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ON THE 90TH ANNIVERSARY OF THE P.N. LEBEDEV PHYSICAL INSTITUTE (LPI)

The P.N. Lebedev Physical Institute of the Russian Academy of Sciences (LPI) has turned 90 years old

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In 2024, 90 years have passed since the establishment of the P.N. Lebedev Physical Institute of the Russian Academy of Sciences (RAS). The date of the founding of the Physical Institute of the USSR Academy of Sciences (LPI) is considered to be April 28, 1934, when the general meeting of the USSR Academy of Sciences adopted a resolution on dividing the Physics and Mathematics Institute into two: mathematical and physical. In the summer of 1934, both institutes, together with the Academy of Sciences, moved to Moscow, occupying a building on Miusskaya Square, and by November scientific work had already begun. Academician Sergey Ivanovich Vavilov (later president of the USSR Academy of Sciences, laureate of four Stalin Prizes) headed the Physical Institute. Vavilov set the goal to create a 'polyphysical' institute in which research is carried out in the main areas of modern physics, dictated by the logic of the development of science and the tasks facing the country in the hard pre-war period. Sergey Ivanovich engaged the brightest specialists, and his wise and far-sighted decisions were brilliantly validated.

He clearly understood that theory is no less important for physics than experiment, and that these two parts of physical science are inextricably linked. It was on these principles that the LPI was built, which soon brought excellent scientific results. Even the first major cycle of research into the luminescence of uranyl salt solutions in 1934 led to the discovery of a new type of radiation: Vavilov–Cherenkov radiation (subsequently awarded the Stalin (1944) and

Building of the Physical Institute on Miusskaya Square (see Lazarev P P, "Physical Institute of the Scientific Institute," *UFN* **1** 54–66 (1918)), which accommodated the Physical Institute in 1934.

Petr Nikolaevich Lebedev (09.03.1866–14.03.1912)

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Translated by S Alekseev

Nobel [1] (1958) prizes in physics), which caused a revolution in the field of elementary particle detectors. More recently, several more Nobel Prizes awaited the LPI: N G Basov and A M Prokhorov in 1964, A D Sakharov in 1975, and V L Ginzburg in 2003, as well as a plethora of high state and international awards for breakthrough achievements in science.

At the end of 2009, the journal *Uspekhi Fizicheskikh Nauk* (*UFN*) [*Physics–Uspekhi*] published a remarkable paper by Academician G A Mesyats, "The P.N. Lebedev Physical Institute of the Russian Academy of Sciences: Past, Present, and Future" (Mesyats G A *UFN* **179** 1146 (2009) [*Phys. Usp.* **52** 1084 (2009)]), on the 75th anniversary of the LPI. It outlined the history of the institute, listed the outstanding achievements of its staff members, and provided an overview of its main work.

Fifteen years have passed, and the LPI has reached its 90th anniversary. Today, the institute successfully carries out work in the most important areas of modern natural science, including nuclear medicine, high-temperature superconductivity physics, theoretical physics, space physics, quantum technologies, and photonics. Significant scientific and applied results have been obtained in all these areas.

Based on the unique medical proton accelerator (Prometheus, developed by the LPI) for the treatment of oncological diseases, a large amount of medical and physical research was undertaken, and the foundations of promising medical technologies were laid. Using the Prometheus medical system, which operates in the A F Tsyb Medical Radiological Research Center (Obninsk), over 500 patients have been successfully treated in recent years.

One of the oldest staff members of the LPI, Academician V L Ginzburg, after receiving the Nobel Prize in Physics in 2003 for his pioneering contribution to the theory of superconductors and superfluids, approached Russian President V V Putin with a proposal to organize a modern laboratory of high-temperature superconductivity at the LPI. On the instructions of the president, the project was supported, and as part of its implementation, the V L Ginzburg Center for High-Temperature Superconductivity was set up and began operating at the LPI in 2019. In terms of its technical equipment and human resources, it is currently one of the best research centers in the world. The center has already developed materials with record critical temperatures, which brings us closer to Academician Ginzburg's dream: superconductivity at room temperature.

For 20 years, the staff of the Lebedev Physical Institute worked on the development of the RadioAstron ground-space radio interferometer, which is the Spektr-R space radio telescope with a diameter of 10 meters operating in concert with ground-based radio observatories. During 7 years of successful work in orbit (2011–2017), unique scientific data were obtained on more than 250 deep-space objects with an unprecedented angular resolution. Important discoveries were made in the field of the physics of quasars, pulsars, and cosmic masers. Spektr-R is noted in the *Guinness Book of Records* as the "Largest Space Radio Telescope." Currently, intensive work is underway to create the Spektr-M space observatory (Millimetron). This 10-meter cryogenic telescope is designed to study objects in the Universe in the range from millimeters to tens of micrometers with the highest sensitivity, which will open up opportunities for observing very distant cosmic objects and recording physical processes in the early Universe and will allow us to come closer to understanding the processes in the immediate vicinity of the event horizon of supermassive black holes.

Current building of the LPI, built on the initiative of S I Vavilov, in which the LPI has been located since 1953.

The LPI is at the forefront in the area of quantum technologies: a new generation of optical frequency standards has been developed, new types of quantum sensors have been implemented (for example, gyroscopes on color centers in diamond), and significant achievements for the country have been obtained in the field of infrared photonics. Major achievements include the making of a 50-qubit ion quantum computer and the implementation of a number of new quantum algorithms, which places the LPI among the world leaders in this area.

Such 'classic' LPI subjects as laser physics, X-ray optics and spectroscopy, high field physics, and field theory have also received a new lease on life. The institute approached its 90th anniversary as an actively working scientific organization, occupying leading positions in many areas of modern physics. Recent years have seen significant changes in the staff: over 40% of the institute's research staff are young scientists, many of whom have already established themselves as leaders in their fields. The work of LPI staff is widely known to the world scientific community and enjoys well-deserved recognition and authority. This issue of *UFN* (*Physics–Uspekhi*), dedicated to the 90th anniversary of the LPI, presents the work of staff members of a number of LPI scientific departments, reflecting the scientific achievements of the LPI in recent years. After reading them, readers of the journal will be able to evaluate their depth and scientific significance for themselves.

Director of the LPI,
Corresponding Member of the Russian Academy of Sciences
Nikolai Nikolaevich Kolachevsky

[1] The 1958 prize was awarded to P A Cherenkov, I E Tamm, and I M Frank. S I Vavilov died in 1951 (at the age of 59), and the Nobel Prize is not awarded posthumously.