

Quantum annealing speedup over simulated annealing on random Ising chains

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We show clear evidence of a quadratic speedup of a quantum annealing (QA) Schrödinger dynamics over a Glauber master equation simulated annealing (SA) for a random Ising model in one dimension, via an equal-footing exact deterministic dynamics of the Jordan-Wigner fermionized problems. This is remarkable, in view of the arguments of H. G. Katzgraber et al. [1], since SA does not encounter any phase transition, while QA does. We also find a second remarkable result: that a “quantum-inspired” imaginary-time Schrödinger QA provides a further exponential speedup, i.e., an asymptotic residual error decreasing as a power law $\tau^{-\mu}$ of the annealing time τ .

[1] H. G. Katzgraber, F. Hamze, and R. S. Andrist, Phys. Rev. X **4**, 021008 (2014).