ATLAS: Australia Telescope Large Area Survey:
Deep Radio Observations of the CDFS-SWIRE and ELAIS-S1 fields

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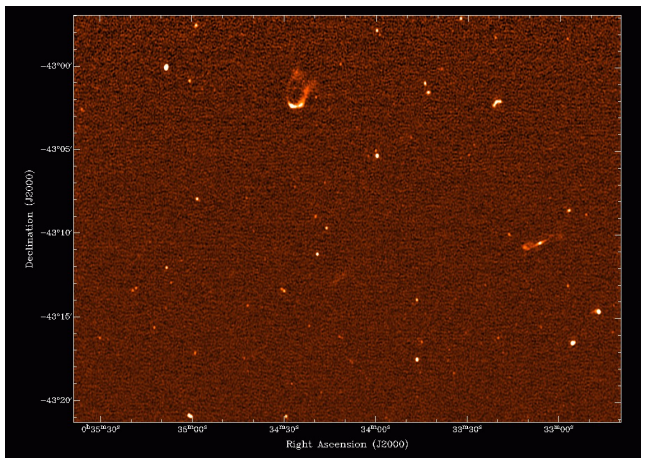
1. Overview

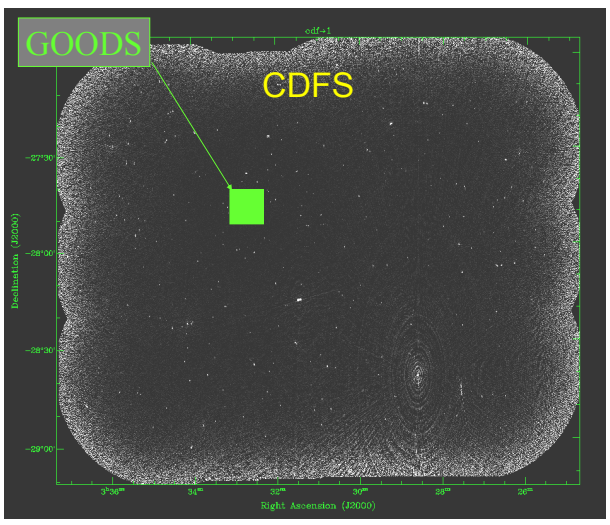
The Australia Telescope Compact Array used to make the radio images in this paper.

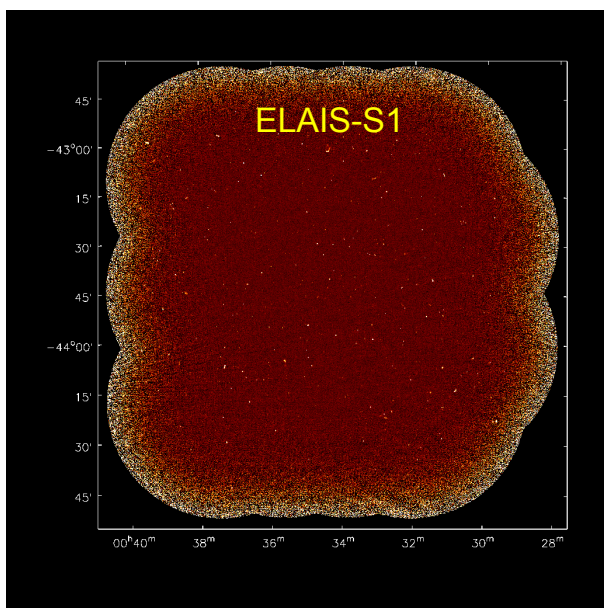
- We are imaging the CDFS and ELAIS-S1 SWIRE fields at 20 cm. Combining radio data with other wavelengths will help us understand the formation and evolution of early galaxies.
- Radio observations give information which is not available at any other wavelength. For example, we have found galaxies with a starburst SED but with a vigorous buried AGN, invisible at any other wavelength.
- When finished, this will be the widest (6^{o2}) deep (10-15 μJy) radio survey ever. It will:
  - not be affected by dust obscuration,
  - uncover rare classes of object,
  - show obscured large-scale structure.
- This is an interim report – we are about half-way through the observations and have not yet reached our final sensitivity.
- Stacking gives an rms_{20cm} ~ 1.5 μJy and shows the radio-FIR correlation extends down to S_{20cm}~10 μJy.
- We identify a class of radio sources (IFRS=Infrared-faint radio sources) with no visible infra-red emission. These may be very obscured or very high-z galaxies.

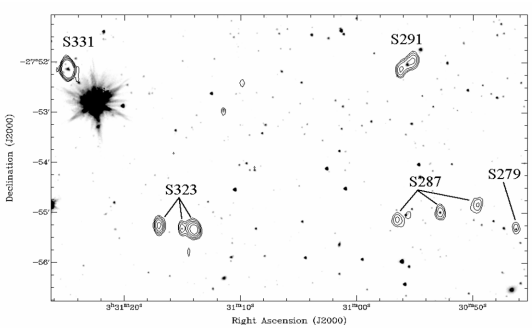


A typical part of the ELAIS-S1 field, showing examples of classical radio doubles and triples, isolated starburst galaxies, and a disturbed head-tail galaxy.

2. Observations & Data





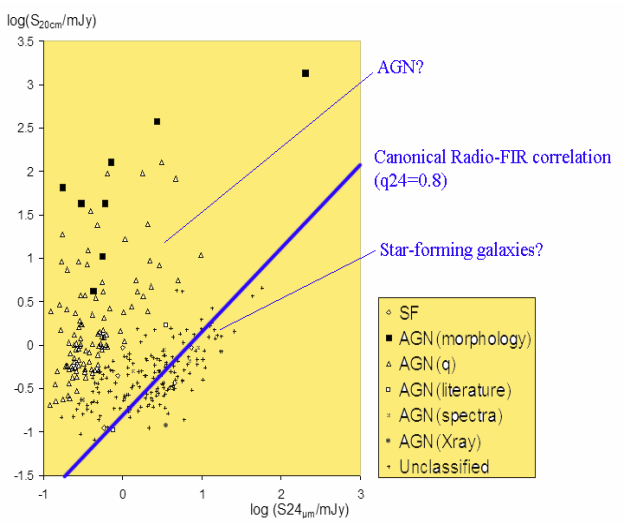


A typical part of the CDFS field with 20 cm radio contours overlaid on the 3.6 μm SWIRE image.

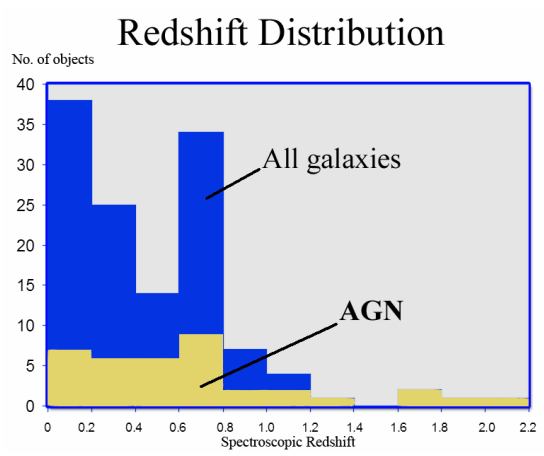
3. Results

Vital statistics

- 6 square degrees observed so far to ~ 40μJy rms
- Hope eventually to get to ~15 μJy rms
- Spatial resolution ~ 6 arcsec
- 1790 radio components detected so far
- These correspond to 1642 sources (some have multiple components)
- Nearly all are also detected by Spitzer



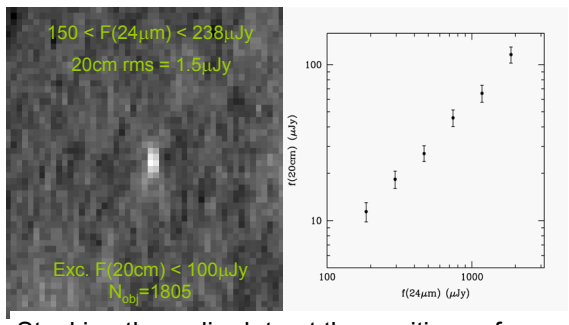
Some sources follow the radio-24μm correlation, indicating they are driven by star formation, while others have a strong radio excess, indicating AGN.



References:
Norris et al., 2006, AJ, in press.
Boyle et al., 2006, to be submitted to MNRAS.
Middelberg et al., 2006, to be submitted to AJ.

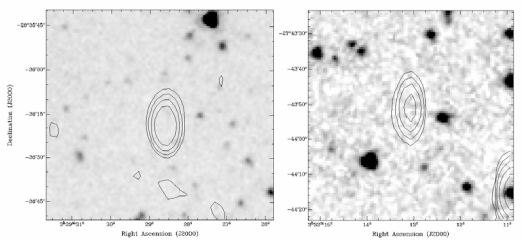
4. Science

Radio-FIR correlation at μJy levels

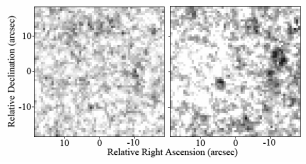


Stacking the radio data at the positions of known 24 μm sources enables us to probe very weak radio fluxes, and shows the radio-FIR correlation holds down to 10 μJy.

Infrared-faint Radio Sources



These mJy radio source (contours) are undetected at 3.6μm (grayscale), or any other Spitzer band. About 3% of our radio sources with good Spitzer data have no IR counterparts, implying an unusually high radio-IR ratio. We call this new class of sources “Infrared-faint radio sources”, or IFRS.



Stacking 3.6μm Spitzer data (above) still shows no counterparts, implying they are well below the detection threshold. These IFRS may be very heavily obscured, or high-z, AGN.