

Physics 6311: Statistical Mechanics (Thomas Vojta)

Part I: Principles of equilibrium statistical mechanics

0. Introduction

- 0.1 Physical description of large systems
- 0.2 What is statistical physics?
- 0.3 Why is it important?
- 0.4 Historical remarks
- 0.5 Plan of the course

1. Minireview of thermodynamics (Chandler chapters 1 and 2, Kardar chapter 1)

- 1.1 Thermodynamic equilibrium
- 1.2 State variables
- 1.3 The laws of thermodynamics
- 1.4 Thermodynamic potentials
- 1.5 Stability of the equilibrium state

2. Elementary probability theory (Kardar chapter 2, Reichl chapter 4)

- 2.1 Definition of probability
- 2.2 Random variables
- 2.3 Averages, moments, cumulants and correlation functions
- 2.4 Examples of distributions
- 2.5 Central limit theorem

3. Principles of Statistical Mechanics (Chandler chapter 3, Kardar chapter 4)

- 3.1 The Statistical Method and Ensembles
- 3.2 Microcanonical Ensemble
- 3.3 Canonical Ensemble
- 3.4 Generalized Ensembles

Part II: Selected applications

4. Non-interacting systems (Chandler chapter 4, Kardar chapters 4 and 7)

- 4.1 Photon gas
- 4.2 Ideal gases of real particles
- 4.3 Electrons in metals
- 4.4 Bose-Einstein condensation

5. Phase transitions (Chandler chapter 5, Pathria chapters 11 and 12)

- 5.1 Ising model
- 5.2 Mean-field theory
- 5.3 Renormalization group