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Fast Generation of Weak Lensing Maps in Modified Gravity with COLA

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Accurate predictions of weak lensing observables are essential for understanding the large-scale structure of the Universe and probing the nature of gravity. In this talk, I will present a lightcone implementation to generate maps of the weak lensing convergence field using the COmoving Lagrangian Acceleration (COLA) method. The lightcone is constructed in spherical shells from the source to the observer following an onion representation of the Universe.

We validate the COLA-generated maps in General Relativity by comparing five statistics - the power spectrum, bispectrum, probability distribution function, peak counts, and Minkowski functionals - to the high-resolution N-body simulations presented in Takahashi $et\ al.$ (2017). These validation tests provide a baseline for the map specifications required for COLA to capture the statistical features of the N-body maps. Using these map specifications, we extend our analyses to two theories of Modified Gravity, demonstrating their imprints on the five convergence statistics considered. This work represents a step towards precise weak lensing predictions under both General Relativity and Modified Gravity with reduced computational cost, providing a robust framework to explore the nature of gravity with field-level inference.

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