Syllabus (tentative)

I. Thermodynamics — Phase Equilibrium; Liquid-Gas Transition

II. Ensemble Theory

III. Classical Gas — Ideal Gas; Interacting Gas (Cluster Expansion)

IV. & V. Ideal Boson and Fermi Gas — BEC, solid heat capacity; blackbody radiation; Fermi Surface metal heat capacity

VI. Phase Transition — Ising Model, critical exponent, Landau approach; * Continuous Symmertry Renormalization Group

Introduction

* Physics so far
  - Deterministic: differential equations with IC or BC
  - Single or few body systems
* Macroscopic Systems: of huge degree of freedom $\sim N_A$

Thermodynamics: phenomenological approach to equal properties of macroscopic system

Statistical Mechanics: a probalistic approach

large $N \gg 1$ leads to: T, phase transition ($N \to \infty$)

liquid, gas, magnetic, superfluidity, superconductivity

Early days of QM ⇔ Stat Mech (verification)

1900 Planck Blackbody Radiation

1907 Einstein
1912 Dedye
)-> Solid heat capacity

1925 Einstein & Boson B-E statistics

1926 Fermi & Dirac F-D statistics

=> Fauler whitedwarf

1927 Sommerfield

Critical exponent & Field theory Renormalization Group

1950s Universality

1966 Kadanoff 1971 Wilson

Recent

Quantum Many-body System – thermolization