First galaxy structure (3<z<7) and the SIDES tool

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CONCERTO collaboration

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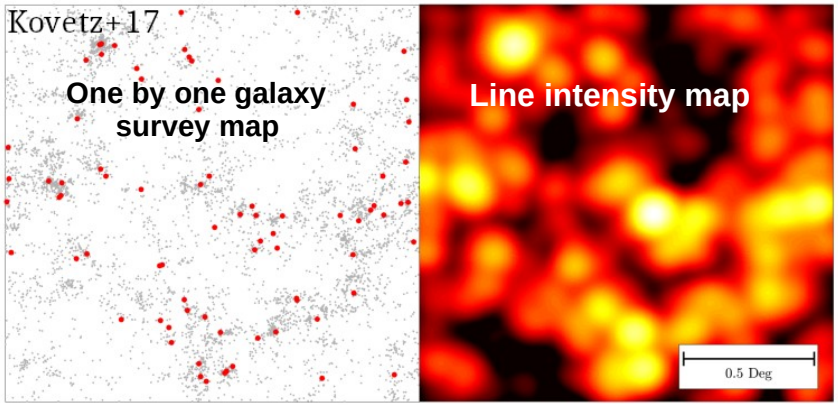
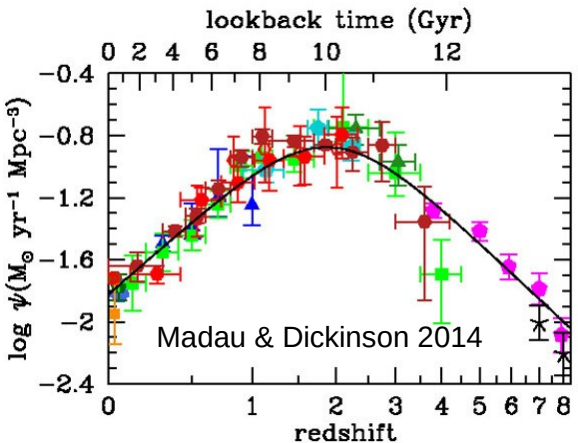
Intensity Mapping

- Intensity mapping vs targeting individual galaxies
- We need to study the formation and evolution of galaxies (SFR)
- CONCERTO: a [CII] intensity mapping experiment probing the z>5.2 range

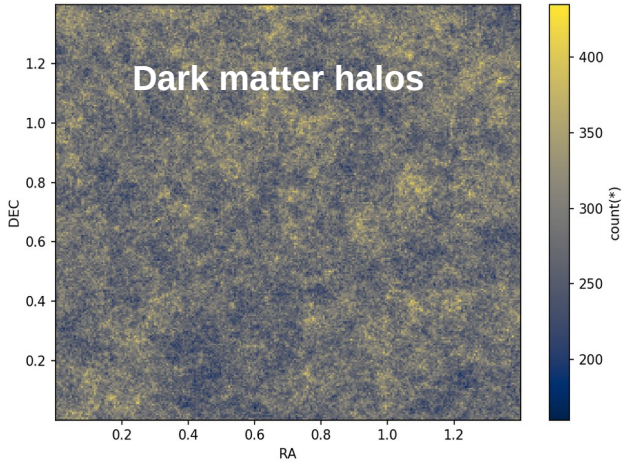


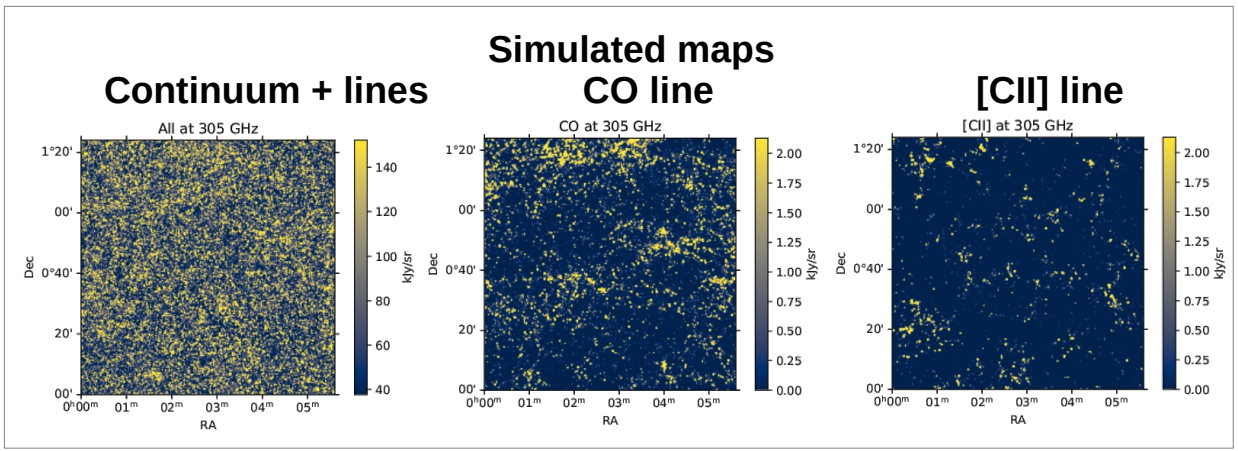


The CONCERTO collaboration 2020

Simulating the Intensity Mapping observables

- Simulations: keys to the pipelines and component separation methods preparation (continuum, [CII], CO)
- Our Intensity Mapping simulation: **SIDES**
- Cosmological simulation: **UCHUU**
- Populate DM halos with galaxies
- Generate galactic properties (e.g., SFR, L_{IR}, starburst or not)
- Add lines forecast (CO, [CII], [CI])

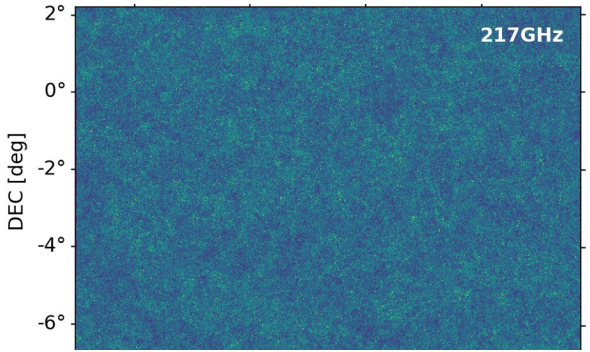


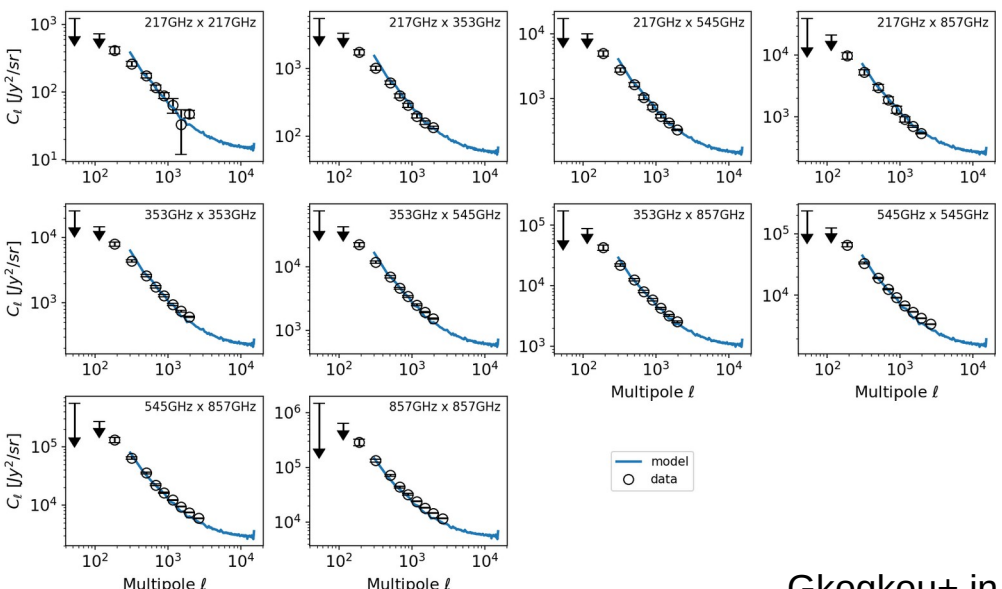


Bethermin+17, The CONCERTO collaboration 2020, Bethermin+ in prep.

Simulation validation - Continuum emission: CIB fluctuations power spectrum

- Generated maps for each filter
- Computed the auto/cross power spectrum of each map
- Compared with observations:
  - **Planck**
  - Herschel (SPIRE)
  - SPT
  - SPTxSPIRE
- Model-data: **great agreement**

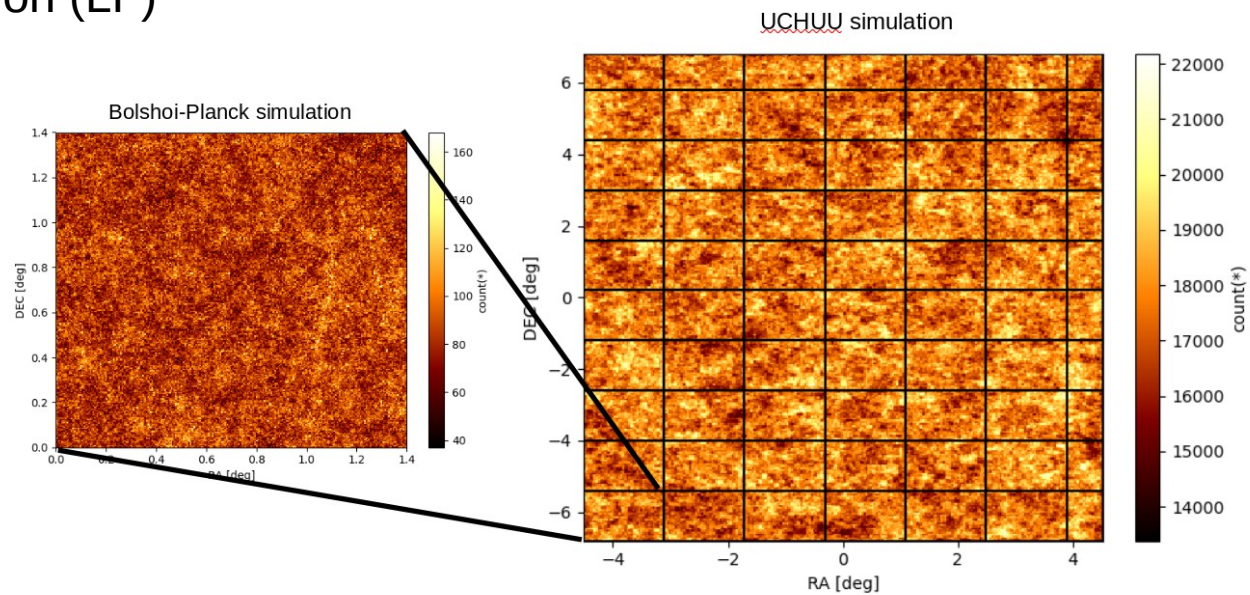




Gkogkou+ in prep.

UCHUU simulation and abundance matching

- Wider cosmological simulation
  (from 2deg^2 to 122 deg^2)
- Cut the Uchuu field into 117 1 deg^2-sized subfields
- For each subfield generate:
  a cube, a map, Luminosity Function (LF)
- Study the field-to-field variance

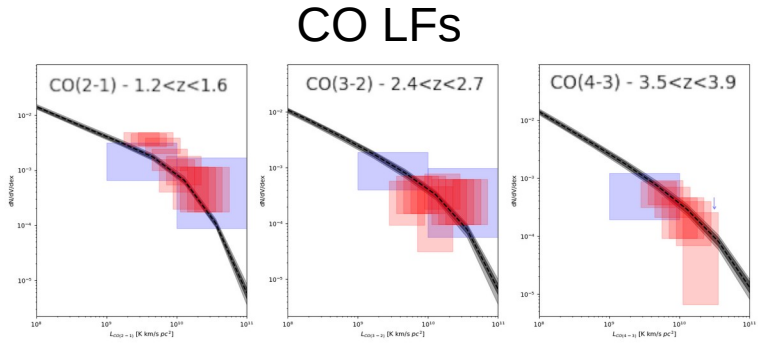


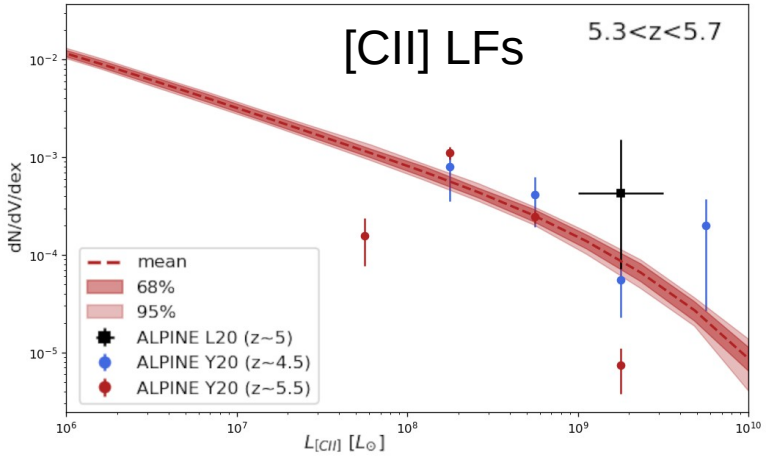
Gkogkou+ in prep.

Simulation validation - Lines emission: CO/[CII] luminosity functions (LFs)

Gkogkou+ in prep.

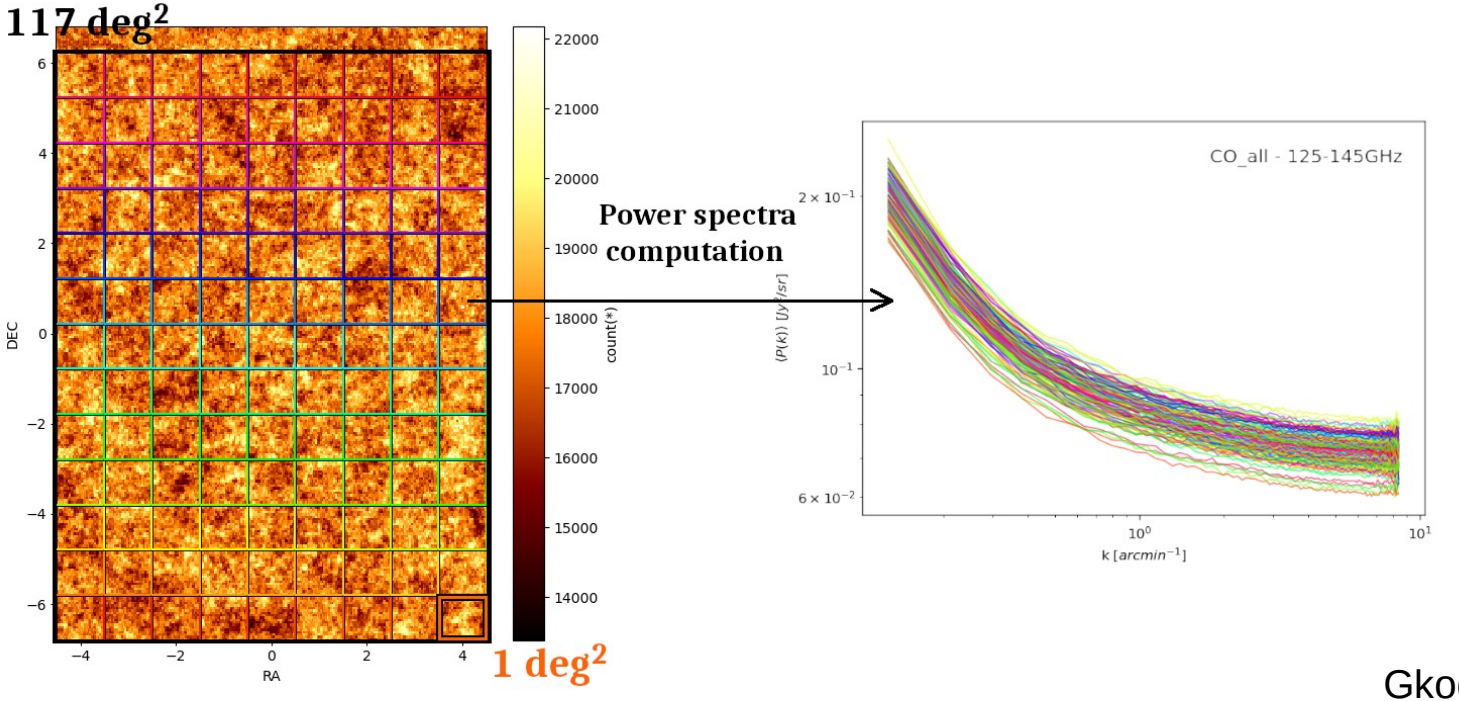
- One LF per subfield (117 LFs in total)
- Plot all the LFs together: test if they all fall inside the observational constraints
- Shaded area = 68% and 95% percentiles
- CO: ASPECS observational data
- [CII]: ALPINE observational data
- **Consistency with observations:** All LFs from the simulation fall inside the observational boxes**!**





Field-to-field variance: Power spectrum

- Cutting the total UCHUU simulation into 117 1 deg^2-sized boxes
- Generating a cube for each 1 deg^2 box
- Computing the power spectrum of each cube (*10.5281/zenodo.4507624*)
- Apparent variance from field to field



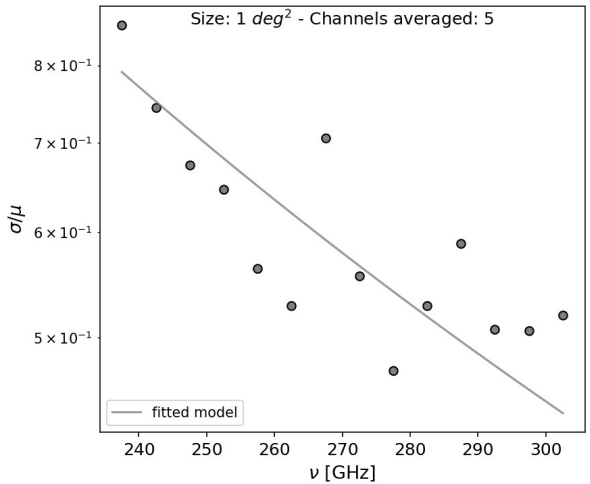
Gkogkou+ in prep.

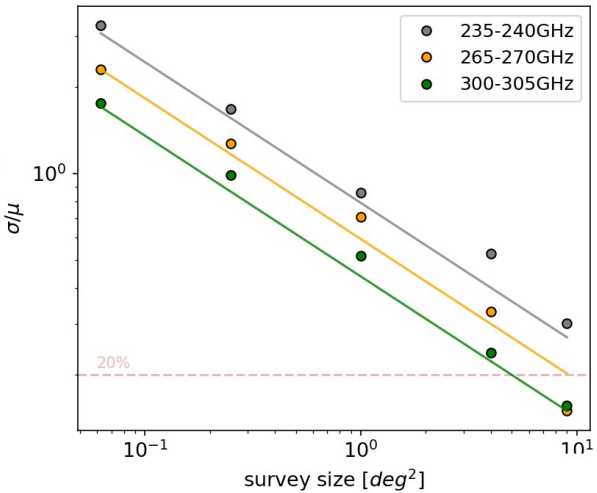
Variance dependence and modeling

Preliminary

- [CII] variance depends on the survey size and the observed frequency

Poisson variance model





- Model for [CII] (*solid lines*):

$$\left(\frac{\sigma}{\mu}\right)_{pois} = 1.2\left(\frac{\nu}{\nu_o}\right)^{-2.4}\left(\frac{\Delta\nu}{\Delta\nu_o}\right)^{-0.5}\left(\frac{\Omega}{\Omega_o}\right)^{-0.49}$$

where $\nu_o = 200GHz$, $\Delta\nu_o = 5GHz$, and $\Omega_o = 1deg^2$

- Different models for: Cosmic variance, Poisson variance
  Other lines (CO, [CI])

Gkogkou+ in prep.

Conclusion

- Intensity Mapping is an advantageous method to study the large scale structures and the galaxy formation and evolution
- Uchuu helped to expand our intensity mapping simulation to gain information on the cosmic variance introduced in the IM observations
- SIDES validation: excellent agreement with both the LF constraints and the CIB anisotropies from Planck (realistic clustering)
- Power spectrum field-to-field variance is non negligible even for 1deg^2 fields