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## Resolving cosmological tensions with a sign-switching cosmological constant

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In this talk, inspired by the recent conjecture originated from graduated dark energy (gDE) that the universe has transitioned from anti-de Sitter vacua to de Sitter vacua in the late universe, we will discuss the superior features of the  $\Lambda_s$ CDM model, which extends the standard  $\Lambda$ CDM model by a cosmological constant ( $\Lambda_s$ ) that switches sign at a certain redshift  $z_\dagger$ , over the standard  $\Lambda$ CDM model in the light of observational data. We will first discuss that, when the consistency of  $\Lambda_s$ CDM with the CMB data is ensured,  $H_0$  and  $M_B$  values are inversely correlated with  $z_\dagger$  and reach  $H_0 \approx 73.4 \text{ km s}^{-1} \text{ Mpc}^{-1}$  and  $M_B \approx -19.25 \text{ mag}$  for  $z_\dagger = 1.6$ , in agreement with the SH0ES measurements, and  $H(z)$  exhibits an excellent fit to the Ly- $\alpha$  data. We will then show that the CMB alone is not able to well constrain  $z_\dagger$  and thus discriminate between  $\Lambda_s$ CDM and  $\Lambda$ CDM models, but the CMB+BAO data set favors the sign switch of  $\Lambda_s$  providing the constraint:  $z_\dagger = 2.44 \pm 0.29$ . The further observational analysis using more data sets reveals that  $\Lambda_s$ CDM is significantly favored over  $\Lambda$ CDM, and it resolves various tensions that prevail within  $\Lambda$ CDM; for instance, the CMB+Pan data set with  $M_B$  prior gives  $z_\dagger = 1.784^{+0.14}_{-0.18}$  along with  $H_0 \approx 72.38^{+0.98}_{-1.10} \text{ km s}^{-1} \text{ Mpc}^{-1}$ ,  $S_8 = 0.785 \pm 0.012$ , and  $M_B = -19.290^{+0.026}_{-0.029}$ , all of which are consistent with their local measurements, and moreover that the physical baryon density value,  $\omega_b$ , better agrees with the BBN constraints on it and  $H(z)$  exhibits excellent fit to the Ly- $\alpha$  data. While using the CMB+Pan+Ly- $\alpha$  data set provides us with the similar constrains, inclusion of the low-redshift BAO data, i.e., using CMB+Pan+BAO data set, leads to some compromise in these improvements. We will close the talk with a discussion on some other observational aspects and theoretical implications of the  $\Lambda_s$ CDM model. This talk is based on the works Graduated dark energy: Observational hints of a spontaneous sign switch in the cosmological constant" [Akarsu, Barrow, Escamilla, and Vazquez, PRD 101 (2020) 063528], "Relaxing cosmological tensions with a sign switching cosmological constant" [Akarsu, Kumar, Ozulker, and Vazquez, PRD 104 (2021) 123512], and "Relaxing cosmological tensions with a sign switching cosmological constant: Improved results with Planck, BAO and Pantheon data" [Akarsu, Kumar, Ozulker, Vazquez, and Yadav, arXiv:2211.05742] and several ongoing works by an extended group of leading researchers in the field of cosmology.

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