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Early Dark Energy During Big Bang Nucleosynthesis

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An early dark energy (EDE) component during big bang nucleosynthesis (BBN) affects some observables like the deuterium abundance (D/H), helium fraction (Y_p), and the effective relativistic degrees of freedom ($N_{\rm eff}$). Thus, we propose a model of EDE present during the BBN epoch where the EDE remains constant until a critical time, after which it transitions into either coupled radiation, dark radiation, or kination. By comparing this model's outcomes with observed elemental abundances and $N_{\rm eff}$ from Cosmic Microwave Background (CMB) data, we constrain the EDE parameters and explore their relationship to BBN inputs like the baryon-to-photon ratio, neutron lifetime, and number of neutrino species. We also explore whether an EDE scenario can resolve the recent tension in primordial helium measurements from EMPRESS.

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