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## *ACADEMICIAN LEV ANDREYEVICH ARTSIMOVICH*

(on his fiftieth birthday)


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ON February 25, 1959 Academician Lev Andreyevich Artsimovich, the outstanding Soviet physicist, celebrated his fiftieth birthday.

Artsimovich, the son of a professor of statistics, was born in Moscow. After completing his secondary schooling he entered the Belorussian State University in Minsk. His brilliant capabilities enabled him to graduate early, and in 1930 he joined the Leningrad Physico-technical Institute.

The Physico-technical Institute, then directed by Academician A. F. Ioffe, occupied in those days undisputed first place among the physics institutes of the country. The atmosphere of devotion to science and scientific enthusiasm, which then characterized the staff of scientists of the Leningrad Physico-technical Institute, has played an exceedingly productive role in the formation of Artsimovich's outlook. During the first years at the Institute, until 1933, Artsimovich did some research, in the laboratory of P. I. Lukirskiĭ, on the optics of x-rays; one particular project, undertaken with A. I. Alikhanov, concerned the difficult problem of the total internal reflection in the x-ray region of the spectrum.[1]

The year 1932 saw the discovery of the neutron, and an intense investigation of its properties began in many laboratories. Much work was also done at the Leningrad Physico-technical Institute on neutron physics. In 1935 Artsimovich, together with I. V. Kurchatov, G. D. Latyshev, and V. A. Khramov investigated, in an interesting research project, one of the simplest nuclear reactions, that of the capture of a neutron by a proton,[2] and demonstrated for the first time that the probability of capture of slow neutrons by protons is relatively large.

However, the main field of Artsimovich's research in the Leningrad Physico-technical Institute, a field in which his outstanding abilities as an experimental physicist — clarity of analysis and high reliability of the results obtained — manifested themselves to the fullest extent, was the investigation of the interaction between fast electrons and matter.[3-5] Artsimovich occupied himself with this problem for approximately four years. It must be recalled that in those days our information on this subject was quite incomplete. It is enough to state that the experimental data on brems-

strahlung and angular distribution of the scattered electrons were at that time different from the theoretical values by two orders of magnitude. Artsimovich's research resulted in extensive experimental material on the dependence of the bremsstrahlung intensity and of the total energy losses on the energy of the fast electrons; he also investigated in detail the spatial characteristics of the scattering process. The final conclusion drawn from these investigations was exceedingly simple: the modern quantum-mechanical theory of the passage of fast electrons through matter agrees with the experimental data, within the limits of experimental accuracy. This important result, which eliminated any existing doubts concerning the correctness of the principal outlines of the theory, pointed at the same time ways towards a precise verification of individual special problems, as the experimental techniques became more perfected.

During the war Artsimovich occupied himself with problems of electron-optics and, in particular, developed a theory of chromatic aberration of electron-optical systems.[6]

In 1945, together with I. Ya. Pomeranchuk, Artsimovich cleared up the important problem of the role of betatron radiation losses.[7] His theoretical analysis made it possible to establish the maximum energy attainable with this new method of electron acceleration.

In the postwar years, the tremendous scope of modern technology has necessitated a new approach to the investigation of natural phenomena. It became Artsimovich's task to guide the development of a new trend in technical physics, namely the development of a technology for electromagnetic isotope separation.

It became necessary to increase by a factor of millions the productivity of the laboratory mass spectrometer, and to convert a feeble and fragile physical instrument into reliably operating technical apparatus. A staff of physicists headed by Artsimovich has solved this problem successfully, and at the present time stable isotopes are used more and more in experimental physics.

In addition to solving numerous specific problems arising in the course of the development of the method, it remained for Artsimovich to make a detailed analysis of the problems involved in aberration-free focusing of wide-angle ion beams in axially-symmetrical magnetic fields. In these investigations he obtained a useful formula to relate the dispersion with the angle of aberration-free focusing. Artsimovich has proposed the construction of the ion-optical system of the source, a system used in all modern equipment.[8]

In the early 50's, the scientific interests of Artsimovich turned towards one of the most interesting and difficult physical problems of our time, the production of a controllable thermonuclear reaction. This type of research calls for a deep insight into the old but far from complete field of plasma physics. Yet, to make progress in this field it is necessary to analyze a large number of theoretical problems and to develop quite new experimental methods. The situation is made even more difficult by the fact that there is no general line of attack on the problem, and that to the present time there have existed and still exist different ways of approaching a possible solution of the problem.

As is known, the group of physicists led by Artsimovich has concentrated its effort during the early stages of the research on a study of high intensity pulsed discharges in rarefied deuterium. During the course of these investigations it became possible not only to obtain (although for only brief instance) a gas-discharge plasma with a temperature of several millions of degrees,[9] but also to discover many new phenomena in the physics of gas discharge. Thus, in 1952 Artsimovich together with A. M. Andrianov, E. I. Dobrokhotov, S. Yu. Luk'yanov, I. M. Pondgornyĭ, V. I. Sinitsyn, and N. V. Filippov has discovered that a high-intensity pulsed discharge in deuterium at low pressure becomes a source of neutron radiation.[10] Sometime later Artsimovich has investigated the important problem of the behavior of a self-constricting plasma in the presence of a longitudinal magnetic field.[11-13] An investigation of this problem is particularly important for the interpretation of experimental data pertaining to so-called plasma paramagnetism.

Further investigations on controllable thermonuclear reactions are being carried out over an extensive front, and the paper by Artsimovich at the Second Geneva Conference on the Peaceful Uses of Atomic Energy[14] contains a brilliant survey of the efforts of Soviet physicists in this direction.

Artsimovich began his pedagogical activity very early. Already in 1930 he lectured at the Leningrad Polytechnic Institute, and then began lecturing at the Leningrad State University. In Moscow he continued to offer courses on atomic and nuclear physics at the Moscow Engineering-Physics Institute, and in recent years at the Moscow State University. Artsimovich's lectures are invariably distinguished for the rigor in which the problem is stated, for clarity, and cleverness of the exposition.

The list of Artsimovich's scientific papers is relatively short, but in the flow of scientific literature that fills the pages of our journals one cannot

skip past any articles signed with the name of L. A. Artsimovich. They are always devoted to urgent and acute problems of modern physics and are characterized by deep critical analysis and lucid exposition.

Artsimovich's scientific merits have been highly valued by the scientific society of our country. In 1946 he was elected a corresponding member of the U.S.S.R. Academy of Sciences and in 1954 he became a full member. Artsimovich was awarded many orders of the Soviet Union: in 1953 he became a Stalin Prize laureate, in 1958 a Lenin Prize laureate.

The editors of the Journal of Experimental and Theoretical Physics wholeheartedly congratulate Lev Andreyevich Artsimovich, and offer sincere wishes of health, happiness, and new creative successes for the benefit of Soviet science and our great Fatherland.

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[1] Total Internal Reflection of X-rays from Thin Layers (with A. I. Alikhanov) J. Exptl. Theoret. Phys. (U.S.S.R.) **3**, 115 (1933).

[2] Absorption of Neutrons in Soda, Paraffin, and Carbon (with G. D. Latyshev, I. V. Kurchatov, and V. A. Khramov), Physik. Z. Sowjetunion **8**, 4 (1935).

[3] Bremsstrahlung for High-Energy Electrons (with V. A. Khramov), J. Exptl. Theoret. Phys. (U.S.S.R.) **8**, 913 (1938).

[4] Energy Losses for Fast Neutrons (with V. A. Khramov), Izv. Akad. Nauk SSSR, Ser. Fiz. **2**, 757 (1938).

[5] Angular Distribution of Fast Neutrons Scattered by Aluminum Nuclei (with I. I. Perrimond) Dokl. Akad. Nauk SSSR **52**, 303 (1946).

[6] Electron-Optical Properties of Emission Systems. Izv. Akad. Nauk SSSR, Ser. Fiz. **8**, 313 (1944).

[7] Radiation of Fast Electrons in a Magnetic Field (with I. Ya. Pomeranchuk) J. Exptl. Theoret. Phys. (U.S.S.R.) **16**, 379 (1946).

[8] Electromagnetic Apparatus of High Resolving Power for Separation of Heavy-Element Isotopes (with G. Ya. Shchepkin, V. V. Zhukov, B. N. Makov, S. P. Maksimov, A. F. Malov, A. A. Nikulichev, B. V. Panin, and B. G. Breshnev) Атомная энергия (Atomic Energy) **3**, 483 (1957).

[9] Investigation of Pulsed Discharges with High Current Strengths (with A. M. Andrianov, O. A. Bazilevskaya, Yu. G. Prokhorov, and N. V. Filippov) Атомная энергия (Atomic Energy) **1**, No. 3, 76 (1956).

[10] Hard Radiation of Pulsed Discharges (with A. M. Andrianov, E. I. Dobrokhotov, S. Yu. Luk'yanov, I. M. Podgornyĭ, V. I. Sinitsyn, and N. V. Filippov) Атомная энергия (Atomic Energy) **1**, No. 3, 84 (1956).

[11] Flow of Large Currents through a Plasma in the Presence of a Longitudinal Magnetic Field, Сб. Физика плазмы и проблема управляемых термоядерных реакций (Collection "Physics of Plasma and Problems of Controllable Thermonuclear Reactions") Vol 2, 1958, p 81.

[12] Magnetic Flux in a Self-Constricting Cylinder, ibid. p 87.

[13] Analysis of Pinch Control in the Presence of an External Magnetic Field, ibid. p 101.

[14] Research on Controllable Thermonuclear Reactions in the U.S.S.R., Second International Conference of the United Nations on the Peaceful Use of Atomic Energy, 15/P/2298.

Translated by J. G. Adashko
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