Physics History and Methodology

Prof. Vladimir Melezhik

Abstract

The course is devoted to the study of the appearance and evolution of the most important physical concepts, the history of the development of physical research techniques and the formation of the scientific method. Other things studied during the course are: the basic branches of physics, peculiarities of modern physics, the connection between physics and other branches of natural science, and the most important achievements in the physics of the 20th century.

The aim of the course is to study the basic branches and peculiarities of modern physics, and its connection with other branches of natural science. The special importance is attached to the study of the evolution of the most important physical concepts, the formation of the modern scientific method, and the history of the development of physical research techniques. The most important achievements in the physics of the 20th century. The information about lives and scientific work of the greatest physicists of the past and present. Basic history of the appearance of radiophysics: from the tasks of radiolocation to the problems of acousto-radio optics, radiophysics as an interdisciplinary science.

Lecture 1. The subject and the aims of the history of physics, the periods of the history of physics.

Lecture 2. The appearance, development and essence of the scientific method. The scientific revolution of the 16-17th centuries. Copernicus, Bruno, Kepler, Galileo, Huygens, Leibniz, Newton. The development of the elements of the scientific method. The aims and tasks of the science.

Lecture 3. Gravitation and long-range action. Galileo's mechanics. Newton – the creation of the theoretical basis of classical physics.

Lecture 4. The development of basic ideas of classical mechanics. Galileo's relativity principle, the analytical apparatus of Newton's mechanics (Euler, Maupertuis, d'Alembert, Lagrange, Poisson, Hamilton, Jacobi, Hertz, Lyapunov, Netter, Poincaré).

Lecture 5. The development of basic ideas of classical optics. 18th century, the breakthrough in optics in 1800-1835, the discovery of spectroscopy. (Huygens, Jung, Fresnel, Bunsen, Fraunhofer, Kirchhoff)

Lecture 6. The development of the ideas of caloric theory.Temperature, thermometer, the appearance and development of thermodynamics, the discovery of energy conservation and transformation law.

Lecture 7. The appearance and development of statistical physics. Maxwell, Boltzmann, Gibbs, entropy, second law of thermodynamics.

Lecture 8. The development of the basic ideas of classical electrodynamics. Long-range and short-range action, the idea of the electromagnetic field, Maxwell's equations, electromagnetic nature of light.

Lecture 9. The development of the electron theory. The development of the idea of atomistics, cathode rays, the discovery of electron.

Lecture 10. The discovery of the periodic law. Atoms and chemical elements, the evolution of the concepts. The role of intuition in the scientific research. (Mendeleev, van den Bruck, Moseley)

Lecture 11. The appearance and development of atomic physics. Atomic models, atomic spectra, black-body radiation, photoeffect, quanta hypothesis, light quanta, Rutherford's experiments, Bohr atom.

Lecture 12. The history of the appearance and development of the basic ideas of quantum physics (Planck, Einstein, Rutherford, Bohr, de Broglie, Heisenberg, Schrödinger, Dirac, Pauli).

Lecture 13. Quantum mechanics and the complementary principle. Wave-corpuscle duality and Heisenberg uncertainty principle. Methodological revolution in physics.

Lecture 14. The appearance and development of nuclear physics, the contribution of the Soviet scientists. (Becquerel, P. and M. Curie, Rutherford, Soddy, J. and I. Joliot-Curie, Gamov, Fermi, Gan, Shtrassman, Meitner, Flerov, Zeldovich, Haritonov, Pontecorvo, Blohintzev)

Lecture 15. The appearance and development of the relativistic theory and particle physics.