Exploring the Hot and Energetic Universe: the 3rd scientific conference dedicated to the Athena X-ray observatory

Report of Abstracts

Oral and e-poster contributions sorted by ID

https://indico.ifca.es/e/athena-2022

Abstract ID : **2**

Characterizing X-ray line complexes using cumulative distribution functions

Content

As part of the Spanish contribution to the X-ray Athena mission, an important effort has been invested in the detailed study of the impact of different algorithms devoted to the proper characterization of the energy of each photon that will be detected by X-IFU (see e.g., Ceballos et al. 2019ab, Cobo et al. 2020, Vega-Ferrero et al. 2022). The spectral resolutions achieved with the different strategies are evaluated by fitting X-ray line complexes corresponding to laboratory data generated with calibrated X-ray sources. Traditionally these data are binned in order to generate histograms which are subsequently fitted using the familiar chi-squared statistic or a maximum-likelihood approach (Fowler 2014).

In this work, we show how the use of cumulative distribution functions can be employed to determine the fit of X-ray line complexes constituted by several lines without the need to perform an a priori data rebinning. The method has been checked using simulated data, and the results indicate that it can recover photons beyond the fitting range. The procedure has been programmed in Python and the source code is publicly available.

Primary author: Dr CARDIEL, Nicolas (Universidad Complutense de Madrid)

Co-authors: Dr CEBALLOS, Maria Teresa (Instituto de Física de Cantabria); Dr COBO, Beatriz (Instituto de Física de Cantabria)

Presenter: Dr CARDIEL, Nicolas (Universidad Complutense de Madrid)

Contribution Type: e-poster

Status: ACCEPTED

Submitted by **CARDIEL, Nicolas** on **Monday, 25 April 2022**

Abstract ID : **3**

Paradigm shift in understanding the Galactic eROSITA Bubbles

Content

The magnificent bubbles at the Galactic center provide a great channel to understand the effects of feedback on galaxy evolution. The newly discovered **eROSITA bubbles** show enhanced X-ray emission from the shells around bubbles. Previous works assumed that the X-ray emitting gas in the shells has a single temperature component and that they trace the shock-heated lower-temperature Galactic halo gas. Here we show that the thermal structure of the eROSITA bubble shells is more complex. Using Suzaku observations we find with high confidence that the X-ray emission from the shells is best described by a two-temperature thermal model, one near Galaxy's virial temperature at kT ≈ 0.2 keV and the other at super-virial temperatures ranging between kT = 0.4 – 1.1 keV. Furthermore, we show that temperatures of the virial and super-virial components are similar in the shells and in the ambient medium, although the emission measures are significantly higher in the shells. We argued that **the X-ray bright eROSITA bubble shells are the signature of compressed isothermal radiative shocks**. The age of the bubbles is constrained to 40–60 Myr. This expansion timescale, as well as the observed non-solar Ne/O and Mg/O ratios, favor the stellar feedback models for the formation of the Galactic bubbles, settling a long-standing debate on the origin of the Galactic bubbles.

Our work provides a paradigm shift to the model of the **eROSITA bubbles** over that have been proposed in the literature. Our results are thus important as well as with a broad appeal. I will present our recent results and will also discuss how our work will provide the necessary ground work for ***Athena*** in understanding the physics, and the origin of the bubbles.

Primary authors: Ms DAS, Sanskriti (Ohio state University); GUPTA, Anjali (Columbus State Community College); Mr KINGSBURY, Joshua (Columbus State Community College); Prof. KRONGOLD, Yair (Universidad Nacional Autonoma de Mexico); Prof. MATHUR, Smita (Ohio State University)

Presenter: GUPTA, Anjali (Columbus State Community College)

Contribution Type: Oral presentation

Status: ACCEPTED

Submitted by **GUPTA, Anjali** on **Tuesday, 3 May 2022**

Abstract ID : **4**

Surprises from X-ray observations of the hot circumgalactic medium

Content

The >=10^6 K hot circumgalactic medium (CGM), despite being challenging to detect, is a treasure trove of galaxy evolution. By probing the hot CGM of the Milky Way (MW) using *absorption* lines of multiple metal ions, we have discovered a **super-virial 10^7 K phase coexisting with the well-known 10^6 K phase, featuring non-solar abundance ratios of light elements, alpha-enhancement, and non-thermal line broadening**. We detect this super-virial phase of MW CGM also in *emission* analyses. We have also discovered the hot CGM *emission* of an MW-like galaxy NGC3221 that is extended out to >150 kpc, and massive enough to account for the missing galactic baryons. The CGM within 100 kpc of NGC 3221 is super-virial, non-isothermal, and fainter along the minor axis than the global average. These results compel us to rethink the impact of galactic feedback on the hot CGM of star-forming galaxies without an active nucleus.

Primary authors: DAS, Sanskriti (The Ohio State University); MATHUR, Smita (Ohio State University); GUPTA, Anjali (Columbus State Community College); KRONGOLD, Yair (Universidad Nacional Autonoma de Mexico)

Presenter: DAS, Sanskriti (The Ohio State University)

Contribution Type: Oral presentation

Status: ACCEPTED

Submitted by **DAS, Sanskriti** on **Tuesday, 3 May 2022**

Abstract ID : **5**

Ejection-accretion connection in highly-accreting supermassive black holes

Content

Accretion and ejection matter in active galactic nuclei (AGN) are tightly connected phenomena and represent fundamental mechanisms regulating the growth of the central supermassive black hole and the evolution of the host galaxy. However, the exact physical processes involved are not yet fully understood. I will present the time-resolved and flux-resolved X-ray spectroscopy results of two highly accreting Narrow Line Seyfert 1 AGN, 1H 0707-495 and 1H 1934-063 using XMM-Newton observations. We find a stratified outflow and a previously unseen response of the ultra-fast outflow (UFO) to the source X-ray luminosity in 1H 0707-495, suggesting a radiative-driven mechanism of the UFO. An unknown broad emission line around 1 keV in 1H 1934-063 spectrum, modeled by the strongly blueshifted reflection, shows an indicative signature of the link between the reprocessing of the inner accretion photons and the outflows. We also find a low-ionized UFO in 1H 1934-063, probably as a result of the interaction between the UFO and the surrounding medium. The comparison between the response of the outflows to the continuum in these sources with a few found in the literature sheds new light on the structure of the disk as well as outflows and their connection in high-accretion systems. Our Athena simulations suggest that Athena will remove the systematic effects of flux-resolved spectroscopy and break the degeneracies between the photoionization solutions.

Primary author: XU, Yerong (INAF-IASF Palermo)

Presenter: XU, Yerong (INAF-IASF Palermo)

Contribution Type: e-poster

Status: ACCEPTED

Submitted by **XU, Yerong** on **Saturday, 7 May 2022**

Abstract ID : **6**

Highly-ionized oxygen statistics in the Warm Hot Intergalatic Medium

Content

The number of observed baryons in the local Universe is ~ 30% lower than the value predicted by Big Bang Nucleosynthesis. These “missing baryons” are expected to reside in low density regions, with temperatures in the range 10^5-10^7 K, and are dubbed Warm-Hot Intergalactic Medium (WHIM). So far, searches of the WHIM have relied upon detections of specific absorption lines in the spectra of bright X-ray sources. On the other hand, integral field spectroscopy with instruments like Athena X-IFU will allow us to perform intensity mapping analysis using the same lines in emission. In this work we use the large suite of state-of-the-art CAMELS hydrodynamical simulations to test this technique. We create realistic surface brightness maps, using the X-IFU instrument specifics, for the two most prominent WHIM emission lines, i.e. the OVII triplet at 0.57 keV and the OVIII singlet at 0.653 keV. From these, we measure number counts of emitters as well as 3D and angular two-point statistics in redshift space. We investigate the impact of different cosmological parameters and baryonic processes (like AGN feedback and galactic winds) both in terms of ratios with respect to a fiducial model and in terms of the statistical uncertainties they introduce. Finally, we provide forecasts on the emitters number counts in upcoming surveys.

Primary author: PARIMBELLI, Gabriele (Università degli Studi di Genova)

Co-authors: Prof. BRANCHINI, Enzo; Prof. VIEL, Matteo; Dr VILLAESCUSA-NAVARRO, Francisco

Presenter: PARIMBELLI, Gabriele (Università degli Studi di Genova)

Contribution Type: Oral presentation

Status: ACCEPTED

Submitted by **PARIMBELLI, Gabriele** on **Tuesday, 17 May 2022**

Abstract ID : **7**

X-RAY EMISSION AROUND STAR-FORMING AND QUIESCENT GALAXIES AT 0.05<z<0.3

Content

The circum-galactic medium (CGM) plays an important role in galaxy evolution as the main interface between the star-forming body of galaxies and the surrounding cosmic network of in- and out-flowing matter. In this presentaion, I characterize the hot X-ray emission arounda large and complete sample of galaxies using recent soft X-ray observations made by SRG/eROSITA.

We stack X-ray events from the 'eROSITA Final Equatorial Depth Survey' (eFEDS) around central galaxies in the 9hr field of the 'GAlaxy and Mass Assembly' (GAMA) survey to construct radially projected X-ray luminosity profiles in the 0.5–2 keV rest frame energy band as a function of their stellar mass and specific star formation rate. We consider samples of quiescent (star-forming) galaxies in the stellar mass range 2×10^(10) – 10^(12) Msun(3x10^9 – 6x10^(11) Msun).

For quiescent galaxies, the X-ray profiles are clearly extended throughout the available mass range; however, the measured profile is likely biased high due to projection effects, as these galaxies tend to live in dense and hot environments. For the most massive star forming samples, there is a hint of detection of extended emission. On the other hand, for star-forming galaxies, the X-ray stacked profiles are compatible with unresolved sources and consistent with the expected emission from faint active galactic nuclei (AGN) and X-ray binaries.

We measure for the first time the mean relation between average X-ray luminosity and stellar mass separately for quiescent and star-forming galaxies. We find that the relation is different for the two galaxy populations: high-mass star-forming or quiescent galaxies follow the expected scaling of virialized hot haloes, similar to clusters of galaxies. The lower mass star-forming galaxies show a less prominent luminosity and a weaker dependence on stellar mass, consistent with empirical models of the population of weak AGN. When comparing our results with state- of-the art numerical simulations (IllustrisTNG and EAGLE), we find an overall consistency on the average emission on large (beyond 80 kpc) scales at masses, but disagreement on the small scales, where brighter than observed compact cores are predicted. The simulations also do not predict the clear differentiation that we observe between quiescent and star-forming galaxies in our samples.

This is a stepping stone towards a more profound understanding of the hot phase of the CGM, which holds a key role in the regulation of star formation. Future analysis using ATHENA and eROSITA data, combined with future generation galaxy evolution surveys, shall provide much enhanced quantitative measures and mappings of the circum-galactic medium and its hot phase(s).

Primary author: COMPARAT, Johan (Max Planck fuer extra-terrestrische Physik (MPE))

Co-authors: Dr MERLONI, Andrea (MPE); Dr PONTI, Gabriele (INAF/MPE)

Presenter: COMPARAT, Johan (Max Planck fuer extra-terrestrische Physik (MPE))

Contribution Type: Oral presentation

Comments:

The main article of interest related to this presetation is available here : https://arxiv.org/abs/2201.05169

Status: ACCEPTED

Submitted by **COMPARAT, johan** on **Wednesday, 18 May 2022**

Abstract ID : **8**

Identifying the first SMBHs with Athena

Content

One of the fundamental topics in extragalactic astronomy concerns the formation and evolution of galaxies through cosmic time. A common approach for shedding more light on this subject is the exploration of the young stages of the Universe, when the first stars and Super Massive Black Holes (SMBHs) were formed and therefore started ionising the intergalactic medium. This Epoch of Re-ionisation (EoR) is considered one of the key areas of extragalactic research that only recently we were able to explore, mostly due to the growing number of identified high-redshift Active Galactic Nuclei (AGNs). In this talk, I will present results on the exploration of the EoR and the SMBH/AGN population, from the theoretical point of view, employing eight state-of-the-art cosmological galaxy formation and evolution models with the main goal of exploring their predictions regarding the number of AGNs that the next generation of telescopes and specifically Athena, would observe at the EoR. Additionally, in order to provide a more advanced prediction, I will present results from a combination of one of these galaxy formation models with a software that simulates the observations from $1\mathrm{deg}^2$ of Athena. This combined methodology can provide for the first time simulated images and spectra from SMBHs at any redshift, while the properties of each source are known from the input model/simulation. Considering that Athena is in its final stage of development, with several key characteristics still to be defined, such end-to-end simulations of the telescope's performance are key to certify that the initial scientific goals are met.

Primary author: AMARANTIDIS, Stergios (Instituto de Radioastronomía Milimétrica)

Co-authors: Prof. AFONSO, José (Institute of Astrophysics and Space Sciences); Dr MATUTE, Israel (Institute of Astrophysics and Space Sciences); Dr MESSIAS, Hugo (Joint ALMA Observatory)

Presenter: AMARANTIDIS, Stergios (Instituto de Radioastronomía Milimétrica)

Contribution Type: Oral presentation

Status: ACCEPTED

Submitted by **AMARANTIDIS, Stergios** on **Monday, 30 May 2022**

Abstract ID : **9**

Characterization of the gas density fluctuations in the X-COP cluster sample

Content

Clusters of galaxies accrete gas, galaxies, and substructures from their larger surroundings. This accretion process induces many shocks at all scales that heat the gas and generate perturbations, from which we expect the emergence of turbulent processes that will contribute to the thermalization of the whole intracluster medium (ICM). The characterization of these turbulent processes provides information on the history of the dynamic assembly of these massive halos. It can be done indirectly by studying the fluctuations of surface brightness at X-ray wavelengths. We have focused our work on a pilot sample of nearby clusters, the X-COP sample, to develop an analysis method that accounts for the stochastic nature of the process through the computation of a comprehensive error budget, under the assumption that density fluctuations originate from turbulent motions. We present the results of our analysis and the constraints we obtained for the parameters characterizing the turbulent cascade. We compare our results to other probes of the dynamical scales of galaxy clusters. Finally, we put the statistical analysis on the X-COP sample in perspective of larger and widely distributed samples such has CHEX-MATE.

Primary authors: DUPOURQUÉ, Simon (IRAP); Dr POINTECOUTEAU, Etienne (IRAP); Dr CLERC, Nicolas (IRAP); Dr ECKERT, Dominique

Presenter: DUPOURQUÉ, Simon (IRAP)

Contribution Type: Oral presentation

Status: ACCEPTED

Submitted by **DUPOURQUÉ, Simon** on **Friday, 3 June 2022**

Abstract ID : **10**

Disk winds during the faint outburst of an accreting millisecond X-ray pulsar

Content

The Neutron Star Low-Mass X-ray Binary Swift J1749.4-2807 is the only known eclipsing Accreting Millisecond X-ray Pulsar. On March 2021, the source underwent a short (11-days) and relatively faint outburst, reaching a X-ray luminosity at the peak of only 2×10^{36} erg s^{-1}. I will present the first ever broadband spectral characterization of the system throughout the whole outburst, analyzing 11 NICER observations and XMM-Newton and NuSTAR single observations. This is also one of the very few times that, thanks to NICER, we had the opportunity to follow an X-ray binary outburst in its entirety in the soft X-ray band. According to our analysis, no direct emission from the disc was found (perhaps due to it being too cool), and the the broadband spectrum is well-modelled with a black body component, most likely emitted by a hot spot on the Neutron Star surface, and a Comptonization spectrum arising from a hot electron corona. A moderate truncation radius for the disc, i.e. at ~20-30 R_G , was obtained from the analysis of the smeared profile of the Fe line in the reflection component. The significant detection of a blue-shifted Fe XXVI absorption line at ~7 keV indicates weakly relativistic disk winds. The discovery of such outflows, typically observed in the soft state of X-ray binaries, is unexpected as the spectral properties of the systems are consistent with a hard-intermediate state. This finding could in principle suggest magnetic propeller-driven winds. In the last few years, a pattern of winds in AMXPs out of the canonical soft states seems to have emerged. However, such detections are typically unconstrained and/or weakly significant, as AMXPs display generally faint outbursts when compared to the other X-ray binaries. I will discuss the perspectives of detecting these features with the groundbreaking sensitivity and spectral resolution of Athena and their potential physical implications.

Primary author: MARINO, Alessio (Institute of Space Sciences (ICE-CSIC))

Co-authors: Prof. DI SALVO, Tiziana (Università degli studi di Palermo, Italy); Dr SANNA, Andrea (Università degli studi di Cagliari); Mr ANITRA, Alessio (Università degli studi di Palermo); Dr MAZZOLA, Simona Michela (Università degli studi di Cagliari)

Presenter: MARINO, Alessio (Institute of Space Sciences (ICE-CSIC))

Contribution Type: e-poster

Status: ACCEPTED

Submitted by **MARINO, Alessio** on **Wednesday, 8 June 2022**

Abstract ID : **11**

Very Fast X-Ray Variabiity in BL Lac Objects: The Athena Prospect

Content

BL Lacs for represent an extreme blazar subclass of with a relativistic jet closely aligned with our line-of-sight and characterized by non-thermal continuum emission across the entire spectrum, superluminal motion, almost featureless optical spectra and strong flux variability in all spectral bands. The latter property is crucial in discerning the innermost structure of these sources which is overwhelmed by the strong, relativistic boosted jet emission. While the fastest, subhour variability in flaring states is widely explained in the framework of the shock-in-jet scenario (the variability triggered by the interaction of the relativistic shock front and jet turbulent inhomogeneities), those observed in lower states can be related to the instabilities in the innermost area of the accretion disc. The latter are of the particular importance: asides providing important information about the triggering instable processes, these instances also allow us to evaluate masses of the central supermassive black holes (SMBHs). In lower X-ray states of BL Lacs, such variability is more evident and easier to detect since it is not overwhelmed by the tremendous nonthermal jet emission generated near the front of the propagating shock. However, the instrumental capabilities of the current space X-ray missions are still not sufficient to reveal the subhour flux variability in lower states owing to the faintness of BL Lacs in those periods. Moreover, the planned X-ray Integral Field Unit at Athena is very important in recording high signal-to-noise 0.2-12 keV spectra within the short time intervals and study very fast spectral variability, which provides us with another powerful tool for the further progress in our understanding of the instable processes in the SMBH vicinity.

Primary author: KAPANADZE, Bidzina (Abastumani Astrophysical Observatory; Ila State University)

Presenter: KAPANADZE, Bidzina (Abastumani Astrophysical Observatory; Ila State University)

Contribution Type: e-poster

Status: ACCEPTED

Submitted by **KAPANADZE, Bidzina** on **Thursday, 9 June 2022**

Abstract ID : **12**

Modelling complex AGN media in full-3D with a new X-ray radiative transfer code

Content

Large amounts of gas and dust are found in the central regions of many active galaxies. These ambient media play a crucial role as they provide the accretion reservoir powering AGN, and reprocess the X-ray, UV and optical emission of the central engine. Yet, the detailed characteristics of these regions and the physics behind them remain unknown. Recent radiative transfer modelling suggests that circumnuclear media are complex with clumps and filaments, while MIR-observations hint towards polar extended structures of gas and dust, as opposed to the classical dusty torus paradigm. Reprocessed spectral X-ray features could form a powerful probe to dissect the inner few parsecs of AGN, given that advanced X-ray models are available that can handle their precise distribution of gas and dust.

We present a new, high-performance Monte Carlo simulation code that can model X-ray radiation transport in arbitrary 3D geometries, which allows for intricate multi-phase media with complex distributions. This code implements a complete set of X-ray physics, including an advanced treatment of dust extinction and bound-electron scattering. Moreover, it allows for self-consistent model predictions over the full infrared to X-ray range. We demonstrate the full-3D capabilities of our code by post-processing hydrodynamical torus simulations, and present mock observations demonstrating how geometry effects will appear in the X-ray spectra of the forthcoming XRISM and Athena observatories.

Primary author: VANDER MEULEN, Bert (Ghent University)

Co-authors: Dr STALEVSKI, Marko (Astronomical Observatory Belgrade); Prof. BAES, Maarten (Ghent University)

Presenter: VANDER MEULEN, Bert (Ghent University)

Contribution Type: e-poster

Status: ACCEPTED

Submitted by **Mr VANDER MEULEN, Bert** on **Thursday, 9 June 2022**

Abstract ID : **13**

Testing General Relativity with black hole X-ray data: a progress report

Content

The theory of General Relativity has successfully passed a large number of observational tests. The theory has been extensively tested in the weak-field regime with experiments in the Solar System and observations of binary pulsars. The past 5-6 years have seen significant advancements in the study of the strong-field regime, which can now be tested with gravitational waves, X-ray data, and mm Very Long Baseline Interferometry observations. In my talk, I will summarize the state-of-the-art of the tests of General Relativity with black hole X-ray data, discussing its recent progress and future developments.

Primary author: BAMBI, Cosimo (Fudan University)

Presenter: BAMBI, Cosimo (Fudan University)

Contribution Type: Oral presentation

Status: ACCEPTED

Submitted by **BAMBI, Cosimo** on **Friday, 10 June 2022**

Abstract ID : **14**

Charge exchange: the present knowledge and future

Content

Despite that charge exchange is commonly acknowledged as a prevailing atomic process at the interface of cold and hot plasmas, its detail is far from clear for many X-ray astronomers. In this talk I will review systematically most of the key knowledge about charge exchange itself: the atomic physics, the uncertainties on theoretical cross sections, the present laboratory efforts, its contribution to ion concentration; as well as the present X-ray observations: the comets, planet atmosphere, neutron star wind, supernova remnants, galaxies, and clusters of galaxies. I will highlight a new discovery of a possible charge exchange component in the X-ray spectra of Seyfert 1 AGN NGC 5548. I will also briefly discuss what can learn and what cannot from charge exchange if it will be observed by a future mission with high sensitivity and high spectral resolution.

Primary author: GU, liyi (sron)

Presenter: GU, liyi (sron)

Contribution Type: Oral presentation

Status: ACCEPTED

Submitted by **GU, liyi** on **Friday, 10 June 2022**

Abstract ID : **15**

Most sensitive constraints on very-light Axion-Like Particles from cluster-hosted AGNs and a bright future with Athena

Content

Axion-Like Particles (ALPs) are predicted by string theory and are promising dark matter candidates. In the presence of a magnetised plasma, photons may inter-convert into ALPs of mass m as determined by the photon-ALP coupling strength g. X-rays from the central active galaxies (AGNs) hosted by cool-core clusters should therefore undergo photon-ALP conversion as they travel through the magnetised intracluster medium (ICM), resulting in irregularities or "wiggles" in the spectrum. This effect can be used to place bounds on g for very-light ALPs, that is, with $\log(m/\mathrm{eV}) < -12.0$, given a model for the ICM magnetic field.

I will present the most recent bounds on very-light ALPs from spectroscopic observations of two cluster-hosted bright AGNs, namely: NGC1275, the central engine of the Perseus cluster, and the powerful cluster-hosted quasar H8121+643. In particular, for the latter, we use a combined 570-ks Low-Energy and High-Energy *Chandra* Transmission Grating observation to infer the highest-quality spectrum of this type-1 quasar. At 99.7% confidence, we exclude $g > 6.3 \times 10^{-13}\ \mathrm{GeV}^{-1}$ for most ALPs of $m < 10^{-12}$ eV, placing the tightest constraints to date on such ALPs. Using a cell-based approach to model the cluster field, our result is most sensitive to the assumption that the plasma beta is constant up to the virial radius.

I will reflect on the exciting prospect that *Athena*'s *X-IFU* provides for cluster-ALP studies, given its unprecedented spectral resolution and collecting area compared to current spectroscopic X-ray missions. I will discuss the impact of the knowledge on the *X-IFU*'s calibration on its projected bounds on very-light ALPs. Finally, I will present a novel machine learning technique through which one may be able to disentangle the energy-dependent features induced by a non-nominal calibration and by ALPs in simulated *X-IFU* spectra of NGC1275.

Primary authors: SISK REYNES, Julia Margalida (Institute of Astronomy, University of Cambridge, UK); Prof. REYNOLDS, Chris (Institute of Astronomy, University of Cambridge, UK); Dr MATTHEWS , James (Institute of Astronomy, University of Cambridge, UK)

Co-authors: Dr RUSSELL, Helen (University of Nottingham, UK); Dr SMITH , Robyn (University of Maryland (College Park), MD, USA); Prof. MARSH , MC David (The Oskar Klein Centre, Stockholm University, Sweden)

Presenter: SISK REYNES, Julia Margalida (Institute of Astronomy, University of Cambridge, UK)

Contribution Type: Oral presentation

Comments:

In this talk, I will present the results found by arXiv:2109.03261 and arXiv:1907.05475. I will also mention several of the findings discussed in arXiv:2202.08875.

Status: ACCEPTED

Submitted by **SISK REYNES, Julia Margalida** on **Friday, 10 June 2022**

Abstract ID : **16**

The IntraGroup Medium as a highly sensitive probe of AGN feedback

Content

Every major modern hydrodynamical simulation suite now includes a prescription for AGN feedback to reproduce realistic populations of galaxies. However, since the simulations are generally calibrated to reproduce certain properties of the galaxy population, comparison to these properties does not offer much insight into the nature of feedback. On the other hand, the hot gas content of galaxy groups is highly sensitive to the implemented feedback scheme: the predicted gas fraction differs by an order of magnitude from one simulation to another. We were recently awarded a large program on XMM-Newton to determine the properties of the IntraGroup Medium over a large fraction of the group's volume, which will eventually be compared with the results of state-of-the-art numerical simulations including various recipes for AGN feedback. I will present early results from this program and the prospects on the topic in light of Athena.

Primary author: ECKERT, Dominique (University of Geneva)

Presenter: ECKERT, Dominique (University of Geneva)

Contribution Type: Oral presentation

Status: ACCEPTED

Submitted by **ECKERT, Dominique** on **Friday, 10 June 2022**

Abstract ID : **17**

Spectral-timing of AGN ionized outflows with Athena

Content

Recent X-ray spectroscopic studies have shown that photoionized outflows are a common component of active galactic nuclei (AGN). However, a complete characterisation of these outflows is not possible with spectral information alone. We show through extensive simulations that a combination of spectroscopy and timing analysis applied to the data of the future Athena X-ray observatory can reveal the key physical properties of this gas. In particular, we demonstrate that the energy-resolved coherence will be a powerful tool to constrain the location and energetics of AGN outflows over a broad range of gas ionization, with important consequences for the feedback in the host galaxy.

Primary author: JURANOVA, Anna (SRON Netherlands Institute for Space Research; Anton Pannekoek Institute for Astronomy, University of Amsterdam)

Co-authors: Dr COSTANTINI, Elisa (SRON Netherlands Institute for Space Research; Anton Pannekoek Institute for Astronomy, University of Amsterdam); Dr UTTLEY, Phil (Anton Pannekoek Institute for Astronomy, University of Amsterdam)

Presenter: JURANOVA, Anna (SRON Netherlands Institute for Space Research; Anton Pannekoek Institute for Astronomy, University of Amsterdam)

Contribution Type: Oral presentation

Status: ACCEPTED

Submitted by **JURANOVA, Anna** on **Friday, 10 June 2022**

Abstract ID : **18**

Properties of cosmic web filaments in absorption against clusters of galaxies.

Content

The physical properties of the faint and extremely tenuous plasma in the filaments of the cosmic web remain one of the biggest unknowns in our story of large-scale structure evolution. The observations with nowadays missions still posses a big challenge, and do not allow us to properly study its spatial properties. Due to the shock-heating during the gravitational collapse of the structures in Universe, the gas locked in these cosmic web filaments is heated to high temperatures and is highly ionized. This makes it a perfect target for X-ray observations. The most common techniques how to observe this medium are either in emission, or in absorption against very bright, point-like sources. In this talk I will focus on the warm-hot intergalactic medium and present yet another technique, which can be explored for now only in theory and with simulations, but it might serve as a complementary tool to explore the properties of the cosmic web with upcoming future X-ray missions. I will present how do the cosmic web filaments look like in absorption against diffuse extended sources, in particular clusters of galaxies. In this case, the high spectral resolution that is needed for the diffuse sources in our studies will only be possible with micro-calorimeter arrays, like XIFU instrument on board of Athena.

Primary author: STOFANOVA, Lydia (Leiden Observatory, SRON)

Presenter: STOFANOVA, Lydia (Leiden Observatory, SRON)

Contribution Type: Oral presentation

Status: ACCEPTED

Submitted by **STOFANOVA, Lydia** on **Monday, 13 June 2022**

Abstract ID : **19**

Mocking a z=2 galaxy group with ATHENA/X-IFU

Content

We investigate the capabilities of an X-ray integral field Unit such as X-IFU on board ATHENA to unveil the gas physics of distant groups of galaxies in the Universe. We make use of a simulated galaxy group at redshift $z = 2$ with mass $M_{500} = 7\ 10^{13} M_{\odot}$, extracted from the HYDRANGEA cosmological SPH simulation. We perform a mock observation with the X-IFU instrument, using the SIXTE software suite. We post-process the mock data in a forward-modelling analysis enabled by Monte-Carlo sampling of the parameter space, in order to recover the main thermodynamical and chemical distribution such as the density, temperature, entropy, pressure as well as abundances distribution for key chemical elements such as Fe, Si, Mg. In complement to our high spectral resolution study, we run a mock observation of our simulated distant group with an X-ray wide field imager such as the WFI/ATHENA to take advantage of the smaller pixel size, and in order to investigate the synergy between the two complementary instruments. We present here quantitative results of this feasibility study in view of the ATHENA scientific requirements.

Primary author: CASTELLANI, Florent (IRAP)

Co-authors: CLERC, Nicolas (IRAP); POINTECOUTEAU, Etienne (IRAP); Dr BAHÉ, Yannick (Leiden University); Dr PAJOT, François (IRAP)

Presenter: CASTELLANI, Florent (IRAP)

Contribution Type: e-poster

Status: ACCEPTED

Submitted by **CASTELLANI, Florent** on **Monday, 13 June 2022**

Abstract ID : **21**

Study the Systematic Uncertainties in the Black Hole Disk Reflection Spectroscopy Based on the Thin Disk Model

Content

Previous modelling of X-ray emission from AGN and X-ray binaries assumes a razor-thin disk model with indefinite small thickness. The thickness of the disk, in reality, may depend on the spin of the black hole and the accretion efficiency. In this presentation, I would like to share the systematic uncertainty in disk reflection spectroscopy when the finite thickness is considered for the models.

I will first present a re-analysis of the XMM-Newton and NuSTAR observing campaign for the well-studied, X-ray-bright AGN MCG-06-30-15. In particular, we consider a disc model with finite thickness. By fitting the disc reflection spectra in the data, we obtain a black hole spin of 0.87–0.99 (90% confidence range) after taking the thickness of the disc into consideration. Spectral models with a grid of mass accretion rates from 0 to 30% of the Eddington limit are calculated for MCG-06-30-15. This result is obtained by considering a free disc reflection fraction parameter and is consistent with previous measurements based on razor-thin disc models. Besides, an isotropic, point-like geometry, i.e. the lamppost geometry, is assumed for the corona in our model. We find that such a geometry overestimates the reflection fraction in the data. This discrepancy may call for a more complicated coronal geometry rather than the simple lamppost in MCG-06-30-15.

In the end, I will also present Athena simulations based on both razor-thin and thin disk models and demonstrate 1) the systematic uncertainties in disk reflection spectroscopy in various parameter spaces and 2) the improvement in reflection measurements compared to XMM-Newton.

Primary author: JIANG, Jiachen (Institute of Astronomy)

Presenter: JIANG, Jiachen (Institute of Astronomy)

Contribution Type: e-poster

Status: ACCEPTED

Submitted by **JIANG, Jiachen** on **Monday, 13 June 2022**

Abstract ID : **23**

X-raying the hot gas in the Milky Way

Content

We will use Athena spectra obtained with the X-ray Integral Field Unit (X-IFU) to study the hot component in the interstellar medium, traced by highly ionized species such as OVII, NeIX, and MgXI, and located in the Galactic thin/thick disc as well as the Galactic halo. Additionally, these observations will provide priceless information for the benchmarking of the theoretical atomic data included in the current generation of X-ray absorption models.

Primary author: GATUZZ, Efrain (MPE)

Co-authors: GARCÍA, Javier (CALTECH); Dr KALLMAN, Timothy (NASA/GSFC); Dr WILMS, Joern (Dr. Karl Remeis-Sternwarte); Dr CHURAZOV, Eugene (MPA); GORCZYCA, Thomas (WMU); Dr CORRALES, Lía (University of Michigan)

Presenter: GATUZZ, Efrain (MPE)

Contribution Type: Oral presentation

Comments:

The content of this talk will be part of the our approved paper for the Astronomy & Astrophysics (A&A) Special Issue on the Athena science (SWG #3.4)

Status: ACCEPTED

Submitted by **GATUZZ, Efrain** on **Tuesday, 14 June 2022**

Abstract ID : **24**

ATHENA's solutions to ULX mysteries

Content

Ultraluminous X-ray sources (ULXs) are accreting binaries in nearby galaxies with luminosities above the Eddington limit of a stellar-mass black hole. The discovery of coherent pulsations and cyclotron lines in some ULXs indicates that a substantial fraction of them host neutron stars as compact objects. The recent discovery of powerful winds confirms predictions from theoretical models of super-Eddington accretion in many ULXs. Such winds carry a huge amount of energy owing to their relativistic speeds and are able to affect the surrounding medium, most likely inflating the surrounding 100pc superbubbles. The winds also limit the amount of matter that can reach the central accretor, slowing down its growth. So far, our understanding of the ULX spectral transitions, the disc structure, and the role of the winds has been badly hampered by the sensitivity of the current X-ray satellites, which limits the observable sample size, requires long observations, and does not permit studies within the fast (minutes-to-hours) timescales of the spectral variability. XRISM, eXTP and - especially - ATHENA will boost the detectability of narrow spectral features and pulsations thanks to their X-ray instruments that combine broadband coverage, high effective area, and spectral resolution. Fourier analysis of the time lags between different lines and continuum energy bands along with state-of-art physical plasma models will break the current model degeneracies, unveiling the disc structure, the spectral lines' origin and shed new light on the overall super-Eddington mechanism. I will review the state-of-art of the field and show how future X-ray missions will revolutionise it through ad-hoc simulations.

Primary author: PINTO, Ciro (INAF - IASF Palermo)

Presenter: PINTO, Ciro (INAF - IASF Palermo)

Contribution Type: Oral presentation

Status: ACCEPTED

Submitted by **PINTO, Ciro** on **Tuesday, 14 June 2022**

Abstract ID : **25**

The chemical universe: enrichment in galaxy clusters unveiled by Athena

Content

Hot, X-ray emitting atmospheres - permeating the large gravitational well of galaxy clusters and groups - are rich in heavy elements, which can be detected via their emission lines in the soft X-ray band. These metals must have been synthesised by stars and supernovae within stellar populations of cluster galaxies, before being ejected in mixed out of their galactic haloes. Despite astonishing findings from XMM-Newton and other X-ray missions over the two past decades, how, when, and from which stellar sources these building blocks of life chemically have enriched the largest structures of the universe remain fundamental questions that are yet to be solved. In this talk, we will see how Athena shall unveil two of these essential questions: (i) how large-scale enrichment has evolved from cluster formation epoch up to now; and (ii) how measuring accurately the gaseous chemical composition of clusters will considerably improve our understanding of star formation and stellar evolution in galaxies.

Primary author: MERNIER, Francois (European Space Agency (ESA))

Presenter: MERNIER, Francois (European Space Agency (ESA))

Contribution Type: Oral presentation

Status: ACCEPTED

Submitted by **MERNIER, Francois** on **Tuesday, 14 June 2022**

Abstract ID : **27**

Athena view of the highest-z X-ray extended jets

Content

Quasar relativistic jets are among the most fascinating astrophysical phenomena, both for their intrinsic characteristics and for their marked effects on the environment. Chandra observations showed that most of the radio jets have X-ray counterparts and that their properties evolve with redshift: indeed, when aligned with our line of sight, high-redshift jetted quasars present bright X-ray jets extending over tens of kpc. This might be due to the interaction of the relativistic electrons with the CMB radiation which is much denser in the early Universe, though this explanation is contentious. Thanks to the combination of large effective area and good spatial resolution, ATHENA will be able to enlarge the sample of high-z extended jets, giving the possibility of studying their properties at an unprecedented level.
In support of this argument I will present detailed simulations of WFI observations of the most distant QSO jets so far observed (z > 6) showing how spatially resolved spectroscopy will characterise different components, giving us the possibility to discriminate between different emission models. On the other hand, thanks to detailed studies of variability, ATHENA will also allow us to probe the extremely small spatial scales of the jets, down to few hundreds of gravitational radii from the accreting super-massive black hole.

Primary author: MORETTI, Alberto (INAF - O.A. Brera)

Presenter: MORETTI, Alberto (INAF - O.A. Brera)

Contribution Type: Oral presentation

Status: ACCEPTED

Submitted by **MORETTI, Alberto** on **Tuesday, 14 June 2022**

Abstract ID : **28**

The VERT-X calibration facility

Content

The ground calibration of the ATHENA mirror assembly raises significant difficulties due to its unprecedented size, mass and focal length. The VERT-X project aims at developing an innovative calibration system which will be able to accomplish to this extremely challenging task. The design is based on a 25 cm2 parallel beam produced by an X-ray source positioned in the focus of a highly performing collimator; in order to cover the whole mirror, the beam will be accurately moved by a raster-scan with the capability to tilt up to 3 degrees in order to test the off-axis performance and out of field stray-light. The VERT-X project, started in January 2018, is financed by ESA and conducted by a consortium that includes INAF, EIE, Media Lario, GPAP, and BCV Progetti. This contribution presents the current status of the development and manufacturing of the most critical systems of the facility, namely the raster-scan mechanism and the source-collimator assembly.

Primary author: MORETTI, Alberto (INAF - O.A. Brera)

Presenter: MORETTI, Alberto (INAF - O.A. Brera)

Contribution Type: e-poster

Status: ACCEPTED

Submitted by **MORETTI, Alberto** on **Tuesday, 14 June 2022**

Abstract ID : **30**

Constraints on the X-ray Luminosity Function of AGN at high redshift

Content

Supermassive Black Holes play an important role within galaxies, influencing their evolution and surrounding environment. Yet little is known about the initial formation of Supermassive Black Holes, in the early Universe, and their subsequent growth, the investigation of which is one of the main science goals of Athena. AGN population growth is traced by the X-ray Luminosity Function (XLF), which is the comoving space density of AGN as a function of redshift and luminosity. Due to limitations in survey depth and sky area possible with current telescopes, there has been insufficient data to fit XLF models at $z > 6$, until now. With only a few observed sources we are able to place some of the first constraints on the $z > 6$ XLF.

I will present work using the new Extragalactic Serendipitous Swift Survey (ExSeSS) catalogue of X-ray selected AGN, covering 2000 degrees^2, to provide constraints on the XLF at high redshifts. Within ExSeSS we identify one $z > 6$ source, with an Optical-to-X-ray slope consistent with the expected relation. Even with just this one source observed in ExSeSS, and an upper limit on the number of more luminous sources, we are able to place constraints to the bright-end of the XLF at $z = 5.7 - 6.4$. Using COSMOS2020 galaxies and the AGN occupation fraction we can also place further constraints on the high redshift XLF, even probing the faint-end of the XLF with deep Chandra data.

Our ExSeSS constraints show that the steep bright-end slope and strong decline in space density toward higher redshift is consistent with extrapolations of current models, based on lower redshift data. We thus expect ongoing all-sky surveys such as eROSITA to detect $\sim 10 - 100$ bright-end AGN at $z > 6$, whilst future telescopes such as Athena will be required to probe the faint AGN population at high redshifts.

Primary author: Ms BARLOW-HALL, Cassandra (The University of Edinburgh)

Co-authors: Mr DELANEY, Jack (The University of Edinburgh); Dr AIRD, James (The University of Edinburgh); Dr EVANS, Philip (University of Leicester); Prof. OSBORNE, Julian (University of Leicester); Prof. WATSON, Michael (University of Leicester)

Presenter: Ms BARLOW-HALL, Cassandra (The University of Edinburgh)

Contribution Type: Oral presentation

Status: ACCEPTED

Submitted by **BARLOW-HALL, Cassandra** on **Tuesday, 14 June 2022**

Abstract ID : **31**

Observational constraint of electron/positron pair halos in X-ray waveband

Content

Very high energy gamma-rays (E > 10 TeV) from Active Galactic Nuclei (AGN) could start electromagnetic cascades because of the absorption of the extragalactic background light (EBL). With sufficiently strong extragalactic magnetic field strengths (1 nG < B < 1 μG), the cascades could develop isotropically and produce electron/positron pairs around the AGN, which is called an electron/positron pair halo. Although, the haloes are originally predicted that they might be observed in gamma-ray waveband, however there has been no evidence of the detection in this waveband yet. Theoretically, they should be observable in X-ray waveband due to the Synchrotron radiation of the electron/positron pairs as well; in fact, this might provide a new window for detecting the haloes. In this work, we aim to test whether the X-ray emission from the haloes would be detectable by the current generation and next-generation X-ray telescopes. We simulated the intrinsic X-ray emissions of the haloes under different conditions of gamma-ray energy and magnetic field. Accounting for the contamination from the central AGN and X-ray background photons, we then analyzed the detectability of the halo emission created from these conditions. In the presentation, we will show whether the haloes would be observable by X-ray observatories; the possible ranges of the parameters which might allow the haloes to be detectable will be discussed. Moreover, we will also present how much the halo emission signal to noise would be gained by Athena, comparing to that of XMM-Newton.

Primary authors: Dr LUANGTIP, Wasutep (Department of Physics, Faculty of Science, Srinakharinwirot University); Dr EUNGWANICHAYAPANT, Anant (Mae Fah Luang University)

Presenters: Dr LUANGTIP, Wasutep (Department of Physics, Faculty of Science, Srinakharinwirot University); Dr EUNGWANICHAYAPANT, Anant (Mae Fah Luang University)

Contribution Type: e-poster

Status: ACCEPTED

Submitted by **Dr LUANGTIP, Wasutep** on **Tuesday, 14 June 2022**

Abstract ID : **32**

WFI and XIFU view of galaxy cluster outskirts

Content

Cosmological simulations have shown that galaxy clusters form through accretion of clumps falling along filamentary structures around the main halo. X-ray observations of these regions are crucial to understand galaxy cluster assembly and their evolution through cosmic time. Unfortunately, emission from these outskirts is predicted to be extremely X-ray faint.

Athena will be a game changer in this context. We built a pipeline that produces and analyses mock WFI and XIFU observations. The products of the pipeline include radial thermodynamic and dynamic profiles such as temperature, entropy and hydrostatic mass profiles. We used this pipeline to simulate the observations 8 massive galaxy clusters drawn from the 300 cosmological simulation dataset and investigated the outskirts physical properties combining WFI and XIFU capabilities.

We present our pipeline, which will be delivered to the public, and the results obtained from the analysis of the 8 clusters. In particular, we discuss the bias of hydrostatic equilibrium mass in these regions.

Primary author: BARTALUCCI, Iacopo (INAF-IASF)

Presenter: BARTALUCCI, Iacopo (INAF-IASF)

Contribution Type: Oral presentation

Status: ACCEPTED

Submitted by **BARTALUCCI, Iacopo** on **Tuesday, 14 June 2022**

Abstract ID : **33**

Mass loss and composition of wind ejecta in type I X-ray bursts

Content

Context.
X-ray bursts (XRB) are powerful thermonuclear events on the surface of accreting neutron stars (NS), where nucleosynthesis of heavy elements occur. In most cases, the high surface gravity prevents the ejection of material directly by the thermonuclear explosion. However, the predicted and observed luminosities sometimes exceed Eddington's value, and some of the material may escape by means of a stellar wind.

Aims.
The present work has two main motivating issues. The first is to determine the mass-loss and chemical composition of the material ejected through radiation-driven winds and its significance for Galactic abundances, with an interest on some light p-nuclei (^{92,94}Mo, ^{96,98}Ru) that are underproduced in every other astrophysical scenario. The second is to study the evolution of observational quantities during the wind phase, which can help constrain the mass-radius relation in neutron stars.

Methods.
A non-relativistic radiative wind model was successfully implemented, with modern opacity tables and treatment of the critical point. This radiative wind model was then linked through a new technique to a series of XRB hydrodynamic simulations, that include over 300 isotopes, allowing us to construct a quasi-stationary time evolution of the wind during the XRB.

Results.
The results of our simulations make it possible to assess the mass ejected by radiative wind during XRBs and its detailed composition. In the models studied, the average ejected mass per unit time represents 2.6% of the accretion rate, with 90% of the ejecta composed by ^{60}Ni, ^{64}Zn, ^{68}Ge and ^{58}Ni. The ejected material also contained a small fraction ($10^{-4} - 10^{-5}$) of some light p-nuclei of interest. Additionally, the observable magnitudes during the wind phase showed remarkable correlations, partly deriving from to the fact that photospheric luminosity stays close to Eddington limit. Some of these correlations involve wind parameters like energy and mass outflows, that are determined by the conditions at the base of the wind envelope.

Conclusions.
The simulations resulted in the first realistic quantification of mass-loss for each isotope synthesized in the XRB. The photospheric correlations found could be used to link observable magnitudes to the physics of the innermost parts of the envelope, close to its interface with the NS crust. This is a promising result regarding the issue of NS radii determination.

Primary authors: Dr HERRERA, Yago (Institute of Space Sciences (ICE-CSIC), Universitat Politecnica de Catalunya, IEEC); Dr SALA, Glòria (Universitat Politecnica de Catalunya -IEEC); Dr JOSÉ, Jordi (Universitat Politécnica de Catalunya - IEEC)

Presenters: Dr HERRERA, Yago (Institute of Space Sciences (ICE-CSIC), Universitat Politecnica de Catalunya, IEEC); Dr SALA, Glòria (Universitat Politecnica de Catalunya -IEEC)

Contribution Type: e-poster

Status: ACCEPTED

Submitted by **HERRERA, Yago** on **Tuesday, 14 June 2022**

Abstract ID : **34**

X-RAYING THE MAGELLANIC CLOUDS: A ROADMAP FROM XMM-NEWTON TO ATHENA

Content

The Magellanic Clouds are gas rich, irregular dwarf galaxies with active star formation histories. Because of the relatively short distance and low Galactic foreground extinction and absorption they are ideally suited for population studies of objects which are not always accessible in the Milky Way. Moreover, understanding the emission components of nearby galaxies is required to understand the unresolved emission from more distant galaxies. The XMM-Newton survey of the Magellanic Clouds have provided the deepest X-ray view of the inner regions of the Magellanic Clouds opening our windows to a systematic study of rich and diverse class of objects; predominantly HMXBs and SNRs. The eROSITA instrument onboard the Spectrum-Roentgen-Gamma satellite has finished its first four-sky surveys, which has provided a deep and complete coverage of the entire Magellanic system revolutionizing our understanding of our nearest star forming galaxies. I will present the first results in this regard including some newly discovered objects that are mainly HMXB pulsars, and a handful of peculiar systems i.e. HMXB pulsars found near the geometrical centre of their natal supernova remnant. Thanks to the very good spectral and spatial resolution coupled with its large effective area, Athena will be able to provide crucial insights into these systems as the X-ray binaries still in their propeller phase can be X-ray faint and requires high sensitivity to be detected. The parent SNRs can also be studied in much greater detail. The study will open windows into the birth properties of neutron star (NS) in binaries and probe the interaction between the accretion torque and the NS magnetic field at very low flux levels.

Primary author: MAITRA, Chandreyee (Max Planck Institute for Extraterrestrial Physics)

Presenter: MAITRA, Chandreyee (Max Planck Institute for Extraterrestrial Physics)

Contribution Type: Oral presentation

Status: ACCEPTED

Submitted by **MAITRA, Chandreyee** on **Tuesday, 14 June 2022**

Abstract ID : **37**

The observation and future prospect of temperature gradient in the shock of SN1006

Content

Collisionless shocks are observed in various environments in space. Behind the collisionless shocks, charged particles are heated in different time scales among elements, and relax to the equilibilium state. However, this heating mechanism is not yet understood well.
We observe the northwestern region of SN1006 with Chandra, which has a filament with thermal dominant X-ray emission. We divide this region into four layers with a thickness of 15" or 0.16 pc, and analyze the spectrum of their regions. The electron temperature was found to increase toward downstream from 0.52-0.62 keV to 0.82-0.95 keV on a length scale of 60 arcsec (or 0.64 pc).
In this paper, we also discuss on the future prospects to study the detailed structure of collisionless shocks with Athena.

Primary author: ICHIHASHI, Masahiro

Co-authors: Prof. BAMBA, Aya (The University of Tokyo; University of Tokyo, 2Research Center for the Early Universe, School of Science); Dr ODAKA, Hirokazu (The University of Tokyo; The University of Tokyo Institutes for Advanced Study, Kavli IPMU (WPI)); Dr KATO, Yuichi (The University of Tokyo); Dr KASUGA, Tomoaki (The University of Tokyo); Dr KATSUDA , Satoru (Saitama Universicty); Dr SUZUKI, Hitomasa (Konan University); Dr NAKAZAWA, Kazuhiro (Nagoya University)

Presenter: ICHIHASHI, Masahiro

Contribution Type: e-poster

Comments:

I will join online from Japan.

Status: ACCEPTED

Submitted by **ICHIHASHI, Masahiro** on **Wednesday, 15 June 2022**

Abstract ID : **38**

Precision of mass and radius determination for neutron star using the ATHENA mission.

Content

We will to show that X-ray spectral observations of the ATHENA mission can constrain the equation of state of superdense matter. We use our well-constrained continuum fitting method for mass and radius determination of the neutron star. Model spectra of the emission from a neutron star were calculated using the atmosphere code ATM24. In the next step, those models were fitted to a simulated spectra of the neutron star calculated for ATHENA's WFI detector, using the satellite calibration files. To simulate the spectra we assumed three different values of effective temperatures, surface gravities and gravitational redshifts. There cases are related to the three different neutron star masses and radii. This analysis allows us to demonstrate the precision of our method and demonstrate the need for a fast detector onboard of ATHENA. A large grid of theoretical spectra was calculated with various parameters and a hydrogen-helium-iron composition of solar proportion. These spectra were fitted to the simulated spectrum to estimate the precision of mass and radius determination. In each case, we obtained very precise mass and radius values with errors in the range 3-10\% for mass and in the range 2-8\% for radius within the 1σ confidence error. We show here that with the ATHENA WFI detector, such a determination could be used to constrain the equation of state of superdense neutron star matter.

Primary author: Dr MAJCZYNA, Agnieszka

Co-authors: Prof. MADEJ, Jerzy; Mr NALEŻYTY, Mirosław; Prof. RÓŻAŃSKA, Agata; Mr BEŁDYCKI, Bartosz

Presenter: Prof. MADEJ, Jerzy

Contribution Type: Oral presentation

Comments:

online participation

Status: ACCEPTED

Submitted by **MAJCZYNA, Agnieszka** on **Wednesday, 15 June 2022**

Abstract ID : **39**

Influence of the binary parameters on the X-ray signature of circumbinary disks around binary black holes

Content

The launching of Athena will offer possibilities for a multi-messenger observation in X-rays and gravitational waves (GWs, provided by LISA or ground-based interferometers) of supermassive binary black hole (BBH) merger systems with an unprecedented spectral resolution. Such observations will inform us on the growth of BHs, of galaxies and on possibly on the re-birth of active galactic nueclei. However, the X-ray signatures of such systems are not firmly identified because few numerical codes are able to model the gravitational impact of the BBH on its accretion disk in General Relativity (GR).

In this talk, I will present results from e-NOVAs (extended Numerical Observatory for Violent Accreting systems), our general-relativistic (GR) magnetohydrodynamical code and the associated GR ray-tracing code, both evolving an analytical BBH metric. Using e-NOVAs, I will show the gravitational influence of a BBH in the inspiral regime on their circumbinary disk. First, I will present the accretion structures that could help us distinguishing BBHs from single BHs. Then, I will show their X-ray signature - both timing and spectral -, investigating whether these are reproducible with single BH models, to know if we could distinguish supermassive BBHs prior to merger from single BHs with X-ray telescopes (including Athena) and therefore allow for a multi-messenger observational compaign with, e.g., LISA.

Finally, the influence of the binary parameters, looking for the most optimistic detectability with Athena, will be discussed.

Primary authors: Dr MIGNON-RISSE, Raphaël (APC, CNES); Dr VARNIERE, Peggy (APC); Dr CASSE, Fabien (APC); Dr DODU, Fabrice (APC)

Co-authors: Mrs ARTHUR, Léna (APC); Dr BAIRD, Jonathon (APC); Dr COLEIRO, Alexis (APC); Dr GONZÁLEZ, Matthias (AIM)

Presenter: Dr MIGNON-RISSE, Raphaël (APC, CNES)

Contribution Type: Oral presentation

Comments:

Relevant sessions: - Multi-messenger astrophysics. - Physics of black hole accretion. - Formation and evolution of supermassive black holes.

Status: ACCEPTED

Submitted by **MIGNON-RISSE, Raphaël** on **Wednesday, 15 June 2022**

Abstract ID : **40**

Influence of the inner disc on ultra-fast outflows in active galactic nuclei

Content

Active galactic nuclei (AGNs) host a variety of powerful outflows that may have a significant impact on the evolution of the host galaxy by altering the course of star formation within. Ultra-fast outflows (UFOs) are high column, highly ionised, extremely rapid winds observed in ~40% of sampled AGNs that are launched from within a few hundred gravitational radii of the central supermassive black hole (SMBH). Importantly, the power carried in these UFOs has been shown to be sufficiently large such that they can be effective drivers of AGN feedback. At this time, however, our understanding of how these outflows are related to the inner disc environment from which they are launched remains incomplete. I will present results from a sample study conducted on 20 radio-quiet Type 1 AGNs in which the relationship between the inner disc environment and ultra-fast outflows is characterized, finding significant correlations of the wind properties with key AGN parameters assessed using a relativistic reflection scenario. We highlight the close relationship shared between AGN outflows and the inner disc environment.

Primary authors: Dr GONZALEZ, Adam (Saint Mary's University); Prof. GALLO, Luigi (Saint Mary's University)

Presenter: Dr GONZALEZ, Adam (Saint Mary's University)

Contribution Type: e-poster

Status: ACCEPTED

Submitted by **Dr GONZALEZ, Adam** on **Wednesday, 15 June 2022**

Abstract ID : **42**

Distant Emission from Mrk 1239: Origin Revealed

Content

New X-ray observations of a hybrid Narrow Line Seyfert 1 (NLS1) galaxy Mrk 1239 with joint NuSTAR and XMM-Newton in the 0.3-40.0 keV band are presented. Below 2 keV direct AGN emission is obscured revealing a complex RGS spectrum rich in emission lines originating from a two-component plasma (collisional- and photo-ionized) at large distances from the black hole. The spectral variability below 3 keV is remarkably consistent over 20 years of observations. Above 3 keV the AGN dominates the emission and the NLS1 nature is revealed. A flaring event was captured with NuSTAR where the 3-30 keV count rate increased by a factor of 5 in a few kiloseconds before returning to near pre-flare levels just as quickly. Ionized partial covering and relativistic blurred reflection have previously been considered for the central region emission. With the new high quality data we are able to determine the underlying continuum model for Mrk 1239.

Primary author: BUHARIWALLA, Margaret (Saint Mary's University)

Co-author: GALLO, Luigi (Saint Mary's University)

Presenter: BUHARIWALLA, Margaret (Saint Mary's University)

Contribution Type: e-poster

Status: ACCEPTED

Submitted by **BUHARIWALLA, Margaret** on **Wednesday, 15 June 2022**

Abstract ID : **44**

Multi-temperature plasma and the spectroscopic-like temperature bias with the Athena X-IFU

Content

Current X-ray observatories equipped with CCDs can not detect multi-temperature plasma when the temperature components are above 2 keV. This has important implications for the study of the thermal structure in galaxy clusters and groups especially when strong temperature gradients are present, such as in shock and cold fronts, or when plasma with different temperature components are co-spatial such as in cool cores. We will show the results of a series of idealized simulations with two temperature components to approximate the differential emission measure distribution of a multi-temperature plasma with the Athena X-IFU resolution to investigate how the scenario will change with the advent of a high resolution, high throughput calorimeter.

Primary author: GASTALDELLO, Fabio (INAF - IASF Milano)

Co-authors: Dr BARTALUCCI, Iacopo (INAF-IASF); Dr MOLENDI, Silvano (INAF-IASF Milano); ETTORI, Stefano (INAF OAS Bologna (Italy)); Dr GHIZZARDI, Simona (INAF-IASF Milano); Dr ROSSETTI, Mariachiara (INAF-IASF Milano); Dr DE GRANDI, Sabrina (INAF-OA Brera)

Presenter: GASTALDELLO, Fabio (INAF - IASF Milano)

Contribution Type: Oral presentation

Comments:

This is the work selected to be one of the papers for the A&A issue companion of the Athena red book

Status: ACCEPTED

Submitted by **GASTALDELLO, Fabio** on **Wednesday, 15 June 2022**

Abstract ID : **45**

A successful quest for a new transitional pulsar candidate

Content

The discovery of three millisecond pulsars capable of alternating between a state in which they behave as radio pulsars powered by the neutron star rotational energy and a subluminous X-ray state characterised by the presence of an accretion disk has revealed the existence of an extremely peculiar phase in the evolution of binary pulsars. These sources are known as transitional millisecond pulsars. I will present the results of extensive multiband observation campaigns from radio to X-ray bands of a recently identified transitional millisecond pulsar, CXOU J110926.4-650224. This discovery paves the way to exciting new opportunities to catch a binary millisecond pulsar in the act of performing a state transition in the future.

Primary author: COTI ZELATI, Francesco

Presenter: COTI ZELATI, Francesco

Contribution Type: e-poster

Status: ACCEPTED

Submitted by **COTI ZELATI, Francesco** on **Wednesday, 15 June 2022**

Abstract ID : **46**

AGN contamination in galaxy clusters: implications for cosmology in the z > 1 regime

Content

We perform the first known census of X-ray clusters that are undetected due to significant central AGN contamination. In recent work (Bhargava et al. 2022, submitted to A&A), we attempt to characterise all known AGN contaminated clusters within the XXL survey footprint and provide a systematic assessment of the cosmological impact of such systems. We find that 5% of genuine clusters within the XXL survey area are undetected due to AGN contamination - the majority of these clusters are above z > 0.6, where X-ray cluster detection efficiency drops significantly and cosmological AGN activity increases. With the increased sensitivity of Athena, we can expect to recover clusters at the current X-ray photon limit up to approximately z ~ 1.9, so the fraction of clusters missed due to AGN is likely to be higher than 5%. Understanding the distribution of AGN and clusters in X-ray samples is therefore crucial to maximise the cosmological potential of clusters, particularly at high redshift.

Primary author: BHARGAVA, Sunayana (CEA Paris-Saclay)

Presenter: BHARGAVA, Sunayana (CEA Paris-Saclay)

Contribution Type: e-poster

Status: ACCEPTED

Submitted by **BHARGAVA, Sunayana** on **Wednesday, 15 June 2022**

Abstract ID : **47**

The spectroscopic legacy of XMM-Newton after more than 20 years

Content

The EU funded XMM2Athena project aims at developing and testing new methods and software to allow the community to follow the X-ray transient sky in quasi-real time, identify multiwavelength/messenger counterparts of the sources detected with XMM-Newton and determine their nature using advanced machine learning methods and probe the faintest sources using innovative stacking and detection algorithms. Within this project we developed software to perform automated fits based on a Bayesian approach. We did spectral fits of the 319565 detections with spectra in the 4XMM-DR11 catalogue using a simple absorbed powerlaw model. Furthermore, we fit combined spectra for the 30325 sources that have been observed more than once, based on the XMM-Newton stacked catalogue, using an absorbed powerlaw as well as an absorbed blackbody model. We performed quality checks and investigated the distributions of the spectral parameters. Here we will present the results of our efforts and promote our catalogues to encourage the community to make use of them.

Primary authors: CARRERA, Francisco; STIELE, Holger

Presenter: STIELE, Holger

Contribution Type: e-poster

Status: ACCEPTED

Submitted by **STIELE, Holger** on **Wednesday, 15 June 2022**

Abstract ID : **48**

X-ray spectroscopy of stars with calorimeters

Content

X-ray spectroscopy of stars provides detailed information about the energetic processes in stars, such as magnetic activity or accretion in young stars. Grating spectroscopy with XMM-Newton and Chandra has been pivotal for our understanding of stars; however, X-ray calorimeters will still be crucial for significant further advances in the understanding of plasmas in young and older cool stars. While grating observations opened the door toward the measurement of densities, line shifts, and abundance studies, their limited sensitivities left us with only a few examples of high signal-to-noise spectra. XRISM and later ATHENA will will not only be sensitive enough to provide densities in young accreting stars routinely up to the distance of the Orion nebula, detect highly embedded protostars, or probe deep into embedded protostars, they will also give us access to the dynamics of cosmic plasmas (bulk motions, non-equilibrium effects in flares). I propose to present some planned calorimeter studies of young stars and more evolved cool stars with XRISM and Athena.

Primary author: AUDARD, Marc (University of Geneva)

Presenter: AUDARD, Marc (University of Geneva)

Contribution Type: Oral presentation

Status: ACCEPTED

Submitted by **AUDARD, Marc** on **Wednesday, 15 June 2022**

Abstract ID : **49**

SYNEX: finding an optimal follow-up strategy between X-ray and gravitational wave facilities

Content

As multi-messenger astronomy flourishes, it is important to adapt follow-up strategies to the different flavors of detectors scheduled over the coming decades. As such, recent work within the multi-messenger community has begun diversifying its approach to follow-up protocols. In this work, we present a new software that harnesses independent simulators of gravitational wave detectors and X-ray telescopes to provide the tools to accurately benchmark and compare follow-up strategies. The SYNEX (SYNergy EXplorer) code provides in-depth assessment of 'detectability' of sources using several figures of merit with characterization of primary parameters that bottleneck strategy performance.

Although our work so far takes the specific example of a LISA-ATHENA SMBH detection, we formulate an architecture that aims to test follow-up strategies for many combinations of gravitational wave and electromagnetic detectors. Moreover, SYNEX is an interface between a full MCMC LISA localization software and a tiling scheduler that uses realistic telescope designs. This allows for a more concrete exploration of tiling strategies when faced with multimodal and isotropic skymaps. In the case of LISA-ATHENA, this includes defining how long to wait before a Skymap is passed to ATHENA, where late times provide tighter source localizations at the expense of observation time for ATHENA to search a skymap.

In this talk we outline the primary features of SYNEX, and outline simple example studies using a joint LISA-ATHENA detection of an SMBH binary system.

Primary author: BAIRD, Jonathon (APC)

Co-authors: Dr MARSAT, Sylvain; COLEIRO, Alexis (APC); ARTHUR, Léna (APC); CASSE, Fabien (APC); DODU, Fabrice (APC); GONZÁLEZ, Matthias (AIM); MIGNON-RISSE, Raphaël; VARNIERE, Peggy (APC)

Presenter: BAIRD, Jonathon (APC)

Contribution Type: Oral presentation

Status: ACCEPTED

Submitted by **BAIRD, Jonathon** on **Wednesday, 15 June 2022**

Abstract ID : **50**

Observational properties of puffy accretion disc

Content

We have performed a general relativistic radiative magnetohydrodynamics (GRRMHD) simulations of a stable accretion disc around a stellar-mass black hole (BH) with sub-Eddington mass accretion rates. The numerical solutions revealed an elevated vertical structure - above a dense geometrically thin core of dimensionless thickness $_{\rho}/ \approx 0.1$, resembling a classic thin accretion disc, a puffed-up, optically and geometrically thick layer of lower density and $_{\tau}/r \approx 1.0$ is formed. We refer to this solution as the *Puffy disc*. We discuss the observational properties of a puffy discs, in particular the geometrical obscuration at higher observing inclinations of the inner area by the puffed-up region, and collimation of radiation along the accretion disc spin axis. These effects may explain the apparent super-Eddington luminosity of some ultraluminous X-ray binaries. We also present synthetic spectra of puffy discs, and show that they are qualitatively similar to Comptonized thin disc spectra. We demonstrate that the existing XSPEC spectral models provide good fits to synthetic spectra of puffy discs but cannot correctly recover the input luminosity, nor the black hole spin. We suggest that puffy discs may correspond to X-ray binary systems in the intermediate spectral state with luminosities above 0.3 of the Eddington luminosity.

Primary author: LANČOVÁ, Debora (Institute of Physics, Silesian University in Opava)

Presenter: LANČOVÁ, Debora (Institute of Physics, Silesian University in Opava)

Contribution Type: e-poster

Status: ACCEPTED

Submitted by **LANČOVÁ, Debora** on **Wednesday, 15 June 2022**

Abstract ID : **51**

Gravitational waves or X-ray counterpart ? No need to choose

Content

Binary black holes emit gravitational waves (GWs) as they inspiral towards coalescence. The possibility to detect both electromagnetic (EM) signal from their circumbinary environment with Athena and GWs emitted by stellar-mass black holes (with ground-based interferometers and LISA weeks before merger) and supermassive black holes (with LISA) could lead to major breakthroughs in astrophysics and even fundamental physics. Indeed, we could e.g. measure the speed of gravity, understand the behaviour of matter in such strong, time-varying, spacetimes, and possibly witness the re-birth of an active galactic nucleus if an EM counterpart is detected soon enough.

In this study, we investigate the impact of such GWs onto the circumbinary disk around stellar-mass and supermassive binary black holes, looking for this EM counterpart signature. To do so, we use general relativistic hydrodynamical simulations and a general relativistic ray-tracing code. We show that, due to the proximity to the binary, pre-merger GWs leave an imprint onto the disk, leading to quasi-periodic patterns in the X-ray lightcurve (MR+22, in prep.). Finally, we discuss the optimal case for an X-ray detection with Athena, in the (total mass ; mass ratio ; spin) parameter space.

Primary authors: Dr MIGNON-RISSE, Raphaël (APC, CNES); Dr VARNIERE, Peggy (APC); Dr CASSE, Fabien (APC); Dr DODU, Fabrice (APC)

Co-authors: Mrs ARTHUR, Léna (APC); Dr BAIRD, Jonathon (APC); Dr COLEIRO, Alexis (APC); Dr GONZÁLEZ, Matthias (AIM)

Presenter: Dr MIGNON-RISSE, Raphaël (APC, CNES)

Contribution Type: e-poster

Status: ACCEPTED

Submitted by **MIGNON-RISSE, Raphaël** on **Wednesday, 15 June 2022**

Abstract ID : **52**

Taking Hard X-ray Spectroscopy from the Local Universe out to the Cosmic Noon

Content

The nature of obscuring structures hiding the central engine of obscured active galactic nuclei (AGN) remains unclear. Broadband X-ray spectroscopy gives us unique insight into the anatomy of obscured AGN in the local universe as hard X-rays punch through even heavy obscuration, enabling us to study both the X-ray source and the properties of the obscuring matter. Much has been learned from hundreds of observations of nearby AGN taken over the first 10 years of NuSTAR, but less so for typical AGN at high redshift closer to the Cosmic Noon, when AGN feedback was more important for galaxy evolution and AGN obscuration may have been structured very differently. I will present results from phenomenological spectral analyses relevant for synthesis models of the cosmic X-ray background and constraints on the geometry of the obscuring structures based on a large sample of nearby obscured AGN observed with NuSTAR. Covering the hard X-ray rest-frame band that includes the critical spectral features, Athena promises to open up a unique window onto the obscuring structures in powerful high-redshift AGN.

Primary author: BALOKOVIC, Mislav (Yale University)

Presenter: BALOKOVIC, Mislav (Yale University)

Contribution Type: e-poster

Status: ACCEPTED

Submitted by **BALOKOVIC, Mislav** on **Wednesday, 15 June 2022**

Abstract ID : **53**

Intense AGN activity in the merging cluster Cygnus A

Content

We report on a detailed spatial and spectral analysis of the large-scale X-ray emission from the merging cluster Cygnus A. We use 2.2 Msec Chandra and 40 ksec XMM-Newton archival datasets to map the thermodynamic properties of the intracluster gas in the merger region between the two sub-clusters in the system. These maps exhibit complex intracluster medium (ICM) structure and temperature fluctuations that imply significant heating along the merger axis. Possible sources for this heating could include the shock from the ongoing merger, past activity of the powerful AGN in the core, or a combination of both. To distinguish between these scenarios, we compare the observed X-ray properties of Cygnus A with simple, spherical cluster models to quantify the morphology and amount of heating in the merger region. The spherical models for the two sub-clusters are constructed using azimuthally averaged density and temperature profiles determined from the data neglecting the merger region. These models for the "undisturbed" sub-clusters were then folded through the MARX instrument simulators to produce realistic mock Chandra observations. The thermodynamic properties in the merger region from these mock X-ray observations were used as a baseline for comparison with the actual observations. This analysis identifies two components in the heated ICM, a series of 3-4 keV temperature peaks presumably associated with past episodic AGN activity, and a smooth, large-scale temperature excess attributed to the ongoing merger. These features are also seen in the XMM data. If attributable to the central AGN, the location and strength of these features imply that Cygnus A has been active for the past 400 Myr injecting a total of 10^{60} erg into the merger region. This value corresponds to ~30% of the energy deposited in the same region by the merger shock. We conclude that the contribution due to AGN outbursts can be a significant fraction of total energy deposited in the ICM over a cluster's lifetime.

Primary author: Mr MAJUMDER, Anwesh (Anton Pannekoek Institute, University of Amsterdam)

Co-authors: Prof. WISE, Michael (Netherlands Institute for Space Research (SRON)); Dr SIMIONESCU, Aurora (Netherlands Institute for Space Research (SRON))

Presenter: Mr MAJUMDER, Anwesh (Anton Pannekoek Institute, University of Amsterdam)

Contribution Type: e-poster

Status: ACCEPTED

Submitted by **Mr MAJUMDER, Anwesh** on **Wednesday, 15 June 2022**

Abstract ID : **54**

Studying the magnetized X-ray parameters as measured through cyclotron resonance scattering features

Content

We demonstrate how to combine various observables of high-mass X-ray binaries to constrain the properties of the wind from the donor star. In addition, we derive the stellar wind velocities and mass-loss rates in several high-mass X-ray binaries from the X-ray accretion luminosity produced by the wind-fed neutron star (NS) and from the estimation of its magnetic field as measured through
cyclotron resonance scattering features (CRSFs). It has been proposed multiple times to use the NS in high-mass X-ray binaries as an orbiting X-ray probe embedded in the wind of its companion in order to constrain the stellar line-driven wind from the blue supergiant. Since the evolution of massive stars is essentially determined by mass loss, and that direct measures of mass-loss rates suffer from important uncertainties due to the unknown micro-structure of the wind. This would help us for the stellar evolution and computation of double compact object merger rates, as rightfully highlighted by this work. It is thus highly laudable to design semi-analytical models to do so, as is done in the present manuscript.

Primary author: TAANI, Ali (Al Balqa Applied University)

Presenter: TAANI, Ali (Al Balqa Applied University)

Contribution Type: e-poster

Status: ACCEPTED

Submitted by **TAANI, Ali** on **Thursday, 16 June 2022**

Abstract ID : **55**

Supernova remnants, interstellar medium, and the diffuse X-ray emission in galaxies

Content

The interstellar medium (ISM) in galaxies is heated and ionised by shock waves caused by stellar winds of massive stars and by supernova (SN) explosions. In particular, supernova remnants (SNRs) inject large amounts of energy into the ISM, carving out new structures and transferring kinetic energy to the ISM. They also act as recycling centres, which return elements processed in stars to the ISM. Shocks compress and change the cold medium, so new star formation occurs. In addition, particles are accelerated to relativistic energies.

With Athena we will be able to detect and analyse the faintest structures in the interstellar plasma and thus study its physics. We will study the emission of SNRs in our Galaxy and the Magellanic Clouds in great detail, study the SNR population and the hot ISM in nearby galaxies, and detect SNe/SNRs and the diffuse X-ray emission in further distant galaxies.

Primary author: Prof. SASAKI, Manami (Dr. Karl Remeis Observatory, Friedrich-Alexander-Universität Erlangen-Nürnberg)

Presenter: Prof. SASAKI, Manami (Dr. Karl Remeis Observatory, Friedrich-Alexander-Universität Erlangen-Nürnberg)

Contribution Type: Invited

Status: ACCEPTED

Submitted by **SASAKI, Manami** on **Monday, 20 June 2022**

Abstract ID : **57**

Mapping turbulence in the ICM with the Athena/X-IFU

Content

The Athena/X-IFU instrument will deliver X-ray spectroscopy data with unprecedented spatial and spectral resolution, enabling the deep physical investigation of the intra-cluster medium (ICM). Spectral diagnosis such as line shift and broadening will allow extracting information about its velocity structure, which is crucial to answer questions related to the assembly and evolution of large-scale structures. Indeed those motions - induced by various processes such as accretion, merger events, or AGN activities - are key to retrace the growth and evolution of groups and clusters of galaxies. The array of TES microcalorimeters aboard the X-IFU will enable such measurements and allow an accurate mapping of turbulence and bulk motion in galaxy clusters.
In this work, we investigate the ability of the X-IFU to probe the hot gas and provide constraints on the physical properties of the turbulent cascade - and so the internal dynamics - of the ICM, in the case of a toy model for non-cool core nearby galaxy clusters at z = 0.1. We show by the mean of end-to-end mock X-IFU observations and Monte Carlo simulations what information the X-IFU instrument will allow us to recover, and open on some discussion regarding the optimization of the observing strategy for future Athena/X-IFU observations toward that end.

Primary author: BEAUMONT, Sophie (IRAP / UMBC - NASA GSFC)

Co-authors: Dr CLERC, Nicolas (IRAP); Dr POINTECOUTEAU, Etienne (IRAP); Dr PAJOT, Francois (IRAP)

Presenter: BEAUMONT, Sophie (IRAP / UMBC - NASA GSFC)

Contribution Type: Oral presentation

Status: ACCEPTED

Submitted by **BEAUMONT, Sophie** on **Wednesday, 22 June 2022**

Abstract ID : **59**

Constraints on the physical origin of winds in BH X-ray binaries thanks to Athena

Content

The last two decades have seen a series of discoveries of narrow blue-shifted absorption features in transient BH LMXB. These features could actually trace massive equatorial outflows that can be dynamically important for the evolution of these systems. All high-inclination sources show these powerful disk winds especially during the soft state, mainly traced by the presence of ionized iron lines (e.g., Fexxv and/or Fexxvi). These winds are however typically absent during the hard state. Nonetheless, a large variety of wind signatures (generally strongly variable) and behaviors exist, revealing a complex connection among winds, jets and the states of the accretion disk. Our precise knowledge of the physical properties (density, ionisation, velocity profiles) of these winds is still quite poor however. For example we still do not know if the wind dynamics is mainly controlled by magnetically or thermally driven mechanisms, both being among the most probable launching mechanisms. We will show in this study, through state-of-the-art simulations, the decisive breakthroughs, in terms of physical diagnostics of the wind properties, we can expect from the high sensitivity and unprecedented spectral resolution of Athena in our understanding of BH LMXB wind and of their impact on the accretion-ejection processes.

Primary authors: Prof. DONE, Christine; Prof. KAZANAS, Demos; PETRUCCI, pierre-olivier (IPAG, Grenoble, France); Prof. BEHAR, Ehud; Prof. BIANCHI, Stefano; Dr CHAKRAVORTY, Susmita; Dr CLAVEL, Maica; Prof. CONTOPOULOS, Iannis; Dr DATTA, Sudeb; Prof. FERREIRA, Jonathan; Prof. FUKUMURA, Keigo; Prof. KALLMAN, Timothy; Prof. MATT, Girogio; Dr PARRA, Maxime; Prof. PROGA, Daniel; Dr TOMARU, Ryota; Prof. TZANAVARIS, Panayiotis; Dr WATERS, Tim; Prof. WILMS, Joern

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Contribution Type: Oral presentation

Status: ACCEPTED

Submitted by **PETRUCCI, pierre-olivier** on **Monday, 27 June 2022**

Abstract ID : **60**

Colliding winds in massive binary systems to be diagnosed with X-IFU

Content

OB and Wolf-Rayet stars feature energetic stellar winds. In massive binary systems, the winds of both components collide. This leads to the formation of a hot X-ray emitting plasma. The properties of this plasma are best studied via Athena/X-IFU observations of the line profiles of the Fe xxv line complex at 6.7 keV. We have designed numerical tools to predict the morphology of those lines for a variety of configurations and to extract a maximum of information from the future observations.

Primary authors: Dr MOSSOUX, Enmanuelle (Liège University); Dr NAZÉ, Yaël (Liège University); RAUW, Gregor (University of Liege)

Presenter: RAUW, Gregor (University of Liege)

Contribution Type: e-poster

Status: ACCEPTED

Submitted by **RAUW, Gregor** on **Tuesday, 28 June 2022**

Abstract ID : **61**

Modeling Fe-Kα Fluorescence in the X-ray Spectra of γ-Cas Stars

Content

Named after their prototype, γ-Cas stars are a subset of early Be-type stars emitting hard, bright and variable X-rays. The origin of these peculiar X-ray emissions is still in debate, although many scenarios have been proposed so far to explain it, including accretion onto a compact object, magnetic interaction of the Be star with its circumstellar disk, and collision between the wind of a stripped helium star companion and the Be disk. In this work, we model fluorescent Fe-K line emission from the rotating circumstellar disk and the photosphere of the Be star. The fluorescent Fe-K line is very sensitive to the physical conditions near the X-ray source. Thus, this line helps to better understand the geometry of the ionizing source and the X-ray emission mechanism in γ-Cas stars. We show that Athena/X-IFU will unveil the morphology of these lines, thereby offering a robust diagnostics to distinguish between the various scenarios.

Primary author: -, Jahanvi (GAPHE, University of Liege)

Co-authors: RAUW, Gregor (University of Liege); NAZÉ, Yaël (Liège University)

Presenter: -, Jahanvi (GAPHE, University of Liege)

Contribution Type: e-poster

Status: ACCEPTED

Submitted by **-, Jahanvi** on **Tuesday, 28 June 2022**

Abstract ID : **62**

Measuring supermassive black hole spin with Athena

Content

Measuring the supermassive black hole (SMBH) spin is a fundamental goal of future Athena extragalactic surveys, with the potential to unveil the growth history of SMBHs. The X-ray reflection spectroscopy offers a powerful tool to measure the black hole spin. However, current CCD-resolution spectra are often insufficient to efficiently disentangle the competing signatures of reflection and complex ionised absorption. In this talk, we will discuss the prospects and challenges that must be overcome by next-generation microcalorimeters to measure SMBH spin with large confidency. We will present our ongoing efforts to explore and characterise the complex parameter space inherent to simulated Athena/X-IFU X-ray reflection spectra using our novel application of global parameter space exploration algorithms.

Primary author: SVOBODA, Jiri (Astronomical Institute of the Czech Academy of Sciences)

Co-authors: Dr BOORMAN, Peter (Astronomical Institute of the Czech Academy of Sciences); Dr DOVCIAK, Michal (Astronomical institute of the Czech Academy of Sciences); Dr KAMMOUN, Elias (IRAP); Dr MINIUTTI, Giovanni (CSIC-INTA); Dr BARRET, Didier (IRAP); Dr CAPPI, Massimo (INAF); Dr KYNOCH, Daniel (University of Southampton); Dr NARDINI, Emanuele (INAF); Dr RISALITI, Guido (University of Florence); Prof. MATT, Giorgio

Presenter: SVOBODA, Jiri (Astronomical Institute of the Czech Academy of Sciences)

Contribution Type: Oral presentation

Status: ACCEPTED

Submitted by **SVOBODA, Jiri** on **Tuesday, 28 June 2022**

Abstract ID : **65**

Diffuse thermal X-ray emission from bow shocks of massive stars

Content

Hot massive stars have strong stellar winds with velocity 1000-3000 km/s that, when shocked, produce hot gas with temperature $10^7 - 10^8$ K. This is observed as diffuse X-ray emission in Wolf-Rayet nebulae, around young star clusters, and around the nearest O star, Zeta Oph. Zeta Oph is a runaway star whose strong wind produces a bow shock from the wind-ISM interaction, and diffuse X-ray emission from the shocked wind was detected in Chandra observations. It therefore provides an excellent testbed for models of bow shocks around massive stars. We present the first 3D magnetohydrodynamic simulations of the bow shock around Zeta Oph, calculating the X-ray luminosity and thermal emission maps as a function of energy. Simulations with a range of different assumptions are compared with infrared and re-analysed X-ray observations. In all cases the simulations underpredict the X-ray emission, and the observed morphology of the emission is not easily understood from models. This first numerical study of the bow shock and wind bubble around Zeta Oph uses a relatively simple model of a uniform ISM and ideal-magnetohydrodynamics, and can be used as a basis for comparing results from models incorporating more physical processes. The faint diffuse emission is difficult to characterise from Chandra observations, and the much greater sensitivity to such nebulae promised by ATHENA will dramatically improve our understanding of the hot ISM, stellar winds, and mixing between hot and warm ISM phases.

Primary authors: MACKEY, Jonathan (Dublin Institute for Advanced Studies); Dr GREEN, Samuel

Co-authors: Dr HAWORTH, Thomas (QMUL); Dr KAVANAGH, Patrick (DIAS); MOUTZUORI, Maria (DIAS); Dr GVARAMADZE, Vasilii

Presenter: MACKEY, Jonathan (Dublin Institute for Advanced Studies)

Contribution Type: Oral presentation

Status: ACCEPTED

Submitted by **MACKEY, Jonathan** on **Wednesday, 29 June 2022**

Abstract ID : **68**

Characterising Compton-Thick AGN and AGN outflows at z~1-3 with Athena

Content

A sizeable part of the observation time of the ESA flagship X-ray observatory Athena is expected to consist of a multi-tiered survey of the extragalactic sky. This is expected to contribute significantly to the understanding of the Hot and Energetic Universe, the main Athena science theme.

One of the expected outcomes of the survey is the detection and characterisation of Compton-Thick (CT) AGN at the heyday of star formation and supermassive black hole growth in the Universe, z~1-3. We will discuss here the capabilities of Athena for characterising the luminosity and column density of moderately CT AGN for different configurations of the survey and angular resolutions of Athena.

AGN activity is often manifested as outflows, which may affect significantly their host galaxies, as postulated by many models of galaxy formation and evolution. The Athena survey is expected to reveal many instances of nuclear outflows among the general AGN population. We will also show how the survey will allow to constrain the prevalence and physical characteristics (column density, ionisation…) of these outflows.

Primary author: CARRERA, Francisco

Co-authors: Dr GEORGAKAKIS, Antonis (NOA); Dr LUCA, Zappacosta (INAF-Osservatorio Astronomico di Roma)

Presenter: CARRERA, Francisco

Contribution Type: Oral presentation

Status: ACCEPTED

Submitted by **CARRERA, Francisco** on **Friday, 1 July 2022**

Abstract ID : **69**

Exploring the outskirts of galaxy clusters with Suzaku and Chandra observations

Content

Suzaku has played a very important role in the past decades to explore the cluster outskirts, while a lot of archival data have never been explored. Analyzing 4 unexplored *Suzaku* observations towards the northwest (NW) edge of Perseus cluster, we find a break near r_{200} in the projected temperature profile, indicating a shock with M = 1.9±0.3. Corresponding discontinuities are also found in the projected emission measure and the density profiles at the same location. This evidence of a shock front so far away from the cluster center is unprecedented, and may provide a first insight into the properties of large-scale virial shocks which shape the process of galaxy cluster growth. In the past decades, *Chandra* have accumulated ultra-deep exposure on Abell 133 and Abell 1795, out to extremely large radii, providing a special coverage in the outskirts even beyond r_{200}. Combining with *Suzaku* data, we explored the thermodynamic profiles and clumping factor of intracluster medium (ICM) in the outskirts of galaxy clusters.

Primary authors: ZHU, Zhenlin (SRON/Leiden University); SIMIONESCU, Aurora (SRON/Leiden Observatory); KOVÁCS, Orsolya (Department of Theoretical Physics and Astrophysics, Masaryk University, Kotlárská 2, 61137 Brno, Czech Republic); WERNER, Norbert (Department of Theoretical Physics and Astrophysics, Masaryk University, Kotlárská 2, 61137 Brno, Czech Republic)

Presenter: ZHU, Zhenlin (SRON/Leiden University)

Contribution Type: e-poster

Status: ACCEPTED

Submitted by **ZHU, Zhenlin** on **Saturday, 2 July 2022**

Abstract ID : **71**

Automated Redshift estimation from X-ray AGN spectra

Content

Spectroscopic redshift extraction is an expensive process. In this work, we have employed an automated method to extract redshift information solely from the X-ray AGN spectra. For this purpose, we have used highly quality NuSTAR hard X-ray spectra to obtain a set of models that best represent the X-ray spectral shape of AGN. We have used UXCLUMPY, a relatively new clumpy torus model that allows for self-consistent multi-wavelength analyses. The models were then used to simulate spectra with Athena WFI response matrices in the redshift range of 1-4, Luminosity $LX_{2-10keV} = 5 \times 10^{44}$ erg/s and exposure times of 84 ks, 840 ks, 980 ks, and 1400 ks. These simulated spectra were then passed on to the classical automated redshift estimating algorithm to recover the redshifts. Our preliminary results show that redshifts can be recovered very well up to z = 2 and suggest it could be improved for z $>$ 2 with sophisticated noise filtering algorithms.

Primary author: VAIYAPURI PALANIMUTHU, Koushika (Instituto de Fisica de Cantabria (CSIC-UC))

Co-authors: CORRAL RAMOS, Amalia; CARRERA, Francisco; LALOUX, Brivael; AKYLAS, Thanassis; GEORGAKAKIS, Antonis (NOA, Athens, Greece)

Presenter: VAIYAPURI PALANIMUTHU, Koushika (Instituto de Fisica de Cantabria (CSIC-UC))

Contribution Type: e-poster

Status: ACCEPTED

Submitted by **VAIYAPURI PALANIMUTHU, Koushika** on **Saturday, 2 July 2022**

Abstract ID : **72**

Measuring turbulence in galaxy clusters: insights from numerical simulations

Content

The X-ray emitting intracluster medium (ICM) pervades the region between galaxies in a galaxy cluster. Mass measurements using the ICM are used to study large-scale structure formation and the cosmic distribution of matter, which are important to infer cosmological parameters. The ICM also plays a critical role in the cosmic baryon cycle of member galaxies, as gas condensing out of the ICM through radiative cooling can flow into the brightest central galaxy (BCG) of the cluster and fuel star formation.

Sloshing by galaxies falling into the cluster, jets driven by active galactic nuclei (AGNs) launched from the BCG can drive turbulence in the ICM. Turbulence provides non-thermal pressure support to the ICM, which causes gas pressure profiles to deviate from hydrostatic equilibrium. This can lead to hydrostatic bias in mass measurements. Turbulent mixing and viscous dissipation can channel the feedback heat from AGN jets into the ICM and prevent it from radiatively cooling, which can decrease the amount of cooler gas flowing into the BCG. However, direct measurements of turbulent velocities of the ICM are currently not possible due to the limited spectral resolution of the X-ray observatories.

I conduct high-resolution simulations of the ICM, including gravitational stratification, radiative cooling and different methods of driving. I study the importance of turbulence as a heating mechanism and how it affects the distribution functions of its density and temperature, the amplitude of gas velocities and the morphology of the X-ray emitting gas. I obtain scaling relations between the amplitude of density and pressure fluctuations and the turbulent velocities. These relations are useful to constrain turbulent velocities from fluctuations in the X-ray surface brightness of the cluster.

Primary author: MOHAPATRA, Rajsekhar (Princeton University)

Co-authors: Prof. FEDERRATH, Christoph (Australian National University); Prof. SHARMA, Prateek (Indian Institute of Science)

Presenter: MOHAPATRA, Rajsekhar (Princeton University)

Contribution Type: Oral presentation

Status: ACCEPTED

Submitted by **MOHAPATRA, Rajsekhar** on **Monday, 4 July 2022**

Abstract ID : **74**

Time-evolving modelling for fits to Xray GRB afterglows

Content

GRB spectra are powerful probes of the circumburst medium of their progenitor and the host galaxy's ISM. The X-ray absorption probes the total column along the line of sight, including the immediate vicinity of the GRB, while optical absorption probes the neutral ISM within the host, providing a complementary window to study the nature of the medium. Additionally, the column densities as derived from the X-ray and the optical differ by up to an order of magnitude, suggesting the presence of a highly ionised region close to the GRB. In this study, we present a combined analysis, with fits to a sample of six GRBs using a newly developed time-evolving photoionisation model in conjunction with the optically derived absorption. We find that our model can successfully fit five bursts, the remaining burst being fully consistent with a neutral medium. We also discuss the implications of our fits and how they can be interpreted in the context of the total column towards the GRB

Primary author: THAKUR, Aishwarya Linesh (INAF-IAPS, Roma)

Presenter: THAKUR, Aishwarya Linesh (INAF-IAPS, Roma)

Contribution Type: e-poster

Status: ACCEPTED

Submitted by **THAKUR, Aishwarya Linesh** on **Monday, 4 July 2022**

Abstract ID : **75**

Pulsar winds and accretion flows in compact binary MSPs

Content

Compact binary millisecond pulsars (MSPs) are providing new insights into sub-luminous accretion flows and pulsar winds near the light cylinder, as well as new constraints on the maximum mass that a neutron star can support. I will present the recent discovery of strong flat-topped noise in the X-ray variability of two (transitional) compact binary MSPs, with characteristic "break" frequencies in the 0.9-2.8 mHz range. I will also review their X-ray emission in the pulsar state (modulated at the orbital period), and the prospects for Athena to study this growing class of pulsars in the X-ray band.

Primary author: LINARES, Manuel (NTNU & UPC)

Presenter: LINARES, Manuel (NTNU & UPC)

Contribution Type: e-poster

Status: ACCEPTED

Submitted by **LINARES, Manuel** on **Monday, 4 July 2022**

Abstract ID : **76**

Athena and extra-galactic fast X-ray transients

Content

Fast X-ray transients serendipitously discovered in Chandra, XMM-Newton, and eROSITA observations are associated with energetic extra-galactic phenomena, although their exact nature has not yet been established. The proposed explanations range from origins in double neutron star mergers, black hole – neutron star mergers, tidal disruption events involving an intermediate-mass black hole and a white dwarf, to off-axis or sub-luminous gamma-ray bursts. In addition, in supernovae the shock that explodes the star leads to a fast X-ray flare when the shock breaks out of the star, however, for several FXTs the observed luminosity is too high for this latter explanation. We will show the ways how Athena's unique capabilities will further this burgeoning research field.

Primary authors: JONKER, P (SRON & Radboud University); Prof. LEVAN, A (Radboud University); Prof. BAUER, F (Universidad Catolica de Chile); Mr EAPPACHEN, D (Radboud University & SRON); Dr EDVIGE RAVASIO, M (Radboud University); Dr QUIROLA-VASQUEZ, J (Universidad Catolica de Chile)

Presenter: JONKER, P (SRON & Radboud University)

Contribution Type: Oral presentation

Status: ACCEPTED

Submitted by **JONKER, P** on **Monday, 4 July 2022**

Abstract ID : **77**

The Hunt for Ultracompact X-ray binaries

Content

The ultra-compact family of low mass X-ray binaries (LMXBs) is composed by those systems with orbital periods shorter than 80 minutes. These short periods imply small Roche lobes, in which only degenerated (hydrogen poor) donor stars can fit. Thus, they are unique laboratories to study accretion processes in hydrogen deficient environments as well as some of the fundamental stages of binary evolution. Last but not least, they will be primary sources for gravitational waves studies at low-frequencies by the forthcoming LISA mission.

However, the discovery and study of these tantalising (but faint) systems are usually hampered by the limitations of current instrumentation, being only possible by pushing the most powerful X-ray and optical observatories to their limits. Therefore, future facilities such as ATHENA and ELT are expected to be game changers. I will review the state-of-the-art of the field and present the latest results on the hunt for new members for the scarce family of Ultra-Compact X-ray binaries. These are based on detailed time-resolved photometry studies, and the investigation of the chemical composition of the donor star by using broadband X-ray spectroscopy as well as optical spectroscopy carried outwith the 10.4-m GTC.

Primary author: Dr ARMAS PADILLA, Montserrat (Instituto de Astrofísica de Canarias)

Presenter: Dr ARMAS PADILLA, Montserrat (Instituto de Astrofísica de Canarias)

Contribution Type: Oral presentation

Status: ACCEPTED

Submitted by **ARMAS PADILLA, Montserrat** on **Monday, 4 July 2022**

Abstract ID : **78**

Chemical enrichment in the Centaurus cluster of galaxies

Content

An active element supply process into the intracluster medium (ICM) from brightest cluster galaxies (BCGs) makes the cool core of galaxy clusters an ideal target to study chemical enrichments and evolutions of the ICM. We present results from over 500 ks Chandra and XMM-Newton observations of the cool core of the Centaurus cluster of galaxies. The absolute abundances of O, Mg, Si, S, Ar, Ca, and Fe show a sharp drop within the central 18 arcsec region. On the other hand, the X/Fe abundance ratios of these elements show flat radial distributions. In addition, by using RGS onboard XMM-Newton, we find that the Ne/Fe profile is also flat within the centre. In the innermost regions where Fe–L lines dominate the observed spectra, the measurements of the absolute abundances are challenging. For example, AtomDB and SPEXACT give inconsistent Fe abundance as Fe = 0.5 and 1.4 solar, respectively. These results indicate that the abundance drop may be at least partly caused by some systematic uncertainties in the atomic data rather than the metal depletion process into the cold dust. While the Si/Fe, S/Fe, Ar/Fe, Ca/Fe, Cr/Fe, and Mn/Fe ratios are close to the solar composition, the O/Fe, Ne/Fe, and Mg/Fe ratios tend to be lower, and the Ni/Fe ratio is higher than the solar ratios. Despite a possibly significant contribution of Type Ia supernovae to the enrichment in the Centaurus core, the entire abundance pattern is still challenging to reproduce with the up-to-date supernova nucleosynthesis yields. Beyond our results with current observatories, what remains shrouded in mystery are the accurate metal distribution and the more detailed enrichment channels in the central coolest part of the ICM. These metal contents in the Centaurus core will be well assessed by XRISM and upcoming Athena; for example, robust abundance measurements for trace elements (e.g., N, Al, Mn) and determination of their distribution with non-dispersive spectra. Updates of the atomic data provided by these missions also offer a unique understanding of the ICM and dispel a deep fog of cosmic conundra.

Primary author: Mr FUKUSHIMA, Kotaro (Tokyo University of Science)

Co-authors: Dr KOBAYASHI, Shogo B. (Tokyo University of Science); Prof. MATSUSHITA, Kyoko (Tokyo University of Science)

Presenter: Mr FUKUSHIMA, Kotaro (Tokyo University of Science)

Contribution Type: Oral presentation

Status: ACCEPTED

Submitted by **FUKUSHIMA, Kotaro** on **Monday, 4 July 2022**

Abstract ID : **79**

Tell-Tale Spectral Signatures of MHD-Driven X-ray UFOs in Athena Era

Content

We aim to explore spectral signatures of the predicted multi-ion AGN UFOs in the broadband X-ray spectra by exploiting an accretion disk wind model in the context of a simple magnetohydrodynamic (MHD) framework. We are focused primarily on examining the spectral dependences on a number of key physical properties of active galactic nuclei (AGNs); i.e. (1) inclination, (2) X-ray photon index, (3) optical/UV-to-X-ray strength, (4) wind density gradient along a line of sight, (5) wind density normalization and (6) Eddington ratio. Considering primarily radio-quiet Seyferts and quasars, multi-ion UFO spectra are systematically calculated as a function of these parameters to show that MHD-driven UFOs are likely to imprint a unique asymmetric absorption line profile with a pronounced blue tail structure on average. Such a "tell-tale" line signature, being almost generic to MHD disk winds due to the intrinsic wind kinematics, might be utilized as a diagnostic proxy to potentially differentiate leading driving processes among thermally-driven, UV line-driven and MHD-driven scenarios. We also demonstrate a high fidelity of microcalorimeter observations in anticipation of the upcoming XRISM/Resolve and Athena/X-IFU data by performing spectral simulations.

Primary author: FUKUMURA, Keigo (James Madison University)

Co-authors: Dr DADINA, Mauro (INAF); Dr MATZEU, Gabriele (University of Bologna); Prof. TOMBESI, Francesco (Tor Vergata University of Rome); Dr SHRADER, Chris (NASA/GSFC/CUA); Dr KAZANAS, Demos (NASA/GSFC)

Presenter: FUKUMURA, Keigo (James Madison University)

Contribution Type: Oral presentation

Status: ACCEPTED

Submitted by **FUKUMURA, Keigo** on **Monday, 4 July 2022**

Abstract ID : **80**

What ULX pulsars tell us about super-Eddington accretion

Content

With the discovery that some ultra-luminous X-ray sources are powered by neutron stars and are therefore pulsating a whole new way of investigating these objects has opened up: pulsar timing and period evolution. First of all, this allows us to determine the orbital ephemeris of the system and hence learn more about its origins and evolution. Secondly, by monitoring the pulse period over a long time, we can study the amount of accreted angular momentum in relation to the observed X-ray luminosity, which gives us clues about the accretion efficiency as well as constraints on the magnetic field of the neutron star.

First, I will present pulse period evolution studies of two ultra-luminous X-ray pulsars (ULXPs), NGC 7793 P13 and NGC 5907 ULX-1. Both sources recently underwent an off-state, where the X-ray flux dropped below the detection limit of Swift/XRT. However, the physical nature of these off-states was very different: while P13 continued to spin-up indicating it continued to accrete, NGC 5907 ULX1 spun-down significantly. This spin-down indicates accretion was halted, possibly by the propeller effect. Both behaviours are excellent tools to study the accretion geometry and measure the magnetic field of the neutron star.

Second, to understand the ULX pulsar population as a whole, and their role in binary and galaxy evolution, we need to perform similar studies for many more sources. Currently we only know about 7 pulsating ULXs. With the advent of Athena we expect to increase this number by 10x-100x. I will briefly discuss our simulation of ULX populations in the nearby universe accessible with Athena. Additionally, Athena can provide the much needed flux and period monitoring in galaxies much further away and with shorter exposure times, allowing us to study different metallicities and environments and their influence on the ULX and X-ray binary population.

Primary authors: FUERST, Felix (ESA/ESAC); Dr WALTON, Dominic (U Hertfordshire and IoA Cambridge); Dr BACHETTI, Matteo (INAF Cagliari); Dr BRIGHTMAN, Murray (Caltech); Dr HEIDA, Marianne (ESO)

Presenter: FUERST, Felix (ESA/ESAC)

Contribution Type: Oral presentation

Status: ACCEPTED

Submitted by **FUERST, Felix** on **Monday, 4 July 2022**

Abstract ID : **81**

X-ray reverberation in BH systems

Content

X-ray reverberation lags are due to the delayed response of the accretion disc to irradiation from a rapidly variable hard X-ray flux. These lags scale with the relative distance between the X-ray source and the reprocessing region in the disc, therefore they are powerful diagnostics of the geometry of the innermost accretion flow. I will review results obtained from studies of X-ray reverberation in BH systems, and discuss how these studies will benefit from the large collecting area and instrumental capabilities of Athena.

Primary author: DE MARCO, Barbara (Universitat Politècnica de Catalunya)

Presenter: DE MARCO, Barbara (Universitat Politècnica de Catalunya)

Contribution Type: Oral presentation

Status: ACCEPTED

Submitted by **DE MARCO, Barbara** on **Monday, 4 July 2022**

Abstract ID : **83**

The eROSITA X-ray clusters

Content

Successfully launched in July 2019, eROSITA, the German-built telescope array operating between 0.3-8 keV on board the Russian-German Spectrum-RG (SRG) mission, provides a unique imaging, spectroscopic, and timing capability. The high sensitivity, large field of view, and high survey efficiency of eROSITA is bound to revolutionize X-ray astronomy. By performing eight all-sky surveys, each lasting half a year in the next four years, eROSITA will deliver the largest catalogs of X-ray sources. Clusters of galaxies trace the highest peaks in the cosmic density field and offer an independent and powerful probe of the growth of structure. The final eROSITA All-Sky Survey catalog with more than 100,000 clusters will map the large-scale structure and put us on the verge of a breakthrough in precision measurements of the cosmological parameters. I will briefly mention the main results of the performance verification phase survey (eFEDS). Then I will review some preliminary results from the first eROSITA All-Sky Survey, presenting, in particular, the properties of clusters and groups of galaxies detected in the first All-Sky survey and the projected constraints on cosmology.

Primary author: GHIRARDINI, Vittorio (Max Planck Institute for Extraterrestrial Physics)

Presenter: GHIRARDINI, Vittorio (Max Planck Institute for Extraterrestrial Physics)

Contribution Type: Oral presentation

Status: ACCEPTED

Submitted by **GHIRARDINI, Vittorio** on **Monday, 4 July 2022**

Abstract ID : **84**

Observations of the Sunyaev-Zeldovich Effect in the Athena Era

Content

The three main forms of the Sunyaev-Zeldovich effect – the classical thermal SZ effect, the kinetic SZ effect, and relativistic corrections to the thermal SZ effect – are already beginning to provide powerful tools to probe the warm/hot intracluster, intragroup, intercluster, and circumgalactic media traditionally probed through in X-ray observations. The current state of the art is dominated by widefield, arcminute resolution surveys such as those with Planck, ACT, and SPT, or by higher resolution targeted observations of very small fields such as those by MUSTANG-2, ALMA, and NIKA2. However, in the 2030s we anticipate the Atacama Large Aperture Submm Telescope (AtLAST) will lead a new generation of high spatial and spectral resolution widefield SZ observations. In this talk I will discuss the developing SZ science cases for AtLAST and how AtLAST can complement Athena.

Primary author: MROCZKOWSKI, Tony (European Southern Observatory (ESO))

Presenter: MROCZKOWSKI, Tony (European Southern Observatory (ESO))

Contribution Type: Oral presentation

Status: ACCEPTED

Submitted by **MROCZKOWSKI, Tony** on **Monday, 4 July 2022**

Abstract ID : **86**

A Hubble diagram of quasars at high redshift with Athena serendipitous observations

Content

We have recently demonstrated that the non-linear X-ray to UV luminosity relation in quasars can be used to build a Hubble diagram up to redshifts z~7 In particular, we built a representative, unbiased sample of more than 2,000 quasars with optical spectra from the SDSS and X-ray spectra from the 4XMM catalog of serendipitous sources. The strength of this sample as cosmological probe critically depends on the reliability and precision of the distance estimates. We have demonstrated that the "bottleneck" in these estimates is the quality of the X-ray flux measurements: for example, a group of only ~20 quasars at z>3 with pointed XMM observations and high signal-to-noise spectra provide a unique test for the cosmological models at high redshift, revealing a significant tension with the "concordance" model. I will show that an analogous work based on Athena archival WFI data after just 1-2 years of observations will allow us to build a Hubble diagram of quasars which will measure the expansion of the Universe in the z=2-7 range with unmatched precision. These measurements will be complementary to all the other cosmological expected in the next decades.

Primary author: RISALITI, Guido (Dip. di Fisica e Astronomia, Università di Firenze)

Co-authors: Prof. ELISABETA, Lusso (University of Florence); Dr EMANUELE, Nardini (INAF - Arcetri Observatory)

Presenter: RISALITI, Guido (Dip. di Fisica e Astronomia, Università di Firenze)

Contribution Type: Oral presentation

Status: ACCEPTED

Submitted by **RISALITI, Guido** on **Monday, 4 July 2022**

Abstract ID : **87**

A joint GW-EM modelling of GW170871: future perspectives

Content

On August 17th 2017, advanced LIGO and Virgo observed GW170817, the first gravitational-wave signal from a binary neutron star merger. It was followed by a short duration gamma ray burst, GRB 170817A, and a non-thermal afterglow emission, opening the way for multi-messenger studies. In this work, a combined simultaneous fit of the electromagnetic (EM, in particular the afterglow) and gravitational-wave (GW) domains is implemented, treating the viewing angle as shared parameter. This is done because, in the EM modelling, the viewing angle θ_v and the jet opening angle θ_c are correlated, leading to high uncertainties in the modelling of these events. The joint EM+GW fit solve this degeneracy, reducing the dispersion better than an EM-only fit. We repeat the same analysis for an event like GW170817 located at 136.5 Mpc. The afterglow is almost one order of magnitude fainter and with, the up to date instruments, only the peak of the light curve would be visible. The EM-only fit alone cannot constraint either the viewing angle or the jet opening angle, while including the GW data leads to tighter constraints on θ_v. As the the rising part of the afterglow is undetected, the jet opening angle remains unconstrained. Athena sensitivity would allow to see the rising and decreasing part of the light curve, leading to tighter constraints also on θ_c, otherwise impossible to measure.

Primary author: GIANFAGNA, Giulia (INAF - IAPS, Rome, Italy)

Co-authors: PIRO, Luigi (INAF - IAPS, Rome, Italy); PANNARALE, Francesco (Dipartimento di Fisica, Sapienza University of Rome, Italy; INFN Sezione di Roma, Italy); VAN EERTEN, Hendrik (Department of Physics, University of Bath, UK); RYAN, Geoffrey (University of Maryland, USA; Astrophysics Science Division, NASA Goddard Space Flight Center, USA; Perimeter Institute for Theoretical Physics, Canada); TROJA, Eleonora (Astrophysics Science Division, NASA Goddard Space Flight Center, USA; University of Rome Tor Vergata, Department of Physics, Italy); RICCI, Fulvio (Dipartimento di Fisica, Sapienza University of Rome, Italy; INFN Sezione di Roma, Italy)

Presenter: GIANFAGNA, Giulia (INAF - IAPS, Rome, Italy)

Contribution Type: e-poster

Status: ACCEPTED

Submitted by **GIANFAGNA, Giulia** on **Monday, 4 July 2022**

Abstract ID : **88**

Cosmic (an)istropy and Athena: finally, a definite answer

Content

The hypothesis that the matter in the late Universe is isotropic and homogeneous within the CMB rest frame is a fundamental pillar of the standard cosmological model. The cosmic expansion rate H0 is thought to be spatially constant, while bulk flows are often presumed to be negligible compared to the Hubble expansion. Any deviation from this consensus can cause a major paradigm shift in modern cosmology. Scaling relations of galaxy clusters can be effectively used for testing the assumption of isotropy. By measuring many different cluster properties, several scaling relations with different sensitivities can be built. Nearly independent tests of cosmic isotropy and large bulk flows are then feasible. We use up to 570 clusters with measured properties at X-ray, microwave, and infrared wavelengths to construct ten different cluster scaling relations and test the isotropy of the local Universe. Through rigorous and robust tests, we detect an apparent 9% spatial variation in the local H0, at a >5 sigma level. Since our used clusters mostly lie at low redshifts (z<0.2), the observed anisotropy could also be attributed to a "local" 900 km/s bulk flow, which seems to extend out to at least 500 Mpc. The exact nature of this anisotropy could be easily identified if one used very distant X-ray clusters (z>0.5), which should only be affected by primordial effects and not by local bulk flows. As a next-generation X-ray telescope, Athena's power will allow us to scrutinize the isotropy of the high redshift Universe in unprecedented detail. Athena will provide a definite answer to the crucial question: does the matter in the late Universe behaves isotropically or there is a primordial anomaly in the cosmic expansion rate?

Primary authors: MIGKAS, Konstantinos (University of Bonn); Dr PACAUD, Florian (University of Bonn); Prof. REIPRICH, Thomas (University of Bonn)

Presenter: MIGKAS, Konstantinos (University of Bonn)

Contribution Type: Oral presentation

Status: ACCEPTED

Submitted by **MIGKAS, Konstantinos** on **Monday, 4 July 2022**

Abstract ID : **89**

Cavity Detection Tool (CADET)

Content

The study of jet-inflated X-ray cavities provides a powerful insight into the energetics of atmospheres of early-type galaxies and the AGN feedback phenomenon. Properly estimating their total extent is, however, non-trivial, prone to biases and nearly impossible for poor-quality data. For these reasons, we have decided to harness the power of machine learning to tackle this problem. Using artificially generated images, we have trained a convolutional neural network to produce pixel-wise predictions capturing both the position and extent of detected X-ray cavities. Furthermore, we present how the network performs on real Chandra images of early-type galaxies.

Primary author: PLŠEK, Tomáš (Masaryk University)

Presenter: PLŠEK, Tomáš (Masaryk University)

Contribution Type: e-poster

Status: ACCEPTED

Submitted by **PLŠEK, Tomáš** on **Monday, 4 July 2022**

Abstract ID : **90**

A unique, distant cluster pre-merger

Content

Galaxy cluster mergers are excellent laboratories for studying a long list of different physical processes. Different phases of the merging process can reveal different aspects of these fascinating systems. For instance, the pre-merger state can help us to understand the conditions under which the cluster gas interaction starts, the effects of the latter on X-ray cluster properties, and the biases that such systems inflict on cosmological analyses. We use XMM-Newton observations to study the SPT-CLJ2228−5828 cluster system, which constitutes a pre-merger system. It is a high-redshift ($z = 0.77$) cluster pair that was believed to be a dissociative cluster post-merger when studied only by SPT via its SZ signal. It exhibits two major, widely-separated centers in its mass distribution, identified by HST weak lensing observations. With the use of X-rays however, it is revealed that SPT-CLJ2228−5828 consists of two closeby clusters of similar mass in a pre-merging state. This strongly demonstrates the need for high-resolution X-ray observations when we study such high redshift complex systems. Performing a spectroscopic analysis, we fully characterize the two cluster members of the merger along with the gas bridge that connects them. We check the consistency of the numerous measured X-ray cluster properties with several scaling relations at the high-z regime. This helps us understand the kind of biases that such systems might introduce to scaling relation studies when unidentified. SPT-CLJ2228−5828 is (to our knowledge) the first such high-z pre-merger consisting of equally-sized clusters to be studied. Due to its observational power, Athena will reveal many more such systems at even larger distances. This will help us better understand the cluster formation processes in the early Universe, the merging dynamics between clusters of different masses, and the evolution of these merging systems with redshift.

Primary author: MIGKAS, Konstantinos (University of Bonn)

Presenter: MIGKAS, Konstantinos (University of Bonn)

Contribution Type: e-poster

Status: ACCEPTED

Submitted by **MIGKAS, Konstantinos** on **Monday, 4 July 2022**

Abstract ID : **91**

Radio-Mechanical AGN Feedback in Early-Type Galaxies

Content

Most galaxies comparable to or larger than the mass of the Milky Way host hot, X-ray emitting atmospheres and central radio sources. Hot atmospheres and radio jets and lobes are the ingredients of radio-mechanical active galactic nucleus (AGN) feedback. We will present recent results based on radio and X-ray observations, which indicate that in massive early type galaxies the central radio sources are mostly switched on. We will show that for galaxies with thermally unstable hot atmospheres, the mechanical jet power correlates strongly with the Bondi accretion power. Further investigating the dependence of jet power on individual quantities in the Bondi formula, such as the supermassive black hole mass and the specific entropy of the gas at the Bondi radius, we find a very tight correlation between the jet power and black holes mass and, although poorly constrained, a hint of an anti-correlation between jet power and entropy. The results indicate that at least for thermally unstable systems, the jet power is set primarily by the supermassive black hole mass.

Primary author: Prof. WERNER, Norbert (Masaryk University)

Co-authors: PLSEK, Tomas (Masaryk University); Dr GROSSOVA, Romana (Masaryk University/Astronomical Institute CAS); Dr TOPINKA, Martin; Dr SIMIONESCU, Aurora (SRON); Prof. ALLEN, Steve (Stanford)

Presenter: Prof. WERNER, Norbert (Masaryk University)

Contribution Type: e-poster

Status: ACCEPTED

Submitted by **WERNER, Norbert** on **Monday, 4 July 2022**

Abstract ID : **93**

Bayesian analysis for X-ray thermal emission in the synchrotron dominated shocks in Tycho's SNR

Content

While a faint thermal signature left by shocked interstellar medium (ISM) should be found in X-ray synchrotron dominated spectra in the vicinity of SNR shock waves, proof for such an emission in Tycho's SNR has been lacking. Switching from traditional fitting methods to more complete Bayesian inference allows for new perspectives, even when using the same Chandra archival data as in the literature. Such an approach allows not only to detect and characterize the properties of shocked ISM in Tycho's SNR, but also to make predictions for the upcoming X-IFU instrument onboard the Athena space mission. Indeed, the refined spectral resolution at low energy (0.5 - 1 keV) of X-IFU should confirm our results for Tycho, and open a new window on our understanding of SNR blast waves in general.

Primary author: ELLIEN, Amaël (Anton Pannekoek Instituut)

Presenter: ELLIEN, Amaël (Anton Pannekoek Instituut)

Contribution Type: Oral presentation

Status: ACCEPTED

Submitted by **ELLIEN, Amaël** on **Monday, 4 July 2022**

Abstract ID : **94**

Doppler tomography of AGN accretion disks with Athena

Content

Rapid variability of the fluorescent emission lines from the accretion disk appears to be ubiquitous in active galactic nuclei, and it has proven to be an invaluable tool to investigate the nature of the X-ray corona and of its coupling with the disk. Yet, a detailed analysis of such features, which range from quasi-periodic signals to transient emission at unusual energies, is currently possible only in a limited number of sources. I will discuss how the great advances in effective area and spectral resolution afforded by the X-ray Integral Field Unit onboard Athena can transform the intriguing but sparse results obtained so far into a brand new field of AGN research, allowing us to study at high spectral and temporal resolution the physical and dynamical properties of the innermost accretion flow around supermassive black holes.

Primary author: NARDINI, Emanuele

Co-authors: BIANCHI, Stefano; CAPPI, Massimo (INAF); DADINA, Mauro (INAF); DE ROSA, Alessandra; KAMMOUN, Elias (IRAP - CNRS); Dr MARINUCCI, Andrea (ASI); MATT, Giorgio; MATZEU, Gabriele (University of Bologna); MIDDEI, Riccardo (Space Science Data Center (ASI)/ OAR (INAF)); PINTO, Ciro (INAF - IASF Palermo); RISALITI, Guido (Dip. di Fisica e Astronomia, Università di Firenze)

Presenter: NARDINI, Emanuele

Contribution Type: Oral presentation

Status: ACCEPTED

Submitted by **NARDINI, Emanuele** on **Monday, 4 July 2022**

Abstract ID : **95**

Understanding shock-cloud interaction on the supernova remnant RCW86 with Athena

Content

Interaction between shocks and molecular clouds (shock-cloud interaction) on the supernova remnants plays an important role for shock evolution, shock heating, and particle acceleration and escape. Thanks to the large effective area of XMM-Newton, we discovered a new sample of shock-cloud interacting region in the south-west of the young supernova remnant, RCW86. The X-ray filaments beautifully surround the molecular cloud, indicating that the shock and the molecular cloud really interact each other. We also discovered that the interacting region shows brighter thermal X-rays and fainter nonthermal one compared with regions without interaction. This suggests that the interaction rapidly cools the accelerated electrons and enhances thermal X-rays due to the compression. This is the first result to show the thermal properties of shock-cloud interaction. On the other hand, we cannot resolve the change of temperatures and plasma timescales. We will discuss how Athena will address this issue.

Primary authors: BAMBA, Aya; Dr SANO, Hidetoshi (Gifu Univeristy); Dr VINK, Jacco (Anton Pannekoek Institute for Astronomy & GRAPPA, University of Amsterdam); Dr YAMAZAKI, Ryo (Aoyama Gakuin University)

Presenter: BAMBA, Aya

Contribution Type: Oral presentation

Comments:

I would like to attend the meeting online (I will be inJST time, so I prefer the presentation time in the morninng for you.)

Status: ACCEPTED

Submitted by **BAMBA, Aya** on **Tuesday, 5 July 2022**

Abstract ID : **96**

A Transformative View of Galaxy Evolution: Mapping the Hot Phases of the CGM with an X-ray IFU

Content

The presence of gaseous halos around galaxies is a fundamental prediction of all past and modern structure formation simulations. While UV observations have made significant progress in mapping the warm gas around galaxies, the dominant phase of the circumgalactic medium (CGM) around Milky Way-type and more massive galaxies is in the form of hot (>10^6 K) gas. This hot gas can only be studied with X-ray observatories. The X-ray phase of the CGM contains a substantial fraction of baryons and also retains the imprint of physical processes, such as energetic feedback from supernovae and supermassive black holes, that shaped the evolution of galaxies from the highest redshift to the present day. Therefore, thorough mapping and characterization of the X-ray CGM provide the missing piece in the puzzle of galaxy evolution. While present generation X-ray observatories detected the CGM around a handful of massive galaxies, mapping the tenuous gas out to large radii and characterizing its thermodynamic properties remains virtually impossible with Chandra or XMM-Newton. In this presentation, I will overview prospects to observe the hot phases of the CGM with a high-resolution X-ray microcalorimeter. I will discuss how an X-ray integral field unit (IFU) will be able to map the CGM out to about R500 around Milky Way-type galaxies, measure its thermodynamic properties, and explore gas flows in and out of galaxies, thereby completely transforming our understanding of galaxy evolution.

Primary author: BOGDAN, Akos (Harvard-Smithsonian Center for Astrophsyics)

Presenter: BOGDAN, Akos (Harvard-Smithsonian Center for Astrophsyics)

Contribution Type: Oral presentation

Status: ACCEPTED

Submitted by **BOGDAN, Akos** on **Tuesday, 5 July 2022**

Abstract ID : **97**

Intercluster Filaments, Cluster Outskirts, and the Interface Between Galaxy Clusters and the Cosmic Web

Content

Several studies have shown that entropy profiles of the intracluster medium (ICM) generally do not match self-similar predictions near the virial radius, with the measured values typically being less than predicted. There are several proposed mechanisms to explain this discrepancy, including weakening accretion shocks, electron-ion non-equilibrium, and unresolved cool gas clumps that bias X-ray measurements. These effects are expected to correlate with the local orientation of cosmic filaments, as they interface with the outskirts of the ICM. I will present results from deep X-ray observation of early-stage, binary cluster mergers, where the merger axis is expected to be aligned with a local large scale filament. We find that the ICM entropy profiles are consistent with self-similar predictions, even in these dynamically active, merging systems, likely due to the relatively low subcluster masses (3-4 keV). We also find tantalizing evidence for diffuse emission with properties that are consistent with the dense end of the warm-hot intergalactic medium (WHIM) only along the merger axes (but **not** at the same radii away from the merger axes), consistent with the expectation that the merger axes in these systems are aligned with local cosmic filaments. Athena, with its reasonably high angular resolution and effective area, will make significant contributions to this area of study, and allow a detailed mapping of the interface region between cosmic filaments and clusters.

Primary author: RANDALL, Scott (Center for Astrophysics | Harvard & Smithsonian)

Co-authors: ALVAREZ, Gabriella (Center for Astrophysics | Harvard & Smithsonian); SARKAR, Arnab (Center for Astrophysics | Harvard & Smithsonian); SU, Yuanyuan (University of Kentucky); BULBUL, Esra (Max Planck Institute for Extraterrestrial Physics); FORMAN, William (Center for Astrophysics | Harvard & Smithsonian); JONES, Christine (Center for Astrophysics | Harvard & Smithsonian)

Presenter: RANDALL, Scott (Center for Astrophysics | Harvard & Smithsonian)

Contribution Type: Oral presentation

Status: ACCEPTED

Submitted by **RANDALL, Scott** on **Tuesday, 5 July 2022**

Abstract ID : **98**

The High-Redshift Clusters Occupied by Bent Radio AGN (COBRA) Survey, New X-ray Detections

Content

We are conducting a survey of distant clusters of galaxies (0.5 < z < 3.0) using bent, double-lobed radio sources driven by AGN as tracers. These types of radio sources are easily detected in the ~10,000 square degree VLA FIRST survey to large distances and are frequently found in clusters since interaction with a surrounding intracluster medium (ICM) can create the ram pressure necessary to bend the radio lobes. The sources can be found in a range of cluster environments, from large-scale cluster-cluster mergers, to more relaxed clusters that include sloshing of the ICM. The bending of the radio lobes enables an estimate of the flows present in the ICM. Unlike many other cluster surveys that are biased towards the most massive clusters, our clusters span a wide mass range. Our COBRA sample includes 646 radio sources, all of which have follow-up Spitzer infrared observations. In addition, we have deep optical imaging for a significant subset of the sample. Based on our multi-wavelength analysis, we confirm that approximately 200 of the targets are clusters, with most of the remainder groups. We present our survey as well as the significant detection of a subset of our distant clusters in the X-ray using observations with Chandra and XMM-Newton. We discuss the advances that will be possible with these types of observations using Athena.

Primary author: Prof. BLANTON, E. (Boston University)

Co-authors: Dr GOLDEN-MARX, E. (Tsinghua University); RANDALL, Scott (Center for Astrophysics | Harvard & Smithsonian); Prof. ASHBY, M. L. N. (Center for Astrophysics, Harvard and Smithsonian); Prof. BRODWIN, M. (University of Missouri, Kansas City); Ms WATSON, C. (Boston University)

Presenter: Prof. BLANTON, E. (Boston University)

Contribution Type: e-poster

Status: ACCEPTED

Submitted by **BLANTON, Elizabeth** on **Tuesday, 5 July 2022**

Abstract ID : **99**

Isolated Neutron Stars: recent results and prospects for Athena

Content

Neutron stars have shown diverse characteristics, leading us to classify them into different classes. In this talk, I will focus on the observational properties of isolated neutron stars: from magnetars, the strongest magnets we know of, to central compact objects, the so-called anti-magnetars, stopping by the rotation-powered pulsars and X-ray dim isolated neutron stars. Moreover, I will show you how some sources have exhibited features straddling those of different groups. I will then finish with some considerations on possible evolutionary links between neutron star families and future prospects for Athena.

Primary author: BORGHESE, Alice (Institute of Space Sciences (ICE, CSIC-IEEC))

Presenter: BORGHESE, Alice (Institute of Space Sciences (ICE, CSIC-IEEC))

Contribution Type: Invited

Status: ACCEPTED

Submitted by **BORGHESE, Alice** on **Tuesday, 5 July 2022**

Abstract ID : **100**

WFI survey performances for the high-z Universe

Content

Trough end-to-end simulations we have studied the expected performances of the Athena WFI survey and their dependencies with mission specifications, with particular focus on the high redshift AGN populations and SMBH seed models constraints. I will present the simulated results of the Athena WFI survey for the high redshift Universe, in the broader context of current results from existing facilities and expected advancements from missions planned for the next decade.

Primary author: LANZUISI, Giorgio (INAF-OAS)

Co-authors: Dr ANDREA, Comastri (INAF-OAS); Dr JAMES, Aird (University of Edinburgh); Dr STEFANO, Marchesi (INAF-OAS)

Presenter: LANZUISI, Giorgio (INAF-OAS)

Contribution Type: Oral presentation

Status: ACCEPTED

Submitted by **LANZUISI, Giorgio** on **Tuesday, 5 July 2022**

Abstract ID : **101**

Probing millisecond pulsars at high energies with current and future observatories

Content

The still undetermined equation of state of dense nuclear matter can be constrained by measuring the masses and radii of neutron stars. X-ray observations of rotation-powered millisecond pulsars (MSP) with NICER provide the phase-energy information necessary to apply the pulse-profile modelling technique and extract their mass and radius. ATHENA will also be enable such analyses with improved sensitivity, lower background, and more importantly, with a background that can be empirically determined.

Nonetheless, a lot of complementary information can be obtained from soft and hard X-ray observations with current and future observatories. I think talk, I will show that the entire (warm) surface emission of MSPs can also help measure the neutron star radius. I will also discuss the possible contributions of non-thermal emission in the soft and hard X-ray band and how they may affect pulse-profile modelling. Finally, in the context of ATHENA observations of MSPs, I will discuss briefly how the high-resolution spectroscopy capabilities of X-IFU might reveal atomic and/or cyclotron spectral features. This would help characterising the surface gravity (redshifting the atomic lines) and/or the magnetic field structure and strength of MSPs

Primary author: GUILLOT, Sebastien (IRAP / CNRS)

Presenter: GUILLOT, Sebastien (IRAP / CNRS)

Contribution Type: Oral presentation

Status: ACCEPTED

Submitted by **GUILLOT, Sebastien** on **Tuesday, 5 July 2022**

Abstract ID : **102**

The Athena view on tidal disruption events.

Content

I will present the observational possibilities Athena will offer in the field of tidal disruption events (TDEs), a filed that is expected to florish even more in the future thanks to current and next-generation monitoring facilities at different wavelengths. In particular, I will show how Athena will enable us to study in great detail the properties of TDEs out to unprecedented redshift, as well as to explore the scarcely populated black hole mass range below ~ 10^5 Solar masses, shedding light on the existence, formation, and evolution of the elusive population on intermediate-mass black holes. I will also discuss how Athena instruments, and the X-IFU in particular, will provide a powerful tool to study absorption features in TDEs, which have been sometimes detected before, but are impossible to be fully investigated with current facilities. Our simulations show that Athena observations will be a fundamental tool to improve our knowledge in the field of TDEs, which will further improve our understanding of a plethora of phenomena ranging from black hole formation to accretion physics.

Primary author: SACCHI, Andrea (Instituto de Física de Cantabria)

Co-author: MINIUTTI, Giovanni (CSIC-INTA)

Presenter: SACCHI, Andrea (Instituto de Física de Cantabria)

Contribution Type: Oral presentation

Status: ACCEPTED

Submitted by **SACCHI, Andrea** on **Tuesday, 5 July 2022**

Abstract ID : **103**

Applications of Silicon Pore Optics beyond Athena

Content

Silicon Pore Optics (SPO) is the new mirror technology developed for Athena. Whereas previous optics employ large concentric shells, SPO consist of many small modules that each contain a number of silicon mirror plates. The production of the modules is highly automated with custom robots, and uses technology from the semiconductor industry. This makes for robust light-weight optics with the high optical performance and large collecting area that Athena requires. Furthermore, the modular SPO technology is highly adaptable to new mission concepts beyond Athena. Here we review such concepts. Arcus is a MIDEX mission proposed to NASA, which combines the SPO modules designed for Athena with transmission gratings to build an X-ray spectrometer with an even higher spectral resolution than Athena within a specific bandpass. The Off-plane Grating Rocket Experiment (OGRE) will manufacture its reflection gratings using the bonding techniques of SPO. The Cosmic Web Explorer was conceived as a next-generation mission concept for ESA's long-term science program "Voyage 2050", which discusses how SPO can deliver the unprecedented 10 m^2 effective area needed for its ambitious science program. In addition to these (concept) missions, SPO can be used in the development of Kirkpatrick–Baez optics with a wider field-of-view, and of X-ray interferometers capable of imaging with angular resolutions as small as 1/1,000,000 arcsec. Finally, the same techniques can be used to produce Silicon Laue Components (SiLC), that focus hard X-rays and soft gamma-rays in the energy range of 80 keV to about 500 keV.

Primary author: KEEK, Laurens (cosine B.V. (Netherlands))

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Presenter: KEEK, Laurens (cosine B.V. (Netherlands))

Contribution Type: Oral presentation

Status: ACCEPTED

Submitted by **KEEK, Laurens** on **Tuesday, 5 July 2022**

Abstract ID : **104**

Exploring the properties of dust in the Galaxy with Athena

Content

X-ray absorption fine structures reveal a wealth of information about interstellar dust. These features near X-ray absorption edges are an excellent tool to investigate the dust properties in the Galaxy, e.g. chemical composition, crystallinity and grain size. X-ray binaries are used as background lights to analyse the intervening dust along several Galactic sightlines.
Thanks to an extensive laboratory campaign to measure the spectra of interstellar dust analogues in Europe [Costantini & De Vries 2013] and Taiwan [Zeegers et al. in prep], new interstellar dust models have been developed. This allowed the exploration of dust in the central part of the Galaxy [e.g. Zeegers 2019, Rogantini 2020], as well as several diffuse sightlines [Psaradaki 2021]. The Athena observatory calls for a refinement of the dust models, because it covers the high energy part of the X-ray band at high spectral resolution. We will, for instance, be able to observe dust extinction features in such detail that we can put limits on dust size distributions and we can study the iron K-edge and the sulfur K-edge in detail [Costantini et al. 2019, Zeegers et al. in prep].
This talk gives an overview of future explorations of dust features with future X-rays missions such as Athena. We present new dust models that contain different size distributions and new laboratory measurements.

Primary author: ZEEGERS, Sascha

Co-authors: ABRIL CABEZAS, Irene; CHEN, Chi-Liang (NSRRC); CHU, Ya-Yu (ASIAA); COSTANTINI, Elisa (SRON Netherlands Institute for Space Research; Anton Pannekoek Institute for Astronomy, University of Amsterdam); MEHDIPOUR , Missagh (STScI); PSARADAKI, Ioanna (University of Michigan); ROGANTINI, Daniele (MIT Kavli Institute); SHANG, Hsien (ASIAA)

Presenter: ZEEGERS, Sascha

Contribution Type: Oral presentation

Status: ACCEPTED

Submitted by **ZEEGERS, Sascha** on **Tuesday, 5 July 2022**

Abstract ID : **105**

Exploring the outskirts of galaxy cluster Abell 1795

Content

Up to now, *Chandra* explored only two nearby galaxy clusters, Abell 1795 and Abell 133, out to extremely large radii, providing full azimuthal coverage beyond the virial radius. These observations present a unique way to probe cluster outskirts, where azimuthal variations in the thermodynamic profiles may occur even in case of dynamically relaxed systems. In addition, one of the critical questions in cluster astrophysics is the role of gas clumping, which may have significant effect on the observed cluster properties. By taking advantage of *Chandra*'s spatial resolution, this question can also be addressed. In this work, we explore the diffuse X-ray emission of the intracluster medium permeating Abell 1795 with particular attention to the outskirts and the role of gas inhomogeneities. We compare our results with those obtained by *Suzaku* for nearby clusters, and with predictions of hydrodynamical simulations.

Primary authors: KOVÁCS, Orsolya; WERNER, Norbert (Department of Theoretical Physics and Astrophysics, Masaryk University, Kotlárská 2, 61137 Brno, Czech Republic); ZHU, Zhenlin (SRON/Leiden University); SIMIONESCU, Aurora (Netherlands Institute for Space Research (SRON))

Presenter: KOVÁCS, Orsolya

Contribution Type: e-poster

Status: ACCEPTED

Submitted by **KOVÁCS, Orsolya** on **Tuesday, 5 July 2022**

Abstract ID : **106**

Measuring interacting binary mass functions with X-ray fluorescence

Content

The masses of compact objects in binaries are best constrained through dynamical measurements, e.g. relying on optical radial velocity determination of the companion star in X-ray binaries. In anticipation of upcoming high spectral resolution X-ray telescopes, we explore the potential to use X-rays from binary systems to measure the mass function of the compact object. Fe K line fluorescence is a common feature in the spectra of X-ray emitting binaries, with a Doppler-broadened component from the inner accretion disc extensively studied. If the corresponding narrow line component from the companion star can be isolated, there is the opportunity to use fluorescence to probe system characteristics in X-rays. Here, we model binary geometrical parameters to determine the companion star's solid angle, and therefore deduce the equivalent width of the iron line. We find
that for systems with a mass ratio > 0.1, the resulting expected equivalent width of the K line is 2–40 eV. Simulations using XSPEC indicate that new microcalorimeters will be able to resolve the energy of the K emission line to produce radial velocity measurements with precision of 5–40 km/s, for source continuum fluxes exceeding 10–12 erg/cm^2/s. Several caveats need
to be considered, and this method is dependent on successful isolation of the narrow line from the broad component, and the observation of clear changes in velocity independent of scatter arising from observation errors and complex wind behaviour. These issues remain to be proven with microcalorimeters, but this method has the potential to constrain the parameters of many binaries that are too obscured or faint to be viable in the optical

Primary authors: DASHWOOD BROWN, Cordelia (University of Southampon); Prof. GANDHI, Poshak (University of Southampton); Prof. CHARLES, Phil (University of Southampon)

Presenter: DASHWOOD BROWN, Cordelia (University of Southampon)

Contribution Type: Oral presentation

Status: ACCEPTED

Submitted by **DASHWOOD BROWN, Cordelia** on **Tuesday, 5 July 2022**

Abstract ID : **108**

The X-ray invisible Universe. A look into the halos invisible to eROSITA

Content

Understanding how many halos are in our Universe is the most crucial test of our cosmological paradigm. So far this test has been limited to the high mass end of the halo mass function in the galaxy cluster regime. However, massive clusters sample only the 2% of the virialized dark matter halo population. Addressing this fundamental problem would require extending the analysis to the bulk of the halo population, in the galaxy group regime. Nevertheless, at this mass scale, our knowledge of the number density of halos and of their properties is still very poor and likely very biased.

We use the GAMA optically selected groups in the eFEDS area to understand how many halos eROSITA is able to capture in the group regime. We retrieve the mean X-ray properties of the undetected systems through stacking in the eROSITA data. The comparison of the mean properties of detected and undetected groups in terms of gas, galaxy, and mass distribution and their relation to the local environment reveal important aspects of their different assembly history. I will review such aspects and how Athena will revolutionize our view of the low mass halo population.

Primary author: POPESSO, Paola (European Southern Observatory)

Co-author: Prof. BIVIANO, Andrea (Univeristy of Trieste)

Presenter: POPESSO, Paola (European Southern Observatory)

Contribution Type: e-poster

Status: ACCEPTED

Submitted by **POPESSO, Paola** on **Tuesday, 5 July 2022**

Abstract ID : **109**

Mirror, mirror on the wall, which coating is the best of them all?

Content

We present the latest results on the development of the X-ray reflective coatings for the ATHENA mission, taking into consideration new configurations for the mission and with focus on what can be achieved by coating design and optimisation. The reflection of X-rays depends strongly on the material adopted as mirror coating, in this study we re-visit the material options as overcoat for Ir and trade-offs. Along with optimised expected performance based on single layer, bi-layer, tri-layer and multilayer coating designs, we also report the experimental results on X-ray performance and stability of the coatings deposited onto SPO.

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Presenter: FERREIRA, Desiree Della Monica (DTU Space)

Contribution Type: Oral presentation

Status: ACCEPTED

Submitted by **FERREIRA, Desiree Della Monica** on **Tuesday, 5 July 2022**

Abstract ID : **110**

The eROSITA view of the Abell 3391/95 field: Cluster Outskirts and Filaments

Content

The A3391/95 system is a complex galaxy cluster system that has been observed by various X-ray instruments, including ROSAT, XMM-newton, Chandra, and eROSITA, especially to search for the WHIM. The eROSITA Performance Verification (PV) observations provide by far the largest and deepest X-ray large-scale overview of the system. An area of ~15 square degrees of the field is covered and a ~15 Mpc continuous soft emission is discovered. This filament connects several galaxy clusters and groups, including the A3391, A3395N/S, the Northern Clump, and the Little Southern Clump (LSC). In this study, we focus on the outskirts (R500 < r < R200) and the detected inter-cluster filaments (> R200). Our results include, firstly, obtaining the characteristic properties (e.g., the X-ray temperature, R500, and M500) of a group of galaxies, the LSC, that is located within the 2R200 of the A3395 cluster and residing in one of the filaments. Secondly, we find that the outskirts metallicities are in good agreement with the reported literature value of ~0.2-0.3 Solar. Furthermore, from the filament region, we detect a <1 keV gas that is consistent with the simulated properties of the WHIM. Finally, with Athena, characterizing nearby WHIM emission filaments should become routine, which shall enable us to systematically trace and characterize the warm/hot phase of the nearby baryons.

Primary author: VERONICA, Angie (Argelander-Institute for Astronomy, University of Bonn)

Co-authors: Prof. REIPRICH, Thomas (AIfA); Dr PACAUD, Florian (AIfA); BULBUL, Esra (Max--Planck-Institut für extraterrestrische Physik); OTA, Naomi (AIfA, Nara Women's University); RAMOS-CEJA, Miriam E. (MPE); LIU, Ang (MPE); BIFFI, Veronica (Universitaets-Sternwarte Muenchen, INAF, IFPU); MIGKAS, Konstantinos (AIfA); ASCHERSLEBEN, Jann (AIfA, Kapteyn Astronomical Institute); CLERC, Nicolas (MPE); DOLAG, Klaus (Universitates-Sternwarte Muenchen); ERBEN, Thomas (AIfA); GATUZZ, Efrain (MPE); GHIRARDINI, Vittorio (MPE); KERP, Jürgen (AIfA); KLEIN, Matthias (MPE); LIU, Teng (MPE); SANDERS, Jeremy (MPE); SPINELLI, Claudia (AIfA)

Presenter: VERONICA, Angie (Argelander-Institute for Astronomy, University of Bonn)

Contribution Type: Oral presentation

Status: ACCEPTED

Submitted by **VERONICA, Angie** on **Tuesday, 5 July 2022**

Abstract ID : **111**

Using Vela X-1 to understand accretion and wind structure in neutron star High-Mass X-ray Binaries (HMXBs)

Content

The spectral and timing behaviour of HMXBs offers a unique opportunity for the investigation of accretion onto compact objects and of wind structure in massive stars. The bright and persistent neutron star HMXB Vela X-1 is one of the key systems for such studies with both current and future instruments. It has a complex clumpy stellar wind, prominent cyclotron resonant scattering features (CRSFs) and strong flares. Understanding the variability of the systems on both short time scales of a few hundreds seconds and along its 9d orbit with current instruments enables us to make predictions for future observations with XRISM and Athena and to devise the best observational strategy for Vela X-1.

Here, we analyse two new observations taken with NuSTAR and XMM-Newton at orbital phases ~0.5 and ~0.75 and follow the evolution of spectral parameters down to the pulse period (~300s) time-scale. The flux-dependency we observe in the spectral shape implies a change in the properties of the Comptonizing plasma and the observed drop of the CRSF energy following a strong flare may indicate a change in the accretion geometry. The strong variability of absorption is due to the presence of a large-scale wind structure, such as accretion- and photoionisation wakes, combined with the variable line of sight as the neutron star moves along the orbit. In particular, we, for the first time, are able to trace the onset of the wakes with high time resolution and compare to predictions from simulations.

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Presenter: DIEZ, Camille (IAAT Tübingen, Germany)

Contribution Type: Oral presentation

Status: ACCEPTED

Submitted by **DIEZ, Camille** on **Tuesday, 5 July 2022**

Abstract ID : **112**

SIXTE simulations of the Perseus cluster

Content

The SIXTE end-to-end simulator for X-ray astronomical instrument is fast and precise. SIXTE allows to model observations of X-ray sources with various instruments, including the WFI and the X-IFU, but also missions such as XMM-Newton or XRISM. With comparably little simulation time, SIXTE permits to take into account important effects such as the spatially varying point spread function, vignetting, dithering observations, and nonlinear detector effects including photon pile-up for the WFI or crosstalk for the X-IFU. The resulting output is compatible with standard X-ray astronomy data reduction pipelines.

Using the Perseus cluster as an example, we will discuss simulations focusing on Athena's capabilities to explore the hot and energetic universe by contrasting its capabilities with those of other missions, including XRISM.

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Presenter: DAUNER, Lea (Remeis/ECAP)

Contribution Type: e-poster

Status: ACCEPTED

Submitted by **DAUNER, Lea** on **Tuesday, 5 July 2022**

Abstract ID : **113**

AGN-ICM study: XRISM feasibility study of the cores of the A3391/95 clusters and X-ray morphological properties of eRASS1-EMU radio pilot survey cluster sample

Content

The A3391/95 clusters harbor bright central radio sources, which makes them ideal objects to probe the ICM-AGN interaction. The future JAXA/NASA/ESA mission, the X-Ray Imaging and Spectroscopy Mission (XRISM) will enable us to resolve line emission and the motion of the ICM affected by AGN feedback. Through simulation using cluster properties obtained from eROSITA and XMM-Newton, a forecast of the best observing strategy for XRISM high-resolution spectroscopy will be made. Given the complexity of the system, we will probe their merger state, as well. We further extend the central AGN-ICM study to a larger sample, namely using the first eROSITA All-Sky Survey (eRASS1) cluster sample in the EMU pilot field using the Australian ASKAP radio telescopes. We present preliminary results of the X-ray morphological properties of this sample. Athena will complete the AGN-ICM study, for instance, to investigate in great detail the chemical distribution and central cluster gas motion due to the central AGN feedback.

Primary author: VERONICA, Angie (Argelander-Institute for Astronomy, University of Bonn)

Co-authors: OTA, Naomi (AIfA, Nara Women's University); REIPRICH, Thomas (AIfA)

Presenter: VERONICA, Angie (Argelander-Institute for Astronomy, University of Bonn)

Contribution Type: e-poster

Status: ACCEPTED

Submitted by **VERONICA, Angie** on **Tuesday, 5 July 2022**

Abstract ID : **114**

Time evolving photoionisation for high-resolution X-ray spectroscopy

Content

Thanks to its unprecedented spectroscopic resolution, XIFU will revolutionise our understanding of X-ray astronomy. Therefore, it is mandatory to timely develop - and test - advanced photoionisation models that will allow to maximise its scientific return. We have developed a Time Evolving Photo-Ionisation Device (TEPID) which allows, for the first time, to follow the gas ionisation, temperature and density in response to a time-varying source of ionising radiation. The code is highly flexible, allowing the user to model any astrophysical scenario, from variable AGNs to Gamma-Ray Bursts (GRBs) and diffuse nebulae. It has a highly modular structure, thus enabling quick updates, especially on the atomic database. It has been benchmarked against existing time-equilibrium models such as Cloudy. We are now analysing archival XMM-Newton observations of those AGNs with reported time-variable absorbers which will be observed in the XRISM Performance Verification (PV) phase (six in total), in order to test TEPID and get ready for the upcoming observations with the microcalorimeter Resolve, which will represent a valuable testbed in view of the Athena-XIFU.

Primary author: LUMINARI, Alfredo (INAF IAPS/OAR)

Co-authors: Dr NICASTRO, Fabrizio (INAF-OAR); Dr KRONGOLD, Yair (UNAM); Dr PIRO, Luigi

Presenter: Dr NICASTRO, Fabrizio (INAF-OAR)

Contribution Type: Oral presentation

Status: ACCEPTED

Submitted by **LUMINARI, Alfredo** on **Tuesday, 5 July 2022**

Abstract ID : **115**

The Cosmic Evolution of XRB populations with Athena

Content

Some of the most energetic sources of stellar origin in the Universe are products of binary stellar evolution. X-ray binaries (XRBs), short gamma-ray bursts, and gravitational-wave sources offer a unique view in secular or transient astrophysical processes such as mass-transfer, accretion and compact-object coalescence. Due to the large distances to these sources, the characterization of the systems and their progenitors is only accessible via the comparison of binary population synthesis (BPS) predictions against observations. However, uncertainties in single and binary stellar evolution are hampering our understanding of the observations through end-to-end simulations. The theoretically-predicted and observationally-constrained metallicity effect in XRB populations, has shown the importance of X-ray observations of nearby and distant galaxies in constraining BPS models.

The sensitivity of the Athena WFI will allow the detection of individual galaxies at the peak of the star formation history of the Universe, and on high-redshift, low-metallicity galaxy samples. In combination with future optical and near-infrared telescopes, these observations will provide the deepest view on the cosmic evolution of XRB populations, and probe the scatter of X-ray scaling relations at low metallicities and redshifts.

We study the effect of factors such as common envelope evolution, core-collapse and supernova kick prescriptions on the cosmological evolution of the X-ray luminosity - star-formation rate scaling relations through the combination of cosmological simulations and population synthesis codes. We comment on the constraining power of Athena observations on the parameters of binary evolution models. We discuss the metallicity effects on the ratio of the neutron-star and black-hole XRBs, and how they translate to a cosmic evolution of the X-ray spectrum of normal galaxies, in the spectral range of Athena. Finally, we highlight the importance of these constraints for the study of the contribution of XRBs in the heating of the intergalactic medium at the early Universe, as well as the implications for the end-points of binary evolution such as compact-object mergers.

Primary authors: KOVLAKAS, Konstantinos (University of Geneva); Dr ANASTASOPOULOU, Konstantina (INAF-Osservatorio Astronomico di Brera); Prof. FRAGOS, Tassos (University of Geneva); Prof. ZEZAS, Andreas (University of Crete)

Presenter: KOVLAKAS, Konstantinos (University of Geneva)

Contribution Type: Oral presentation

Status: ACCEPTED

Submitted by **KOVLAKAS, Konstantinos** on **Tuesday, 5 July 2022**

Abstract ID : **116**

Could the presence of a SMBHB impact the shape of the K-alpha emission line at a dectable level so that it can be used as another diagnostic of the presence of a SMBHB ?

Content

Supermassive black hole (SMBH) binaries are difficult to differentiate from a single massive black hole using electromagnetic data because of their small orbital separation (they are unresolved in most cases) and because of the uncertainties about the uniqueness of their observational signatures. Thus, numerical simulations are a key step to identify observational signatures of SMBH binaries that might be searched for in future datasets (in particular in the soft X-ray domain). In this study, we focus on gravitationally bound SMBHs during the first stages of their coalescence. In the simulations performed with the open-source code AMRVAC, we are looking at the gravitational influence of a secondary SMBH on the accretion disc of a primary SMBH. Among other features, the gravitational influence of the second SMBH creates a spiral in the disc. Previous studies showed that spiral waves in a disc could be imprinted in the shape of the iron K-alpha emission line, which could be detected with high resolution X-ray spectroscopy. Thus, the X-IFU spectrometer onboard Athena may be a very important facility to diagnose the presence of a SMBH binary at the center of a galaxy in the first stages of its coalescence by resolving the shape of the iron K-alpha emission line.

In this work, we compute the shape of the K-alpha emission line using an analytical model based on simulations of discs prone to the gravity of both a primary and secondary black hole. This allows us to study the potential detectability of such a spiral wave and the associated population of binary systems (in terms of mass ratio, distance, orbital separation, …) that could potentially be detected with X-IFU.

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Contribution Type: e-poster

Status: ACCEPTED

Submitted by **ARTHUR, Léna** on **Tuesday, 5 July 2022**

Abstract ID : **117**

Reverberation Mapping of X-ray black hole binaries with Athena

Content

Black hole binaries in the hard state show time lags between direct photons from the primary source of X-rays - a hot plasma close to the black hole often called the corona - and reflected photons from the accretion disk. Using “reverberation mapping” one can measure the distance between the corona and the accretion disk, which is otherwise far beyond the resolution limit of any telescope. Bright black hole binaries are seen to vary on all timescales with the shortest fluctuations corresponding to the region closest to the black hole. Resolving the very short variability is therefore key to study the inner accretion geometry. Because black hole binaries are typically bright and can be affected by pile-up, we use SIXTE to determine the temporal detection limit of time lags in the future Athena WFI Fast Detector, effectively probing how close to the black hole Athena will still be able to resolve signals. To do so, we use a general relativistic ray-tracing code to model the response of the accretion disk to changes in a lamp-post corona of a bright Cyg X-1-like source. We create energy-resolved lightcurves and spectra as input for our simulation and then pipe the source through SIXTE to address the WFI instrument effects. The setup can also be used to simulate the performance of the X-IFU.

Primary author: KÖNIG, Ole (Remeis-Observatory & ECAP, FAU Erlangen-Nuernberg)

Co-authors: DAUNER, Lea (FAU); DAUSER, T.; KIRSCH, C.; LORENZ, M.; MASTROSERIO, Guglielmo (Caltech); POTTSCHMIDT, Katja (CRESST, NASA/GSFC); RAU, Arne (Max Planck Institute for Extraterrestrial Physics); UTTLEY, Phil (Anton Pannekoek Institute for Astronomy, University of Amsterdam); WILMS, Jörn (Remeis/ECAP)

Presenter: KÖNIG, Ole (Remeis-Observatory & ECAP, FAU Erlangen-Nuernberg)

Contribution Type: e-poster

Status: ACCEPTED

Submitted by **KÖNIG, Ole** on **Tuesday, 5 July 2022**

Abstract ID : **119**

The Athena X-IFU end-to-end simulator

Content

We present the implementation of the official simulator of the *Athena* X-IFU instrument within the SIXTE end-to-end simulation package.

For the X-IFU, SIXTE implements all relevant physical effects that are necessary for a faithful representation of the imaging spectroscopy capabilities of the instrument. SIXTE can therefore be used to simulate X-IFU observations of point sources and extended sources, including sources with spatially variable spectral shapes and very bright sources.

Examples of the microcalorimeter effects that are implemented are event grading and crosstalk. These effects cause the energy reconstruction of an X-ray event to be affected by photons impacting either on the same pixel or on different pixels coupled via the focal plane or the readout chain, respectively. The different types of crosstalk are parametrized using both laboratory data and physics simulations with the X-IFU instrument simulator xifusim.

As a result of these effects, the X-IFU performance degrades for very bright sources. To mitigate this degradation, the simulator can be operated in different observation modes, such as the use of Be filters to block lower energy photons and a defocused mode, which spreads events from a point source over the whole detector.

Primary author: KIRSCH, Christian (Dr. Karl Remeis-Observatory & ECAP)

Co-authors: Dr CUCCHETTI, Edoardo (Centre national d'études spatiales); DAUNER, Lea (FAU); DAUSER, Thomas; KÖNIG, Ole (Remeis-Observatory & ECAP, FAU Erlangen-Nuernberg); LORENZ, Maximilian (Remeis Observatory & ECAP); Dr PEILLE, Philippe (Centre national d'études spatiales); WILMS, Jörn (Remeis/ECAP); COBO, Beatriz (Instituto de Física de Cantabria); CEBALLOS MERINO, Maite (IFCA)

Presenter: KIRSCH, Christian (Dr. Karl Remeis-Observatory & ECAP)

Contribution Type: e-poster

Comments:

This poster is part of a group of SIXTE-related posters submitted by M. Lorenz, L. Dauner and O. König. T. Dauser will also submit an abstract for an oral presentation about SIXTE. We think these posters might be useful for the participants of the conference, who will likely be interested in running simulations.

Status: ACCEPTED

Submitted by **KIRSCH, Christian** on **Tuesday, 5 July 2022**

Abstract ID : **120**

R-matrix collision data for H- and He-like ions

Content

Plasma models built on extensive atomic data are essential to interpreting the observed cosmic spectra. H-like Lyman series and He-like triplets observable in the X-ray band are powerful diagnostic lines to measure the physical properties of various types of astrophysical plasmas. Electron-impact excitation is a fundamental atomic process for the formation of H-like and He-like key diagnostic lines. Electron-impact excitation data adopted by the widely used plasma codes (AtomDB, CHIANTI, and SPEX) do not necessarily agree with each other. Here we present a systematic calculation of electron-impact excitation data of H-like and He-like ions with the atomic number $Z = 6-30$ (i.e., C to Zn). Radiation damped R-matrix intermediate coupling frame transformation calculation was performed for each ion with configurations up to $n = 6$. We compare the present work with the above three plasma codes and literature to assess the quality of the new data, which are relevant for current and future high-resolution X-ray spectrometers.

Primary author: MAO, Junjie (Tsinghua University)

Presenter: MAO, Junjie (Tsinghua University)

Contribution Type: e-poster

Status: ACCEPTED

Submitted by **MAO, Junjie** on **Tuesday, 5 July 2022**

Abstract ID : **121**

The Athena WFI end-to-end simulator

Content

We give an overview of the official Athena WFI instrument simulator implemented in the SIXTE end-to-end simulation toolkit.

From a description of any astrophysical source, SIXTE simulates the entire detection pipeline of the Athena WFI to the final data product. The source description can consist of point sources and extended sources, including sources with spatially and temporally variable spectra and deep X-ray fields with thousands to millions of sources.

The simulator aims to provide a representative model for the imaging and spectroscopic performance of the WFI in order to study and optimize the instrument's capabilities and scientific potential. The setup includes the most important detector and readout effects specific to the WFI DEPFET sensors, such as pile-up and charge cloud splitting.

As an application, we present the WFI performance during observations of very bright sources where high incident photon rates can degrade the overall instrument performance. With increasing pile-up, the measured spectrum hardens, and emerging invalid split patterns reduce the overall throughput. Using different filter options and window operating modes, we demonstrate approaches to mitigate these effects in the scientific data and show the flux limits of each configuration.

Primary author: Mr LORENZ, Maximilian (Remeis-Observatory & ECAP)

Co-authors: Mr KIRSCH, Christian (Remeis-Observatory & ECAP); Mr KÖNIG, Ole (Remeis-Observatory & ECAP); Ms DAUNER, Lea (Remeis-Observatory & ECAP); Mr DAUSER, Thomas (Remeis-Observatory & ECAP); Mr RAU, Arne (Max Planck Institute for extraterrestrial Physics); Mr WILMS, Jörn (Remeis-Observatory & ECAP)

Presenter: Mr LORENZ, Maximilian (Remeis-Observatory & ECAP)

Contribution Type: e-poster

Status: ACCEPTED

Submitted by **LORENZ, Maximilian** on **Tuesday, 5 July 2022**

Abstract ID : **123**

SIXTE: The Athena end-to-end simulator

Content

SIXTE is the official end-to-end simulator for the WFI and the X-IFU instruments onboard Athena. From an astrophysical description of the source, Sixte performs detailed photon based simulations, including a detailed description of the optics and the detection processes for each instrument. I will summarize the implementation of the WFI and X-IFU in Sixte and highlight its capabilities for studying the science cases of the Athena mission. Detailed example simulations will be shown to demonstrate the performance of both instruments. A focus will be put on presenting the modular concept of simulator. It means that once defined, the same astrophysical object can be easily simulated with a large number of other missions, including, for example, XMM-Newton, eROSITA, AXIS, or XRISM.

Primary author: DAUSER, Thomas

Co-authors: DAUNER, Lea (Remeis Observatory & ECAP); KÖNIG, Ole (Remeis Observatory & ECAP); KIRSCH, Christian (Remeis Observatory & ECAP); LORENZ, Maximilian (Remeis Observatory & ECAP); CEBALLOS, Maite (IFCA); COBO, Bea (IFCA); CUCCHETTI, Edoardo (CNES); PEILLE, Philippe (CNES); POTTSCHMIDT, Katja (GSFC); PTAK, Andrew (GSFC); RAU, Arne (MPE); TZANAVARIS, Panayiotis (GSFC); WILMS, Jörn (Remeis Observatory & ECAP)

Presenter: DAUSER, Thomas

Contribution Type: Oral presentation

Status: ACCEPTED

Submitted by **DAUSER, Thomas** on **Tuesday, 5 July 2022**

Abstract ID : **124**

Simulating surveys with the Athena Wide-Field Imager: a window on a whole new population of X-ray emitting extragalactic sources

Content

In my presentation, I will report on the results of extended end-to-end simulations of deep- and wide-field surveys with the Athena Wide-Field Imager (WFI). These simulations take advantage of the SIXTE tool to flexibly test different telescope configurations, and are performed using newly developed mock catalogs of active galactic nuclei (AGN), non-active galaxies and clusters. I will show how Athena-WFI will allow us to perform a whole new kind of X-ray science by detecting for the first time a new population of targets, that has so far been missed by X-ray surveys. These targets include, for example, hundreds of AGN at z>6, as well as thousands of galaxies up to z~5 where the X-ray emission is coming from processes other than supermassive black hole accretion.

Primary authors: MARCHESI, Stefano (INAF-OAS Bologna); LANZUISI, Giorgio (INAF-OAS); GILLI, Roberto (INAF-OAS Bologna); Dr COMASTRI, Andrea (INAF-OAS Bologna); GRUPPIONI, Carlotta (INAF-OAS Bologna); Dr ZEZAS, Andreas (University of Crete)

Presenter: MARCHESI, Stefano (INAF-OAS Bologna)

Contribution Type: Oral presentation

Status: ACCEPTED

Submitted by **MARCHESI, Stefano** on **Tuesday, 5 July 2022**

Abstract ID : **125**

Probing Supermassive Black Hole Spins via X-ray Spectroscopy

Content

The X-ray relativistically broadened fluorescent iron line and the Compton hump reflected from the innermost accretion flows around a supermassive black hole (SMBH) can be used to probe black hole spin rates. In particular, X-ray spectroscopy helps us measure the SMBH spins in nearby Seyfert 1 galaxies whose central innermost regions are not largely blocked by the dusty torus. In this study, a MCMC-based method is employed to probe the best-fit parameters of a relativistic reflection model in X-ray archival data of a sample of nearby Seyfert 1 active galaxies observed by the XMM-Newton and NuSTAR space telescopes. Future high-resolution X-ray spectroscopic observations with the Advanced Telescope for High-ENergy Astrophysics (Athena) as demonstrated by simulations will certainly allow us to put better constraints on SMBH spins, which have profound implications for our understanding of the mechanism behind ultra-fast outflows launched at the centers of Seyfert 1 galaxies.

Primary author: Dr DANEHKAR, Ashkbiz (Eureka Scientific)

Presenter: Dr DANEHKAR, Ashkbiz (Eureka Scientific)

Contribution Type: e-poster

Status: ACCEPTED

Submitted by **Dr DANEHKAR, Ashkbiz** on **Tuesday, 5 July 2022**

Abstract ID : **126**

BUILDING ROBUST AGN MOCK CATALOGS for Athena

Content

In this talk I will delineate a robust methodology to create mock AGN catalogs for future X-ray surveys, built on top of large N-body dark matter simulations via state-of-the-art semiempirical models. We show that by using as independent tests the AGN clustering at fixed X-ray luminosity, galaxy stellar mass, and BH mass, along with the fraction of AGNs in groups and clusters, it is possible to significantly narrow down the choice in the relation between BH mass and host galaxy stellar mass, the duty cycle, and the average Eddington ratio distribution, delivering well-suited constraints to guide cosmological models for the coevolution of BHs and galaxies. Avoiding such a step-by-step methodology inevitably leads to strong degeneracies in the final mock catalogs, severely limiting their usefulness in understanding AGN evolution and in survey planning and testing.

Primary author: ALLEVATO, Viola (INAF - OACN)

Co-author: Prof. SHANKAR, Francesco (University of Southampton)

Presenter: ALLEVATO, Viola (INAF - OACN)

Contribution Type: Oral presentation

Status: ACCEPTED

Submitted by **ALLEVATO, Viola** on **Tuesday, 5 July 2022**

Abstract ID : **128**

Soft corona in magnetically dominated accretion disk in AGN

Content

We present self consistent modelling of the magnetically supported accretion disk with optically thick corona, where the gas is heated by magneto-rotational instability dynamo (MRI), and cooled by radiation which undergoes absorption and Compton scattering. We determine the parameters of warm corona in AGN using disk-corona structure model that takes into account magnetic and radiation pressure. We aim to show the role of thermal instability (TI), as a constraint for warm X-ray corona in AGN. We show that magnetic heating is strong enough to heat upper layers of the accretion disk atmosphere, which form the hot corona covering the disk. However, magnetic pressure does not remove TI caused by radiative processes operating in X-ray emitting plasma. TI disappears only in case of accretion rates higher than 0.2 of Eddington, and high magnetic field parameter > 0.1.TI plays the major role in the formation of the warm corona above magnetically driven accretion disk in AGN. The warm, Compton cooled corona, responsible for soft X-ray excess, resulted from our model has typical temperature in the range of 0.01-2 keV and optical depth even up to 50 which agrees with recent observations.

Primary author: ROZANSKA, Agata (N. Copernicus Astronomical Center, Polish Academy of Sciences)

Presenter: ROZANSKA, Agata (N. Copernicus Astronomical Center, Polish Academy of Sciences)

Contribution Type: e-poster

Status: ACCEPTED

Submitted by **ROZANSKA, Agata** on **Tuesday, 5 July 2022**

Abstract ID : **131**

Accretion and Outflows in Cataclysmic Variables

Content

Cataclysmic variables (CVS) are compact binary systems with white dwarves (WDs) as a primary. They constitute laboratories to study accretion flows, gas dynamics, outflows, transient outbursts, and explosive nuclear burning under different astrophysical plasma conditions in relation to other compact object binaries and active galactic nuclei. I will discuss spectral-timing analysis of these systems to study accretion physics in nonmagnetic CVs. CVs demonstrate band limited noise (BLN) in the UV, X-ray and optical, with detected frequency breaks (mainly dwarf novae) in the range (1-6) mHz in quiescence and indicate an optically thick disk truncation (transition) showing existence of advective hot flows (RIAF ADAF-like flows) in the inner regions (Balman & Revnivtsev 2012, Balman 2019, Balman 2020). High state CVs have accretion rates 10^−9 - few x10^−8 Msun/yr with wind outflows. I find similar broadband noise to DNe with BLN noise breaking in a range 2.5-10 mHz and prominent Lorentzian noise components dominating the BLN with occasional mHz QPOs as the accretion rate increases with spectral characteristics revealing nonequilibrium ionization plasma and ouflows detected in the X-rays (Balman et al. 2022). A power law component also exits that becomes more prominent with increasing accretion rate. I will discuss how spectral-timing studies can be probes to determine accretion history and state changes in WD binaries. I will elaborate with simulations how Athena can resolve some of the important complexities we are facing on accretion and improve our understanding of advective hotflows in these systems.

Primary author: BALMAN, Şölen (Istanbul University)

Presenter: BALMAN, Şölen (Istanbul University)

Contribution Type: Oral presentation

Status: ACCEPTED

Submitted by **BALMAN, Şölen** on **Tuesday, 5 July 2022**

Abstract ID : **132**

HYPERION Year One: towards the deepest X-ray view of titan QSOs at the Reionization Epoch

Content

The presence of already full grown >10^9 Msun supermassive black-holes (SMBH) powering luminous quasars (QSO) at the Reionization Epoch (i.e. z>6, EoR) is one of the most debated topics in modern astropysics. Understanding the formation and evolution of such QSOs is one of the main drivers for Athena and current/future generation astronomical facilities at all wavelengths. The existence of these sources prompted so far extensive multi-band observational campaigns to characterize their properties. Nonetheless the lack of a sensitive new generation X-ray observatory and the limited capabilities of current ones, prevent a reliable high quality X-ray picture of these sources. HYPERION is a recently approved 2.4 Ms Multi-Year Heritage XMM programme designed to overcome this limitation by significantly improving the X-ray understanding of the titans among QSO at EoR (i.e. those which experienced the fastest SMBH growth). HYPERION is expected to deliver unprecedented constraints on nuclear, accretion/ejection and disc/corona properties on a sample of 17 QSOs by assembling and characterizing a reference sample for the X-ray study of QSO at EoR. As such HYPERION will pave the way for the future Athena characterization of the first QSOs. I will present results from the first year of observations of the HYPERION programme and present the prospects for a vastly improved X-ray characterization of these sources by Athena.

Primary author: Dr ZAPPACOSTA, Luca (INAF-OAR)

Presenter: Dr ZAPPACOSTA, Luca (INAF-OAR)

Contribution Type: Oral presentation

Status: ACCEPTED

Submitted by **ZAPPACOSTA, Luca** on **Tuesday, 5 July 2022**

Abstract ID : **133**

Galaxy Clusters in the Athena/WFI Survey : selection function and cosmological forecasts

Content

Surveys with the Athena Wide Field Imager will probe the galaxy cluster population down to the group scale out to $z = 2$. The $1 < z < 2$ range is the era of cluster assembly but very poorly sampled to date. This is of great interest not only to study cluster-AGN interactions, but also to address open questions on precision cosmology. We consider two survey designs, one similar to the 'canonical' Athena Survey I, $50deg^2$ at $80ks$, and a second, wider of $200deg^2$ at $20ks$. In both cases, our derivation of the selection function shows that several hundreds of clusters will be detected in the $1 < z < 2$ range. Using a forward modelling of the X-ray cluster observable parameters, we provide cosmological forecasts for both survey configurations.

Primary author: CERARDI, Nicolas (CEA DAp)

Presenter: CERARDI, Nicolas (CEA DAp)

Contribution Type: e-poster

Status: ACCEPTED

Submitted by **CERARDI, Nicolas** on **Tuesday, 5 July 2022**

Abstract ID : **134**

State of the art and future developments in understanding wind accretion in X-ray binaries

Content

Accretion onto compact objects of material from strong stellar winds, be it in High-Mass X-ray Binaries (HMXB) or Symbiotic X-ray Binaries (SyXB) is among the earliest mechanisms identified to power X-ray sources, but still surprisingly little understood in detail. Questions like the rule of the clumps forming in stellar winds, the role of feedback through ionization on the wind structure, the onset of possible, transient disk formation, the geometry of the material accreted close to the compact object and many other aspects are still being strongly debated. Getting a better handle on these questions is important to understand these binaries and their evolution as possible predecessors of compact binary merger systems. We will give an overview of the state of knowledge and open questions and indicate pathways for future simulation efforts as well as the discovery opportunities with current and future X-ray missions.

Primary author: KRETSCHMAR, Peter (European Space Agency)

Co-authors: MARTÍNEZ-NÚÑEZ, Silvia; WILMS, Jörn (Remeis/ECAP); GRINBERG, Victoria (ESA/ESTEC); FUERST, Felix (ESA/ESAC); DIEZ, Camille (IAAT Tübingen, Germany); ABALO RODRÍGUEZ, Luis (cosine B.V. (Netherlands)); BOZZO, Enrico (University of Geneva); Dr MANOUSAKIS, Antonios (University of Sharjah); EL MELLAH, Ileyk (IPAG)

Presenter: KRETSCHMAR, Peter (European Space Agency)

Contribution Type: Oral presentation

Status: ACCEPTED

Submitted by **KRETSCHMAR, Peter** on **Tuesday, 5 July 2022**

Abstract ID : **135**

The X-ray Intergral Field Unit performance optimization

Content

The X-ray Integral Field Unit (X-IFU) is the next generation microcalorimeter planned for launch onboard the Athena observatory. With detectors operating at a bath temperature of 50 mK and providing very high energy resolution, special care must be taken to optimize the instrument performances while minimizing the required resources. This assessment relies on the use of early laboratory measurements of key subsystem characteristics, such as prototype sensors or readout elements, in combination with modeling tools and early versions of the onboard data processing and ground-based correction algorithms. In this contribution, we will present the current status of such studies and the link between performances and instrument design drivers.

Primary authors: Dr PEILLE, Philippe (Centre National d'Etudes Spatiales); BARRET, Didier (IRAP); ALBOUYS, Vincent (Centre National d'Etudes Spatiales); Prof. DEN HERDER, Jan-Willem (SRON); PIRO, Luigi (INAF - IAPS, Rome, Italy)

Presenter: Dr PEILLE, Philippe (Centre National d'Etudes Spatiales)

Contribution Type: Oral presentation

Comments:

The author list will eventually be precised. This contribution is made on behalf of the X-IFU consortium.

Status: ACCEPTED

Submitted by **Dr PEILLE, Philippe** on **Tuesday, 5 July 2022**

Abstract ID : **137**

MAXI Analyzer: a fully-automated software for long-term monitoring studies of X-ray Binaries

Content

The Monitor of All-sky X-ray Image (MAXI) experiment is mounted to the Japanese Experiment Module on the International Space Station (ISS) and uses several wide field-of-view X-ray detectors to monitor astronomical X-ray sources for variability, scanning the sky every 92-minute ISS orbit. As a result of this investigation, we present "MAXI Analyzer", a fully automated online data retrieval and command-line processing algorithm. "MAXI Analyzer" provides the user with science-ready, cleaned data products in the 2–20 keV energy band from the Gas Slit Camera. These can then be used to calculate hardness ratio curves, long-term lightcurves and ultimately help in constraining stellar wind parameters from *any* X-ray binary system. We have tested this software on over 10 years of Vela X-1 data to probe its long-term absorption variability and compare to existing theoretical model predictions, revealing intriguing information about the clumpy stellar wind in this system. These observations can further be complemented with detailed pointed observations by XMM-Newton and in the future Athena.

Primary author: Mr ABALO, Luis (ESAC - UCM - cosine measurement systems)

Co-authors: Dr KRETSCHMAR, Peter (ESAC); Dr FUERST, Felix (ESAC)

Presenter: Mr ABALO, Luis (ESAC - UCM - cosine measurement systems)

Contribution Type: e-poster

Status: ACCEPTED

Submitted by **ABALO RODRÍGUEZ, Luis** on **Tuesday, 5 July 2022**

Abstract ID : **138**

Chandra Legacy Observation of the LMC SNR N132D: Expansion of the Forward Shock

Content

We present results from a deep (900 ks) observation of the Large Magallenic Cloud supernova remnant N132D with the Chandra X-ray Observatory. N132D is an O-rich supernova remnant (SNR) of a 15-25 Mdot progenitor and is the most X-ray luminous SNR in the Local Group (L_x~1.0e38 ergs/s [0.3-10.0 keV]). The Chandra images reveal the spatial distribution of the elements Ne, Mg, Si, S, and Fe in unprecedented detail and a bright rim in the south where the shock is interacting with a molecular cloud complex. We have compared the images of the bright rim from a Chandra observation in 2006 to our new data to derive an expansion of 0.110 +/- 0.023 arcsec over the 14.5 yr baseline which corresponds to a shock velocity of 1850 +/- 386 km/s. We measure a shock velocity of 3435+/-374 km/s for a feature in an apparent blowout region in the north-east and use this value to estimate the deceleration of the shock wave in the molecular cloud interaction region. Spectral fits to narrow regions near the shock front result in an electron temperature of T_e~1.00 keV assuming a non-equilibrium ionization model with abundances typical of the interstellar medium in the LMC. This electron temperature implies a shock velocity of ~855 km/s assuming full electron-ion equilibration. We explore whether this apparent discrepancy between the electron temperature inferred from the measured shock velocity and that inferred from the spectral fits may be explained by cooling from Coulomb collisions and adiabatic expansion within the spectral extraction region.

Primary author: Dr PLUCINSKY, Paul (SAO)

Co-authors: Dr LONG, Xi (SAO); Dr GAETZ, Terrance (SAO); Dr KASHYAP, Vinay (SAO); CHANDRA N132D LEGACY TEAM

Presenters: Dr LONG, Xi (SAO); Dr GAETZ, Terrance (SAO); Dr KASHYAP, Vinay (SAO); CHANDRA N132D LEGACY TEAM

Contribution Type: e-poster

Status: ACCEPTED

Submitted by **PLUCINSKY, Paul** on **Tuesday, 5 July 2022**

Abstract ID : **139**

A careful search for X-ray detected intermediate-mass black holes

Content

Intermediate-mass black holes (IMBH) are thought to be the seeds which give rise to the formation of supermassive black holes. The observational evidince for these seeds remains elusive, with the possible exception of the recently discovered gravitational wave event GW190521, massive black holes seen in dwarf galaxies and HLX-1. As a member of the sparse class of hyperluminous X-ray sources (HLX, brighter than 10⁴¹ erg/s in X-rays and located outside the nucleus of a massive galaxy), and showing a tremendous variability which suggests partial tidal disruption events, HLX-1 is the perfect illustration of two methods to probe for IMBH in large X-ray surveys. However, this data mining task first requires a reliable identification of large fractions of existing X-ray detections in the archives, still unexplored to a large extent.

To this end, I will present a general-purpose, probabilistic approach to classify X-ray sources found in catalogues, in which sources are classified based on their spatial, spectral and variability properties on different timescales and their multi-wavelength counterparts. I will show how this optimized Naive Bayes classifier can be applied to clean up samples of ULXs and HLXs, and demonstrate its reliability and suitability to data mining purposes for the Swift, XMM and Chandra catalogues, with the perspective of maximising the scientific return of Athena. Last but not least, I will show recent results from applying this classification to the X-ray populations in dwarf galaxies.

Primary author: TRANIN, Hugo (IRAP, Université Toulouse III)

Presenter: TRANIN, Hugo (IRAP, Université Toulouse III)

Contribution Type: Oral presentation

Status: ACCEPTED

Submitted by **TRANIN, Hugo** on **Tuesday, 5 July 2022**

Abstract ID : **141**

A new finite-volume code for the thermal evolution of magnetized neutron stars in 3 dimensions

Content

The study of the thermal and magnetic evolution of neutron stars (NSs) in time is fundamental to understand the spectral and temporal properties of these sources and shed light on the origin of the different NS populations. To this aim, a numerical study of the heat diffusion and magnetic evolution equation is required, coupled with a detailed calculation of the microphysical property of the star, such as neutrino emissivity and heat and electric conductivity. Moreover, in order to account for the non-axisymmetric effects, which are expected to lead to the formation of a non-axisymmetric temperature map on the stellar surface, a solution of the equation in 3D is required. In this talk, I present the preliminary implementation of the thermal evolution part of our new 3D magneto-thermal evolution code, which aims to generalize the axisymmetric finite-volume code previously developed by our group.

Primary author: ASCENZI, Stefano (ICE (CSIC-IEEC))

Co-authors: DEHMAN, Clara (ICE (CSIC-IEEC)); Prof. PONS, Jose (Universitat d'Alacant); Dr VIGANÒ, Daniele (ICE (CSIC-IEEC))

Presenter: ASCENZI, Stefano (ICE (CSIC-IEEC))

Contribution Type: e-poster

Status: ACCEPTED

Submitted by **ASCENZI, Stefano** on **Tuesday, 5 July 2022**

Abstract ID : **142**

Theory Meets Reality: Testing Accretion Disk Models with LMC X-3 and GRO J1655-40

Content

We will present a detailed investigation of X-ray spectral models used to fit the thermal accretion disk emission in black-hole X-ray binaries. We fit ~2000 RXTE observations of GRO J1655-40 and LMC X-3 to explore the nature of the accretion disk in strong gravitational fields via non-relativistic and relativistic disk models. We find that the non-relativistic multi-color disk blackbody model (diskbb) gives significantly (about ~50-60%) higher values for disk temperatures and lower (often unphysical) inner disk radii than relativistic disk models. We find that this difference in the disk temperature and inner disk radius cannot be explained by only changing spectral hardening factor and changing inner disk radius in combination with relativistic treatment of the disk is a more probable explanation for the previously reported deviations in the $L - T^4$ relationship in a subset of black hole X-ray binaries. Our study clearly shows the importance of self-consistent modeling of the thermal emission in accreting compact objects, especially when estimating the black hole spin with the continuum-fitting method.

Primary author: YILMAZ, Anastasiya (Astronomical Institute of the Czech Academy of Sciences)

Co-authors: Dr SVOBODA, Jiri (Astronomical Institute of the Czech Academy of Sciences); Dr GRINBERG, Victoria (European Space Agency (ESA), European Space Research and Technology Centre (ESTEC)); Dr BOORMAN, Peter (Astronomical Institute of the Czech Academy of Sciences); Dr BURSA, Michal (Astronomical Institute of the Czech Academy of Sciences); Dr DOVCIAK, Michal (Astronomical Institute of the Czech Academy of Sciences)

Presenter: YILMAZ, Anastasiya (Astronomical Institute of the Czech Academy of Sciences)

Contribution Type: e-poster

Status: ACCEPTED

Submitted by **YILMAZ, Anastasiya** on **Tuesday, 5 July 2022**

Abstract ID : **143**

The great synergy between ATHENA and next generation GRB missions

Content

Main international projects for next generation GRB missions, like THESEUS, selected by ESA for a Phase A study (2018-2021) as candidate M5 mission and re-proposed to the M7 call, or Gamow Explorer, proposed to the last NASA/MIDEX call, aim at fully exploiting Gamma-Ray Bursts for investigating the early Universe andas key phenomena for multi-messenger time-domainastrophysics. By providing unprecedented combinations of X-/gamma-ray monitors, on-board IR telescope and spacecraft autonomous fast slewing capabilities, these space missions would be wonderful machines for the detection, multi-wavelength characterization and
redshift measurement of any kind of GRBs and many classes of X-ray transients, including high-redshift GRBs for cosmology (pop-III stars, cosmic reionization, SFR and metallicity evolution up to the "cosmic dawn") and electromagnetic counterparts to sources of gravitational waves. (short GRB, possible soft X-ray emission, KN emission).
THESEUS-like missions would thus provide an ideal synergy with the very large facilities of the future in both e.m. and multi-messenger domains, and, in particular, will greatly benefit ATHENA in fully achieving its scientific objectives on probing stars in the early Universe, using GRBs as backlights to probe the WHIM, probing galactic and extra-galactic variable sources, such as TDEs, AGN and stellar binary systems, and, more in general, in enhancing its scientific return for multi-messenger astrophysics.

Primary author: AMATI, Lorenzo (OAS Bologna)

Presenter: AMATI, Lorenzo (OAS Bologna)

Contribution Type: Oral presentation

Status: ACCEPTED

Submitted by **Dr CEBALLOS MERINO, Maite** on **Thursday, 7 July 2022**

Abstract ID : **149**

First results from the Imaging X-ray Polarimetry Explorer

Content

The Imaging X-ray Polarimetry Explorer (IXPE) was launched on December 9, 2021, reopening, after more than 40 years, the polarimetric window in the classical X-ray band. In this talk I will describe the main IXPE characteristics, discuss science prospects and report on first results.

Primary author: MATT, Giorgio (Universita' Roma Tre)

Presenter: MATT, Giorgio (Universita' Roma Tre)

Contribution Type: Invited

Status: ACCEPTED

Submitted by **MATT, Giorgio** on **Monday, 25 July 2022**

Abstract ID : **153**

X-ray emissions in the solar system: state-of-the-art and prospects for Athena

Content

Through observations spanning more than 20 years XMM-Newton and Chandra have provided us with a wealth of X-ray data from the solar system; these have opened a new window on the phenomena taking place in planetary atmospheres and magnetospheres, and on their response to solar activity. Observations have led to more questions about the nature and relative roles of the physical processes that may be driving auroral X-ray emissions in particular, e.g. magnetic reconnection, Kelvin Helmholtz instabilities, solar wind compression events.

Most of these questions can be resolved by knowledge of what is actually taking place in situ, e.g. of magnetic field conditions, particle populations and their acceleration mechanisms. We are currently in a golden era for joint X-ray and in situ studies of Jupiter, with Juno orbiting the planet and a campaign of multi-wavelength observations taking place simultaneously, with XMM-Newton and Chandra playing a prominent role.

This presentation will highlight the discoveries that such measurements can achieve, and will look forward to the time when ESA's next major X-ray observatory, Athena, will be flying, and may well do so in synergy with the JUICE spacecraft visiting the Jupiter's system. Athena will offer an unparalleled step-up change in our ability to investigate the details of the physics producing X-ray emissions in the solar system, ultimately leading to a better understanding of what we can expect to be taking place in planetary environments surrounding other host stars.

Primary author: BRANDUARDI-RAYMONT, Graziella

Presenter: BRANDUARDI-RAYMONT, Graziella

Contribution Type: Invited

Status: ACCEPTED

Submitted by **BRANDUARDI-RAYMONT, Graziella** on **Tuesday, 26 July 2022**

Abstract ID : **154**

Constraining neutron star properties with NICER: current results and future prospects for Athena

Content

"Constraining NS properties with NICER: current results and future prospects for Athena"

NICER, the Neutron Star Interior Composition Explorer, uses Pulse Profile Modeling (PPM) to measure neutron star masses and radii. PPM which exploits relativistic effects on X-rays emitted from the hot magnetic polar caps of millisecond pulsars, also lets us map the hot emitting regions on the stellar surface. I will present NICER's latest results and discuss the implications for our understanding of ultradense matter, pulsar emission, and stellar magnetic fields. I will also discuss the prospects for neutron star mass-radius and surface-mapping measurements with Athena, using PPM and other techniques.

Primary author: WATTS, Anna (University of Amsterdam)

Presenter: WATTS, Anna (University of Amsterdam)

Contribution Type: Invited

Status: ACCEPTED

Submitted by **WATTS, Anna** on **Thursday, 28 July 2022**

Abstract ID : **155**

Baryon circulation and chemical enrichment in cluster of galaxies

Content

Large-scale structure formation connects physical processes spanning an enormous range of scales: nuclear reactions in the core of a star produce chemical elements that may later be expelled from the host galaxy by jets launched near the event horizon of a supermassive black hole (SMBH); these metals roam through the cosmos and can then accrete onto a different halo, many millions of light years away. The enrichment pattern of the hot metals in clusters and groups of galaxies contains valuable information about how various chemical elements are produced and spread throughout the Universe. I will discuss our current view of these processes based on past and present X-ray observations, and highlight some outstanding questions that will be answered by upcoming space-based detectors, including Athena.

Primary author: SIMIONESCU, Aurora (SRON Netherlands Institute for Space Research)

Presenter: SIMIONESCU, Aurora (SRON Netherlands Institute for Space Research)

Contribution Type: Invited

Status: ACCEPTED

Submitted by **SIMIONESCU, Aurora** on **Thursday, 4 August 2022**

Abstract ID : **156**

Scientific highlights of eROSITA and the prospects of wide X-ray surveys in the 2030s

Content

The next generation of wide-area, sensitive X-ray surveys designed to map the hot and energetic Universe has arrived, thanks to eROSITA (extended ROentgen Survey with an Imaging Telescope Array), the core instrument on the Russian-German Spektrum-Roentgen-Gamma (SRG) mission. eROSITA high sensitivity, large field of view, high spatial resolution and survey efficiency will have a significant impact on various fields of X-ray astronomy and deliver large legacy samples for many classes of astronomical objects in the energy range 0.2-8 keV. I will present an overview of the instrument capabilities, the current status of the mission, a few selected early science results and the expectations for the survey program, which has completed last December the fourth of its eight planned charts of the whole sky. Finally, I will present an outlook of the key questions for eROSITA's successors in the next decade.

Primary author: MERLONI, Andrea (MPE)

Presenter: MERLONI, Andrea (MPE)

Contribution Type: Invited

Status: ACCEPTED

Submitted by **MERLONI, Andrea** on **Wednesday, 17 August 2022**

Abstract ID : **157**

The cosmological evolution of AGNs

Content

I will review the results from large X-ray surveys, which have enabled us to track the evolution of AGN across a broad range of cosmic time, and discuss the prospects for future studies of the Energetic Universe. Measurements of the X-ray luminosity function provide a powerful tracer of the overall accretion density, which broadly follows the cosmic star formation rate density showing how black hole growth and the build-up of galaxies are closely linked. In particular, X-ray surveys are able to reveal - and quantify - the extent of obscured AGN that dominate the overall black hole growth. Furthermore, deep X-ray surveys can pick out sources where the host galaxy dominates the optical light, allowing us to quantify in detail the distribution of AGN activity within the galaxy population. Recent studies show that the bulk of AGN lie in massive, star-forming galaxies, but their incidence may be enhanced in compact star-forming galaxies as well as in extended quiescent galaxies at high redshifts, indicating a broad range of physical mechanisms may trigger AGN activity and drive black hole growth. Finally, I will discuss how a dedicated large-scale survey programme with the Athena Wide-Field Imager will enable new studies, providing a detailed quantification of AGN activity at cosmic noon and tracking the early growth of black holes out to z>6.

Primary author: AIRD, James (University of Edinburgh)

Presenter: AIRD, James (University of Edinburgh)

Contribution Type: Invited

Status: ACCEPTED

Submitted by **AIRD, James** on **Thursday, 18 August 2022**

Abstract ID : **158**

Event Horizon Telescope Imaging of Sagittarius A* and M87 black holes in unpolarized and polarized light

Content

I will talk about images of black holes in Sagittarius A* and M87
obtained with the Event Horizon Telescope. Both images have a ring-like morphologies consistent with predictions of magnetohydrodynamical simulations of gas dynamics in Kerr metric. EHT results provide new window for future tests of gravitational physics and unique way to observe physics of accretion and jet formation around supermassive black holes.

Primary authors: EVENT HORIZON TELESCOPE COLLABORATION; MOSCIBRODZKA, Monika (Radboud University)

Presenter: EVENT HORIZON TELESCOPE COLLABORATION

Contribution Type: Invited

Comments:

This invited talk is given on behalf of the Event Horizon Telescope Collaboration. I have preference to give this talk either on Wednesday or Thursday. I cannot attend meeting on Monday due to teaching duties.

Status: ACCEPTED

Submitted by **MOSCIBRODZKA, Monika** on **Monday, 22 August 2022**

Abstract ID : **159**

The Cluster XMM-Heritage project CHEX-MATE: current results and future prospects for Athena

Content

The Cluster HEritage project with XMM-Newton – Mass Assembly and Thermodynamics at the Endpoint of structure formation (CHEX-MATE) is a three-mega-second Multi-Year Heritage Programme to obtain X-ray observations of a minimally-biased, signal-to-noise-limited sample of 118 galaxy clusters detected by Planck through the Sunyaev–Zeldovich effect. The programme aims to study the ultimate products of structure formation in time and mass.
I will present the most recent results obtained from our large international collaboration, highlighting the role of X-ray and SZ data in resolving the astrophysics of the most massive collapsed halos in the universe and in studying the interplay between the hot plasma and dark matter.
These studies will pave the way in using the next generation of X-ray observatories, like XRISM and Athena, to construct a consistent picture of the formation and composition in mass and energy of galaxy clusters.

Primary author: ETTORI, Stefano (INAF OAS Bologna (Italy))

Presenter: ETTORI, Stefano (INAF OAS Bologna (Italy))

Contribution Type: Invited

Status: ACCEPTED

Submitted by **ETTORI, Stefano** on **Tuesday, 23 August 2022**

Abstract ID : **160**

The large-scale distribution of ionised metals in IllustrisTNG simulation: predictions and implications for WHIM and CGM

Content

Hydrodynamical cosmological simulations have proven to be a great tool to understand the physical mechanisms regulating the baryonic gas properties and their large-scale distribution. On the other hand, the capabilities planned for Athena X-IFU will provide a unique opportunity to study the warm-hot Universe in great detail.
In preparation for the next-generation observatories I will present predictions obtained using the IllustrisTNG simulation. I will show how the abundance of CII, CIV, MgII, NV, NeVIII, OVI, and SiIV embedded in filaments, haloes, and voids evolves and how they are distributed in the different gas phases from $z = 6$ to $z = 0$. These results provide new hints in the context of the well-known missing baryon problem. We find that the Warm-Hot Intergalactic Medium (WHIM; 10^5 K < T < 10^7 K) constitutes ~ 46% of the baryons at redshift $z \sim 0$. We also show that OVI, NeVIII, and NV are good tracers of the warm/hot and low-dense gas at low redshifts, regions that are likely to contain most of the missing baryons in the local Universe.

Primary authors: ARTALE, Maria Celeste (University of Padova); Dr HAIDER, Markus; Prof. MONTERO-DORTA, Antonio D. (Universidad Técnica Federico Santa María); Prof. VOGELSBERGER, Mark (MIT); Dr MARTIZZI, Davide; Prof. TORREY, Paul; Prof. BIRD, Simeon; Prof. HERNQUIST, Lars; Prof. MARINACCI, Federico

Presenter: ARTALE, Maria Celeste (University of Padova)

Contribution Type: Invited

Status: ACCEPTED

Submitted by **ARTALE, Maria Celeste** on **Saturday, 27 August 2022**

Abstract ID : **161**

BEaTriX, the new facility to measure the modular X-ray optics of the Athena telescope with an expanded and parallel X-ray beam

Content

BEaTriX (Beam Expander Testing X-ray) is a unique facility present at the INAF-Osservatorio Astronomico Brera (Merate, Italy). In a small lab (about 10 m × 20 m) we have created a beam line able to perform the X-ray acceptance tests (PSF and Aeff) of the ATHENA Silicon Pore Optics Mirror Modules (MM) at their production rate (2 MM/day), with an X-ray beam that approximate the one created by an astronomical source. A microfocus X-ray source produces a divergent beam which is conditioned (collimated, monochromatized, and expanded) by a parabolic mirror and silicon crystals. The beam, at the energy of 4.5 keV, was demonstrated to be collimated to about 2-3 arcsec, with a flux of 60 photons/s/cm2, and sufficiently large (170 mm × 60 mm) to cover the entrance pupil of the MMs. The PSF and Aeff of the first optically representative MM were performed. A feasibility study is now on going to replicate the facility at the cosine premises, to test the SPO MM at 1.5 and 6.4 keV.

Primary authors: SALMASO, Bianca (INAF Osservatorio Astronomico Brera); BARRIERE, Nicolas M. (cosine); Dr BASSO, Stefano (INAF-OAB); Dr BAVDAZ, Marcos (ESA); Dr BURWITZ, Vadim (MPE PANTER); Dr CHRISTENSEN, Finn (DTU); COLLON, Maximilien J. (cosine); Dr COTRONEO, Vincenzo (INAF-OAB); Dr DELLA MONICA FERREIRA, Desiree (DTU); Dr FERRARI, Claudio (CNR-IMEM); Dr FERREIRA, Ivo (ESA); Dr FIORINI, Mauro (INAF-IASF); Dr GHIGO, Mauro (INAF-OAB); Dr MASSAHI, Sonny (DTU); Dr PARESCHI, Giovanni (INAF-OAB); Dr PARODI, Giancarlo (BCV); Dr SANCHEZ DEL RIO, Manuel (ESRF); Dr SIRONI, Giorgia (INAF-OAB); Dr SPIGA, Daniele (INAF-OAB); Dr TAGLIAFERRI, Gianpiero (INAF-OAB); Mr USLENGHI, Michela (INAF-IASF); VACANTI, Giuseppe (cosine); Dr VECCHI, Gabriele (INAF-OAB)

Presenter: SALMASO, Bianca (INAF Osservatorio Astronomico Brera)

Contribution Type: e-poster

Status: ACCEPTED

Submitted by **SALMASO, Bianca** on **Tuesday, 6 September 2022**

Abstract ID : **162**

AGN variability and QPEs: current results and future prospects for Athena

Content

Since their discovery, quasi-periodic eruptions (QPEs) have not stopped surprising astronomers. Discovered serendipitously in the nucleus of the galaxy GSN 069 at the end of 2018, QPEs have been observed so far in four other galaxies, some of these active, and all of low-mass and with connections to tidal disruption events (TDEs).

QPEs are sudden and intense flares of soft X-rays, lasting about an hour, and repeating quasi-periodically every few hours. They manifest themselves as thermal emission with a temperature $kT \sim 100 - 250$ eV, much warmer than the temperature measured in quiescence. The quiescent X-ray spectrum of the QPE host galaxies is super-soft, generally well described by an accretion disk with $kT \sim 40 - 70$ eV, and weak or absent hard X-ray power-law emission. With each flare, QPEs carry a $0.3 - 2$ keV luminosity of about 10^{42-43} erg s^{-1}.

The time scales and the amount of energy emitted imply phenomena associated with super massive black holes (SMBHs), but the physical scenarios capable of interpreting the QPE observations are manifold. Among them, there are accretion flow instabilities, gravitational lensing of binary black holes, magnetic reconnection, and extreme mass ratio inspirals (EMRI).

I will briefly recall the story of the discovery of QPEs, to present, then, the latest observational results and their implications for the theoretical interpretations. I will conclude with the expectations that we might have regarding observations during the next decade of these new cosmic phenomena lightning up the X-ray sky.

Primary author: GIUSTINI, Margherita (Centro de Astrobiologia (CAB), CSIC-INTA)

Presenter: GIUSTINI, Margherita (Centro de Astrobiologia (CAB), CSIC-INTA)

Contribution Type: Invited

Status: ACCEPTED

Submitted by **GIUSTINI, Margherita** on **Wednesday, 7 September 2022**

Abstract ID : **164**

The X-Ray Imaging and Spectroscopy Mission (XRISM)

Content

The X-Ray Imaging and Spectroscopy Mission (XRISM) is now at the final stage of the development, under the international collaboration by JAXA, NASA, and ESA. XRISM will open a new window on high energy astrophysics with the unprecedentedly high spectral resolution achieved by the X-ray microcalorimeter Resolve and the wide field of view provided by the CCD detector Xtend. The major scientific goal of this mission is to reveal "the formation history of galaxy clusters," "the history of baryonic circulation," and "the mechanism of energy transportation and circulation in the universe." I will present our current development status and scientific activities, as well as prospects for Athena as a successor of high-resolution, wide-field-of-view X-ray mission.

Primary author: YAMAGUCHI, Hiroya (ISAS/JAXA)

Presenter: YAMAGUCHI, Hiroya (ISAS/JAXA)

Contribution Type: Invited

Status: ACCEPTED

Submitted by **YAMAGUCHI, Hiroya** on **Thursday, 15 September 2022**

Abstract ID : **165**

The unaltered pulsar: GRO J1750-27, a super-critical X-ray neutron star that doesn't blink an eye

Content

When accreting X-ray pulsars (XRPs) undergo bright X-ray outbursts, their luminosity-dependent spectral and timing features can be analyzed in detail. The XRP GRO J1750-27 recently underwent one of such episodes, during which it was observed with NuSTAR and monitored with NICER. Such a data set is rarely available, as it samples the outburst event over more than a month at a luminosity that is always larger than the critical luminosity, where a radiative shock is formed above the neutron star's surface. Our data analysis of the joint spectra confirms the discovery of a deep cyclotron line at a centroid energy of about 44 keV, corresponding to a magnetic field strength of 4.7x10^12 G. This value is independently supported by the best-fit physical model for spectral formation in accreting XRPs, which also favors a distance of 14 kpc, in agreement with recent findings. Contrary to theoretical expectations and observational evidence from other similar sources, the pulse profiles as observed by NICER through the outburst raise, peak and decay remain remarkably steady. The NICER spectrum, included the Iron Kα line best-fit parameters, also remain almost unchanged at all probed outburst stages, similar to the pulsed fraction behaviour. We argue that all these phenomena are linked, and interpret the observed behavior as a saturation effect of the accretion column's emission at work in the explored high-luminosity regime.

Primary author: Dr MALACARIA, Christian (International Space Science Institute (ISSI))

Presenter: Dr MALACARIA, Christian (International Space Science Institute (ISSI))

Contribution Type: e-poster

Status: ACCEPTED

Submitted by **MARTINEZ, Silvia** on **Monday, 19 September 2022**

Abstract ID : **166**

Scientific highlights from JWST

Content

The James Webb Space Telescope (JWST) is rapidly transforming our view of the Universe, from observations in our own Solar System, out to the early formation of galaxies just after the Big Bang, and everything in between. I will give an overview of the mission following its successful launch last December and summarise some of the exciting first results now coming out from its science programmes. These include the remarkable first images and spectra released in July, and some of the first published papers from the Early Release Science (ERS) programmes.

Primary author: EVANS, Chris (ESA)

Presenter: EVANS, Chris (ESA)

Contribution Type: Invited

Status: ACCEPTED

Submitted by **EVANS, Chris** on **Friday, 30 September 2022**

Abstract ID : **167**

Decomposing X-ray Pulsar Profiles using Blind Source Separation

Content

The emission regions of accreting X-ray pulsars provide a natural laboratory for physics under extreme conditions. However, various factors have prevented this potential from being fully exploited so far. Two of these factors are 1) the angular dependence of the cross-sections defining the radiative transport in the presence of strong magnetic fields and 2) the fact that we can observe emission from both poles of the neutron star simultaneously at some or even all phases of the pulse cycle. Coupled together, the observed emission is the result of two independent and intrinsically complex emission regions that is notoriously difficult to interpret.

We have developed a novel technique to address this problem and decompose contributions of individual poles based on the observed pulse-to-pulse variability properties of pulsar light curves. Here we present the technique that is based on the Blind Source Separation problem, first results of its application to RXTE observations of Cen X-3, and discuss the comparison with earlier work aimed at solving the same problem.

Primary author: SAATHOFF, Inga (IAAT, University of Tübingen, Germany)

Co-authors: Dr DOROSHENKO, Victor (IAAT, University of Tübingen, Germany); Prof. SANTANGELO, Andrea (IAAT, University of Tübingen, Germany)

Presenter: SAATHOFF, Inga (IAAT, University of Tübingen, Germany)

Contribution Type: e-poster

Status: ACCEPTED

Submitted by **SAATHOFF, Inga** on **Friday, 30 September 2022**

Abstract ID : **168**

Six years supporting the Athena Community Office

Content

The *Athena* Community Office has been supporting the ESA's Athena Science Study Team and the broad *Athena* scientific community since June 2016. Currently, the community counts more than 1000 researchers spread around the world.

In this poster, we will present some of the most relevant projects carried out in the last years, such as: supporting the production of the multimessenger-*Athena* and Rubin-*Athena* white papers; coordinating the *Athena* science monthly webinars; developing simulation software; and last but not least, keeping the community informed about the project and providing outreach open material through social media and the community web portal, that recently has been revamped.

Primary author: Dr MARTÍNEZ-NÚÑEZ, Silvia (IFCA (CSIC-UC))

Co-authors: Dr BARRET, Didier (IRAP); Dr BOZZO, Enrico (Uni. Geneve); Dr CARRERA, Francisco J. (IFCA (CSIC-UC)); Dr CEBALLOS, María Teresa (IFCA (CSIC-UC)); Dr RAU, Arne (MPE)

Presenter: Dr MARTÍNEZ-NÚÑEZ, Silvia (IFCA (CSIC-UC))

Contribution Type: e-poster

Status: ACCEPTED

Submitted by **MARTINEZ, Silvia** on **Tuesday, 4 October 2022**

Abstract ID : **169**

Examination of regular/chaotic nature of the orbits based on the kick velocity imparted to binary pulsars

Content

The kick velocity which is arising during the binary interaction plays an important role in order to determine the fate of the binaries, whether surviving or disruptive. A pure two-body system (like a binary pulsar) is regular, but chaos may happen by changing with the frequency of the "periodic kicker", which adds the necessary time-dependency for having chaos. We will use as a numerical integrator a standard N-body solver, the Rebound package (Rein & Papaloizou, 2010, A&A, 524, A22). This numerical engine integrates the motion of particles under the influence of gravity, allows the use of a variety of integrators, and supports orbital parameters to change in place at a given instant. We present high complexity in the dynamical chaos given in binary pulsars. We gain some insight into the regularity properties of binaries, although some chaotic behavior can be also generated by the kick velocity even for much lower values of this kick.

Primary author: Dr TAANI, Ali (Al Balqa Applied University)

Presenter: Dr TAANI, Ali (Al Balqa Applied University)

Contribution Type: e-poster

Status: ACCEPTED

Submitted by **TAANI, Ali** on **Thursday, 6 October 2022**

Abstract ID : **170**

Innovative overcoatings for soft X-ray enhancement

Content

Low-density, carbon-based overcoatings, deposited on top of conventional reflecting coatings, can enhance the reflectivity of X-ray mirrors in the softer part of the spectrum (below ~5 keV) and are under study for the reflectivity e coating of the ATHENA mirrors. We have studied the possible use of alternative materials, which provide a similar performance enhancement, but can be deposited with a much simpler and cost-effective process, by simply immerging the optics in a liquid precursor solution (dip-coatings), with the spontaneous formation of a thin film on the mirror surface. We have deposited these coatings on top of different conventional reflecting materials (Au, Ir or Ir/Cr bilayers) and measured their reflectivity in X-rays, finding an excellent agreement with the model, and showing that the technology has a good potential for application to X-ray telescopes.

Primary authors: COTRONEO, Vincenzo (INAF - Osservatorio Astronomico di Brera); Mr RIVOLTA, Giacomo (INAF - Osservatorio Astronomico di Brera); GIBERTINI, Eugenio (Politecnico di Milano); Mr BAVDAZ, Marcos (ESTEC, ESA); Mr BRUNI, Ricardo (Center for Astrophysics, Harvard & Smithsonian); Dr CIVITANI, Marta M. (INAF - Osservatorio Astronomico di Brera); Prof. DÖHRING, Thorsten (TH Aschaffenburg); FERREIRA, Ivo (ESTEC, ESA); KRUMNEY, Michael (Physikalisch-Technische Bundesanstalt); GIGLIA, Angelo (IOM, CNR); GOLLWITZER, Christian (Physikalisch-Technische Bundesanstalt); IOVENITTI, Simone (INAF - Osservatorio Astronomico di Brera); MAGAGNIN, Luca (Politecnico di Milano); MAHNE, Nicola (IOM, CNR); NANNARONE, Stefano (IOM, CNR); Dr PARESCHI, Giovanni (INAF-OAB); ROMAINE, Suzanne (Center for Astrophysics, Harvard & Smithsonian); SETHARES, Leandra (Center for Astrophysics, Harvard & Smithsonian); SHORTT, Brian (Physikalisch-Technische Bundesanstalt); Dr SIRONI, Giorgia (INAF - Osservatorio Astronomico di Brera); Dr SPIGA, Daniele (INAF - Osservatorio Astronomico di Brera); STROBLIN, Dieter (Physikalisch-Technische Bundesanstalt); Dr TAGLIAFERRI, Gianpiero (INAF - Osservatorio Astronomico di Brera); VALSECCHI, Giuseppe (Media Lario Srl)

Presenter: COTRONEO, Vincenzo (INAF - Osservatorio Astronomico di Brera)

Contribution Type: e-poster

Comments:

I apologize for the late submission, I hope a poster can still be accepted. Thank you.

Status: ACCEPTED

Submitted by **COTRONEO, vincenzo** on **Saturday, 8 October 2022**