Physics & Astronomy PhD Project Proposal

Project Title: The physics of Gamma-Ray Bursts and multi-messenger sources

Project reference: STFC – O'Brien

Groups: Astrophysics

Supervision Team:

- Professor Paul O'Brien (pto2@leicester.ac.uk)
- Professor Nial Tanvir (nrt3@leicester.ac.uk)

Three Key Points

- Exploit Leicester access to the new SVOM and Einstien Probe missions to find transients, particularly GRBs
- Combine high-energy data with optical/IR data from Stargate consortium, GOTO survey, JWST and other facilities
- Study electromagnetic counterparts to multi-messenger sources

Project Description

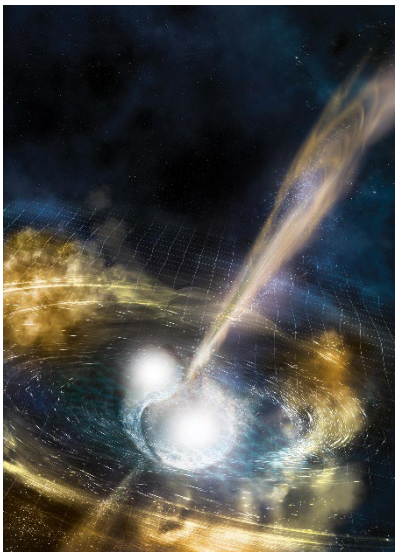
Gamma-Ray Bursts are the most powerful sources of electromagnetic energy known in the universe. They are also closely related to other transients, most notably as potential counterparts of gravitational wave sources. The electromagnetic discovery space has recently expanded dramatically thanks to the availability of two new powerful space missions called SVOM and Einstein Probe. Paul O'Brien, the first supervisor of this PhD, has unique UK investigator status on both missions, with full data rights to the proprietary surveys (he is a Co-investigator on SVOM and the ESA appointed scientist on Einstein Probe). The student will have access to these data and to complementary data from other facilities, particularly from the Stargate consortium with observing time on ESO telescopes.

This PhD is to exploit the observational data from SVOM and Einstein Probe, and multiple related facilities, to constrain the multi-wavelength properties of GRBs and to investigate the properties of multi-messenger sources. In particular, this PhD project will exploit the power of the new missions to: (a) probe the early emission from GRBs, constraining the emission process, the production of flares and the relation between the observed emission and the central engine; and (b) search for counterparts to gravitational-wave sources using the extremely wide-field soft X-ray survey capability of Einstein Probe. By combining the data from multiple facilities, we both discover and characterise transients. Over the next few years, the combination of enhanced survey capability simultaneously in the optical, X-ray, gamma-ray and very high-energy emission bands will bring many new discoveries.

We have a large, highly successful team of staff and students studying many types of transient, providing a strong support system for PhDs. We also construct detailed models which predict the behaviour of transient sources. Although primarily an observational project, there will be ample scope during the PhD to fit theoretical models to the data. The students will also have the opportunity to interact with the mission teams. The ability to work with people who designed and built the observing facilities, developed the data processing software, construct theoretical models and interpret the results provides the ideal environment for rapid progress.

Further Reading:

- The SVOM mission - https://www.svom.eu/en/portfolio/the-svom-mission/
- The Einstein Probe mission - https://ep.bao.ac.cn/ep/
- Paul O'Brien's publications - https://ui.adsabs.harvard.edu/user/libraries/0odI6YCRT5G4N7SnGyJpJw
- Gamma-Ray Bursts - https://iopscience.iop.org/book/mono/978-0-7503-1502-9



Images/Graphics:

GW170817.jpg. Artists impression of a binary neutron star merger which is emitting gravitational waves and launching a relativistic jet. Credit: LIGO Scientific Collaboration

Application advice: Please see web page

https://le.ac.uk/study/research-degrees/funded-opportunities/stfc