The GLEAM 4-Jy (G4Jy) Sample: the brightest radio-sources in the southern sky

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What is an active galactic nucleus (AGN)?

Credit: Aurore Simonnet, Sonoma State University
How do jets interact with their surroundings?

Emission at different spatial scales for M87

Composite image by Francesco de Gasperin
The GLEAM 4-Jy (G4Jy) Sample

Fainter radio sources (lower power or higher redshift)

White et al. (2020a, 2020b)

$S_{151 \text{ MHz}} > 4 \text{ Jy}$

Hurley-Walker et al. (2017)

3CRR type sources
(N = 274/1863)

Active galactic nuclei (AGN) dominate the sample
Selection at low radio-frequencies

\[ S_o = S_e D^p, \]

where
\[ p = 3 - \alpha. \]

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

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

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

Credit: “Is every quasar beamed?” (Barthel 1989)
Creation of the G4Jy catalogue

- **GLEAM catalogue and images**
- **TGSS**
- **AllWISE**
- **AT20G**
- **6dFGS**

**Create and inspect overlays**

**Determine the morphology**

**Determine the host galaxy**

**Exclude stars**

**G4Jy catalogue and overlays**

- Summed GLEAM flux-densities (72-231 MHz)
- Summed flux-densities at 843/1400 MHz
- Angular sizes at 843/1400 MHz
- 4 sets of spectral indices
- Host-galaxy positions for 1,606 sources
- Mid-infrared magnitudes

**Available on VizieR and at https://github.com/svw26/G4Jy**

(White et al. 2020a, 2020b)

Using MeerKAT to follow-up G4Jy sources

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

MeerKAT (1.3 GHz), 140 sources, 5 mins each (PI: White, Co-I: Heywood et al.)

G4Jy 318

G4Jy 1067

G4Jy 1311

Katlego Sejake
SARAO MSc
Rhodes University
Or... with 10 hr for observing a very-extended source...

Further MeerKAT imaging via:
- X-shaped sources selected from FIRST and the G4Jy Sample (PI: Kshitij Thorat)
- 3C/4C sources (PI: Tiziana Venturi)
- Galaxy Cluster Legacy Survey (PI: Kenda Knowles)
- IC 4296 (Condon et al.)

Figure 1. This reproduction of fig. 6a in Leahy & Williams (1984) shows the main features of the hydrodynamical backflow model for XRGs.

G4Jy 1613 (PKS 2014-55)
Cotton et al. (2020)
Spectral curvature, from 70 MHz to 20 GHz

16% “convex”
Young radio-sources?
See Callingham et al. (2017)

8% “concave”
Mostly blazars

Piloted a new outreach initiative:
ATARP = Australian Teacher Astronomy Research Program
(Michael Fitzgerald & Rob Hollow)

GLEAM + NVSS/SUMSS + ATCA

Subset of 208 sources
76% following ‘power-law’ description

A few sources with ‘kinks’ in the spectrum
Radio spectra of restarted radio-galaxies

Even when unresolved at higher redshift, candidate restarted radio galaxies can be identified from their broad-band radio spectra.

Giant radio galaxy, PBC J2333.9-2343 (Hernández-García et al., 2017)

Figures courtesy of Tom Franzen
The G4Jy Sample: properties and follow-up

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

Cumulation of past activity

Recent or ongoing activity

Determine the duty-cycle of the AGN

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Papers I and II (White et al., 2020a, 2020b).

A complete sample, ideal for detailed AGN studies, and without an orientation bias

https://github.com/svw26/G4Jy

Optical spectroscopy from SALT (PI: White)

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