Understanding the host galaxies of fast radio bursts

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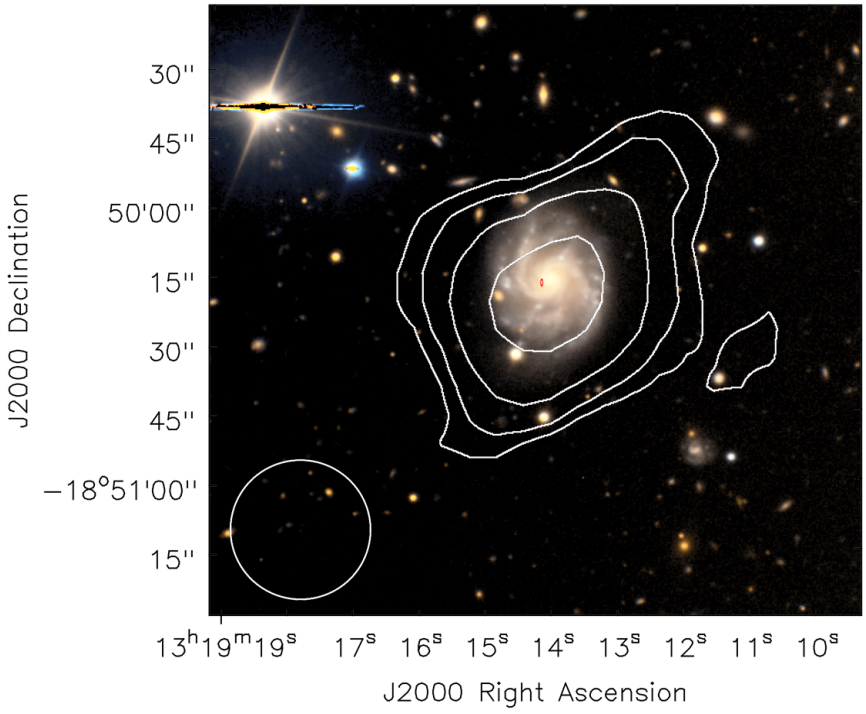
Description: Fast radio bursts (FRBs) are extremely powerful radio transients, so luminous they are visible across the Universe, which occur within mere milliseconds. FRBs have been detected in distant galaxies and used to find the previously 'missing baryons' in the Universe. Yet, to date only a handful of FRBs have been localised, and the origin of FRBs is not yet known. Studying the FRBs environments is the next key step.

The Curtin Institute for Radio Astronomy (CIRA) is a member of the Commensal Real-time ASKAP Fast Transients Survey (CRAFT) with the Australia Square Kilometre Array Pathfinder (ASKAP). By localising the FRB emission to within an arcsecond on the sky, we can identify the host galaxies. CRAFT will localise one FRB every two days through the CRAFT COherent (CRACO) upgrade.

Through the data reduction and analysis of commensal and follow-up radio spectral-line observations of FRB host galaxies from multiple radio telescopes both in Australia and abroad, the first statistically meaningful study of the FRB host galaxy gas properties will be conducted. The student will:

- Analyse existing radio and other multiwavelength information of FRB host galaxies
- Analyse new high-time resolution data of the FRB emission uniquely available to CRAFT to combine with our knowledge of the host galaxy to understand the medium the FRB signal propagates through
- Conduct new observations and data reduction to study the neutral hydrogen, the star-forming fuel, of these host galaxies to inform models on the creation of FRB progenitors
- Combine the properties of the hot ionised gas in galaxies with the cold neutral gas to form a complete picture of FRB host galaxies
- Analyse hydrodynamical galaxy simulations and link the populations in these simulations to our observed sample of FRB host galaxies

FRBs are a new phenomenon that are still not well understood, and hence the FRB field is rapidly changing; the student should be prepared to adapt their research. There is a possibility of SKAO co-supervision.



A localised FRB by CRAFT (red ellipse) towards the centre of a nearby spiral galaxy. The cold neutral hydrogen gas, from which stars form from, was also detected by ASKAP in the first commensal detection, and informs us on the recent history of the FRB host galaxy. Previous cases had greatly disturbed gas distributions, a clue that those FRB host galaxies had recently undergone a galaxy merger event. However, new examples like these show it is not that straightforward. (Glowacki et al. 2023).