Curtin University

Shedding further light on a cosmic manatee at low radio frequencies

Research Field
Radio Astronomy

Project Suitability
Honours
Masters

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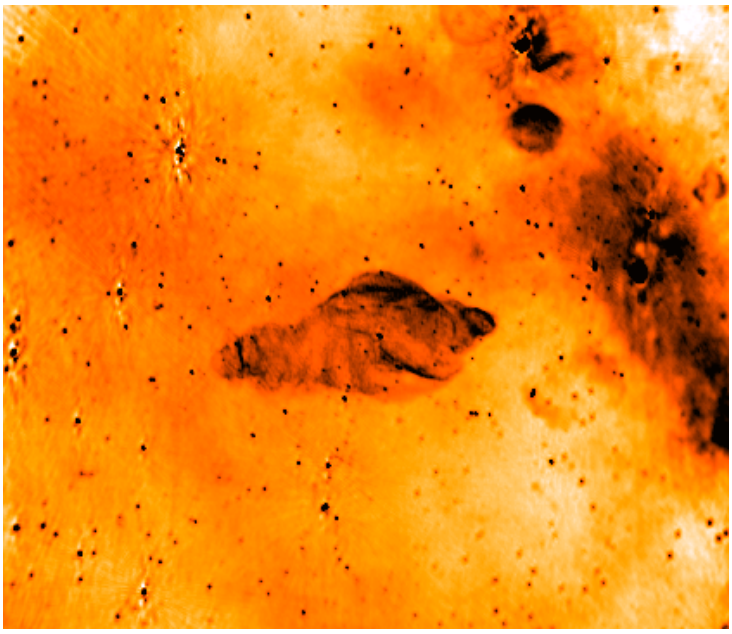
SS433 is a famous Galactic 'microquasar' located at a distance of 18 000 light years from Earth. Through accretion from a companion star onto a compact object - likely a stellar-mass black hole - a pair of relativistic jets are thought to have inflated 'ear-like' structures in the associated surrounding supernova remnant, W50. The resulting distinct shape of W50 has seen it referred to in the past as the 'Manatee Nebula'.

The SS433-W50 system was, until recently, relatively poorly explored at the lowest radio frequencies (i.e. below 250 MHz). In Broderick et al. 2018 (MNRAS, 475, 5360), we presented the deepest map of SS433-W50 made thus far at these frequencies. We used averaged 115-190 MHz data from LOFAR, the Low-Frequency Array, a pan-European radio telescope with its core located in the Netherlands. In our image, shown below, we clearly detected (i) the point-like source SS433 at the centre of the nebula, (ii) the rich structure of W50, including numerous arcs and filaments, and (iii) further extended emission from the nearby Galactic plane, as seen along the right-hand side of the map.



Microquasars evolve on time-scales much faster than their active galactic nuclei (AGN) cousins, hence being excellent laboratories for studying accretion, relativistic jet formation, and the subsequent influence on the ambient environment. In this project, you will recalibrate the 115-190 MHz SS433-W50 LOFAR dataset using the latest standard techniques, as well as additional LOFAR data at an even lower frequency of 60 MHz. By being able to use the full broadband information in the data, and venturing into virtually uncharted parameter space at the very lowest frequencies, you will enable new and important insights into the low-frequency radio spectra of both SS433 and W50, particularly the associated absorption processes thought to be at work (e.g. foreground free-free absorption from ionised gas along the line of sight). You will also investigate the variability of SS433 at low frequencies, and whether the predicted flux densities match well with those extrapolated from much higher-frequency data. This in turn will provide vital information to enable broadband modelling of the synchrotron-emitting plasmons produced when the microquasar begins to flare.

This project will uniquely exploit the frequency coverage of LOFAR, and potentially make use of available Murchison Widefield Array (MWA) data as well. It would be particularly suitable for those students with an interest in the technical aspects of interferometry and radio data analysis. Some programming experience, for example in shell scripting and Python, is useful but not essential.