Level: bachelor

Course title: Quantum statistical physics

Status: elective

ECTS: 6

Requirements: Modern theoretical physics, Quantum physics, Statistical physics

Learning objectives

Acquiring the knowledge of modern methods of quantum statistical physics, as well as its application to some research fields in the Condensed matter physics.

Learning outcomes

After taking the course, the student should have developed:

General abilities: basic knowledge of this field, following the literature, analysis of various solutions and the choice of the most adequate solution, application in practice and other subjects.

Subject-specific abilities:

Acquiring the modern methods in statistical physics (application of Green functions method, as well as second quantization method to interacting particle systems).

Syllabus

Theoretical instruction

Virial theorem. Equation of state for real gases. Virial expansion and thermodynamic functions for real gases. Ideal quantum gases – low and high temperatures. Small oscillations and phonons in one and three dimensions. Nonequilibrium statistical operator. Green function method and linear response. Spectral representation of Green and correlation functions. Application of Green function method in theory of magnetism. Heisenberg ferro- and antiferromagnet: quasiparticles - magnons. Exactly solvable models. Wick's theory for Bose- and Fermi- systems. Nonideal Bose-gas: superfluidity of He. Microtheory of Bogoliubov. Cooper pairs. Electron-phonon interaction and superconductivity. Freilich transformation and effective electron-electron interaction. BCS theory. Unitary "u-v" transformation, spectra and energy gap in superconductors. Boltzmann transport equation and H-theorem. Basic kinetic equation.

Practical instruction

Exercises and seminars.

Weekly teaching load				Other:
Lectures: 3	Exercises: 1	Other forms of teaching:	Student research: 1	