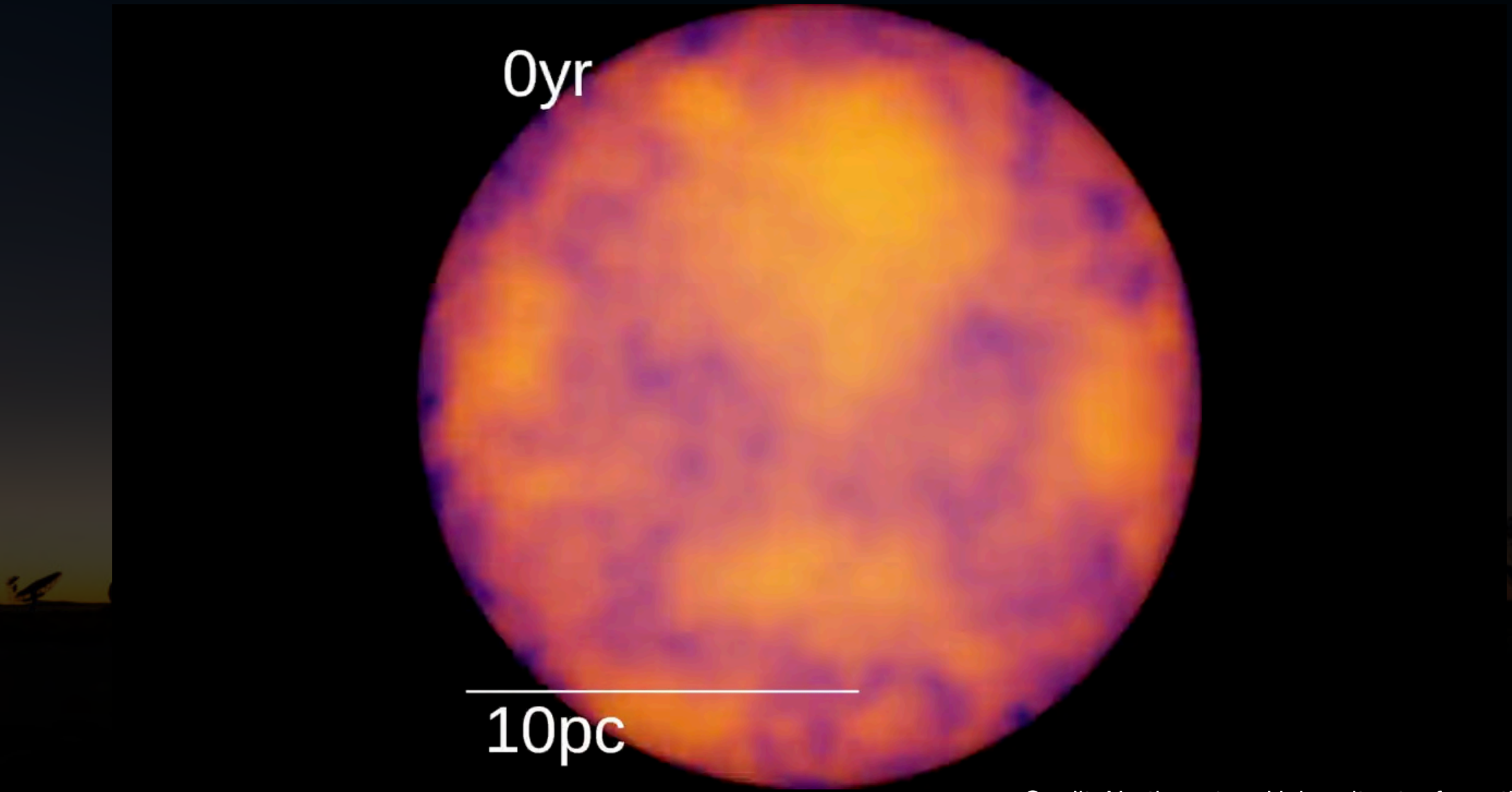
L-band properties of HII regions in the SARAO MeerKAT Galactic Plane Survey (SMGPS)

James O. Chibueze
UNISA Centre for Astrophysics & Space Sciences (U-CASS),
College of Science, Engineering and Technology,
University of South Africa

Collaborators: Willice Obonyo, Chukwuebuka J. Ugwu, Portia Legodi
Athanaseus Ramaila, Mark Thompson, Oleg Smirnov

East-Asian Meeting on Astronomy (EAMA11) 8-12 December 2025 Niigata, Japan

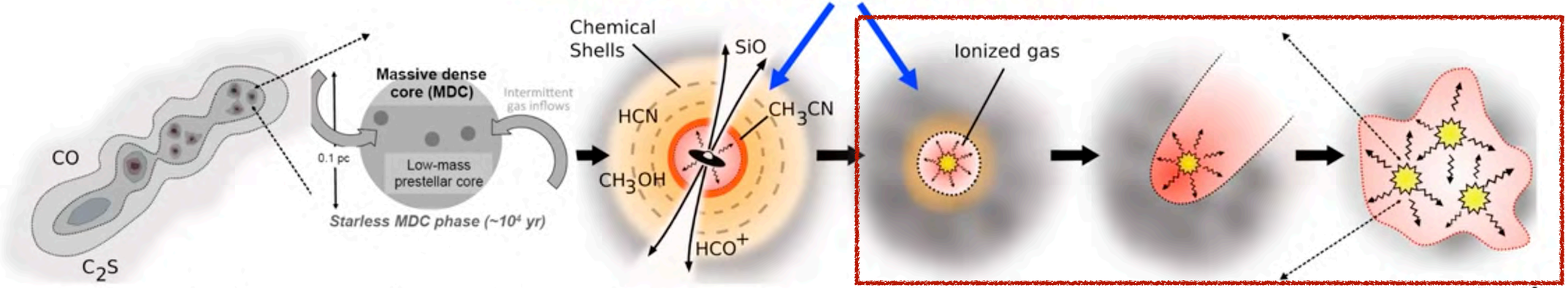
Star formation



Credit: Northwestern University star formation group

Evolutionary stages of high-mass stars

COMs: Complex Organic Molecules



clumpy molecular cloud

L ~ several pc

massive prestellar cores (very elusive)

R < 0.1 pc

hot molecular core

hypercompact HII region

R < 1000 au

ultracompact HII region

R < 10000 au

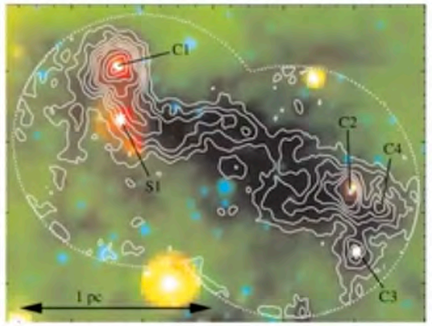
HII region / OB association

R > 0.1pc

Not distinct stages; incl. EGOs 4.5um

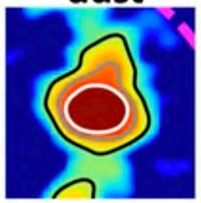
accretion outbursts occur here

modest time variability (DePree+2018)

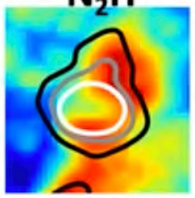


e.g. G19.30+0.07
Devine+2011

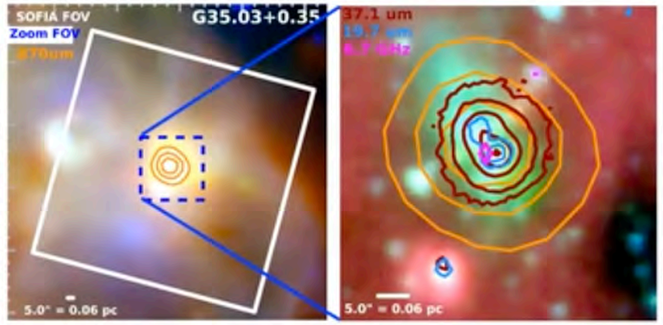
dust



N_2H^+



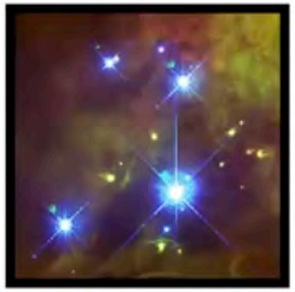
e.g. G11.92-0.61MM2
Cyganowski+2014



e.g. G35.03+0.35, Towner+2018



e.g. G29.96-0.02
Kalcheva+2018



Orion Trapezium
Ba

Search for HII regions at L-band with MeerKAT

- HII regions could be deeply embedded and undetectable in IR
- How many HII regions do we have in the Milky Way?
- Can we leverage HII regions to study Milky Way morphology?

Chibueze et al. (submitted) and Ramaila et al. (in prep)

MeerKAT telescope



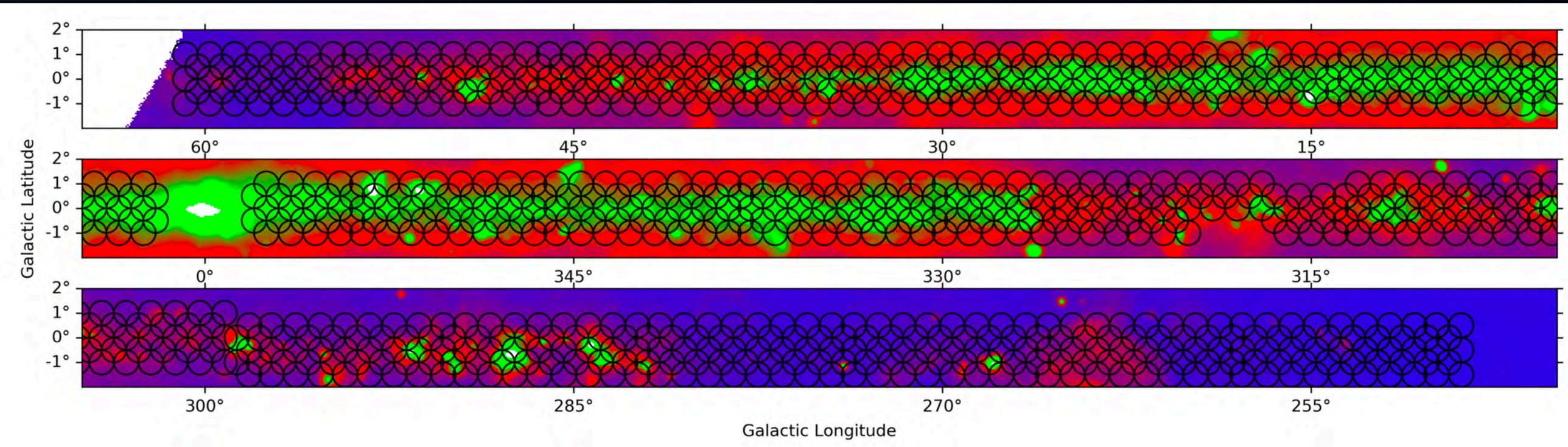








SARAO MeerKAT Galactic Plane Survey (SMGPS)

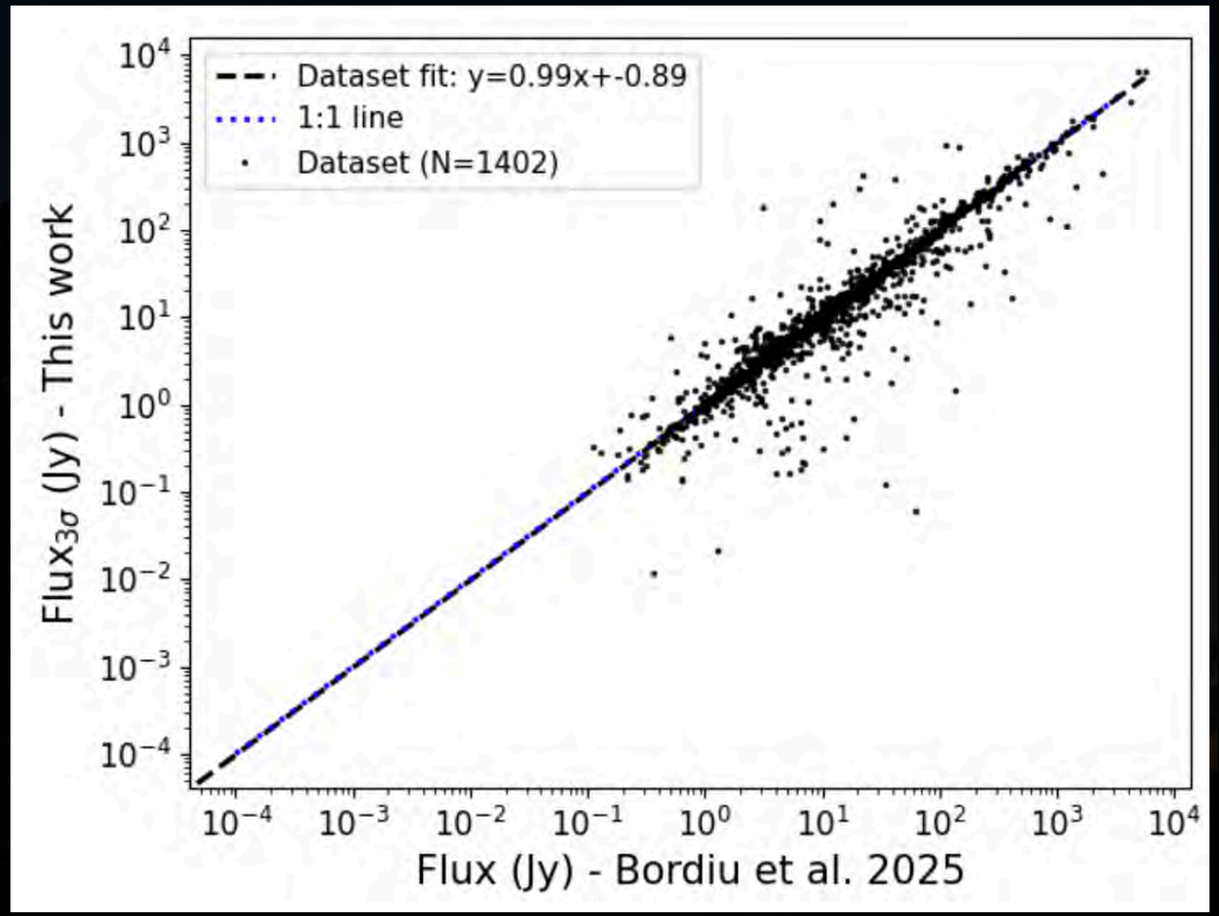


4 microJy/beam sensitivity, 7 arcsec resolution

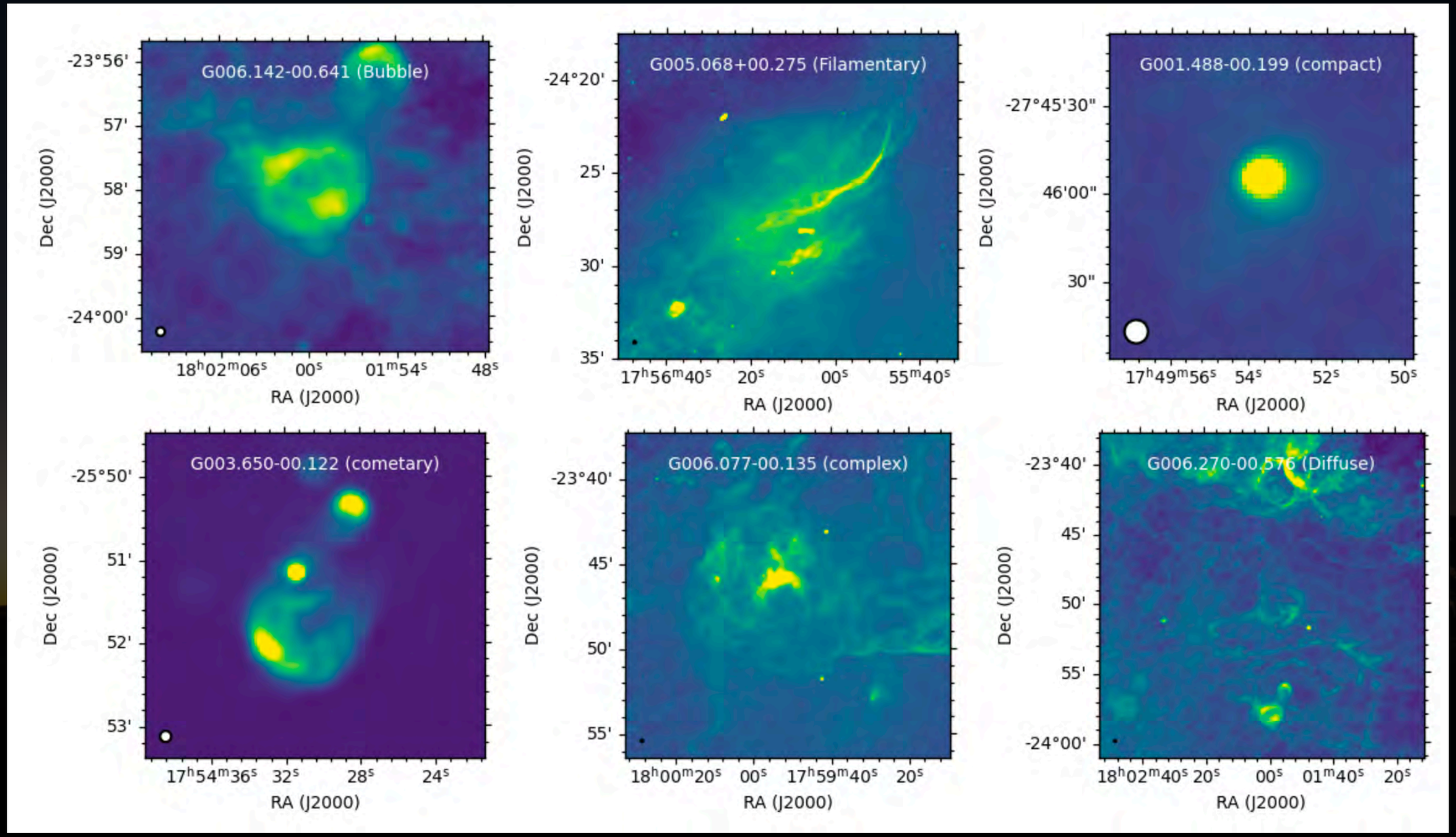
Goedhart et al. (2024)

Key HII region statistics from SMGPS

- 2016 known (WISE identified) HII regions detected
- 2376 new candidate HII regions detected
- 82% of HII regions previously classified (Anderson et al.) as radio-quiet detected
- Radio-quietness is merely sensitivity limitation

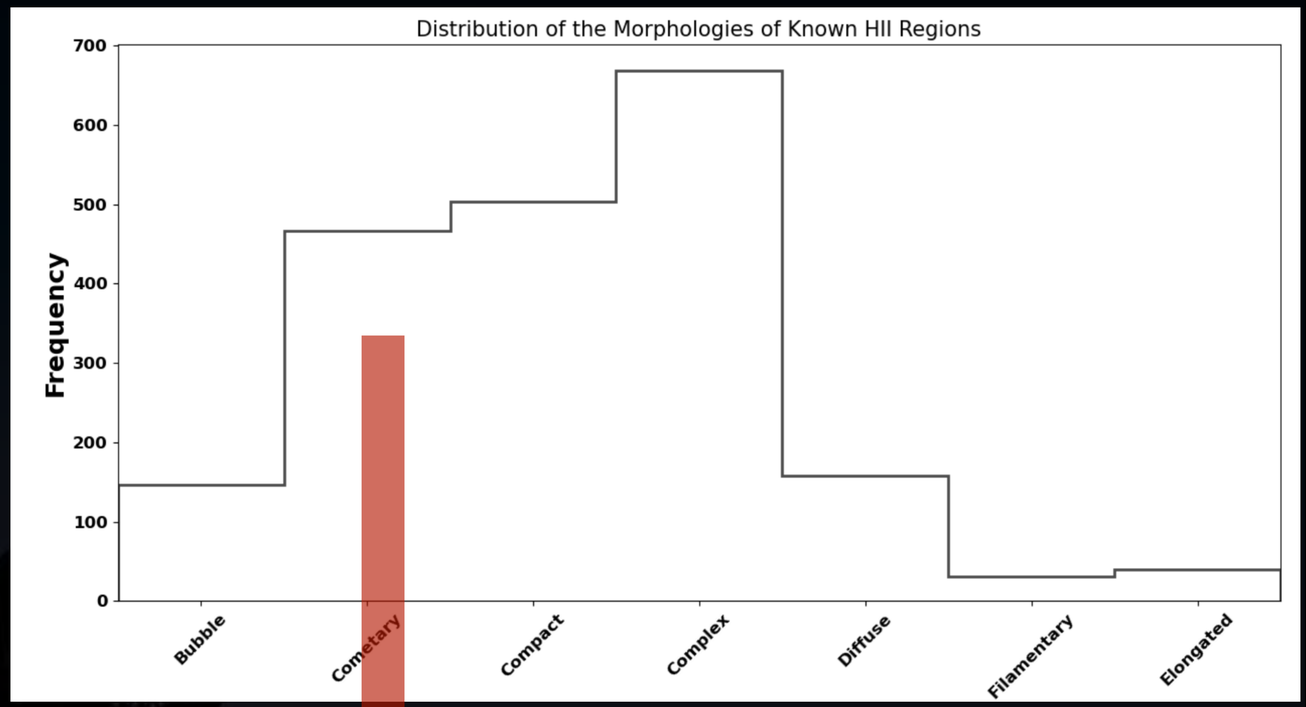


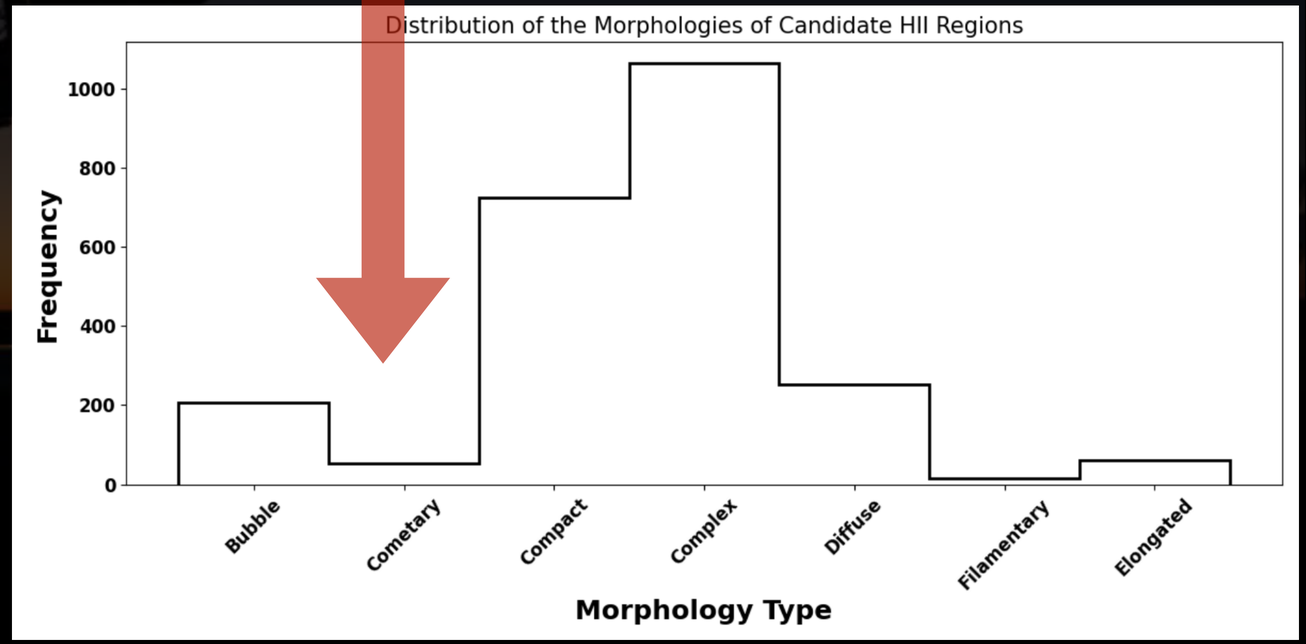
Morphologies of HII regions



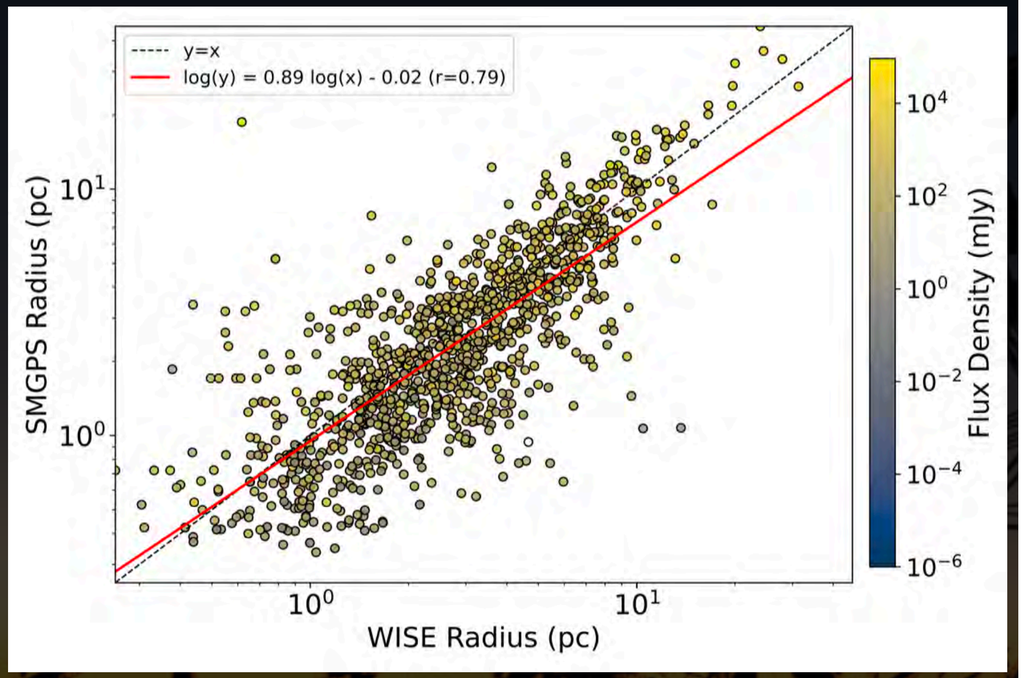
Significant statistical difference of cometary HII region between known and candidate HII regions.

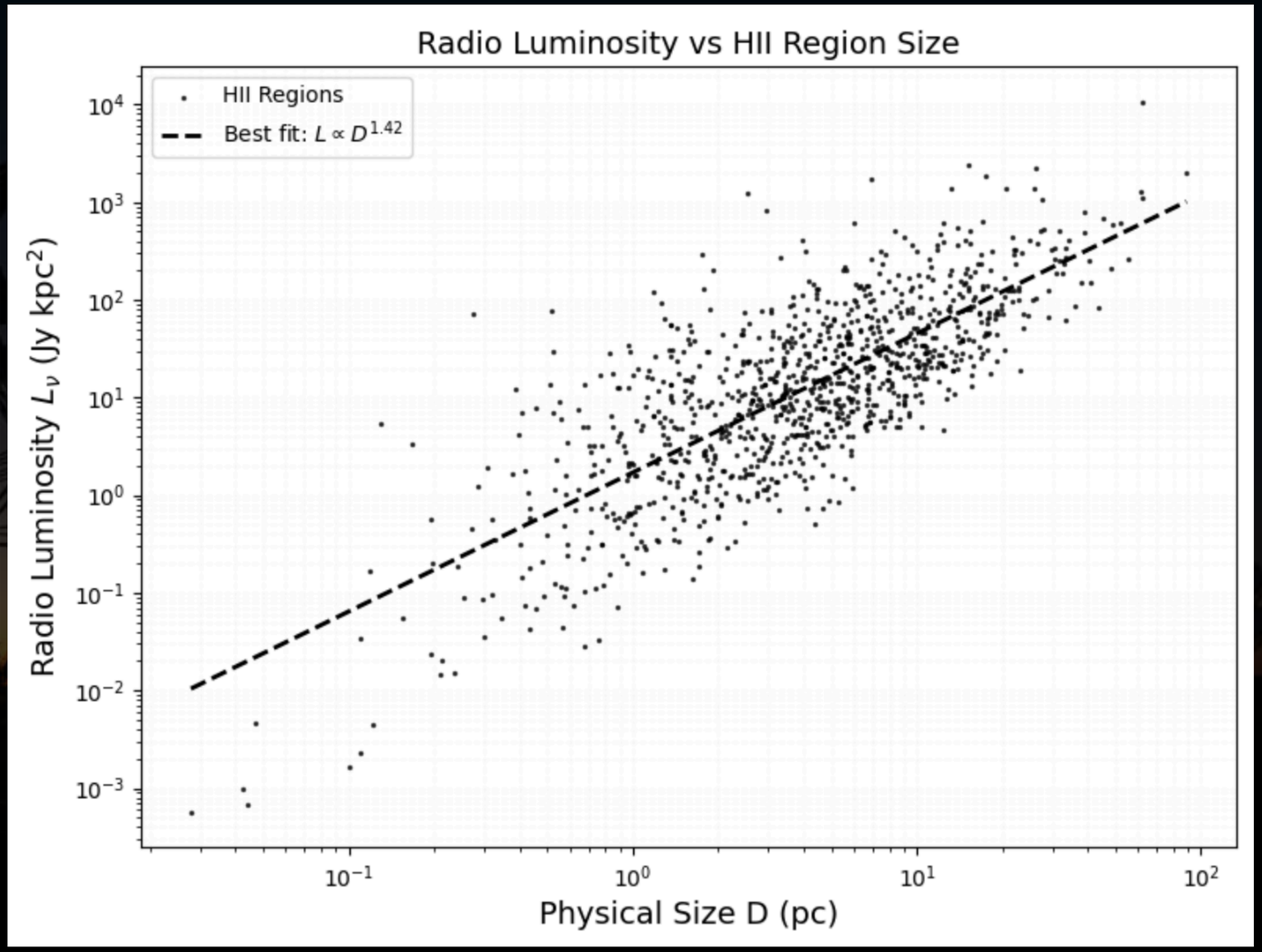
Evolutionary stage related?



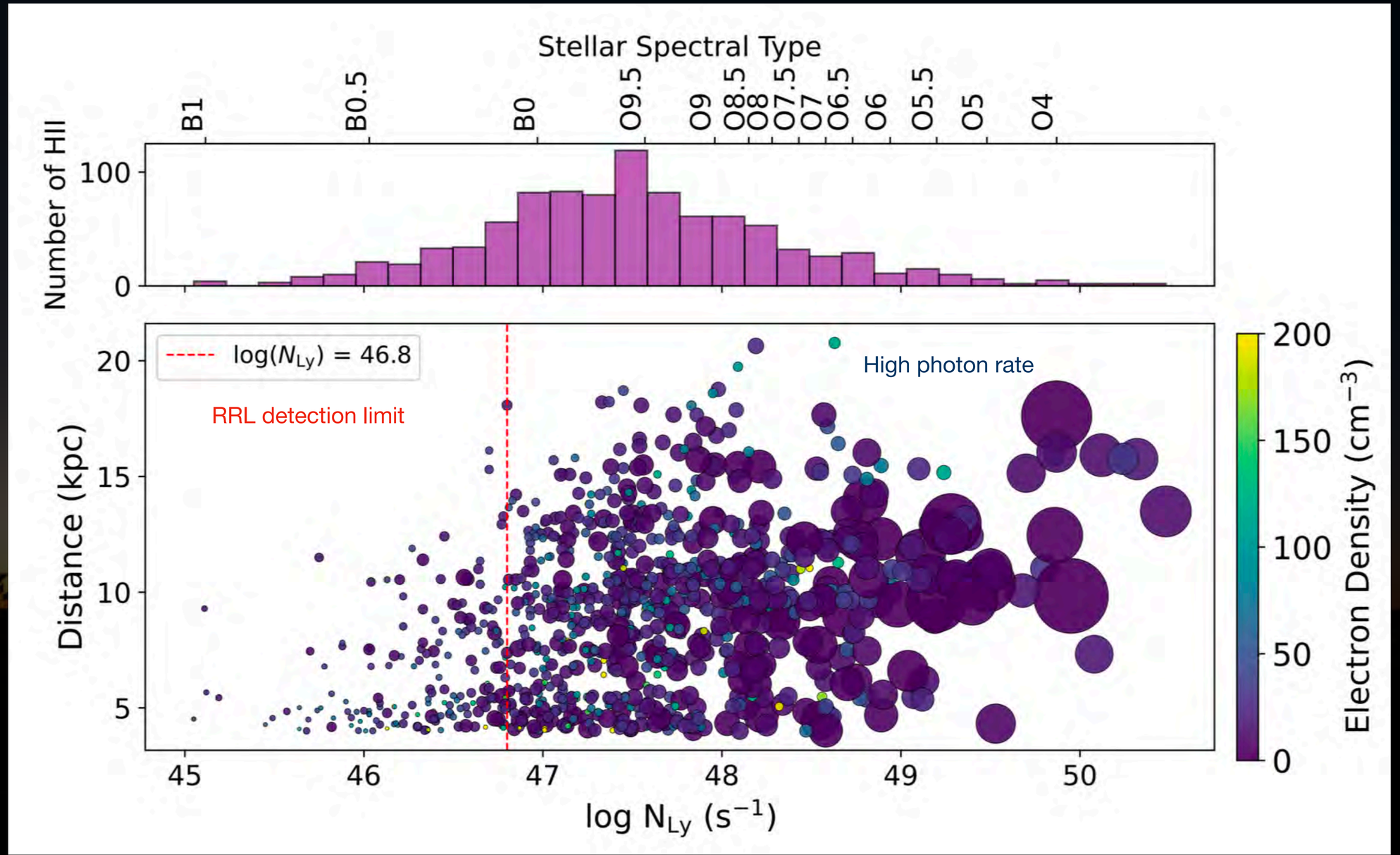


Radio luminosity - size relation of HII regions

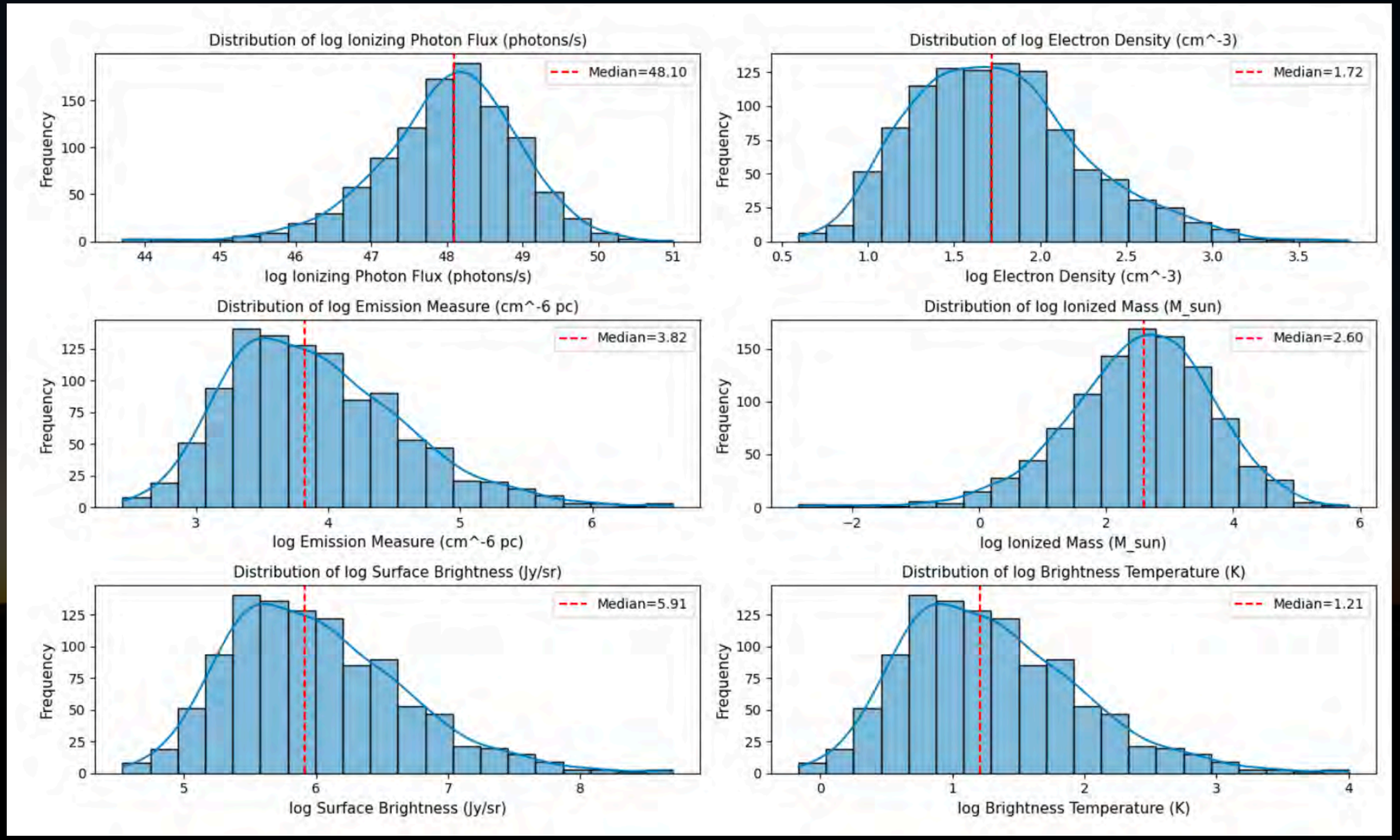




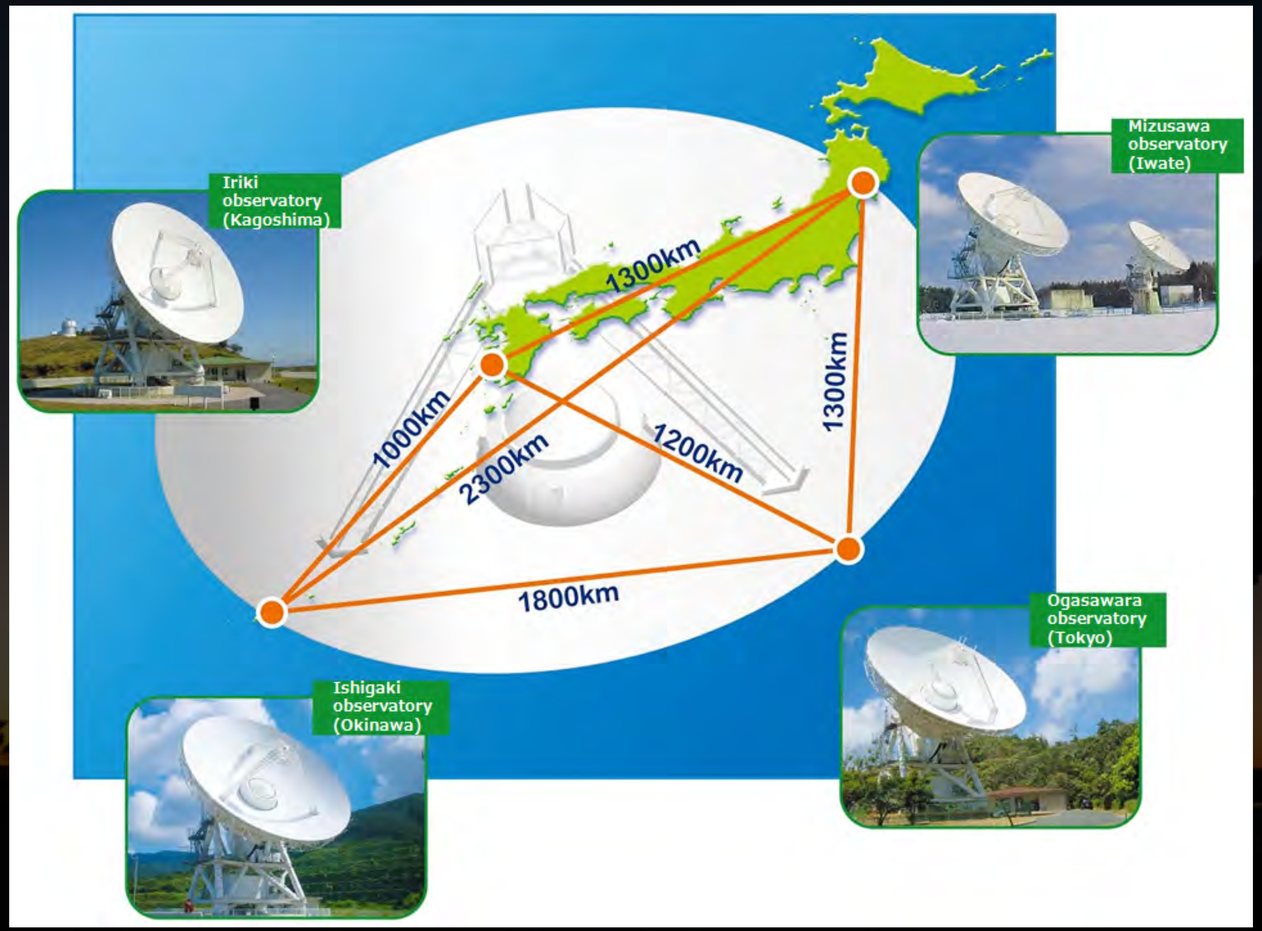
Distribution of the properties of the HII regions

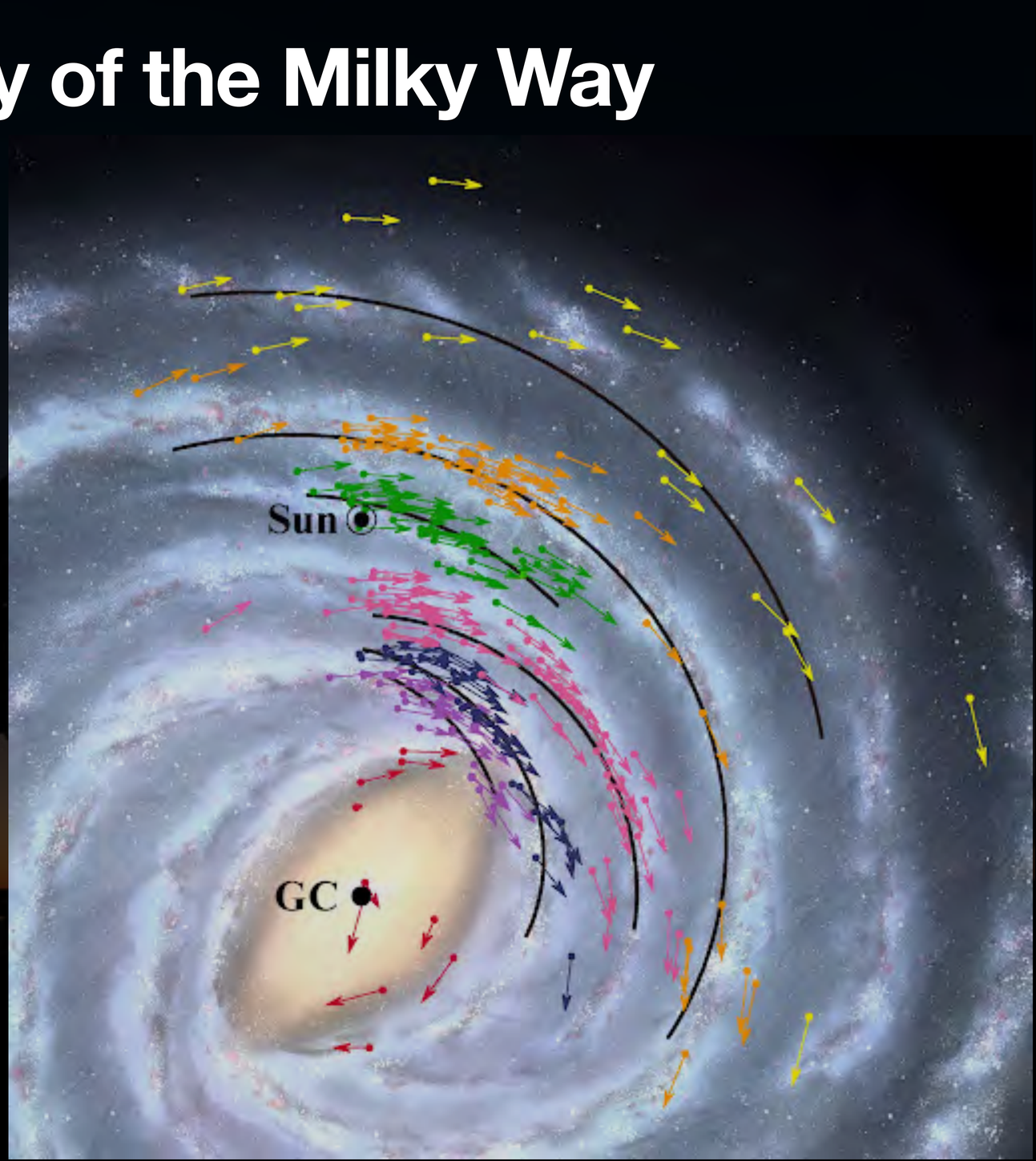


Distribution of the properties of the HII regions



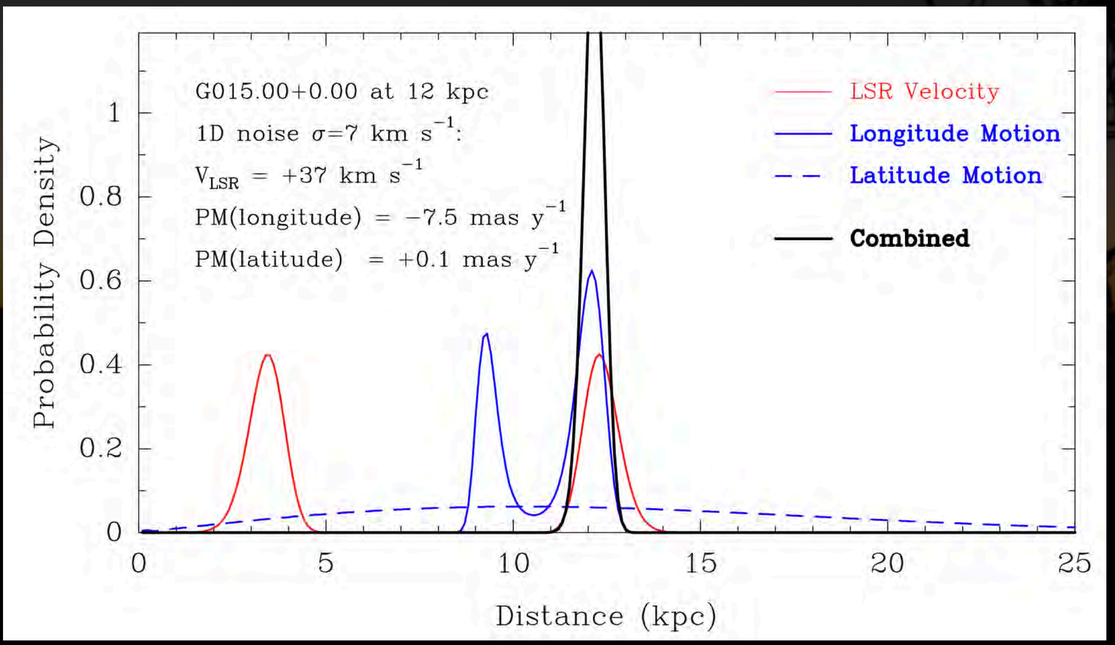
3-D morphology of the Milky Way

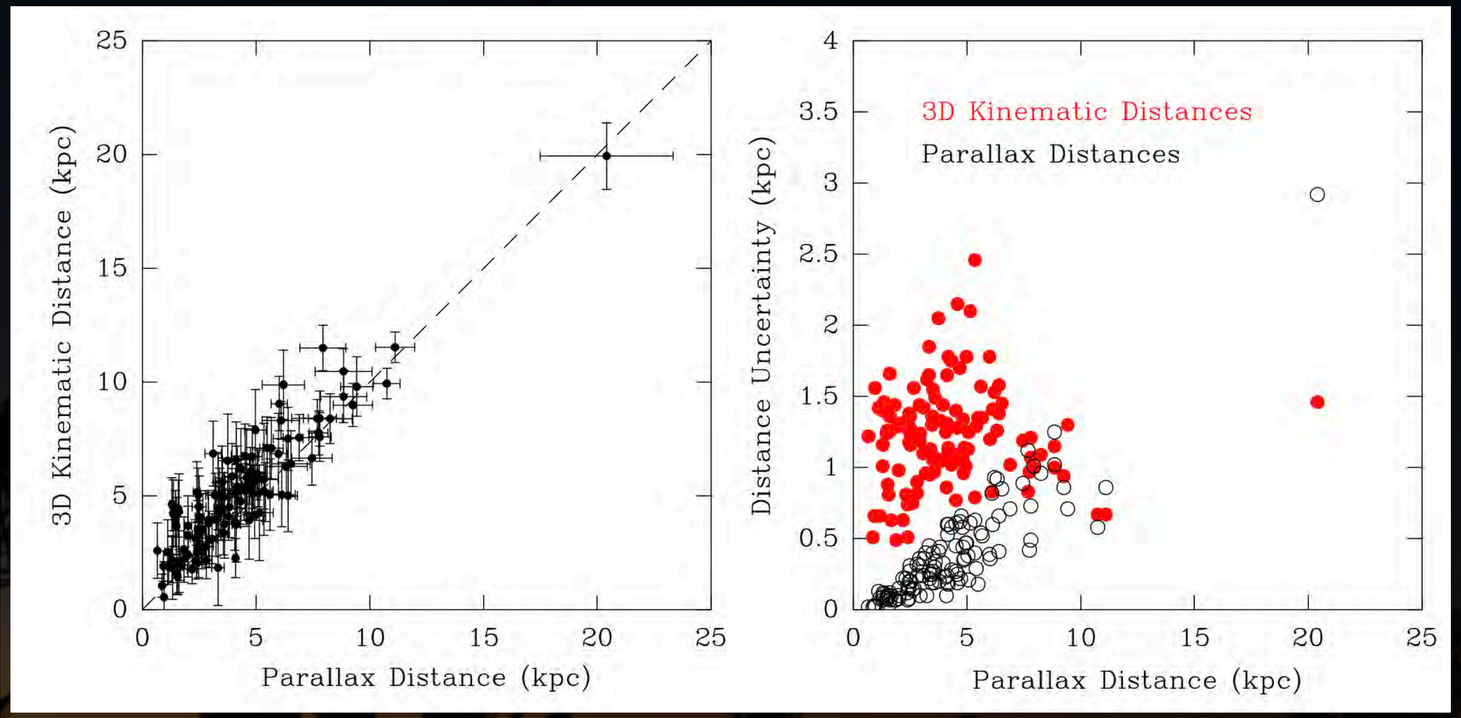


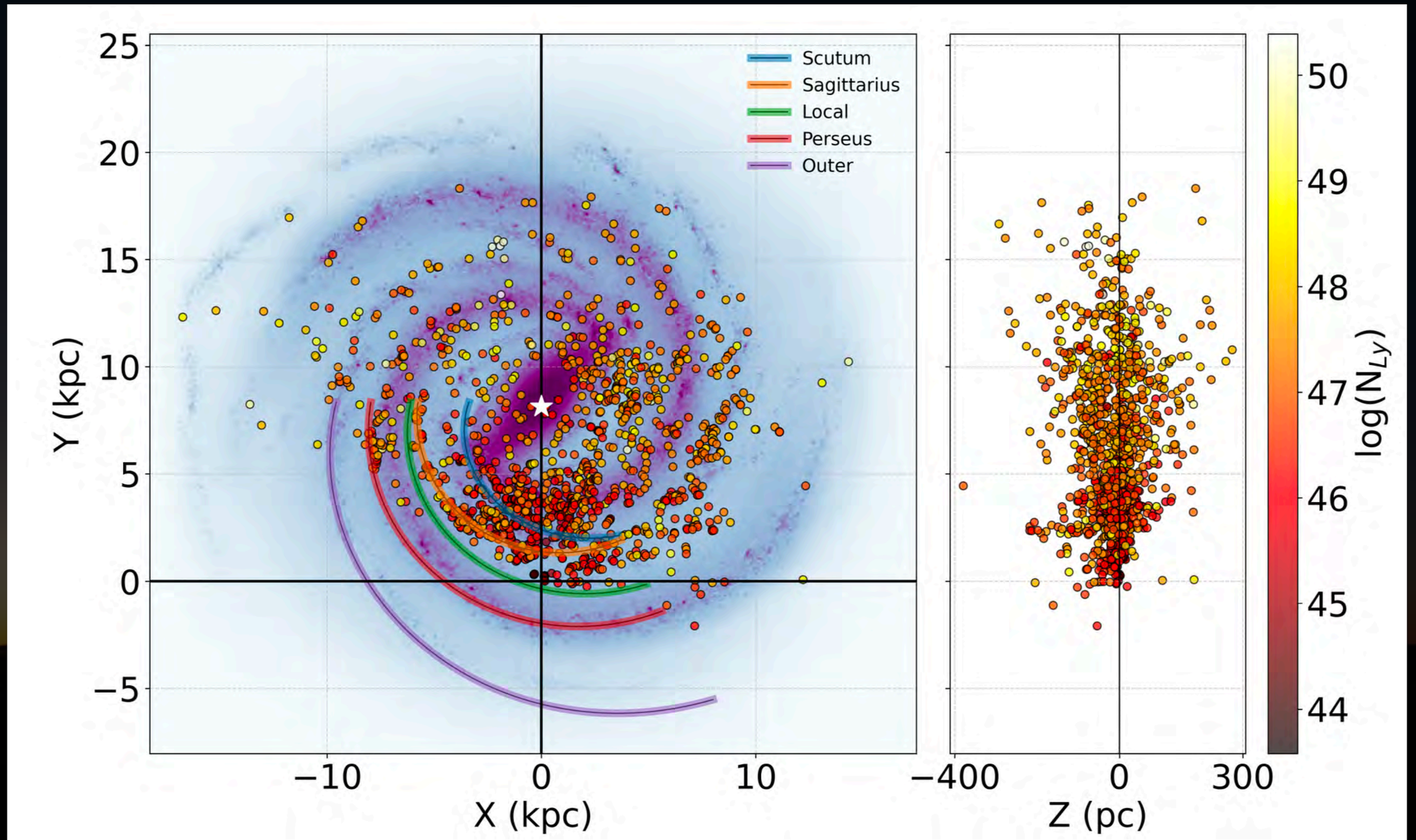


Reid (2022) 3-D kinematic distance using Bayesian probability

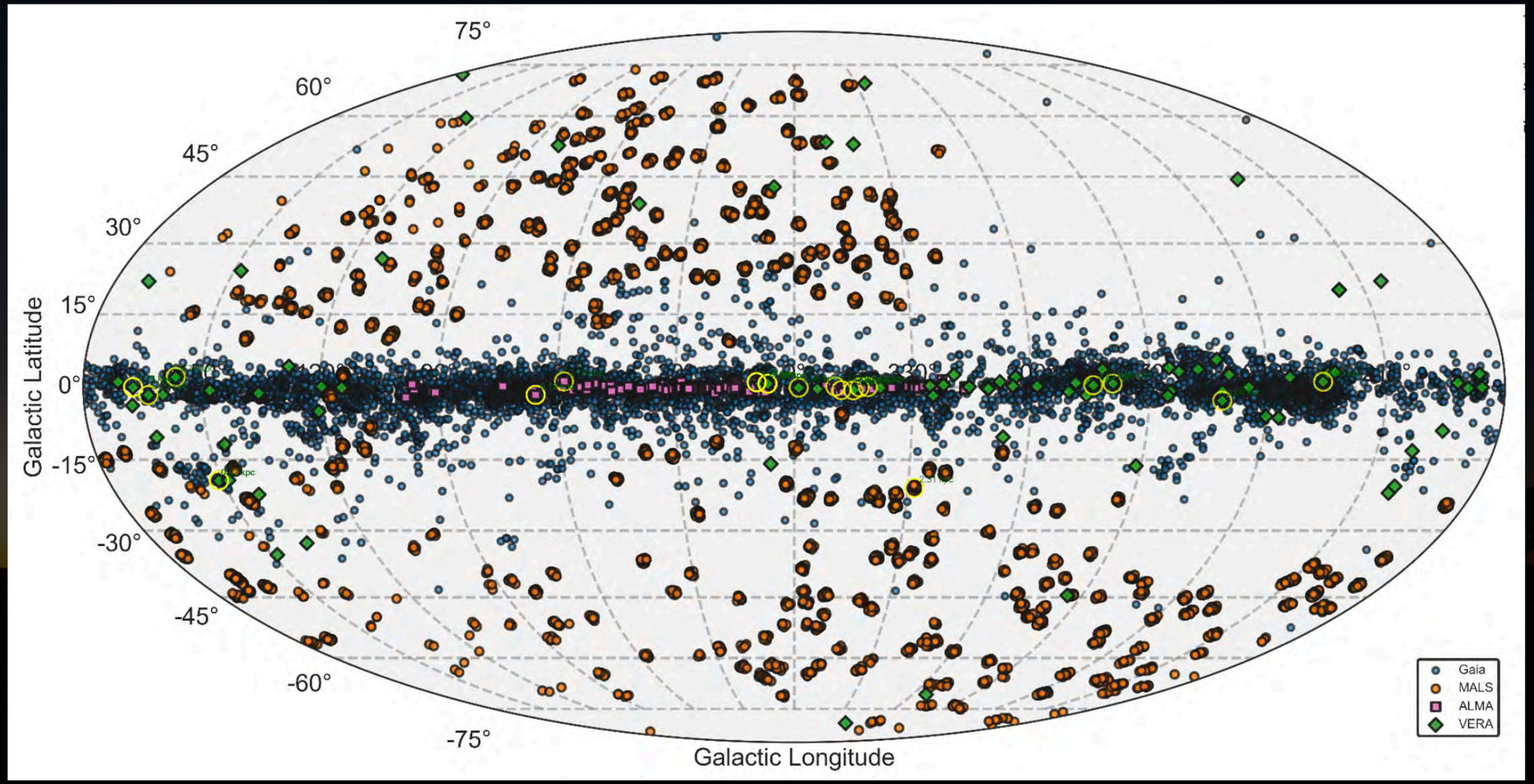
- Position and accurate VLSR required





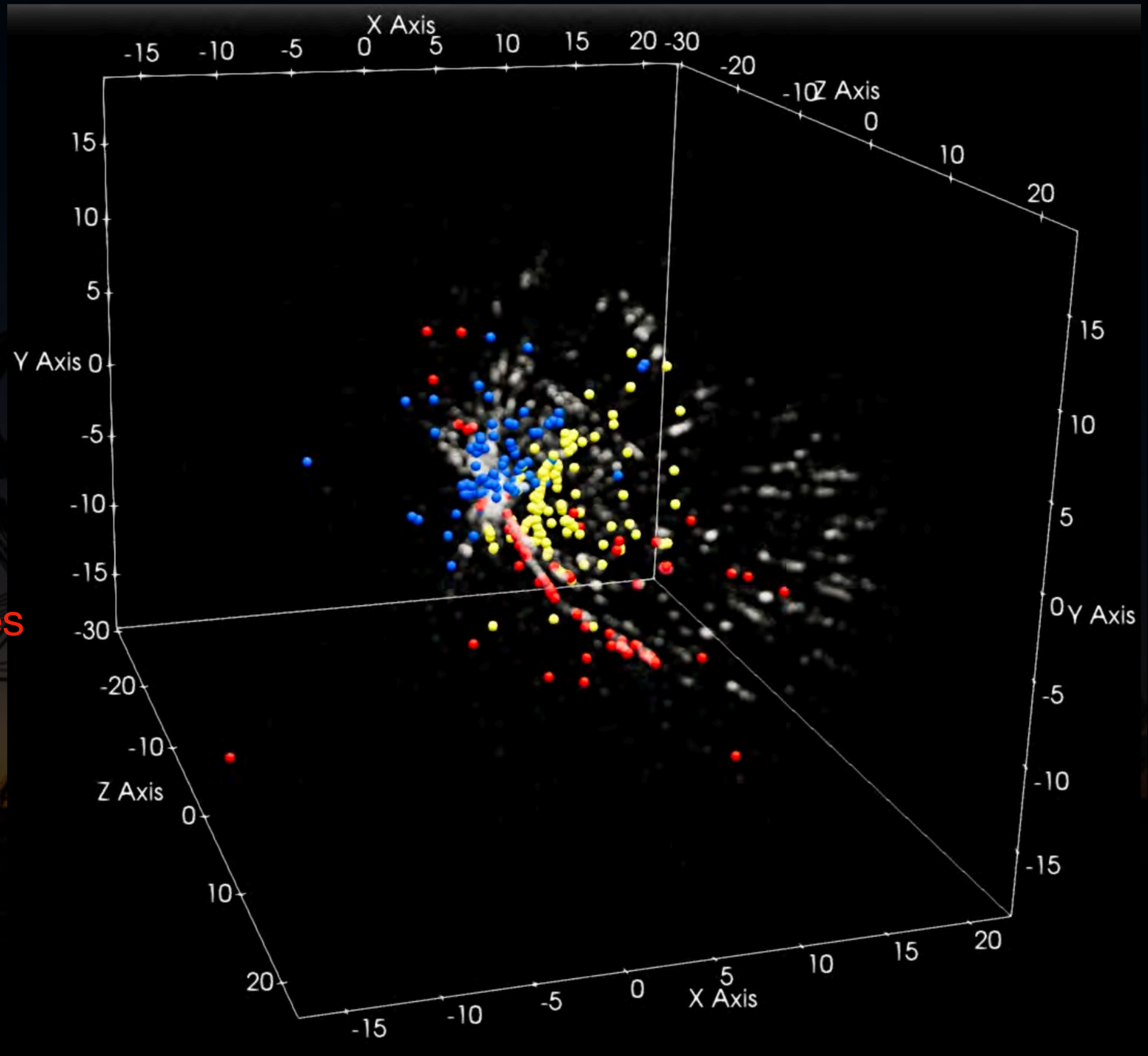

Scutum
Sagittarius
Local
Perseus
Outer
Y (kpc)
X (kpc)
Z (pc)
log(N_Ly)
25
20
15
10
5
0
−5
−10
0
10
−400
0
300
50
49
48
47
46
45
44

Increasing the sample even further…



Stay tuned….

- All MALS
- VERA
- ALMA
- MALS with independent parallaxes



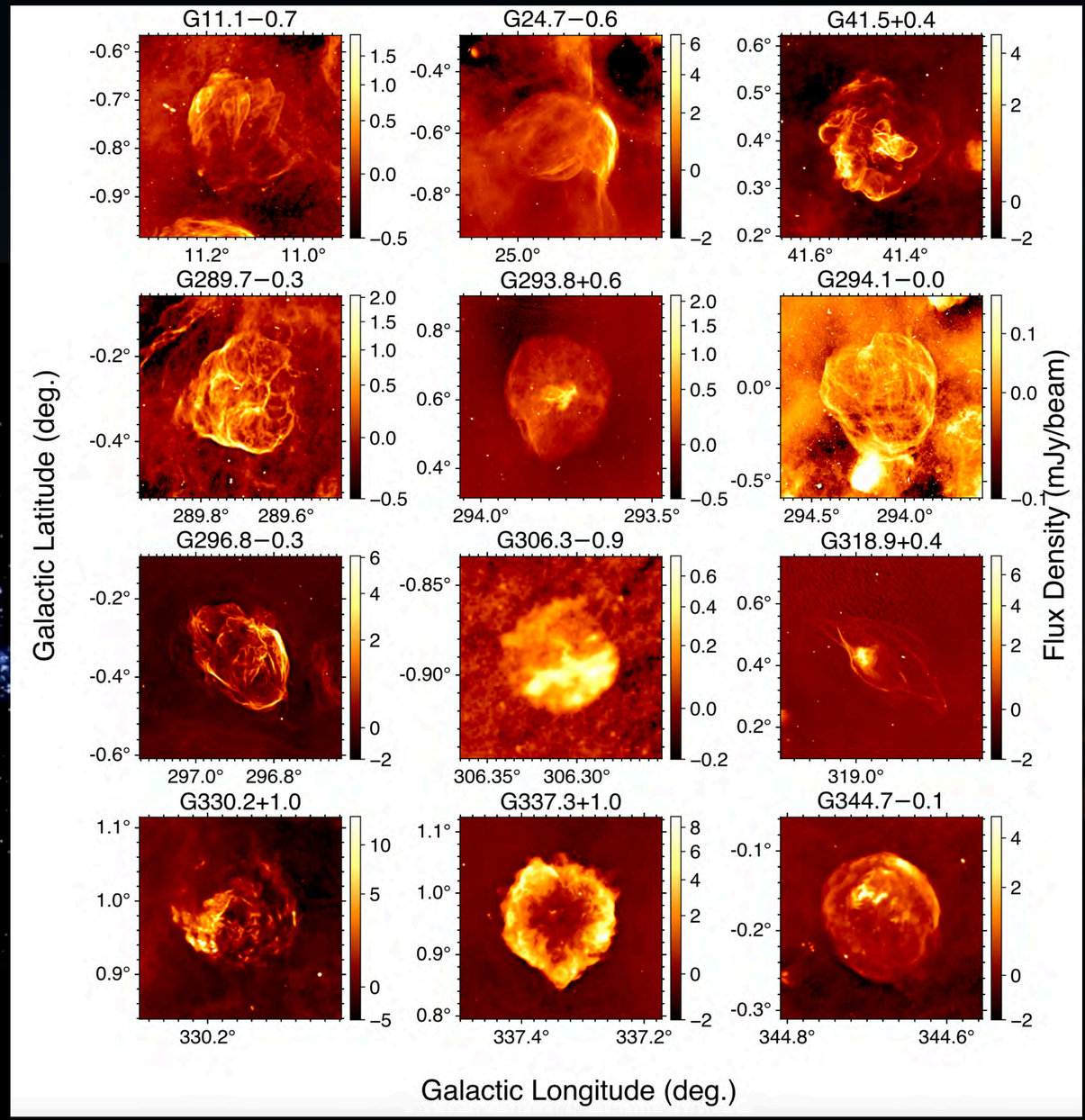
Please use our MeerKAT survey data for your research

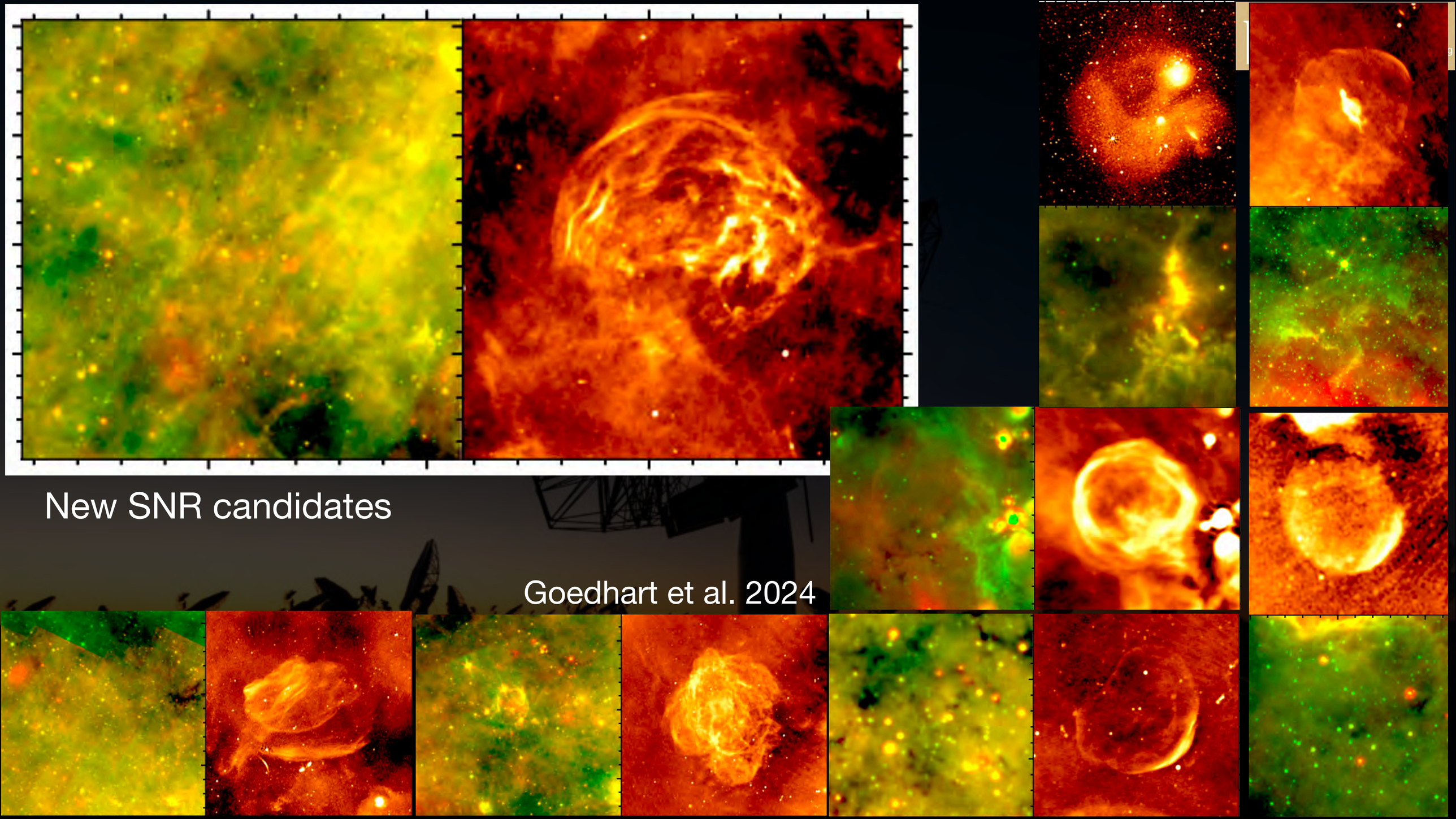
- For known SNR, MeerKAT's resolution and sensitivity reveal never-seen-before details



Supernova Remnant (bonus)

Goedhart et al. 2024




New SNR candidates
Goedhart et al. 2024