Week 5: Assignment Ising-2. Comp-Physics (lec of 13-19Sept, 2021).

Implement a Ising model in **3-d,** such that you have a **L*L*L** cubic lattice with periodic boundary conditions. Write the code such that the length of the lattice L is a input parameter of simulation. Moreover, the number of iterations (niter) at a particular temperature **T** are also input parameters. Thermal energy $\mathbf{k_BT}$ is measured in units of J_ising, where J_ising=1.0. N=L*L*L. Thermal energy
k_B T is measured in units of J_ising, where $\mathbf{k_B=1}$.

Run the simulation for **L=7, L=8, L=9** for Temperature (T) range of of **k_B T =4.7 to 3.8**. Change T in in steps of **0.02**. At each value of T, use **10000 MCS for equilibration**. After equilibration at each temperature, collect statistical data each MCS for $\mathbf{10^6}$ iterations for thermodynamic averaging. Calculate specific heat suscptibility (\chi) at each T using fluctuations of the energy $\mathbf{M_L}$, where $\mathbf{M_L}$ is the instantaneous magnetization of ALL the spins on lattice (and NOT magnetization per spin) corresponding to lattice size **L**. Also calculate magnetization per spin $\mathbf{(M_L/N)}$ at each value of T and plot this versus T for different values of **L.** Similar calculate heat capacity Cv for N spins using $\mathbf{E_L}$, where $\mathbf{E_L}$ is the energy for N spins**.** Also calculate energy per spin for the system.

(You can expect the runs to take around 15 to 45 minutes depending on the value of L. All numbers are specified in simulation units)

Plot chi x versus T for different values of L, and then answer the following questions

Q1. The value of the quantity chi at the temperature T=4.50000d0 , for the different values of L are approximately : .

Ans:

Q2. The value of Cv at the peak position for L=8 is (approximately):

Ans:

Q3. The value of Cv at the peak position for L=9 is (approximately) : _____

Q4. At temperature 3.8, the value for magnetization per spin for L=7 : _____

Q5. There are multiple energy levels (E_1, E_2,... E_n....) in a system in equilibrium at temperature T. The average number of particles in Energy level E_5 is 100, and the average number of particles in E_10 is 50. The value of energy at level E_10 is greater than that of energy level E_5. The number of particles jumping from E_5 to E_10 is 10 per second. Then the number of particles jumping per second from E_10 to E_5 is:

Q6. Calculate and plot Binder cumulant for different lattice sizes, thereby find the actual transition temperature.