Fall 2007

STATISTICAL MECHANICS, PH 7310, M & W 1:25PM – 2:40PM, Lecture Hall JFB B1

First Class meeting: Monday, August 20, 2007

From Statistics to Temperature, Energy, Entropy, and Thermodynamics in a few Simple Steps.

This course emphasizes the *reasoning* process that allows thermal fluctuations into physics. Thermodynamics will be derived from first principles. The discussions emphasize the measured functions of the thermodynamics of condensed matter: specific heat, magnetic and electric susceptibilities, conductivity, etc. and the independent variables: pressure, temperature, magnetic field, etc. We examine changes of phase: the Curie point in magnetism, the lambda transition in liquid helium, the superconducting phase transition, and other such phase transitions, all derived from simpler "first principles."

Much of this material can be understood using classical concepts, but the more interesting features require proficiency in quantum theory. Several examples of *quantum statistical mechanics* of interacting particles will be investigated, including Feynman's theory of liquid helium.

We investigate collective phenomena such as sound propagation and dissipation in fluids and solids, and disorder in glassy and amorphous materials. An introduction to *critical exponents* follows and if time permits, an introduction to *thermodynamic Green functions*.

Homework is required to be handed in 1 week following each assignment, but a *project* may be substituted for the final exam. Collaboration is encouraged both in the homework and in the projects. A list of possible and/or acceptable projects will be negotiated half-way into the course.

Instructor: D.C. Mattis,
[mattis @ physics.utah.edu]
Office: room B2 (JFB Bldg.)
Tel: 581-3690
Class hours: 1:25- 2:45 PM, M & W in room B1
Sec'y: Jackie Hadley (Physics main office)
Grader: S. Goupalov

Text

Statistical mechanics Made Simple, First Edition, Second Printing revised and corrected, plus additional handouts. (A list of corrections and addenda will be distributed.)

(A Second Edition is on its way but will not be available until the end of the semester.)

Lectures:

We follow the text linearly, up to and including chapter 9.

Prerequisites

A year's course in quantum theory, some classical mechanics, elementary thermodynamics.