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A resolved and multiscale study of star-formation in local U/LIRGs

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As part of the e-MERLIN Legacy Project & Collaboration (LIRGI), this work has as objectives to stablish resolved calibrated star formation (SF) rates for local ($z < 0.1$) Luminous and Ultra-Luminous Infrared Galaxies (U/LIRGs), and separating the emission related to active-galactic-nuclei (AGN). Detailed studies of local U/LIRGs play a fundamental role in the understanding of SF activity and how it is connected with AGN feedback and accretion mechanisms. This is essential for the inference of physical properties of distant U/LIRGs in later studies, where angular resolution is limited.

Our strategy is to use multiscale imaging and image processing techniques to decompose the radio emission into multi-components, at various spatial scales. We started by using *e*-MERLIN observations at 5 GHz and VLA observations at the same frequency, achieving angular resolutions from 0.05" to 0.3", respectively. With *e*-MERLIN, we resolve the nuclear regions at $\sim 20 - 50$ pc scales in order to probe compact radio components and disentangle it from the nuclear diffuse emission at scales $\sim 100 - 200$ pc. With VLA, we characterise the large scale diffuse emission (> 1 kpc), mostly associated with SF activity. To complement, we are now using multi-frequency observations ($1.4 \sim 33$ GHz) to compute resolved spectral mapping to distinguish distinct mechanisms and calculate associated thermal fractions, thus achieving more accurate SFR estimates.

We introduce new techniques to take advantage of combined interferometric data, maximizing the science output from high-resolution images. We show how the entire process can be automated, thus appliable to larger datasets. We also present an automated and fast strategy for self-calibration of multi-frequency interferometric data, towards the reproducibility of science results.

Our first results demonstrated that the emission from SF processes (compact starburst, nuclear diffuse emission and large scale emission – i.e. multiscale SF emission) can be easily underestimated whilst AGN contribution overestimated. Thus, we present a multiscale SF tracer in order to quantify such differences and evaluate how SF is relevant to the radio emission.

keywords

local galaxies; star-forming galaxies; ULIRGs; calibration; imaging; image fitting; image processing; automated techniques

In-person or online?

in-person

Career level

Student

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