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Apparent w<-1 and a Lower S8 from Dark Axion and Dark Baryons Interactions

The fundamental natures of dark energy and dark matter remain two of the biggest mysteries in modern cosmology. We show that a simple coupling between dark energy and dark matter can simultaneously address two distinct hints at new physics coming from cosmological observations. The first is the recent evidence from the DESI project and supernovae observations that the dark energy equation of state is evolving over cosmic time from an earlier value that is <-1 to a present-day value >-1. The second observation is the so-called S8 tension, describing the suppression of the growth of matter overdensities compared to that expected in the ΛCDM model. We propose a stable, technically natural particle physics implementation of this idea, in which dark matter consists of dark baryons in a strongly-coupled hidden sector, and the dark energy field is the associated dark axion. The time-variation of the dark matter mass results in an effective dark energy equation of state that exhibits a phantom crossing behavior consistent with recent results. It also results in a slight delay in matter-radiation equality, which suppresses the overall growth of density perturbations.

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