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# Constraining BAO parameter with Bispectrum clustering of DESI Tracers

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**ABSTRACT**

We use simulations with and without BAO signal to assess the possibility of extracting more information from higher order statistics. We measure the BAO constraints from the power spectrum and the bispectrum of DESI LRG like samples. We show taht the BAO in the bispectrum has a potential of significantly improving the distance constraints compared to the power spectrum alone analysis. The improvement seems to be stable when we marginalize over possible theoretical systematics. We validate our results on simulations with and wihtout BAO for a range of redshifts. We measure isotropic BAO from AbacusSummit simulations that are designed to replicate DESI BGS, LRG, ELG, and QSO samples. We find that, in the absence of additional systematic effects we are able to constrain the distance scale with the precision of xxx per cent, xxx per cent, and xxx percent respectively for BGS, LRG, and ELG samples. The forecasted BAO constraints for the power spectrum only are xxx, xxx, and xxx percent respectively.

**Key words:** Awesome keywords: Perfect

## 1 INTRODUCTION

DESI is a great experiment. We need higher order statistics to extract more information. Reconstruction techniques can improve the precision, but the amount of information is limited by cosmic variance. Possible ways to improve is to go higher order statistics.

Cite Lado's paper that if bispectrum used as a standard ruler, a significant improvement is distance scale can be achieved. Much better than the standard reconstruction. Difficult to model the full bispectrum though. In this paper, we would like to do a standard ruler analysis of bispectrum BAO with different DESI-like tracers.

We find a factor of X improvement, and what happens at different redshifts. Worse for QSO probably, because of high shotnoise and less bispectrum clustering at higher redshifts.

$$\log \mathcal{L} = \Delta r^{\dagger} C^{-1} \Delta r, \tag{1}$$

where $\Delta r = r(\mathbf{k}) - r(\alpha\mathbf{k})$ with $r$ being defined as the ratio of

## 2 GLAM SIMULATIONS

Sec 2. Glam Section Plot Glam with and without BAO measurements. Describe Molino's covariance and put some justification. 1 Gpc cub. Reference Jayashree's paper that the template works well for a range of redshifts. make a plot for sigma alpha vs kmax, with and without nuisance parameters. Use CAMB to get the bao constraints for reconstructed power spectrum with GLAM parameters.

Sec 3. BAO is DESI samples. Analyse Abacus mocks with template from Jayashree. Renormalize Molino's covariance by the ratio of spectra to get covariance for Abacus. Maybe use Glam and Molino to show that spectra ratio scales proportional to dispersion ratio.

Sec 4. BAO detection level. How well we can fit BAO with a smooth function. Mean Glam' with and without BAO as model 1 and 2, and mean Glam with BAO as data. Chi2 vs alpha.

## ACKNOWLEDGEMENTS

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## DATA AVAILABILITY

Instruct how data used in this work can be accessed.

## REFERENCES

## APPENDIX A: EXTRA

You can put extra stuff here as appendix.

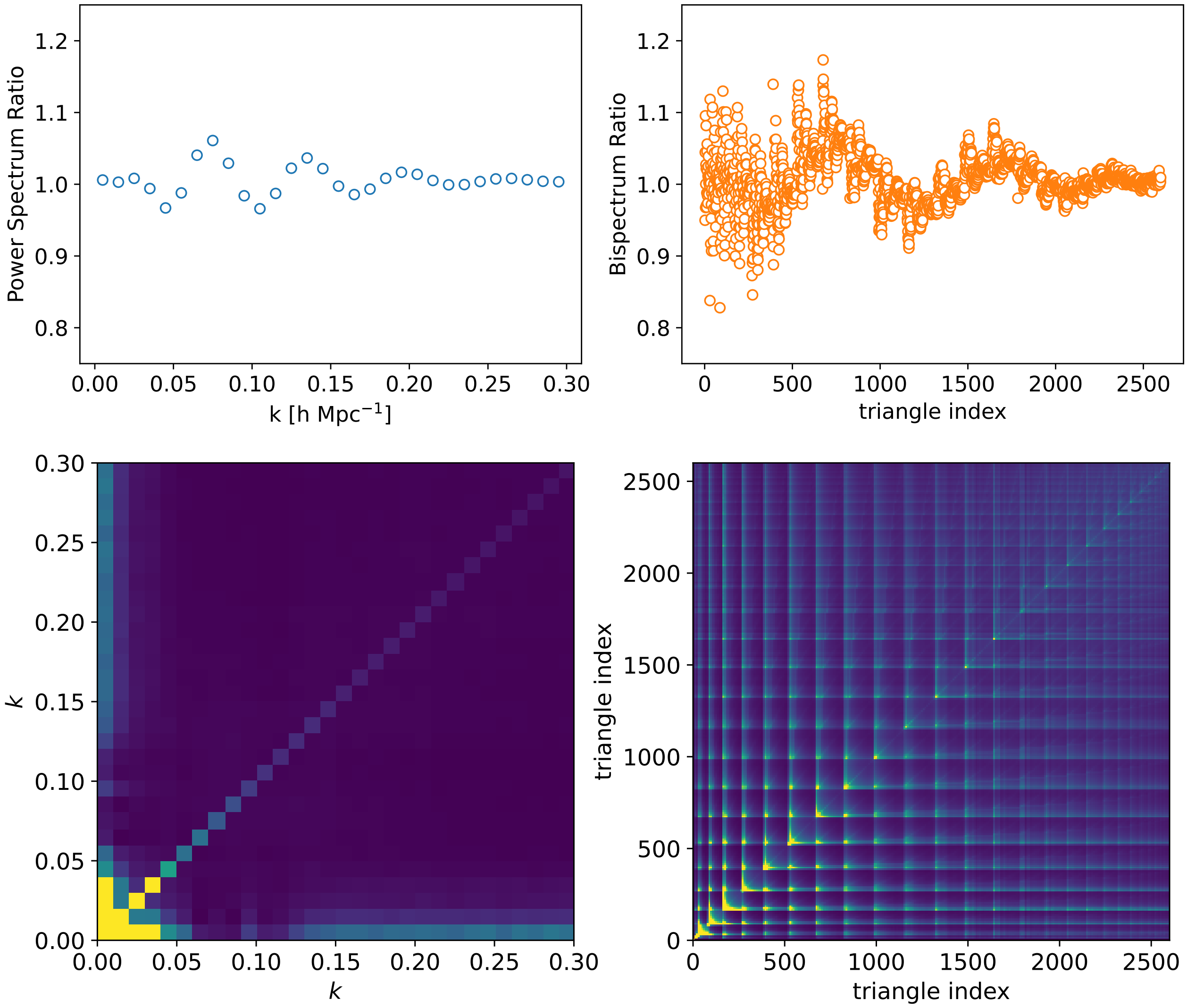


**Figure 1.** Mean power spectrum (bispectrum) of Glam mocks with BAO feature to that of the mocks without BAO. Covariance matrices of Molino mocks normalized by Glam.

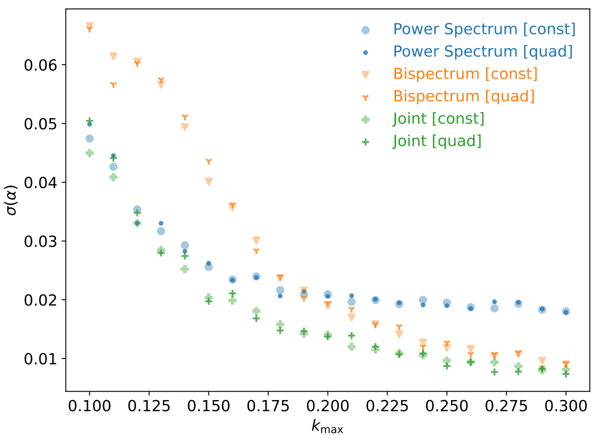


**Figure 2.** One sigma statistical uncertainty of BAO parameter $\alpha$ from Power Spectrum, Bispectrum, and Joint analysis.