Results from ASKAP: the SCORPIO field

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Talk outline

- Introduction to SCORPIO
- ASKAP early science observations
- Group activities related to “Our Galaxy”

ASKAP and the Galactic plane

First observations on the Galactic plane:

- ASKAP early science began in 2017
- Observations started with band 1 (~900 MHz) and 12 antennas
- First observations on the Galactic plane in January 2018
- SCORPIO as Galactic target

SCORPIO: project overview

Original survey design:

- covered area: $\sim$5 square degrees
- survey centre: $l = 343.5°$, $b = 0.5°$
- instruments: **ATCA** (multiple configurations)
- total integration time: $\sim$320 hours
- frequency range: 1.4 - 3.1 GHz
- sensitivity: from $\sim$30 to $\sim$100 µJy/beam
- resolution: $\sim 10''$

SCORPIO: project overview

First blind survey of the Galactic plane at this frequency with a planned sensitivity of 30 μJy/beam.

Scientific goals:

- unbiased search for radio stellar emission
- insights on the physics of particular classes of stellar systems
- search for coherent radio emission from stellar systems
- study the occurrence of different Galactic object
- provide us with a clear forecast on the potential of SKA and its precursors in the field of Galactic radio astronomy

SCORPIO: project overview

Shaping the strategy for the Galactic part of the EMU survey (10 μJy/beam - 75% of the sky) approved for ASKAP (Norris et al. 2011).

Technical goals:

- strategy for data reduction, especially imaging
- issues due to complex structure
- issues due to the variable sources
- issues due to the diffuse emission
- issues due to contamination of nearby sources
- how to identify different populations

Related papers

Published papers:

- Umana et al. 2015 - point-source catalogue of the pilot field
- Riggi et al. 2016 - source extraction algorithm
- Cavallaro et al. 2018 - point-source characterization

In preparation:

- whole-field catalogue (Trigilio et al.)
- extended-source characterization (Ingallinera et al.)
- ...

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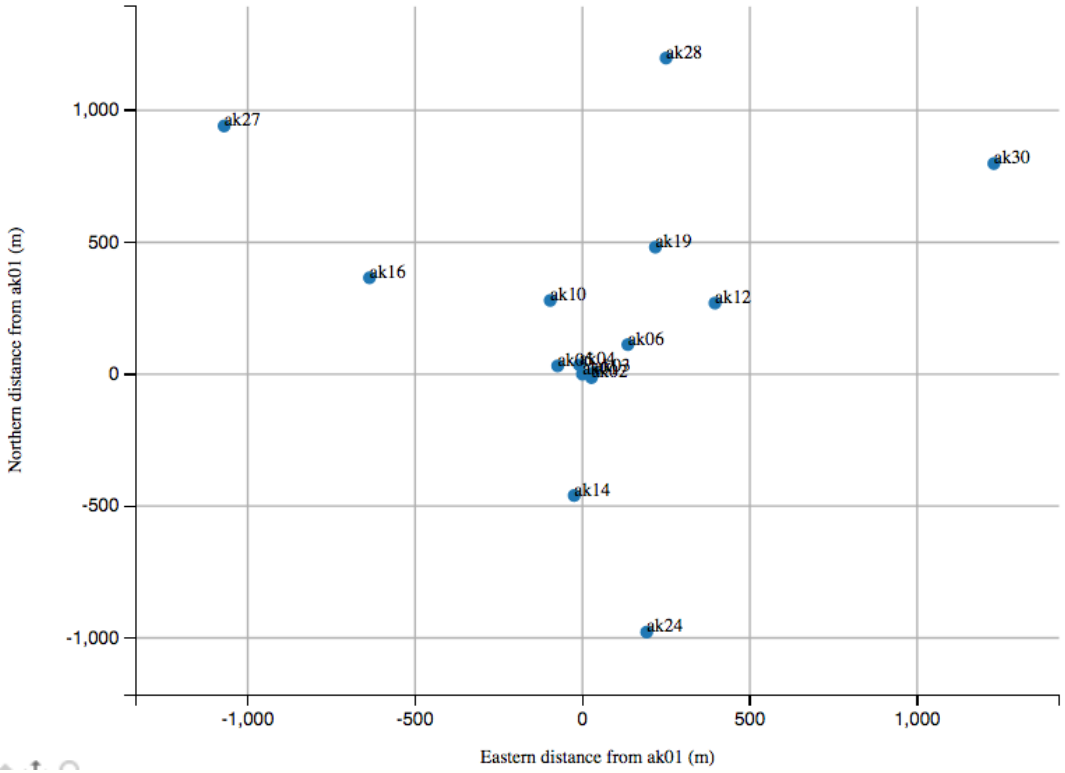
ASKAP early science observations

Performed in January 2018 in band 1



15 antennae used, with baselines ranging from 22 m to 2.3 km

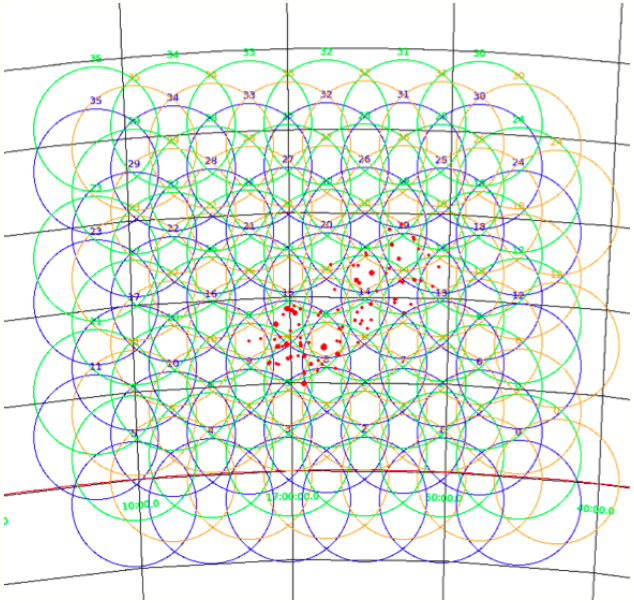
Resolution: ~20″

Theoretical LAS: < 40′

First ASKAP early science observations in the Galactic plane.

ASKAP early science observations

Total covered area ~40 square degrees!



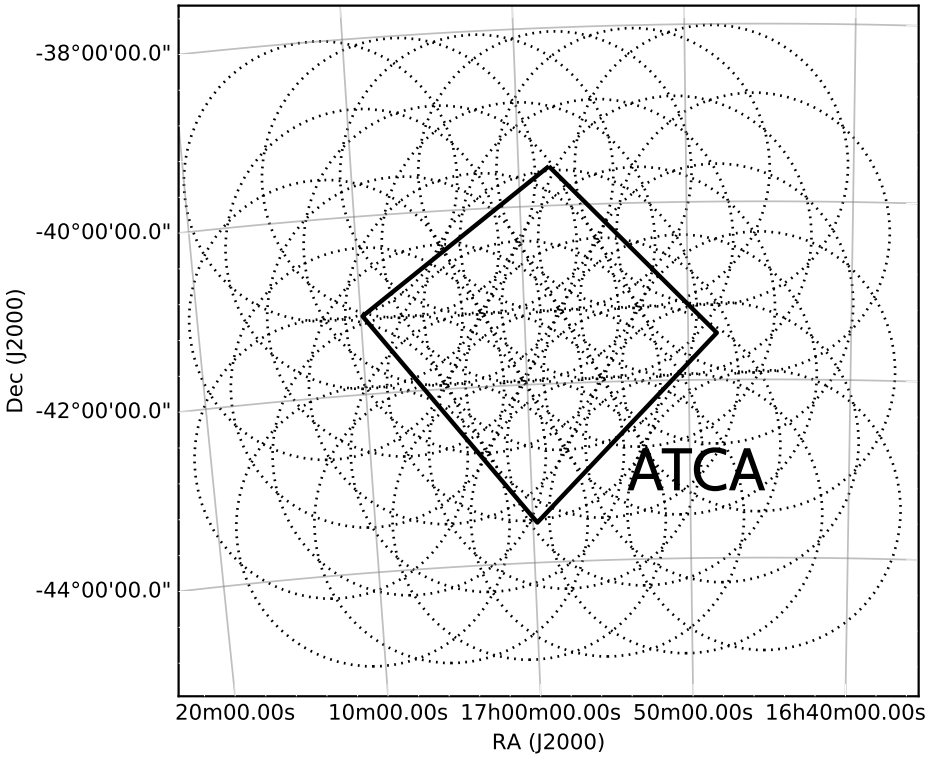
Three-field strategy:

field A

field B

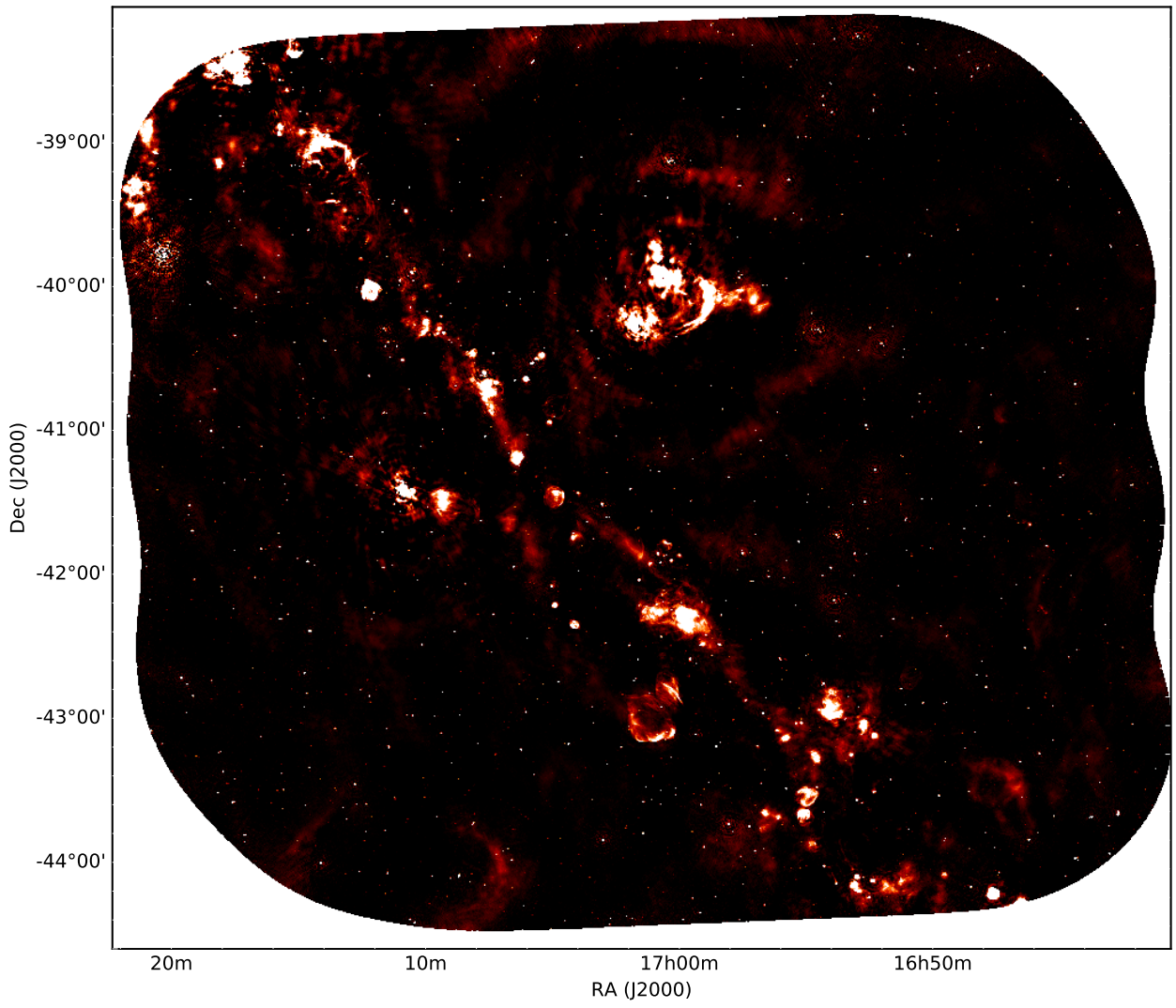
field C

Sky coverage of field A



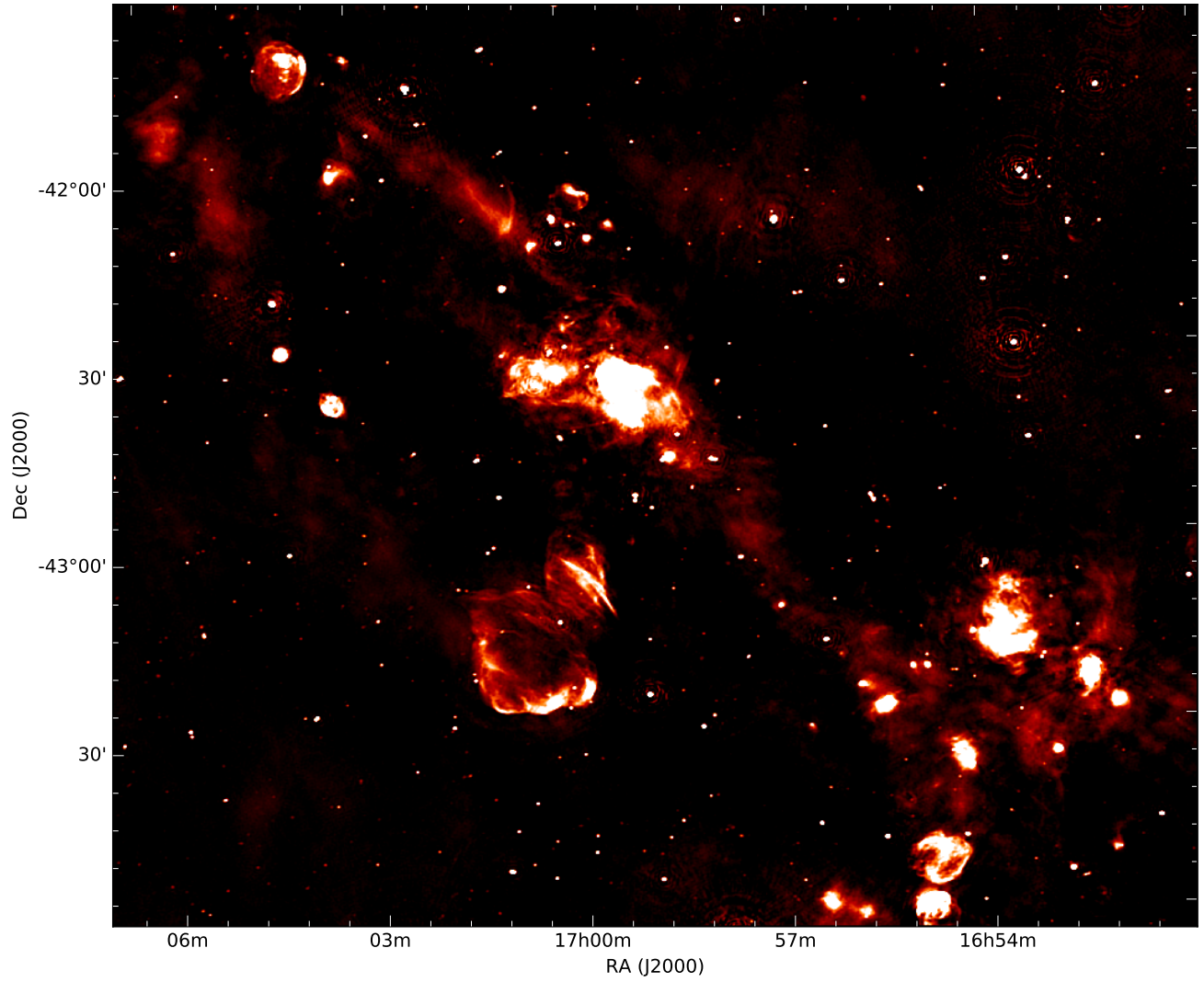
SCORPIO observations with ASKAP early science

Final map, 3 fields combined (Umana et al. *in prep.*)



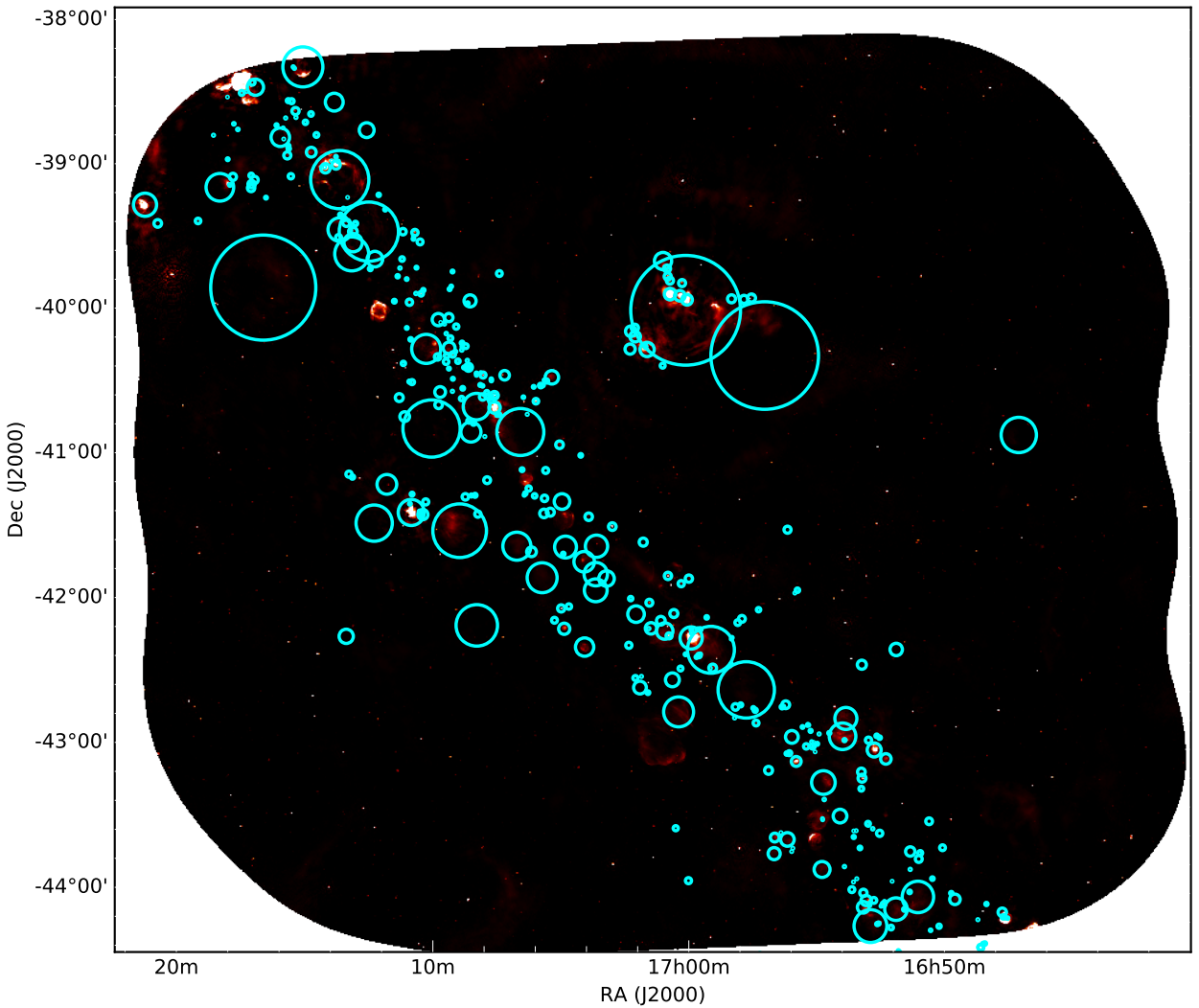
SCORPIO observations with ASKAP early science

Zooming in...



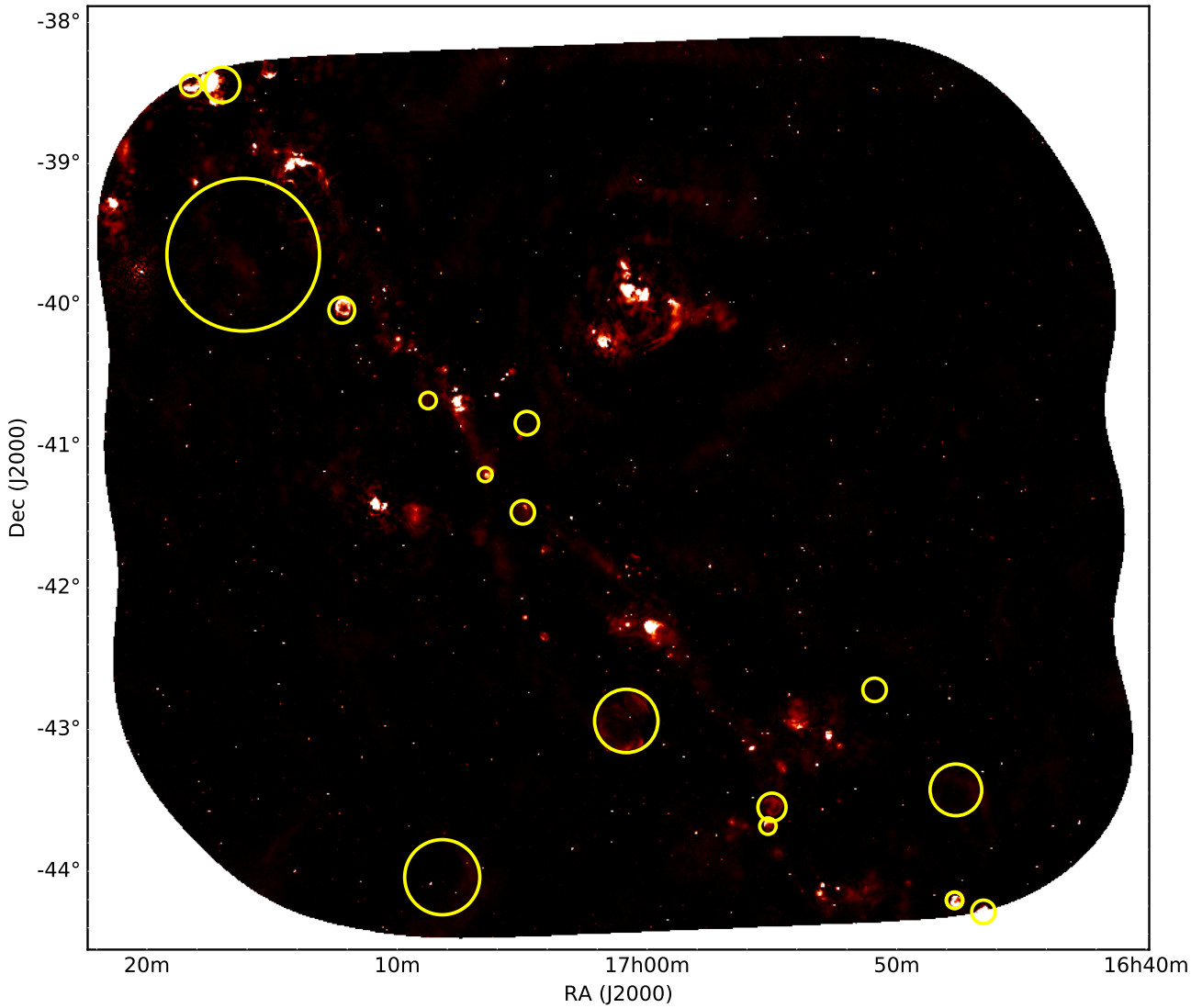
Preliminary search for H II regions

400+ H II regions in Anderson et al. 2014



Preliminary search for SNRs

16 SNRs in Green 2014



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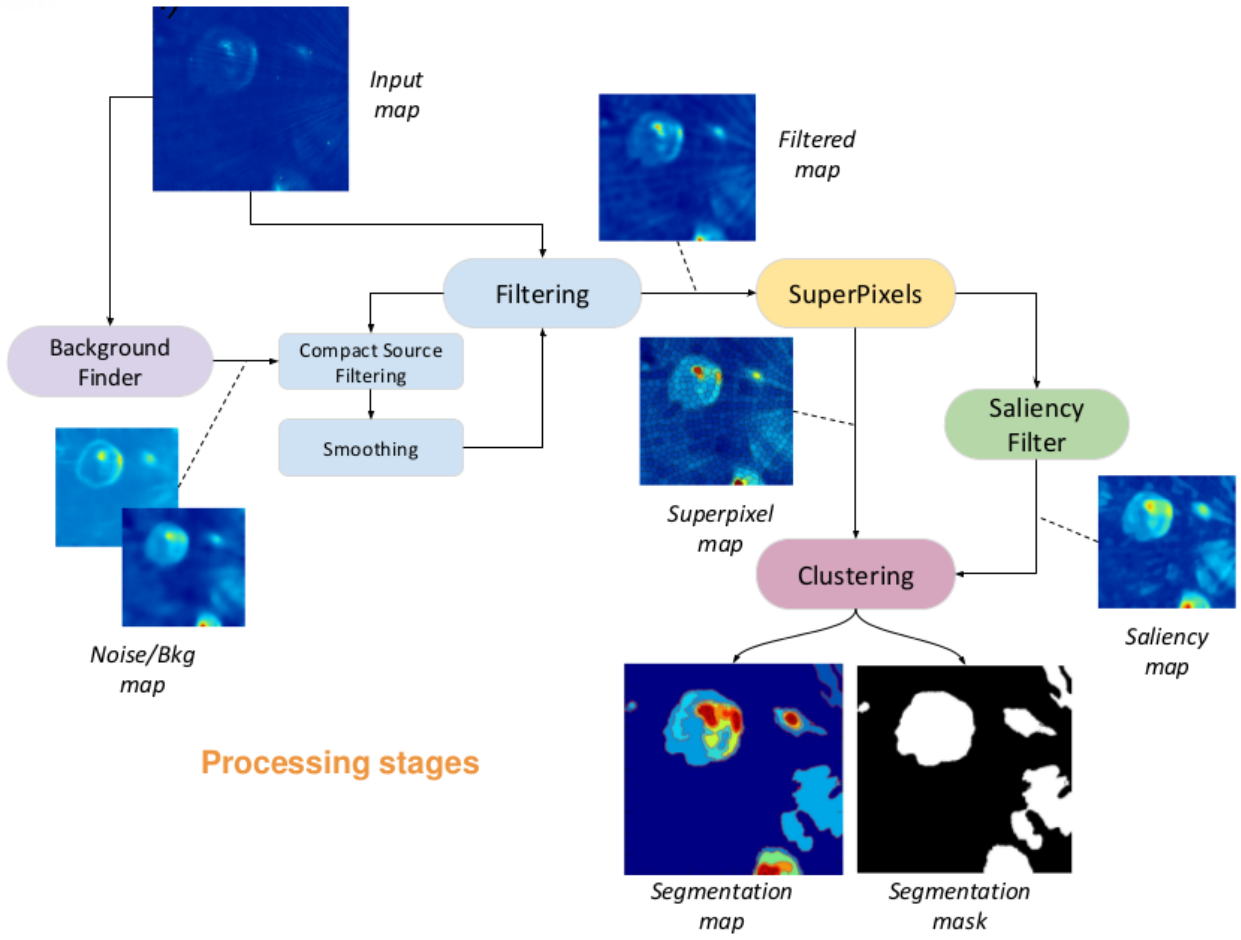
Automating source extraction and characterization

Source extraction algorithm

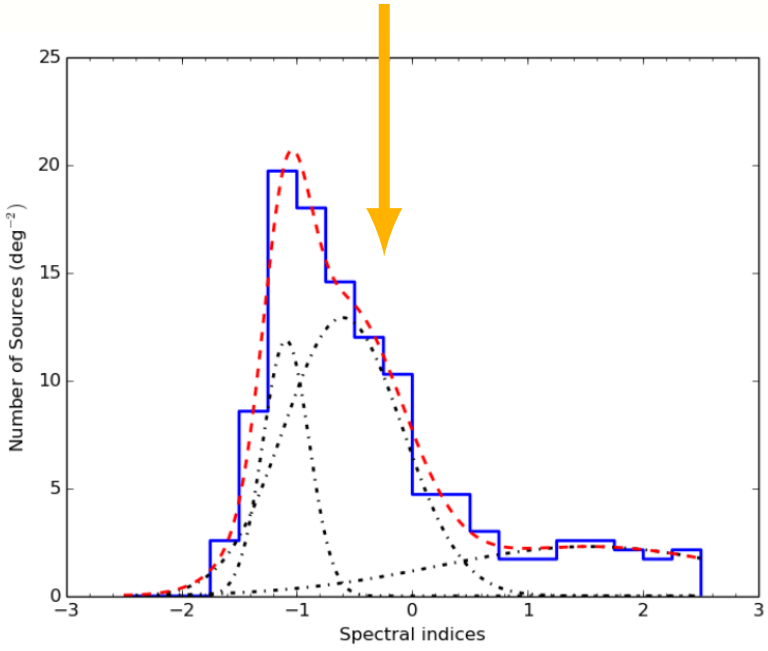


Riggi et al. 2016

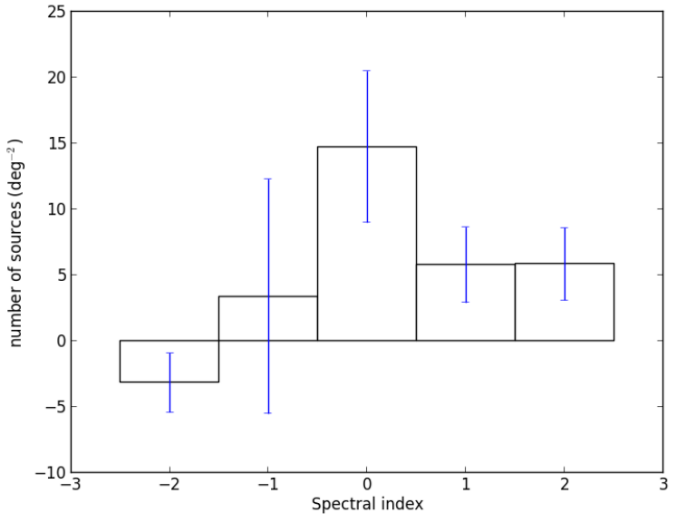
Automating source extraction and characterization

Radio spectral index analysis to characterize the point source emission.

SPECTRAL INDEX DISTRIBUTION



Cavallaro et al. 2018



Comparison with ATLAS:

- no difference for $\alpha \ll 0$
- source excess for $\alpha \gtrsim 0$

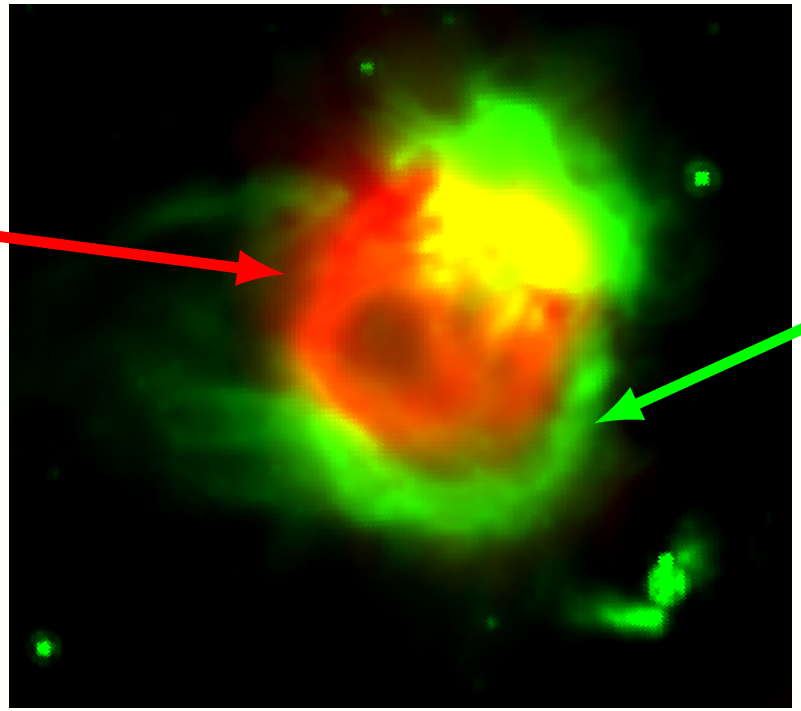
Automating source extraction and characterization

Distinguish evolved stars from radio (Ingallinera et al. 2016)

- PNe: roundish or elliptical objects
- massive evolved stars: central star + nebula

And use IR to disclose H II regions:

RADIO:
ionized gas

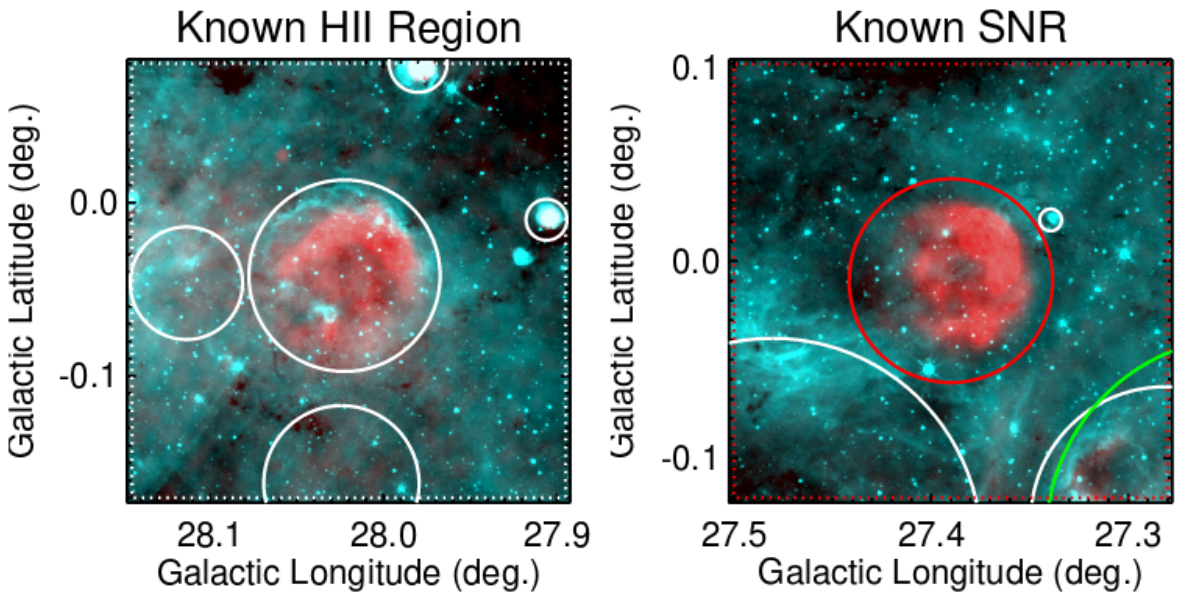


IR (8 μm):
PAH emission

Automating source extraction and characterization

Using IR to spot SNRs:

- MIR/radio much lower than H II regions
- produce 2D maps of the dust physical properties (T, β and τ_ν)
- finding missing SNR population (Bufano et al. *in prep.*)



Anderson et al. 2017

Conclusions

- Great discovery potential in interferometric Galactic survey
- Precursors as technical benchmark but also scientific forecast
- Crucial inputs for SKA observation planning
- Optimizing SKA data reduction and analysis