ANNIVERSARY OF THE SCIENTIST
ЮБИЛЕЙ УЧЕНОГО

Congratulations to Academician Boris Nikolaevich Chetverushkin on his 80th Birthday!

Boris Nikolaevich Chetverushkin was born on January 26, 1944, in Moscow. In 1966, he graduated from the Faculty of Control and Applied Mathematics at the Moscow Institute of Physics and Technology (MIPT), and in 1968, he completed his postgraduate studies at MIPT. Following this at the Institute of Applied Mathematics of the USSR Academy of Sciences (since 1978, the Institute for Problems in Mechanics named after M.V. Keldysh), he held various positions: junior researcher, researcher, senior researcher, and head of department. From 1990 to 1998, he served as the deputy director of the Institute of Mathematical Modelling of the Russian Academy of Sciences (RAS), and from 1998 to 2008, he was the director of the Institute of Mathematical Modelling of the RAS. In 2008, due to the merger of the Institute for Problems in Mechanics named after M.V. Keldysh of the RAS and the Institute of Mathematical Modelling of the RAS, he was appointed director of the Institute for Problems in Mechanics named after M.V. Keldysh of the RAS. Since 2016, he has been the scientific director of the Institute.

Since 1972, he has taught at the Faculty of Computational Mathematics and Cybernetics of Lomonosov Moscow State University (MSU): initially at the Department of Computational Mathematics, and since 1982, at the Department of Computational Methods: assistant (1972–1978), associate professor (1978–1989), professor (since 1989). Currently, he is the head of the Department of Computational Methods at the Faculty of Computational Mathematics and Cybernetics of MSU, and the head of the basic department of Mathematical Modelling at MIPT.

He has been a corresponding member of the Russian Academy of Sciences since 2000 and became an academician in the Department of Mathematical Sciences in 2011.

Academician B.N. Chetverushkin is an outstanding Russian mathematician, a prominent specialist in the field of applied mathematics, parallel computing, mathematical modelling, continuum mechanics, and the author of fundamental results that have gained international recognition and acclaim. He has developed algorithms for solving problems of radiating gas dynamics, including the original method of Lebesgue averaging over the photon frequency and the "α–β" iterative method for solving systems of lattice equations, and proposed a new approach to solving problems of hydro and gas dynamics-kinetic difference schemes. These methods have been applied to model important scientific, technical, and defense problems.

The editorial board of the journal "Computational Mathematics and Information Technologies" and colleagues of Boris Nikolaevich sincerely congratulate the dear and highly respected jubilee on his 80th birthday, wish him good health, new ideas and creative achievements, and great human happiness!

Brief Overview of Key Scientific Achievements of Academician of RAS B.N. Chetverushkin

Boris Nikolaevich Chetverushkin is a leading specialist in the field of applied mathematics, parallel computing and mathematical modelling, mechanics of continuous media, and the author of fundamental results that have gained international recognition and acclaim. He has developed algorithms for solving problems of radiating gas dynamics, including the original method of Lebesgue averaging by photon frequency and the "α–β" iterative method for solving systems of grid equations. He proposed a new approach to solving hydrodynamic and gas dynamic problems — kinetic difference schemes. These methods have been applied to model important scientific, technical, and defense tasks.

B.N. Chetverushkin has developed a series of original methods for solving problems of magnetic radiation gas dynamics. His proposed new method of averaging by groups, particularly when using multi-group approximation to solve transport problems, is of particular interest.

B.N. Chetverushkin, and subsequently, by his students and colleagues, has developed and refined a generalization of the classical Gaussian elimination algorithm, involving simultaneous iteration of both the values of the sought function and the tridiagonal matrix coefficients (termed by the author as the "α–β iterative algorithm").

B.N. Chetverushkin has achieved remarkable results in a new and important class of problems: mathematical modelling of submicron semiconductor devices. He made a significant contribution to the development of a quasi-hydrodynamic model, enabling accurate description of electron-hole plasma in this new domain. He successfully extended previously developed algorithms for semiconductor device modelling.

Drawing on accumulated experience in solving kinetic equations, B.N. Chetverushkin proposed a new approach to constructing difference schemes for gas dynamics equations — kinetic-compatible difference schemes. The key idea is to use difference schemes for Boltzmann equations and then average them. Research on the resulting equations has demonstrated several significant advantages over traditional schemes. Currently, this direction is being actively pursued both in his own works, the works of his students, and by other research groups, including internationally.

B.N. Chetverushkin has developed modeling based on original kinetic-compatible difference schemes for viscous gas and liquid flows, which are of great interest in modern computational hydrodynamics and related problems such as unsteady and transitional flows, aeroacoustics, and combustion processes. Recent studies have shown the effectiveness of this approach in solving problems of magnetic hydrodynamics, high-temperature gas dynamics, and plasma physics. This approach has proven fruitful in tackling the most challenging aerodynamic problems for numerical simulation.

The pioneering computations conducted by B.N. Chetverushkin on a series of complex problems using computers of new architecture (transputers) essentially opened up a new major and rapidly developing direction — mathematical modelling of super complex processes on modern supercomputers utilizing state-of-the-art parallel computing technologies. Under his leadership, a whole range of multiprocessor transputer programs has been developed that effectively operate for solving various scientific and engineering tasks Computations performed using algorithms and programs developed by B.N. Chetverushkin and his students have demonstrated the practical efficiency of multiprocessor transputer systems.

B.N. Chetverushkin is one of the pioneers in the utilization of the first multiprocessor systems with distributed memory in our country. He successfully develops the concept of computational algorithms adaptable to the architecture of multiprocessor computers with distributed memory, models, algorithms, and mathematical software enabling successful modelling of scientific and engineering tasks on high-performance multiprocessor systems. In 2010, relying on these scientific approaches, the first hybrid computing complex K-100 was created and put into operation in Russia.

Algorithms and applied software developed by B.N. Chetverushkin and under his guidance (programs for data visualization of high-performance computing, programs for rational domain decomposition for unstructured grids) have been successfully applied in solving problems of continuum mechanics. He is engaged in practical application issues of massive parallel computing systems for solving complex scientific and engineering problems.

B.N. Chetverushkin's scientific interests include algorithms for massively multicore processors based on graphics cards, which are utilized for solving problems in mathematical physics

He and his students devote considerable attention to addressing environmental problems, primarily related to the development of environmentally friendly processes based on mathematical modelling of organic fuel combustion. The results obtained in this area offer hope for a significant reduction in the emission of nitrogen oxides into the atmosphere during methane combustion. Another important direction of this activity is modelling tasks related to oil and gas extraction.

B.N. Chetverushkin is a prominent participant in numerous prestigious scientific forums and actively participates in the work of the European Community on Computational Methods in Applied Sciences (ECCOMAS). He is involved in the "Mathematical Genealogy" project.

B.N. Chetverushkin heads the Department of Mathematical Modelling and Applied Mathematics at the Moscow Institute of Physics and Technology (MIPT), which is based at the Institute for Problems in Mechanics named after M.V. Keldysh of the Russian Academy of Sciences (IPM RAS). The establishment of the department reflects the increased role of mathematical modelling methodology in modern scientific and technological progress. The essence of mathematical modelling lies in replacing the original object with its "image" — a mathematical model — and subsequently studying the model using computational and logical algorithms implemented on computers. This method of cognition, construction,

and design combines many advantages of both theory and experiment. It is not surprising that the methodology of mathematical modelling is rapidly developing, covering new and diverse areas — from the development of technical systems and their management to the analysis of complex economic and social processes. The triad "model — algorithm — program", formulated by Academician A.A. Samarsky, is today the intellectual core of information technologies.

Additionally, B.N. Chetverushkin heads the Department of Computational Methods at the Faculty of Computational Mathematics and Cybernetics of Lomonosov Moscow State University. The main task of the department is to train specialists capable of creating new computational algorithms and using them to solve scientific and technological problems on high-performance systems.

B.N. Chetverushkin has established a scientific school that develops models, algorithms, and mathematical software enabling successful modelling of scientific and technical problems on high-performance computing systems. Many of his students have become well-known scientists, including two corresponding members of the Russian Academy of Sciences (RAS), six doctors of science, and over 30 candidates of science.

He serves as the Editor-in-Chief of the journal "Mathematical Modelling" and is a member of the editorial board of the journal "Computational Mathematics and Mathematical Physics". Additionally, he holds the position of Editor-in-Chief for the serial scientific publication "Preprints of the Institute for Problems in Mechanics named after M.V. Keldysh".

B.N. Chetverushkin is the author of over 400 scientific works, including four monographs and four inventions. Among his notable works are: "Mathematical Modelling of Problems in Radiating Gas Dynamics", "Kinetically Finite Difference Schemes and Their Application to Transitional Flow Prediction", "Kinetic-Compatible Schemes in Gas Dynamics", "High-Performance Multiprocessor Computing Systems: Issues of Utilization and Workforce Training", "Kinetic Schemes and Quasigasdynamic System of Equations", "Solution of One-Dimensional Problems in Radiative Gas Dynamics", "NuFuSE Project and Development of RMHD Techniques for Predictive Modelling of Processes in Thermonuclear Energy Devices", and "Academician A.A. Samarsky's Model: Selected Articles. Essays. Documents" (compiled and edited by B.N. Chetverushkin), among others.