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Gravitational Production of Ultra light Dark(est) Matter

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I will present the results of our study of the non-adiabatic cosmological production of ultra light dark matter (ULDM) under a minimal set of assumptions: a free ultra light real scalar as a spectator field in its Bunch-Davies vacuum state during inflation and instantaneous reheating into a radiation dominated era. For (ULDM) fields minimally coupled to gravity, non-adiabatic particle production yields a distribution function peaked at low comoving momentum. The infrared behavior is a remnant of the infrared enhancement of light minimally coupled fields during inflation. We obtain the full energy momentum tensor, show explicitly its equivalence with the fluid-kinetic one in the adiabatic regime, and extract the abundance, equation of state and free streaming length (cutoff in the matter power spectrum). Taking the upper bound on the scale of inflation from Planck, the (ULDM) saturates the dark matter abundance for particles with mass $\sim 10^{-5}$ eV. Thus this cosmologically produced (ULDM) yields a cold dark matter particle without any coupling to Standard Model species and with solely gravitational interactions. We argue that the abundance from non-adiabatic production yields a lower bound on generic (ULDM) and axion-like particles (ALP) that must be included in any assessment of (ULDM)/(ALP) as a dark matter candidate.

Summary

Novel production mechanism for ultra light scalar degrees of freedom.

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