INVESTIGATING THE PHYSICAL PROPERTIES AND ENERGETICS OF JETS AND LOBES IN 3C 272.1 AND 3C296 USING e-MERLIN AND VLA OBSERVATIONS

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Abstract

Radio-loud Active Galactic Nuclei (AGNs) generate powerful jets and extended lobes that are essential for understanding AGN feedback and the co-evolution of supermassive black holes with their host galaxies. Despite sufficient energy being available from these structures, key questions remain about how feedback is regulated and how the intergalactic medium is heated. This study will utilise high-resolution, multifrequency radio observations from the e-MERLIN jets legacy programme, complemented by Very Large Array (VLA) data, to map the jets and lobes of 3C 272.1 and 3C 296, quantify their mass, momentum, and energy inputs, and analyse their interactions with the surrounding environment. The research aims to address gaps in current literature by providing detailed insights into feedback mechanisms. This work seeks to contribute to astrophysical models of galaxy evolution. Findings could guide future observational strategies and simulations.

Introduction

Active Galactic Nuclei (AGNs) are compact, highly energetic regions at the centers of galaxies, fueled by accretion onto supermassive black holes and emitting across the spectrum.

In radio-loud AGNs, relativistic jets and lobes play a pivotal role in AGN feedback processes, injecting energy into the intergalactic medium and influencing the co-evolution of black holes and their host galaxies (Hardcastle & Croston, 2020).

Fig 1. M84 Virgo cluster elliptical galaxy

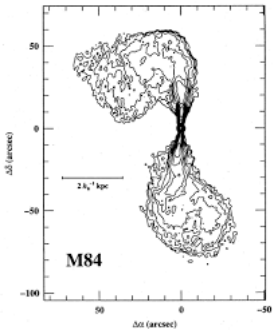

Fig 2. Radio map of M84 at 4.9 GHz

Methods

This study employs a quantitative observational approach, utilising archival data and new analytical techniques.

The sample consists of two FRI AGNs (3C 272.1 and 3C 296) from the e-MERLIN Jets Legacy Program. These were selected for their brightness and morphological diversity (Beswick et al., 2020)

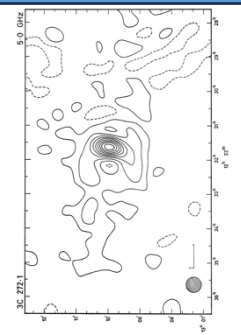

Fig 3. Radio map of 3C 272.1 at 5.0 GHz

Expected work

- Generating matched high-resolution maps using CASA
- Constructing spectral index maps of the science targets
- Quantifying flux densities, polarisation, and rotation. Calculation of energetics (mass, momentum and energy)
- Modelling the surrounding medium's density and pressure to analyse Jet interactions

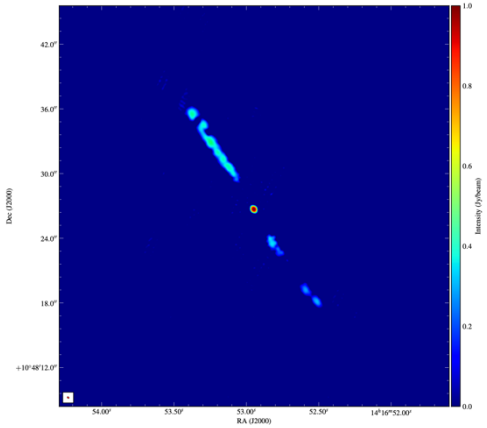

Fig 4. eMERLIN radio map of 3C296 at 1.5GHz 0.1-arcsec

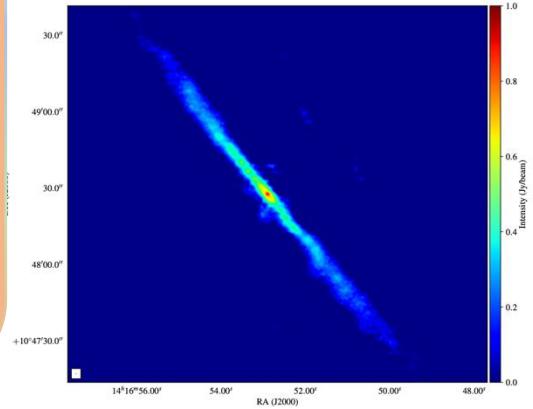

Fig 6. LOFAR radio map of 3C296 at 144 MHz 0.3-arcsec

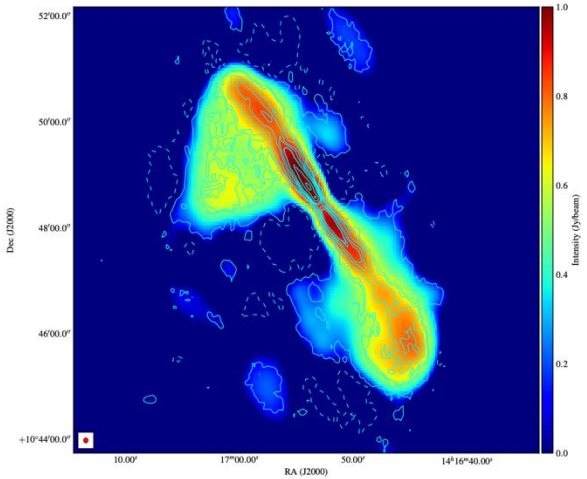

Fig 6. LOFAR radio map of 3C296 at 144 MHz 6-arcsec

Expectations

The research intends to;

Generate detailed maps that reveal the efficiency of feedback mechanisms

Provide insights into environmental factors influencing jet-lobe interactions

References

Beswick, R. J., et al. (2020). The e-MERLIN legacy survey of nearby galaxies. *Monthly Notices of the Royal Astronomical Society, 491*(3), 3456-3472.

Hardcastle, M. J., & Croston, J. H. (2020). AGN feedback in galaxy clusters. *New Astronomy Reviews, 88*, 101539.

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