

# The role of CMB spectral distortions in the Hubble tension

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Based on Lucca 2020 [arXiv:2008.01115]



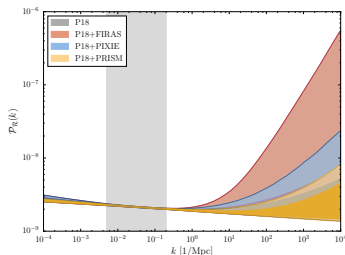
## What are CMB spectral distortions (SDs)?

In a nutshell:

- ▶ **SDs are deviations from a pure BB shape in the CMB energy spectrum** (commonly caused by energy injections when scattering and number-changing processes become inefficient)

Most notably:

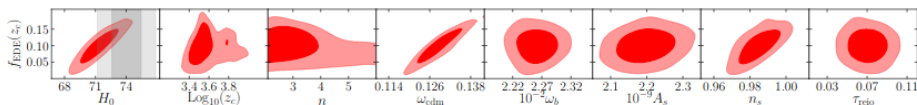
- ▶ At small scales  $\gamma$ s can travel from overdense to underdense regions "effectively" injecting energy  $\rightarrow$  Creation of SDs
- ▶ "Amount of energy injection" depends on primordial PS
- ▶ **SDs can place tight bounds on inflation and in particular on the scalar spectral index  $n_s$**



Adapted from  
Schöneberg et al. 2020 [2010.07814]

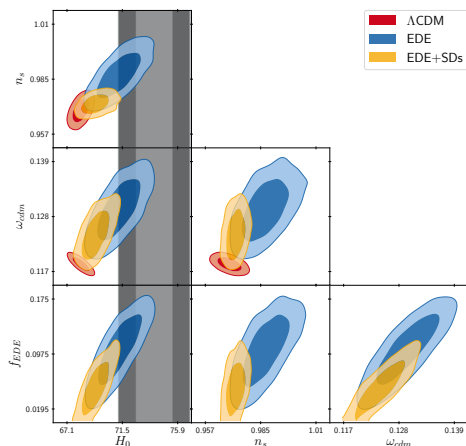
## What is the connection to the Hubble tension?

- ▶ Growing consensus around the idea that **for a solution to the Hubble tension to be successful it needs to modify the expansion history** of the universe just **before recombination** (see e.g., Knox & Millea 2019 [1908.03663])
- ▶ The **new physics** often **needs to be compensated for by significant shifts in the standard  $\Lambda$ CDM parameters**
- ▶ **If one of these parameters is  $n_s$ , SDs can place an independent prior on it and thereby test the model's ability to solve the tension** (even if the model itself does not directly create any SDs)
- ▶ This is precisely the case for Early Dark Energy (see e.g., the introduction of Hill et al. 2020 [2003.07355])



Adapted from Smith et al. 2019 [1908.06995]

# Proof of principle applied to the case of Early Dark Energy



All implemented in **CLASS v3.0**:  
 First code able to evaluate CMB  
 power spectra, SDs and much  
 more with a single run! (see  
 Lucca et al. 2019 [1910.04619])

Adapted from Lucca 2020 [2008.01115]