The QUOCKA Survey

QU Observations at Cm wavelength using Km baselines with the ATCA

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We introduce the QUOCKA Survey, a broadband full-polarization study of radio galaxies detected in linear polarization with the ASKAP radio telescope during its Early Science program.

The first semester of ATCA observations is complete. Here we present preliminary data and survey plans.

Survey overview

Primary scientific aims

- **Reveal the magnetoionic structure of radio galaxies** on multiple scales and link those properties to the evolution of the galaxies themselves, through QUOCKA observations and associated modelling. Linearly polarized synchrotron radiation is a sensitive tracer of magnetic fields in distant radio galaxies, and a delicate probe of material co-located with the emitting regions or in the foreground. Broadband data are required to uncover the properties and distribution of the gas and magnetic fields.
- **Jet magnetic fields** are powerfully traced by circular polarization emitted by radio galaxies, which has not been comprehensively studied. QUOCKA will provide unique information about how many radio galaxies produce circular polarization and allow new understanding of the emission mechanism. QUOCKA results will motivate follow-up with the SKA.

QUOCKA will also help to interpret the ASKAP POSSUM (all-sky polarization) survey. ASKAP will soon be the most efficient instrument in the world for detecting polarized radio galaxies, but provides limited bandwidth (0.7–1.8 GHz). The ATCA enhances ASKAP's ability to understand cosmic magnetism.

Sample selection

We have developed the QUOCKA sample using ASKAP Early Science data following polarization calibration. We detected reliably polarized radio galaxies within available ASKAP fields. The QUOCKA sample is drawn from those radio galaxies that display sufficiently high fractional polarization that they are not dominated by instrumental effects, and are bright enough that snapshot ATCA observations can characterise their properties. Results so far are promising and we will expand these techniques for future observations.

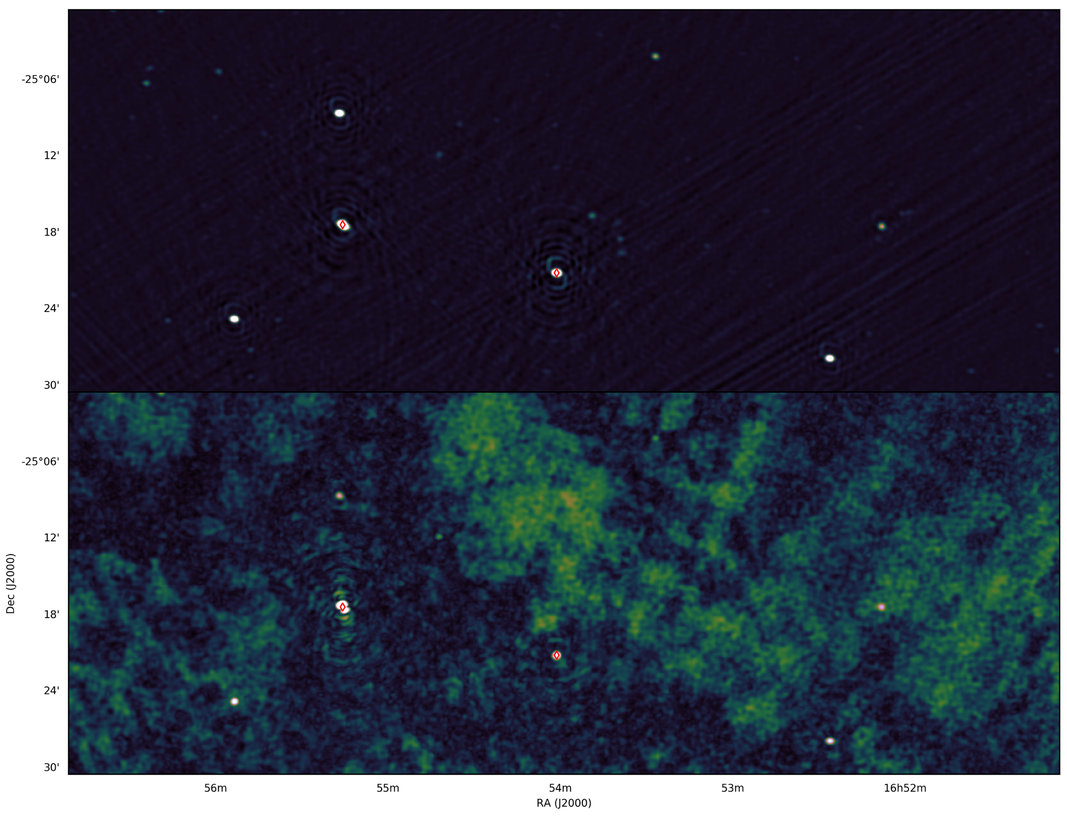

Figure 1: Example ASKAP images (here, small subsections of the actual 30 square-degree mosaics) that are used to develop the QUOCKA sample. Top: Total intensity; Bottom: Peak linear polarization (after RM Synthesis). The diffuse emission in the bottom panel is real and originates in the Galactic foreground. Sources included in the QUOCKA sample are indicated with red diamonds.

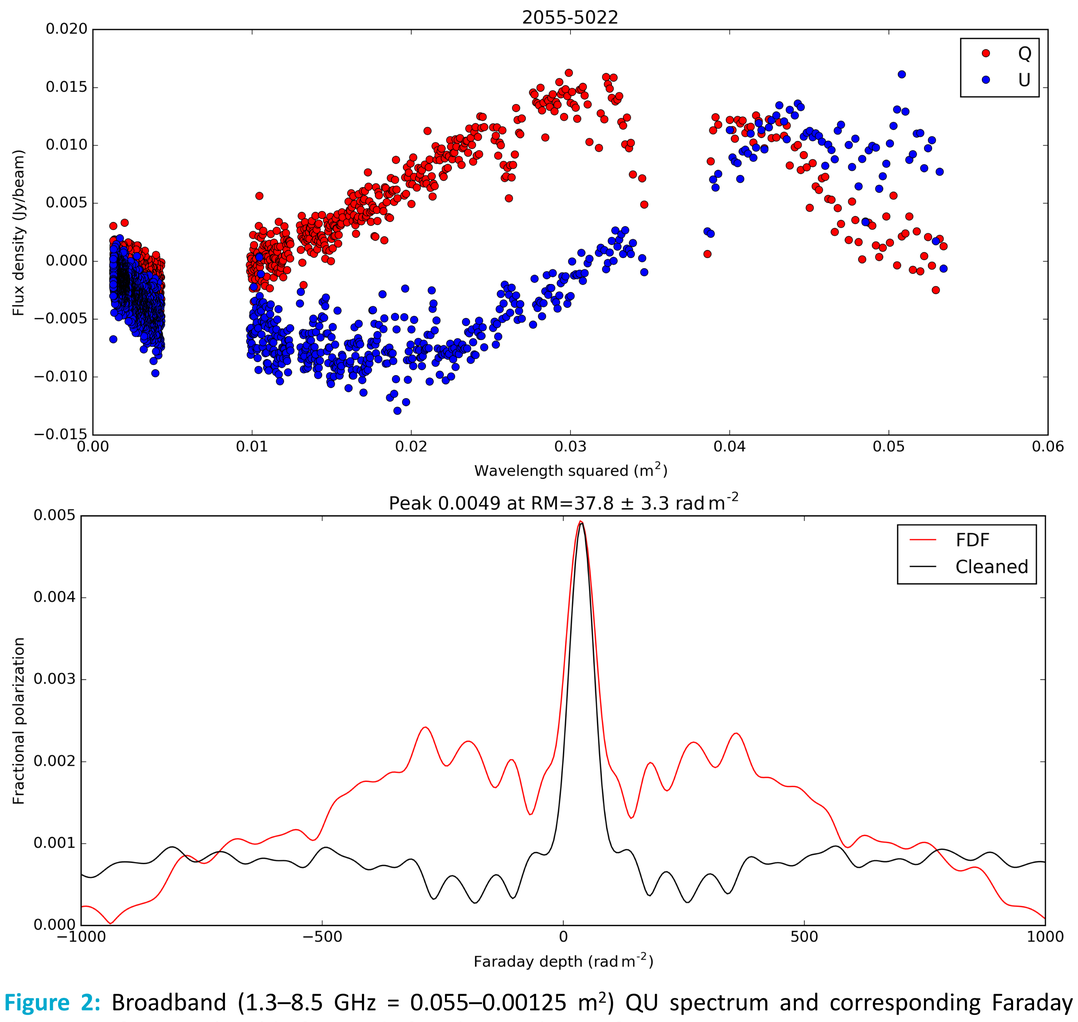

Figure 2: Broadband (1.3–8.5 GHz = 0.055–0.00125 m^2) QU spectrum and corresponding Faraday dispersion function (FDF) before and after deconvolution, for QUOCKA source J205503-502206.

Observations and preliminary data products

Observations are carried out with ATCA at 1-3 and 4.5-8.5 GHz, in extended east-west configurations. Short snapshots are used to improve imaging capability. The typical sensitivity is ~100 µJy/beam in each frequency band.

We have developed a data reduction pipeline that is based on standard MIRIAD procedures. We have performed initial processing of all 201 sources observed to date. In addition, 12 highly extended sources have also been observed with the same frequency setup and are being analysed separately.

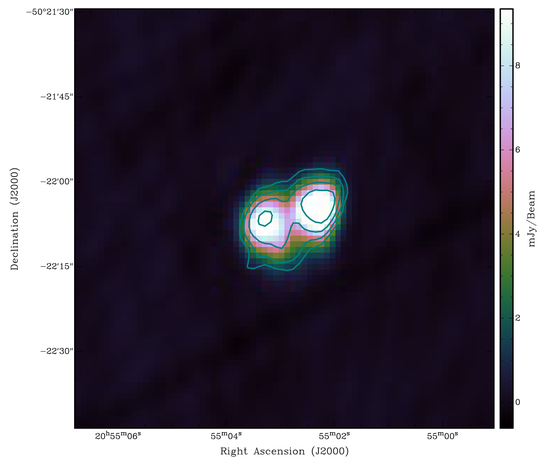

Figure 3: Example ATCA image quality, for QUOCKA source J205503-502206. Broadband total intensity images are presented as colourscale for the 4.5-8.5 GHz band, and with contours for the 1-3 GHz band.

Project progress and data release

QUOCKA project progress will be shared on our website:

https://research.csiro.au/quocka

We are planning to provide final data products via the CSIRO ASKAP Science Data Archive (CASDA).

FOR FURTHER INFORMATION

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