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PERSONALIA

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In memory of Andrei Nikonovich Starostin

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The prominent world-renowned scientist, doctor of physics and mathematics, and professor at the Moscow Institute of Physics and Technology (MIPT), Andrei Nikonovich Starostin, passed away on April 16, 2020 after a short serious illness. He was a specialist in the field of low-temperature plasma physics, physical kinetics, and radiation–matter interaction. He was also a Lenin Prize laureate and Man of the Year, 2012 (town of Troitsk). February 25, 2020 was his 80th birthday.

Andrei Starostin was born on February 25, 1940 in Moscow. His father, Nikon Fedorovich Starostin, was from the province of Tula. From 1932 to 1957, he worked in the Academic Theater of the Soviet Army in Moscow. Andrei's mother — Nina Ivanovna — had also worked in the theater before the birth of her son and later worked in the Ministry of Construction of Power Stations. The son chose physics.

In 1957, Andrei Starostin finished Secondary School No. 193 with a gold medal and the same year entered Moscow Power Engineering Institute (MPEI). At MPEI, he got involved in theoretical physics and began attending extracurricular seminars in the Physics Department, then headed by V A Fabrikant. In the Physics Department, Starostin completed his graduate work in 1962 under the guidance of theoretical physicist B A Veklenko in the area that, from 1962, was referred to as the 'laser technique'. The next five years after receiving his diploma (1963–1968), Andrei Starostin was a postgraduate student and then assistant professor in the Physics Department at MPEI. At the same time, he joined the well-known group of young theoreticians guided by L M Biberman. This group further underlay the Theoretical Department at the Institute for High Temperatures of the USSR Academy of Sciences (IHTAS). The collective of the Theoretical Department always took A N Starostin as their colleague.

In 1968, A N Starostin went to work at the Scientific Research Institute of Nuclear Physics (SRINP) at Lomonosov Moscow State University, at the Plasma Physics Laboratory, headed at that time by Vyacheslav Dmitrievich Pismennyi, and worked there until 1978. At that time, the range of his main scientific interests was finally outlined: first of all, low-temperature plasma physics and its branch (which was being intensively developed in those years) — the physics of so-called 'nonideal' plasma as a system with strong Coulomb interaction.

In 1971, Starostin prepared and successfully defended his candidate thesis, "Some questions on nonideal plasma theory," under the guidance of Aleksandr Alekseevich Vedenov. Simultaneously, at the MSU Faculty of Physics, he delivered a special course on low-temperature plasma, which he established.

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Translated by M V Tsaplina

Andrei Nikonovich Starostin
(25.02.1940 – 16.04.2020)

In the late 1960s, A N Starostin and G E Norman published a series of now classical studies devoted to the theory of the so-called 'plasma' phase transition. These studies remain topical hitherto. The distinctive feature of this type of phase transitions, called in the literature Norman–Starostin transitions, is a sharp jump-like variation in the degree of plasma ionization caused by strong Coulomb interaction ('nonideality'). These studies by Norman and Starostin paved the way for a whole series of studies on plasma phase transitions. One of the vehement followers of the idea of plasma phase transitions and an active researcher in this field was the well-known theoretical physicist from Germany, Werner Ebeling.

At the present time, the existence of the Norman–Starostin plasma phase transition has already been confirmed in a whole number of experiments, including the unique 'explosive' experiments (carried out at the Russian Federal Nuclear Center (RFNC) in Sarov) on quasi-entropic deuterium compression to extreme megabar pressures typical of the interior of Jupiter and Saturn and also of the large family of extrasolar planets ('hot Jupiters') discovered in recent decades.

Already at SRINP, Andrei Starostin closely co-operated with theoreticians from Troitsk, and when in 1975 V D Pismennyi went to a branch of the Kurchatov Institute of Atomic Energy (from 1991 the State Research Center (SRC) of the Troitsk Institute for Innovation and Fusion Research — TRINITI), his co-workers followed him. In 1978, A N Starostin began working at TRINITI, in the Theoretical Department, headed by Aleksandr Mikhailovich Dykhne.

This period was very fruitful in the life of Andrei Nikonovich. The range of his scientific interests widened. He obtained new important scientific results and in 1981 defended the doctoral thesis, "Physical and chemical kinetics of nonideal and quantum systems." At that time, A N Starostin was already a mature and reputable theoretical physicist. In 1982, he became head of the Laboratory of the Computational Theoretical Department of BIAE and in 1994 head of the Department of the Kinetics of Nonequilibrium Systems of the Center of Theoretical Physics of SRC TRINITI. The range of questions and problems in the sphere of A N Starostin's enduring interests and the work being done with his immediate participation was exceedingly wide. They included the elaboration and design of high-power laser systems, the physics of interaction of high-power laser pulses with plasma under conditions crucial for solving the problem of laser thermonuclear fusion, and a whole number of special and technological applications. The results of A N Starostin's work proved to be extremely important in the examination of issues surrounding radiation transport in dense media for the creation of high-power X-ray lasers; in the field of gas discharge physics, dense plasma physics, and the physics of so-called complex plasma with high-charge macroparticles of condensed disperse phase; and many other things. In 1984, A N Starostin deservedly became a laureate of the Lenin Prize for the creation of high-power gas lasers.

An important stage in A N Starostin's scientific activities was his participation in a series of studies on solar plasma physics (helioseismology). The motivation of these studies was the requirement for high precision of the equation of state of plasma, allowing the use of precision measurements of the solar vibration spectrum for the reconstruction of local solar plasma sound velocity. On the basis of the strict results in statistical mechanics of Coulomb systems obtained by A N Starostin in his candidate thesis, he developed, together with colleagues, the asymptotical model of the equation of state of solar plasma realized in the special computational code SAHA-S. The calculations based on this code showed perfect agreement with the precision data of helioseismology.

One of the main problems to which Andrei Nikonovich returned repeatedly in his scientific work was radiation in low-temperature plasma. In one of his first studies, he considered electron bremsstrahlung on neutral systems. His study of the effect of Stark microfields on the weak-signal amplification factor in hydrogen-like ion plasma was also related to radiation. A N Starostin showed in his work that, in spite of the effect of self-reversal in the center of the line, the radiation coming from weakly inhomogeneous media possesses a noticeable residual intensity exceeding by an order of magnitude the one obtained from the Standard Theory. In work on the theory and numerical simulation of the resonance laser breakdown, Andrei Nikonovich obtained for the first time quantitative agreement between experimental data and the results of calculations of dense resonant plasma. As concerns particular experimental results, A N Starostin was also the first to analyze the effect of quantum processes of stimulated braking absorption on the energy gain by electrons.

A N Starostin obtained a number of important results in the theory of dust plasma, in particular, the study of the phenomenon of superhigh dust-particle charging in plasma with dual-temperature electron distribution. He took part in the theoretical and experimental proof of the possibility of attaining superhigh charges caused by the action of a high-energy electron beam on dust particles.

One of the main problems to which Andrei Nikonovich paid great attention was the study of anomalous effects in the distribution functions of high-energy particles in dense media. He carried out an important series of investigations of the theory of quantum asymptotics of the distribution function of particles for high momentum values and the influence of the anomalies discovered by him upon the rates of physical and chemical processes. In particular, he derived new formulas for the rates of thermonuclear and threshold chemical reactions, whose calculations showed perfect agreement with experiment.

Along with intensive scientific research, A N Starostin devoted much time and effort to pedagogical work. For several years, he delivered a special lecture course (established by him) on low-temperature plasma physics at the MSU Faculty of Physics. Later on, A N Starostin made an invaluable contribution to the formation of the educational process at the Faculty of the Problems of Physics and Energetics (FPPE) of MIPT, participating with A M Dykhne and Yu G Krasnikov in the preparation of a syllabus at FPPE. In addition, A N Starostin made a great contribution to the organization of scientific research at the Department of Applied Physics of MIPT, where a number of original devices were designed under his guidance, and important results were obtained in laser physics and laser–matter interaction physics.

A N Starostin was greatly focused on scientific management and training the scientific community. He founded a reputable scientific school on nonideal plasma physics. A N Starostin was an honored professor at several institutes and the Higher Physics School of State Corporation (SC) Rosatom. In 2009, he was given the title Honored Professor of MIPT. Sixteen candidate and eight doctoral theses were defended under his guidance.

A N Starostin's scientific heritage is great. He is the author of five monographs and over 400 scientific publications, including now classical studies on nonideal plasma physics, the fundamental problems of statistical mechanics of Coulomb systems, controlled thermonuclear fusion and the physics of electromagnetic radiation–matter interaction, laser physics, solar plasma physics, etc. A N Starostin was an editor-compiler and the author of articles in the well-known Encyclopedia of Low-Temperature Plasma.

He took an active part in scientific organizational activities. For many years, he was deputy chief editor of the journal *Fizika plazmy* (*Plasma physics reports*) and a member of the editorial board of *Zhurnal Eksperimental'noi i Teoreticheskoi Fiziki* (*Journal of Experimental and Theoretical Physics*). In addition, A N Starostin was member of academic and dissertation councils of SRC TRINITI, JIHT RAS, and the RRC Kurchatov Institute. He was also a member of the Academic Council of RAS on low-temperature plasma physics and a member of the Academic Council of SC Rosatom.

For his scientific advances, A N Starostin was given state prizes and awards. He was a laureate of the Lenin Prize for the creation of high-power gas lasers (1984) and received the Prize of the RF Government for scientific research and textbooks on low-temperature plasma physics (2010). Starostin was also awarded the jubilee medal, 65 Years of the Atomic Industry of Russia, the insignia Veteran of Atomic Energetics of the Ministry of Atomic Energy of RF, and the lapel pins Academician I V Kurchatov and Academician A P Aleksandrov. Furthermore, in 2019, A N Starostin became a laureate of the Prize of the Council on Low-Temperature Plasma Physics of RAS.

A N Starostin had manifold talents. He was not only a unique theoretical physicist, but knew literature well, was a connoisseur of poetry and perfectly recited poems. His colleagues recalled how Andrei Nikonovich would give a brilliant scientific talk at a conference in the daytime and another, no less brilliant 'poetic talk', in the evening, reciting his favorite rhymes in his circle of friends. In the opinion of his friends and acquaintances, Andrei Nikonovich possessed a refined sense of humor and loved music, both classical and other good music. He knew wines and the art of cooking well and, as is often the case, did not like doctors, although he had to meet them often, especially in his last years. Those who did not know Andrei well might think that he was a reticent or even an austere man, but his friends and colleagues were well aware that under the mask of seeming austerity there was a responsive man always ready to render help.

His death occurred abruptly. On April 12, his colleagues spoke with him over the phone, discussing research plans, and nothing seemed to foreshadow the tragic outcome. But already the next day he fell ill with pneumonia and suspected coronavirus, and three days later he died! The tragic departure of Andrei Nikonovich Starostin is an irreparable loss, not only for his relatives, but also for the whole Russian scientific community.

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A N Lagar'kov, V B Mintsev, A P Napartovich,
G E Norman, O F Petrov, V P Smirnov,
E E Son, V E Fortov, V E Cherkovets