

In memory of Kamil' Akhmetovich Valiev

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Kamil' Akhmetovich Valiev, a talented theoretical physicist and pedagogue, an outstanding organizer of science, Full Member of the Russian Academy of Sciences, Academician of the Tatarstan Academy of Sciences and member of a number of foreign Academies of Sciences, Doctor of Physical and Mathematical Sciences, and Professor, died on 28 July 2010, after a grave disease.

K A Valiev was born on 15 January 1931 in the village of Verkhniy Shander, Takanysh (now Mamadysh) region, Tatar ASSR, into a peasant family. In 1949, he attended the Department of Physics and Mathematics at Kazan State University (KGU in *Russ. abbr.*), where he specialized in theoretical physics under the supervision of Professor S A Al'tshuler.

On graduating from university, K A Valiev becomes a postgraduate student of S A Al'tshuler, and his first scientific paper, published in *Scientific Proceedings of KGU* (1955), was devoted to resonance magnetic absorption in a conducting cylinder. The prediction of amplification effect of a nuclear magnetic resonance (NMR) signal due to the presence of an electron spin in an atom, allowing the NMR observation on nuclei of paramagnetic atoms, was the main result of K A Valiev's PhD thesis (1958).

After completing his PhD work, K A Valiev was assigned a job at the Kazan State Pedagogical Institute (KGPI in *Russ. abbr.*), where he worked until 1964 as a senior teacher, then an associate professor and head of the chair of physics at KGPI. In 1958–1959, S A Al'tshuler and K A Valiev performed theoretical studies of the electron spin-lattice relaxation for complexing metal ions in liquid electrolyte solutions, whereby they proposed the relaxation mechanism which became widely known as the Al'tshuler–Valiev mechanism.

The results of K A Valiev's studies on the theory of magnetic resonance and optical spectroscopy of liquids were summarized in his doctoral dissertation, which he defended in November 1963 at the Institute of Physics of Metals, the Academy of Sciences of the USSR. In 1997, K A Valiev was awarded the International E K Zavoisky Prize for the sum total of his fundamental theoretical studies on electron paramagnetic resonance. Later on, he published the results of his dissertation in a monograph *Studies of Liquids by Spectroscopic Methods* (Moscow: Nauka, 2005).

In 1964, K A Valiev accepted a position at the Microelectronics Research Center in Zelenograd to take part in the development of the electronic industry in the USSR. In February 1965 he founded a new industrial Research Institute of Molecular Electronics (NIIME in *Russ. abbr.*) for developing semiconductor (silicon) integrated circuits (ICs) and became the director of this institute. The theoretical physicist carried away by fundamental studies found himself caught up in the thick of organizational activity on the selection and training of researchers and practised engineers for industry, the development of basic microelectronic technology, the creation of the first automated system



Kamil' Akhmetovich Valiev
(15.01.1931–28.07.2010)

(SAPR) for the IC design (the first SAPR in our country based on a BESM-6 computer at NIIME was awarded the State Prize in 1975) and the whole complex of technological equipment, the layout of industrial clean rooms, the organization of the production of a huge number of ultrapure materials, and solving many other problems. Already in 1966, the developments of the first domestic ICs were completed at NIIME, and a workshop for their fabrication was organized. Basic technologies were introduced at the Micron plant, where the productive capacity achieved 100 million chips in 1980, and at many other plants of the electronic industry.

The most important developments of computers, radio-electronic equipment for the nation's economy, and military systems were based at that time on serial ICs developed at NIIME. These included the uniform computer system 'Ryad' developed in the countries of the Council for Mutual Economic Assistance, C-300 anti-aircraft rocket systems, anti-rocket defense systems based on El'brus computers, and many other developments. Thus, NIIME became the parent enterprise in a new rapidly developing microelectronics industry. K A Valiev played the decisive role in this development. He was awarded the Lenin Prize in 1974 for the development of microelectronic industry in the USSR, and the State Azerbaijan Prize in 1976 for the organization of microelectronic production in Baku.

Having a deep understanding of the role of fundamental science, Kamil' Akhmetovich organized at the industrial research institute a physics department, including experimental and theoretical laboratories. This department has played an important role in the achievement of qualitatively new applied results. K A Valiev had time to personally participate in studies performed at the department. For example, he directed the studies of the metal–semiconductor phase transition in vanadium oxides having a sharp resistance and reflection coefficient jump under changes of temperature. This effect was utilized to create a prototype of high-capacity random-access holographic memory. K A Valiev initiated the investigations of devices and manufacturing technology of ultrahigh-speed gallium arsenide ICs with a high radiation resistance and a broad working temperature range. These ICs found applications in satellite-borne devices, and this result was honored with the Prize of the Government of Russia in Science and Technology.

Academician A M Prokhorov appreciated the results of studies obtained at the NIIME Physics Department and supported the election of K A Valiev as a Corresponding Member at the Division of General Physics and Astronomy of the Academy of Sciences of the USSR in 1972.

In 1965, the Moscow Institute of Electronics Technology was founded in Zelenograd on the initiative of A I Shokin, the Minister of the Electronics Industry, for educating and training researchers for enterprises of the Scientific Center. In 1968, K A Valiev organized and headed until 1978 a Chair of Integrated Semiconductor Circuits at the institute. He held for the students of the new institute classes on general and theoretical physics, solid-state physics, and the course 'Physical foundations of microelectronic technology'. The results of works on microelectronics were summarized by him in a number of monographs: *Digital Integrated Circuits on MIS Transistors* (Moscow: Sovetskoe Radio, 1971) (jointly with M A Korolev and A N Karmazinsky), *Semiconductor Integrated Memory Circuits on Bipolar Transistor Structures* (Moscow: Sovetskoe Radio, 1979) (jointly with A A Orlikovsky), *Application of a Metal–Semiconductor Contact in Electronics* (Moscow: Radio i Svyaz', 1981) (jointly with Yu I Pashintsev and G V Petrov). The results of studies by K A Valiev and his coworkers performed in those years are published in many physical and technical journals.

In 1978, Academician A M Prokhorov invited K A Valiev to head a Laboratory of Microelectronics at the Lebedev Physical Institute, which after reorganization became the Department of Microelectronics at the General Physics Institute (IOFAN in Russ. abbr.). In 1983, K A Valiev became one of the deputy directors of IOFAN. Academician E P Velikhov offered K A Valiev a part in the organization of the new Division of Informatics, Computational Techniques and Automation in the Academy of Sciences of the USSR. In 1984, K A Valiev was elected Full Member of the Academy of Sciences of the USSR in this Division. In 1988, supported by A M Prokhorov, K A Valiev founded a new Institute of Physics and Technology of the Academy of Sciences of the USSR and became its first director. In the same year, he became the editor-in-chief of the journal *Microelectronics*. K A Valiev organized the base Chair of Physical and Technological Problems of Russian Microelectronics in the Faculty of Physical and Quantum Electronics at the Moscow Institute of Physics and Technology.

The field of fundamental and applied studies chosen by K A Valiev for his new institute encompassed a broad scope of physical problems in microelectronics. The main focus was lithography methods, because these methods determine the level of microelectronics technology.

The results obtained in those years in the field of microelectronics were partially presented in the monographs *Microelectronics: Achievements and Avenues of Progress* (Moscow: Nauka, 1986) and *The Physics of Submicron Lithography* (Moscow: Nauka, 1990; New York: Plenum Press, 1992), and in numerous scientific papers. In books on lithography, K A Valiev realized his old dream of writing a technology book in the manner of a book on theoretical physics. Such approach is the only one in the world literature devoted to technological problems.

In 1998, K A Valiev began to work in the new field of quantum computers and quantum computations and, more generally, of quantum informatics, including, along with quantum computers and computations, quantum communications and quantum metrology. He established a special laboratory of the physics of quantum computers in his institute and organized a scientific seminar devoted to quantum computations and quantum computers, which attracted the attention of researchers at other institutes of the RAS and educational institutions. In December 1999, the First Russian School on Quantum Data Processing Methods headed by K A Valiev was held at the Institute of Microelectronics Technology and High-Purity Materials, RAS (Chernogolovka).

K A Valiev and A A Kokin wrote a monograph *Quantum Computers: Hopes and Reality* [Moscow–Izhevsk: RKhD, 2001 (2002, second edition)] on quantum computers and computations. The review article "Quantum computers and quantum computations" by K A Valiev published in *Physics–Uspekhi* 48 (1) 1 (2005) became an excellent addition to this monograph.

K A Valiev organized a Chair of Quantum Informatics at the Department of Computational Mathematics and Cybernetics at Moscow State University. In 2000, he participated in the establishment of the international journal *Quantum Computers & Computing*. K A Valiev headed International Conferences on Quantum Informatics QI-2002, QI-2004, QI-2005, QI-2007, and QI-2009 held in Russia. He was interested in the problems of quantum computations and quantum informatics and the prospects of realizing quantum computers until the end of his life. Academician K A Valiev initiated the development of quantum communication systems at the Rzhanov Institute of Semiconductor Physics, Siberian Branch of the RAS and Lomonosov Moscow State University.

During the 55 years of his scientific, pedagogical, and organizational activities, Kamil' Akhmetovich worked with full dedication. A civic-minded person, he was very hard-working, could rapidly orientate himself toward a new scientific field, and respected people.

The scientific and organizational activities of K A Valiev were recognized with governmental awards: two Orders of the Red Banner of Labor (1971, 1981), the Order of the October Revolution (1988), the Order of Merit to the Motherland of the Fourth Class (1999), medals, the Lenin Prize of the USSR, the State Prize of the Russian Federation, the International Zavoisky Prize, and the Lebedev Prize of the RAS.

A grave disease befell Kamil' Akhmetovich Valiev and he died when he was still full of creative strength and plans for further investigations. The blessed memory of him will remain in our hearts forever.

V B Betelin, E P Velikhov, Yu V Gulyaev,
A A Kokin, Yu V Kopaev, G Ya Krasnikov,
F A Kuznetsov, V F Lukichev, I G Neizvestnyi,
A A Orlikovsky, A V Rakov, Yu A Chaplygin