Non-Gaussianities due to Relativistic Corrections to the Observed Galaxy Bispectrum

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Abstract. High-precision constraints on primordial non-Gaussianity (PNG) will significantly improve our understanding of the physics of the early universe. Among all the subtleties in using large scale structure observables to constrain PNG, accounting for relativistic corrections to the clustering statistics is particularly important for the upcoming galaxy surveys covering progressively larger fraction of the sky. We focus on relativistic projection effects due to the fact that we observe the galaxies through the light that reaches the telescope on perturbed geodesics. These projection effects can give rise to an effective $f_{\rm NL}$ that can be misinterpreted as the primordial non-Gaussianity signal and hence is a systematic to be carefully computed and accounted for in modelling of the bispectrum. We develop the technique to properly account for relativistic effects in terms of purely observable quantities, namely angles and redshifts. We give some examples by applying this approach to a subset of the contributions to the tree-level bispectrum of the observed galaxy number counts calculated within perturbation theory and estimate the corresponding non-Gaussianity parameter, $f_{\rm NL}$, for the local, equilateral and orthogonal shapes. For the local shape, we also compute the local non-Gaussianity resulting from terms obtained using the consistency relation for observed number counts. Our goal here is not to give a precise estimate of $f_{\rm NL}$ for each shape but rather we aim to provide a scheme to compute the non-Gaussian contamination due to relativistic projection effects. For the terms considered in this work, we obtain contamination of $f_{\rm NL}^{\rm loc} \sim \mathcal{O}(1)$.