ID de la contribución : **934** Tipo : **no especificado**

PNG-UNITsims: Halo clustering response to primordial non-Gaussianities as a function of mass

miércoles, 20 de noviembre de 2024 10:30 (15)

In this presentation I will talk about the PNG-UNITsims suite, which includes the largest full N-body simulation to date with local primordial non-Gaussianities (local PNG), the PNG-UNIT. The amplitude of the PNGs is given by fNLlocal=100. The simulation follows the evolution of 4096^3 particles in a periodic box with Lbox=1h^−1Gpc, resulting in a mass resolution of mp=1.24×10^9h^−1M⊙, enough to finely resolve the galaxies targeted by stage-IV spectroscopic surveys. The PNG-UNIT has fixed initial conditions with phases also matching the pre-existing UNIT simulation with Gaussian initial conditions. The fixed and matched initial conditions reduce the simulation uncertainty significantly. In this first study of the PNG-UNITsims, we measure the PNG response parameter, p, as a function of the halo mass. halos with masses between 1×10^12 and 5×10^13h^−1M⊙ are well described by the universality relation, given by p=1. For halos with masses between 2×10^10 and 1×10^12h^−1M⊙ we find that p<1, at a significance between 1.5 and 3.1σ. Combining all the halos between 2×10^10 and 5×10^13h^−1M⊙, we find p consistent with a value of 0.955±0.013, which is 3σ away from the universality relation. We demonstrate that these findings are robust to mass resolution, scale cuts and uncertainty estimation. We also compare our measurements to separate universe simulations, finding that the PNG-UNITsims constraints outperform the former for the setup considered. Using a prior on p as tight as the one reported here for DESI-like forecast can result in fNL constraints comparable to fixing p. At the same time, fixing p to a wrong value (p=1) may result in up to 2σ biases on fNL.

Abstract

I will introduce PNG-UNITsims, one of the largest N-body simulation incorporating local primordial non-Gaussianities. By evolving 4096^3 particles in a 1 Gpc/h box and matching initial conditions with the Gaussian UNIT simulation, we reduce uncertainties in the PNG response parameter p.

Our measurements reveal a 3sigma deviation from the universality relation, obtaining p=0.955+/-0.013. This finding has important implications for future cosmological analyses, as incorrect assumptions about could bias measurements.

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Clasificación de la sesión : Física Teórica

Clasificación de temáticas : Física Teórica