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Constraining Early Dark Energy with Large Scale Structure

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The Hubble tension is conventionally viewed as that between the cosmic microwave background (CMB) and the SH0ES measurement. A prominent proposal for a resolution of this discrepancy is to introduce a new component in the early universe, which initially acts as “early dark energy” (EDE), thus decreasing the physical size of the sound horizon imprinted in the CMB and increasing the inferred H_0 , bringing it into near agreement with SH0ES. However, this impacts cosmological observables beyond the CMB – in particular, the large scale structure (LSS) of the universe across a range of redshift. The H_0 tension resolving EDE cosmologies produce scale-dependent changes to the matter power spectrum, including 10% more power at $k=1$ h/Mpc. Motivated by this, I will present the results of two analyses of LSS constraints on the EDE scenario. Weak lensing and galaxy clustering data (from, e.g., the Dark Energy Survey) significantly constrain the EDE model, and the resulting H_0 is in significant tension with SH0ES. Complementary to this, including data from the Baryon Oscillation Spectroscopic Survey (BOSS), analyzed using the effective field theory (EFT) of LSS, yields an EDE H_0 value that is in significant (3.6 σ) tension with SH0ES. These results indicate that current LSS data preclude the EDE model as a resolution of the Hubble tension, and, more generally, that the EDE model fails to restore cosmological concordance. A sensitivity forecast for EUCLID suggests that future LSS surveys can close the remaining parameter space of the model.

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