Future Work

Although the motive behind this project was to investigate the origin of glassy dynamics and understand the nature of glasses. In principle, we are far away from simulating glassy dynamics for several reasons. The model we considered here is the Kinetic Ising model (With strong local constraints). The kinetic Ising model (Eq 1.) at its core is not interesting at all and getting ground state energies is quite trivial. But we impose local kinetic constraints. These take the form of a flip rate for the i^{th} spin which depends strongly on m_i, the number of nearest-neighbor spins which are in the up state.

$$E = h \sum_i^N \sigma_i \qquad \text{Eq. 1}$$

A physical interpretation is that the up spins correspond to defects of some sort. While their number is not strictly conserved, the kinetic constraints ensure that creation and annihilation of a defect must occur adjacent to *n* existing defects and the mean concentration of these defects are fixed by βh ($\beta \propto 1/T$) values so that their dynamics over long times resembles that of conserved objects. The concentration of up spins is fixed at the particular value of βh and given by Eq. 2.

$$c = \frac{1}{1+\exp(2\beta h)} \qquad \text{Eq. 2}$$

The values of βh we are considering are {0.8, 1.2}. The reason being Fredrickson and Brawer[1] found that the value $\beta h = 1.2$ to be the largest that could be applied before finite-size effects in the relaxation time become significant. At $\beta h = 0.8$ and 1.2 values, the concentration of spin-up defects is around 16.79% and 8.31% of the total population. So given only 24 qubits, it's near to impossible to initiate the spin flipping and see glassiness. We are exploring the potential use of the adiabatic model of quantum computation. These are the aspects which we think are worthwhile to investigate in the future.

- Starting from 1D systems and building the linear relaxation function to see if it shows non-Arrhenius behavior corresponding to fragile nature.
- Quantifying what exactly the active site means and analyze if there exists a generalized pattern that restricts the propagation from active sites.
- The motive is to see if the use of Quantum Simulations gives us any potential speedup/advantage in comparison to the MC simulations.
- The final goal is to move on to a 50 x 50 lattice model and see the dynamics and compare it with the previous results

1: G. H. Fredrickson and S. A. Brawer, J. Chem. Phys. 84,3351 (1986).