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Deciphering the Archaeological Record: Cosmological Imprints of Non-Minimal Dark Sectors

Wednesday 19 May 2021 14:00 (15 minutes)

Many proposals for physics beyond the Standard Model give rise to a dark sector containing many degrees of freedom. In this talk, we discuss the cosmological implications of non-trivial dynamics that may arise within such dark sectors, focusing on decay processes which take place entirely among the dark constituents. First, we demonstrate that such decays can leave dramatic imprints on the resulting dark-matter phase-space distribution. In particular, this distribution need not be thermal—it can even be multi-modal, exhibiting a non-trivial pattern of peaks and troughs as a function of momentum. We then proceed to show how these features can induce modifications to the matter power spectrum. Finally, we assess the extent to which one can approach the archaeological inverse problem of deciphering the properties of an underlying dark sector from the matter power spectrum. Indeed, one of our main results is a remarkably simple conjectured analytic expression which permits the reconstruction of many of the important features of the dark-matter phase-space distribution directly from the matter power spectrum. Our results therefore provide an interesting toolbox of methods for learning about, and potentially constraining, the features of non-minimal dark sectors and their dynamics in the early universe.

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