Condensed matter theory Spring semester 2014/2015

Dmitri Ivanov

Course program:

- 1. Introduction
 - 1.1 Electrons in metals: methods and approximations.
 - 1.2 Non-interacting fermions: specific heat, electrical and thermal conductivities, Wiedemann–Franz law.
- 2. Symmetries of electronic states in crystals.
 - 2.1 Groups and their representations.
 - 2.2 Crystal symmetries and degeneracies of energy bands.
- 3. Electron-electron interactions.
 - 3.1 Second quantization, introduction to diagrammatic methods.
 - 3.2 Hartree-Fock approximation.
 - 3.3 Random-phase approximation and screening of Coulomb interactions.
 - 3.4* Landau Fermi liquid theory.
- 4. Electron-phonon interactions.
 - 4.1 Phonons. Specific heat of phonons.
 - 4.2^* Resistivity due to phonons.
 - 4.3 Attraction between electrons mediated by phonons.
- 5. BCS theory of superconductivity.
 - 5.1 BCS Hamiltonian and mean-field approximation.
 - 5.2 BCS ground state, Cooper pairs, quasiparticles.
 - 5.3 Relation between the transition temperature and the zero-temperature gap.
- * if time permits

Literature:

Recommended books:

[AM] N. W. Ashcroft and N. D. Mermin, Solid State Physics.

[Mar] M. P. Marder, Condensed Matter Physics.

[PC] P. Coleman, Introduction to Many Body Physics.

Organizational details:

- 12 lectures and 12 exercise sessions (11 problem sets)
- Final exam: oral
- Requirement: completed 7 out 11 problem sets
- Course web page (lecture notes, problem sets, etc.): http://www.physik.uzh.ch/lectures/th-pkm/
- My e-mail: ivanov@phys.ethz.ch