A novel quantum simulation method for complex system-reservoir dynamics

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Accurate modeling of decoherence and dissipation in complex quantum devices – or in the exploration of dissipative quantum phase transitions – must be based on techniques beyond the standard quantum optical master equations. This need is most pronounced in the case of non-monochromatic driving, where the rotating-wave fails even in weak-coupling scenarios. Currently the hierarchical representation of reservoir-induced self-interactions (Hierarchical equations of motion, HEOM) and exact non-hermitian stochastic modeling (Stochastic Liouville-von Neumann equation, SLN) are available to address this need, among others. However, both become prohibitively expensive when the regimes of low temperature or strong coupling are investigated. This problem is overcome by a judicious combination of both methods, allowing previously intractable problems to be studied.