

The 120th anniversary of the birth of Academician D V Skobeltsyn (Joint meeting of the scientific session of the Physical Sciences Division of the Russian Academy of Sciences and the Research Councils of the Lebedev Physical Institute of the Russian Academy of Sciences and of the Skobeltsyn Institute of Nuclear Physics of Lomonosov Moscow State University, 28 November 2012)

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A joint meeting of the scientific session of the Physical Sciences Division of the Russian Academy of Sciences (RAS) and the Research Councils of the Lebedev Physical Institute of the RAS and of the Skobeltsyn Institute of Nuclear Physics of Lomonosov Moscow State University took place at the conference hall of the Lebedev Physical Institute of the RAS on 28 November 2012.

The following reports were put on the session agenda as posted on the website www.gpad.ac.ru of the RAS Physical Sciences Division:

(1) **Mesyats G A** (Lebedev Physical Institute, RAS, Moscow) “Opening remarks”;

(2) **Sadovnichy V A** (Lomonosov Moscow State University, Moscow) “Academician D V Skobeltsyn and Moscow State University”;

(3) **Dalkarov O D** (Lebedev Physical Institute, RAS, Moscow) “Cosmic rays studies at FIAN”;

(4) **Panasyuk M I, Romanovskii E A** (Skobeltsyn Institute of Nuclear Physics of Lomonosov Moscow State University, Moscow) “Academician D V Skobeltsyn—the founder of the scientific school of nuclear physics at Moscow State University”;

(5) **Mikhailin V V** (Skobeltsyn Institute of Nuclear Physics of Lomonosov Moscow State University, Moscow) “Synchrotron and undulator radiations and their application in spectroscopy”;

(6) **Toptygin I N** (St. Petersburg State Polytechnic University, St. Petersburg) “The Petersburg period in the life of D V Skobeltsyn”.

Articles based on talks 1, 2, 4–6 are printed below.

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Academician D V Skobeltsyn and FIAN

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Dmitrii Vladimirovich Skobeltsyn was born in St. Petersburg on 24 November 1892 into a family of ancient nobility tracing

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Dmitrii Vladimirovich Skobeltsyn
(24.11.1892–16.11.1990)

its roots back hundreds of years. His father, Vladimir Vladimirovich Skobeltsyn, held a post of Professor of physics at the Polytechnic Institute.

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Dmitrii Vladimirovich received a good education and spoke three languages. In 1910, he graduated from the Tenishev commercial college, whose humanitarian traditions and high level of education were famous, and in 1915 graduated from the Faculty of Physics and Mathematics at Imperial Petrograd University. Dmitrii Vladimirovich stayed at the Department of Physics and trained for a teaching career, and in 1916 began working at St. Petersburg Polytechnic Institute. In 1925, combining his research interests with teaching, D V Skobeltsyn began scientific studies at Leningrad Physical-Technical Institute. His first experiments were devoted to the Compton effect.

Dmitrii Vladimirovich's work on the Compton effect, the scientific level of which was several years ahead of the physics of the time, provided the basis for interpreting the mechanism of gamma-rays absorption and constituted the first experimental confirmation of the Klein–Nishina–Tamm formula describing the relationship between the photon energy and the absorption coefficient, based on the relativistic Dirac equation. This work also provided a quantitative method for the study of the spectra of gamma rays.

In 1927–1929, D V Skobeltsyn made an important discovery in the field of cosmic rays. His experiments with a magnetic cloud chamber showed that cosmic rays carry a high-energy charge particle component (compared with the energy of particles in radioactive decay) which manifest themselves as showers. These results stimulated intensive studies into the nature and composition of cosmic rays.

Cosmic rays had not attracted much interest before D V Skobeltsyn published his results. No one suspected that cosmic rays carried high-energy particles whose interaction with matter results in the emergence of principally new phenomena.

This discovery immediately moved cosmic rays into the range of the most important issues of modern physics and launched the field of high-energy physics. D V Skobeltsyn supervised in the USSR several large-scale experiments on studying cosmic rays at high-altitude research stations (in the Pamirs and the Tien Shan mountains) and in the stratosphere, using high-altitude probes and rockets.

In 1928, Dmitrii Vladimirovich was invited to the Cavendish Laboratory to deliver a course of lectures. In April 1929, he received an award from the Rockefeller Committee of the Radium Institute of the University of Paris, where he conducted experimental studies of gamma rays and cosmic rays in collaboration with Frédéric Joliot and Irène Joliot-Curie.

Having returned to the USSR, D V Skobeltsyn continued his studies of cosmic rays using a magnetic cloud chamber. He observed tracks of positively charged particles, whose properties resembled those of electrons. It was later understood that these were positrons which others discovered in cosmic rays practically at the same time. In track photographs D V Skobeltsyn discovered events of the creation of particle pairs and 'particles moving upwards' (i.e., positrons), even though he failed to identify them in terms of Dirac's theory. This fact was interpreted in the famous paper by Blackett and Occhialini in 1933, in which D V Skobeltsyn's pioneering role was duly recognized. Carl D Anderson, who discovered the positron, also cited D V Skobeltsyn's work.

In 1934, D V Skobeltsyn received a professorship in the Department of Physics, as well as a DSc degree (in Physics and Mathematics) without a *viva voce* defense.

Dmitrii Vladimirovich's work on multiple cascade processes was also seminal and served as a basis for further progress in this field of physics. His role as the founder of high-energy physics was emphasized by Ernest Rutherford, Walter Heisenberg, Paul Dirac, and Frédéric Joliot.

In 1936, D V Skobeltsyn's monograph *Cosmic Rays* was published. It would be difficult to find a book on cosmic rays published in Russia or abroad, which would not quote D V Skobeltsyn's results or would not refer to his papers. In the same year, D V Skobeltsyn was awarded the D I Mendelev Prize of the USSR Academy of Sciences.

In the summer of 1934, a number of research institutes affiliated with the Academy of Sciences began to transfer to Moscow, in view of a governmental decree. Even before this transfer, the Department of Physics (headed since 1932 by S I Vavilov) of the V A Steklov Institute of Physics and Mathematics of the USSR Academy of Sciences was transformed into the Physical Institute of the USSR Academy of Sciences (FIAN in *Russ. abbr.*). In 1934, at S I Vavilov's urging, this institute was given the name of the outstanding Russian physicist P N Lebedev. S I Vavilov wanted for the new institute to be 'polyphysical' in nature, i.e., to represent all major branches of physics research under the guidance of the leading scientists in each specific field. S I Vavilov's foresight and sagacity manifested themselves in, among other things, the attention that he paid to the work at FIAN on nuclear physics, despite the skepticism, which was dominant at the time, of many physicists towards this field of science: it seemed to be useless for any imaginable practical application. Already in Leningrad, S I Vavilov had put together a group of young physicists who, after relocating to Moscow, were assigned to the Laboratory of the Physics of Atomic Nucleus (headed by S I Vavilov himself). In 1935, D V Skobeltsyn became a consultant on nuclear physics and cosmic rays in this laboratory, without leaving his position at the Physical-Technical Institute in Leningrad. That is why he travelled to FIAN in Moscow every month until 1937. In 1938, he moved to Moscow and became fully occupied at FIAN. In 1940, S I Vavilov transferred to D V Skobeltsyn his position of Head of the Laboratory of Atomic Nucleus.

In the pre-war years, S N Vernov, D V Skobeltsyn's student, carried out an extensive program of high-altitude cosmic ray studies by launching radiosonde balloons at various geomagnetic latitudes. Analysis of the latitude dependence of cosmic ray fluxes showed that most of their energy is brought in by charged particles that are deflected in magnetic fields. These studies demonstrated that the primary cosmic rays consist mostly of electrically charged particles. In February 1939, D V Skobeltsyn was elected a Corresponding Member of the USSR Academy of Sciences.

In 1940, D V Skobeltsyn began teaching at the Faculty of Physics of Moscow State University (MSU) and created the Department of Atomic Nucleus and Radioactivity. The lectures were delivered to students majoring in two fields: atomic nucleus physics, and cosmic ray physics.

During the Great Patriotic War, D V Skobeltsyn, like the rest of the FIAN, was evacuated to Kazan, where he supervised a number of programs of defense and practical nature. At the same time, he continued his theoretical work on cosmic rays, mostly on cascade processes and extensive air showers.

It is a well-known fact that the actual work on the Soviet Atomic Project began in this country in 1942. On 19 May 1944, M G Pervukhin, Vice Chairman of the USSR Council

of People's Commissars, submitted to I V Stalin a memorandum, "On the uranium question", in which he proposed involving Professor D V Skobeltsyn with his team of young employees working at FIAN. Already on 26 May 1944, I V Kurchatov wrote to M G Pervukhin that he had held talks on this matter with Professor Skobeltsyn and had been informed that Skobeltsyn agreed to take part in the work, having included it in the plan of activities of the FIAN Laboratory of Atomic Nucleus for 1944. Correspondingly, a research group was organized by mid-1944 under the leadership of I M Frank at FIAN, which started to familiarize itself with the experimental and theoretical study of scientific issues of nuclear reactors, together with USSR Academy of Sciences Laboratory No. 2 (the current National Research Centre 'Kurchatov Institute').

The work on implementation of the Soviet Atomic Project picked up high speed in the fall of 1945, after the USA exploded an atomic bomb in the war against Japan. By the end of 1945, D V Skobeltsyn started to organize a scientific and educational center at Moscow State University for training specialists in nuclear physics, where the process of education was inseparable from research, using modern equipment belonging to the center. In 1946, the Second Physics Institute was created at MSU (NIFI-2, reorganized in 1957 into the Institute of Nuclear Physics), of which D V Skobeltsyn was appointed Director (the position he occupied for the subsequent 15 years). In 1946, he was elected Full Member of the USSR Academy of Sciences.

From 1946 till 1948, D V Skobeltsyn was assigned to the USSR Mission to the United Nations in New York as a consulting expert.

D V Skobeltsyn was an important social figure. From 1954 till 1974, he was a deputy in the Supreme Soviet, first of the Russian Soviet Federal Socialist Republic (RSFSR), and then of the USSR, and in 1950–1974, he headed the Committee for International Lenin Prizes 'For Strengthening Peace Among Nations'. He sat on the Soviet Committee for Peace Protection starting since 1951. In 1955, he headed the delegation of the USSR at the First International Conference on Peaceful Uses of Atomic Energy in Geneva, and was elected Vice President of this representative forum. D V Skobeltsyn was one of the organizers and activists of the Pugwash movement of scientists for peace.

In the last two years of the WW II, nuclear studies also involved the physics of cosmic rays, which at the time offered the only source of high-energy particles. D V Skobeltsyn and V I Veksler, in the frightfully difficult conditions of war time, started to prepare an expedition to the Pamirs, which took place in September 1944. In spring 1946, the government passed a resolution considerably expanding FIAN research on accelerators and cosmic rays, including the building of the high-altitude scientific station in the Pamirs for work on cosmic rays and the creation of the Dolgoprudny Scientific Station. Expeditions to the Pamirs station were subsequently organized every year until the beginning of the 1960s. Later on, a number of extraneous factors began to thwart the progress of work in the Pamirs, which led to the decision to relocate the station to the Tian Shan.

An updated general picture of the phenomena taking place in cosmic rays (for instance, the concept that extensive air showers are a product of a complicated nuclear cascade process, not just purely electron–photon avalanches) was presented by Dmitrii Vladimirovich in his speech to the General Meeting of the USSR Academy of Sciences in

February 1950. Cosmic ray physics had thus, in fact, evolved into a branch of high-energy nuclear physics. In 1952, D V Skobeltsyn was awarded the S I Vavilov Gold Medal of the USSR Academy of Sciences for his outstanding achievements in physics.

In 1951, Sergei Ivanovich Vavilov died and D V Skobeltsyn was appointed a FIAN Director.

D V Skobeltsyn's work as FIAN Director let his exceptional erudition and intuition, his enormous prestige, and the principles which guided him through life come to the fore. His style of work—an enviable depth of penetration into the physical content of even the most complex problems—had a favorable effect on the work of the research divisions of which FIAN was composed. D V Skobeltsyn not only supported work in the areas close to his own specialty, but also actively stimulated progress in emerging new fields of physics. For example, he vigorously supported the work of V I Veksler on accelerators of charged particles, and was one of the first who assessed the importance of quantum electronics, radio astronomy, and some other lines of inquiry. His support contributed very much to the rapid development of the relevant research at FIAN.

A good number of the outstanding research programs of which physics in this country is duly proud were implemented at FIAN at the time when Dmitrii Vladimirovich headed FIAN. His friendly and critical participation and support helped this success to no small degree. We can list among the outstanding achievements of the FIAN scientists, in addition to topics already mentioned, the discovery of the solar supercorona and the outer radiation belt of Earth, self-focusing and the light-hydraulic effects, exciton condensation, the formulation of the supersymmetry principle of quantum fields, the development of semiconductor diodes, transistors, and solar cells, the creation of laser stimulation methods for chemical reactions and laser isotope separation, and so forth. During this period, the achievements of FIAN scientists brought them two Nobel Prizes in Physics (5 winners), eight Lenin Prizes (18 winners), and six State Prizes (37 winners).

D V Skobeltsyn held the position of FIAN Director until 1973. This period of Dmitrii Vladimirovich's directorship proved to be extremely important in the life of the Institute. The number of research staff increased severalfold over this period, despite the fact that over the same time several laboratories detached from FIAN providing a basis for establishing newborn institutes, such as the Acoustical Institute, the Institute for Nuclear Research of the USSR Academy of Sciences, the Laboratory of High Energy at the Joint Institute for Nuclear Research, the Institute of Semiconductor Physics of the Siberian Branch of the USSR Academy of Sciences, and the Institute of Spectroscopy of the USSR Academy of Sciences. More than 500 researchers and practising engineers transferred to these institutes from FIAN. Over the same period, FIAN was being enlarged due to creating the Tien Shan high-altitude scientific station for studying cosmic rays, the Crimean Scientific Station, the radio astronomy station in Pushchino, and the Special Design Bureau in Troitsk. New buildings were also erected for FIAN's laboratories and services.

Dmitrii Vladimirovich knew perfectly well that FIAN's strength lay first and foremost in its complex structure and multifaceted profile, and worked to maintain the necessary balance of interests.

D V Skobeltsyn lived a long life—almost 100 years—and influenced many prominent scientists who regarded him as their mentor. The story of his life is of interest not only to specialists in cosmic ray problems. Dmitrii Vladimirovich Skobeltsyn lived through revolutions and wars, was one of the creators of revolutionary changes in physics, and took active part in training specialists for the Soviet Atomic Project and in launching space research projects. The range of his scientific interests covered the physics of elementary particles and atomic nuclei, and cosmic ray physics.

D V Skobeltsyn was honored with the degree of the USSR Hero of Socialist Labor, six Orders of Lenin, and two Orders of the Red Banner of Labor. He won the USSR State and Lenin Prizes and was a member of many international scientific societies. There can be no doubt that D V Skobeltsyn was one of the greatest scientists in our country.

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Academician D V Skobeltsyn and Moscow State University

V A Sadovnichy

The twenty fourth of November was the 120th anniversary of the birth of Academician Dmitrii Vladimirovich Skobeltsyn—the patriarch of nuclear physics in the USSR, a scholar of international renown, a Hero of Socialist Labor, a laureate of the Lenin and USSR State Prizes, the founder of the first department of experimental nuclear physics in the USSR and of the Division of Nuclear Physics in the Faculty of Physics at Lomonosov Moscow State University (MSU) and MSU Institute of Nuclear Physics (NIIYaF MGU in *Russ. abbr.*), which has borne his name since 1993.

D V Skobeltsyn's name is inseparable from important events in the history of physics. His pioneering work in the observation of tracks left by charged particles in magnetic cloud chambers was the cornerstone of the experimental foundations of quantum electrodynamics. D V Skobeltsyn's discovery of cosmic ray showers consisting of genetically related high-energy particles launched a new avenue of research in high-energy physics. He was for a long time the scientific leader of a large series of experimental programs in cosmic-ray physics, whose development in consequent years led to results of the highest importance.

The teaching and research activities of Dmitrii Vladimirovich Skobeltsyn at Moscow State University began in 1940 when the Department of Atomic Nucleus and Radioactivity was created in the MSU Faculty of Physics at the initiative of Academician Sergei Ivanovich Vavilov, Director of P N Lebedev Physical Institute of the USSR Academy of Sciences (FIAN) at that time. D V Skobeltsyn, one of the most

outstanding scientists in the Soviet Union, whose name was closely connected with the paramount results in nuclear physics, was appointed as its Head.

The creation of the new department at MSU was due to the fact that the fundamental discoveries in nuclear physics made in the early 1930s set in motion a rapid development of this field of knowledge. It is the nuclear physics that was becoming one of the most significant areas among the natural sciences. In the USSR, this was pursued at institutes in Leningrad and Kharkov. The creation in 1934 in Moscow of the Physical Institute named after Petr Nikolaevich Lebedev prepared the foundation there for the development of experimental and theoretical research in nuclear physics. Obviously, this meant the need to train physicists specializing in nuclear physics. After moving in 1938 from Leningrad to Moscow, D V Skobeltsyn became Head of the Laboratory of Atomic Nucleus at FIAN, which worked in close cooperation with its Theory Department headed by Igor' Evgen'evich Tamm.

In those years, the conditions at MSU to conduct experimental work in nuclear physics were nonexistent. Students keen on studying nuclear physics were therefore assigned to experimental departments whose specializations were as close as possible to nuclear physics. Theoretical physicists did their work on nuclear physics either at MSU or at FIAN under the supervision of I E Tamm and his colleagues.

D V Skobeltsyn's organization of the department of experimental nuclear physics in 1940 at MSU Faculty of Physics played the decisive role in the Great Patriotic War years when, beginning with the fall of 1942, the widespread investigation into the Soviet Atomic Project was launched.

Already in October 1943, D V Skobeltsyn's department resumed training specialists in nuclear physics, having invited the leading scientists from FIAN and Laboratory No. 2 headed by I V Kurchatov to lecture for the students. A laboratory was equipped at the department where it became possible to conduct physics research in cosmic rays and nuclear spectroscopy.

Understanding full well that in the war years it would be impossible to organize the training of a required number of specialists for work on the Atomic Project without a special decision of the State Defense Committee (GKO), D V Skobeltsyn and I V Kurchatov (who became an MSU professor since November 1944) succeeded in pushing through the governmental resolution, “On training specialists in the physics of the atomic nucleus”, in February 1945. The resolution specified the planned numbers of specialist that would graduate from the department and the need to provide laboratory space to set up a practicum on nuclear physics, and formulated an order to the Committee on Higher Education Affairs to build a cyclotron for MSU and another order to the military services to urgently demob from the Soviet Army and transfer to “D V Skobeltsyn's authority” a group of graduates of the MSU Faculty of Physics for the purpose of retraining. Students, lecturers, and staff of the department were exempt from conscription. These students' scholarships were increased.

Following the orders of this resolution, in 1945 D V Skobeltsyn organized for the second-year students of the Faculty of Physics a special group which also accepted students of the 2nd and 3rd years from other educational institutes, extended the pre-planned training of students of the 3rd and 4th years, created a group for retraining 5th-year

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