulsars spin down energy in the 20 to 100 keV domain. To date INTEGRAL has made clear detections of more than ten PWN, all of which are associated with energetic young pulsars. In this talk the observational properties of the gamma-ray emissions will be discussed in the context of the physical attributes of the parent pulsars. Comparisons with Chandra and XMM images will also be made as a tool to understand the precise origin of the gamma-rays in the context of the complex morphological structures (jets, torii etc.) inherent to the PWN systems.

## **Faint LMXBs identified by INTEGRAL**

*M. Del Santo et al.*

Two faint X-ray binaries have been recently unveiled by INTEGRAL to be type-I X-ray bursters. On 2005 March 22nd the INTEGRAL satellite caught a type-I X-ray burst from XMMU J174716.1-281048, serendipitously discovered with XMM-Newton in 2003. Based on the type-I X-ray burst properties we suggest that the system is undergoing a prolonged accretion episode of many years. AX J1754.2-2754 was an unidentified source till INTEGRAL caught a type-I burst on April 16, 2005. We provided with Swift/XRT a refined position with an estimated error radius of 3.8 arcseconds. New data related to recent observations will be presented.

## **Extreme AXPs in the hard X-ray regime - Detailed spectral and temporal characteristics**

*P.R. den Hartog, L. Kuiper, W. Hermsen, V. Kaspi, R. Dib, J. Knödlseder*

Three years after the discovery by INTEGRAL of hard X-ray emission (>20 keV) from anomalous X-ray pulsars 1E 1841-045, 1RXS J1708-4009 and 4U 0142+61, INTEGRAL is uncovering more and more of their characteristics at high energies. Exploiting the several megaseconds of INTEGRAL exposure, we can report on detailed studies of their hard X-ray spectra with power-law photon indices around 1 which extend up to at least 150 keV. First evidence for a spectral break has been found. Also, more constraining information can now be obtained on any long-term variability. Thanks to RXTE monitoring observations we can derive accurate timing parameters, required for timing studies with INTEGRAL. We will present pulse profiles up to ~270 keV (for 1RXS J1708-4009, at a flux level consistent with 100% pulsation!), and improved pulsed spectra which are harder than the spectra of the total emission. The high-energy (1 - 270 keV) pulse profiles change shape with energy. We will present phase-resolved spectra over this broad energy range using INTEGRAL, XMM-Newton and RXTE data, identifying the different components contributing to the total pulsed emission seen from these AXPs. The new detailed characteristics are very constraining for the theoretical models proposed so far for explaining the production of high-energy emission in the magnetospheres of AXPs.

## Hard X-ray emission in soft states of LMXBs

*T. Di Salvo, R. Iaria, L. Burderi, A.D'ai'*

We review recent results on the hard X-ray emission in soft states of low mass X-ray binaries, both Z sources and atoll sources. Using broad band instruments as BeppoSAX, INTEGRAL and RXTE we present with particular attention the last results on the correlation of the hard X-ray emission with the mass accretion rate as inferred from the X-ray color diagram and other properties of these sources, such as radio emission.

## INTEGRAL and XMM broad-band spectrum of blazar PKS 1830-211.

*Immacolata Donnarumma*

We show the X-rays broad band spectrum of PKS 1830-211 combining INTEGRAL and XMM observations since 2003. First we studied the hard-X-rays long term variability analyzing four years INTEGRAL observations (2003-2007) of this blazar. Moreover we combined the X-ray broad-band spectrum with available radio, optical and gamma rays data to study the Spectral Energy Distribution of PKS 1830-211.

## Suzaku Observation of the Galactic Ridge

*Ken Ebisawa, Shigeo Yamauchi, Yasuo Tanaka, Katsuji Koyama, Yoshiaki Hyodo, Yuichiro Ezoe, Aya Bamba, Motohide, Kokubun, Masahiro Tsujimoto, Hiromitsu Takahashi, and Greg Brown*

We have observed several Galactic plane blank fields with Suzaku to study the Galactic Ridge X-ray Emission (GRXE). Thanks to the low background and high spectral resolution of Suzaku, we were able to resolve, for the first time, three narrow iron K-emission lines from low-ionized (6.4 keV), helium-like (6.67 keV), and hydrogenic ions (7.0 keV) in the GRXE spectrum. These line features constrain the GRXE emission mechanism, since both thermal and non-thermal processes are required to account for the 6.67 keV and 7.0 keV lines from the equilibrium plasma, and the 6.4 keV line due to fluorescence from the cold material. We also study variation of the iron emission lines at different Galactic longitudes on the Galactic plane. Flux ratios of the 6.4 keV line flux/6.7 keV line flux and the 7.0 keV line flux/6.7 keV line flux seem to be variable with Galactic longitudes.

## **A particle acceleration site in the Coma cluster?**

*Dominique Eckert*

Previous observations of the Coma cluster have shown a hard X-ray excess in the spectrum that could be interpreted as the presence of a particle acceleration site. However, existence of point sources could change this interpretation. The better angular resolution of INTEGRAL allowed us to analyze the morphology of the hard X-ray emission. Our results show that the morphology of the source differs from the X-ray profile, and that contamination by a point source embedded in the cluster is unlikely. Finally, we find that the hard X-ray emission coincides with the 1.4 GHz radio emission, which suggests that the hard X-ray emission comes from IC scattering of GeV electrons.

## **The INTEGRAL Ultra Compact X-ray Binaries**

*Fiocchi et al.*

We present the results of the timing and spectral analysis of all Ultra Compact X-ray Binaries observed by INTEGRAL, combining the IBIS with the Swift, Chandra and BeppoSAX data. These sources make up a very interesting sample to be investigated because of the combination of compact objects, short period variability and peculiar chemical composition. They are an unique astrophysical laboratory to study accretion and thermonuclear burning on neutron star surfaces and to test the binary evolution theory. Finally, we report on their physical characteristics and the possible new method to identify this objects class using X-ray data.

## **Gamma-ray polarization of the Crab nebula between 200 and 800 keV**

*M. Forot, I.A. Grenier, P. Laurent*

The INTEGRAL-IBIS telescope has been used in its Compton mode to search for linearly polarized emission from the Crab nebula in the 200-800 keV energy band. A specific method has been developed to reject the background and ensure a uniform azimuthal response to Compton scattered events by combining the coded mask aperture and the precise double-layer Compton detector. We present the resulting performance and its application to the Crab pulsar data. We will present convincing evidence for a highly polarized signal from the Crab in the phase interval outside the two main pulses. We find a polarization fraction and angle in close agreement with the optical data. In particular, the high-energy polarization appears to be parallel to the projected rotational axis of the pulsar and it is fully consistent with the angle measured in the optical within 0.1 pc of the pulsar, not with the larger angle seen in the visible and X-rays further away in the nebula.

## **A multi-instrument study of Cygnus X-1**

*S. Fritz, J. Wilms, E. Kendziorra, I. Kreykenbohm, K. Pottschmidt, M.A. Nowak, M.G. Kirsch, A. Santangelo*

The black hole binary Cygnus X-1 was observed with INTEGRAL simultaneously with XMM-Newton and RXTE for four times in November and December 2004. This was the first time the XMM-Newton EPIC-pn was operated in the so called Modified Timing Mode. This mode allows the observation of bright sources with high time resolution and a very high signal to noise ratio. We present recent results of the analysis of the 2.5 keV - 1 MeV broadband continuum as well as of the relativistic Fe K-alpha line and its variability.

## **The Cosmic X-ray Background measured with BeppoSAX PDS and its consequences**

*Filippo Frontera*

I present a measurement of the CXB in the 15--50 keV range performed with the PhoSpec Detection System (PDS) instrument aboard the BeppoSAX satellite, whose results have already been recently reported elsewhere (Frontera et al. 2007). After the recently reported 2--10 keV CXB measurements obtained with the imaging instruments aboard the X-ray satellites (BeppoSAX MECS, XMM-Newton, Chandra) that give CXB intensities systematically higher than those obtained with HEAO-1 in the same energy band (Marshall et al. 1980, Gruber et al. 1999), suspects of systematic errors in the HEAO-1 measurements at low and higher energies were raised by several authors. I will discuss the BeppoSAX PDS results obtained using all the available data of the instrument at high galactic latitude ( $|b| > 15$  deg). I will also discuss some of its consequences.

## **Recent Hard X-ray Activity of SAX J1810.8-2609**

*R. Galis, V. Beckmann, J. Chenevez, S. Brandt, G. Belanger, E. Kuulkers, M. Cadolle Bel, C. Sanchez-Fernandez, A. Bazzano, I. Donnarumma, M. Fionchi, L. Natalucci, D. Götz, W. Hermsen, J.-C. Leyder, S. Piraino, K. Pottschmidt, N. Shaposhnikov, A. Paizis, L. Sidoli, J. Tomsick, R. Walter, K. Watanabe, and R. Hudec*

We report on the very recent longest lasting and brightest outburst of source SAX J1810.8-2609 observed so far by INTEGRAL. During the last two weeks the binary system SAX J1810.8-2609 became increasingly brighter. For a very short time of less than a minute it was even brighter than the Crab. In SAX J1810.8-2609 a compact object (most likely a neutron star) accretes matter from its companion, which is a 'normal type' star. SAX J1810.8-2609 is the neutron-star X-ray transient (Ubertini et al. 1998, IAUC # 6838), which renewed activity was recently monitored by SWIFT (N. Degenaar, M. Klein-Wolt and R. Wijnands. ATel #1175). The source X-ray spectrum was fitted using an absorbed powerlaw model with a hydrogen column density of  $N_{\text{H}} \sim 0.5 \text{E}22 \text{ cm}^2$  and a powerlaw index of  $\sim 2$ . The source flux shows a gradual increase from  $\sim 4.7 \text{E}11 \text{ erg/cm}^2/\text{s}$  on August 6, to  $\sim 8.0 \text{E}11 \text{ erg/cm}^2/\text{s}$  on August 8 and up to  $\sim 1.1 \text{E}10 \text{ erg/cm}^2/\text{s}$  on August 9 (2-10 keV unabsorbed fluxes). Assuming a distance to SAX J1810.8-2609 of 5 kpc (inferred from type-I X-ray burst analysis; Natalucci et al., 2000, ApJ 536, 891), the derived fluxes translate into X-ray luminosities of  $\sim 1.4 \text{E}35 \text{ erg/s}$ ,  $\sim 2.4 \text{E}35 \text{ erg/s}$  and  $\sim 3.3 \text{E}35 \text{ erg/s}$ , respectively.

## Joint Swift-INTEGRAL Observations and Plans

*Neil Gehrels, Jack Tueller*

There is a great synergy between the Swift and INTEGRAL missions. Swift provides wide-field hard x-ray monitoring and sensitive x-ray and UV/optical observations. INTEGRAL provides optical through gamma-ray coverage with emphasis on hard x-ray imaging and gamma-ray spectroscopy. For hard x-ray survey studies, the BAT and IBIS instruments are complementary with BAT covering the full sky every day and IBIS scanning the galactic plane. For GRBs, Swift follows up bursts detected by INTEGRAL. X-ray and optical observations give arcsecond positions and afterglow lightcurves. For IGR sources, X-ray observations identify counterparts. The joint BAT and IBIS survey data are giving the most complete picture of the hard x-ray sky ever obtained. This talk will review Swift capabilities and discuss joint observations that are taking place and planned

## INTEGRAL Monitoring of Magnetars' high energy tails

*Diego Götz*

I will present the status of the long term monitoring of the persistent emission from the Magnetars SGR 1806-20 and SGR 1900+14 in terms of spectra and timing. In addition I will present the results of our recent multi-wavelength observation campaign of the Anomalous X-ray Pulsar 1RXS J1708-4009.

## New X-ray Novae with INTEGRAL

*P. Goldoni, M. Cadolle Bel, L. Barragan, E. Kuulkers, J. Rodriguez, S. Chaty, M. Ribo', P. D'Avanzo et al.*

We present preliminary results of INTEGRAL observations with associated multiwavelength campaigns of two recent X-ray Novae: XTE J1818-245 and XTE J1817-330. The INTEGRAL observations consist of ToO observations and of Galactic Bulge monitoring. This rather extensive coverage allows us to follow with considerable detail the evolution of their outburst which show several spectral state transitions. Adding the multiwavelength data allow us also to get more insight on the nature of the system. Altogether our results suggest that both these objects harbor a Black Hole as compact object.

## **Fast X-ray transients observed with INTEGRAL**

*S.A. Grebenev*

We describe common X-ray properties of fast X-ray transients (appearing on the sky for only a few hours) discovered (or detected during outbursts) by INTEGRAL. Many of such transients were recently identified with OB-supergiants. We discuss mechanisms responsible for their outbursts, in particular, unsteady accretion from the clumpy stellar wind and emphasize the importance of the propeller effect for explanation of the phenomenon. Only few persistently bright X-ray binaries with supergiant companions are known in the Galaxy and the discovery of similar transient sources rouse the interest to the phenomenon a lot.

## **Discovery and long term study of hard X-ray emission of SN1987A with MIR/KVANT.**

- The science that INTEGRAL was designed to do. -

*S.A. Grebenev*

We describe the history of the discovery and long term study of hard X-ray emission of SN1987A with MIR/KVANT. The emission appeared due to Compton down-scattering of gamma-quanta emitted in radioactive decays of isotopes of Co-56 and Co-57 inside the expanding supernova envelope. There are about 0.078  $M_{\text{solar}}$  of Co-56 synthesized during this explosion. We compare the results of these observations with our Monte-Carlo simulations of Compton down-scattering in the envelope and estimate some important parameters of the explosion. Finally we describe more recent interesting events observed from this wonderful supernova that flared up on the sky exactly 20 years ago. Up to the date INTEGRAL was able to put the most strong upper limit on the total stellar remnant luminosity of this supernova.

## **Spectral, spatial and temporal properties of GRBs observed by INTEGRAL.**

*Lorraine Hanlon*

INTEGRAL has localised 45 gamma-ray bursts to date. We discuss the global characteristics of this sample, using IBIS and SPI data. Spectral properties are determined for a variety of spectral models, including Band, power-law+blackbody and simple power-law. Spectral lags have been determined from the burst time profiles for about half the sample, despite the extreme faintness of many INTEGRAL bursts. INTEGRAL's sensitivity across the energy range of interest for prompt gamma-ray burst emission allows us to investigate the hypothesis of a low-luminosity, nearby population of bursts. Individual bursts of special interest are also highlighted.

## **Long-term monitoring of GRS 1915+105 with INTEGRAL**

*D. Hannikainen, J. Rodriguez, S. Shaw, on behalf of a larger collaboration*

Since AO1, we have had a monitoring program with INTEGRAL of GRS 1915+105. As expected, the source was shown to be very variable during the monitoring, exhibiting different known classes of variability and including one new one. In addition to INTEGRAL, we have also had supporting RXTE and radio observations for most of the monitoring program. Here we shall present some of the more salient results of this program, especially from those observations for which we have radio coverage, thus enabling us to speculate on the accretion-ejection mechanisms in this source.

## **The Bulge/Disk Ratio of Galactic Positron Annihilation Luminosity & Positron Propagation in the ISM**

*J. C. Higdon, R. E. Lingenfelter and R. E. Rothschild*

The ratio of the luminosity of 511 keV positron annihilation radiation from the Galactic bulge (<1.5 kpc) compared to that of the disk is  $\sim 2$ , roughly 10 times that of Galactic supernovae thought to be the principal positron source. This large discrepancy has prompted a search for new sources. Here, however, we show that this luminosity ratio can be easily explained by the propagation of the relativistic positrons in the various phases of the interstellar medium. Such propagation can also account for both the Positronium annihilation fraction and the ratio of broad to narrow components of the 511 keV emission.

## **INTEGRAL results on cataclysmic variables and related objects**

*R. Hudec, R. Galis, F. Munz, V. Simon, P. Sobotka, P. Kubanek, R. Urban*

The ESA INTEGRAL satellite has detected 24 Cataclysmic Variables (CVs) and related objects so far, mostly by its IBIS gamma-ray telescope. Some objects represent newly identified CVs. This is more than originally expected and CVs nowadays represent important class of hard X-ray emitters observed by INTEGRAL. The most objects represent intermediate polars which tend to be hard X-ray emitters. In several cases, the gamma-ray spectra and gamma-ray light curves could be obtained and studied. In some cases, the X-ray emission extends to 80 keV. The most interesting cases of CVs observed by INTEGRAL will be presented and discussed.

## **INTEGRAL OMC and Variable Stars**

*R. Hudec, P. Sobotka et al.*

The INTEGRAL optical OMC camera has, in addition to providing optical simultaneous data for high-energy sources, some advantages in analyses of specific types of variable stars. It is based on the fact that OMC is able to deliver uninterrupted observations covering hours to days, which cannot be accessed from the ground due to day/night changes. We will present and discuss examples of the results of INTEGRAL analyses of specific types of variable stars such as eclipsing binaries or short-period pulsating variables.

## **INTEGRAL results on blazars**

*R. Hudec, E. Pian, L. Foschini, F. Munz, R. Galis et al.*

The ESA INTEGRAL satellite is an efficient tool to detect blazars in their flaring states when the 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.

## **Identification of INTEGRAL Sources with Astronomical Archival Plates**

*Rene Hudec, Filip Munz, Petr Kubanek*

The ESA INTEGRAL satellite (International Gamma Ray Laboratory) launched in October 2002 continues to deliver valuable data about the gamma-ray sky. Hundreds gamma-ray sources have been detected so far mainly by the IBIS onboard instrument, and others are expected in the future. Identification of the sources is important but not easy task. We propose alternative method based on astronomical archival plates. We show that The Sonneberg Field Patrol and Leiden/Johannesburg Franklin Adams Plates represent suitable database for identification and analysis of INTEGRAL sources. They both provide numerous data for regions along the Galactic Plane and in the Galactic Center. Examples of gamma-ray INTEGRAL sources studied on astronomical archival plates will be shown.

## **Five years of monitoring the transient sky with the SPI ACS**

*Kevin Hurley, Arne Rau, Giselher Lichti, Andreas von Kienlin*

The anticoincidence system of the INTEGRAL spectrometer has been an essential component of the interplanetary network since launch. It has observed over 470 events which have been confirmed as either soft gamma repeaters or cosmic gamma ray bursts by other instruments in the IPN. (It has also observed over 120 events which are unconfirmed, but almost certainly are weak bursts below the thresholds of the other IPN experiments). I will review the highlights of these observations, which include gamma-ray bursts, soft gamma repeaters, and possible extragalactic giant magnetar flares.

## **5 years of INTEGRAL observations of positron-electron annihilation radiation**

*P. Jean on behalf the SPI team*

In this review I present the current observational knowledge about the spatial distribution and spectral characteristics of electron-positron annihilation in the Galaxy. The most recent analysis is based on 4.3 years of measurements made with SPI on board ESA's INTEGRAL observatory. The spatial distribution shows a surprisingly high concentration of annihilation radiation in the central regions of our Galaxy. It can be modelled by a sum of a Galactic bulge plus a Galactic disk emission. A spectral analysis of the different emission components is presented. The implications of these results on the origin of the positrons will be discussed.

## **High energy spectrum of the Crab Nebula: an absolute spectrum from SPI observations**

*E. Jourdain, J.P. Roques*

We report on detailed Crab nebula observations with SPI. We will show the stability of the instrument and the quality of the data. We present an absolute Crab nebula spectrum based on extensive pre-launch calibration effort. These results allow us to discuss the detailed spectral shape of the Crab nebula from 25 keV to a few MeV.

## **TeV Observations of the Binary Pulsar PSR B1259-63/SS 2883 near 2007 Periastron with H.E.S.S.**

*M. Kerschhaggl, F. Aharonian, J. Hinton, D. Khangulyan, U. Schwanke on behalf of the H.E.S.S. Collaboration, M. Chernyakova, T. Takahasi, Y. Uchiyama*

The binary pulsar system PSR B1259-63/SS 2883 is known as a variable TeV gamma-ray emitter since its first detection by H.E.S.S. around the last periastron in 2004. Being the first detected of the TeV gamma-ray binaries, similar to objects like LS 5039 and LS I+61 303, it represents a very interesting laboratory for the study of pulsar wind interactions with the ambient radiation field and circumstellar matter outflow from a massive companion star. The interaction mechanisms like particle acceleration due to pulsar wind termination shock dynamics and subsequent emission of TeV photons, are expected to become efficient near the periastron of the highly eccentric ( $e=0.87$ ) pulsar orbit, where the separation between the two objects is  $\sim 0.7$  AU. As the orbital period of the system is roughly 3.4 years the next periastron since the first VHE observations took place on July 27, 2007. The lack of pre-periastron VHE lightcurve data of this source motivated therefore a 60h H.E.S.S. observation campaign for this passage. The results of this campaign will be discussed, compared to previous data and interpreted within the framework of current models.

## **Energetic Particle Properties from Gamma-Ray Line Observations of Solar Flares**

*Jürgen Kiener*

Gamma-ray line observations of solar flares benefit from the high resolving power inherent to Ge detectors since the launch of RHESSI and INTEGRAL in 2002. Both satellites are equipped with gamma-ray cameras consisting of high-volume HP-Ge detector arrays with imaging capabilities. Three flares with gamma-ray line emission have been observed by INTEGRAL, among them the very intense flare of Oct. 28, 2003 providing one of the highest-quality gamma-ray line data of solar flares up to now. After a brief description of the gamma-ray production in solar flares, the analysis of the gamma-ray lines observed with the INTEGRAL spectrometer SPI will be presented. The results concerning the composition, the spectral and the directional distribution of the energetic particles interacting within the solar atmosphere will be discussed.

## **INTEGRAL observations of Her X-1**

*D. Klochkov, R. Staubert, K. P. Postnov, N. I. Shakura, A. Santangelo, J. Wilms, I. Kreykenbohm, C. Ferrigno*

INTEGRAL observations of the intermediate mass X-ray binary system Her X-1/HZ Her are analyzed in the context of other X-ray observations of the source (RXTE, CGRO/BATSE). Short-time scale variations of the 1.24s pulse period are studied. A positive correlation between the X-ray luminosity of the source and the spin-up rate of the neutron star is reported. The value of the magnetic field strength found from this correlation is consistent with the one derived from the energy of the cyclotron line. Evolution of the X-ray pulse profile with 35d phase is discussed. Pulse-phase variability of the spectral continuum and the cyclotron line parameters is explored. Spectral changes during X-ray dips are studied.

## **$^{26}\text{Al}$ Spectroscopy and Structure & Kinematics in the inner Galaxy**

*K. Kretschmer, R. Diehl, W. Wang, H. Halloin, M. Lang*

We investigate the spatial distribution and kinematics of interstellar gas in the inner Galaxy through high-resolution spectroscopy of the  $^{26}\text{Al}$  line, analyzing Doppler motion. The radioactive  $^{26}\text{Al}$  is produced by massive stars, the angular and radial velocity distributions of the line emitted when it decays can be used to infer the conditions in the surrounding ISM. We measure the line position and shape resulting from Doppler shifts due to both Galactic rotation and the source specific motion such as stellar winds by fitting the SPI data with parametric models of the  $^{26}\text{Al}$  emission in the inner Galaxy. We compare different models of the Galaxy's disk and spiral arm components and a suggested bar structure.

## **Review of accreting pulsars observed by INTEGRAL**

*I. Kreykenbohm, R. Staubert, J. Wilms, J. Torrejon, P. Kretschmar, S. Fritz, D. Klochkov, A. Santangelo*

We review some highlights on accreting X-ray pulsars. Specifically we will discuss the spectral and temporal analysis of 4U 1909+07 and Vela X-1 (among others). 4U 1909+07 is a poorly studied source in the GRS 1915 region which was only recently discovered to be a pulsar. We show that the source has a remarkable high energy pulse profile and has recently undergone a torque reversal. Vela X-1 on the other hand is a very well known source that triggered some excitement when it displayed unexpected giant flares. We present the results of a thorough analysis of the full data set including the detection of off states.

## **Large Scale structure of the local Universe with INTEGRAL observatory**

*Roman Krivonos*

All-sky hard X-ray survey obtained recently with the INTEGRAL observatory provides a unique tool for studying the Large Scale Structure of the local Universe. Obtained sample of hard X-ray emitting AGNs provides the unbiased (free from influence of intrinsic photoabsorption) census of the nearby accreting supermassive black holes. We detect spatial anisotropy of distribution of INTEGRAL AGNs and show that it well correlates with known nearby anisotropies of the matter density distribution. Using AGN sample from INTEGRAL all sky survey we for the first time directly show that the density fluctuations of the matter in the local Universe linearly translates into the density fluctuations of accreting supermassive black holes and measure their zero redshift bias factor.

## **INTEGRAL data user access - INTEGRAL Source Results lists and beyond**

*Petr Kubanek, Rene Hudec*

INTEGRAL data are complex in nature. For science publications, they are used after they are processed by OSA. This tedious process is right for regular users, which are familiar with it. But it present significant barrier for scientists working with data from other instruments, which are only interested in having quick look on INTEGRAL data. In this poster, we present INTEGRAL Source Results pages, which were designed for quick access to processed data. We discuss the Virtual Observatory, and it possible integration to INTEGRAL data access possibilities.

## **Gamma-ray pulsar studies with INTEGRAL**

*Lucien Kuiper, Wim Hermsen, H. Ur Rehman*

Before the launch of INTEGRAL the number of spin-down powered pulsars detected to emit soft gamma rays in the INTEGRAL window between 50 keV and 10 MeV was only 4: the Crab, Vela, PSR 1509-58 and PSR B0540-69. This small sample showed very different characteristics. Exploiting INTEGRAL and RXTE data, four new young soft gamma-ray pulsars have been detected. In this presentation these new findings will be presented, as well as the status of INTEGRAL studies of the above mentioned pulsars and millisecond pulsars.

## **Swift/INTEGRAL observations of cataclysmic variable**

*R. Landi & M.T. Fiocchi*

INTEGRAL/IBIS survey observations have revealed that cataclysmic variable (CVs) are emitters at high energy bands. In particular, the third IBIS/ISGRI catalog lists 22 CVs most of which observed for the first time at high energies. Recently, some of these sources have been observed with the X-ray Telescope (XRT) on board the Swift satellite and their spectra measured in the 0.2-10 keV energy band. By combining XRT and INTEGRAL observations it is possible to study these objects in a wide range of energies (typically 0.8-100 keV), which is crucial in determining the different components and completely characterize their X-/gamma-ray emission. Here we present a preliminary work aimed at investigating the spectral behaviour in the soft and hard X-ray bands of 3 newly discovered CVs (IGR J16167-4957, IGR J17303-0601 and IGR J17195-4100).

## **Study of the galactic structure using the millisecond pulsars timing**

*T.Larchenkova*

We considered the possibility to use observations of millisecond pulsars to identify invisible compact objects and to study the distribution of both visible and dark matter in various components of our and nearby galaxies. The method based on the relativistic time delay of pulsars radiation in the gravitational field of a massive body located close to the line of sight. This effect doesn't depends on the energy band and can be observed also in hard X-rays. On the example of our Galaxy we have derived dependences of the event probability on the Galactic latitude and longitude of sources for different models of the mass distribution and estimated rates of such events.

## **High energy spectra of microquasars**

*Piotr Lubinsk*

Currently INTEGRAL is the only mission providing spectra in 300-600 keV range. This allows for studies of non-thermal components in the spectra of various objects. In this talk the results of studies of hard X-ray/soft gamma-ray spectra emitted by the brightest microquasars will be presented. In addition to the previous INTEGRAL results PICsIT spectra are used. Based on a new method that incorporates a careful modelling of background and handles directly the probability density distributions, PICsIT spectra are more accurate for crowded fields above 300 keV than the SPI spectra. Moreover, PICsIT calibration appears to be very good when compared with SPI.

## **Unusual bright state of the X-ray pulsar 4U0352+309/X Persei**

*Lutovinov A., Chernyakova M., Revnivtsev M., Lyuty V.*

We present results of analysis of the binary system 4U0352+309/X Persei, performed during long time in the optical, X-ray (RXTE observatory) and hard X-ray (INTEGRAL observatory) energy bands. We draw our attention to the significant (in several times) increasing of the X-ray source intensity in 2001-2004 and studied possible changes in source spectral parameters, pulse period as well as correlation between X-ray and optical fluxes. We also report for the first time a significant detection of the source emission in the energy range  $> 100$  keV.

## Observations of the Coma Cluster with INTEGRAL

*Lutovinov A., Vikhlinin A., Churazov E.*

Results of a broadband study of the Coma cluster are presented. Using data of INTEGRAL, RXTE and ROSAT observatories we reconstructed the Coma spectrum in a 0.7-100 keV energy band and found that it can be well approximated by a MEKAL model with the temperature of  $\sim 8.2$  keV. The cluster hard X-ray flux (44-107 keV) detected at the significance level of  $\sim 1.5$  sigma are in an agreement with previous results of BeppoSAX and RXTE. We also built the temperature map of the central part of the cluster and shown that the gas temperature is varied from  $\sim 7$  to  $\sim 12$  keV.

## INTEGRAL/IBIS observations of Narrow Line Seyfert 1s

*A. Malizia, L. Bassani, N. Masetti, et al.*

Narrow Line Seyfert 1 galaxies (NLS1) are very interesting objects which display particular properties. The presence of extreme spectral complexity has also been found in the X-ray waveband. Characterization of their hard X-ray spectra ( $> 10$  keV) is of crucial importance in order to discriminate between the two models (partial covering versus reflection) invoked to explain this complexity in the X-ray band. The INTEGRAL/ISGRI spectra (17-100 keV) of the four NLS1 objects detected in the third IBIS survey have been analyzed and for two sources Swift/XRT data (2-8 keV) have been used in order to perform the broad band spectral analysis. The high energy spectra of the four NLS1 observed by INTEGRAL seem to be significantly steeper compared with those of classical Seyfert 1 galaxies. In the two cases where we could perform broad band spectral analysis, we found a 0.5-100 keV continuum well fitted by a power law of photon index of about 2 but with a strong reflection component and a cut-off energy ( $< 100$  keV) lower than in classical type 1 Seyfert galaxies. With the exception of a couple of NLS1 detected at high energies by the PDS instrument on board BeppoSAX, these are the first detections of this class of AGN above 10 keV.

## The Cygnus region seen in gamma-ray lines

Implications on massive stars nucleosynthesis and evolution

*Pierrick Martin, Jürgen Knödlseder*

We report on a search for the most famous gamma-ray lines ( $^{26}\text{Al}$ ,  $^{60}\text{Fe}$  and 511 keV) in the Cygnus area. The region is thought to harbor one of the most important concentrations of massive stars of the Galaxy, especially the young globular cluster Cyg OB2, but very few supernova remnants. This particular feature is exploited to assess our current understanding of massive star evolution and nucleosynthesis. The observations performed with INTEGRAL/SPI are compared to the theoretical predictions from some of the latest stellar and nucleosynthesis models.

## **The quest for the nature of unidentified INTEGRAL sources**

*N. Masetti*

The surveys of the hard X-ray sky performed with INTEGRAL have shown that about one fourth of the detected objects are unidentified or unclassified sources. We here present the main results of our program for the identification of the nature of these sources through optical spectroscopy.

## **Possible optical-TeV correlation in blazars and new constraints on extragalactic background light derived from MAGIC data of distant sources.**

*D. Mazin for the MAGIC Collaboration*

The MAGIC collaboration is performing Target of Opportunity (ToO) observations whenever alerted that blazars were in a high flux state of optical emission. Here we report on triggered observations, results of the analysis, and a possible optical-TeV correlation seen in the data. Furthermore, we present constraints on the density of extragalactic background light from optical to mid infrared. The constraints are derived using very high energy gamma-ray spectra of distant blazars.

## **Polarisation studies of the prompt emission from GRB 041219a using SPI**

*S. McBreen, S. McGlynn, D. J. Clark, A. J. Dean, L. Hanlon, B. McBreen, A. J. Bird, S. Foley*

A search for linear polarisation in the most intense pulse of duration 66 seconds and in the brightest 12 seconds of GRB 041219a was performed in the 100–350 keV, 100–500 keV and 100 keV–1 MeV energy ranges. The multiple event data from SPI was analysed and compared with the predicted instrument response obtained from Monte-Carlo simulations. The degree of polarisation in the brightest pulse (66 s) was found to be  $63 \pm 31\%$  at an angle of  $70 \pm 14$  degrees in the 100–350 keV energy range. The degree of polarisation was also constrained in the brightest 12 s of the GRB and a polarisation fraction of  $96 \pm 40\%$  at an angle of  $60 \pm 14$  degrees was determined over the same energy range. However, extensive analysis and simulations could not definitively exclude a systematic effect that could mimic the weak polarisation signal. We conclude that the procedure described here demonstrates the effectiveness of using SPI as a polarimeter, and is a viable method for measuring polarisation levels in intense GRBs.

## The INTEGRAL look on the high energy extragalactic sky

*Manuela Molina*

The latest IBIS/ISGRI catalogue (Bird et al. 2007) lists 421 sources, of which 125 are classified as AGN or AGN candidates. This number, however, is still increasing as more and more data become available, thus providing an excellent starting point for an in depth analysis of different classes of high energy emitting extragalactic sources. Amongst the extragalactic objects detected by INTEGRAL there are, a part from "normal" Seyfert galaxies, heavily obscured sources, Narrow Line Seyfert 1s and also Broad Line Radio Galaxies. Particularly, INTEGRAL can contribute to a better understanding of the high energy behaviour of radio galaxies, which recent studies have shown to have peculiar high energy characteristics, such as, for instance, very complex absorption. Thanks to INTEGRAL, and its imager IBIS, these sources can now be studied from a different point of view: broad-band spectra can be obtained by combining INTEGRAL data and other X-ray missions measurements, offering a wider view and understanding of the phenomena occurring in the central engines of AGN.

## The deepest INTEGRAL extragalactic field

*S. Paltani, R. Walter*

We present a deep imaging analysis in the 20-60 keV energy range of the field around 3C 273 observed with the IBIS/ISGRI imager on board the INTEGRAL satellite. We use all available pointings around 3C 273. The total exposure time is about 4 Ms, with an effective exposure time close to 700 ks on 3C 273. The  $5\sigma$  flux limit reaches  $0.5 \cdot 10^{-11} \text{ erg s}^{-1} \text{ cm}^{-2}$  in the most exposed areas. We detect 31 sources with a significance of  $5\sigma$  or more. We find a surface density of about 0.04 sources per deg<sup>2</sup> at the faintest flux limit. We check the counterparts of these sources, and find 17 Seyfert galaxies and 2 blazars. Some normal galaxies are also detected, but most remaining objects are unidentified. The fraction of objects with intrinsic hydrogen column absorption  $N_{\text{H}} > 10^{22}$  is at least 47% and at most 68%.

## INTEGRAL's Mission Perspective

*A.N. Parmar, P. Kretschmar, M. Schmidt, C. Winkler*

After 5 years in orbit INTEGRAL is in great shape with sufficient resources to last for many more years. The instruments are working well and bringing home the science they were designed for. In order to continue operating INTEGRAL and XMM-Newton beyond 2010, within the budget allocated to astronomy mission extensions, it is necessary to reduce costs. This will be achieved by combining the MOC teams operating INTEGRAL and XMM-Newton and other savings. This "Revised Operations" concept will be described in my talk together with the prospects for the further extension being requested to the Science Programme Committee in November.

## **New SPI Housekeeping & Source Results Web Pages**

*D. Petry, X. Zhang*

We are now providing a new service for the scientific community which consists of two sister webpages: one for SPI Science Housekeeping (created by Xiao-Ling Zhang) and one for SPI Revolution-wise Point Source Results (created by Dirk Petry). Both are meant to help the general user to judge the quality of a given dataset and understand the achieved sensitivity. They also provide a quick-look analysis for bright point sources. The poster will describe the main features of the pages.

## **TeV sources as seen by SPI**

*D. Petry*

There are now more than 50 known astronomical sources of gamma-rays above 200 GeV. Among these sources are many AGN and many unidentified objects. At least for these, the origin of their high-energy emission is still poorly known. A decision between the two families of models, hadronic and leptonic, still remains to be taken. In order to come closer to the answer, precise hard X-ray spectra are very helpful since it is at energies above a few 10 keV where all models predict a second peak in the spectral energy distribution with subtle differences between the models. We use all available SPI data to provide average spectra of these counterparts or upper limits, where applicable, in the 20 - 8000 keV range and discuss implications for the models.

## **Resonant cyclotron scattering in magnetars' magnetosphere**

*Nanda Rea*

One of the recent breakthrough in the magnetar field was the INTEGRAL discovery of their hard X-ray emission. Customarily the soft and hard X-ray spectra of "magnetars" are empirically fitted with a three component model, an absorbed blackbody plus two power-laws. It has been recently proposed that the presence of a hot plasma in magnetars' magnetosphere might distort, through efficient resonant cyclotron scattering, the thermal emission from the neutron star surface, resulting in production of non-thermal spectra. Under certain magnetospheric conditions this process might be also responsible for the hard X-ray emission discovered by INTEGRAL. Here we present the development and the applications of this resonant cyclotron scattering model to all the known "magnetars". We found that this process might explain well the 0.5-250keV spectral distribution of the anomalous X-ray pulsars (AXP), while it still has some difficulties in representing alone the persistent emission of soft gamma-ray repeaters (SGR). We then discuss the physical parameters we can infer from our modelling, as well as possible intrinsic differences between AXPs and SGRs.

## Young SNRs through the $^{44}\text{Ti}$ gamma-ray lines with IBIS/ISGRI

*Matthieu Renaud*

The  $^{44}\text{Ti}$  isotope belongs to the rare class of radioactive nuclei accessible to gamma-ray astronomy. It is exclusively produced in SNe explosions and has a lifetime of  $\sim 86$  years. Its decay produces three gamma-ray lines which consequently provide a unique tool for probing the details of these stellar explosions, as well as finding young SNR-candidates in the Galaxy without the common ISM-extinction problem.

The INTEGRAL IBIS/ISGRI results, obtained during the first five years of the mission, on known SNRs like Cas A, Tycho and Vela Junior, will be presented. In addition, the problematic topic of the search for "hidden and missing" SNRs in the Galactic Plane will be reviewed.

## INTEGRAL contribution to the discovery of the nature of the Galactic ridge X-ray emission

*Mike Revnivtsev*

I would like to review recent advances in understanding of the nature of Galactic background emission with special emphasis on hard X-ray energy band. Combination of high sensitivity for detection of point sources with wide field of view of main INTEGRAL instruments allowed to solve long standing puzzle of hard X-ray background emission of our Galaxy. Using results of RXTE, CHANDRA and INTEGRAL observatories it become possible to demonstrate that the majority of the Galactic background emission is produced by a large number of accreting white dwarfs and coronally active stars. In the hard X-ray energy band the vast majority of the emission is provided by the accreting white dwarfs. Accurate measurements of the spectral shape of the Galactic background emission allowed to make estimate of the Galaxy-averaged mass of the white dwarfs.

## The enigmatic Seyfert core inside IGR J21247+5058

*Claudio Ricci, V. Beckmann, T.J.-L. Courvoisier, et al.:*

Among the sources discovered by INTEGRAL, the brightest AGN so far is IGR J21247+5058. It exhibits an average flux of about  $4.5 \cdot 10^{-11}$  ergs/cm<sup>2</sup>/sec in the 20-40 keV energy band. The hard X-ray source was identified to be a radio galaxy by Ribo et al. (2004) and Combi et al. (2004b). We present a detailed spectral and timing analysis of the object, based on new data from XMM-Newton, Swift, and INTEGRAL. The optical data seem to show a superposition of a star in the line of sight and the AGN itself. But X-ray and radio data confirm that the source hosts a moderately absorbed Seyfert core inside a radio galaxy.

## **TeV Observations of microquasar candidates with the MAGIC telescope**

*J. Rico for the MAGIC Collaboration*

MAGIC is a telescope for Very High Energy ( $E > 100 \text{ GeV}$ ) astronomy. During the first two years of observations it has observed several microquasar candidates. In this talk we will review the most important experimental results obtained, namely, the discovery and detailed study of LS I +61 303 and the evidence of emission of the black-hole X-ray binary Cygnus X-1

## **High Energy Sources Observed with OMC.**

*D. Rísquez, A. Domingo, J.M. Mas-Hesse, E. Kuulkers.*

The INTEGRAL Optical Monitor Camera, OMC, has detected many high energy sources. We have obtained V-band fluxes and light-curves for their counterparts. In the cases of previously unknown counterparts, we have searched for characteristic variations in optical sources around the high-energy target position. Results about Galactic Bulge Monitoring, IGRs, and many other high energy sources will be presented. We will also discuss the implications of the correlation/non-correlation between the optical and high energy emissions in different kind of objects.

## **High energy emission of compact objects with SPI**

*J.P. Roques, E. Jourdain, L. Bouchet*

Thanks to more than 4 years of observations a significant number of sources has been detected in the hard X-ray domain. We have especially studied the presence of a high energy tail ( $E > 200 \text{ keV}$ ) for some of them. Such a feature, even though already observed by high energy instruments, is still controversial but of particular interest to understand the source evolution through their various states. SPI observations reveal that such features might be common in the spectrum of hard X-ray sources.

## **The high energy spectrum of 1E1740.7**

*J.P. Roques, E. Jourdain, L.Bouchet, A. Bazzano, M. del Santo.*

We present the spectrum of 1E1740 in the hard state as revealed by 4 years of Integral observation. The high SPI sensitivity at high energy has been combined with the excellent ISGRI/IBIS angular resolution in order to extract the source spectrum in this crowded region. The spectrum extends up to 800 keV and confirms the peculiar nature of this source. The high energy emission and its variability will be discussed.

## **Statistics of local hard X-ray selected AGN: clues for the CXB and unification model.**

*Sergey Sazonov*

Abstract: The recently completed INTEGRAL hard X-ray all-sky survey provides a sample of more than 100 nearby AGN selected without regard to absorption effects. I will report a number of results from this survey, including the hard X-ray luminosity function, absorption column density distribution, large-scale spatial distribution and composite hard X-ray spectrum of local AGN and discuss the implications for the cosmic X-ray background and AGN unification model.

## **Using GRO J1655-40 to test Swift/BAT as a monitor for bright hard X-ray sources**

*F.Senziani, G.Novara, A.De Luca, P.A.Caraveo, T.Belloni, G.F.Bignami*

While waiting for new gamma-ray burst detections, the Burst Alert Telescope (BAT) onboard Swift covers each day 50% of the sky in the hard X-ray band ("Survey data"). Thanks to its large field of view (FOV), high sensitivity and good angular resolution, BAT can be used as an all-sky hard X-ray monitor. We have developed and tested a complete procedure entirely based on public Swift/BAT software tools to analyse BAT Survey data, aimed at assessing the flux and spectral variability of bright sources in the 15-150 keV energy range. As a first step, we analyzed a set of Crab observations spread over 7 months. The Crab tests have shown that our procedure recovers both the flux and the source spectral shape over the whole FOV of the BAT instrument. Next, we studied the case of GRO J1655-40, a strongly variable source, which experienced a 9-month long outburst, beginning on February 2005. Such an outburst was systematically monitored with the well-calibrated PCA and HEXTE instruments onboard the RXTE mission. Thanks to the good BAT temporal coverage of the source, we have been able to cross-check BAT light-curves with simultaneous HEXTE ones. Using our procedure, BAT reproduces HEXTE fluxes within a 10-15% uncertainty with a 3 sigma sensitivity of about 20 mCrab for an on-axis source, thus establishing its capability to monitor the spectral and flux evolution of relatively bright hard X-rays sources.

## Cyclotron Harmonic Lines and Distances to X-ray Pulsars

*A.V.Serber*

Motivated by observations of absorption harmonically spaced features in spectra of several X-ray pulsars, we apply the analytical non-LTE theory of cyclotron-line formation in the hot spot of an X-ray pulsar to interpret the observational results. The line-forming region is modeled by a plane-parallel slab permeated by a uniform magnetic field. Since the time of cyclotron radiative transitions of electrons at the first harmonic is much shorter than the time between particle collisions, transfer of the first-harmonic radiation is dominated by resonance scattering, while the higher-harmonic emissivities and opacities are functions of the specific intensity  $IE(EB)$  at the first cyclotron harmonic  $EB$  in the source. This means that the relative intensities of cyclotron lines at the higher harmonics are determined not only by the hot-spot plasma parameters, but also by the value of  $IE(EB)$ . Hence, interpretation the observed cyclotron harmonic lines within the framework of our model yields the value of  $IE(EB)$ , and the distance  $d$  to the source can be determined simply by the inverse square law scaling the obtained intensity in the source,  $IE(EB)$ , to the observed flux  $FE(EB)$  at the first harmonic:  $FE(EB) \propto IE(EB) [D^*/d]^2$ , where  $D^* \sim 1$  km is the hot-spot size. Thus, distances to X-ray pulsars can be evaluated using the relative intensities of the cyclotron harmonic lines and the observed radiation flux at the first harmonic.

## Supergiant Fast X-ray Transients observed with INTEGRAL

*Vito Sguera*

The IBIS instrument onboard INTEGRAL is playing a key role in unveiling a new class of Supergiant High Mass X-ray binaries (SGXBs) which has been named as Supergiant Fast X-ray Transients (SFXTs). Most of the time they are undetectable, then occasionally they undergo fast X-ray transient activity lasting less than a day, typically a few hours. This kind of X-ray behaviour is very surprising since classical SGXBs were, until recently, only seen as bright persistent X-ray sources. To date, eight firm SFXTs have been reported in the literature in a few years so that their number is already comparable to that of persistent classical SGXBs discovered in almost 40 years of X-ray astronomy. A detailed study of a 3 year database of IBIS observations, from February 2003 to April 2006, has been performed to search for fast X-ray outbursts. As a result, we will present detailed temporal and spectral analysis of all 8 known firm SFXTs as well as 3 candidates SFTXs. An investigation of the general timing and spectral characteristics of the entire sample of SFXTs will be also presented.

## The wind structure in Supergiant Fast X-ray Transients: the case of IGRJ11215-5952

*Sidoli L., et al.*

The monitoring of the X-ray emission from the unique Supergiant Fast X-ray Transient known to undergo periodic outbursts, IGRJ11215-5952, is particularly interesting, since it allows to constrain the wind structure of the supergiant donor and to unveil the outburst mechanism in Supergiant Fast X-ray Transients. The X-ray observations of the latest outburst in 2007, together with a campaign of the quiescent emission, are discussed. A new mechanism to explain the short outbursts in this new class of transients is presented.

## **The multiwavelength variability of 3C273.**

*Simona Soldi, M. Tuerler, S. Paltani, T. J.-L. Courvoisier, M. Chernyakova, on behalf of a larger multiwavelength collaboration.*

We updated a multiwavelength database of 3C273, one of the best observed quasars at all energies, concentrating on the X-ray data, where in the last 10 years a large number of observations have been performed by BeppoSAX, RXTE, XMM, INTEGRAL and Swift. We analyse 3C273's variability behaviour using different approaches. Preliminary results show that both the variability amplitude and the characteristic time scale of variability strongly depend on the frequency, allowing to identify at different energies, from radio to gamma-rays, the contribution and the inter-connections of the different processes, e.g. synchrotron, dust emission, disk emission, and suggesting that External Compton models are more likely to explain the high energy emission of this very peculiar object.

## **Notes on free precession in the neutron star Her X-1**

*R. Staubert*

The fundamental physical process of free precession may be at work in several well known neutron stars, including Her X-1. We will present new observational evidence for free precession (on a  $\sim 35$  day timescale) in Her X-1 and will discuss its relationship to the precession of the accretion disk.

## **EGRET/INTEGRAL cross-correlation studies: a few likely associations and prospects for GLAST**

*J.B. Stephen et al*

More than sixty percent of the 271 high energy gamma-ray sources reported in the 3rd EGRET Catalogue are unidentified, with no firmly established counterparts at other wavebands, and the identification of these objects is one of the great challenges of contemporary gamma-ray astronomy. The main drawback in identifying EGRET sources is their large error boxes with positional uncertainties often more than a degree, including unknown systematic shifts due to the diffuse background model and confusion with weaker sources, therefore a positional correlation with a known object is usually not enough information with which to identify a source. For this reason, a multiwavelength approach, using X-ray, optical, and radio data is often needed in order to understand the nature of these sources. Searches for X-ray counterparts, particularly at higher energies, are useful in finding a positionally-correlated, highly-unusual object with special parameters that might be expected to produce high energy gamma rays. The IBIS imager on the INTEGRAL satellite is particularly suited for this type of search as it offers 3 great advantages: a) it allows a full contemporaneous coverage of the EGRET error box, b) it provides arcminute location accuracy and good sensitivity at the mCrab level and c) it gives information in an energy band which is much closer to the EGRET regime than usually obtainable with X-ray satellites. A correlation analysis between the catalogue of IBIS/ISGRI detections above 20 keV and the 3rd EGRET catalogue can be used to assess in a statistical manner the reality of the above mentioned coincidences as well as to highlight others that could result from this study. It also provides insight into the nature of these gamma-ray emitters: detection or lack of such in the IBIS band clearly helps in characterizing their spectral energy distribution and therefore their nature.

## **INTEGRAL Observations and Chandra follow-up of the X-ray flash XRF 040812**

*G. Stratta, G. De Cesare, P. Ubertini, A. Tarana*

The X-ray flash XRF 040812 has been detected by IBIS/ISGRI in the 15-200 KeV band with the INTEGRAL Burst Alert System on August 12, 2004 at 06:01:50UT. After the first GCN, which reports source position with an accuracy of 2 arcmin, radio, optical and X follow up observations have been performed. In particular, about 5 days after the prompt emission, an X-ray Chandra counterpart has been identified in the IBIS error box. We present a detailed spectral and temporal analysis of both the prompt and the afterglow emission. We then compared our results with the currently available sample of XRFs.

## **Interstellar and source contributions to Galactic high-energy emission**

*A. Strong, R. Diehl, D. Petry, I.V. Moskalenko, T. Porter, E. Orlando*

Currently available SPI data are used to produce a new spectrum of the diffuse Galactic continuum emission. Combining this with data from other missions, we re-evaluate the interstellar non-thermal emission from keV to TeV energies, using latest gas data and interstellar radiation fields, and current cosmic-ray data. In addition we make a re-evaluation the contribution of point-sources to the unresolved Galactic emission.

## **The Hard X-Ray Emission from Scorpius X-1 as Seen by INTEGRAL**

*S. J. Sturmer, G. Weidenspointner, C. R. Shrader*

We present the results of our hard X-ray and gamma-ray study of the LMXB Sco X-1 utilizing INTEGRAL IBIS/ISGRI and SPI data as well as contemporaneous RXTE PCA data. We have concentrated on investigating the high-energy spectral properties of the Sco X-1 including the nature of the high-energy spectrum and its possible correlations with the location of the source on the color-color diagram. We also present the results of a search for positron-electron annihilation line emission from Sco X-1, as it is the brightest of a bulge X-ray binary population which approximately traces the 511-keV spatial distribution inferred from SPI.

## **Suzaku Broadband Observations of Galactic Black Hole Binaries in the Low/Hard states**

*Hiromitsu Takahashi and the Suzaku team*

We present Suzaku observational results of two Galactic black hole binaries, Cyg X-1 and GRO J1655-40, in the low/hard state. With the broad-band spectral analysis from sub keV to several 100 keV, both sources show high-energy spectral cutoffs around  $\sim 100$  keV, and have the harder photon index above 10 keV than that in the softer energy band. This feature cannot be reproduced by a single thermal-Comptonization model, even considering reflection effects. Instead, the spectra (except the soft excess) can be successfully explained by invoking two thermal-Comptonization components with different  $y$ -parameters. We also discuss spectral differences between the two sources, attributing their different system inclination.

## **Suzaku observations of SNR RX J1713.7-3946 in the energy range up to 40 keV**

*Takaaki Tanaka, Yasunobu Uchiyama, Tadayuki Takahashi, Felix Aharonian, Aya Bamba, Junko Hiraga, Una Hwang, Jun Kataoka, Tetsuichi Kishishita, Motohide Kokubun, Kazuhiro Nakazawa, Robert Petre, Hiroyasu Tajima*

The supernova remnant RX J1713.7-3946 is a prominent source of nonthermal X-rays and TeV gamma-rays and provides strong evidence that shell-type SNRs are sites of acceleration of galactic cosmic rays. In order to study the nature of the nonthermal X-ray emission, we performed broadband X-ray observations with the Suzaku satellite. We have covered almost the entire remnant with 11 pointings. Thanks to the low background of the HXD, we have successfully detected hard X-ray up to 40 keV, and, together with the XIS data, we have obtained broadband spectra ranging from 0.4 keV to 40 keV. Based on the Suzaku data, we will discuss the implication for the particle acceleration in the remnant. We will also show results from multi-wavelength studies.

## **INTEGRAL and RXTE observations campaign of the Atoll source 4U 1728-34**

*Antonella Tarana*

We report results on the Low Mass X-ray Binary 4U 1728-34 with an INTEGRAL and RXTE long observations campaign, starting on 2006 March up to 2007 June. From the light curves in different energy range, spanning between 3 to 300 keV, and the hardness intensity diagram we show the source repeatedly moves from the banana to the island state. We report the spectral and timing results, and finally compare this source behaviour to the other Atoll ones.

## **AGILE in orbit**

*Marco Tavani on behalf of the AGILE Team*

The Italian gamma-ray mission AGILE was successfully launched on April 2007 and is devoted to the study of the high-energy Universe. Its instrument is highly innovative and compact, and combines a Silicon Tracker sensitive in the range 30 MeV-30 GeV with a hard X-ray imager (20-60 keV), a Calorimeter (0.4-100 MeV), and an anticoincidence system. We will present the first scientific results of the mission obtained during its initial science verification phase.

## **High-energy results of the Galactic-Center campaign 2007**

*G.Trap, A.Goldwurm, R.Terrier, G.Belanger, M.Falanga, D.Porquet*

Over the past decade, a wealth of data and discoveries about the Galactic Center have piled up, especially thanks to broad simultaneous multiwavelengths monitoring of this region. More specifically, Sagittarius A\*, the supermassive black hole lurking there, has been witnessed flaring several times, both at infrared and X frequencies. A new extensive campaign gathering telescopes from radio to gamma, was carried out last spring and detected activity from Sagittarius A\*. We will report INTEGRAL's results and compare them to XMM's observations. In addition, the study of two transient X-ray sources in outburst during the campaign will be presented.

## **IBIS/ISGRI Spectrum of the Cosmic X-ray Background from INTEGRAL's Earth Observation**

*Marc Türler (and several other ISDC scientists)*

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 consistent with the historic cosmic X-ray background (CXB) spectrum of HEAO-1 with a normalization  $\sim 10\%$  higher. We present here a completely different analysis of the IBIS/ISGRI data with the improved energy calibration of OSA 7. Our approach consists in fitting the observed detector lightcurves by the modulation expected from the Earth emission and its occultation of the CXB, the galactic ridge emission and several point sources. By doing this in different energy bins, we derive a model-independent spectrum of the CXB in the 15-100 keV band.

## **Formation of relativistic electron spectra through diffusive shock acceleration and their losses in radiation dominated environments.**

*Giulia Vannoni*

We discuss the impact of inverse Compton losses on the shock acceleration of electrons which takes place in radiation dominated environments, i.e. in regions where the radiation energy density exceeds that of the magnetic field. We demonstrate, through accurate numerical calculations, that the inverse Compton losses of electrons, in the Klein-Nishina regime, lead to spectra of ultra-relativistic electrons which may significantly differ from classical Diffusive Shock Acceleration solutions. We discuss the implications of this effect on the hard X-ray synchrotron and gamma ray inverse Compton radiation, produced by shock accelerated electrons in young supernova remnants in the presence of large radiation fields (e.g. in the galactic center). We also discuss possible implications of our results for clusters of galaxies.

## **INTEGRAL Observations of the Blazar Mrk 421 in Outburst**

*Andreas von Kienlin*

A ToO observation of the TeV-emitting blazar Mrk 421 with INTEGRAL was triggered in June 2006 by an increase of the RXTE count rate to more than 30 mCrab. The source was then observed with IBIS, JEM-X and OMC of INTEGRAL for a total exposure of 829 ks. During this time several outbursts were observed. Multi-wavelength observations were immediately triggered and the source was observed from radio up to TeV energies. The data obtained during these observations were analysed with respect to correlated variability, time lags, spectral evolution and hardness ratios. A quasi-simultaneous energy-density spectrum was composed and compared with theoretical models. The results of the analysis will be presented.

## **INTEGRAL observations of new HMXB systems unveil clumpy stellar winds**

*R. Walter et al*

Evidences for the clumpiness in the winds of massive star are coming from various observations in the optical and high energy domain and from hydrodynamic modelling. Clumpiness has important implication for the mass loss rate determination in massive stars and consequently on the their evolution and the evolution of Galaxies. In super-giant HMXB, the structure of the stellar wind can be directly studied using the compact object as a probe. INTEGRAL discovered many of those systems and the high-energy data could be used to constrain the structure (density, size, mass loss) of stellar wind clumps.

## SPI Detection of $^{60}\text{Fe}$ Radioactivity in the Galaxy

*W. Wang, M. Lang, M. Harris, H. Halloin, R. Diehl*

The long lived radioactive isotope  $^{60}\text{Fe}$  ( $\tau=2.2$  My) is believed to be co-produced with  $^{26}\text{Al}$  by massive stars and core-collapse supernovae in the Galaxy. From combined SPI data of INTEGRAL's survey observations, using suitable background models, we clearly detected the two decay lines from  $^{60}\text{Fe}$  decay at 1173 keV and 1333 keV. The average line flux from combination of both lines and both SPI event types is  $4.4 \pm 9 \times 10^{-5}$  ph cm $^{-2}$  s $^{-1}$  rad $^{-1}$  for the inner Galaxy. Our same analysis for  $^{26}\text{Al}$  flux determines the flux ratio between  $^{60}\text{Fe}$  and  $^{26}\text{Al}$  gamma-rays to  $(15\pm 6)\%$ . These results are consistent with predictions from theoretical models. We discuss the uncertainties in all different aspects of the measurement and of the theoretical models and their implications on this diagnosis of massive-star nucleosynthesis.

## Large-scale properties of Galactic $^{26}\text{Al}$ emission

*Wang W., Diehl R., Halloin H., Kretschmer K., Lang M.*

$^{26}\text{Al}$  emission traces current nucleosynthesis across the Galaxy. Observations of the 1808.65 keV gamma-ray line with the high-resolution spectrometer SPI provides constraints on the kinematic properties of interstellar gas in the  $^{26}\text{Al}$  source regions, in addition to a new and independent view at the earlier measurements from, e.g., the COMPTEL sky survey. The general result of extended  $^{26}\text{Al}$  emission along large parts of the Galaxy's plane is confirmed. The  $^{26}\text{Al}$  gamma-ray line is found to be rather narrow, suggesting interstellar velocities not in excess of about 100 km/sec in the source regions. We present an update of the  $^{26}\text{Al}$  line width constraints, extending it beyond the inner-Galaxy region, and also separating different regions of the Galaxy. We discuss implications for the Galaxy's massive star population and their surroundings.

## The sky distribution of 511 keV line emission: status

*G. Weidenspointner, G. Skinner, P. Jean, J. Knödlseher, P von Ballmoos, R. Diehl, A. W. Strong, B. Cordier, S. Schanne, C. Winkler*

We present the status of our studies of the sky distribution of 511 keV line emission after about 4 years of observations. We demonstrate that utilizing SPI the latitude distribution of 511 keV line emission from the Galactic disk can, for the first time, be constrained. However, concerning the central region of our Galaxy, the existing sky coverage is still insufficient to distinguish "bulge like" of "halo like" emission from the central cusp. This distinction, as well as a definitive determination of the latitude extent of the disk emission, will crucially depend on the continuation of observations at intermediate latitudes.

## **Are supergiant fast X-ray transient a new class of HMXB?**

*Juan A. Zurita Heras*

A new sub-class of high-mass X-ray binaries (HMXB) has recently emerged since the discovery of several transient supergiant HMXB with short luminous flares (minutes to few hours at maximum). These sources show features that are common to persistent accreting pulsars with hard X-ray spectra with a high-energy cutoff. However, their high-energy emission is transient with short flares and the luminosity show a large difference between the flare and the quiescent phases with varying factors higher than 100 in some sources. In a few cases, periodical modulations have been observed similar to the orbital periods of HMXB with Be companion star. From these observational features, these sources were classified as Supergiant Fast X-ray Transient (SFXT). We will present the observational characteristics of the whole SFXT candidates confronted to classical HMXB and determine their intrinsic properties. In particular, we will present new data and analysis on several SFXT candidates: IGR J16465-4507, AX J1749.1-2733 and AX J1845.0-0433, based on multiwavelength observations (from infrared to hard X-rays, ESO/NTT, XMM-Newton, INTEGRAL).

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