

# Solid state physics, photonics and quantum technologies

National Research Nuclear University MEPhI (Moscow Engineering Physics Institute)

Degree or qualification is awarded: **Master degree**

Language of study: **Russian**

Mode of study: **full-time**

Duration: **2 years**

Availability of free education: **yes**

Price: **196 820 rubles per semester**

Programme curator: **A. Menushenkov**

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**Basic department:** Physics of Solid State and Nanosystems (No. 70).

**Program coordinator:** A. P. Menushenkov, Professor, head of the basic department.

**The goal of the program** is to train specialists in physics of condensed matter, including solid state physics, laser physics, laser applications in industrial complexes and high-precision measuring systems, physics of interaction of concentrated streams of radiation with matter, photonics, optical fiber technology, metamaterials and nanosystems.

**The graduate's professional activity** includes the research, development and technology, aimed at designing solid-state materials, lasers and laser systems, in optoelectronics and photonics areas, as well as their use for technological purposes, for remote sensing and precision measurements, for the matter diagnostics; research, development and technology, aimed at the registration and optical processing of information, the development of the theory, the creation and use of plants and systems in the field of nanotechnology, condensed matter physics, the study of distribution and interaction of radiation with objects animate and inanimate nature.

**Objects of professional activity:** optical detectors, alloys with shape memory effect, nanomaterials, metamaterials, thin film, gas detectors, photonic crystals, lasers and applications, laser technology, materials with different types of magnetic ordering, nonlinear optics, mathematical models of theoretical, experimental and applied research of phenomena and laws in the field of photonics and laser physics, gas and condensed matter, distribution and the interaction of radiation with matter.

**Educational plan:** The main feature of the educational process is the fundamental physical and mathematical and engineering training, which allows you to master the main basic and special disciplines: "Special chapters of higher mathematics", "Theoretical Quantum Electronics", "Interaction of radiation with matter", "Laser technology", "Methods Laser Diagnostics", "Laser spectroscopy and the cooling of atoms", "Generation and amplification of short laser pulses", "Optical methods in biology and medicine", "Fiber lasers" and others. Use the individual approach in teaching students, taking into account the variability of their previous education and specifics of employment of graduates. Part of the curriculum is also implemented in English.

**The competitive advantages of the program are as follows.** Scientific research work and practice, being an integral part of the training of masters, are available on a wide range of topics, from actual problems of condensed matter physics and superconductivity to photonics and laser technology of the surface, both connected with the experiment, and theoretical studies and computer simulation. All research is carried out on the state-of-the-art equipment of the basic department and its partners: Institutions of the Russian Academy of Sciences (RAS), National Research Centre "Kurchatov Institute," and other scientific institutions and enterprises.

Graduates of the department are trained for a wide range of problems in the first place, such as the development and construction of:

- Optical sensors
- Lasers and quantum electronics devices;
- Photonic systems and optical information processing systems;

- Programs for the simulation of physical processes in lasers and photonics, and the processes of interaction of laser radiation with matter.

**The list of enterprises for practice and employment of graduates:** the State Atomic Energy Corporation "Rosatom," National Research Centre "Kurchatov Institute", Lebedev Physical Institute of RAS, Shubnikov Institute of Crystallography of RAS, Joint Institute for High Temperatures of RAS, Institute of Solid State Physics of RAS, Kotel'nikov Institute of Radio Engineering and Electronics of RAS, and others. The department collaborates with international synchrotron center DESY (Hamburg, Germany), BESSY (Berlin, Germany), MAX-lab (Lund, Sweden), ALBA-CELLS (Barcelona, Spain), the Saclay Neutron Research Centre (France), the International Magnetic Laboratory (Wroclaw, Poland), the University of Arizona (United States), University of Jena (Germany), University of Oslo (Norway), University of Mainz (Germany).

## **Specializations within this programme**

### **Nuclear Physics and Technologies**

The objects of professional activity of the graduates are nanomaterials, metamaterials, photonic crystals, superconductors, semiconductors heterostructures, thin film materials with different types of magnetic ordering, nanopowders, and other modern problems of the condensed matter physics.