

Simulated Intensity Mapping Survey via Interferometry for SKA and its Precursors

Sara A. Safari

ETH zürich

Digital-Twin Team:

ETHZ: Alexandre Réfrégier, Devin Crichton, Marta Spinelli,
Pascal Hitz, Pascale Berner

FHNW: André Csillaghy, Stefan Kögl, Simon Felix, Lukas Gehrig,
Rohit Sharma, Filip Schramka, Christoph Vögele

Swiss SKA Days - Lugano

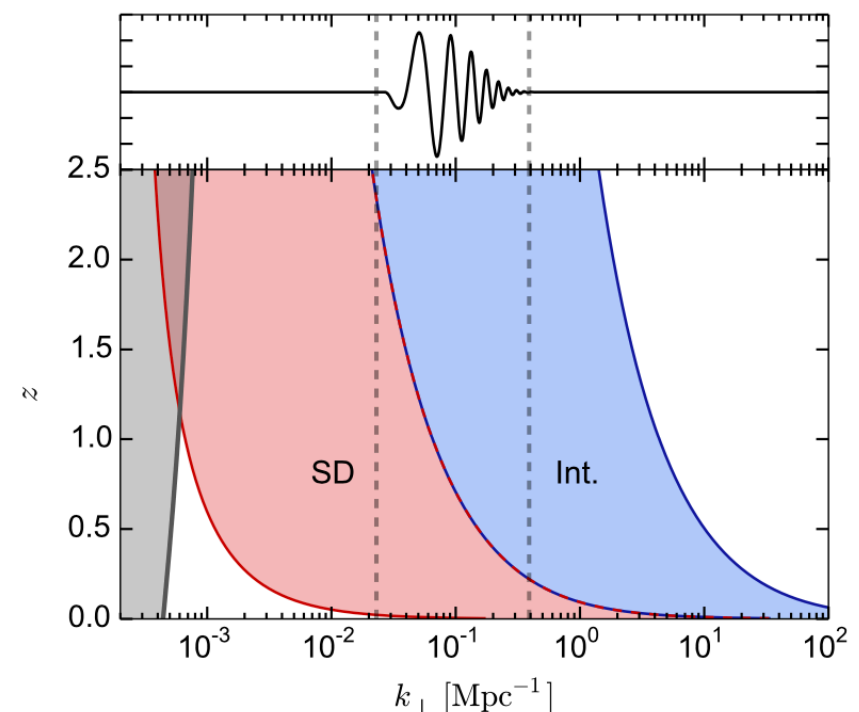
3 Oct 2022

Interferometric Intensity Mapping

- Different survey strategies are available for Intensity Mapping via both single dish and interferometry.
- We use interferometry for simulating a 21 cm Intensity Mapping survey which enables us study intermediate scales complementary to the large scale available via single dish.



(Photo from www.skatelescope.org)



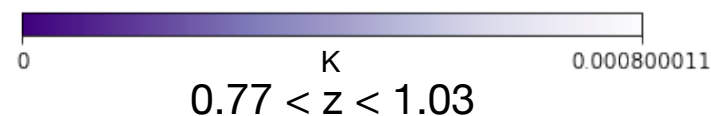
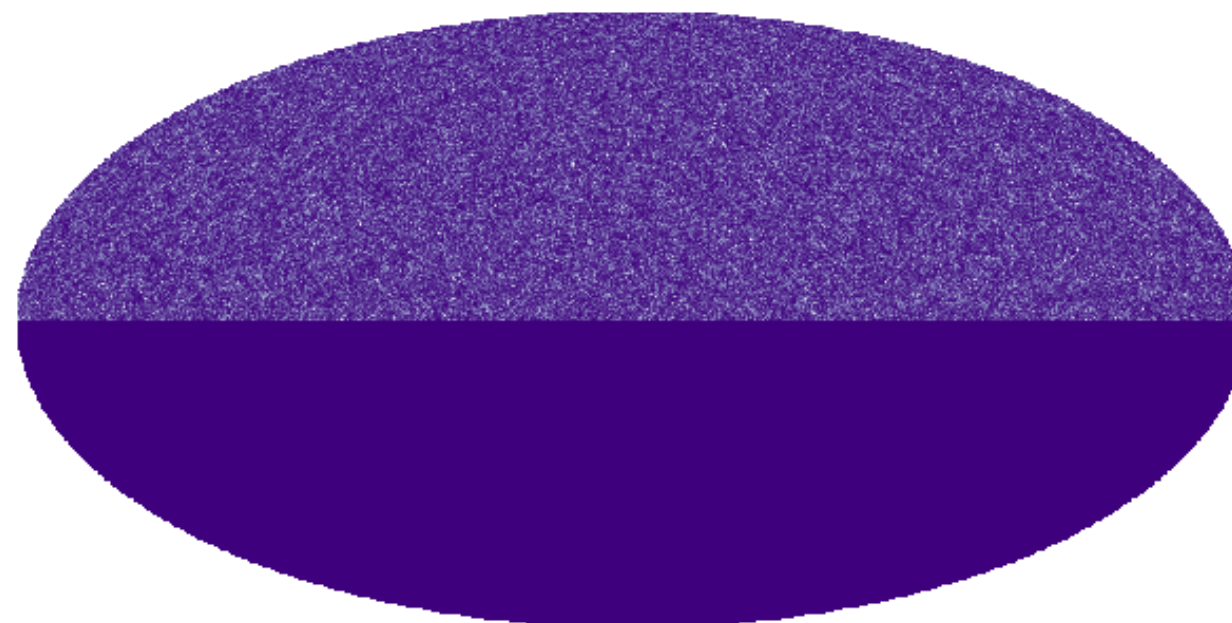
(Figure from Phil Bull+ 2014)

Sky and Telescope Simulations

- We generate sky model HI halo models based on PINOCCHIO that can be injected as a list of point sources.

(Credit to Pascal Hitz and Pascale Berner)

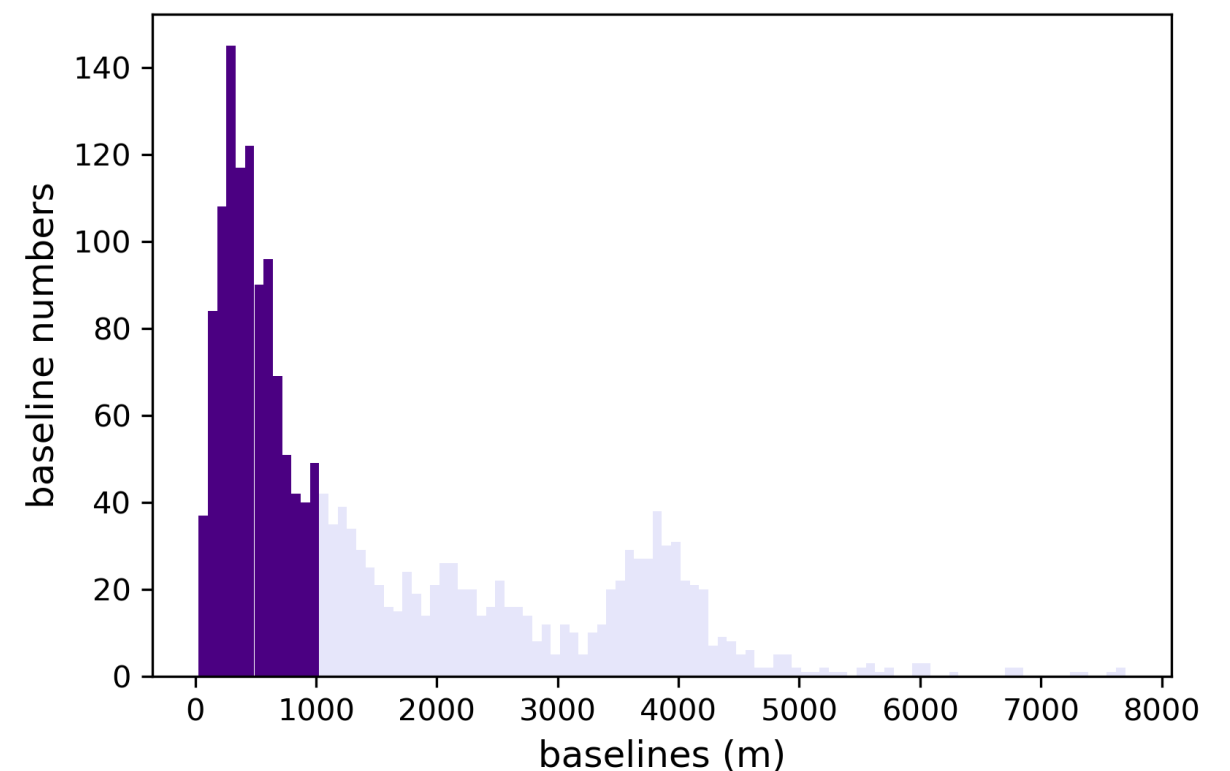
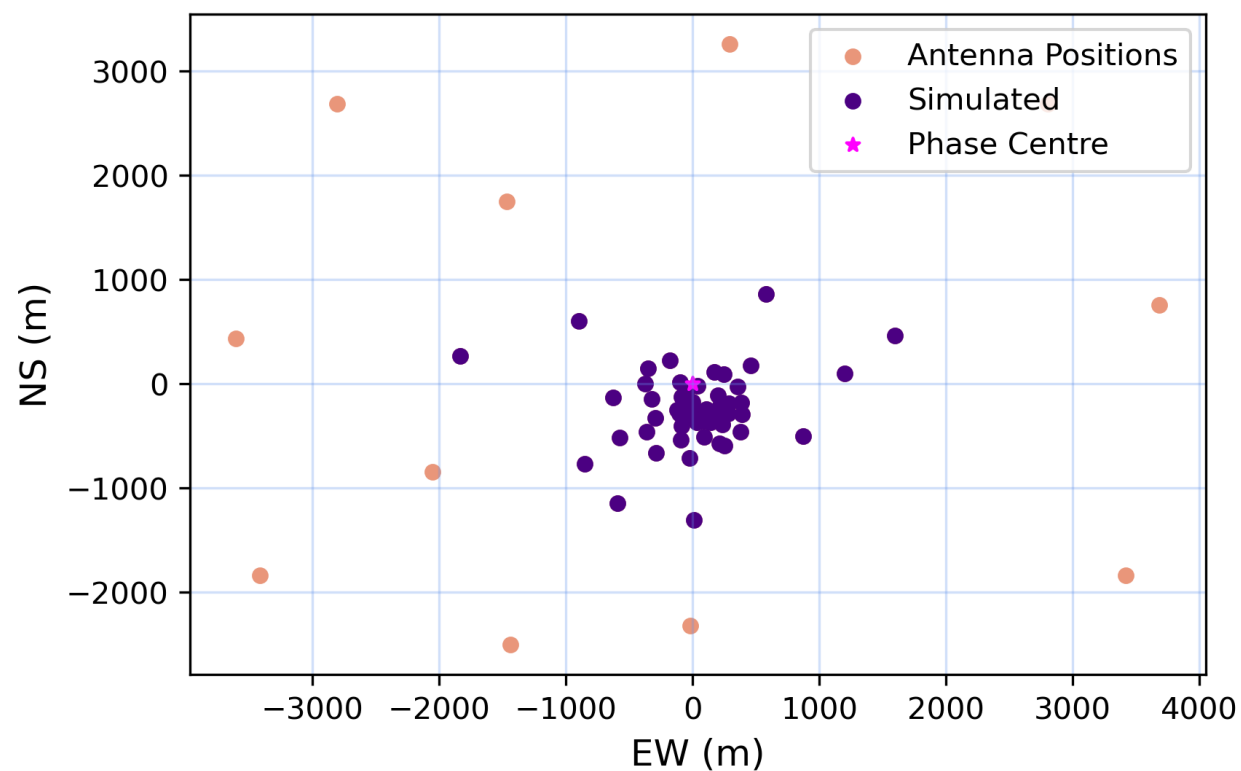
- SKA telescope simulations with OSKAR; now implemented in Karabo.



Survey Configuration

Simplified MeerKAT-like survey:

- Field of view = 5 deg
- $0.77 < z < 1.03$ corresponding to $0.703 \text{ MHz} < \text{frequency} < 0.806 \text{ MHz}$
- 8 hours of exposure
- Gaussian primary beam of FWHM ~ 1 deg

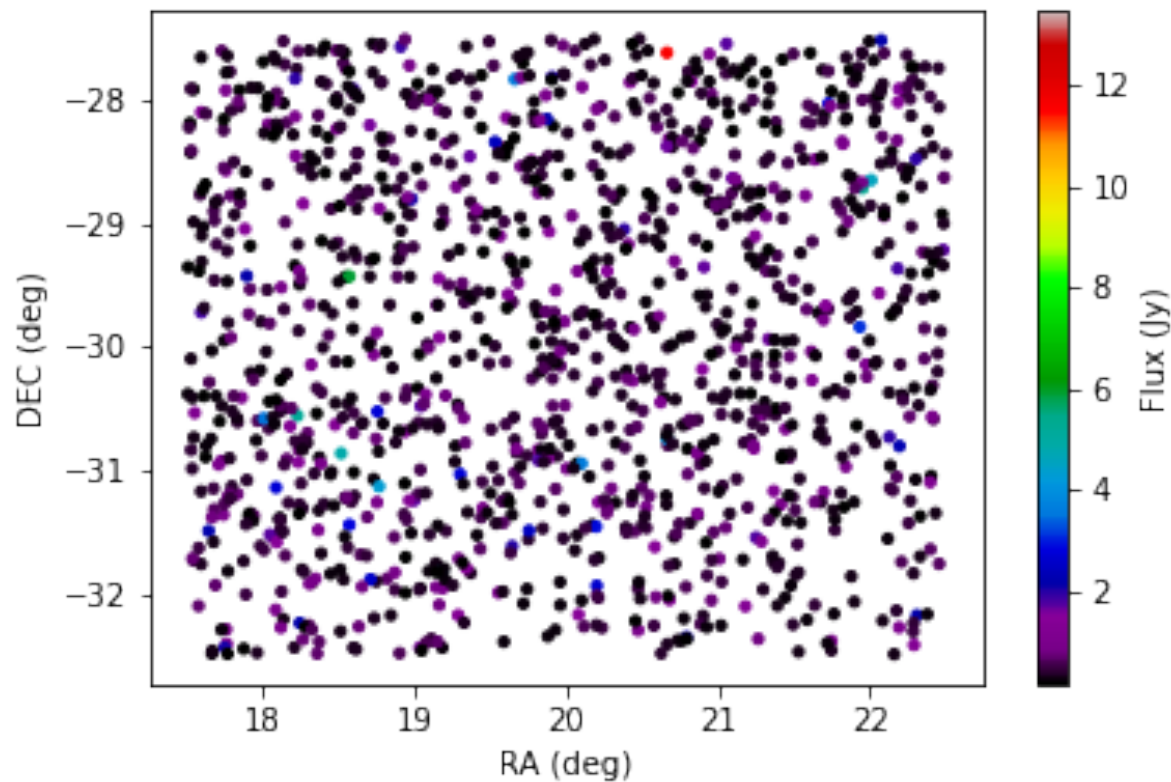


Simulation and Reconstruction

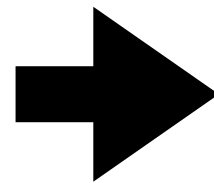
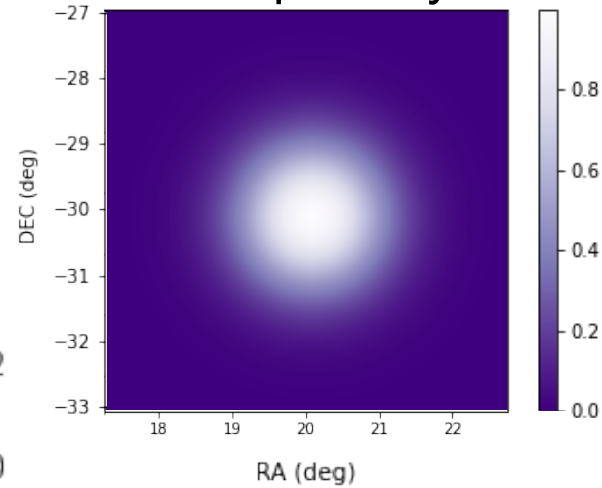
Input to OSKAR is a catalog of discrete sources.

(Catalog generated by Pascal Hitz)

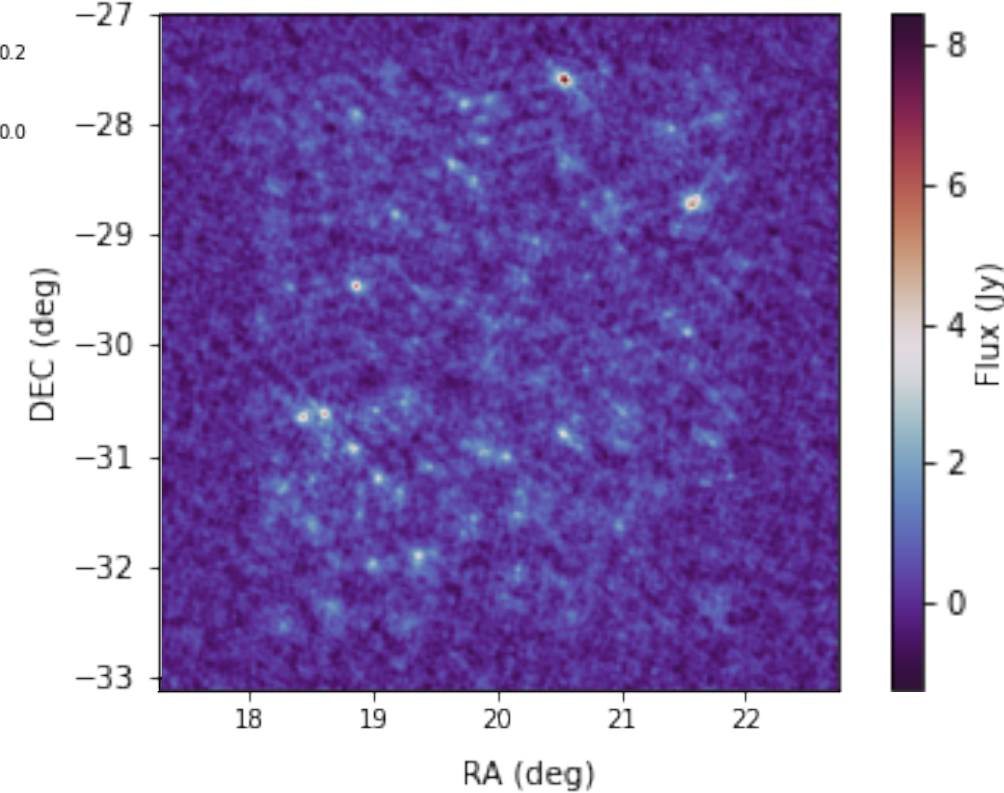
Point source catalog



Gaussian primary beam



Reconstructed image

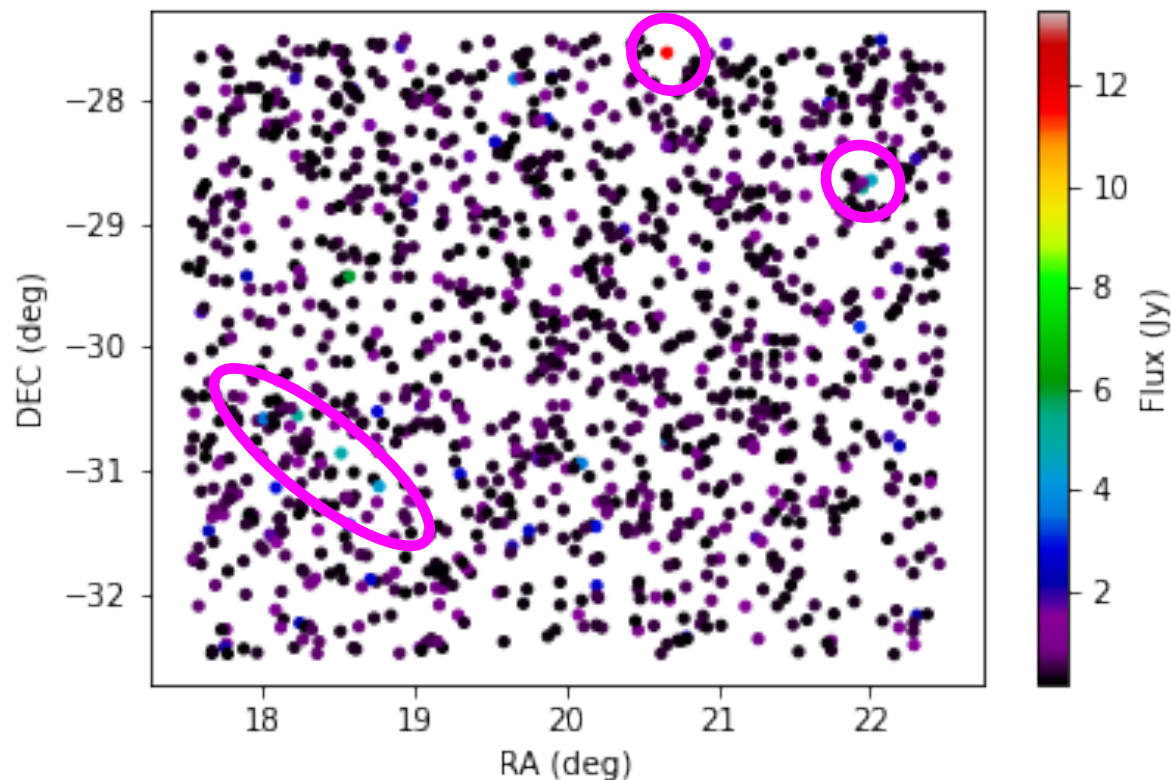


Simulation and Reconstruction

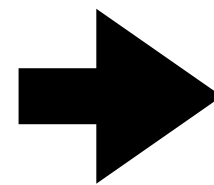
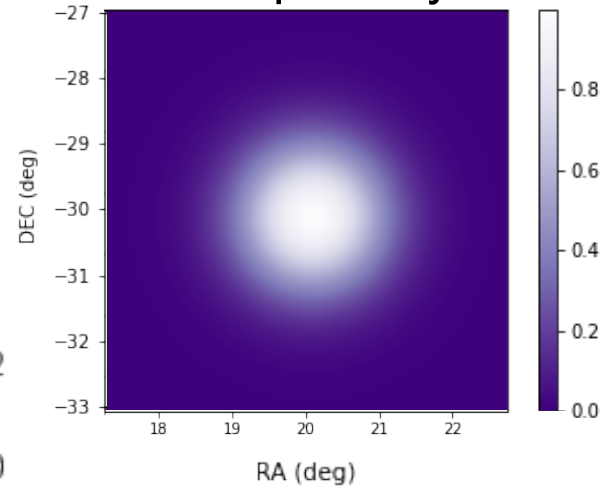
Input to OSKAR is a catalog of discrete sources.

(Catalog generated by Pascal Hitz)

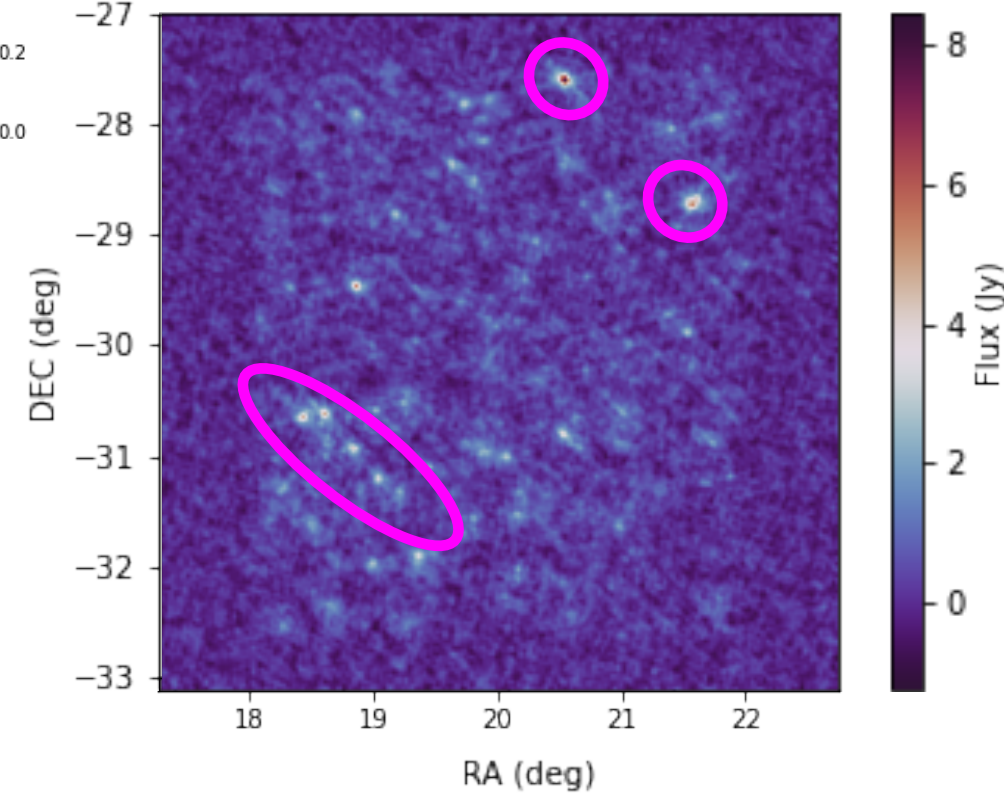
Point source catalog



Gaussian primary beam

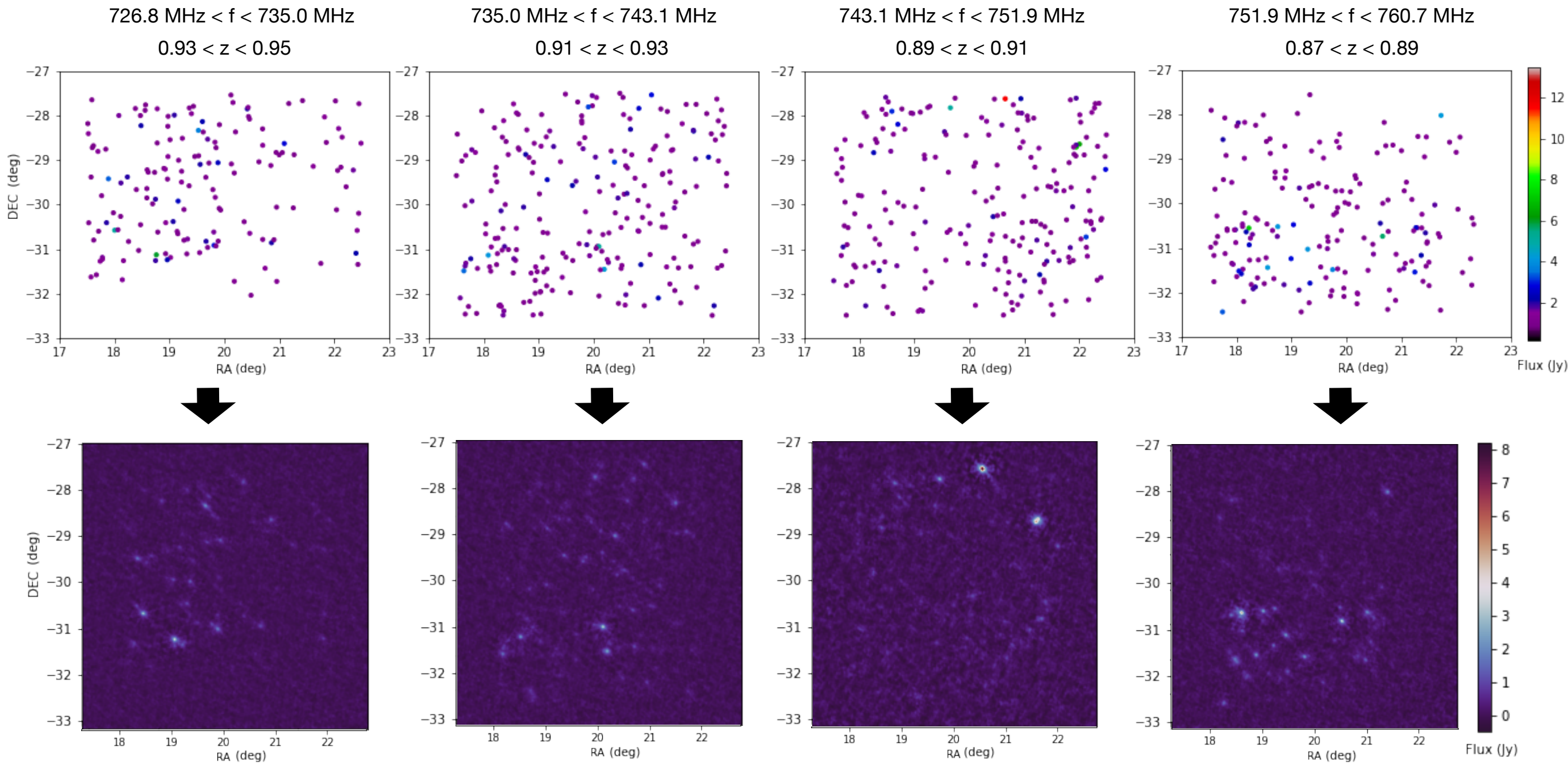


Reconstructed image



Simulation and Reconstruction

Dividing the sky model into different redshift bins and feed them into corresponding frequency channels.



Next Steps

On going developments in Digital-Twin:

- Higher resolution fast halo catalog simulation is needed for the SKA resolution.

(In collaboration with CSCS)

- Extending OSKAR capabilities with Karabo:

Enable more general source spectra in OSKAR, and realistic primary beams for the SKA via OSKAR compatible with the numerical/analytical models.