Variability of Radio Galaxies at Low Radio Frequencies

Radio galaxies are powered by accretion onto the super-massive black holes they host at their centres. Variation of the accretion rate is reflected in variation of the radio emission over time. Monitoring these variations can tell us about the accretion process onto the central black hole. The timescales are long (many years) as these black holes are millions to billions solar masses, so they require a long-term monitoring and/or dedicated observations. The wide-field of view of the Murchison Widefield Array and its frequent observations of calibrators over the last seven years provides an exciting, yet untapped data set with which to investigate radio galaxy variability at low radio frequencies of many thousand radio sources. These calibration observations continue today and allow us to catch exciting variations when they happen (e.g. Fig 1).

Research Field
Radio Astronomy

Project Suitability
PhD
Masters/Honours

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The aims of this project are:

(i) produce images of calibrator fields over the last seven years to determine light curves of thousands of radio sources. This initial work will provide the best measure of variability for this population to date.

(ii) develop novel methods to classify the varying sources into different classes (e.g. are the changes periodic, the same at all frequencies or fall into rate classes such as in Fig. 1)? Are they intrinsic to the source or due to foreground material (scintillation and micro-lensing),

(iii) follow-up exciting rare sources of variability such as binary black holes and micro-lensing events with VLBI observations,

(iv) use the long-term monitoring of the radio galaxies to quantify the timescales on which AGN accretion rates can change.

This project will uniquely exploit the frequency coverage of many Australian radio telescopes such as the ATCA, ASKAP and the Curtin-operated telescopes MWA.

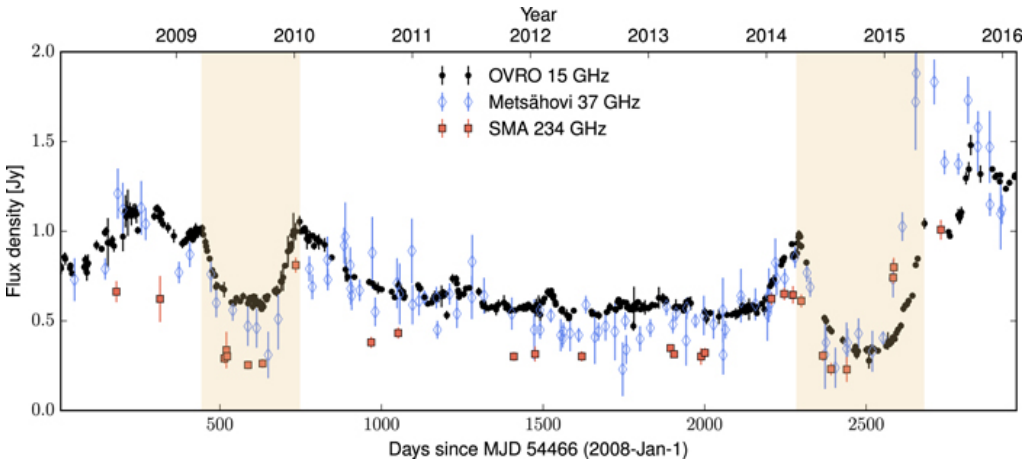

Fig 1. Example of a long-term light curve of a radio galaxy from Vedantham et al. (2017). In this case the authors ascribed the variations due to micro-lensing from a foreground object, possibly a free-floating black hole.