<u>Ferromagnets: Ising Model Simulation</u>

A ferromagnet has a high susceptibility to the magnetization, the magnetic strength of which is dependent upon the applied magnetizing field. The ferromagnet can often keep its magnetization even after the external field has been removed — a result of the parallel magnetic alignment of neighboring atoms within the material. There is quite a significant number of atomic dipoles in a ferromagnet which makes it exceptionally difficult to model on a computer. The use of Monte Carlo Summation can be used to generate random sampling of each dipoles orientation and then use the metropolis algorithm to see which energy states have the highest occupancy. The Ising model uses these statistical mechanics to model a ferromagnets magnetic dipole moments and their interactions with neighboring atoms.

The use of typical Python packages will be used, such as NumPy and

A two-dimensional grid lattice with periodic boundary conditions will be the space in which this Ising model exists and from that, a series of individual functions will define the physics of our ferromagnet within this two dimensional bounded space. These functions that define the physics of the ferromagnet must be able to randomly pick the orientation of a dipoles spin, flip the spin when an external magnetic field is generated, and calculate the total energy or magnetization of the lattice after the values of the dipoles nearest neighbor have been calculated. This Ising model will start at some temperature T, come to equilibrium and then come to a steady-state after some amount of time. The Markov Monte Carlo approach will choose a random particle that exists within the two-dimensional lattice then that particle will be subject to a function defining the probability of flipping spin that is dependent upon the change in energy of the system. This process will repeated some N number of times in order to get a legitimate model that represents a possible two-dimensional physical ferromagnet. There are a series of objectives that must be accomplished in order to eventually achieve the two-dimensional Ising model, they are (1) defining the adequate physics of the model that properly represent the physical system in question (2) using Monte Carlo methods to randomly choose and flip a spin in realistic sense (3) measuring the energy change of the system and calculating certain parameters of the neighbors (4) run the model and measure the consequences on the system after some number of trials N.