SFB/TRR 21 - Colloquium

5. Juni 2015, Ulm

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Quantum Brownian Dynamics of Open Systems*

A quantum analogue of the traditional Brownian motion has been established for dissipative systems described by the system-plus-bath model. It is shown that the evolution of the system or the reduced density matrix satisfies a stochastic Liouville equation driven by complex noises. As a theoretical tool, this stochastic formulation can be used to derive both approximate master equations and exact ones for specific systems. It can also be employed as a practical technique for simulating nonequilibrium dynamics numerically via a direct implementation or being transformed to a deterministic algorithm a la hierarchical equations.
It has been demonstrated that a mixed random-deterministic scheme allows us to calculate the zero-temperature dynamics of the spin-boson model with Ohmic dissipation. It is found that for strong dissipation the population in the localized state obeys a simple rate dynamics. Moreover, the time scale is proportional to the ratio of the energy splitting of the two-state system to the cutoff frequency of the environment. The underlying physics of this observation still awaits a further theoretical understanding.
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