Dmitriĭ Ivanovich Blokhintsev (on his 70th birthday)

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One of the most prominent Soviet physicists, Dmitriĭ Ivanovich Blokhintsev attained the age of 70 on January 11, 1978.

The name of D. I. Blokhintsev is inseparably associated with the history of the peaceful atom, with the organization of Soviet science, with the development of different fields of modern physics, and with work on philosophical and methodological problems of science.

Dmitriĭ Ivanovich Blokhintsev was born in Moscow in 1908. He manifested an interest in science and technology since his youthful years. In 1925 he became acquainted with the work of K. E. Tsiolkovskiĭ correspondence with whom not only gave him an impetus to a subsequent fascination with the idea of cosmic flight, but introduced him to the world outlook of the great scientist which was based on an admiration of the beauty and harmony of the Universe. At this same time having graduated from the Moscow Industrial-Economic Technical School Dmitriĭ Ivanovich attended preparatory courses for admission to the Military-Airforce Academy. Being seriously fascinated by rocket theory he became interested in atomic energy as a possible form of fuel. The famous experiments of Rutherford on the splitting of the atomic nucleus forced him to alter his intentions, and in 1926 he entered the course of studies in the Physics Faculty of the Moscow State University. Physics and theoretical physics in particular had completely captured his enthusiasm.

At the Moscow State University he attended lectures of such outstanding physicists and mathematicians as L. I. Mandel'stam, S. I. Vavilov, I. E. Tamm, N. N. Luzin and D. F. Egorov. Dmitriĭ Ivanovich has himself stated that the greatest influence on him during his student years was exerted by L. I. Mandel'stam and I. E. Tamm under whose influence he began specializing in theoretical physics. On graduating from the University he was retained as a postgraduate student by Professor I. E. Tamm.

The years of study at the Moscow State University and the time that he spent in graduate studies coincided with the period of the birth of quantum mechanics and of its widespread application to the description of physical phenomena occurring in atoms constituting matter. With all his passion Dmitriĭ Ivanovich devoted himself to the study of the difficult and deep foundations of this theory.

His first papers were devoted to the application of quantum mechanics to the explanation of a number of electronic properties of metals and solids which at that time appeared to be puzzling. His first published scientific paper was written together with I. E. Tamm in 1932. In it was calculated the work function for the removal of electrons from metals. The first independent paper by D. I. Blokhintsev dealt with the theory of the motion of electrons in a periodic potential of a crystal where a generalization of the Bloch theory was given to the case of overlapping bands. Of particular significance was the formula obtained by him for the energy of overlapping bands, which made possible an explanation of a number of anomalous magnetic and thermoelectric effects in metals.

DMITRIĬ IVANOVICH BLOKHINTSEV

In the thirties the problem of current rectification by solid state rectifiers was the subject of multifaceted experimental investigations. The essence of this phenomenon was explained by D. I. Blokhintsev. Starting with the equations of electrodynamics he showed that the rectification effect is associated with the appearance of volume charges near the surface of separation between conductors leading to a nonlinear Ohm's law. He also gave a simple quantum-mechanical explanation for another phenomenon puzzling at that time and being widely investigated experimentally—the phosphorescence of crystalline phosphors. It turned out that the surprisingly long afterglow time of phosphors can be easily explained by the appearance of local electron states in the forbidden energy band in the case of a local deformation

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of the lattice. A number of papers related to the field of physics under consideration was devoted to the kinetics of phosphorescence, to the theory of heteropolar crystals, to the theory of tinted crystals (the so-called F-centers). These pioneering papers of D. I. Blokhintsev later played an enormous role in the development of investigations in this domain of quantum theory of solids.

Already in his earlier papers he demonstrated a deep knowledge of the foundations of quantum mechanics and originality of physical thinking.

In 1934 D. I. Blokhintsev defended his doctoral dissertation, and in 1936 he became a professor in the department of theoretical physics in Moscow State University. Since then, D. I. Blokhintsev has been continuously working as a professor in the Physics Faculty, being at present in charge of the chair of nuclear theory. He has given a large number of different theoretical courses, among which special note should be taken of the course in quantum mechanics which he started giving already in 1933 on completing his postgraduate work. Subsequently on the basis of these lectures he wrote the first university text, "Osnovy kvantovoĭ mekhaniki" ("Foundations of Quantum Mechanics"). The book was awarded the State Prize of the USSR. At present the textbook has been translated into five languages and is widely known throughout the world.

Since 1935 D. I. Blokhintsev along with his scientific-educational activity at Moscow State University has also been working as a senior scientist in the P. N. Lebedev Physics Institute of the Academy of Sciences of the USSR. During the same years Dmitriĭ Ivanovich participated in the work of the Kiev Physics Institute; here he directed the work of young Ukrainian physicists. In 1938 he was elected a corresponding member of the Academy of Sciences of the Ukrainian SSR.

During the period from 1935 to 1941 he published approximately twenty papers on different problems of theoretical physics. He is the author of one of the first papers on nonlinear optics—a field rapidly developing in recent years. In particular he has worked out the theory of the Stark effect in a strong alternating field and for the first time studied nonlinear effects. The formulas obtained in that paper have not only a theoretical significance, they turned out to be of practical use after the invention of optical quantum generators.

Even prior to the beginning of the Great Patriotic War Dmitriĭ Ivanovich participated in work dealing with defense subjects. During the war years he almost completely switched over to this work. A group of acoustics specialists was formed in the Physics Institute of the Academy of Sciences and D. I. Blokhintsev became a member of it. The group at first devoted its attention to the problem of aircraft noise, sonar, defense against acoustic mines, etc. Dmitriĭ Ivanovich had to concentrate his attention on theory which at that time was restricted to the linear approximation in the equations of acoustics described in Rayleigh's book "Theory of Sound." The linear theory led to a large number of paradoxes and did not explain certain phenomena in inhomogeneous and moving media. On the basis of general equations of gas hydrodynamics D. I. Blokhintsev obtained acoustics equations of the most general form. This system of equations formed the basis for the solution for the propagation of sound waves in a moving and inhomogeneous medium. Thus, Blokhintsev developed the theory of acoustics of moving and inhomogeneous media. He calculated theoretically the generation of sound by flows and by moving media, in particular by aircraft and ship propellors, and also phenomena associated with a moving detector of sound at subsonic and supersonic velocity of the detector.

The results of this work were later collected in the monograph "Akustika dvizhushcheĭsya sredy" ("Acoustics of Moving Media") published in the USSR and translated in the USA.

His work on defense subjects was recognized by a high government award—the Order of Lenin.

In the postwar period D. I. Blokhintsev worked extensively and fruitfully on questions of interpretation of quantum mechanics. A generalization of this research was the monograph "Printsipial'nye voprosy kvantovoĭ mekhaniki" ("Fundamental Problems of Quantum Mechanics") which appeared in the series "philosophical problems of natural science" in 1966.

Since 1947, D. I. Blokhintsev began actively working on the development of Soviet atomic science and technology.

In 1951 D. I. Blokhintsev was appointed Director of the Scientific Research Laboratory in Obninsk. He was also put in charge of managing the construction of a 5,000 kW atomic electric station which was completed towards the middle of 1954.

The scientific research laboratory grew into a powerful high quality institute which at present is one of the leading institutes in the domain of nuclear energy.

A special place among the scientific papers of Dmitriĭ Ivanovich is occupied by his work devoted to the theory and to the technical problems of chain reactions in atomic reactors. Under his guidance began the development of the theory of fast neutron reactors which appear promising both in their scientific and industrial aspects. D. I. Blokhintsev personally participated in the development of effective methods for the calculation of reactors based on neutrons of intermediate energy and also in solving many theoretical and engineering problems of systems using thermal neutrons.

In the mid-fifties discussions were held in Obninsk concerning the construction of a reactor with a constant neutron flux. Instead of the proposed plan of a high power reactor provided with a selector for producing short pulses (which would lead to utilizing only a negligible part of the reactor power) D. I. Blokhintsev proposed the idea of a pulsed reactor. The idea of the proposal consisted of attaching a portion of the fissionable material on a rotating disc and arranging conditions such that at the moment of coincidence of the moving and the stationary parts the reactor would become supercritical in terms of prompt neutrons. Thus, a controllable

power pulse would develop during each revolution of the disc. As a result, the neutron flux would be pulsed as is required for nuclear physics purposes. Being of very low power (1 kW) the pulsed reactor gives a neutron flux which is produced by an ordinary continuously operating reactor with a power rating 10^3 times higher. The theory and the design of this reactor were developed in the physical-energetic institute in Obninsk and later, after certain improvements, it was constructed in the neutron physics laboratory in Dubna.

In 1956 as a result of a proposal by the Soviet government there was organized in Dubna the Joint Institute for Nuclear Research (JINR) which united the efforts of all the socialist countries in the field of research on the nature of elementary particles. The most prominent scientists of the Soviet Union were brought in to head the laboratories of the Joint Institute. In March 1956 the Committee of Plenipotentiary Representatives of eleven countries unanimously elected D. I. Blokhintsev as the first Director of the JINR.

Since that time his activity acquired a still larger scale. To Dmitriĭ Ivanovich belongs the initiative of creating within the structure of the JINR of two new laboratories—the theoretical physics laboratory and the neutron physics laboratory. During the period that D. I. Blokhintsev occupied the position of Director (1956–65), the Institute completed its organizational growth, became one of the leading broad-based scientific research institutes, became a remarkable school for scientific specialists for socialist countries, and by its research investigations won a position of high authority. Now not a single international conference on the problems of elementary particle physics takes place without participation in it of representatives from the JINR.

The scientific interest of D. I. Blokhintsev since his transfer to the JINR have become completely concentrated in the domain of elementary particle physics.

In 1957, D. I. Blokhintsev advanced the hypothesis concerning fluctuations in the compressibility of the density of nuclear matter within the small nuclear volume. The unusual nature of "fluctuons" consists of the fact that they are capable as a unit of absorbing a very high momentum. At first this idea was utilized for a qualitative understanding of the nature of "deuteron" pions in reactions of quasielastic scattering of high energy protons by nuclei in experiments carried out in the laboratory for nuclear problems of the JINR and for predicting the yields of other clusters in reactions of such a type. The fruitfulness of the idea of "fluctuons" in nuclei became most vividly manifest almost 20 years later when reactions of cumulative type were discovered in the high energy laboratory of the JINR. They showed that for very high momentum transfer the incident particle indeed interacts at once with a group of nucleons within the nucleus as an entity and the investigation of the mechanism of such processes and of the structure of fluctuons themselves opens up a new promising direction in modern relativistic nuclear physics.

At the end of the fifties and in the beginning of the sixties information concerning strong interactions of elementary particles was still very meager. Experimental studies of the interaction between nucleons showed that inelastic processes become essential above the threshold for meson production, and that elastic scattering is of a diffraction nature. This circumstance led Dmitriĭ Ivanovich to the thought of the usefulness of regarding the scattering of pions by nucleons as scattering in a medium with high absorption, i.e., to the optical model of the nucleon. Such a method of calculating the scattering of particles, which now has been given the appellation of the "eikonal method," later was given a basis within the framework of quantum field theory.

The papers of Blokhintsev are characterized by the originality and novelty of ideas advanced in them, and at times by anticipation of physical directions subsequently acquiring great urgency, the "artillery shells" of Dmitriĭ Ivanovich's ideas often "overshot the target." This was the case with the prediction of the Lamb shift in 1938 when he qualitatively correctly calculated the magnitude of the effect thereby being 10 years ahead of the development of quantum electrodynamics. But this paper was not understood and was not accepted by the editors of a scientific journal.

The idea of several different vacuums in field theory which is intensively utilized in modern unitary theories of elementary particles under the name of "spontaneous vacuum transitions" was advanced by Dmitriĭ Ivanovich in the article "Does "dualism" of waves and particles always exist?" published in Usp. Fiz. Nauk (1951).

In a paper devoted to an investigation of the limits of applicability of quantum electrodynamics Dmitriĭ Ivanovich was the first to estimate the significant contribution of the weak interaction at high energies compared to the electromagnetic interaction and pointed out the existence of the so-called unitary limit as an energy boundary beyond which entirely new phenomena in elementary particle physics might be discovered. In connection with this the well-known American experimental physicist W. Panofsky remarked following the presentation by D. I. Blokhintsev of his paper: "You are apparently working for the distant future." It has now become clear that this future was even then not so distant since the present generation of accelerators is approaching the frontier of the unitary limit.

We could continue to enumerate the remarkable ideas and proposals advanced and developed by Dmitriĭ Ivanovich both in the domain of fundamental problems of quantum theory—macrocausality, nonlocal and nonlinear interactions, stochastic geometry and many others—and also in applied fields of physics: the design and construction in Dubna of a new pulsed reactor IBR-2, the theory of containment of ultracold neutrons, but the limitation of space for this article does not allow us to dwell on them in detail.

The present biographical note would not give a complete idea of the significance of the activity of D. I. Blokhintsev if it were not to touch upon his social activity.

D. I. Blokhintsev is a passionate fighter in defense of peace. In his articles and public pronouncements he

repeatedly emphasized that a scientist must not withdraw into a narrowly professional shell: ".... Our duty, the great duty of scientists and engineers of our time, and no one should shirk it, consists of explaining to all people what a threat hangs over the world, and let then the ire of the whole humanity stop the madmen of atomic war." Dmitrii Ivanovich is a member of the Soviet Committee for the Defense of Peace. He was elected a delegate to the XXII Congress of the Communist Party of the Soviet Union.

The prominent scientific and social activity of D. I. Blokhintsev has received international recognition. In 1957 he was awarded an honorary doctorate by the Higher Technical School in Prague. In 1958 Dmitrii Ivanovich was elected corresponding member of the Academy of Sciences of the USSR, and in 1959 he was awarded the honorary degree of doctor of natural sciences by the Natural Science-Mathematics Faculty of the Karl Marx University of Leipzig (GDR), in 1960 he was elected a member of the Hungarian Academy of Sciences, in 1965 he was elected a member of the Academia Leopoldina (GDR).

D. I. Blokhintsev served as a councillor on the Scientific Council in the U. N. General Secretariat, and in 1963 was elected Vice-President of IUPAP (International Union of Pure and Applied Physics associated with UNESCO), and then from 1966 to 1969 he was the President of IUPAP.

The meritorious service of D. I. Blokhintsev has been recognized by the highest awards, he is a Hero of Socialist Labor, four times recipient of the Order of Lenin, a recipient of the Order of the October Revolution and of the Order of the Red Banner of Labor, and also of other orders and medals of the USSR and other socialist countries, and a laureate of Lenin and State Prizes.

A man of a wide circle of interests and enthusiasms, Dmitrii Ivanovich Blokhintsev on the eve of his seventieth birthday is full of creative plans and aspirations. We wish him good health and new successes in his fruitful activity.

Translated by G. Volkoff