

Complexity of the Quantum Adiabatic Algorithm

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I will discuss the problem of solving hard optimization problems on a quantum computer. At present it is not known whether a quantum computer would be more efficient than a classical computer in solving them. One proposed approach is the quantum adiabatic algorithm (QAA) of Farhi et al. We have used Quantum Monte Carlo simulations to study the efficiency of the QAA when applied to a particular "constraint satisfaction" problem known as Exact Cover. We find that, for large sizes, the system undergoes a first order quantum phase transition which renders the QAA inefficient. Whether the QAA will be more efficient for other optimization problems remains to be seen. I also discuss a possible connection between quantum complexity classes and the "minus sign problem" in quantum Monte Carlo simulations.