INTRODUCTION TO MANY BODY PHYSICS: 620. Fall 2003

Exploratory Quiz

Welcome to Physics 620, introduction to Many Body physics. It would be very helpful to me if I could have some idea of your interests and backgrounds. The quiz here is not going to be used for evaluation. I would appreciate if you could please bring your answers, with your name on them, to the next class. If you are not familiar with a given question, skip it. I don't intend you to go to the library, or to spend a lot of time on these questions. I shall hand out the first question sheet next week. (Alternatively, extract it from the website).

Many thanks, Piers Coleman.

Your name:

1. What would you most like to learn about in this many body course?
2. Do you yet know which areas of research do you want to specialize in? Experiment, or theory? Particles, nuclear or condensed matter?
3. Have you taken a course in solid state physics and/or statistical physics?
4. What is the distinction between a fermion and a boson?
5. Are you familiar with second quantization?
6. What is a path integral?
7. Suppose a sudden electric field pulse is applied to a material, $\vec{E} = E_o\delta(t)$. Sketch qualitatively, as a function of time, the current $j(t)$ that would develop in (i) a metal, (ii) a superconductor and (iii) an insulator. Please label the time-scales in your sketch, both in qualitative and quantitative terms.
8. What happens to a fluid of bosons if you cool it to low temperatures?
9. As the complexity of a material increases, the system the system starts to develop new types of "emergent" or macroscopic property, such as magnetism. Make a list of "emergent" states of condensed matter that you know.
10. What is the Fermi energy of a metal?
11. A metal is cooled in a magnetic field, and becomes superconducting. Sketch what happens to the magnetic field lines.
12. How does the specific heat of a metal depend on temperature?
13. Obtain an approximate value for the integral $I = \int_0^{5\pi} e^{-\lambda \cos^2 x} dx$, where λ is very large.
14. Materials physicists can make crystals with up to 5 different elements per unit cell. Make an order of magnitude estimate of the number of stable compounds of this complexity. What proportion do you think have been explored.