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Interacting dark sector with dark matter entropy couplings

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The persistent discrepancies between predictions of the standard cosmological model and high-precision measurements across multiple probes remain a significant challenge in modern cosmology. Over the past decade, mounting evidence for tensions in key cosmological parameters - derived through both model-dependent and independent methods - has motivated the exploration of extensions to the standard paradigm. Among the most compelling directions is the dark sector, whose fundamental nature remains largely unknown. In particular, the microphysical properties of dark matter are still poorly understood beyond its gravitational role. In this talk, I will introduce a new class of interactions between dark matter and dark energy, formulated within a relativistic fluid framework. In this scenario, dark matter carries non-trivial intrinsic entropy with scale-dependent fluctuations, encoding additional internal degrees of freedom. Coupling this entropy to a scalar-field dark energy component gives rise to distinctive signatures in the growth of cosmic structure, opening a novel window into dark sector physics and on new physics in the standard model as a way of reconciling the observed cosmological tensions.

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