Australia/eROSITA-DE Joint Collaboration Workshop

25-27 March 2024

This online workshop brings together the Australian and German eROSITA/eROSITA-DE communities to collaborate, discuss ongoing projects and foster ideas for new projects.
You can see the event webpage here.

Monday 25 March

Time - AEDT Start	Time - AEDT End	Time - CET Start	Time - CET End	Speaker/s	Talk titles
19:00	19:05	9:00	9:05	Christian Wolf	Welcome
19:05	19:35	9:05	9:35	Andrea Merloni	Invited talk: eROSITA: Overview and Science examples
19:35	20:00	9:35	10:00	-	Discussion: Barriers; or what supports more uptake?
20:00	20:15	10:00	10:15	-	Break
20:15	21:15	10:15	11:15	Stars and Interstellar Medium (ISM)	
				Laura Driessen	Updating the stellar X-ray - radio relation using ASKAP and eROSITA
				Artur Avakyan	Hunting down new X-Ray Binaries in eROSITA DR1
				Miltiadis Michailidis	X-ray counterpart detection and γ-ray analysis of the supernova remnant G279.0+01.1 with eROSITA and Fermi-LAT
				Martin Mayer	Hot interstellar medium in the Large Magellanic Cloud
21:15	21:30	11:15	11:30		Networking & new collaborations

Tuesday 26 March

Time - AEDT Start	Time - AEDT End	Time - CET Start	Time - CET End	Speaker/s	Talk titles
19:00	20:00	9:00	10:00	Natasha Hurley-Walker Andrew Hopkins Christian Wolf	Invited talk: Australian survey data overview (radio+opt)
20:00	20:15	10:00	10:15	-	Break
20:15	21:15	10:15	11:15	Active Galactic Nucleus (AGN)	
				Neelesh Amrutha	Combining optical and X-ray data to disentangle accretion and obscuration phenomena in AGN
				Christopher Onken	Feeding X-ray Searches with the Brightest Optical Quasars
				Blessing Musiimenta	Incidence and energetics of AGN winds in the distant universe
				Christian Wolf	Temperature profiles of QSO accretion discs
21:15	21:30	11:15	11:30		Networking & new collaborations

Wednesday 27 March

Time - AEDT Start	Time - AEDT End	Time - CET Start	Time - CET End	Speaker/s	Talk titles
19:00	19:45	9:00	9:45	Tidal Disruption Events (TDEs)	
				Megha Sharma	Partial Tidal disruption events: elixir of life
				Adelle Goodwin	ATCA radio follow-up observations of eROSITA selected tidal disruption event candidates
				Iuliia Grotova	The eROSITA population of Tidal Disruption Events and other nuclear transients
19:45	20:00	9:45	10:00		Networking & new collaborations
20:00	20:15	10:00	10:15	-	Break
20:15	21:00	10:15	11:00	Large Scale Structures (LSS)	
				Ajay Dev	Stacking of optically selected eRASS1 groups and clusters
				Marcus Brüggen	New insights into the non-thermal Universe
				Jakob Dietl	Discovery of a >13 Mpc long X-ray filament using eROSITA data
21:00	21:30	11:00	11:30		Networking & new collaborations

Monday 25 March

Stars and Interstellar Medium (ISM) | 8:15-9:15pm AEDT | 10:15-11:15am CET

Updating the stellar X-ray - radio relation using ASKAP and eROSITA	
Author	Laura Driessen, University of Sydney
Collaborators	Tara Murphy (University of Sydney), George Heald (CSIRO), Andrew Zic (CSIRO), Emil Len (CSIRO), Joshua Pritchard (University of Sydney), Jan Robrade (Hamburger Sternwarte), Beate Stelzer (IAAT)
Abstract	We have used ASKAP and eROSITA to observe the largest sample of X-ray and radio detected stars to date. We can now use this sample of stars to explore the relation between stellar X-ray and radio emission: the Guedel-Benz relation. The correlation between X-ray and radio emission from stars reveals information about the coronae, magnetic fields and emission mechanisms of chromospherically active stars. Until recently, only a handful of stars have been used to explore this correlation. We will present over 500 stars detected by both ASKAP and eROSITA, and we will use these to demonstrate that the correlation between X-ray and radio emission is not as expected.

Hunting down new X-Ray Binaries in eROSITA DR1	
Author	Artur Avakyan, Institute for Astronomy and Astrophysics Tubingen
Collaborators	Aafia Zainab (FAU), Victor Doroshenko (IAAT), Joern Wilms (FAU), Andrea Santangelo (IAAT)
Abstract	Following the first eROSITA data release, we aim to reveal new X-ray Binary (XRB) candidates found in its data. The goal of this work is to wider the list of faint quiescent XRBs, as well as to provide a basis for subsequent follow-up observations using instruments such as XMM-Newton, NuSTAR, Chandra, etc. All sources classified as XRBs (among with other X-ray emitting class sources) were selected as such upon their multi-wavelength (MW) behaviour obtained through the identification of corresponding counterparts. Both counterpart identification and source nature classification were performed using random forest (RF) machine learning (ML) algorithms analysing MW data.

X-ray counterpart detection and γ-ray analysis of the supernova remnant G279.0+01.1 with eROSITA and Fermi-LAT	
Author	Miltiadis Michailidis, IAAT
Collaborators	Gerd Puehlhofer (IAAT), Andrea Santangelo (IAAT), Werner Becker (MPE), Manami Sasaki (FAU)
Abstract	Analyzing the diffuse X-ray excess near the Carina spiral arm by utilizing the first four eROSITA all-sky surveys, we report the detection of an X-ray counterpart of G279.0+01.1, a ~3 deg supernova remnant. A partially occluded appearance of the X-ray emission in the 0.3-1.1 keV energy band is observed, likely linked to dust clouds in the nearby regions. The remnant's radio angular size, as determined by PMN data, seems to extend even further compared to the latest estimate of ~ 2.3 deg matching its X-ray counterpart size. Fermi-LAT data covering 14.5 years confirms the presence of a GeV source spatially aligned with the remnant. Results of the GeV spectral analysis and updated skymaps are provided, favoring an association of the GeV source with the remnant. The SNR is usually assumed to be at a distance of 2.7 kpc, resulting in a physical size of 140 pc. An alternative scenario that places the remnant at a much closer distance of 0.4 kpc than what was previously reported in the literature and its implications on the remnant's properties is examined.

Hot interstellar medium in the Large Magellanic Cloud	
Author	Martin Mayer
Collaborators	Manami Sasaki (FAU)
Abstract	The Large Magellanic Cloud (LMC) is a relatively large and nearby satellite Galaxy of the Milky Way. Due to its orientation and low foreground absorption, the properties of its hot interstellar medium (ISM) can be ideally probed via its diffuse soft X-ray emission. Thanks to the location of the LMC, eROSITA provides a deep exposure of the whole LMC in X-rays. In this talk, we present the results of a morphological and spectral analysis campaign of ISM in the LMC, based on eRASS:4 X-ray data complemented with multiwavelength information. Based on our findings, we discuss the correspondence of X-ray absorption with the cold phase of the ISM, the distribution and temperature of hot ISM in comparison with stellar populations, and the presence of nonthermal X-ray emission from accelerated particles near star-forming regions.

Tuesday 26 March

Active Galactic Nucleus (AGN) | 8:15-9:15pm AEDT | 10:15-11:15am CET

Combining optical and X-ray data to disentangle accretion and obscuration phenomena in AGN	
Author	Neelesh Amrutha, The Australian National University
Collaborators	Christian Wolf (ANU) Christopher Onken (ANU) Potentially: Mara Salvato (MPE), Mirko Krumpe (AIP)
Abstract	Type-1 Seyfert AGN show a range of broad-to-narrow line ratios that have motivated subtype labels including 1.2, 1.5 and 1.8. While accreting black holes are expected to exhibit stochastic variability in optical emission, some broad emission line (BEL) AGN manifest extreme changes in the broad H-beta line either due to a change in accretion activity, or obscuration by a passing dust cloud. These phenomena cannot be disentangled in the optical alone. However, line-of-sight column densities (N_H) from X-ray observations have proven effective in measuring the level of obscuration in AGN. The Six-degree Field Galaxy Survey (6dFGS; 2001-2009) contain optical spectra for a complete sample of BELAGN in the Southern sky at z<0.1. Leveraging this dataset, we acquired a second epoch of optical spectra for this BELAGN sample over the past five years, coinciding with eROSITA scans of the sky. By combining N_H column densities with two epochs of broad H-beta measurements, our aim is to disentangle accretion-driven variations from obscuration phenomena in these variable AGN over a 15-20 year timescale.

Feeding X-ray Searches with the Brightest Optical Quasars	
Author	Christopher Onken, ANU
Collaborators	Christian Wolf (ANU)
Abstract	I will present the on-going progress of the All-Sky, Bright Complete Quasar Survey (AllBRICQS), which is obtaining spectroscopic confirmation of optically bright quasars overlooked by previous studies. With simple selection criteria from Gaia and WISE, we have identified over 200 quasars with Gaia Bp<16.5 or Rp<16.5mag, which span a redshift range from z=0.07 - 4. Representing the most luminous quasars at their epochs, these objects will be interesting targets for X-ray studies and the investigation of UV/X-ray correlations.

Incidence and energetics of AGN winds in the distant universe	
Author	Blessing Musiimenta, University of Bologna and INAF
Abstract	In the context of an evolutionary model, the outflow phase of an active galactic nucleus (AGN) occurs at the peak of its activity, once the central supermassive black hole (SMBH) is massive enough to generate sufficient power to counterbalance the potential well of the host galaxy. This outflow feedback phase plays a vital role in galaxy evolution. I will present results from my two recent studies. In the first study, we develop an approach to select powerful AGNs in the feedback phase using optical/IR colours, and optical and X-ray spectral properties from the eROSITA Final Equatorial-Depth Survey (eFEDS). We trace and characterise outflows using SDSS spectroscopy, and explore the link between AGN luminosity and outflow properties. We find that the X-ray selection (eROSITA) is a powerful tool to select AGN in the feedback phase and this X-ray active, obscured phase is the best tracer of fast winds. In the second study, we perform a spatially resolved analysis of a red, X-ray obscured and X-ray luminous quasar (“the Goldfish galaxy") at a redshift of z=0.6031. Our analysis reveals that the quasar resides in a complex interacting system, possibly merging with three other galaxies, and driving extended outflows of about 9.6 solar masses per year. The outflows in this quasar are AGN-driven rather than star formation driven and they are less significant from the energetic point of view.

Temperature profiles of QSO accretion discs	
Author	Christian Wolf, Australian National University
Abstract	Accretion discs are heating by viscosity and by irradiation. In X-ray binaries the geometry of the disc and radiative heating source is often such that the outer temperature profile of the disc is flatter than the inner part. In QSO discs the assumed geometry is predicted to cause a single temperature power law. This may not agree with some other observations. I'd like to propose a project that uses optical-IR spectra with SED breaks to correlate this with X-ray properties in a search for a possible broken temperature profile.

Wednesday 27 March

Tidal Disruption Events (TDEs) | 7:00-7:45pm AEDT | 9:00-9:45am CET

Partial Tidal disruption events: elixir of life	
Author	Megha Sharma, Monash University
Collaborators	Prof. Alexander Heger and Daniel Price
Abstract	It has been estimated that about 10^4 –10^5 stars have survived tidal disruption events (TDEs) in our Galactic Centre, resulting in partial tidal disruption events. These events occur when a supermassive black hole (SMBH) interacts tidally with a star, giving rise to surviving remnants. Employing the 1D stellar evolution code Kepler and the 3D smoothed particle hydrodynamics code Phantom, we investigate the tidal disruption of 1, 3, and 10 M⊙ models at zero-age (ZAMS), middle-age (MAMS) and terminal-age main- sequence (TAMS). We mapped the remnants formed into Kepler to understand post- disruption evolution. Our findings reveal distinct characteristics in the remnants, including increased radius, higher rigid rotation in the central region, and differential rotation in the outer layers. The remnants undergo composition mixing which affects their stellar evolution. Remnants formed from disruption of ZAMS models evolve similarly to Kepler models of the same mass. But for remnants of MAMS and TAMS models, the remnants have higher effective luminosity and temperature. We discuss potential observational signatures, particularly focusing on nitrogen and carbon abundances post Kelvin-Helmholtz time, providing insights into the unique evolutionary paths of remnants from various stellar models.

ATCA radio follow-up observations of eROSITA selected tidal disruption event candidates	
Author	Adelle Goodwin, ICRAR-Curtin University
Collaborators	Gemma Anderson (ICRAR-Curtin) James Miller-Jones (ICRAR-Curtin) Are Rau (MPE) Iuliia Grotova (MPE) Zhu Liu (MPE)
Abstract	When a star passes too close to a supermassive black hole (SMBH) it can be destroyed, temporarily increasing the accretion rate onto the SMBH. Such tidal disruption events (TDEs) produce bright flares across the electromagnetic spectrum that provide a unique window into the central region of a galaxy, including the previously dormant black hole. The eROSITA all-sky surveys have allowed the search for and identification of many TDE candidates. In this talk I will present an overview of the radio follow-up campaign we have been conducting of eROSITA-discovered TDE candidates, to understand the prevalence of radio emission from bright X-ray TDEs. Radio observations of TDEs are essential for probing synchrotron emission from electrons that are accelerated in the shocks formed from outflows. However, <30 TDEs have

	published radio detections so the origin of these outflows is still under debate, with scenarios including accretion disk winds, weak radio jets launched by accretion onto the SMBH, or collisions between debris streams. Some events even displayed an unexplained late-time radio flare or rebrightening years after the disruption. Here I will discuss our radio follow-up strategy for eROSITA TDEs with the Australian Compact Array Telescope (ATCA), and will focus on the early results from our systematic follow-up of the eROSITA TDE "golden sample" to determine the prevalence of radio emission from X-ray bright TDEs.

The eROSITA population of Tidal Disruption Events and other nuclear transients	
Author	Iuliia Grotova, Max Planck Institute for Extraterrestrial Physics
Collaborators	Arne Rau, Zhu Liu, Pietro Baldini, Andrea Merloni (all MPE) and Adelle Goodwin, Gemma Anderson, James Miller-Jones (Curtin University)
Abstract	The SRG/eROSITA all-sky survey offers a unique insight into the transient and variable X-ray sky. While previous studies showed the dominance of regular AGN variability, a small fraction of sources expected in such a survey arise from more exotic phenomena such as tidal disruption events (TDEs), quasi-periodic eruptions or other short-lived events associated with supermassive black hole accretion. Using data obtained during the first two all-sky surveys, we have compiled the largest systematically-selected sample of extragalactic X-ray transients without prior signs of AGN activity (eRO-ExTra). Benefiting from the unprecedented sensitivity of eROSITA, we have characterized the diversity of the population of nuclear transients and have identified a sample of TDE candidates. In this talk, I will present the selection of eRO-ExTra, review its key properties, and discuss how canonical stellar TDE candidates are identified against a background of non-TDE induced transients. This subsample of eROSITA-selected TDE candidates provides insights into otherwise quiescent massive black holes, letting us explore the formation of accretion disks, and probe different regimes of accretion, as well as the production of outflows, which can be observed as late-time radio flares.

Large Scale Structures (LSS) | 8:15-9:00pm AEDT | 10:15-11:00am CET

Stacking of optically selected eRASS1 groups and clusters	
Author	Ajay Dev, ICRAR - UWA
Collaborators	Simon Driver (UWA), Paola Popesso (ESO)
Abstract	The eRASS1 has unveiled an unprecedented X-ray dataset ever produced alongside the release of the largest catalogue of X-ray detected groups and clusters, reaching down to Milky-way sized halos. However, the number of X-ray detected halos are far less compared to the optically identified halos from spectroscopic surveys such as GAMA or SDSS except at the high halo mass end. The detections would naturally be biased towards more X-ray luminous sources at any halo mass. Hence, for an unbiased study of the X-ray properties of halos it would be useful to select halos based on optical detection. However, this would only be possible by using techniques such as stacking of the X-ray undetected halos. In our study, we employ stacking analysis of eRASS1 optically selected halos to study the luminosity and gas mass relations as a function of halo mass. In this presentation, I will show the first stacking results of our optically selected halos from eRASS1.

New insights into the non-thermal Universe	
Author	Marcus Brüggen, Uni Hamburg
Abstract	What is the origin of magnetism on large cosmic scales? How are cosmic rays accelerated and how do they move through the cosmos? What are their effects on galaxy clusters and other structures? These are the questions we explore in this talk. Recent advances in radio observations have shed new light on the cosmic ray and magnetic field distributions in the Universe, from the circumgalactic medium all the way to cluster of galaxies and cosmic voids. Cosmic rays play a crucial role in driving galactic winds, which, in turn, play a key role in the evolution of baryons. Radio observations provide unique insights into the transport mechanism of cosmic rays. Radio observations have also revealed magnetic fields in cosmic filaments of galaxies and bridges between galaxy clusters. In combination with cosmological simulations, we can derive constraints on the origin of cosmic magnetism. Low-frequency radio observations have shown that clusters of galaxies can host huge reservoirs of cosmic rays, in a phenomenon that we have called megahalos.

Discovery of a >13 Mpc long X-ray filament using eROSITA data	
Author	Jakob Dietl, Argelander Institute for Astronomy, Bonn
Abstract	A significant fraction of the missing baryons in the local Universe is expected to reside in large-scale filaments. These filaments of warm-hot intergalactic medium (WHIM) may be observable in soft X-ray emission. Until now, however, very few candidate emission filaments have been found in individual systems, and none beyond three times the virial radius of the clusters at the nodes of those filaments. I will report on the discovery of such an X-ray filament between the two nearby galaxy clusters Abell 3667 and Abell 3651 that are separated by a projected transverse distance of ∼13 Mpc, using data from the SRG/eROSITA All-Sky Survey. With the superior response to extended soft X-rays in terms of effective area and field-of-view, we carried out thorough surface brightness analysis between the clusters and in their outskirts studying enhanced emission in different directions. The X-ray emission in the direction of the filament shows a (30 ± 3)% enhancement with a significance of 11σ.