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Hydrodynamic description of correlations in Quantum Fluids
FABIO FRANCHINI, ALEXANDER ABANOV, Suny Stony Brook — We employ field theory methods to study correlation functions of Spin Chains. We derive asymptotic behaviors of the correlators through a hydrodynamic formulation of the problem. In particular, we are interested in a correlator known as Emptiness Formation Probability (EFP), which measures the probability $P(n)$ of formation of an empty region of length n in the quantum fluid at low temperature. The EFP in the leading order is found as the action of the instanton solution of hydrodynamic equations of motion. This hydrodynamic approach has already been applied in the study of a number of systems, for instance the XXZ Spin Chain, a Bose gas with delta repulsion and free 1D fermions. The EFP for the XY Spin Chain is asymptotically Gaussian in n at the isotropic point and exponential in the anisotropic regime. We study the crossover between these two regimes by calculating the leading intermediate asymptotics of the EFP using a bosonization approach (linearized hydrodynamics). To study the subleading contributions to the EFP, we include gradient corrections to hydrodynamics and study quantum fluctuations around the saddle-point "instanton" solution.

Fabio Franchini
Suny Stony Brook

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