SI2380 Advanced Quantum Mechanics 7.5 credits

Kvantmekanik, fortsättningskurs

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

Establishment

Course syllabus for SI2380 valid from Autumn 2015

Grading scale

A, B, C, D, E, FX, F

Education cycle

Second cycle

Main field of study

Physics

Specific prerequisites

Recommended prerequisites:
Mathematical Methods in Physics.
Quantum Physics.

Language of instruction

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

Intended learning outcomes

After completion of the course you should be able to:

- describe the formal structure of quantum mechanics.
- apply Dirac's bra-ket notation, and manipulate Hermitian and unitary operators in quantum mechanical derivations.
- describe in detail the time evolution of quantum systems, the propagator, and the Schrödinger and Heisenberg pictures.
- know the path integral formulation of quantum mechanics.
- calculate the expectation value of various physical quantities and how the measurement process works in quantum mechanics.
- solve the Schrödinger equation for various problems, such as the harmonic oscillator using algebraic methods.
- use statistical operators (density matrices).
- know something about quantum mechanics interpretations and Bell's inequalities.
- describe in detail the consequences of discrete and continuous symmetries and conservation laws.
- calculate different aspects of the angular momentum and spin, for example, addition of angular momentum.
- analyze systems consisting of identical fermions or bosons.
- describe the Aharonov-Bohm effect.
- apply the main approximation methods for stationary and time-dependent quantum mechanical problems.

Course contents

- The basic ideas and concepts of quantum mechanics: Hilbert spaces, bra-ket formalism, operators, matrix representation, observables, the measurement process, uncertainty relations, the position and momentum representation, density matrices, Bell's inequalities.
- Quantum dynamics: temporal evolution, Schrödinger and Heisenberg picture, the propagator, path integrals.
- Harmonic oscillator, creation and annihilation operators.
- Symmetries in quantum mechanics: translation, rotation, parity, spatial and temporal inversion.
- The theory of angular momentum: ladder operators, spin, addition of angular momentum.
- Permutation symmetry, identical particles.
- Approximation methods for time-independent and time-dependent problems, the interaction picture.

Course literature

- See current course homepage.

Recommended literature

- L.E. Ballentine, Quantum Mechanics: A Modern Development, World Scientific 2nd edition (2014).

- J.J. Sakurai, Modern Quantum Mechanics, 2nd edition, Addison-Wesley (Pearson) (2007)

- R.L. Liboff, Introductory Quantum Mechanics, Addison-Wesley (2003)

- R. Shankar, Principles of Quantum Mechanics, Kluwer (1994)

Examination

- TEN1 - Examination, 7.5 credits, grading scale: A, B, C, D, E, FX, 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.

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

Other requirements for final grade

A written exam (TEN1; 7,5 university credits).

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.