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System-environment Interaction in the Non-Perturbative Regime

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Abstract:

Multicomponent quantum systems in strong interaction with their environment are receiving increasing attention due to their importance in a variety of contexts, ranging from solid state quantum information processing to the quantum dynamics of biomolecular aggregates. Unfortunately, these systems are difficult to simulate as the system-bath interactions cannot be treated perturbatively and standard approaches are invalid or inefficient. We combine the time-dependent density matrix renormalization group with techniques from the theory of orthogonal polynomials to provide an efficient method for simulating open quantum systems, including spin-boson models and their generalizations to multicomponent systems. We present the method, explore some of its analytical properties and apply it to some examples demonstrating its feasibility as a numerical tool.

This talk is based on:

J. Prior, A.W. Chin, S.F. Huelga and M.B. Plenio.
“Efficient simulation of strong system-environment interactions.”
Phys. Rev. Lett. 105, 050404 (2010)

A.W. Chin, A. Rivas, S.F. Huelga and M.B. Plenio.
“Exact mapping between system-reservoir quantum models and semi-infinite discrete chains using orthogonal polynomials.”
J. Math. Phys. 51, 092109 (2010)