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**HISTORY AND ACHIEVEMENTS
OF THE INSTITUTE OF PHYSICS
OF LODZ UNIVERSITY OF TECHNOLOGY**

History and achievements of the Institute of Physics of Lodz University of Technology is briefly presented on occasion of 40 anniversary of the Department of Technical Physics, Information Technology and Applied Mathematics.

Keywords: Institute of Physics, Lodz University of Technology.

1. INSTITUTE OF PHYSICS

The Institute of Physics was erected in 1970 in the Lodz University of Technology (LUT) from the Technical Physics Department of the Electrical Faculty and from the Physics Department of the Chemical Faculty. It was organized by Dr. Jan Karniewicz, later the full professor in physics, who became its first director from 1970 up to 1983. Afterwards the Institute of Physics directors were Dr. Andrzej Lipiński (1983-1986), Dr. Antoni Drobnik (1986-1992), DSc Cecylia Malinowska-Adamska, LUT professor (1992-2001), Professor Włodzimierz Nakwaski (2001-2015) and currently DSc Robert Sarzała, LUT professor.

First researches in the Institute of Physics were devoted to experimental and theoretical investigation of processes leading to creation of crystalline and amorphous substances, investigation of their physical properties and study of interaction between coherent radiation and matter. Research conducted in the Institute of Physics has been modified during last 40 years according to development of its research staff. New research

groups were created which increased the research domain and included contemporary problems in science.

Currently, scientific investigations in the Institute of Physics are conducted in six research groups: Photonics, Biogenic Crystals, Physics of Dielectrics, Theoretical Physics, Physics of Liquid Crystals and Physics of Monocrystals. Research problems include investigations of semiconductor emitters of radiation (mostly semiconductor lasers), problems of quantization through deformation in the theory of integrable systems and in the relativity theory, application of the Weyl-Wigner-Moyal formalism in quantum mechanics, investigation of electrical properties of thin layers of the diamond-like carbon, numerical investigations of macroscopic properties of liquid crystal systems, investigations of crystallization processes from solutions together with analysis of the mechanism of crystal growth inside human body, development of quantum methods and calculation algorithms used to describe electronic structure of matter and to study electro-optical phenomena.

Research and didactic staff of the Institute of Physics is currently composed of 25 academic teachers including 11 professors and DSc doctors, 12 doctors and 2 MSc teachers. During 2011-2016, one research worker received the full professor title, the DSc title was received by 3 research workers, and the PhD title was granted to four research workers. Every year the staff of Institute of Physics participates in many scientific conferences delivering reports and presenting results of the latest investigations. Besides, the Institute of Physics organizes domestic and international conferences. Recently the institute organized the VCSEL Day conference (2015) and was one of organizers of the VI Workshop on Physics and Technology of Semiconductor Lasers (2015) as well as the first Conference of Polish Society of Relativity (2014).

Results of investigations performed in the institute are published every year in tens of papers in many high-range scientific journal. In 2012-2015, the research workers from the Institute of Physics published 88 papers in journals listed in the official register of the Ministry of Science and Higher Education. Besides, our results are also permanently published in our Scientific Bulletin of the Lodz University of Technology, Physics (edited by Professor G. Derfel).

Over 20 research projects (for over 5.5 million PLN) have been accomplished in the Institute of Physics during last 6 years. Most of them have been accomplished under the following Polish and international grants: *“The model of a high-power, stable operated single-mode VCSEL based on photonic crystals”* (LIDER, PhD M. Dems), *“Modern surface-emitting lasers with a photonic crystal and high-contrast grading”* (SINGAPUR, DSc T. Czyszanowski), *“Fedosov construction in non-commutative field theories”* (MNiSW JUVENTUS PLUS, PhD M. Dobrski), *“Development of new methods of quantum-chemical embedding with the aid of reduced density matrixes”* (SONATA BIS 2, DSc K. Pernal), *“Investigations of physical mechanisms of nucleation, growth and aggregation of carbonate apatite and struvite in relations to the infectious urinary Stones and investigations of an influence of substances able to modulate of these processes”* (OPUS 6, DSc J. Prywer), *“Modeling of surface-emitting nitride semiconductor lasers with a vertical cavity”* (OPUS 7, DSc R. Sarzała).

In 2016, four projects (for 2.5 million PLN) were started including the project entitled *“Photonic analog processor using nonlinear VCSEL answer”*, obtained by DSc T. Czyszanowski, under the SONATA BIS program.

Some of our projects are realized as a collaboration with foreign institutions: the University of Southern Denmark (Odense, Denmark), the Université Pierre et Marie Curie (Paris, France), the École Polytechnique Fédérale de Lausanne (Lozanna, Switzerland), the Technische Universität (Berlin, Germany), the Vrije Universiteit Brussel (Bruksela, Belgium), the Nanyang University of Technology (Singapore), the Laboratoire d'Analyse et d'Architecture des Systèmes (Tuluza, France), the Rutherford Appleton Laboratory (Didcot, England). Besides, a bilateral agreement was signed with the Vrije Universiteit Brussels concerning common PhD students. The researchers from the Institute of Physics are collaborating with scientists from many countries. They visited foreign institutes as visiting professors and coordinated international projects.

Some activity in the field of applications is also carried out in the institute. Results of these investigations have been awarded many times during international exhibitions and have been protected by many patents. In particular, during last ten years our researchers have been awarded

14 patents. Their achievements have been presented during various international exhibitions and have been awarded 37 prizes, including 11 gold medals. For example, “*Diamond electrode for detection of heavy metals in water*” received 4 prizes, “*Biosensor based on a diamond layer*” received gold medal during the international exhibition of inventions in 2014. Researchers from the Institute of Physics have been awarded many times the state distinctions and were awarded for merits for Lodz (“*Łódzkie Eureka*” statuette in 2014 r.). Besides, they received many individual and collective Rewards from the Minister of Science and Higher Education, including the 2010 award for innovative activities and many rewards and distinctions awarded by international bodies.

In 2015, DSc Katarzyna Pernal, was awarded the IAQMS Medal of the International Academy of Quantum Molecular Science for her outstanding research achievements and her contribution in the theory of functional density matrix. The medal is awarded every year to one person only by the international academy assembling the highest world research authorities (including a number of Noble Prize winners), and is the most prestigious award in the quantum and theoretical chemistry.

Research Workers of the Institute of Physics are editors or members of international advisory boards of some research journals: Research and Technology (DSc J. Prywer), Scientific Reports (DSc K. Pernal), Opto-Electronics Review (DSc T. Czyszanowski), Optica Applicata (Professor W. Nakwaski). Besides, they are taking part in the activity of National Science Centre and in groups of experts of the Ministry of Science and Higher Education.

Institute of Physics takes also pride in achievements in didactics of physics. Our students are educated on the stationary studies of the first degree in two specializations: Technical Physics as well as Science and Technology, on the stationary studies of the second degree also in two specializations: Medical Physics and Optoelectronics and on the studies of the third degree finished with doctorate in physics. During their studies, students are actively participating in investigations carried on in research groups of our institute. Besides, they develop their interest in the student science circle “*Schrödinger cat*”. In 2009, the students from this circle got the prestige award in the competition Popularizer of Science organized by the Ministry of Science and Higher Education. Our students

have received many times the title of the Best Graduate Student of the Lodz University of Technology. The total number of Technical Physics graduates reached 657, including 403 graduates during last 15 years.

In 2015, a reconstructed and modernized industrial building was erected for the Institute of Physics. Today the building is one of the most modern didactic objects in the Lodz University of Technology. The work conditions of our didactic staff have been significantly improved. In the new building, 6 new lecture-rooms, 11 didactic laboratories, 2 rooms for designing projects and 3 rooms for personal student work have been created. Laboratories have been equipped in 479 modern didactic devices for 3 million PLN. In the building, 940 students and pupils may have classes simultaneously. Among others, the laboratory for interactive experiments for teenagers (XLAB) and the room for demonstration of physical phenomena for children (Arena Magica) have been organized. In this modern building, as many as about 40 popularized scientific lectures and classes for about 1500 pupils from fundamental, grammar and high schools have been given until now.

HISTORIA I NAJWAŻNIEJSZE OSIĄGNIĘCIA INSTYTUTU FIZYKI POLITECHNIKI ŁÓDZKIEJ

Streszczenie

Z okazji 40. rocznicy powstania Wydziału Fizyki Technicznej, Informatyki i Matematyki Stosowanej przedstawiono historię i najważniejsze osiągnięcia Instytutu Fizyki Politechniki Łódzkiej jako jednej z jednostek organizacyjnych tego Wydziału.