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Thermalization by Rapid Repeated Interactions

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We investigate the open dynamics of a quantum system undergoing short discrete repeated interactions. We assume the joint dynamics of the system and the ancilla are unitary and the interaction is of brief duration δt. We then take the unique Markovian interpolation between the discrete post-interaction states and find its Master Equation. To zeroth order in δt we find the evolution is unitary and maintains the purity of the state. To first order in δt we see the leading dissipative effects.

In order for these dynamics to cause equillibration, they must be able to purify some state. We analyze exactly when these dynamics can purify finding that only interactions with a certain degree of complexity can purify. Restricing our attention to Gaussian states and Transformations we find that thermalizing interactions are given by a two parameter family of interaction Hamiltonians.

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