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A flexible parameterization to test early physics solutions to the Hubble tension with future CMB data

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The discrepancy between local measurements of the Hubble constant and inferences from CMB and galaxy clustering data, known as the 'Hubble tension', has motivated numerous models introducing additional components active before recombination. While many such models have been proposed, none are currently strongly favoured by data. This highlights the critical role of upcoming CMB experiments, which aim to achieve higher precision in measuring small-scale acoustic peaks and polarization signals, in detecting or constraining deviations from ΛCDM.
We present a phenomenological parameterization based on the generalized dark matter framework and specifically tailored for Simons Observatory. We show that this model is able to reproduce a wide range of theoretical models and forecast how well Simons Observatory will be able to constrain it.
When applied to Planck data, we find good consistency with the
ΛCDM model, but the data also allows for a large Hubble parameter, especially if the sound speed of the additional component is not too different to that of radiation. This approach offers a flexible and general framework to interpret data from upcoming CMB experiments, providing valuable insights into potential resolutions of the Hubble tension.

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