Quantum Mechanics of Open Systems with Three Classes of Bath

TCI SEMINAR

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Correlated system-bath coherence occurs whenever quantum nature of environment cannot be neglected. This is a type of quantum entanglement, which is playing ever increasing roles in many fields of science nowadays. In this talk, I will present a newly developed theory, the many-dissipaton density matrix formalism, for hybrid system and bath dynamics [1]. With a quasi-particle picture for bath influence, this theory unifies the treatments on three distinct classes of environments, electron bath, phonon bath, and exciton (two-level spin) bath. The new theory is closely related to the hierarchical equations of motion formation [2], but also identities the auxiliary density operators to the quasi-particles dynamics of hybridizing bath [1]. The present formalism offers efficient and accurate means for the study of steady state (nonequilibrium and equilibrium) and real-time dynamical properties of both systems and hybridizing bath. It further provides universal evaluations, exact in principle, on various correlation functions, including even those of hybridizing bath degrees of freedom. Induced bath dynamics could be reflected directly in experimentally measurable quantities, such as Fano resonances and quantum transport current noise spectrum. Some benchmark evaluations on correlated systems in the aforementioned three classes of bath will be presented [3,4].

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