Day 1

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Title:(Sub)Exponential advantage of adiabatic quantum computation with no sign problem

Abstract:
We demonstrate the possibility of (sub)exponential quantum speedup via a quantum algorithm that follows an adiabatic path of a gapped Hamiltonian with no sign problem. This strengthens the superpolynomial separation recently proved by Hastings. The Hamiltonian that exhibits this speed-up comes from the adjacency matrix of an undirected graph， and we can view the adiabatic evolution as an efficient O(poly(n))-time quantum algorithm for finding a specific “EXIT” vertex in the graph given the “ENTRANCE” vertex. On the other hand we show that if the graph is given via an adjacency-list oracle， there is no classical algorithm that finds the “EXIT” with probability greater than $\exp(-n^\delta)$ using at most $\exp(n^\delta)$ queries for $\delta= 1/5 - o(1)$. Our construction of the graph is somewhat similar to the “welded-trees” construction of Childs et al.， but uses additional ideas of Hastings for achieving a spectral gap and a short adiabatic path.

This work has been done in collaboration with Matthew Hastings and Umesh Vazirani.