

EVN imaging of the LIRGI sample

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My main research topic deals with the study of the central kpc region of a sample of Luminous Infra Red Galaxies in the Local Universe, using high angular radio observations (supervisor: Miguel A. Pérez-Torres, IAA; co-supervisor: Antxon Alberdi Odriozola, IAA)

Local U/LIRGs as cosmic SFR tracers

- Galaxies can be classified on the basis of its infrared emission. The most powerful emitters on this spectral region are the so called **U/LIRGs** (Ultra/Luminous Infrared Galaxies).
- The dusty innermost regions of this kind of galaxies are heated by **AGNs**, **starburst** processes, or a combination of both. Discerning which is the heating mechanism requires a deep analysis of the nuclear regions.
- **Local U/LIRGs** galaxies are expected to be similar to star forming galaxies at high redshift. Hence, the study of local LIRGs is a tool to better understand the main SFR contributors at high z.

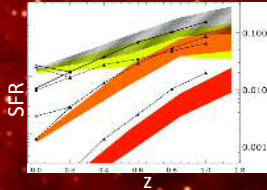


Figure: The star formation density of the Local Universe ($z=0$) is dominated by normal spiral galaxies. However, at approximately $z=1/z=2$, LIRGs/ULIRGs start to dominate the SFR density (from Magnelli et al. 2009, A&A)

Specific goals:

As the enormous amount of dust in LIRGs does not allow to observe its central regions in optical and infrared ranges, it is necessary to resort to radio wavelengths for a deep view inside. Moreover high angular resolution observations (from hundreds to milliarcsecond resolution) obtained with radio-interferometers allow us to resolve the overall structure in compact radio sources, and thus:

- discriminate **AGN vs. Starburst scenarios**
- unveil the largely hidden core-collapse SN population
- measure the **energy contribution** of AGN and SNe/SNRs.

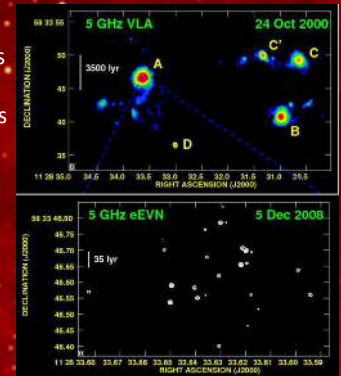
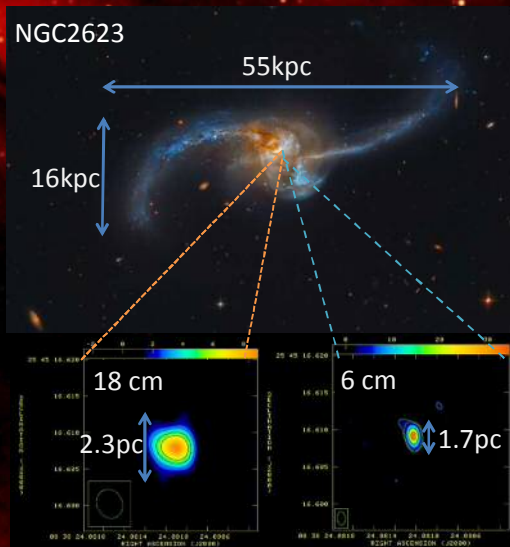


Figure: 5 GHz VLA (top) and VLBI (bottom) observations of Arp299. Note the existence of a large population of bright compact sources in the A nucleus, most of them supernovae and supernova remnants (from Pérez-Torres et al. 2009, A&A Letters)

Preliminary results: Ongoing project



Once we obtain the cleaned images we measure peak fluxes of the radio sources detected in both bands (6 and 18 cm). In that way we infer the spectral indices of each one and obtain unique information of the nature of the source: AGN or SNR.

GALAXY	Peak flux [μ Jy/beam]	rms [μ Jy/beam]	Spectral Index
IC5298	18cm 106,77	25,63	0,28
	6cm 144,30	26,12	
Mrk331	18cm 285,85	71,20	0,40
	6cm 442,65	42,97	
III ZW035	18cm 105,31	22,40	1,40
	6cm 475,53	31,05	
IRAS03359+15	18cm 66,028	20,01	0,69
	6cm 139,77	25,41	
MCG+12-02-00	18cm 251,91	28,65	0,15
	6cm 298,02	31,55	
NGC2623	18cm 8954	456,4	1,24
	6cm 33950	269,2	
NGC5256A	18cm 398,35	64,23	-0,53
	-6cm 225,90	43,27	
NGC5256B	18cm 85,45	22,52	0,78
	6cm 198,32	41,70	

Figure (left): NGC2623 in optical wavelengths observed with HST (above). In the inner nuclear regions we detect a bright compact radio source both in 18 cm (bottom left) and 6 cm (bottom right).

Table 1 (above): Summary of some of the LIRGI sources observed with the EVN. The spectral index is obtained as the slope of the SED region between the 6 and 18 cm band.

LIRGI (LIRG Inventory)

LIRGI stands for Luminous InfraRed Galaxy Inventory, a legacy project of the eMERLIN radio interferometer in the UK (PIs: John Conway and Miguel Pérez Torres)

- LIRGI:**
42 galaxies with $\log(L_{IR}/L_{\odot}) > 11.4$
- $D_{max} = 250$ Mpc
- Dec > 8 deg
<http://lirgi.iaa.es/>

- GOALS**
... included in the well studied GOALS survey (180 U/LRGs). It spans the range of different types of AGNs and starbursts at different wavelengths.
<http://goals.ipac.caltech.edu/>

- IRAS Revised bright galaxy sample:**
... and the GOALS galaxies belong to the IRAS-Bright Galaxy Sample (Sanders et al. 2003), which includes 629 brightest 60-micron extragalactic sources in the whole sky.



LIRGI makes use of the electronic Multi-Element Remotely Linked Interferometer Network (**e-MERLIN**):

- Interferometric array of 7 antennas across the UK.
- Frequencies: 1.7 and 5.0 GHz
- Angular resolution: 0.15-0,05 arcsec

Methods:

In this contribution we present preliminary results for a subset of our LIRGI sources observed with European VLBI Network (EVN). We have performed continuum European VLBI Network (EVN) observations:

- > with high resolution (mas)
- > with high sensitivity (mJy/beam)
- > @ 1,7 GHz and 5 GHz



- Quasi-simultaneous observations at both frequencies taken in March and October 2012.
- On-source time ~ 1 hr/target.
- Data calibration and imaging using the AIPS (Astronomical and ImageProcessing System) software.