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Beyond the Free-Streaming Scale: The Detailed Shape of the Dark-Matter Velocity Distribution and its Impact on Cosmic Structure

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In scenarios in which multiple production channels contribute the overall dark-matter abundance, the primordial dark-matter velocity distribution can exhibit a highly non-trivial shape involving multiple, well-separated peaks and can receive significant support across a broad range of scales. The effect of free-streaming in such scenarios can give rise to patterns of cosmic structure which drastically differ from those obtained in scenarios with narrow, unimodal dark-matter velocity distributions — even scenarios with the same nominal free-streaming scale. In this talk, I discuss how the detailed shape of the dark-matter velocity distribution *beyond* the free-streaming scale impacts structure formation in both the linear and non-linear regimes. I examine the implications for the Lyman-alpha forest, for the halo-mass function, and for observables such as subhalo and cluster-number counts.

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