The Evolutionary Map of the Universe

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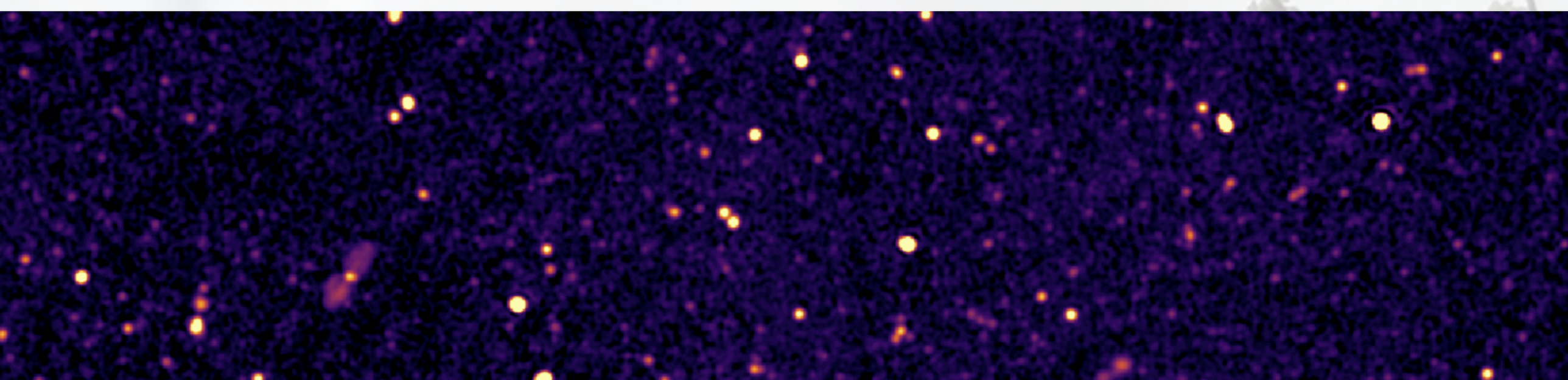
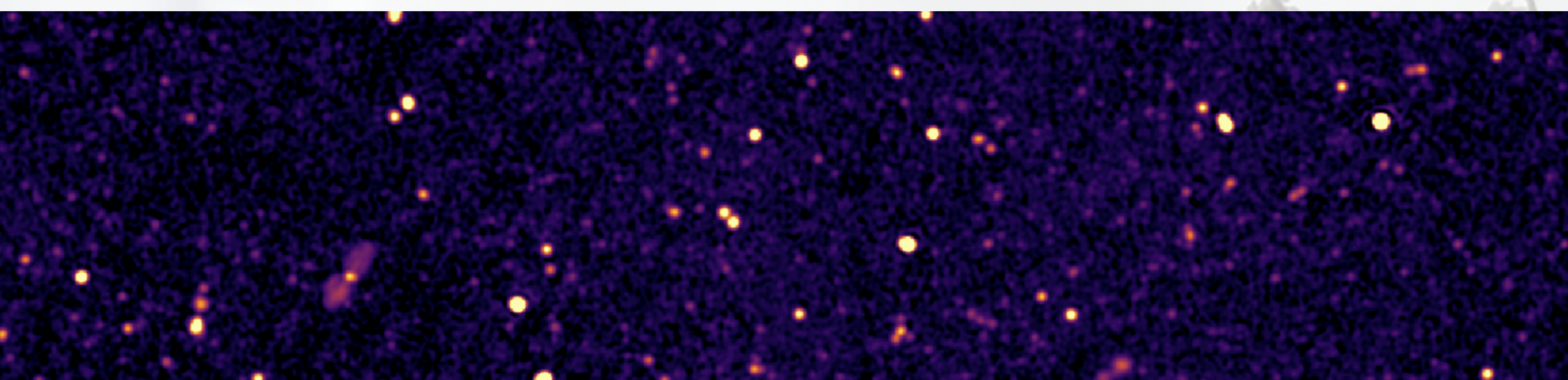
EMU Overview

- Radio continuum survey with the ASKAP telescope, covering the sky south of +30° declination (30000 sq. deg., 3π 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.
- **ASKAP 5 yr plan includes 8533hr (~1 yr) to EMU (+POSSUM), allowing 2π sr coverage. Anticipate extending survey to full coverage subsequently.**



EMU Science

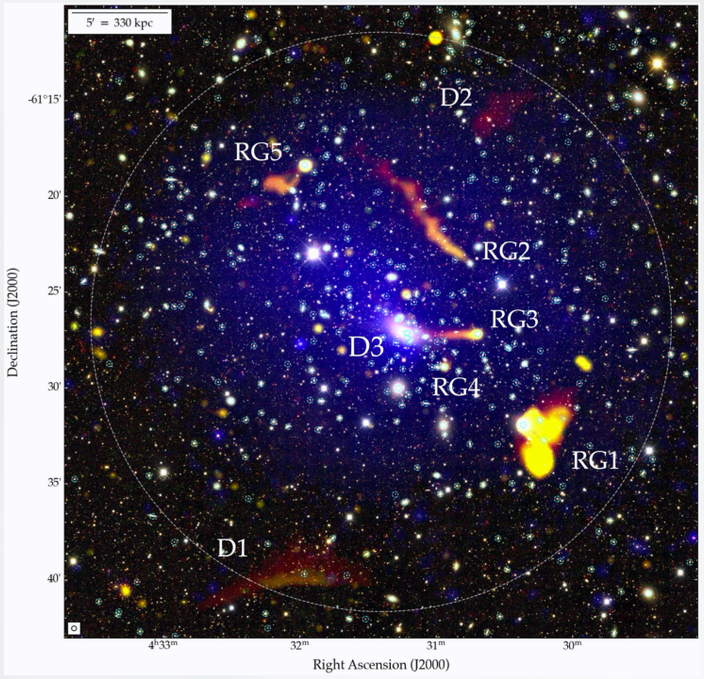
- Evolution of star formation in galaxies
- Evolution of massive black holes, and understanding their relation to star formation
- Explore the large scale structure and cosmological parameters of the Universe
- Explore an uncharted region of observational parameter space
- Explore diffuse, low surface-brightness 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



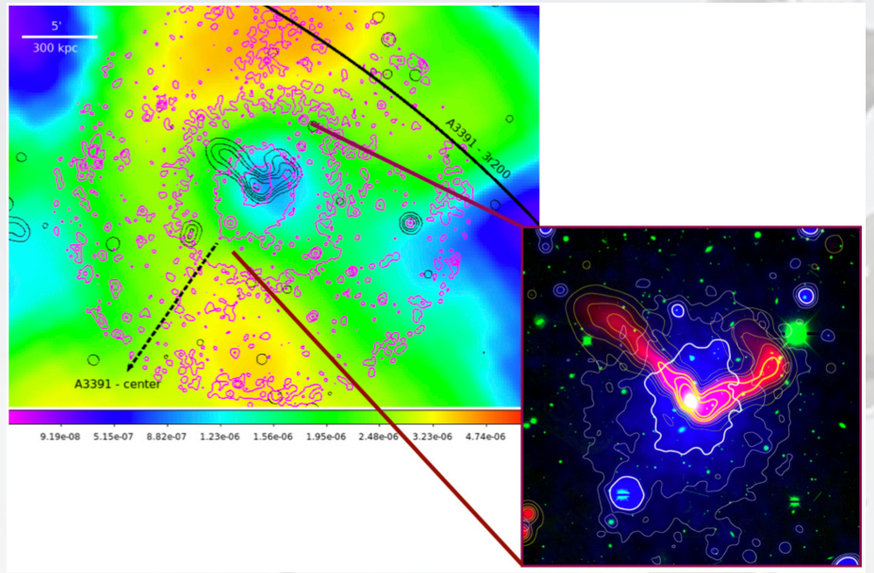
EMU status

- Early data taken during commissioning and early science phases.
  - Observations of GAMA 23, LMC/SMC, SCORPIO, and a “cosmology field” are already providing a fruitful resource for science due to the extensive complementary datasets available.
- EMU Pilot phase 1 data (2019) provides an outstanding resource for science with EMU.
  - Over 270 sq. deg. to rms ~25 μJy, with ~220,000 measured components, already possibly the largest radio survey to this depth to date.
  - Pilot data paper published (Norris et al., 2021, PASA, 38, e046) and data products available for team use.
- EMU Pilot Phase 2 (2021/22), includes:
  - 6 tiles of an extragalactic region around RA = 2^h20^m Dec = -4^o40^m which encompasses GAMA’s G02, the XMM-XXL field, and overlaps DES and the ACT SZ survey field.
  - 5 tiles in the Galactic Plane, including 4 encompassing the SCORPIO field
  - 1 tile that is commensal between EMU, WALLABY, and POSSUM
- **EMU Main Survey (beginning 16 Nov 2022)!**

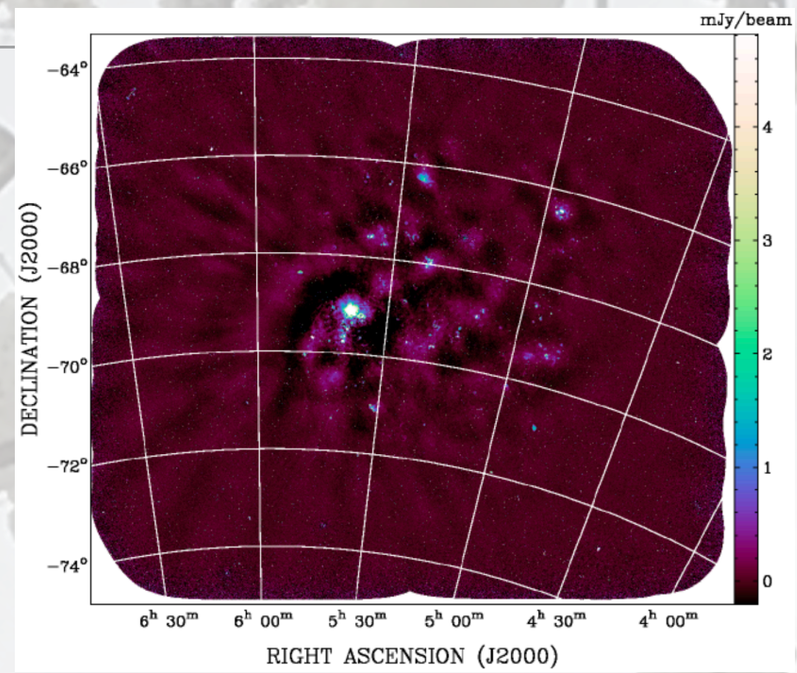
EMU science



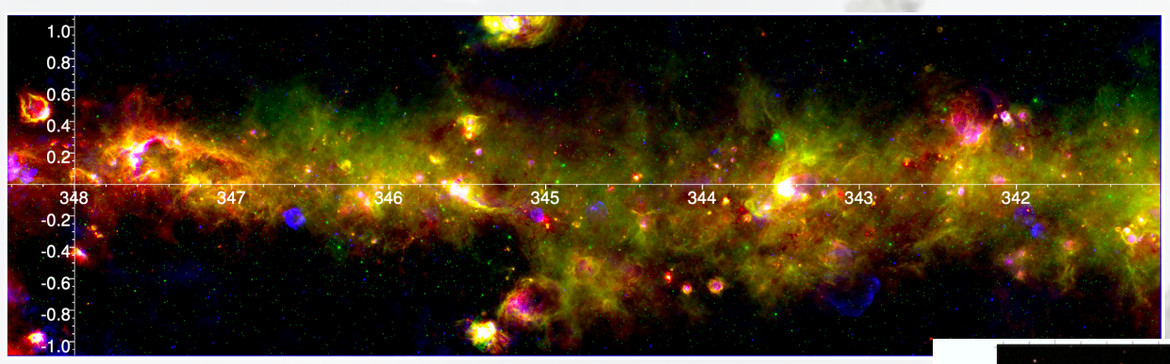
Riseley et al., 2022, MNRAS, 515, 1871



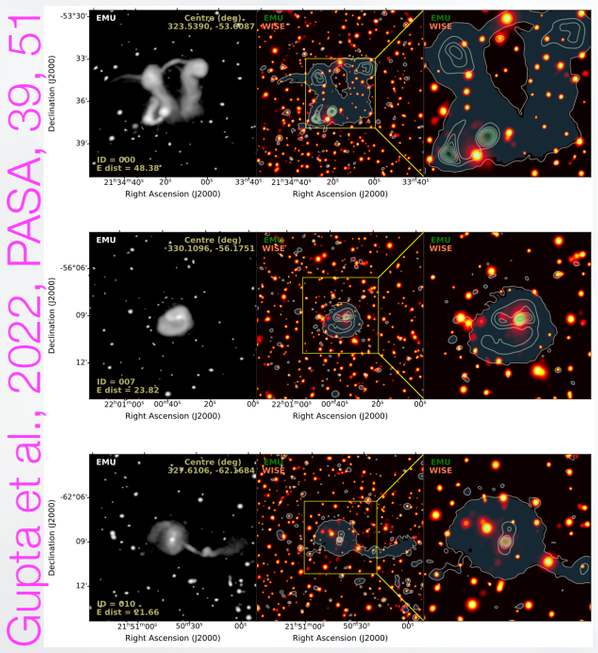
Veronica et al., 2022, A&A, 661, A46



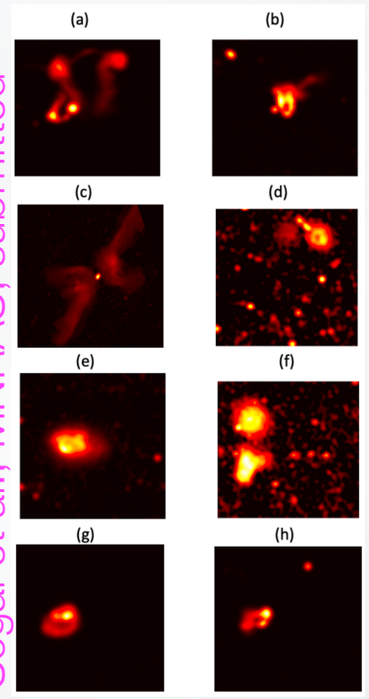
Pennock et al., 2021, MNRAS, 506, 3540



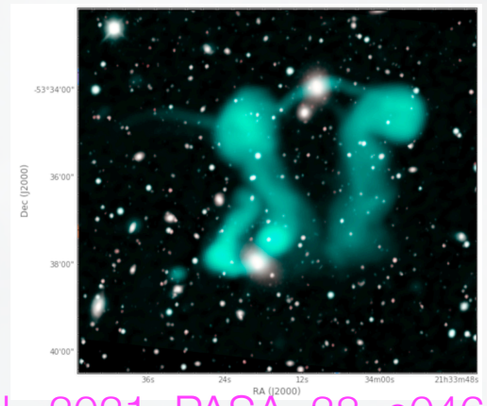
Umana et al., 2021, MNRAS, 506, 2232



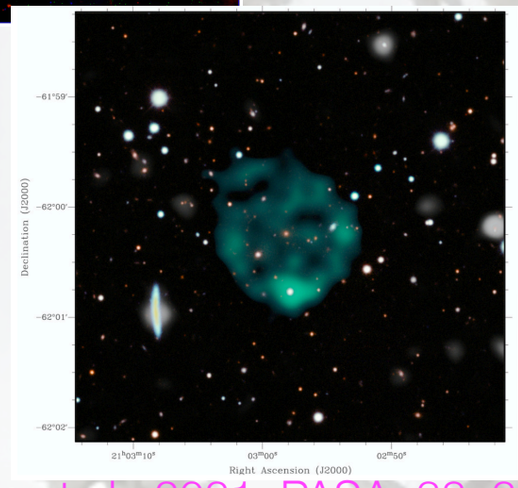
Gupta et al., 2022, PASA, 39, 51



Segal et al., MNRAS, submitted



Norris et al., 2021, PASA, 38, e046



Norris et al., 2021, PASA, 38, 3

EMU current progress

- 31 refereed EMU papers published, 6 under review, and another 60+ approved/in progress.
- EMU has 12 Key Science Projects, each encompassing multiple papers, to structure the EMU science goals.
- Building a Validation Team to ensure timely validation in CASDA of EMU data as it arrives.
- Continued development work on EMUCAT.
- Please send any queries to:

  O365-Group-EMU_Management@mq.edu.au

The future of EMU, ASKAP, ATCA, and Parkes

- ATCA being used already to follow up ASKAP discoveries. Fully expect this to continue, and increase, as main surveys begin.
  - Mainly using higher frequency (and hence higher resolution) to understand spectral indices over larger frequency baselines than in-band ASKAP data. Also improves morphology measures.
  - Future plans could include a quick and sensitive VLBI snapshot program (e.g., using the ATCA-Parkes baseline) to survey thousands of sources to discriminate SF from AGN, selected from those where other discriminants (spectra or photometry) are not available, especially to identify high-z AGN systems.
- Parkes/Murriyang is being used to provide a single-dish complement to EMU through “PEGASUS” (Carretti+). Future coverage through a similar project using the cryoPAF would be valuable to improve sensitivity on the largest scales.
- Future ASKAP developments that would improve EMU:
  - Joint imaging of 2x5hr SBs (northerly tiles, key for future northern expansion to cover full 3π sr)
  - Use of sky model to improve dynamic range near bright sources
  - Implementation of DDFacet, W-projection, or similar, in ASKAPsoft to improve wide-field imaging performance
  - Improved instrument sensitivity. A next-gen EMU survey with 2-3 times the sensitivity would more than double the discovery phase space.

Excited to see EMU off and running!