Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

Scaling of Decoherence for a Decoupled Multi-spin System[1] XUEDONG HU, Department of Physics, University at Buffalo, SUNY, JUN JING, Institute of Atomic and Molecular Physics, Jilin University — We study the decoherence of n confined but decoupled electron spin qubits by examining the state fidelity for various initial states under the influence of hyperfine interaction with local environmental nuclear spins. We find that n-qubit inhomogeneous broadening time $T_2^*(n)$ and the narrowed-state free induction decay time $T_2(n)$ have the same scaling behaviors. For a superposed state whose product basis states are all from the same Zeeman manifold, both $T_2^*(n)$ and $T_2(n)$ are scale-free with respect to n and the number of basis states, m. For a superposed state whose product basis states are selected from different Zeeman manifolds, both $T_2(n)$ and $T_2^*(n)$ are roughly inversely proportional to $\sqrt{n}$. Our results can be extended to other decoherence mechanisms, and to decoherence mechanisms in the presence of dynamical decoupling, such as decay of spin echo. This analysis should allow a more meaningful discussion on the scalability of any spin-based solid state quantum technology.

[1]We thank financial support by US ARO, NSF PIF, and NSF China.

Xuedong Hu
University at Buffalo, SUNY

Date submitted: 13 Nov 2014 Electronic form version 1.4