MeerKAT follow-up of enigmatic G4Jy sources

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Introduction

- **Active Galactic Nuclei (AGN)** studies are crucial in understanding the two fundamental processes of **galaxy evolution**; star formation and black hole accretion. The energy source of AGN in a **radio galaxy** is thought to be powered by accretion onto a supermassive black hole and, in some cases, resulting in the production of radio jets and lobes.
- Impact of AGN activity in the host galaxy;
  - Suppress star formation by expelling gas from the system (Fabian, 2012) and/or
  - Promote star formation; radio jets impact upon a molecular cloud, triggering its collapse and subsequent star formation (Croft et al., 2006).

The GLEAM 4Jy Sample

White et al. 2020a,b

- A sample of the brightest radio sources in the southern sky (Declination, $\delta < 30°$) $\sim$ 1,863 sources, with observations from the Murchison Widefield Array (MWA).
- MWA provides radio images of $\sim$2′ resolution at low frequencies (72–231 MHz), the better spatial resolution of TGSS (25" resolution), NVSS (45" resolution) and SUMSS (resolution of 45" $\times$ 45" $\mathrm{cosec}|\delta|$) for radio morphology classification.
- Flux density S > 4Jy at 151 MHz.
- Ten times larger than the revised Third Cambridge Catalogue of Radio Sources (3CRR; Laing et al. 1983).
- White et al. (2020a,b) provided host galaxy identification for 86% of the sample (1,606 sources) and prompted 140 sources for a follow-up with MeerKAT (PI: White).
- **In this project, we aim to identify host galaxy for 140 G4Jy sources with the new images from MeerKAT.**

Objectives

Overlay radio contours of GLEAM, NVSS/SUMSS, TGSS and MeerKAT on the mid-infrared AllWISE image. Identify the **radio morphology**, then the host galaxy of the **radio emission**.

Method

- Visually inspect each of the G4Jy sources (see figures in Results) by overlaying multiple sets of radio contours (GLEAM (170-231MHz), NVSS (1.4GHz), or SUMSS (843MHz), TGSS (150 MHz), MeerKAT (1.3GHz)) onto mid-infrared image (WISE ($3.4\mu m$, W1 band)).
- Determine the radio morphology of the sources based on the $\sim 7''$ images from MeerKAT (image credit: Ian Heywood). This instrument has the sensitivity to diffuse radio emission at 1.3 GHz.
- Identify the host galaxy through cross identification and literature checks.

Results

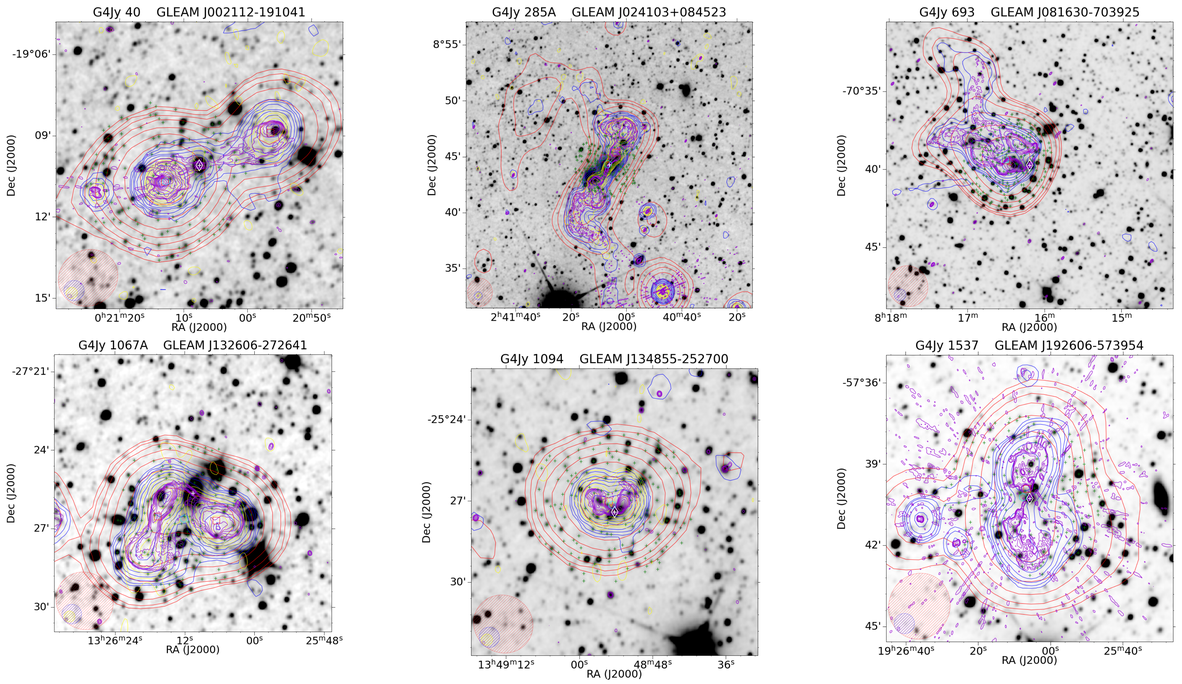


Table 1: Radio sources with identified host galaxy in the 140 G4Jy sources.

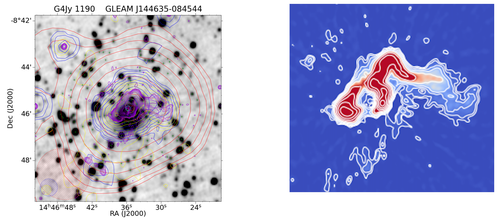
G4Jy name	ALLWISE	Redshift	Spectral index	$L_{151\mathrm{MHz}}$ [W/Hz]	L_ν [W/Hz]	$L_{1.3\mathrm{GHz}}$ [W/Hz]
G4Jy 40	J002107.53-191005.4	0.0956	-0.70041	1.09e+26	2.29e+25 at 1400MHz	2.83e+25
G4Jy 285	J024106.17+084416.9	0.0208	-0.46980	4.05e+24	1.42e+24 at 1400MHz	1.30e+24
G4Jy 693	J081611.74-703945.3	0.0332	-0.56445	1.28e+25	4.85e+24 at 843MHz	3.67e+24
G4Jy 1067	J132610.59-272538.6	0.0437	-0.61475	2.76e+25	7.03e+24 at 1400MHz	7.56e+24
G4Jy 1094	J134854.17-252724.5	0.1262	-1.13456	1.75e+26	1.40e+25 at 1400MHz	1.56e+25
G4Jy 1537	J192605.75-574016.4	0.0610	-0.75498	5.25e+25	1.43e+25 at 843MHz	6.53e+24

Discussion

- Using the $\sim 7''$ images from MeerKAT, we have identified galaxies hosting radio emission for 86 radio sources in 140 G4Jy sources, leaving 54 sources unidentified. G4Jy 1190 is one of the 54 sources.

Discussion continued

- Due to the complex morphology of G4Jy 1190 revealed even by MeerKAT, we are unable to identify the host galaxy for this source.



- In the Result section, we show **6 jetted G4Jy radio sources** that we have identified their host galaxy through visual inspection and literature checks. There is a clear indication of the core detected by MeerKAT for the triple morphology G4Jy 40 and the Wide Angle Tail (WAT) sources; G4Jy 693, G4Jy 1067 and G4Jy 1537.
- The extended radio emission of G4Jy 40, also known as PKS B0018-19, is hosted by the mid-infrared AllWISE J002107.53-191005.4, also detected in 6dFGS as g0021075-191006.
- The host galaxy of the WAT radio source G4Jy 1094 in the cluster Abell 1791 is the AllWISE source J134854.17-252724.5, also in 6dFGS (g1348542–252724). The identification of G4Jy 40 and G4Jy 1094 agrees with White et al. (2020a,b).
- G4Jy 285 - NGC 1044 – the mid-infrared AllWISE J024106.17+084416.9 is the host galaxy of the extended radio emission.
- We identify AllWISE J192605.75-574016.4 as the host galaxy of G4Jy 1537 (PKS 1921-577). The host galaxy identification provided in our work for G4Jy 285 and G4Jy 1537 agrees with White et al. (2020a,b) and van Velzen et al. (2012)
- The host galaxy of the WAT radio source G4Jy 1067 in the cluster Abell 1736 is the AllWISE source J132610.59-272538.6. The host galaxy identification provided in our work for G4Jy 1067 agrees with van Velzen et al. (2012).
- G4Jy 693 is one of the newly identified source in our work. The AllWISE source that coincides with the core contours from MeerKAT is J081611.74-703945.3.