Master's thesis project in Space, earth and environment

Radio and millimeter interferometric studies of luminous infrared galaxies

Background

Luminous and ultraluminous infrared galaxies ((U)LIRGs) are gas-rich systems that radiate immensely in the infrared portion of the electromagnetic spectrum, with infrared luminosities in excess of 10^{11} $L_{\odot}$ and 10^{12} $L_{\odot}$, respectively. These large luminosities are due to dust-reprocessed radiation from intense star formation, an active galactic nucleus (AGN), or both. A newly discovered subclass of (U)LIRGs are the compact obscured nuclei (CONs) which are heavily obscured objects with optically thick dust continuum up to millimeter wavelengths. These opaque nuclei seem to be evolving rapidly with accreting supermassive black holes and/or growing compact stellar spheroids providing the nuclear energy source. This nuclear activity may be caught in a very short-lived phase of its development because feedback from the central activity will quickly clear the obscuring material. Studying the properties of the CONs is thus a key element in the probing of the most active phase of nuclear growth in the local Universe. However, observations of these enshrouded galaxy nuclei are hampered at many wavelengths by the large amounts of obscuring material that surrounds them. By going to long wavelengths (millimeter to radio), where the dust opacity is negligible, this problem can be alleviated. Furthermore, the availability of modern interferometers at these wavelengths offers a tool to achieve the high angular resolution and sensitivty required to resolve and perform detailed studies of such objects.

Task description

The details of the project can be tailored to the specific interests of the student, but it will focus on the analysis, and possibly also calibration and imaging, of interferometric data from current state of the art interferometers such as ALMA, the VLA, and e-MERLIN. Depending on which dataset the student is interested in working with, the project may have different aims including, but not limited to:

- **Resolving the structure of continuum or megamaser emission in a heavily obscured galaxy nucleus.** The analysis may for example include determining the location, orientation, and morphology of a known molecular outflow using high resolution continuum and/or emission line data.
- **Searching for hidden molecular outflows using rotationally excited OH.** This project would focus on determining how common it is for the most obscured galaxy nuclei to exhibit molecular outflows that are hidden at short wavelengths but observable in the radio. If detected, it will also be possible to put constraints to the spatial origins and velocity structures of the outflows.
- **Imaging of emission from the reactive ion HOC^+.** Here the focus is on investigating the unusually strong emission from HOC^+ observed in some galaxies. The analysis will include determining the incidence of HOC^+ detections in a sample of $\sim$40 galaxies as well as imaging of this emission to determine its location.

Required education and course requirements

The courses "Galaxies and observational cosmology" (RRY091) and "Radio Astronomical techniques and interferometry" (RRY131) are highly recommended for this Master's research project. Programing skills, specifically in Python, are helpful, but may also be developed as part of this thesis.

Credits

30 credits

Starting time

The project can start at any time.

Contact information to supervisor

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