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MATTHIAS BARTELMANN

ITP (Uni Heidelberg)

"Kinetic field theory for cosmic structure formation "

25 October 2019 11:30 AM

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“Kinetic field theory: more on the generating functional“

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ABSTRACT

Kinetic field theory for cosmic structure formation

Based on the path-integral formulation of classical mechanics, a kinetic field theory (KFT) for classical particle ensembles in or out of equilibrium can be constructed in a way akin to statistical quantum field theory. If the equations of motion of the particles are linear, the particle trajectories are described by a Green's function. If they are symplectic, Liouville's theorem further ensures that the classical phase-space flow has unit functional determinant. Under these conditions, the central object of KFT, i.e. its generating functional, can be set up in a straightforward manner. Particle interactions are represented by an exponential interaction operator which either suggests a standard perturbative approach or allows a mean-field approximation. In the talk, I will describe KFT and its application to cosmological structure formation as an example. Since the theory is based on the full phase-space information of the particle ensemble, problems notorious in other analytic approaches to cosmic structure formation are avoided by construction. The theory can easily be extended to cover wide classes of cosmological models, dark-matter properties, and theories of gravity, for which I will show examples.

Kinetic field theory: more on the generating functional

The generating functional of KFT, specialised to initially Gaussian random fields has some interesting properties. In particular, it can be factorised, allowing closed expressions for power spectra, but also for the generating functional itself in the limit of high particle numbers. This should open a way towards the 1-PI effective action of the theory and towards renormalisation. I will describe this factorisation, hoping for hints, recommendations and discussions.

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