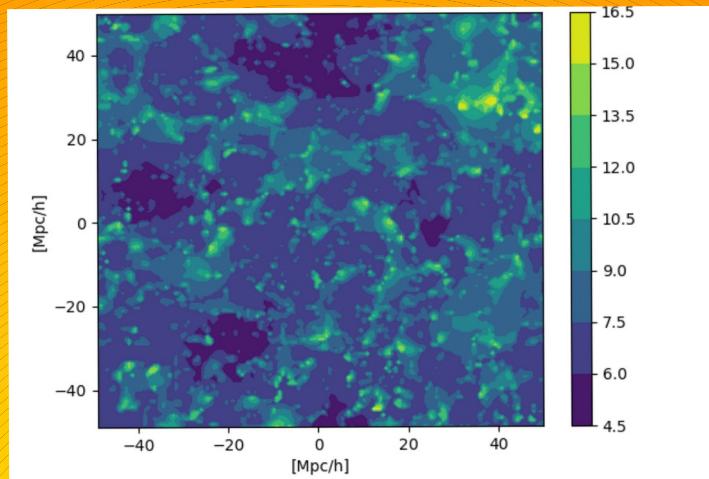


Linking 21cmFASt with z-reion : the adventure



By : Hugo Baraer

Cosmic Dawn group McGill University

Two reionization models

21cmFAST

- Physically accurate
- Computes the redshift of reionization field INDEPENDANTLY from the density field
- Not computationally efficient for high resolutions

Zreion

- Semi analytical model (purely math)
- Computes the redshift of reionization from the density field
- Computationally efficient for high resolutions

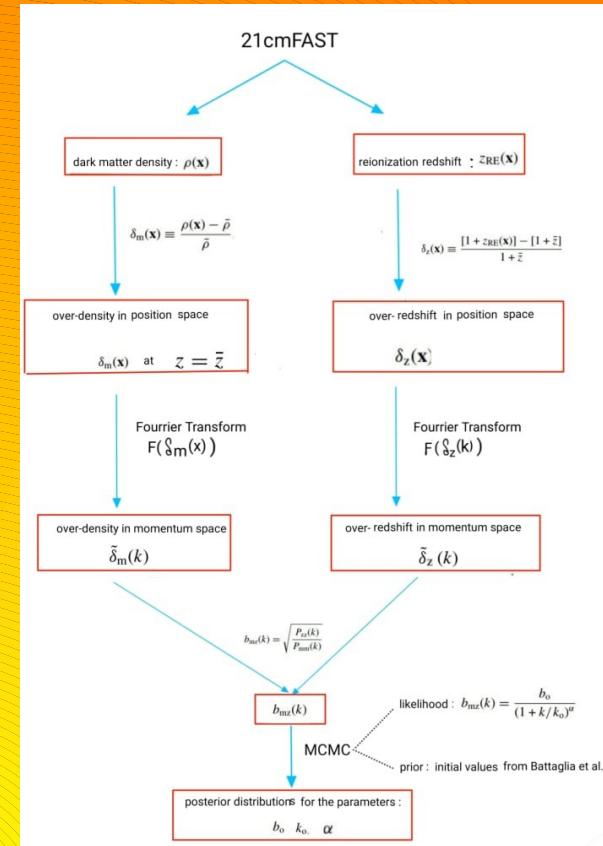
The initial project

$$\tilde{\delta}_z(k) = b_{mz}(k)\tilde{\delta}_m(k),$$

$$b_{mz}(k) = \sqrt{\frac{P_{zz}(k)}{P_{mm}(k)}}$$

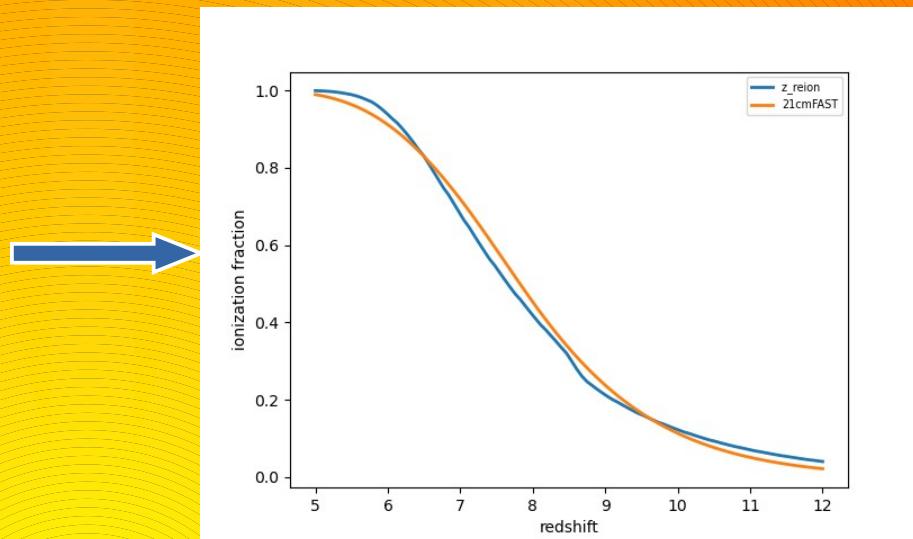
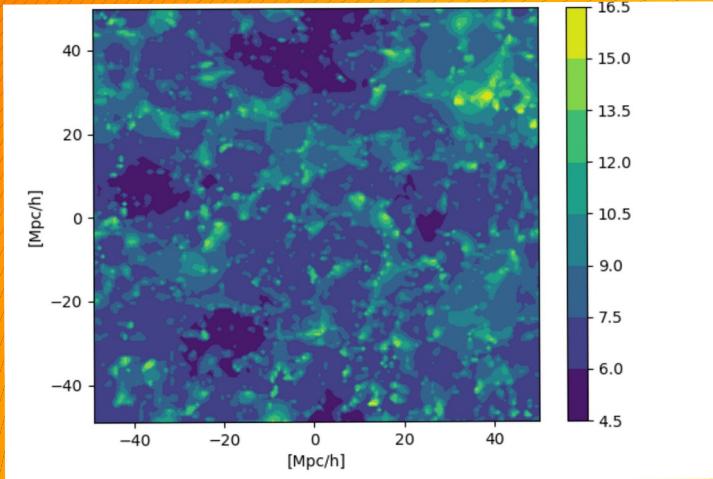
$$b_{mz}(k) = \frac{b_o}{(1 + k/k_o)^\alpha},$$

- Check the parameter variability



Ionization history

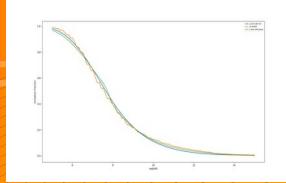
- Plug alpha, b_0, k_0 and z_re mean in zreion and get the redshift of reionization field to get the ionization history



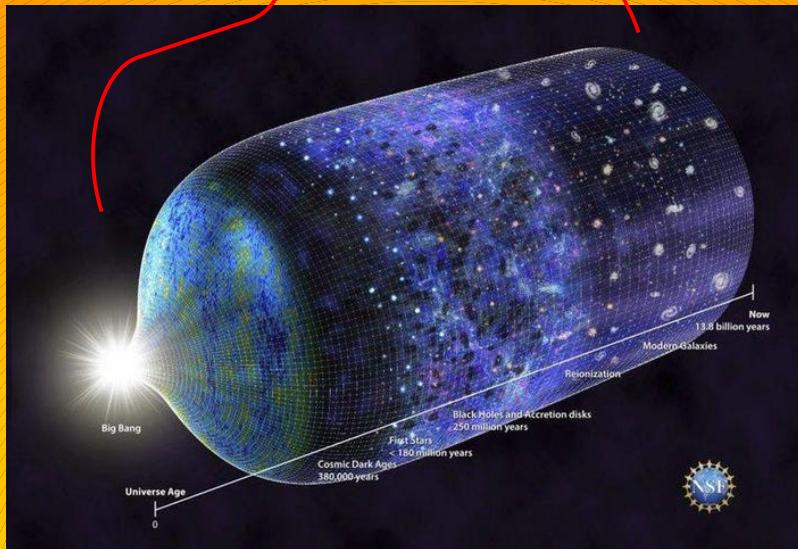
James work

- Computes the free parameter values from ionization history using machine learning





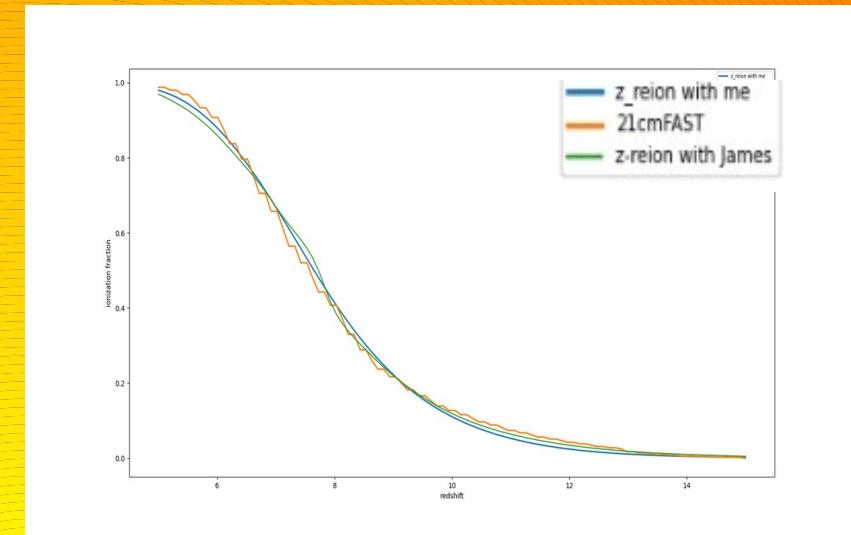
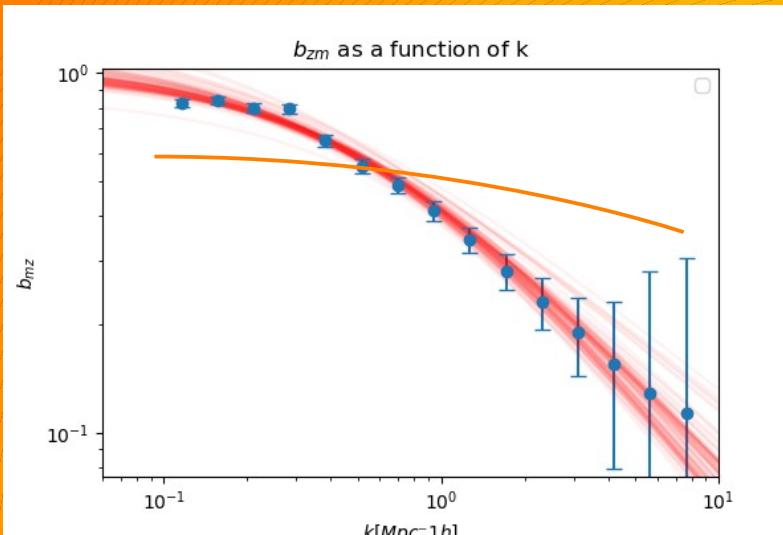
TAU



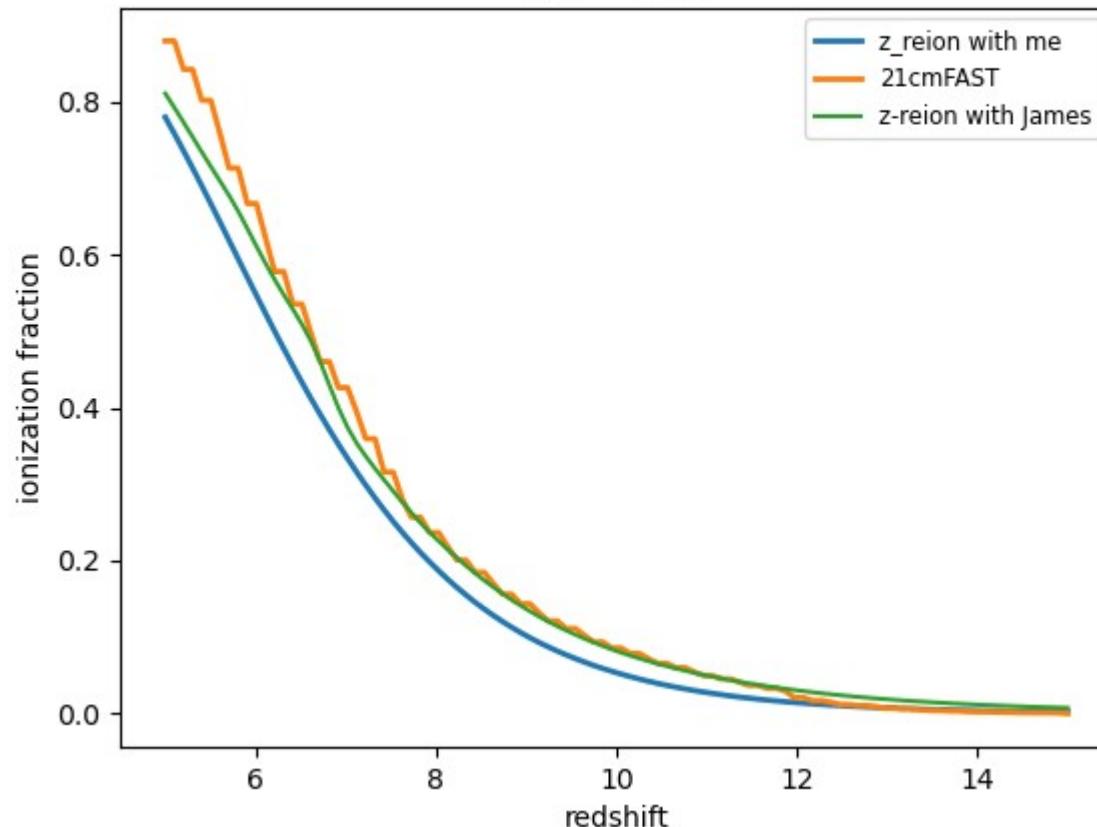
- James is interested in TAU
- Model independance
- Get the ionization history from single ionization map⁶

The findings

- Different parameter value, same ionization curves
- No exact power spectrum in the power spectrum

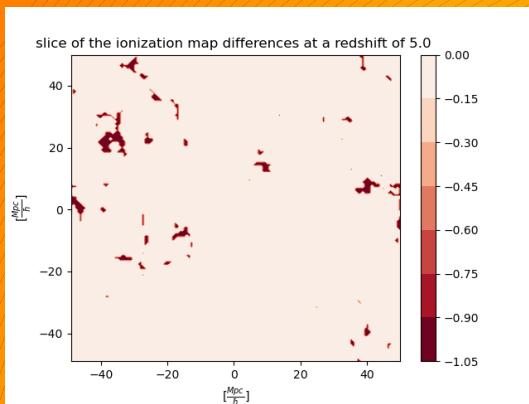


$H_{\text{eff}} = 20.0$

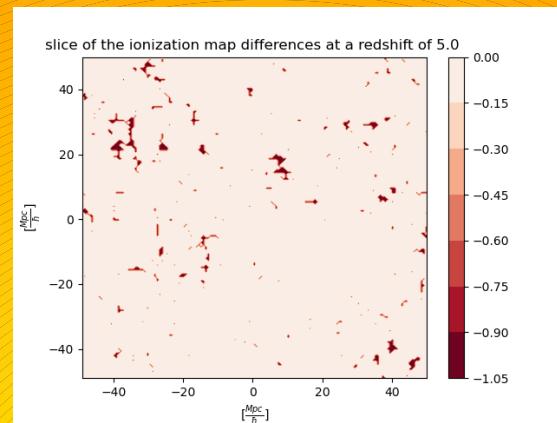


Differences in the ionization map

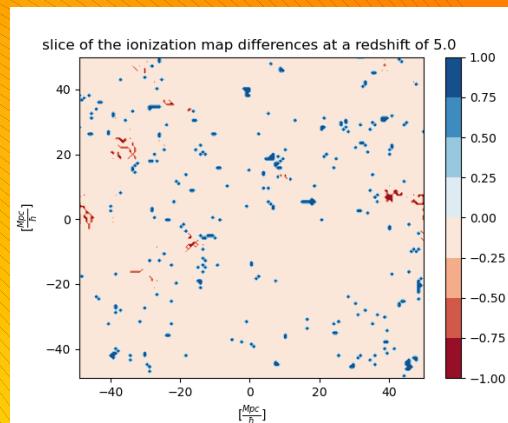
My values and 21cmFAST



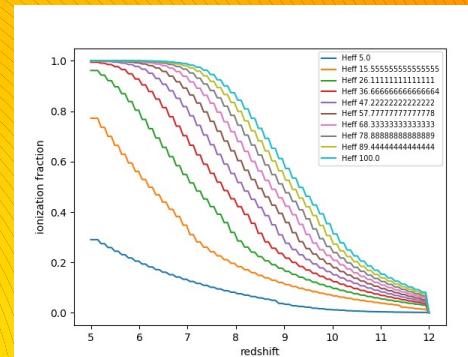
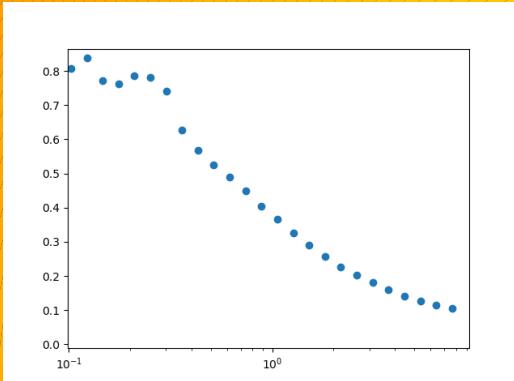
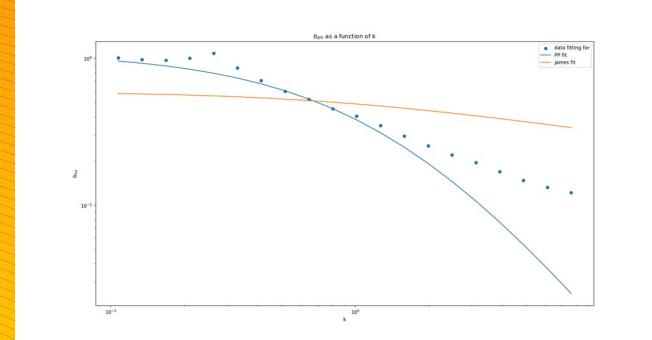
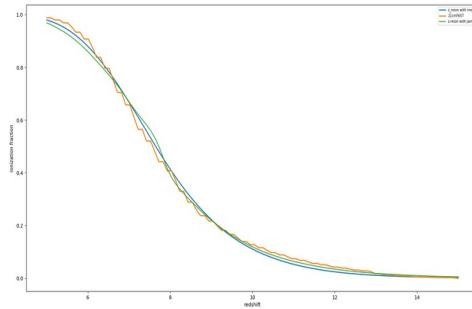
James values and 21cmFAST



James and me



The new perspective

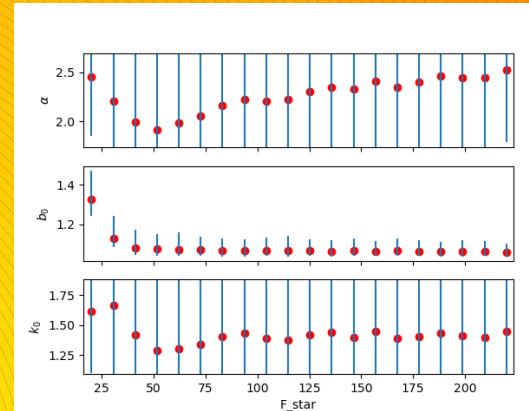


But how?

- Compute similar power spectrum with different 21cmFAST input
- Example F_{star} versus F_{esc}

What do we do next?

- Transdimensional MCMC to figure out link between 21cmFAST inputs and parameters
- Further push model stability with Paul's idea

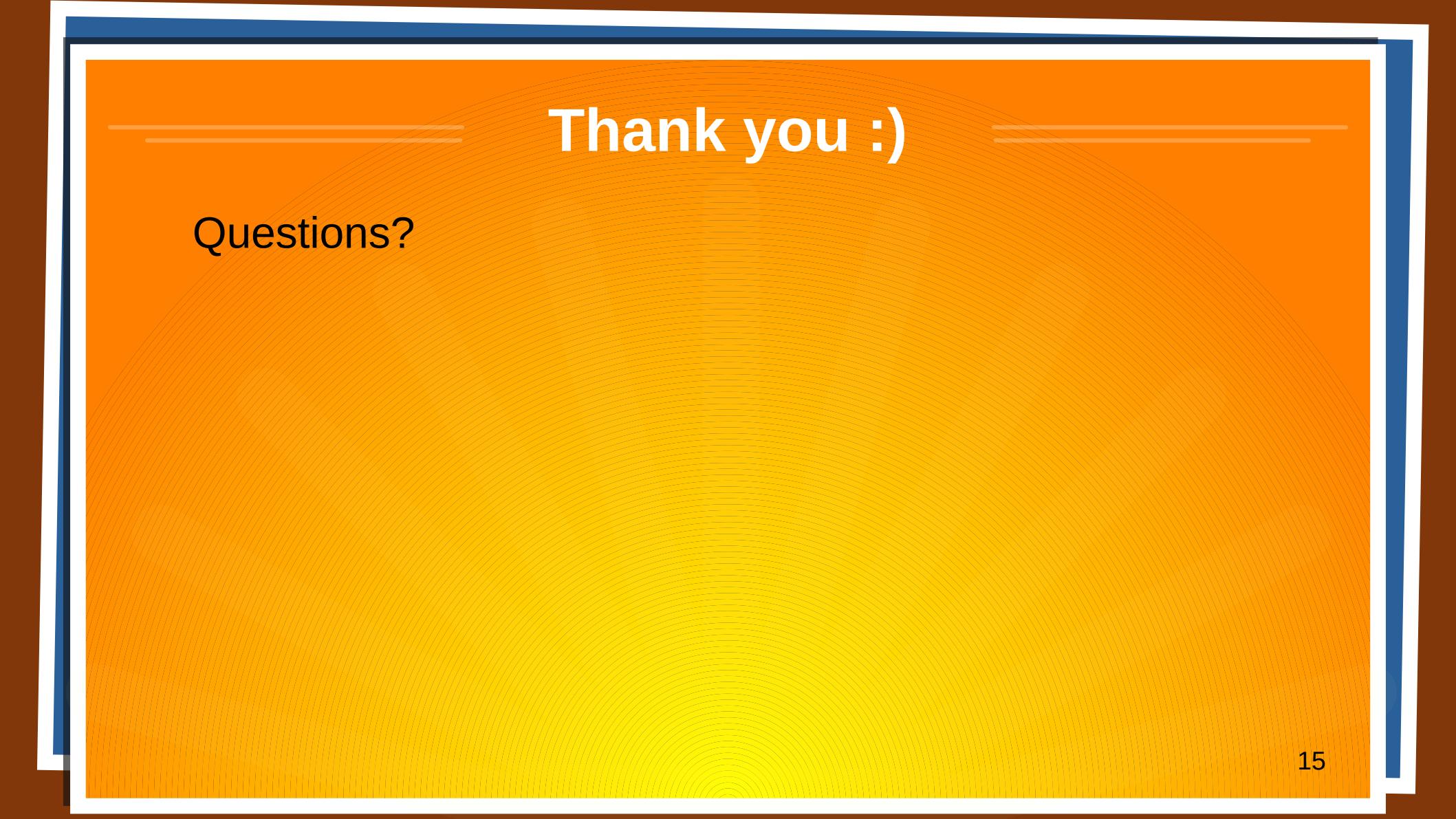


Paul's idea

- Compute and compare the power spectrums of both redshift of reionization field (expect differences at high k)
- Play with the different mean of reionization when computing (remember the density field is redshift dependent)
- Include spin temperature
- Compare the brightness temperature of several redshifts (should look similar near the midpoint)

Other interesting stuff

- Qin et al. 2022 have a similar approach than z-reion to compute using EFT (perturbation theory) to compute 21cm field with density field (future comparison could be interesting)
- Sailer et al. 2022 can compute Tau from a 21cm field using EFT



Thank you :)

Questions?