

PERSONALIA

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Lev Mitrofanovich Barkov (on his 80th birthday)

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On October 24, 2008 Academician Lev Mitrofanovich Barkov turned 80. These days he is a chief researcher at the G I Budker Institute of Nuclear Physics of the Siberian Branch of the Russian Academy of Sciences (RAS).

One of a galaxy of brilliant physicists of the first graduating class of the Physico-Technical Department of Moscow State University (today the Moscow Institute of Physics and Technology), L M Barkov began to work at USSR Academy of Sciences Laboratory No. 2, which later became the worldwide-known I V Kurchatov Institute of Atomic Energy (today known as the Russian Research Centre 'Kurchatov Institute'), already when he was a second-year student. At the time, his interests lay in the field of measurements of the energy spectra of neutrons that emerge in the fission of uranium and plutonium isotopes and the study of their moderation and diffusion in uranium – water systems. All this work was closely related to a plan of building uranium and heavy water nuclear reactors destined for defense industry and national economy.

During the same period in his scientific career, Lev Barkov became interested in high-energy physics. From 1952 up to the end of the 1950s, he actively participated in work on measuring the pionization cross sections and studying the dynamics of interaction of low-energy pions in the Dubna phasotron. In these experiments, the Coulomb shift in the spectra of charged pions was discovered for the first time.

The study of the physics of the interaction of pions and kaons was continued in experiments that used a propane bubble chamber in a pulsed magnetic field. Barkov's remarkable ability to find simple and ingenious solutions to complex problems, characteristic of all his subsequent work, considerably contributed to the success of the whole work.

The year 1967 began a new period in the scientific career of L M Barkov: Gersh Itskovich Budker invited him to work in Novosibirsk at the rather recently organized Institute of Nuclear Physics (INP) of the Siberian Branch of the USSR Academy of Sciences. Here he established a laboratory whose first goal was to continue research on the structure of hyperons. The experiment proposed by him to measure the magnetic moment of the Σ^--hyperon, which utilized an electron beam extracted from a storage ring in the accelerator with colliding electron – positron beams (VEPP-3), was based on using ultimately attainable magnetic fields of about one megagauss. To reach such fields, the newest ideas about magnetic explosion generators were utilized. Solid hydrogen was taken for the target, and the hyperon decay products were registered by nuclear photographic emulsion. Later on, the same method was employed in measurements of the magnetic moment of the Λ^0-hyperon at the Serpukhov U-70 proton accelerator. What was also measured was the antiproton production cross section for the interaction of high-energy protons with various nuclei. This was very important in view of the construction of the proton – antiproton collider at CERN.

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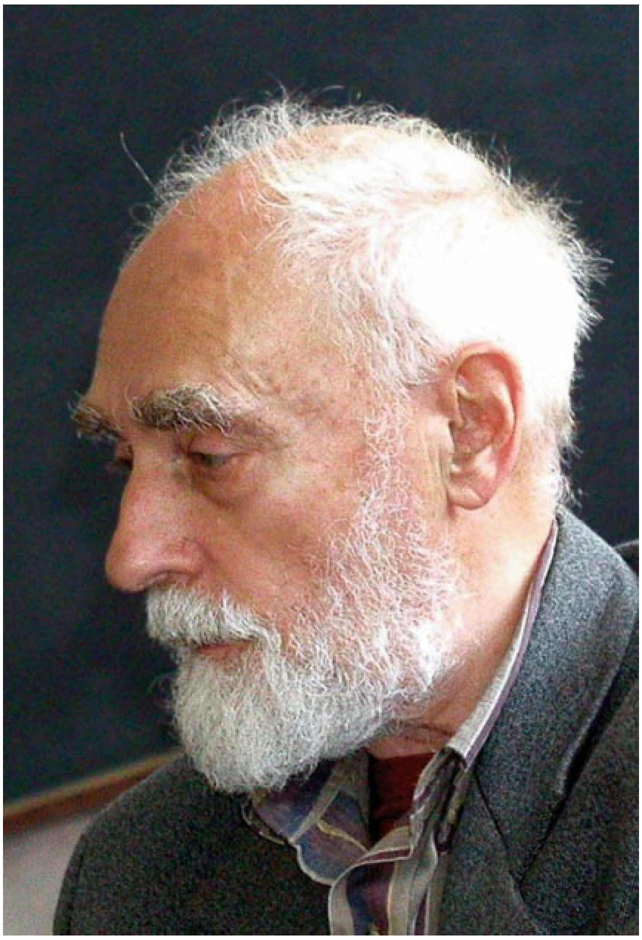

Lev Mitrofanovich Barkov

In the mid-seventies, L M Barkov was eager to apply X-ray fluorescence elemental analysis via synchrotron radiation to find the island of stability for superheavy elements. He helped to design and build the world's first twenty-pole superconducting wiggler which made it possible to produce a 1.2-kW beam of X-ray synchrotron radiation, i.e., the brightness of the source in the X-ray range was increased by a factor of 200! At the same time, when work on building a new source of radiation was in progress, unique experimental facility for X-ray fluorescence analysis was under construction. This facility increased the sensitivity of the method by an additional factor of 100. Despite the fact that no superheavy elements were discovered in the experiments, Barkov's work contributed significantly to the development of the technology of generating synchrotron radiation and its applications in this country.

The 1970s and 1980s proved to be a very intensive period in Barkov's life. In 1974 – 1978, he and M S Zolotorev conducted an experiment in which optical rotation in bismuth atomic vapor was discovered. The rotation of the polarization plane suggested that there is weak electron–nucleon interaction for which neutral currents are responsible. The magnitude of the observed effect amounted to 7×10^{-7} radian, which was thousands of times smaller than the numerous background contributions. To measure such a minute effect, the researchers had to think up a variety of radically novel decisions and realize them in new devices, some of which were later protected by international patents. The results of these observations formed one of the cornerstones of the Standard Model.

Lev Mitrofanovich Barkov became one of the initiators of building the VEPP-2M electron – positron collider at the Institute of Nuclear Physics of the Siberian Branch of the USSR Academy of Sciences. This facility had center-of-mass energies ranging from 2×180 MeV to 2×700 MeV and beam luminosities of about 3×10^{30} cm^{-2} s^{-1}. For this collider, the team of researchers under the leadership of Barkov designed a cryogenic magnetic detector (CMD) that had no analogs both at INP and in the entire Soviet Union. In it the magnetic field was furnished by a superconducting solenoid and an optical spark chamber operated at cryogenic temperatures and elevated pressures. At the design stage Lev Mitrofanovich displayed his great abilities as a scientist and administrator. Barkov succeeded in mustering a group of young researchers who brilliantly coped with the tasks in hand. In many parameters the detector significantly exceeded all other devices of this kind, and the group of researchers was awarded the USSR State Prize for the precision experiments conducted at VEPP-2M. Moreover, as a result of building the CMD, the Institute accumulated experience in constructing large superconducting devices, experience that was later successfully drawn in manufacturing the famous Siberian wigglers, the undulators and solenoids for a new generation of detectors.

The CMD experiments had not been completed when L M Barkov and collaborators initiated the development of a new universal detector, which became known as CMD-2. This detector comprised all the ingredients characteristic of modern devices of this type: a superconducting solenoid, a jet type drift chamber, an electromagnetic calorimeter based on the use of CsI crystals in the cylindrical part and BGO crystals at the end caps of the detector, and a muon identification system that utilized tubes with a limited streamer discharge. Experiments with CMD-2 continued at the VEPP-2M collider from 1991 to 2000. These experiments produced many new data on rare decays of light vector mesons, including those on radiative decays of the ϕ-meson into a photon and a scalar meson, which play an important role in the development of the physics of strong interactions.

Moreover, the CMD-2 detector was used in precision measurements of the cross section of electron–positron annihilation into hadrons. These experiments hold much significance for elementary particle physics since, on the one hand, they make possible a detailed study of the dynamics of quark interactions and, on the other hand, constitute a reliable source of information necessary for exact calculations in the Standard Model. The data gathered play a decisive role in determining the running fine-structure constant on the mass of the Z-boson and the muon's anomalous magnetic moment. The measurement of the latter quantity in a joint experiment conducted at the Brookhaven National Laboratory (USA) is a very important step in the development of the concept of supersymmetric interactions.

The development of experimental elementary-particle physics has proceeded in such a way that the range of energies between 1.4 GeV (the highest energy reached on VEPP-2M) and 3 GeV (the mass of the J/Ψ particle) has been very poorly studied. At the same time, this range is known to be heavily populated by resonances, whose study can bring us a lot of surprises. To experiment in this energy range, the Institute of Nuclear Physics of the Siberian Branch of the Russian Academy of Sciences is putting into commission a new electron – positron collider, VEPP-2000, with center-of-mass energies up to 2 GeV and luminosities of about 10^{32} cm^{-2} s^{-1}. A new detector, CMD-3, is being built to work with this collider. Today, the main work in building the detector is being done by Barkov's pupils, but he continues to play the leading role in the detailed designing of the main components of the detector. It should be stressed that the majority of the beautiful new solutions are appearing as a result of Barkov's unflagging energy and ingenuity.

Friends and colleagues wish Lev Mitrofanovich Barkov happy eightieth birthday and lots of good health, happiness, and highly productive scientific work in the many days to come.

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