Probing the high redshift universe with gamma-ray bursts

- **Addressing fundamental questions around the formation of the first stars and galaxies**
- **Exploiting existing and new facilities for discovery and study of high-redshift GRBs**
- **Using GRBs as unique probes of early galaxies**

Level	PhD
First Supervisor	Nial Tanvir
Second Supervisor	Paul O'Brien
Application Closing Date	19 January 2022
PhD Start date:	26 September 2022

Project Details:

Long-duration gamma-ray bursts (GRBs), are exceptionally bright explosions can be detected at great distances. Some GRBs occurred during the first billion years in the life of the universe, and so can be used to probe the early stars and galaxies in which they arose, and their effects on the intergalactic medium around them. This era is of great interest, and a primary target of our existing large telescope campaigns (e.g. using the ESO/VLT) and new facilities such as the James Webb Space Telescope. GRBs allow us to measure the amount of star formation taking place; pinpoint the kinds of galaxies it was occurring in; measure the build-up of heavier chemical elements; measure the amount of ionizing radiation escaping from these galaxies and hence their contribution to reionizing the universe.

In Leicester, we have a long history of discovering and studying the most distant known GRBs, and are world leaders in using them to study the era of reionization. We also are a partner institute in the Swift and new SVOM satellite, which discover and localise the GRBs. The student will benefit from working in the lively astrophysical transients group in Leicester, and from interactions with other astronomers in our extensive global networks, including the large European STARGATE collaboration.
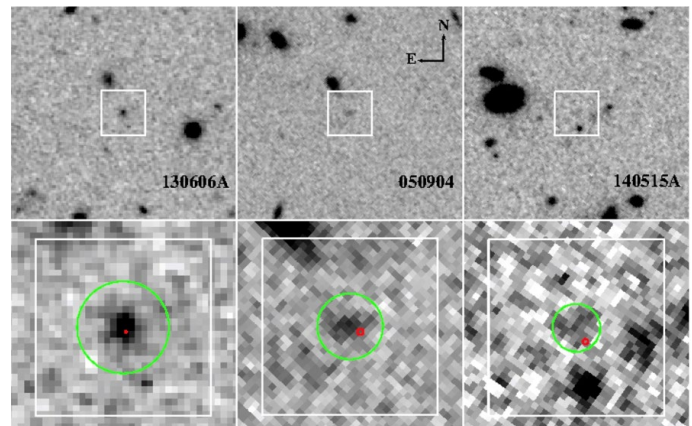
Three GRB hosts at redshift 6

The main aims of the proposed PhD are to investigate the use of GRBs to explore open questions in galaxy evolution, and to use the host populations to constrain the progenitors of GRBs. Some background knowledge of stellar astrophysics, cosmology or galaxy evolution would be helpful; while the student will be trained in necessary data analysis techniques.

References:

1 Tanvir et al. 2009 Nature 461 1254

2 Tanvir et al. 2012 ApJ 754 46

3 Hartoog et al. 2015 A&A 580 139

4 McGuire et al. 2016 ApJ 825 135

5 Tanvir et al. 2019 MNRAS 483 5380

Further information on how to apply and funding can be found HERE