Studies of phase transitions in magnetic systems

Vegard Falmår and Sigurd Sørlie Rustad

University of Oslo
Norway
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CONTENTS

I. INTRODUCTION

II. THEORY

Analytical expressions for 2x2 lattice

Table I shows the energy and magnetization of the 2D lattice for different spin configurations, as well as the multiplicity of each configuration. From this table we see that there are only five possible values for the energy differences ΔE:

- $\Delta E = \pm 16$ J for the difference between 8 J and -8 J (both ways)
- $\Delta E = \pm 8$ J for the difference between ± 8 J and 0 J (both ways)
- $\Delta E = 0$ J

III. METHODS

As presented in the Theory section (section II), we already know the energy differences in the lattice before we start the simulation. We can thus compute and store the different values of $e^{-\beta \Delta E}$ beforehand to avoid making these computations every time we update the energy.

A. Boundary conditions

We are going to simulate a 2D lattice with periodic boundary conditions. This means that the neighbour to the right of s_N takes the value of s_0 and the neighbour to the left of s_0 takes the value of s_N.

IV. RESULTS

V. DISCUSSION

Number spins up	Degeneracy	Energy, [J]	Magnetization
4	1	-8	4
3	4	0	2
2	4	0	0
2	2	8	0
1	4	0	-2
0	1	-8	-4

Table I. Table showing the energy, multiplicity and magnetization of different configurations of spins in a 2×2 2D-lattice with periodic boundary conditions.

[1] Department of Physics, Univeristy of Oslo, Fall semester 2020, Computational Physics I FYS3150/FYS4150, Project 3.
[2] Ryan S. Park, Alan B. Chamberlin, NASA, 27. October 2020, https://ssd.jpl.nasa.gov/horizons.cgi#top.