Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

Quantum error suppression with commuting Hamiltonians: Two-local is too local IMAN MARVIAN, DANIEL LIDAR, University of Southern California — We consider error suppression schemes in which quantum information is encoded into the ground subspace of a Hamiltonian comprising a sum of commuting terms. Since such Hamiltonians are gapped they are considered natural candidates for protection of quantum information and topological or adiabatic quantum computation. However, we prove that they cannot be used to this end in the 2-local case. By making the favorable assumption that the gap is infinite we show that single-site perturbations can generate a degeneracy splitting in the ground subspace of this type of Hamiltonians which is of the same order as the magnitude of the perturbation, and is independent of the number of interacting sites and their Hilbert space dimensions, just as in the absence of the protecting Hamiltonian. This splitting results in decoherence of the ground subspace, and we demonstrate that for natural noise models the coherence time is proportional to the inverse of the degeneracy splitting. Our proof involves a new version of the no-hiding theorem which shows that quantum information cannot be approximately hidden in the correlations between two quantum systems, and should be of independent interest. The main reason that 2-local commuting Hamiltonians cannot be used for quantum error suppression is

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Date submitted: 15 Nov 2014 Electronic form version 1.4