

A Study of Different Subclasses of Irregular-Morphology Radio Galaxies

Sabyasachi Pal (MCC), Shobha Kumari (MCC), Souvik Manik (MCC, IIT Kanpur), Netai Bhukta (SKBU, MCC) and Sushanta K Mondal (SKBU)

Abstract: We summarize our recent efforts to identify and characterize various subclasses of irregular radio galaxy morphology using modern all-sky surveys, with the aim of understanding the physical mechanisms responsible for producing these rare structures. Our work draws primarily on data from the TIFR GMRT Sky Survey (TGSS), the Faint Images of the Radio Sky at Twenty-cm (FIRST) survey, the MeerKAT Absorption Line Survey (MALS), and the LOFAR Two-metre Sky Survey (LoTSS). Our main results are as follows: (i) using MALS and FIRST, we discovered 36 and 33 hybrid-morphology radio sources (HyMoRS), respectively, together constituting the largest sample of HyMoRS assembled to date; (ii) through TGSS, FIRST, and LoTSS, we identified 58, 296, and 33 winged radio galaxies, respectively, substantially increasing the known population of these objects; (iii) we also report 717 head-tailed radio galaxies from FIRST, 267 from TGSS, and 35 from LoTSS; and (iv) we discovered several odd radio circle (ORC)-like diffuse emission objects—mysterious, extremely rare sources whose origin remains debated—including one exhibiting circularly symmetric radio emission surrounding an elliptical galaxy, and another displaying a horseshoe-shaped ring of radio emission. These large, systematically identified samples of diverse radio galaxy subclasses provide valuable insight into the morphological and physical diversity of active galactic nuclei. We further present multi-wavelength follow-up studies of several of these irregular sources, aimed at investigating the role of the surrounding environment—particularly the intergalactic and intracluster medium—in shaping their unusual morphologies.