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Path Integrals and Effective Field Theory of Large Scale Structure

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Abstract : In this work, we recast the equations describing large scale structure, and by extension all nonlinear fluids, in the path integral formalism. We first calculate the well known two and three point functions using Schwinger Keldysh formalism used commonly to perturbatively solve path integrals in non- equilibrium systems. Then we include EFT corrections due to pressure, viscosity, and noise as effects on the time-dependent propagator. We are able to express results for arbitrary two and three point correlation functions in LSS in terms of differential operators acting on a triple K master intergral. We also, for the first time, get analytical results for more general initial conditions deviating from the usual power law $P \propto k^n$ by introducing a mass scale in the initial conditions. This robust field theoretic formalism empowers us with tools from strongly coupled QFT to study the strongly non-linear regime of LSS and turbulent fluid dynamics such as OPE and holographic duals. These could be used to capture fully the strongly non-linear dynamics of fluids and move towards solving the open problem of classical turbulence.

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