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In memory of Sergeĭ Mikhaĭlovich Polikanov

Sergeĭ Mikhailovich Polikanov, a nuclear physicist and the author of several basic research studies which had earned him wide acclaim in the world of science, died unexpectedly on Sept. 2, 1994 in a small town of Grafenhausen near Darmstadt, Germany.

S M Polikanov was born on 14 September 1926 in Moscow. Having graduated from the Moscow Mechanical Institute, he set out on his path in science in 1950 under the supervision of Georgiĭ Nikolaevich Flerov at the Laboratory of Measuring Instruments (LIPAN, now the Russian Research Centre 'Kurchatov Institute'). During this early period, the scientific interests of the young physicist were concentrated on applied studies. Together with E D Vorob'ev and I E Kutikov, S M Polikanov took an active part in a survey on U-235 and Pu-239 reactors with a 'concentrated' hydrogen moderator. The importance of this work for the atomic industry was emphasised by G N Flerov in his report at the session of the USSR Academy of Sciences concerned with the peaceful application of atomic energy in 1955.

In 1953, G N Flerov initiated studies on the physics of heavy ions, then a new field of nuclear research in the USSR. S M Polikanov was his nearest associate in this work. The principal objective of these studies was to use heavy ions for the synthesis of transuranic elements. By virtue of Polikanov's initiative, the recoil nuclei method was developed, which offered on elegant solution the difficult task of separating to a small number of atoms of the new element from the target of highly-radioactive matter. The first experiments on the acceleration of heavy ions were carried out on the LIPAN cyclotron as early as 1954. S M Polikanov became leader of a group of young physicists in the Sector headed by G N Flerov. Simultaneously with the major research on transuranics, the scientists conducted a series of pioneering studies on the interaction between heavy ions and nuclei, which laid the ground work for a new line in nuclear physics. S M Polikanov contributed to this work by his first experiments on nuclear fission by heavy ions (Dissertation Cand. Sci., 1959).

S M Polikanov continued his studies on the physics of heavy ions in the Laboratory of Nuclear Reactions, the Joint Institute for Nuclear Research, Dubna, where a cyclotron for the acceleration of heavy ions was constructed under the supervision of G N Flerov in 1960. S M Polikanov devoted much time and energy to setting up this Laboratory of which he was for years deputy-director. In 1961, S M Polikanov and his young co-workers made a discovery that brought world-wide fame to them: they described a new type of nuclear isomery, isomery of shape, which up till now remains a rich source of ideas for physicists. In fact, S M Polikanov made this discovery accidentally while he was trying to synthesise element 104 in the ^{22}Ne (^{242}Pu, 4n) ^{260}104 reaction. In compliance with the systematics of those days, he expected to have the half-life period for spontaneous fission of the isotope synthesised in the range of $(0.01 \div 0.1)$ s. He actually managed to obtain a spontaneously fissionable nuclide with the lifetime of around 0.02 s. However, a series of control measurements showed that this nuclide had nothing in common with an isotope of the new element. It was soon demonstrated that the isotope thus obtained was actually an unusual isomer of Am-242 with the probability of spontaneous fission at least 20 orders of magnitude higher than that for the ground state. Since that time, S M Polikanov for many years focused his efforts on the study of this phenomenon using various bombarding particles and devices. It took him about two years to study spontaneously fissionable isomers in a tandem-

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generator during his stay in the N Bohr Institute, Copenhagen. Simultaneously, the new phenomenon was investigated in different laboratories of other countries which resulted in about 40 such isomers from U-236 to Bk-245 being currently known to physicists. The present-day understanding of the nature of this type of nuclear isomery is inseparable from the name of V M Strutinskiĭ, who suggested a new method for estimating shell corrections in nuclear mass calculations. Due to this, the concept of the 'double-humped' fission barrier was developed. In this model, the state with large deformation at the bottom of the second potential well corresponds to the isomer undergoing spontaneous fission.

The discovery of isomers subject to spontaneous fission was truly an important event because it had never been predicted. It greatly influenced the further development of studies concerned with the structure and spontaneous fission of heavy nuclei. Results of the work on isomers showing spontaneous fission were used by S M Polikanov in 1966 to defend his doctoral dissertation. In 1967, he was awarded the Lenin Prize for this discovery. These results were also recognised abroad: he shared with V M Strutinskii the 1977 Bonner Prize of the American Physical Society.

From 1970, S M Polikanov worked in the Laboratory of Nuclear Problems while remaining interested in fission studies using beams of pions and muons generated with the synchrocyclotron at the Joint Institute for Nuclear Research. Specifically, he investigated fission of heavy mesoatoms and undertook a search for shape isomers during muon capture by U-238 nuclei. In 1977, these studies were continued on the CERN synchrocyclotron, and a special device for the same purpose was constructed in Dubna. These experiments demonstrated that the presence of a meson in the 1s orbit resulted in an enlarged fission barrier and a decrease in the fission width during nonradiative 3d–1s transition. Interesting data were obtained on the muon's behaviour during fission of heavy mesoatoms. Muons were shown to be largely taken by a heavy fission fragment; also, muon conversion by excited fragments was recorded. These findings have served as the starting point for the use of mu-mesons in studies on nuclear fission dynamics.

S M Polikanov was a talented experimental physicist, a man of great learning and unparalleled singlemindedness which contributed immensely to his scientific career. By 1978, he became professor, received orders and medals from the Soviet government, was elected Corresponding Member of the USSR Academy of Sciences and awarded prizes for first-class achievements in science. Then, a drastic change in his life occurred. In 1978, S M Polikanov had to emigrate to Denmark from which he moved to Switzerland and later to Germany. He found himself compelled to start all over again and reaffirm his scientific authority by new original results of research activity. S M Polikanov set up an international collaborative group and initiated experiments on heavy mesoatom fission, first at CERN and then at the mesonfabric in Zurich. Having achieved interesting results, S M Polikanov proposed study fission of hypernuclei resulting from the capture of slow antiprotons. This proposal was stimulated by the hypothesis of A Salam of the possible restoration of spontaneously broken symmetry in strong electric and magnetic fields inside heavy nuclei. According to this hypothesis, the lifetime of ρ-hyperon in a heavy nucleus may be significantly longer than in a vacuum. A special method was developed to measure for the first time the lifetimes of Bi_Λ and $^{238}\mathrm{U}_\Lambda$ hypernuclei, which turned out to be very similar to those of free hyperons. This finding is at odds with the exotic hypothesis propounded by A Salam, but allows the choice to be made between the two possible modes of mesonless disinegration of hypernuclei (in favour of the ρ-meson exchange model).

After completing his experiments on antiproton beams, S M Polikanov began to study heavy ions at the well-known nuclear centre in Darmstadt. Here, he carried out experiments which illustrate his exceptional creative power and resourcefulness. By virtue of his initiative and personal guidance, a search for supermassive (with $A = 10^3 \div 10^7$) strange nuclei, which might have persisted since the Big Bang, was undertaken. To this effect, the Rutherford scattering of U-238 by a number of specially selected targets was employed. This allowed unusually low limits to be obtained for concentrations of such relic nuclei ($\sim 2 \times 10^{-7}$ per nuclon).

The very last paper of S M Polikanov was published in *Zeitschrift für Physik A* three days prior to his death. It concerned Coulomb and nuclear fission of uranium by a relativistic lead beam. S M Polikanov was preparing for new experiments. He reported one of his new projects at a conference in the city of Dubna which he visited again in May 1993 after having been absent for 15 years. This project was designed to study spontaneously fissionable isomers at a new methodological level. Specifically, it envisaged investigation into giant dipole resonance 'built up' on the isomeric state using relativistic ions of U-238 to obtain U-236 isomer. The final goal was to obtain direct information about the deformation parameter of the isomer of shape. This project has get to be realised.

The scientific achievements of S M Polikanov won him high appraisal among the world's scientific community. He was elected among honorary professor of the Department of Physics and Astronomy, University of Heidelberg, Germany, honorary doctor of the University of Uppsala, Sweden, and Member of the Danish Royal Academy of Sciences.

S M Polikanov was a bright and creative personality. His name will always remain in the history of nuclear physics and in the hearts of his numerous colleagues and friends both in this country and abroad.

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