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Obituary

In memory of Nikolay S. Kardashev (25.04.1932–03.08.2019)

Nikolay Semenovich Kardashev, one of the leading Russian astrophysicists, head of the Astro Space Center of the Lebedev Physical Institute, and a full member of the Russian Academy of Sciences passed away on August 3, 2019, at the age of 87.



Nikolay S. Kardashev (25.04.1932–03.08.2019)

N.S. Kardashev was a really outstanding scientist, an inspirational leader in the field of the science of astronomy. He graduated from M.V. Lomonosov Moscow University in 1955 and started his work in science at the Sternberg Astronomical Institute. He presented his PhD dissertation in 1962.

In December 1976, N.S. Kardashev became a corresponding member of the USSR Academy of Sciences. On March 21, 1994, he was elected the Academy full member.

In 1990, N.S. Kardashev created the Astro Space Center of the Lebedev Physical Institute of Russian Academy of Sciences and became head of the Astro Space Center from 1990, until his last day. In 1999, he was appointed Chairman of the Council on Astronomy of the Russian Academy of Sciences.

The scientific results obtained by N.S. Kardashev are widely known and recognized by the world scientific community. He predicted the possibility of observing recombination spectral lines in the radio band formed in transitions between the upper quantum levels of excited atoms of hydrogen, helium, and other elements. His prediction was successfully confirmed in observations by Soviet radio astronomers.

N.S. Kardashev developed the theory of cosmic radio sources, synchrotron radiation spectrum evolution, claimed the presence of a neutron star in the Crab Nebula even before the discovery of pulsars. He advocated the theory of multiple universes (Multiverse) and of "wormholes" probably existing near some massive black holes and connecting our Universe with other ones.

N.S. Kardashev was a pioneer in the search for extraterrestrial intelligence (SETI) and he is the author of the world-recognized classification of extraterrestrial civilizations in terms of their energy use. The Kardashev Scale ranked civilizations from Type I: civilizations capable of using energy resources of a single planet, to Type II: civilizations that use the full energy of a star, to Type III civilizations that have access to the energy of a galaxy. He initiated and personally supervised the search for signals from extraterrestrial civilizations in the decimeter-wavelength range conducted in the USSR in late 1960s – early 1970s.

Nikolay Kardashev was at the head of a wide cooperation of many scientific organizations and international collaborations. In 1964, jointly with his colleagues, he proposed the method of radio interferometry with very long baselines (VLBI), employing receivers with independent local oscillators on antennas separated by several thousands of kilometers and this equivalent by angular resolution to a radio telescope as large as the Earth. This method is of crucial importance in modern radio astronomy, it has been used for more than half a century in global interferometric networks. A further development of this method was the ground-space interferometer "RadioAstron", the international space VLBI mission developed under the leadership of N.S. Kardashev, which operated successfully for more than seven years, achieving an angular resolution of several millionths of an arcsecond, unprecedented in astronomy, and obtaining a large amount of new scientific data. In the recent years, N.S. Kardashev actively worked on the project of a unique "Millimetron" observatory, a further development of the "RadioAstron" project. He was an internationally well-known author and editor of many major scientific publications including:

- Transmission of information by extraterrestrial civilizations – Kardashev, N.S., 1963, Astr. Zh. 41, 2; 1964, Soviet Astronomy AJ, 8, 217.
- Radioastron: A radio telescope much greater than the Earth – Kardashev, N.S., 1997, Experimental Astronomy 7, 329–343.
- Is there a simple dependence between the scales of radio sources and their radio luminosities – N.S. Kardashev, B.V. Komberg, V.I. Zhuravlev, Astronomical and Astrophysical Transactions, 18, 39–42, 1999.
- RadioAstron: A telescope with a size of 300 000 km. Main parameters and first observational results – N.S. Kardashev et al., Astronomy Reports 57, 153–194, 2013.
- Review of scientific topics for Millimetron space observatory. N.S. Kardashev, I.D. Novikov, V.N. Lukash et al., Uspekhi Fizicheskih Nauk 184, 1319–1352, 2014.
- The Millimetron Project – Kardashev, N.S., Andreyanov, V.V., Gromov, V.D. et al. in: Radioastronomical Tools and Techniques, edited by N.S. Kardashev and R.D. Dagkesamanksii, Cambridge Scientific Publishers, 2007.

N.S. Kardashev was awarded many prizes for his activities in science. He was twice a recipient of the USSR State Prize in science and engineering: in 1980 for the creation

of the first space radio telescope KRT-10, which operated onboard the Salyut-6 orbital station, and in 1988 for the discovery and investigation of spectral radio lines of highly excited atoms (radio recombination lines). In 2011, N.S. Kardashev was awarded the Order of Honour of Russia for his great contribution to science and for achievements in scientific research. In 2012, N.S. Kardashev received the Grote Reber Medal dedicated to the memory of this first radio astronomer of the world. In 2014, N.S. Kardashev was awarded the Demidov Prize, national scientific prize in Russia awarded annually to the members of the Russian Academy of Sciences.

N.S. Kardashev harmoniously combined rare qualities: the talent of a scientific researcher and organizer, able to consolidate scientific teams to solve the most complex observational problems. His whole life is an example of selfless service to science. His passing away is deeply felt by his family and colleagues. We shall always remember him as an outstanding scientist, a talented leader, a dear and respected colleague and a nice person.

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