

Adiabatic Quantum Simulators

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In his famous 1981 talk, Feynman proposed that unlike classical computers, which would presumably experience an exponential slowdown when simulating quantum phenomena, a universal quantum simulator would not. An ideal quantum simulator would be error resistant, easily controllable, and built using existing technology. Moving away from gate-model and projective measurement based implementations of quantum computing may offer a less resource-intensive, and consequently a more feasible solution. Here we consider an adiabatic quantum simulator which simulates the ground state properties of sparse Hamiltonians consisting of one- and two-body interaction terms, using sparse Hamiltonians with at most three-body interactions. Properties of such Hamiltonians can be well approximated with Hamiltonians containing only two-local terms. The register holding the simulated ground state is brought adiabatically into interaction with a probe qubit, followed by a single diabatic gate operation on the probe which then undergoes free evolution until measured. This allows one to recover e.g. the ground state energy of the Hamiltonian being simulated. Given a ground state, this scheme can be used to verify the QMA-complete problem LOCAL HAMILTONIAN, and is therefore likely more powerful than classical computing.

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