Fast, faster, fastest: Probing the physics of fast radio bursts using high-time-resolution data from the CRAFT survey

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Description: Fast radio bursts (FRBs) are millisecond-duration extragalactic transient events, so powerful that they can be detected after travelling more than half the age of the Universe to reach earth. Currently, the origin of FRBs is unknown, although leading theories include young, rapidly rotating, and highly magnetised neutron stars; and the merger of compact objects such as a neutron star and a white dwarf. By virtue of their extragalactic origin, FRBs are useful probes of the distribution of matter in the Universe, and provide an independent way of estimating the cosmological parameters. The 'CRAFT' Collaboration uses the ASKAP radio telescope to detect FRBs, determine their host galaxies, and critically, study the properties of their emission down to nanosecond timescales. A recently commissioned new detection mode, the CRAFT Coherent Upgrade (CRACO), will increase the rate of FRB detections ten-fold, and will enable study of a large sample of FRBs with unprecedented details. The CRAFT Collaboration is centred on Perth, Melbourne, and Sydney, but has extensive international collaborators in e.g. Chile, the USA, Germany, and Japan.

The aim of this project is to use precision measurements of the time-profiles and polarisation properties of FRBs to determine their origins, and study the media through which they traverse. We also aim to disentangle the effects of astrophysical plasmas in intervening galaxies along the line of sight to FRBs from effects due to their progenitors.

This project will involve analysis of a large number of FRBs detected by the CRACO system on ASKAP, and study their high-time-resolution properties. This work will utilise the OzStar supercomputing facility in Swinburne, Melbourne, and the student will work with – and extend – the FRB post-processing pipeline.

Study of fast radio bursts is currently one of the most active fields in astronomy. The CRAFT Collaboration is one of the world leaders in the field, and with the advent of CRACO, will continue to be at the forefront of international efforts. FRBs are promising candidates to address some of the most intriguing problems relevant to all of astrophysics – for example, resolving the Hubble Tension, locating the so-called "missing matter", determining the physics of neutron stars and perhaps even their equation of state.

Image Credit: OzGrav, Swinburne University of Technology.