

## ALEKSANDR IL'ICH AKHIEZER

*(In commemoration of his 60th birthday)*V. E. IVANOV, Ya. B. FAĬNBERG, A. G. SITENKO, G. Ya. LYUBARSKIĬ, V. G. BAR'YAKHTAR,  
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**A**LEKSANDR Il'ich Akhiezer, member of the Academy of Sciences of the Ukrainian S.S.R., one of the founders and leaders of the Khar'kov school of theoretical physicists, will be 60 on October 31, 1971.

A. I. Akhiezer began his scientific career in 1934 under L. D. Landau. From 1938, after Landau had moved to Moscow, till now A. I. Akhiezer has been directing the theoretical division of the Physico-technical Institute of the Academy of Sciences of the Ukrainian S.S.R. Because of his seething energy, inexhaustible capacity for work, and ability to determine correctly the most promising directions of development of physics, A. I. Akhiezer has trained a large detachment of scientists, who are successfully working in many branches of theoretical physics.

Akhiezer's field of activity and interests are extraordinarily wide. Among them are quantum electrodynamics and elementary particles, nuclear physics and spin waves, oscillations in a plasma and magnetohydrodynamics.

Akhiezer's name is connected with the development of a number of new directions in theoretical physics—the theory of diffraction phenomena in nuclear physics, the theory of neutron scattering in crystals, the theory of the interaction of charged particle beams with a plasma, the theory of kinetic processes in ferro- and antiferromagnets, the theory of sound absorption in solids.

The term "Akhiezer-Pomeranchuk model" is used in nuclear physics to designate a method for calculating diffraction phenomena in the scattering of charged particles by nuclei.

An investigation into the scattering of weakly bound nuclear structures by heavy nuclei led Akhiezer (jointly with A. G. Sitenko) to predict a new effect—the diffraction breakup of deuteron (1955).

In a paper which has now become a classic, Akhiezer and Ya. B. Faĭnberg predicted the effect of beam instability—the exponential growth of fluctuations in a plasma penetrated by an electron beam (1949). This paper together with papers by A. A. Vlasov and L. D. Landau became the basis of investigations into the collective interactions in a plasma.

An important role in the development of the theory of shock waves in magnetohydrodynamics was played by a paper by Akhiezer (written jointly with G. Ya. Lyubarskiĭ and R. V. Polovin), in which the conditions for the evolutionism of shock waves were first formulated. His works on the kinetic theory of the oscillations of a magnetically active plasma (1948) and on the theory of fluctuations in a plasma were pioneer investigations.

In the field of solid state theory, Akhiezer has carried out fundamental investigations into the absorption of sound in solids and the kinetic processes in magnetically ordered crystals.

In papers on the theory of sound absorption in solids (1938), Akhiezer formulated and solved the problem of the energy of a quasiparticle (of the phonon and electron) in a crystal in which a low-frequency sound wave is propagating. As was shown by him, the acoustic field modulates the energy of a quasiparticle, as a result of which this energy becomes a function not only of the quasimomentum, but of the coordinate of the quasiparticle as well. Allowance for the change in the spectra of the quasiparticles during the action of an external field makes it possible to construct a kinetic equation for the quasiparticles, establish the H-theorem for a gas of quasiparticles, and develop a kinetic theory of the absorption of the energy of the acoustic field.

These ideas were used by Akhiezer and his pupils to investigate the absorption of ultrasound in metals, dielectrics, and magnetically ordered crystals. At present these ideas are firmly established in the arsenal of the "technical means" of theoretical physicists. There are hundreds of papers, in which not only ultrasound absorption in solids (including superconductors), but the absorption of a slowly varying magnetic field in elementary magnets, as well as quite a number of other phenomena (the mechanism underlying the absorption due to the modulation of the energies of the quasiparticles by an external field is called in the world literature the Akhiezer absorption mechanism), are investigated on the basis of these "technical means."

In a basic work on the theory of kinetic phenomena in ferroelectrics (1945), Akhiezer formulated, for the first time, the concept of interacting spin waves, constructed the Hamiltonians describing the interactions of the spin waves among themselves and with the lattice vibrations, and derived the kinetic equation for the spin waves—magnons. The foundation was laid in this work for the kinetic theory of the high-frequency and relaxation properties of magnetically ordered crystals. Quite a number of results was obtained in this direction by Akhiezer and his school, e.g., the theory of magnetic moment relaxation. It is significant that after 25 years any paper on the kinetic theory of magnetically ordered bodies begins with reference to Akhiezer's basic work.

Akhiezer (jointly with V. G. Bar'yakhtar and S. V. Peletminskiĭ) developed the theory of coupled magnetosonic waves (1956) and predicted a new phenomenon—magnetosonic resonance, which consists in the fact that when the frequencies and wave vectors of the spin and

acoustic waves coincide, a sharp increase in the interaction between the waves occurs. This increase results in a rearrangement of the energy spectrum of the crystal and appears in the resonant excitation of ultrasound by an external alternating magnetic field, as well as in the excitation of oscillations of the magnetization of a crystal by external ultrasound. Under the conditions of a magnetosonic resonance, anomalies develop in the absorption of ultrasound, the plane of polarization begins to rotate in neutron scattering, etc. Intensive investigations in this field are being continued by Akhiezer's school, as well as by other scientists (in this country mainly in Sverdlovsk and Leningrad). As a result of these investigations, a new direction in magnetism—the physics of magnetoacoustic phenomena—has now been formed.

Several first-class investigations have been carried out by Akhiezer in quantum electrodynamics. These include an investigation into the scattering of high-energy photons by photons and an investigation (done jointly with I. Ya. Pomeranchuk) into the coherent scattering of photons in the Coulomb field of a nucleus (1936). It is important to note that the divergences met there were eliminated in the spirit of modern quantum electrodynamics.

Akhiezer (jointly with M. P. Rekalov) recently wrote a number of papers devoted to the quark model; in particular, in these papers a quark model was proposed for the processes of photoproduction of neutral vector mesons on nucleons and nuclei, and the theory of the diffraction scattering of hadrons at high energies and small momentum transfers was developed.

The theory of pion scattering in nuclear matter has been developed in papers (written jointly with I. A. Akhiezer) in which the pions were considered as a Fermi liquid.

Akhiezer has made important contributions to the solution of such problems of great practical importance as the problem of neutron moderation, the development of linear accelerators, etc.

Of great importance are the monographs and review papers written by him, on which more than one generation of physicists have been already raised. His "Quantum Electrodynamics," written together with V. B. Berestetskii, is one of the best in the world literature.

The following monographs by Akhiezer are widely known: "Some Problems of Nuclear Theory," written jointly with I. Ya. Pomeranchuk (has been awarded the Mandel'shtam Prize of the U.S.S.R. Academy of Sciences), "Spin Waves" (written jointly with V. G. Bar'yakhtar and S. V. Peletminskii), "Collective Oscillations in a Plasma" (written jointly with I. A. Akhiezer, R. V. Polovin, A. G. Sitenko and K. N. Stepanov), as well as reviews on the theory of accelerators, diffraction scattering, and others.

Akhiezer is a brilliant lecturer, who devotes much energy and attention to the business of teaching at the University.

Of great methodological importance are Akhiezer's philosophical speeches, in which he analyzes, from the standpoint of dialectical materialism, many complex and subtle problems of modern physics.

Aleksandr Il'ich Akhiezer is not only the scientific leader of his co-workers, he is also a charming person and a close friend of theirs. His numerous pupils and friends wish him good health and many years of fruitful work.

Translated by A. K. Agyei