

# Feliks Aleksandrovich Berezin (Obituary)

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Professor Feliks Aleksandrovich Berezin, Doctor of Physicomathematical Sciences and well-known mathematician and physicist, died tragically on July 14, 1980. He died at the peak of his energy and talent, when he still had so much to contribute. He would have celebrated his fiftieth birthday on April 25, 1981.

The tendency clearly formulated during the last ten years to bring mathematics and physics closer together became a feature of his personality. F. A. Berezin was a scientist with a deep understanding of physics which he regarded as an inexhaustible source of new and striking mathematical ideas. At the same time, he made important contributions to our understanding of many essentially physical problems and to their solution.

The scientific interests of F. A. Berezin were very broad. At the beginning of his creative career he was concerned with the theory of representations of groups, which had long found important applications in theoretical physics. His most important contributions in this area were concerned with the description of infinite-dimensional irreducible representations of complex semisimple Lie groups in Banach spaces and the description of the Laplace-Casimir operators. Toward the end of the 1950s, F. A. Berezin took up an active interest in theoretical physics, in the first instance, quantum field theory. The result was the eventual publication of his remarkable book "The Method of Second Quantization" (Nauka, Moscow, 1965; English translation published by Academic Press, 1966 under the same title). This book gained world-wide acceptance among theoretical physicists and mathematicians.

The essence of the functional approach is the establishment of a correspondence between quantum-mechanical operators and their so-called symbols, i.e., certain systems of functions (functionals in the case of field theory) in the phase space of the classical system. F. A. Berezin succeeded in deriving new inequalities, in the language of these symbols, for the spectral function of the Hamiltonian operator of an arbitrary quantum mechanical system. In the course of this work he also exhibited, for the first time in the method of functional integrals, the well-known quantization ambiguities that are connected with the ordering of operators.

F. A. Berezin systematically extended the functional approach to Fermi fields. This led him to the development of an analysis involving on an equal footing both ordinary functions and functions of anticommuting variables, i.e., elements of the Grassmann algebra. He put forward and substantially developed the key ideas involved in the extension of basic concepts of mathematical analysis and group theory to this general case.



Feliks Aleksandrovich Berezin (1931-1980)

The concept of the integral evaluated over commuting and anticommuting variables, which he introduced, turned out to be particularly useful. The analog of the Jacobian for such integrals is now called the Berezinian in his honor. Researches in the theory of supergroups and supermanifolds that he initiated have now led to a new subject—supermathematics. F. A. Berezin's results and ideas in this field have played an exceedingly important role in the development of the formalism of supersymmetric theories of fundamental particles and, particularly, supergravitation—one of the most promising areas in contemporary theoretical physics.

Because of his great erudition, F. A. Berezin was able to work fruitfully in other branches of theoretical physics as well. For example, he was one of the first to understand the specific features of the quantum mechanical many-body problem. His ideas and methods contributed substantially to the correct formulation and elucidation of the spectrum in this problem. As far back as 1961, F. A. Berezin and his students put forward a model of the two-dimensional field theory, which had an exact solution. He returned to two-dimensional fields in the course of later years when such problems attracted the attention of many other physicists. F. A. Berezin was also responsible for a new approach to the quantization of dynamic systems of a general form, the phase space of which had a non-Euclidean geometry. He frequently emphasized the importance of geometric ideas in contemporary physics. The increasing penetration of contemporary theoretical physics by new

mathematical ideas and powerful methods frequently led Soviet and foreign physicists to consultations with Feliks Aleksandrovich, one of the few that had full command of both the mathematical and the physical languages. Any contact with him was always instructive; consultations were always useful and fruitful.

Many will remember F. A. Berezin as an able and demanding teacher. For many years, he gave courses of lectures on functional analysis, quantum mechanics, and statistical physics at the Department of Mathematical Mechanics of the Moscow State University. His lecture notes (some of which were published by MSU Press) are distinguished by the depth and freshness of

his approach. For many years, F. A. Berezin led a Seminar on theoretical physics which, for many theoretical physicists, was virtually a university of modern mathematical culture.

In recent years, F. A. Berezin's activities in science education were particularly fruitful. A freak accident cut short his life in full bloom.

All those who knew Feliks Aleksandrovich Berezin will always remember him as a profoundly honest, talented, and highly erudite man.

Translated by S. Chomet