An outline of measuring cosmic shear bispectrum extending the pseudo power spectrum method

Takanori Taniguchi (IPMU)
in collaboration with Masahiro Takada (IPMU)

1. Introduction

☐Cosmic shear is a very powerful probe of cosmological parameters. (Hikage+19; Hamana+20)
☐However, the 2-point correlation function or the power spectrum cannot extract the full statistical information of the cosmic shear field.

Goals:
☐Develop a method of measuring the bispectrum (the Fourier counterpart of the 3-point correlation function) from the cosmic shear field, which is the lowest-order correlation function to extract the non-Gaussian information.
☐Apply the method to the HSC-SSP data to improve the cosmological constraints, when combined with the power spectrum.

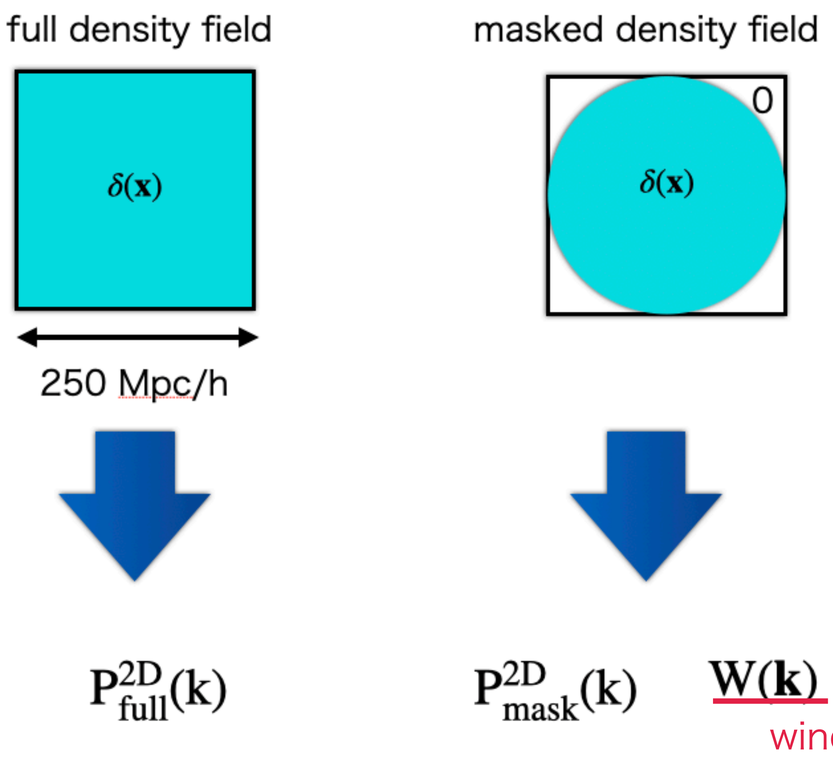
2. Approach to cosmic shear bispectrum

2D matter power spectrum
↓
cosmic shear power spectrum
↓ extending the pseudo power spectrum method
cosmic shear bispectrum

☐First, using the pseudo power spectrum method, we develop codes to measure 2D matter power spectrum and cosmic shear power spectrum from mock data.

☐Extending the pseudo power spectrum method, we will make a pipeline for cosmic shear bispectrum.

3. The pseudo power spectrum method for 2D matter power spectrum



masked = the effects due to the non-trivial survey boundary and the masks due to bright stars

What we can measure from the data is the power spectrum convolved with a survey window function

$$P^{2D}_{mask}(\mathbf{k}') = \int \frac{d^2k}{(2\pi)^2} W(\mathbf{k}'-\mathbf{k}) P^{2D}_{full}(\mathbf{k})$$

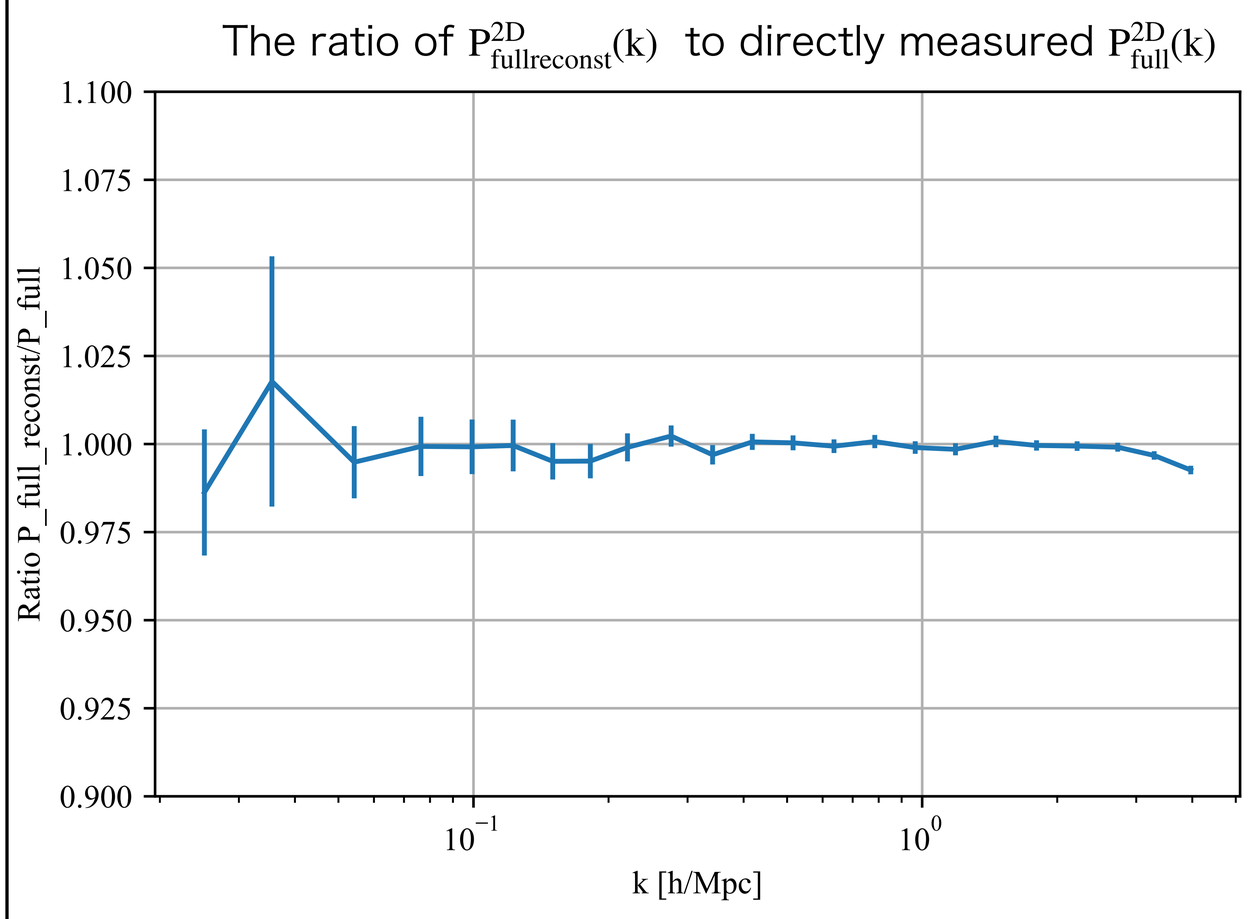
We perform the azimuthal angle average over k and k' and approximate the integral by the discrete summation. Then we can reconstruct the underlying power spectrum from the measured power spectrum as

$$P^{2D}_{fullreconst}(k) = \sum_{k'} W^{-1}_{kk'} P^{2D}_{mask}(k')$$

This method is called "the pseudo power spectrum estimator".

4.Result

Our method nicely recovers the underlying power spectrum, to better than 1% accuracy.



5.Reference

・Chiaki Hikage et al., 2019, PASJ, 71, 2, 43
・Takashi Hamana et al., 2020, PASJ, 72, 1, 16