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Early and not so early dark energy. What do cosmological observations tell us about them?

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Dark energy might be in charge of the late-time acceleration of the universe, but not only so. Many quintessence models possess scaling or attractor solutions where the fraction of dark energy follows the one of the dominant component in previous epochs of the universe's expansion. Hence, they could play a role in some physical processes at redshifts z»O(1). For instance, the presence of a non-negligible early dark energy (EDE) component around the matter-radiation equality time teq has raised as an interesting mechanism of loosening the famous H0 tension. In this work we constrain the fraction of EDE using some simple fluid parametrizations and also a non-parametric approach based on the binning of the EDE density. The latter allows us to reconstruct the shape of Ωde(z) not only before the decoupling of CMB photons, but also after it. We have employed the CMB temperature, polarization and lensing data from Planck 2018, the Pantheon compilation of supernovae of Type Ia (SNIa), data on galaxy clustering from several surveys, the prior on the absolute magnitude of SNIa obtained from the first steps of the cosmic distance ladder by SH0ES, and weak lensing data from KiDS+VIKING-450 and DES-Y1. We update previous constraints on the constant fraction of EDE in the radiation- and matter-dominated epochs, and show that with such a simple shape EDE has a negligible impact on the cosmological tensions. We reconfirm that for more complicated forms of Ωde(z), with a significant value around teq, EDE can alleviate the H0 tension at the expense of enhancing the large-scale structure (LSS) formation processes in the universe with respect to the standard ΛCDM model. This holds not only when we employ σ8 and S8 as our LSS estimators, but also when we use the recently proposed σ12 and S12 parameters. This issue can be alleviated through the presence of EDE during the post-recombination era.

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