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Constraining local primordial non-Gaussianity using the large-scale modulation of small-scale statistics

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We implement a novel formalism to constrain primordial non-Gaussianity of the local type from the large-scale modulation of the small-scale power spectrum. Our approach combines information about primordial non-Gaussianity contained in the squeezed bispectrum and the collapsed trispectrum of large-scale structure together in a computationally amenable and consistent way, while avoiding the need to model complicated covariances of higher N-point functions. We perform a simulation based study and explore using both matter field and halo catalogues from the Quijote simulations. We find that higher N-point functions of the matter field can provide strong constraints local on non-Gaussianity parameter f_{NL}, but higher N-point functions of the halo field, at the halo density of Quijote, only marginally improve constraints from the two-point function. In subsequent work, we take this idea further and train a neural network to locally estimate the amplitude of linear fluctuation σ_8 from matter density field and correlate these local estimates with the large-scale density field. We apply our method to N-body simulations, and show that $\sigma(f_{NL})$ is 5.5 times better than the constraint obtained from a standard halo-based approach. We show that our method has the same robustness property as large-scale halo bias: baryonic physics can change the normalization of the estimated f_{NL}, but cannot change whether f_{NL} is detected.

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