

QUALIFICATION PROFILE

Doctoral Program: DOCTORAL PROGRAM: "PHYSICS OF WAVE PROCESSES"

Field of higher education: 4. NATURAL SCIENCES, MATHEMATICS AND INFORMATICS

Professional field: 4.1. PHYSICAL SCIENCES

Program Objective

The doctoral program “Physics of Wave Processes”, within professional field 4.1. Physical Sciences, prepares highly qualified specialists in the field of wave optics. The program combines in-depth theoretical training with experimental work, carried out under the supervision of experienced academic staff and using modern scientific equipment available in the laboratories of the Institute of Optical Materials and Technologies – Bulgarian Academy of Sciences (IOMT-BAS).

Form and Duration of Study

- Full-time learning: up to 3 years
- Distance learning: up to 4 years
- Independent learning: up to 5 years

Main Research Areas

The program focuses on the development and application of coherent optical methods based on the phenomena of interference and diffraction. These methods are characterized by:

- High spatial resolution;
- Large information capacity;
- Non-destructive testing capability;
- Real-time monitoring of dynamic phenomena.

Thanks to these advantages, coherent optical methods are widely used in:

- Materials science;
- Photonics and nano-optics;
- Informatics and holography;
- Biology and medicine (optical tomography, holographic microscopy);
- Chemical and physico-chemical surface and structure analysis.

Research topics addressed through these methods include:

- Studying mechanical deformations and internal stresses in various materials;
- Topographic and tomographic imaging of surfaces, micro- and macro-objects;

- Observation and analysis of fast dynamic processes – thermal, mechanical, chemical, and biological;
 - Development and optimization of holographic displays for 3D television and virtual reality;
 - Holographic data recording and long-term storage, including on novel media;
 - Use of coherent light for optical measurement of micro- and nano-object parameters;
 - Precision control and optical diagnostics of thin films and nanostructures;
 - Development of optical methods for industrial and medical nanomanufacturing;
 - Integration of coherent optical methods into sensor systems and biophotonic applications;
 - Interferometric and holographic techniques for observing biological tissues and cellular structures;
 - Building automated monitoring and control systems based on holographic methods.
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Learning Objectives

- Establishing systematic knowledge in the physics of wave phenomena in optical media;
 - Mastering modern theoretical, experimental, and numerical methods for the analysis of wave processes;
 - Preparing for independent research and innovative activities;
 - Encouraging participation in scientific forums and international research programs.
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Acquired Knowledge and Skills

Graduates of the “*Physics of Wave Processes*” doctoral program will possess the following knowledge, skills, and competencies:

- Profound and diverse understanding of wave physics and analytical methods for materials using electromagnetic waves;
- Familiarity with the operation principles, capabilities, and applications of modern scientific instruments and experimental techniques relevant to the field;
- Ability to critically read, interpret, and apply original scientific literature;
- High level of foreign language proficiency for effective scientific communication and participation in international forums and projects;
- Proficiency in modern computer technologies, programming environments, and software tools for modeling, simulation, and scientific data analysis;
- Mastery of fundamental and current theoretical and applied achievements in wave physics and its interdisciplinary applications in materials science, chemistry, engineering, and biomedical sciences;
- Experimental experience including planning, conducting, and analyzing scientific experiments;
- Capability to apply theoretical knowledge effectively, using interdisciplinary approaches, logical and analytical thinking to solve complex scientific and practical problems;
- Ability to communicate scientific ideas effectively and to think critically.

Career Opportunities

With the acquired knowledge, skills, and scientific training, holders of the PhD degree in “Physics of Wave Processes” can pursue successful careers in a wide range of institutions, including:

- Scientific Research – as researchers in academic institutions, university laboratories, and specialized research centers conducting fundamental and applied studies in wave processes, photonics, materials science, and nano-optics;
- Academic Teaching – as lecturers or professors at universities and colleges in subjects related to physics, optics, photonics, and related disciplines;
- Applied and Development Work – as experts or team leaders in laboratories, R&D departments, production enterprises, and high-tech companies where the following are required:
 - Analytical thinking and scientific approach;
 - Innovative problem-solving;
 - Organizational and project management skills.
- Consulting and Commercial Activities – as experts or consultants in companies involved in:
 - Trade and integration of scientific and laboratory equipment;
 - Delivery of optical systems and measuring instruments;
 - Technology transfer and innovation.
- International Research Mobility – through participation in postdoctoral programs, international scientific projects (e.g. Horizon Europe, Marie Skłodowska-Curie, COST, etc.), and academic exchanges with leading research institutions;
- Lifelong Learning and Professional Development – via postgraduate training, specializations, and professional certification programs in physics, engineering, biomedicine, etc.