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Extracting Primordial Dark-Matter Velocity Distribution from Halo Masses: A Reconstruction Conjecture

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In many scenarios beyond the traditional thermal paradigm, dark matter could be produced with a non-thermal (and sometimes highly nontrivial) primordial velocity distribution. The distribution of primordial dark-matter velocities can significantly influence the growth of cosmological structure. In principle, one can therefore exploit the halo-mass distribution in order to learn about the dark sector. In practice, however, this task is both theoretically and computationally intractable. In this talk, we present a simple one-line conjecture which can be used to "reconstruct"the primordial dark-matter velocity distribution directly from the shape of the halo-mass function. Although our conjecture is completely heuristic, we show that it successfully reproduces the salient features of the underlying dark-matter velocity distribution —even for non-trivial distributions which are highly non-thermal and/or multi-modal, such as might occur for non-minimal dark sectors. Our conjecture therefore provides an operational tool for probing the dark sector which does not rely on the existence of non-gravitational couplings between dark and visible states.

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