Confirming the redshift range of radio sources invisible in optical and infrared

Supervisors

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Description

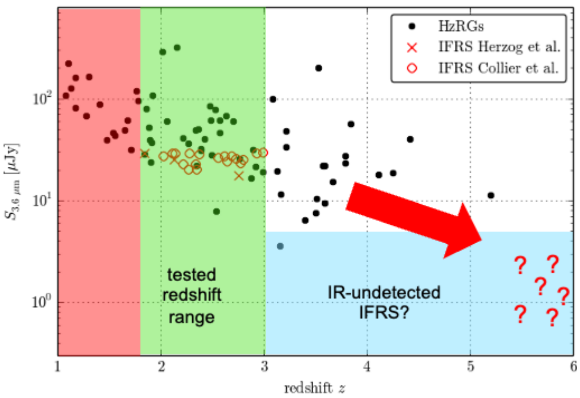
Within two of the deepest and most-well-studied fields in the sky, ~50 strong radio sources were identified that had no infrared (IR) or optical counterparts, down to a very faint level. Named “Infrared-Faint Radio Sources” (IFRSs), and related to the class of optically-invisible radio sources, follow-up of these objects has found no IR down to extremely sensitive levels (< 1 uJy), and has found evidence to suggest they’re very distant active galactic nuclei. Similar brighter IFRSs samples have confirmed their extreme distances at redshifts 1 < z < 5, and more recent examples have been found at similar extreme redshifts via ALMA CO observations. However, the redshift range of the original and most extreme IFRSs, with no optical or IR counterparts, remain a mystery, and their potential high redshift status presents interesting implications for standard models of hierarchical black hole growth.

This project aims to explore the optical/IR properties of the most extreme IFRSs, and confirm their redshift range.

The objectives of this project would be:

1. Search for optical/IR counterparts of IFRSs using recent observations, such as JWST and Euclid, within deep fields, such as the CDFS and ELAIS-S1 fields
2. Gather new observations of IFRSs within deep fields, such ALMA observations of CO, and optical/IR spectroscopy from JWST
3. Compare the most extreme IFRSs to their brighter and more well-known counterparts, aiming to determine whether they’re a related or continuous distribution of the same class of object
4. Identify any new selection criteria for finding high-redshift radio galaxies (HzRGs)

Fig 1: The IR brightness of selected IFRSs and HzRGs across redshift, and the assumed high-redshift range of those undetected in IR



Any properties uncovered in optical/IR, or redshifts measured of these extreme IFRSs, will be the first of their kind, helping to determine their nature. If confirmed as very numerous high-redshift AGN, this presents challenges against current models for the formation of supermassive black holes in the early universe. Determining new methods for finding high-redshift radio sources is crucial for understanding the early universe, and for providing background sources against which HI absorption can be identified at high redshift. This project also opens up the possibility to lead proposals on prominent telescopes, such as ALMA and JWST.

The successful candidate will join an active group working on high redshift AGN, which is embedded within the Curtin Institute of Radio Astronomy (CIRA), and includes the three members of the supervisory panel. New data within several deep fields already exists, so the first part of the project is ready to go. Support will be given when submitting new observing proposals, both internally within this group, and externally via various collaborations, connections and networks. There will be plenty of opportunity to present results at international and domestic conferences through funding from Curtin.