BINARY STARS IN THE SPACE ERA

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Book of Abstracts

Keele UNIVERSITY

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S1: Space photometry and modelling binary systems

Binary Stars in the Space Era

July 1
S1
Invited

John Southworth
Keele University

The study of binary stars is vital for the understanding of how stars evolve, both in isolation and via mass exchange or loss. On the observational side, the study of binary star systems can be demanding both in effort and telescope time. This situation has changed completely: huge and high-quality datasets from missions such as CoRoT, Kepler and TESS have revolutionised most aspects of this work. I trace the results from space missions, from the venerable OAO and Voyager missions to the current riches of TESS, then look forward to what the PLATO mission promises.

Modeling binary systems

July 1
S1
Invited

Andrej Prša
Villanova University

The last two decades fundamentally transformed the way we model binary systems. This shift is caused partly by the deluge of data coming out of modern, time-resolved surveys of the sky, and partly by the advances in computing infrastructure. In this talk I will review some of the novel approaches to modeling binary stars, most notably on how to properly interpret and assign parameter uncertainties in model solutions. As these solutions calibrate swaths of modern astrophysics, it is crucial that we recognize the common pitfalls in attributing unrealistically small uncertainties to our solutions.

PHOEBAI: Solving Hundreds of Thousands of Eclipsing Binary Light Curves with Deep Neural Networks

Marcin Wrona
Villanova University

Studying eclipsing binary (EB) stars is crucial for understanding fundamental stellar properties and astrophysical processes. Traditionally, sophisticated modeling programs like PHOEBE-2 are employed to derive parameters from periodic brightness variations, though these methods are computationally intensive. To overcome this limitation, we propose using a deep neural network (NN) trained on synthetic data, significantly accelerating analysis from days to seconds [1]. Our research focuses on optimizing the NN architecture, quantifying systematic uncertainties, and applying this network to derive photometric parameters—such as the sum of fractional radii, radius and temperature ratios, eccentricity, orbital inclination, and argument of periastron—from extensive EB catalogs, including those obtained from space-based missions like TESS and ground-based surveys such as OGLE. [1] Wrona, M. and Prša, A., ApJS 277 (2025) 1, DOI:10.3847/1538-4365/ada4ae.

S2: Benchmark stars (1)

Benchmark eclipsing binary stars

July 1
S2
Invited

Nicola Miller
Uppsala University

Over the last decade, space-based observations of double-lined detached eclipsing binaries (SB2 DEBs) by TESS, Kepler and CHEOPS, along with stable high-resolution spectroscopy, have significantly improved measurements of stellar masses and radii – in the best cases it is now common to approach <0.2% in precision. DEBs are fast becoming a valuable source of precise benchmark stellar properties, needed for testing stellar evolution models, calibrating empirical relations (asteroseismology, cosmological distance scale), and validating data-driven or machine-learning pipelines (PLATO, 4MOST). While 350+ systems now have masses and radii measured to 2% or better, some important physical properties (e.g. effective temperature) and spectral types (e.g. M-dwarfs) still suffer from inhomogeneity and systematic effects, requiring further study. I will review recent results and challenges in the field of benchmark DEBs, and look ahead to future prospects, notably the upcoming launch of PLATO.

Understanding M Dwarf Radius Inflation - Insights from Low Mass Eclipsing Binaries

July 1
S2

Yasmin Davis
University of Birmingham

Precise measurements of host stars are crucial in the search for Earth-like exoplanets, and M dwarfs are particularly favourable targets in this quest. Low-mass eclipsing binaries (EBLMs) provide unique opportunities to empirically determine stellar masses and radii, especially in regimes where stellar models may be systematically biased. We present results from one of the largest homogeneous studies of EBLMs, investigating the radius inflation problem. By combining space-based photometry with ground-based spectroscopy, we leverage the methods' complementary strengths to achieve high-precision constraints on stellar parameters. This approach highlights the critical role of single-lined binaries in stellar characterisation, demonstrating that they are essential for refining mass-radius relationships, even

alongside double-lined binaries. Our work enhances confidence in the accuracy of stellar parameters, particularly for single stars where empirical measurements are unattainable.

Single to double-lined: absolute dynamical SB1 masses with HRCCS

July 1
S2

Adam Stevenson
University of Birmingham

High contrast ratio eclipsing binary systems provide an opportunity to probe mass-radius relations for low-mass stars. Being single-lined, secondary parameters are ultimately dependent on stellar models. Using novel high-resolution cross-correlation techniques on optical spectra, we can now extract the weak signal of the secondary and determine its semi-amplitude. This turns the system into a double-lined eclipsing binary, allowing for absolute dynamical masses to be calculated. I will present results for targets in the EBLM project, where we measure the masses of 0.2 M_{sun} secondary companions with accuracy of 1-2%. EBLM targets are eclipsing binaries comprised of F/G + M-type stars, with a typical flux ratio of 10^{-4}. I will also compare absolute to modelled secondary and primary masses, demonstrating that single-lined results are as reliable as double-lined binaries. These results help glean understanding of the M-dwarf domain, where parameters are often poorly constrained.

High-precision masses and ages of white dwarfs in wide binaries

July 1
S2

JJ Hermes
Boston University

White dwarf stars have been used for decades as precise and accurate age indicators. I will present results from an extensive experiment to use wide (>100 au) WD+WD binaries discovered from Gaia, which should be coeval and never interacted, in order to empirically test the precision and accuracy of white dwarf age-dating. Further, I will discuss a select set of growing measurements that use the gravitational redshift of white dwarfs in wide binaries to yield precise insights into the white dwarf mass-radius relationship. These observations hold the potential to measure the distribution of hydrogen-layer masses in white dwarf stars, as well as could help empirically determine the maximum mass for carbon-oxygen white dwarf progenitors to Type Ia supernovae.

S3: Astrometric binaries / Gaia (1)

Perspectives on astrometry of binary stars with Gaia DR4 (and a little bit of interferometry)

July 1
S3
Invited

Pierre Kervella
LIRA, Paris Observatory & CNRS French-Chilean Laboratory for Astronomy

Gaia DR4 will be different from previous releases thanks to the publication of individual astrometric epochs for all targets. Previously released parameters were limited to average values over the Gaia observing window (3 years for the DR3). Epoch measurements will enable much more refined analyses taking into account the complexity of individual objects through a dedicated modeling of their sky trajectories. Two main cases can be distinguished: binaries or multiple stars for which each component is measured separately by Gaia (resolved systems) and binary targets for which the companions are either very faint or spatially unresolved. A large number of resolved systems is present in existing Gaia releases. Anomalies in the motion of single targets provide unique hints on dark and/or very low mass orbiting companions. I will present the examples of the Gaia BH3 black hole and exoplanets. I will conclude on how to prepare for the interpretation of Gaia DR4 data.

Population modeling with Gaia astrometric binaries

July 1
S3

Kareem El-Badry
Caltech

By precisely measuring the motions stars on the sky over time, the Gaia mission is conducting a comprehensive census of the Milky Way's binary stars. These data have enormous potential to constrain the population of binary stars, giant planets, and compact objects in the Solar neighborhood. But in order to use the published orbit catalogs for statistical inference, it is necessary to understand their selection function: what is the probability that a binary with a given set of properties ends up in a catalog? I will describe a generative model for the selection function of Gaia astrometric orbits that broadly reproduces the Gaia DR3 binary sample. I will describe our emerging view of the populations of black holes, neutron stars, and white dwarfs in au-scale binaries, focusing in particular on their mass, period, and eccentricity distributions.

In Search of the Invisible: Hunting for Dormant Black Holes with Gaia DR3

July 1
S3

Johanna Müller-Horn
Max-Planck-Institut für Astronomie

With a vast set of orbital solutions, Gaia DR3 has revolutionised binary physics, and lead to the exciting discoveries of dormant black holes in binary systems with luminous stars. Yet, many binaries with dark companions likely remain undetected, falling below DR3's stringent signal-to-noise thresholds for orbit publication. To uncover these hidden systems, we have developed a candidate selection scheme that combines astrometric, kinematic, and photometric variability indicators from Gaia. Using a forward modelling approach, we identify Gaia BH lookalikes—systems exhibiting similar signatures to confirmed BHs but lacking explicit orbital solutions in DR3. In this talk, I will present our new catalog of compact object binary candidates, along with results from our high-resolution spectroscopic follow-up campaign. I will highlight the most promising dormant BH candidates and discuss how these efforts can improve our understanding of binary evolution and compact object formation.

Realistic predictions for Gaia black hole discoveries: comparison of isolated binary and dynamical formation models

July 1
S3

Pranav Nagarajan
Caltech

Gaia astrometry has enabled the discovery of three dormant black holes (BHs) in wide binaries, challenging traditional binary evolution models. Numerous alternative formation models have been proposed, with several using simplified detectability metrics to forecast future detections. I apply a realistic forward-model of Gaia's astrometric orbit catalog to synthetic BH binary populations from (a) isolated binary evolution (IBE, Chawla et al. 2022) and (b) dynamical formation in star clusters (Di Carlo et al. 2024). The IBE model predicts that no BH binaries should have been detected in DR3, while the dynamical model overpredicts the observed number instead. I discuss the differences in assumptions between the population synthesis models that could drive this discrepancy. Adopting the dynamical model and re-scaling to DR3, I make realistic predictions for Gaia BH discoveries in future data releases, and estimate the fraction of Milky Way stars that have BH companions in au-scale orbits.

S4: Astrometric binaries / Gaia (2)

Revisiting symbiotic stars with interferometry and Gaia

July 1
S4

Henri Boffin
ESO

Symbiotic stars serve as exceptional laboratories for investigating mass transfer processes in binary systems. While radii inferred from rotational velocities or spectral types suggest small Roche-lobe filling factors, the presence of ellipsoidal variability in their light curves, presumably caused by tidally deformed giants in many symbiotic systems, indicates the opposite. Interferometric observations of symbiotic giants - in this case, with the PIONIER instrument on the VLTI - combined with distance measurements provided by the Gaia satellite, offer a promising avenue to resolve this discrepancy. I will present the analysis of 13 symbiotic stars and another symbiotic-like system, showing what we can learn on their Roche lobe filling factor and their evolutionary state. I will also show what is the perhaps the most convincing case of tidal deformation of a red giant being observed directly, thanks to the interferometric technique.

A forward model of Gaia's astrometric WD + MS binaries

July 1
S4

Natsuko Yamaguchi
Caltech

Close binaries hosting white dwarfs (WDs) around main sequence (MS) stars are useful probes of binary interactions that occurred when the WD progenitor was a giant. The third data release of the Gaia mission contained astrometric orbital solutions for hundreds of thousands of binaries which led to the discovery of over 3000 WD + MS binary candidates. They have AU-scale orbits which are intermediate to standard predictions of post-stable mass transfer and post-common envelope products, making their formation histories elusive. A population-level study characterizing their intrinsic properties and occurrence rates is called for, but is challenging due to the complex selection functions involved. In this talk, I will provide an overview of our current efforts to tackle this challenge through a forward modeling approach of the astrometric WD + MS binary sample.

Calibrating asteroseismology scaling relation by interferometric observation on Gaia binaries

July 1
S4

Yi Lu
University of Exeter

Asteroseismology has much potential to provide masses for large sample. However, the scaling relation method assumes stars have internal structures homologous to the Sun. Since this assumption is unrealistic, masses obtained need to be verified, and the scaling relation needs to be calibrated with model-independent mass. This calibration currently rests on a sample of only 17 RGB calibrators, where seismic masses and dynamical masses are available. Combining a single interferometric epoch around 30 minutes with Gaia photocenter orbit, the full-3D orbits, dynamical masses, and precision ages of both components can be derived. In this talk, I introduce the method and compare seismic and dynamical masses for the first targets observed. Our method could provide calibrators efficiently and those at different evolutionary stages for the first time. In the end, I aim to use the revised scaling relation to calibrate published seismic mass measurements, maximizing the outcome of PLATO.

Characterising the population of binary white dwarf stars with astrometry, photometry and spectroscopy

July 1
S4

Ingrid Pelisoli
University of Warwick

White dwarf binaries are behind some of the most informative astrophysical events. They are the progenitors of type Ia supernovae used as standardisable candles in cosmology, they are strong sources of gravitational waves detectable by the upcoming Large Interferometer Space Antenna mission, and they are excellent tools for constraining binary evolution. Existing samples of white dwarf binaries are either highly inhomogeneous, or limited to lowest mass systems, limiting our ability to use them as astrophysical tools. The Gaia space observatory has revolutionised our ability to identify white dwarf binary candidates, providing an opportunity to address the limitations of existing samples, as homogeneous samples of candidate white dwarf binaries can be identified using its astrometric and photometric data. In this talk, I will present my group's work on characterising well-defined samples of white dwarf binaries by combining Gaia data with light curves and spectroscopy.

Intermediate-Separation White-Dwarf Binaries in the Gaia Era

July 1
S4

Na'ama Hallakoun
Weizmann Institute of Science

The Gaia mission has unveiled a previously unexplored region in the parameter space of binary systems hosting white-dwarf companions. These systems, with orbital separations around 1AU and often non-zero eccentricities, are unexpected given the interactions during the white-dwarf progenitor's asymptotic giant branch (AGB) phase. Consequently, they challenge our current understanding of mass transfer, and are not represented in standard binary population synthesis studies. Moreover, they appear to be related to other post-AGB stars, such as barium stars, CH stars, carbon-enhanced metal-poor stars, blue stragglers/lurkers, symbiotic stars, and hot subdwarfs. In this talk, I will present the distinctive properties of these systems, as revealed by an unprecedented sample that we have recently identified in Gaia DR3 data, and discuss their implications for binary evolution. I will also outline our roadmap for follow-up observations and detailed characterization in anticipation of Gaia DR4.

S5: Binary formation

The formation of multiple stellar systems

July 2
S5
Invited

Paul Clark
Cardiff University

We review the current state of theoretical and numerical research on the formation of binary stars and higher-order multiples. Over the past decade or so, numerical (magneto-)hydrodynamical simulations have become increasingly complex, including much of the physics that is thought to play a role during the collapse and fragmentation of prestellar cores. Particular attention has focused on the role of dust cooling as a way to rid the gas of thermal support as attempts to fragment in discs. A better understanding of the way magnetic fields orientate the accretion flows has also emerged, to the point where the infamous magnetic breaking catastrophe has likely been side-stepped. What is emerging is now a rough consensus on how multiple systems are formed, and how they get their wide variety of properties. We will also cover some recent work on N-body dynamics, which helps us understand the dynamical evolution that takes us beyond the initial formal phase, and into the observable regime.

Binary birth distributions through evolution back-tracing

July 2
S5

Alex Kemp
KU Leuven

The birth distributions of binary stars form the initial conditions upon which our understanding of binary stellar evolution is built. Yet no derivation of binary birth distributions to date accounts for the effects of binary evolution, compromising the accuracy of modern binary stellar evolution models. As binaries are increasingly invoked to explain diverse astronomical phenomena, the need for robust, observationally calibrated birth distributions has never been more pressing. In my talk, I will explain how binary population synthesis modelling can be used to derive birth distributions – and other quantities – efficiently for large binary populations, accounting for a comprehensive set of binary physics and incorporating modern, asteroseismically callibrated stellar evolution models. I will also present progress towards enriching a population of 15000 TESS eclipsing binaries with physical properties including masses and radii.

The evolution of W UMa contact binaries

July 2
S5

Matthias Fabry
Villanova

W UMa-type contact binaries are the progenitors of stellar mergers. Several luminous red novae (LRNe) transients have been associated with stellar merger events, most notably V1309 Sco. To understand the origin of LRNe, detailed models of the progenitor channels are needed, including W UMa binaries. As of yet, we have no complete understanding about the structure, evolution and merger conditions of W UMa systems. Only partial models exist, or binary-interaction processes are ignored. In this talk, I will present ongoing work in W UMa modeling. I will discuss the effects of energy transfer in the common envelope, which I implemented in the binary-evolution code MESA. I find that the models evolve away from equal masses due to thermal relaxation oscillations. I will show the results of the first evolutionary grids of W UMa stars and connect the efforts on the evolutionary side to constraints obtained from photometric modeling of TESS light curves.

A Census of Massive Eclipsing Binaries in a Milky Way-like Galaxy

July 2
S5

Cheyanne Shariat
California Institute of Technology

The evolution of close binaries containing massive stars remains poorly understood, despite their importance as direct progenitors of exotic astrophysical phenomena such as gravitational wave mergers, high-mass X-ray binaries, and stripped-envelope supernovae. Central to their evolution is mass transfer, a ubiquitous yet transient phase. In the Milky Way, most massive binaries are hidden from our view by dust, making population-level studies challenging. A less biased view of the massive binary population can be achieved with resolved-star studies of nearby galaxies. We present a census of the 100 most luminous eclipsing binaries in the Whirlpool Galaxy (M51), a face-on spiral 8 Mpc away. Our study leverages a 50-epoch photometric survey carried out with the Hubble Space Telescope and reveals both detached and contact systems. This population provides a critical benchmark for testing models of binary interaction and the formation of compact object binaries.

S6: Binary populations

Populations and Formation Processes of Binary Stars

July 2
S6
Invited

Maxwell Moe
University of Wyoming

Multiplicity statistics shed invaluable insight into the formation processes of binary stars. I will review both canonical and recently discovered trends among various binary properties, including multiplicity fraction, stellar mass, orbital period, mass ratio, eccentricity, spin, metallicity/abundance, and environment. I will discuss these trends in the context of protobinary fragmentation, accretion, and dynamical migration. At the end, I will highlight how Gaia DR4 will fill in the missing gaps within this multi-dimensional parameter space.

Binarity at LOw Metallicity (BLOeM): An ESO/FLAMES monitoring of 1000 Massive Stars in the SMC

July 2
S6

Tomer Shenar
Tel Aviv University, Israel

Extensive surveys have shown that binarity is ubiquitous among massive stars, yet their multiplicity at low metallicity remains largely unexplored. In my talk, I wil present early results from the Binarity at LOw Metallicity (BLOeM) survey (2023–2025), an ESO large programme to spectroscopically monitor 1000 massive stars in the SMC at 1/5 solar metallicity. Preliminary findings indicate an initial binary fraction of 80%, the highest measured for any galaxy to date. I will compare binary fractions across evolutionary stages—main sequence, OBe, blue supergiants, and yellow supergiants—and outline future plans for hunting dormant black holes and obtaining precise mass measurements in the 8 – 80 Msun range. Finally, I will describe how this survey sets the stage for space-based (e.g., TESS) asteroseismology at low metallicity by establishing a clean, bias-controlled sample of single stars and binaries.

Multiple Star Results for Nearby Mid-to-Late M Dwarfs from an All-Sky, High-Res Spectroscopic Program

July 2
S6

Jennifer Winters
Bridgewater State University

We present results from a five-year program to gather multi-epoch, high-resolution spectra of an all-sky, volume-complete sample of 413 fully convective M dwarfs (masses 10-30% that of the Sun) within 15 parsecs. We identified both long- and short-period multiple systems, and measured orbits for those with short periods. We combined our radial velocities with precise astrometric data to calculate Galactic space motions to search for any multiplicity-age relation. We find no significant difference between the stellar multiplicity rates of the thin disk and thick disk populations (proxies for age) in our sample. We are also obtaining complementary TESS photometric data and high-resolution speckle imaging data for this benchmark sample, which will complete the search for stellar companions at all separations. Our survey will more than triple the number of these fully-convective stars with both high-resolution spectroscopic, astrometric, and photometric data.

Dwarfs of Fire and Ice: Studying irradiated white dwarf-brown dwarf binaries

July 2
S6

Jenni French
University of Birmingham

Irradiated white dwarf—brown dwarf binaries are ideal laboratories for studying highly irradiated atmospheres at high SNRs. Building on a comprehensive HST program that revealed patterns in atmospheric properties, we are investigating JWST NIRSpec phase curves of five such systems. Four of these systems eclipse, allowing direct observations of the brown dwarfs' nightsides. The program will constrain key processes in irradiated atmospheres including photochemistry, vertical transport and cloud formation. Our targets sample three orders of magnitude of external irradiation flux to constrain key atmospheric processes and explore how irradiation flux influences heat transport efficiency and disequilibrium chemistry. I will present an overview of our sample, and the results of the prior HST work, comparing to hot Jupiters and other brown dwarf systems. I will show the initial results from our first set of JWST expectations, and discuss the expectations from the observations yet to come.

S6: Binary evolution

The Uncertainties in Binary Star Evolution

July 2
S7
Invited

Elizabeth Stanway
University of Warwick, UK

The crucial role of binary star evolution in shaping the destiny of massive stars is now widely recognised. These are the stars which dominate the ionizing photon production in a stellar population, and which dominate the light from young, low metallicity stellar populations such as distant galaxies. However binary stellar evolution physics in many of the key evolutionary phases, particularly those in massive stars, remains uncertain and must be probed by stellar evolution modelling and comparison of its outputs with observational data. Here I will discuss the key aspects of binary stellar evolution and the uncertainties therein.

Chemical evolution of close binaries - tidally-enhanced or tidally-suppressed mixing?

July 2
S7

Luca Sciarni
University of Geneva, Switzerland

In binaries, interactions (tides, mass transfer) shape the stellar rotation, affecting the chemical evolution. In detached short-period systems, tides are generally thought to enhance mixing, leading in the most extreme cases to chemically homogeneous evolution. I present state-of-the-art GENEC simulations incorporating both dynamical tides with radiative damping and equilibrium tides acting on small sub-surface convective zones, following and improving the treatment proposed in POSYDON. The link between tides and mixing turns out to be more complex, as it depends on the assumptions for the angular momentum transport (AMT, magnetic or hydrodynamic with advecto-diffusive transport) and the system's configuration (mass, period). Synchronization velocities decrease with increasing periods and depending on the AMT, tides reduce or increase mixing compared to what is predicted for single stars. I discuss observational consequences of these results (nitrogen enrichment, location in the HRD).

Population studies of accreting white dwarfs

July 2
S7

Anna Francesca Pala
European Southern Observatory (Germany)

Thanks to their large numbers, proximity, and brightness, accreting white dwarfs are ideal laboratories for constraining the models of binary evolution. In this talk, I will discuss how the synergy between the largest ground-based telescopes, the Hubble Space Telescope, and the ESA Gaia space mission, allowed us to (i) derive masses and accretion rates for a large sample of accreting white dwarfs, and (ii) build the largest volume-limited sample of accreting white dwarfs within 300 pc. Thanks to these results, we have revealed the presence of an anti-correlation between the average accretion rates and white dwarf masses, and shown that the observed space density is about 1-2 order of magnitude lower than predicted. These findings provide observational evidences for the presence of an additional mechanism of angular momentum loss not accounted for by most evolutionary models, and I will present these results in the context of the current models of compact binary evolution.

Apsidal Motion in (O-Star) Binaries: GENEC rotating binary models put to the k2-test

July 2
S7

Sophie Rosu
University of Geneva, Switzerland

The apsidal motion rate (AMR) in close eccentric binaries is a means to unveil the stars' internal structure. I make use of it to test GENEC internal mixing processes. The AMR depends on the tidal interactions occurring between the stars through k2, a measure of the star's inner density profile. The AMR is commonly derived from the eclipses' times of minima, made possible thanks to high precision TESS/Kepler observations. I propose to derive the AMR from RVs obtained over a long timescale combined with LCs to get high-accuracy consistent physical and orbital parameters. I illustrate it for massive binaries. Confronted to observations, standard non-rotating single star models usually predict stars with too low a density contrast (the well-known k2-discrepancy). I confront GENEC models including tidally-enhanced rotational mixing to observed systems and reveal the mixing processes' efficiency necessary to reproduce the density contrasts, paving the way for the next generation of models.

S8: Interacting binaries and mergers

X-ray emission from helium star+black hole binaries as probes of tidally induced spin-up of second-born black holes

July 2
S8
Invited

Koushik Sen
Steward Observatory, University of Arizona

Tidally induced spin-up of stripped helium stars in short-period (< 1 d) binaries with black holes (BHs) has been proposed as one of the possible mechanisms to reproduce the high-spin tail of the BH spin distribution derived from gravitational wave (GW) merger observations. At such short periods, a fraction of the intense stellar wind from the stripped helium stars may be accreted by the BHs, and its gravitational potential energy may be released as X-rays. We estimate lower limits on the X-ray luminosity and its observability from the population of stripped helium star+BH binaries that evolve into GW mergers. We find that 10-50 % of stripped-helium stars in the above population transfer enough wind matter onto the BH to produce X-ray luminosities above 10**35 erg/s, up to 10**39 erg/s. We show that most of these X-ray-bright systems also have the shortest orbital periods where tides spin up the stripped helium star component, thereby establishing an empirically testable correlation.

Stellar interactions, nucleosynthesis and pulsations as seen by binary-polluted stars

July 2
S8

Ana Escorza
Instituto de Astrofísica de Canarias (IAC)

The interaction between stars with extended convective envelopes and their companions creates a fascinating zoo of peculiar objects. Understanding the properties of binary products is crucial for unraveling the interaction history within such systems, as well as the physical and chemical processes of their progenitors. Barium stars, a key example of these objects, form when an Asymptotic Giant Branch star transfers material enriched with heavy elements to a companion. However, existing binary evolution and nucleosynthesis models fail to fully reproduce their orbital and chemical

characteristics, presenting an opportunity to learn about single and binary stellar evolution. In this talk, I will present recent observational data on barium stars and their companions, focusing on their presence among pulsating stars. I will discuss how the comparison between binary polluted and single pulsators could offer valuable clues about the effects of mass transfer on stellar structure and evolution.

Assessing the impact of binary interactions on the timing and location of supernovae with cogsworth

July 2
S8

Tom Wagg
University of Washington

A binary's evolution affects its final properties (e.g., orbital architecture) and its position and velocity in the host galaxy. However, the galactic potential can alter trajectories and velocities. We present cogsworth, a general purpose tool that couples binary evolution and galactic dynamics. Using cogsworth, one can self-consistently evolve a large-scale population of binaries following a chosen star formation history and integrate their orbits through a galactic potential, accounting for the impact of supernova kicks on galactic trajectories. As a first application, we show how binary interactions can delay and displace core-collapse supernovae (CCSN): we find that 14% occur >100 pc from their parent cluster, and 26% occur >44 Myr after star formation in our simulations. We evaluate the robustness of these results to variations in binary physics, initial conditions, and galaxy parameters, as well as construct an analytic model for the distributions.

Short-term variability of symbiotic binaries observed with TESS

July 2
S8

Jaroslav Merc
Astronomical Institute of Charles University

Symbiotic stars, interacting binaries with an evolved red giant and a white dwarf or neutron star, exhibit diverse photometric variability. On short timescales, accretion-driven flickering from accretion disks is observed. We analyzed TESS light curves of a large sample of symbiotic stars, detecting flickering-like variability in 20 systems, including 13 new cases. This raises the total number of symbiotic stars with confirmed flickering to 35. While rare across all symbiotics, flickering is detected in up to 80% of accreting-only systems, highlighting the prevalence of accretion disks. Additionally, we identify periodic signals on timescales of tens of minutes, likely linked to magnetic white dwarf rotation. In one system, we observe a shift in the rotational period by 80 seconds over 25 years, challenging current models of the evolution of these objects.

S9: Pulsations in binaries (1)

Asteroseismology of multiple systems: how binarity and pulsations go hand-in-hand for constraining stellar structure theory

July 3
S9
Invited

Dominic Bowman
Newcastle University

Most stars in the Universe are born with at least one companion. In single stars, our understanding of convection, mixing, and rotation is incomplete, but a companion star can further compound these uncertainties through tides, mass transfer, and even mergers. Asteroseismology of pulsating stars allows us to probe physical processes deep within stellar interiors, whereas eclipsing binaries provide model-independent masses and radii. When combined these complementary methods yield the most precise constraints for stellar theory. Through recent space photometry surveys, high-quality light curves of thousands of pulsating binary systems are now available. In this review talk, I will provide an overview of how detached eclipsing binaries are excellent laboratories for measuring precise masses and radii. Moreover, I focus on the insight gained from asteroseismology of binary systems, and how they provide unique constraints for improving stellar structure and evolution theory.

The First Two Tri-axial Pulsators

July 3
S9

Rahul Jayaraman
Massachusetts Institute of Technology

The Transiting Exoplanet Survey Satellite (TESS) has enabled the discovery of novel pulsating stars, including tidally tilted pulsators (TTPs), where the pulsation axis of a star in a tight binary is pulled in line with the system's tidal axis. The recently-discovered phenomenon of "tri-axial pulsation" (TAP) appears to be a broader phenomenon than TTPs. In a TAP, radial and non-radial pulsations are split about three orthogonal axes, readily enabling mode identification. I will discuss our discovery of the first two TAPs–TIC 184743498 and TIC 435850195, both Delta Scuti stars in tight binaries (P $<$ 3 d)–and highlight pulsational properties of these stars. In particular, TAPs exhibit "Y10y"

modes, whose amplitude peaks at the maximum of the ellipsoidal light variations. I will introduce our tools to perform physically-motivated light curve and SED modeling to constrain stellar parameters. Finally, I will introduce a toy model for these systems that was recently broadened to all TAPs.

Push, pull and pulse: Tidally perturbed Beta Cephei stars in eclipsing binaries

July 3
S9

Ayush Moharana
Keele University

Beta Cephei Stars (BCEP) are one of the few probes into the stellar structure of massive stars. To translate the structural parameters to evolutionary changes, we need estimates of stellar parameters. BCEP in eclipsing binaries (EBs) can give us a complete set of parameters needed to explore massive star evolution. But being in a binary, especially close binary makes the star experience tidal pulls which deviates the star from the simple spherical symmetry. Using 10 sectors of observations from TESS and high-resolution spectroscopy, we present a case study of two BCEP in EBs and use the complexity of the situation to probe not only the stellar structure and evolution, but also apsidal motion and light travel time effect in these complex systems.

Tracing binary evolution with asteroseismology and spectroscopy of B stars in four Galactic open clusters

July 3
S9

Federica Nardini
Newcastle University

Massive stars drive the chemical and dynamical evolution of galaxies. The majority of them are found in binary systems, where interactions significantly alter their evolution, making it challenging to infer their physical properties and their final fate. Identifying and characterizing binary interaction products is extremely challenging but being able to identify them is key to understanding the impact of binary evolution. In this talk, I will present the combined analysis using Gaia astrometry, HERMES/Mercator spectroscopy, and asteroseismology using TESS mission light curves for a sample of B stars in four young Galactic clusters of different ages, and discuss their binary and pulsation properties with a focus on interesting objects. Particular attention will be given to those that exhibit signatures of binary interaction, shedding light on the diverse outcomes of massive star binaries.

S10: Pulsations in binaries (2)

Unlocking Stellar Secrets: The Advantages of Combining Asteroseismology and Binary Star Physics

July 3
S10
Invited

Kelly Hambleton Prša
Villanova University

Asteroseismology, provides unparalleled insights into the internal structure and evolutionary states of stars. When applied to binary systems, seismic analysis gains an extra edge by combining asteroseismic inference with independent orbital constraints, enabling precise determinations of stellar masses, radii, and ages. Well-detached binaries serve as pristine laboratories where seismic scaling relations can be rigorously tested. Conversely, interacting binaries—with their tidal forces, angular momentum exchange, and episodes of mass transfer—alter seismic signatures, giving rise to interesting asteroseismic phenomena including tidally excited pulsations, underluminous stars and tidally tilted pulsators. In this talk, we will explore the influence of binary star modeling on asteroseismology and highlight the critical role asteroseismology has played in understanding complex binary systems.

Pulsation timing binaries in all-sky space photometry

July 3
S10

Simon Murphy
University of Southern Queensland

Pulsation timing has provided orbits for hundreds of pulsating stars in binaries from space-based photometry. While most of these have been found with Kepler, the time span of TESS data now exceeds 7 years, which allows for studies of comparable precision but across the whole sky. I will present the results of a search for TESS pulsation timing binaries, including for the bright dSct star alpha Pictoris, for which tight astrometric constraints also exist. Some of the new pulsation timing binaries have thick-disc kinematics, suggesting they are field blue stragglers that have undergone mass transfer.

Sounding the treasure trove – Asteroseismology of solar-like oscillators and binaries systems

July 3
S10

Paul Beck
Universidad de la Laguna & Instituto de Astrofísica de Canarias

Asteroseismology of solar-like oscillators offers unique insights into stellar evolution from the main sequence to the advanced giant phases. In this talk, we explore how stellar oscillations, combined with binary dynamics, allow us to trace changes in orbital period, eccentricity, and stellar activity driven by evolution and tidal interactions. We show how asteroseismology reveals the impact of star-star interactions on activity and mass loss. However, the lack of solar-like oscillators in eclipsing binaries limits our ability to calibrate models. We highlight how data from ESA's Gaia and the upcoming PLATO mission will address this gap, offering benchmark systems to improve seismic scaling relations and stellar evolution models.

KIC10001167: The prototype eclipsing binary for red giant seismology in the old in-situ Milky Way population

July 3
S10

Jeppe Sinkbæk Thomsen
University of Bologna

The study of resonant oscillation modes in low-mass red giant branch (RGB) stars enables age inference of unprecedented (<10%) precision. I will present a percent-level dynamical mass determination for a red-giant branch star in a detached eclipsing binary, which serves as a fundamental validation point for asteroseismology-based age determinations of old stars. While asteroseismology is now accepted as a prime astrophysical tool that can provide stellar ages with unrivalled precision throughout the Milky Way, it previously lacked independent validation, especially at old (10 Gyr) ages. In our work we provide such a long-sought calibrator, allowing us to test and verify the accuracy of asteroseismic mass measurements to a level of 1.4% and hence the age scale to 6%. These findings provide a significant step forward in our ability to temporally resolve structures in our Galaxy, affirming asteroseismology's potential for defining an accurate age scale linking ancient stars in the Milky Way to studies of the formation and evolution of galaxies at early cosmic times.

S11: Comparison to theoretical models

Binary Population Synthesis: Past, Present, and Future

July 3
S11
Invited

Poojan Agrawal
KU Leuven

Binary population synthesis is a computational technique to rapidly model the evolution of a large number of binary star systems while taking into account their diverse interactions, such as mass transfer and tidal coupling. It has been instrumental in understanding various astrophysical processes including stellar transients and the chemical enrichment of galaxies. Over the last decade, the emergence of robust and user-friendly stellar evolution codes has transformed our approach to binary population synthesis. At the same time, advancements in our observational capabilities - especially the detection of gravitational wave signals from compact binary mergers - have highlighted the need for a better understanding of binary evolution parameters. In my talk, I will review the rapid binary population techniques of the past, outline current methods in binary population synthesis, and explore what the future holds as multi-dimensional stellar evolution codes become available.

Unveiling the hidden population of massive stars stripped in binaries with new UV photometry

July 3
S11

Bethany Ludwig
KU Leuven

Intermediate mass stripped stars are predicted to be hot, compact, and strong emitters in the extreme UV. Consequently, a subset of these stars can be identified by a UV excess, appearing bluewards of the MS. However, exploiting this signature requires UV data for many stars—a challenge due to uncertain distances, reddening, crowding. Here, I present a new UV photometric catalog containing over 700,000 sources in the Magellanic Clouds, where low extinction, known distances, and testable metallicity effects provide an ideal environment. I identify hundreds of candidates in each galaxy, with brightnesses and colors that agree with expectations for

stripped stars of 2–8 Msun, bridging the gap between subdwarfs and WR stars. I show how these candidates are being spectroscopically confirmed and characterized by discussing an interesting case study of a stripped star in a short period (4.2 h) orbit around a compact object companion, a possible progenitor of a compact object merger.

Stripped stars in the Magellanic clouds: beyond the tip of the iceberg

July 3
S11

Lisa Blomberg
California Institute of Technology

Recent work has discovered a population of intermediate-mass stripped helium stars in the Magellanic clouds, which are higher-mass (1-5 Msun) analogs of canonical hot subdwarfs (sdBs). The objects discovered so far are likely to only represent a small and biased fraction of the total population. To characterize the completeness of the known stripped star sample, we forward-model a simulated stripped star population, inject the simulated sources into Swift UV images, and reproduce the cascade of quality cuts used to select the observed stripped star candidates in the Clouds via UV excess. Our analysis reveals that a large majority of stripped stars will not be selected by searches based on UV excess, because of crowding, dust extinction, and flux dilution from binary companions which bury them in the main sequence. I will discuss the inferred total stripped star population of the Clouds and the predicted properties of the stripped stars that have thus far evaded detection.

Critical tests of Binary Physics with Space Mission Data of Post Interaction Binaries

July 3
S11

Selma de Mink
Max Planck Institute for Astrophysics

Space missions bring are advancing our understanding of binary physics. UV data (SWIFT, UVEX) revealed stripped stars; astrometry (GAIA) uncovers binaries and runaways; and asteroseismology (TESS, PLATO) probes interiors of mergers and mass gainers. Time permitting, I will present examples from our most recent work. 1. Be+sdOB binaires directly constrain the efficency of mass transfer. We find evidence for highly conservative accretion, challenging current widely-adopted binary models (Lechien+25). 2. In our new study of the orbital properties of Be X-ray binaries we find strong evidence for extremely low supernova kicks and for kicks aligned with stellar spin (Valli+25). 3. Space photometry enables unprecedented insight into stellar interiors. We explore promising asteroseismic signatures of binary interaction predicted by theory (Wagg+24, Bellinger+24). 4. Is Betelgeuse a stellar merger? I discuss new insight from 3D modelling of Red Supergiants (Ma+24,+25).

S12: Looking forward to PLATO

From Telemetry to Discovery: PLATO Simulations for Binary Star Science

July 3
S12
Invited

Andrew Tkachenko
Institute of Astronomy, KU Leuven

PLATO is an M-class mission of the European Space Agency, focused on the detection and characterisation of Earth-like exoplanets around Sun-like stars. In addition to its core science, PLATO will dedicate 8% of its telemetry to the exploration of various topics within the Complementary Science Program. This program will be implemented through open calls for Guest Observer proposals, inviting projects that aim to maximise the scientific return of the mission. While PLATO is scheduled for launch toward the end of 2026, now is the ideal time for the community to become familiar with the mission's capabilities and prepare for its first observations. To support this, the PLATO Complementary Science leadership, in collaboration with the PlatoSim team, has initiated the design and execution of a set of realistic, end-to-end simulations. In this contribution, we will give an overview of the simulations conducted so far and delve deeper into the dataset related to (eclipsing) binary stars.

Expanding the CensuExpanding the Census and the Diversity of Circumbinary Planets with PLATO

July 3
S12

Hans Deeg
Instituto de Astrofísica de Canarias

Well-characterised circumbinary planets (CBPs) remain scarce, with only 14 confirmed transiting CBPs from Kepler and TESS. These CBPs share common traits: most reside near the inner stability limit of their binaries, and very short-period binaries rarely host transiting CBPs. While some trends align with theory, others—such as binary periods, planetary sizes, and orbital coplanarity—may reflect observational biases from the small sample. The current sample of CBPs resembles the early years of exoplanet research, suggesting that a more diverse CBP population might still be found. PLATO's high-precision photometry offers a unique chance to expand the census of CBPs and their diversity, particularly for misaligned systems that are difficult

to detect and confirm. However, CBP detection is not part of PLATO's Exoplanet Analysis System pipeline. To address this, a data challenge for the community is prepared, to detect CBPs within simulated PLATO light curves.

Death and Dearth of Circumbinary Planets

July 3
S12

Mohammad Farhat
University of California, Berkeley

It has long been argued that the occurrence rate of circumbinary planets (CBPs) should be comparable to that of planets around single stars. Yet, only 14 transiting CBPs have been identified by Kepler and TESS, suggesting a dearth in CBPs detection. This dearth is striking among short-period binaries, with two-thirds of observed eclipsing binaries having periods <7 days, while the shortest-period binary known to host a CBP is Kepler-47 (7.45 days). One then wonders if these signatures are indicative of physical evolution pathways, or are due to observational bias. Here, we propose a novel mechanism to explain these features, based on the effect of encountering a non-linear, secular resonance in the course of these systems' evolution histories. When a system is captured into this resonance, angular momentum exchange between the binary and the planet continuously pumps the planet's eccentricity, placing it at the peril of dynamical instabilities, ejection, or engulfment by the binary.

Stability of light curve solutions for benchmark candidates in PLATO's LOPS2 field

July 3
S12

Ganesh Pawar
CAMK, Toruń

Detached eclipsing binaries (DEBs) with radii and masses with precision below 1 percent are poised to serve as benchmark stars for forthcoming space missions, like ESA's PLATO mission. We are focusing on DEBs in PLATO's LOPS2 field, and these five benchmark candidates were observed from TESS in multiple sectors coupled with multi-epoch radial velocities. Using diverse modelling codes, we estimate stellar parameters using light curve and radial velocity modelling across each sector. We found an inconsistency in achieving sub-percent precision, significantly influenced by stellar activities and atmospheric parameters were derived via spectral disentangling with a focus on ensuring the consistency between multiple model-independent photometric and spectroscopic effective temperature estimates. The study emphasizes the critical role of precise parameter determination, highlighting its substantial impact on determining stellar ages accurately.

S13: Distance scale

Local distance scale with eclipsing binary stars

July 4
S13
Invited

Dariusz Graczyk
CAMK, Poland

To be announced.

Exploring Spectroscopic Binaries: From SB9 to the 4MOST Large Survey

July 4
S13

Thibault Merle
BLU-ULB - Royal Observatory of Belgium

The properties of binary stars are fundamental for understanding star formation and evolution. Spectroscopic binaries (SBs) are genuine binaries that probe short to intermediate orbital periods, shedding light on various stellar evolution pathways. We propose: (i) to present the current status of the Ninth Catalogue of Spectroscopic Orbits (SB9) with the recent Non-Single Stars catalogue from Gaia DR3, focusing on SBs; (ii) to provide insights into the detectability and characterisation of SBs in a forthcoming large multi-object spectroscopic survey 4MOST, which is set to begin operations early next year.

Demographics and properties of delta Scuti stars in binary systems

July 4
S13

Alexios Liakos
IAASARS, National Observatory of Athens, Greece

The revised catalogue of delta Scuti stars in binary systems, along with their statistical properties, is presented. Owing to space missions, more than 900 delta Scuti pulsators in binaries have been included. The sample is classified based on the Roche geometry of the binary systems to investigate potential systematic differences in the evolution of the pulsators due to the proximity of their companion star. Statistics, demographics, and distributions of these pulsating stars within evolutionary diagrams are provided. Furthermore, updated correlations between pulsation and orbital periods, as well as evolutionary status, are examined. We note that absolute parameters have been precisely determined for only a small fraction of the total sample. Consequently, this study aims to encourage researchers to undertake systematic analyses of these objects to increase the number of systems with well-defined physical properties.

Improving the treatment of stellar distortions in spectroscopic and photometric studies

July 4
S13

Michael Abdul-Masih
Instituto de Astrofisica de Canarias (IAC)

Deviations from spherical symmetry due to rotation or binary interactions are common. In addition to affecting the evolution, stellar distortions also lead to non-uniform surface gravity and temperature distributions across the surface of distorted stars, which are often neglected when modelling them. This is problematic as these 3D effects can lead to vastly different observed parameters depending on the inclination of the object and the specific gravity darkening law used in the modelling. For example, a critically rotating massive star can appear thousands of kelvin cooler when viewed edge-on than when viewed pole-on, and the eclipse depths of a semi-detached system can change by several percent depending on the chosen gravity darkening prescription. In this talk, I will present new methods to better account for these 3D effects both spectroscopically and photometrically, which will prove to be game changing in the PLATO era.

S14: Benchmark stars (2)

Detached eclipsing binaries and benchmark stars

July 4
S14
Invited

Krzysztof Hełminiak
NCAC Toruń, Poland

The interest in precise estimation of stellar parameters is growing due to new exoplanet space missions coming soon: PLATO and Ariel. This interest is also driven by improved models of stellar structure and evolution. The need for precise and accurate sets of fundamental stellar parameters is now stronger than ever. One of the best sources of them are detached eclipsing binaries (DEBs). In my talk I will present the (not so distant) history of gathering "the best of the best" DEBs, the recent developements, as well as the work that directly supports the PLATO mission.

The Radius Inflation Problem in M-dwarfs - Insights from CHEOPS and TESS and a look to the future

July 4
S14

Matthew Swayne
University of Glasgow

M-dwarf stars are the most common in the galaxy and have long been a subject of great interest in astrophysics. However, in observations over the last decades many M-dwarfs have been observed with radius measurements differing significantly from those predicted by theoretical models. Such a difference could indicate missing physics and impact on predictions of M-dwarf properties and measurements of any bodies orbiting around them. As part of the Eclipsing Binaries with Low-Mass stars (EBLM) Project, we set out to explore this problem. We observed 23 eclipsing binaries with the CHEOPS satellite as part of their Ancillary program using accompanying measurements from TESS to calculate radius inflation. In this talk we display these results alongside other recent inflation results, discussing if we can infer any trends behind the effect and examining potential directions for future observation projects.

A catalog of low-mass TESS M&M eclipsing binary orbital and physical properties

July 4
S14

Dominic Oddo
University of New Mexico

Eclipsing binaries offer key insights into stellar astrophysics. With the NASA Transiting Exoplanet Survey Satellite (TESS) mission's near-entire sky coverage and exceptional sampling cadence, we now have the ability to characterize large numbers of tight eclipsing binary (EB) systems. This allows us to probe the stellar properties and, at a population level, the formation channels for a large number of tight EBs. We have compiled a catalog of low-mass TESS binaries comprised of M dwarfs primaries and secondaries (M&Ms). We have identified likely EBs en masse in TESS light curves, vetted these signals, and calculated their orbital and physical properties. At a population level, we find a relative over-abundance for these low-mass tight binaries to be in twin pairs, which is consistent with other spectral types. We additionally find that our period distribution fits well to a Gaussian distribution, which is likely a result of dual selection and observational biases.

Wide Binaries Elucidate Mid-to-Late M-Dwarf Spindown

July 4
S14

Emily Pass
Massachusetts Institute of Technology

Age estimates are challenging for M dwarfs; wide binaries can therefore provide a unique window into the evolution of these stars. The rotation periods of mid-to-late M dwarfs are bimodal, suggesting an abrupt transition between fast and slow rotation rates. By studying M dwarfs in wide binaries with stars of known age, I observe gradual spindown within the rapidly rotating mode for a few billions of years before the abrupt transition, although some stars make the jump by 600 Myr. By measuring the magnetic activity of stars in wide M-M binaries, I also find a strong mass dependence: 0.3 $M_\odot$ M dwarfs spin down to a quiescent state billions of years earlier on average than their 0.1 $M_\odot$ counterparts. These findings have important implications for planetary atmosphere retention and the `cosmic shoreline' of mid-to-late M dwarfs, suggesting many key planets for atmospheric characterization received a historic XUV flux that exceeds the canonical scaling relation by more than a factor of 3.5.

Posters

Tercentenary of John MIchell (1725-1793)

July 1
S4
P1

Edwin Budding
RASNZ VSS

John Michell, the 'father of double star astronomy', was born just 300 years ago. His lifetime fits fairly centrally into the 18th Century enlightenment era– a period characterized by reason, liberality and scepticism. Although relatively little is known about this science pioneer, it is enough to make his reputation outstanding. The connection with binary stars starts with his statistical analysis, showing that some observed pairs of stars must be locally bound and not just optical pairs. But the 1767 paper includes that result as only part of a wider discussion with far-reaching implications on stellar systems and the means to observe them. Michell's ideas were largely overlooked for a long time, perhaps because they were so much in ad vance of contemporary science. The best-known example is probably his dark star (1784) discussion – an early forerunner of the Black Hole concept.

High-precision masses and distances of binary stars

July 1
S4
P2

Alexandre Gallenne & Pierre Kervella
LIRA, Paris Observatory & CNRS French-Chilean Laboratory for Astronomy

Stellar masses are often unavailable or imprecise, offering weak constraints on stellar structure and evolution. Comparing theoretical models with varying input physics and chemical compositions requires masses with <1% accuracy. Such precision is achievable only by observing binary stars and combining spectroscopy with astrometry. Our prior studies using VLTI/PIONIER interferometry achieved mass accuracies of 0.05% and distance accuracies of 0.4%. These highly precise parallaxes also enable cross-validation with Gaia measurements. The project now utilizes GRAVITY, aiming for distance accuracies <0.2%. Here are the latest results from the PIONIER, GRAVITY, and MIRCX instruments.

Visual Orbits & Alignments of Planet Hosting Binary Systems

July 1
S4
P3

Katie Lester
Mount Holyoke College

Roughly half of Solar-type planet hosts have stellar companions, so understanding how these binary companions affect the formation and evolution of planets is an important component to understanding planetary systems overall. Measuring the dynamical properties of planet host binaries enables a valuable test of planet formation in multi-star systems and requires knowledge of the binary orbital parameters. Using high resolution speckle imaging, we measured the relative astrometry of 20 binary systems in which one of the stars is known to host a transiting exoplanet, then fit the visual orbits of these systems using the orbitize! code. Our results indicate that the orbits of the binary hosts and the transiting planets have similar inclinations and are well aligned, which match the predictions of planet formation simulations.

High Angular Resolution Techniques and Results for Binary Stars with the CHARA Array

July 1
S4
P4

Christopher Farrington
CHARA / Georgia State University

The Center for High Angular Resolution Astronomy (CHARA) Array is well suited for observing a large variety of binaries with angular separations down to sub-milliarcsecond range using multiple visible and infrared interferometric techniques. Targets like eclipsing short period binaries, wide multi-year multiple star systems, and evolved interacting binary components with disks, can be observed with different methods with our six 1-m telescopes. Observations can obtain accurate component masses for double-lined spectroscopic binaries, imaging of resolved components determining the ages and direct physical sizes, and much more, all with the powerful instruments on the CHARA Array. We present here results over the last 20 years of observing binary stars along with the techniques that make it possible. We also invite the conference attendees to apply to our open-access program through NOIRLab that grants 100 nights per year for worldwide access to the Array.

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s-Process Enrichment in Gaia MS+WD Binaries

July 1
S4
P5

Param Rekhi
Weizmann Institute of Science

We investigate the s-process abundances of intermediate-separation main-sequence + white dwarf (MS+WD) binaries by leveraging data from the Gaia NSS and GALAH DR3 catalogs. These binaries, recently identified in Gaia DR3, challenge current models of binary evolution. Our results reveal a distinct domain where enhanced Ba and Y abundances depend on both the WD mass and metallicity, consistent with parameter spaces identified from asymptotic giant branch (AGB) nucleosynthesis studies having higher s-process yields. Notably, we find no correlation between s-process enhancement and orbital parameters in our sample, suggesting that accretion history is decoupled from orbital evolution in our dataset. Looking ahead, ongoing spectroscopic follow-ups of the MS+WD sample with FEROS, along with an expanded analysis of s-process-enriched MS stars from GALAH DR4, will refine our understanding of s-process abundance distributions and provide better constraints for accretion during binary evolution.

Finding Brown Dwarf Binaries in the WFPC2 Archives

July 1
S4
P6

Matthew Cole
University of Edinburgh

Ultracool dwarfs (UCDs) are difficult targets to resolve into binary components at close separations due to their inherent faintness. The distribution of UCD binaries drops off at smaller separations, possibly due to observational limitations or intrinsic formation processes. Knowing the limits at which these systems form is vital for understanding planet formation across the deuterium burning limit. Detection of UCDs at the smallest separations requires particularly deep, sharp images, such as that of the Wide Field Planetary Camera 2 (WFPC2). We use a tested and proven MultiNest based double-PSF fitting method built on extensive ePSF libraries, run over $\sim$150 of the best-studied UCDs. Firstly, we apply the method to known UCD binaries, effectively halving the previous parameter error measurements. We then repeat the process with individual UCDs, probing closer separations, analysing the potential binarity of each and placing the tightest constraints yet on companions down to $\sim$1AU.

Periodic methanol masers: from a colliding wind binary perspective

July 1
S4
P7

Fanie van den Heever
North West University, Potchefstroom, South Africa

Since the discovery of periodic class II methanol masers at 6.7 and 12.2 GHz associated with high-mass star formation regions (HMSFRs), a number of possible driving mechanisms have been proposed to explain this phenomenon. Here, we apply a more realistic treatment of the original colliding wind binary (CWB) model explanation to investigate to what extent it can describe the flare profiles of the periodic methanol masers, similar to that of the source G009.62+0.20E. It was found that the CWB hypothesis is feasible from an energetics standpoint, because the emission from the shocked gas does cause an outward shift of the position of the ionization front (IF). This confirms that the energy budget available from the shocked gas is enough to be the driving force behind the CWB model. The CWB model describes the light curve of the 1.25 km s-1 12.2 GHz velocity feature of G9.62 + 0.20E very well over 4000 d, which suggests that the time-dependent free-free emission is a possible explanation.

The Hierarchical Triple HD 74925 & the Importance of Long-term Radial Velocity Monitoring for Benchmark EBs

July 1
S4
P8

Daniel Stevens
University of Minnesota Duluth

We present the characterization of the HD 74925 star system. The detached single-lined eclipsing binary (SLEB) is composed of a late-F dwarf and a mid-M dwarf on a long, 18-day orbit that is ideal for probing the M-dwarf radius inflation and temperature suppression effects seen in shorter-period EBs. TRES radial velocities (RVs) over a 13-year baseline indicate the presence of a distant tertiary object that remains unresolved in high-contrast imaging from the NESSI speckle interferometer. We use the NESSI non-detection and the RV trend to constrain the tertiary's properties, and we show how the flux it contributes to the TESS light curves and broad-band spectral energy distribution photometry would, if unaccounted for, reduce the accuracy of the physical parameters determined for the inner EB. HD 74925 thus illustrates the importance of monitoring potential "benchmark" eclipsing binaries over long timescales.

Pulsating Stars in Close Binaries: An Overview

July 1
S4
P9

Gerald Handler
Nicolaus Copernicus Astronomical Center, Warsaw

Applying asteroseismic methods to stars located in (eclipsing) binary systems holds the promise of deriving the most accurate global and interior stellar parameters. Proximity effects can complicate such analyses - or be an asset. Located close binary systems, the tidally tilted pulsators have their pulsation axes tipped into the orbital plane by the gravitational pull of their companion. The pulsation modes are hence seen over all aspect angles during an orbital cycle permitting pulsation mode identification, overcoming one major obstacle for asteroseismology. Recently it has been realized that some of these objects pulsate around three different axes, which has been explained by a new theory that predicts new pulsation modes and how these can be identified. The first observational proofs have been obtained. Here, tidally tilted and triaxial pulsators are discussed from both an observational and a theoretical point of view, including group properties and evolutionary aspects.

NGTS-EB-7: one of the longest period EBLM systems ever found

July 1
S4
P10

Toby Rodel
Queen's University Belfast

We present the discovery of the NGTS-EB-7 AB system, a low-mass eclipsing binary (EBLM) system containing an evolved G-type primary star and a fully convective late M dwarf secondary similar to the planet host TRAPPIST-1. The secondary star has a radius of 0.125$\pm$0.006$R_{\odot}$, a mass of 0.096$\pm$0.004$M_{\odot}$ and follows a highly eccentric (e=0.71436$\pm$0.00085) orbit every 193.35875 $\pm$ 0.00034 days. The large separation between the stars means interaction will be minimal, making them a good benchmark for testing stellar evolution models for single M dwarf planet hosts. PLATO will observe the system with 26 cameras, allowing for more precise characterisation.

First Doppler image and starspot-corrected orbit for λ Andromedae: A multifaceted activity analysis

July 1
S4
P11

Özgün Adebali
AIP (Leibniz Institute for Astrophysics)

RS CVn type binary systems demonstrate high level of magnetic activity. Lambda Andromedae is one of those systems that is convenient to study this phenomenon with its brightness (Vmag = 3.82) and how it affects different layers of stellar atmospheres. By using long-term (2 years) spectroscopic observations, we present an empirical model for how stellar activity distorts the determination of radial velocities, i.e., orbital parameters. In addition, with the help of high resolution spectra, we determined the stellar surface structures by using the Doppler imaging technique. Those detections enable us to develop an understanding of connections between the surface structure (e.g., size, location and temperature of spots) and activity indicators (e.g., chromospheric emission, radial velocity jitter) of a star which can be used to interpret different science cases such as, the detection of exoplanets or the evolution of binary stars.

Measuring the Milky Way Galatic Potiential Using Eclipsing Binaries

July 1
S4
P12

Mara DeCesare
University of Minnesota Duluth

The Milky Way galaxy is a dynamical system, and it is hard to measure true parameters from within, for example, the size and shape of it. We do not know the exact number of stars,their locations throughout, their movements, nor the actual shape of the galaxy. Based on observations astronomers can only assume that the Milky Way's mass distribution is similar to the Andromeda Galaxy. Directly measuring the 3D mass distribution allows astronomers to better understand dark matter, which can be applied universally. One promising method to measure the 3D mass distribution is eclipse timing. This method uses eclipsing binaries, EBs, to measure a $\sim$0.1-second drift in the observed eclipse times over a 10-year baseline. We present preliminary eclipse timing results for KIC 10274244, an EB for which a timing precision of $\sim$2.14s has been previously determined from its Kepler light curve and for which we expect a 0.1s timing precision to be achievable from extant HiPERCAM data. Across multiple eclipse modeling methodologies, we find a typical timing precision of 1.5 s, which is 10 times larger than the 0.1s quoted in the literature. We show that we can only recover a 0.1s timing precision if we do not fit for photometric error term in our analysis. Additional work is needed to understand the role of noise, both instrumental and astrophysical, which may help achieve the literature's timing precision.

Stellar companions hinted by a spiral-shell pattern: Is the carbon star CW Leonis a triple system?

July 1
S4
P13

Hyosun Kim
Korea Astronomy and Space Science Institute (KASI)

Bipolar or multipolar lobes in pre-planetary nebulae (pPNe) often exhibit intertwined outer spiral-shell patterns, resulting from stellar wind matter accumulation during the asymptotic giant branch (AGB) phase. These structures are likely triggered by stellar or substellar companions. We regard that CW Leonis currently stands at a critical transition moment, providing a vivid illustration of the progression from an AGB star in a binary system to a pPN. We have utilized an eccentric-orbit binary model to explain the position-angle dependence in the expansion velocity of the spiral-shell pattern around CW Leonis. The necessity of a second (inner) companion is recognized by the morphological characteristics of the spiral-shell pattern. Further identifying and monitoring phase-transition candidates at the tip of AGB will provide valuable insights into the AGB-pPN transition and the role of companions in shaping the morphological evolution of these stellar objects.

Off-centre convective zones in mass accreting stellar models

July 1
S4
P14

Amadeusz Miszuda
Nicolaus Copernicus Astronomical Center PAS

We report the physical origin of transient off-centre convective zones (oCZs) that arise in mass accreting stellar models. Using detailed MESA simulations of binary evolution, we find that these oCZs are not numerical artefacts but emerge due to a local increase in density near the retreating edge of the convective core. The density enhancement raises the local opacity, which amplifies the radiative temperature gradient $\nabla_{\rm rad}$. If this gradient surpasses the Ledoux threshold $\nabla_{\rm L}$, defined by both thermal and compositional stratification, the region becomes convectively unstable. The resulting oCZs are detached from the convective core and transient: mixing within the oCZ erases the local gradient in mean molecular weight, leaving a sharp ∇_μ discontinuity at the boundary, stabilising the adjacent layers. This mechanism naturally explains the presence and evolution of oCZs, as previously reported in massive interacting stars.

The Sample and Binary Fraction of Red Supergiants in M31 and M33 by the HST Observational Data

July 2
S8
P15

Min Dai
Beijing Normal University

Previous studies show that the binary fraction of RSGs is within 15% - 40%. To refine these estimates, we investigate the binary fraction of RSGs in M31 and M33 by using the HST photometry for its high spatial resolution to resolve more stars. A preliminary step is to identify a reliable and complete sample via the F110W-F160W versus F160W diagram, which yields 2611 and 3305 RSGs in the HST/Phat and Phatter area for M31 and M33 respectively. Correspondingly, there are a total of 6567 and 7592 RSGs in the whole galaxy, significantly more numerous than previous numbers based on the ground observation, which is attributed to the high spatial resolution. The stellar parameters of RSGs, namely, effective temperature (Teff), radius (R), and luminosity (L), are derived from fitting the spectral energy distribution (SED) across the visual and near-infrared bands. The binary system is detected by finding the ultraviolet (UV) excess in the SED in comparison with the model-predicted one. The binary fraction is found to be 33.4% $\pm$ 0.9% and 30.8% $\pm$ 0.8% in M31 and M33, respectively. For luminous RSGs with log L/L_{sun} > 4.0, the binary fraction reduces to 31.7% $\pm$ 1.9% and increases to 34.6% $\pm$ 1.8% in M31 and M33, respectively. The derived binary fraction is well consistent with the prediction from the BPASS binary evolution model.

SBX: the eXtended catalogue of Spectroscopic Binary orbits

July 2
S8
P16

Thibault Merle
BLU-ULB - Royal Observatory of Belgium

The 9th Catalogue of Spectroscopic Binary Orbits (SB9) has long served as a reference for binary star research, compiling orbital solutions from decades of publications. However, its legacy infrastructure, based on flat text files and an outdated web interface, posed serious limitations in terms of accessibility, interoperability, and maintainability. To align with community standards, a standardized data query service was deployed, facilitating seamless integration with external tools and data extraction for analysis including a TAP service. The result is a catalogue renamed SBX, the eXtended Catalog of Spectroscopic Binary orbits, which opens new perspectives for community-driven extensions, enhances user interaction, and large-scale statistical studies of binary stars.

Revealing Contact Binary Light Curve Asymmetries through Big Data and Space Observations

July 2
S8
P17

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In the era of big data, the asymmetries between the two maxima of the light curves of contact binaries, known as the O'Connell effect, have been extensively studied using data from several large-scale sky surveys, including the ASASSN, NSVS, OGLE, and OMC. Our study includes 43,659 contact binaries, filtered to 797 systems with significant maxima asymmetries ($|\Delta m|$ up to 0.13 mag). We incorporated distance and temperature data from Gaia DR3 and LAMOST, examining statistical distributions and correlations of periods, temperatures, and asymmetry indices. While starspots may explain asymmetries in stars with convection zones, our findings in 161 early-type systems above the Kraft break suggest an alternative mechanism. We also report systems with peculiar unequal maxima, highlighting the unique insights provided by space-based observations.

Untangling binary stars with APOGEE spectra

July 2
S8
P18

Rhys Seeburger
Max Planck Institute for Astronomy

SDSS-IV and V have accumulated more than 50,000 APOGEE spectra for stars where Gaia has spectroscopic or astrometric evidence of binarity. We use APOGEE to search for signs of two luminous components, and try to estimate their relative fluxes, and in a few cases masses. This information breaks modelling degeneracies the beset the Gaia information. I will show first results of some interesting and unusual systems.

Impact of the stellar physics on the evolutionary pathways of massive hierarchical triple systems

July 2
S8
P19

Luca Sciarini
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In binaries, interactions (tides, mass transfer) shape the stellar rotation, affecting the chemical evolution. In detached short-period systems, tides are generally thought to enhance mixing, leading in the most extreme cases to chemically homogeneous evolution. I present state-of-the-art GENEC simulations incorporating both dynamical tides with radiative damping and equilibrium tides acting on small sub-surface convective zones, following and improving the treatment proposed in POSYDON. The link between tides and mixing turns out to be more complex, as it depends on the assumptions for the angular momentum transport (AMT, magnetic or hydrodynamic

with advecto-diffusive transport) and the system's configuration (mass, period). Synchronization velocities decrease with increasing periods and depending on the AMT, tides reduce or increase mixing compared to what is predicted for single stars. I discuss observational consequences of these results (nitrogen enrichment, location in the HRD).

HD 5501: A Rapidly Evolving Eclipsing Binary with a Variable Light Curve and H-alpha Emission

July 2
S8
P20

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Vatican Observatory

HD 5501, a hitherto little studied eclipsing binary with an early A-type primary, has been caught in a short-lived, astrophysically interesting phase of its binary evolution. Both photometric and spectroscopic observations, including photometric data from TESS, show this is a system with a highly variable light curve as well as complex variability that includes both absorption and emission components at H-alpha. A recent observation campaign involving both professional and amateur observatories, allied with modeling, has led to new insights into this remarkable system, now at the onset of Roche-lobe overflow. Strategies are numerous for future research from ground and space.

Characterization of AmFm Stars in Binary Systems: High-Resolution Spectroscopy and TESS Photometry

July 2
S8
P21

Natalia Posiłek
University of Wrocław

Chemically peculiar (CP) AmFm stars show elemental abundance anomalies due to diffusion and separation processes. They feature weak Ca and Sc lines and enhanced iron-group and rare-earth elements. In binary systems, they provide key insights into mass transport, rotation effects, and stellar evolution. This study examines binary systems with AmFm stars using high-resolution spectroscopy and space-based photometry. We analyzed radial velocities from ESO, ELODIE, SOPHIE, and FIES archives, along with new CAOS@OAC and HRS@SALT observations. Photometric data came from the TESS mission. Radial velocities were derived via cross-correlation, and orbital parameters such as periods, eccentricities, and velocity amplitudes were determined. Atmospheric modeling with ATLAS9 and SYNTHE provided effective temperatures, log g, and chemical compositions. The obtained parameters were combined with TESS photometry to gain a better understanding of pulsations in AmFm stars.

Hunting for mass-transferring eclipsing binary systems in 30 Doradus

July 2
S8
P22

Henry Willems
MPIA

Most massive stars are in binary or multiple systems. Binary interaction, often through mass transfer, can alter their evolution, making it important to identify systems that have undergone such processes. The B-type Binaries Characterisation Programme (BBC) is a multi-epoch spectroscopic study of 88 early B-type binary candidates in the star-forming region of 30 Doradus, yielding orbital solutions for 84 systems. Combined with OGLE photometry and PHOEBE modelling, key parameters like temperatures, radii, and inclinations are constrained, allowing HR diagram placement and comparison with isochrones. Of 14 systems analysed in detail, six show signs of mass transfer by deviating from a common isochrone. This highlights the need to combine spectroscopy and photometry for accurate identification and classification of (post-)mass-transferring systems. To conclude, mass transfer is a common feature in close massive binary systems, and it has to be studied to fully understand their evolution.

V3101-Cyg in the FUV: A Challenge to cataclysmic variable evolution.

July 2
S8
P23

Sergio Humberto Ramirez Ramirez
The University of Warwick

Cataclysmic variables (CVs) are key to studying accretion physics and binary evolution. We highlight the importance of UV observations through V3101 Cyg, which underwent a 9 mag superoutburst in 2019. HST COS data enabled the first direct study of its white dwarf (WD), revealing a low mass of 0.47$\pm$0.04 $M_{\odot}$—challenging current CV evolution models. Systems with WD masses below $\sim 0.6 M_{\odot}$ are not expected to follow the standard evolutionary track. Its radial velocity amplitude (22$\pm$1 km/s) and mass ratio (q=0.1) suggest a substellar companion. V3101 Cyg is a strong candidate for a WD-brown dwarf progenitor merging into the standard CV track. FUV spectra also reveal two unseen optical components: 1) emission from the boundary layer between the accretion disk and WD, and 2) a veil around the WD sharpening iron absorption lines. These findings demonstrate that UV observations are crucial for disentangling system components and improving CV characterization.

OGLE-2002-BLG-360: a unique remnant of a stellar merger

July 2
S8
P24

Thomas Steinmetz
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One of the more explosive fates of binary systems is a violent merger that potentially arises from common envelope evolution, leading to an intermediate-luminosity eruption characterised by multiple peaks. The result of the merger is a single star resembling an evolved giant with a low effective temperature that results in significant molecular and dust formation, and often exhibit disks and bipolar features. OGLE-2002-BLG-360 is an example of a Galactic red nova which erupted in 2002. It is the least studied red nova, with only one previous study. In a recent paper accepted to A&A, and presented in this poster, we show results of spectral energy distribution analysis that reveal the morphology, stellar properties, and chemistry of the source, and therefore show one of the most unusual results of a binary system that terminates in a merger.

Binary stars take what they get: Evidence for efficient mass transfer from Be+sdOB binaries

July 2
S8
P25

Thibault Lechien
Max Planck Institute for Astrophysics

Binary stars and their interactions are fundamental to understanding the formation of compact binaries, supernovae, and gravitational wave sources. A major uncertainty in binary evolution is the degree to which mass transfer occurs conservatively, with significant implications for the fate of both stars. Be+sdOB binaries, which consist of a rapidly rotating Be star and a stripped hot subdwarf companion, provide excellent opportunities for studying mass transfer. We analyze a new sample of 16 Be+sdOB binaries with well-constrained masses from spectroscopic and interferometric observations. Our results demonstrate substantial mass retention during stable mass transfer in these systems, with more than half showing mass transfer efficiencies above 50%. We discuss this new result, which challenges common assumptions used in binary evolution modeling and has significant implications for our understanding of supernovae, blue stragglers, X-ray binaries and gravitational wave sources.

One century of data of tau Canis Majoris reveals an overcontact binary and an eccentric orbit with retrograde apsidal motion

July 2
S8
P26

Sophie Rosu
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tau Canis Majoris (CMa) is an intriguing system that has captured astronomers' attention for more than a century. The two main components Aa and Ab are two evolved O stars 117au apart. Aa is itself a SB1 with a 155-days period and a 0.3 eccentricity. Since Hipparcos, we know that a 1.3-days period eclipsing binary is hidden somewhere in Aa or Ab, but nowhere else. Our recent analysis finally disentangles the system. We calculated the visual Aa-Ab orbit from our AstraLux imaging. We detected the SB2 nature of Aa based on STIS spectra, the companion being an O star. Our analysis of TESS data unravels the mystery of the hidden EB: the culprit is Ab, itself an overcontact binary! Even more spectacular, the 155-days orbit shows significant retrograde apsidal motion of -0.5°/yr as derived from spectroscopic data taken over a century and associated radial velocities. A retrograde motion necessarily comes from a third companion on an orbit highly inclined with respect to Aa. Who's the culprit?

Chemical Variations in Open Cluster Close Binaries

July 2
S8
P27

Amaya Sinha
University of Utah

Using SDSS-V DR19 radial velocities and spectra we seek to measure the impact that close binarity has on surface chemistry across the HR diagram in a broad set of abundances. To accomplish this we leverage the assumptions of chemical homogeneity in open clusters, and compare the surface abundances of SB1s to non-binary stars at similar evolutionary states. We determine binarity by jointly analyzing RV variations and SEDs with The Joker and BINOCS. We derive abundances from DR19 spectra using BACCHUS. We constrain the median abundances, as well as the intrinsic scatter, within the binary and nonbinary populations. From this analysis, we measure that binary populations in open clusters are enriched in carbon and cerium as compared to their non-binary counterparts, and observe a potential correlation between separation and enrichment.

New criteria for assessing the orbital stability of circumbinary planets

July 3
S12
P28

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New York University Abu Dhabi

In this work we present the latest developments in the problem of the stability of circumbinary planets. With the aim of identifying stable and unstable orbits in such systems, we perform a large number of numerical simulations of planets revolving around a binary. Three dimensional and eccentric planetary orbits are considered. Based on the results of our simulations, we determine an outer border beyond which all planetary orbits are stable and an inner border closer to the binary below which all planetary orbits are unstable. In between the two borders, we find a mixture of stable and unstable orbits. We provide empirical expressions for the critical borders. We also train a machine learning model on our data set in order to have an extra tool for predicting stable and unstable motion. The fits are also applied to known circumbinary systems, confirming the stability of the planets in these systems. Finally,the empirical fits are compared against previously derived stability criteria.

The PLATO Multiple Star Working Group

July 3
S12
P29

John Southworth
Keele University

The PLATO mission is scheduled for launch in December 2026. It is an ESA M-class mission aiming to find small planets around bright stars via the transit technique. The light curves it obtains will be wonderful for other science goals, among which is the study of binary and multiple stars. We are creating the Multiple Star Working Group (MSWG) to co-ordinate the community to best exploit this unique opportunity. We will assemble the many science cases, create target lists, and co-ordinate applications for PLATO observations.

Searching for orbital decay in hot Jupiters

July 3
S12
P30

Lex Griffiths
Keele University

Hot Jupiters are large planets that occupy extremely short-period orbits of less than 10 days. The close distances to their host stars make them excellent candidates for detecting orbital decay. We have conducted a transit timing analysis on four transiting hot Jupiters (HIP 65 Ab, WASP 173 Ab, NGTS-6b and NGTS-10b) using 30 new transit light curves from the 1.54 m Danish Telescope plus additional data from TESS and past publications. We have refined the orbital ephemerides of these systems but not yet detected orbital period variations in any of them.

Eclipse timing study of new hierarchical triple star candidates in the Northern Continuous Viewing Zone of TESS

July 3
S12
P31

Tibor Mitnyan
Baja Astronomical Observatory of University of Szeged, Hungary

We compiled a list of more than 3500 eclipsing binaries located in and near the northern continuous viewing zone of the TESS space telescope to search for hidden components in these systems. We obtained the TESS light curves of all targets by applying convolution-aided differential photometry on the TESS full-frame images from sectors up to sector 60. From the light curves, we calculated eclipse-timing variations (ETVs) to search for nonlinear variations that could be attributed to a light travel-time effect or dynamical perturbations. We were able to fit a model solution for the ETVs of 135 triple candidates, 10 systems of which were known from the literature, and the remaining 125 systems are new discoveries. We also compared the distributions of some orbital parameters from our solutions with those from a previous Kepler sample. Finally, we verified the correlations between the available parameters for systems that have Gaia orbital solutions with those from our ETV solutions.

A new low-mass long-period eclipsing binary system showing large eclipse timing variations.

July 3
S12
P32

Louiza Lantzi
ICE-CSIC

In this poster, we will present the full characterization of a long-period eccentric eclipsing binary system, composed by low-mass stars detected by TESS. We will describe the analysis of the TESS light curves, as well as the photometric time series we have gathered from ground-bades observatories (Montsec and Wise observatories). We are currently monitoring the system with the high-resolution spectrograph CARMENES at the Calar Alto Observatory. We will make use of cross-correlation techniques to measure the radial velocity of the components and derive their absolute properties. The system shows large eclipse timing variations of several minutes, which are compatible with the presence of a third body companion causing secular perturbations to the orbital elements of the binary.

A pipeline for the bulk characterization of detached eclipsing binary stars

July 3
S12
P33

Stephen Overall
Keele University

Detached eclipsing binary stars (dEBs) are a key source of data on fundamental stellar parameters. While there is a vast source of candidate systems in the light curve databases of survey missions such as Kepler and TESS, published catalogues of well-characterised systems have yet to reflect this abundance. We are developing a pipeline which will perform bulk characterisation of dEB systems by combining the analysis of TESS light curves, supported by initial parameter estimation carried out with a machine learning model, with the fitting of spectral energy distributions to derive the absolute physical parameters of the target systems.

Quadruples at Masaryk University

July 3
S12
P34

Miloslav Zejda
Masaryk University, Brno, CZ

The study of multiple eclipsing systems has become one of the current topics in stellar astrophysics. Quadruple stars in the 2+2 configuration constitute a significant part of these systems. The main aim of the group Squadra consisting of academics, students, and citizen scientists established at the Department of Theoretical Physics and Astrophysics, Masaryk University is modelling and multiplicity confirmation. This poster shows the first results of the Squadra group.

Close binary case studies: VV Ori

July 3
S12
P35

Edwin Budding
RASNZ VSS

Photometric data (including new BVR and TESS) were combined with spectroscopy of the Orion Ib,triple-star VV Ori. MJUoC spectra were analysed using FDBinary. Precise new parameters – including masses, radii, luminosities, orbital separations, distance and age – were derived. The primary's beta Cep type oscillations support these parameters and confirm general understanding of the system's evolutionary status. Examination of He I line profiles showed the primary to have a significantly low rotation speed: some 80% of synchronous. This can be explained in terms of precession of an unaligned spin axis. This idea can also resolve variations of the apparent inclination as well as address other longer-term irregularities reported in the literature. This work invites further observations and follow-up theoretical study of this intriguing object.

Exploring Binarity and Pulsations: A Multivariate Analysis of β-Cephei Stars in Eclipsing Binary Systems

July 3
S12
P36

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We investigate the interplay between binarity and pulsations in β-Cephei pulsators in eclipsing binaries. Using a multivariate approach, we analyse a sample of 75 such systems combining high-precision photometric and spectroscopic data. Pulsation frequencies were extracted from TESS light curves, while binary parameters were derived through light curve modeling and radial velocity data. Our analysis reveals moderate to very weak correlations between orbital characteristics and pulsation behaviour, suggesting the possible observable dependencies and interactions between binarity and pulsations. This study highlights the importance of binary context in the asteroseismic interpretation of massive stars and demonstrates how multivariate methods can uncover complex dependencies between stellar structure, pulsation, and orbital dynamics.

Testing the impact of different approaches to modelling massive pulsating eclipsing binaries

July 3
S12
P37

Logan Dennis
Newcastle University

Understanding the structure and evolution of massive stars is key for understanding a myriad of physics, including galactic evolution, black holes and neutron stars. Asteroseismology of pulsations probes stellar structure and, when combined with binarity provides ultra-precise constraints on interior physics such as rotation and mixing. However, there is a lack of asteroseismology studies for massive pulsating eclipsing binaries. In this poster, we present the results of binary modelling using the PHOEBE software and pulsation analysis for selected massive pulsating eclipsing binaries. This binary modelling computes the dynamical masses and radii of these stars. In addition to deriving dynamical masses and radii for these systems, we also test the impact of different approaches in pulsation analysis on these binary modelling results. Finally, we compare our PHOEBE binary modelling results to literature studies that relied on the JKTEBOP binary modelling software.

Asteroseismic binaries in the Kepler Field: Identifying bound systems with Gaia DR3

July 3
S12
P38

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Asteroseismic binaries—systems where two solar-like oscillators are observed in the same light curve—offer unique opportunities to test stellar models by combining asteroseismology with orbital dynamics. Although theoretical predictions suggest that around 200 such systems should exist in the Kepler data, only a handful have been reported. In this work, we analyse 43 asteroseismic binaries. We combine Gaia DR3 astrometry with asteroseismic masses and evolutionary stages to assess the likelihood of these systems being gravitationally bound. Our results show that most of these systems are likely chance alignments. Remarkably, KIC 6501237 and KIC 1009454, have relative orbital motion and seismic properties in agreement with a wide binary scenario. These candidates offer valuable benchmarks for testing seismic scaling relations.

Eclipse fitting procedure for binaries with solar-like oscillations and instrumental variability

July 3
S12
P39

Thomsen Jeppe Sinkbaek
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Solar-like oscillators in detached eclipsing binaries (dEBs) are prime candidates for assessing the performance of stellar evolution models. However, dEBs with perfect observation criteria are very rare, and a significant fraction of the small sample of Kepler systems with detectable oscillations are in long-period systems. These have a low number of eclipses which makes astrophysical noise sources (e.g. oscillations) particularly impactful on the results, and their few eclipses risk coinciding with instrumental variability and quarterly re-pointing. This will be even more challenging for the upcoming PLATO mission, as its longest pointing duration (2 yrs) is expected to be half of that of Kepler. I will present a custom-made eclipse fitting procedure that can be used to mitigate this through simultaneous linear modelling of instrumental variability, and to obtain realistic stellar parameter uncertainties through statistical resampling of the asteroseismic signal.

Testing the mass-radius relation of white dwarfs in common proper-motion binaries

July 3
S12
P40

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The mass-radius relation is an important property of white dwarfs that is related to their composition and evolutionary stage. We have measured precise gravitational redshifts from high-resolution optical spectra of 50 hydrogen-dominated white dwarfs in common proper-motion binaries that, combined to independent photometric radii, allow an empirical measurement of their masses. Our analysis confirms the reliability of the theoretical mass-radius relation from the lightest to the heaviest objects with in our sample (0.38-1.3 Msun). Additional tests on white dwarfs with helium-dominated atmospheres are be presented.

Binary Stars Population Parameters from Astro-Photometric Data

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Studies attempting to derive the underlying statistical properties of the binary star population of the MW based on traditional observational methods (spectroscopic, eclipsing, astrometric) are challenged by selection effects and their need for multiple epoch sampling. We explore a novel approach enabled by Gaia parallaxes to derive these properties, such as the binary fraction or the period and mass ratio distributions, by searching for signatures of binary stars in the colour-absolute magnitude diagram (CAMD). We make use of extensive databases of astrophotometric data, such as 2MASS and the Gaia mission, to create an observational CAMD and then compare it to the CAMD of a synthetic galaxy based on the Galaxia model. Method validation indicates this could be a viable new avenue for constraining binary population parameters, and while observational effects do add to the uncertainty of recovered parameters, our improved binary population model shows promising results.