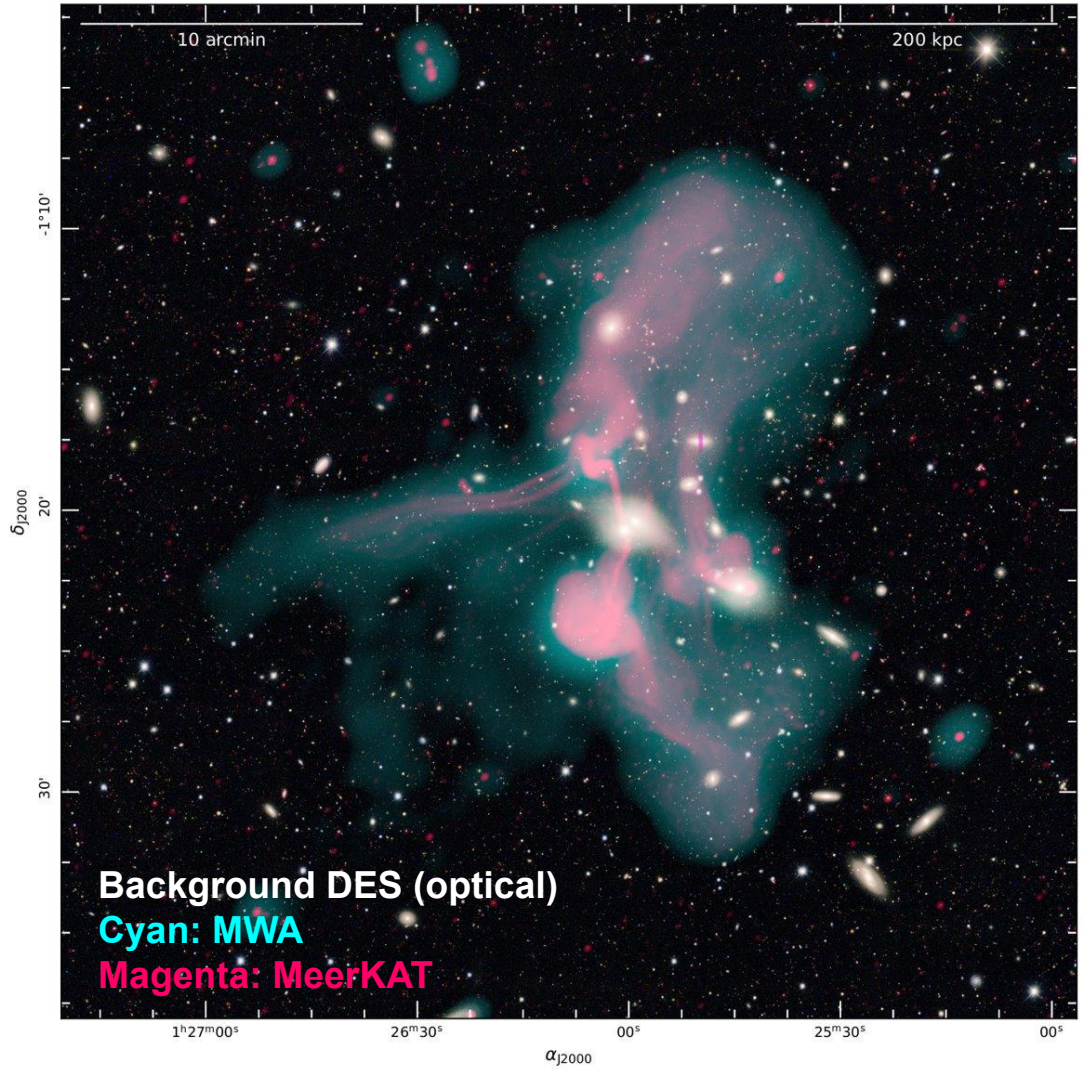
Abell 194 and the utility(?) of archival datasets

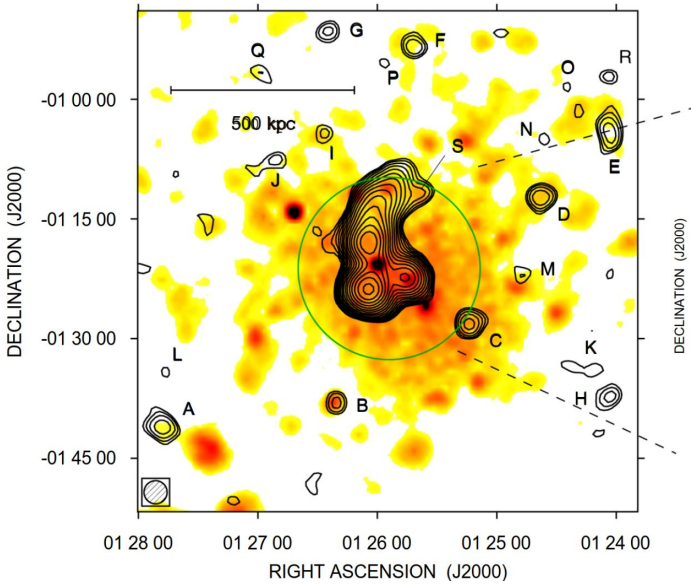
Stefan Duchesne



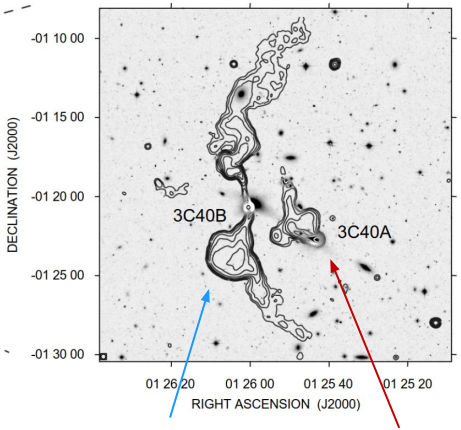
Abell 194

- Nearby (z=0.018) low-mass galaxy cluster
- Features bright, complex radio galaxies **3C 40A** and **3C 40B**
- Low magnetic field at the cluster center: $\langle B_0 \rangle$ = (1.5 ± 0.2) μG (Govoni+ 2017), but increases towards the cluster periphery
- Rich multi-frequency dataset available

Govoni+2017
Contours: Sardinia Radio Telescope
Background: X-ray(ROSAT)



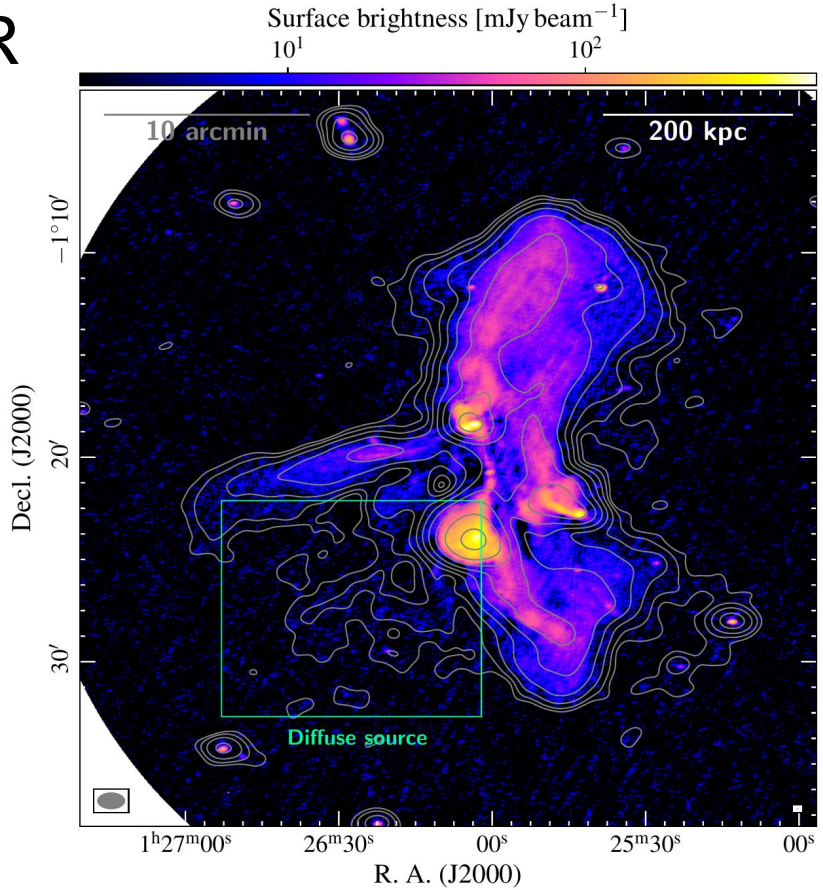
Contours: VLA



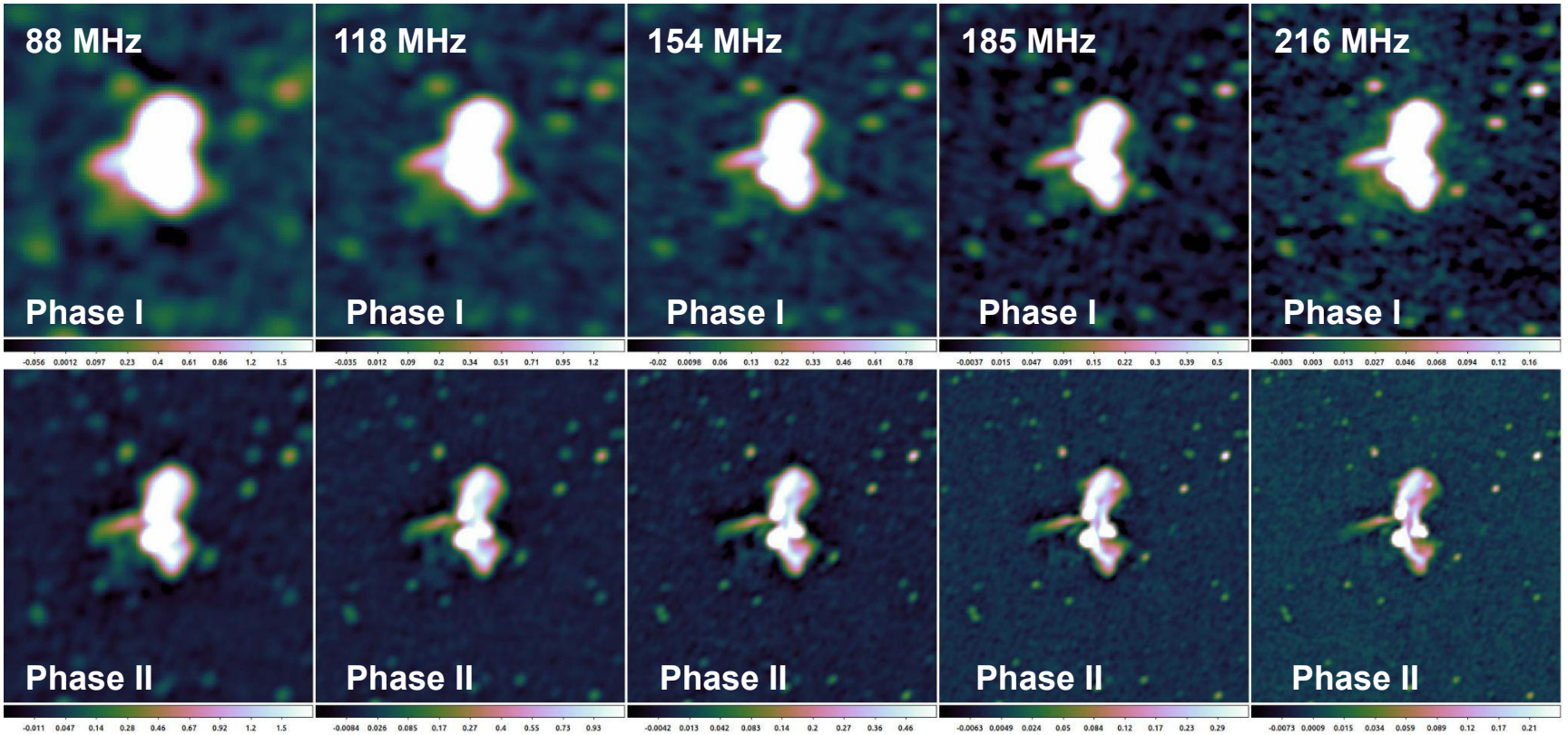
3C 40B **3C 40A**

Abell 194: MeerKAT and LOFAR

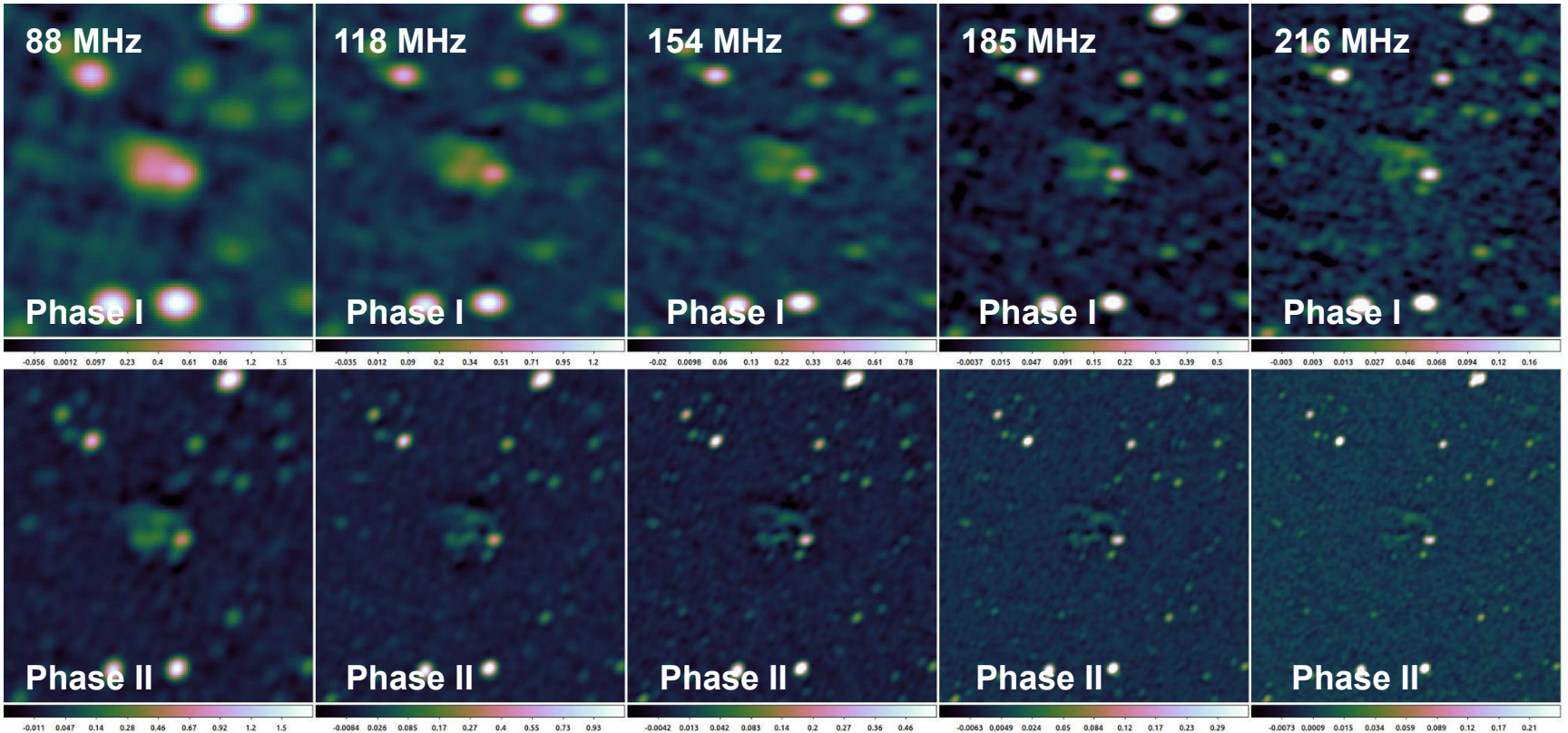
- Observed as part of the MeerKAT Galaxy Cluster Legacy Survey (Knowles+2022)
- Rudnick+2022 showcase filamentary features from MeerKAT data
- LOFAR data show large diffuse patch below filaments →
- **What is it the diffuse component?**



Abell 194 and the MWA - normal image stacking

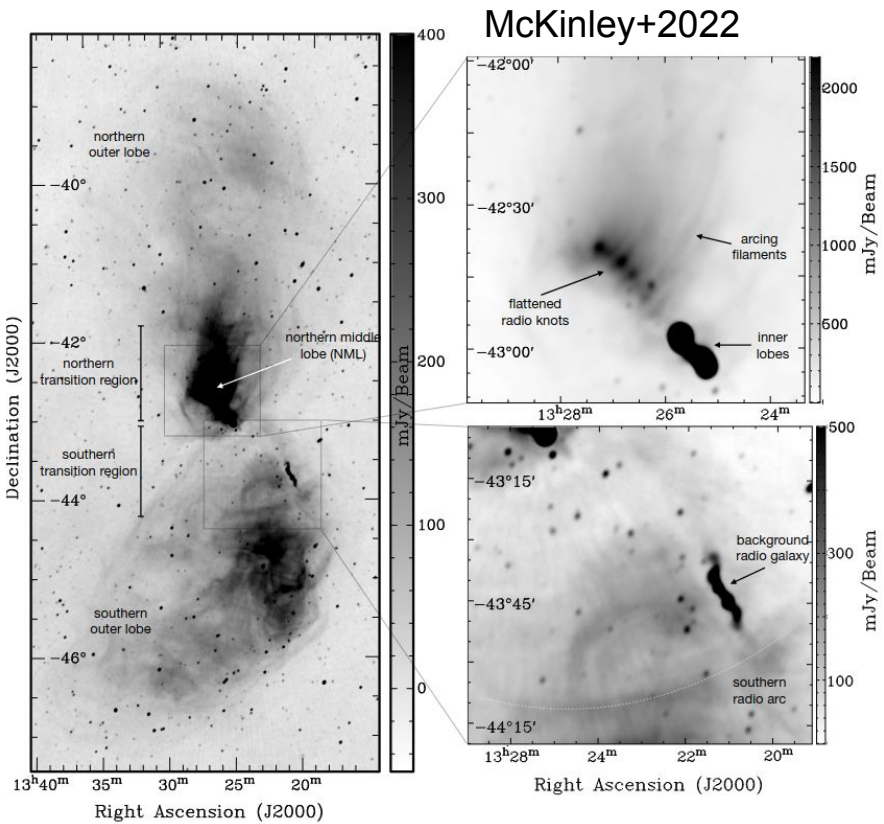


Abell 168 and the MWA - normal image stacking

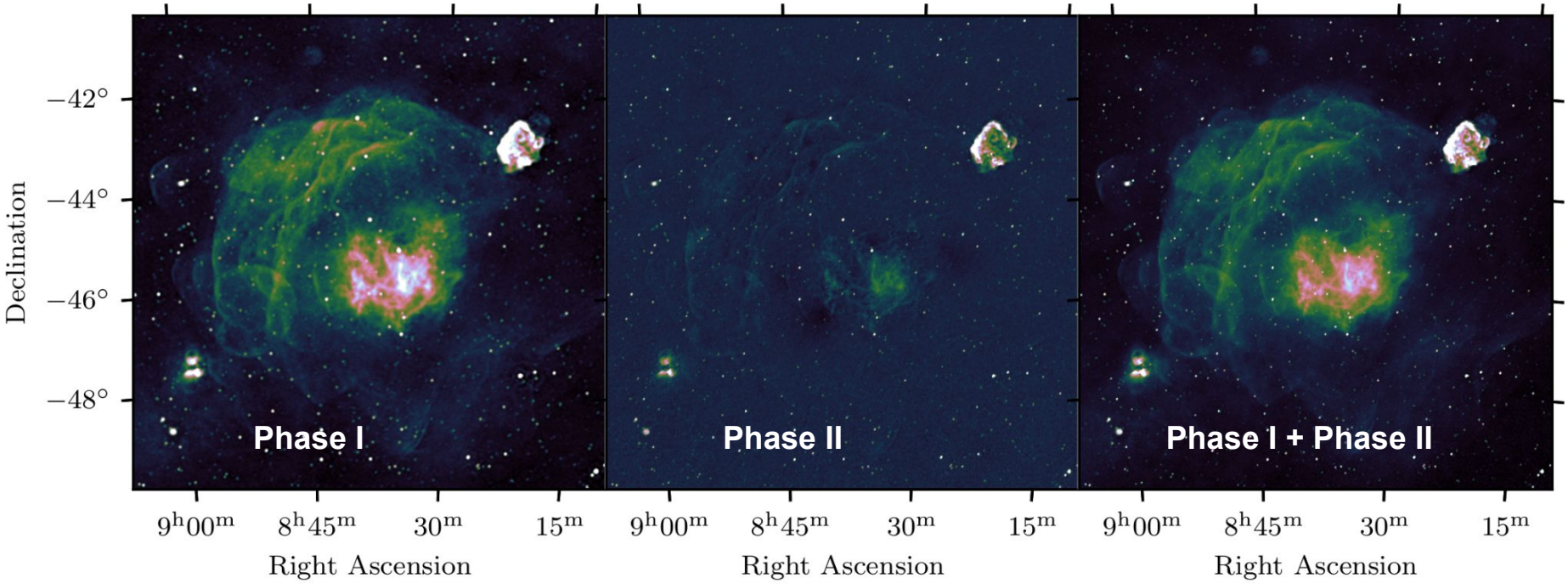


Joint-deconvolution to fill in the gaps

- Combine MWA Phase I (compact) and phase II (extended) configuration data
- **Image Domain Gridder** (IDG; van der Tol+ 2018), implemented in wsclean
- Grid data from each MS with individual a-term screens
  - Primary beam
  - TEC screens (not used here)
  - RA/DEC offsets
  - Diagonal screens (not used here)
- Uses GPUs + CPUs, but still takes time proportional to number of MSes
  - Max ~24-30 MS within 24-hr, depending on screens used
  - Split large obsID groups into smaller chunks, then stack the separate IDG images as per usual



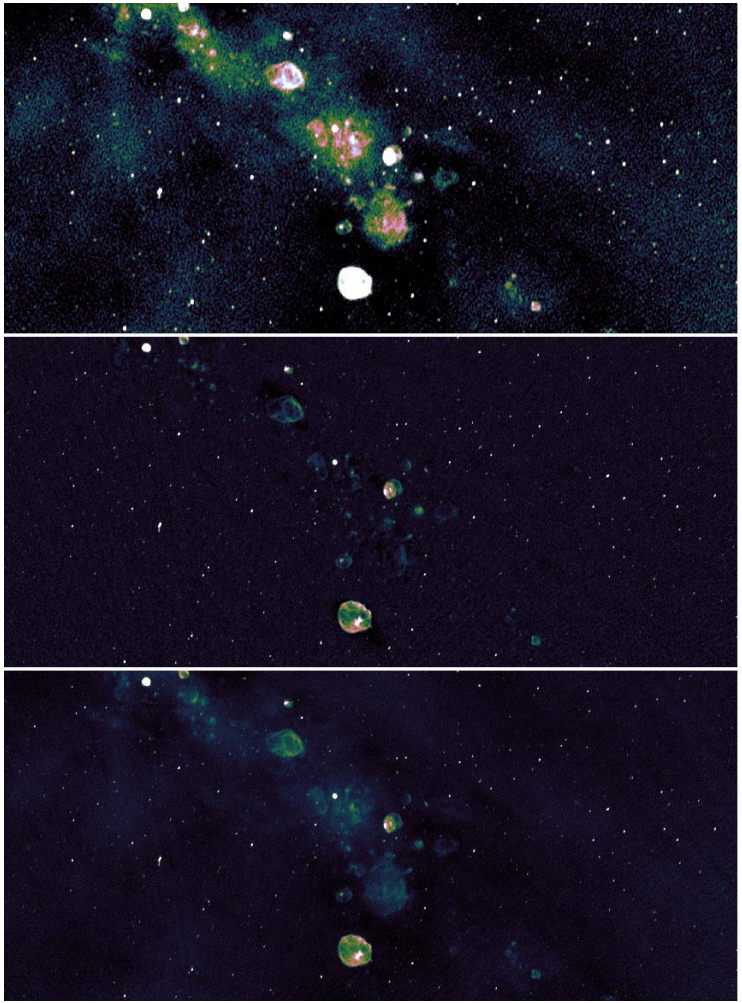
Galactic Plane examples



Hurley-Walker+2022

The full(?) Galactic Plane

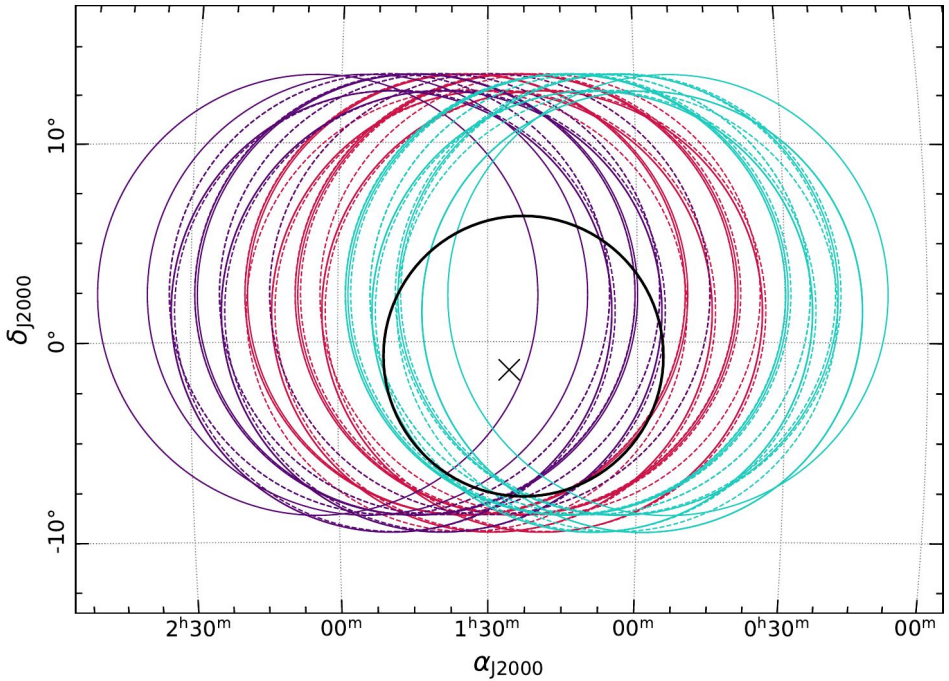
- GLEAM/-X Galactic Plane processing being done by **Silvia Mantovanini (see her poster for more nice images)**
- Joint-deconvolution of snapshot pairs or smaller groups
- Match Phase I and II pairs from GLEAM/GLEAM-X and image each pair/small group
- Stack afterwards as usual
- Still refining process, but initial results are promising!



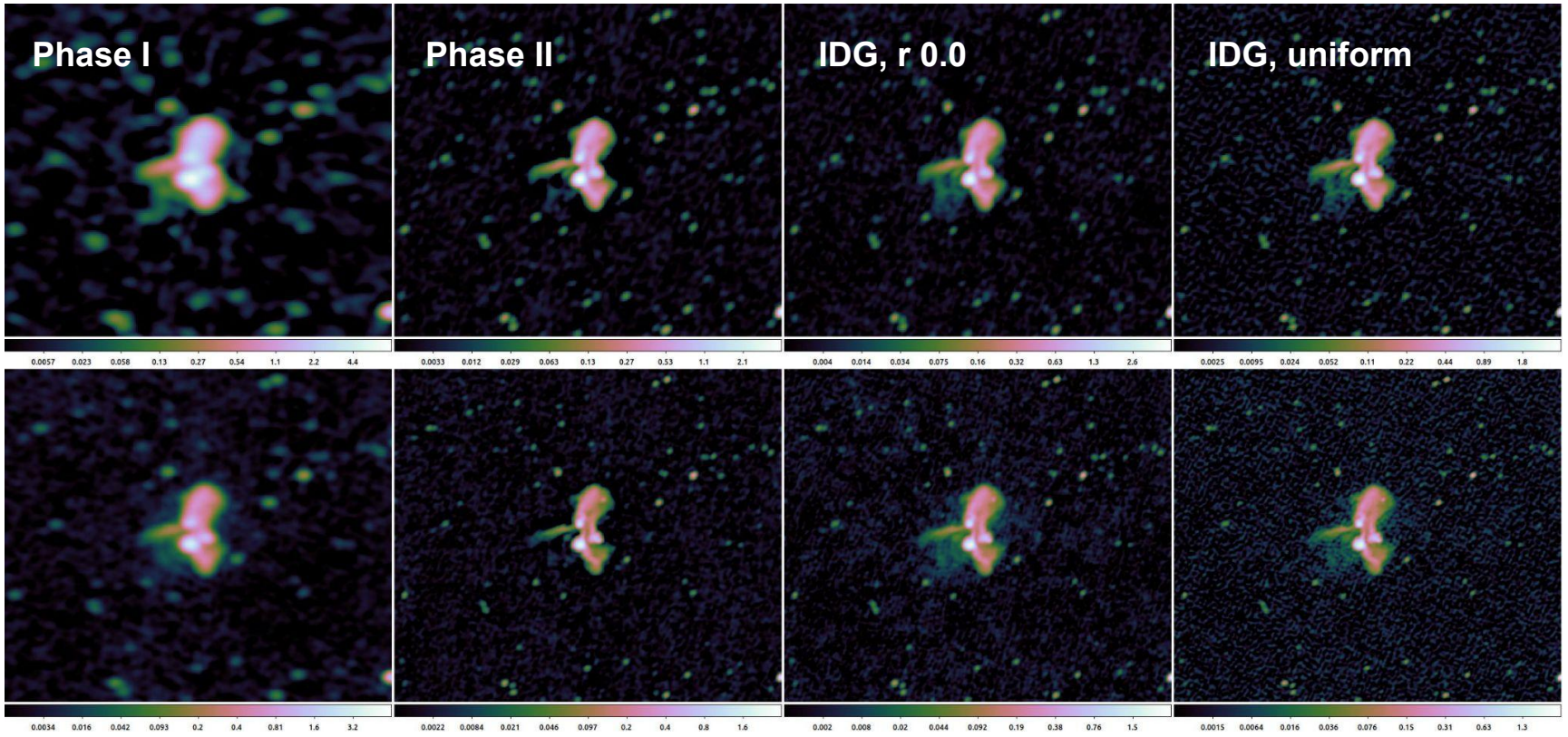
Images courtesy of Silvia →

IDG with single targets

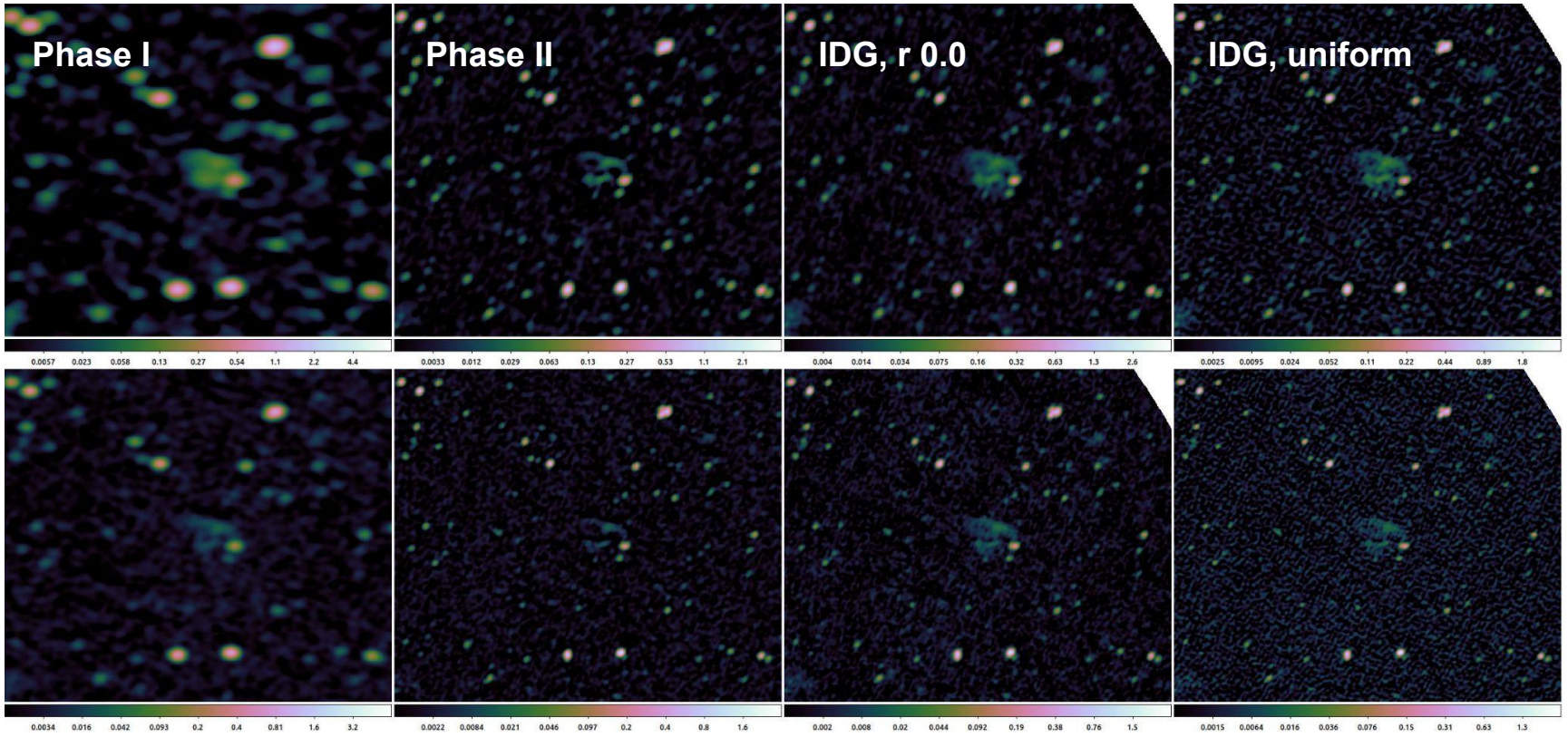
- Create groups of obsIDs (~20-30)
- Add (roughly) equal Phase I and Phase II snapshots that are closest to group centres
- Image each group jointly then stack the IDG group images as per usual
- Optionally subtract out sources away from the target
- Example at 216 MHz -->
  - GLEAM + GLEAM-X observations only
  - Phase I == dashed
  - Phase II == solid
  - Abell 194 == black cross



The full MWA images of Abell 194

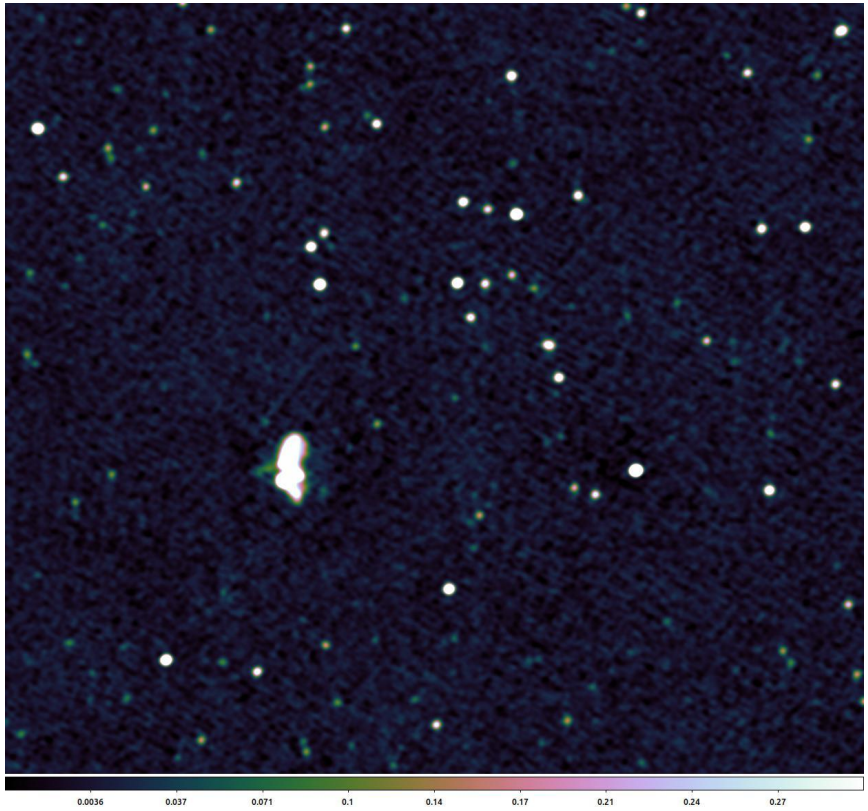


The full MWA images of Abell 168

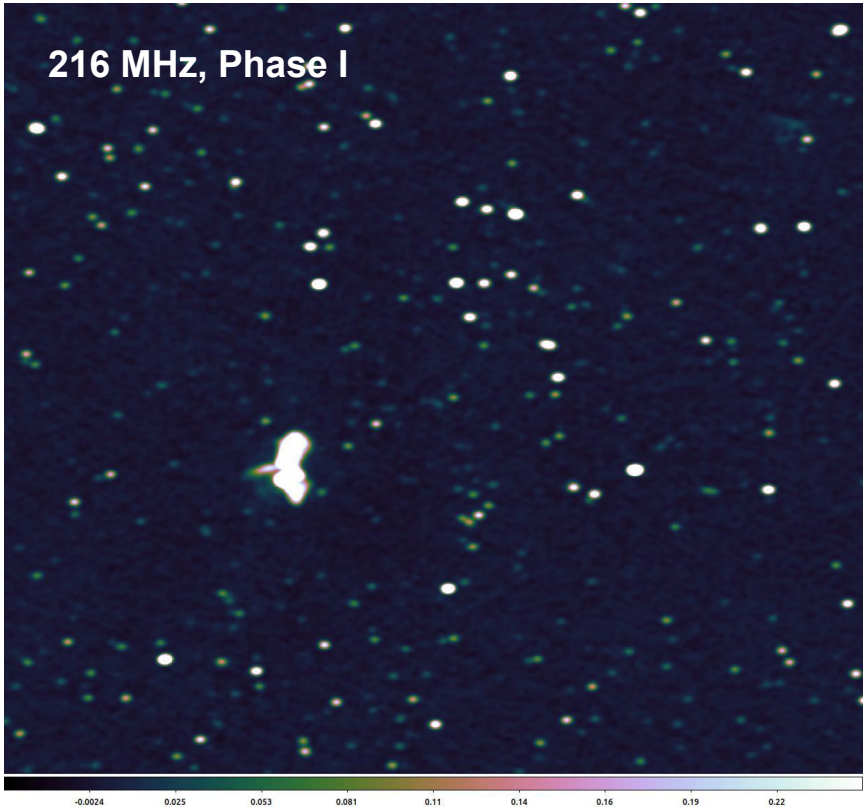


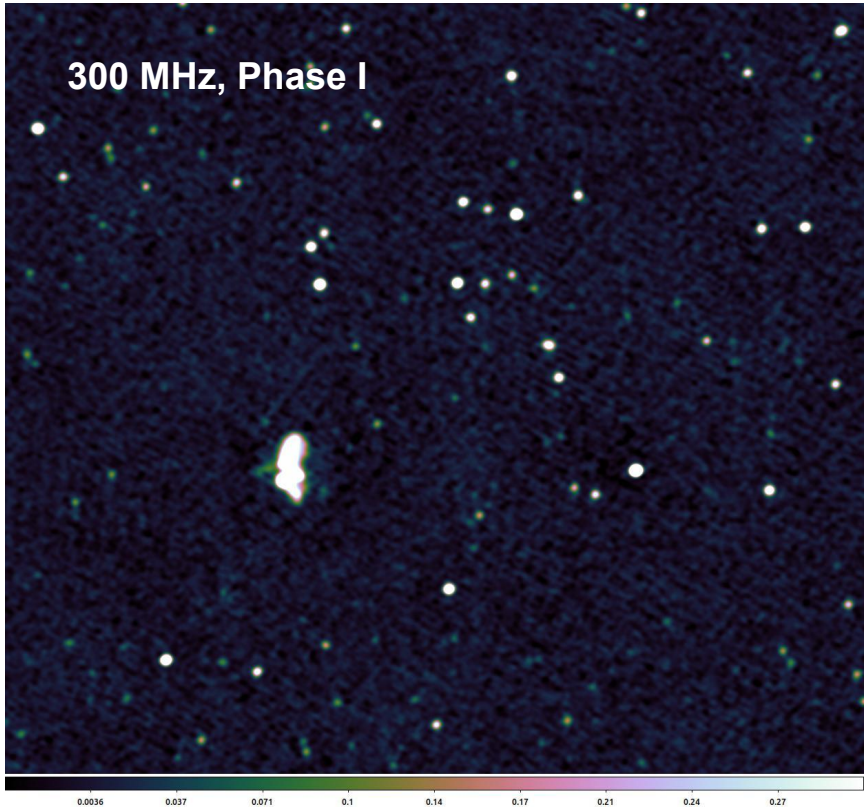
Looking for more data: 300 MHz observations

- Observations from the unpublished MWA 300-MHz survey
- Help from **Jaiden Cook** – see his work on 300-MHz data processing: 10.1017/pasa.2021.55
- Dec strip = +1.6 deg, -5.9 deg, ~60 observations
- Angular resolution ~ 2.5 arcmin
- Uniform weighting
  ~ 10 mJy/beam →
- Robust 0.0 weighting
  ~8 mJy/beam with similar resolution.

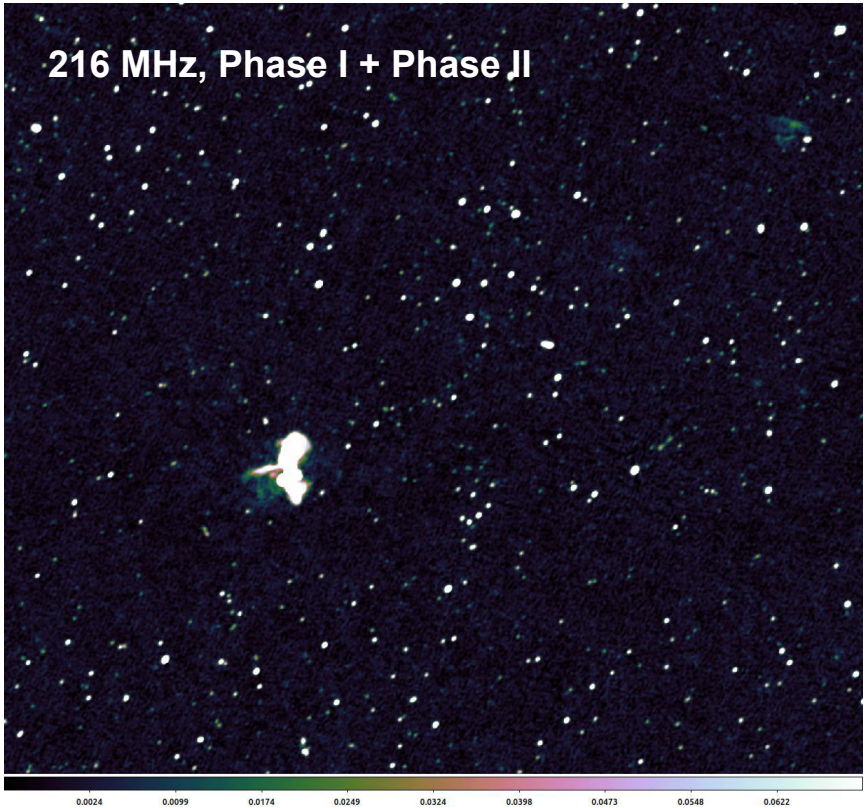


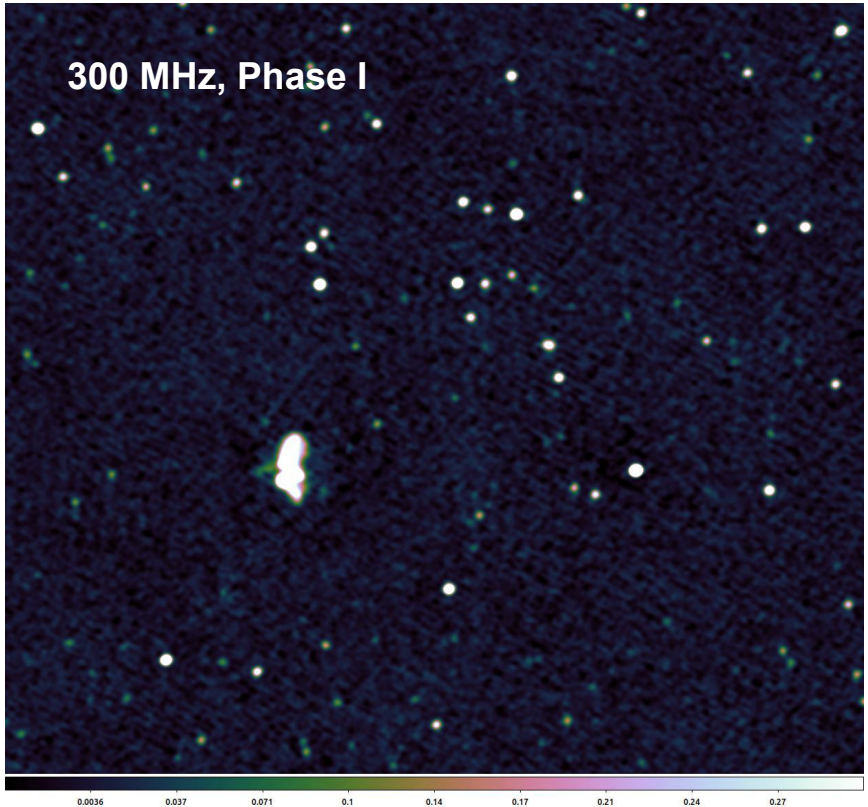
Looking for more data: 300 MHz observations





Looking for more data: 300 MHz observations





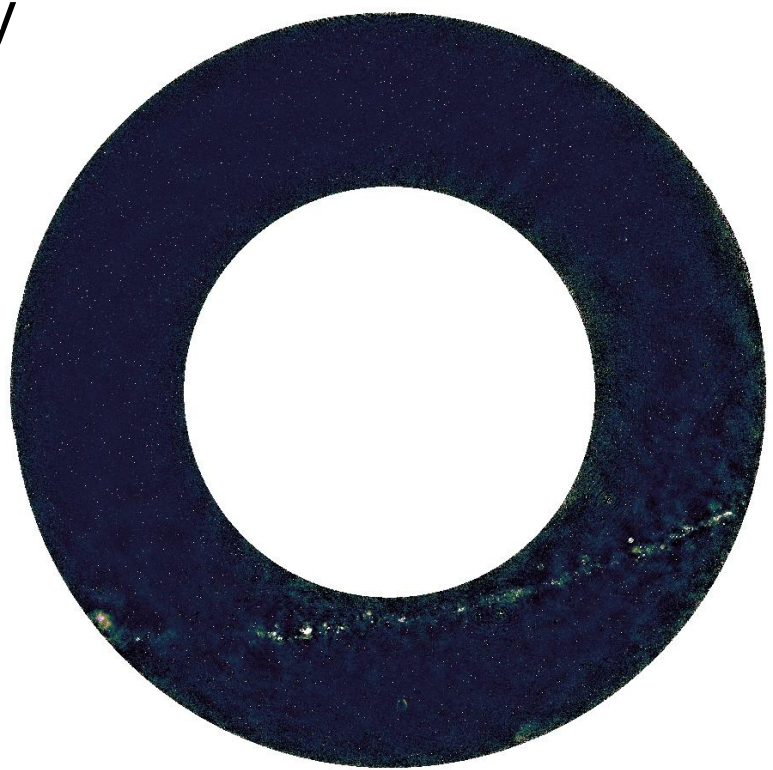
The GLEAM 300 MHz survey

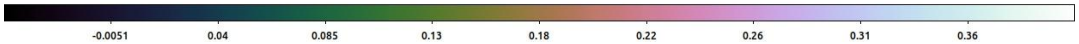
Full survey:

- 12 000 snapshots
- 13 declination strips
- Nothing at the south celestial pole
- Starting with dec -55 →

Calibration:

- Mixture of infield + nearest neighbour interpolation in time (i.e. closest in time solutions)
- High failure rate for infield calibration
- Self-calibration not working





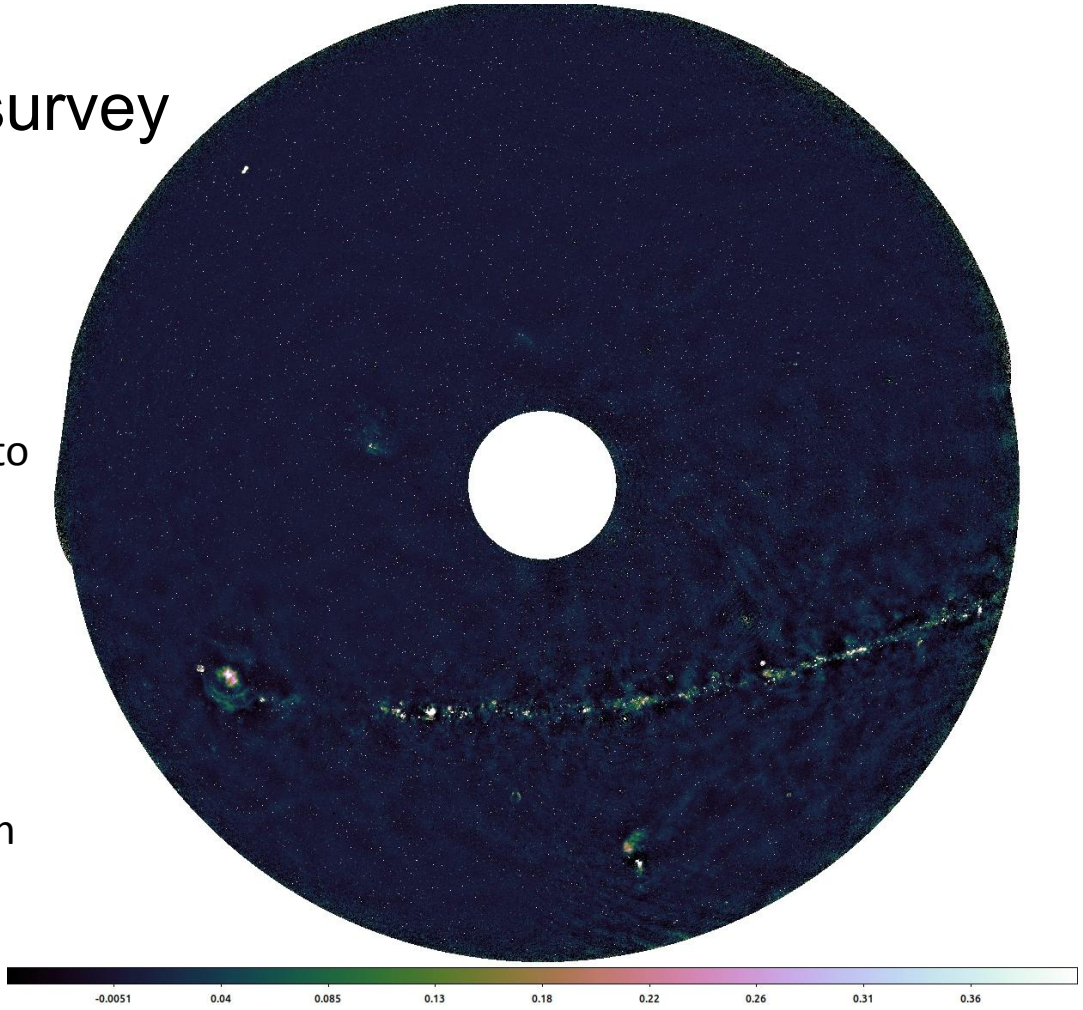
The GLEAM 300 MHz survey

Progress so far:

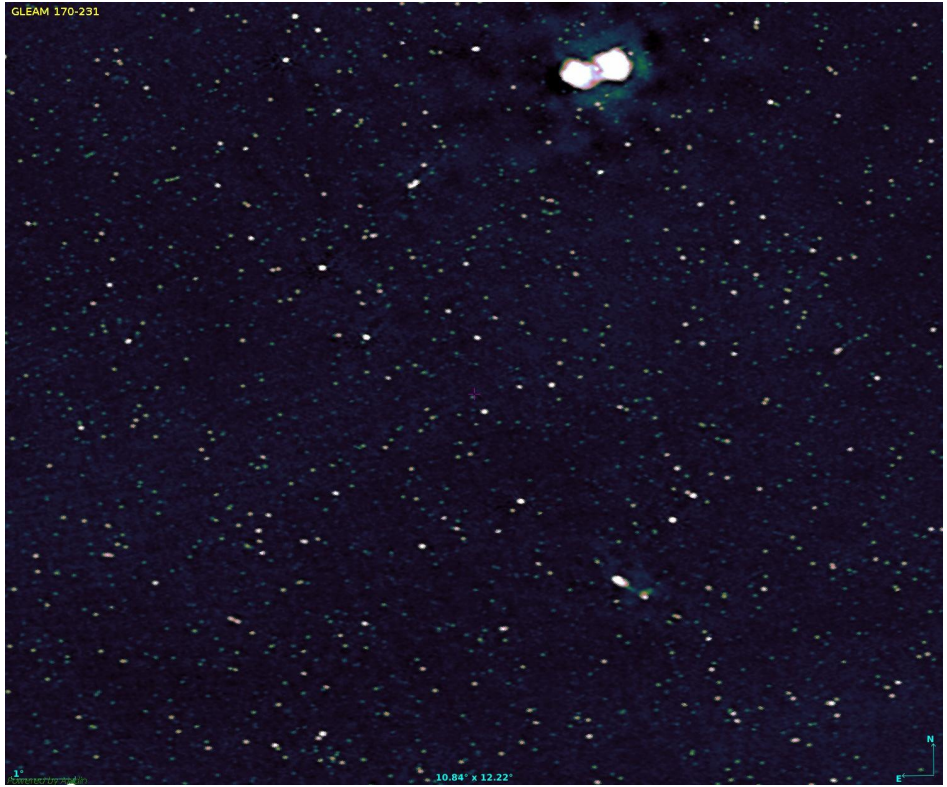
- 5 dec strips: -40.4, -47.5, -55.0, -63.1, -72.0
- ~ 100 000 sources between -33 to -80 declination
- rms noise: ~3 - 15 mJy/beam
- resolution: median ~ 2 arcmin

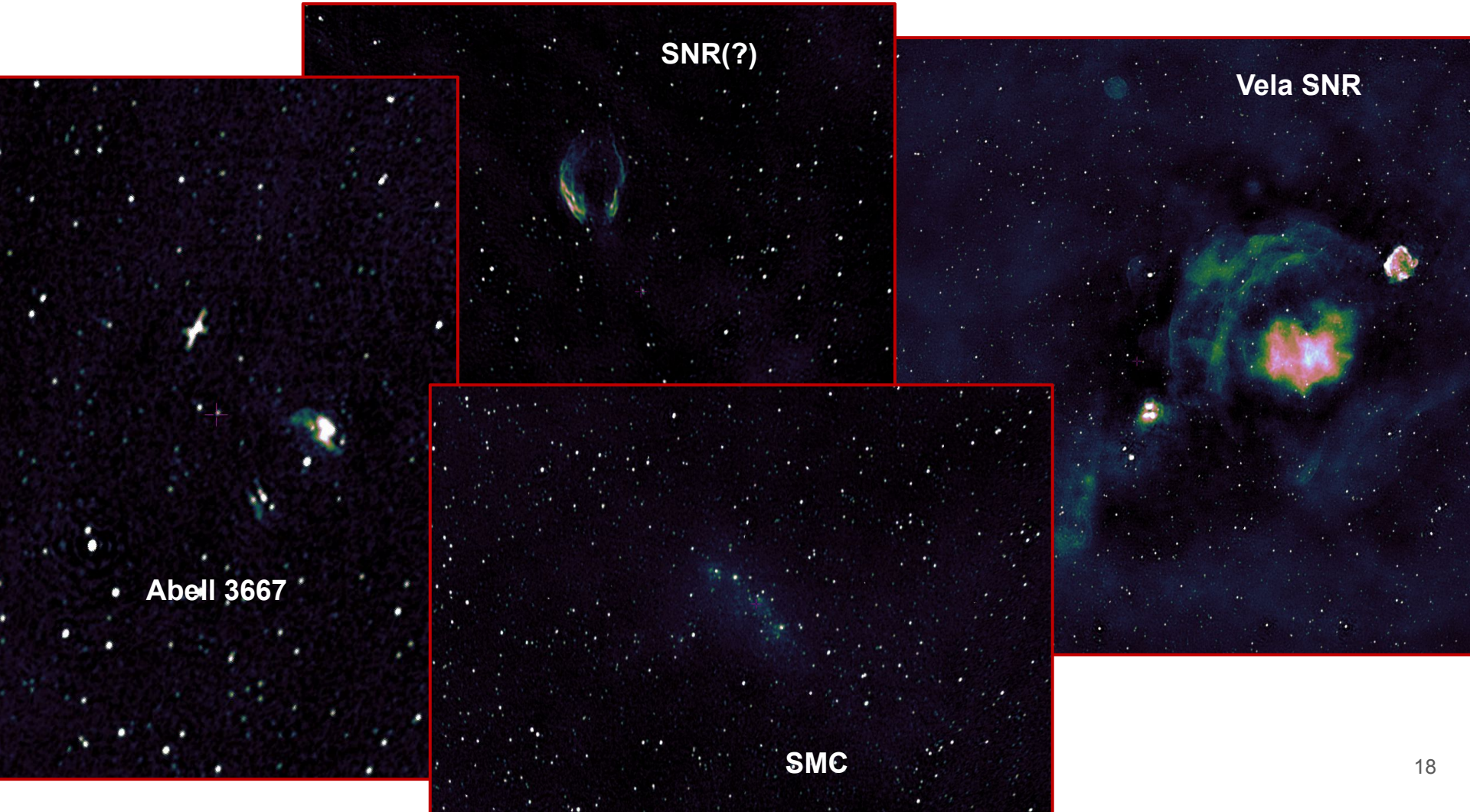
Where to from here?

- Calibration solution interpolation
- Mosaicking + source-finding
- Sky model inclusion



The GLEAM 300 MHz survey




SNR(?)
Vela SNR
Abell 3667
SMC