

PREFACE

Neither the power of your tools
Neither the elegance of your mathematical models,
Neither the accuracy of your calculations
Do not replace your original thought.

This issue is dedicated to the 10th International interdisciplinary seminar "Mathematical models and simulation of laser-plasma processes & advanced science technologies." The seminar started its work in 2003 by an initiative of the scientists of two institutions of the Russian Academy of Sciences - Keldysh Institute of Applied Mathematics (Prof., Dr. of phys.-math. sci. V.I. Mazhukin) and Prokhorov Institute of General Physics (Dr. of phys.-math. sci. S.V. Garnov). In 2007, the organizers of the seminar were joined by a group of scientists from the University of Montenegro (Prof. Labud Vukcevic, Prof. Zarko Pavicevic). Largely due to their initiative in 2009, a second section appeared at the Seminar - "Mathematical modeling in advanced science technologies." Currently, the seminar consists of two sections – the natural scientific and the humanitarian-economical. They are united by a common methodological framework – mathematical modeling. Modern mathematical modeling is a versatile research technology based on the replacement of the original process of physical or information-logical nature with its image – a mathematical model. Mathematical models allow us to abstract from reality, while highlighting the main features and connections that are common to many real processes. This ensures the universality and unity of the approaches of mathematical modeling to analyzing and solving problems of different nature.



Академик А.А. Самарский

Historically, the use of methods of mathematical modeling started in the natural sciences, where mathematical tools are an integral part of the description of the phenomenon and its subsequent analysis. One of the founders and ideologists of modern mathematical modeling in natural sciences is well-known Soviet and Russian scientist Academician A.A. Samarskii, whose contribution to the development of mathematical sciences has received numerous government awards, including the title Hero of Socialist Labor and winner of the Lenin and State prizes. He owns many of the basic ideas of mathematical modeling, including the formulation of computational experiment and the famous triad: **Model – Algorithm – Computer program**. Under his leadership, a number of unique computational experiments were carried out for the first time, including the phenomenon of the T-layer, the problem of laser fusion, plasma phenomena in Tokomak, laser-plasma processing of materials, etc. Because of the efforts of A.A. Samarskii, mathematical modeling is currently acquired the status of an independent science.



Академик А.М. Прохоров

Among the many scientific fields, developed at the Keldysh Institute of Applied Mathematics, traditional direction for the scientific school of A.A. Samarskii is mathematical modeling of the problems of laser action on materials, in the so-called technological range of the radiation intensity. Research on this subject for many years was carried out in close collaboration with the scientific school of Nobel laureate Academician A.M. Prokhorov, who is the founder of the Prokhorov General Physics Institute of RAS. The name of A.M. Prokhorov is widely known in his country and abroad. Aleksandr Mikhailovich Prokhorov is one of the founders of quantum electronics and laser physics – the subjects belonging to one of the greatest scientific achievements of the XX century. His scientific work was recognized with an international reputation – the Nobel Prize in 1964 – and the government – the title of Hero of Socialist Labor, Laureate of Lenin and State prizes and other awards.

In the natural sciences section of the Seminar, the efforts are concentrated on the study of laser physics, the development of mathematical methods and modeling of the numerous applications of laser technology. Fifty years after its birth (1961), the laser is a modern, efficient and elegant tool with numerous applications in physics, chemistry, biology, materials science, medicine, space and security issues.

The latest achievements of fundamental and applied research in the field of laser materials processing, synthesis, and diagnostics for the nano-pico-femtosecond pulses are discussed at the meetings. Urgent topics are the problems of mathematical modeling of laser nanostructuring and generation of nanoparticles, pulsed laser deposition of thin films, interaction of ultrashort laser pulses with materials and laser ablation.

Section on "Mathematical modeling in advanced science technologies" discusses the application of mathematical methods in such areas of knowledge as economics, linguistics, history, demography, sociology, medicine, ecology, where the problems are not easy to formalize, and the results of unknown technologies are not so obvious. The level of complexity of these areas at the present stage of development requires new approaches to solving them. In the post-industrial society, where science has become a direct productive force, the information technology and the information impact on all spheres of human activity came to the forefront. The economy gained a highly complex character, which is determined by a large number of interdependent relationships between economic structures and the influence of politics, human factors, the risks of different nature, and other factors. The depth and breadth of the computer or information revolution requires extensive use of mathematical knowledge to solve the complicated problems in various spheres of social life, social and economic activities. Mathematical modeling is now actively integrated into the structure of the modern information society, as the intellectual core of information technology. The possibility of applying the methodology of mathematical modeling in history, linguistics, medicine, ecology, and demography are discussed in the section "Mathematical modeling of advanced science technologies". The economic problems are the most adapted to the mathematical modeling. Of particular interest is the theme of space exploration in historical, humanitarian, informational aspects that is discussed at the meetings of the section.

A distinctive feature of the seminar discussions were always urgent issues of timely reaction of the scientific and academic community to the challenges of a rapidly changing situation in the field of scientific research and higher education. Traditional topical discussions are "State of the fundamental science" and "Education in the XXI century".

This issue reflects all the traditional areas discussed in the scientific and the humanity and economical sections, and the most interesting topics of discussion. Articles are grouped into the following rubrics:

- Laser-plasma processes. Experiment and Modeling;
- Mathematics and Modeling;
- Space;
- Modeling in Economics;
- Actual problems of the humanities.

Chair of the Scientific Committee, Prof. Dr. V. Mazhukin
Keldysh Institute of Applied Mathematics of Russian Academy of
Sciences (<http://lppm3.ru/>).

