UNIVERSITÄT BIELEFELD
Faculty of Physics

LOFAR

Welcome to the 4th LSKSP Mini Symposium *LOFAR Cosmology*

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LOFAR Surveys KSP — Cosmology Team

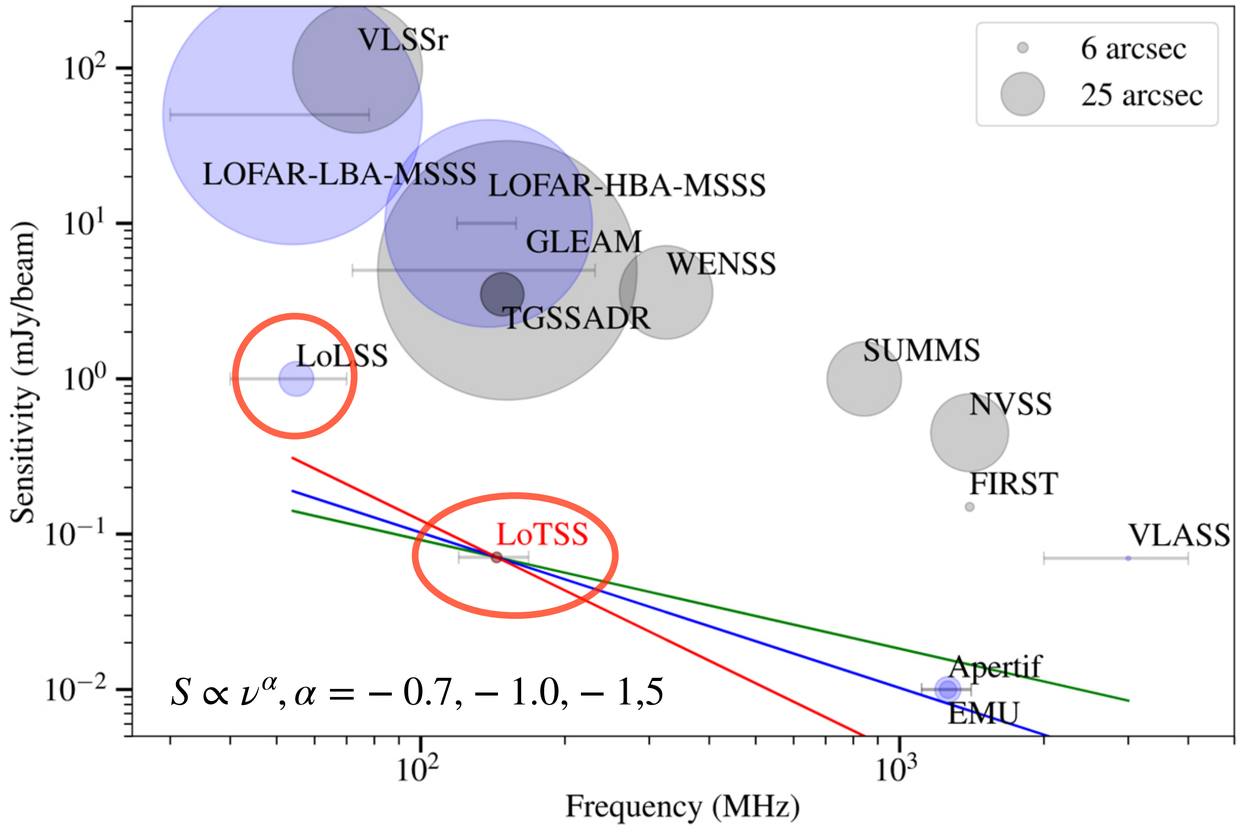
January 8, 2021

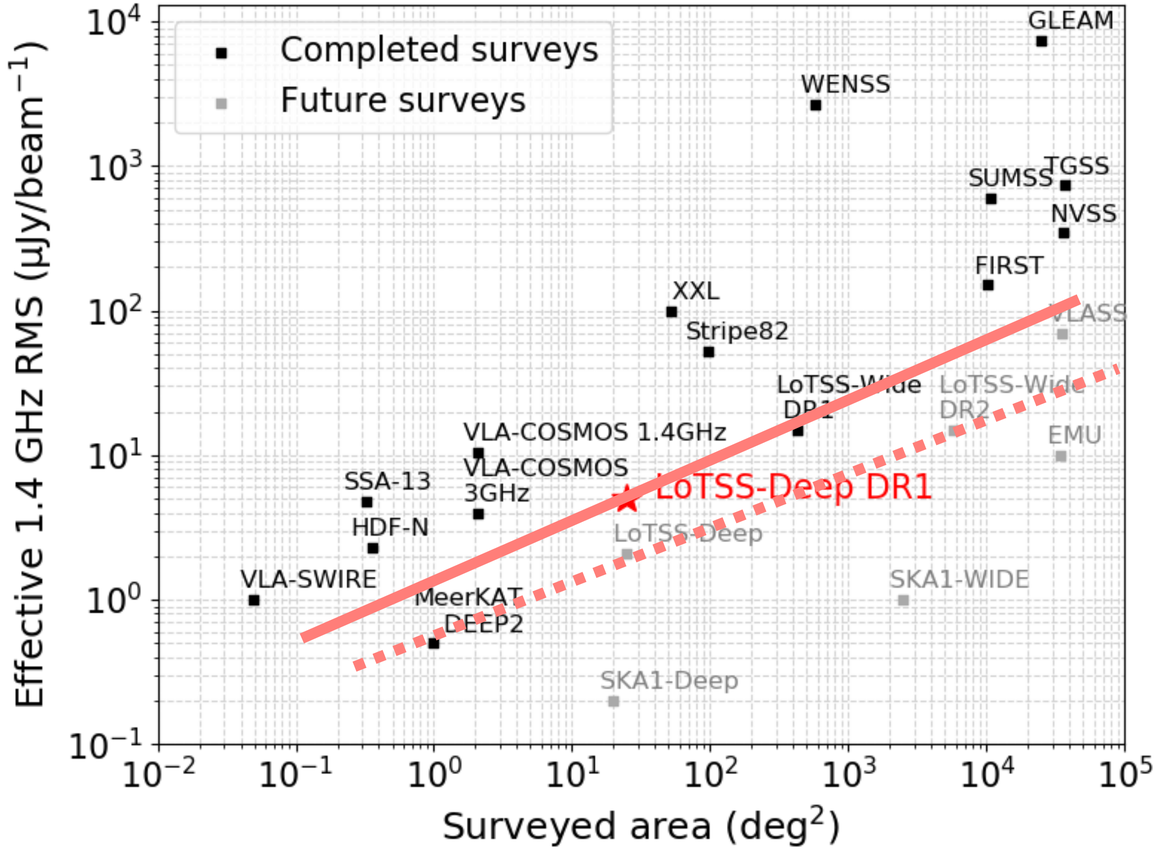
Schedule

- Welcome and Introduction (10’)
- **Catherine Hale** (20’ + 5’)
  Improved mock catalogues for LoTSS and initial investigations into the Conditional Luminosity Function in the deep fields
- **Thilo Siewert** (20’ + 5’)
  The counts-in-cell distribution and angular two-point correlation function in LoTSS-DR1
- **David Alonso** (20’ + 5’)
  Cross-correlation with CMB lensing convergence, redshift distribution and bias of LoTSS-DR1 sources
- **Cristy Garcia** (20’ + 5’)
  Investigations of clustering in LoTSS Deep Fields
- General discussion (10’)

LOFAR Surveys

lofar-surveys.org



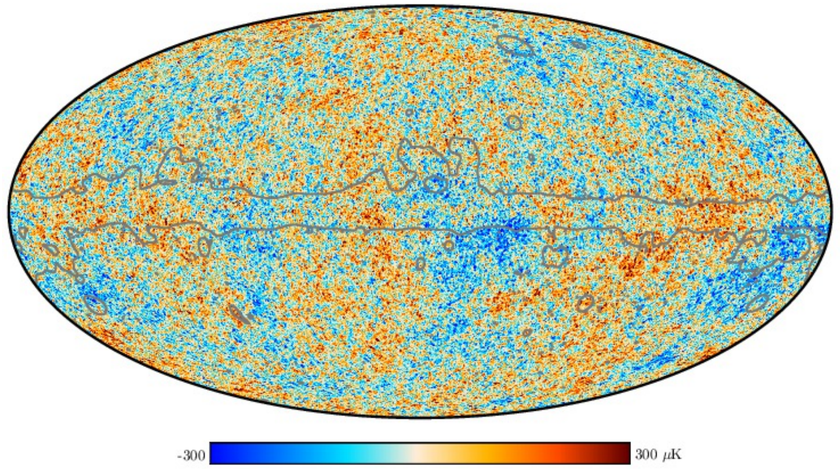


LoTSS-Wide DR1: Shimwell et al. 2019

LoTSS-Deep DR1: Tasse et al. 2020

Status of cosmology

- Statistically isotropic and homogeneous Universe
- Gaussian matter and curvature fluctuations
- Scale-free power spectrum



Planck collaboration 2018

- Structure grows via gravitational instability, described by general relativity
- Dark matter and cosmological constant
- **OPEN ISSUES:** H_0 and S_8 problems, measure relativistic effects, anomalously large dipole in NVSS, WENSS, SUMSS, TGSS catalogues

Consequences for radio sky

- In cosmological standard model, all information on the very early Universe is contained in the **one- and two-point (auto- and cross-) distributions**

- Radio sources are test particles to **probe the large-scale structure at large and ultra-large scales and over a wide redshift range** (distribution and evolution)

- Provide **multiple tracers** of the large-scale structure (e.g. SFGs and AGNs) to reduce **limitations from cosmic variance**, especially on ultra-large scales

- Studies of the large-scale structure are limited by shot noise and cosmic variance, which require **large number of sources** and **wide sky coverage**

- Cosmological studies require good systematic understanding of the value added LoTSS catalogues, including photo-z's, classification of sources, etc.

Published LoTSS Cosmology

- T.M. Siewert et al.,
  One- and Two-point Source Statistics from the LOFAR Two-metre Sky Survey First Data Release,
  A&A **643** (2020) A100, arXiv:1908.10309

- D. Alonso et al.,
  Cross-correlating radio continuum surveys and CMB lensing: constraining redshift distributions, galaxy bias and cosmology,
  MNRAS accepted, arXiv:2009.01817

- M.J. Hardcastle et al.,
  The contribution of discrete sources to the sky temperature at 144 MHz,
  A&A accepted (part of LoTSS Deep Fields Special Volume), arXiv:2011.08294

Plans for LoTSS Cosmology

- **LoTSS Deep Fields DR1:** Learn more on clustering, photo-z distribution, and bias (ongoing)

- **LoTSS-DR2** (5700 square degrees, 4.5 million radio sources, improved flux density calibration), will gain an order of magnitude in sky coverage and statistics, will allow us to constrain cosmological models —
  plan for a series of 6 papers, including cross correlations to Planck and eBOSS
  Teams have been formed, work started

- **LoLSS:** Corresponding survey at 42 — 66 MHz, will cover 25 - 30% of sky, cross-matching exercise is under way

- **LOFAR-WEAVE** will provide spectroscopic follow up of 1 million LoTSS selected radio sources, no detailed plans yet, but will be very useful

Acknowledgements
LOFAR Surveys Key Science Project

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