

Computational Manybody Physics

Problem Set #1

Due: Oct 25, in class

In this problem set, we will implement a Monte Carlo simulation of a 2D-Ising model

$$H = - \sum_{\langle ij \rangle} \sigma_i \sigma_j - h \sum_i \sigma_i$$

on a square lattice with dimensions $L \times L$.

1. Write a code to perform simulations using the Metropolis algorithm.
2. Use the program to plot m vs T , $|m|$ vs T , E vs T , C_v vs T , χ vs T , and U_2 vs T for system sizes of $L = 8, 16, 32, 64$. Determine T_c .
3. Implement the Wolff cluster update with improved estimator χ . Compare with the result you obtained previously.
4. Measure the autocorrelation time of E and $|m|$ for the Metropolis and Wolff updates.
5. Using the simulation data, determine the critical exponents α, β, γ and ν . Plot the data collapse for $|m|$, χ , and C_v