Physics – Uspekhi **50** (3) 325 – 326 (2007)

PERSONALIA

PACS number: **01.60.+q**

In memory of Andrei Grigor'evich Bashkirov

DOI: 10.1070/PU2007v050n03ABEH006289

Andrei Grigor'evich Bashkirov, the well-known Russian theoretical physicist, with a DSc in Physics and Mathematics, is no more, the victim of a tragic accident. He belonged to the brilliant constellation of highly talented students of D N Zubarev, and was also a highly respected representative of N N Bogoliubov's school of statistical physics.

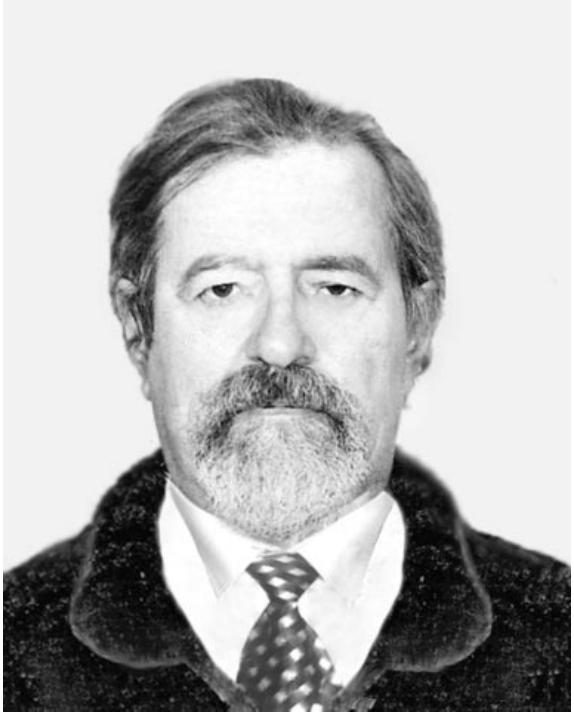
Having graduated cum laude from the secondary school, Bashkirov devoted his life to physics, successfully graduating in 1963 from the Physics Department of M V Lomonosov Moscow State University (MGU). On graduation, he was assigned to work in a closed and classified 'mailbox' research establishment. However, he was attracted to fundamental science and began to regularly attend seminars at the V A Steklov Institute of Mathematics (MIAN). The path of the young physics researcher was decisively influenced by Dmitrii Nikolaevich Zubarev. The close ties between them grew with time beyond the teacher – pupil format and survived until Zubarev's last days.

Having entered science as a graduate from the MGU Chair of the Physics of Oscillations, Bashkirov quickly found his way in the world of problems and methods of theoretical physics. In 1965 – 1971, he published a considerable number of papers jointly with Zubarev; they contained quite a few of Bashkirov's independent ideas. Bashkirov obtained important results in the theory of Brownian motion and in the generalization of the Fokker – Planck equation. He was the first to derive the explicit form of the Liouville equation for an open system, to derive at the fundamental level the Kramers – Zel'dovich equation for the growth of a seed of liquid phase from a gas, and to develop the kinetic theory of homogeneous nucleation.

On the basis of this work, he submitted to MIAN and defended a thesis "Application of the method of a nonequilibrium statistical operator to deriving generalized Kramers – Fokker – Planck equations" for Candidate of Physico-mathematical Sciences. One could say that with this work Bashkirov announced his presence as a full-fledged physics theorist in statistical mechanics; indeed, many results presented in it were later mentioned in Zubarev's classical monograph *Nonequilibrium Statistical Thermodynamics*.

Alas, the further career of Bashkirov the scientist did not progress smoothly. This was partly caused by bureaucratic barriers that existed at the time for hiring people in academic research institutions and partly by the specific features of Bashkirov's personality: he always applied the loftiest principles when needing to resolve problems of science and morality. He was extremely passionate about whatever he was doing, constantly searching for new interesting fields in which to unleash his independent and unconventional way of thinking.

Uspekhi Fizicheskikh Nauk **177** (3) 341 – 342 (2007)
Translated by V I Kisin



Andrei Grigor'evich Bashkirov
(27.06.1940 – 07.10.2006)

The second stage of Bashkirov's research activities started in the 1970s – 1980s at the Institute of the Problems of Mechanics (in the town of Zhukovsky, Moscow region) and in the Sector of the Mechanics of Inhomogeneous Media affiliated with the Division of Mechanics and Problems of Control of the USSR Academy of Sciences, headed by Academician V V Struminsky. During this period, Bashkirov carried out a number of important projects of classified nature. At the same time, he continued to extend the methods of nonequilibrium statistical mechanics and to apply them to a wide range of various problems; he was an active member of the theoretical seminars of Zubarev and Yu L Klimontovich.

This work was centered on the study of heterogeneous gas – liquid systems that are encountered in cosmic physics, geophysics, and chemical technology, and in a number of technical fields. The main target of Bashkirov's effort was to apply nonequilibrium statistical mechanics to the study of mechanical and thermal transport processes and fluctuations in systems with interphase boundaries. He was able to derive the n-particle kinetic equation for particles suspended in a liquid, which became fundamental for the kinetic theory of disperse systems. Bashkirov proposed treating the shock wave as a discontinuity surface. He was able to derive its stability conditions by the Gibbs method and obtained equations of surface hydrodynamics and the equation of Brownian motion of a heavy particle in a thermally nonuniform viscous fluid.

As a result, Bashkirov developed a general approach that made possible the construction of nonequilibrium statistical thermodynamics of heterogeneous systems with stepwise changes in thermodynamic parameters at interfaces. In this way, he pioneered the development of the molecular theory of such processes, making it possible not only to create firm foundations for the existing phenomenological thermodynamic theory but also to include into it in an organic manner the fluctuation effects.

This stage was logically completed with Bashkirov presenting and defending his DSc thesis "Molecular theory of nonequilibrium processes in heterogeneous gas – liquid systems" at the Institute for High Temperatures of the Russian Academy of Sciences (RAS). Its main results (including some from his CSc thesis) were published in English as a monograph *Nonequilibrium Statistical Mechanics of Heterogeneous Fluid Systems* (Boca Raton, FL: CRC Press, 1995, 162 pp.), widely known among specialists.

The third and most fruitful stage of Bashkirov's research began in the 1990s and coincided with joining the O Yu Schmidt Laboratory of the Origin of the Earth that was first in the RAS Institute of Terrestrial Physics but then transferred in 1997 to the RAS Institute of the Dynamics of Geospheres. At this stage, he actively joined the work in promising areas of geophysics (neutrino tomography of the Earth) and astrophysics (large-scale structure of the Universe and black hole entropy). Bashkirov's ideas on the dynamic shielding of correlations in gravitating media and its role in the interpretation of the periodic structure of the Universe on the scale of dozens and hundreds of Megaparsec, as well as his interpretation of black hole entropy based on the model of the oscillator in a coherent state, generated great interest among colleagues.

Bashkirov was able to show, among other things, that owing to the thermal motion of particles there can be formed, both in charged and in gravitating dusty plasmas, an effective alternating-sign potential resulting in dynamic shielding of long-range forces. One consequence of this effect would be the formation of a quasicrystalline structure (a plasma crystal) on a scale dictated in the case of gravitating media by the characteristic Jeans wave number.

In the last ten years, Bashkirov had been especially engrossed in the idea of extending statistical thermodynamics. His research during this period concentrated on generalizing classical thermodynamics based on the R'enyi entropy. He published a series of papers on this subject in Russian and foreign journals, which attracted much attention. Bashkirov was frequently invited to conferences on nonextensive thermodynamics as a principal speaker. At the prestigious International Workshop on the Mathematics and Physics of Complex and Nonlinear Systems (Indian Institute of Technology, 2004) he read a series of lectures on "Non-Boltzmann entropies for complex classical systems, quantum coherent states and black holes" which was soon published in English as a separate volume (Berlin, New York: Springer-Verlag, 2006).

We could say that the subject that absorbed his interest the most in statistical thermodynamics in recent years was the application of the R'enyi entropy to self-organization processes in complex open systems. For these, Bashkirov suggested an original approach to resolving the generally recognized contradiction between self-organization processes and consequences of the second law of thermodynamics. He showed that in contrast to the Gibbs – Shannon entropy the R'enyi entropy may reach a maximum when an open system transfers to a more ordered state. Not long before the tragedy that befell him, Bashkirov presented his approach to this subject in a monograph *Self-Organization and the Second Law of Thermodynamics* prepared for publication.

Bashkirov had an excellent command of English. The scientific community knew him as a brilliant translator and editor of many volumes on statistical and general physics. In recent years, he had made important contributions to preparing the publication of multivolume collections of the scientific works of P A M Dirac and N N Bogoliubov. Bashkirov was for decades the chief editor of the section "Physics of gases and fluids, thermodynamics, and statistical physics" in the reference journal *Physics*, and a consultant and author of entries to *Physics Encyclopedia* and the *Great Russian Encyclopedia*; he also refereed leading Western and Russian journals.

Bashkirov came out of a well-known family which had longstanding traditions of serving world science and culture. His great-grandfather V K Zvorykin was the famous scientist and radio engineer who developed color television technology. His grandmother E A Polevitskaya was the outstanding dramatic actress whose fame shone in pre-revolutionary Russia, then on European stages, and then again in Russia. Bashkirov's attitudes and psychology were greatly influenced by the traditions that family members inherited from generation to generation.

He was a true specimen of the Russian intelligentsia, with its uncompromising concepts of honor and human dignity. His outward calm and even imperturbability shielded a vulnerable soul. Every step he made revealed his profound competitive drive: in collecting smoking pipes and in scientific debates. With friends and within the family circle he showed a touch of irony but was invariably magnanimous and kind. All his life Bashkirov was a keen athlete: he loved all-weather swimming and bicycle riding, was and a passionate yachtsman (in his youth, he was even the country's champion in sailing regattas).

Andrei Grigor'evich Bashkirov left us still on an upward arc. He was denied the chance of expressing himself in full. The tragic death cut short his path in science. This is an irreplaceable loss to anyone who knew him or worked with him.

V V Adushkin, S I Anisimov, N V Vdovichenko,
A V Vityazev, V G Kadyshevskii, A A Kirsh,
O N Golubeva, G V Pechernikova, N M Plakida,
A D Sukhanov, E E Tareeva, Yu A Tserkovnikov