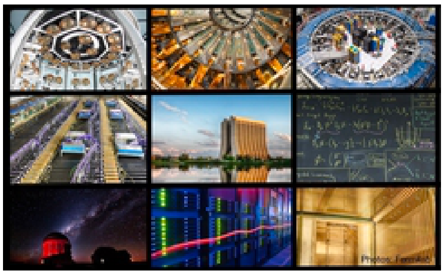

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Incorporating galaxy cluster triaxiality in stacked cluster weak lensing analyses

Monday, 16 August 2021 10:00 (15 minutes)

Counts of galaxy clusters offer a high-precision probe of cosmology, but control of systematic errors will determine the accuracy, and thus the cosmological utility, of this measurement. Using Buzzard simulations, we quantify one such systematic, the triaxiality distribution of clusters identified with the redMaPPer optical cluster finding algorithm, which was used in the Dark Energy Survey Year-1 (DES Y1) cluster cosmology analysis. We test whether redMaPPer selection biases the clusters' shape and orientation and find that it only biases orientation, preferentially selecting clusters with their major axes oriented along the line of sight. We quantify the boosting of the observed redMaPPer richness for clusters oriented toward the line of sight by modeling the richness-mass relation as log-linear with Poissonian intrinsic scatter, we find that the log-richness amplitude is boosted with a significance of 14σ, and the richness-mass slope and intrinsic scatter suffer minimal bias. We test the correlation of orientation with two other leading systematics in cluster cosmology−miscentering and projection−and find a null correlation, indicating that triaxiality bias can be forward-modeled as an independent systematic. Analytic templates for the triaxiality bias of observed-richness and lensing profiles are mapped as corrections to the observable of richness-binned lensing profiles for redMaPPer clusters. The resulting mass bias confirms the DES Y1 finding that triaxiality is a leading source of bias in cluster cosmology. However, the richness-dependence of the bias confirms that triaxiality, along with other known systematics, does not fully resolve the tension at low-richness between DES Y1 cluster cosmology and other probes. Our model can be used for quantifying the impact of triaxiality bias on cosmological constraints for upcoming weak lensing surveys of galaxy clusters.

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