

## Session 1: AGN

I. Georgantopoulos

### Obscured AGN in the Universe

I will review our current knowledge of heavily obscured AGN in the Universe as revealed by X-ray (and IR surveys). X-ray surveys provide the most efficient way to find AGN. Still at very high column densities even X-rays have difficulties in detecting AGN. Although it is difficult to detect the most obscured AGN, X-ray background synthesis models predict their presence although their exact number remains controversial. The BAT detector (14-195 keV) made a leap forward in detecting heavily obscured AGN in the local Universe exploring fluxes down to  $\sim 10^{-11}$  cgs. At the same time NUSTAR owing to its angular resolution probed at least two orders of magnitude deeper in hard X-ray flux. At the same time additional constraints come from the number of heavily obscured AGN detected at softer energies in the Chandra and XMM in deep fields. Finally, mid-IR surveys may help us to detect a number of the most heavily obscured AGN that avoid detection in X-rays.

M. Page

### AGN populations in X-ray surveys

Since the 1970s, type 1 AGN have formed a major constituent of X-ray surveys. The robust and simple procedure for finding these sources in X-ray surveys has made this approach particularly appropriate for statistical studies of the population. I will review some of the key population studies derived from X-ray surveys, including the cosmic evolution and space density of type 1 AGN, their X-ray spectra and multiwavelength spectral energy distributions, the incidence of winds and outflows, and the star formation properties of their hosts.

Beatriz Mingo, Mike Watson, Martin Hardcastle, Andrew Blain, Simon Rosen, Francisco Carrera, Silvia Mateos and Gordon Stewart

### Radio-loud AGN through the eyes of 3XMM, WISE and FIRST/NVSS

As part of the ARCHES European FP7 collaboration work, we combine FIRST and NVSS with a new technique, cross-correlating the result with the WISE and 3XMM catalogues using the ARCHES xmatch tool. With this radio selection we obtain a large, clean sample of radio-loud AGN across a wide range of luminosities, as well as a smaller sample of nearby star-forming galaxies. Free from the constraints of traditional X-ray and mid-IR selection cuts, we study faint AGN in systems where the host dominates the emission, and draw better constraints on the luminosity relations for AGN and star formation activity that allow us to devise a series of powerful diagnostic tools. We also explore the relation, or lack thereof, between radiative output and jet kinetic power in AGN, which is key to our understanding of accretion, discussing its implications on regulating mechanisms for the jet, and long-term variability timescales.

Sotiria Fotopoulou, S. Paltani,, L. Chiappetti, M. Brusa, A. Bongiorno and M. Pierre

#### Cross correlations of the XXL-1000-AGN sample

Catalog cross correlations, key in unveiling the multiwavelength properties of astronomical sources, are particularly challenging for all-sky surveys where the data volume prohibits detailed human intervention. I will present issues and lessons learned from the cross correlations of the XXL-1000-AGN sample, the first public release of the XMM-XXL survey. Covering 50 sq. deg., the XXL is the ideal training field standing in between modern deep X-ray surveys and future all-sky missions.

F.J. Carrera, I. Georgantopoulos and M. Paolillo

#### Exploring the XMM-ATLAS survey with the ARCHES tools

We will show the result of using the ARCHES cross-correlation tool on the XMM-ATLAS, KIDS, VIKING and WISE catalogues. We will discuss the general properties of the counterparts found in different catalogues and their SEDs (if possible using the ARCHES SED tool), in the context of the AGN-galaxy co-evolution scenario.

Tonima Tasnim Ananna, Mara Salvato, C. Meg Urry, Stephanie M. Lamassa and the Stripe 82X Collaboration

#### X-ray-selected AGN sources from the Stripe 82X survey

We present preliminary spectroscopic and photometric redshifts of 5000 X-ray-selected AGN sources from our Stripe 82X survey, which is designed to study rare high-redshift and/or high-luminosity AGN like the luminous quasars identified in the Sloan Digital Sky Survey but also including heavily reddened AGN not identified as such in SDSS. The sample covers a total of 31.3 deg<sup>2</sup> in Stripe 82, a combination of 15.6 deg<sup>2</sup> XMM AO13 data, 10.6 deg<sup>2</sup> XMM AO10 and archival data, and 7.4 deg<sup>2</sup> archival Chandra data. About 80% of the newly discovered X-ray sources have an optical counterpart in the co-added SDSS data; of these, roughly half have spectroscopic redshifts. We derived estimates of the photometric redshifts for the rest, using multiwavelength photometry from GALEX, SDSS, UKIDSS, VISTA, 2MASS, Spitzer, and WISE. The photometric redshifts will be used to determine the fraction of obscured black hole growth at high redshift and/or high luminosity, as well as to derive the evolving X-ray luminosity function and to measure AGN clustering in several redshift slices — information vital to understanding the co-evolution of galaxies and their central black holes.

A. Ruiz, F.J. Carrera,, S. Mateos and A. Alonson-Herrero

[OIII]5007A emitting galaxies in the SDSS-dr10/3XMMe/WISE cross-correlation

We present a study of a sample of SDSS-dr10 galaxies with significant [OIII]5007A emission lines (a good proxy for nuclear activity and/or star formation) in fields included in the 3XMMe catalogue. Using the tools and techniques of the ARCHES project we cross-correlated the SDSS-dr10 (optical), the 3XMMe (X-rays) and the WISE All-Sky (MIR) catalogues. We assembled a sample of 1659 [OIII]5007A emitting galaxies with multi-wavelength data. In a first view of the properties of these sources we found 1063 galaxies showing some evidence of an AGN in some energy range. However, only for 419 sources (~40%) the AGN is detected in all ranges (optical, MIR and X-rays). We can therefore test the efficiency of AGN detection in different energy ranges and through an extensive multi-wavelength study we can understand why the AGN is not detected (optical or X-ray obscuration, low luminosity, galaxy dilution, etc).

## Session 2: Clusters

Thomas Reiprich

Galaxy cluster surveys

Galaxy cluster surveys with emphasis on the X-ray band will be reviewed.

M. Pierre, on behalf of the XXL consortium

The XXL XMM survey: an overview

The XXL survey, granted by the AO10, is the largest XMM programme to date (>6 Ms). The observations were completed mid-2013. It covers two extragalactic regions of 25deg<sup>2</sup> each. To date, 13 articles have been submitted to A&A. We describe the scientific goals, the processing of the 542 XMM observations and the production of the X-ray mosaic maps. We present the AGN and cluster identifications techniques as well as the associated follow-up programmes and catalogue work. We give an overview of the scientific results obtained so far. Website of the project: <http://irfu.cea.fr/xxl> Other XXL presentations on focussed topics are proposed at this workshop.

A. Mints and A. Schwobe

The Integrated Cluster Finder

We present the Integrated Cluster Finder - a tool to search for clusters associated with X-ray sources by looking for galaxy overdensities using multiple galaxy catalogues. We test the tool on several lists of known clusters and produce a new catalogue using 3XMMe data as an input

Marian Douspis and Nabila Aghanim

### The SZ Meta-Catalogue

We are presenting the SZ Meta-Catalogue (SZMC) of 2690 clusters and candidates observed in SZ. This is a compilation of Planck, SPT and ACT catalogues with additional information from CARMA and AMI when available. The SZMC is available through an online interface at the Integrated Operation and Data Center (IDOC) and through the Virtual Observatory. I will describe the construction of the meta-catalogue and a few examples of its possible use.

Tatyana Sadibekova, Marguerite Pierre, Nicolas Clerc , Lorenzo Faccioli, Rene Gastaud, Jean-Paul Le Fevre , Eduardo and Eli Rykoff

Case-study correlation between the RedMapper (SDSS) and XCLASS (XMM) cluster catalogues.

We present a comprehensive correlation analysis between optically selected and X-ray-selected cluster samples to develop a holistic picture of galaxy clusters utilising the catalogues with well-understood selection functions. For that, we correlated the X-CLASS serendipitous cluster catalogue extracted from the XMM archive with the redMaPPer optical cluster catalogue derived from the Sloan Digitized Sky Survey (DR8). This study particularly focuses on the non-matching objects in either waveband. It has proven very instructive as to the defects of both catalogues and the dangers of blind correlation procedures. The results are published in Sadibekova et al 2014, A&A 571, 87.

Jethro Ridl and Nicolas Clerc

### The XMM Cluster Archive Super Survey

The XMM Cluster Archive Super Survey (X-CLASS) is a serendipitous, X-ray selected cluster catalogue, containing 850 galaxy clusters, extracted from 2774 observations from the XMM archive following the methodology of the XMM-LSS/XXL. I will present details of an optical and near-infrared follow-up of 250 members of the sample with the seven-channel ( $g'r'i'z'$ JHKs), simultaneous imager GROND on the MPG/ESO 2.2m telescope at La Silla. These clusters form a part of the extended X-CLASS cosmological sample, which benefits from a uniquely well-controlled selection function over 90 deg<sup>2</sup>. By making use of an algorithm designed to take advantage of both the XMM and GROND data, this provides an efficient tool for the determination of cluster photometric redshifts. This in turn allows for the characterization of the clusters for future cosmological analyses. These observations will assist with the refining of observational and analytical strategies for future eRosita cluster studies, particularly in areas not covered by large surveys such as SDSS or DES. This work compliments that of Tatyana Sadibekova, who will present a demonstration of a cross-matching procedure on the X-CLASS and redMaPPer cluster catalogues.

Elias Koulouridis, SAp CEA Saclay

Finding rare AGN in the XXL survey

The XXL survey offers a unique opportunity to study rare populations of AGN because of its large area which covers two 25 sq. deg. fields. The XXL observations have been completed and processed and more than 10000 AGN have been found. However, to discover and classify robustly the different types of AGN, for example the rare unobscured-type-2 AGN, the heavily obscured Compton-thick AGN, or the high-redshift X-ray AGN, we need to apply various multiwavelength diagnostics, to model the SEDs and to study available spectra. In this talk I will present a multiwavelength approach of selecting and classifying AGN.

### **Session 3: Cross-correlation techniques, SEDs and general surveys**

Mara Salvato, J. Buchner, T. Budavari and T. Dwelly

Multiwavelength cross-correlation methods

The landscape of photometric surveys has increased significantly over the last decade and it is now in principle possible to construct detailed Spectral Energy Distributions (SEDs) for most astrophysical objects. However, complications arise from different positional accuracies and spatial resolutions associated with the different surveys and instruments, in particular at X-ray, UV and MIR wavelengths. In addition, the survey depths rarely match each other and thus depending on redshift and SED, a given source might or might not be detected in a certain survey at a certain wavelength. All this makes the pairing of sources between multiple catalogs not trivial, especially in crowded fields. In my talk I will review the problems and the traditionally applied methods of sources associations and will also present a new Bayesian pairing code that we have developed at MPE. Specifically, I will show its application to the finding of reliable counterparts to point-like sources detected in the ROSAT X-ray all-sky survey.

François-Xavier Pineau on behalf of the ARCHES consortium

The ARCHES cross-correlation tool

In the frame of the ARCHES project we have been establishing the foundations for probabilistic multi-catalogue cross-matches. The selection of candidates is based on chi-square hypothesis tests. We compute Bayesian probabilities taking into account the effects of the selection criteria. The method, its advantages and limits, will be presented. We have also been developing a generic and flexible cross-correlation tool which is used to generate ARCHES output catalogues. A selection of the tool features will be presented, together with complications arising from the cross-correlation of several catalogues at the same time.

Mauro López del Fresno and Enrique Solano Márquez

The ARCHES Spectral Energy Distribution archive of 3XMM sources.

In this presentation I will describe the main functionalities of the SED archive developed at Centro de Astrobiología (CAB, INTA-CSIC). The generation of the spectral energy distributions from the cross-correlated catalogues, their compliance with the Virtual Observatory standards, the flux determination using the Filter Profile Service, the types of queries and the visualisation and download capabilities implemented in the system are some of the topics that will be presented in the talk. The archive also implements the SAMP protocol which allows sending the SEDs to any Virtual Observatory tool. We'll give some examples on how this functionality can help to the optimum scientific exploitation of the ARCHES datasets.

A. De Luca, INAF/IASF Milano

The EXTraS project: Exploring the X-ray Transient and variable Sky.

Modern X-ray observatories can yield unique insights into time domain astrophysics. Indeed, a huge amount of information is already stored - and largely unexploited - in data archives. EXTraS will harvest the hitherto unexplored temporal domain information buried in the serendipitous data collected by the European Photon Imaging Camera (EPIC) instrument onboard the ESA XMM-Newton mission since its launch. This will include a search for fast transients, missed by standard image analysis, as well as a search and characterization of variability (both periodic and aperiodic) in hundreds of thousands of sources spanning more than nine orders of magnitude in time scale and six orders of magnitude in flux. X-ray results will be complemented by multiwavelength characterization of new discoveries. Phenomenological classification of variable sources will also be performed. All our results, together with new analysis tools, will be made available to the community at the end of the project (2016, December). The EXTraS project, funded within the EU/FP7-Cooperation Space framework, is carried out by a collaboration including INAF (Italy), IUSS (Italy), CNR/IMATI (Italy), University of Leicester (UK), MPE (Germany) and ECAP (Germany).

R. P. Mignani

Identification of Fermi-LAT gamma-ray sources

The recently released Third Fermi-LAT gamma-ray source catalogue derived from the first 4 years of observations contains 3033 sources, about 30% of which still unidentified. Statistical classification methods provide useful hints to classify these sources. However, for many of them the statistical classification needs to be verified against X-ray and optical observations. It is obvious that an automated classification of the X-ray sources in the gamma-ray error boxes is the only way to apply this strategy on a large scale. In this talk I describe current results and future plans.

J. J. Rodes, J. M. Torrejón, E. Solano, G. Bernabéu, K. L. Page, P. Evans, J. P. Osborne, Á. García-Giménez, D. I. Méndez and J. Á. Berná

### Optical/infrared counterparts to X-ray binary sources

In the framework of an ongoing programme to discover and characterize optical/infrared counterparts to X-ray binary sources, we start to cross-match the catalogues 2MASS versus UKIDSS. Then we use the X-ray catalogues provided by XMM-Newton and Swift/XRT observatories to cross-correlate with the previous result. To do this we are using Virtual Observatory tools such as CDS Aladin, TopCat and VOSA. This work will contribute to the observed abundances of different types of binary systems.

## Session 5: Galactic Surveys

Robert Warwick

### Galactic X-Ray Surveys And Galactic X-Ray Source Populations

In this talk, I will outline how X-ray surveys have shaped our knowledge of the various Galactic X-ray source populations. The determination of the X-ray luminosity function (XLF) of a source population is key to the prediction of the statistical properties of that population. Using "template" 2-10 keV XLFs for low-to-intermediate luminosity sources (in the form of active stars and cataclysmic variables), I investigate the contribution of such sources to the Galactic X-ray source counts and the hard X-ray Galactic Ridge Emission. The problem of X-ray source identification in the Galactic plane at different X-ray survey depths is also discussed in the context of recent observational programmes.

Kumiko Morihana, Masahiro Tsujimoto, and Ken Ebisawa

### Near-Infrared Follow-up Study of the Faint Sources constituting the Galactic Ridge X-ray Emission

The Galactic Ridge X-ray Emission (GRXE) is apparently extended X-ray emission along the Galactic Plane. The X-ray spectrum is characterized by hard continuum with a strong Fe K emission features. Substantial fraction (~80%) of the GRXE around Fe band was resolved into point sources by deep Chandra imaging observations. To investigate the populations of these sources, we carried out near-infrared (NIR) spectroscopic observations in two deep Chandra fields located in the Galactic bulge and plane at  $(l,b)=(0.1^\circ, -1.4^\circ)$  and  $(28.5^\circ, 0.0^\circ)$ . We obtained 65 NIR spectra. We found that Galactic sources are categorized into three main classes: (A) hard X-ray spectra and NIR spectra with emission features such as H $\alpha$  (Br $\gamma$ ), He I, and He II (2 objects), (B) soft X-ray spectra and NIR spectra with absorption features such as H $\alpha$ , Na I, Ca I, and CO (46 objects), and (C) hard X-ray spectra and NIR spectra with absorption features same as class B (17 objects). From these features, class A sources are considered to

be cataclysmic variables (CVs, which are semi-detached binaries), and class B sources are X-ray active stars, as the current knowledge. However, class C sources stand out as a new group, which has not been well recognized so far.

F. Jiménez-Esteban, E. Solano and J. Sanz Forcada

Debris discs in young late type stars

Young late-type (F-M), main sequence stars are copious X-rays emitters due to stellar activity. This emission decreases with the stellar age, which can be estimated from the stellar X-ray luminosity. A large fraction of these stars harbour a debris disc, whose infrared emission is also expected to decrease with the stellar age. With the aid of the Virtual Observatory, we are using ARCHES spectral energy distributions and catalogues to both identify new debris discs and study their evolution with the stellar age. In this talk we are presenting the methodology and the results obtained.

Estrella Sánchez, Ada Nebot Gómez-Morán, Christian Motch and François-Xavier Pineau

A multi-wavelength view of the X-ray stellar content of the Galaxy.

From the multi-wavelength catalog generated by the ARCHES consortium and making use of the Principal Component Analysis and of the Kernel Density Classification algorithm we identified a clean sample of X-ray stars detected by the XMM-Newton satellite. Comparing the observed ARCHES-SEDs with stellar atmosphere models, we determined their effective temperatures. The majority of these stars are consistent with spectral types from A to M and have, as expected, soft X-ray (<2 keV) emission. Nevertheless there is a hard (>2 keV) stellar population of dwarfs and giants likely residing in binary systems of the type RS CVn or BY Draconis type. We would like to constrain the properties (age distribution, spectral type, luminosity function,...) of these X-ray emitting sources, in particular of the hard X-ray stellar population. For that purpose we will update the X-ray count model developed by Guillout et al. 1996 and based on the evolution synthesis population model from Besançon. This will provide us with the surface density of sources detected as a function of X-ray flux, age and spectral type, at any direction of the Galaxy to be compared with our observations.

Ada Nebot Gomez-Moran, Christian Motch and The ARCHES consortium

A catalog of X-ray emitting WR stars

We present a X-ray catalogue of Wolf-Rayet stars built cross-correlating the Galactic Wolf-Rayet Catalogue maintained by P.A. Crowther with the multi-wavelength catalogue of serendipitous X-ray sources detected by the XMM-Newton satellite generated by the ARCHES consortium. We discuss the X-ray properties of WR stars with special emphasis on the hard X-ray emission found among a subset of these WR stars.



Kumiko Morihana, Masahiro Tsujimoto and Takayuki Hayashi

#### Suzaku X-Ray Study of gamma Cas and gamma Cas analogues HD110432

Gamma Cas and gamma Cas analogues are early-B type stars with hard thermal X-ray emission above 10 keV with the fluorescent Fe line (6.4 keV) and highly ionized Fe lines (6.7 and 7.0 keV). These features are harder than any X-ray emitters of stellar origin. Despite of intensive X-ray observations, the X-ray production mechanism is uncertain. Detection sensitivity more than 10 keV and spectral capability of the Fe lines in X-ray bands are crucial to constrain the X-ray emitting region by reprocessed emission. Suzaku is suitable for revealing the X-ray emission mechanism using XIS's spectral capability and wide-band sensitivity combining XIS and HXD-PIN. We carried out wide-band X-ray spectral fittings focusing on geometry. In the wide-band spectrum, we found signatures of Fe fluorescence and Compton scattering, which indicate the reprocessed X-ray emission. We modeled the spectrum self-consistently to account for both the direct and the reprocessed emission. Using the equivalent width of the Fe fluorescence line, we constrained the emission geometry, in which the height of the emitting region above the stellar surface is less than 8% of the radius of the central object (a white dwarf or a Be star).

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