UNIVERSITÄT BIELEFELD
Fakultät für Physik

Summary statistics from LoTSS wide and deep fields

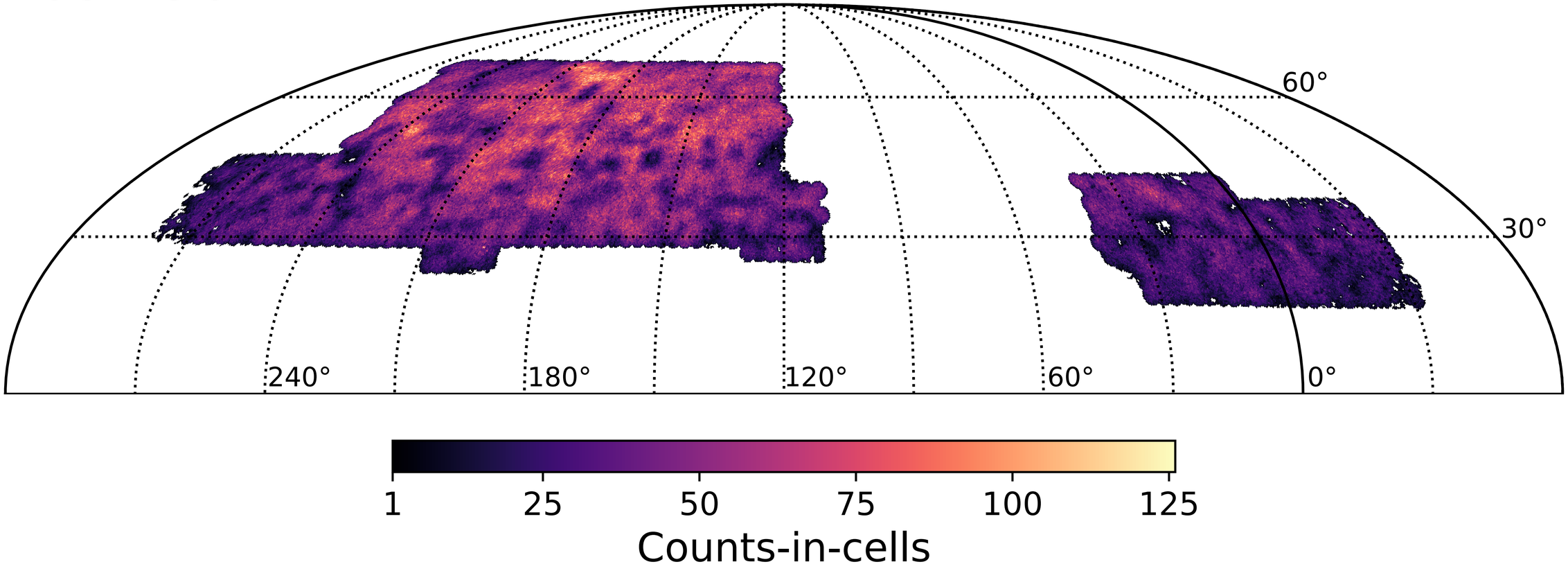
Counts-in-cells, redshift distribution and radio luminosity function

Dominik J Schwarz

Radio 2024, Erlangen

LOFAR Two-metre Sky Survey

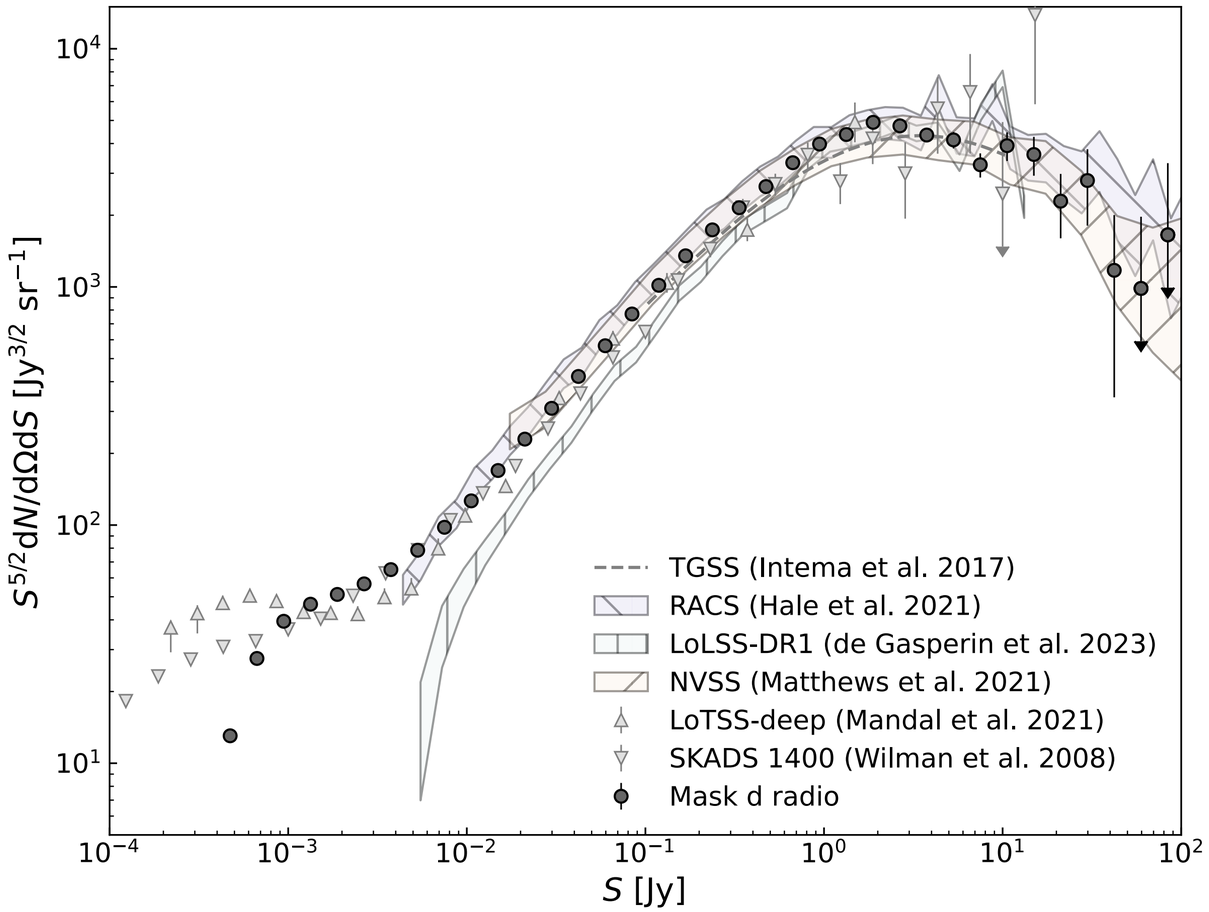
Wide Field DR2

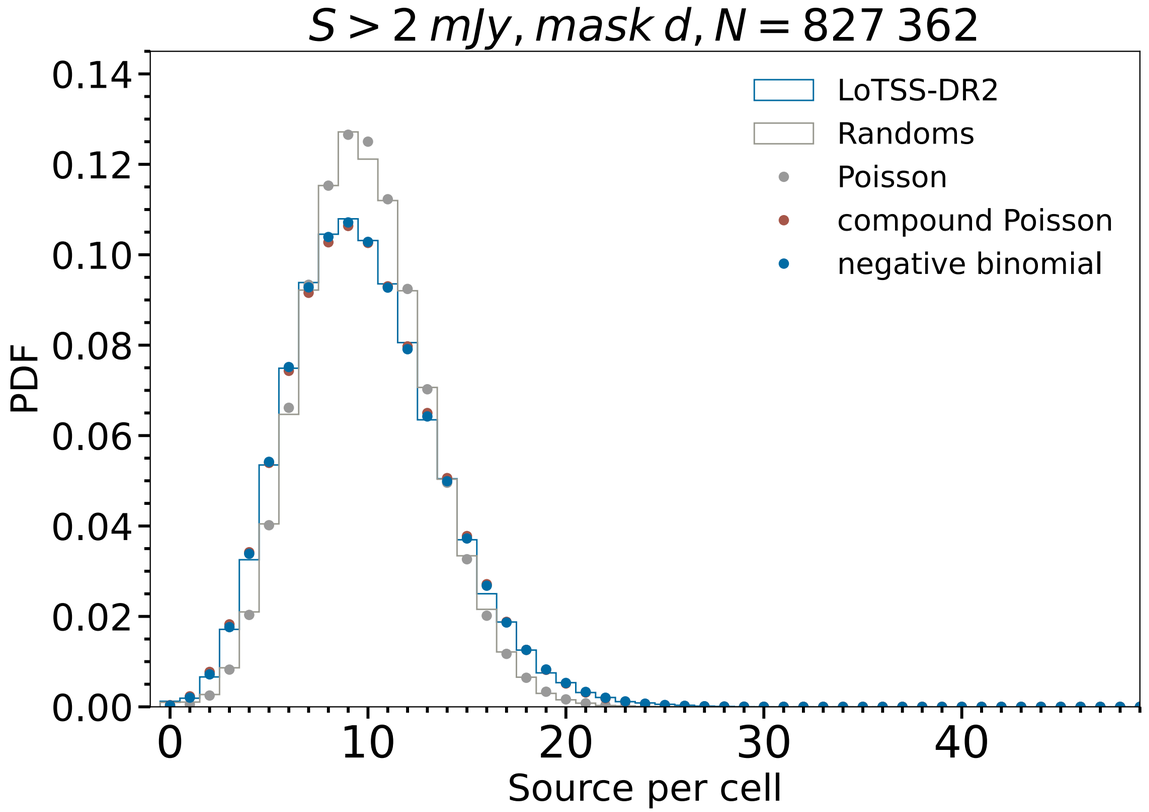


Pashapour-Ahmadabadi et al. submitted

LOFAR Two-metre Sky Survey

Wide Field DR2





Cox process: Negative binomial distribution
- physical sources: Poissonian
- radio components: logartithmic

Pashapour-Ahmadabadi et al. submitted

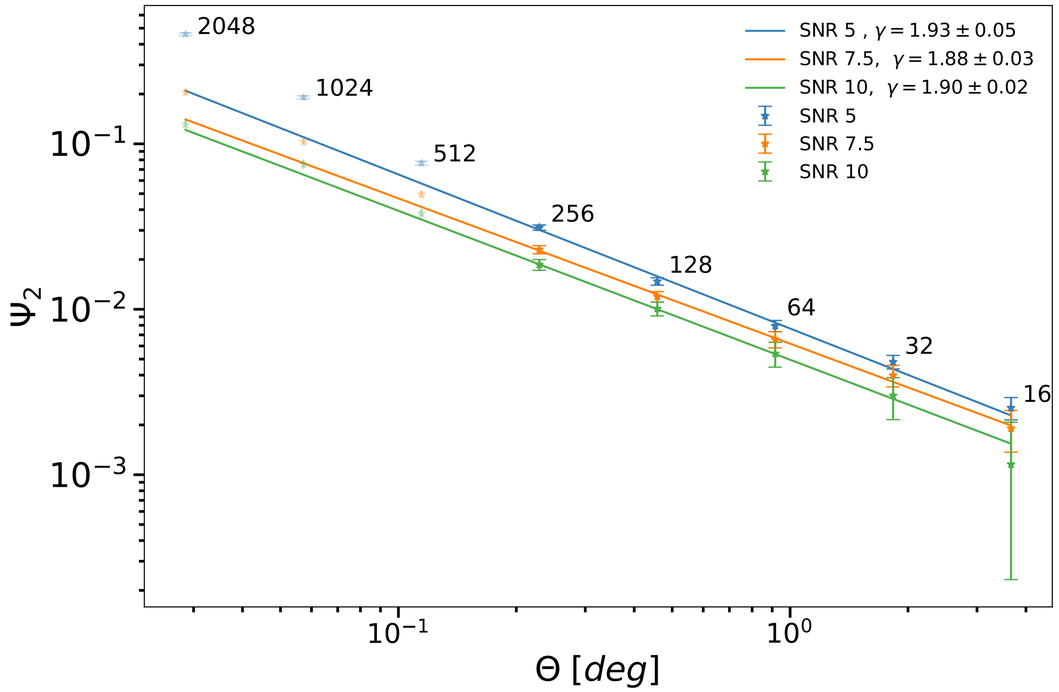
LOFAR Two-metre Sky Survey

Wide Field DR2

- Differential source counts: **AGNs** and **SFGs**
- Physical objects can have several components; source counts best described by **negative binomial distribution**
- Source counts scale as expected, normalised & scaled variance,

$$\Psi_2 = \frac{\sigma^2 - \mu}{\mu^2},$$

allows for a computationally cheap estimator of **auto-correlation function**

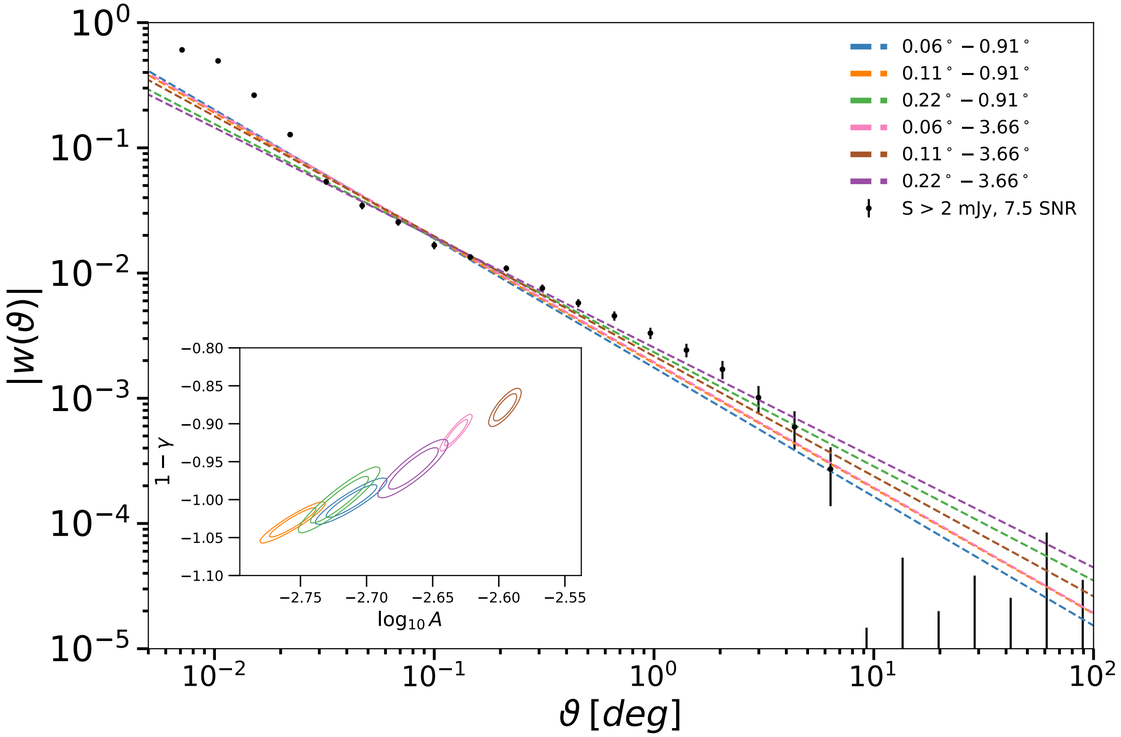


Pashapour-Ahmadabadi et al. submitted

LOFAR Two-metre Sky Survey

Wide Field DR2

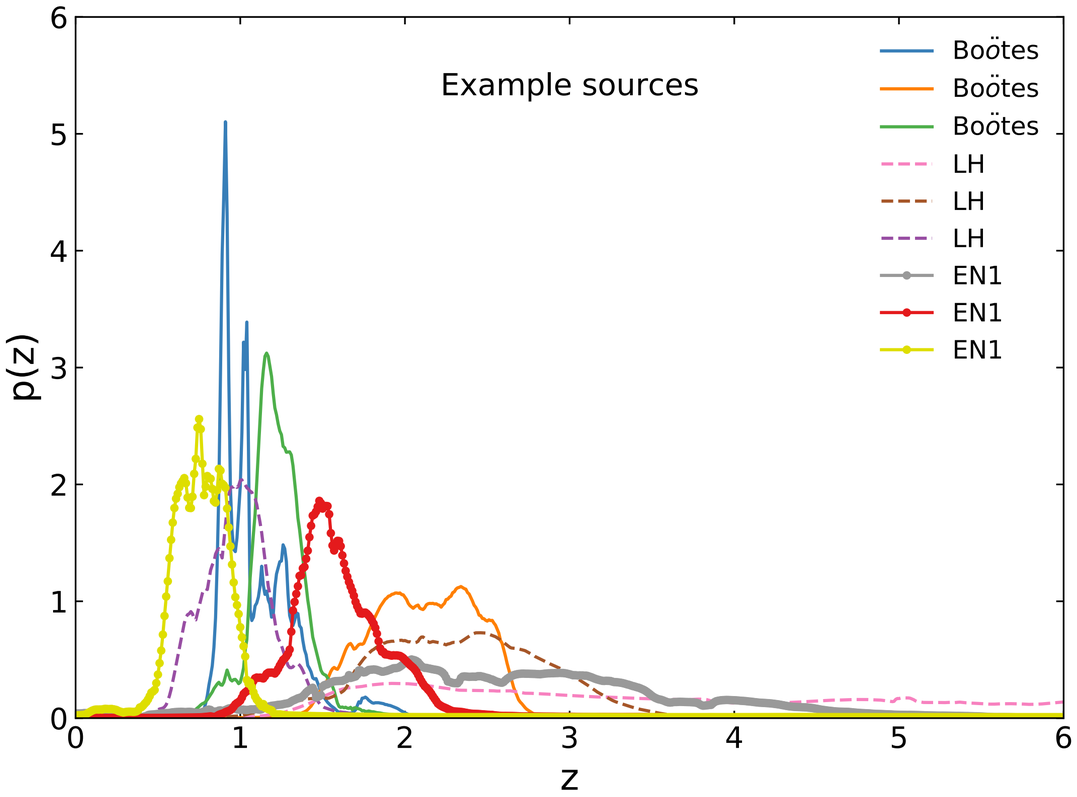
- Compute effort of optimal estimator (Landy-Szalay) scales as N_{rand}^2
- Counts-in-cell based estimate scales as $N_{\mathrm{data}} N_{\mathrm{cells}}$
- Agrees nicely (power-law model was assumed here)

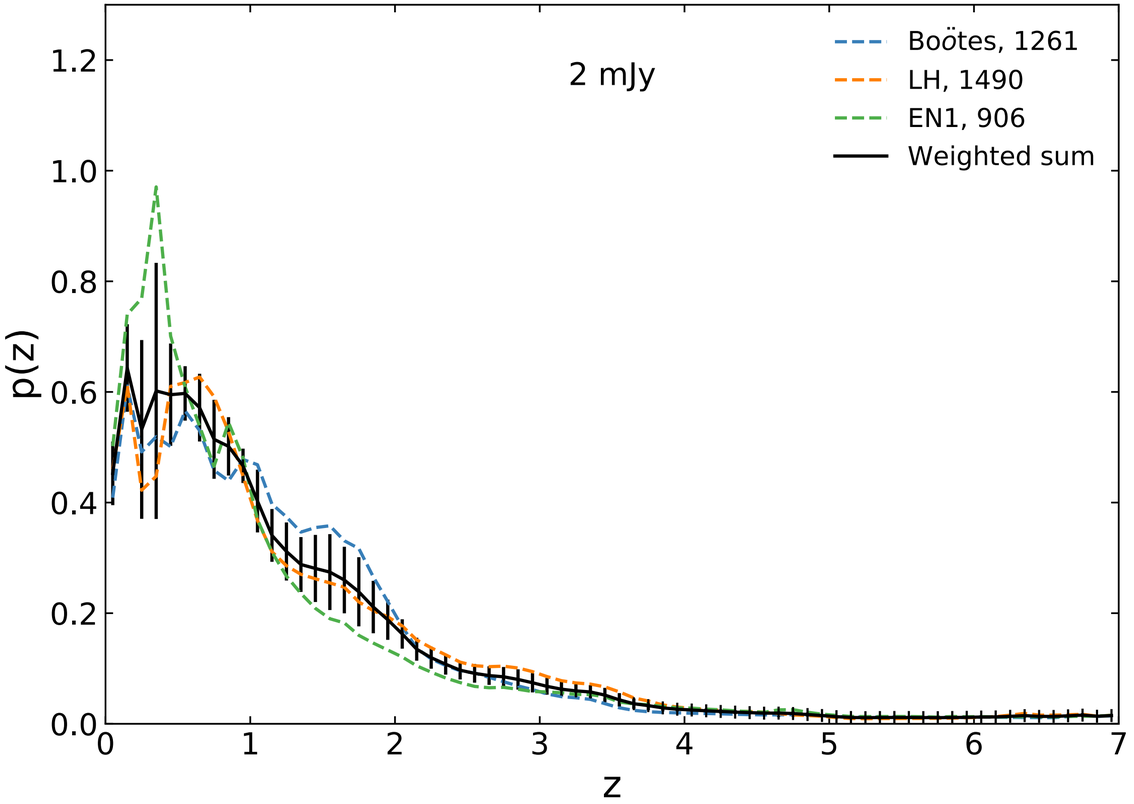


Pashapour-Ahmadabadi et al. submitted
and compare with
Hale et al. 2024 (analysis of 2pt correlation)

LOFAR Two-metre Sky Survey

Deep Field DR1 — Photometric redshifts

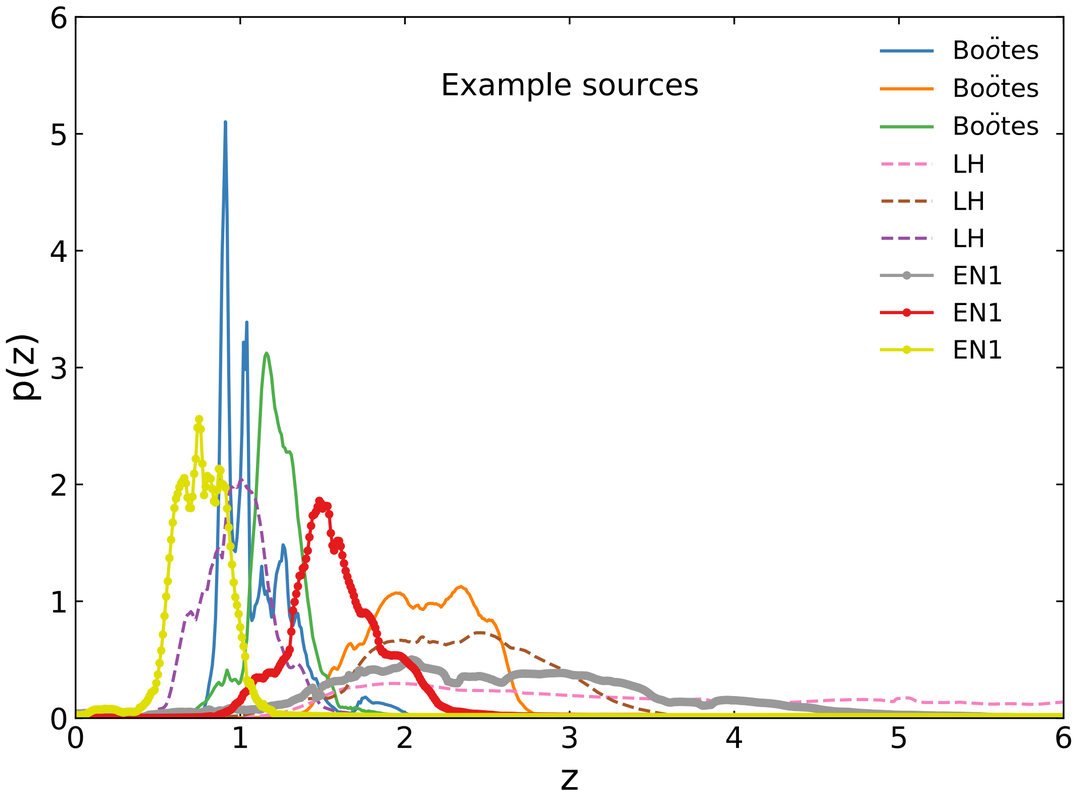


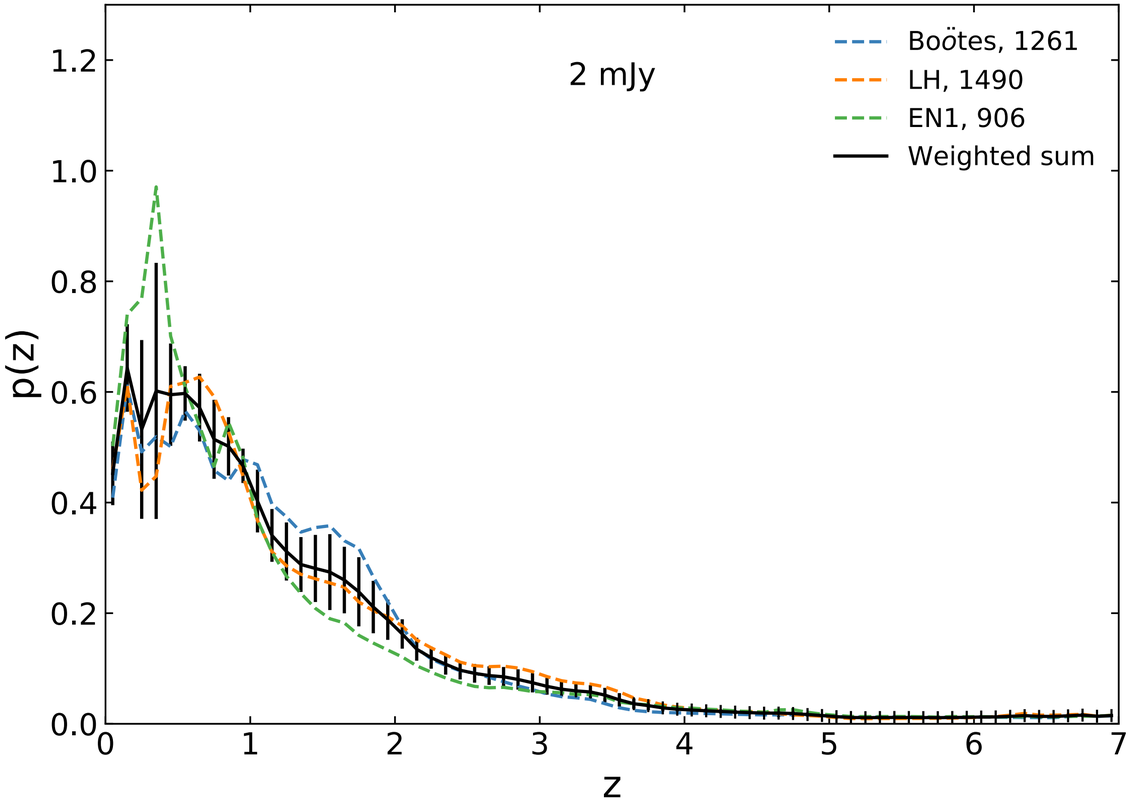


Bhardwaj et al. accepted

LOFAR Two-metre Sky Survey

Deep Field DR1 — Photometric redshifts

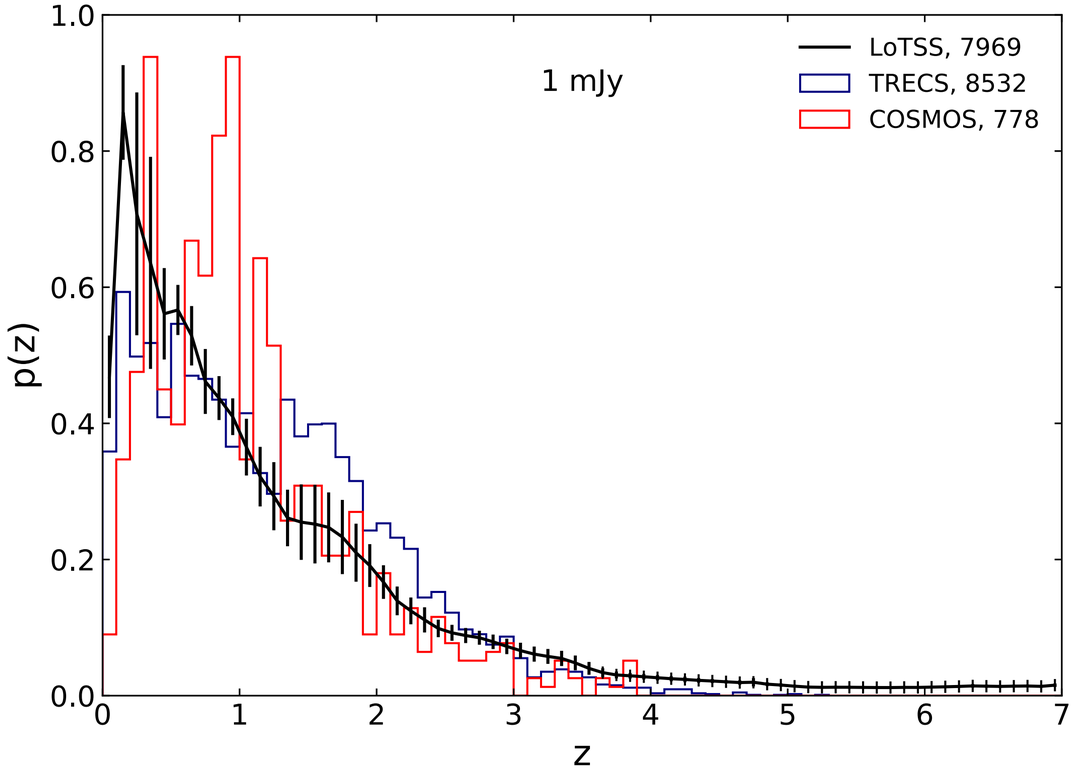




Bhardwaj et al. accepted

LOFAR Two-metre Sky Survey

Deep Field DR1 — Photometric redshifts

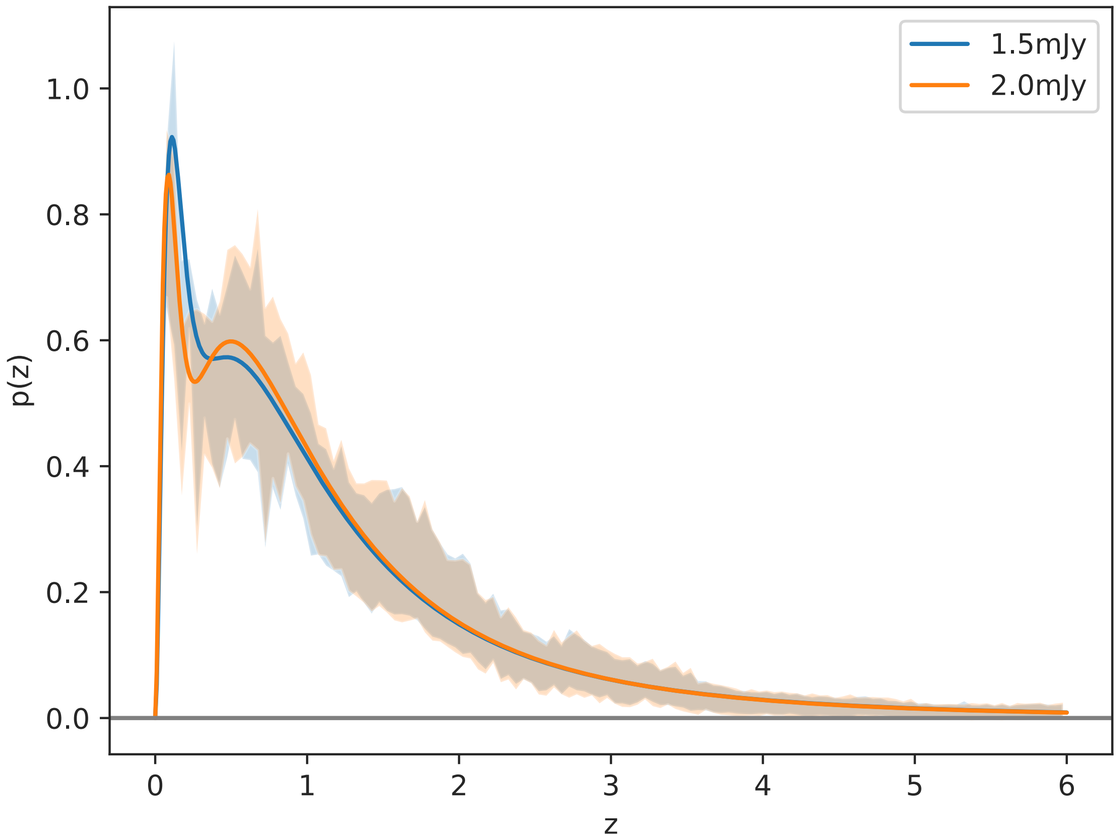


- Use full posterior pdf — not just the best guess for z
- SKADS and TRECS might differ from the truth
- COSMOS field is rather small and thus affected by cosmic variance

Bhardwaj et al. accepted

Combining Deep and Wide fields

Redshift distribution



Nakoneczny et al. 2024

$$p(z) \propto \frac{z^2}{1+z}\left(\exp\left(\frac{-z}{z_0}\right) + \frac{r^2}{(1+z)^a}\right)$$

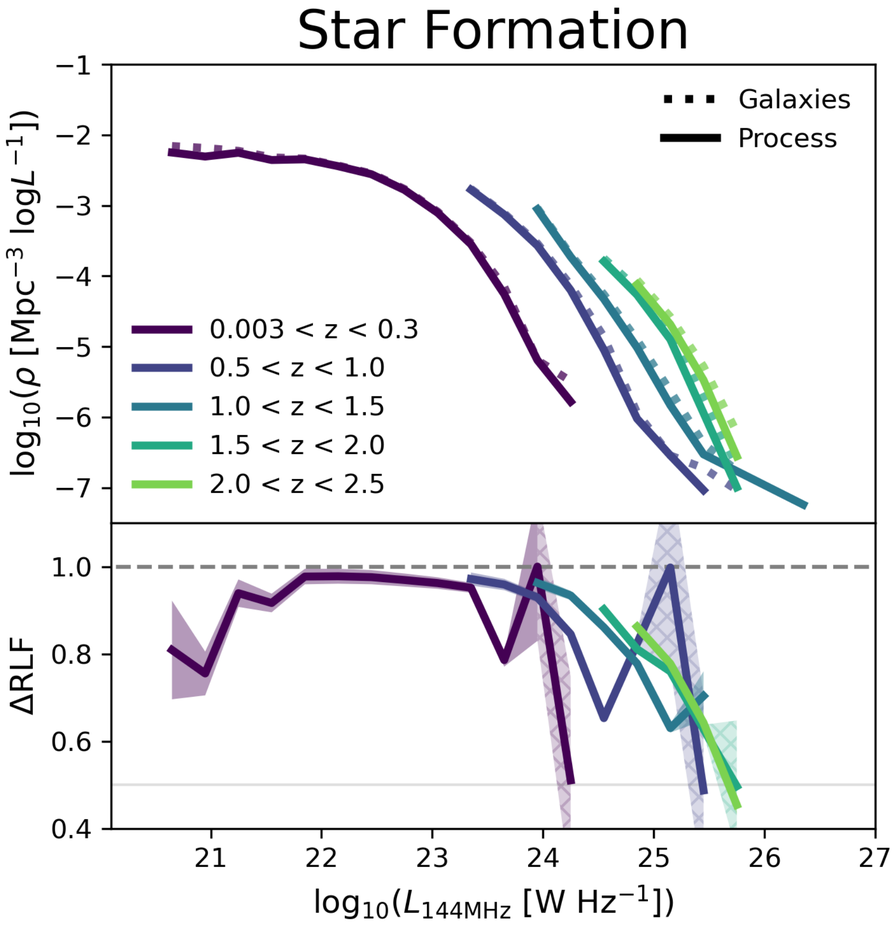
Sample	z_0	r	a
1.5 mJy	0.05 ± 0.01	0.20 ± 0.03	4.9 ± 0.1
2.0 mJy	0.04 ± 0.01	0.17 ± 0.03	5.0 ± 0.1

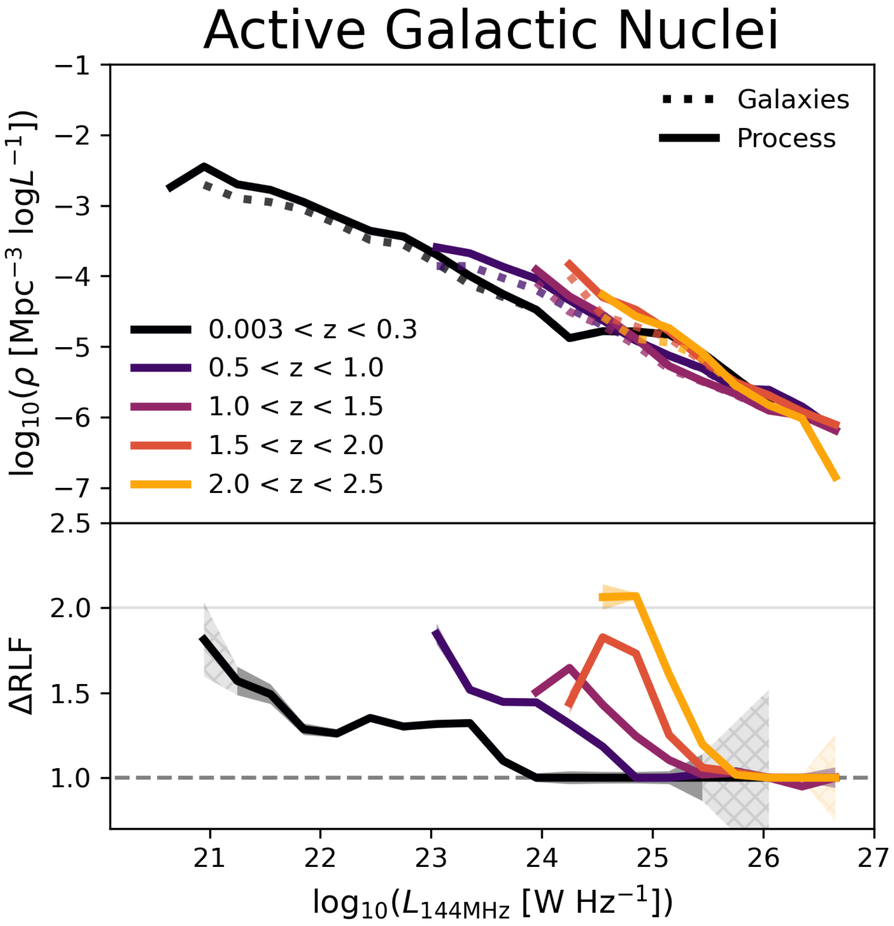
- Semi-empirical model
- 2 populations:
  SFGs (Schechter), AGNs (power-law)
- At small z: counts are homogeneous in comoving volume, $z^2/(1+z)$ in LCDM cosmology
- Probability distribution p(z)

LOFAR Two-metre Sky Survey

Deep Field DR1 — High resolution

- First process based radio luminosity function based on international baselines imaging of EN1
- AGN have been underestimated at low luminosities, especially at higher z
- SFGs have been overestimated at high luminosities, especially at high z

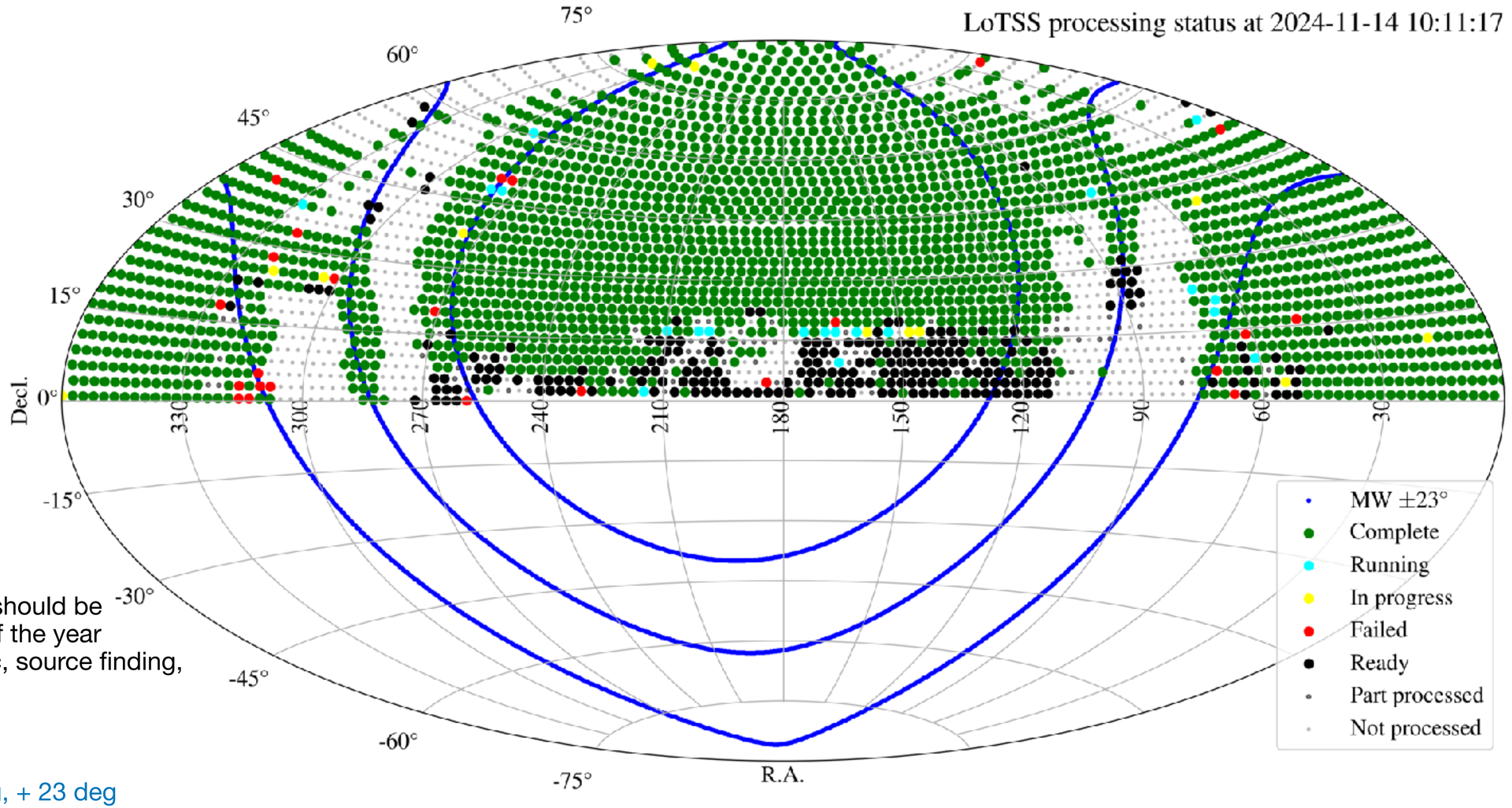




Morabito et al. accepted

LoTSS-DR3

Stay tuned



Analysis ongoing, should be complete by end of the year
Next steps: mosaic, source finding, source cross ids

Blue lines:
b = - 23 deg, 0 deg, + 23 deg

Conclusions

Towards competitive cosmological constraints with LoTSS-DR3

- So far, understood nature and redshift distribution of sources
- So far, understood systematics for sources with SNR > 7.5 and flux density > 1.5 mJy
- DR3: Larger sky coverage will provide competitive cosmological parameters, detect integrated Sachs-Wolfe effect (so far only at best at 2.8σ from Planck-RACS-low correlation), cosmic source count dipole, higher order statistics, …