

IN MEMORY OF VSEVOLOD M. BYAKOV

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On October 24, 2021, Vsevolod Mikhailovich Byakov passed away at the age of 90. He was a well-known expert in the radiation chemistry of condensed matter, doctor of physical and mathematical sciences, professor, scientific adviser of the director of the Alikhanov Institute for Theoretical and Experimental Physics.

Vsevolod Mikhailovich was born on February 22, 1931, in the village of Karagai, Perm region, in the family of doctors. In 1939 his family moved to Ryazan, where he graduated from a school. In 1949 he entered the Physical Faculty of the Lomonosov Moscow State University. His diploma work was devoted to the study of the origin of high-energy cosmic rays. It was done at the Cosmic Ray Chair (Matter Structure Division of the Physical Faculty of the MSU) under the guidance of Prof. Yakov Petrovich Terletsky (whose books "Statistical Physics" and "Paradoxes of Relativity" have been translated into many foreign languages).

After graduating from Moscow State University in 1954, from February 1, 1955, and until his last days he worked at the Institute of Theoretical and Experimental Physics, Moscow. In 1955-1964 he

developed theoretical models of some processes in a homogeneous boiling nuclear reactor (movement and growth of steam bubbles, spatial distribution of steam-water mixture density under barbotage conditions, volumetric heat release in water by uranium fission products, radiation-chemical processes in a reactor core). The results of these works are presented in 3 monographs and in his Ph.D. thesis "On the Theory of Radiolysis of Water and Aqueous Solutions under the Influence of Gamma-rays and Fast Electrons", which was successfully defended in 1964. Thanks to this work, he became deeply interested in radiation chemistry, it was of great importance in water homogeneous reactors, where aqueous solutions of nuclear fuel salts are used.

After that V.M. Byakov guided an investigation on radiation chemical synthesis of important chemical compounds - ethylene and propylene glycols - from methanol and its aqueous solutions. This synthesis was carried out at the ITEP nuclear reactor in 1966-1967 for the first time in the USSR. The obtained products have been successfully tested at civil and military enterprises. Based on these works, he proposed a method for suppressing the formation of oxygen in a nuclear reactor with aqueous coolant by introducing small additives of alcohols into it. This method is currently used in reactors in Germany and Japan. V.M. Byakov et al. proposed to use the depolarization parameters of μ^+ -mesons in condensed media to determine the rate constants of chemical reactions of hydrogen-like atoms (1964).

In 1973 he proposed a model describing positronium, muonium, and radiolytic hydrogen formation. He suggested that quasifree electron (arising in tracks of ionizing particles before solvation) is the main precursor of all these species. In 1985 he completed his work entitled "Physical and chemical processes in tracks of ionizing particles in liquids", which he defended as his doctoral thesis (specialization: chemical physics, including physics of combustion and explosion; 1986). In 1992 Vsevolod Mikhailovich got the title of Professor.

At the end of the 1970s, V.M. Byakov developed a new mechanism of primary biological action of ionizing radiation. The main role in this mechanism is assigned not to effects produced by radiolytic radical products, but rather to local increases of acidity in the intracellular medium along the trajectory of energized charged primary particles. The proposed mechanism describes an extremal behavior of relative biological effectiveness (RBE) of ionizing radiation vs. linear energy transfer and an increase of RBE at ultrarelativistic energies.

In the 80's V.M. Byakov et al. developed the radiation-thermal mechanism of the formation of natural energy resources on the Earth – coal and oil. His experiments and analysis of several geological phenomena showed that the formation of coal and oil is controlled not only by temperature but also by another important parameter – the intensity of ionizing radiation from radioactive nuclides of uranium disseminated in sedimentary rocks. The obtained equation of carbonization describes well the stages of metamorphism of coals and oil-producing rocks and allows to estimate the maximum paleotemperature of sedimentary rocks, their absolute age, as well as the threshold oil-formation temperature.

Vsevolod Mikhailovich's scientific interests over the last 20 years have been related to positron annihilation spectroscopy and radiobiology. Using positron spectroscopy data he has shown that aqueous solutions of alcohols (containing up to 50% of alcohol) are not true solutions, but rather emulsions of alcohol nanodroplets in water. He proposed a model of the positronium atom in a condensed medium, which takes into account the internal energy of e^+e^- -Coulombic attraction during Ps localization in a nanobubble. This model explained the existence of the quasifree state of Ps with a lifetime of 50-100 ps, which was observed in GiPS AMOC experiments in liquid water and glycerol. His earlier prediction that the quasifree track electron (but not a hydrated one) is the precursor of the positronium atom was also confirmed experimentally.

Vsevolod Mikhailovich is the author of three books and more than 300 scientific papers. He gave lectures at many conferences on positron spectroscopy and radiation chemistry. His research has been awarded prizes and certificates of merit. The first edition of his textbook “Fundamentals of

Radiation Chemistry” was translated into Japanese in 2014.

In the last years of his life, he was involved in teaching, giving lectures and seminars at Mendeleev Russian Chemical University, at the Chemistry Faculty of Lomonosov Moscow State University, and the NRNU "MEPhI”.

Vsevolod Mikhailovich Byakov was a very kind, highly decent, and wise man. The bright and everlasting memory of him will remain in our hearts.

**Relatives, friends, colleagues,
and the Editorial Board RENSIT journal**