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Vadim Georgievich Soloviev (1925-1998)

Vadim Georgievich Soloviev was born in 1925 on October 12, in Kazan. His parents were physicians. Vadim spent his childhood and school years in Volsk, a small town on the banks of the Volga river.

In January 1943, when Vadim was a high school student, he was drafted into the Red Army. He was trained at the military school and then was on acting service. Before going to the army Vadim managed to pass the exams to obtain the school-leaving certificate, which secured him admittance to the Physics Department of Leningrad University right after demobilization in October 1945.

After successfully graduating from the university in December 1950, he began working at the Hydraulic Engineering Laboratory in Dubna in the sector of theoretical physics. The object of his early research was the elementary particle physics. However, the results obtained by Soloviev at that time were published only as classified reports. They were published in scientific journals only several years later (in 1954-1955).

Vadim Soloviev. 22.06.1943

In 1953, Soloviev met N.N. Bogoliubov and started to attend his seminars at the Physics Department of Moscow State University and at the Steklov Mathematical Institute and worked under Bogoliubov's supervision. For a certain period, Soloviev's scientific interest was quantum field theory, and in 1956, he defended the Ph.D. thesis *"Construction of the Approximate Green's Functions in the Pseudoscalar Meson Theory"* at Moscow State University.

In March 1956, the Joint Institute for Nuclear Research was founded in Dubna. The first director of JINR was Prof. D. I. Blokhintsev, who initiated the establishment of the Laboratory of Theoretical Physics. Soloviev actively participated in the foundation of the Laboratory and became one of its first staff members together with many other students of Bogoliubov. As a postdoctoral researcher Soloviev was attracted by the problem of parity conservation in strong and electromagnetic interactions. He suggested that the conservation of spatial parity was connected with the gauge invariance of the interaction. This idea brought about a very passionate discussion.

At the same time, Soloviev took interest in the problem of superfluidity of nuclear matter and a possible role of pairing correlations of the superconducting type in atomic nuclei. It all happened under the influence of Bogoliubov and his works on the microscopic theory of superconductivity. The problem of pairing correlations of the superconducting type in atomic nuclei was a topical one and attracted the attention of many scientists. The first Soloviev's research paper in this field entitled *"On the Interaction of Nucleons Resulting in the Superfluid State of the Atomic Nucleus"* (Zh. Eksp. Teor. Fiz., 1958, vol. 35, p. 823) made him one of the leading theoreticians in the field.

In 1958-1962, Soloviev developed the theory of pairing correlations of the superconducting type in atomic nuclei. Conditions under which the Cooper pairing in nuclei occurs were investigated and the blocking effect (the influence of unpaired particles on the pairing characteristics of the whole system) was predicted as well as the existence of multi-quasiparticle excited states of nuclei. Vadim Georgievich first studied the way pairing correlations influence the probabilities of nuclear beta- and gamma-decays and discovered that they are the main phenomena that cause the acceleration of alpha-transitions between the ground states of even-even nuclei.

These investigations, part of which he conducted in Copenhagen at the Niels Bohr Institute, brought him international recognition. In 1962, Vadim Georgievich defended doctoral dissertation on the subject *"Pairing Correlations of the Superconducting Type in Atomic Nuclei"*. It became the basis of his first book *"The Influence of Pairing Correlations on the Properties of Atomic Nuclei"* (Gosatomizdat, M., 1963) and its English version in "Selected Topics in Nuclear Structure" (IAEA, Vienna, 1963), collected papers of the International Agency on Atomic Energy.

In 1963, a group of scientists who worked on various theoretical problems of nuclear physics formed the Department of low and intermediate energy physics at the Laboratory of Theoretical Physics. Vadim Georgievich became the head of this department and, at the same time, Deputy-Director of the Laboratory of Theoretical Physics. He headed the Department for the whole period of its existence, i.e. during 25 years.

Since the mid-1960s, Soloviev's scientific interests concentrated on problems of nuclear theory. He applied the methods of the many-body theory to explain the properties of vibrational excitations of deformed nuclei and their connection with quasiparticle ones. Soloviev with collaborators carried out vast investigations of spectra of low-lying nonrotational states of deformed nuclei. Those studies were performed in close contact with experimenters from Dubna and Leningrad and strongly influenced the development of nuclear spectroscopy. The structure of quadrupole and octupole oscillations of deformed nuclei was investigated for the first time. The existence of the deformed shape of the nuclei with the mass numbers A$\sim$100 was predicted and later on (in 1970) was confirmed in experiments. The hypothesis about the possible difference of the equilibrium deformations of the ground and excited states of the nuclei was put forward. Profound knowledge and new results of the theory were summed up by Soloviev in the monograph *"Theory of Complex Nuclei"* (Nauka, Moscow, 1971; Pergamon Press, 1976).

A. Bohr, N.N. Bogoliubov, and V.G. Soloviev at the Intern. Conference on Nuclear Physics (Dubna, Russia, 1968) Courtesy of JINR Photo Archives.

Vadim Georgievich was an expert in spectroscopy of deformed atomic nuclei. It seemed sometimes to his collaborators that he knew by heart the energies and decay parameters of tens and hundreds of nuclear excited states. Soloviev could easily describe the nature of one or another state and estimate the reliability of new data, comparing those of various experiments with theoretical calculations. He followed very systematically the experimental successes reported in the literature and kept in touch directly with experimental groups. The book *The Structure of Even Deformed Nuclei* (Nauka, M., 1974), written together with E. P. Grigoriev from Leningrad State University, is a good example of Soloviev's collaboration with experimenters.

In the early 1970s, studies of nuclear structure shifted from low-excited states to high energies of excitations. Soloviev started to develop the microscopic approach that had to explain the nonstatistical effects observed at these energies in many cases. As a first step, he proposed to use the model wave function represented as a sum of components with an increasing number of quasiparticles. Soloviev noticed that the greatest part of available experimental data on such excitations was connected with the simplest components of that wave function. To understand the spectra of nuclei, one has to learn to calculate the distribution of these components over nuclear levels. Working on the practical realization of his idea, Soloviev formulated the quasiparticle-phonon nuclear model of a nucleus (QPM). In this model, not only quasiparticles but also quanta of nuclear vibrations (phonons) are considered as elementary blocks when constructing the model wave function. Characteristics of phonons are calculated within the quasiparticle random phase approximation. The idea appeared to be very fruitful.

Within the QPM, Soloviev and his collaborators investigated and explained a wide range of the properties of nuclear excitations. They estimated the contribution of the collective excitation modes of a nucleus to the density of nuclear states at the binding energy of a nucleon. Then, for the first time within the framework of the microscopic theory they succeeded in calculating neutron and radiation strength functions and explaining why there are substructures at the low-energy tail of the dipole photoabsorption. The first microscopic calculations of the spreading widths of the giant resonances in heavy nuclei was a very big success for the group. It was shown, in particular, that the mechanisms of the formation of those widths are different in spherical and deformed nuclei. The QPM appeared to be a very flexible model: the formalism was developed and improved by Soloviev and his group for many years. For example, a consistent procedure was developed that allowed one to consider the corrections related to the fermion structure of phonons. The resonance-like structures connected with the excitation in the reactions of the nucleon transfer of high-lying one- or two-quasiparticle states were systematically studied, as well as the spin and charge-exchange giant resonances.

Since then, much time has passed but till now Soloviev's ideas on the microscopic mechanisms of fragmentation of simple nuclear modes due to their coupling with the sea of more complex ones underlie microscopic nuclear models.

V. G. Soloviev founded the scientific school of theoretical nuclear physics in Dubna. He taught and worked a lot with young physicists. He started to give lectures on the modern methods in nuclear theory to the students of the Department of Physics of Moscow State University who visited Dubna in 1961. These lectures, later changed and modified in accordance with the new achievements of nuclear theory, became the basis of his monographs: already mentioned *"The Theory of Complex Nuclei"* and the other two written later on, *"The Theory of the Atomic Nucleus: Nuclear Models"* (Energoizdat, M., 1981) and *"The Theory of the Atomic Nucleus: Quasiparticles and Phonons"* (Energoatomizdat, M., 1989, and IoP, Bristol and Philadelphia, 1992). For more than 15 years, he was a professor and Deputy Head of the chair of the theory of atomic nucleus of the Department of Physics of Moscow State University.

V. G. Soloviev at the Intern. School on Selected Topics in Nuclear Structure (Alushta, Crimea, 1980). Courtesy of JINR Photo Archives.

V.G. Soloviev was a member of many Scientific Councils, Advisory Committees and Boards. He initiated and organized several large International Conferences and Schools on Nuclear Structure held in Dubna and Alushta (the Crimea).

V.G. Soloviev's merits to science and his scientific authority were recognised by the home and world scientific communities. He was awarded the title of 'Honoured Scientist" of the Russian Federation, a silver medal "For Merits to Science and Community" by the Czechoslovak Academy of Sciences and other orders and medals of the JINR Member States.

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