Astrophysics Seminar Speakers 2018-19

Jack Baggaley (University of Canterbury, New Zealand)

The flow of Interstellar Dust into the Solar System

3 October 2018

Estimates of the spatial density of interstellar dust grains can be gained from light extinction methods and far IR absorption and emission spectra can be employed to investigate surface composition of the grains. Spacecraft have gained crude directions of influx direction of grains into the Solar System while the Stardust mission has been able to capture such grains and after Earth-return perform laboratory examinations. Such material is significant because of their evolution in pre-solar epochs. For accurate source identification of inflowing grains, detailed dynamical properties are needed. We have been operating a radar system that is able to delineate Earth-impacting dust trajectories and hence heliocentric orbits to better map their possible sources. I will give an outline of our radar system and discuss how the dynamical properties compare with those of space missions.

Barbara Ryden (Ohio State University, USA)

Red Galaxies, Blue Galaxies, and the Green Valley

17 October 2018

Since the mid 1920s, it has been known that luminous galaxies fall into two main classes. Edwin Hubble initially classified galaxies as "late" (with a complex, irregular appearance) or "early" (with a smooth, featureless appearance). In the 21st century, it is more common to classify galaxies by the color of their stellar population; "blue" galaxies have their light dominated by hot, luminous, short-lived stars, while "red" galaxies are dominated by cooler, older red giant stars. Generally speaking, late galaxies (in Hubble's sense) are blue, while early galaxies are red. However, there also exists an intriguing population of galaxies with intermediate colors and morphologies, known as "green valley" galaxies. In my talk, I will address the nature of these unusually colored galaxies. One of the oddities of green valley galaxies is their high probability of hosting active galactic nuclei (AGN). By comparing the properties of the stellar population in a green valley galaxy with the properties of its central AGN, clues can be derived about the much-debated role of AGN feedback on a galaxy's star formation rate.

Nicholas Devereux (Embry-Riddle Aeronautical University, USA)

Giant Broad-Line Regions in Low Luminosity active galactic nuclei.

31 October 2018

The nearby lenticular galaxy NGC 3998 hosts the best example of an active galactic nucleus (AGN) fueled by chaotic cold accretion (CCA) whereby 10^4 K gas condenses out of a 10^6 K circumgalactic halo and falls toward the central supermassive black hole. Photoionization modelling of visible spectra obtained with STIS aboard the Hubble Space Telescope indicate that the central UV—X-ray source of NGC 3998 has ionized a large spherical volume (~ 7pc in radius) of low density (~10^4 cm-3) gas of such extraordinarily low metallicity (~ 1/100 solar) as to dictate a circumgalactic origin. The gas pressure gradient in the H+ region of the best fitting photoionization model is several orders of magnitude smaller than required for hydrostatic equilibrium. Thus, an inflow at the free-fall velocity is inevitable, consistent with the distinctly triangular shape observed for the broad Balmer emission lines. In general, CCA can explain the low duty-cycle observed for AGN and, more specifically for NGC 3998, redirection of the jets powering the larger scale radio lobes. NGC 3998 is just one of several nearby, non-reverberating, low-luminosity AGN associated with an unusually large broad-line region. Other nearby examples will be discussed including M81, NGC 3227, NGC 3516, NGC 4051 and NGC 4203.

Diana Worrall (University of Bristol)

Hard-working radio galaxies: morphologies and interactions

21 November 2018

Radio galaxies of intermediate power dominate radio-power injection in the Universe as a whole, making them the best candidates for interactions that provide the heat that regulates the growth of galaxies and other large structures. The population spans a wide range of radio morphology and environmental richness, and sources of all ages are amenable to study. I will describe structures and interactions, with emphasis on radio galaxies with deep high-resolution Chandra X-ray data. As compared with low-power radio sources, there is evidence that the physics changes, and the work done in driving shocks can exceed that in evacuating cavities. Ongoing local interactions are common.

Noelia Noël (University of Surrey)

Dissecting the Small Magellanic Cloud

5 December 2018

A “Grand Challenge” in modern astrophysics is to understand how galaxies form and evolve. Our Local Group of galaxies, i.e., the galaxies around Andromeda and the Milky Way, are the best laboratories we have at hand. In particular, the "Magellanic Clouds”, our two nearest Irregular dwarf galaxies, provide the best workplace to study galaxy formation. The Magellanic Clouds are currently interacting with one another while orbiting around the Milky Way. Their close proximity allows us to resolve their individual stars, providing a unique ‘rosetta stone’ for understanding galactic encounters and mergers. In this talk I will show how to use stars to perform "galactic

archaeology", unpicking the fossil record of a galaxy's past by forensically dissecting its stellar content.

Richard Ellis (University College London)

Early Galaxies and Cosmic Reionisation: Progress and Challenges

13 February 2019

The birth of galaxies represents the last unexplored frontier of cosmic history and it is commonly believed such early systems led to the transformation of neutral gas in the intergalactic medium into its presentfully-ionised state. Some progress has been made in charting the demographics of early galaxies into the era when reionisation is thought to occur, but little is known about their nature of their stellar populations, the possible role of active nuclei and whether galaxies are capable of generating sufficient ionizing radiation. Spectroscopy holds the key to addressing these questions, targeting both individual sources at high redshift as well as carefully-chosen analogs at intermediate redshift. I will describe the recent progress and challenges as we anticipate the launch of JWST and the arrival of next-generation large telescopes.

Tim Naylor (University of Exeter)

Stellar variability through the planet-forming process

27 February 2019

Young stars accrete material from the discs which surround them, which results in photometric variability from both the variation of accretion rate, and from geometric effects as the accretion structures rotate in and out of our line-of-sight. Although the periodic part of this variability has been used to obtain the rotation rate of many young stars, the a-periodic variability remains little studied and poorly understood. This is despite its potential to yield information about the inner astronomical unit of young-star discs, the equivalent of the region where the terrestrial planets are thought to have formed.

I will discuss how structure functions can be used to characterise the periodic variability of young stars, clearly separating it into a short-term component related to the rotation of the star, and a longer term component presumably related to changes in accretion rate. This part of the variability extends beyond 10 years, which links to a survey we have carried out of very long-term variability using Gaia and the photographic Schmidt surveys. On timescales of a hundred thousand years we see large (5 magnitude) outbursts which imply waves of material moving through the terrestrial zone as the planets are forming, which has implications for the planet-forming process.

Rob Crain (Liverpool John Moores University)

Calibrated simulations of the formation and evolution of galaxies, their globular clusters and the circumgalactic medium

13 March 2019

I will briefly introduce the EAGLE project, a campaign of large cosmological hydrodynamical simulations that has ushered in the era of realistic galaxy population models. I will discuss novel new extensions to EAGLE, including the addition of a self-consistently varying stellar initial mass function, and a sub-grid model for the formation and evolution of globular cluster populations. I will showcase results recently obtained using this extended family of EAGLE simulations, focussing on the origin of the bimodality of alpha-element abundances in the Galactic disc, the use of globular cluster properties to infer the assembly history of the Galaxy, and the coupled role of supermassive black holes and the circumgalactic medium in quenching galaxies.

Mathew Page (Mullard Space Science Laboratory, UCL)

Quasi-Stellar Objects, submillimeter emission and galaxy formation

3 April 2019

Once an outlandish idea, active galactic nuclei having a strong influence on galaxy evolution is now the standard paradigm. Somehow, galaxy bulges and black holes grew in a coordinated fashion, and the heyday of quasi stellar objects (QSOs) corresponds pretty well with the peak of the cosmic star formation history between redshifts of 1 and 3. The most powerful star forming galaxies are deeply enshrouded in dust and emit the majority of their power in the infrared. Hence long-wavelength observations have long been anticipated as a way of charting the most powerful star-forming galaxies in the $1<z<3$ era, and exploring their relationship with accretion onto massive black holes. I will discuss submillimeter observations of QSO host galaxies, what it has told us about the formation of the black hole and bulge components of massive galaxies, and what we have still to learn.

Andrew Levan (University of Warwick)

New opportunities in multi messenger astronomy

10 April 2019

The discovery of GW170817 — a binary neutron star merger seen in gravitational waves and across the electromagnetic spectrum opens up new routes to answering old questions. I will outline the insight that has been possible from this single event, from the origin of short GRBs, to the synthesis of heavy elements to a new route to cosmological distance measurements. As we enter the next observing run for Advanced LIGO and VIRGO I will discuss what we might hope to learn in the next year, and the next decade.