PHYSICS 880.20: Autumn 2009

Introduction to Magnetism

Time & Place: Tues. and Thurs. 9:30 - 11:18 AM

Room: 0018 Lazenby Hall, Building 041, 1827 Neil Ave Mall

Instructor: Professor Mohit Randeria
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Course Website:
www.physics.ohio-state.edu/∼randeria/courses/magnetism/magnetism.htm

Goal: This goal of this course is to introduce graduate students to some of the basic ideas and concepts in the quantum theory of magnetism. This course is designed to be of interest to both *theorists and experimentalists*.

In Winter 2010, Professor Chris Hammel plans to teach a second course which will focus on experimental aspects of magnetism.

Prerequisites:
Quantum Mechanics (827, 828 & 829 or equivalent) and
Statistical Mechanics (846 & 847 or equivalent).

I will *not* assume that the students have already taken graduate courses in E & M and in Solid State Physics, but it would certainly help if they are taking those classes concurrently.

Syllabus: An optimistic plan is to cover the following topics

- Magnetic ions in solids: Hund's rules, crystal fields, Jahn-Teller, spin-orbit coupling
- Linear response and Kramers-Kronig relations
- Probes of magnetism: neutron scattering and NMR
- Insulators: Exchange, Ferromagnets and Antiferromagnets: Mean-field theory and Spin waves
- Metals: Paramagnetism, Diamagnetism; Ferromagnetism: Stoner theory and double-exchange; Spin density wave antiferromagnetism.

I will illustrate the topics discussed in class using examples of topics of current interest such as colossal magnetoresistance in manganites, double perovskites, dilute magnetic semiconductors, AFM in Mott insulators, topological insulators, frustrated magnets and spin-liquids.

Grading:
There will no final exam. Each student will have to write a term paper.

References:
There is no designated text book. For parts of the course, I will use

"Theory of Magnetism" by K. Yosida, (Springer, 1998) [ISBN 3-540-60651-3]
and
"Lecture Notes on Electron Correlation and Magnetism", by P. Fazekas (World Scientific, 1999) [ISBN 981-02-2474-5].

The NMR lectures will be based on (a very small subset of) the classic "Principles of Magnetic Resonance" by C. P. Slichter (Springer, 1996) [ISBN 0-387-50157-6].