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Error correction for adiabatic quantum computing

KEVIN YOUNG, Sandia National Laboratories

Adiabatic quantum computing (AQC) is an alternative to the standard circuit model of quantum computation, wherein a quasistatic Hamiltonian, whose ground state at time T = 0 is simple and easily prepared, evolves slowly so that by the final time T = 1 the ground state encodes the answer to a problem. This procedure admits a novel set of natural algorithms for optimization problems, and is computationally equivalent to the circuit model in the absence of noise. But noise, and its effect on computational power, cannot be ignored. In light of this, AQC is particularly intriguing, possessing an intrinsic resilience to certain kinds of errors, including flawed time-dependent control Hamiltonians, dephasing in the energy basis, and energy relaxation. But these are far from the only errors afflicting quantum information processors, and any practical model of computation must be fault-tolerant to all expected forms of noise and error. With respect to this broader class of errors, true fault tolerance for AQC has remained elusive. In this talk we will discuss our progress towards this goal: (1) we identified and solved a variety of challenges on the road to error correction and fault tolerance in AQC; and (2) we identified a couple of major roadblocks, which appear insurmountable, and make us ultimately pessimistic that fault-tolerant AQC will ever be achieved.