

Tracking down reionization (using the IGM thermal history)

Elisa Boera (UCR)

G. Becker (UCR)

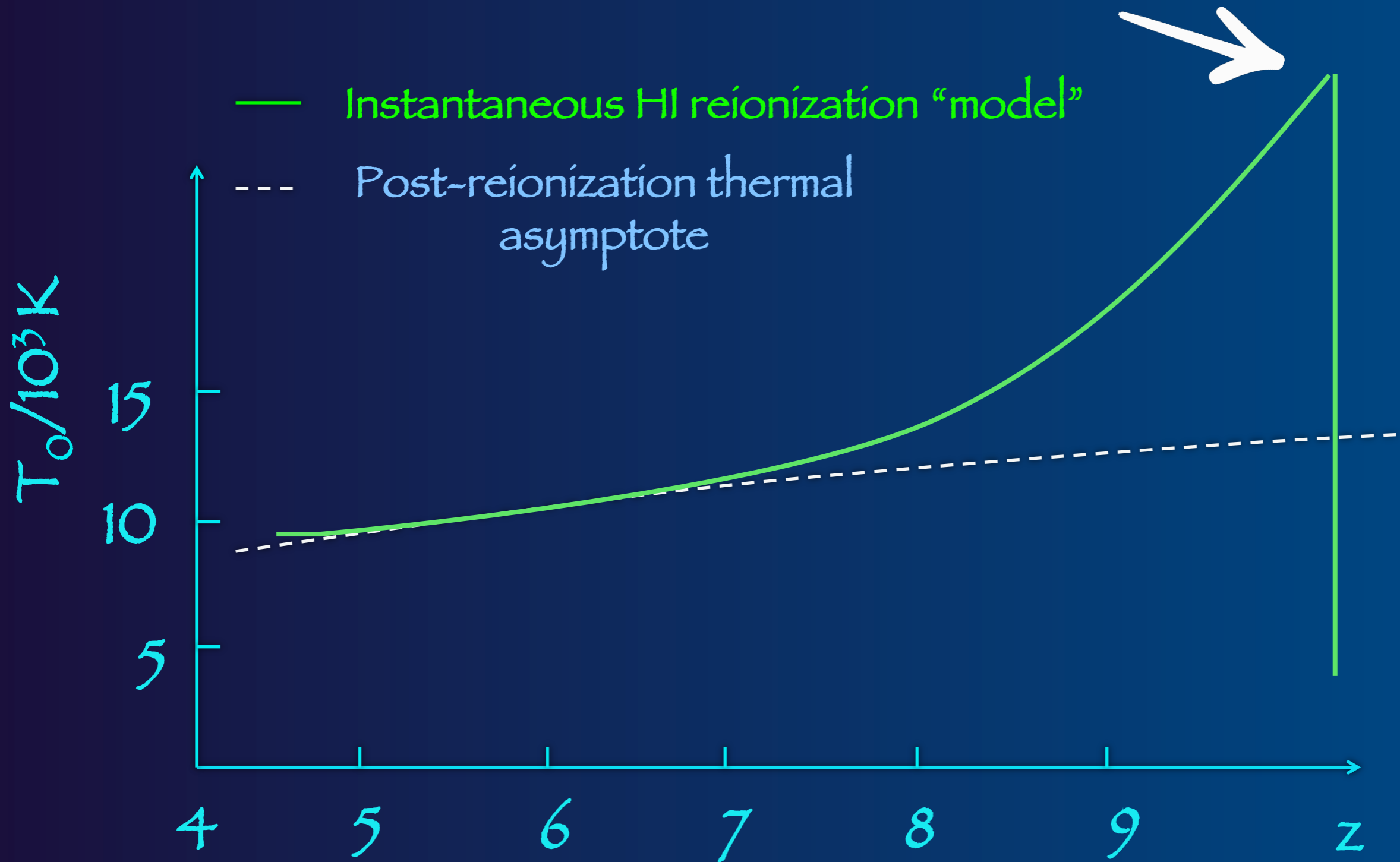
J. Bolton (Uni. of Nottingham)

Intergalactic interconnections, 12 July 2018, Marseille

Which are the imprints of reionization?

The imprints of photoheating

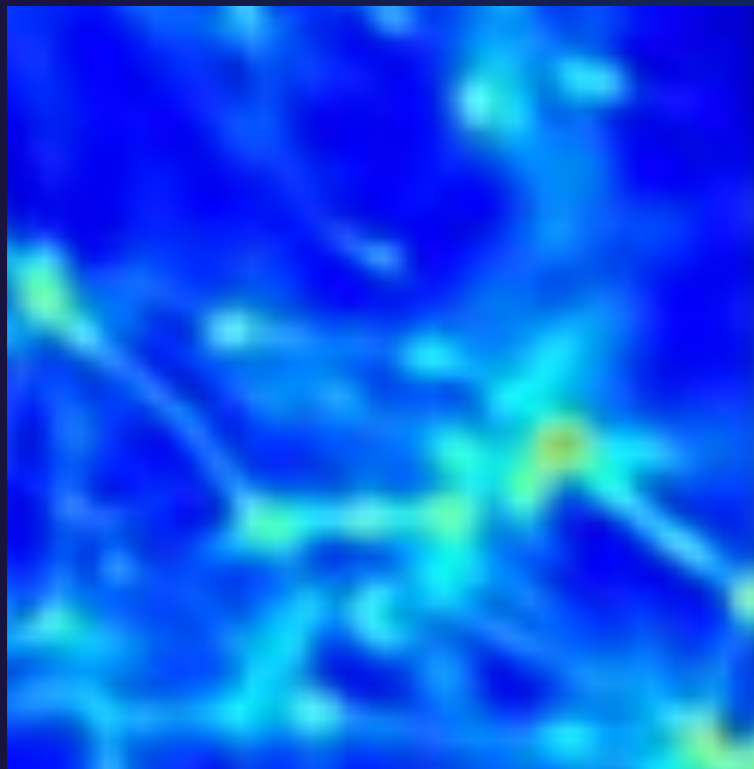
- 1) Peak in the temperature evolution at the mean density (T_0)



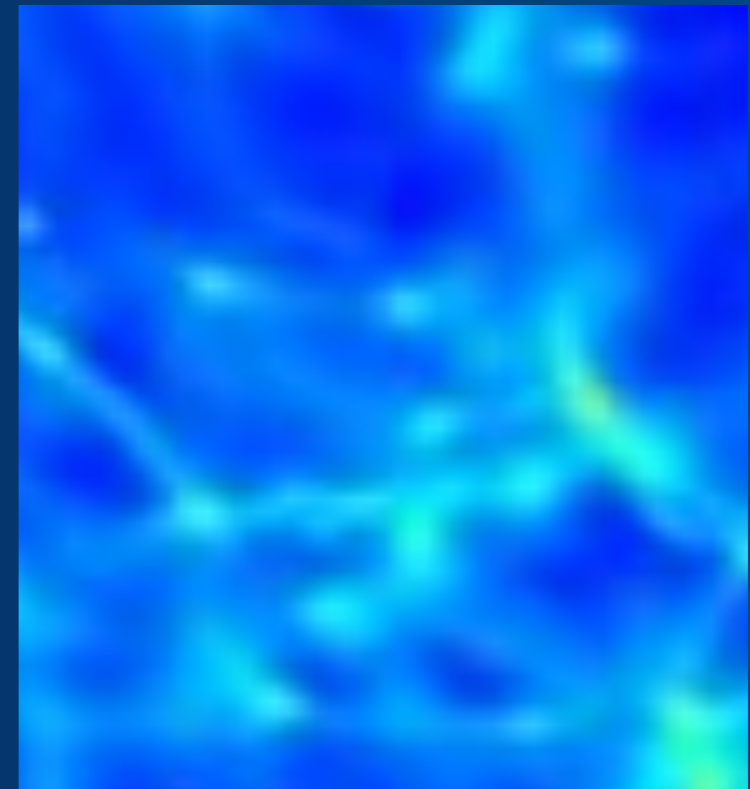
The imprints of photoheating

- 2) Smoothing out of the gas in physical space by increased gas pressure (Jeans smoothing effect)

Before



After



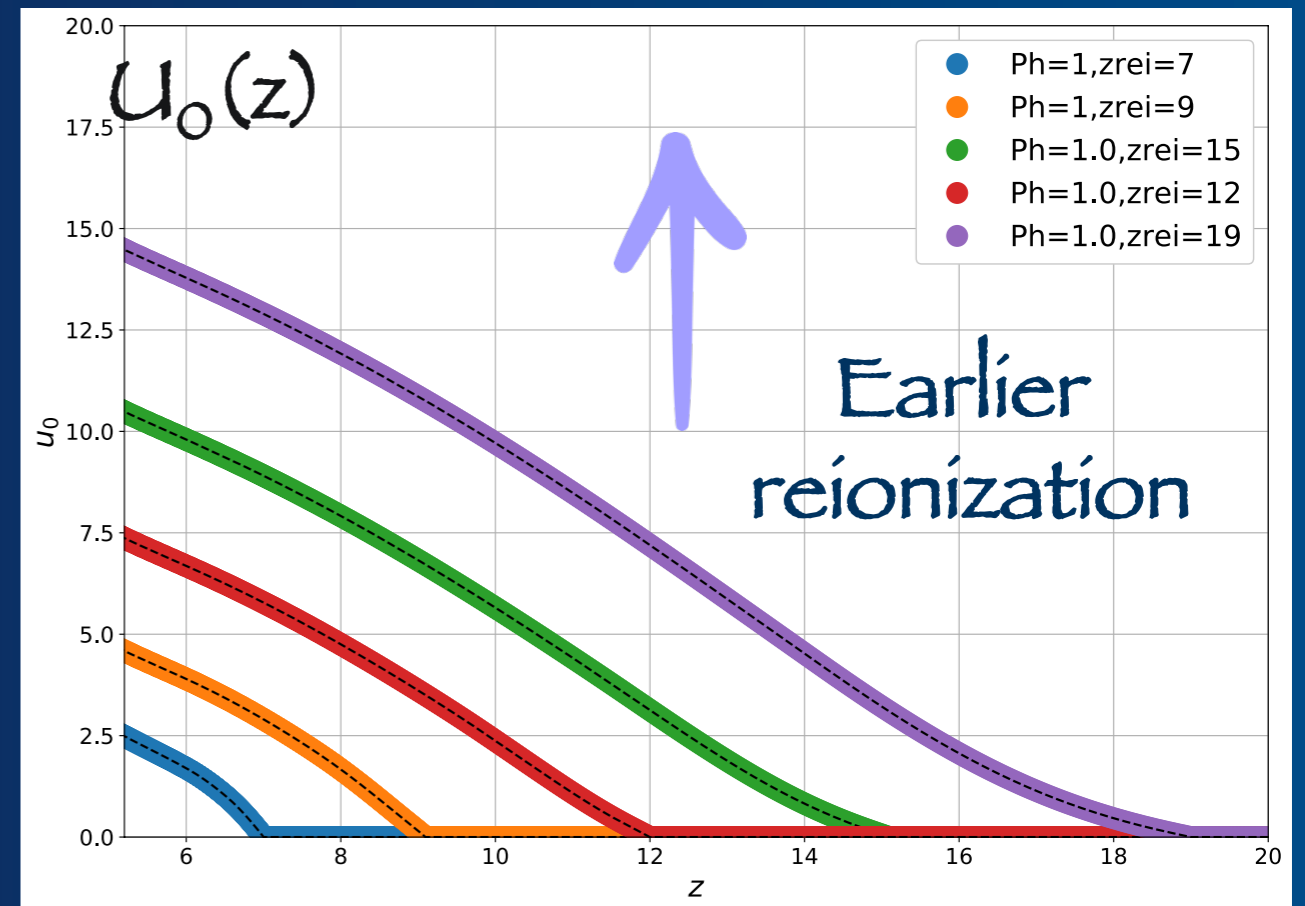
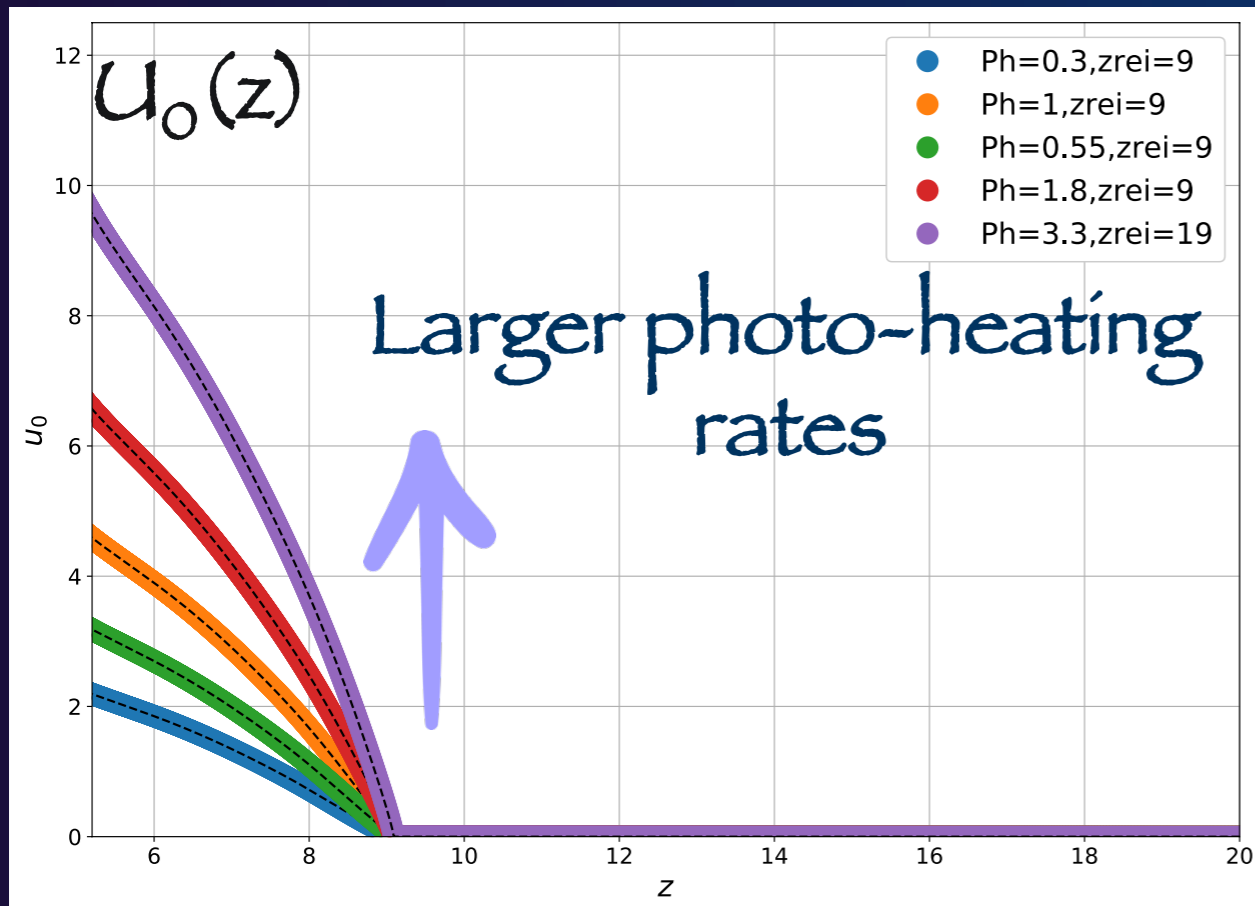
Jeans Smoothing = $f(\text{integrated thermal history from } z_{\text{rei}})$

The integrated thermal history

$$U_0(z) = \int_{z_{\text{rei}}}^z \frac{Ph}{\bar{\rho} H(z)(1+z)} dz$$

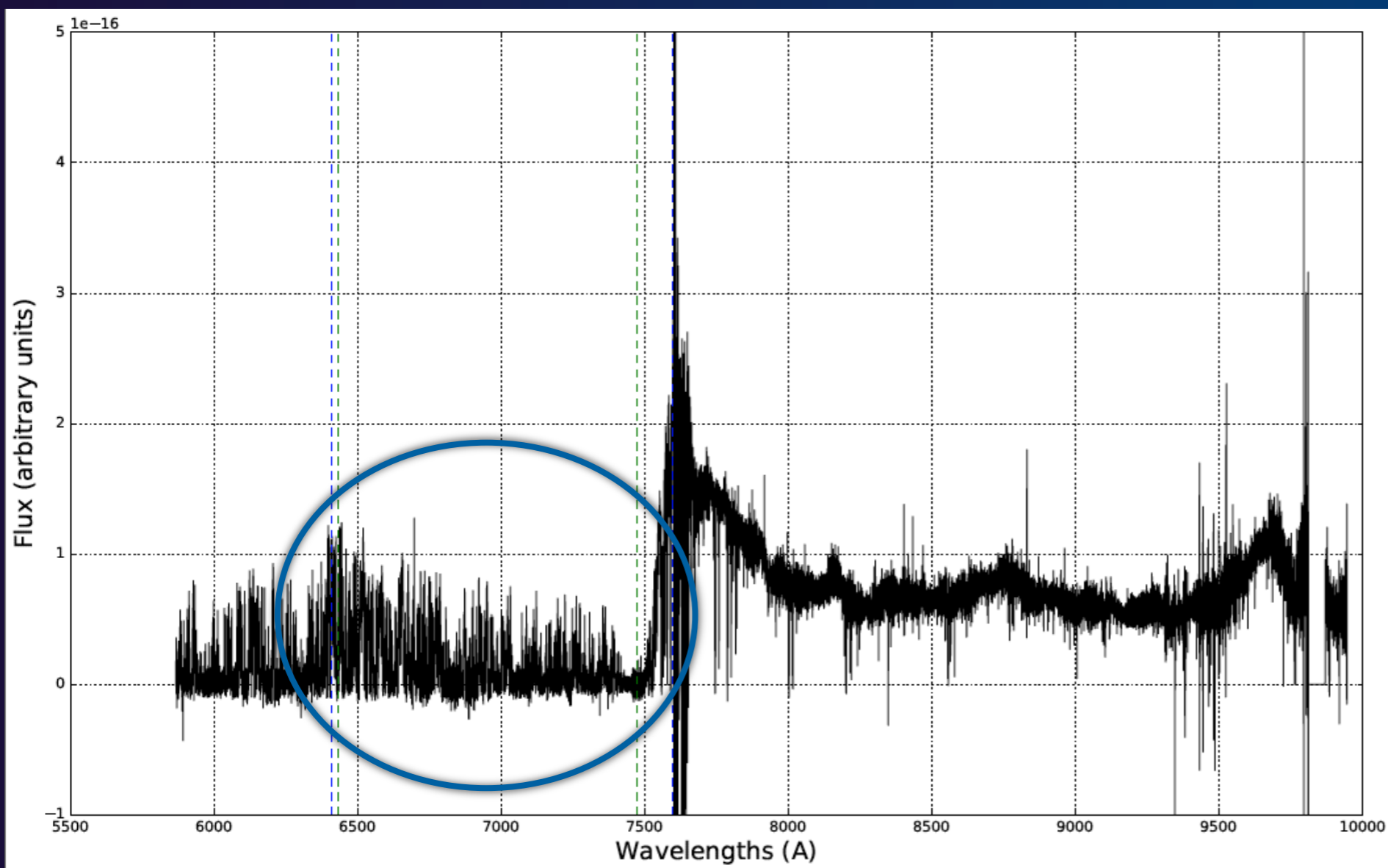
z_{rei}
 Ph
 $\bar{\rho}$
 $H(z)$
 $(1+z)$
 z

Nasir et al. 2016



How can we constrain T_0 and u_0 ?

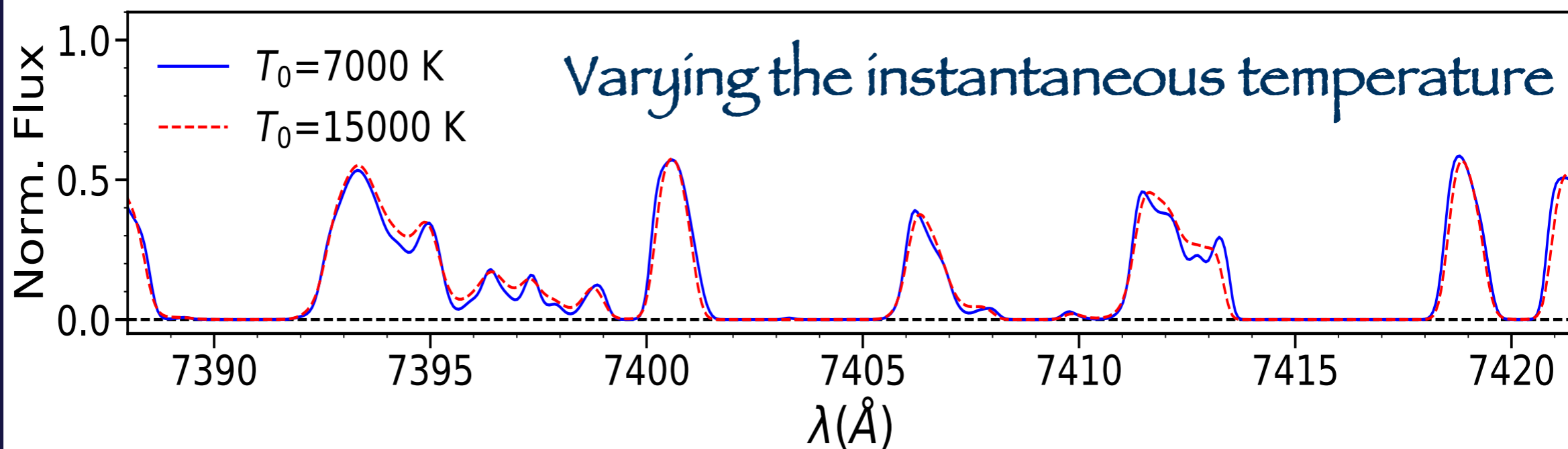
...looking at the absorption features of the Ly- α forest



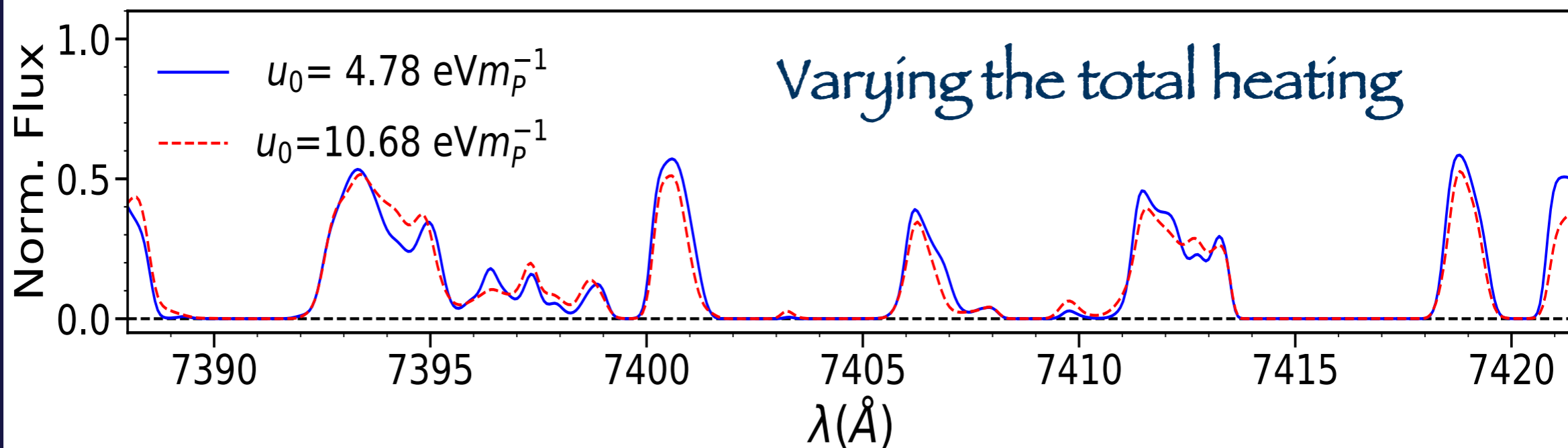
The impact on the Ly- α forest

$z=5$

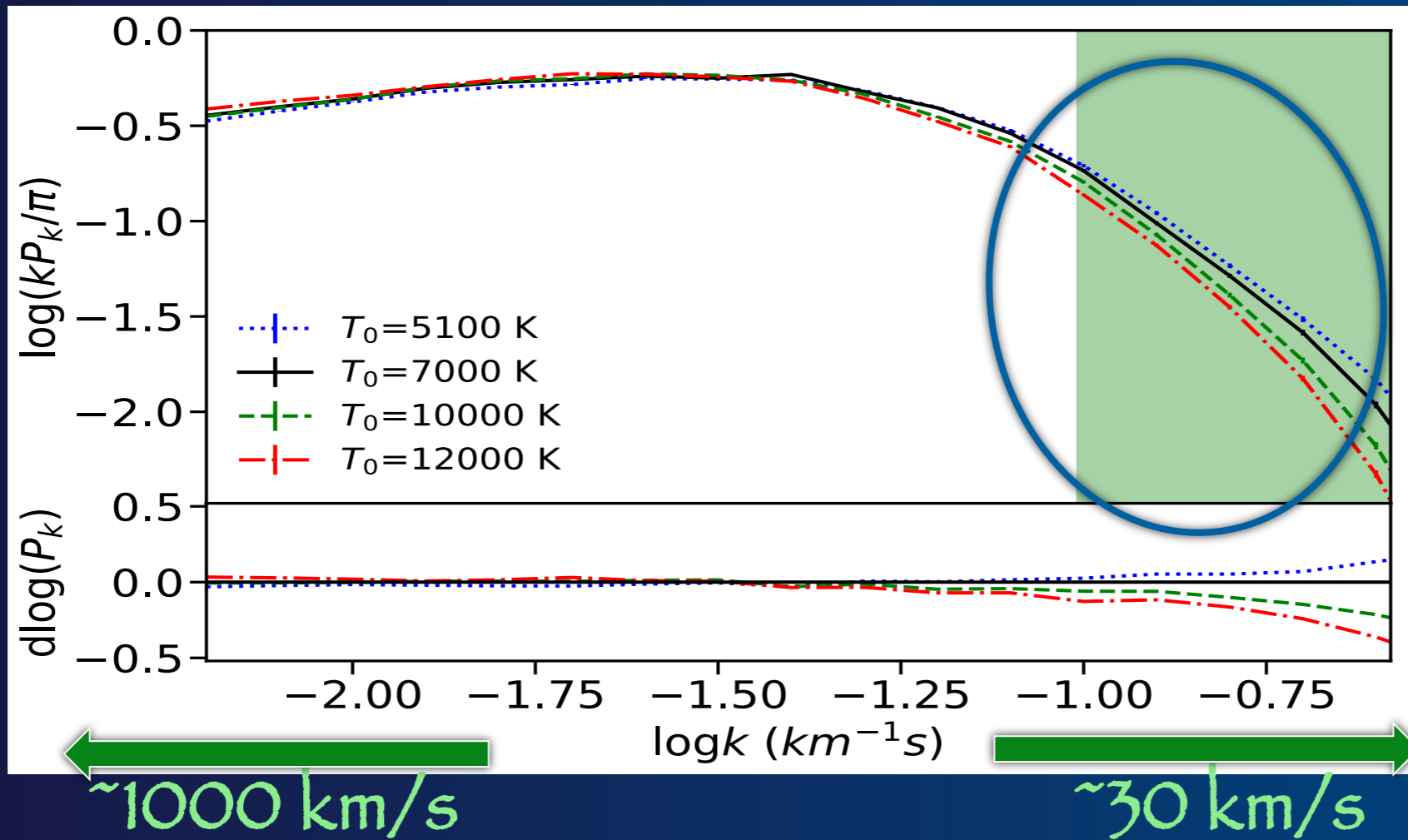
1) T_0



2) u_0

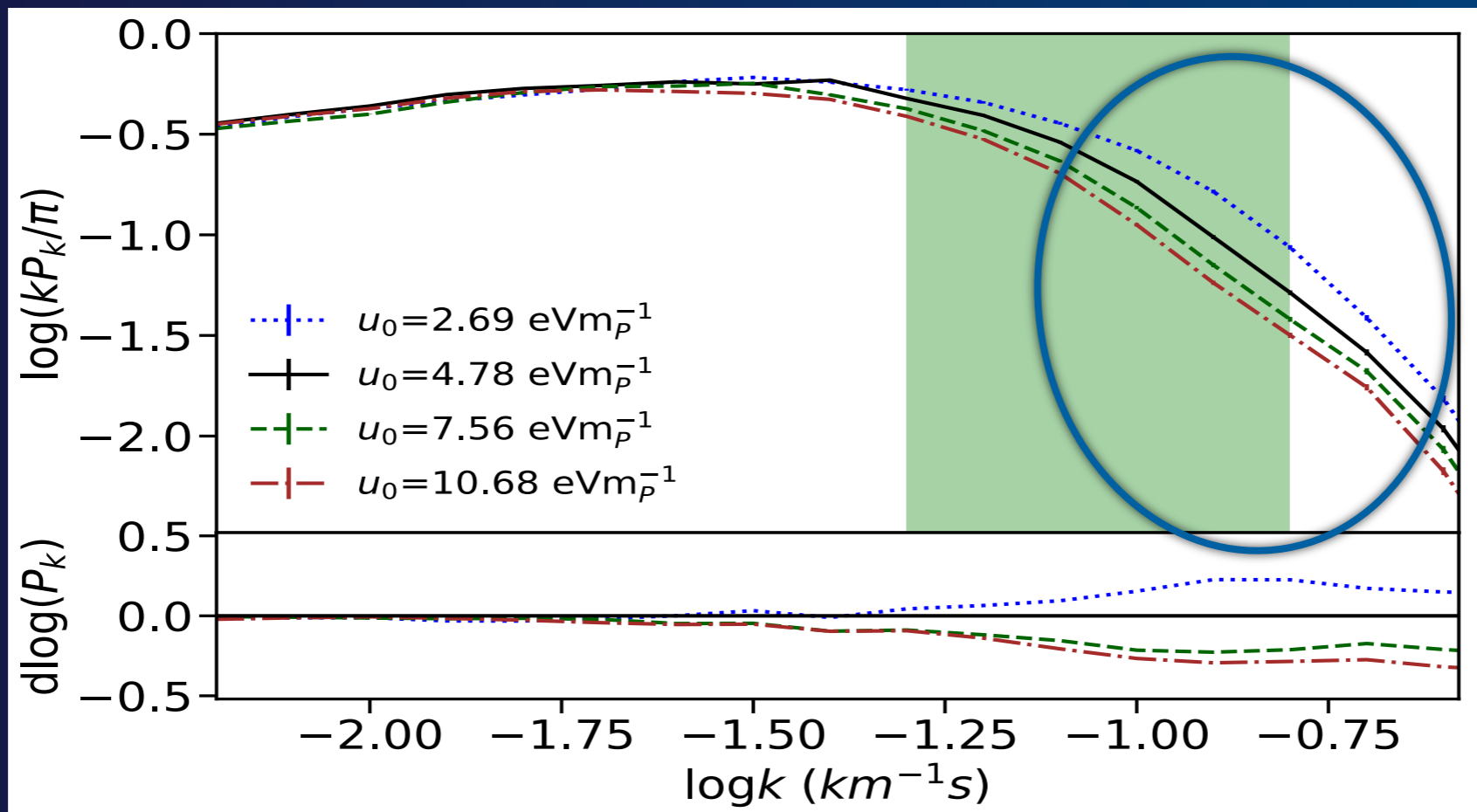


1) T_0



Varying the instantaneous temperature

2) u_0

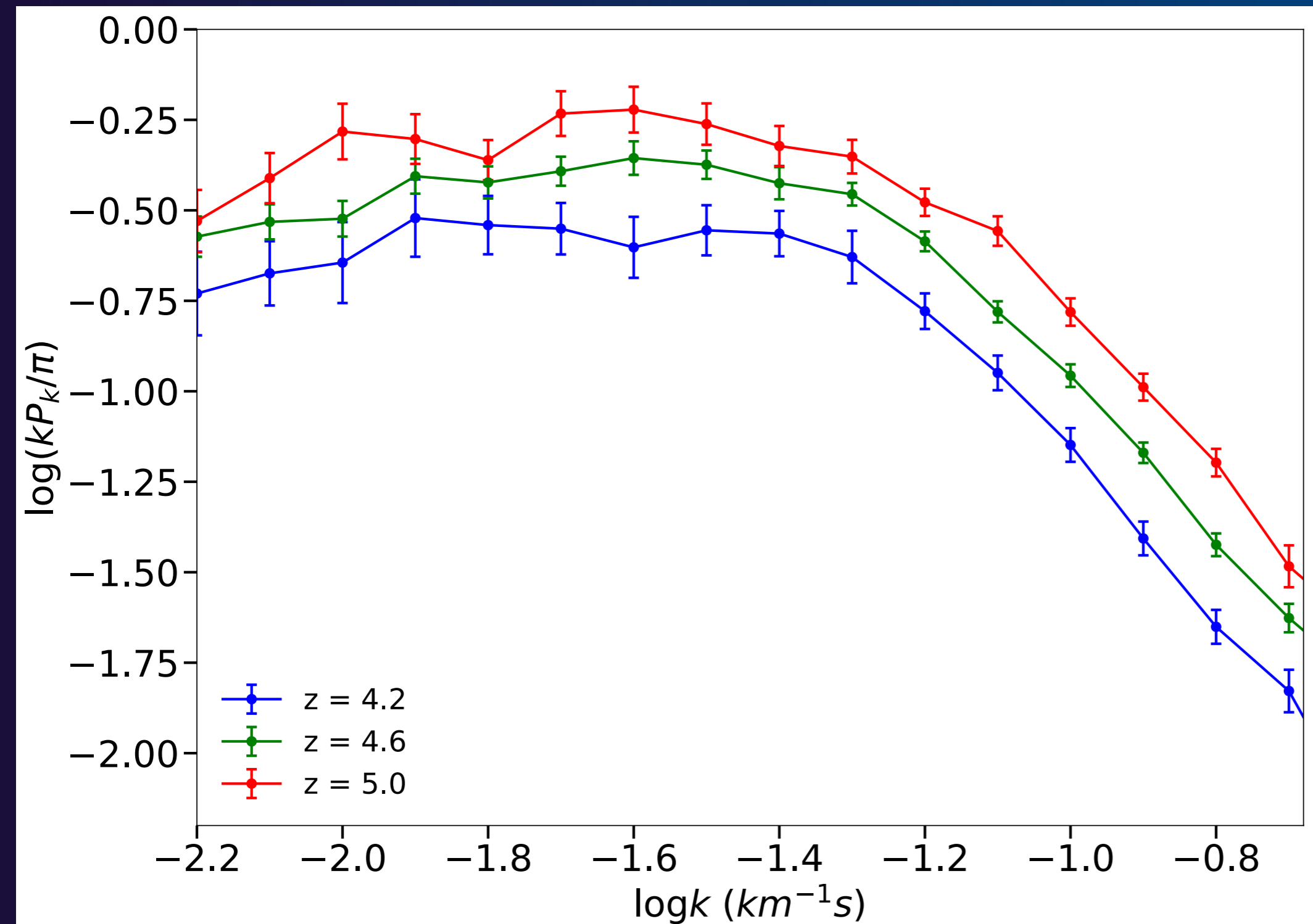


Varying total heating

Boera et al. in prep.

Real data

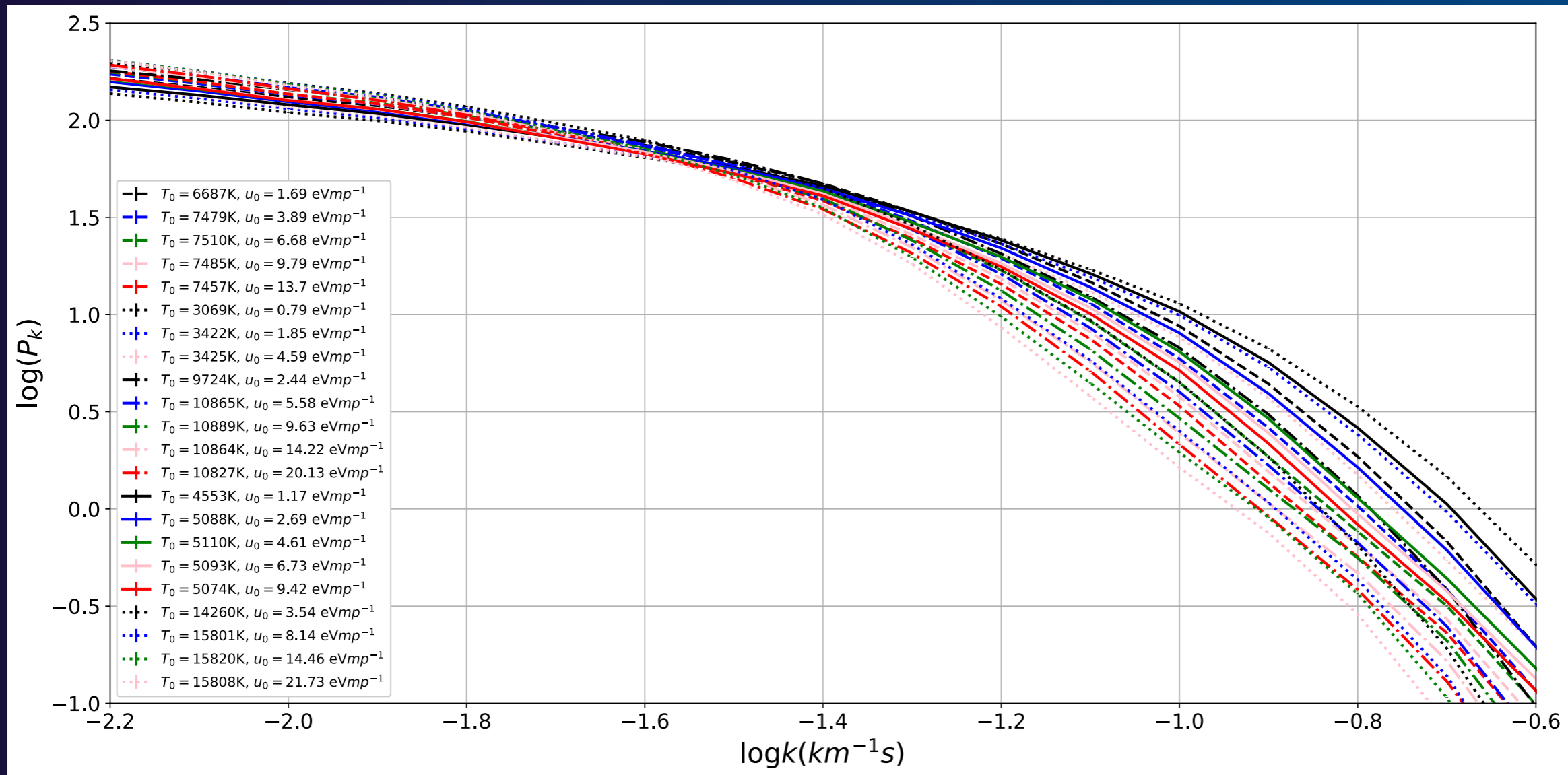
15 high resolution & high S/N, UVES & HIRES spectra



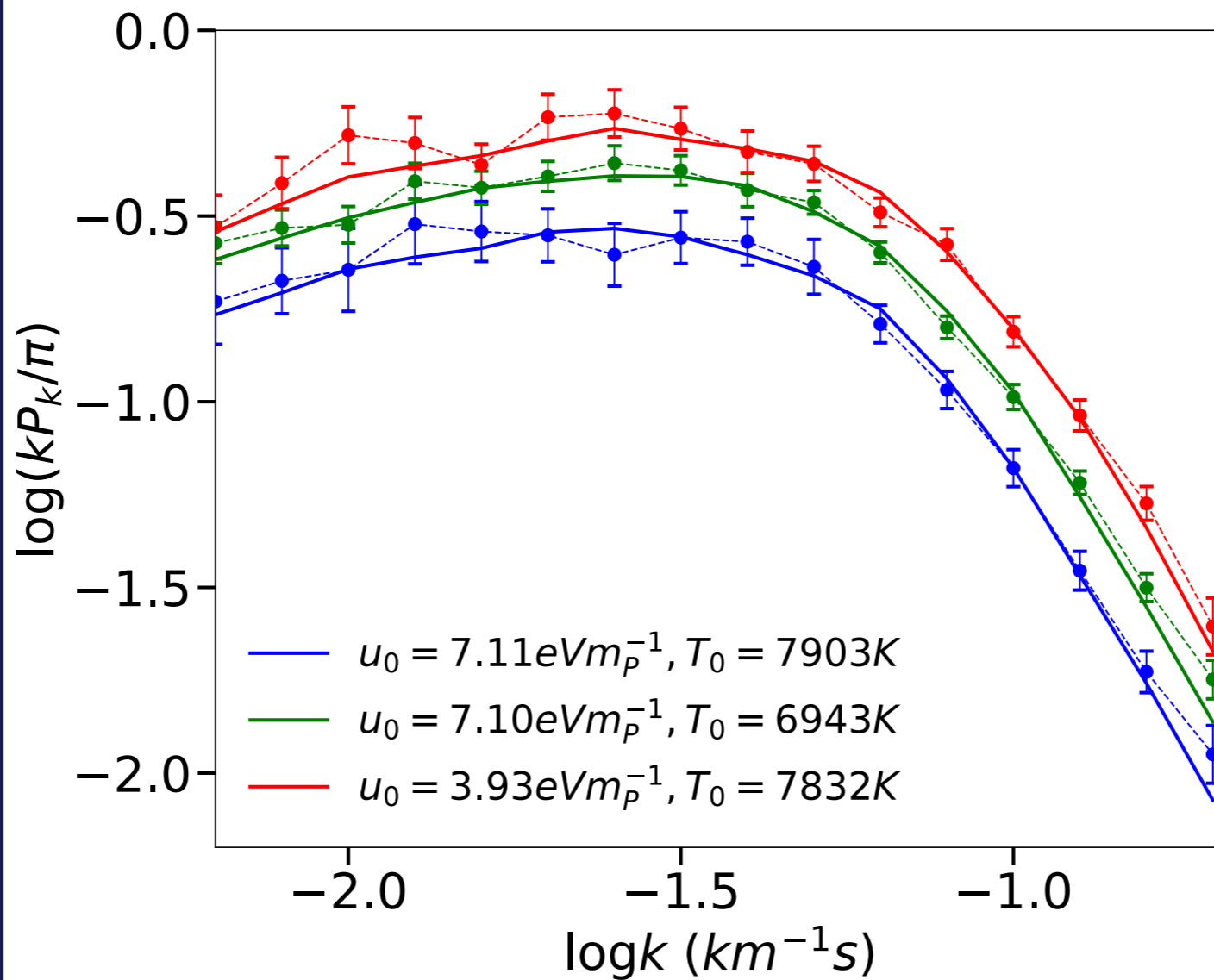
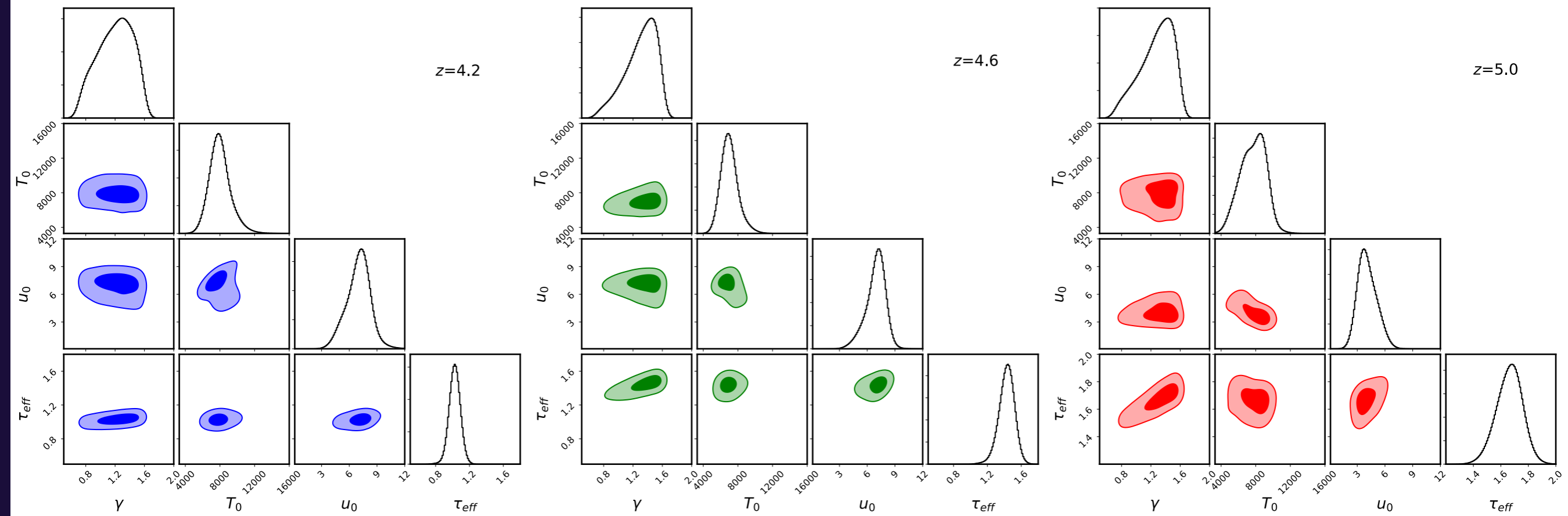
Boera et al. in
prep.

Simulations

Grid of self-consistent thermal histories calibrated using the real spectra: with a variety of u_0 and T_0 values



...from hydro dynamical simulations ($10 h^{-1}\text{cMpc}$ box)



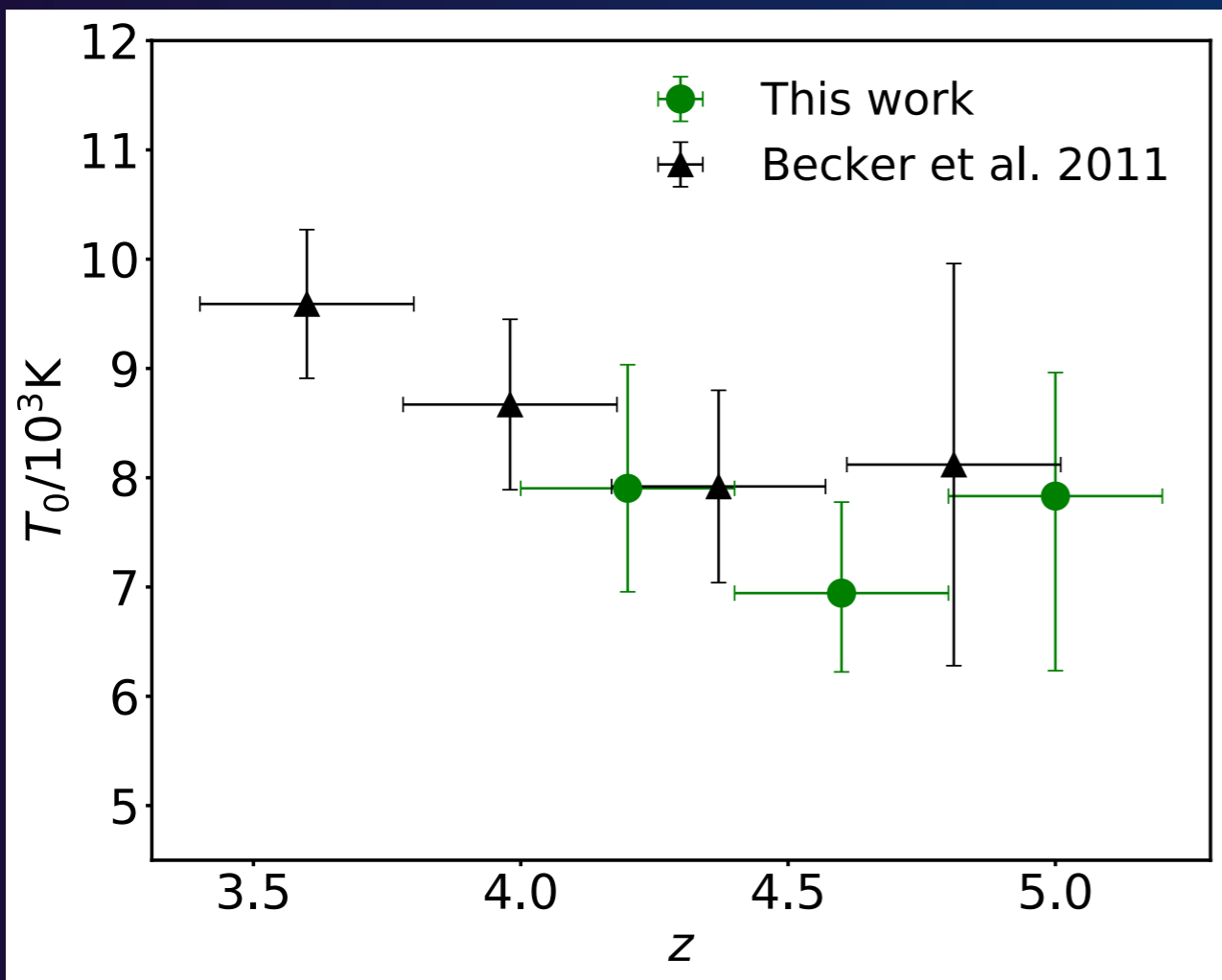
Boera et al. in prep.

Best fit parameters

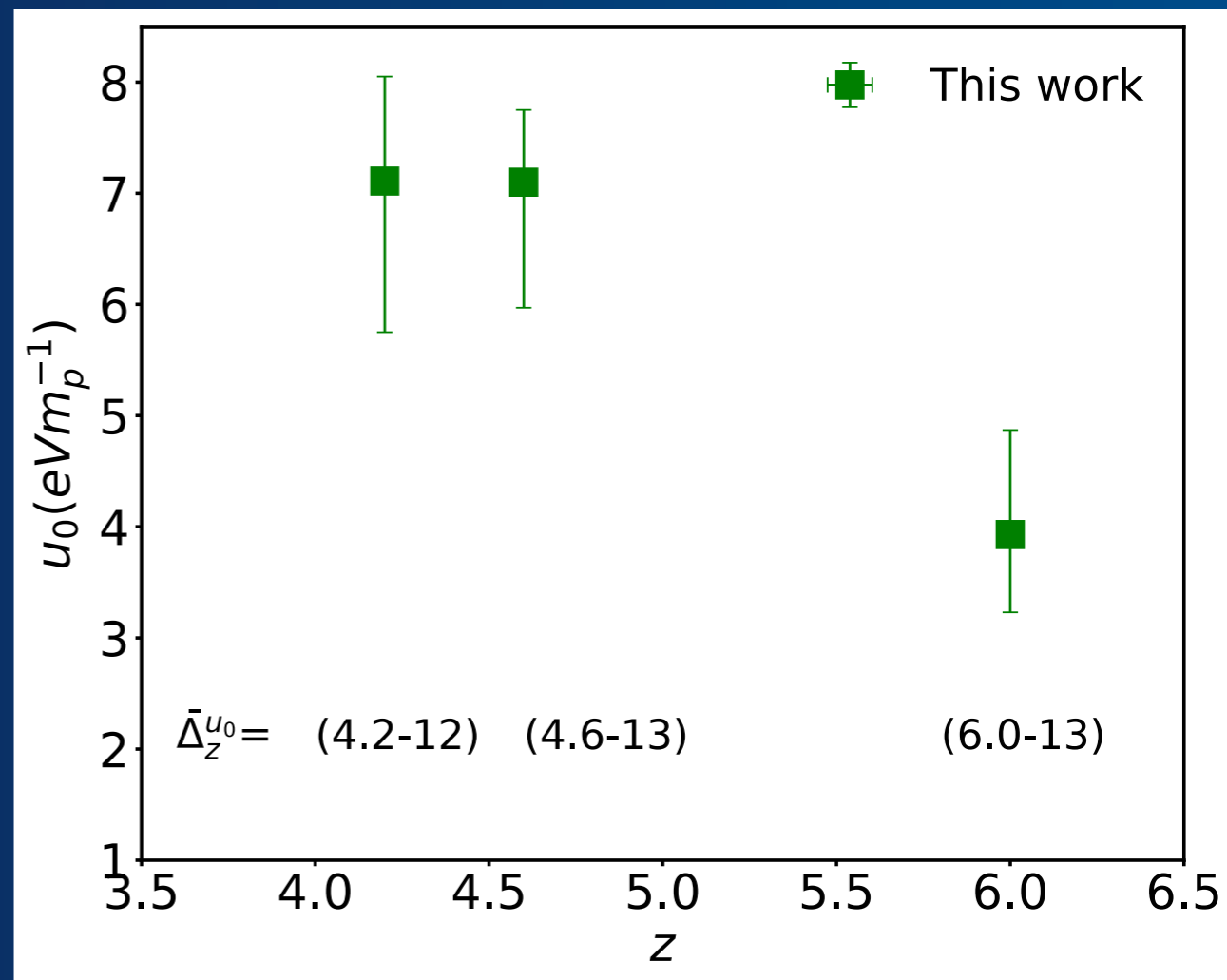
Results

Instantaneous temperature

Total heating



$T_0(z)$



$u_0(z)$

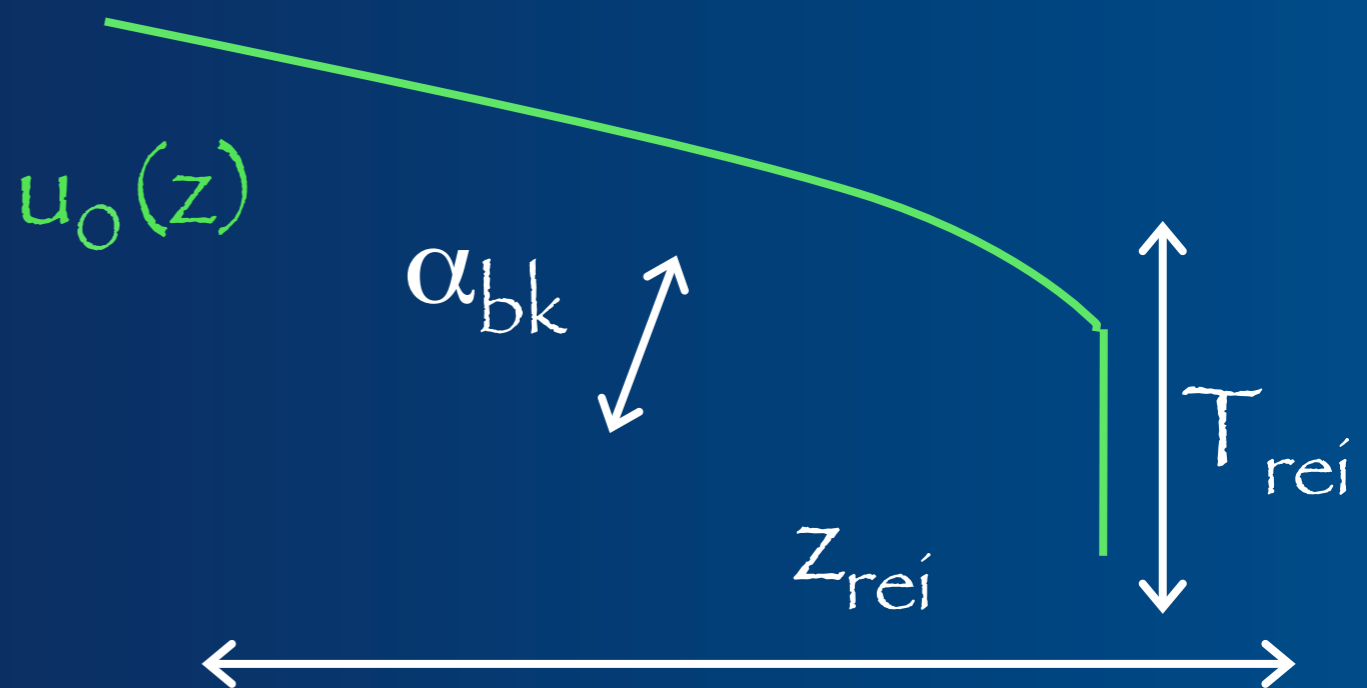
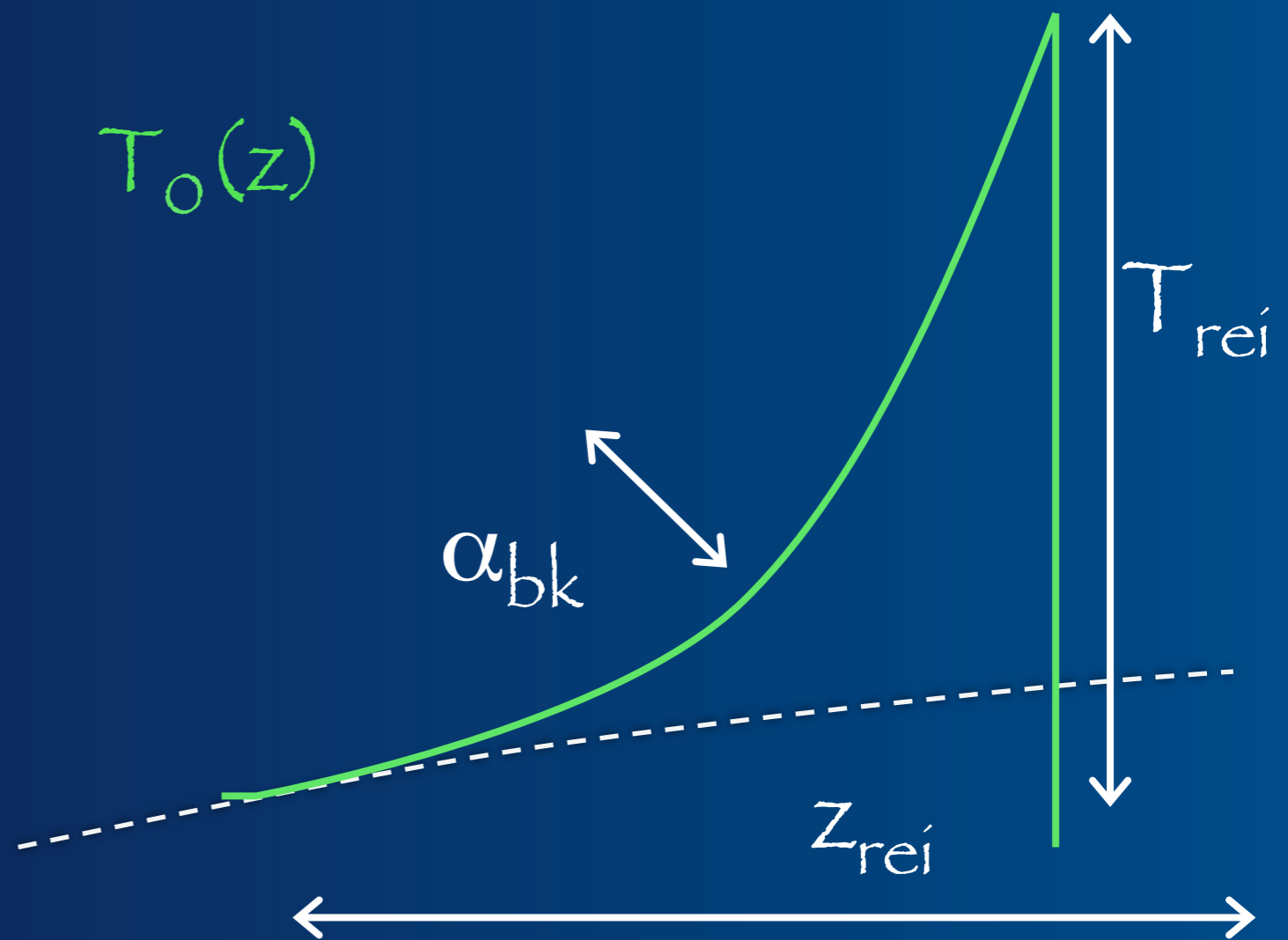
...a first step

A 3 parameters model:

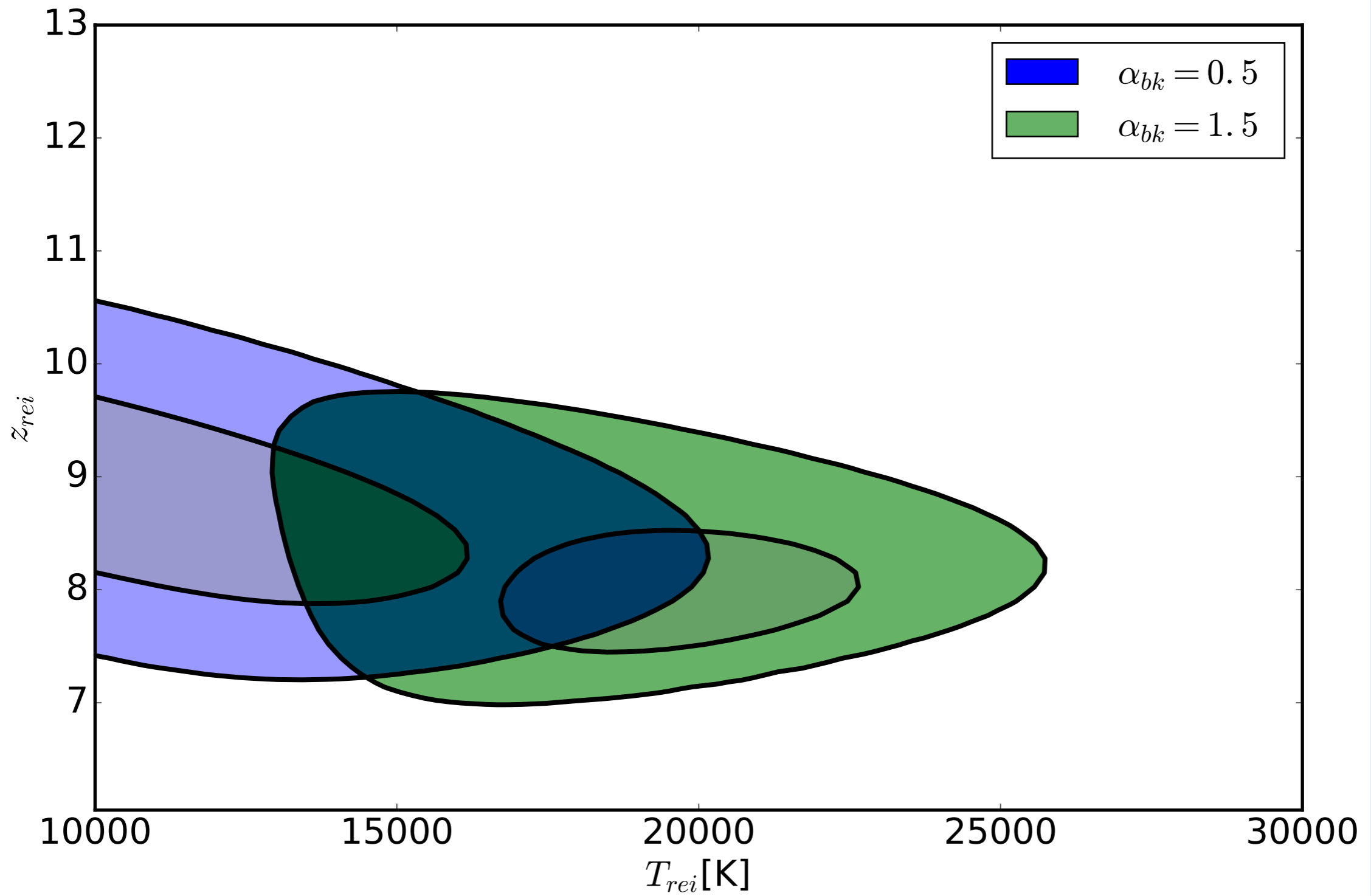
z_{rei} : redshift of instantaneous reionization

T_{rei} : IGM temperature after reionization

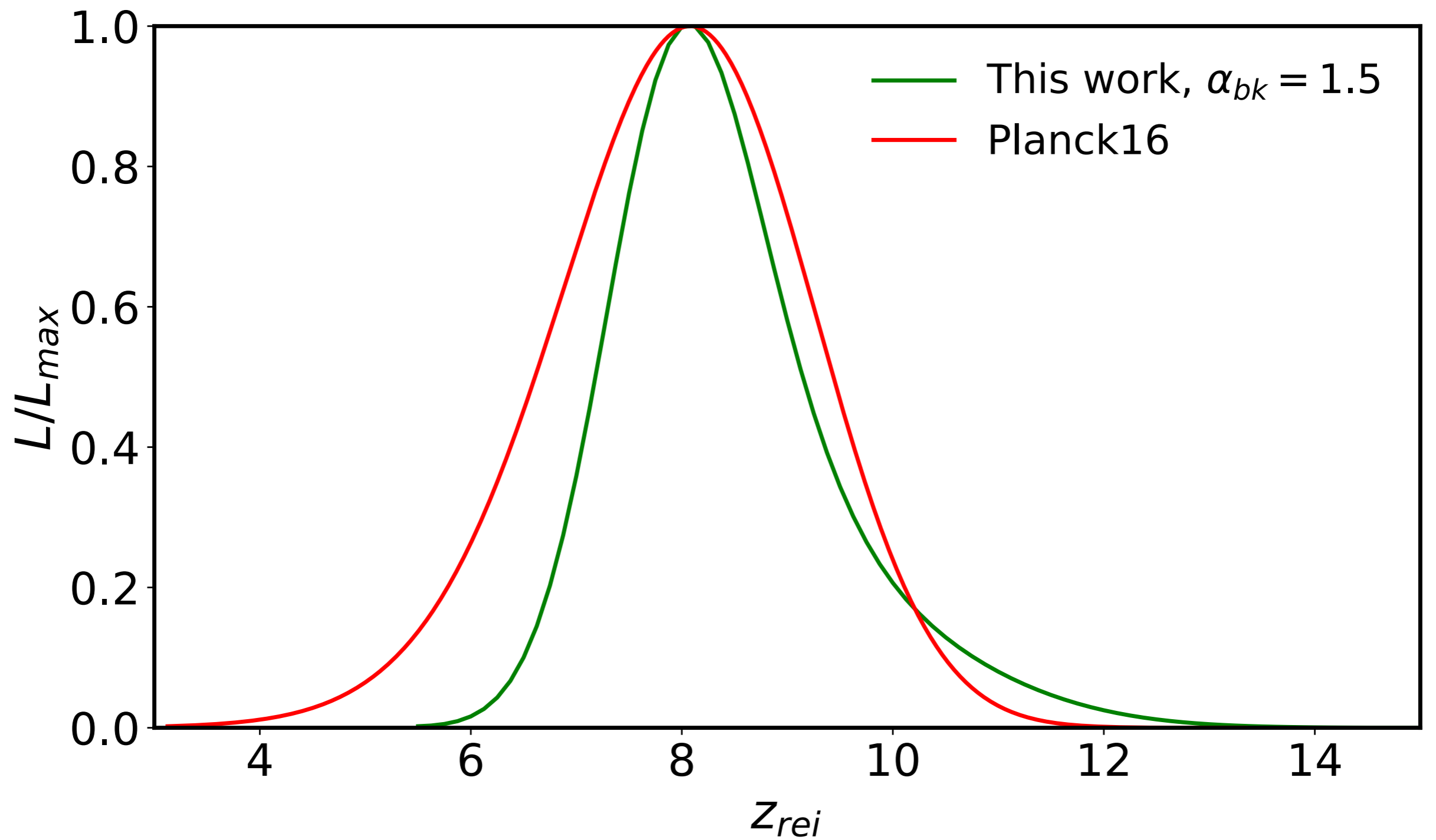
α_{bk} : spectral index of the post reionization background



Results



Results: comparison with Planck



Conclusions

We have obtained a first constraint on the post reionization IGM integrated thermal history, measuring T_0 and u_0 from the high- z Ly- α power spectrum.

The integrated IGM thermal history allows to obtain information on the timing and sources of Reionization

Our preliminary results, based on simplistic models favour a Reionization driven by sources with a soft bkg spectral index, and are consistent with recent Planck results.

More sophisticated modelling will allow relevant improvements in this analysis.

