Astrophysics Seminar Speakers 2023-24

Benjamin Gompertz (Birmingham University)

Long-duration gamma-ray bursts from compact binary mergers

27 October 2023

Gamma-ray bursts (GRBs) are canonically divided into “short” and “long” GRBs either side of a gamma-ray duration of 2 seconds. Historically, this was thought to map onto two separate progenitor channels, with short GRBs being driven by the mergers of compact objects, and long GRBs being driven by the collapse of massive stars. In this talk, I will discuss two “long” GRBs that were apparently driven by compact object mergers: GRBs 211211A and 230307A. Both showed infra-red excesses consistent with kilonovae, the thermal signature of heavy element nucleosynthesis. JWST spectroscopy of GRB 230307A revealed a candidate emission line from tellurium, a 2nd r-process peak element. I will discuss the strong spectral evolution seen in their high energy emission, and our prospects for distinguishing them from “regular” long GRBs from core collapse.

Andreia Carrillo (Durham University)

The Milky Way's history through Galactic archaeology

10 November 2023

The Milky Way provides an unparalleled view into galaxy formation, aided by the chemistry, kinematics, and ages of its individual stars. In this talk, I will discuss how we have advanced our understanding of our Galaxy's assembly as told by stars in its different components: the stellar halo which is predominantly built through mergers and the disk which is mostly made up of in-situ stars. First, I will present the chemical abundances in the alpha, light, odd-Z, iron-peak, and neutron-capture groups of elements of accreted halo stars from the Milky Way's last significant merger, Gaia-Enceladus/Sausage (GES), to contrast with in-situ stellar populations and surviving Milky Way satellites. Next, I will discuss the many ways we select these GES stars and the biases they introduce on our inferred progenitor properties. Additionally, we benchmark our results in the observations with simulations of Milky Way-like galaxies in the Auriga hydrodynamical cosmological simulations. Lastly, I will switch gears and focus on the Milky Way in-situ population where observations have shown that one only needs a star's age and metallicity to predict its detailed chemical abundances. I will show how current state-of-the-art simulations are able to capture the detailed chemistry of the real Milky Way and what physical conditions give rise to the predictive nature of a star's age and metallicity.

Stuart Eves (SJE Space Ltd)

Space traffic control

8 December 2023

There is a growing realisation that, unless some form of control is introduced to regulate satellite traffic and to control the space debris population, we could lose access to some of the most valuable "orbital real estate". This seminar will explain the nature of problem, and indicate the technical, legal, and financial measures that are likely to be needed to manage the issue.

Bio: Dr Stuart Eves is a consultant working in the space industry. He has an MSc. in Astrophysics, a PhD in satellite constellation design, and has been a Fellow of the RAS for more than 30 years. His book entitled Space Traffic Control was published in 2017.

William Baker (University of Cambridge)

The observational evolution of galaxies probed by scaling relations and morphology

12 February 2024

In this seminar, I will present my research exploring star-formation, metallicities and morphology in both local and high-redshift galaxies.

These quantities exhibit strong inter-correlations, and I will start by exploring their relationships through scaling relations. By analysing these relations, we can both characterise different galaxy populations and also constrain the underlying physical processes occurring.

During the talk, I will distinguish between fundamental scaling relations and those that emerge as indirect by-products by finding the intrinsic (“true”) drivers of metallicities and star-formation rates, utilising both statistical and machine learning methods. I will delve into the significance of metallicities as a crucial indicator of a galaxy's chemical enrichment and quenching, reflecting gas inflows and outflows, AGN feedback, and star formation activity. Furthermore, I will present my latest research involving JWST, exploring a core-disc galaxy in the early universe at a redshift of 7.4 (existing over 13 billion years ago). By examining the stellar population properties of its core and disc components, I will reveal valuable insights into the galaxy's star-formation history and its build up of mass via inside-out growth during the first 700 million years of the universe’s existence.

Sotiria Fotopoulou (University of Bristol)

Cosmic detective: how Euclid will shed light onto the dark side of the Universe

1 March 2024

The Euclid Space telescope has been designed to measure, with extreme precision, the cosmological parameters that describe our Universe. The first images from this european telescope have been in the news recently, showcasing the spectacular capabilities of the two instruments. In this talk, I will first introduce the main goals and my contribution to the Cosmology mission and then highlight my interest in the Legacy aspect of this exceptional

dataset. In particular, I summarise the work of the AGN work package and the work in my group, diving into the machine-learning aspect of our work. Finally, I will discuss current challenging data analysis problems that have attracted a lot of attention from the computer science community.

Erminia Calabrese (University of Cardiff)

New frontiers in cosmology with Cosmic Microwave Background surveys (with a focus on the UK programmes)

3 May 2024

The Cosmic Microwave Background (CMB) is a unique probe of the physics of the Universe. This light, travelling since ~380,000 years after the Big Bang, contains relic signatures of the physical processes that took place at the origin of the Universe, as well as unique features allowing us to determine precisely the abundances of the main Universe constituents which govern its evolution on large scales. During the last three decades, the astonishing agreement between CMB theory and increasingly-precise observations has led to the establishment of our standard model of cosmology. While the parameters of this model have been constrained to sub-percent precision, many fundamental questions about the Universe are still unanswered. In the near future, a series of ground-based and satellite experiments promise to deliver new breakthroughs in cosmology and fundamental physics via precise measurements of the CMB polarization signal.

In this talk I will give a snapshot of where we are in CMB cosmology, how we got here and where we are heading next. I will cover in particular the UK flagship programmes: the Simons Observatory experiment and the LiteBIRD satellite mission.