Position-dependent power spectrum - a new statistics for bispectrum

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ABSTRACT

The bispectrum of galaxies is a powerful probe of the non-linear gravitational evolution and galaxy formation. Non-linear evolution and non-linear galaxy biasing yield a non-vanishing bispectrum even in the absence of primordial non-Gaussianity. Despite its promise, measurements of the bispectrum have been a challenge due to complicated window function effects and the covariance matrix. Here, we propose a new method for measuring the bispectrum in the squeezed configurations, where one wavenumber is smaller than the other two, by using the "position-dependent power spectrum."

We first divide a survey volume (from N-body simulation) into many sub-volumes, and measure the power spectrum in each sub-volume. By correlating the power spectra with the mean overdensity (with respect to the survey volume) in the sub-volumes, one measures how the small-scale structures (power spectra in sub-volumes) modulate with long-wavelength modes (mean overdensity), which is essentially the squeezed bispectrum. As the properties of the power spectrum as well as the overdensity are extensively studied in the literatures, one would have better control on both quantities, and thus can extract information about the bispectrum without directly measuring the bispectrum.

Since the measured quantity (correlation between local power spectrum and mean overdensity) corresponds to an integral over the bispectrum, it is therefore at leading order sensitive to the linear and quadratic bias parameters $b_1$ and $b_2$. This enables us to obtain constraints on $b_1$ and $b_2$ without directly measuring the bispectrum, which is computationally and theoretically a much more complicated quantity.

Using this approach we do not consider all the information encoded in the bispectrum. Hence, although this method is not optimal in that sense, its simplicity and straightforward applicability to observational data makes it an attractive alternative for measuring galaxy bias.