
# The Evolutionary Map of the Universe (EMU) and eROSITA

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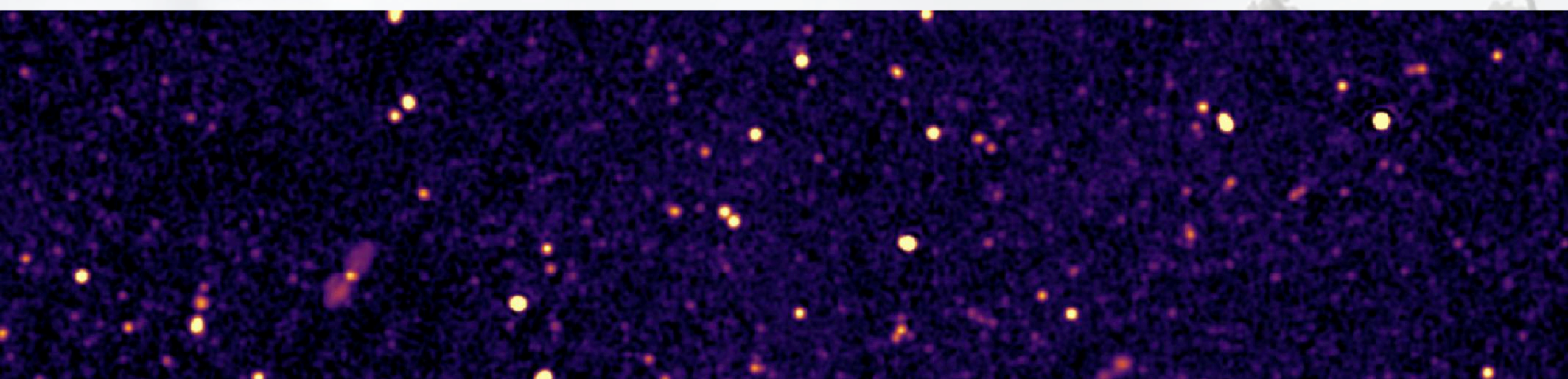
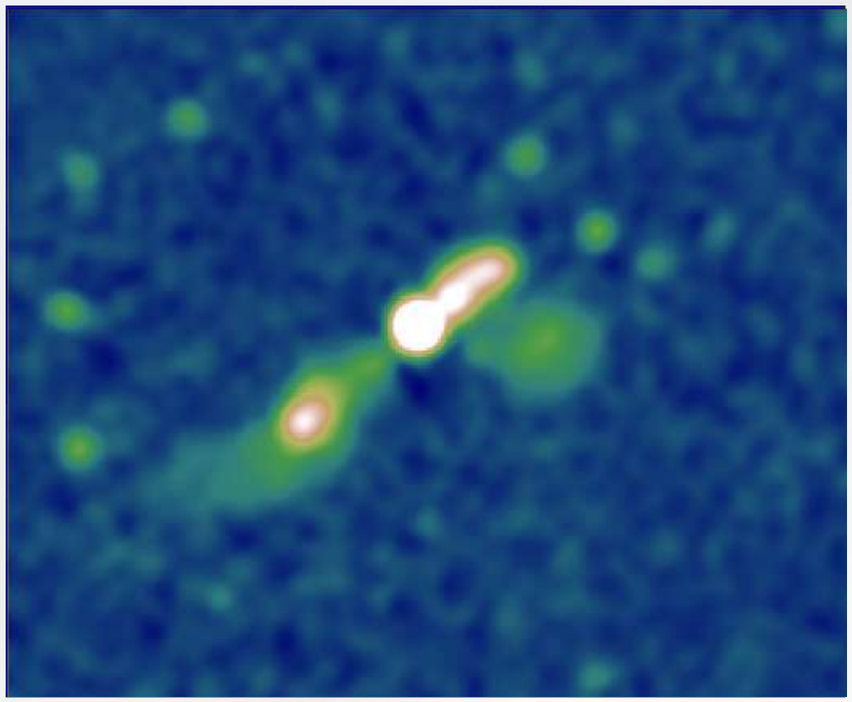
# EMU Overview

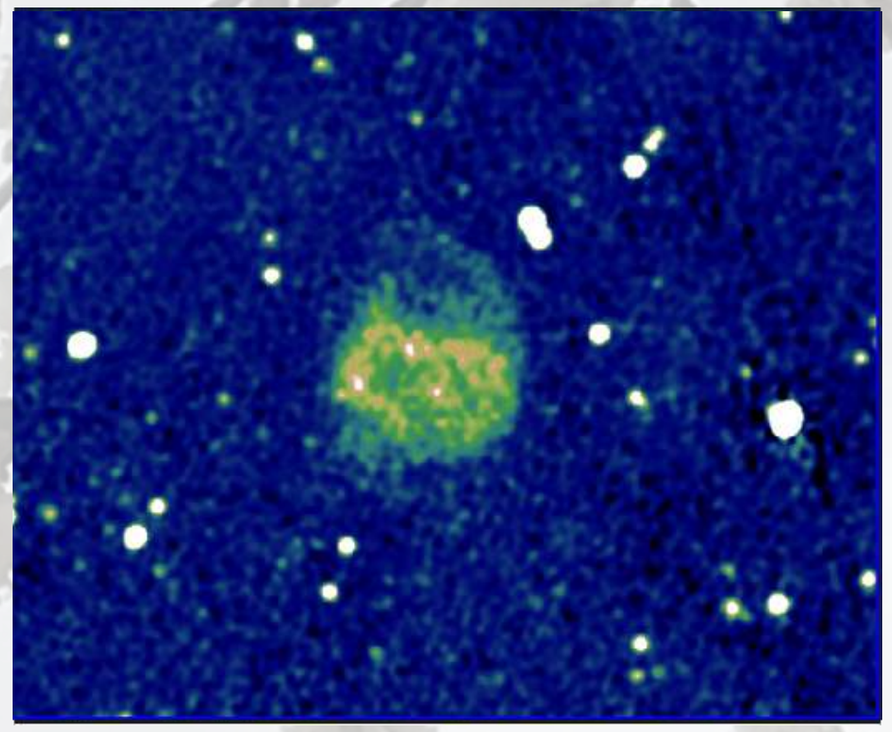
- Radio continuum survey with the ASKAP telescope, covering the sky south of +30° declination (30000 sq. deg., 3$\pi$ steradians)
- Expected RMS noise level of ~**20 μJy**, 25-30 times fainter than NVSS and SUMSS and about 10 times fainter than FIRST.
- Resolution (synthesised beam size) of ~**15″ FWHM**, about 3 times better than NVSS and SUMSS, about 3 times poorer than FIRST but over 3 times its sky area.
- Expect to measure ~**30-40 million sources**, an order of magnitude more than the total number of currently known radio sources (a progressively out-of-date claim…).
- **ASKAP 5 yr plan includes 8533hr (~1 yr) to EMU (+POSSUM), allowing 2$\pi$ sr coverage. Anticipate extending survey to full coverage subsequently.**

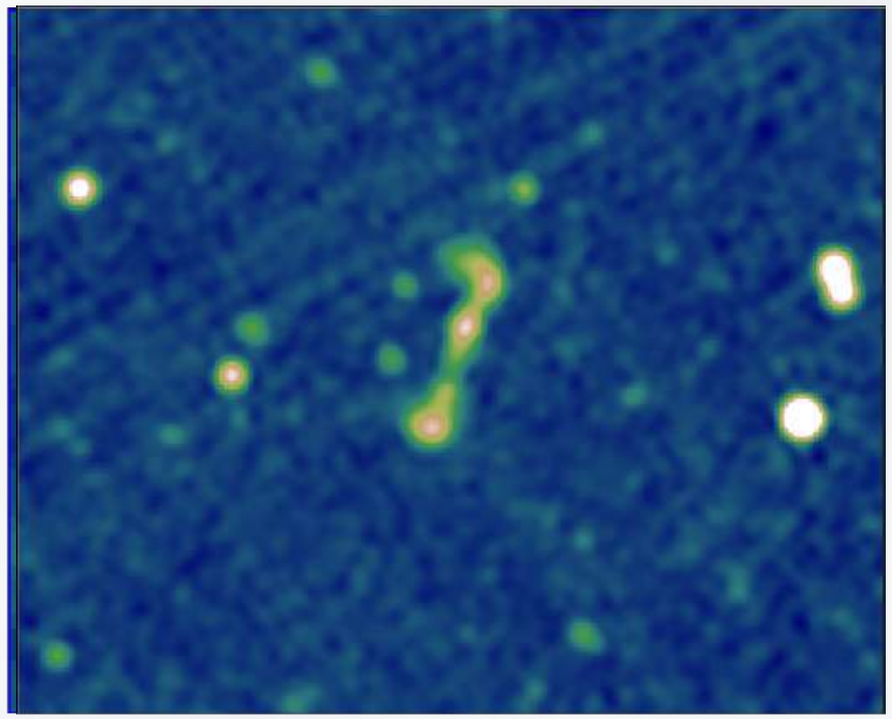


# EMU compared to NVSS



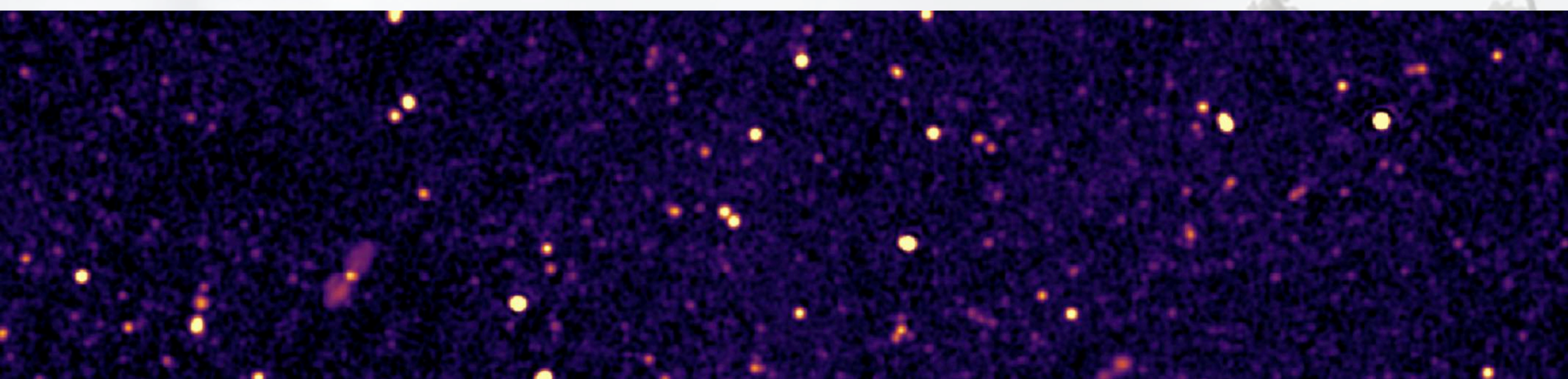
NVSS images





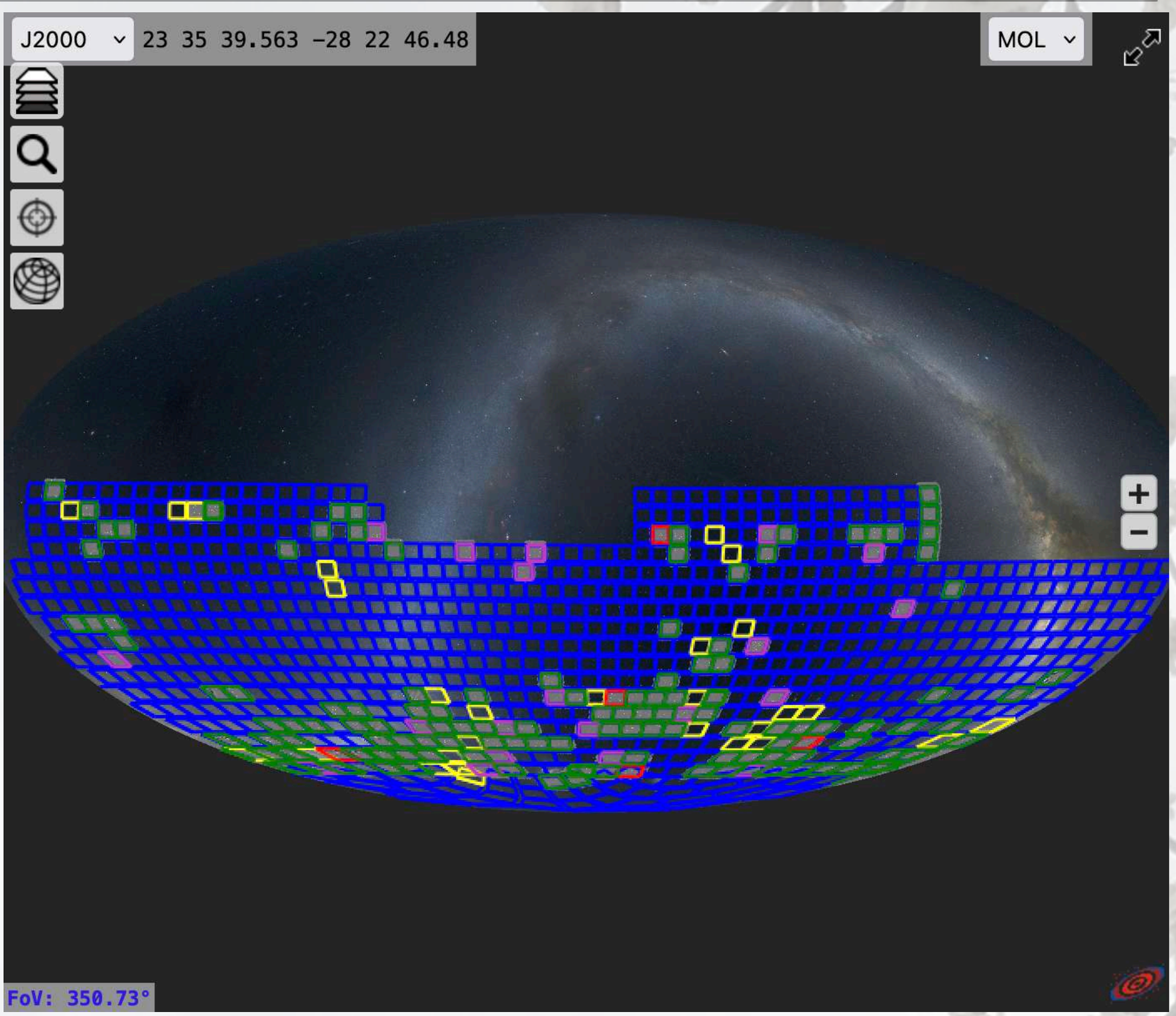
# EMU Science

- Evolution of star formation in galaxies
- Evolution of massive black holes, and understanding their relation to star formation
- Explore the large scale structure and cosmological parameters of the Universe
- Explore an uncharted region of observational parameter space
- Explore diffuse, low surface-brightness objects
- Generate an unparalleled atlas of the Galactic Plane
- Legacy value of a complete hemispheric survey
- *Norris et al., 2011, PASA, 28, 215* and *Norris et al., 2021, PASA, 38, e046*

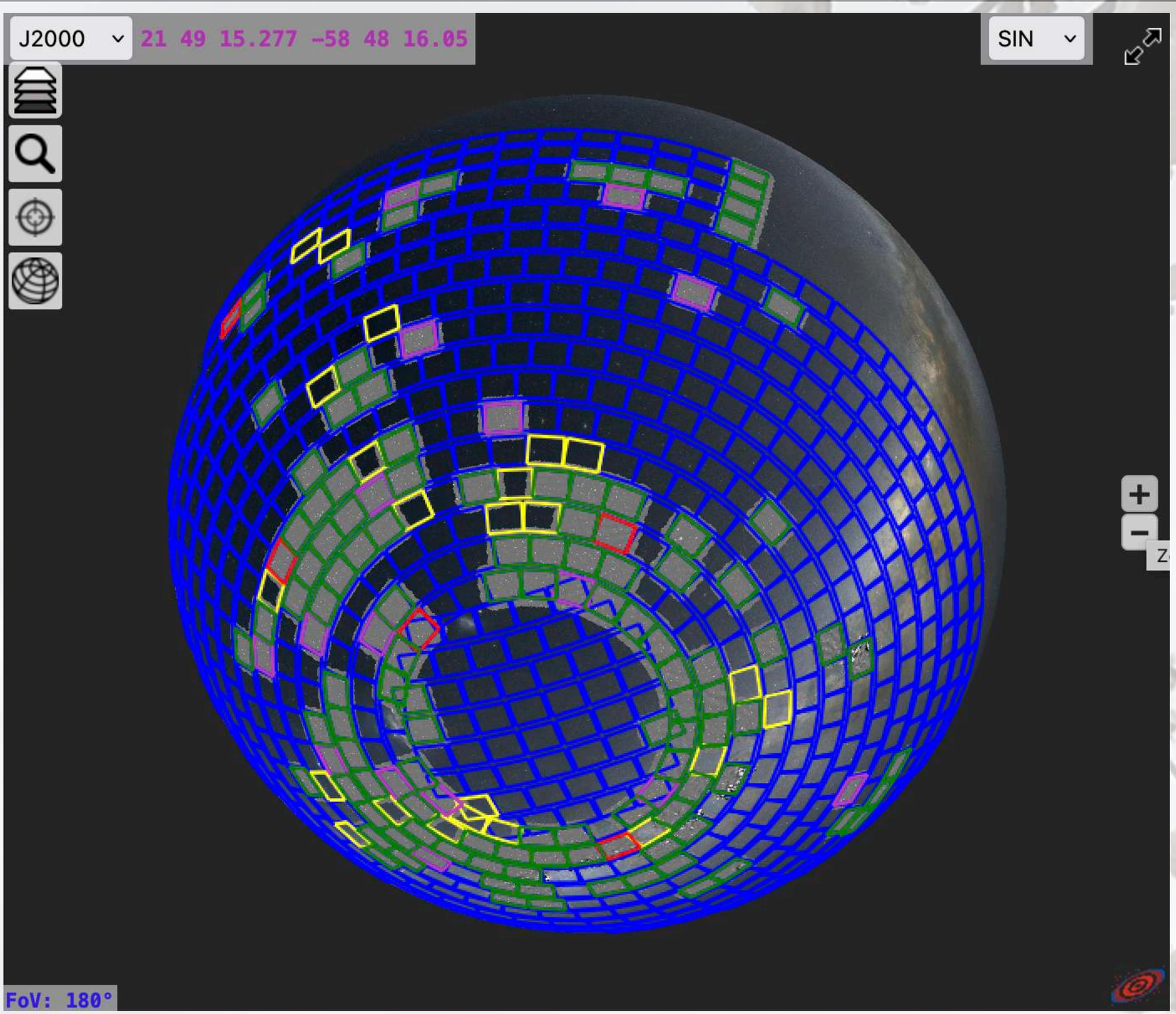


# EMU main survey progress

Observations ~15% complete. Expect to finish by early 2028.

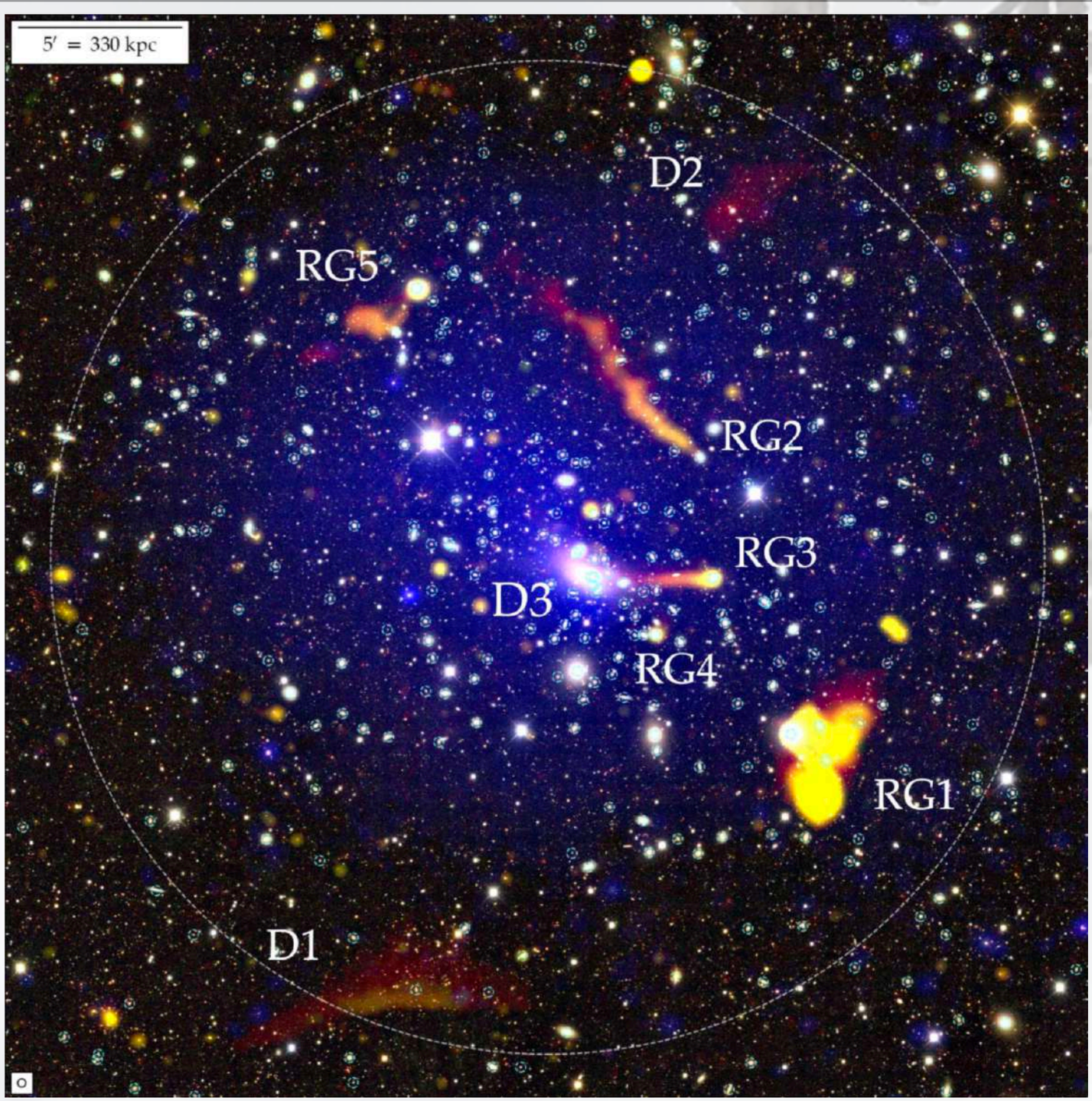


# EMU main survey progress



# Synergies: Clusters

**A3266**: “complex merging galaxy cluster that exhibits significant substructure”

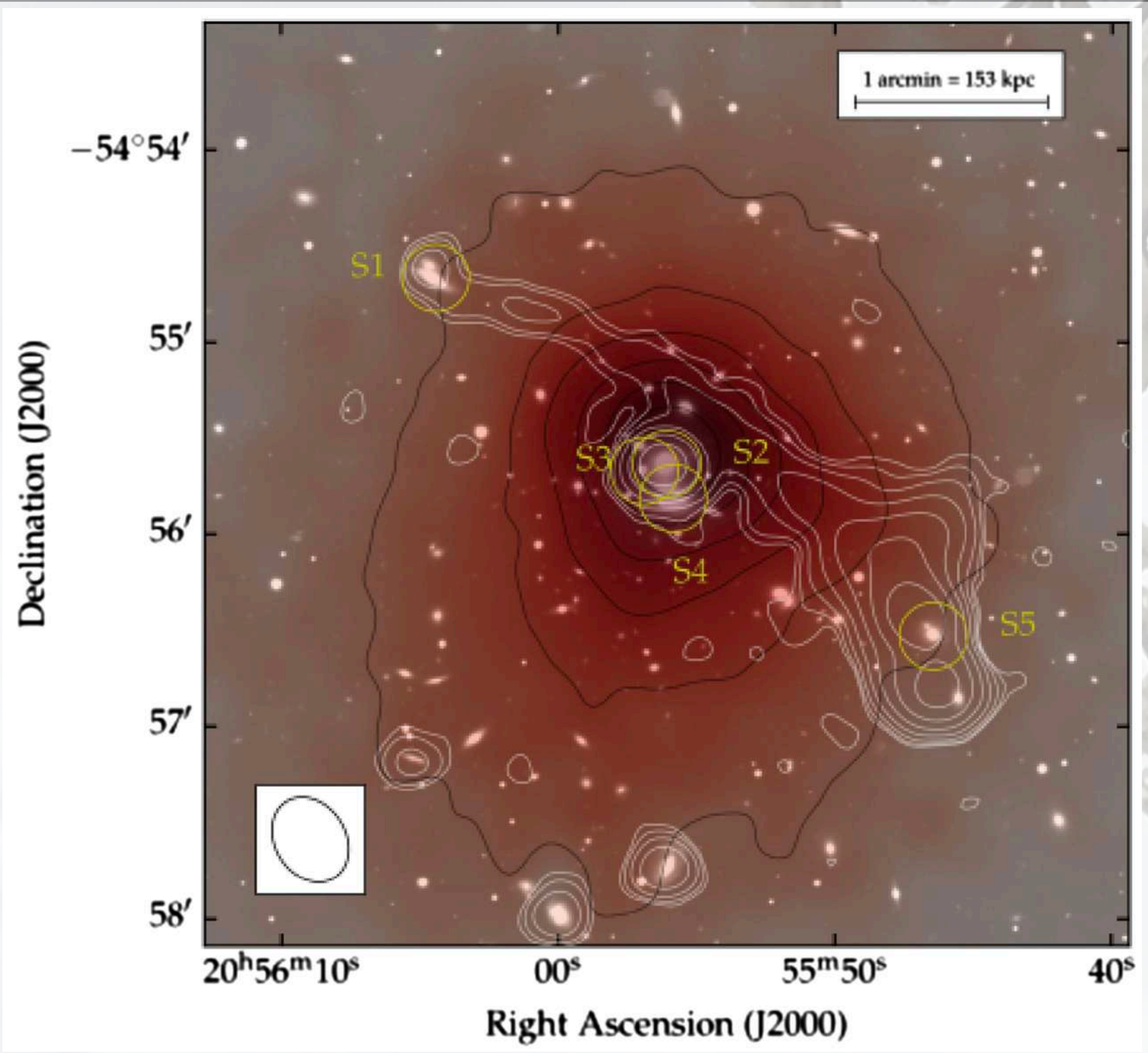



Riseley et al., 2022, MNRAS, 515, 1871

# Synergies: Clusters

**600 kpc radio structure in A3718**

"clear asymmetry of the X-ray surface brightness distribution perpendicular to the direction of the largest angular extension of the radio source"

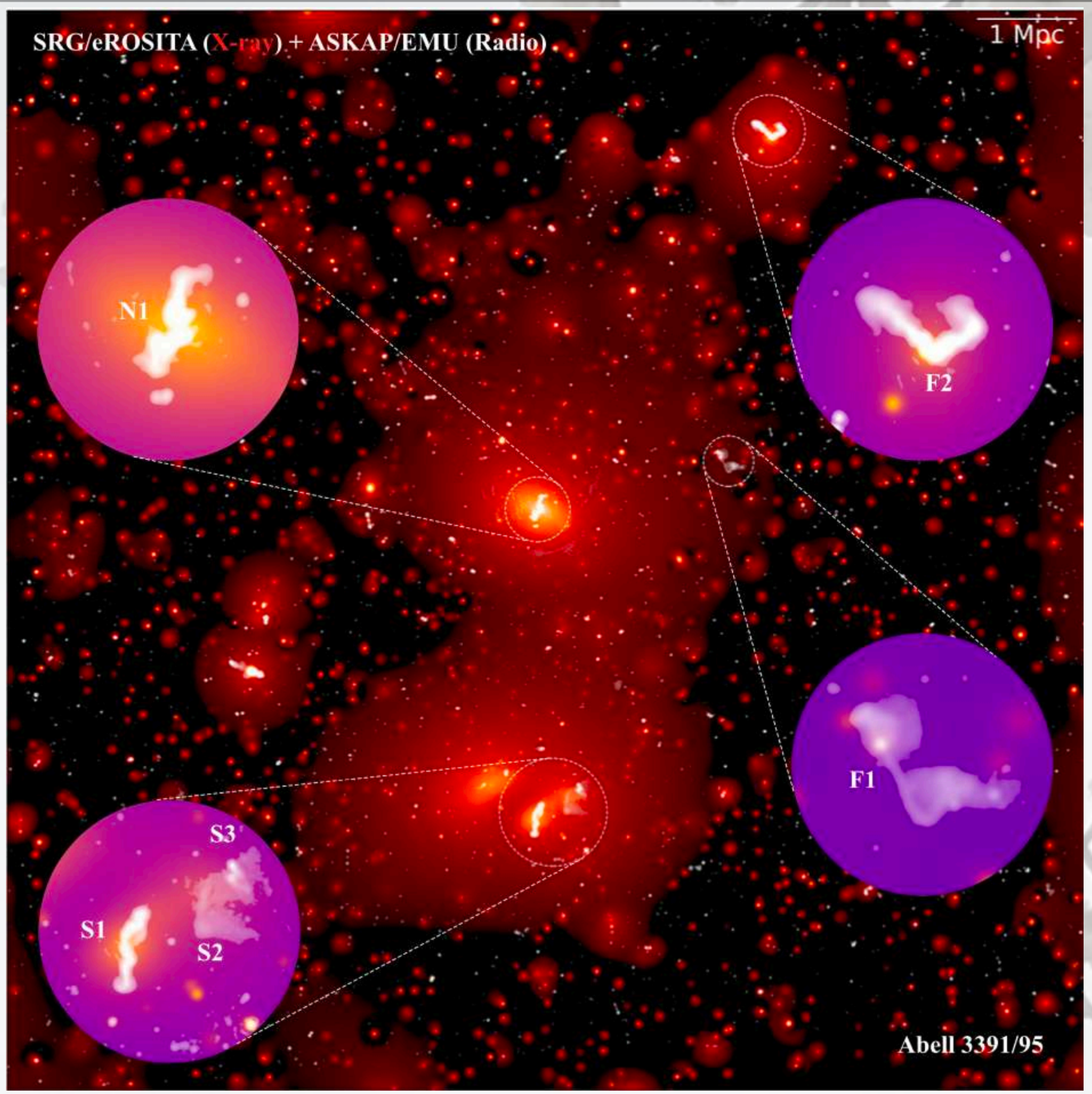



Loi et al., 2023, A&A, 672, A28

# Synergies: Clusters

**A3391/95**

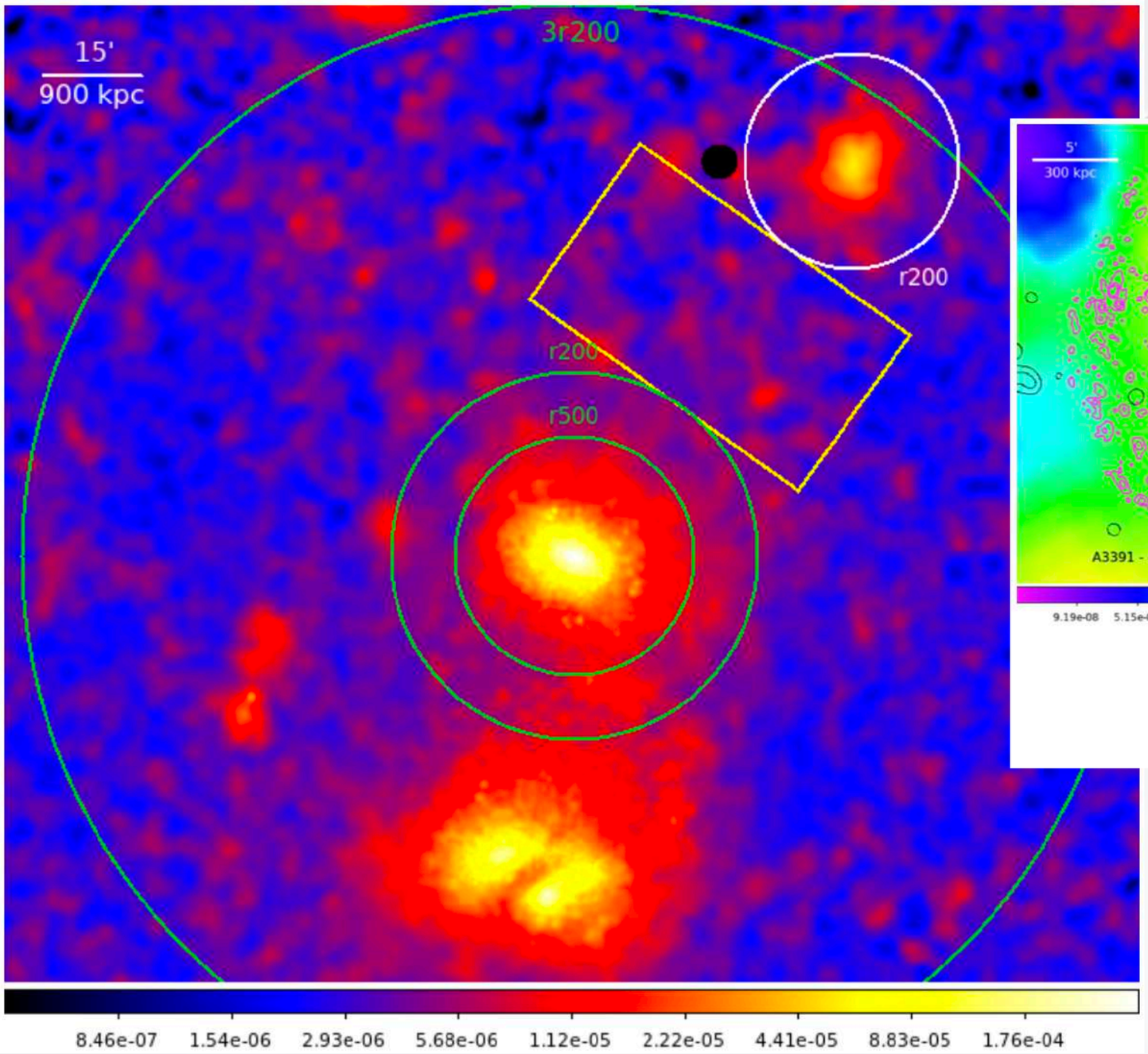
“We discover an emission filament north of A3391 connecting to the Northern Clump. This emission filament extends south of A3395. The total projected length of this continuous warm-hot emission filament is 15 Mpc, running almost 4 degrees across the entire eROSITA PV observation field.”




Reiprich et al., 2021, A&A, 647, A2

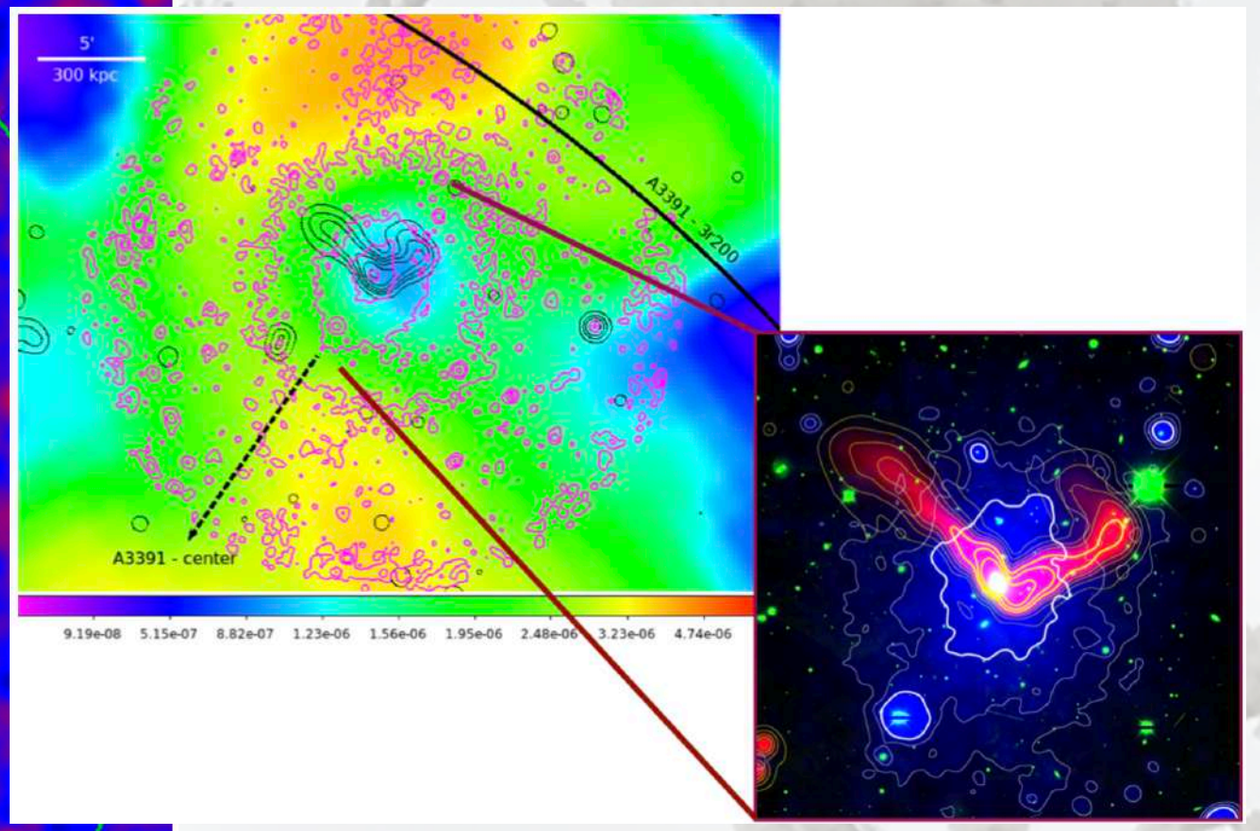
Brüggen et al., 2021, A&A, 647, A3

# Synergies: Clusters




Veronica et al., 2022, A&A, 661, A46

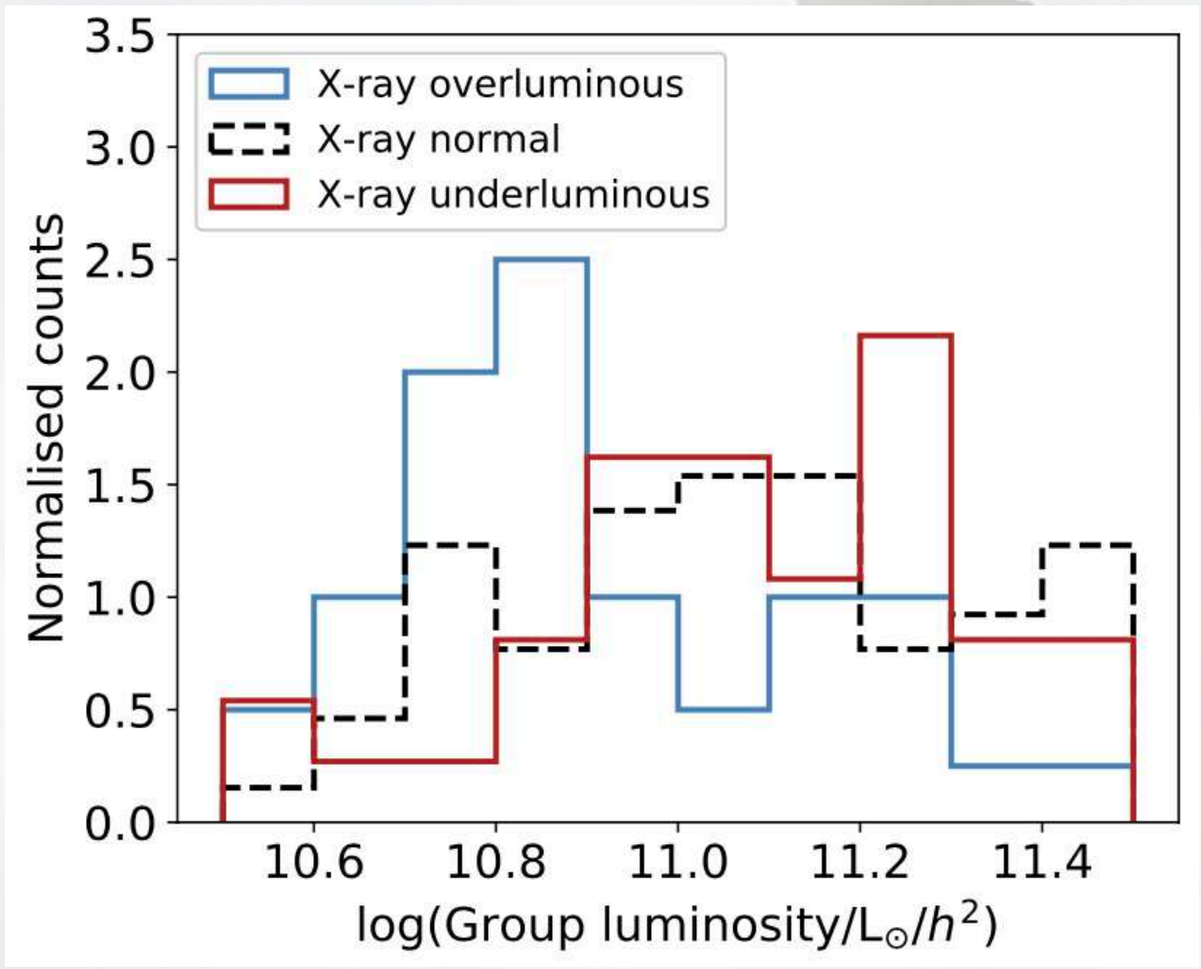
**Wide-angle radio tail system in merging clusters A3391/95**

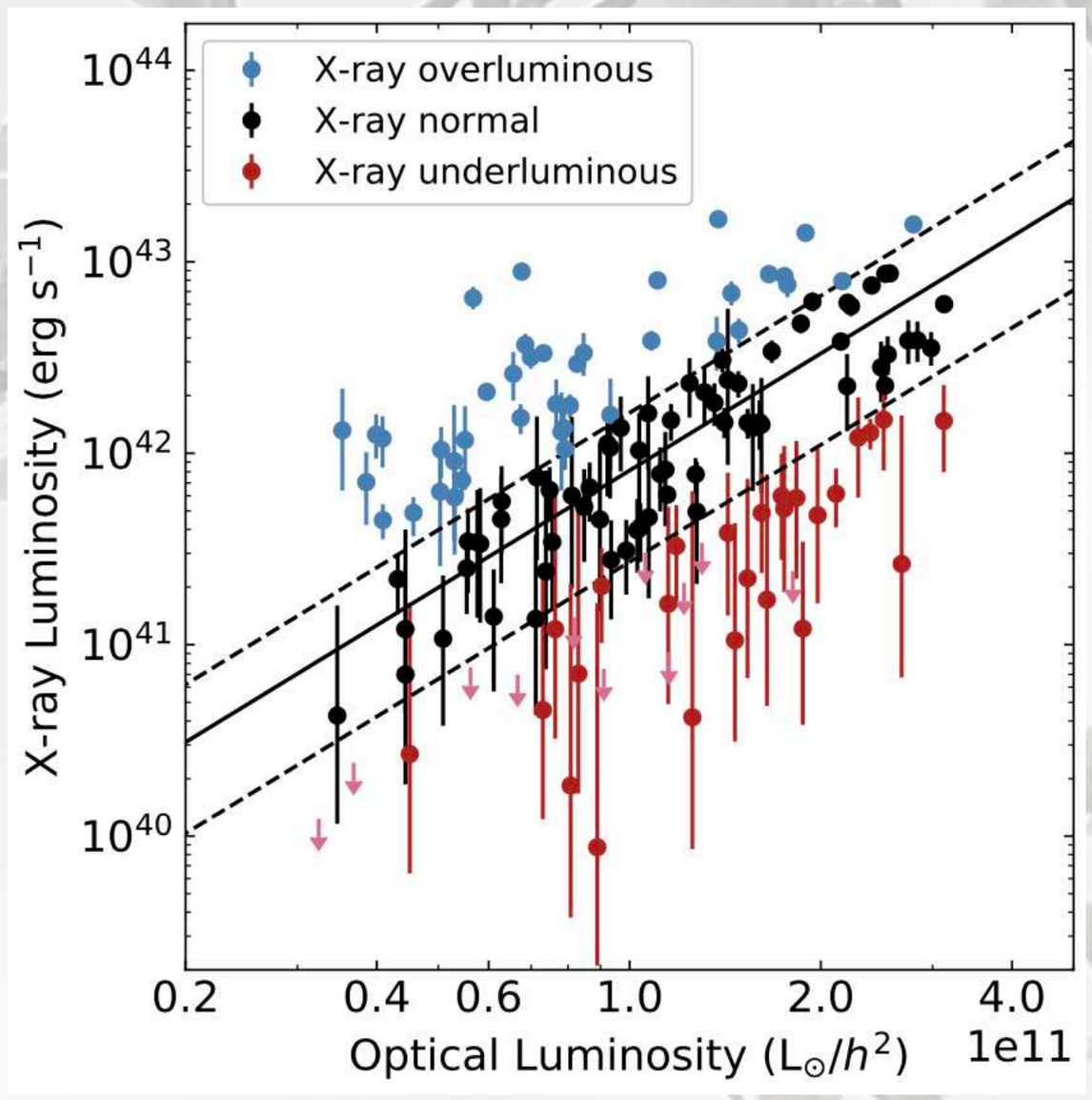



"The Northern Clump is a dynamically active system and far from being relaxed. Its atmosphere is affected by an interaction with the WAT and by gas sloshing or its infall toward Abell 3391 along the filament."

# Synergies: Galaxy groups

"X-ray overluminous groups contain a lower fraction of both blue and star forming galaxies compared with X-ray underluminous systems" and "X-ray overluminous systems are more dynamically evolved than underluminous groups, having had more time to develop a luminous intragroup medium, quench member galaxies, and build the mass of the central galaxy through mergers compared to underluminous groups."

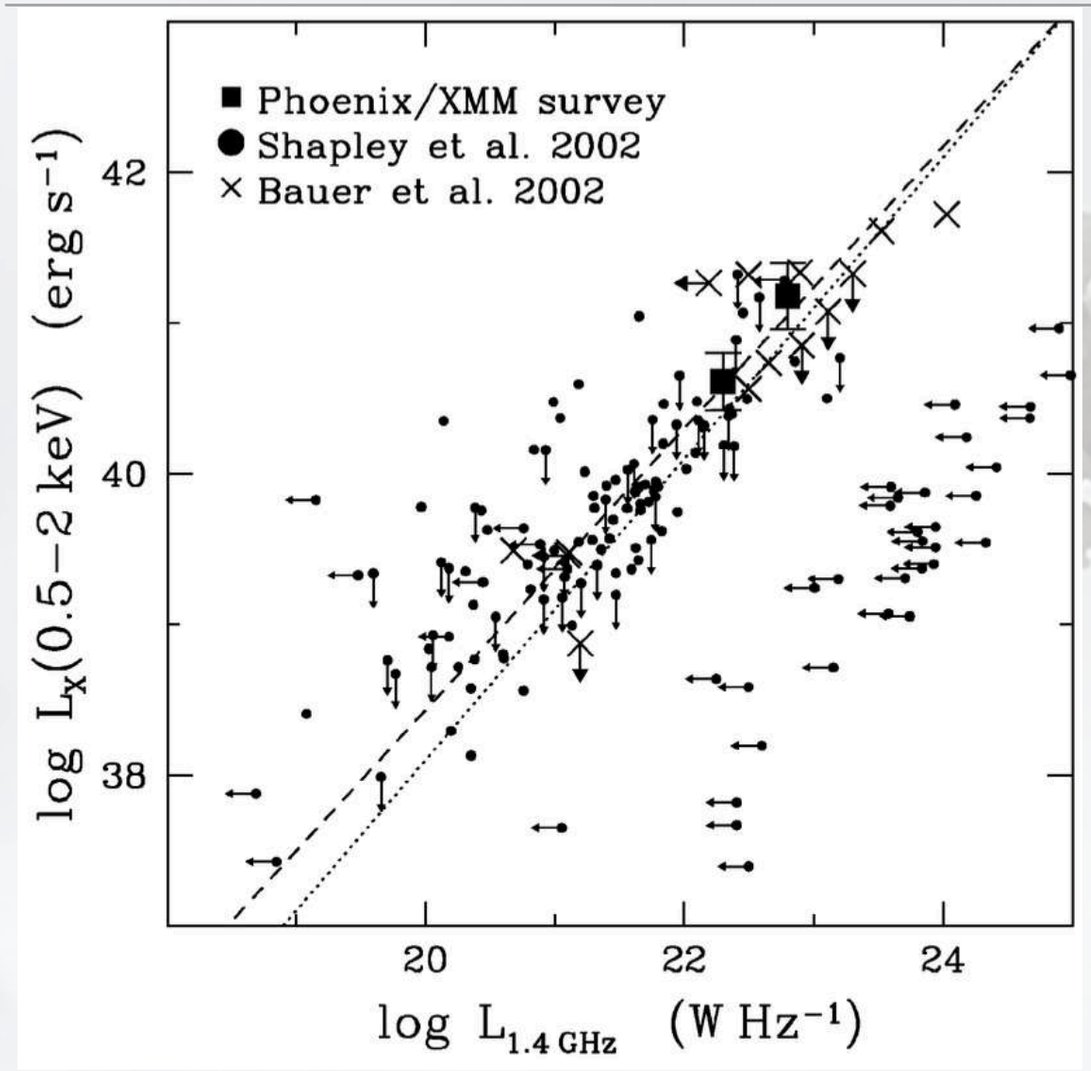


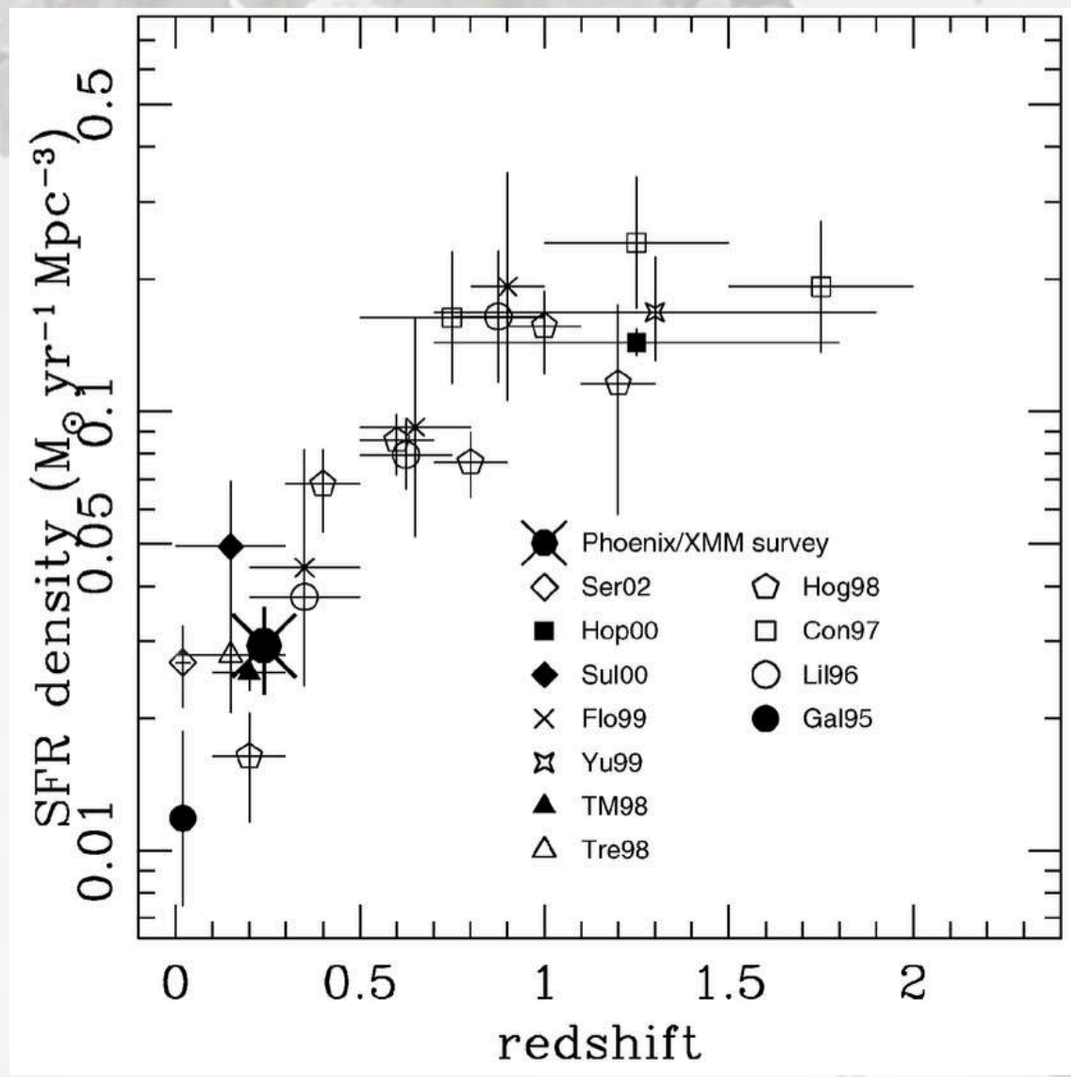

Crossett et al., 2022, A&A, 663, A2

**GAMA and XXL**

# Synergies: Galaxies



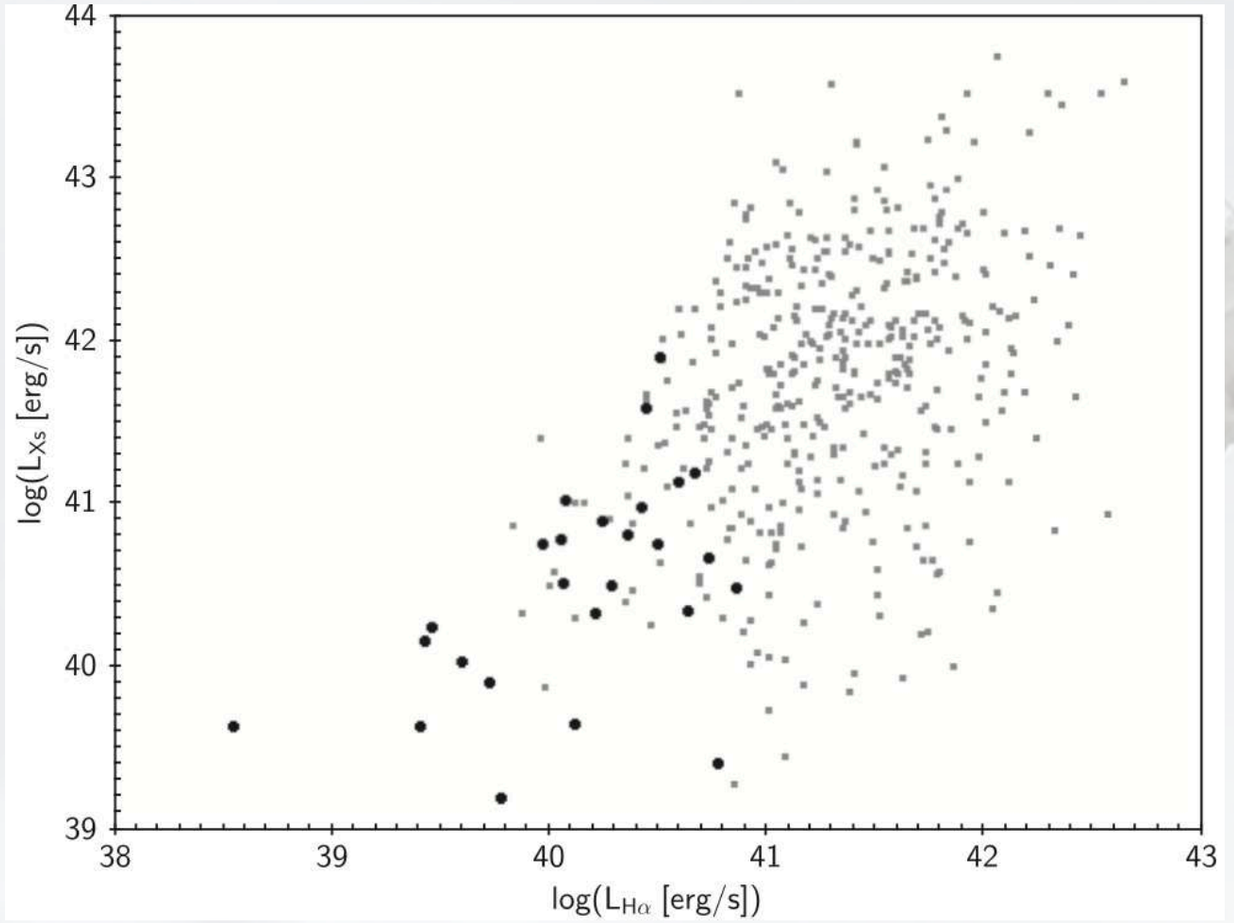

Georgakakis et al., 2003, MNRAS, 345, 939



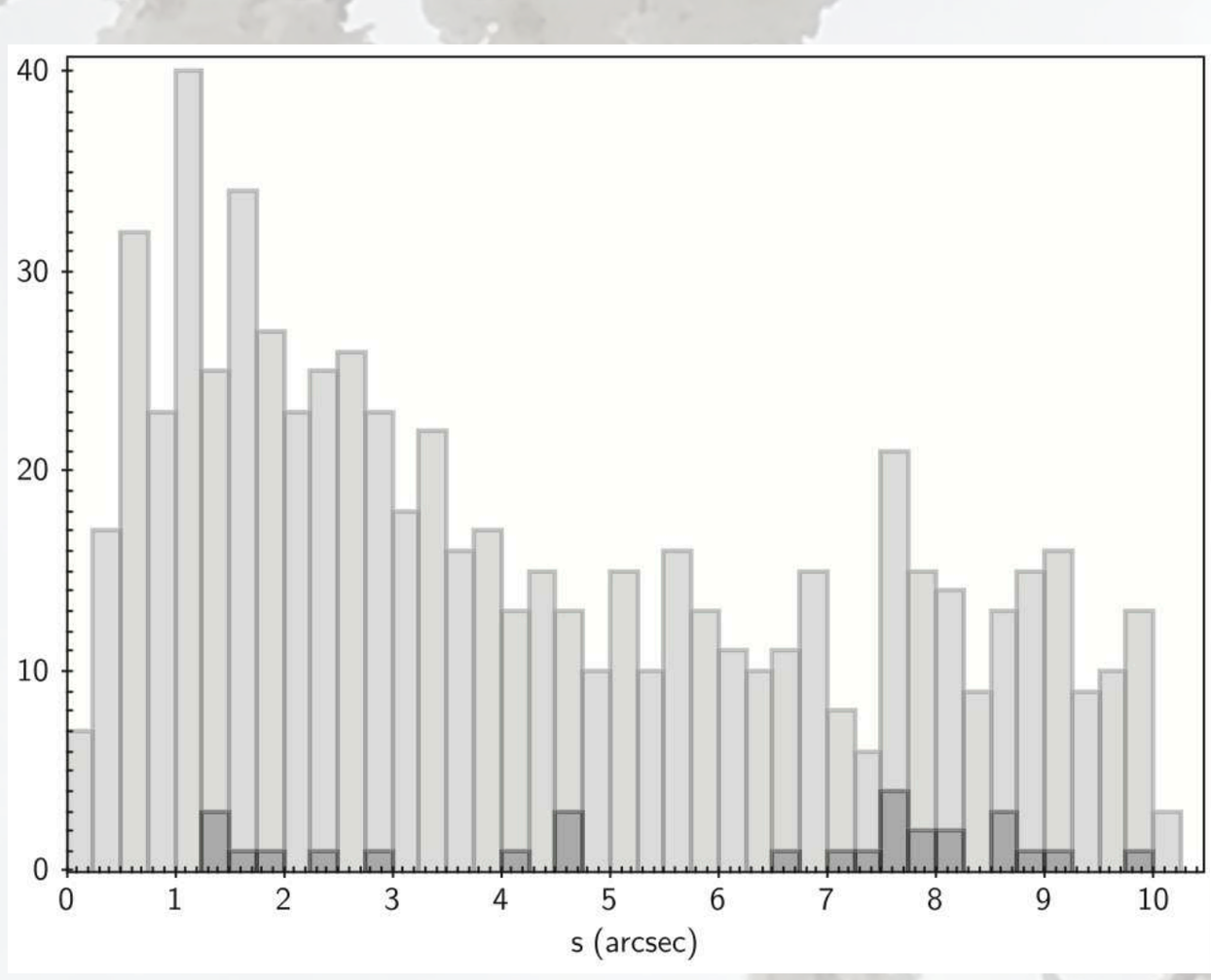

Established an X-ray to SFR calibration, and measured the local SFR density. Used stacking analysis on XMM-Newton data.

**The Phoenix Deep Survey**

# Synergies: Galaxies



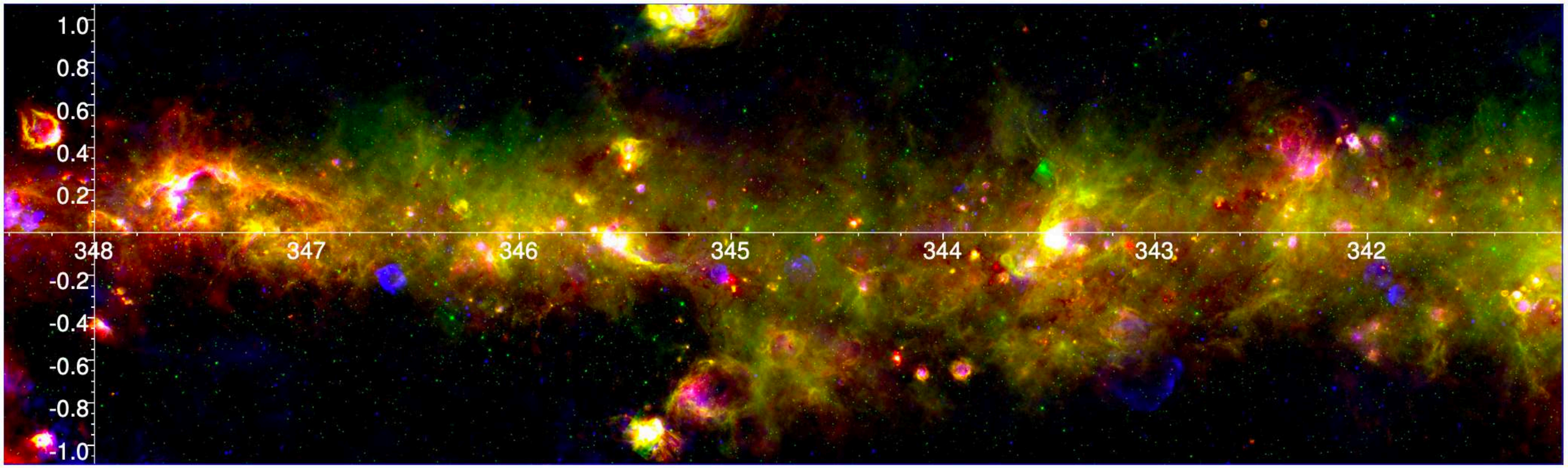

Nwaokoro et al., 2021, MNRAS, 502, 3101



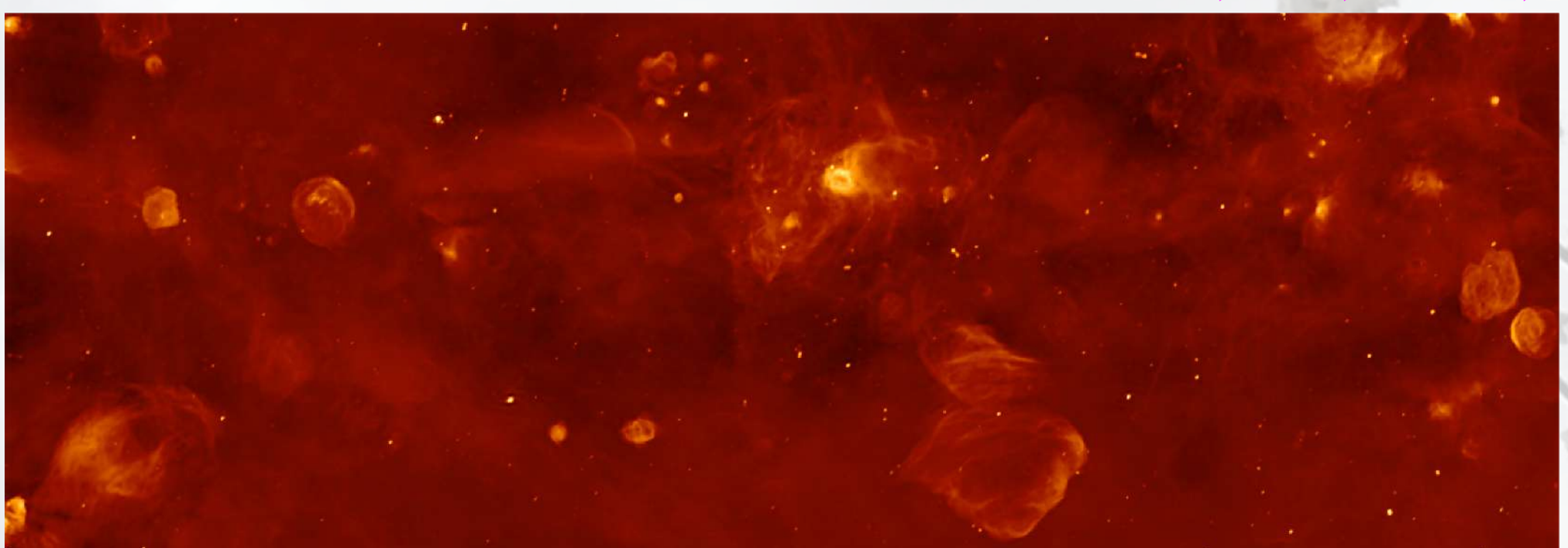

"most of the ~20 X-ray sources genuinely in low-mass galaxies are high-mass X-ray binaries in star-forming galaxies".

**GAMA and XXL**

# Synergies: The Milky Way (SCORPIO)

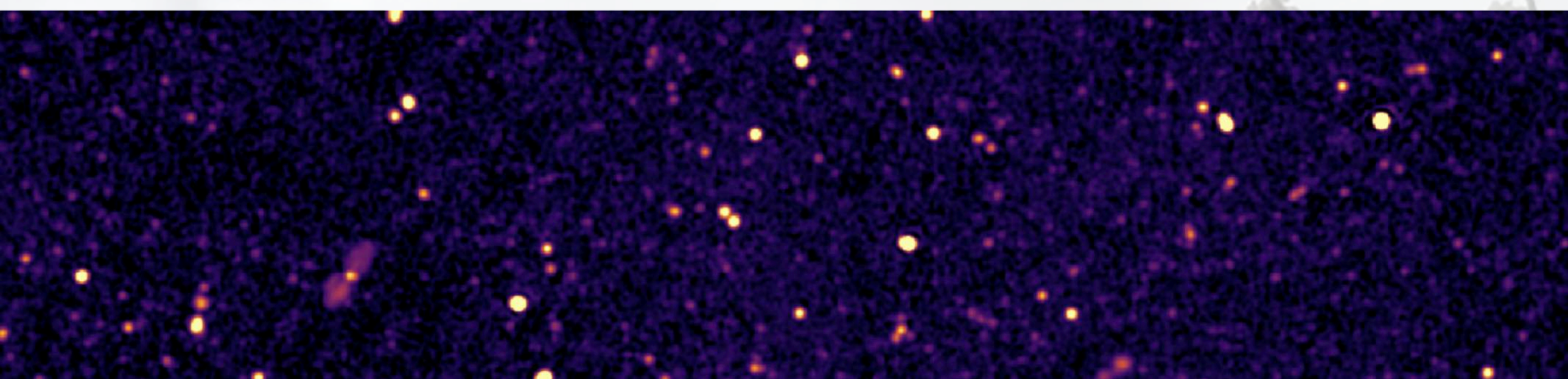



Green: Spitzer IRAC (8μm); Red: Herschel PACS (70μm); Blue: ASKAP (912 MHz) Umana et al., 2021, MNRAS, 506, 2232



# EMU Team

- Over 400 team members from 27 countries!
  - http://askap.pbworks.com/TeamMembers
  - Management Team: Andrew Hopkins (Lead), Tessa Vernstrom (Project Scientist), Josh Marvil (Technical Lead), Anna Kapinska (Project Manager)
- Data is available on CASDA:
  - https://data.csiro.au/domain/casdaObservation
    - Search for “EMU” or project ID “AS201”
- Membership is open. To be added, simply contact the EMU Management Team: emu_mt@mq.edu.au



# EMU is off and running!

Credit: Wajarri artist, Zachriah George