Constraining the axiverse with reionization

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Based on 2506.19096 and paper to appear soon

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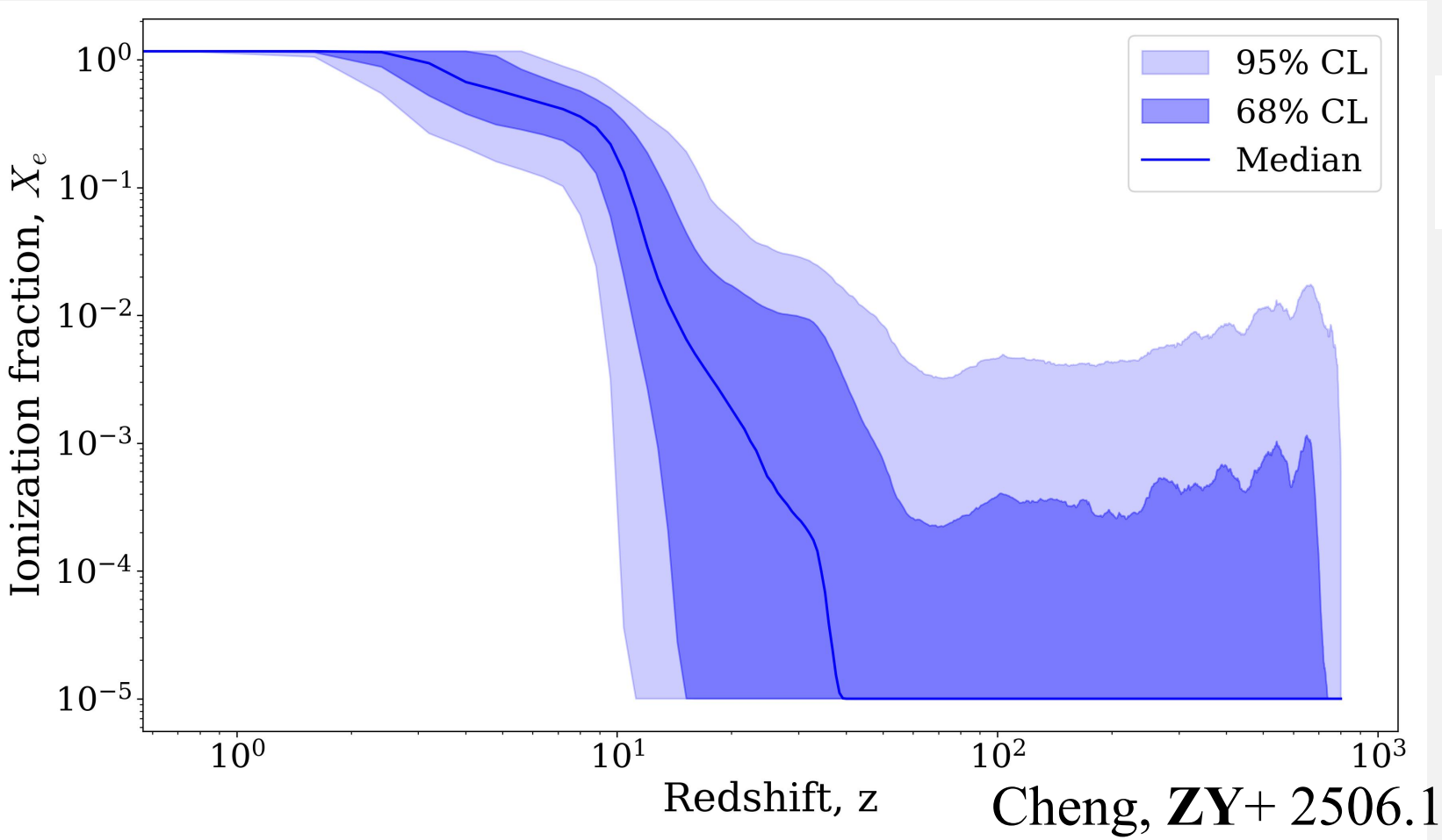
Model independent method for reionization history reconstruction

We develop a Gaussian Process Regression to constraint the ionization fraction

We use *Planck* low-*l* EE polarization to compute the optical depth $\tau_{\rm highz}$



$$\tau_{\rm highz} = \int_{z_c}^{z_{\rm max}} \sigma_T \, n_e(z) \frac{{\rm d}z}{(1+z)H(z)}$$

$$z_c \in [20, 40]$$

$$z_{\rm max} = 800$$

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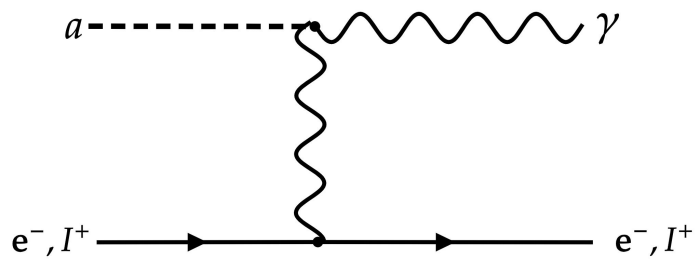
Axion production and decay

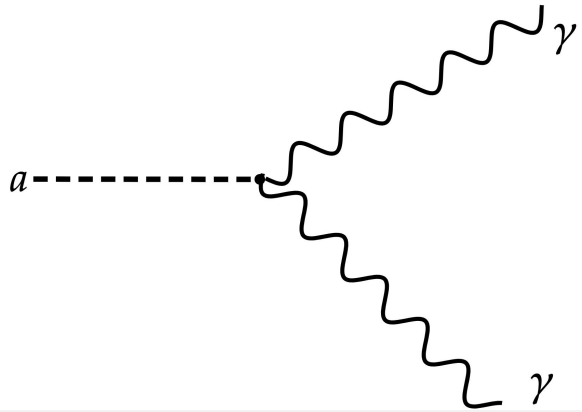
Axion freeze-in via axion photon coupling

$$\mathcal{L}_{a\gamma\gamma} = -\frac{1}{4} g_{a\gamma\gamma} a F_{\mu\nu} \tilde{F}^{\mu\nu} ,$$

Primakoff process

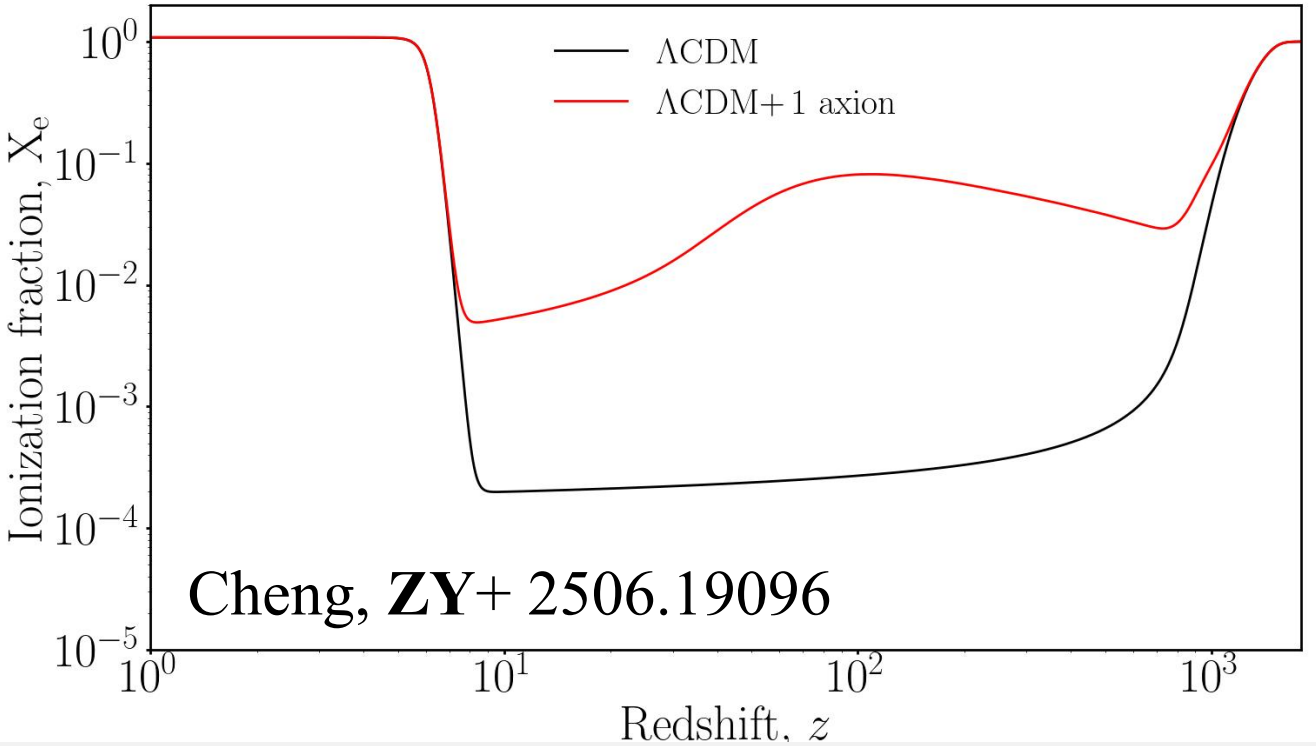


Inverse decay

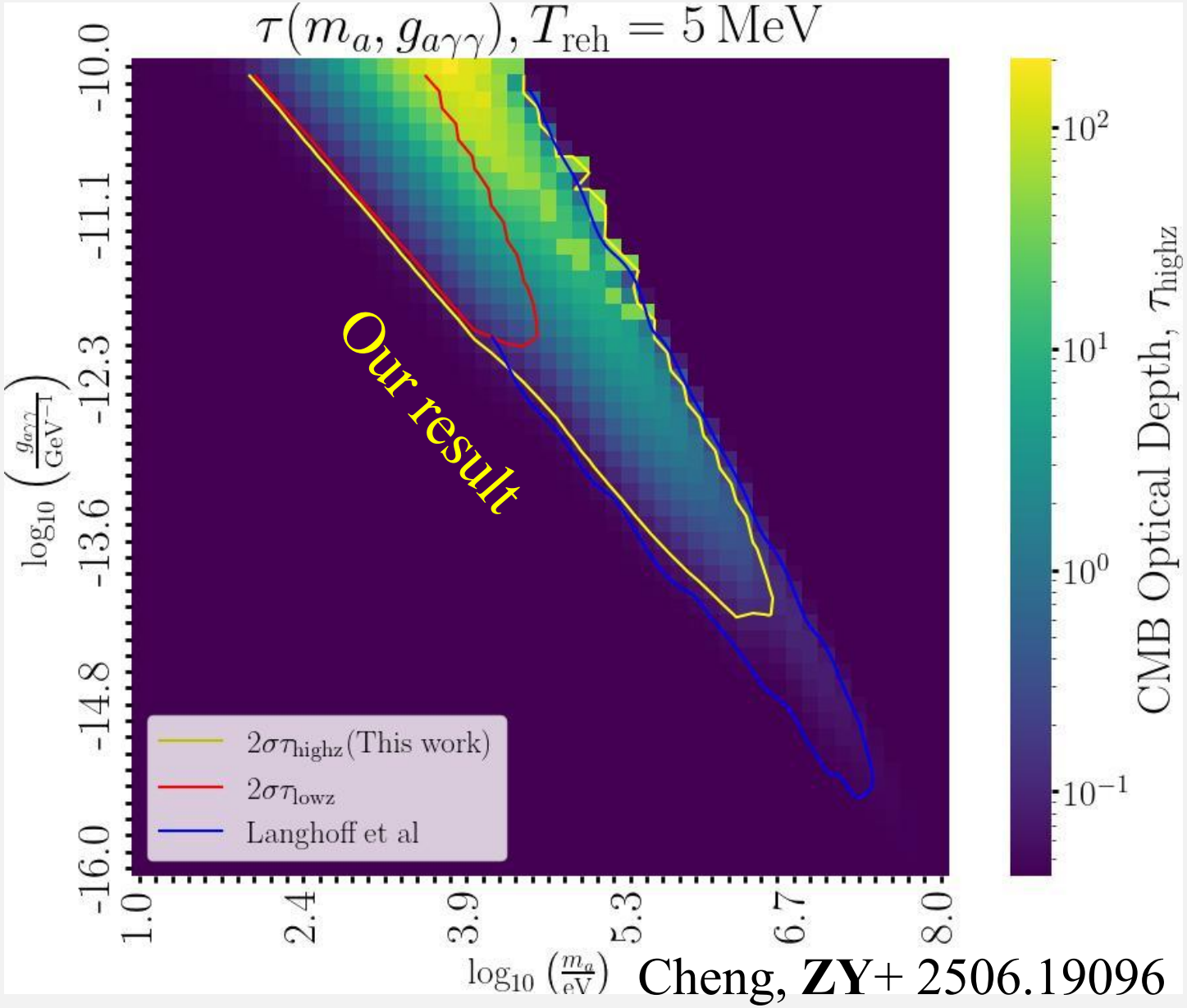


$$m_a = 10^5\,\mathrm{eV},\ g_{a\gamma\gamma} = 6 \times 10^{-13}\,\mathrm{GeV}^{-1}$$

$$T_{\mathrm{reh}} = 5\,\mathrm{MeV}$$



Single axion decay parameter space



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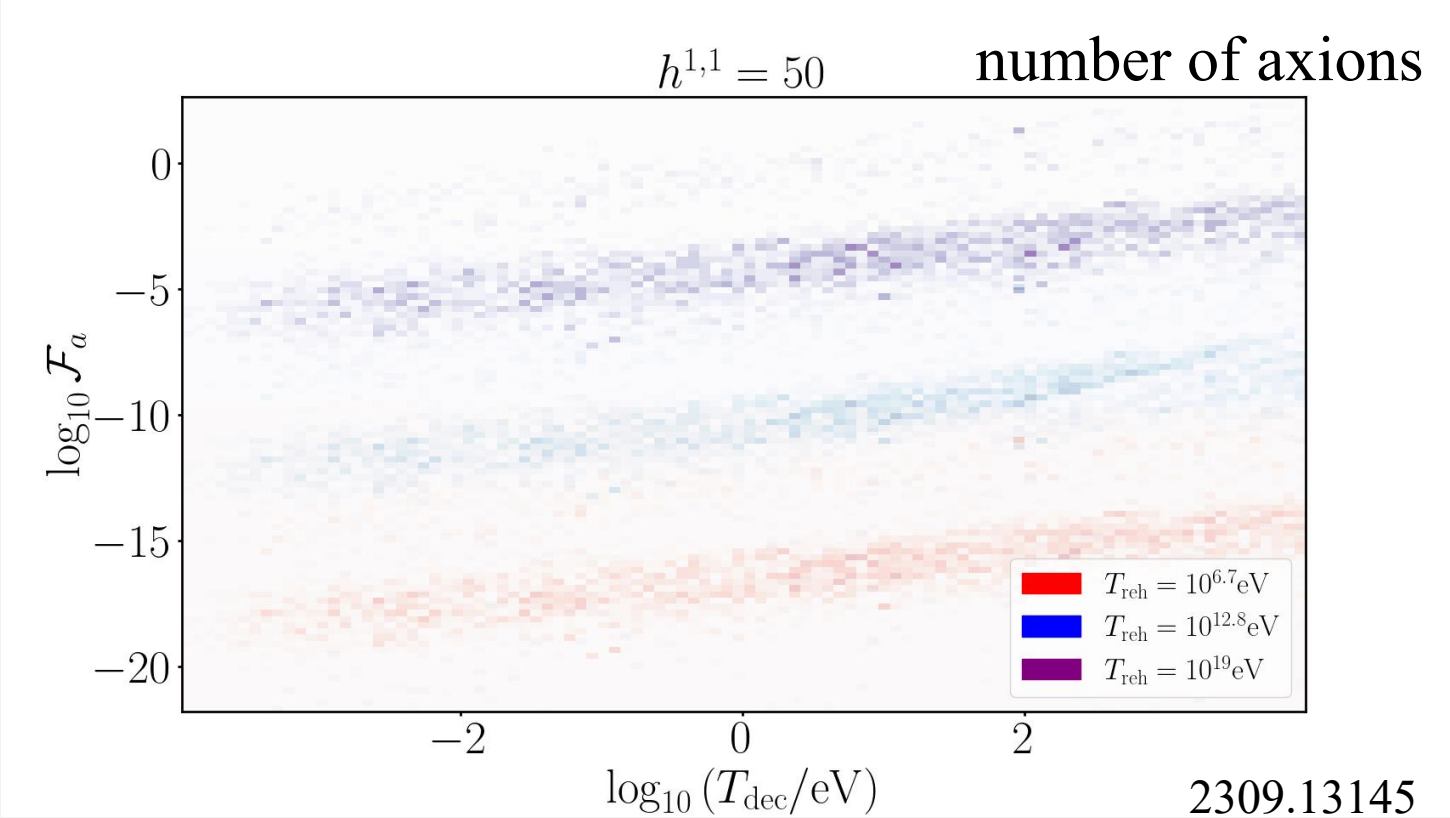
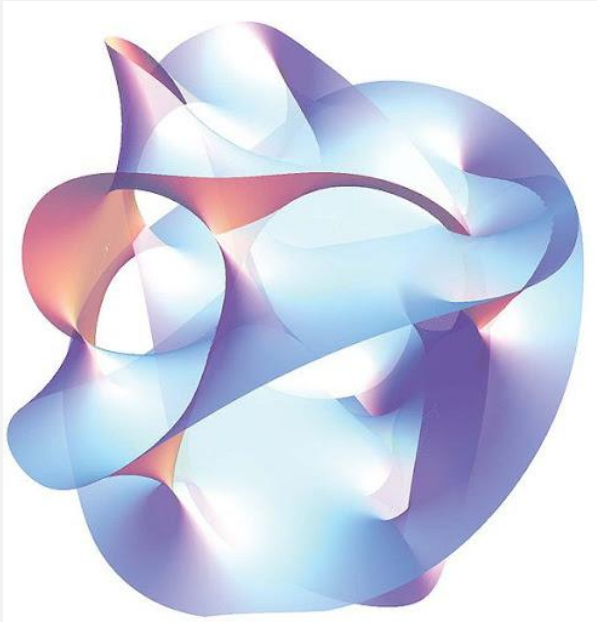
String axion abundance

Masses&couplings for multi-axions are predicted within string theory see Gendler+2309.13145

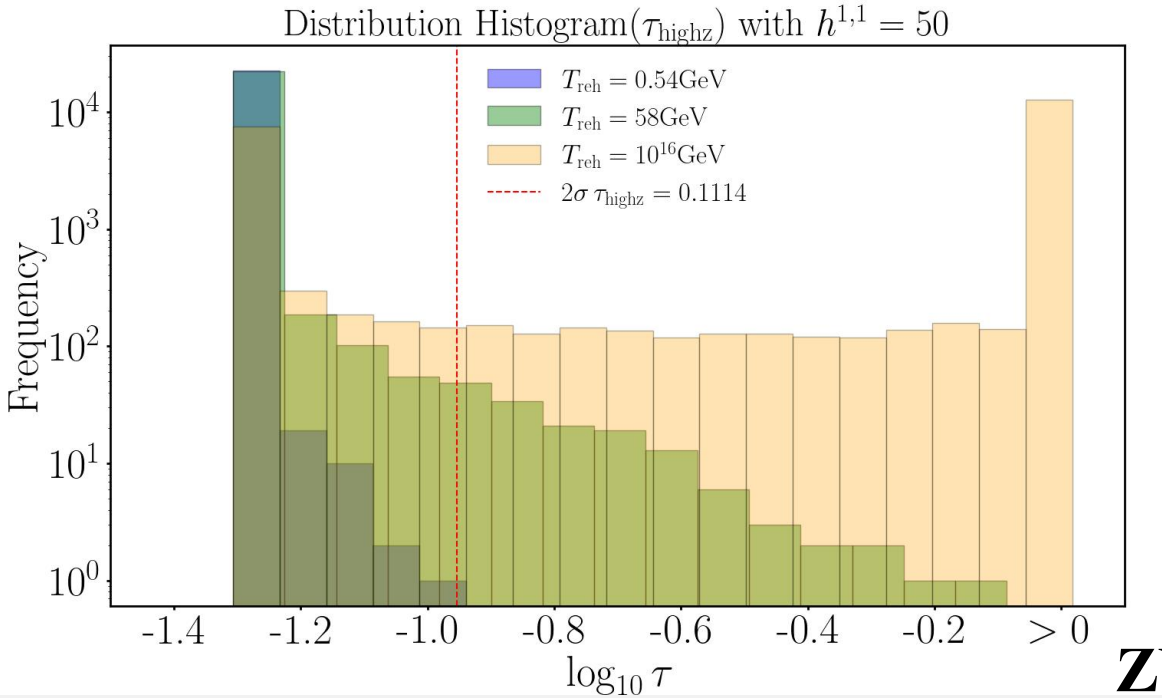
We obtain abundance and lifetime for each axion in a given theory

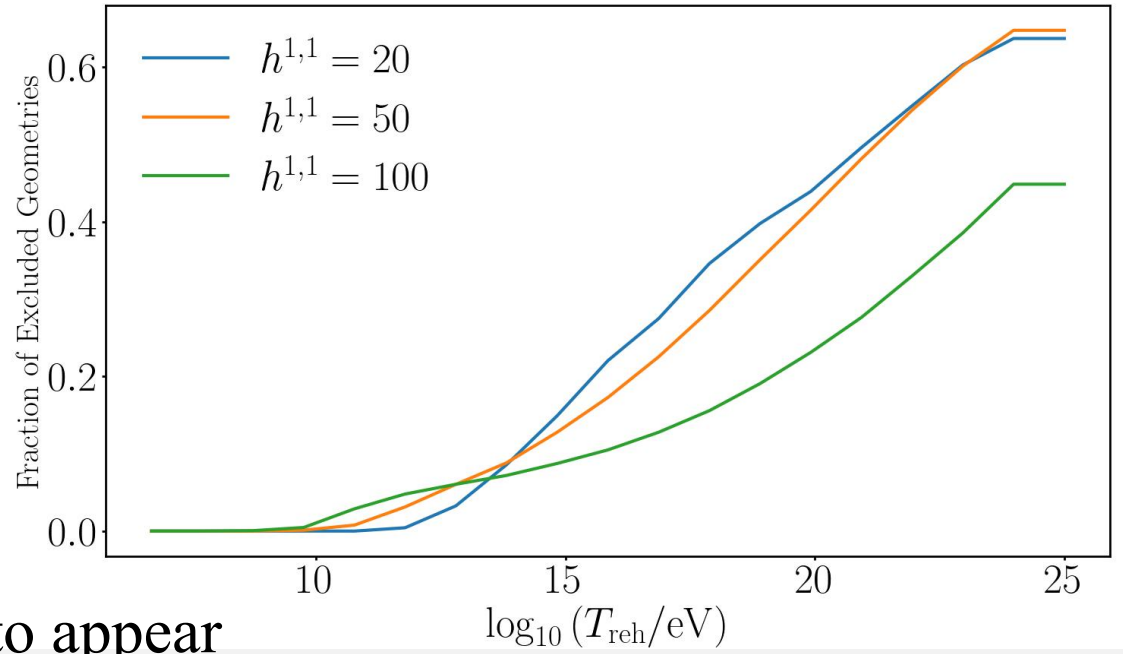




We want to constrain ensembles from string theory

Main preliminary results





ZY+ to appear

We find that 50% of the models in ensembles with $h^{1,1} = 20$ and 50 prefer low reheating temperature $T_{reh} \lesssim 10^{11}$ GeV(10^{13} GeV) at 68% C.L.(95% C.L.).

谢 谢！

Thanks