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PERSONALIA

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Sergei Petrovich Denisov (on his 70th birthday)

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This year Professor Sergei Petrovich Denisov, corresponding member of the Russian Academy of Sciences, DSc in Physics and Mathematics, celebrated his 70th birthday. He was born on May 4, 1937 in Moscow, into a family of university teacher-researchers. Having graduated with a gold medal from famous Moscow school No. 110 in 1955, he enrolled in the physics department of the Moscow State University and graduated from there *cum laude* in 1961; he was accepted to continue as a graduate student.

Denisov began his research career at the end of the 1950s in P A Cherenkov's Photomeson Laboratory of the P N Lebedev Physics Institute (FIAN). He took part, under guidance of B B Govorkov, in experiments on photoproduction of π^0-mesons and in construction the first-ever setup for photon 'tagging' using the particle beam extracted from the 265 MeV synchrotron. Nowadays, the 'tagged' photon technique is widely used in many accelerator centers worldwide. The results of this work became the subject of Denisov's PhD thesis, ''Experimental investigation of photoproduction of π^0-mesons in complex nuclei near the threshold,'' submitted and defended in 1964. In March 1964 he began working at the Institute of High Energy Physics (IHEP). Together with Yu D Prokoshkin, Denisov became a leading scientist in the preparation and launching of first-priority experiments in the IHEP particle accelerator, which at the start of operations in 1967 produced protons with energy twice higher than that of the largest accelerators in the world. Denisov was able to solve a most important problem for experiments in the now accessible energy range, namely the reliable identification of particles. A group of physicists led by Denisov designed and built a special set of unique Cherenkov gas counters (threshold and differential) with record resolution in particle velocity. Among these, they created a 10-meter differential Cherenkov helium-filled counter with particle velocity resolution $\delta\beta/\beta = 2 \times 10^{-6}$ and extremely low background (less than 10^{-6}). They also created threshold Cherenkov counters with resolution $\delta\beta/\beta = 6 \times 10^{-6}$ and background level 3×10^{-4}. Differential and threshold counters with such record characteristics are capable to separate particles of different masses in beams with energies of hundreds of GeV. Denisov thus succeeded in solving the problem of particle identification not only for the IHEP accelerator but for accelerators of the next generations as well. Reliable identification of particles made it possible to discover in the IHEP accelerator experiments such very important features of hadron interactions as the increase of the total cross-sections with increasing energy and scale invariance ('scaling') in hadron production. These discoveries were made by a joint IHEP – CERN group in the historically first joint experiment whose co-leader from our side was Denisov. The increase of total cross sections was discovered in K^+p-interactions. It was far from easy to detect this effect as the growth in cross section in the momentum range from 15 to 55 GeV/c was only a few percent while the fraction of K^+-mesons in the beam at the 55 GeV/c momentum was only 5×10^{-3}. Subsequent experiments with more powerful accelerators showed that the growth in total cross sections discovered at IHEP is a universal phenomenon for all hadrons. As a result, some theoretical concepts had to be substantially reconsidered. In 1972 Denisov submitted and defended his DSc thesis, ''Measuring total cross sections of interactions of pions, kaons, and antiprotons with protons and deuterons in the momentum range up to 65 GeV/c.''

Sergei Petrovich Denisov

In 2002 Denisov won the P A Cherenkov Prize of the Russian Academy of Sciences for the discovery of the total cross sections growth (so called 'Serpukhov effect'); in 1986 he received the Lenin Prize for scale invariance discovery (together with Prokoshkin, M A Mestvirishvili, and Nguen Van Hieu).

The Cherenkov counters developed by Denisov played an important role in discovering the nuclei of antihelium-3 in experiments at IHEP in which he also took part.

In 1974 Denisov supervised the launching of the Sigma universal spectrometer which was then used to study elastic scattering of positive particles by protons and to carry out the

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series of experiments on the dynamics of J/ψ particles production. As a result the data containing detailed information on the J/ψ particles production on a number of nuclei in a broad range of kinematic variables were obtained for the first time.

From 1974 to 1982 an experiment was conducted on the Sigma spectrometer for studying the scattering of π^--mesons by virtual photons in the Coulomb field of atomic nuclei. As a result the Compton effect on π^--meson was observed for the first time and an important structural characteristic of the π^--meson, namely its polarizability was measured.

In the 1980s Denisov and coworkers developed the MARS-1 and MARS-2 liquid-argon total-absorption spectrometers with record-breaking energy resolution. In 1992 BARS was launched — the largest liquid-argon spectrometer in the world, containing nearly 600 tons of high-purity argon and 30,000 channels to measure the signals pulse heights. The extremely fine spatial resolution of the spectrometer and its high information potential make it possible to use this instrument in a wide variety of experiments, including cosmic rays studies. The BARS spectrometer continues to be the largest operating liquid-argon calorimeter in the world.

Denisov also supervised the development of a new technique for studying neutrino interactions — the method of 'tagged' neutrinos — and the construction of a complex experimental setup — the Tagged Neutrino Facility (TNF). This setup allowed one recording for the first time tagged neutrino interaction events. The TNF was also used in a comprehensive program of studies of $K^{\pm}$ decays (including a search for direct CP violation) and cosmic rays. Thus, the energy spectrum of horizontal flux of cosmic muons in the TeV energy range was investigated and the cross section of the rare process of muon pairs production by muons was registered for the first time. To evaluate the energy of cosmic muons in the BARS spectrometer, Denisov, in collaboration with A A Petrukhin's group (from Moscow Engineering Physics Institute), applied the new 'parmeter' technique, which is free of upper limits on muon energy.

The latest achievements of the Denisov's group in particle detector technique include the series of gas ionization calorimeters and large scintillation hodoscopes with time resolutions down to 35 ps for time-of-flight particle identification. These important achievements in the detector technique were presented at several international conferences on instrumentation for high energy physics.

The group of physicists led by Denisov takes an active part in international cooperation. Thus, it contributed significantly to experiments with the D0 detector at Fermilab on which the top quark was discovered in 1995 and $B_s \to \bar{B}_s$ oscillations were observed in 2006. Denisov is actively participating in preparations for experiments at the European collider — the LHC.

Denisov's outstanding achievements in high energy physics brought him an honorary diploma of Indiana University (USA).

Denisov carries a heavy load of science-management and teaching responsibilities. He is a member of the Scientific and Technical Councils of the IHEP, the Scientific Council of Nuclear Physics Institute of Moscow State University, and the Scientific Council of Neutrino Physics of the fundamental research program of the RAS Presidium, is a member of the editorial boards of the journals *Uspekhi Fizicheskikh Nauk* [*Physics – Uspekhi*] and *Yadernaya Fizika* [*Nuclear Physics*], and is a professor of Moscow State University where he teaches two lecture courses and heads the Elementary Particle Physics Department of the Physical Faculty at IHEP. He is an author and coauthor of more than 400 publications in physics journals. Among his students, twelve have been awarded PhD degrees and eight DSc degrees. He was also awarded the Order of Honor.

In wishing Sergei Petrovich Denisov happy 70th birthday, his friends and colleagues also wish him good health, much happiness, and further achievements in science.

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