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Efficient computation of non-Gaussian Scalar-Induced Gravitational Waves

Large density perturbations in the early-universe may lead to the formation of primordial black holes and source at 2nd order, scalar-induced gravitational waves (SIGW). The spectrum of the SIGW depends on the statistical properties of the density fluctuations, providing an opportunity to constrain small-scale density perturbations via GW observations. In particular, non-Gaussianity of the scalar perturbations leaves characteristic imprints in the SIGW, highlighting the importance of such GW observations. However, the computation of these non-Gaussian effects is challenging due to the high-dimensional integrals involved, especially as one considers higher and higher order effects. Drawing from CMB/LSS techniques, we present a multipole space method to efficiently and accurately compute such SIGW for local type non-Gaussianity. We discuss applications of this technique and compare it against other methods to evaluate such non-Gaussian SIGW, highlighting its strengths and weaknesses.

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