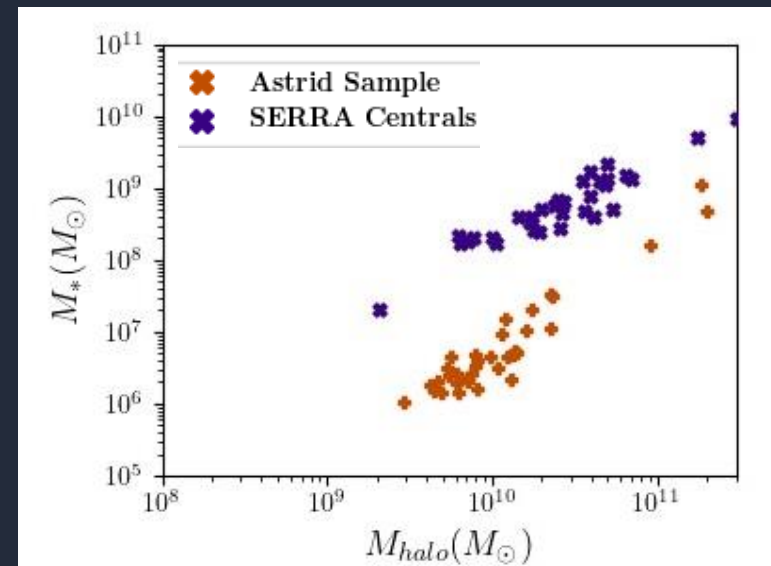
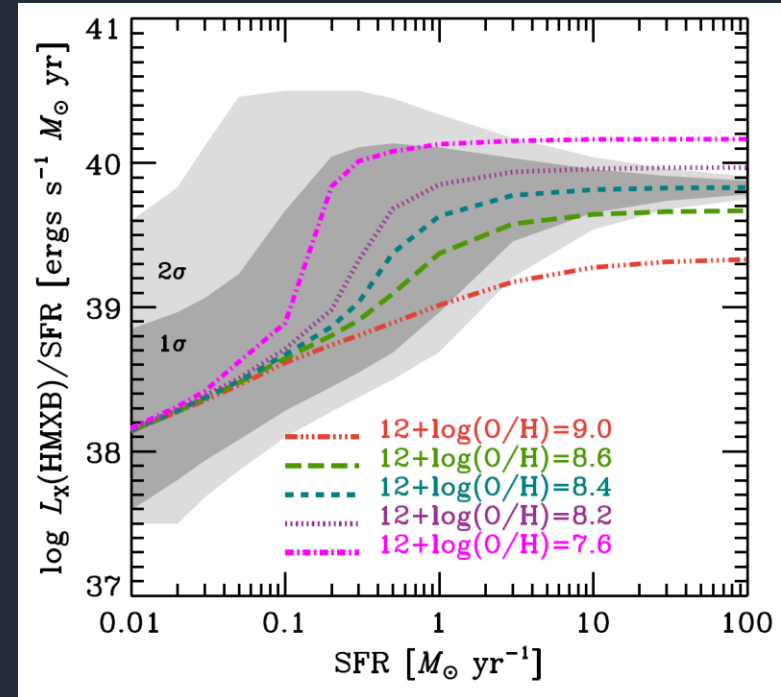


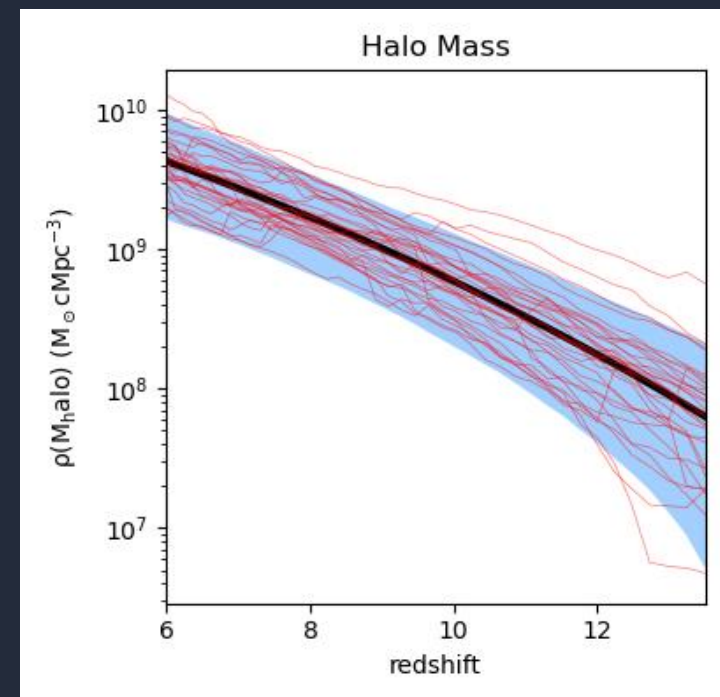
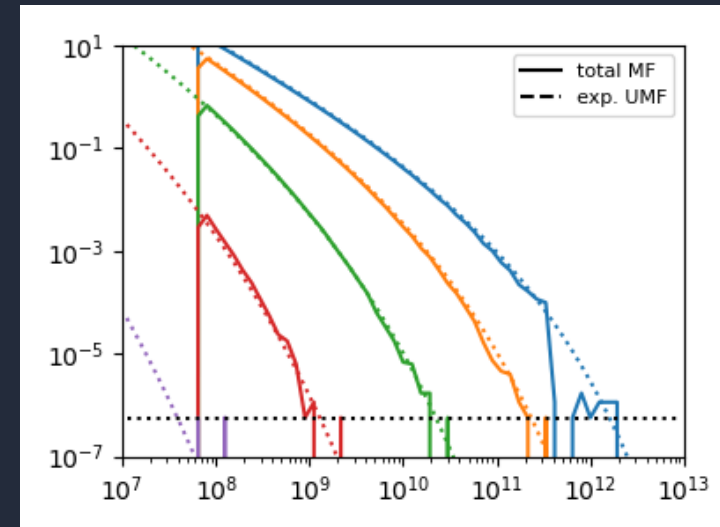
Stochasticity in Early Galaxies

- Observations show significant scatter in the properties of galaxies, and there is significant disagreement in high-redshift galaxy property distribution in simulations, particularly toward lower masses.
- We aim to infer the distributions and correlations between galaxy properties from observations of both galaxies and IGM using fast, flexible models.
- We have developed a stochastic source model for the semi-numerical code 21cmFAST which will not only include the effects of stochasticity, but the resulting discrete source fields will allow us to compare with observations dependent on source properties. Extending the range of observations we can use for inference.

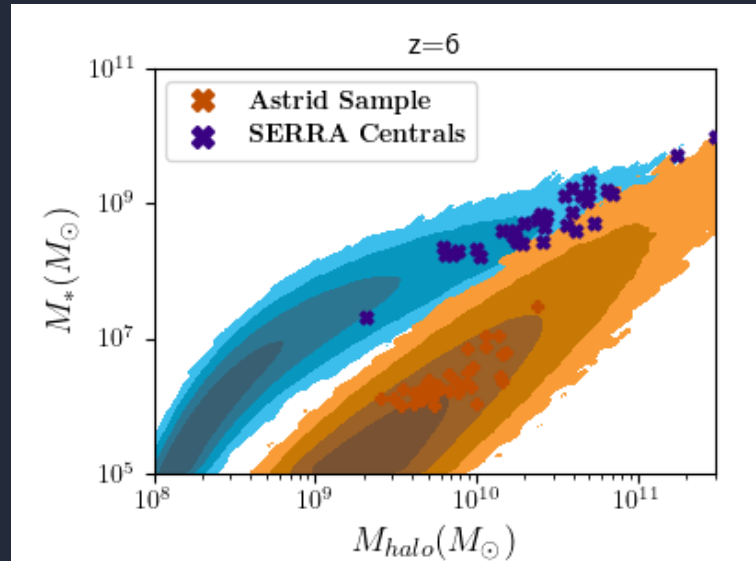


New features in 21cmFAST

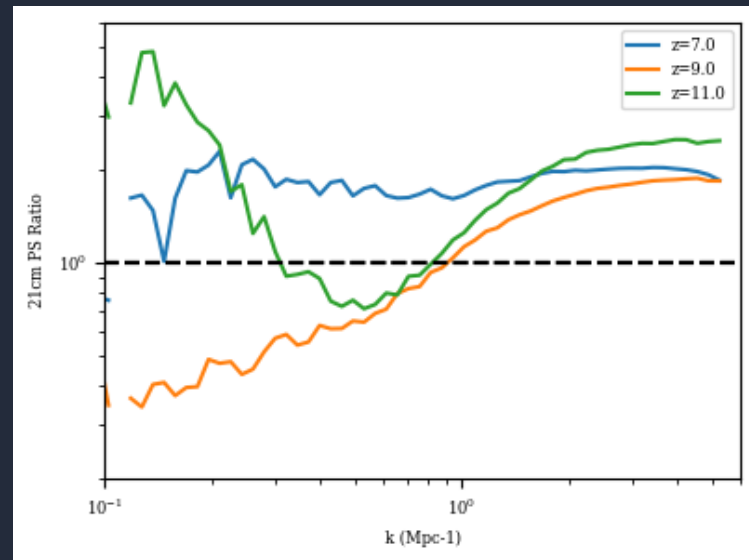
- A Stochastic source model which samples any given conditional mass functions and scaling relations to produce a discrete source population on the cell scale
- A simple merger tree implementation which keeps dark matter halos consistent with the mass functions across cosmic time
- Free parameters controlling the scatter in the SHMR and SSFR
- Updates to radiative background calculations which to take advantage of the discrete source field
 - An exponential filter to model a redshift-dependent ionising mean-free path (e.g Davies & Furlanetto 2021)
 - X-ray emissivity calculated self-consistently from halo properties at a particular distance/redshift using a spherical shell filter
- Fully consistent with existing excursion-set halo finder (DexM) to find halos above the cell-scale
- Outputs both halo catalogues and gridded quantities
- **Runtime down to 10^8 solar masses is less than double the default, with many optimizations to come!**



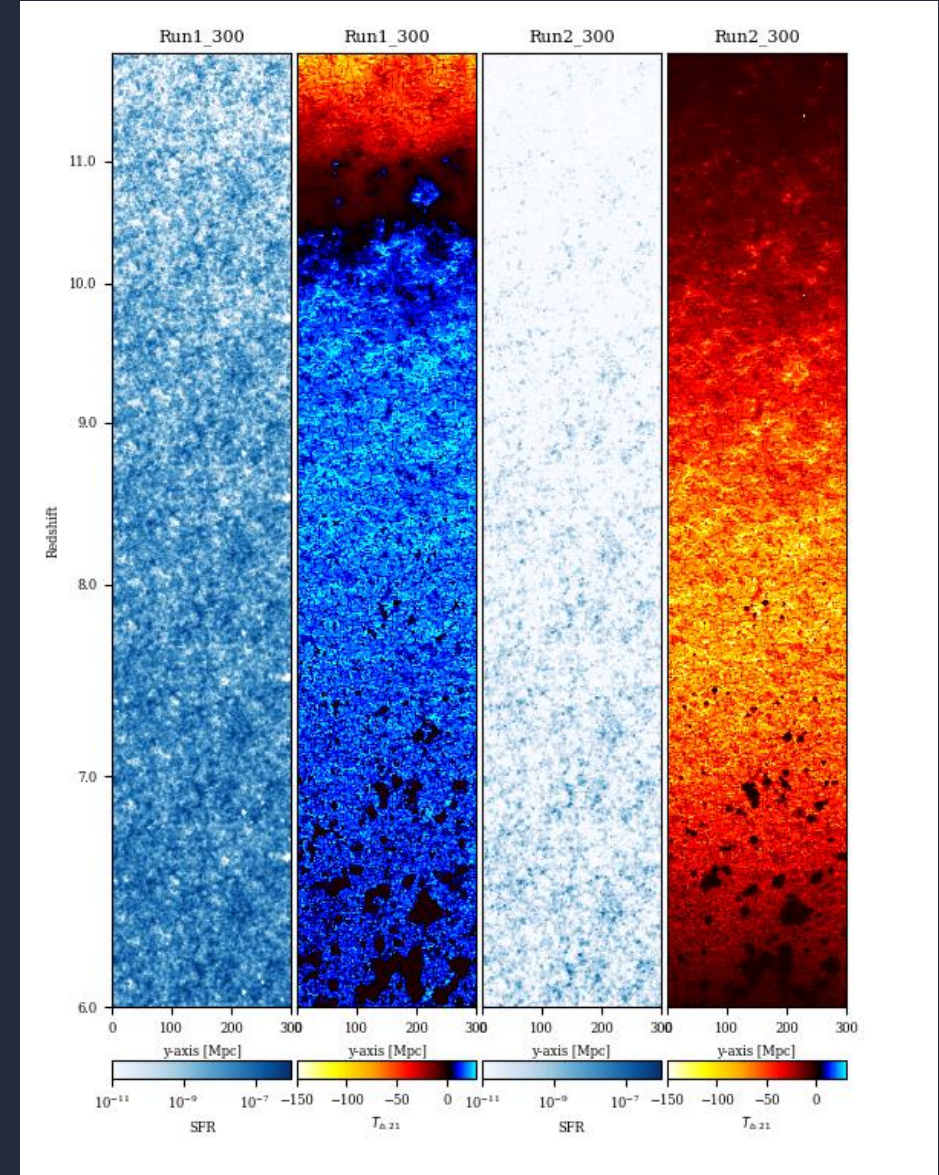
Flexible Stochastic Model



Calculate radiation
fields from galaxies



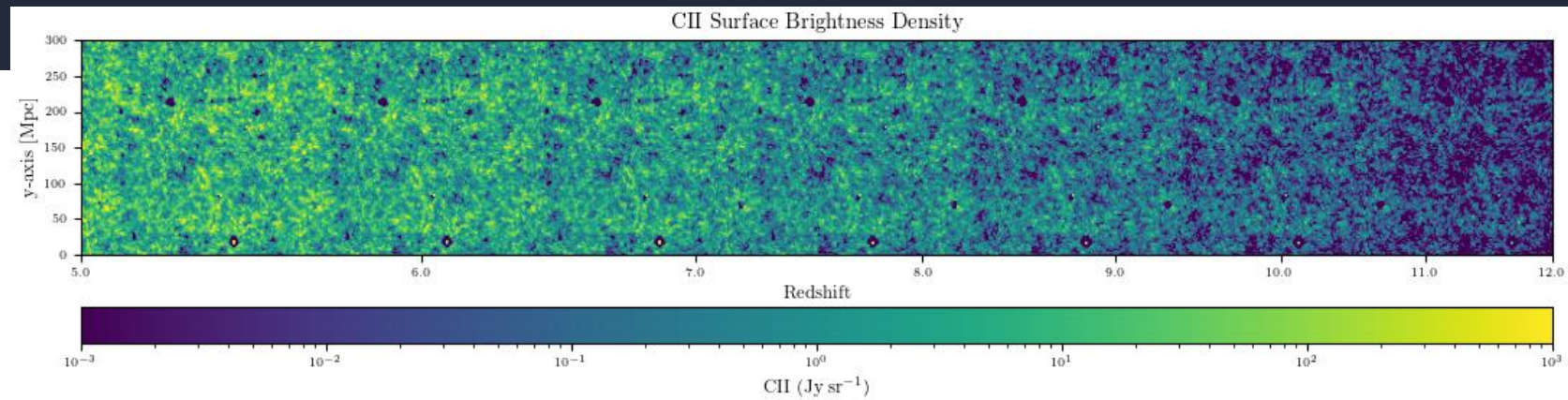
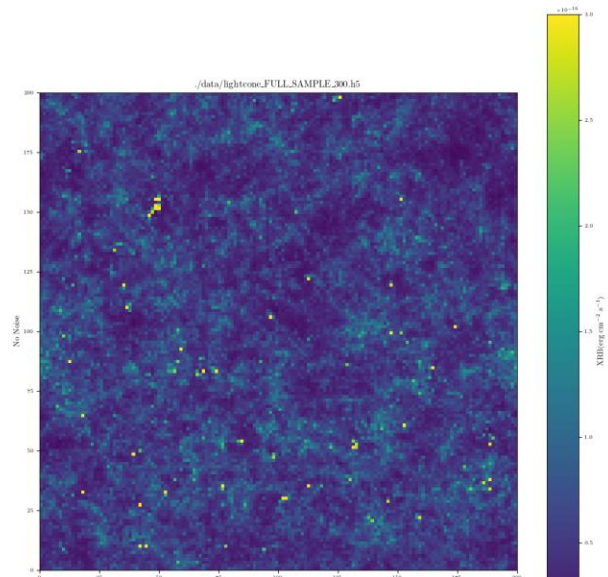
Extract statistical
properties



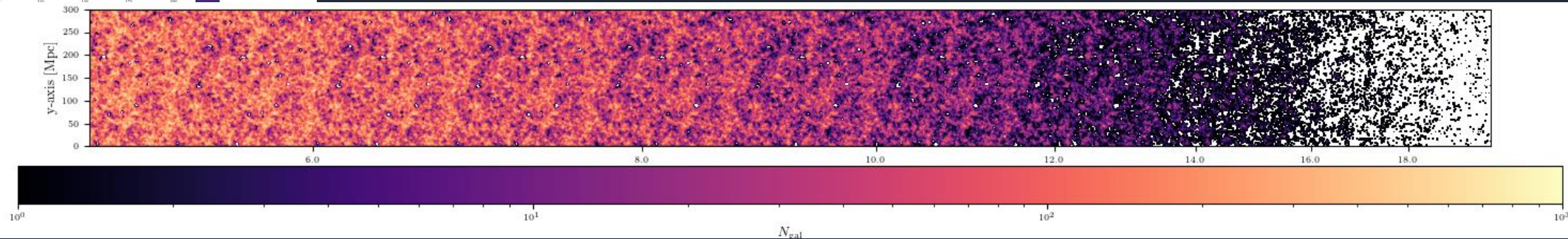
New Observables

Line Intensity Maps

X-Ray



Galaxy Number Density



Github Branch

- **21cmFAST branch:**
Stochastic option will soon be merged into the main 21cmFAST repository

