FSH3313 Quantum Many Body Physis 7.5 credits

Kvantmångkroppsfysik

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 FSH3313 valid from Spring 2016

Grading scale

Education cycle

Third cycle

Specific prerequisites

Language of instruction

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

Intended learning outcomes

The main aim of the course is to understand the basic concepts in many-body physics and energy density functional theory. When completing the course, the students should be able to use the second quantization, solve the Hatree-Fock equations and the BCS equation for

superconductivity. They should also be able to describe advanced approaches to treat the pairing problem including generalized seniority model, the Richardson model as well as the Hartree-Fock-Bogoliubov approach. They will be able to apply the pairing models to analze the properties of complex quantum systems including atomic nuclei. The course aims also at understanding and implementing numerical methods. To achieve this the students will be provided with both basic and advanced numerical tools for solving complicated many-body problems. They should be able to implement one or several of those tools and understand the results. The students are also expected to write their own codes for solving complex systems in a simple way and write the scientific report in a standard manner.

Course contents

Hohenberg-Kohn theorem

Hellmann-Feynman theorem

Local-density approximation

The general variational principle

The Hartree-Fock method

Pairing correlation and the BCS model

Nuclear interaction and nuclear superfluidity

The Hartree-Fock-Bogoliubov theory

Richardson model

Tamm-Dancoff and Random-Phase approximations

Nuclear collective motion

Disposition

Lecture notes will be distributed and the students are expected to study mostly by themselves. Discussions and lectures will be arranged together with the students.

Course literature

P. Ring and P. Schuck, Nuclear Many body problem, (Springer, Berlin) 1980 (Chap. 5-8).

D. Rowe and JL Wood, Fundamentals of Nuclear Models: Foundational Model och egna material.

Examination

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

To pass the course the students should give 1-2 open seminars on the subject and hand in a study report. In both cases the students should demonstrate that they have obtained good understanding of the subject and be able to apply their knowledge to practial problems and answer the questions and comments raised by the teacher and other students in a proper way.

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.