Proposed BSc Honours Project 2025

A tale of a bent-tail radio galaxy

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The project is offered at all nodes: NWU, UCT and UKZN.

Background: Radio galaxies (RGs) have long been widely split into Fanaroff-Riley type I (FR I) and type II (FR II) based on their morphology and the distribution of the radio surface brightness in the lobes. However, follow-up studies have revealed a significant population showing unusual and distinct morphologies such as bent-tail RGs. The characteristic shape of this class of RGs, in which the jets and tails are significantly bent or distorted from the expected straight line trajectory, is likely attributed to the weather of the surrounding intracluster medium (ICM). Bent RGs are thus useful tracers of galaxy clusters/groups to help us understand the effect of radio mode feedback operating in the subclusters and the influence of the gas environment on the radio galaxies.

Project description: This project uses multi-frequency radio surveys (LOFAR/LoTSS DR2, FIRST, NVSS, and VLASS) to conduct a comprehensive study of a bent-tail RG J0858+5053, possibly with a restarted nuclear activity. Restarted radio galaxies are another interesting class of RGs arises from the activity of the core. The student will perform radio spectral analyses as well as visual inspection of the radio images of the source to determine its nuclear activity and to shed more light on the impact of cluster environment on its distorted morphology.

Special requirements: The project will require searching and retrieving archival data. Basic (python) programming skills and a desire to learn how to use new astronomy software are thus required to complete the project.

References: Baoqiang et al. 2025, ApJS, 276, 46 • Mingo et al. 2019, MNRAS, 488, 2701 • Missaglia et al. 2019, A&A, 626, A8 • Morganti 2024, Galaxies, 12, 11 • Safouris et al. 2008, MNRAS, 385, 2117 • Vardoulaki et al. 2021, Galaxies, 9, 93

If you are interested, you should get in touch for further details and to discuss the project.

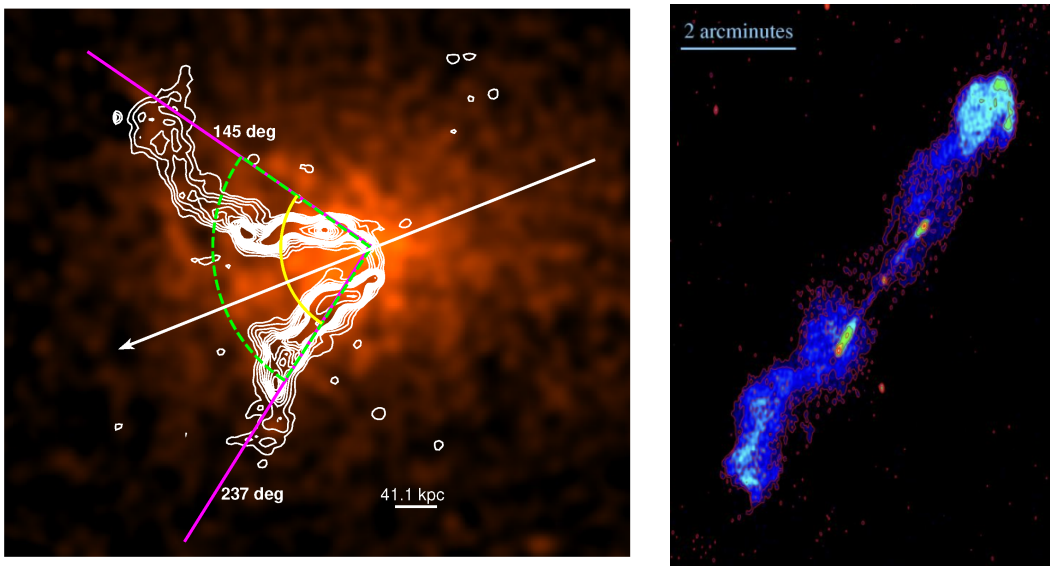

Figure 1: *Left:* An example of a bent-tail radio galaxy, more specifically a wide-angle tailed (WAT) source. The arrow shows the bisection of the angle between the two tails of the WAT, showing that the elongated X-ray emission extends down the middle of the radio tails. Credit: Tiwari & Singh, 2022. *Right:* A typical restarted radio galaxy with the so-called double-double structure, which consists of two pairs of double lobes. The outer pair of lobes are older and they are slowly fading away. The inner pair of lobes are created after the radio galaxy is born again. Credit: Safouris et al. 2008.