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Ground state geometry and the energy spectrum of local Hamiltonians

By generalizing a standard framework from the analysis of Markov chains to arbitrary (non-stoquastic) Hamiltonians we are naturally led to see that the spectral gap can always be upper bounded by a geometric quantity that depends only on the ground state probability distribution and the range of the terms in the Hamiltonian, but not on any other details of the interaction couplings. This means that for a given probability distribution the inequality can constrain the spectral gap (and other low-lying eigenvalues) of any local Hamiltonian with this distribution as its ground state probability distribution in some basis. These constraints reveal that some probability distributions will take exponential time to be precisely reached by a purely adiabatic evolution, while also showing the necessity of removing bottlenecks in the ground state geometry to improve the performance within the adiabatic paradigm.
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