

Astrophysics Seminar Speakers

2017-18

Patricia Schady (Max Planck Institute for Extraterrestrial Physics, Germany)

The environment of explosive stellar transients - clues to the progenitors of gamma-ray bursts, supernovae and super-luminous supernovae

4 October 2017

Time-domain astronomy has experienced a reemergence with the implementation of high-cadence, wide field surveys, which has led to the identification of a new class of superluminous supernova (SLSN), and a dramatic increase in the samples of different transient types. Nevertheless, there remain large discrepancies in our understanding of the progenitors and environmental dependencies that give rise to different supernova (SN) types. In this talk I present state-of-the-art, high spatial resolution spectral data of the very nearby environments of a range of transient stellar explosions. At the spatial resolution of these data, the H-alpha equivalent width (EW) can be used to trace the age of the stellar population at the transient location, and any environmental dependencies can be explored. Combined with the properties of the stellar explosion, these host galaxy data provide new insights on the role that progenitor initial mass and environmental factors have on a star's final demise.

Mark Hannam (Cardiff University)

Decoding gravitational waves to measure black holes and neutron stars

8 November 2017

Gravitational waves are beginning to teach us about black holes and neutron stars throughout the universe. Information about the sources (the properties of the individual objects, the binary, and its location) are encoded in the signal, and can be extracted by comparison to theoretical models. I will discuss what we can (and cannot) measure from the signals we have measured so far, and what we hope to find in the future.

Stephen Wilkins (University of Sussex)

Exploring the Epoch of Reionisation

14 February 2018

Understanding the early phase of galaxy formation and evolution is one of the key goals of modern extragalactic astronomy and one key drivers of upcoming observational facilities. This critical

phase of the Universe's history began with the formation of the first stars and super-massive black holes (SMBHs) some few hundred million years after the recombination, bringing an end to the cosmological dark ages. Over the subsequent billion years (the epoch of reionisation, EoR) the intense radiation produced by these galaxies likely drove the reionisation of the Universe. The first generations of stars to form in these galaxies enriched their surroundings with heavy elements, resulting in the transition from (metal-free) population III to population II star formation and laying the foundations for subsequent chemical evolution of the Universe.

Thanks to the Hubble Space Telescope, ALMA, and other facilities along with advances in numerical simulations significant progress in understanding this period of the Universe's history has been made in the last few years. In this talk I'll outline some of this recent progress and discuss prospects for the future, and in particular what we expect to learn from JWST.

Christine Done (Durham University)

Black holes: Einstein's gravity and rocket science!

21 February 2018

I will review how black holes went from a speculative extension of Einstein's gravity to a mainstream observational science via the development of rockets and X-ray astronomy at the start of the space age. I will show how we now use the X-rays from accreting black holes in our own galaxy to test General Relativity in the strong field limit, with observational evidence for the event horizon, last stable circular orbit and, most recently, Lense-Thirring precession as the origin of the strong, low frequency quasi-periodic oscillations seen in these systems. Not only does this solve the 25 year mystery of the nature of these signals, it also addresses more recent controversies over the nature and geometry of the accretion flow in this state.

Martin Krause (University of Hertfordshire)

Black-hole jets: constraining the central engines

21 March 2018

The realisation that highly energetic radio lobes that easily surpass their host galaxies in size were powered by regions in the nuclei of galaxies comparable in size to the solar system was an early milestone in establishing that black holes are real astrophysical objects. Modelling the radio emission still provides interesting new constraints on this central engine, because quantities like energy, mass, lepton and particle number, momentum and magnetic flux are conserved during transport through the supersonic beam and accumulated in the radio lobes.

From a sample of powerful jet sources, we find that the jet power is limited approximately by the Eddington luminosity, linking to both, accretion and spin-energy extraction. No evidence for dynamically important protons is found thus the jet plasmas might be dominated by electron-positron pairs.

Complementary evidence comes from Galactic black holes: We have observed the microquasar V404 in its 2015 outburst at MeV energies and for the first time clearly detected the formation of a pair plasma outflow, probably forming the basis of the later observed radio jet. The enigmatic

Galaxy-wide annihilation signal could plausibly be related to a jet outburst of the Milky Way's supermassive black hole, Sgr A*, or a number of microquasars.

We can further constrain the central engines from high-resolution radio maps: For a complete sample of powerful radio jets we find that the majority is precessing. This likely points to a new population of tightly bound, spinning supermassive black hole binaries.

Aprajita Verma (University of Oxford)

Rise of a Giant: The Extremely Large Telescope

11 April 2018

With a primary mirror of 39.3m, ESO's Extremely Large Telescope (ELT) will be the "World's Biggest Eye on the Sky" operating in the visible to infrared wavelength range. The ELT will collect 13 times more light than the largest visible-infrared telescopes today and the telescope's fully adaptive design will deliver images 16 times sharper than the Hubble Space Telescope. The sensitivity and spatial resolution afforded by the ELT will revolutionise our understanding of the Universe addressing numerous scientific questions from the nature of extra-solar planets to detecting first-light in the early Universe. The ELT has now begun its construction phase and I will review the status of the ELT project including the design, the first light and second generation instruments along with prime science cases. I will also describe the UK's ELT instrument programme. The UK is one of the major contributors to the ELT science case and studies for ELT instruments. One of these studies (HARMONI) has been selected by ESO to be the ELT's first-light spectrograph and is being designed and built by a European consortium led by Prof N. Thatte (University of Oxford).