### PHYS 7540 STATISTICAL MECHANICS

# **INSTRUCTOR:** J. Sirker (Allen 515)

### **TEXTBOOKS:**

There is no required textbook for this course. Course notes will be published online. However, you might want to consult some of the textbooks listed below:

1) LD Landau and EM Lifshitz, *Statistical Physics, Part 1* (Elsevier Butterworth-Heinemann, 1980). Excellent discussion of many of the core concepts.

2) RK Pathria, Statistical Mechanics (Butterworth-Heinemann).

Another good introduction into the classical topics of Stat. Mech.

3) Roger Bowley and Mariana Sánchez, *Introductory Statistical Mechanics* (Oxford Univ. Press, 1999). This is an undergraduate textbook. It contains helpful explanations of the main ideas and is easy to read.

### 1. INTRODUCTION:

- Objectives of Statistical Mechanics
- Hamiltonian mechanics, phase space
- Liouville theorem, Poincare theorem
- Density operators classical and quantum
- Dirac notation

## 2. BASICS OF EQUILIBRIUM STATISTICAL MECHANICS

- Ensembles
- Entropy
- Partition functions, thermodynamic relations, fluctuations
- 3. THE IDEAL GASES
  - The classical ideal gas
  - Identical particles: Fermions and Bosons
  - The ideal Bose gas (Photon gas, vibrations of solids, Bose-Einstein condensation)
  - The ideal Fermi gas

### 4. BOSE-EINSTEIN CONDENSATION IN WEAKLY INTERACTING GASES

- Cold atomic gases, traps, optical lattices
- 5. MAGNETIC SYSTEMS
  - The Ising model (Solution in one dimension)
  - The Hubbard and the Heisenberg model

### 6. PHASE TRANSITIONS

- Mean Field Theory
- Classification of Phase Transitions: Landau theory
- Critical exponents