

In memory of Dmitrii Vasil'evich Shirkov

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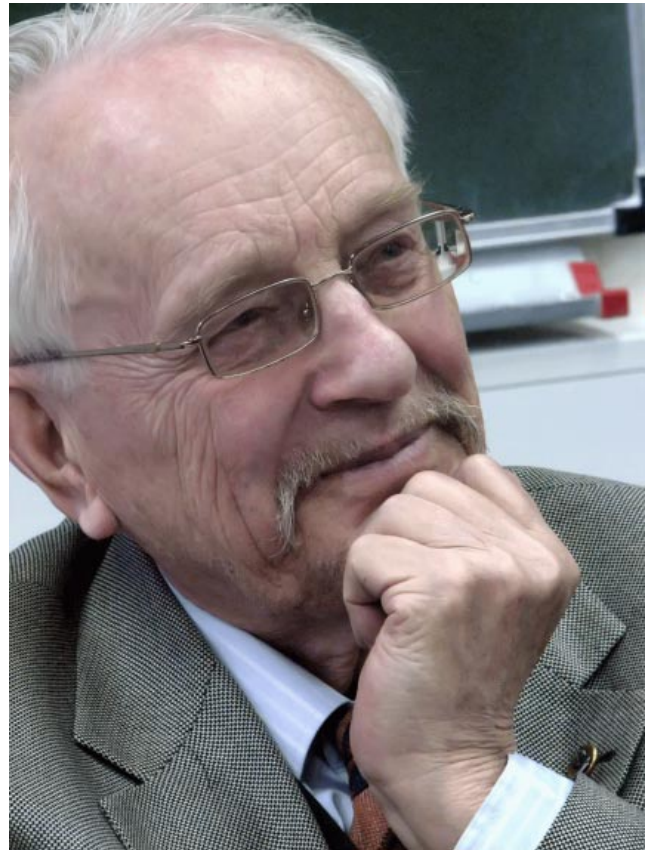
The prominent Russian theoretical physicist, Full Member of the Russian Academy of Sciences (RAS), Honorary Director of the Bogoliubov Laboratory of Theoretical Physics at the Joint Institute for Nuclear Research (JINR), Dmitrii Vasil'evich Shirkov, passed away on 23 January 2016, forty days before his 88th birthday.

Dmitrii Vasil'evich was an extraordinary personality. He was a great scientist—one of the classics of quantum field theory, a brilliant pedagogue who brought up a huge number of disciples, an authoritative public figure, a buoyant, not indifferent and wise man. His characteristic feature was the urge to innovate in all spheres of human activity from science and teaching to public life.

Dmitrii Vasil'evich (DV) was quite young when he became interested in science. Having finished a secondary school as an external pupil in the senior classes, he entered the Faculty of Physics of Moscow State University (MSU) at the age of 16. DV recollected that, when a student, he was not limited to the standard program at the Faculty of Physics, but attended lectures at the Faculty of Mechanics and Mathematics and also classes for students a year older. Together with his friends, he organized a seminar where they analyzed the latest advances in sciences, not only in physics but, for example, also in molecular genetics, which was then in disgrace.

In the fifth year at university, fate brought him together with the 40-year-old Nikolai Nikolaevich (NN) Bogoliubov, which successfully determined DV's further creative life. According to an imaginative expression from DV himself, NN was at that time a fount of ideas which he bounteously allotted to his students. Under the guidance of Bogoliubov, DV took part in work on special topics first at the Institute of Chemical Physics, USSR AS and then in Arzamas-16. After the successful completion of this work, he returned to Moscow to the V A Steklov Mathematical Institute, USSR AS but NN and fate led him farther, and in 1956 he became one of the first researchers in the Laboratory of Theoretical Physics (LTP), established by Bogoliubov and Blokhintsev at the Joint Institute for Nuclear Research (Dubna).

Precisely at that time, two monumental reviews, “The problems of quantum field theory” and “The problems of quantum field theory. II. The removal of divergences from the scattering matrix,” were written. They were published in the journal *Uspekhi Fizicheskikh Nauk* in 1955 and were immediately translated into the German language in the journal *Fortschritte der Physik*. These two reviews underlay the famous monograph by NN Bogoliubov and DV Shirkov, *Introduction to the Theory of Quantized Fields*, which brought fame to its authors and made the name D V Shirkov well known all over the world. The monograph, printed in 1957,



Dmitrii Vasil'evich Shirkov
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was the first consistent book on quantum field theory in the world expounding the renormalization theory, the renormalization group, and the theory of dispersion relations—sections in which the authors carried out fundamental pioneering work representing the most up-to-date arsenal of high-energy physics at that time. It truly became a handbook for many generations of theoretical physicists, having lasted through seven editions in our country and abroad and remaining topical to date.

Enthusiastic about a grandiose project of M A Lavrent'ev on the foundation of a scientific center in Siberia, DV, who at the age of 32 was elected a Corresponding Member of the USSR Academy of Sciences (Siberian Branch), moved to Novosibirsk, where he organized and headed the Department of Theoretical Physics at the Institute of Mathematics of SB USSR AS and the Chair of Theoretical Physics at Novosibirsk State University.

In the late 1960s, DV returned to JINR LTP as a world-renowned scientist full of strength and new ideas. He worked there till the end of his life, being engaged in science and at the same time in extensive pedagogical, publishing, and organizational work.

Dmitrii Vasil'evich was known for his ability to recognize the germs of novelties in science as soon as they appeared. For example, he very quickly appreciated the beauty and prospects of gauge field theory. In spite of the fact that in those years it was not in the stream of development of theoretical high-energy physics, and many eminent scholars thought of it as something exotic, DV decided to apply his beloved renormalization group method to the analysis of this theory. And the first task he gave to his new undergraduates at MSU upon returning to Dubna was to calculate the renormalization-group beta-function in gauge theories. Notably, it coincided in time with the work in which the phenomenon of asymptotical freedom was discovered in the theory of the strong interaction and which was later awarded the Nobel Prize in Physics 2004.

It soon became clear that terms of not only the first but also of successive orders of perturbation theory are important in many problems. This made topical the elaboration of computational methods of multiloop Feynman diagrams and their application to finding the higher-order terms of perturbation theory in models of quantum field theory (QFT). Under the ideological influence of DV—under his direct or indirect guidance—an active group of young scientists from LTP and other institutes practically founded the modern industry of calculations of multiloop diagrams and obtained world-record results.

Another example of DV's scientific predictions should be mentioned as well. He managed to foresee the impending role of computers in carrying out analytical calculations, whereas before that time computers had mostly been used exclusively for numerical calculations. DV developed this avenue of inquiry very actively. He organized an All-Moscow Seminar on Analytical Calculations and headed it for many years. The groups and laboratories engaged in analytical calculations that now occupy leading positions in the world were organized on his initiative at JINR and other institutes.

The fact that the standard series of perturbation theory in QFT are asymptotic determined his interest in the methods of summation of divergent series. In spite of the advances of these methods in application to the problems of quantum field theory and the theory of critical phenomena, DV was not fully satisfied; the functions obtained had a singular point at the origin in the plane of the coupling constant. DV's special attitude toward analyticity, which can be traced back to his early work with NN on dispersion relations, made him look for another approach. His deep comprehension of the role of causality in quantum field theory (and as a consequence analyticity) allowed DV and his students to propose a new analytical perturbation theory in quantum chromodynamics where the requirement of analyticity of the effective coupling constant in a momentum space annihilates the ghost pole and leads to a new non-power-law perturbation theory that possesses the convergence property.

As has already been said, the pioneering work on the renormalization group in quantum field theory is due to DV, along with NN. Many years later, DV returned to the method of renormalization group, having imparted to it the meaning of symmetry of a solution (rather than equations) under scale transformations. On the basis of such a representation, it turned out to be possible to reformulate the concept of the renormalization group, using a new concept of functional self-similarity generalizing the ordinary (power-law) self-similarity, and to extend the renormalization group method to mathematical physics, which found

substantial applications to nonlinear problems in different fields of physics.

DV began an active pedagogical work still in Novosibirsk. The institutes of the new Siberian Branch of USSR AS needed many young scientists. DV delivered lectures to students, organized students' seminars, was engaged in school education in Akademgorodok and began applying different new pedagogical forms and techniques.

DV generalized, advanced, and realized his teaching experience gained in Novosibirsk at Moscow State University, where he began working as a Professor on returning from Siberia to Dubna after 10 years, with scientific seminars for students, a system of tasks and taking colloquiums by students, specially selecting students by passing exams on chapters of the book *Introduction to the Theory of Quantized Fields*, lectures on QFT for student-experimentalists, lectures on QFT for junior undergraduates, popular lectures for students from other faculties, and what not. He took all this upon himself again and again.

Many pedagogical initiatives originated by DV have become particularly significant today. Physical and mathematical schools affiliated with universities remain the 'oases' that keep up the required level of school education. And competitions of schoolchildren help to reveal young talents and insure them against unfortunate incidents at formal Unified State Exams (USE).

DV perhaps inherited an enlightening vein from his great-grandfather, the well-known Siberian enlightener and publisher P I Makushin. The publication of scientific and popular-scientific books was no less important to DV than teaching or his own research work. Nowadays, when the attitude of society toward fundamental science has changed, popular-scientific books have become particularly necessary.

Dmitrii Vasil'evich was an enraptured scientist. Science was the chief but not the only passion in his life. He liked traveling, loved the mountains, headed water-skiing classes in Dubna, was fond of history, and was a member of the Rotary Club. He always wanted to do more and often achieved the goal in spite of skepticism from surrounding people. Many will remember him as untiring and assertive, a classic of science and a man of heart, an authoritative scientist and intellectual companion, a teacher and a colleague. Dmitrii Vasil'evich Shirkov will live on in his books, work, and the memory of those who have ever got together with him.

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