FSI3210 Many Particle Physics 7.5 credits

Mångpartikelfysik

This is a translation of the Swedish, legally binding, course syllabus.

If the course is discontinued, students may request to be examined during the following two academic years

Establishment

Course syllabus for FSI3210 valid from Spring 2019

Grading scale

P, F

Education cycle

Third cycle

Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

Intended learning outcomes

After completed course, the PhD student should be able to:

- use second quantization formulation of quantum field theory.
- use Green's function technique.
- use Feynman diagrams.

- master the theories for the electron gas, superconductivity (BCS theory), and for superfluids.
- master the theoretical background for magnetism.

Course contents

Part 1.

The first part of the course is devoted to explain basic formalism of the many body theory. It starts from the second quantization representation of quantum mechanical operators acting in the Hilbert space of a system consisting of many identical particles. Based on this technique the Green's functions are introduced and then their analytical properties are discussed. The perturbation theory and Feynman rules are discussed both for the ground state and equilibrium systems at finite temperatures, fermions and bosons. The linear response theory is introduced.

Part 2

During the second part of the course the general formalism will be applied to several examples of collective phenomena in condensed matter systems. The microscopic physics of superconductivity will be discussed in detail. Superfluidity in a weakly interacting Bose gas will be considered. The basic models of magnetism and spin-dependent collective phenomena like Kondo effect and RKKY interaction between magnetic impurities will be introduced.

Specific prerequisites

Good knowledge about all compulsory physics courses and statistical mechanics.

Course literature

Fetter och J. Walecka, Quantum theory of many particle systems, McGraw-Hill 1971.

A. A. Abrikosov, L. P. Gorkov och I. Y. Dzyaloshinskii, Quantum field theoretical methods in statistical physics, Pergamon, 1965.

A. Zagoskin, Quantum theory of many-body systems: techniques and applications, Springer-Verlag, 1998

R. White, Quantum Theory of Magnetism, Springer-Verlag, 2007

Examination

- TEN1 - Oral exam, 7.5 credits, grading scale: P, F

Based on recommendation from KTH's coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability.

The examiner may apply another examination format when re-examining individual students.

Other requirements for final grade

Hand in problems, oral exam.

Ethical approach

- All members of a group are responsible for the group's work.
- In any assessment, every student shall honestly disclose any help received and sources used.
- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.