Elongated Radio Galaxies in MeerKAT Observations of Proto-galaxy clusters

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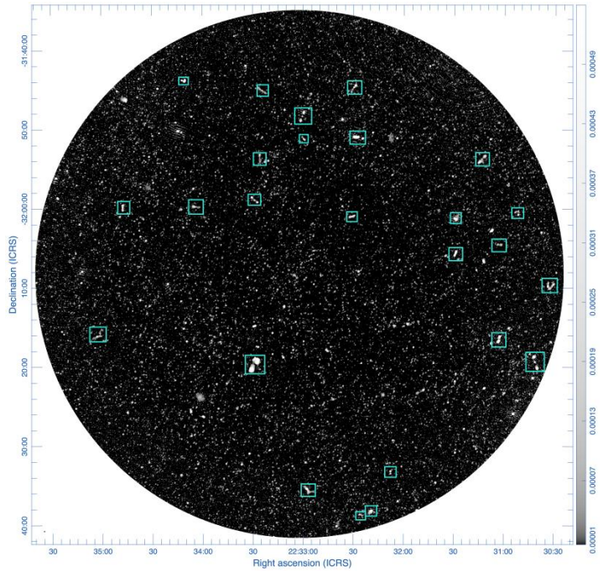
Introduction

In recent history, MeerKAT has enabled the observations of high density star proto clusters with z>1 (M J. Jarvis et al 2016). The previous methods in observing these proto-clusters using observations such as optical and FIR/Submm have shown to be unreliable. MeerKAT 1.28 GHz observations were capable of taking high resolution imaging using radio wavelengths unbiased by dust emissions that obscure most observations in other wavelengths.

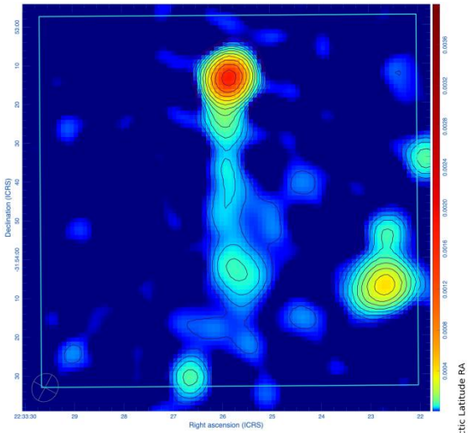


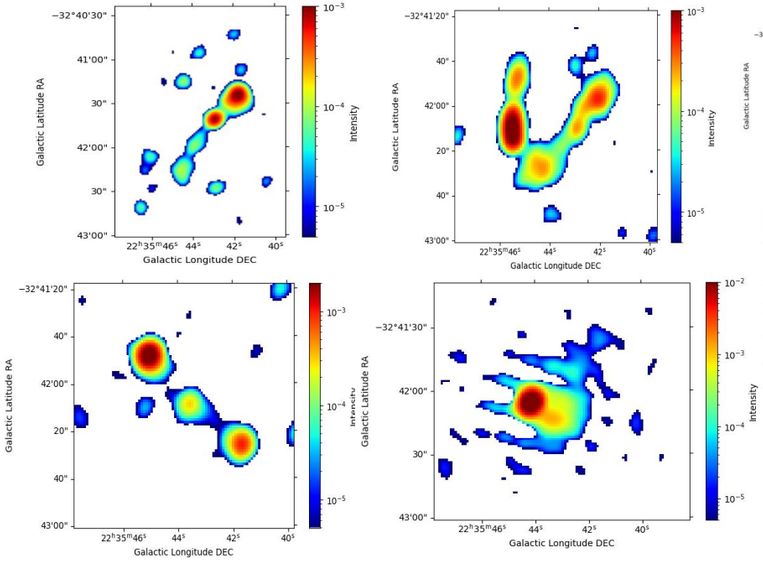
Of the images taken, target G014.99- 59.64, referred to as G014, is dusty star forming galaxy proto-cluster candidate that has more has over 5000 radio sources (Y. Ding et al. 2024). Observed with L-Band recievers, the beam target was in position 22h33m02s .16 −32°08’0 16’’. 8 at size 7.55’’x6.6’’. The elongated radio galaxies are a subset of the largest known Giant Radio Galaxies which have immense radio emmiting structures that extend far beyond the host galaxy.

Objective

To identify, characterize and analyze selected Elongated Radio Galaxies detected in the MeerKAT galaxy proto-cluster observations and see what light they may shed in our understanding of the causes or nature of their morphology-evolution.

Results





27 Sources were selected from the 5013. The examples shown here are examples of a one sided GRG (above) as well as symmetrical and non-symmetrical galaxies with external lobes that extend beyond the host galaxy. I have named each of the RG by R01 to R27, Top to bottom, left to right respectivily.

Radio Galaxies

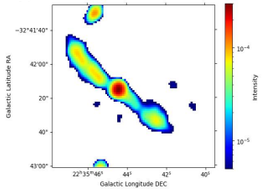
These galaxies have emissions that stretch beyond its visible structure and that have large energetic lobes (Mpc distance) that are powered by the active galactic nucleus. The radio galaxy structure is the result of the Super massive black hole at the center of the AGN producing synchotron emissions that form the lobes (L. Saripalli et al 2012).

These radio loud galaxies are subdivided into 3 main classes that are determined by their morphology, called the Fanaroff & Riley Classes. The structure of these galaxies consist of a bright core/ Nucleus (where the AGN is positioned and its dominance) and one or two lobes that protrude with varying luminosity within them displaying a variety of shapes (U-shape, S-shape).

The following classes will show an example from the select targets that fit the description of their class type.

Fanaroff & Riley Class 1 (FRI)

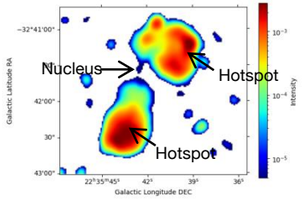
FRI and FRII were the two earliest classifications for radio galaxies sperated by the high ratio of surface brightness of lobes to core. FRI has a bright core with outer lobes being fainter (core-brightened). There norrow lobes expand long distances from the core denoting the age of its extremities.



R02 is non symmetrical example of an FRI that have 2 jets parallel. The larger jet being large enough to contain 2 hotspots. Of the select RG’s, this was the only one that classified as such.

Fanaroff & Riley Class 2 (FRII)

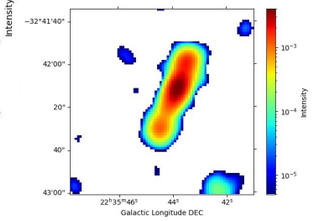
Refered to as edge-darkened, the luminosity of the lobes can overshadow the core. The pronounced lobes/ jets of these galaxies are wide and contain hotspots that can be detectd in X-ray imaging.



The radio galaxy refered to as R19 is a clear example of the jets being greater in size than the original host galaxy. The Nucleus is only seen in optical wavelengths.

Fanaroff & Riley Class 0 (FRO)

The most recent addition to the classification FR classes have found itself to be the dominant population within the radio sky. They are similar to FRI in that they are core dominated but are more compact with shorter extensions (Giovannini, G., et al. 2023).



The compact status of FRO was identified as FRI galaxy types have kiloparsec distances from the core. The jet emmisions that result in R14 having resolved yet compact features

Summary and Conclusion

The core dominance in respect to the lobes are the main factor in how to catagorize radio galaxies into the three classes. All of the 27 radio Galaxies have been catagorised among these three catagories, showcasing a majority of FR0. However further analysis is required to subdivide the catatgories through analysis of the select radio galaxies flux distribution and their properties in different wavelengths.

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