Summary of SI2510 Statistical Mechanics

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August 25, 2020

Abstract

This is a summary of SI2510 Statistical Mechanics.

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1 Basic Concepts

Phase Transitions Landau introduced the concept that phase transitions are defined by spontaneous symmetry breaking.

Order Parameters An order parameter describes spontaneous symmetry breaking. It is zero in one phase and non-zero in another.

The Ising Model The Ising model is a simple model of magnets. In this model, a magnet is a collection of spins on a lattice. Its generalized coordinates are σ_i, which may take the values ± 1, signifying a particular spin pointing up or down. The Hamiltonian is

$$\mathcal{H} = -J \sum_{i,j} \sigma_i \sigma_j.$$

The order parameter defining its phase transition is $m = \langle \sigma_i \rangle$.