Abstract Submitted
for the MAR17 Meeting of
The American Physical Society

Imaginary Time Dynamics of Low Energy States in Quantum Many-Body Hamiltonians[1] PHILLIP WEINBERG, ANDERS SANDVIK, Boston Univ — Here we use imaginary time dynamics to extract the dynamic exponent z of Quantum many-body Hamiltonians H which have a ground state with long range order. This is done by evolving an excited state in imaginary time (e.g. with $e^{-\tau H}$) and measuring the time it takes for the state to relax to the ground state. We derive a generic finite size scaling theory which shows that this relaxation time diverges as L^z where z is the dynamic exponent of the low energy state(s). This scaling theory is then used to develop a systematic way of numerically extracting the dynamic exponent from finite size data. Using Quantum Monte Carlo to numerically simulate imaginary time, we apply this method to spin-1/2 Heisenberg Anti-ferromagnets on two different lattice geometries: A 2-dimensional square lattice, and a site diluted square lattice at the percolation threshold. For the 2-dimensional square lattice we recover $z = 2.001(5)$, which is consistent with the known values $z = 2$. While for the site dilute Heisenberg model we find that the dynamic exponent is $z = 3.90(1)$ or $z = 2.055(8)D_f$ where D_f is the fractal dimension of the lattice. This is an improvement on previous estimates of $z \approx 3.7(1)$.

[1]NSF DMR-1410126

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Date submitted: 10 Nov 2016 Electronic form version 1.4