# The First Vasto Accretion Meeting

Palazzo D'Avalos, Vasto

19 – 23 June 2023

VAM 2023

## Book of Abstracts

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# Abstracts

## New Insights Into Classical Novae

WEDNESDAY
21 JUNE
09:00am

Elias Aydi

Michigan State University

Novae are panchromatic transients triggered by a thermonuclear runaway on the surface of white dwarfs in interacting binaries. Our understanding of how novae are powered has been altered with Fermi-LAT establishing novae as GeV gamma-ray sources and has underscored the role of strong shocks in powering novae. In this talk I will highlight the ongoing multi-wavelength efforts aimed at improving our understanding of shocks in novae. These efforts will help us probe critical but poorly understood processes, such as common envelope interaction, super-Eddington luminosities, particle acceleration efficiency, and dust formation around explosive transients, and will be essential for a better understanding of other shock-powered transient such as Type Ia-CSM SNe, stellar mergers, and TDEs.

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## MHD Simulations of Accretion Disks and Variability in Compact Binaries

MONDAY
19 JUNE
09:20am

Omer Blaes

University of California, Santa Barbara

Magnetic fields have dominated theoretical studies of angular momentum transport in accretion disks for some decades now, but much remains to be understood about how they might help explain the observed phenomenology of many systems, including accreting compact binaries. I will discuss how magnetic fields might affect our understanding of observed variability, and how they might be constrained by that variability, focusing in particular on ionization-driven outbursts, superhumps, and rms-flux relations.

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WEDNESDAY
21 JUNE
16:15pm

## Mapping accretion disks in stellar-mass black holes

Barbara De Marco
Universitat Politecnica de Catalunya

The study of the accreting gas in the vicinity of black holes (BH) is key to probe how these powerful engines work. Stellar-mass BHs in X-ray binary systems (BH XRB) are interesting laboratories to study the complexity of the accretion phenomenon. These sources show evidences for drastic changes in the physical properties of the innermost accretion flow during the relatively short time scales characterizing an outburst of activity. Such changes manifest as quick variations of the global X-ray spectral and timing properties of the source. In this talk I will review how combining the X-ray spectral and timing information has been allowing us to map out the accretion disk in stellar-mass BHs.

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THURSDAY
22 JUNE
09:00am

## Wind accretion, disk formation and coronal heating in BH-hosting X-ray binaries

Ileyk El Mellah
CIRAS - USACH

Accreting black holes (BHs) in X-ray binaries display characteristic photo-spectral behaviors which betray their own properties but also the nature of their immediate environment. From the orbital scale to the event horizon, the accreted material probes a wide variety of radiative, gravitational and magnetic conditions. Multi-scale / multi-physics numerical simulations provide a convenient framework to follow the plasma on its journey to the BH.
In low-mass X-ray binaries, mass is steadily supplied by Roche lobe overfilling of the stellar companion but in other systems, mass transfer is mediated by an inhomogeneous stellar wind. I will stress on the conditions suitable for a transient accretion disk to form through the capture of the stellar wind, and show that they are much less restrictive for BHs than for neutron stars.
In the collisionless and highly magnetized plasma surrounding the BH within a few 10 gravitational radii, the magnetic field lines advected inward by the accretion disk funnel a jet. In the jet sheath, particles are accelerated up to relativistic speed at magnetic reconnection sites where they upscatter soft X-rays from the disk via inverse Compton. Recent 3D global particle-in-cell simulations illustrate how this coronal heating mechanism yields an illuminating source of hard X-rays whose geometry, luminosity and spectrum essentially depend on the BH spin. I will discuss the implications for X-ray reverberation mapping. Last, I will show how angular momentum can be transferred from the BH to the disk thanks to coupling magnetic field lines, with possible consequences for disk wind launching and transition between different accretion regimes.

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## Outbursts and thermonuclear eruptions in interacting white dwarf binaries

THURSDAY
22 JUNE
11:05am

Lilia Ferrario
Mathematical Sciences Institute, ANU

In this talk I will present a summary on the state of research on compact magnetic and non magnetic white dwarf binaries. In particular, I will present current and new results on the interaction of a massive white dwarf with its companion leading to thermonuclear eruptions, explosions, and possible merging events.

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## Constraining the evolution of cataclysmic variables via the masses and accretion rates of their underlying white dwarfs

FRIDAY
23 JUNE
11:15am

Anna Francesca Pala
European Space Agency (ESA)

Cataclysmic variables (CVs) are ideal laboratories in which to test our understanding of the evolution of all types of compact binaries, as they are numerous, nearby and relatively bright. In this talk, I will discuss how the synergy between the Hubble Space Telescope and the ESA Gaia space mission allowed us to derive masses, temperatures and accretion rates for a large sample of CV white dwarfs. Thanks to these results, we have revealed the presence of an anti-correlation between the average accretion rates and the white dwarf masses, which suggests the presence of an additional mechanism of angular momentum loss not accounted for by most evolutionary models. These results provide new stringent constraints on the models describing the evolution of these binaries and I will present them in comparison with the currently available theoretical framework.

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## High Mass X-ray binaries as chance to accretion and stellar wind studies

TUESDAY
20 JUNE
14:30pm

Victoria Grinberg
ESA

Bright and variable, high mass X-ray binaries are ideal sources to understand wind accretion in general and accretion processes onto black holes and onto often highly magnetized neutron stars in particular. Yet, they are also complex objects, where the material from the massive companion star strongly shapes the observed emission, introducing additional complications in both spectral and timing domain. Observationally, disentangling the larger scale environment from the accretion processes is often highly challenging.
Focussing on the case of Supergiant high mass X-ray binaries, i.e. high mass X-ray binaries with an O/B supergiant companion, I will re-frame the problem and argue that recent developments in the field have shown that the complexity of this sources is not a problem but instead a unique chance. It allows us to study not

only the accretion processes and their feedback on the immediate stellar environment. Often, we are able to probe a range of luminosities in the same source and to derive fundamental knowledge about the outflows of the stellar companion. Today's studies are limited to mainly the brightest objects, but future missions, such as XRISM and Athena, with their high sensitivity, will allow us to expand today's detailed, time-resolved analyses to shorter timescales and fainter sources, allowing population studies and better comparisons to simulations

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TUESDAY
20 JUNE
09:00am

## The internal shock model for compact jets in X-ray binaries

Julien Malzac

IRAP (CNRS/Universite de Toulouse/ CNES)

Internal shocks driven by fluctuations of the jet velocity could constitute the main dissipation mechanism powering the emission of compacts jets. This scenario appears to account for the observed radio to IR emissions of several X-ray binaries both in terms of spectral energy distribution and and multi-wavelength variability. I will review the modelling efforts pursued over a decade and the observational evidence obtained so far.

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THURSDAY
22 JUNE
09:25am

## Ultraluminous X-ray sources - our window onto Super-Eddington accretion

Matthew Middleton

University of Southampton

Ultraluminous X-ray sources (ULXs) provide the most readily accessible view of super-Eddington accretion in the local universe. Given that many of the observable ULXs must contain neutron stars, it is vital to try and understand the impact of surface effects and strong magnetic fields which can complicate our attempts to extract physics from the phenomenology. In this talk I will review some of the key evidence extracted from observations of ULXs and the prospects of making progress.

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## Accretion disc winds from low-mass X-ray binaries

MONDAY
19 JUNE
16:25pm

Teo Munoz-Darias
Instituto de Astrofísica de Canarias

In the last decades, observations of the X-ray and radio continuum have been used to investigate in great detail the coupling between accretion and ejection processes in accreting black holes and neutron stars. However, we have only recently started to systematically study the evolution of their X-ray, optical, and infrared spectral lines. I will review the state-of-the-art of the field, to then focus on the dramatic changes that we are observing in the optical and infrared spectra of X-ray binaries by using dedicated programs in some of the largest telescopes. I will show how this variability in the spectral lines can be in most cases associated with the presence of massive outflows. This can be inferred from the detection of wind-related observational signatures, such as P-Cyg line profiles. I will discuss the impact of these winds on the accretion process and their apparently close relation with the hotter outflows observed in X-rays.

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## Bridging accretion and rotation-powered neutron stars, the case of transitional millisecond pulsars

THURSDAY
22 JUNE
14:35pm

Alessandro Papitto
INAF - OAR

Millisecond pulsars in binary systems play a substantial role in the astrophysics of neutron stars. We usually observe them as either radio/gamma-ray pulsars powered by the rotation of their magnetic field or as X-ray pulsars that accrete mass transferred by the companion star. According to a long-standing paradigm, these two mechanisms are mutually exclusive. However, in transitional millisecond pulsars, variations of the mass accretion rate produce swings between a radio pulsar regime and an X-ray pulsar state. These systems showcase the different possible outcomes of the interaction between a quickly spinning magnetized NS and the accretion disk matter as they unfold over timescales accessible to human life. I will review the rich and complex phenomenology unveiled by a decade of observations of transitional millisecond pulsars. In particular, I will focus on the peculiar state achieved when the accretion luminosity is comparable to the pulsar spin-down power. In this context, the recent discovery of optical and UV pulsations from a transitional (and later from an accreting) millisecond pulsar suggests that magnetospheric particle acceleration can proceed even when an accretion disk surrounds a pulsar. The dichotomy between radio and X-ray millisecond pulsars might be less pronounced than commonly assumed, with accretion and rotation-powered processes coexisting under certain circumstances.

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MONDAY
19 JUNE
14:30pm

## Accreting Neutron Stars Via Relativistic MHD Simulations

Kyle Parfrey

Trinity College Dublin

Accretion onto magnetised neutron stars is responsible for several distinct families of high-energy sources, whose rich phenomenology has the potential to unlock some of the secrets of accretion in binary systems. The star's own magnetic field increases the complexity of the problem over the better-understood case of accretion onto a black hole. I will describe a series of 3D GRMHD simulations that begin to explore the available combinations of stellar field orientation and mass accretion rate, focusing on the implications for relativistic jets powered by the star's rotation. I will also show some results of axisymmetric radiation-GRMHD simulations appropriate for a pulsar-ULX system, in which super-Eddington luminosity and a high beaming factor were obtained.

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FRIDAY
23 JUNE
10:15am

## eROSITA results on accreting compact binaries

Axel Schwope

AIP

eROSITA on the SRG mission (Spektrum-Roentgen-Gamma) has performed 4 complete X-ray all-sky surveys with an imaging telescope array in the energy range 0.2-10 keV. It has a much improved spatial and spectral resolution compared to ROSAT, a significantly extended energy range, and the surveys have a longer exposure per sky pixel. Repeated all-sky survey observations uncover strongly variable sources. The sensitivity between 0.3 and 2.3 keV is similar to that of XMM-Newton. All these properties make eROSITA the ideal discovery machine of accreting compact binaries (ACBs), in particular with white dwarf primaries. The talk will review the mission profile, discoveries made serendipitously during the first two years and describe the initiatives underway to comprehensively explore the full content of the eROSITA all-sky survey catalogs.

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## Basic parameters of white dwarfs in intermediate polars in Gaia era

THURSDAY
22 JUNE
11:30am

Valeri Suleimanov

University of Tuebingen

Hard X-ray spectra of magnetic cataclysmic variables allow to determine the masses of white dwarfs (Was) in these systems on the base of spectral modeling. Numerous hard X-ray observations of intermediate polars carried out during the last decade by NuSTAR and Swift/BAT observatories gave us possibility to determine the WD masses in several dozen objects. The resulting average WD mass in these system is 0.8/pm0.2 solar masses. The distances to almost all systems are known from Gaia measurements. Therefore, the luminosities and corresponding mass accretion rates were also estimated. The mass accretion rates of the most systems are in the range 1e-8 - 1e-9 solar masses per year. The magnetic field strengths on the WD surface can be evaluated using assumption that t he magnetospheric radii are equal to corotational radii in these systems. The estimated mean value of the magnetic field strength is log B =6.6$\hat{\{}$+0.4}_{-0.4} in MG in the considered sample.

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## Absorption variability of Vela X-1: long-term monitoring study in the 2–10 keV energy band

TUESDAY
20 JUNE
16:55pm

Luis Abalo

Leiden University; cosine measurement systems

Vela X-1 is important for the understanding of the accretion processes in high-mass X-ray binaries on account of its natural variability and inhomogeneous wind, being easily observable due to the close distance and high inclination of the system. The softer energy bands are much more susceptible to photoabsorption thanks to the rapidly declining cross-section of photoabsorption with increasing energy as sigma E$\hat{-}$3. In this project, we conduct a systematic long-term X-ray monitoring study of the source in the 2 to 10 keV energy bands with the Monitor of All-sky X-ray Image mission, which offers a unique avenue to explore the significant fluctuations of absorption over the orbit. To do this, we use the hardness ratios as an indicator of variability in absorption and look at individual binary orbits in contrast to the average trends of the more than thirteen years of observations. Our output is consistent with previous works that explain this variability with a model of an inhomogeneous environment, where the overdensities arise from the line-driven instability triggered in the stellar wind near the photosphere. Furthermore, we look at individual binary orbits of the time intervals of spin-up and spin-down episodes aiming to find recurring evolutions. These results provide us insights into the accretion and wind physical properties of Vela X-1 in particular, but they also shed light on the properties of other similar sources.

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WEDNESDAY
21 JUNE
17:25pm

## Optical precursors to X-ray outbursts in XRBs with XB-NEWS

Kevin Alabarta
New York University Abu Dhabi (NYUAD)

X-ray binary (XRB) outbursts are often first detected by X-ray all-sky monitors like MAXI or Swift/BAT. Only after the detection of new outbursts by these instruments, observations with more sensitive multi-wavelength telescopes are triggered. This causes a gap in the coverage during the rising parts of the outbursts, limiting our knowledge of their early stages. In order to increase our knowledge of the accretion process in XRBs, it is beneficial to combine X-ray observations with optical monitoring. The disc-instability model (DIM) establishes that XRBs show an earlier optical brightening than X-rays at the beginning of outbursts. In this talk, we show that, with our regular monitoring of
50 XRBs with the Faulkes Telescopes/Las Cumbres Observatory (LCO), we are detecting the prior brightening of XRBs at optical wavelengths. Furthermore, we show that the optical rise of the outbursts of several XRBs is blue (shorter wavelengths rise before longer wavelengths). Finally, we present our real-time data analysis pipeline, the "X-ray Binary New Early Warning System (XB-NEWS)" which aims to detect and announce new XRB outbursts within days of their first optical detection. This allows us to trigger multi-wavelength campaigns during the very early stages of outbursts, allowing us to shed light on the physical mechanisms that trigger outbursts.

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THURSDAY
22 JUNE
09:50am

## The ultraluminous X-ray source M81 X-6: a weakly magnetised neutron star with a precessing accretion disc?

Roberta Amato
IRAP/CNRS Toulouse

Ultraluminous X-ray sources (ULXs) are X-ray binaries accreting at super-Eddington regimes. As such, they display traits that are both peculiar and common to all accreting compact binaries (disc-fed accretion, disc winds, spectral state transitions, etc). To understand how the physical characteristics of binary systems are altered at super-Eddington accretion rates it is crucial to study the spectral and temporal evolution of these sources. However, an important point is whether and how the nature of the compact object influences the properties of ULXs. To tackle this question, we conduct a comprehensive spectral and temporal study of the ULX M81 X-6, using all available archival X-ray data of the last decade. We identified two main spectral regimes, coincident with the high and low source's luminosity states along its superorbital period. The corresponding spectral transitions cannot be explained by changes in the mass accretion rates or a propeller scenario, but they can be attributed to a precession of the accretion disc. By applying a Lense-Thirring precession model, we were able to assess the nature of the source: a neutron star with a low magnetic field (B $\lesssim$ 1e10 G), for which we predict a spin period of a few seconds. The lack of detection of pulsations from the source can be ascribed to the magnetic, spin, and orbital axes' mutual misalignment, with the pulsation being diluted by the wind funnel. This methodology can be applied to all ULXs, helping investigate the nature of their compact objects.

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## Pulse profile diagnostics in Neutron Stars High Mass X-ray Binaries

TUESDAY
20 JUNE
16:40pm

Elena Ambrosi
INAF-IASF /PA

I will present the first outcomes of a project which aims at characterizing the energy-dependent emission of magnetized X-ray binaries folded at their spin frequency, the so-called pulse profiles. We collected all the observations performed on this class of sources with the NuSTAR satellite, apply a consistent reduction pipeline and investigate common patterns in the energy-resolved pulsed profiles. At first, we focused on the pulsed fraction and find that there are clear drops of this quantity in correspondence of line-like features in the energy spectrum, namely iron fluorescence lines and cyclotron resonance scattering features. We also find a general increasing trend of the pulsed fraction with energy and a change of slope around 10-20 keV. We discuss the implication of our results in relation to the spectral models and radiation beam patterns. In particular, we show how timing signatures can be used as a complementary diagnostic tools.

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## Swift J1357.2-0933: the high inclination black hole X-ray transient

FRIDAY
23 JUNE
15:15pm

Alessio Anitra
Università degli studi di Palermo

Swift J1357.2-0933 is a transient low-mass x-ray binary hosting a stellar black hole with an estimated mass greater than 9.3 $M_\odot$. The source exhibited dips in the optical light curve, with periodic features during the outburst, that led to allocate the system among the high inclination sources ( extgreater 70°). Despite the number of studies carried out on this source, some questions about the inclination angle and the lack of total eclipses in such a suspected high inclination system, still remain. We analysed eight observations collected by the Gran Telescopio CANARIAS (GTC) during the quiescence phase, focusing on the H$\beta$ emission line, with the aim of deriving the orbital parameters of the system and providing a possible model for the source geometry. We derived the orbital period, the systemic velocity and the compact object radial velocity using the diagnostic diagram and we employed for the first time a new method to obtain an estimate of the inclination angle, which includes the use of the diskline model. The application of both methods allowed us to obtain a wider description of the system. In our proposed scenario the H$\beta$ emission line is emitted by an outer ring in the disc, between 9000 Rg and 63000 Rg, moreover, our results point to an inclination angle of the system of about 83 degrees, supporting thus the high inclination hypothesis. In conclusion, we discussed our results and proposed an explanation for the lack of eclipses in this highinclination source.

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FRIDAY
23 JUNE
15:00pm

## UltraCompCAT: a Catalogue of Ultra-Compact and Short Orbital Period X-ray Binaries

Montserrat Armas Padilla

Instituto de Astrofísica de Canarias

The ultra-compact family of low-mass X-ray binaries (LMXBs) consists of those systems with orbital periods shorter than 80 minutes. Such short periods imply small Roche lobes, into which only degenerate (hydrogen-poor) donor stars can fit. They are unique laboratories for studying accretion processes in hydrogen deficient environments, in addition to some fundamental stages of binary evolution. They will also be primary sources for low-frequency gravitational wave studies with the upcoming LISA mission.
I will present UltraCompCAT, a new catalogue of ultra-compact and short orbital period X-ray binaries, in which we have compiled all the available multi-wavelength information for the current population of these objects. This allows us to study, for the first time, this tantalising family of X-ray binaries as a whole. I will review the state-of-the-art in the field, and then discuss some of the global and most fundamental properties of this family, such as their nature (e.g. the evolutionary state of their donor stars) and galactic distribution.

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TUESDAY
20 JUNE
11:45am

## Multi-wavelength study of outbursting cataclysmic variable star CRTS J033349.8-282244 in the LADUMA field using MeerKAT and MeerLICHT.

Sumari Barocci-Faul

University of Cape Town/South African Astronomical Observatory

I will report on the optical-radio study of outbursting cataclysmic variable star CRTS J033349.8-282244 in the LADUMA field. The source has extensively been observed with multiple facilities. I will present the results from observations of CRTS J033349.8-282244 done with MeerLICHT, MeerKAT and SAAO telescopes throughout outbursts, super-outbursts and during quiescence. The LADUMA field is frequently observed by the MeerKAT radio array as well as MeerLICHT, which observes the field in multiple filters. This resulted in a unique dataset to study the colour evolution of CRTS J033349.8-282244 as a function of outburst phase across its many dwarf nova outbursts.

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## Using X-ray variability to estimate the nature of the compact objects powering ULXs

FRIDAY
23 JUNE
15:30pm

Francesco Barra

Università degli Studi di Palermo

It is not very clear if the spectral transitions in the Ultra-luminous X-ray sources (ULXs) are due to stochastic variability in the wind or orbital modulation in the accretion rate or in the source geometry. In this talk I will compare the results obtained on two different variable ULXs: NGC 55 ULX-1 and HOLMBERG II X-1. The XMM-Newton satellite collected data that were modelled with a double thermal component, adding a power-law component especially for the latter source that presents an harder spectrum. The Luminosity-Temperature relation for both thermal components broadly agrees with the results expected from theoretical models of thin discs. However, at higher luminosities significant deviations are present. If such deviations are due to the accretion rate exceeding the Eddington limit or the supercritical rate, a stellar-mass black hole is forecasted in both accreting sources.

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## Disc Wars: The Thin disc strikes back

MONDAY
19 JUNE
11:30am

Deepika Bollimpalli

Max Planck Institute for Astrophysics

Many accreting black holes and neutron stars exhibit rapid variability in their X-ray light curves, termed quasi-periodic oscillations (QPOs); The commonly observed type is the low-frequency ( extless 10 Hz), type-C QPOs, thought to originate from the Lense-Thirring precession of a hot, geometrically thick accretion flow misaligned with the black hole spin axis. Numerous simulations in the past have demonstrated that such misaligned accretion flows precesses at frequencies matching the observations. However, none of these simulations involves more realistic geometries like a truncated disc (a geometrically thin disc surrounding an inner hot accretion flow), leaving an open question: What is the effect of the outer, thin disc on the precession of the inner, hot accretion flow? To address this, we perform GRMHD simulations of a truncated disc with the inner, hot flow misaligned with the spin axis of the black hole. The key finding of our simulations is that the presence of an outer-thin disc decreases the precession rate of the inner torus by nearly 95 per cent due to the exchange of the angular momentum between the inner and outer discs, thus relieving some of the remaining tensions between the Lense-Thirring precession model and observations. The misalignment also excites variability in the inner, hot flow at higher frequencies, which is otherwise absent in the aligned discs.

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THURSDAY
22 JUNE
15:15pm

## A Mutiwavelengh campaign on AR Scorpii

David Buckley
South African Astronomical Obsrvatory

I present preliminary results of a multi-wavelength (radio, optical, X-ray) campaign on the enigmatic detached system, AR Scorpii, a white dwarf ”pulsar”. The observations, obtained over 3 nights in June 2020, involved optical observations (time resolved spectroscopy and photometry) from SALT, Keck and the SAAO 1-m telescope. In addition, X-ray observations were obtained during this period with NICER and L-band radio observations with the MeerKAT radio telescope array. These contemporaneous (and some simultaneous) observations are used to investigate the wavelength dependence of the periodic modulations seen in AR Sco across the E-M spectrum.

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MONDAY
19 JUNE
15:40pm

## Simultaneous panchromatic observations of the low mass X-ray binary (LMXB) Swift J1858.

Noel Castro Segura
University of Southampton

I will present the results of a unique multi-wavelength campaign focused on the long-lived outburst of the neutron-star low mass X-ray binary Swift J1858.6-0814. This system displayed extreme variability in both X-ray and optical bands, similar to the famous black hole binary V404 Cyg during its 2015 outburst. Our observations covered the full frequency range from X-ray to radio and were provided by observatories including HST, NuSTAR, NICER, VLTs, Gemini, GTC, VLA, and MeerKAT. A key feature of the campaign is a 4-hour window during which we obtained time-resolved, strictly simultaneous observations across the whole electromagnetic spectrum during its bright hard state. Our simultaneous spectroscopy covering from the far-UV to the near-IR reveals for the first time the presence of multi-phase outflows. By applying a spectral decomposition technique to study the variability of the observed spectrum, we find that the outflow is not connected to the luminous flares. This type of persistent mass loss is consistent with recent simulations, and suggests the presence of steady disk winds, similar to those invoked to account for the high angular momentum losses inferred from light curve modelling of these transients. The modelling of the observed spectral energy distribution allowed us to infer the mass accretion rate and line-of-sight extinction among other disk parameters. We compare these results with the multi-wavelength observations (including HST) carried out during its soft state and quiescent. Finally, we will use the far-UV spectroscopy to discuss the chemical abundances of the donor star and the system’ secular evolution.

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## Bursts, Magnetic Fields and Burst Oscillations

WEDNESDAY
21 JUNE
09:25am

Yuri Cavecchi
Universitat Politècnica De Catalunya

Type I bursts are thermonuclear explosions that consume the accreted material on the surface of neutron stars in low mass X-ray binaries. The flame propagation is regulated by various properties of the star such as its spin and its magnetic field.
Associated with the X-ray flashes are the burst oscillations: fluctuations in the lightcurves that are thought to be produced when the surface emission is not homogeneous. One key aspect of the burst oscillations is that, if we are able to model them, we could extract information of the underlying star such as mass and radius and use these to put constraints on the equation of state of its core.
In this talk I will discuss what we know about the propagation of the flame during the Type I bursts and how this can be related to the phenomenology of the burst oscillations. In particular, I will present recent results about the X-ray pulsar XTE J1814-338 which may provide a crucial clue to what causes burst oscillations in sources where a dynamically important magnetic field is present.

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## Observing the 3D geometry of nova shells with MUSE

WEDNESDAY
21 JUNE
15:00pm

Lientur Celedon
Universidad de Valparaíso

The geometry and kinematics of nova shells can be used to constrain the physical processes that shape their morphology, which is essential to understand how the ejection mechanism operates during nova eruptions. We used integral field spectroscopy as a way to study the morphology and kinematics of nova shells given the possibility to construct a 3D frame of the shell from the datacube solely. We employed the MUSE instrument at ESO-Paranal to observe several nova shells. We selected our sample based on surveys carried out at the end of the past century, to additionally study how these shells have evolved during the last 25 years. We find that the overall geometries of the shells are preserved while expanding. Our data suggest the deceleration of the oldest shells may have already started. By assuming that the material of the shell is expanding radially we have created a 3D frame for each nova shell, which reveals complex and unnoticed structures in all of them. Rings, filaments, fragmented and cocoon shells are observed. By contrasting their geometry with the predictions of hydrodynamic simulations we can have insights on the physics behind the nova event experienced by the system. Up to date very few nova shells have been studied through IFS observations. This work effectively doubles the number of observed shells, and we plan to continue to increase the number of observed shells in the near future.

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FRIDAY
23 JUNE
12:10pm

## New evidence for a black hole in the X-ray binary system Swift J1910.2-0546

Jesus Corral Santana

ESO

Swift J1910.2-0546 is a transient X-ray binary discovered in 2012 when the system was detected in outburst. During that state, it showed the typical behaviour found in black holes, although the nature of the compact object has not been established since.
In this contribution we show a comprehensive study of Swift J1910-2-0546 using optical photometry and spectroscopy obtained in outburst (with the INT and NOT) and quiescence (with WHT, GTC and VLT), obtaining that the donor star is G2V. We also establish constraints to the orbital period ( extless8.7 h) and distance ( extgreater 4.6 kpc) which, together with the lack of double peak lines (suggesting an inclination extless 35 deg) and the radial velocity estimates obtained from the Halpha line in quiescence, support the presence of a black hole in the system.

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THURSDAY
22 JUNE
15:00pm

## Matter ejections behind the highs and lows of a transitional millisecond pulsar

Francesco Coti Zelati

Institute of Space Sciences (ICE,CSIC)

The discovery of three millisecond pulsars in binary systems that swing between an accretion-powered state and a rotation-powered state has posed a challenge to current theories on the evolution of neutron stars in low-mass X-ray binaries. These sources, known as transitional millisecond pulsars (tMSPs), represent a unique laboratory to gain insight into the mechanisms of mass accretion and ejection in X-ray binaries harboring rapidly rotating neutron stars.
I will describe the results of the most extensive multiwavelength observational campaign ever carried out on the prototype of the class of tMSPs, PSR J1023+0038. The campaign aimed to find an explanation once and for all for the peculiar variability pattern shown by the source during its current sub-luminous X-ray accretion disc state. The results of the data analysis indicate that this phenomenology is ultimately due to the interaction between the pulsar wind and the innermost region of the accretion disc. This interaction causes the emission of discrete mass ejecta on top of that of a compact jet when the source switches from the high-intensity mode to the low-intensity mode. A subsequent re-enshrouding of the pulsar accounts for the switch in the opposite direction.

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## Optical accretion disc winds in Accreting White Dwarfs

MONDAY
19 JUNE
17:20pm

Virginia Cuneo
Instituto de Astrofísica de Canarias

Accreting white dwarfs have long been known to exhibit ultraviolet spectral features associated with winds. At optical wavelengths, however, wind detections have only been reported for a few sources. In the latest years, optical accretion disc winds were also detected in other accreting systems, such as X-ray binaries. However, despite the increasing number of X-ray binaries showing wind features, some aspects, such as the wind origin or the triggering mechanism, still remain unknown. Given the significantly bigger population of accreting white dwarfs, these systems represent a unique opportunity to study the optical outflows systematically and to test their possible relation with those of X-ray binaries. As part of an observational campaign that already provided spectra of
100 accreting white dwarfs, I present in this talk the results from the analysis of the 4 sources with the most conspicuos wind features from our sample: BZ Cam, V751 Cyg, MV Lyr, and V425 Cas.

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## Simulating accreting neutron stars

THURSDAY
22 JUNE
16:45pm

Pushpita Das
Anton Pannekoek Institute, University of Amsterdam

Numerical modelling of accreting millisecond X-ray pulsars (AMXPs) allows us to understand the physical origin of different observational signatures detected from these systems. Since the birth sites of these signals are strongly affected by the gravitational potential of the star, magnetohydrodynamic (MHD) simulations in full GR (GRMHD) are essential to accurately capture space-time curvature effects and inherent variations in the X-ray spectra. Due to extremely small rotational periods, the surface X-ray emission from AMXPs presents a unique channel to constrain the dense matter equation of state via pulse-profile modelling. In this talk, I will present results from 3D GRMHD simulations of accreting neutron stars with oblique magnetospheres. I will be discussing the pulse profiles generated from the GRMHD simulations and their impact on M-R inference for the accreting sources. Apart from the surface features, AMXPs are also good candidates to study neutron star jet formation. Though there have been extensive investigations into black hole jet formation, neutron star jets remain highly unexplored. Our 2D axisymmetric study in the quiescent regime suggests that the thick disk collimates the initial open stellar flux, leading to jets like the Blandford-Znajek mechanism proposed for black holes. However, much remains to be done before we can draw a complete picture of jets launched from neutron stars. 3D GRMHD simulations of accreting neutron stars allow us to explore neutron star jet formation mechanisms in detail for the very first time.

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FRIDAY
23 JUNE
17:00pm

## Cataclysmic Variables in the J-PLUS and J-VAR surveys

Alessandro Ederoclite
CEFCA

The third data release of the Javalambre Photometric Local Universe Survey (J-PLUS) has provided data for over 3,000 square degrees of sky in the five SDSS filters and seven narrow band filters (including Halpha). Its sky coverage is complementary to IGAPS and its depth complementary to Gaia spectroscopy. The Javalambre VARiability survey (J-VAR) observes 11 times those fields already calibrated by J-PLUS using only the 7 most efficient filters (3 broadband and 4 narrow band ones). So far, J-VAR has observed almost 300 square degrees, providing almost 2 million light curves in all its filters. In their present status, these surveys already harbour a number of known cataclysmic variables (CVs): 162 from the Ritter and Kolb catalogue are found in J-PLUS and 9 in J-VAR. In this talk, I will describe how J-PLUS and J-VAR can be used to study known CVs, reviewing and expanding our previous work on the position of CVs in the colour-magnitude diagram with colour-colour diagrams, in particular taking advantage of narrow band filters. Finally, I will show how new CVs can be identified in these surveys and present the first catalogue of CVs based on J-PLUS.

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TUESDAY
20 JUNE
11:15am

## Jet composition in the microquasar Cyg X-1

Elise Egron
INAF-Observatory of Cagliari

We studied the issue of the abundance of electron-positron (e ±) pairs in the jet of the microquasar Cygnus X-1. While there are strong hints that extragalactic jets contain substantial numbers of e ± pairs, this is much less clear for jets in microquasars. In either case, the mechanisms producing the putative pairs remain uncertain. A viable mechanism is e ± pair production within the jet base by collisions of photons emitted by the accretion flow. We calculated the electron-positron pair production rate at the base of the jet of Cyg X-1 by collisions of photons from its hot accretion flow using the measurement of its average soft gamma-ray spectra by the Compton Gamma Ray Observatory and INTEGRAL satellites. We found that this rate approximately equals the flow rate of the leptons emitting the observed synchrotron radio-to-IR spectrum of the jet core. This coincidence shows the jet composition is likely to be pair-dominated. The same coincidences were found before in the microquasar MAXI J1820+070 and in the radio galaxy 3C 120, which shows that the considered mechanism can be universal for at least some classes of relativistic jets.

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## The low mass X-ray binary Cyg X-2 as a prototype for the science with the IXPE satellite

FRIDAY
23 JUNE
09:30am

Ruben Farinelli

INAF - Bologna

With the launch of the IXPE satellite, X-ray polarimetry has newly become a topic of great scientific interest. Among the targets observed by IXPE there are low mass X-ray binaries hosting a neutron star. Historically, one of the most famous and best studied is Cyg X-2. In this talk, I will show results of the spectropolarimetric analysis of the source performed by IXPE, Nicer and INTEGRAL. The polarization degree in the 2-8 keV energy band was found to be about 1.8 per cent, while the polarization angle, aligned with the direction of the formerly observed radio jet, has provided for the first time tight constraints about the accretion geometry of bright neutron star X-ray binaries in soft state. Moreover, data have shown some hint that the polarization angles of the soft and hard component are perpendicular to each other. I will also discuss how theory and numerical simulations from newly developed codes are fundamental to investigate the physics of accretion for systems where the global polarization signal comes from the boundary layer, the accretion disk as well as from Compton reflection at the disk surface.

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## Deducing accretion dynamics from thermonuclear bursts

WEDNESDAY
21 JUNE
10:10am

Duncan Galloway

Monash University

Thermonuclear (type-I) bursts on the surface of neutron stars offer an independent probe of the accretion flow onto these objects. Measurements of the burst energetics for regular bursts, when compared with numerical models, can provide a measure of the (local) accretion rate, and hence (with the X-ray flux) the emission anisotropy. Constraints on the burst fuel composition provide indications for the degree of spallation from infalling material. Infrequent and inefficient bursts observed at high accretion rates provide evidence for simultaneous equatorial steady burning, possibly accompanied by additional mixing moderated by the neutron-star spin. I will review these topics and present new datasets and tools that are helping to make such approaches promising ways to probe the accretion process.

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WEDNESDAY
21 JUNE
12:00pm

## Filming the evolution of symbiotic novae with VLBI

Marcello Giroletti
INAF Istituto di Radioastronomia

In symbiotic novae, the material ejected from the surface of the white dwarf after the thermonuclear runaway drives a strong shock through the dense circumstellar gas produced by the red giant wind. Recurring symbiotic novae such as V407 Cyg and RS Oph are perfect real-time laboratories for studying physical processes as diverse as accretion, thermonuclear explosions, shock dynamics and particle acceleration; in many ways they are like supernova remnants on fast forward. In this talk, I will present the results of two intensive high angular resolution campaigns carried out for the two high energy symbiotic novae V407 Cyg and RS Oph, after their explosions in 2010 and 2021, respectively. These campaigns provided a resolved view of the structure of the ejected material and of its evolution, setting unique and independent constraints on the emission mechanisms, the physical processes at work, the presence and location of shock acceleration, the geometry of the system, and the density profile of the red giant wind.

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FRIDAY
23 JUNE
17:15pm

## Ultracompact binaries in the MeerLICHT and BlackGEM Surveys

Paul Groot
Radboud/UCT/SAAO

The MeerLICHT wide-field telescope is linked to the MeerKAT radio array to provide a simultaneous optical-radio view of the Southern skies. The BlackGEM will start operations in Chile in Q3. Both projects are geared towards time-series photometry on transients and variables. We will outline our observing strategies and highlight some of our recent discoveries, which will also be presented in associated talks

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TUESDAY
20 JUNE
17:10pm

## Accretion and evolution in the high-mass black hole binary M33 X-7

Wolf-Rainer Hamann
Potsdam University

M33 X-7 is the only known eclipsing black-hole high mass X-ray binary. It is located in a metal-poor galaxy and serves as a unique laboratory for studying the winds of metal-poor stars, as well as helps us to understand the potential progenitors of black hole mergers. I will report new measurements of the donor star and the black hole properties using the first UV spectroscopy of this system obtained by the Hubble Space Telescope and complemented by the XMM-Newton observations in X-rays. Our results overturn the conventional view on this template system. The component masses are strongly reduced, furthermore we show that the donor star fills its Roche lobe. I will discuss the accretion in RLOF high-mass X-ray binaries on the basis of our detailed modeling of donor stars and their winds. Finally, I will place M33 X-7 in the context of evolutionary scenarios for gravitational wave sources and HMXBs.

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

WEDNESDAY
21 JUNE
11:00am

Yago Herrera

ICE-CSIC

X-Ray bursts (XRB) are powerful thermonuclear events on the surface of accreting neutron stars (NS), which can synthesize intermediate-mass elements. Their luminosities sometimes exceed Eddington's value, and some of the material may be ejected by radiation-driven winds. We aim at determining the mass-loss and chemical composition of this ejecta and its significance for Galactic abundances. We also report on the evolution of observational quantities during the wind phase, which can help constrain the mass-radius relation in NS. A modern non-relativistic radiative wind model was linked through a new technique to a series of XRB hydrodynamic simulations, that include over 300 isotopes. This allows us to construct a quasi-stationary evolution of the XRB+wind. Results show 0.1% of the envelope mass ejected per burst, at an average rate of 2.6% the accretion rate, and 90% of the ejecta composed by 60Ni, 64Zn, 68Ge and 58Ni. The ejecta also contained traces of some light p-nuclei, but not enough to account for their Galactic abundances. The photospheric magnitudes showed remarkable correlations that could be used to link observable quantities to the physics of the envelope's interface with the NS crust. This is a promising result regarding the issue of NS radii determination.

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## The accreting millisecond pulsar SAX J1808.4-3658 during its 2022 outburst: hints of an orbital shrinking

THURSDAY
22 JUNE
16:30pm

Giulia Illiano

INAF - Osservatorio Astronomico di Roma

Accreting millisecond pulsars (AMSPs) are rapidly rotating neutron stars hosted in a tight binary system with a low-mass companion. Their millisecond periods result from a Gyr-long phase in which old radio pulsars are spun up by accreting matter from a donor via a Roche lobe overflow. The detection in 1998 of 401 Hz X-ray pulsations from the transient low-mass X-ray binary SAX J1808.4-3658 marked the long-awaited discovery of the first AMSP and the confirmation of this evolutionary scenario. Since its discovery, this source has undergone ten $\tilde{1}$ month long outbursts with $\tilde{2}$-3 years recurrence, making it the most thoroughly investigated of its type. When the onset of a new outburst was detected in August 2022, we performed a multi-wavelength campaign with three X-ray telescopes - XMM-Newton, NuSTAR, and NICER -, the fast optical photometer TNG/SiFAP2, and the Hubble Space

Telescope. I will present a coherent timing analysis of X-ray pulsations during this latest outburst, confirming the long-term spin-down rate compatible with the expected energy losses from a rotating magnetic dipole. This may be an indication that probably a radio pulsar is active in the system during quiescence. For the first time in the last twenty years, we found hints of an orbital decay. I will discuss this evolution in terms of a gravitational coupling between the orbit and variations in the mass quadrupole of the companion star.

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TUESDAY
20 JUNE
16:25pm

## Post-EXTraS discovery of a new pulsar in the LMC: a peculiar BeXRB or a new candidate magnetar?

Matteo Imbrogno

Università degli Studi di Roma "Tor Vergata", INAF-OAR

The Exploring the X-ray Transient and variable Sky project (EXTraS) represents the most thorough living search for new X-ray pulsators in the XMM-Newton archive, leading to the discovery of about 60 new pulsators and still counting. Recently, we discovered a X-ray pulsator in the outskirts of the Large Magellanic Cloud (LMC). The source (J0456 from now on) shows a coherent signal at a periodicity of P$\sim$7.25 s, which allows us to classify it as a spinning neutron star, a scenario supported also by spectral analysis. Furthermore J0456 is a highly variable source, with only one detection out of five XMM and eROSITA observations. The vast majority of X-ray pulsars in the LMC are found in binary systems with a Be companion star (BeXRBs). The transient behavior of these systems is ascribed to the presence of a decretion disk around the Be star which triggers the accretion. I will discuss the properties of J0456 and compare them with the ones shown by the known BeXRBs in both the Large and Small Magellanic Cloud, which also hosts a large number of BeXRBs. However, the particularly high pulsed fraction ($\sim$86%), very rarely observed in BeXRBs, might suggest that J0456 is instead a magnetar, the third outside our Galaxy. Regardless of its classification, this new pulsar represents a peculiar object: future measurements of the spin derivative are expected to remove the degeneracy.

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WEDNESDAY
21 JUNE
11:45am

## Effects of non-equilibrium collisional plasma on the X-ray emission from the RS Ophiuchi during its recent eruption

Nazma Islam

NASA Goddard Space Flight Center and University of Maryland Baltimore County

RS Ophiuchi is a recurrent nova consisting of a massive white dwarf and a red giant (RG) donor star in a binary orbit of 453.6 days. It underwent its most recent eruption on 8 August 2021 and was monitored extensively by NICER. The rapidly evolving NICER spectrum consisted of both line and continuum emission which we modelled using non-equilibrium ionization collisional plasma models. The evolution of the X-ray spectrum is consistent with the nova ejecta driving a forward shock in the dense stellar wind of the RG star.

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## The 2021 anomalous event and its precursor of the dwarf nova SS Cyg

MONDAY
19 JUNE
10:15am

Mariko Kimura
RIKEN

The brightest dwarf nova SS Cyg had repeated outbursts with intervals of 1 month; however, it showed an anomalous event in 2021, in which there was no clear difference between the outburst and quiescent states. It was even similar to the standstill observed in Z Cam-type dwarf novae. We performed optical & X-ray simultaneous observations, and found that (1) the enhancement of the viscosity in the disk was likely to be responsible for the anomalous event, and (2) the X-ray emitting plasma would expand during the anomalous event and its precursor. We also performed numerical simulations of the disk instability model, and found that not only the enhanced viscosity but also the gas-stream overflow may generate the anomalous event. Our research will contribute to solving the following three outstanding problems in cataclysmic variables: (1) what triggers the standstill, (2) what the geometry of X-ray emitting plasma is, and (3) why the quiescent X-ray luminosity is more than two orders of magnitudes higher than expected by the standard disk instability model. In this talk, I introduce our observational and numerical results, and discuss future observations with XRISM, Tomo-e Gozen, and so on.

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## Disentangling pulse profiles of accreting X-ray pulsars

THURSDAY
22 JUNE
17:00pm

Peter Kretschmar
European Space Agency

The pulsed emission from accreting X-ray pulsars is marked by a rich variety of observable behaviour. Pulse profiles, obtained by folding X-ray lightcurves with the pulse period come in a wide range of shapes, from very simple to rather complex, and various patterns of dependence on energy, luminosity, orbital and super-orbital phases or plausible changes in accretion modes. Sources expected to be similar in their properties can show very different profiles, while intrinsically very different sources can appear surprisingly similar. Modelling efforts of this pulsed emission have been ongoing for decades, but disentangling the various factors shaping the observable profiles, with complex emission patterns, strong lightbending and impact of zones far from the original emission has proven to be very challenging. We present an overview of the observable behaviour and the state of the art in pulse profile modelling for an extended source sample including also an outlook to similarities and differences with other pulsating X-ray sources.

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MONDAY
19 JUNE
17:05pm

## The role of outflows in black-hole X-ray binaries

Nick Kylafis
FORTH

In the standard picture of black-hole X-ray binaries (BHXRBs), the hard X-rays are produced in the corona (i.e., in the hot inner flow) and the radio in the jet (a narrow structure, a few gravitational radii, $R_g$, wide at its base). However, an outflow (tens to hundreds of $R_g$ at its base) must emanate from the hot inner flow, because of its positive Bernoulli integral. Thus, the corona is not static, but outflowing. We have considered both Comptonization and radio emission from a parabolic outflowing corona and we have been able to explain quantitatively a number of observations and correlations. These are: 1) the spectrum from radio to hard X-rays, 2) the time lag of the hard X-ray photons with respect to the softer ones and their correlation with Fourier frequency in Cyg X-1 and GX 339-4, 3) the correlation between the time lag and the spectral index $\Gamma$ in GX 339-4 and other sources, 4) the fact that this correlation depends on the inclination of the source, 5) the phase-lag – cutoff-energy correlation observed in GX 339-4, 6) the narrowing of the auto-correlation function with increasing photon energy seen in Cyg X-1, 7) the correlation between the Lorentzian frequencies in the power spectrum and the spectral index, $\Gamma$, in Cyg X-1 and GX 339-4, 8) the spectral index $\Gamma$ as a function of phase of the type-B QPOs in GX 339-4, 9) the demonstration that the outflow provides a natural lamppost for the hard X-ray photons that return to the disk, where reflection and reverberation take place, and 10) a quantitative explanation of the radio – X-ray correlation in GX 339-4. All the above observations and correlations are explained with only two parameters: the radius at the base of the parabolic outflow and the Thomson optical depth along the axis of the outflow. For all the observations and correlations, these two parameters vary in the same narrow ranges: 10 ¡ $R/R_g$ ¡ 1000 and 1 ¡ $\tau$ 10. Last, but not least, the density is largest at the base of the outflow and the transverse optical depth there is huge. Thus, the soft input photons from the accretion disk that get Comptonized there see something like a “slab” at the bottom of the outflow. This may explain the observed polarization in BHXRBs.

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THURSDAY
22 JUNE
12:10pm

## New look at magnetic accretion: centrifugal barriers, magnetic torques on the star, and internal structure of the disks.

Maxim Lyutikov
Purdue University

We will discuss: (i) centrifugal barriers in accretion onto magnetize star (they are not at the corotation radius); (ii) structure of magnetospheres with magnetically confined disks (accounting for toroidal currents in the disk - highly non-dipolar); (iii) internal structure of a disk which is magnetically coupled to the central star (Hartmann flow with alpha-like prescription for resistivity and viscosity). Applications range from young stellar objects to X-ray binaries.

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## Supersoft X-ray sources as progenitors of Type Ia supernovae

WEDNESDAY
21 JUNE
14:30pm

Chandreyee Maitra

Max Planck Institute for Extraterrestrial Physics

Type Ia supernovae are instrumental to our understanding of the Universe due to their use as cosmic distance indicators, and their importance in enriching the interstellar medium with heavy elements. They are understood to be the thermonuclear explosions of white dwarfs, but their formation paths are still debated, especially their progenitors. There are two classes of progenitor models. In 'single-degenerate' models, the progenitors are accreting white dwarfs (WDs). In 'double-degenerate' models, the explosion is initiated through mass transfer between and/or the merger of two WDs. Here we present two supersoft X-ray sources in the direction of the LMC which are promising candidates as progenitors of SN 1a. In one case we find a supersoft source as a candidate for a double degenerate polar. In the other case we find the first evidence of a supersoft source with an accretion disk whose optical spectrum is completely dominated by helium, suggesting that the donor star is hydrogen-free. The He burning supersoft source provide direct evidence for pathways towards Chandrasekhar-mass explosions, and allow to recover the population of the sub-energetic so-called Type Iax supernovae.

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## A polarimetric-oriented X-ray stare at EXO 2030+375 with IXPE, Insight-HXMT and SRG/ART-XC

FRIDAY
23 JUNE
10:00am

Christian Malacaria

International Space Science Institute (ISSI)

Accreting X-ray Pulsars (XRPs) are presumably ideal targets for polarization measurements, as their high magnetic field strength is expected to produce emission with a polarization degree up to
80%. However, such expectations are being challenged by recent observations of XRPs with the Imaging X-ray Polarimeter Explorer (IXPE). Here we report on the results of another XRP, EXO 2030+375, observed with IXPE and contemporarily monitored with Insight-HXMT and SRG/ART-XC. In line with recent results obtained with IXPE for similar sources, our joint analysis of EXO 2030+375 reveals a low Polarization Degree of 0-4% at $2\sigma$ c.l. in the phase-averaged study and variation in the range 2-7% in the phase-resolved study. By means of the rotating-vector model we constrain the geometry of the system and obtain a magnetic obliquity of 60 deg similar to the the pulsar inclination angle of 53 deg, implying that the system is a nearly orthogonal rotator and the magnetic axis swings through the observer line of sight.

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TUESDAY
20 JUNE
11:00am

## A unified accretion ejection paradigm for X-ray binaries : the JED-SAD paradigm

Gregoire Marcel

University of Cambridge

The hysteresis behavior of X-ray binaries during their outbursts remains a mystery. In this work, we developed a paradigm where the disk material accretes in two possible, mutually exclusive, ways (Ferreira et al. 2006). In the usual alpha-disk mode (SAD, Shakura & Sunayev 73), the dominant local torque is due to a radial transport of the disk angular momentum. In the jet-emitting disk mode (JED), magnetically-driven jets carry away mass, energy, and all the angular momentum vertically. Within this framework, the transition from one mode to another is related to the magnetic field distribution, an unknown.
We developed a two-temperature plasma code that computes the thermal balance at each radius for a large ensemble of disk parameters (Marcel+18a, A&A 615, A57). These parameter include the disk accretion rate (mdot) and a transition radius between the two accretion modes (rJ). The local spectra of any set of parameter is self-consistently computed at each radius, providing the global spectra emitted by the entire disk. We have shown that typical hard states of X-ray binaries can be reproduced up to unprecedented X-ray luminosities in this paradigm (Marcel+18a). In addition, we used a simple physical model to estimate the radio fluxes (at 8.6-9 GHz) radiated by the jets for any given set of parameter. Strikingly, both spectral features fit extremely well. Playing now on both mdot and rJ, we have shown that the X-ray spectral behavior of the X-ray binary GX 339-4 can be covered, both in X-ray and radio (Marcel+18b, A&A 617, A46). We then extended this work to 3 more outbursts from GX 339-4 Marcel et al., 2019, A&A 626, A115). This is, to our knowledge, the first time that accretion-ejection cycles are being reproduced, using both accretion (X-rays) and ejection (radio) constraints.
We have since improved the fitting procedure with direct spectral fits on XMM-Newton+NuSTAR data from the AGN HE 1143-1810 (Ursini et al,. 2020, A&A 634, A92), XRT+NICER+NuSTAR+BAT data from the X-ray binary MAXI J1820+070 (Marino et al. 2021, A&A 656, A63), and RXTE data from the X-ray binary GX 339-4 (Barnier et al. 2022, A&A 657, A11). Moreover, we have addressed the production of low frequency quasi-periodic oscillations during the outbursts (Marcel et al. 2020, A&A 640, A18), as well as the radiative efficiency of the accretion flow and the associated radio–X-ray correlation (Marcel et al. 2022, A&A 659, A194). The timing properties have also since been addressed (Malzac et al., to be submitted, Marcel et al, in prep.).
I will introduce the model and present a summary of all its associated results.

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## Investigating the disc-jet coupling in the NS XRB 4U 1820-30 with multiwavelength observations

TUESDAY
20 JUNE
10:10am

Alessio Marino

Institute of Space Sciences (ICE-CSIC)

4U 1820-30 is a persistent ultra-compact X-ray binary (XRB) (orbital period of only 11 mins) harbouring a neutron star (NS) and a highly evolved companion star. Throughout its ̃170-180 d super-orbital accretion cycle, the system evolves between phases of high and low X-ray modes, driving dramatic changes in the accretion disk and the jets. In this work, I will present the results of a dense multi-wavelength observational campaign on the NS XRB 4U 1820-30, including quasi-simultaneous radio (ATCA) and X-ray (NICER, NuSTAR, Swift) observations spanning four months in 2022. Throughout this campaign, we are able to follow how the spectral/timing behaviour of the accretion flow and the jet properties evolve in tandem, something rarely done in NS XRBs. Our results show that the accretion disc properties are stable over the full accretion cycle, while a cyclic evolution of the Comptonisation component seems entirely responsible for the observed X-ray flux modulation. Interestingly, a compact radio jet is detected during the low modes, but is quenched when the X-ray flux increases above a certain threshold. This jet quenching seems to be unrelated to the spectral hardness. Such a trend appears critically different to what typically observed in black hole (BH) XRBs, where jet quenching occurs over spectral state transitions. I will discuss these results in the context of the poorly understood accretion flow / jet correlation in NS XRBs, trying to address how and why such a correlation may differ between NS and BH XRBs.

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## X-ray polarimetric observations of accreting stellar mass black holes in soft-state

FRIDAY
23 JUNE
09:45am

Lorenzo Marra

Università degli Studi Roma Tre

So far, the Imaging X-ray Polarimetry Explorer (IXPE) have observed two accreting stellar mass black holes in the soft, thermal state: the transient low mass XRB 4U 1630–47 during an outburst, and the persistent high-mass XRB LMC X-1. The two sources show very different polarization properties, with just an - albeit tight - upper limit for LMC X-1 but a strong polarization signal for 4U 1630-47. In this talk, the IXPE results will be presented, and possible intepretation discussed.

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TUESDAY
20 JUNE
09:55am

## Compelling evidence that the hard lags of the type-C QPO in GRS1915+105 come from the jet

Mariano Mendez

University of Groningen

Accreting black holes emit highly collimated radio jets expanding at speeds approaching light speed. While magnetic fields are thought to be responsible for collimating the ejecta, the mechanism that accelerates the material in these jets remains unexplained. It has been proposed that thermal instabilities in the accretion disk lead to the ejection of the inner parts of the disk into the jet. I use X-ray and radio observations of the galactic black hole GRS 1915+105 over a 10-year period to reveal a strong correlation between (i) the radio flux that comes from the jet and the flux of the iron emission line that comes from the disk and (ii) the temperature of the hard X-ray corona and the amplitude of a high-frequency variability component that comes from the innermost part of the accretion flow. At the same time, the radio flux and the flux of the iron line are strongly anti-correlated with the temperature of the X-ray corona and the amplitude of the high-frequency variability component. These findings show that the energy that powers this black-hole system can be directed in different proportions either to the X-ray corona or to the jet. These facts, plus the modelling of the variability in this source, suggest that in GRS 1915+105 the X-ray corona turns into the jet. Finally, I will show new results that provide compelling evidence that the hard lags of the quasi-periodic oscillation in GRS 1915+105 are associated to the jet.

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THURSDAY
22 JUNE
10:20am

## Spectral results from RMHD simulations of black hole accretion and connections with observations

Brianna Mills

University of Virginia

The majority of ultraluminous X-ray sources (ULXs) are now accepted to be X-ray binary systems with super-Eddington accretion rates onto a black hole or neutron star. The physical mechanisms which drive super-Eddington accretion are still under investigation and require numerical simulations to evaluate current theoretical accretion models. We present Monte Carlo post-processed X-ray spectral results from the Athena++ radiation MHD simulations of super-Eddington accretion onto a stellar mass black hole. We compare these simulated spectra with current accretion spectral models as well as observations of the ULX source NGC 1313 X-1, showing that the numerical simulations are promising for the field of super-Eddington accretion onto black holes.

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## New X-ray detections of magnetic period-bounce cataclysmic variables from XMM-Newton and SRG/eROSITA

FRIDAY
23 JUNE
11:55am

Daniela Munoz Giraldo

Eberhard Karls Universität Tübingen

Period-bounce cataclysmic variables (CVs) are systems where a white dwarf accretes from a brown dwarf donor, having reached a point where the degeneracy of the donor reverses the orbital period evolution. A large portion of the CV population, between 40% and 70%, is predicted to be made up of period-bouncers, however, due to their intrinsic faintness, only a few of these systems have been observed and confidently identified so far. We emphasize the importance of X-ray data in order to identify period-bounce CVs, as it provides proof of accretion from the substellar companion onto the white dwarf because in this type of system the coronal emission of the donor is below the sensitivity of current instruments. We have observed the period-bouncer candidate SDSS J151415.65+074446.4 with XMM-Newton and report here the detection of X-ray orbital modulation. We determine the orbital period through the analysis of the X-ray light curve and we derive a mass accretion rate from the X-ray luminosity. Our analysis establishes SDSS J151415.65+074446.4 as a sibling of SDSS J121209.31+013627.7, the only other white dwarf and L dwarf system confirmed as a period-bouncer through its X-ray properties. We provide an outlook of the eROSITA all-sky survey capabilities for the X-ray detection of period-bouncers and first eROSITA results on such systems.

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## General relativistic magneto-hydrodynamic simulations of truncated accretion disks

MONDAY
19 JUNE
10:00am

Gibwa Musoke

University of Amsterdam

Accretion of matter is a fundamental astrophysical process, however the mechanisms responsible for the transport of angular momentum remain the topic of significant investigation. In order to understand the dynamical evolution of accretion disks and their connection to powerful jet outflows it is critically important to understand both the processes responsible for the outward flux of angular momentum and the transport of magnetic flux in the disk.

In this talk I focus on the evolution of truncated accretion disks around black holes. I analyse a high-resolution, long duration (tmax = 190,000rg/c) general relativistic magneto-hydrodynamic (GRMHD) simulation of a truncated accretion disk, focusing on exploring the processes responsible for the transport of angular momentum and magnetic flux in the disk along with the evolution of the disk truncation radius. I show that large-scale poloidal magnetic fields threading the disk carry angular momentum outwards using the Blandford-Payne (BP) mechanism, forming a BP disk wind. This is one of the first demonstrations of a BP type disk wind in a high resolution, turbulence resolving GRMHD simulation (i.e. outside of simulation studies

that employ viscosity and resistivity). I find that the BP wind acts to collimate the jet, which has considerable implications for large-scale jet dynamics and AGN feedback.

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MONDAY
19 JUNE
11:00am

## Phase-resolved spectroscopy of QPOs seen in simultaneous NuSTAR & XMM-Newton observations of H1743-322 across multiple outbursts

Edward Nathan
CalTech

Black hole (BH) X-ray binaries (XRBs) are binary systems containing a stellar-mass BH which accretes matter from a companion star, with the accretion system shining brightly in X-rays. We see the characteristic reflection of high energy X-ray photons incident onto the accretion disc in the observed X-ray spectrum, such as the relativistically distorted Fe K/*alpha* line. Quasi-periodic oscillations (QPOs) are commonly observed in the X-ray flux of these sources. There are many theories to the origin of these QPOs, all of which have predictions of how the X-ray spectrum varies (or not) over a QPO cycle.
I will present work phase resolving the X-ray spectrum of type-C QPOs seen in simultaneous NuSTAR and XMM-Newton observations of the BH XRB H1743-322. The observations cover three outbursts in 2014, 2016, and 2018; although I will focus on the 2016 outburst which has the best quality data. These observations suggest the presence of an axi-asymmetric illumination profile, along with modulations in the reflection fraction which adds to the evidence that these QPOs have a geometric origin. Finally, this work highlights the signal requirements of spectral-timing techniques, but also how powerful these techniques will be with data from future X-ray missions, such as HEX-P, in uncovering the accretion processes at play in extreme gravity.

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FRIDAY
23 JUNE
16:30pm

## Optically thin accretion discs in cataclysmic variables with a low mass-transfer rate

Vitaly Neustroev
University of Oulu (Finland)

Despite more than fifty years of intensive study of accretion discs, accretion disc theory is still incomplete. One critical issue is the inability of the theory to correctly describe and explain the disc properties in cataclysmic variables (CVs) in quiescence. The physics of emission line formation in accretion discs is complex and the existing models cannot reproduce emission lines, observed in CV spectra, with the correct equivalent widths and the Balmer decrements.
The situation becomes even less certain when we examine accretion discs in CVs with a very low mass-transfer rate. Even from the observational side such discs are difficult to study due to their low luminosity, which is only a small fraction of the

white dwarf luminosity. However, the equivalent widths of emission lines from such discs can reach a thousand and even more angstroms.
Here we will present a sample of spectra of optically thin accretion discs which we managed to extract from spectra of short-period CVs. We will then discuss their common features, the main differences, and the underlying physics behind them.

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## A multi-X-ray-mission view of the 2021 outburst of RS Ophiuchi

WEDNESDAY
21 JUNE
11:30am

Marina Orio

INAF-Padova & University of Wisconson

RS Ophiuchi, the best monitored symbiotic nova, had a new outburst in August of 2021 and was observed at all wavelengths, from the gamma-ray energy of Cherenkov telescopes to radio. I will discuss the dense, long-lasting monitoring done with NICER, as well as a hard X-ray exposure done with NuSTAR when the nova was also a gamma-ray source, and X-ray grating spectra obtained with Chandra and XMM-Newton. The copious flux and rapid cooling due to shocks in the ejecta poses unexpected questions regarding the actual site of these shocks, and what their relationship with the sources of gamma-rays is. After a "stormy" transition phase, probably due to variable ionization state in the ejecta, a luminous supersoft X-ray source was observed with a steady, large amplitude modulation with
35 s quasi-period, not associated with accretion, but with nuclear burning. The looming and intriguing question is whether this is the spin period of a rapidly rotating white dwarf, or what the root case is. Finally, while the ejecta were still showing shocked material, the supersoft X-ray source faded, and I will present evidence that this is due to an actual turn-off, more rapid than in 2006, rather than due to a sudden obscuration of most of the central source, as it has been hypothesized.

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## Gamma Cassiopeiae - defining a new class of accreting binaries

TUESDAY
20 JUNE
15:10pm

Lida Oskinova

Potsdam University

One of the brightest stars on the northern sky is gamma Cassiopeiae. Its peculiar X-ray properties indicate that the star is an accreting binary but the type of the compact object is a subject of intense debate. Recent X-ray surveys uncovered that the gamma Cas-type binaries are abundant in the Galaxy. Thus, we are dealing with a new type of accreting system of unknown nature. I will describe what is known about gamma Cas-type stars, compare current models, suggest possible solutions, and invite the meeting participants to share their views on this long standing puzzle.

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TUESDAY
20 JUNE
09:25am

## Disc-jet coupling in accreting systems

Francesca Panessa

INAF

A possible pathway towards the understanding of the universal accretion and ejection physiscs is through the comparison between different other accreting sources, from young stellar objects (YSOs), to XRBs (either BHs or neutron stars) and active SMBHs. These various accreting sources display substantial differences — for example, in the central mass, outflow velocities, disk temperatures, energy output and magnetic fields — and a number of common features and parameters — for example, disk morphology, degree of collimation, ejection velocity and direction. I will discuss observational evidence in favour of the disc-jet coupling at different luminosities and accretion rate scales in these systems. The results will be discussed within the current accretion-ejection physical scenarios and in view of future observing facilities at multi-frequency.

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MONDAY
19 JUNE
16:50pm

## The current state of disk wind observations in BHLMXBs through X-ray absorption lines in the iron band

Maxime Parra

Università Roma Tre/ Université Grenoble Alpes

The first detection of X-ray wind signatures (mainly FeXXV/XXVI absorption lines between 6 and 8 keV) in Black Hole Low Mass X-ray Binaries (BHLMXBs) took place more than 20 years ago. In the last decade, it has become apparent that these winds are only detected in strongly inclined objects, hinting at them originating from the disk, although there is still no unequivocal evidence for a magnetic or thermal origin. On the other hand, most detections occur during the soft spectral state, for reasons yet to be understood. We present an update of the current state of wind detections in BHLMXBs, through the analysis of all available XMM-EPIC and Chandra-HETG data of all LMXBs currently classified as BH or BH candidates, from the BlackCAT and WATCHDOG catalogs. We will discuss the number of sources with statistically significant detections in the 6-8 keV band, the associated EWs, blueshifts and line ratios, and their correlation with inclination and spectral state. Following this, we will present preliminary comparisons with synthetic spectra of MHD accretion-ejection models.

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## A (successful!) targeted search for binary white dwarf pulsars

THURSDAY
22 JUNE
15:30pm

Ingrid Pelisoli

University of Warwick

One of the most remarkable white dwarf binary systems identified to date is AR Scorpii (henceforth AR Sco). AR Sco is composed of an M-dwarf star and a rapidly spinning, magnetised white dwarf in a 3.56-hour orbit. It shows strongly pulsed emission with a period of 1.97 minutes over a broad range of wavelengths, from radio to X-rays, which led to it being known as the first white dwarf pulsar. However, it is binary interaction that triggers AR Sco's pulses, unlike in neutron star pulsars where no companion is required. Despite its fascinating characteristics, AR Sco has remained the only known system of its kind, six years after its discovery, preventing us from testing the models that could explain its observed properties. We have performed a systematic search for binary white dwarf pulsars like AR Sco, relying on Gaia astrometry and photometry, and on variability in photometric surveys such as TESS and WISE to identify potential candidates. Follow-up was carried out primarily with the high-speed photometer ULTRACAM. In this talk, we report the results of this search, which include the discovery of a new binary white dwarf pulsar. The newly discovered system harbours a white dwarf in a 4.03-hour orbit with an M-dwarf and exhibits strongly pulsed emission from radio to X-rays with a period of 5.30 minutes.

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## The effects of rotation in the evolution of AM CVn systems

FRIDAY
23 JUNE
14:30pm

Luciano Piersanti

INAF-Osservatorio Astronomico d'Abruzzo

We will review the evolutionary properties of AM CVn system with a non-degenerate donor by considering as case study the PTF J2238+743 system. We will present a new evolutionary model obtained with the FuNS code by modelling simultaneously both the accretor and the donor. In particular we will discuss the chemical and physical properties of the accretor by including the effects of rotation which naturally arises in these systems. Basing on the obtained results we will speculate on the potential of AM CVn systems as progenitor of explosive phenomena of supernova proportion.

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MONDAY
19 JUNE
11:15am

## General relativistic radiation magento-hydrodynamic simulations of luminous accretion disks

Oliver Porth

University of Amsterdam

The processes leading to accretion disk truncation and formation of a hot tenuous disk corona play a key role in the X-ray binary phenomenon and are subject to intensive study. State of the art GRMHD simulations now offer a unique way to explore the relevant physics with a limited set of assumptions. In this talk I will present results obtained with the "next generation" of high-resolution, radiative two-temperature simulations of aligned and tilted accretion disks which were run on our recent PRACE computing allocation (among others). The simulations demonstrate that when a geometrically thin accretion disk is threaded by large-scale net poloidal magnetic flux, it self-consistently transitions at small radii into a two-phase medium of cold gas clumps floating through a hot, magnetically dominated corona. This transition occurs at a well-defined truncation radius determined by the distance out to which the disk is saturated with magnetic flux. Since the electron heating and cooling is explicitly included in the simulations, we can now quantify the electron temperatures in the truncated disk region which are consistent with coronal temperatures inferred from the hard X-ray component in X-ray binaries and AGN. When the disk is strongly tilted, we find the somewhat surprising result that even where the disk is radiation pressure dominated, the accretion disk appears thermally stable. In addition, we find that warps cause localized electron heating to 1e8-1e9K linked to extreme azimuthal scale height variations which differs significantly from idealized models.

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FRIDAY
23 JUNE
15:45pm

## SWIFT J0503.7-2819: a nearly synchronous intermediate polar below the period gap?

Nikita Rawat

Aryabhatta Research Institute of observational sciencES (ARIES)

Intermediate polars (IPs) are the low magnetic field strength (B $\sim 10^6$-$10^7$ G) subclass of magnetic cataclysmic variables. IPs are asynchronous systems, and they follow the asynchronism relation as the spin period of the white dwarf (WD) is relatively less than the orbital period of the binary system. Most IPs have orbital periods longer than the 'period gap' of 2-3 h. However, there is a special class of IPs known as nearly synchronous IPs for which the spin period of WD is approximately in the range of (0.7-0.9) times the orbital period of the WD. These systems are thought to be in the process of attaining synchronism and evolving into polars. Within this frame of reference, we will discuss the X-ray and optical properties of recently discovered nearly synchronous IP, namely SWIFT J0503.7-2819. The X-ray and optical variations of this target have been found to occur at the period of $\sim$65 min, which we propose as the spin period of the white dwarf. The energy-dependent modulations at this period, which are due to the photoelectric absorption in the accretion flow, also assure this conjecture. If the proposed spin period is indeed

the actual period, then SWIFT J0503.7-2819 could be the first nearly synchronous intermediate polar below the period gap.

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## Unraveling the nature of an ULX: analysis of the UV and optical spectrum of Ho II X-1.

THURSDAY
22 JUNE
10:05am

Sabela Reyero Serantes
University of Potsdam

Ultraluminous X-ray sources (ULXs) are high mass X-ray binaries with an X-ray luminosity above $3 \cdot 10^{39}$ $erg/s$, which would exceed the Eddington limit for a 20 $M_\odot$ black hole (BH). Alternatively to adopting such high BH masses, super-critical accretion has been proposed for explaining their X-ray brightness. On long terms, an ULX might become the progenitor of a BH merger like those observed by gravitational waves. The ULX Holmberg II X-1 (Ho II X-1) is a perfect test case to unravel its true nature, as it is relatively close and bright. Several studies have been devoted already to analysing its properties both in the X-ray and optical regime. Now we went one step further and obtained the first ever ultraviolet spectrum of an ULX with the HST COS spectrograph. These new UV spectra of Ho II X-1 and its surrounding nebula, complemented by optical data, are analysed in detail using stellar atmosphere (`PoWR`) and nebula (`CLOUDY`) models. According to our preliminary results, we can model the observed spectrum as originating mainly from an B-type donor star which feeds the accreting BH, plus a bright X-ray ionised nebula.

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## The impact of type I X-ray bursts on the radio jets from neutron star X-ray binaries

WEDNESDAY
21 JUNE
09:40am

Thomas Russell
INAF-IASF Palermo

Type I X-ray bursts arise from unstable thermonuclear burning of accreted material on the surface of neutron stars. These seconds to minutes long X-ray bursts greatly impact the accretion flow, altering both the properties of the disk and corona, as well as the mass accretion rate. Here, I will present an intensive radio monitoring program focused on two known bursting neutron star X-ray binaries, with the aim of detecting the effects that type I X-ray bursts may have on the emitted jets. We find a clear radio enhancement in the minutes immediately after each X-ray burst, lasting tens of minutes. In this talk, I will show the detailed radio results from this campaign, discussing the origin of the radio brightening and the constraints it allows us to place on the speed of the neutron star jet. These results open a new and unique window for studying the disk-jet connection in neutron star X-ray binaries.

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WEDNESDAY
21 JUNE
17:10pm

## On the geometry of the reprocessing sites in X-ray binaries

Dave Russell

New York University Abu Dhabi

Optical emission from low-mass X-ray binaries (LMXBs) is usually dominated by reprocessing of X-rays on the surface of the accretion disc. Evidence for this reprocessing on the irradiated disc comes from spectral energy distributions, correlated optical and X-ray behaviour, and optical lags seen on light travel timescales. The latter process can be used in echo mapping to reveal the geometry and spatial scale of reprocessing sites. Here, we present a compilation of optical/IR reprocessing time lag measurements, which includes at least six black hole and ten neutron star LMXBs. Several neutron star LMXBs have lags measured from type-I bursts on the neutron star surface, whereas the black hole system lags are from accretion fluctuations only. We compare these lag measurements to the orbital separations and disc sizes known independently, from the orbital parameters. For black hole LMXBs, we find a linear correlation between the time lag and the disc size, with the peak of the lag corresponding to
70% of the outer disc radius. Optical lags from neutron star LMXBs are systematically larger than this expected relation, implying that the lag has a contribution from the companion star and in one system the lag is modulated with the orbital phase. We discuss possible reasons for the reprocessing sites to differ between black hole and neutron star systems. These include the relative disc sizes, the vertical extent of the X-ray emitting region, differences in the X-ray spectrum, and the angular size of the companion subtended as viewed from the compact object.

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MONDAY
19 JUNE
14:55pm

## Strongly magnetized disks and the X-ray binary hysteresis: a numerical point of view

Nicolas Scepi

University of Southampton

Since the finding that the magneto-rotational instability can transport angular momentum outward, the role of magnetic fields has been confined to producing an effective viscosity in standard accretion disk models. However, in the past ten years (GR)MHD simulations have shown that the properties of strongly magnetized disks largely deviate from standard models. Indeed, magnetic field can support the disk vertically, can produce accretion through vertically elevated layers and launch powerful outflows. All of these effects will dramatically affect the observational signature of accretion disks. In this talk, I will show a comprehensive analysis of a set of three GRMHD simulations showing how the properties of strongly magnetized accretion disks vary when going from thick, hot disks to cold, thin disks. I will first focus on the effect of the magnetic field on the dynamical structure of accretion disks and then on their thermal and radiative properties. I will present most of my results in the framework of the X-ray binary hysteresis cycle to particularly show that, similarly to what has been proposed in the past, a strongly magnetized disk can act as

a truncated hot disk up to high luminosities in a wind-driven disk having powerful outflows. These simulations are scale-free and can also apply to Active Galactic Nuclei to explain their hard X-ray coronal emission and their Ultra-Fast Outflows.

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## Nova eruptions and the evolution of CVs

WEDNESDAY
21 JUNE
14:45pm

Linda Schmidtobreick
ESO

Theory predicts that between nova eruptions, the binary inside appears as a 'normal' cataclysmic variable (CV). For the first tens or hundreds of years, however. the white dwarf is still heated up which most probably affects the mass-transfer rate of the binary.
To study the effect nova eruptions have on the white dwarf, we have conducted a long-term project to recover old novae and to study the binary within. The results show indeed that for the vast majority of old novae, the white dwarf is hot and mass transfer is high. Very few examples exist where a possible cooling of the white dwarf is observed and for any decent statistic, we need to find more novae that are at least a few hundred years old. We are conducting a deep, wide-field Halpha +

$$NII$$

survey of cataclysmic variables to search for remnant nova shells, tell-tale signs of ancient novae. Here we summarise the results of the search and discuss the detections and non-detections in the context of CV evolution.

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## Binary interaction dominates mass ejection in classical novae

WEDNESDAY
21 JUNE
11:15am

Ken Shen
UC Berkeley

Classical novae are thermonuclear outbursts in the accreted surface layers of white dwarfs in cataclysmic variable systems. In this talk, I will describe our new hydrodynamic calculations of nova mass loss with MESA, which demonstrate the formation of optically thick winds, confirming previous analytic and numeric work. However, for the first time, we consider the influence of the binary companion on the formation of these winds. For most of the mass loss phase, we find that the wind velocity at the white dwarf's Roche radius is so low that the companion must disrupt the wind; thus, mass loss is instead primarily driven by the binary interaction as an equatorial outflow. A successful spherical optically thick wind is only launched near the end of the ejection phase. This new picture of nova mass loss has broad implications for observables, including shock-induced high-energy emission, and the long-term survival of cataclysmic variables.

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TUESDAY
20 JUNE
14:55pm

## The lowest X-ray luminosity state captured in Supergiant Fast X-ray Transients

Lara Sidoli

INAF/IASF-Milano

We report on our recent discovery of the faintest X-ray state ever observed in two Supergiant Fast X-ray Transients (SFXTs), IGRJ08408-4503 and XTEJ1739-302, at a level of a few 10$\hat{3}$1 erg/s. SFXTs are high mass X-ray binaries (HMXBs) powered by accretion onto a compact object of a fraction of the wind from the O-type supergiant donor. But at odds with supergiant HMXBs shining in the X-ray sky persistently, SFXTs reach Lx
10$\hat{3}$6 erg/s only during short flares. Their flare duty cycle is less than 5%. Remarkably, less known than their flares are the quiescent states. Our recent XMM-Newton observation of IGR J08408-4503 caught this SFXT in an extremely faint state for the first time. Thanks to the very low absorption towards the source, the X-ray spectrum could be deconvolved to three spectral components: two collisionally ionized plasma (kT1=0.24 keV and kT2=0.76 keV), together with a steep powerlaw model dominating above 2 keV. We interpreted the two-temperature plasma as the intrinsic X-ray stellar wind emission of the donor star, while the powerlaw component as residual accretion onto the compact object. This interpretation has led us to identify the lowest X-ray luminosity emitted by a compact object in a SFXT, to date: 5x10$\hat{3}$1 erg/s (contributed by the powerlaw component only). More recently, a similar, very low X-ray luminosity was serendipitously caught also in the SFXT XTE J1739-302, during the XMM-Newton survey of the Galactic center region. We will discuss these findings which challenge accretion models proposed for these transients.

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THURSDAY
22 JUNE
17:15pm

## What does polarized emission from accreting neutron stars look like if we forget (just for a second) about the accretion columns?

Ekaterina Sokolova-Lapa

Remeis-Observatory & ECAP, FAU Erlangen-Nuernberg

The general picture of accretion onto highly magnetized neutron stars has been known for many decades. The ionized flow reaches the vicinity of a neutron star at nearly relativistic velocities and is decelerated by particle collisions or the standing shock wave. The produced X-ray emission is strongly modified by Comptonization in the hot magnetized plasma. The modeling efforts of last decades mainly concentrated on the continuum formation in the extensive accretion columns by bulk Comptonization. To make the task treatable, the radiative transfer models often adopted an angle- and polarization-averaged approach. Resonant cyclotron scattering, which produces the absorption line-like features in the spectra ("cyclotron lines"), was typically excluded from the simulations. The resulting smooth power-law-like continua with high-energy cutoff describe the general shape of the observed spectra but fail to explain the finer spectral features: dips and humps modifying the power law at intermediate energies. These often lead to the usage of the two-component Comptonization models or additional broad Gaussian features in emission or absorption ("10-keV" features) to obtain a satisfactory data description. In this work, we step back and investigate main principles of spectral formation in a highly magnetized hot medium. We use our polarized radiative transfer code, which consistently treats resonant and continuum Comptonization and provides angle-dependent emission. We show that polarization and anisotropy effects, as well as the proximity of the cyclotron resonance, have a crucial influence on the spectral formation. We put our work in the context of recent observational and theoretical discoveries.

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## Type I X-ray bursts as probes of the neutron star accretion environment

WEDNESDAY
21 JUNE
09:55am

Julia Speicher
Georgia Institute of Technology

Neutron star accretion in low-mass X-ray binaries can lead to unstable nuclear burning on the neutron star surface, causing a Type I X-ray burst. The burst irradiates the accretion environment, consisting of an accretion disk and a corona. Theoretical models predict that the burst radiation will change accretion flow properties. The burst photons exert Poynting Robertson drag on the disk, which enhances the mass accretion rate in simulations, and which could be the cause of an increased persistent emission and an observed soft excess $< 3$ keV during the burst. The enhanced accretion rate furthermore drains the inner disk region, causing its inner edge to recede outwards. Calculations also predict a highly ionized disk during the burst. The predicted reflection spectra feature emission lines and a soft excess varying in strength as the flux irradiating the disk changes. Additionally, the burst will cool the corona, causing a drop in observed hard X-ray flux $> 30$ keV related to the corona geometry. In this presentation, I will review the theoretical predictions of the burst interaction with the accretion flow and how they translate into observational properties. Overall, X-ray bursts provide a unique opportunity to probe accretion disk physics with a repeatable experiment.

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## What we can learn about accretion heating from pulsating WDs in CVs

FRIDAY
23 JUNE
16:45pm

Paula Szkody
University of Washington

It is observationlly well known that dwarf nova outbursts heat the white dwarf and they subsequently cool but the amount of heating and duration of the cooling sequence are not well determined. Asteroseismology allows a way to determine the effects of the outburst by monitoring the pulsations driven by the underlying convection zones. Many dwarf novae have relatively short outburst timescales of months between outbursts but a few have extreme outbursts of 8-9 magnitudes. The available data from following two such systems for years will be discussed in relation to the impact of the accretion onto their white dwarfs.

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MONDAY
19 JUNE
15:10pm

## What powers black hole accretion disc winds in low-mass X-ray binaries?

Ryota Tomaru

Durham University

Understanding winds from the accretion flow is essential in understanding AGN feedback, but there are many possible mechanisms (radiative, magnetic, thermal). Instead, the stellar-mass black holes in low-mass X-ray binaries give a simpler set to investigate the wind launching as their higher disc temperatures mean radiative acceleration (UV and dust-driven) is not likely to become dominant. Magnetic winds are not constrained, but thermal winds are deterministic by observed spectra, luminosities, and disc sizes. Thus, we calculate their properties and test them using observational data. We obtain the wind dynamics/structure and detailed line profiles by combining radiation hydrodynamics simulations and Monte-Carlo radiation transfer simulations. These simulations match well with the observed data from winds in H1743-322, GX 13+1, and GRO J1655-40, strongly suggesting that thermal heating is the major launch mechanism rather than magnetic fields. This result means that the winds in AGN are also probably not magnetic, opening the way to predicting their energy/momentum transport for AGN feedback from their observed spectra and luminosities.

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FRIDAY
23 JUNE
14:45pm

## Dwindling accretion of CVs at the turnaround of period minimum. The case of V498 Hya.

Gagik Tovmassian

UNAM

The should by a spike in number of short period CV at the period minimum. However, we don't know many, because accretion rates decrease considerably as they reach the turnaround point. We report here results of GTC spectroscopy of V498 Hya, a faint g=20.5 CV, harboring a massive white dwarf.

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## A new stochastic model for simulating accretion disks in 2D: propagating fluctuations and epicyclic motion

WEDNESDAY
21 JUNE
16:40pm

Samuel Turner

Institute of Astronomy, University of Cambridge

The theory of propagating fluctuations, in which random fluctuations within an accretion disk travel inwards and combine, has long been used to explain the observed variability in accreting systems. Recent numerical work has expanded on the extensive analytical literature but has been restricted to using the 1D diffusion equation for modelling the disk behaviour. I will present a novel numerical approach for 2D (vertically integrated), stochastically driven $\alpha$-disk simulations, generalising existing 1D models. This is achieved through defining $\alpha$ as a function of a stochastic random variable $\beta$ which is advected as a tracer field and stochastically evolved in time according to an Ornstein-Uhlenbeck process. These simulations reproduce a wide range of observational features of accretion disks, including the linear rms-flux relationship, a broadband power spectrum and lags between emission in different energy bands. We find that the disk luminosity is only log-normally distributed when the disk is sufficiently thick, with thinner disks instead showing a normal distribution. The thicker disks are also significantly more variable, providing a compelling explanation for the greater variability seen in the hard state versus the soft state of X-ray binaries. We also highlight the potential importance of epicyclic motion (which cannot be captured in 1D) on the local disk dynamics. Finally, we find that the break frequency in the luminosity power spectrum is strongly dependent on the driving timescale of the stochastic evolution of the $\beta$ parameter within the disk, providing a possible observational signature for probing the magnetorotational instability (MRI) dynamo.

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## Propagating fluctuations in the NICER era

MONDAY
19 JUNE
09:45am

Phil Uttley

University of Amsterdam

X-ray spectral-timing studies of black hole X-ray binaries in the hard state provide a powerful tool to study accretion variability close to the black hole. NICER provides a wealth of new data which probe the variable disk emission in soft X-rays, and the connection to the corona. We will show how propagating accretion fluctuation models for the variability can explain most of the observed spectral-timing properties. The observed time lags between disk and coronal power-law emission can be used to explore and constrain the radial extent and speed of the propagating fluctuations. The data strongly imply that fluctuations over at least two decades in time-scale originate in the blackbody-emitting accretion disk, over a relatively small range of radii close to the black hole. We suggest that strong magnetisation of the disk is the key driver of the variability, and of the shape of the variability power spectrum.

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THURSDAY
22 JUNE
11:55am

## Revisiting the white-dwarf mass determination in magnetic cataclysmic variables

Claudia V. Rodrigues

Instituto Nacional de Pesquisas Espaciais (INPE)

A common method to estimate the white-dwarf (WD) mass in magnetic cataclysmic variables (MCVs) relies on the modelling of their X-ray spectrum. The high-energy emission in those systems comes from the so called post-shock region, the portion of the magnetic accretion column near the WD surface. In this contribution, we revisit the determination of the WD mass in MCVs for some systems that also have the WD mass estimated by other methods as radial velocity curves or WD atmosphere fittings. We also discuss the relevance of the cooling processes considered in the solution of the physical properties of the post-shock region.

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MONDAY
19 JUNE
15:25pm

## MHD winds to explain quiescent accretion of compact binary discs

Marc Van Den Bossche

Institut de Planétologie et d'Astrophysique de Grenoble

Dwarf Novae and low-mass X-ray binaries are eruptive binary systems comprised of a Roche-lobe overflowing solar-type star and an accreting compact object. Their recurrence time can be explained by a low-accreting phase called quiescence, during which the angular momentum transport parameter is inferred to be $\alpha \approx$ 10ˆ-2 by the Disc Instability Model (DIM). Non-magnetics mechanisms, such as spiral wave transport, only achieve angular momentum transport an order of magnitude too low, at best, because these discs are so thin (H/R ≈10ˆ-3) during quiescence. During this phase, the Magneto-rotational Instability is known to be suppressed by the increased resistivity of the plasma which is very little ionised. Here, I explore the possibility that an MHD wind arises and increases the angular momentum transport in low magnetic Reynolds number (Rm ≈ 100) and realistic plasma parameter ($\beta$ ≈ 10ˆ2-3) regimes. I quantify the efficiency of the arising MHD wind and compare the modelled transport parameter values to values inferred from observations by the DIM. I will introduce the new GPU-accelerated finite volume code Idefix that I used to produce global full 3D ideal and resistive MHD simulations with realistic disc aspect ratio, and fine enough grid to resolve the thin-disc dynamics' scales.

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## Constraining outer disc edge with broad-band aperiodic variability

WEDNESDAY
21 JUNE
16:55pm

Martina Veresvarska
Durham University

Flickering, and more specifically aperiodic broad-band variability, is an important phenomenon used in understanding the geometry and dynamics of accretion flows. More importantly, observational features can provide new observables that can constrain simulations of accretion flows. Although the inner regions of accretion flows are known to generate variability on relatively fast time-scales, the broad-band variability generated in the outer regions has mostly remained elusive due to its long intrinsic variability time-scales. Here, I will present the first low-frequency power spectral analysis of the ultracompact accreting white dwarf system SDSS J1908+3940. The analysis reveals a low-frequency break at $\tilde{6}.8 \times$ 1e-7 Hz in the time-averaged power spectrum as well as a second higher frequency component with characteristic frequency of $\tilde{1}.3 \times$ 1e-4 Hz. I will show that the low-frequency break can be associated with the outer disc regions of a geometrically thin accretion flow using the fluctuating accretion disc model. The detection of the low-frequency break in SDSS J1908+3940 provides a precedent for further detection of similar features in other ultracompact accreting systems.

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## The stellar wind properties in Cygnus X-1

TUESDAY
20 JUNE
15:25pm

Eleonora Veronica Lai
Nicolaus Copernicus Astronomical Center (PAN)

In High Mass X-ray Binary systems, the compact object accretes via the stellar wind from their companion star. The strong wind presents highly dense and strongly inhomogeneous regions or clumps. When a clump passes along the line of sight, it absorbs part of the X-ray emission and causes variability in the observed flux. However, the available X-ray instruments do not allow us to study absorption from a single clump. Nonetheless, this problem can still be addressed using an alternative and powerful approach, which is based on the modellisation of colour-colour diagrams. We performed an analysis of the most recent EPIC-pn XMM Newton monitoring for the black hole binary Cyg X-1/HDE 226868, being part of the CHOCBOX (Cyg X-1 Hard state Observations of a Complete Binary Orbit in X-rays) multi wavelength campaign. In this talk, I will present the latest results concerning the study of the stellar wind characteristics for this system via modelling of colour-colour diagrams. In particular, I will show how the stellar wind properties change along the orbit close to a passage at superior conjunction.

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TUESDAY
20 JUNE
09:40am

## A shared accretion instability for black holes and neutron stars

Federico Vincentelli
Instituto Astrofísico de Canarias

Swift J1858.6-0814 is a transient neutron star low mass X-ray binary which between 2018 and 2020 underwent an outburst showing remarkably strong flaring on very short timescale across the almost all the electromagnetic spectrum. Here we present the analysis of an unprecedented dataset that included strictly simultaneous, high time resolution data in X-ray, UV, optical, IR, and radio conducted in August 2019. By modeling the measured X-ray to IR delays together with the radio variability, we found that the complex multiwavelength variability of Swift J1858 is quantitatively explained with accretion disk instabilities and discrete jet ejecta in the same way as it is done for the archetypal highly accreting black hole GRS 1915+105 or V404 Cygni. This new association, therefore, allows us to identify the main physical components responsible for the fast multiwavelength variability of highly accreting compact objects, and unlocks the possibility of measuring the physical parameters of disks and jets in these sources.

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TUESDAY
20 JUNE
11:30am

## Episodic jets from black-hole X-ray binaries

Andrzej Zdziarski
N. Copernicus Astronomical Center, Warsaw

We study episodic jets launched during the hard-to-soft state transitions of black-hole X-ray binaries, e.g., in GRS 1915+105, MAXI J1348-630. Their sizes are much larger than those of compact jets (present in the hard state), they are very massive, 1e23 g, and are observed up to
1e18 cm. Often twin ejecta, with the approaching and receding components, are seen. The physics of their launching remained unknown. Our work shows that such events can be explained using the MAD (magnetically arrested disk) paradigm. The almost ballistic jet trajectories show they initially propagate in low-density cavities surrounding the binaries. We show that the cavities can be inflated by un-collimated Blandford-Znajek outflows generated during the soft states. We also consider their energetics, often claimed to exceed conventional limits on the jet power by orders of magnitude. This, in turn, would require the true disk accretion rate to be extremely high and super-Eddington. We show, however, that the ejecta energies are compatible with conventional accretion physics. In particular, the previous kinetic energy estimate of extgreater $10\hat{\{}46\}$ erg in the ejection from MAXI J1348-630 based on its deceleration in the ISM can be reduced by two orders of magnitude by considering the presence of a transition layer separating the cavity and the ISM.

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## Low accretion rate white dwarf binaries found with ZTF

FRIDAY
23 JUNE
11:40am

Jan van Roestel

University of Amsterdam

Cataclysmic variables with low accretion rates are faint and/or show only subtle features that indicate accretion, making them more difficult to find compared to high accretion rate systems. This has left some gaps in our knowledge of post common-envelope binaries. Using the Zwicky Transient Facility (ZTF), we have discovered more than a thousand eclipsing white dwarf systems, including a few systems that initially seemed detached, but after more detailed followup are shown to be accreting. These are long period AM CVn systems; cataclysmic variables with very low-mass donors ('period bouncers'); but also magnetic, wind-accreting white dwarf – M-dwarf binaries. I will give an overview of the low accretion rate white binaries we discovered with ZTF and how we found them. In addition, I will discuss how these systems fit into our current understanding of post-common envelope evolution. Specically, some of these systems are the final stage of CV evolution and the discoveries suggest that they never stop accreting or become dynamically unstable. In addition, the discovery of wind accreting systems sheds light on how magnetic fields are generated in PCEBs.

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## Athena, the next-generation X-ray observatory: synchrotron facilities for the assembly and characterization of Silicon Pore Optics

POSTER

Luis Abalo

Leiden University; cosine measurement systems

Athena is the next-generation X-ray observatory from the European Space Agency to be launched in the mid-2030s. It uses a unique modular technology to realize its 2.5 m diameter optics made of several hundreds of co-aligned mirror modules. The telescope has a Wolter-Schwarzschild design with a 12-m focal length, aiming to give 1.4 m2 of the effective area with a point spread function of 5" half-energy width at 1 keV and an energy range of 0.2 to 12 keV. For this new technological challenge, Silicon Pore Optics (SPO) has been developed using the highest-grade double-side polished 300 mm wafers commercially available. The mirror modules are assembled and characterized using beamlines at synchrotron radiation facilities. In this work, we present an overview of the work carried out at the X-ray Pencil Beam Facilities (XPBF1 & XPBF2) of the PTB at BESSY II (Berlin, Germany) and, in the near future, MINERVA at ALBA (Barcelona, Spain). The new beamline is planned to be operational during 2023.

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POSTER

## Optical identification and follow-up observations of SRGA J213151.5+491400: A new Puzzling Polar-type MCV

Solen Balman
Istanbul University

We optically identify a new source SRGA J213151.5+491400, found by Spectrum Roentgen-Gamma (SRG) observatory to be a polar-type magnetic cataclysmic variable (MCV) along with the X-ray confirmation. We present optical data from telescopes in Turkey (RTT150 and T100 at the TUBITAK National Observatory), and in Russia (6m and 1m at SAO RAS), together with the X-ray data obtained with ART-XC and eROSITA telescopes aboard SRG and the NICER observatory. We detect the source in high state in 2020 (17.9 mag) that decreases about 3 mag into a low state (21 mag) in 2021. We find the white dwarf spin/orbital period to be 0.059710(1) days (85.98 min) using optical photometry. The long slit spectroscopy in the high state yields a power law continuum increasing towards the blue with a prominent He II line along with the Balmer line emissions with no cyclotron humps; consistent with MCV nature. ART-XC detection yield an X-ray flux of about (4.0-7.0)e-12 erg/cm$\hat{2}$/s in the high state. eROSITA detects a dominating hot plasma component kT_max extgreater 32 keV in the high state declining to
7e-13 erg/cm2/s in 2021 (low state). The NICER data obtained in the low state reveal a two-pole accretor dominated with electron scattering opacity and show a soft X-ray component with a blackbody temperature of 12-19 eV and an unabsorbed flux of 3.0e-11 erg/cm$\hat{2}$/s which has never been recovered for a polar system before. Doppler Tomography confirms the polar nature revealing ballistic stream accretion along with magnetic stream during the high state. (–note that the abstract has 23 co-Authors)

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POSTER

## Connecting QPO lags and accretion variability in MAXI J1820+070

Niek Bollemeijer
University of Amsterdam

While quasi-periodic oscillations (QPOs) have been observed in many black hole X-ray binaries (BHXRBs) and seem to be a fundamental property of the accretion process, their origin is still a point of discussion. QPOs have been linked to variations in coronal geometry, which in itself is also a subject of debate. Novel X-ray spectral-timing techniques may help to break degeneracies between different QPO and corona models, telling us more about the shape and dynamics of the accretion flow. The NICER observations of the very bright BHXRB MAXI J1820+070 provide us with the unique opportunity to study the relation between accretion variability and the QPO on the QPO coherence time-scale. I will present a new X-ray spectral-timing analysis of MAXI J1820+070 in its hard state, demonstrating that the timing properties of the QPO change on short time-scales and are highly dependent on the compared energy bands. The results suggest a strong link between coronal geometry and accretion variations on a time-scale of tens of seconds.

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## Confirming the magnetic nature of the white dwarf in J1603+19

POSTER

Ana Carolina Mattiuci Figueiredo
INPE

CRTS CSS160906 J160346+193540 (J1603+19) is a cataclysmic variable (CV), classified as a polar candidate. The system has an orbital period of 81.96 min, near the minimum observed value in CVs. In the long term, J1603+19 alternates between high- and low-brightness states, which differ by 2 - 3 magnitudes in optical bands. Recent studies indicate that the system has a mid-infrared (IR) flux in excess of the expected from the secondary star. This emission modulates with the orbital period with an amplitude of around 1 mag, which is interpreted as cyclotron emission from a magnetic accretion structure. Cyclotron humps in the near-IR spectrum indicate a white-dwarf magnetic field of about 5 MG, a very low value for a polar. Spectroscopic time series show emission lines with two components, which can be associated with the magnetic accretion column and the secondary surface region facing the white dwarf. In this contribution, we present optical photometry and polarimetry of J1603+19 in V, R, and I bands obtained in the high-brightness state. In R and I bands, both the flux and the polarization show a variation consistent with the orbital period, as observed in mid-infrared wavelengths, corroborating the existence of magnetic accretion. The flux amplitudes reach a few hundredths of magnitude and the circular polarization is small and alternates between positive and negative values. We discuss these results in light of the proposed configuration for the system.

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## Multi-band observations of Intermediate polars with OPTICam

POSTER

Noel Castro Segura
University of Southampton

OPTICam, a new multiband instrument mounted in the 2m telescope at San Pedro Martir. I will present the first results from two campaigns focused on accreting white dwarfs (WDs) where the accretion disc is truncated by the magnetic field of the WD. Our multi-colour data reveal differences in phase and amplitude of the optical modulations. The signal the harmonic of the spin period is dominated by longer wavelengths suggesting a non-thermal origin, however at shorter wavelengths the spin period is and its beat frequency present in the power-spectrum, probably associated to the hot-spot in the surface of the star. We also present a multiwavelength campaign with OPTIcam + NICER of the recent outburst from the old nova GK-Per.

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POSTER

## X-ray flashes from the low-mass X-ray binary IGR J17407-2808 revealed by NuSTAR and XMM-Newton

Lorenzo Ducci

University of Tuebingen

In this study, we report the results of an observational campaign on the low-mass X-ray binary IGR J17407-2808, using quasi-simultaneous observations from NuSTAR and XMM-Newton. Our data reveal an atypical active state of the source, characterised by significant flaring events on timescales of a few seconds, with flux enhancements of more than 1000 times at intervals of a few tens of seconds. In addition, we used available near-infrared data to refine the classification of the donor star in the system. By conducting a comparative analysis with other X-ray binaries exhibiting exceptionally high variability, we probe the nature of IGR J17407-2808 and discuss the origins of its remarkable, powerful, and fast X-ray flares.

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POSTER

## A comparative broadband X-ray study of the dwarf nova SS Cyg during Quiescence and Outburst

Anirban Dutta

Raman Research Institute, Bangalore, India

SS Cyg is one of the brightest dwarf novae that undergoes outbursts every 40-50 days and lasts 10-12 days. The outburst is associated with thermal-viscous instability in the accretion disk, which changes the geometry and properties of the X-ray emitting boundary layer (BL). Using simultaneous broadband X-ray data (0.3-50 keV) from XMM-Newton and NuSTAR observatories, we present a comparative study on how the nature of the X-ray emitting plasma changes during the quiescent and outburst phases of SS Cyg. We notice significantly hard X-ray spectra during quiescence and copious soft X-ray emission in the form of blackbody during outburst, highlighting the changes in the BL's opacity and mass accretion rate. Our study conclusively confirms the presence of the reflection hump in the 10-30 keV range for both phases, which arises when X-ray photons hit colder material and undergo Compton scattering. We discuss the differences in the reflection parameters during the two phases and what are the potential reflection sites i.e. white dwarf surface and/or accretion disk. We also explore the effect of intrinsic absorbers near the source and possible additional contributors affecting photons in X-rays.

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## Spectroscopic observations of the bounce-back cataclysmic variable SDSS J105754.25+275947.5

POSTER

Juan Echevarria

UNAM

We present spectroscopic observations of SDSS J105754.25+275947.5, obtained with the GTC-Osiris. We have complete orbital cycles in both H$\alpha$ and H$\beta$. We will compare our determination of the semi amplitude of H$\alpha$, the strongest lines, with the results of McAllister et al. (2017). The K1 semi-amplitude appears larger that previously thought. We also present Doppler tomography of both lines an discuss their structure. An attempt has been made to show the co-added spectra in H$\beta$ and a possible fit to the visible broad lines in absorption, coming from the white dwarf.

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## The Impact of Resolution on Accreting Stellar Mass Black Holes

POSTER

Simone Gordon

University of Edinburgh

The Bondi-Hoyle-Lyttleton (BHL) model is a widely-used black hole accretion scheme in cosmological simulations. First written in the 1950s, it is applied to situations in which the relevant scales for accretion cannot be resolved, yet it does not fully capture the complex gas dynamics surrounding the black hole. In this study, we investigate the performance of the BHL model at down to an unprecedented minimum cell width of 1e-4 pc in a 3D cosmological hydrodynamical simulation to motivate the adaptation of the BHL model for use in low-resolution simulations of accretion onto stellar-mass black holes. In order to make the environment from which the black hole accretes as realistic as possible, we simulate the radiative lifetime and death of the population III star (zero-metallicity) from which it forms. With the black holes' gravitational zone of influence resolved, one can directly simulate the dynamics of the surrounding gaseous disc and thus more accurately determine the accretion rate onto the black hole using a simple mass-flux scheme. We compare the behaviour in the under-resolved and well-resolved cases to determine a prescription for black hole accretion as a function of resolution.

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POSTER

## The long-term (a)periodic variability of Ultraluminous X-ray sources

Andres Gurpide
University of Southampton

The majority of Ultraluminous X-ray sources (ULXs) are now thought to be powered by super-Eddington accretion onto stellar-mass compact objects, offerring an observational template to understand extreme accretion physics. One of the puzzles still surrounding ULXs is the nature of their superorbital periods in the tens to hundreds of days identified in the Swift-XRT lightcurves. Even if these are believed to be due to accretion of the (super-)critical disk, the mechanism producing precession still remains unclear. Moreover, the long-term aperiodic variability remains unstudied owing to the inherent difficulty in the analyses of irregularly sampled time series. In this talk, I will present our analyses of the aperiodic and periodic variability present in the Swift-XRT lightcurves of a sample of 20 ULXs. We have overcome problems related to the irregular sampling using a combination of Gaussian Processes (GP) and lightcurve simulations to infer the long-term Power Spectral Densities (PSD). Using the best-fit broadband continuums, we have rigorously assessed the presence of any narrow peak in the PSD, finding clear evidence for the periods to be transient or varying, supporting earlier assertions that the periodicities are unstable. Analysing the properties of the broadband noise against the spectral properties (hardness ratio and/or temperature of the soft component), we have discovered a strong anti-correlation between the break of the PSD and the hardness ratio i.e. harder ULXs are much more variable in the long-term than softer sources. I will discuss the implication of such correlation with regards the viewing angle of ULXs. Finally, I will discuss how the analysis of the spectro-periodic properties has allowed us to rule out a three of the models put forward to explain the superorbital periods, although their nature still remains unclear.

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POSTER

## Superorbital modulations in supergiant High Mass X-ray binaries

Nazma Islam
NASA Goddard Space Flight Center and University of Maryland Baltimore County

A puzzling variety of superorbital modulations have been discovered in several supergiant High-Mass X-ray binaries. To investigate the mechanisms driving these superorbital modulations, we have analyzed Swift BAT lightcurves of these sources and constructed their dynamic power spectra and superorbital intensity profiles. These Swift BAT observations are complemented by pointed Swift XRT, NICER and NuSTAR observations performed at the predicted maximum and minimum phase of a single superorbital cycle for each of these sources. The results from this analysis indicate the possible presence of structures in the stellar winds of the supergiant stars in the form of multiple co-rotating interaction regions (CIRs) or from tidal oscillations.

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## The candidate CV CXOGlb J002415.8-720436 in the globular cluster 47 Tucanae: a new magnetic CV in the period gap

POSTER

Nicola La Palombara

INAF

CXOGlb J002415.8-720436 is a candidate cataclysmic variable in the globular cluster 47 Tucanae, with an orbital period of 8649 s. Here we report the results obtained with a systematic timing and spectral analysis of all the observations of this X-ray source performed between 2000 and 2022 with Chandra. In all cases the source spectrum can be described equally well with a power-law model, a thermal Bremsstrahlung model, or a model from hot diffuse gas (vmekal in XSPEC). The source does not show any spectral variability, though its overall flux varies over time. In most observations the source flux is in the range fx = (4-8)E-14 erg/cm2/s (corresponding to a source luminosity of the order of $10\hat{3}2$ erg/s), while in the remaining observations it is significantly lower. The timing analysis confirms the orbital period of 8649 s but reveals that the pulse profile is highly variable: it changes not only between observations performed at different epochs, but also between observations performed at a few days of distance from each other. This implies that the profiles are complex and variable on time scales of less than a day. Our findings strongly support a classification as Polar CV for CXOGlb J002415.8-720436.

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## Magnetospheric interaction in white dwarf binaries AR Sco and AE Aqr

POSTER

Maxim Lyutikov

Purdue University

We develop a model of the white dwarf (WD) - red dwarf (RD) binaries AR Sco and AE Aqr as systems in a transient propeller stage of highly asynchronous intermediate polars. The WDs are relatively weakly magnetized with magnetic field of $\sim$ few $10^6$ G. Currently, the WD's spin-down is determined by the mass loading of the WD's magnetosphere from the RD's at a mild rate of $\dot{M}_{WD} \sim 10^{-11} M_\odot$/yr. The WD was previously spun up by a period of high accretion rate from the RD via Roche lobe overflow with $\dot{M} \sim 10^{-9} M_\odot$/yr, acting for as short a period as tens of thousands of years. The non-thermal X-ray and optical synchrotron emission come from (relativistic) analogues of terriestrial van Allen belts (particles trapped in the WD's magnetosphere).

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POSTER

## Analysis of the photometric behavior of the symbiotic star CH Cyg on short (hours-days) time scales.

Vladyslava Marsakova & Sergey Shugarov

Odesa Richelieu Scientific lyceum & Astronomical Institute of the Slovak Academy of Sciences

CH Cyg is one of the most interesting symbiotic variable stars that exhibits various types of variability on different timescales, including eclipsing, pulsating, irregular rapid variability and flickering caused by accretion processes. In this study, we present our analysis of approximately 8000 optical CCD-observations in the B-band with a time resolution of 60 seconds during the active stage of this variable. Our analysis revealed complex brightness variations, including rapid fluctuations with a characteristic time of approximately one hour or less, short variations, which we cannot analyze in detail because of relatively long exposition of our frames and irregular brightness oscillations from night to night. We also identified a relatively regular variability with a period of about 0.18-0.19 days, which had not been reported in previous publications on CH Cyg. Notably, our earlier observations in 2014-15 also showed a period of approximately 0.19 days. We suggest that this period may be associated with pulsations or other processes on the white dwarf, since at longer wavelengths, fast brightness variations disappear and radiation from the red giant dominates. We investigated the stability of the new period and features of other brightness variations and compared them with previously published results.

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POSTER

## A Machine Learning driven search for members of the cataclysmic variable population

Dharmesh Mistry

Liverpool John Moores University

The study of cataclysmic variables (CVs) has played a crucial role in our understanding of white dwarf accretion across a range of conditions. For example, by examining the AM Her and DQ Her subtypes, we can study magnetically controlled accretion under a variety of white dwarf magnetic field strengths. Meanwhile, the superhumps and superoutbursts of SU Uma systems, particularly the WZ Sge and ER Uma subclasses that mark extremes in supercycle length, facilitate a deeper understanding of dwarf nova outbursts, which are best described by different variations of the accretion disk instability model; and as a further example, the rare AM CVn systems offer valuable insights into accretion of helium-rich matter under extremely short orbital periods. To advance our understanding of accretion physics, we need to expand our sample size, particularly of more elusive subclasses. Wide field synoptic surveys provide a great opportunity to achieve this. However, given that alerts of transient events can exceed a million per night in the case of ZTF (a rate set to be dwarfed by LSST), we need the assistance of machine learning (ML) algorithms for source classification to handle this data deluge and to pinpoint rare sources for follow-up. In this talk, I will present details of our ML pipeline, designed

for the extraction of various CV subtypes from the ZTF transient alert stream. I will discuss the light curve characteristics most informative for discriminating between subclasses and then share the results of spectroscopic follow-up of interesting targets identified by our pipeline.

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## Polarised reflection: Creating polarised XILLVER tables

POSTER

Edward Nathan
CalTech

The results from recent IXPE observations suggest that the X-rays reflected off accretion discs form an important contribution to the polarisation spectrum seen from accreting systems. This poster will showcase the latest work to expand the X-ray reflection code XILLVER to solve the radiative transfer problem with the addition of polarisation information, to produce tables of the polarised reflection spectra.

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## The 100-month Swift catalogue of SFXTs: diagnostics from outburst properties

POSTER

Patrizia Romano
INAF-Osservatorio Astronomico di Brera

Supergiant Fast X-ray Transients (SFXT) are HMXBs with a supergiant displaying X-ray outbursts reaching luminosities of 10e38 erg/s. We present our comprehensive analysis of the SFXT Swift triggers that provides tools to predict whether a transient with no X-ray counterpart may be an SFXT candidate. These tools can be exploited to develop future X-ray missions with large FoV instruments. We examined all available data on SFXTs outbursts that triggered the Swift/BAT collected between 2005-08-30 and 2014-12-31, particularly those for which Swift/XRT data are also available. We processed all Swift data uniformly with the Swift Burst Analyser to produce spectral evolution dependent flux light curves for each outburst. The BAT data let us infer useful diagnostics to set SFXT triggers apart from the general GRB population, showing that SFXTs give rise uniquely to image triggers and are simultaneously very long, faint, and 'soft' hard-X-ray transients. The BAT data alone can discriminate SFXTs from other fast transients such as anomalous X-ray pulsars and soft gamma repeaters. However, to distinguish SFXTs from, for instance, accreting millisecond X-ray pulsars and tidal disruption events, the XRT data collected around the time of the BAT triggers are decisive. The XRT observations of 35 SFXT BAT triggers show that in the soft X-ray SFXTs display a decay in flux from the peak of the outburst of at least 3 orders of magnitude within a day and rarely undergo large re-brightening episodes, favouring a rapid decay down to the quiescent level within 3-5 days at most.

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POSTER

## TW Pictoris as a transitional accreting white dwarf?

Simone Scaringi
Durham University

Accreting white dwarfs are often found in close binary systems with orbital periods ranging from tens of minutes to several hours. In most cases, the accretion process is relatively steady, with significant modulations only occurring on time-scales of days or longer. We report the discovery of abrupt drops in the optical luminosity of the accreting white dwarf binary system TW Pictoris by factors up to 3.5 on time-scales as short as 30 minutes. The optical light curve of this binary system obtained by TESS clearly displays fast switches between two distinct intensity modes that likely track the changing mass accretion rate onto the white dwarf. In the low mode, the system also displays magnetically-gated accretion bursts (equivalent to Type-II bursts in accreting neutron stars), implying a weak magnetic field of the white dwarf truncates the inner disk at about the co-rotation radius in this mode. The properties of the mode switching observed in TW Pictoris appear analogous to those observed in transitional millisecond pulsars, where similar transitions occur, although on timescales of about tens of seconds. Our discovery establishes a previously unrecognised phenomenon in accreting white dwarfs and suggests a tight link to the physics governing magnetic accretion onto neutron stars.

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POSTER

## What is a micronova, and can we trigger one?

Simone Scaringi
Durham University

Nova explosions are caused by global thermonuclear runaways triggered in the surface layers of accreting white dwarfs. I will report the discovery of optical bursts observed in the accreting white dwarfs TV Columbae, EI Ursae Majoris and ASASSN-19bh. The bursts have a total energy of approximately 1e-6 times than those of classical nova explosions and bear a strong resemblance to the thermonuclear explosions occurring on the surfaces of accreting neutron stars (type-I X-ray bursts). One common feature between two out of the three systems is that the white dwarf magnetic field is strong enough to reveal the white dwarf spin period, and thus funnel material onto the magnetic poles. I will introduce a simple model that may explain the observed rapid bursts through thermonuclear runaway explosions occurring on a magnetically confined footprint in accreting white dwarfs.

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## Cataclysmic variables: a key population of gravitational wave sources for LISA

POSTER

Simone Scaringi

Durham University

Cataclysmic variables are semi-detached compact binaries with periods in the range 75 min $\lesssim P_{\rm orb} \lesssim$ 1 day in which a white dwarf accretes from a (roughly) main-sequence or sub-stellar companion. Here, we estimate the predicted gravitational wave signals from the Galactic population of cataclysmic variables and evaluate their significance for *LISA*. First, we find that cataclysmic variables will contribute significantly to the *LISA* Galactic binary background, thus limiting the mission's sensitivity in the relevant frequency band. Second, at least three known systems are expected to produce strong enough signals to be individually resolved within the first four years of *LISA*'s operation. Third, we predict a spike in the unresolved gravitational wave background at a frequency corresponding to the cataclysmic variable minimum orbital period $P_{min}$. This excess noise may impact the detection of other low signal-to-noise systems near this characteristic frequency. Fourth, we note that the amplitude of the excess noise spike associated with $P_{min}$ can be used to measure the cataclysmic variable space density without the biases and selection effects that plague samples selected from electromagnetic signals. Our results highlight the need to explicitly include the Galactic cataclysmic variable population in *LISA* mission planning, both as individual gravitational wave sources and generators of background noise, as well as the exciting prospect of characterising the cataclysmic variable population through their gravitational wave emission.

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## Accreting white dwarfs in symbiotic binaries in the light of multiwavelength SED modelling

POSTER

Augustin Skopal

Astronomical Institute of the Slovak Academy of Sciences

I will present some basic effects resulting from wind accretion onto white dwarfs in symbiotic binaries, the nature of which can be understood using the method of multiwavelength SED modelling of their global spectrum. I would mention the issue of their outbursts, which are connected with the formation of a disk-like structure in the orbital plane, enhanced mass outflow, and the ejection of bipolar jets. Also I will mention some tasks for future research.

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POSTER

## Multiwavelength research of the of orbital and pulsation variability of symbiotic nova PU Vul

Sergey Shugarov

Astronomical Institute of the Slovak Academy of Sciences

PU Vul is a rare symbiotic nova system with observable deep eclipses. It is an important for analysis of stellar systems parameters and understanding the processes of interaction between red giant, accreting white dwarf and common envelope. We present UBVRI light curves of PU Vul after the outburst in 1978, composed of our own photometric observations and those compiled from sources, as well as our measurements using photographic plates. The last eclipse was either not detected or had a very small amplitude, possibly due to low activity and brightness of the accretion structures in recent decades. We rectified the orbital period of the system and analyzed the red giant's pulsation variability, which has a cycle of about 215-219 days. The shape and amplitude of pulsation light curves change with the passband (due to different contributions of white dwarf and red giant on different wavelength) and the phase of orbital period (so the oscillations become more pronounced and regular before and after the eclipse). We discuss the physical reasons on that behavior. We also studied variations of color indexes, and tested multicolor variation for period changes and multiperiodicity. Our findings shed light on the complex interactions and physical processes that occur in interacting binary stellar systems and may have implications for understanding the common-envelope evolution of these systems.

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POSTER

## A classical nova with a not so classical shell configuration

Claus Tappert

Universidad de Valparaíso

The classical nova V1425 Aql, 23 years after the eruption, presents two significantly different ejecta components, one being centred symmetrically around the post-nova, the other consisting of about three times higher velocity material that is not visible in the allowed transitions, and that is located at about 2.3 arcsec to the south-west of the position of the binary. Comparing the velocities and spatial extensions of the two ejecta, we find that both originated in the same nova eruption. Using optical long-slit spectroscopy, narrow-band imaging and integral field spectroscopic data, we explore possible extrinsic and intrinsic mechanisms for the asymmetry of the high-velocity material.

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## The corona-jet evolution of black hole X-ray transients MAXI J1535-571 and MAXI J1820+070

POSTER

Yuexin Zhang

Kapteyn Astronomical Institute, University of Groningen

MAXI J1535−571 and MAXI J1820+070 are black hole X-ray transients that exhibited very bright outburst. Given the high flux, several X-ray space observatories obtained unprecedented high signal-to-noise data of key parts of the outburst. We studied the corona of MAXI J1535−571 and MAXI J1820+070 in the hard/soft-intermediate state (HIMS/SIMS). Using our time-dependent Comptonization model, we found that in the bright hard state and HIMS the corona is horizontally extended, while in the HIMS to SIMS transition the corona is vertically extended. We follow the evolution of the corona and the radio jet during the HIMS-SIMS transition, and find that the jet flux peaks after the time when the corona extends to its maximum vertical size. The jet flux starts to decay after the corona contracts vertically towards the black hole. This behavior points to a connection between the X-ray corona and the radio jet similar to that seen in other sources.

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## High-speed photometry of Intermediate Polar CTCVJ2056-3014

POSTER

Anke van Dyk

South African Astronomical Observatory

CTCV J2056-3014 is a fast-spinning (29.61s) intermediate polar system with a reported short orbital period of 1.76 hours. We have conducted extensive high-speed optical photometry (1-s cadence) using two 1m diameter telescopes at the South African Astronomical Observatory. Differential lightcurves were analysed using the Lomb-Scargle Fourier technique to identify periodicities in the power spectra. We present our preliminary analysis confirming the presence of the previously reported spin period of the white dwarf. However, dynamic power spectra also reveal quasi-periodic behaviour on occasion, showing frequency modulations inconsistent with a beat between the spin period and the reported orbital period. Amplitude modulations are also present at the 29.61-second spin on timescales of $\sim$ 1000 seconds. Flickering and variability in the lightcurves on timescales of 1 - 20 minutes are compatible with turbulence in the inner disk region.

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