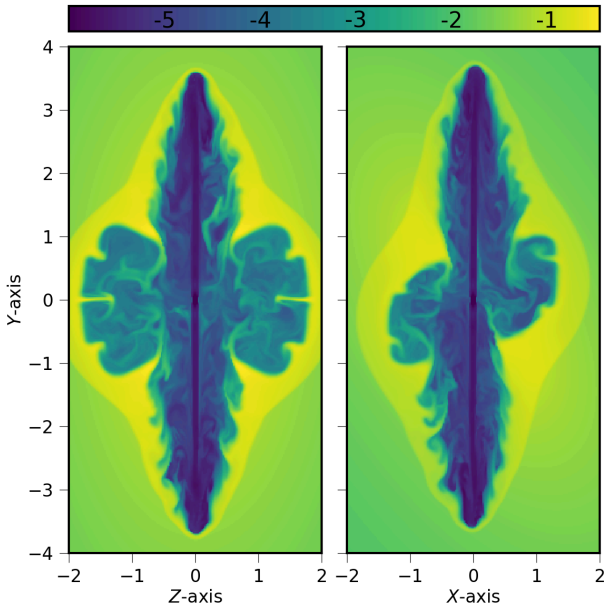
# **Analyzing Unusual Radio Outflows in extended RAdio-galaxies** (AURORA)

In a small fraction of the extragalactic jets, an intriguing phenomenon occurs wherein the initially straight trajectory of the jet starts bending, giving rise to peculiar morphologies that appear like X-, S-, and Z-shapes or in general, “winged”-shapes. With the remarkable resolution and sensitivity of current-day telescopes, a substantial increase in the discovery of winged radio galaxies has commenced. These discoveries present an opportunity to delve into the origins of such phenomena, a topic that has long been debated. However, while observations provide valuable insights into different emission components, they often fall short in fully constraining the underlying formation processes. This is where numerical simulation becomes important. By implementing diverse configurations of jets and ambient mediums, such works allow us to systematically test the proposed hypotheses of such sources’ origin.

The primary goal of this project is to develop a simulation framework aimed at addressing a fundamental question: Can a universal formation model for winged sources explain all observable phenomena, or are different models required for distinct sources? Within the framework of "AURORA," efforts have already been undertaken to develop distinct models, primarily focusing on smaller scales (~10s of kpc; ***Left Figure***). The next phase of the project aims to extend these models to encompass larger-scaled sources, spanning 100s of kpc to Mpc. So, the project's primary objective is to model the late-stage evolution of winged sources and establish a database, serving as a prediction set for observations conducted by telescopes such as MeerKAT and LOFAR.




As a key component of this project, the student will initially gain a solid understanding of magnetohydrodynamic simulations, with ample resources available for learning through existing test examples within the MHD code. Following this foundation, the student will progress to conducting simulations on realistic astrophysical systems, using previous tests conducted on smaller scales. The project's highlight is simulating winged sources using different physical conditions and comparing them with observed data through emission maps. This evaluation aims to assess the effectiveness of a unified model in explaining the characteristics observed in different winged sources.

**Special Requirements:** Familiarity with python coding and Linux environment is a must.

**Research Area:** Astrophysics
**Project Level:** Masters
**This Project Is Offered At The Following Node(s):**
(UCT) (NWU)

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