Some Suggested Topics for Term Projects

Physics 880.06: Fall, 2003

The following is a list of some suggested term project topics for Physics 880.06 for Fall, 2003. You have a choice of three types of projects:

• Written paper (10-15 pages, typed, double-spaced)
• Oral presentation (20 minutes + 5 minutes for discussion)
• Computer project (several possibilities listed below)

Two of you can choose the same overall topic; in that case, one of you should give a paper and other should do an oral presentation.

Here is a non-exclusive list of some possible topics:

1. Electronic structure (i.e., band structure) of some wide-bandgap semiconductors (e.g., GaN).
2. Photonic band gap materials. (These are materials with a spatially varying but periodic dielectric function; they may have band gaps for photons as semiconductors have band gaps for electrons.)
4. Quasicrystals. A quasicrystal is a material which has sharp Bragg spots, like an ordinary three-dimensional crystal, yet does not have three-dimensional periodicity. They were discovered in the mid 1980’s.
5. Band structure of graphite.
6. The tight-binding model for electronic structure in a magnetic field.
8. Atoms in optical lattices. An optical lattice is formed by interfering light waves of different wave vectors but the same frequency. An atom moving in such a lattice occupies a Bloch state just like an electron in a more conventional crystal lattice. This topic would involve explaining some of the physics behind these lattices.


10. The Hubbard Hamiltonian (difficult topic).

11. Electronic structure of ferromagnetic metals (e. g. Fe, Co, Ni).


13. Nuclear magnetic resonance in solids: basic concepts and selected applications.


15. Other methods of band structure: Green’s function (Korringa-Kohn-Rostocker) method; augmented plane wave method.

16. Kohn anomalies in the density of states in one, two and three dimensions; experimental verification.

17. Band structure of one-dimensional materials (e. g. conducting polymers).

18. X-ray diffraction and order-disorder transitions in solids.

I will have additional suggestions in the next few days. Please, feel free to suggest your own topic. If you do so, please see me and get my approval before you start. I welcome suggestions related to your planned research.

Time schedule (tentative):

- Friday, November 14. Topic must be selected by this date (including one or two references and a couple of sentences of description). You may send this information by email to me.
• Friday, December 5. Last day of classes, and all written projects due by this date. Oral presentations will be given on Wednesday and Friday of this week, with further dates scheduled as needed.