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Theoretical ℓ1-norm from one-point PDF prediction

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Abstract

The phenomenon of light deflection due to the presence of massive objects is called gravitational lensing, which leads to the distortion of the observed images of these distant galaxies. These distortions are usually very small and can be detected only by averaging over a huge number of galaxies. This regime is what we call weak lensing. Weak gravitational lensing serves as a major tool in unraveling the universe's large-scale structure. One of the key focuses of upcoming surveys is quantifying non-Gaussianities. Traditional two-point statistics fall short in capturing these non-Gaussian features, necessitating the adoption of higher-order statistics. However, a missing piece of the puzzle is a robust theoretical framework.
One of the higher-order statistics methods that enables us to extract the non-Gaussian information from cosmic shear surveys is by using the one-point probability density functions. In a significant step forward, recent work by [Barthelemy et al. 2021] introduced a theoretical prescription to obtain the one-point probability density function based on the large deviation principle. Building upon this foundation, our study extends the theoretical framework to provide, for the first time, predictions for the ℓ1-norm. Previous work by [Ajani et al. 2021] has shown that ℓ1-norm performs better than the power spectrum by a considerable margin. With this work now have a theoretical prediction for the ℓ1-norm. We also explore the cosmological dependence of this statistic and validate our findings using simulations.
Our results demonstrate that the theoretical predictions of the aperture mass ℓ1-norm align remarkably well with existing simulations, accurately capturing the non-Gaussian information. Furthermore, our work sheds light on the cosmological implications of these findings, paving the way for more precise and informed cosmological investigations.

References

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Author: Mlle TINNANERI SREEKANTH, Vilasini (CosmoStat, CEA Paris-Saclay)

Co-auteurs: Dr CODIS, Sandrine (AIM/CNRS); Dr BARTHLEMY, Alexandre (Universitäts-Sternwarte, Fakultät für Physik, Ludwig-Maximilians-Universität München, Scheinerstraße 1, 81679 München, Germany); Dr STARCK, Jean-Luc (CosmoStat, CEA Paris-Saclay)

Orateur: Mlle TINNANERI SREEKANTH, Vilasini (CosmoStat, CEA Paris-Saclay)

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