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In memory of Lidia Vasil'evna Kurnosova

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Lidia Vasil'evna Kurnosova, well-known expert in cosmic physics, astrophysics, and the physics of cosmic rays, DSc in physics and mathematics, who devoted 65 years to serving science, departed this life on June 28, 2006.

Kurnosova was born in Moscow on September 17, 1918 into the family of a minor merchant employee. In 1926, she entered school and studied with interest and eagerness; she showed success in all subjects, beginning with history and literature and ending with mathematics and physics. In 1936, she graduated from secondary school and chose the Mechanics and Mathematics Department of Moscow State University for further studies. Later on, following the recommendation of Sergei Ivanovich Vavilov, uncle of her future husband Oleg Vavilov, who was a student in the Physics Department, she transferred to the Physics Department. In the height of summer of 1941, on completion of the fourth course, students were to be assigned to specific chairs of the department but the war with Germany flared up on June 22 and those who completed four years of studies received their diplomas and were sent to specific jobs.

On 13 July 1941, Kurnosova started her working life as Junior Researcher at the Institute of Mechanical Engineering (IMASh) of the USSR Academy of Sciences, in the Laboratory of Nondestructive Testing headed by Professor Raevsky. The Moscow phase of her work at IMASh was rather short: German planes started bombing Moscow on July 22 and the institutes of the USSR Academy of Sciences were evacuated to Kazan', where her laboratory switched to war-oriented research. Kurnosova took part in testing samples of aviation equipment in the laboratory: she manufactured strain gauges, which required much skill and careful attention, adjusted them and run test shootings in the underground shooting gallery.

In the summer of 1946, Kurnosova was invited to transfer to the P N Lebedev Physics Institute (FIAN) to take part in studying cosmic rays in the Pamir Mountains. This abrupt change in research subject demanded that Kurnosova urgently master new techniques, and she succeeded very well. In expeditions 1946 and 1947, she carried out measurements of the characteristics of cosmic ray showers under thick layers of ground. She worked in a cave in the Pamir Mountains in a severe climate and very difficult conditions for day-to-day survival.

In 1948 – 1949, Kurnosova prepared several new experimental setups and had them flown by balloon to a height of 10 – 12 km; this gave her unique data on the structure of cosmic ray showers in the atmosphere. Her independent measurements in the mountains and in the atmosphere made important contributions to the array of experimental results that formed the basis of the nuclear-cascade process theory.

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Lidia Vasil'evna Kurnosova
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In 1949, the C-25 synchrotron was put into operation at FIAN. It generated photons with energies up to 250 MeV and Kurnosova agreed enthusiastically to conduct a study of Compton scattering in this previously inaccessible energy range. This experiment was one of the very first using the C-25 accelerator, so that Kurnosova encountered numerous obstacles of an organizational and experimental nature. She overcame them successfully. Having conducted the measurements very rapidly, she was able to show that the measured cross section at the energy 235 – 247 MeV agrees with the calculated one obtained using the Klein – Nishina – Tamm formula and she thereby resolved the controversy that took place at the moment regarding the nonpoint structure of the electron on the scale of 10^{-13} cm. This work was the core of her thesis for Candidate of Physicomathematical Sciences that she defended in 1954.

That was the time when work on developing an artificial earth satellite was unfolding in the USSR; the Interdisciplinary Scientific and Technology Council (MNTS) was established at the Academy of Sciences, chaired by the Academician M V Keldysh. The task of MNTS was to coordinate research in various fields of science that would use such satellites. Three green Candidate of Sciences holders, Kurno-

sova, L A Razorenov, and M I Fradkin, decided to join forces and start cosmic ray research on board the satellites. They prepared, with the participation of a Corresponding Member of the USSR Academy of Sciences Vitalii L Ginzburg, a list of research projects that appeared important at that moment and proposals for running specific experiments in space. These proposals were approved by MNTS, and the just formed 'Kurnosova's group' was given funding and staff for implementing their research program. It became clear that this alliance was very efficient and for the subsequent 40 years (until Razorenov's accidental death in 1994) this 'Tripartite Alliance' headed by Kurnosova worked actively and in unison and created a team of highly qualified experts who generated many interesting and valuable new results.

On that day in October 1957 when the first artificial satellite (sputnik) was launched, Kurnosova was participating as a member of the delegation of the USSR Academy of Sciences in the work of the Astronautic Congress in Barcelona. Her talk to the Congress, authored by S N Vernov, Ginzburg, Razorenov, Fradkin, and herself, discussed for the first time the Soviet program of cosmic ray studies using satellites. Less than eight months after this communication, Kurnosova and her colleagues obtained pioneering results by measuring the nuclear composition of galactic cosmic rays on board a satellite.

When setting up experiments aboard satellites, Kurnosova and her colleagues were almost invariably pioneers who had to solve numerous problems stemming from specific conditions of working in space. The team resolved such difficulties quite satisfactorily and in the first ten years of the space flight era (from 1958 to 1968) it conducted more than 15 successful experiments aboard satellites and space rockets.

The cosmic ray studies with space probes, carried out under the supervision of Kurnosova, made it possible to obtain new information on primary cosmic rays and on the composition and properties of radiation in the circumterrestial space, and to discover a number of previously unknown effects. It was thus shown that the composition of cosmic rays in the range of high Z corresponded to the natural abundance of elements; cases of heavy nucleus acceleration on the Sun to cosmic ray energies were recorded, and substantial instability was discovered in the position and intensity of the outer radiation belt of the Earth.

Kurnosova has made great strides toward discovering a radiation anomaly: the existence of a region with increased radiation intensity at altitudes of 200 – 300 km. This result was later certified as an official discovery.

At every step of her life in science Kurnosova paid much attention to perfecting the experimental methodology and to using the newest research techniques. The best word characterizing many of the experiments carried out under her guidance is 'pioneering': she pioneered the use of a Cherenkov counter for measurements on board a satellite in 1958, although it was still a rare device even in laboratory experiments; in 1960, she pioneered the development of nuclear emulsions exposed in space; in 1968, she sent up a gas Cherenkov counter, and in 1967, she successfully tested the use of a superconducting magnet. This is a far cry from a complete list of pioneering methodical efforts implemented by Kurnosova's group and it illustrates the broad range of her scientific interests and her skills as an experimenter.

The leaders of MNTS could not help noticing the energy, initiative, and ability to overcome difficulties, so characteristic of Kurnosova, and M V Keldysh made her a member of the Council, where she was his assistant for eight years and carried the huge load of organizing space research in this country. She participated in preparing documents for issuing governmental decisions and in organizing science meetings for discussions of the research program and of progress in its implementation, and she coordinated the collaboration of the academic institutes and industrial plants. As a result, she made personal contacts with many scientists at the USSR Academy of Sciences institutes and industrial research institutes, set up business contacts with directors and designers-in-chief of these institutes, and was on good terms with the leaders and staff of the Presidium of the USSR Academy of Sciences, the Military and Industrial Committee of the Council of Ministers, and industrial ministries. Kurnosova's contribution to the organization of cosmic research in the USSR was highly valued by the leaders of the program and enjoyed well-deserved respect.

Three satellites were placed in orbit in the USSR between October 4, 1957 and May 15, 1958, and experimental studies began in earnest. A question arose of where to publish the results obtained. Since space research belonged to a large number of research areas (mechanics, astronomy, physics, geophysics, biology, medicine, etc.), MNTS decided to start publishing special issues of the collected papers under the title "Artificial Earth Satellites". Kurnosova was made the executive editor of this series characterized by an extreme diversity of topics in the contributions; between 1958 and 1963 she published 17 collected issues. In 1963, these issues gave way to the now widely known journal *Kosmicheskie Issledovaniya* (*Space Research*) based on them.

Kurnosova was well known by the international scientific community and in 1969 became a Fellow of the International Astronautic Academy.

Kurnosova also contributed to the training of younger scientists: she had up to 15 graduate students simultaneously working on their diplomas in her team; over the years, ten staff researchers and postgraduates presented their candidate theses and obtained degrees. For many years Kurnosova chaired the State Examination Commission at the Moscow Engineering Physics Institute (MIFI).

The government rewarded her for the work at MNTS and for the scientific achievements of the group that she headed with the Order of the Red Banner of Labor, the Badge of Honor, and a Medal for Distinction in Labor), with memorable medals of the USSR Academy of Sciences and with medals of the Exhibition of Achievements of the National Economy (VDNKh).

Kurnosova's research team was reorganized in June 1971 into a sector and she herself, having risen to the position of sector head, continued implementing her plans for further space experiments with more intensity, having added to the program problems in gamma astronomy (GAMMA-1, the USSR – France joint experiment); she also organized sessions of stratospheric measurements in India and Brazil. Being fully engrossed in her research, Kurnosova found it possible only in 1987 to deliver a viva voce doctoral thesis presentation that generalized her results of many years of space research.

At the same time, Kurnosova became enthusiastic about studying dark matter and suggested carrying out direct measurements of the spectrum of gamma radiation in the energy range up to 1 TeV in order to detect monoenergetic gamma lines generated in neutralino annihilation events (according to one of the more popular hypotheses, the neutralino is a component of dark matter). She worked on

this problem, which was included in the program of space research in Russia (the GAMMA-400 project), until the last days of her life. Unfortunately, the possibility to conduct physics research has changed catastrophically in the last decades: as a consequence of niggardly funding and of the virtual disappearance of technological departments within research institutes, the time required to prepare an experiment has increased tenfold or more, so the time it takes to arrive at the ultimate result has become ridiculously long. Kurnosova, with her selfless devotion to her research, felt miserable in this situation and tried, within her power, to take part in various public campaigns aimed at resurrecting science in Russia.

The position that she took vis-à-vis the current social and political reality in this country stemmed naturally from her ideology and her principles of morality that she grew up in her youth. She was a died-in-the-wool communist and refused to adapt to a society in which money forms the basis of all human relations. Kurnosova hated money-grubbing, greed, carelessness, and intrigues behind people's backs, both in science and in life in general. She was socially very active and felt inseparable from the fate of her country and her people. Hence, she actively participated in public meetings, demonstrations, and subbotniks (the Soviet system of Saturday unpaid labor gatherings). In 1941, Kurnosova was among voluntary laborers working on defense constructions near Kazan'; she also combined work at IMASh with regularly helping out at the military hospital where she would work gratis as an X-ray technician after a ten-hour-long working day at the institute.

Kurnosova's reputation among colleagues was very high and she was constantly elected to governing bodies of social organizations. At FIAN, she rose to deputy secretary of the communist party committee and was often a regular committee member. Kurnosova held the confidence of the staff in very high regard and carried out her elective responsibilities with great honesty and selflessness. She helped many colleagues to solve their work- and family-centered problems and to resolve conflicts in a humane manner. When the party committee discussed aspects of internal relations at the Institute, she would take positions of principle and stand for the success of research projects, regardless of the opinions of higher party echelons. Kurnosova's work as a member of this committee helped sustain the FIAN traditions of scientific honesty and transparency, general friendliness, and protection of its reputation.

Lidia Vasil'evna Kurnosova possessed enviable human qualities: she was kind, respected and loved people, and had an acute sense of duty and personal responsibility; she was very attractive, with a kind of severe beauty combined with sharp intelligence, lively disposition, open character, and considerable charm. Among the people acquainted with her, many (both men and women) were virtually in love with this exceptional woman.

Her family life was accompanied by tragic events whose number was too high for a single person. In 1943, two years after her marriage, her father-in-law, Academician Nikolai Ivanovich Vavilov, died of hunger in prison in Saratov, and three years later, in February 1946, Oleg Vavilov, her husband, went to the Caucasus after the defence of his thesis and perished in the mountains under uncertain circumstances. She travelled there with a group of climbers, spent two months searching, found his body, and buried him in Dombai. Another shock followed 53 years later: in February 1999, her only son, 36-year-old Mikhail Moiseevich Kurnosov, on a business trip to Kabardino-Balkariya, was kidnapped in the city of Baksan, transferred to Chechnya, and kept hostage for a year. All attempts to get him out ended in failure and in March 2000 the kidnappers bludgeoned him to death; even the place where he was buried by his friends remains unknown.

Kurnosova grieved these deaths but her courage did not fail her; people around her never noticed any external manifestations of her terrible misfortune. She continued to work and carry on with her many activities, finding some kind of solace in this and in the company of her grandson.

All of us who knew Lidia Vasil'evna Kurnosova — a devotee to science and one of the founders of space research in this country — will never forget this noble soul.

Yu N Vavilov, T I Galkina, V L Ginzburg,
A V Gurevich, N S Kardashov, V G Kurt,
A N Lebedev, G A Mesyats, N M Nesterova,
Yu I Stozhkov, N P Topchiev, M I Fradkin