The results of 14th International Interdisciplinary Seminar "Mathematical models and modeling in laser-plasma processes & advanced science technologies» (LPpM3-2016).

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Abstract. The article provides an overview of the work of the 14th International Interdisciplinary scientific seminar "Mathematical models and modeling in laser-plasma processes & advanced science technologies» (LPPM3-2016), which took place from 4 to 9 July 2016 the Moscow Humanitarian University (Moscow).

Keywords: Mathematical modeling, laser- plasma processes, parallel computing, heterogeneous computational technologies, laser technologies, laser plasma, laser ablation, computational mathematics, Russian space, advanced sciency technologies.

From 4 to 9 July 2016 was held 14th International Scientific Seminar "Mathematical models and modeling in laser-plasma processes and advanced science technologies» (LPpM3-2016) at the Moscow University for the Humanities. During the seminar was held youth school-conference "Mathematical modeling and computational experiment in modern scientific investigations." 14th International Scientific Seminar and Youth School-Conference organized on the initiative and with the financial support of the Russian Science Foundation (project 15-11-30039). Seminar organized by Keldysh Institute of Applied Mathematics of Russian Academy of Sciences, A.M. Prokhorov General Physics Institute of Russian Academy of Sciences, University of Montenegro (Podgorica), National Nuclear Research University "MEPhI", Forum of university professors and researchers in Montenegro, scientific journal "Mathematica Montisnigri", Moscow University for the Humanities.

The seminar began its work on July 4 in Moscow.
At the 14th Seminar were presented plenary, invited and oral presentations heard in two parallel sections: "Laser-plasma processes, laser action" and "Advanced science technologies". Part of the reports was presented in the form of short messages.

Fig. 1. The participants of the 14th International Scientific Seminar "Mathematical models and modeling in laser-plasma processes and advanced science technologies" (LPpM3-2016).

The Seminar was attended by more than 140 well-known scientists from twelve countries: Russia, Germany, Greece, Poland, France, Italy, Spain, Montenegro, Great Britain, Switzerland, the United States and Brazil.
The Russian side was represented by:
Eleven institutes of the Russian Academy of Sciences:

1. Keldysh Institute of Applied Mathematics of RAS
2. A.M. Prokhorov General Physics Institute of RAS
3. P.N. Lebedev Physical Institute of RAS
4. Joint Institute for High Temperatures of RAS
5. Landau Institute for Theoretical Physics of RAS
6. FSC Scientific Research Institute for System Investigations of RAS
7. Institute of Numerical Mathematics of RAS
8. FNITS "Crystallography and photonics" of RAS
9. Computing Centre of FITS IU of RAS
10. Nuclear Safety Institute of RAS
11. Institute of Mathematical Problems of Biology – the Branch of Keldysh Institute of Applied Mathematics of RAS

Eight scientific research institutes:

1. International Laser Center of Lomonosov Moscow State University

2. N.N. Bogoliubov Institute for Theoretical Problems of Microphysics, Lomonosov Moscow State University
3. Sternberg Astronomy Institute of Lomonosov Moscow State University
4. State Research Center of Russian Federation “Troitsk Institute for innovation and Fusion Research”
5. Dukhov All-Russia Research Institute of Automatics
6. Russian Scientific Centre "Kurchatov Institute"
7. Advanced Energy Technologies LLC
8. Institute of Fundamental and Applied Research of Moscow University for the Humanities

Nine universities:

1. Lomonosov Moscow State University
2. National Research Nuclear University «MEPhI»
3. Moscow Institute of Physics and Technology
4. Bauman Moscow State Techical Univeersity
5. ITMO University
6. Moscow University for the Humanities
7. Moscow Technological University (MIREA)
8. Moscow State Automobile and Road Technical University (MADI)
9. Moscow Technical University of Communications and Informatics

Montenegro was represented by researchers from the University of Montenegro (faculties: Maritime (Kotor), Natural Sciences and Mathematics (Podgorica), Medical (Podgorica)), and the Institute of Physical Examination (Podgorica).

Germany - Laser Zentrum Hannover e.V.; Hannover, Fraunhofer Institute for Machine Tools and Forming Technology (IWU), Chemnitz; Fraunhofer Institute for Material and Beam Technology, Dresden.

Greece - Solid State Section, Department of Physics, University of Athens; University of Patras.

Poland - Poland Institute of Fundamental Technological Research of Polish Academy of Sciences.

France - Department de Physique, University-Sud of Orsay Paris; Irradiated Solid Laboratory, Ecole Polytechnique; CELIA, Université Bordeaux; Electrical Engineering Laboratory (GeePs); The National Centre for Scientific Research (CNRS); Centrale Supélec, University Paris-Sud; Sorbonne Universités-UPMC.

Italy - Politecnico di Torino, Department of Applied Science and Technology; University of Padova, Physics Department; University of Bologna.

Spain – Barcelona supercomputing center, Heat and Mass Transfer Technology Centre of the Polytechnic University of Catalonia (CTTC UPC, Barcelona)

Great Britain - University of Manchester, Queen Mary University of London.

Switzerland - University of Zurich.

United State of America - University of Virginia, Department of Materials Science and Engineering; University of Notre Dame; University of Colorado, Department of Mechanical Engineering.

Brazil - Universidade Tecnológica Federal do Paraná; Universidade Estadual de Maringá, Departamento de Física.

In the first section of the seminar "Laser-plasma processes, laser action" are the following scientific thematic topics:

- Laser ablation - experiment, theory, statement of problems, modeling
- The models of mathematical physics and computational methods.

In the framework of topic "Laser ablation - experiment, theory, statement of problems, modeling" were discussed two approaches to the study of the problems of laser action on materials - natural and computational experiment. In the framework of an approach based on natural experiment were considered the results of experimental studies on the basis of which the problems were formulated to study by means of methods of mathematical modeling and statement of computational experiments. In the discussion of an approach based on computational experiments, efforts were mainly focused on the fundamental problems of development continuum and atomistic models, research of processes of laser physics, modeling of a variety of laser technology applications. In the meeting discussed the latest achievements of fundamental and applied research in the field of laser material processing, synthesis and diagnostics for -nano, -pico, femtosecond influence modes. Problems of mathematical modeling of processes of laser nanostructuring of nanoparticles generating, pulsed laser deposition of thin films, the interaction of ultrashort laser pulses with materials and laser ablation were current topics.

In the topic "Models of mathematical physics and computational methods" were discussed the problems of development of computational mathematics methods, improving the mathematical apparatus needed for research in various subject areas.

The second section, "Advanced science technologies" unites four research topics:

- Heterogeneous Computing Technologies
- Parallel technologies in computational gas dynamics
- Mathematical Methods in Biology
- Russian space.

In the framework of topic "Heterogeneous computational technologies" were discussed the problem of creating heterogeneous parallel algorithms and the efficient use of hybrid computational systems that combine CPUs and massively parallel accelerators. In particular, were presented reports that demonstrate the calculations on hundreds of various accelerators architecture, including Intel Xeon Phi coprocessors and graphics GPU processors, was presented the experience of using domestic CPUs for general-purpose computing, presented a heterogeneous parallel solvers library based on multigrid methods.

In the topic "Parallel technologies in computational gas dynamics" were discussed the problem of creating efficient parallel algorithms for computational gas dynamics, including on the basis of higher order of accuracy methods. Were presented reports on the development of new numerical schemes on unstructured grids, stochastic finite volume methods for of high order, a report on the application of parallel software platform for distributed grids of general type in the computational code for radiation safety, methods of multiscale modeling of nonlinear processes and others.

In the framework of section "Advanced science technologies" have been a number of reports under the topic "Russian Space", where were discussed the problems of development strategies of research systems of the outer planets, space monitoring of objects, development of surveillance systems and statistical processing of obtained data, as well as the problems associated with the use of morphological multiscale modeling in research of Mars and the Moon. Also were discussed problems of creating a virtual environment systems for visualization of robotic tools and the creation of an ergonomic interface for management of space simulators.

Seminar still retains an interdisciplinary focus, based on a scientific methodology of mathematical modeling, which allows to combine scientists working in various subject areas: mathematics, physics, chemistry, biology, medicine, economics, and history. In the framework of section "Advanced science technologies" was heard a number of reports under the topic "Mathematical Methods in Biology." Were considered modeling problems in biomedicine, including heart biophysics problems, reconstruction problems of functional structure of the human body according to multi-channel magnetic measurements, brain spectra according to magnetic encephalography, treatment methods, storage of data of different nature in biomedical research.

During the seminar were held thematic discussions in the form of "round table" organized by the Institute of Fundamental and Applied Research (IFAR) of Moscow University for the Humanities. The topics of discussion affecting the scope of the humanitarian and social issues, which complements the theme of the main conference, revealed the interdisciplinary focus of the seminar. The discussion was attended, as the Russian participants and scientists from Germany, Poland, Italy, USA, Montenegro and other countries. "Round tables" reflected the forming interaction between representatives of the sciences and humanities in the application of the achievements of mathematical and computer modeling in the field of human knowledge and understanding of man and his world. Held the following discussion:

- "Russian Diaspora in USA" (05.07.2016), where they discussed issues of formation of the Russian diaspora in the context of Russian-American relations at different historical stages, socio-cultural adaptation of immigrants, difficult fates of immigrants - the science and art workers (Moderator - Doctor of Historical Sciences A.B. Ruchkin, author of the monograph "Russian diaspora

in the United States of America in the first half of the twentieth century" (Moscow, 2007) and coauthor of published in New York in 2011 book "Russians in the United States: Public organizations of Russian emigration in XX-XXI centuries").

- "Shakespeare and the constants of world culture" (06.07.2016), is dedicated to fulfill in 2016 the 400th anniversary of the death of William Shakespeare. Meaning the heritage of Shakespeare in the world, including Russian culture was represented by the moderator of the "round table" NV Zakharov, doctor of philosophy (PhD), Director of the Centre of theory and cultural history of IFAR of Moscow University for the Humanities.
    - "Human perspectives" (07.07.2016), where they discussed the contradictory processes in the society and culture of modern man, daily occurrence of which makes more familiar experiments affecting the nature of human as a biosocial creature. The moderator of this debate was a doctor of philosophical sciences, professor, honored worker of science of the Russian Federation, Director of the Institute of Fundamental and Applied Research of Moscow University for the Humanities Val. A. Lukov. He described the direction of research of institute headed by him, which is associated with the problems of bioethics and developed in recent years (in particular, with the active role of Lukov) biosociology. The theme of "round table" has determined the main attention of the participants to the children and youth.

Youth School-Conference "Mathematical modeling and computational experiment in modern scientific research" was organized to familiarize young scientists, graduate and undergraduate students with the latest achievements in the development of numerical methods, computational algorithms, parallel technologies, statements of problems and mathematical modeling of gas-dynamic problems, laser action and the fundamental properties of plasma, activation of scientific work of graduate students and young scientists working in the fields related to the study and application of methods of mathematical modeling in various fields of research and industry.

The scientific program of the youth school-conference included 16 scientific and 12 academic lectures by leading experts of the largest scientific centers of Russian and foreign universities. Leading Russian scientists spoke before young audiences with scientific lectures: academician of the RAS B.N. Chetverushkin (Keldysh Institute of Applied Mathematics of RAS), academician O.N. Krokhin (P.N. Lebedev Physical Institute of RAS, National Nuclear Research University "MEPhI"), corresponding member of the RAS V.I. Konov (A.M. Prokhorov General Physics Institute of RAS), professor S.V. Garnov, professor A.A. Samokhin (A.M. Prokhorov General Physics Institute of RAS), professor N.A. Inogamov (Landau Institute for Theoretical Physics of RAS), doctor A.G. Kaptilny, doctor K.V. Khishchenko (Joint Institute for High Temperatures, of RAS), professor V.N. Bagratashvili (FSRC "Crystallography and photonics" of RAS), professor A.I. Aptekarev, professor G.K. Borovin, professor M.P. Galanin,

professor V.I. Mazhukin (Keldysh Institute of Applied Mathematics of RAS), professor I.N. Zavestovskaya (P.N. Lebedev Physical Institute of RAS, National Nuclear Research University "MEPhI"), professor A.B. Savelyev (Lomonosov Moscow State University). In the framework of the youth school-conference with academic lectures has spoke a number of leading foreign scientists, including professor Giovanni Barbero, and professor Giovanni Ummarino from Turin University (Italy), professor Leonid Zhigiley from the University of Virginia (USA), Oleg Vasiliev from the University of Colorado (USA), doctor Ricard Borrell from the Polytechnic University of Catalonia (Spain), professor Dinshaw Balsara from the University of Notre Dame (USA), doctor Sergey Karabasov from Queen Mary University of London (England), professor Giuseppe Maino of the University of Bologna (Italy), professor Zarko Pavicevic from the University of Montenegro, doctor Ulrich Semmler from the Fraunhofer Institute (Chemnitz, Germany).

In the youth school-conference was attended by 50 students, graduate students and young scientists from MEPhI, MIPT, MTUCI, MSTU MIREA, MADI, Lomonosov MSU, Bauman MSTU, Keldysh IAM, A.M. Prokhorov GPI, JIHT, P.N. Lebedev PI. There were youth scientific sessions, in which young scientists was made 25 reports on the subject of a scientific seminar LPpM3.

DECISIONS OF THE SEMINAR

The following decisions were taken:

- in every possible way intensify and develop international scientific cooperation in the application of methods of mathematical modeling;
- maintain the basic principles of of the Seminar, strengthening its interdisciplinary, involving for this scientists from various fields of science;
- hold in 2016 the 15th International scientific seminar LPpM3 in autumn (from September 24 to October 2) in Montenegro.

Chairman of the Programme Committee, professor V.I. Mazhukin. *(*http://lppm3.ru/*).*