Physics – Uspekhi **54** (12) 1299 – 1300 (2011)

PERSONALIA

PACS number: **01.60.+q**

In memory of Vladimir Mikhailovich Lobashev

DOI: 10.3367/UFNe.0181.201112p.1371

Domestic and world science have suffered a severe loss with passing away Academician Vladimir Mikhailovich Lobashev on 3 August 2011. He was an outstanding physicist, a great authority in the field of nuclear and elementary particle physics, and founder of scientific schools of neutron physics at the Petersburg Institute of Nuclear Physics, Russian Academy of Sciences (RAS) and experimental physics of elementary particles at the Institute for Nuclear Research, RAS.

Vladimir Mikhailovich was born on 29 July 1934 in Leningrad into a family of scientists. His father Mikhail Efimovich Lobashev was an outstanding geneticist, Head of the Chair of Genetics at Leningrad State University (LSU), and his mother Nina Vladimirovna Evropeitseva was a Senior Researcher at LSU. At the beginning of the Great Patriotic war, he was evacuated from Leningrad to Buinsk, a town in the Tatar Autonomous Republic of the USSR, where he attended school. In 1944, he returned to Leningrad, where he continued his schooling. After graduating with a Silver Medal from a secondary school in 1952, he attended the Department of Physics at LSU from which he graduated with honors in 1957. Then, he joined the A F Ioffe Physical and Technical Institute, Academy of Sciences of the USSR.

Vladimir Mikhailovich made his way from a senior laboratory assistant to the head of a sector, first at the Ioffe Physical and Technical Institute and then at the B P Konstantinov Petersburg Institute of Nuclear Physics, RAS, where he worked till the end of his life. In 1972, V M Lobashev became the head of the Department of Experimental Physics at the Institute for Nuclear Research, RAS.

Vladimir Mikhailovich was one of the most prominent experimental physicists of our time. He was a man of great erudition, extraordinary memory, brilliant intuition, subtle comprehension of an experiment, and a violent persistence. Vladimir Mikhailovich was simultaneously a scientist and an inventor. His motto was to achieve the unachievable. He always tried to solve the most difficult problems and achieved success. And he always obtained pioneering results, ahead of the rest of the world.

In 1965, Vladimir Mikhailovich proposed an integral method for measuring small effects, which was used for the first detection and measurements of the P-odd circular polarization of gamma quanta in the decay of nonpolarized nuclei with the relative accuracy of 10^{-5}–10^{-6}. This experiment is undoubtedly among the most subtle and elegant experiments performed ever in the world practice. It seemed amazing at that time, and still does today, that researchers managed to detect such weak effects. The integral (current) method for detecting particles was based on the measurement of circular polarization from current variations in a particle detector caused by a periodic change in the magnetization direction of the core in a gamma-quantum polarimeter. A resonance amplifier separated the first harmonic of a periodic signal which was converted to a mechanical force with the aid of an electromagnetic system and was fed to a resonance storage representing an astronomical clock pendulum. The pendulum Q factor was at a level of about 10^6, and it could freely oscillate for 18 days, which exceeded the Q factor of quartz resonators by approximately an order of magnitude. It is by this method that the circular polarization in gamma transitions of nonpolarized ^{175}Lu, ^{181}Ta, and ^{41}K nuclei was first discovered. These experiments conclusively proved the existence of the weak nucleon–nucleon interaction and were awarded, together with the pioneering work of Abov's group observing the P-odd asymmetry in the escape of gamma quanta during the capture of polarized neutrons by a ^{113}Cd nucleus, the Lenin Prize 1974 "for the discovery and study of spatial-parity-violation effects in nuclear electromagnetic transitions" [Yu G Abov, P A Krupchitskii (ITEP), and V M Lobashev, V A Nazarenko (PINP)].


Vladimir Mikhailovich Lobashev
(29.07.1934 – 03.08.2011)

This work was further developed for measuring the P-odd circular polarization of gamma quanta in the reaction of radiative capture of a neutron by a proton ($n + p \rightarrow d + \gamma$), which, due to its simplicity, is ideal for studying a weak nucleon–nucleon interaction and its theoretical interpreta-

Uspekhi Fizicheskikh Nauk **181** (12) 1371 – 1372 (2011)
DOI: 10.3367/UFNr.0181.201112p.1371
Translated by M N Sapozhnikov

tion. However, any enhancement of the effect is absent in this case (unlike complex nuclei with a high density of excited states), and effects were expected at a level of $\sim 10^{-7}$, which seemed unachievable for measurements. Vladimir Mikhailovich proposed using a water cavity as a high-intensity gamma-quantum source formed at the center of the core of a water-moderated water-cooled VVR-M reactor in order to emit the maximum possible thermal neutron flux in this experiment. The idea of mounting a complex device with shields weighing as much as 500 kg in the reactor core and the displacement of many (up to 90) fuel elements seemed adventurous at first. Nevertheless, Vladimir Mikhailovich managed to persuade R G Pikulik and K A Konoplev, the 'major' reactor researchers at PINP, that the idea was realistic, and they supported it. The realization of this idea required exceptional courage and considerable reconstruction of the entire control and protection systems of the reactor. In these experiments, a record accuracy of 2×10^{-7} for measuring the circular polarization of gamma quanta was achieved, and an upper limit to the direct neutron–proton weak interaction was obtained.

In 1971, researchers in Lobashev's group discovered and studied a new effect in quantum electrodynamics — the rotation of the polarization plane of hard gamma quanta in a medium of polarized electrons, which was registered on 22 December 1988 as a discovery, with priority from 12 February 1965 concerning the theoretical prediction (V G Baryshevskii, V L Lyuboshits, JINR), and from 28 July 1971 concerning the experimental proof of the phenomenon (V M Lobashev, A P Serebrov, L M Smotritskii).

After the discovery of the CP invariance violation in decays of neutral kaons in 1964, interest increased in the search for the electric dipole moment (EDM) of a neutron, because the P and CP invariance violations suggested the possibility of its existence. By this time, the first restrictions on the value of the neutron EDM had already been obtained by researchers in Ramsey's group in a cold neutron beam. In 1968, the first ultracold neutrons (UCNs) were obtained in Dubna, and F L Shapiro proposed using them in searching for the neutron EDM. This idea promised a considerable reduction in false effects from the interaction of the neutron magnetic moment with electric fields and the improvement of the Ramsey result by a few orders of magnitude. However, the UCN number density in the first experiments was extremely low, on the order of 10^{-6} neutrons cm^{-3}. To perform the experiment, the UCN density had to be increased by 7–8 orders of magnitude, and V M Lobashev and A P Serebrov decided to create a high-intensity UCN source based on a moderate-power reactor, although this seemed impossible at that time. Again, the almost impossible was done: to obtain UCNs, first a cooled beryllium converter and then a liquid hydrogen converter were mounted in the reactor core. As a result, for a decade, beginning from the mid-1970s, the world's most intense UCN source operated in Gatchina, and only after the startup of the UCN source based on a high-flow reactor in Grenoble did the former source become only a few times inferior.

Using this source, the record restriction on the neutron EDM, $d_{\text{n}} \leqslant 9.7 \times 10^{-26}\, e$ cm, was obtained by 1989, which has been improved over the last two decades only by a factor of three. This restriction is one of the most important for the understanding of the CP invariance violation in the microworld and the possibility of explaining the baryonic asymmetry of the Universe.

In 1983, Vladimir Mikhailovich, along with P E Spivak, proposed a new method for measuring the neutrino mass in the beta decay of tritium with the help of an integral electrostatic spectrometer with magnetic adiabatic collimation. A specific feature of the spectrometer is a longitudinal magnetic field forming a magnetic mirror trap (probkotron) type configuration, with the ratio of a strong magnetic field in the magnetic mirror region to a weak magnetic field in the median plane region equal to a few thousand. The tritium source and detector of decay electrons are located in the magnetic mirror region. The electrostatic spectrometer is placed in the median part of the magnetic mirror trap in the homogeneous field region. High resolution is achieved due to the adiabatic motion of electrons in the magnetic field, which reduces the transverse component of the electron kinetic energy in the median plane proportionally to the strong–weak field ratio in the magnetic mirror region. The resolution of this spectrometer is independent of the source size, which allowed achieving a record sensitivity of the Troitsk ν-mass setup developed at INR, RAS to the mass of an electron antineutrino. Vladimir Mikhailovich's ideas form the basis of the international KATRIN project, planning to obtain an upper limit to the mass of an electron antineutrino at a level of 0.2 eV/c^2.

Based on the probkotron concept, Vladimir Mikhailovich, together with R M Djilkibaev, proposed in 1989 a new approach to the search for the muon–electron conversion process in a nucleus, which provided an increase in the measurement sensitivity by five orders of magnitude. This idea was based on the employment of a pulsed proton beam and on the integration of a muon source, a system forming the beam, and a detector in the single magnetic system with an inhomogeneous field. Such a drastic increase in the measurement sensitivity can lead to the discovery of new interactions produced by new particles with masses on the order of 1000 TeV, which cannot be generated in the near future in colliders. This approach provides the basis for the Mu2e experiment which is being prepared at present at the Fermi National Laboratory in the USA.

Vladimir Mikhailovich Lobashev made a great contribution to the development of the research program at the Moscow meson facility. His intuition and excellent knowledge of many topical physical problems led to the development of the unique project of the experimental complex for studies in the fields of nuclear and neutron physics. Most of the projects proposed at that time were later realized under his supervision. The informal association with Vladimir Mikhailovich helped many young researchers at the INR Department of Experimental Physics, headed by him, to find their place in science.

The achievements of Academician V M Lobashev, an outstanding scientist, were awarded the Lenin, Pontecorvo, and Markov prizes, and Russian medals. Vladimir Mikhailovich received the title of Honorary Citizen of Troitsk. V M Lobashev focused great attention on the training of researchers. His pupils include tens of candidates and doctors of sciences. The fond memories of Vladimir Mikhailovich Lobashev will live in his work and the hearts of his relatives, friends, colleagues, and disciples.

Yu G Abov, E V Geraskin, S S Gershtein,
R M Djilkibaev, V F Ezhov, L V Kravchuk,
V A Matveev, V A Rubakov, V M Samsonov,
A P Serebrov, A N Skrinsky, V V Fedorov