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Computational Bottlenecks of Quantum Adiabatic Annealing SERGEY KNYSH, SGT Inc., NASA Ames Research Center — Quantum annealing in a transverse field with rate $d\Gamma/dt$ inversely proportional to the system size N suppresses non-adiabatic transitions for fully connected spin glass such as the Sherrington-Kirpatrick (SK) model at the quantum critical point. This alone is not sufficient to ensure that the problem is solvable in polynomial time. I conjecture the appearance of small gaps associated with macroscopic tunneling events deep in the spin glass phase. This effect is demonstrated rigorously for the annealing of a toy model that shares a set of crtical exponents with SK model: Hopfield network with two Gaussian patterns. It presents with $0.15 \ln N$ additional bottlenecks with gaps that scale as a stretched exponential $\exp[-c(N\Gamma)^{3/4}]$. Further, I extend the analysis to the ρ-landscapes model (random energy model with correlations) which more faithfully represents real spin glasses.

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