Galaxy evolution and galaxy cluster dynamics in the GCAV sample explored with MeerKAT and JWST

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Abstract

This project aims to study galaxy evolution across different cluster environments (dense regions, cluster outskirts, merging, and relaxed clusters) using optical and radio data, targeting **Abell 85**, **Abell 370**, and **Abell 2744**, selected from the GCAV sample, with observations complemented by MeerKAT and JWST data. This will enable a detailed study of the radio galaxy population, extending down to the transition regime between AGN and starburst in elliptical galaxies.

Radio data: MGCLS

All our targets were observed as part of the MGCLS, which consists of long-track observations (6–10 hours) of 115 galaxy clusters using MeerKAT's L-band (856–1712 MHz) receiver. Images have been produced at resolutions of ~7" and ~15", and reach an average sensitivity of ~3 to 5 μJy/b (Knowles et. al. 2022).

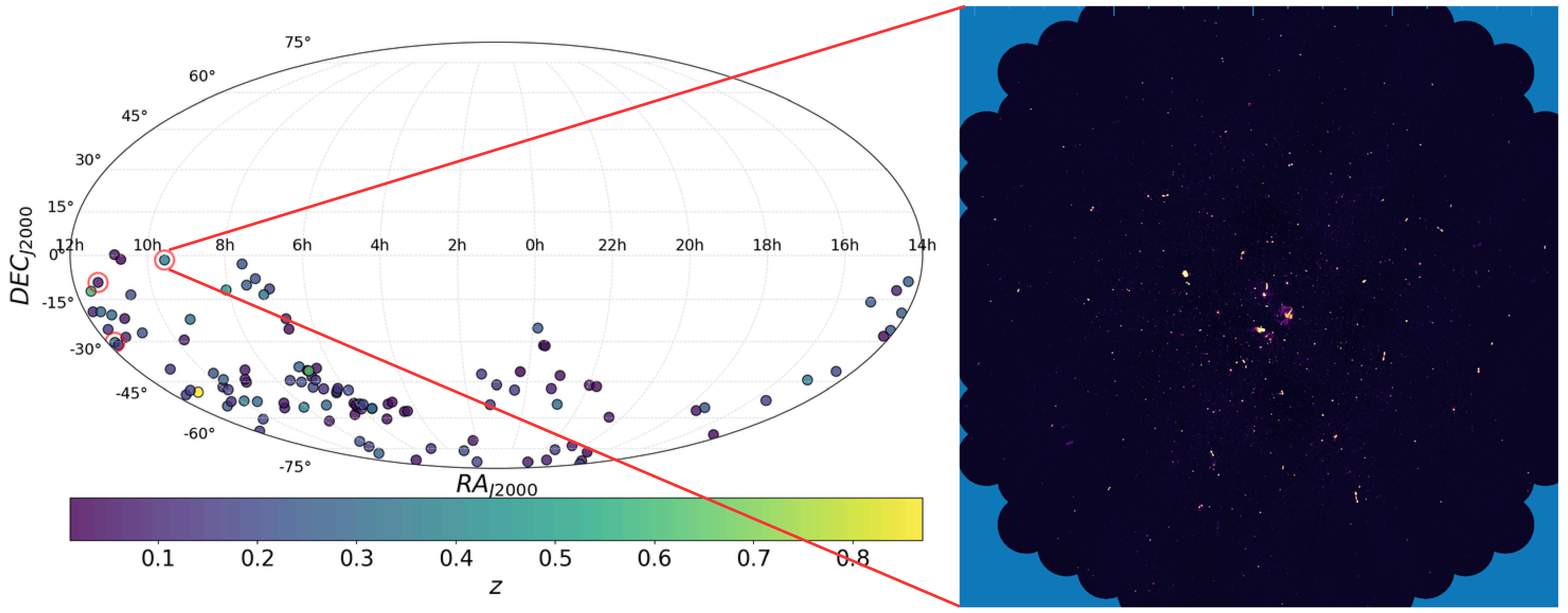

Fig 1. Sky distribution of the 115 MGCLS cluster fields. The red circles indicate the target sample.

Field	RA (J2000)	DEC (J2000)	z	RMS (μJy/b)	Mass (10^{14} $M_\odot$)	State
Abell 85	00:41:48.7	−09:19:04.8	0.055	3.3	12.6	Relaxed
Abell 370	02:39:50.5	−01:35:08.0	0.375	6.9	~200	Merging
Abell 2744	00:14:16.1	−30:22:58.8	0.308	2.9	~80	Merging

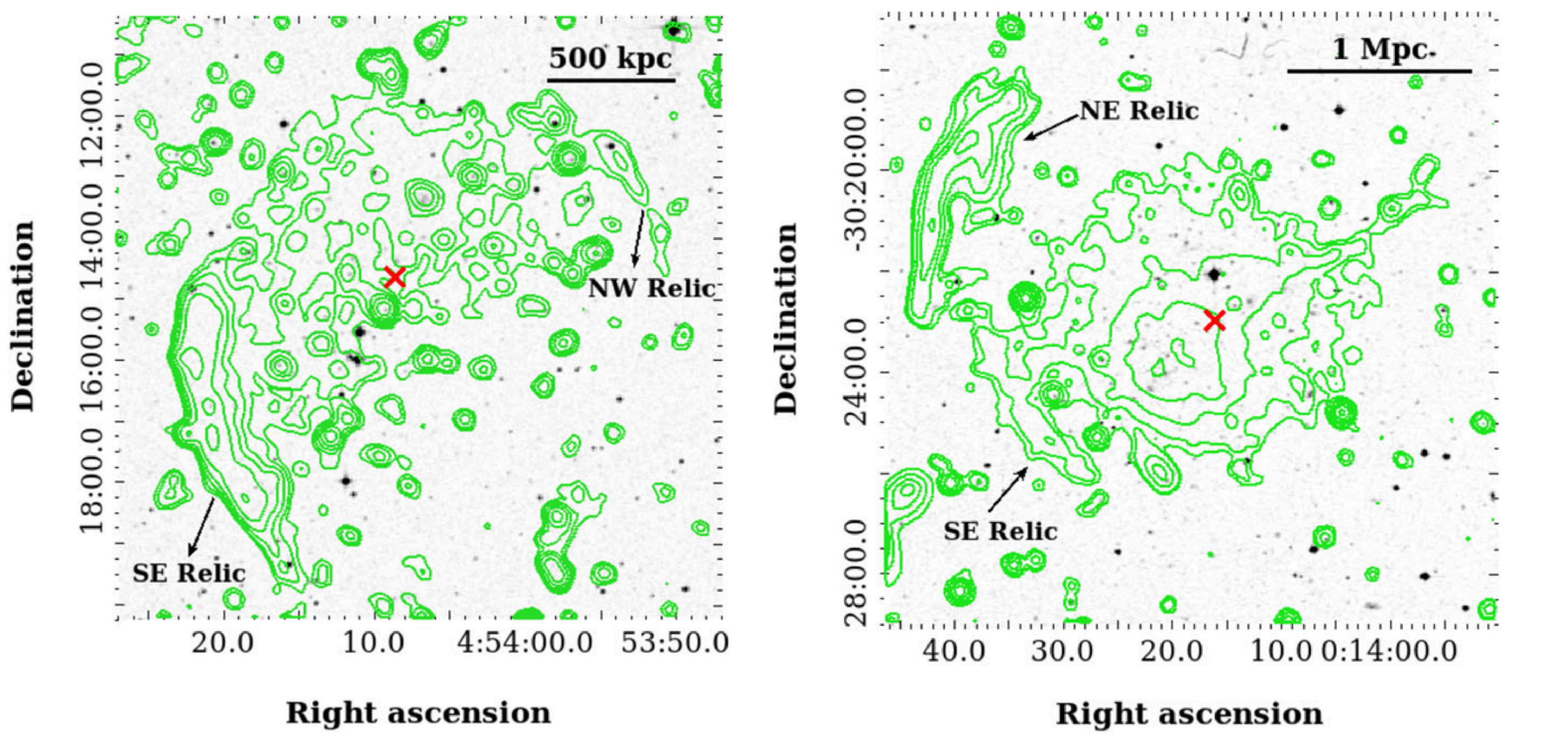

Fig 2. MGCLS low-resolution contours overlaid on the r -band DSS optical image. *Left* Abell 370, *Right* Abell 2744 (K. Kolokythas et al. 2025).

Infrared data: JWST & GCAV

JWST provides exceptionally deep imaging and spectroscopy across 0.6–28.5 μm through instruments such as NIRCam (0.6–5 μm) and MIRI (5–28 μm), offering high spatial resolution with pixel scales of 0.031"–0.11" and fields of view up to a few arcminutes (JWST, 2017).

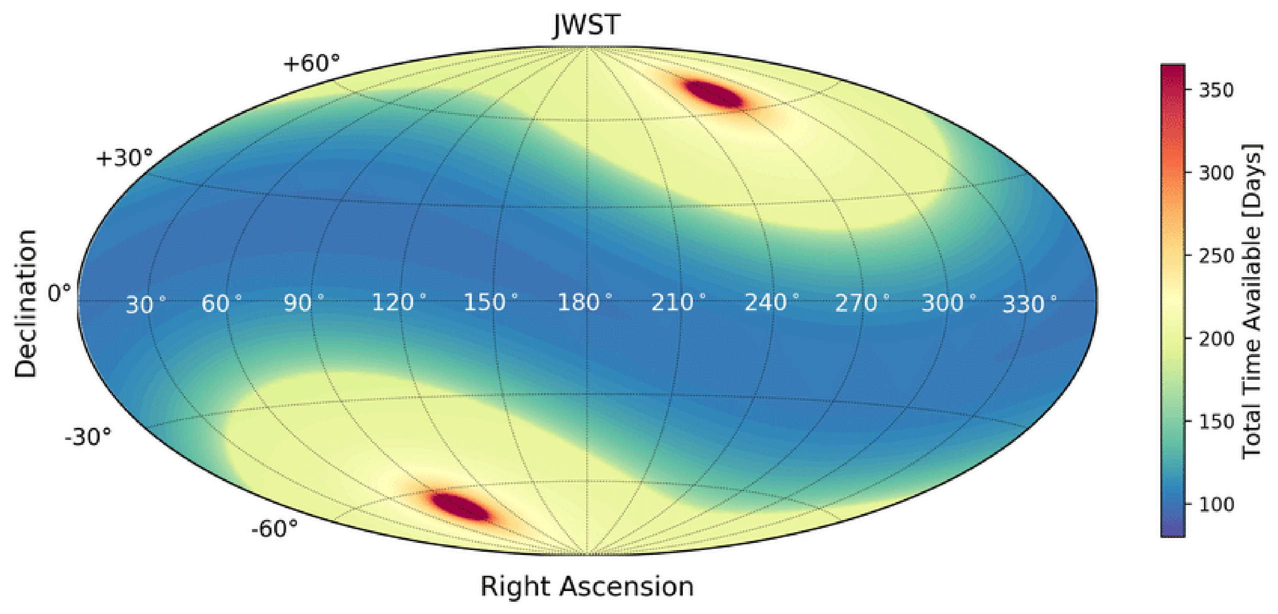

Fig 3. Sky coverage of JWST

GCAV is an infrared, Y, J, Ks, 560 hrs survey for a sample of 20 clusters of galaxies, evenly distributed over the 0h-24h R.A. (M. Nonino, 2008).

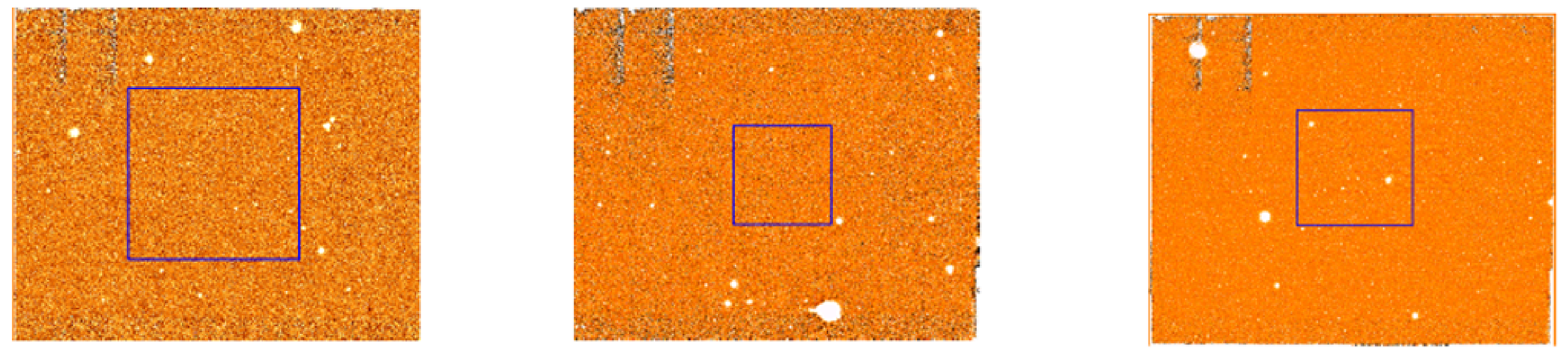

Fig 4. Abell 2744, ACT-CLJ0102-49151, WHLJ24.3324-8.477

Build radio + optical catalogues

The first step for our study is the extraction of optical (photometric and spectroscopic) and radio catalogues of the three clusters under investigation. This is currently in progress, by means of:

- Source extraction in each MGCLS field using **PyBDSF**;
- Cross-match the radio catalogues with **CFHT**, **DESI** and **SDSS** data using the likelihood ratio method and the literature information.

Expected Outcomes

- Characterise the radio galaxy population, separating AGN and starburst galaxies. For both classes, the radio luminosity function will be our main statistical tool.
- Given the very high sensitivity of the MeerKAT images, we expect to probe the faint end of the distribution of AGN and starburst galaxies
- We will compare the results for the three clusters, which are in different evolutionary stages, to address the role of the environment.
- For Abell 85 and Abell 370, we will perform a radial study to explore the properties of AGN and starburst galaxies in the central denser regions and in the outskirts.

References