

# ShapleyS

Investigating the evolution of galaxies  
and non-thermal components  
in the stormy environment of the  
Shapley Supercluster

P. Merluzzi - T. Venturi

Programme 2002 - 2025

**RSN1** - RSN4 - RSN2

# Team

RADIO	IR-VIS-UV	X	Models/theory
<b>ShapleyS</b>			
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Other collaborators			
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- 1** - Naval Research Laboratory, USA, formerly INAF;
- 2** - Leiden Observatory, NL, formerly INAF;
- 3** - INAF;
- 4** - SARAO and Rhodes University, RSA;
- 5** - University of Minnesota, USA;
- 6** - INCT Universidad de Atacama, Chile, formerly INAF;
- 7** - University of Hull, UK;
- 8** - MPI Bonn, DE;
- 9** - Australian National University, AU;
- 10** - Universität Innsbruck, A;
- 11** - National Astronomical Observatory of Japan, JP;
- 12** - Hiroshima University, JP;
- 13** - ESO;
- 14** - University of Durham

**FTE (INAF)**      2002-2020 : 1.6 FTE/yr  
                          2021-2025 : ~2 FTE/yr + (possibly) 1 *radio* FTE/yr

Total: ~40 FTE

2002 - 2020 : 25 refereed articles  
 (from early '90s: 40 refereed articles)

# Fundings

## Fundings that contributed to different extents to ShapleyS

- European Community's Human Potential Program: HPRN-CT-2002-0031 SISCO (PI: Shanks; local PI: **GB**)
- Marie Curie FP7-PEOPLE-IRSES-2008 ACCESS: A Complete CEnsus of Star formation in the Shapley supercluster (PI: **PM**)
- OPTICON Trans-National Access programme 2013A (PI: **PM**)
- Cooperazione bilaterale Italia-Sudafrica PGR-ZA18GR02 RADIOSKY2020 (2018-2021; PI: **TV**)
- MIUR: COFIN2003 Evolution of Galaxies and Cosmic Structures after the Dark Age (PI: Marano; local PI: **GB**)
- MIUR: COFIN2004 The Evolution of Stellar Systems: A Fundamental Step Towards the Scientific Exploitation of VST (PI: Capaccioli)
- PRIN-INAF 2011: Galaxy evolution with the VLT Surveys Telescope (PI: **AG**)
- PRIN-INAF 2014: Galaxy Evolution from Cluster Cores to Filaments (PI: Poggianti; local PI: **PM**)
- PRIN-INAF-SKA 2017: ESKAPE (PI: Hunt; local PI: **AM**)
- Regione Campania 2002: Evolution of Normal and Active Galaxies (PI: **GB**)
- INAF FO

**Total estimated funds dedicated to ShapleyS: 245000 EUR.**

**Total estimated INAF contribution: 59000 EUR, of which 25000 EUR expected in the next 5 years.**

# ShapleyS

AIMS

investigate the influence of cluster-scale mass assembly on galaxy evolution and to trace its effects on intracluster gas and non-thermal components.

- Mapping the environment through galaxy and stellar mass density, hot gas and dark matter.
- Identifying and measuring signs of ongoing transformations in galaxies to improve our comprehension of star formation quenching processes.
- Imaging and studying the signatures of the merging and assembly processes on the diffuse cluster and intracluster scale emission to understand their origin and to test the scaling relations.

## SHAPLEY SUPERCLUSTER

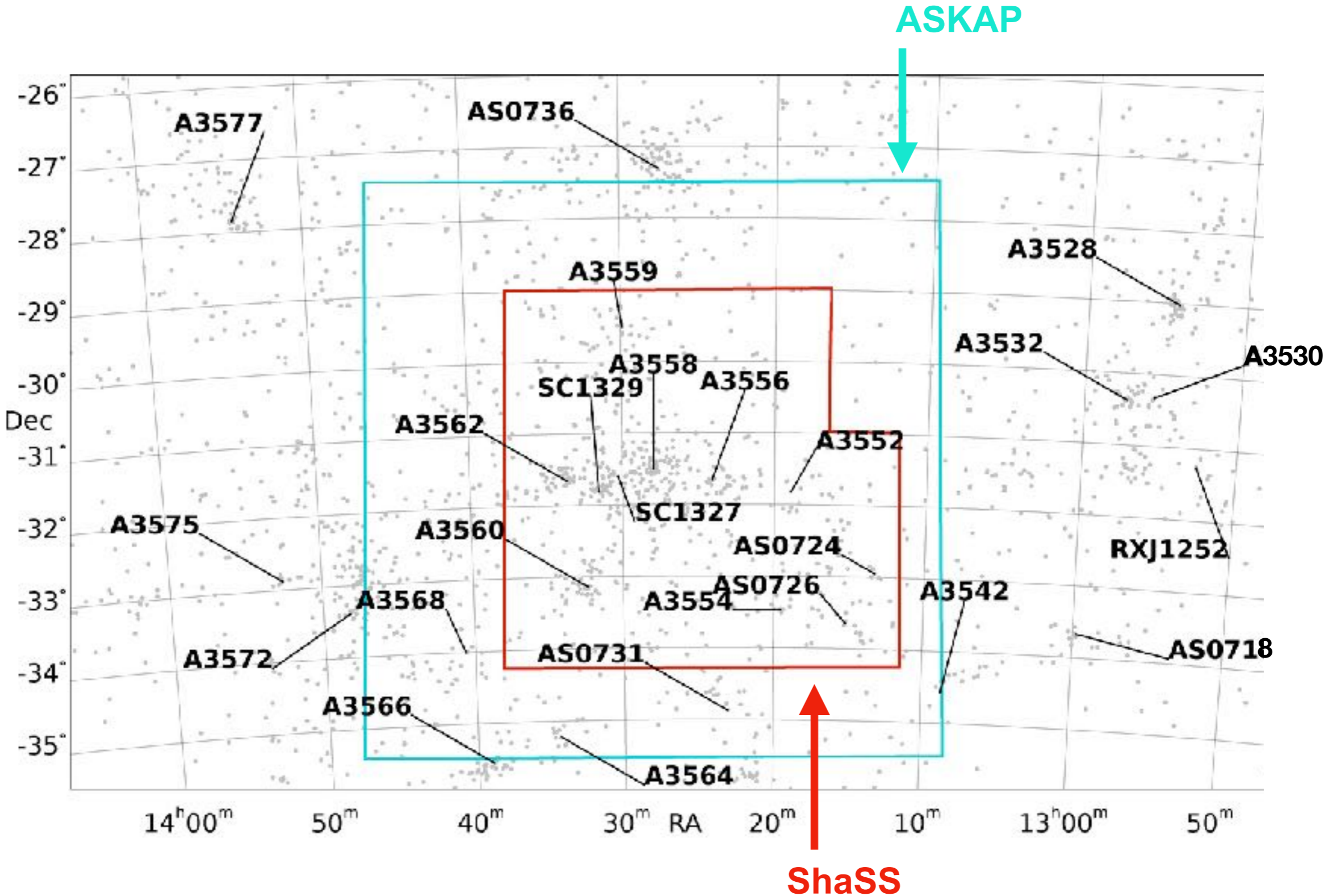
- one of the most massive structures in the local Universe
- 25 Abell clusters  $0.035 < z < 0.06$  over  $15 \times 10 \text{ deg}^2$
- high-density core with five connected clusters within 8 Mpc
- multiple signs of ongoing and past cluster-cluster interactions
- different environments from filaments to cluster cores
- close enough to allow sub-kpc photometry

# Dataset

Data type	Facility	Description	P.I.
Radio continuum	GMRT - 240, 320,610 MHz	Shapley supercluster core (4deg <sup>2</sup> ) and A3528 complex (2deg <sup>2</sup> )	TV
Radio continuum	ASKAP - 880 MHz	Early Science - 36deg <sup>2</sup> on A3558	TV
Radio continuum	MeerKAT - 1.2 GHz	Shapley Supercluster core (4deg <sup>2</sup> ) and A3528 complex (2deg <sup>2</sup> )	TV
Radio continuum	GMR, VLA, ATC - 240, 610 MHz, 1.28, 1.4, 2.3, 4.8, 8.4 GHz	A3560	TV
<i>IR</i>	Spitzer MIPS	Shapley supercluster core (3 deg <sup>2</sup> )	CPH
<i>K</i>	ESO - VISTA	ShaSS: 25 deg <sup>2</sup> on SSC	CPH
<i>H<math>\alpha</math></i>	MMT	Individual galaxies	CPH
<i>ugri</i>	ESO - VST	ShaSS: 25 deg <sup>2</sup> on SSC + 12 deg <sup>2</sup> on A3528 complex	PM
<i>UV</i>	GALEX	Shapley supercluster core (3 deg <sup>2</sup> )	RJS
<i>X-ray</i>	XMM - 0.5 - 2.5 keV	SSC	HB, MR
<i>X-ray</i>	XMM, Chandra	A3560	MR, SB
MOS spectroscopy	ESO 3.6m, MEFOS,OPTOPUS	SSC and A3528 complex (2deg <sup>2</sup> )	SB
fibre spectroscopy	AAOmega	4030 redshifts in the area of ShaSS	PM
Integral-field spectr.	WiFeS (ANU), ESO-MUSE	20 galaxies	MAD+PM

WISE - 3.4, 4.6, 12, 22  $\mu$ m (data reprocessed)

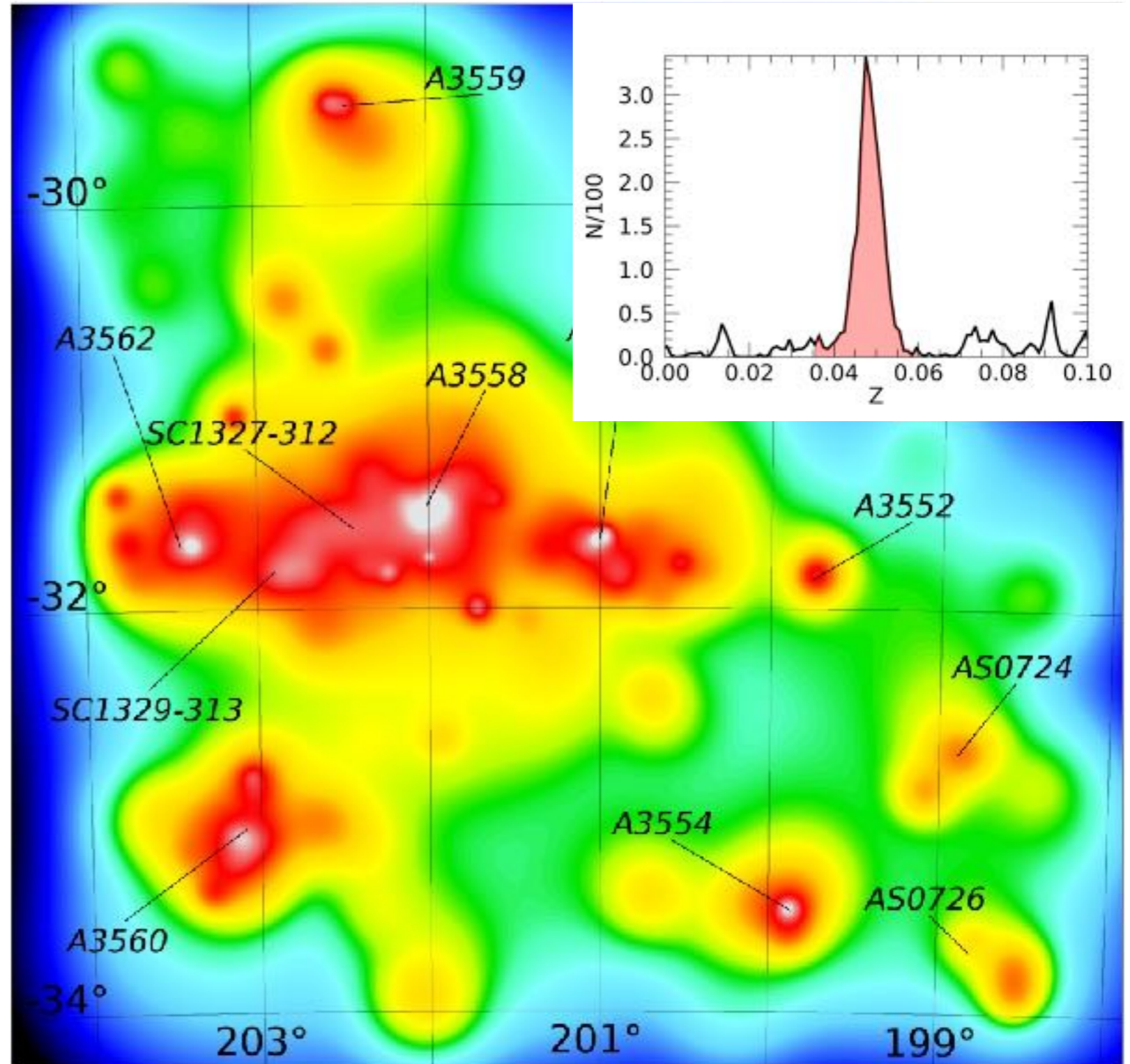
# Shapley supercluster



# Full mapping of the supercluster environment in and around its core

Merluzzi+2015 Haines+2018 Higuchi+2020

- galaxy number and stellar mass density
- hot gas
- dark matter
- dynamical analysis



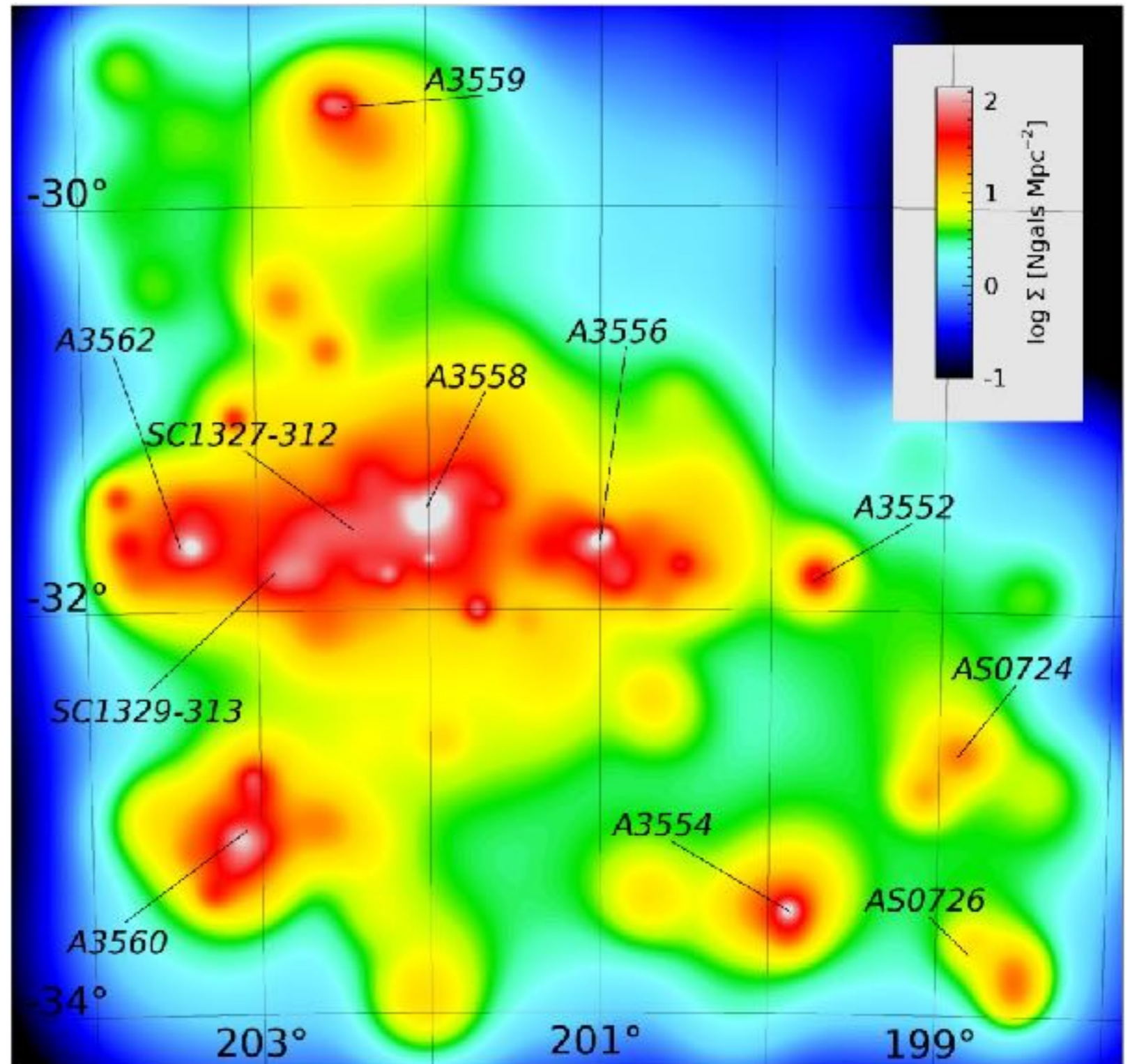
# Full mapping of the supercluster environment in and around its core

Merluzzi+2015 Haines+2018 Higuchi+2020

- galaxy number and stellar mass density
- hot gas
- dark matter
- dynamical analysis

The 11 clusters in ShaSS are all inter-connected and lie within a coherent sheet of galaxies filling the entire survey region without gaps. The whole structure is gravitationally bound and in the process of collapse.

See Pearson & Batuski (2013) for N/body simulations.





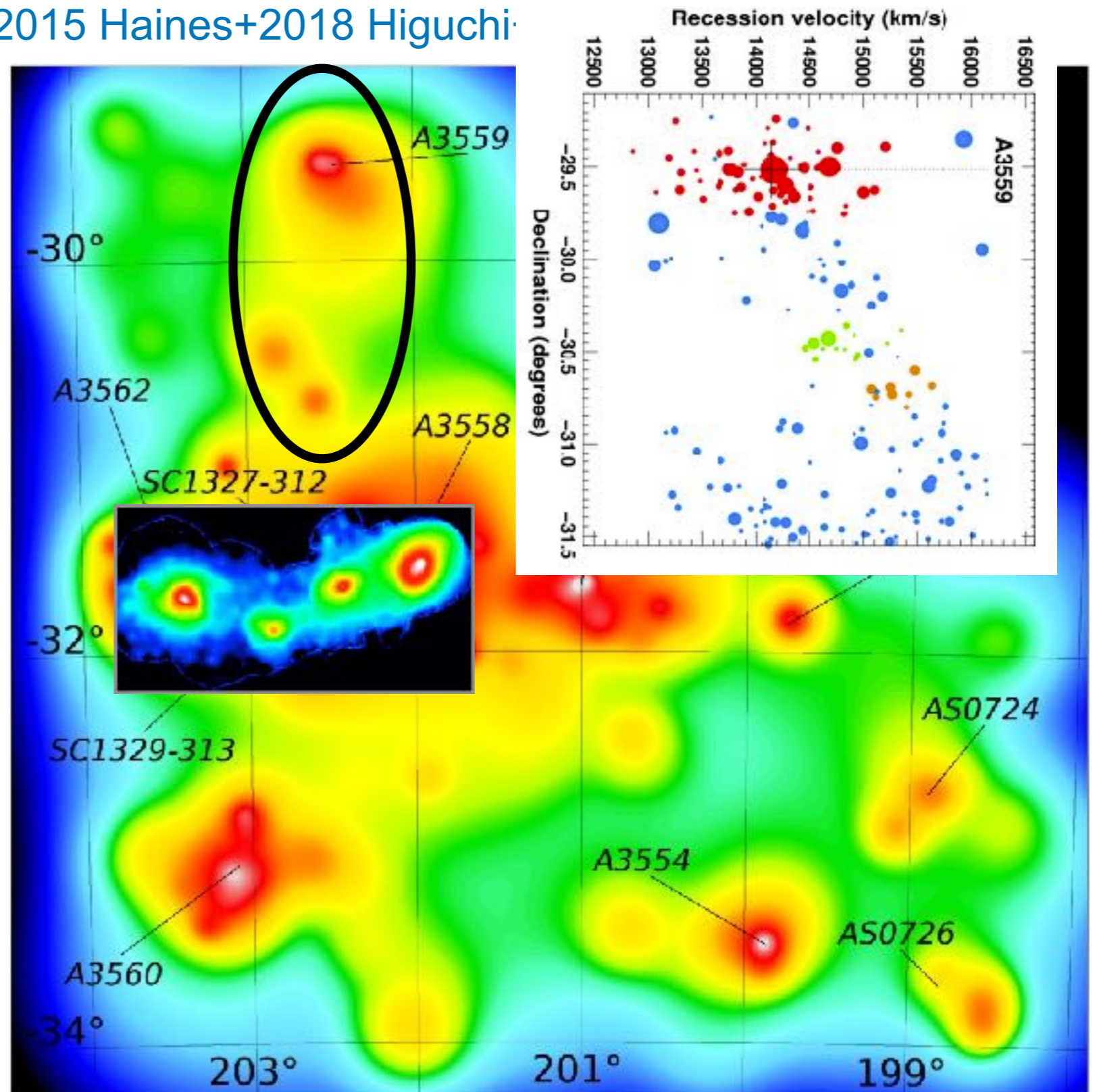
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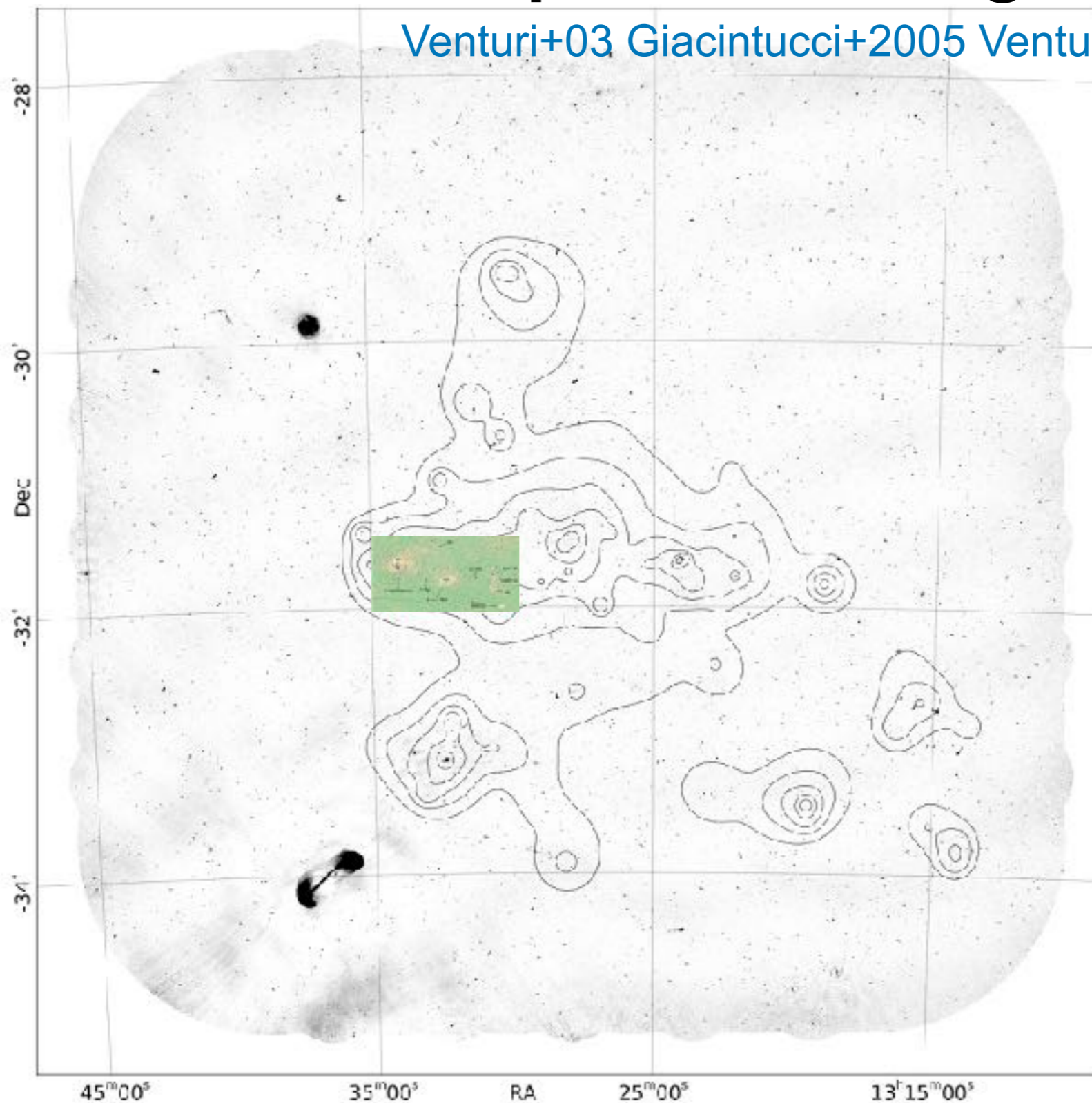
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# Radio footprints of a cluster minor merger: from supercluster to galaxy scale

Venturi+03 Giacintucci+2005 Venturi+2021



ASKAP  
Early Science Project 20  
PI. [Venturi](#)

$\nu = 880 \text{ MHz}$

$\Delta\nu = 200 \text{ MHz}$

$\langle \text{rms} \rangle \sim 30 \mu\text{Jy/b}$

$\Theta = 13'' \times 10''$

FoV =  $6^\circ \times 6^\circ$

MeerKAT  
PI. [Venturi](#)

$\nu = 1.28 \text{ GHz}$

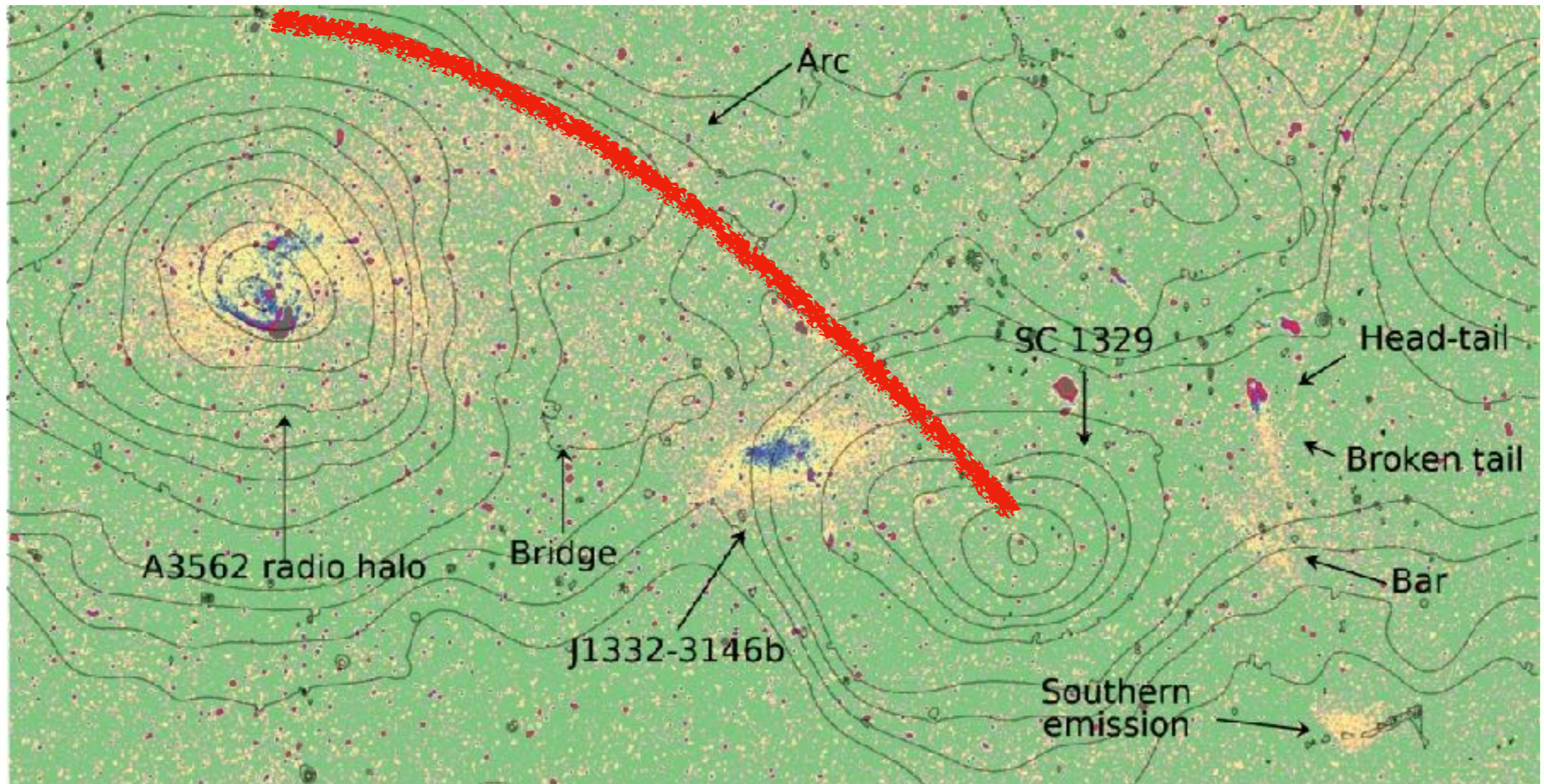
$\Delta\nu = 800 \text{ MHz}$

$\langle \text{rms} \rangle \sim 5 \mu\text{Jy/b}$

$\Theta = 7'' \times 7''$

Full mosaic =  $4^\circ \times 4^\circ$

# Radio footprints of a cluster minor merger: from supercluster to galaxy scale



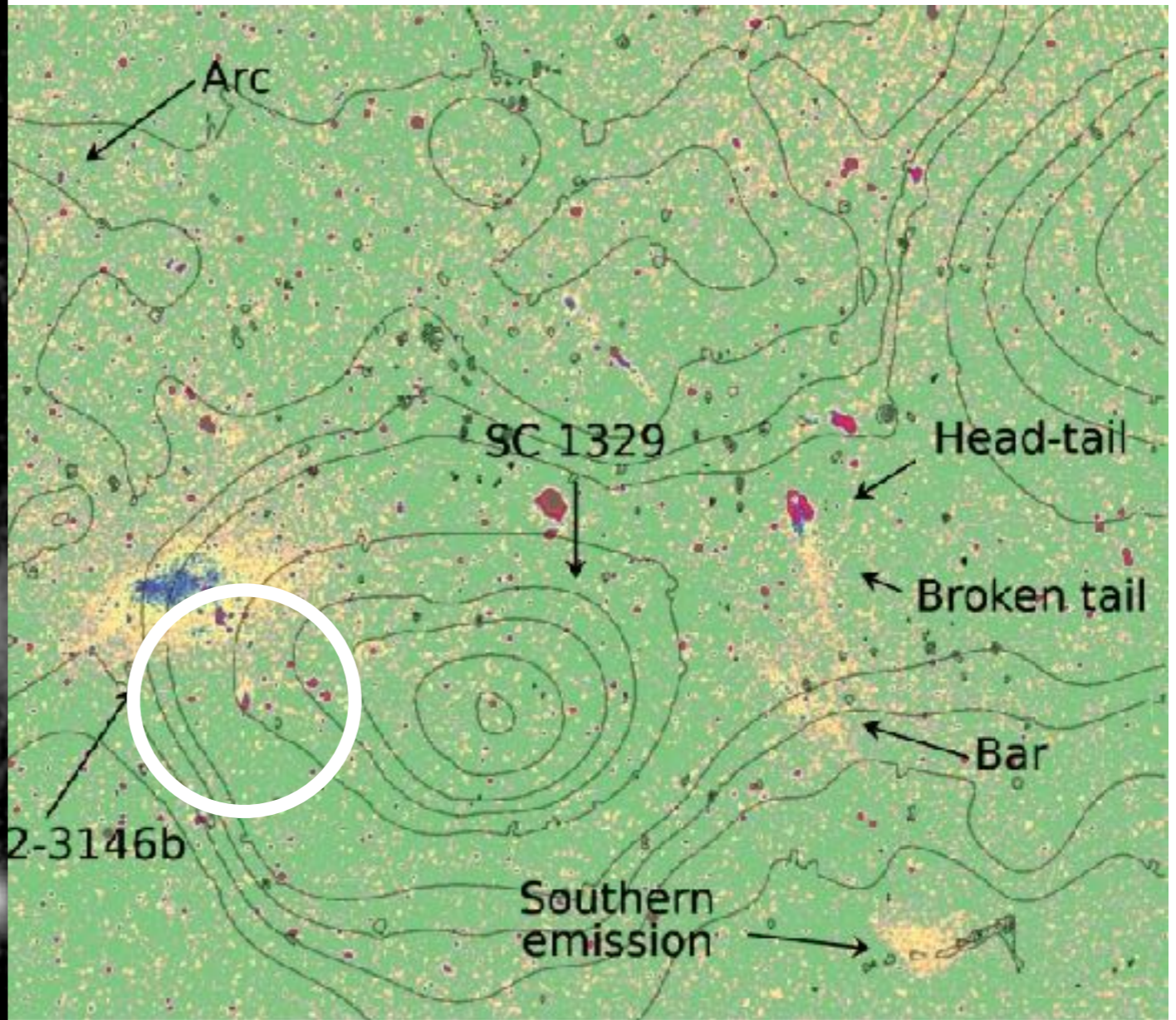
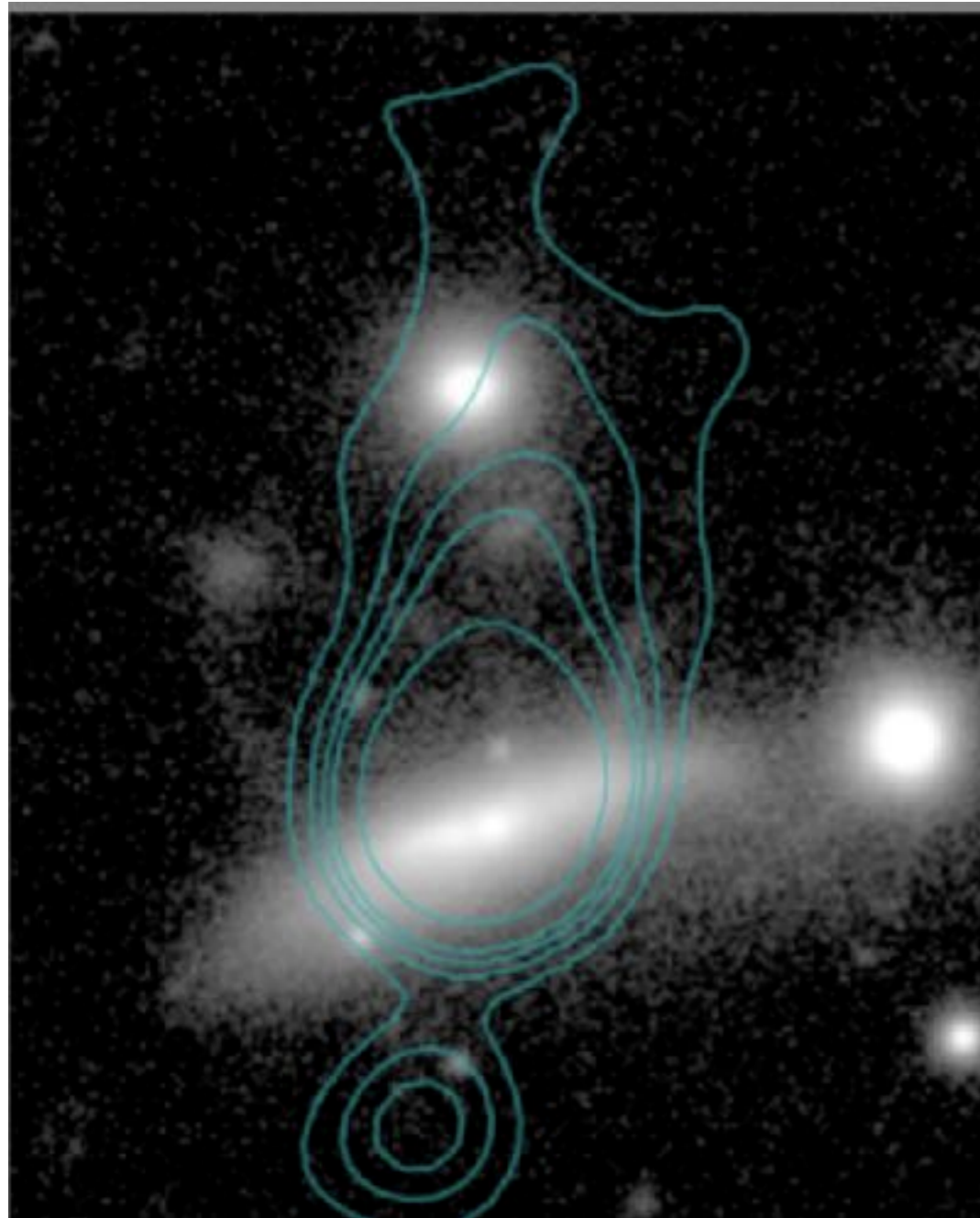
1.28 GHz MeerKAT (PI [TV](#))

XMM contours 0.5-2.5 keV energy band (PI [HB](#), [MR](#))

$$M_{500}(\text{A3562}) = 4 \times 10^{14} M_{\odot}$$

$$M_{500}(\text{SC1329}) = 6 \times 10^{13} M_{\odot}$$

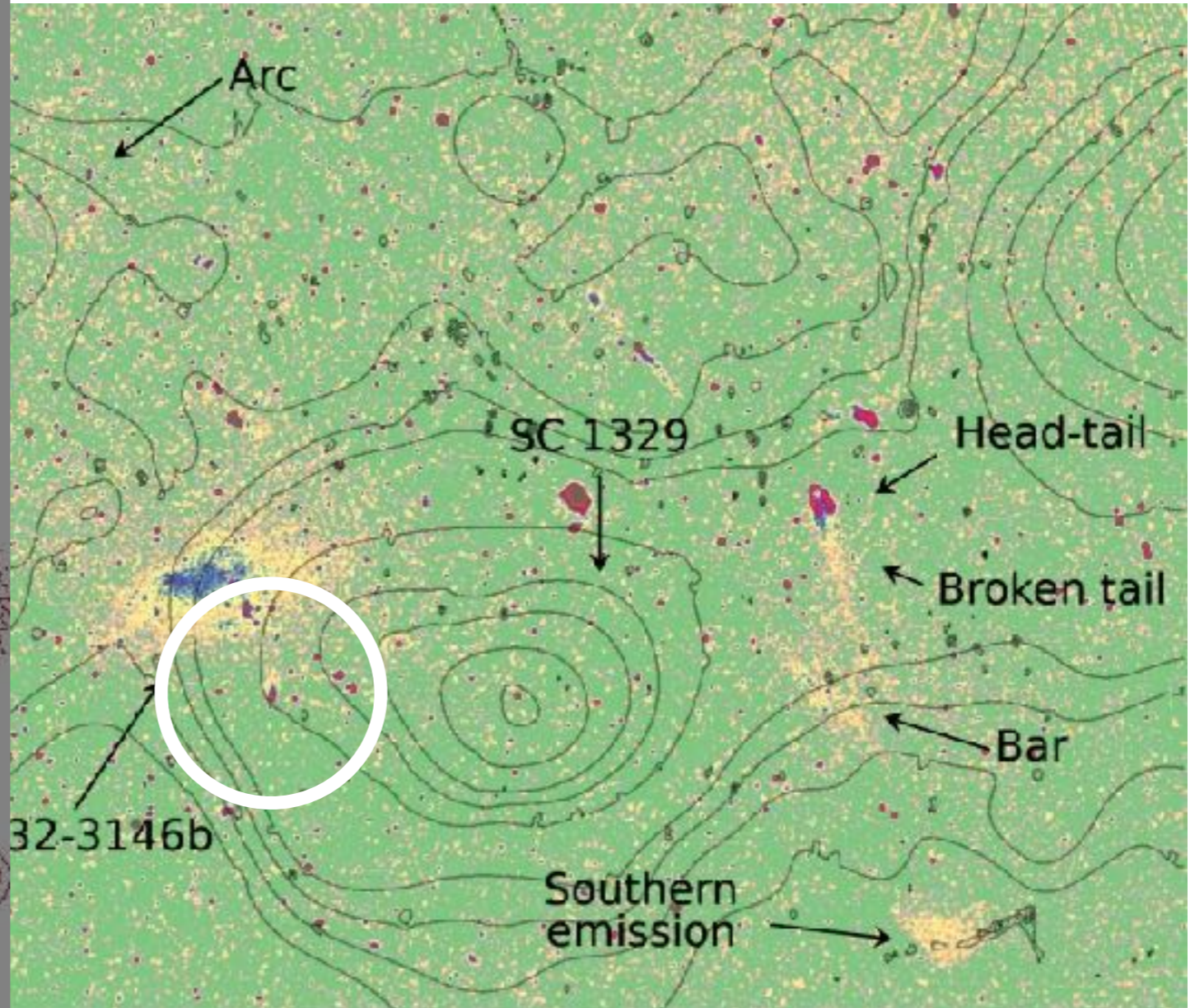
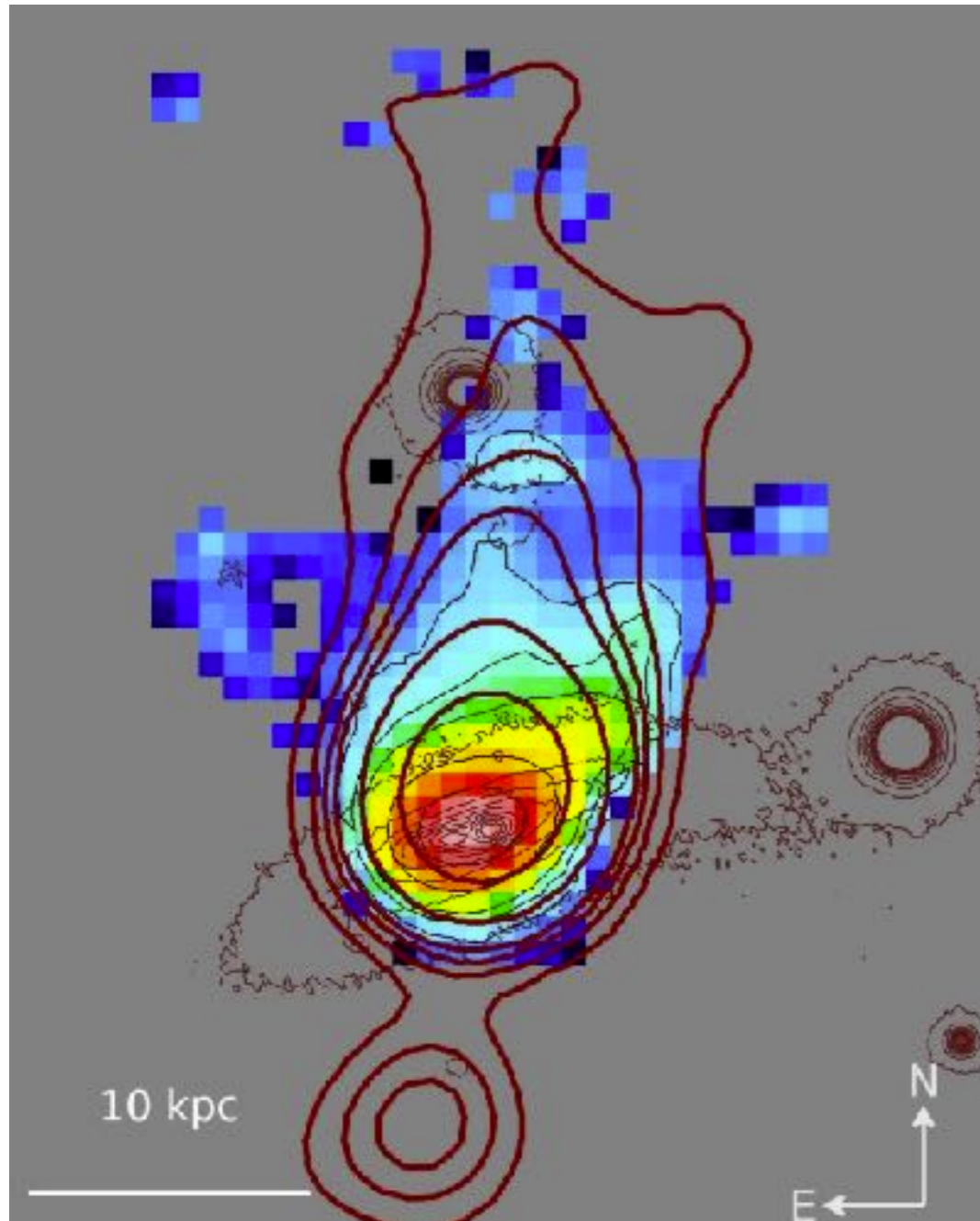
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1.28 GHz MeerKAT (PI [TV](#))  
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# Future

2021-2023

- **ASKAP + MeerKAT** : origin of diffuse emission vs. structures dynamics, key-case study of minor merger event;
- **Radio + e-Rosita** : role of the cluster interaction in individual cases of RPS galaxies;
- **Radio + VIS + IR** : analysis of the galaxy properties (e.g. radio emission, SF, morphology, etc.) as function of the environment;
- Census of star formation across the whole survey region
- **IFS** : analysis of a new case of massive galaxies affected by RPS with ultra deep observations.

Shapley Supercluster as target

- ASKAP-POSSUM (referent [EC](#))  
(PI Gaensler, McClure-Griffith, Heald; Dunlap Institute, Uni of Toronto ANU CSIRO-CASS)
- CHANCES: CHileAN Cluster galaxy Evolution Survey 4MOST public survey  
(referents [PM](#), [GB](#); (PI CPH; Universidad de Atacama)

Funding for the 2021-2023 depending on INAF FO