The MWA GLEAM 4-Jy Sample

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The southern sky at low radio-frequencies

GaLactic and Extragalactic All-sky MWA Survey
(Wayth et al. 2015, Hurley-Walker et al. 2017)

- Extragalactic catalogue of ~300,000 components
- Frequency range: 72 – 231 MHz
- 20 flux-densities per component
- -90 < Dec / deg < +30

The Murchison Widefield Array (MWA)
Credit: Natasha Hurley-Walker
Selection at low radio-frequencies

$\log_{10}(F_{\text{density}, Jy})$

$\log_{10}(\text{Frequency} / \text{MHz})$

steep-spectrum lobe emission

flat-spectrum core emission

flux limit at high frequency

Credit: Aurore Simonnet, Sonoma State University
Selection at low radio-frequencies

steep-spectrum lobe emission

flat-spectrum core emission

Doppler-boosted flux limit at high frequency

\[ S_o = S_e D^p, \]

where \( p = 3 - \alpha \).

\[ \alpha = \text{spectral index} \]

\[ D = \frac{1}{\Gamma(1 - \beta \cos \theta)} \]

\[ \beta = \frac{v}{c} \]

\[ \Gamma = \text{Lorentz factor} \]

Credit: “Is every quasar beamed?” (Barthel 1989)

Credit: Aurore Simonnet, Sonoma State University
The GLEAM 4-Jy sample

Jackson et al. (2016)  
$S_{151 \text{MHz}} > 4 \text{ Jy}$

Fainter radio sources (lower power or higher redshift)

Active galactic nuclei (AGN) dominate the sample


Radio brightness, $S_{151} / \text{Jy}$
Studying galaxy evolution with the 4 Jy sample

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Star formation and accretion: peak over $1 < z < 3$

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Co-evolution of the black hole and host galaxy

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Star formation triggered by radio jets
Visual inspection to determine the morphology

Collapse ‘component list’ into a ‘source list’ ->
~ 74% are compact at ~ 1 GHz

Background: AllWISE (W1)    TGSS (150 MHz)
GLEAM (200 MHz)    NVSS (1.4 GHz)
AT20G detection (20 GHz)

GLEAM (200 MHz)
image of IC 4296

40 arcmin across,
z = 0.012 -> 614 kpc across

Abell 3565 is 26 arcsec away
Intermittent jet activity, and “bent-tail” radio-galaxies

TGSS (150 MHz)
GLEAM (200 MHz)
SUMSS/NVSS (843/1400 MHz)

X- / Z-shaped sources

Wide- / narrow-angle tails
Thorough checks against the literature

Current host galaxy for 3C 198 (Wyndham 1966)

TGSS at 150 MHz
NVSS at 1.4 GHz
GLEAM at ~200 MHz
Background: WISE (W1)
Thorough checks against the literature

Current host galaxy for 3C 198 (Wyndham 1966)

Map produced from NRAO archives (Massaro et al. 2012)

TGSS at 150 MHz
NVSS at 1.4 GHz
GLEAM at ~200 MHz
Background: WISE (W1)

X-ray background from Chandra (0.5 - 7 keV)
Thorough checks against the literature

Current host galaxy for 3C 198 (Wyndham 1966)

Map produced from NRAO archives (Massaro et al. 2012)

TGSS at 150 MHz
NVSS at 1.4 GHz

GLEAM at ~200 MHz
Background: WISE (W1)

X-ray background from Chandra (0.5 - 7 keV)

True origin of the radio emission

The GLEAM 4-Jy Sample - Sarah White, June 2018
G4Jy sources in mid-infrared colour-colour space

Wright et al. (2010)

White et al. (in prep.)

The GLEAM 4-Jy Sample - Sarah White, June 2018
Spectral curvature, from 70 MHz to 20 GHz

GLEAM
Sydney University Molonglo Sky Survey (SUMSS)

$R^2 = 0.84$
$\alpha = -0.57$

Australia Telescope Compact Array (ATCA)

See talk by Darren Hamley & Anusha Veerahoo (tomorrow at 17:15)
Full-sample properties and optical follow-up

GLEAM 4-Jy catalogue and overlays
- Summed GLEAM flux-densities
- Summed flux-densities at 843 MHz / 1.4 GHz
- Angular sizes at 843 MHz / 1.4 GHz
- Spectral indices
- ~1,800 host-galaxy positions
- Mid-infrared magnitudes

70-230 MHz $\alpha$ steeper than 230-1000 MHz $\alpha$

230-1000 MHz $\alpha$ steeper than 70-230 MHz $\alpha$

No mid-infrared counterpart -> high redshift

Follow-up spectroscopy from the Taipan Galaxy Survey
- ‘Priority’ targets
- ‘Ancillary’ targets

White et al., in prep.