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How much information can be extracted from galaxy clustering at the field level?

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Talk will be based on arXiv:2403.03220 and references therein.

LSS surveys have significantly advanced from measuring angular clustering of galaxies using photographic plates to mapping three-dimensional clustering with spectroscopic fibers and robots. Meanwhile, statistical methods to analyze galaxy clustering and other biased tracers of LSS still rely on modeling two- and three-point correlation functions. This leaves open the question:

"How much cosmological information can be robustly extracted from galaxies and LSS tracers?"

In this talk, I will introduce a Lagrangian, EFT-based, forward-modeling framework (LEFTfield) to perform field-level Bayesian inference (FBI) of galaxy clustering. The latter aims to extract simultaneous constraints on amplitude and growth rate of matter fluctuations, namely sigma8 and f(z). I will then present the first direct, apple-to-apple comparison between sigma8 constraints obtained with FBI versus those obtained with a combination of power spectrum plus bispectrum (P+B)—using the same LEFTfield forward model and analysis scale cut—on nonlinear clustering of dark matter halos in N-body simulations. The FBI constraints show an improvement [over P+B] of 1.7-2.6, increasing with the analysis cutoff scale. These results underline the wealth of cosmological information in (nonlinear) clustering, currently beyond the reach of low-order n-point functions, which will become more significant as the cosmological volumes and tracer densities further increase in Stage-V surveys.

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