Biographical Encyclopedia of Astronomers

Kolmogorov, Andrei Nikolaevich

Born Tambov, Russia, April 25, 1903

Died Moscow, Russia, October 20, 1987

The works of leading Soviet mathematician Andrei Kolmogorov found diverse applications in the treatment of dynamical systems and the study of turbulence or chaos theory as those fields applied to astronomy. The so-called Kolmogorov spectrum describes, for instance, the structure of turbulence in the interstellar medium reasonably well. Kolmogorov's father was Nicholas Matveyevich Katayev; his mother, Maria Yakovlevna Katayeva (née Kolmogo-rova), died from complications surrounding his birth. He was then adopted by his aunt, Vera Yakovlevna Kolmogorova, and received her family name. He married Anna Dmitriyevna Kolmogorova (née Egorova).

Before the October 1917 Bolshevik Revolution, Kolmogorov studied in Moscow at the private E. A. Repmann Gymnasium; After the revolution, he attended a secondary school. In 1920, he was admitted to Moscow University as a student of the Faculty of Mathematics. There, Kolmogorov began his scientific activities under the guidance of professors P. S. Urysohn, A. K. Vlasov, V. V. Stepanov, and especially N. N. Luzin. In 1922, he gained experience as a secondary school mathematics teacher, a profession to which he voluntarily returned after the age of 60. Kolmogorov graduated from Moscow University in 1925 and then enrolled as a postgraduate student. After completing his postgraduate studies, Kolmogorov obtained a position as chair of mathematics at the Karl Liebknecht Pedagogical Institute in Moscow. He also began scientific research at the Mathematical Institute of Moscow University.

Kolmogorov's early research explored the theory of functions of a real variable. He investigated the convergence of trigonometric series, the theory of measure, the theory of functional approximations, set theory, and the theory of integrals. In 1925, working with

A. J. Khintchine, he applied methods of the theory of functions to the theory of probabilities. In 1933, Kolmogorov constructed the axiomatic foundations of the theory of probabilities and established the theory of Markovian random processes in continuous time. During the period from 1939 to 1941, he solved extrapolation and interpolation problems concerning stationary processes. He clarified the link between the theories of random processes and that of Hilbert spaces and formulated many problems in terms of functional analysis. Kolmogorov investigated ergodic theorems and formulated the necessary and sufficient conditions of applicability for the law of large numbers He made significant contributions to constructive logic and topology, having introduced in 1935 the so-called upper limit operator (or nabla operator) and the topological invariant of the cohomology ring. Kolmogorov formulated the idea of a topological vector space and was deeply engaged in the theory of differential equations and functional analysis. In his works concerning fluid mechanics, Kolmogorov created and developed the concept of local isotropy of turbulence in a viscous, incompressible

fluid (at large Reynolds numbers), having established with Alexander M. Obukhov the spectrum of local turbulence (the Kolmogorov-Obukhov law of 2/3).

In celestial mechanics, Kolmogorov's results are especially applicable to the theory of dynamical systems as related to perturbed motions in Hamiltonian systems. These relationships describe, for example, the motion of an asteroid in an elliptical orbit under the perturbing influence of Jupiter. The same equations are pertinent to a wide range of problems addressing the stability of magnetic surfaces in fields with tokamak geometries (e.g., inside toroidal chambers known as "magnetic traps" and used in thermonuclear fusion experiments) and the stability of rapid rotation of a massive asymmetric rigid body. This work has been continued and expanded by his pupil, Vladimir I. Arnold, who examined the stability of quasi-periodicity in the three-body problem. Generalized methods to construct inverse functions by successive approximations, which overcame difficulties caused by small divisors, were developed by Kolmogorov, Arnold, and Jürgen Moser. The corresponding theory, known as KAM theory, derives its name from the initials of these three men. It plays an important role in investigations of the stability of the Solar System over very long (cosmogonical) timescales.

Kolmogorov was elected a member (academician) of the USSR Academy of Sciences (1939), the academician-secretary of the Department of Mathematics of the USSR Academy of Sciences (1939), a member of the USSR Academy of Pedagogical Sciences (1968), and president of the Moscow Mathematical Society (1964–1966). He received honorary doctoral degrees from the Sorbonne University in Paris (1955), Stockholm University (1960), and the Institute of Statistics in India (1962). Kolmogorov was awarded the Stalin Prize (1940), the Eugenio Balzan Prize (1963), and the Lenin Prize (1965). He was declared a "Hero of Socialist Labor" (1963) and was decorated with many orders and medals from the USSR, Hungary, and the German Democratic Republic.

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