Aleksandr Sergeevich Davydov (Obituary)

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On 19 February 1993, barely having attained his eightieth birthday, the prominent theoretical physicist, academician of the Ukrainian Academy of Sciences Aleksandr Sergeevich Davydov died.

A. S. Davydov was born on 26 December 1912 in the city of Evpatoriya into the family of a worker. On graduating from school, Davydov moved to Moscow, where in 1932, after completing studies at the workers' faculty at the Moscow State University, he became a student at the physics faculty of that university. Already during his student years, Davydov gave evidence of great ability to be a theoretical physicist, and the results of his diploma project devoted to working out the statistical theory of scattering of electromagnetic waves in condensed media near phase transitions have not lost their significance until now and are frequently quoted.

After graduating from the Moscow State University in 1939 Davydov became a graduate student of I. E. Tamm under whose guidance he began to study questions of the theory of internal conversion and the decay of atomic nuclei. The relativistic equations for particles with spin 3/2 proposed by him in his candidate's thesis were later widely used by other authors.

A. S. Davydov spent the war years in Ufa where he worked at an aviation factory. In April 1945, he was invited to Kiev into the Physics Institute of the Academy of Sciences of the Ukraine and he impetuously began the research quite new for him on the optical properties of molecular crystals. In 1948, he published his paper on the removal of degeneracy of molecular terms in crystals with several molecules in a unit cell which brought him world renown and which later was named the "Davydov splitting." Actually this paper marked the beginning of the true study of exciton states in crystals which essentially changed the aspect of this area of solid state physics.

Davydov retained an interest in excitons in all the subsequent years: he thoroughly developed the theory of the interaction of excitons with phonons and photons, he calculated the shape of the lines of exciton absorption, he introduced the concept of deforming excitons, he substantiated the Urbach rule for the long-wavelength edge of the exciton absorption band. The problems of the passage of light through crystals taking spatial dispersion into account and the study of absorption of light by crystals with impurities where a number of quite essential results also belong to him occupied an important place in his research.

In the early 1950's, Davydov in accordance with a decision of the government of the USSR became the head

Aleksandr Sergeevich Davydov
(1912–1993)

of the theoretical division of the Physics and Power Institute in the city of Obninsk. From that time begins the "nuclear" period of his activity which lasted approximately fifteen years. He demonstrated the greatest interest in the study of the collective excitations of atomic nuclei and became the founder of the phenomenological theory of the structure of heavy nonspherical nuclei. In the paper "Rotational states of nonaxial nuclei" (1958), which has become a classic, he together with his student, G. F. Filippov, formulated and developed the principal propositions of the model of a rigid nonaxial rotator which enabled one to explain from a unified position many of the regularities of low-energy excitations of a large group of nonspherical nuclei. This model is known in world science as the Davydov–Filippov model. The citation index of this paper is one of the largest ones in the field of research in theo-

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retical nuclear physics. In subsequent papers on the nucleus Davydov generalized the proposed model to even-even nuclei, developed the theory of electromagnetic transitions in nuclei taking their deformability into account. Practically all the results obtained by A. S. Davydov in the area of theory of the nucleus have been confirmed in laboratories both of our country and also abroad.

The return to Kiev in the middle of the 1960's brought Davydov back to the problems of the physics of condensed media. He again became interested in their elementary excitations, but starting from approaches and problems that were new in principle, namely, how can quasiparticles of the electronic (or vibrational) type moving in a deformable medium be formed and realize effective transport. As a result of a deep analysis of this problem Davydov introduced the idea of two-component solitons—special nonlinear excitation whose great stability (long lifetime) is due to the fact that the most significant part of the interaction of a bare light particle with the displacements of the ions from the position of their equilibrium in the form of a deformation is taken into account in seeking the ground state of the system as a whole. The corresponding long-lived excitations in molecular (including biological) systems have been given the name of "Davydov solitons." This idea has played a prominent role in the resolution of the so called "crisis in bioenergetics," and the Davydov solitons have become generally accepted and indispensable objects for describing such phenomena as the transport of energy and charge along molecular chains, the absorption and emission of electromagnetic radiation by biological objects, phase transitions in one-dimensional electron-phonon systems, etc.

The interest of A. S. Davydov in nonlinear phenomena led him also to study resonance tunneling of electrons through multibarrier systems of potentials. He succeeded in showing that nonlinear behavior, or bistability, of such systems is their internal characteristic feature, which can be used in the design and development of a new generation of electronic devices the operation of which is based at the molecular level. He facilitated the organization and actively participated in the first international conferences on the problems of molecular electronics.

A. S. Davydov became very widely known as a result of his monographs and textbooks as the "record-holder" among them. His "Quantum Mechanics" can be rightly regarded. It has been republished many times both in Russian, and also in other languages. In particular, in Germany it has been published in eight editions. For many years he headed the departments of theoretical physics at the Moscow State University and at Kiev University.

A. S. Davydov was an excellent lecturer. His lectures were distinguished by their simplicity and clarity of exposition and invariably attracted a full auditorium both at the Moscow University where he lectured on quantum mechanics, and at Kiev University where in addition to giving a course on quantum mechanics he also gave a course on the theory of solids.

One can say without exaggeration that A. S. Davydov represented that brilliant constellation of physicists whose attitudes were formed in the 1930's and for whom theoretical physics, and physics in general, was not divided into a multitude of independent subfields quite distant from one another. He is the author of papers in different fields of physics, and in all of them he succeeded in gaining recognition and authority due to his original approaches, and his deep understanding of the physical essence of a problem. No matter what he undertook he left a firm scientific imprint in the form of a generally recognized result named after him.

In spite of his numerous scientific and government awards (laureate of the Lenin Prize, Hero of Socialist Labor, a member of a number of international academies and many other awards), and his great authority and recognition, Aleksandr Sergeevich was a simple man in the very best sense of this word—approachable, attentive, obliging. His diligence and persistence, a clear, even an optimistic vision of the final result, a rare ability and readiness to bring new results to his audience and to his readers led to a remarkable summation of his seamless and selfless science, of the love and respect accorded to him by his colleagues, and by all those who had the good fortune to come in contact with him and to discuss different problems in physics, biology, and other sciences. He was interested only in scientific problems, for the discussion of which he spared neither his time nor his health.

He shall be remembered by his colleagues and his students as a kind and decent man, a passionate polemicist with a very active and definite position on all subjects.

One can without exaggeration say that A. S. Davydov worked till the very last days of his life completing a new monograph "Nonlinear quantum mechanics." This is the way we shall always remember him, ceaselessly working and creating.

Translated by G. Volkoff