

Modified gravity and dark energy from one point matter statistics

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The late universe contains a wealth of information about fundamental physics and gravity, wrapped up in non-Gaussian fields. To make use of as much information as possible it is necessary to go beyond power spectra. Rather than going to higher order N-point correlation functions, this talk will demonstrate that the probability distribution function (PDF) of spheres in the matter field (a 1-point function) already contains a large fraction of this non-Gaussian information. The matter PDF dissects different density environments which are lumped together in 2 point statistics, making it particularly useful for probing modifications of gravity or expansion history.

With an analytic model for the matter PDF we extend this formalism into cosmologies beyond Λ CDM, including $f(R)$ and DGP modified gravity and evolving dark energy. In all cases, the matter PDF provides an excellent complement to the matter power spectrum. Combining weakly non-linear power spectrum information with the matter PDF yields 5σ detections of both modified gravity theories, and increases the Figure of Merit for dark energy by a factor of 5 beyond power spectrum information alone.

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