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DARK AND BARYONIC MATTER IN EULERIAN COSMOLOGICAL PERTURBATION THEORY TO FIRST ORDER

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In modern cosmology, the problem of large-scale structure formation has been studied through various analytical and computational methods and has become a cornerstone of astrophysics. The complexity of the equations that describe the evolution of small fluctuations in the matter field, with respect to the Friedmann - Lemaître - Robertson - Walker (FLRW) universe, commonly known as the theory linearized gravitational perturbations, makes it a valuable framework for describing the problem. Specifically, the approximation of sub-horizon scale allows us to explore scenarios where semi-analytical tools play a significant role in gaining a better understanding of how significant structures in our universe have evolved and how the cosmic web structure is formed. In this sense, these types of techniques have allowed for comparisons with extensive simulations and have provided a basis for contrasting with high-precision observations in this context. Therefore, in this lecture, we present a semi-analytical description of the evolution of contrast density in cold dark matter (CDM), including baryonic matter, in a linear regime in Fourier space. We achieve this by using the Jeans filtering function (JFF), considering only proportional solutions, and then comparing them with the numerical solutions calculated for the JFF equations to zero and first order. Finally, we discuss and elaborate upon some of the results obtained for various initial conditions in redshift.

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