A Unified Derivation Of Transport Equations Based On Renormalization Group Method

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Abstract

The renormalization group(RG) equation is applied to derive transport equations, i.e., Boltzmann equation, Fluid dynamical equations, Fokker-Planck equation, for classical and quantum theories. The mechanism of the occurrence of the time-irreversibility is elucidated in terms of the notion of attractive manifolds in the theory of dynamical systems, putting an emphasis on the significance of the choice of the initial conditions. Starting from Zubarev's formulation of the Liouville equation, we derive the classical Boltzmann equation as an RG equation. The Boltzmann equation is further reduced to a fluid dynamical equations for slow and long-wave length motions. Multiplicative Langevin equation is converted to Fokker-Planck equation by a lowest order perturbative exoansion, irrespective to the Gaussian noise or not, starting from the stochastic Liouville equation. An application of the formalism will be applied also to Kadanov-Baym equation for Gauge theories.

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