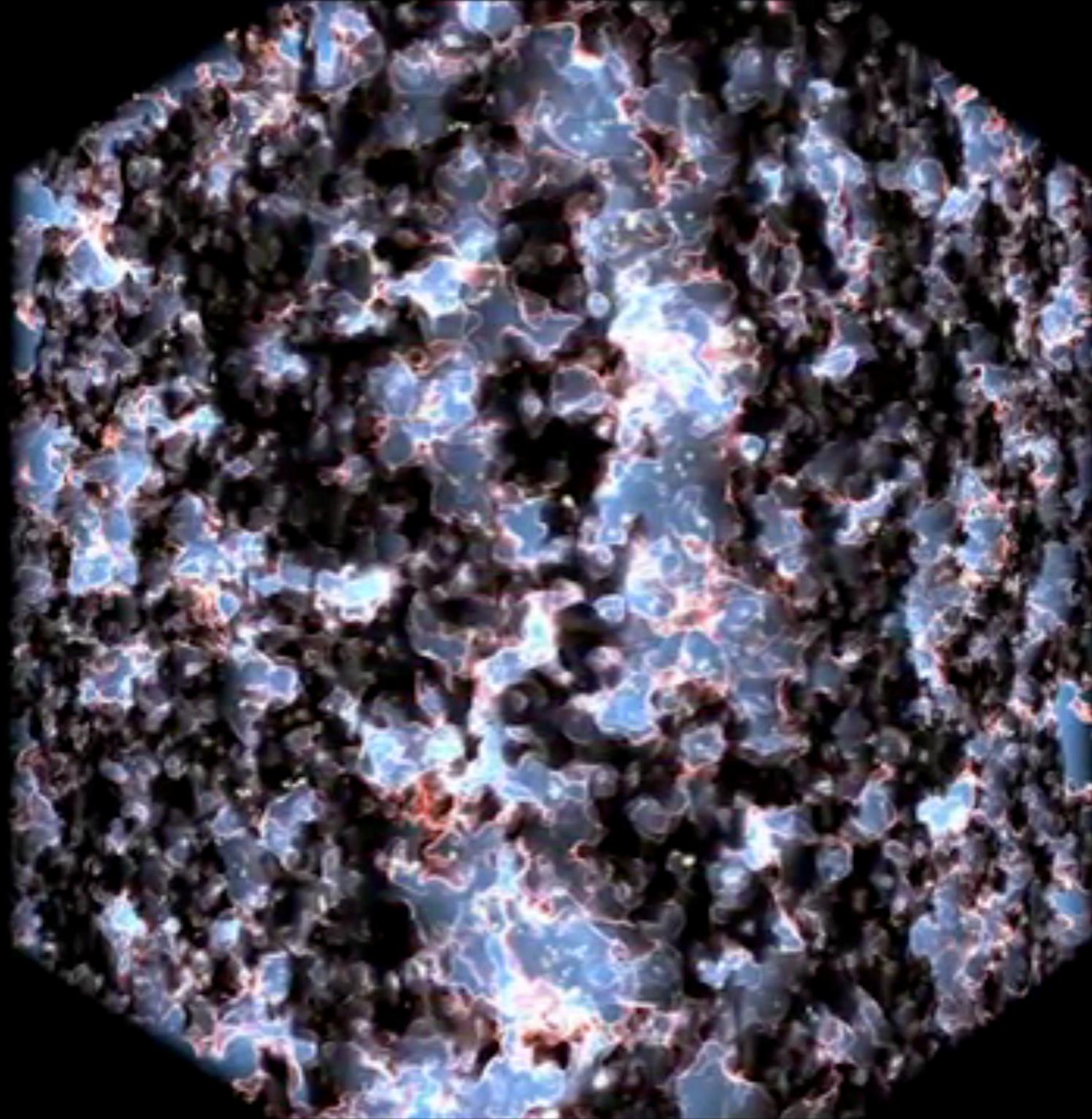


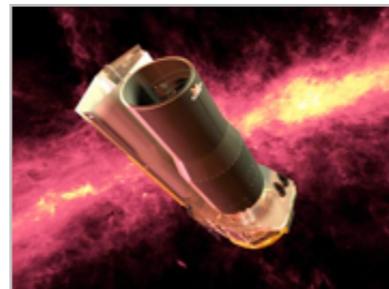
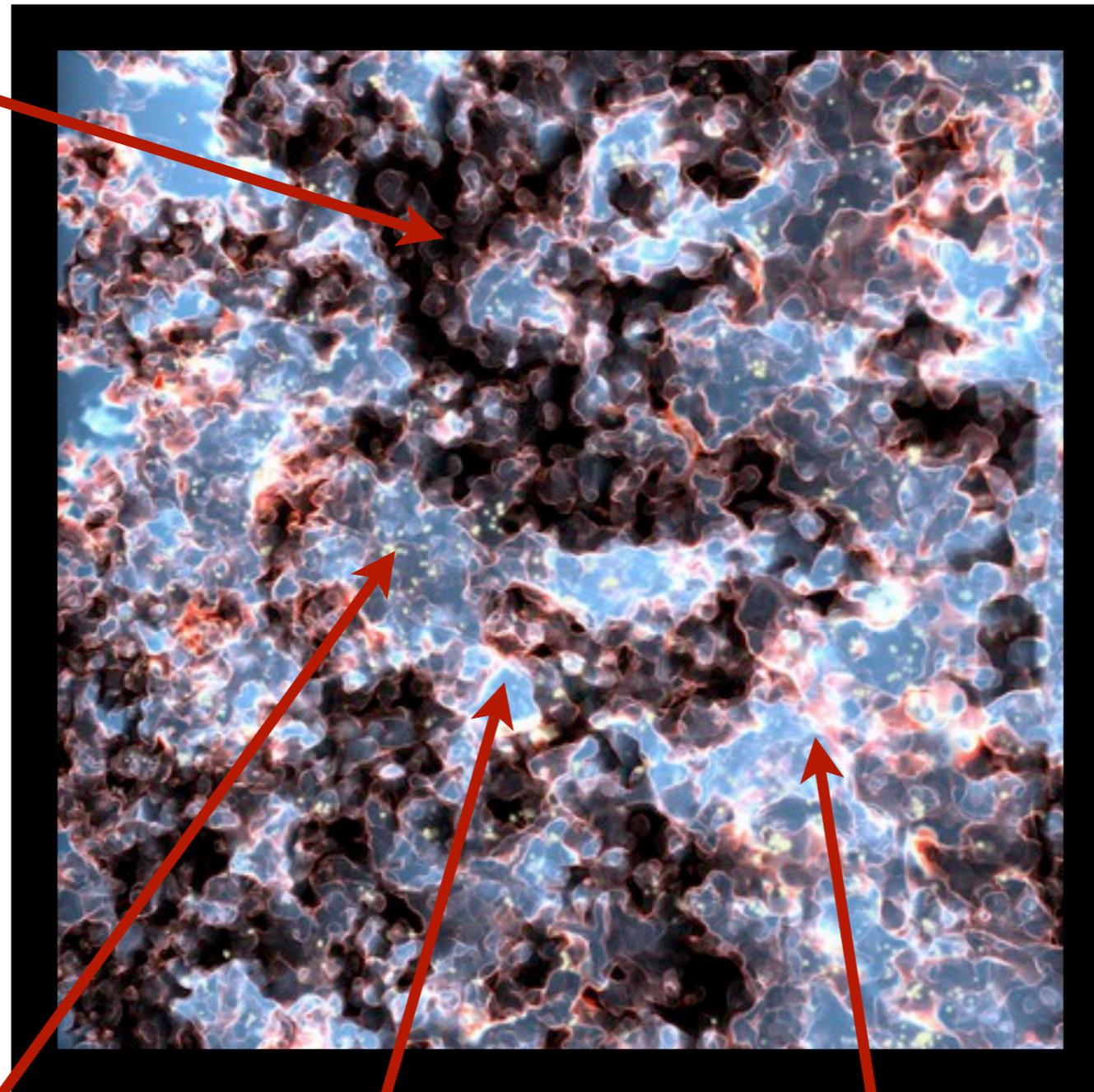
Scrutinizing the Epoch of Reionization



Probes of the EoR and its Sources



→ SKA1-LOW



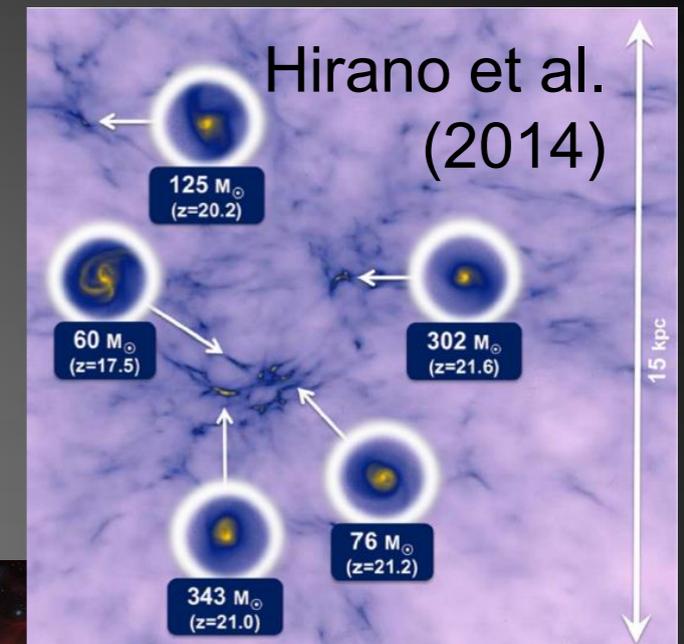
→ SKA1-MID

The Physics that we are trying to constrain

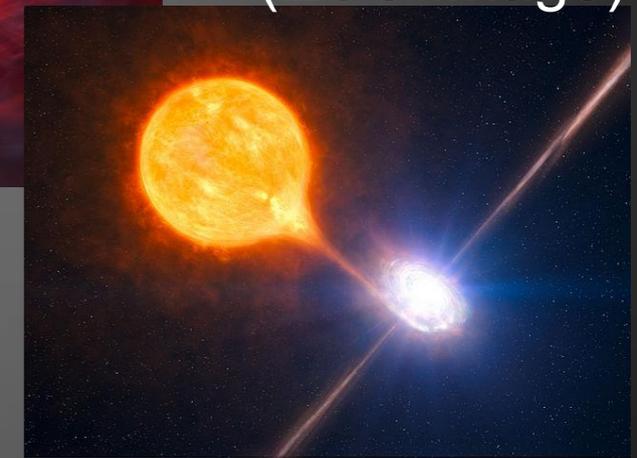
Unconstrained High-z Universe

- Minimal mass of star forming halos and efficiency of star formation:
 - Cooling mechanism, feedbacks
- Star formation efficiency
- Sources of UV and X-rays

Our goal: to explore the full parameter space of the global 21-cm signal resulting from the astrophysical parameters of the high-redshift universe.



A black hole binary (ESO image)

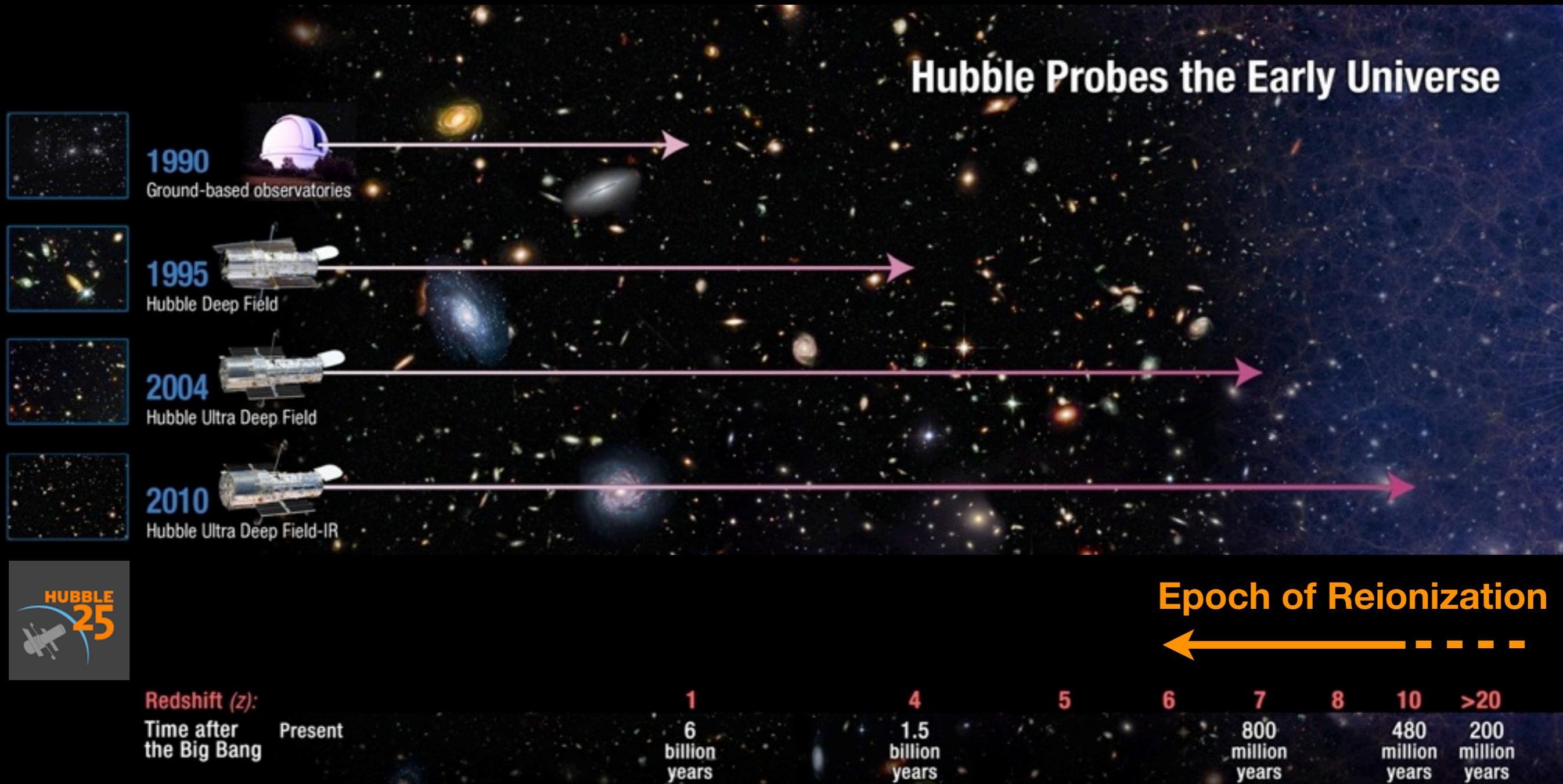


Slide from Anastasia Fialkov

These are the same parameters that we are trying to constrain from galaxy observations

The history of astronomy is a history of receding horizons.

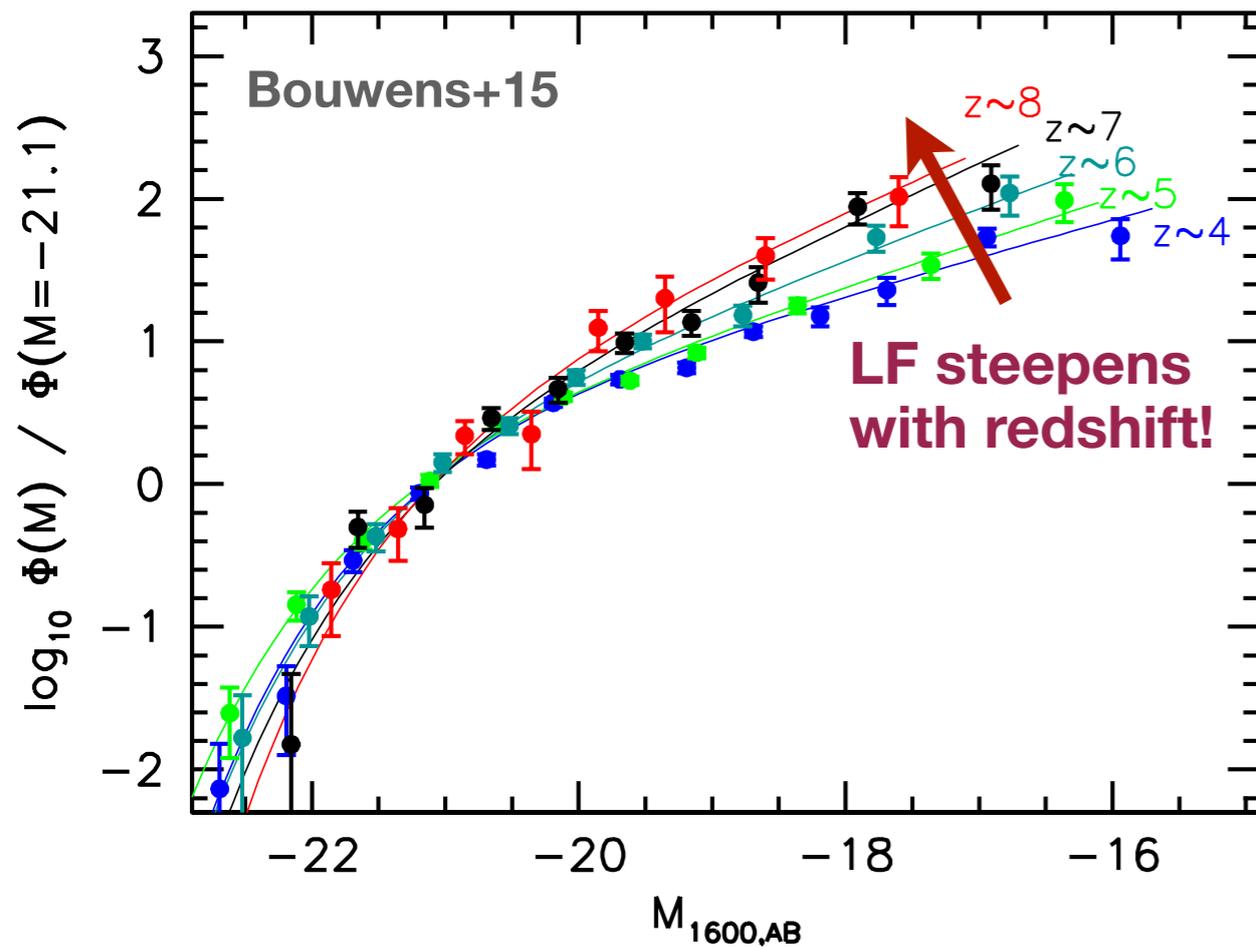
E. P. Hubble



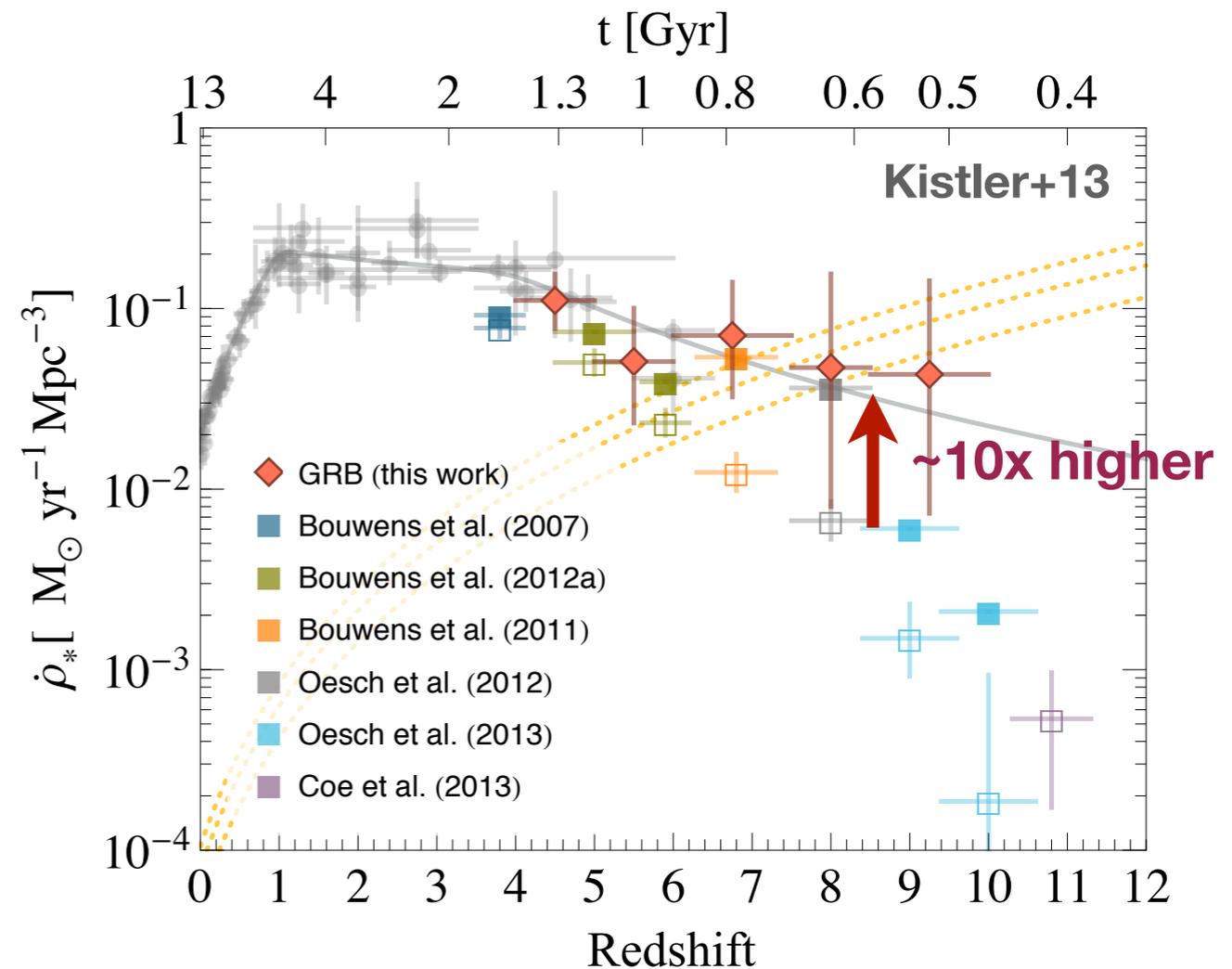
Faint Galaxies Dominate the UV Flux at High-z

Independent evidence for dominant contribution of ultra-faint dwarf galaxies to total UV flux:

1: faint-end slopes of UV LFs

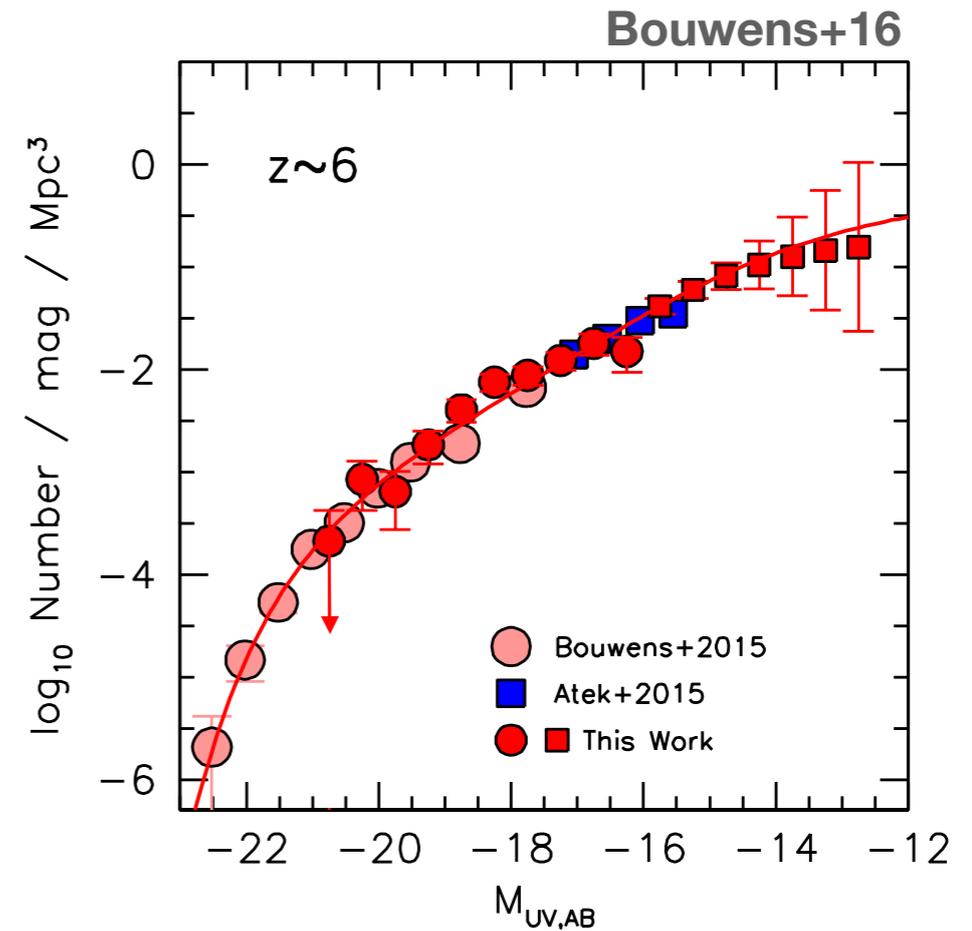
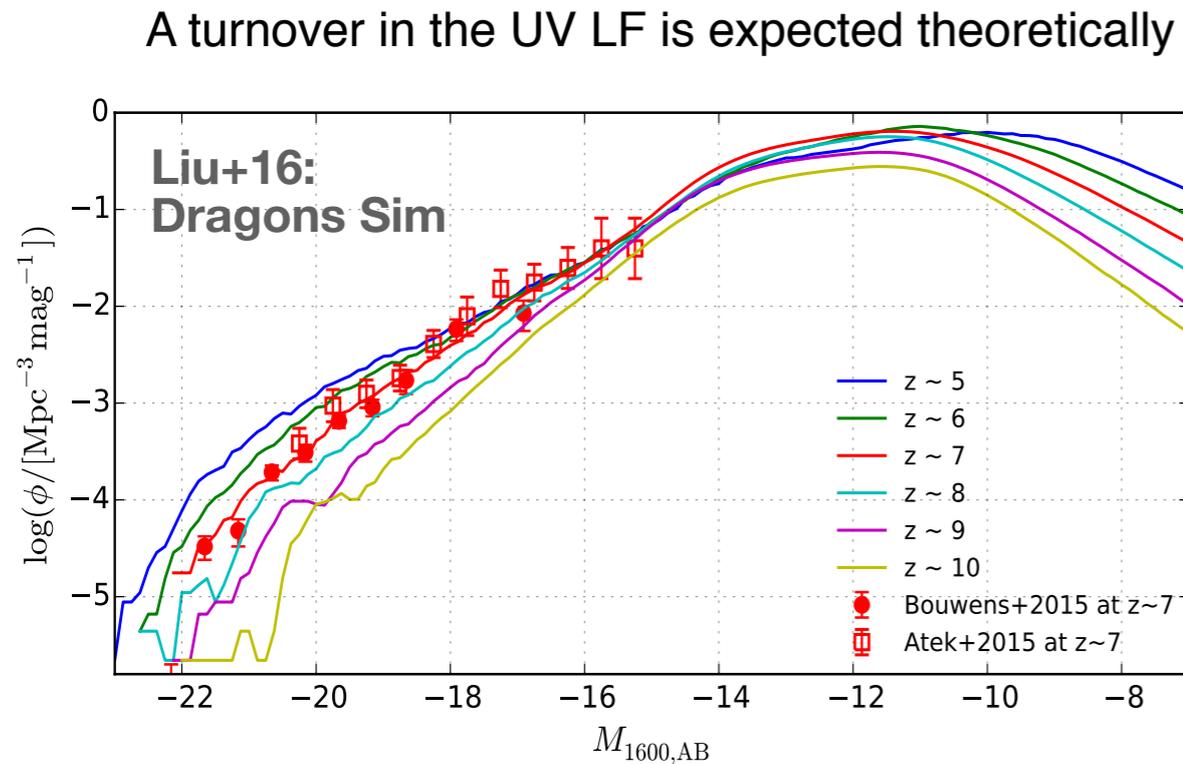


2: total SFRD traced by GRBs



(see also, e.g., Trenti+12, Robertson+12, Tanvir+12)

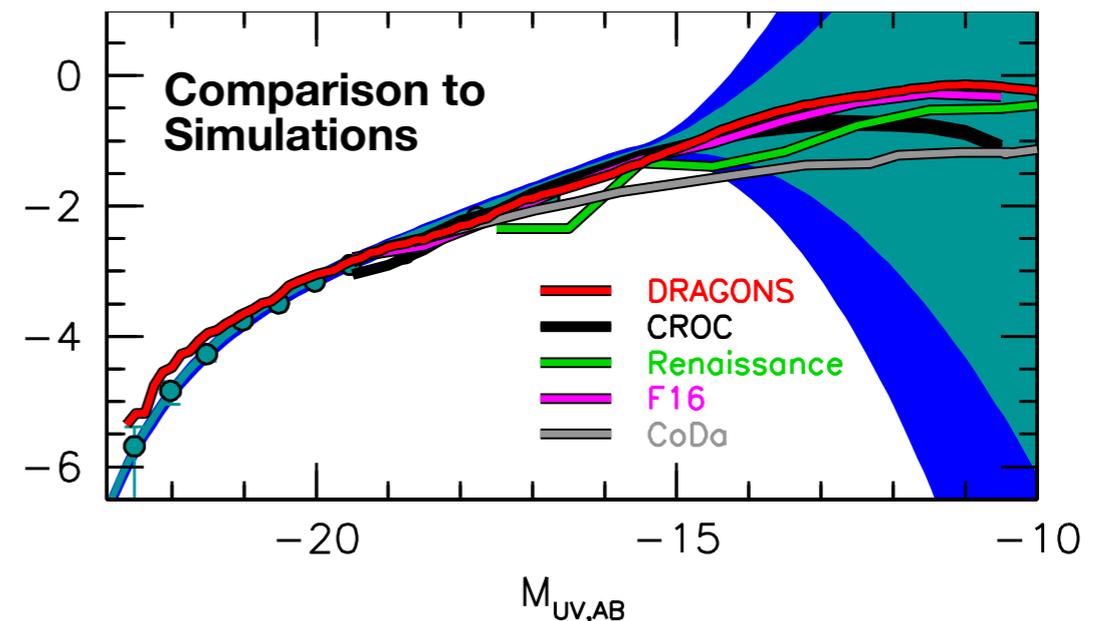
New Frontier: Faint-End Cutoff/Turnover?



Hubble Frontier Fields: can probe possible turnover in LF at faint luminosities thanks to lensing

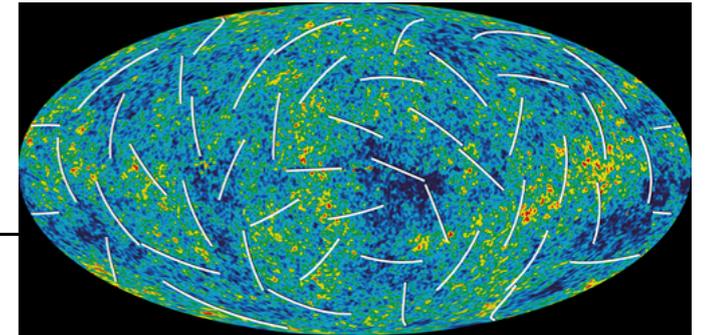
Can probe to $\sim 3\text{mag}$ fainter than HUDF, below that systematics due to lensing blow up

clear: LF continues steep at least to $M_{UV} \sim -14$, no turn-over detected so far

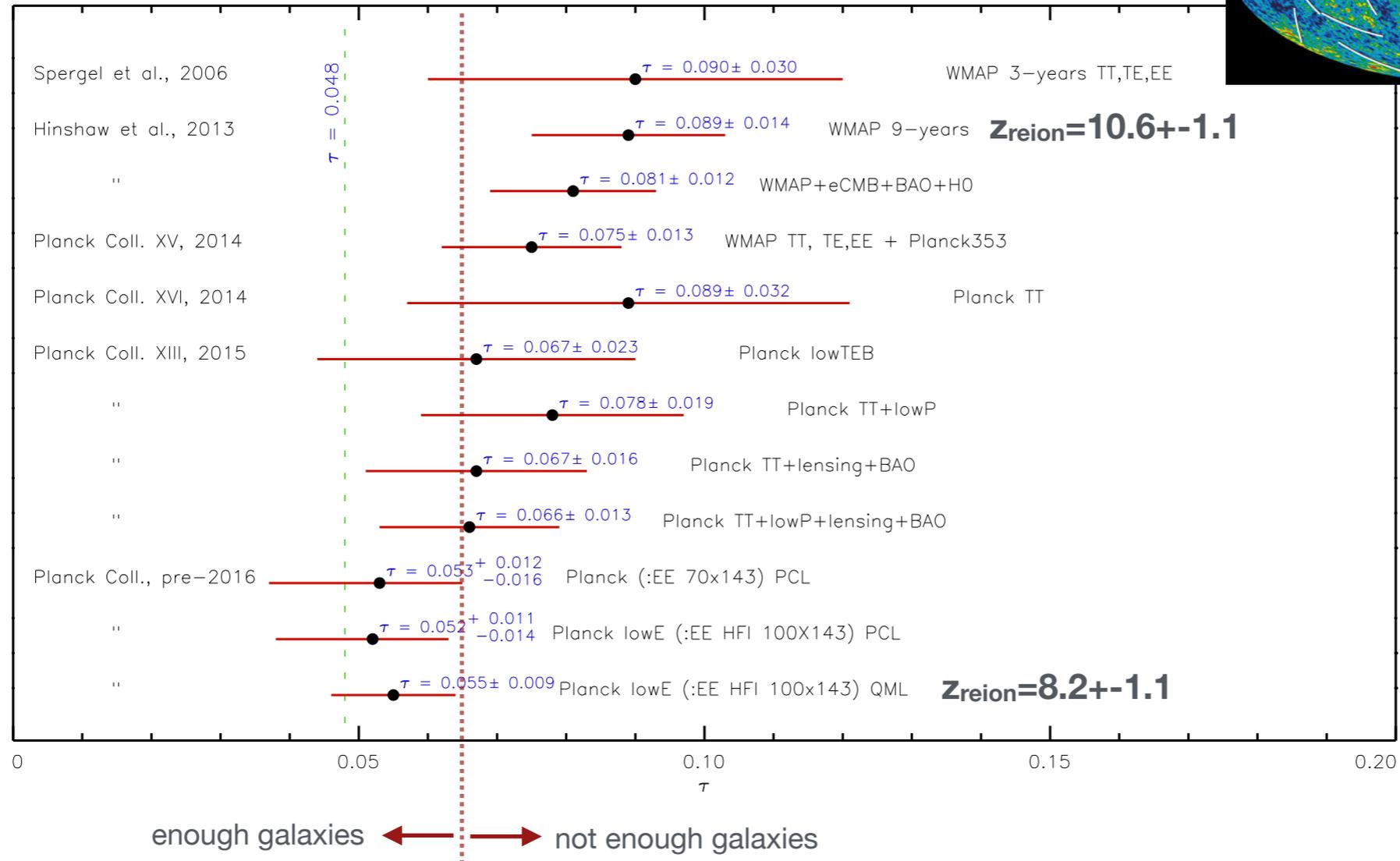


See also: Atek et al. 2015, Alavi et al. 2014, Castellano et al. 2015, Livermore et al. 2016, ...

The “Evolution” of the Redshift of Reionization



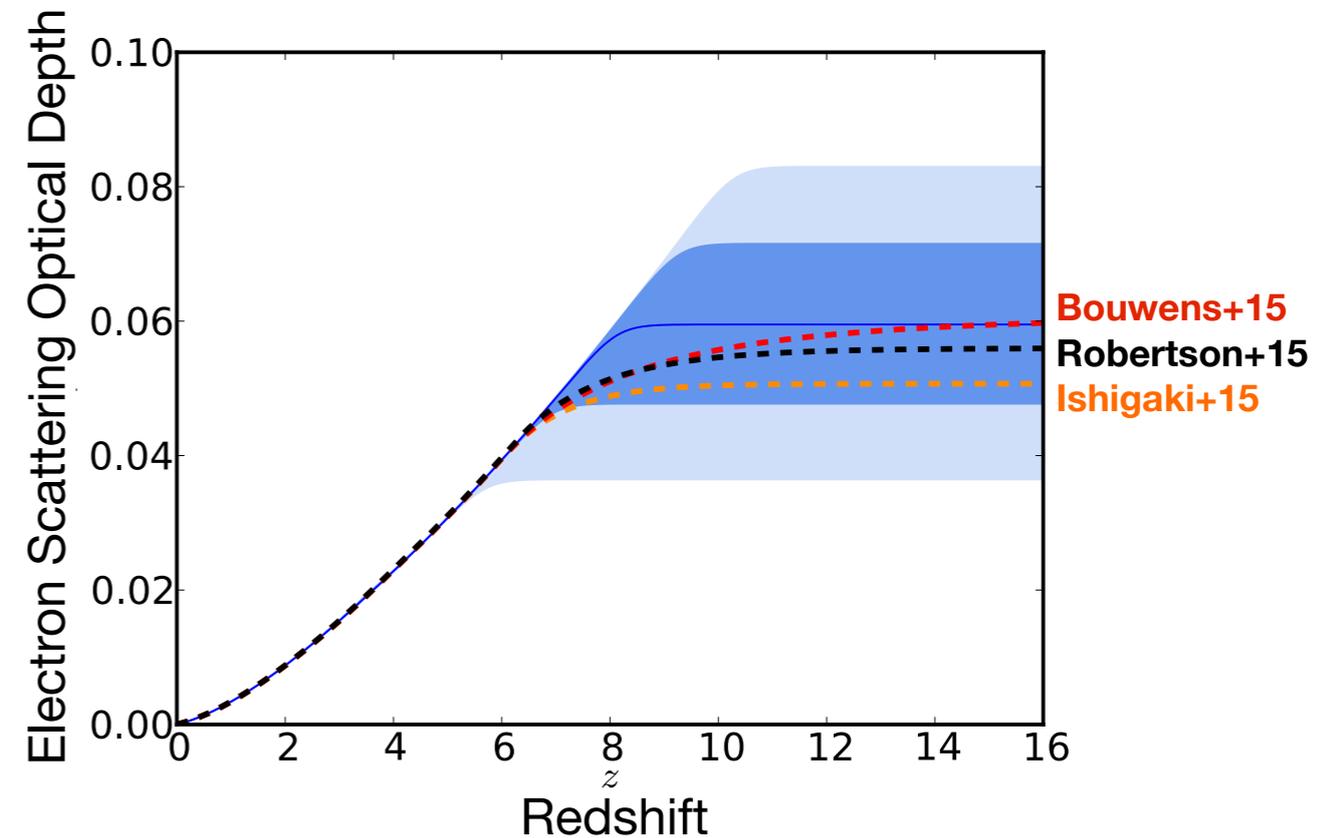
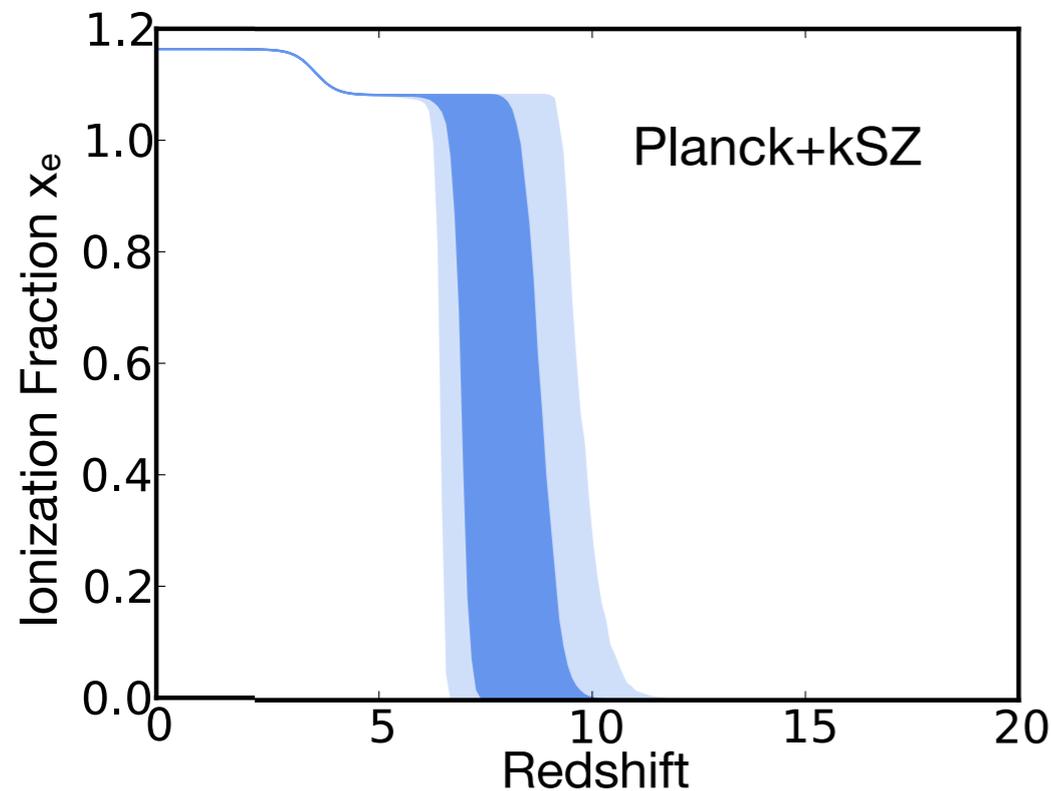
Planck intermediate results. XLVI.
Planck Collaboration: Large-scale polarization and reionization



Inferred value from Galaxy Evolution Studies $\tau_e \sim 0.065$

Lower limit: instantaneous reionization at $z=6$, i.e. $\tau_e = 0.039$

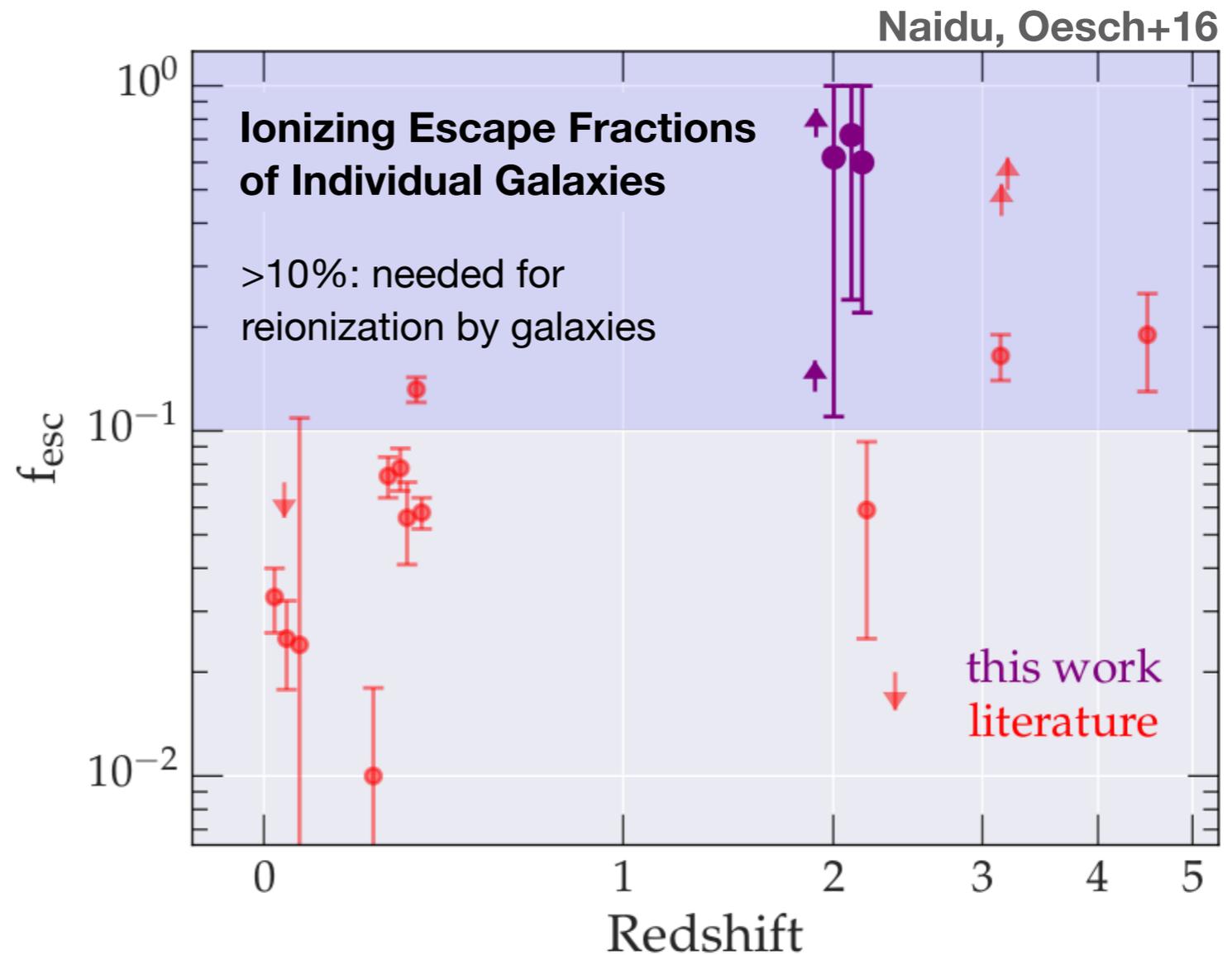
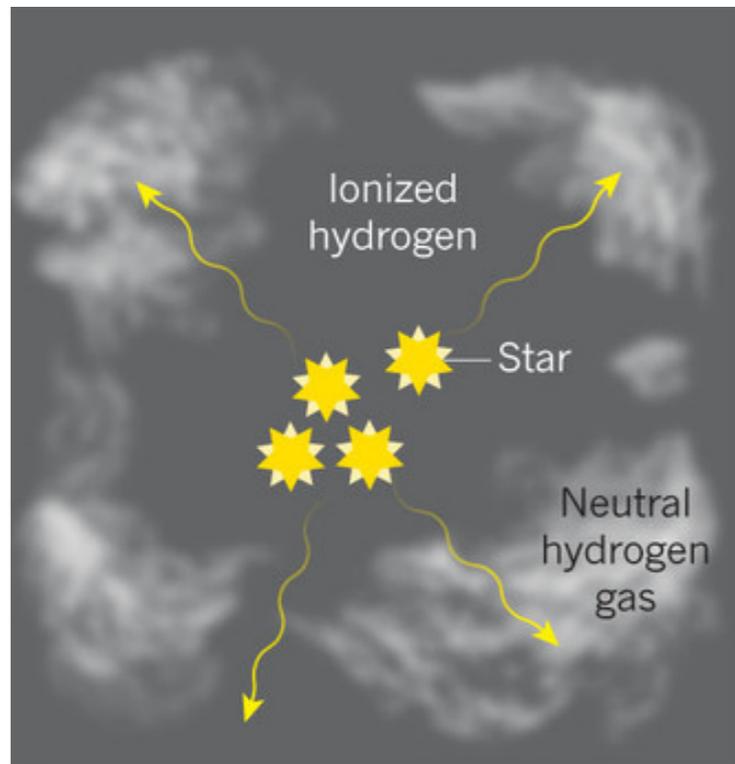
Consistency with Measurements of Reionization



New Planck polarization results (2016; XLVII.)
Early onset of reionization “strongly disfavoured”
 $\tau_e = 0.058 \pm 0.012$, i.e. $z_{\text{reion}} = 8.2 \pm 1.1$

Galaxy population is completely consistent with driving reionization now.

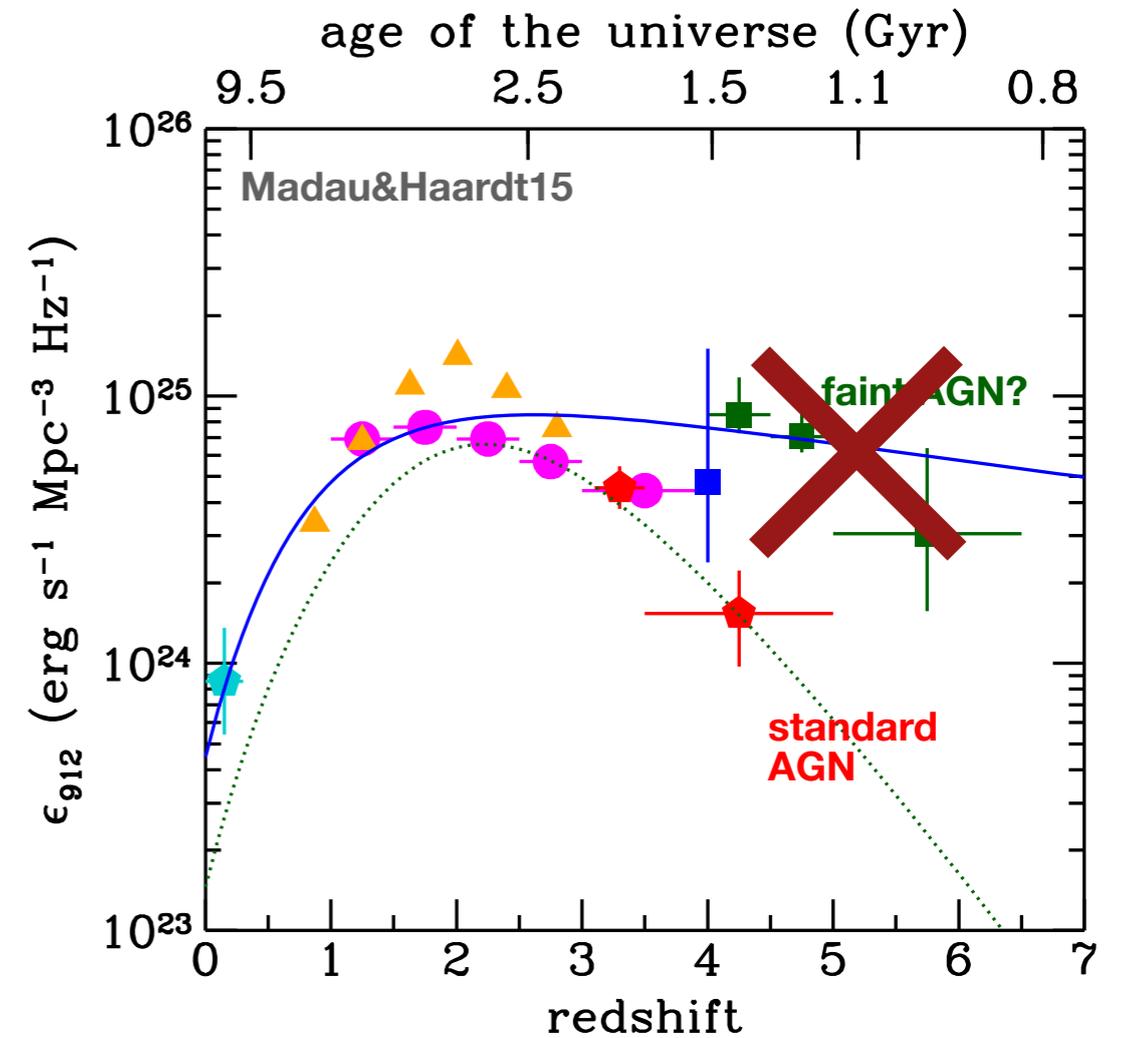
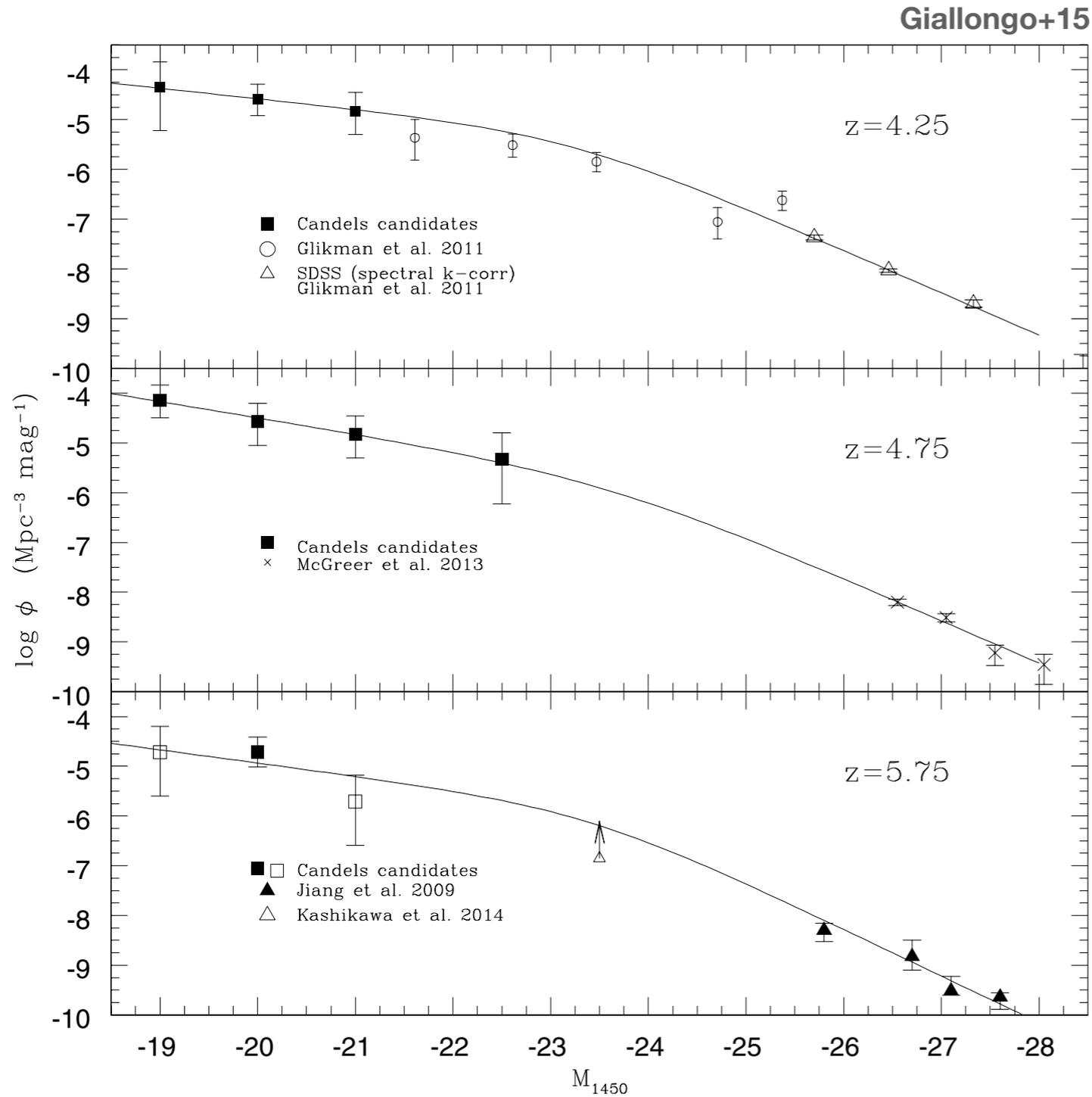
Escape of Ionizing Photons?



Escape fraction of ionizing photons is the most uncertain parameter for reionization studies.

Recent progress: some sources at high redshift certainly have high enough f_{esc}

What about Quasars?

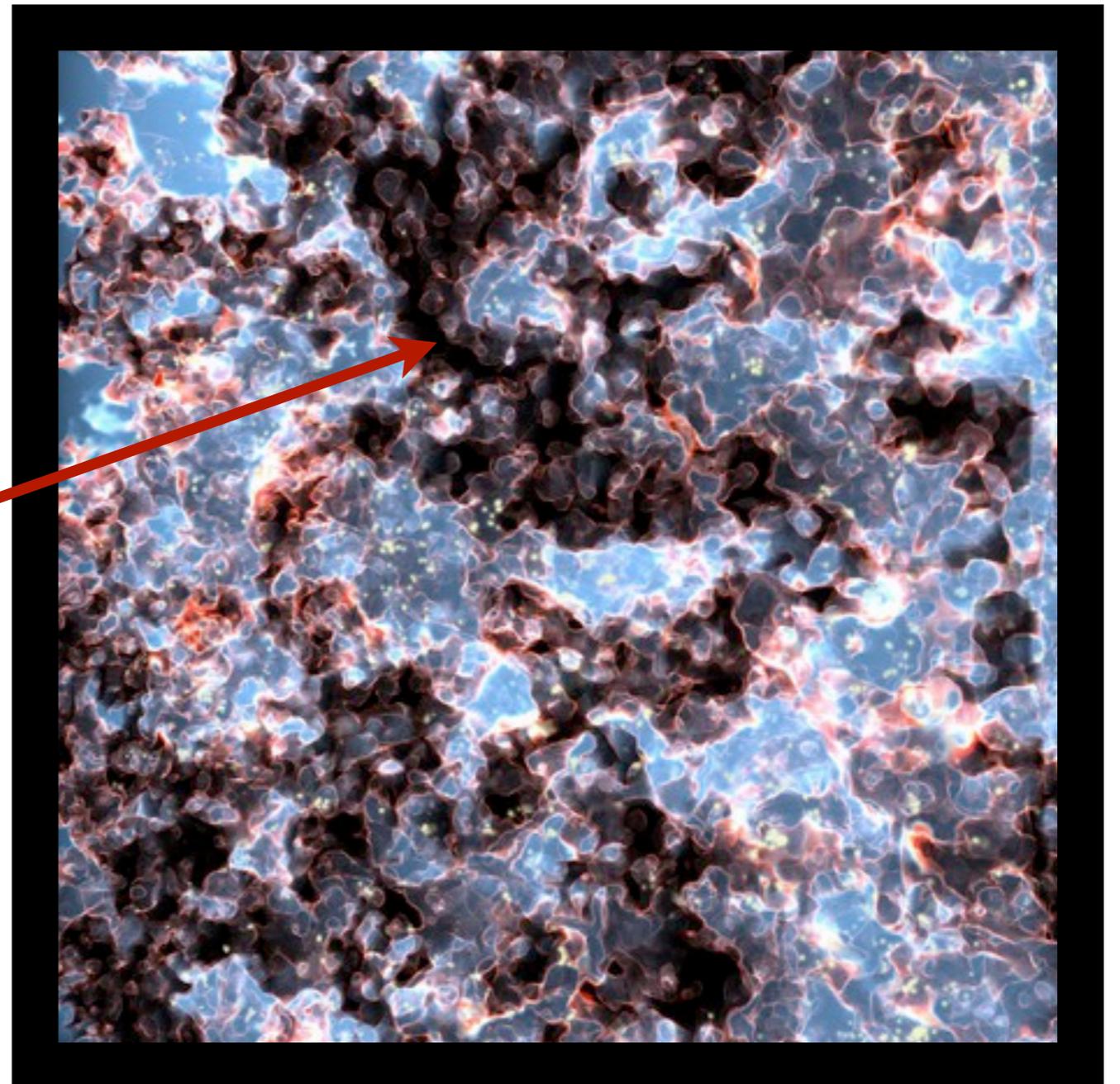


The “Dark Side” of Reionization - 21cm



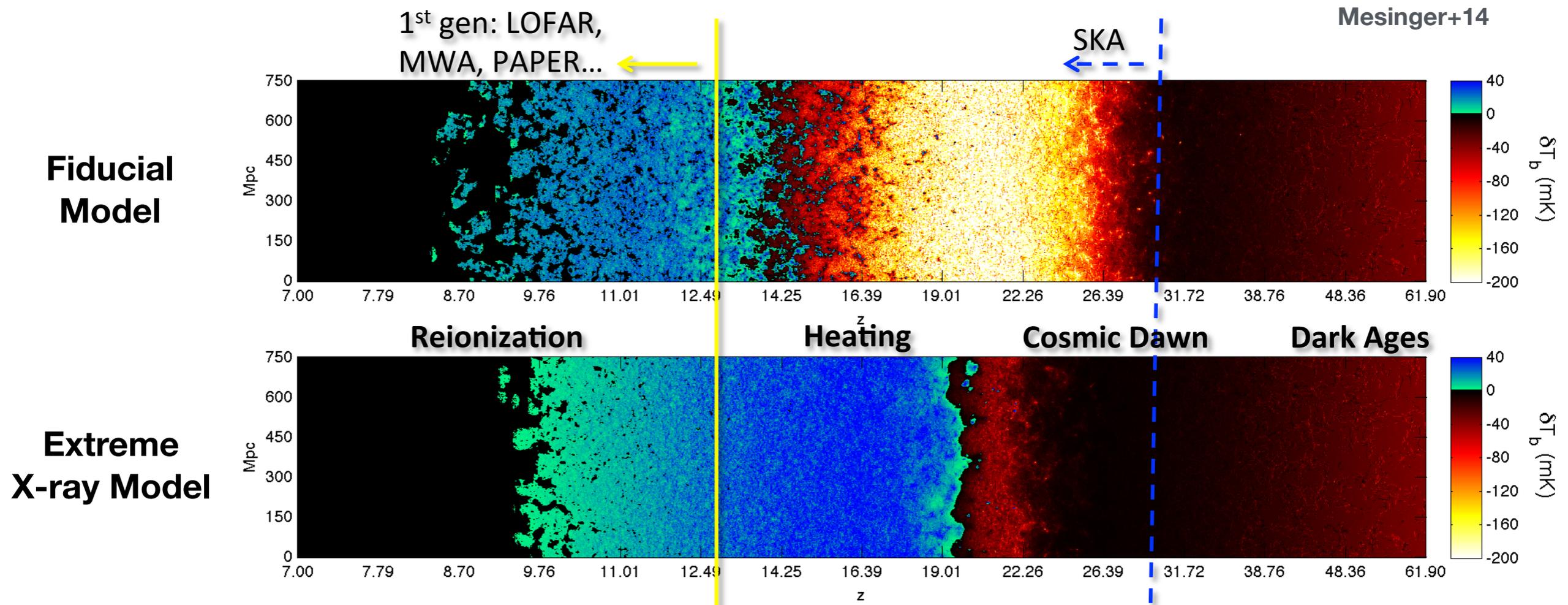
**MWA, DARE, PAPER,
HERA, EDGES, SKA, ...**

Tomography,
Duration,
End of Dark Ages,
Topology



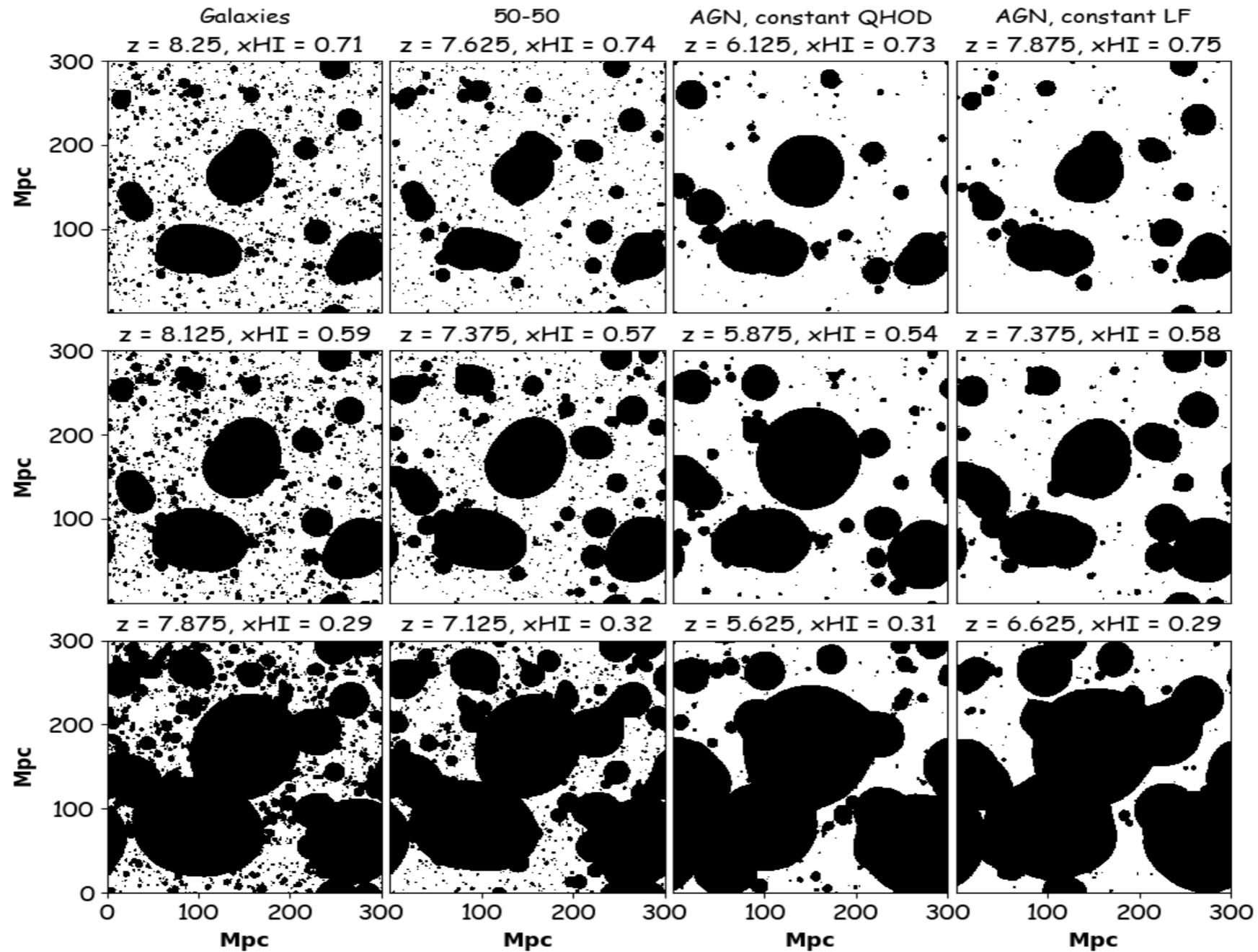
simulation: Alvarez et al. 2009

The EoR in 21cm



Evolution of 21cm emission/absorption is strongly dependent on physical parameters of star-formation in DM halos

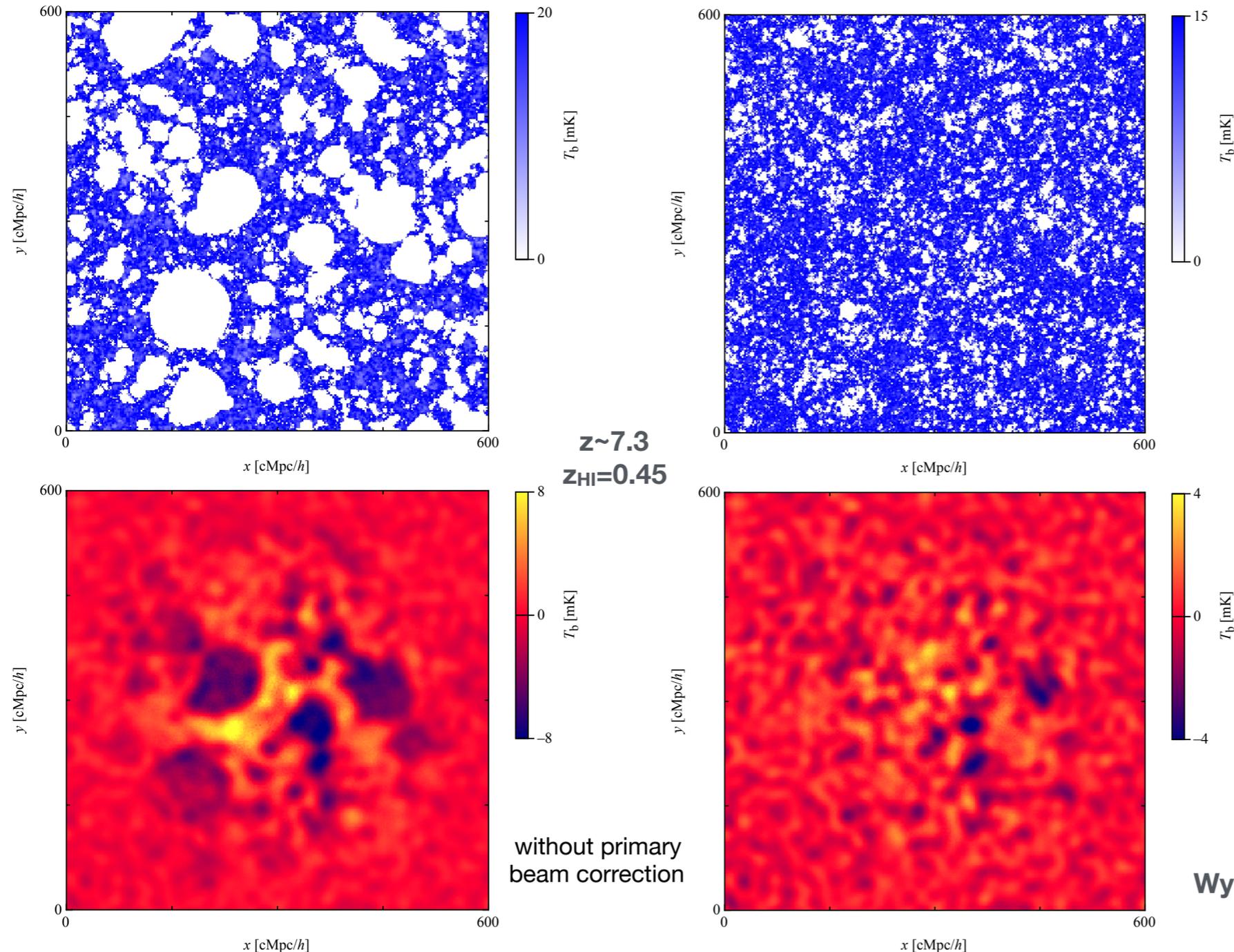
EoR Topology Depends on Sources of Reionization



Hassan+17

Imaging the EoR - Constraints on Galaxy Formation

Two models of feedback, same neutral fraction



Extremely exciting possibility to directly identify sources of reionization and the ionized bubbles they create!

Build a completely self-consistent model of high-redshift galaxy formation during the EoR

We are in an excellent position here at UniGE+EPFL: MOONS+EUCLID+SKA..

Question: How feasible is this?

Simulated observations with SKA1-LOW: 1000hrs