



Contribution ID: 1324

Type: DM

## A Reconstruction Conjecture: Deciphering the Structure of the Dark Sector from the Matter Power Spectrum

*Tuesday 25 May 2021 17:30 (15 minutes)*

Non-trivial dynamics within the dark sector can give rise to a complicated, non-thermal dark-matter phase-space distribution, which in turn can have a significant impact on the growth of the cosmic structure. In this talk, we explore the cosmological implications of such non-trivial dark-sector dynamics. We show how the non-trivial features in the phase-space distribution can lead to modifications to quantities of structure formation such as the matter power spectrum and the halo mass function. We then examine the extent to which one can address the archaeological “inverse” problem of deciphering the properties of the underlying dark sector from the matter power spectrum. We present a simple one-line conjecture which can be used to “reconstruct” the dark-matter phase-space distribution directly from the shape of the matter power spectrum and show that salient features of the distribution can be successfully reproduced – even for non-trivial distributions which are highly non-thermal and/or multi-modal. Our conjecture therefore provide an operational tool for probing the dark sector which does not rely on the existence of non-gravitational couplings between dark and visible states.

### Summary

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**Session Classification:** DM IV