Day 1

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Title: Energetic Perspective on Rapid Quenches in Quantum Annealing

Abstract:
There are well-developed theoretical tools to analyze how quantum dynamics can solve computational problems by varying Hamiltonian parameters slowly，near the adiabatic limit. On the other hand，there are relatively few tools to understand the opposite limit of rapid quenches，as used in quantum annealing and (in the limit of infinitely rapid quenches) in quantum walks. In this work，we developed several tools that are applicable in the rapid-quench regime. Firstly，we analyzed the energy expectation value of different elements of the Hamiltonian. From this，we showed that monotonic quenches，where the strength of the problem Hamiltonian is consistently increased relative to fluctuation (driver) terms，will yield a better result on average than random guessing. Secondly，we developed methods to determine whether dynamics will occur locally under rapid-quench Hamiltonians and identify cases where a rapid quench will lead to a substantially improved solution. In particular，we found that a technique we refer to as “preannealing” can significantly improve the performance of quantum walks. We also showed how these tools can provide efficient heuristic estimates for Hamiltonian parameters，a key requirement for practical application of quantum annealing.

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