The Impact of Proto-clusters on Radio Galaxies

Research Field
Radio Astronomy

Project Suitability
PhD
Honours

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Clusters of galaxies are the most massive bound structures in the Universe lying at the crossroads of the large-scale structure. In the nearby Universe they are dominated by massive galaxies with very low star formation rates, but in past they must have been forming stars at a prodigious rate. However, finding young proto-clusters in the distant Universe is difficult as typical search methods (e.g. X-ray surveys, Sunyaev-Zel'dovich effect) become much less sensitive. High redshift radio galaxies are known to lie in over-dense, proto-cluster environments and to be beacons regions of extreme star formation. This is due to the radio galaxy being powered by a massive and rapidly growing black hole. Scaling relations then suggest that this black hole will be in the most massive dark matter halo. This project will take advantage of low-frequency radio surveys with the Murchison Widefield Array (MWA) and a plethora of other higher frequency radio data (from ATCA to ALMA) to study how the radio galaxy impacts the cluster and how the cluster impacts the radio galaxy.

This project will comprise three parts:

(i) Compiling and modelling high to low radio frequency observations to measure the powers and ages of the radio jets.

(ii) Modelling the expected X-ray emission from the radio galaxy due to the interaction of reletivitic electrons in the jet with the Cosmic Microwave Background via Inverse Compton losses. These predictions can be compared with X-ray emission from *eROSITA*.

(iii) Using high and low resolution radio images to search for evidence of Sunyaev-Zel'dovich effect in proto-clusters at high redshift. Such results will provide the first direct measure of the total mass (including dark matter) of these proto-clusters.

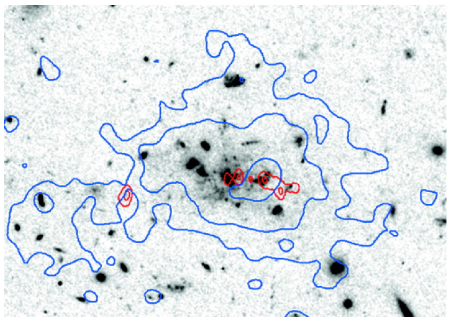

Fig 1: The Spiderweb Galaxy. Deep Hubble image of the core of the MRC 1138-262 protocluster at z = 2.2 obtained with the Advanced Camera for Surveys.(Miley et al., 2006). Superimposed on the *HST* image are contours of Ly**α** (blue) obtained with ESO's very Large Telescope (VLT), delineating the gaseous nebula and radio 8GHz contours (red) obtained with NRAO's VLA, delineating the non-thermal radio emission.