Seminarium Astrofizyczne
wtorek 08.10.2024 godz. 12:30
ul. Pasteura 7, sala 404

transmisja on line
https://www.gotomeet.me/NCBJmeetings/seminarium-astrofizyczne
Password: AstroSemi

Dr Pratik Dabhade

Postdoctoral Researcher
(NCBJ, BP4)

From unveiling Giant Radio Galaxies to harnessing them as astrophysical probes

Giant Radio Galaxies (GRGs) are galaxies hosting active supermassive black holes that produce powerful bipolar radio jets, resulting in structures extending over megaparsec scales. These are the largest single structures known in the Universe, with current research indicating they can grow up to ~7 Mpc in size, surpassing even the dimensions of massive galaxy clusters. Although GRGs were discovered 50 years ago, significant insights into them have emerged only in the past eight years, largely due to the efforts of project SAGAN ('Search & Analysis of GRGs with Associated Nuclei'), which has been at the forefront of understanding these enigmatic giant radio sources.

Research continues to investigate whether the immense sizes of GRGs are due to the high efficiency of their powerful central active galactic nuclei (AGN), the sparser environments in which they evolve, or a combination of both. To delve into the formation, growth, and evolution of GRGs—and to assess their utility as probes of other astrophysical processes—we initiated the dedicated project called ‘SAGAN’ in 2016. To date, 8 research papers have been published from this project, including one review paper. These publications have not only discovered the largest samples of GRGs, thereby dispelling the myth of their apparent rarity but have also illuminated their key properties and refuted

some previously proposed models explaining their sizes. Our collective efforts through project SAGAN and its results have inspired and rejuvenated interest in the field; consequently, numerous research papers on the topic have been published by different groups around the world.

In this seminar, we will present how our understanding of GRGs has been transformed over the past eight years, thanks to the advent of deep radio surveys such as the LOFAR Two-metre Sky Survey (LoTSS), which has been instrumental in discovering the largest and faintest GRGs. We will discuss how using optical-infrared data from the Sloan Digital Sky Survey (SDSS) and the Wide-field Infrared Survey Explorer (WISE), we studied the AGN accretion properties of GRGs and compared them with those of normal-sized radio galaxies. Additionally, we will describe how millimetre-wave data from the IRAM 30-metre telescope was utilised to understand the fuelling of AGNs in GRGs. By employing multiple radio surveys and conducting dedicated observations with all major radio telescopes, we determined key radio properties of GRGs using large samples for the first time. We will present high-quality radio images obtained from GMRT, unveiling previously unseen low-surface-brightness radio structures in GRGs. These data, as part of our ongoing work, have enabled more precise estimates of the ages and magnetic fields of these structures. Using optical data, we constrained their environments and assessed how these affect their growth, thereby disproving some previous models. Lastly, we will demonstrate how GRGs have been—and can increasingly be—used as cosmic probes of the large-scale environment and magnetic fields, which has significant implications for our understanding of magnetogenesis.

The upcoming Square Kilometre Array (SKA) will achieve unprecedented sensitivity in significantly shorter observation times, enabling us to discover more GRGs and study them in greater detail. The SKA's advanced capabilities will allow us to detect the faintest and most distant GRGs, shedding light on their role in cosmic evolution and the large-scale structure of the Universe. Our future research with the SKA will further enhance the utility of GRGs as cosmic probes, deepening our understanding of fundamental astrophysical processes.

Serdecznie zapraszam,
Kishan Deka, on behalf of the SOC