Fast follow-up of long Gamma-Ray Bursts with the Murchison Widefield Array

Research Field
Radio Astronomy

Project Suitability
PhD
Honours

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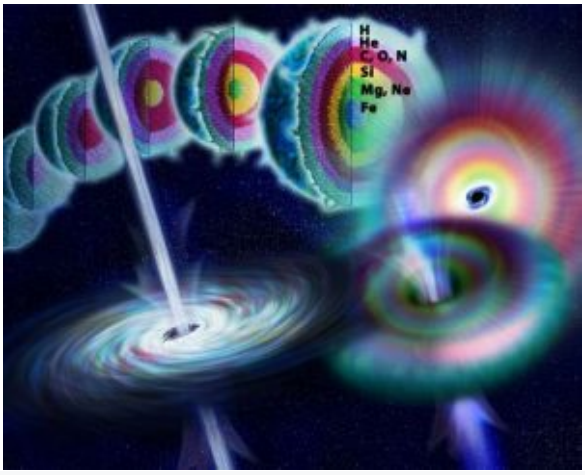
Long Gamma-Ray Bursts (GRBs) occur either when a massive star goes supernova to form a black hole. Over a short period of time, a huge amount of material is accreted onto a newly formed black hole and a very powerful jet of gamma-rays is launched into space. For a small fraction of these events, the jet is aimed toward the Earth where it can be detected by gamma-ray satellites such as Fermi and Swift. These space missions then send immediate alerts to a network on the ground, allowing telescopes such as the Murchison Widefield Array (MWA) to rapidly begin observing the event.

The MWA is a low frequency (80-300 MHz) radio telescope operating in Western Australia and the only operational Square Kilometre Array (SKA)-Low precursor telescope. The MWA is an entirely electronically steered instrument, meaning that it can 'slew' to any part of the sky nearly instantaneously. The MWA also has an extremely large field of view. The large field of view and fast slew time means that the MWA is uniquely placed to provide the fastest follow-up radio observations of transient (explosive or outbursting) events, including GRBs.

For the last 5 years, the MWA has been automatically responding to GRBs detected by the Fermi and Swift satellites, obtaining 30 minutes of observations following each outburst. There are now over 700 observations in the database that are being processed, and even more are being taken all the time. An automated pipeline is in place to download and process all these data and make the required images.

In this project you will analyse radio images to look for signs of prompt radio emission generated by GRBs – something that has never been seen before at low radio frequencies. Such a detection would directly aid our understanding of the central engines of the most powerful explosions in the Universe. This project will help build your programming and time management skills, and will allow you to work on the Pawsey supercomputers.



A massive star undergoing core-collapse to produce a brief jet of gamma-rays. As the jet breaks through the material left by the dying star there is a flash of radiation detectable at radio wavelengths. This radio flash is yet to be detected (credit: Wikipedia).