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## Tangled and Flash Reionization

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Recent cosmological tensions have renewed interest in the role of reionization in cosmological parameter inference. In particular, “flash reionization” has been proposed as a transient episode of ionization at high redshift that could increase the Thomson optical depth,  $\tau$ , while remaining compatible with CMB polarization measurements.

In this work, we present the first Markov Chain Monte Carlo analysis of flash reionization using Planck CMB temperature, polarization, and lensing data. Using Planck PR4, we find that the CMB permits a wide range of flash redshifts, with the allowed redshift strongly correlated with the peak ionization fraction. For benchmark scenarios at  $z_{\text{flash}} = 20$  and 25, we obtain  $x_{\text{flash}} = 0.24^{+0.13}_{-0.07}$  and  $0.15^{+0.07}_{-0.05}$ , respectively.

Despite this additional freedom in the ionization history, the standard  $\Lambda$ CDM parameters remain largely unchanged. In particular, we find  $\tau = 0.061 \pm 0.007$  compared with  $\tau = 0.059 \pm 0.006$  for standard tanh reionization. Interestingly, repeating the analysis with Planck PR3 removes the mild preference for a flash and instead yields upper limits on its amplitude. I will discuss what these results tell us about how much non-standard reionization history can be hidden within current CMB data and the implications for cosmological inference.

### Did you give a contributed talk at CASCA 2026?

No

### If you are selected for a poster, would you be interested in giving a short flash talk on your work?

Yes

### What is your career level?

MSc

### Which keyword describes the area of focus of this talk?

Cosmology

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