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Quantum Phase Transition and complexity of adiabatic quantum algorithm for Constraint Satisfaction problem SERGEI KNYSH, Mission Critical Technologies, VADIM SMELYANSKIY, NASA Ames Research Center — We study the dynamics of adiabatic quantum computation (AQC) for solving the problem of satisfiability of randomly chosen clauses, each with 3 Boolean variables (3sat). We map this problem to that of a diluted long-range spin glass in traverse magnetic field and derive a self-consistent equation for the order parameter. We show the existence of the first-order quantum phase transition and investigate analytically and numerically the phase diagram on the plane: strength of the transverse field Γ vs the ratio γ=M/N of a number of clauses M to a number of variables N. We show that the phase transition line approaches Γ=0 at the point of a classical replica symmetry breaking transition γ_{RSB}. We discuss the implications of the quantum phase transition for the complexity of the AQC for the 3sat.

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