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Efficiently simulable Multipartite Collision Model reproducing any Markovian master equation

We introduce the Multipartite Collision Model to simulate the Markovian dynamics of any multipartite open quantum system by decomposing the system-environment interaction into elementary collisions between subsystems and ancillae, thus providing a simple decomposition in terms of elementary quantum gates for quantum computation. The generality of the model allows for the study of any possible Markovian global and local master equation in the presence of any kind of bath at any temperature, and makes it particularly suitable to address scenarios in which the fundamental interaction and energy exchange between subsystems and environment takes on great importance, e.g. in quantum thermodynamics. Moreover, we develop a method to estimate an analytical error bound for any repeated interactions model, and we use it to show that the error of the Multipartite Collision Model displays an optimal behavior. Finally, we proof that the Multipartite Collision Model is efficiently simulable on a quantum computer according to the dissipative quantum Church-Turing theorem.

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