In 2013, a team of astronomers conducting a large sky survey for pulsars with the Parkes telescope announced the discovery of an exciting new class of transient sources – Fast Radio Bursts (FRBs; Thornton et al. 2013). This landmark discovery triggered a world-wide hunt to find many more, with the recent breakthrough by the Canadian CHIME telescope marking a major milestone, i.e. ~100s of bursts detected down to ~400 MHz. These bursts are thought to originate from cosmological distances (~Gpc), and they are potential new probes for cosmology; e.g. to measure the baryonic content of the Universe, and the magnetic field of the Intergalactic Medium.

The physics governing the origin of these energetic bursts remains a mystery, despite a continuing flurry of theoretical ideas, including exotic possibilities including dark matter, and even cosmic strings; and even after their interferometric localisations at sub-arcsecond resolution. The plot further thickens with no burst emission seen to date at frequencies below ~300 MHz.

Prompt follow-up of FRBs is technically challenging due to their extremely short time durations (~ms). The co-location of the Australian SKA Pathfinder (ASKAP) telescope and the Murchison Widefield Array (MWA) was recently exploited (via shadowing) to circumvent this (Sokolowski et al. 2018), but the time resolution achievable is limited to ~500 milliseconds, which is not optimal given their short durations.

This PhD project will focus on the development and scientific exploitation of a major new capability that will allow high-time resolution trigger possible with the newly-commissioned voltage buffer mode of the MWA (Meyers et al. 2018). Along with the rapid-response observing mode that will soon be released, this will allow receiving and responding to the trigger alerts from facilities such as the ASKAP. This will enable unique science relating to the FRB emission physics, as well as their propagation and progenitor models, and thus will contribute to advancing our understanding of these mysterious sources.

Figure 1: FRB 110220 – one of the brightest FRBs discovered in the Parkes high time resolution Universe survey (Thornton et al. 2013). The burst’s dispersion measure of 945 pc cm$^{-3}$ results in an arrival time spread of approximately 1100 milliseconds across the 400 MHz observing band of Parkes survey observations. The burst would have arrived at the MWA 185 MHz band approximately 112 seconds after its time of detection at Parkes. The inset shows the shape of the pulse, where an exponential tail resulting from multi-path scattering through the intergalactic medium is clearly visible, and follows the expectations based on a Kolmogorov-type turbulence.