

## The interplay of hydrodynamics and fluctuations

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Fluctuations are ubiquitous phenomena emerging across all physical length scales and play a crucial role in determining properties and dynamics when the system's degrees of freedom are notably finite. Such extreme conditions can be achieved in heavy-ion collision experiments, where fluctuations are important measures of collectivity and criticality. We focus on non-equilibrium fluctuations integrated into hydrodynamics — an interplay of long-wavelength effective theory and additional non-hydrodynamic modes. This integration leads to a deterministic and covariant description of fluctuation dynamics through a closed set of nonlinear differential equations for n-point correlation functions involving full hydrodynamic degrees of freedom. I will discuss recent progress and future challenges within this general formalism.

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