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Tackling the tensions of cosmology with a negative dark energy density

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In this talk, relying on the fact that the comoving angular diameter distance to last scattering, $D_M(z_*)$, is strictly constrained almost model-independently, I will present how a dark energy (DE) density that attains negative values in the past can alleviate the H_0 tension along with the S_8, and Ly-α discrepancies. Observational studies suggest that matching the mean value of the Ly-α data requires a negative DE density, and to keep $D_M(z_*)$ unaltered compared to that of ΛCDM, this is naturally accompanied by a higher H_0 value. Of course, a negative DE density should transit to the positive regime to drive the present-day acceleration of the universe, and for a continuous density function, this requires that the DE density vanishes at a certain time. This vanishing point is accompanied with a singularity in the equation of state parameter of the DE, I will discuss why such a singularity is necessary, and how a negative energy density is not problematic from the point of view of fundamental physics. Finally, imposing that $D_M(z_*)$ is constant amongst different models, along with an identical pre-recombination and present-day universe, requires that any modifications to the Hubble radius of ΛCDM should be described in terms of \textit{ admissible wavelets}. The oscillatory behaviour of wavelets provides a natural way to fit a multitude of BAO data, and through their characteristics, I will discuss how the bumps found in the Hubble function and the DE density in their observational reconstructions may be fake.

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