

Frankfurt, June 9, 2015

Exercises for Computational Methods in Solid State Theory
SS 2015

Exercise Set 5

(Due date: Monday, June 22, 2015)

Exercise 7 (Calculating integrals with the Metropolis Algorithm) (5 points)

We consider the following three-dimensional integral:

$$(1) \quad I = 128 \frac{\int_0^1 dx dy dz x^3 y^2 z e^{-x^2 - y^2 - z^2}}{\int_0^1 dx dy dz e^{-x^2 - y^2 - z^2}}$$

- Identify the Boltzmann distribution and the observable.
- Generate the Boltzmann distribution using the Metropolis algorithm. Calculate the value of I using the Boltzmann distributed random numbers.

Exercise 8 (Two-dimensional Ising model) (5 points)

We investigate the two-dimensional Ising model without magnetic field using the Metropolis algorithm.

$$(2) \quad H = -J \sum_{\langle i,j \rangle} \sigma_i \sigma_j$$

- Implement the Metropolis algorithm for the 2D Ising model.
- Use a lattice of 8×8 spins. Measure the magnetization for ferromagnetic coupling ($J > 0$) as a function of the inverse temperature β .