SI2380 Advanced Quantum Mechanics 7.5 credits

Kvantmekanik, fortsättningskurs

Course syllabus for SI2380 valid from Autumn 15

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

Grading scale: A, B, C, D, E, FX, F
Education cycle: Second cycle
Main field of study: Physics

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 main content

- 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.

Language of instruction

Language of instruction is specified in the course offering information in the course and programme directory.

Eligibility

Recommended prerequisites:
Mathematical Methods in Physics.
Quantum Physics.

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

Requirements for final grade

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