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PERSONALIA

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In memory of Yuriĭ Dmitrievich Prokoshkin

The scientific community of both Russia and the world has suffered a heavy loss. On March 1, 1997, Yuriĭ Dmitrievich Prokoshkin, an outstanding Russian physicist, a full member of the Russian Academy of Sciences and the European Academy, and a member of the *Uspekhi Fizischeskikh Nauk* editorial board, died of a short but severe illness in his 68th year. His name was linked to remarkable research and fundamental discoveries in the physics of elementary particles and new techniques in high-energy physics.

Yurii Dmitrievich was born in Moscow on December 19, 1929. He started his bright scientific career in Laboratory No. 2 (LIPAN) in 1951 while a student at Moscow University's Faculty of Engineering Physics. In 1953, he was transferred to the Laboratory of Nuclear Problems at Dubna.

In 1953 – 1954, he made a series of original studies on the theory of particle motion in strong focusing accelerators and began work on new experimental techniques. Even in the earliest studies he did on his own, he demonstrated his unusual talent as an experimental physicist. The success he scored with techniques for the observation of gamma quanta (and of neutral pions on that basis) went a long way toward promoting his brilliant investigations. Yuriĭ Dmitrievich worked to develop ever better and improved techniques for the observation of gamma quanta throughout his life.

In 1955 – 1960, Yuriĭ Dmitrievich carried out a highly precise and exhaustive study concerned with the formation of neutral pions in nucleon – nucleon and nucleon – nucleus collisions. He was able to measure both resonant and non-resonant phases of scattering, to make a follow-up check on isotopic invariance, and to observe the birth of pions upon the scattering of nucleons by nuclei at energies below the birth threshold of a free nucleon. His study of the $pp \to pp\pi^0$ reaction was the subject of what he planned as a candidate of science dissertation, but it earned him a doctoral degree in physics and mathematics in 1961.

In 1960, Yuriĭ Dmitrievich devised an experiment which had as its objective the direct verification of the conservation of the vector current — a fundamental point in the theory of universal weak couplings. In the experiment, he was to detect and measure the probability of the beta decay of the charged pion: $\pi^+ \to \pi^0 + e^+\nu$. Many thought the task could not be achieved because the probability of beta decay of the pion was extremely low (about one part in a hundred million). The crucial snag was the background associated with the reversal of charge of charged pions as they were stopped by the target nuclei. When, thanks to his art as an experimenter, Yuriĭ Dmitrievich managed to suppress the background (which was reported in his first publication in 1962), a way was clear for the beta decay of the pion to be detected. The first few events of beta decay were observed by his group in the same 1962. Later, the beta decay of the pion was registered by C. Rubbia at CERN. In 1964, Yuriĭ Dmitrievich's group, having measured the probability of pion decay on a significantly larger statistical material, corroborated the law of conservation of the vector current. The experimental discovery of the beta decay of the pion won Yuriĭ Dmitrievich the Kurchatov Gold Medal. Concurrently with their search for the beta decay of the pion, his group observed, for the first time ever, the capture of negative pions by protons in hydrogen-containing compounds. The inquiry into the pattern of this phenomenon led to a model of 'large' molecules and became part of a new line of research known as meson chemistry.

Yuriĭ Dmitrievich Prokoshkin

In 1963, Yuriĭ Dmitrievich was appointed Head of the Division of Experimental Physics at the Institute of High Energy Physics (IHEP). He did much for the institute to establish itself, and helped in setting up an experimental base and in drawing up a program of research on the then largest in the world 70 GeV accelerator. He both directed and took part

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in the timely development of a unique facility that enabled experiments to be started on the IHEP accelerator just as it was started in 1967 — a rare occurrence in world practice.

The priority research program he implemented led to a number of fundamental discoveries. Among other things, it was found that the effective hadron interaction cross-sections behaved differently with increasing energy from what was expected. A growth was observed in the effective cross-sections for the scattering of positive kaons by nucleons and a slow-down was noted in the rate of decrease in the cross-sections for the scattering of pions by protons and the cross-sections of nucleon–nucleon interactions. This discovery was acclaimed as sensational at the time, and the phenomenon itself came to be called the Serpukhov effect. As was later found in the experiments carried out at the Fermi Laboratory and CERN's intersecting storage rings (the ISR machine), at higher energies the slow-down in the rate of decrease of pion – nucleon and nucleon – nucleon couplings would go over into a growth similar to the one in kaon – nucleon interactions. The discovery of the Serpukhov effect gave strong impetus to the formulation of new theoretical views.

The experiments carried out by Yuriĭ Dmitrievich and his coworkers also revealed scale invariance in the inclusive birth of particles. This discovery and its interpretation led to a major advance in the physics of strong interactions: it was now possible to predict the yield of particles in hadron-hadron interactions. These studies won Yuriĭ Dmitrievich the Lenin Prize of 1986.

Yuriĭ Dmitrievich and his coworkers first established the restrictions on the existence of fractionally charged quarks, discovered the nuclei of antihelium-3 ($^3\widetilde{\mathrm{He}}$), and measured the yield of antideuterons.

Yuriĭ Dmitrievich owed the success that he scored in his subsequent studies to his outstanding achievements in the techniques whereby events with a great number of gamma quanta could be registered. Using the NICE, GAMS-2000, and GAMS-4000 facilities, charge-exchange processes were investigated to the utmost accuracy, several new resonances (including mesons with spins of 4 and 6) were discovered, and the probabilities of many rare channels for the decay of known particles η, η' and f_2 (1285) were detected and measured. Of the decays thus investigated, special mention should be made of the $\eta' \to 3\pi^0$ decay which proceeds with a violation of G-parity — its measured probability made it possible to determine the masses of current 'u' and 'd' quarks independently of other data. The GAMS-type gamma-quantum detector used in the LEPTON facility built with Yuriĭ Dmitrievich's direct participation offered a way to measure the probabilities of the $\eta \to \mu^+\mu^-\gamma$ and $\omega \to \pi^0\mu^+\mu^-$ decays and to determine, for the first time ever, the electromagnetic form factors for the transitions of neutral mesons. For the most part, the data gleaned by Yuriĭ Dmitrievich and his coworkers are now included in the latest tables of elementary particles. In his last years, he placed a special emphasis on gluon-rich exotic resonances: glueballs and hybrids. The scalar boson, O^{++} G(1590), with exotically boosted decays over the $\eta'\eta$ and $\eta\eta$ channels is, at present, the most reliable candidate for a glueball.

An important line of research for Yuriĭ Dmitrievich was the search for new exotic states in the central region of high-energy particle interactions, which he did using the GAMS-400 facility and the OMEGA spectrometer at CERN. The tensor resonance 2^{++} with a mass of about 2200 MeV, which he observed on the GAMS-4000 facility, is, in the exotic nature of its decay, another candidate for the glueball state in the same multiplet with the G meson. This study was to be continued on the COMPASS facility then under construction at CERN. Yuriĭ Dmitrievich was happy when he learned, shortly before his death, that his experiment was given a 'go-ahead'. His gamma-quantum registration system, lying at the basis of the GAMS facilities, has won worldwide recognition. It has been used in experiments on CERN's European Hybride Spectrometer, at the Fermi laboratory, at the Brookhaven laboratory, and elsewhere. In his last years, Yuriĭ Dmitrievich was enthusiastic about the use of lead tungstate single crystals for the calorimeter of the SMS facility which was to be part of the Large Hadron Collider under construction at CERN. He and his coworkers accomplished a huge methodological and technological work which was crowned by CERN's acceptance.

Yuriĭ Dmitrievich's contributions to high-energy physics were not limited to his own work. He did much to transform IHEP into a truly national research center where all institutes of the Soviet Union could carry out their studies on its accelerator, the largest one at the time, and broadly assisted in setting up experiments proposed by other teams. He was no less active in the full-scale international cooperative project undertaken for the first time in the Soviet Union, using the IHEP accelerator. Among those who took part in his studies on the IHEP accelerator from the very beginning were J Allaby, A Wetheral, and other CERN scientists. He struck up a lasting friendship with Professor J P Stroot, L Montagne, and K Takamatsu. A closely-knit international team was built around the GAMS facilities. As Chairman of the Committee for Science Policy under the State Program for High Energy Physics, Yuriĭ Dmitrievich did much to promote (and, lately, to preserve) this area of fundamental research in Russia.

Yuriĭ Dmitrievich had a surprising ability to work. Already a sick man and fully aware that his illness was incurable, he courageously fought back until his last days hoping to extend his life so he could implement his plans. Lying in a hospital ward on a drip, he kept a continuous watch on the accelerator experiment, was happy over the success of the session where a prototype of a lead tungstate single crystal calorimeter was used, and hoped to stage a full-scale test at the next session. His inherent courage and determination stood out with particular clarity in his last days.

Yuriĭ Dmitrievich was an unusually talented person of diverse gifts. His discoveries have gone into the golden fund of science, and his memory will remain for ever in the hearts of his friends, colleagues, and disciples.

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