Givi Razhdenovich Khutsishvili (Obituary)

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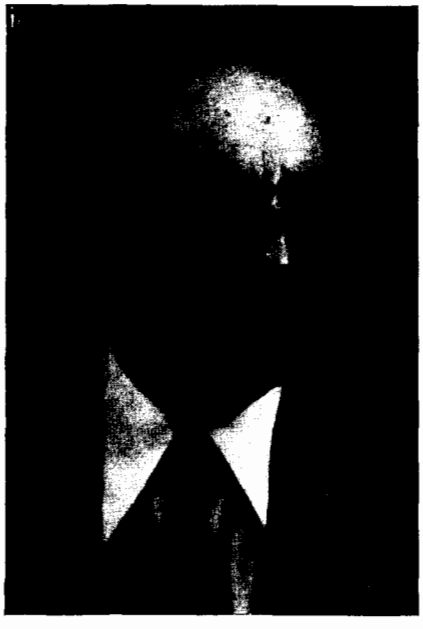
Soviet science has suffered a heavy loss. Professor Givi Razhednovich Khutsishvili, Corresponding Member of the Academy of Sciences of the Georgian SSR, well-known Soviet physicist, noted contributor to the development of the theory of magnetoresonance phenomena in solids, and Laureate of the State Prize of the Georgian SSR and of the Melikishvili Prize, died in August 1979 at the age of 59.

G. R. Khutsishvili was born on January 11, 1921 in Tbilisi. His farther, Rzhden Varfolomeevich Khutsishvili, was a well-known Georgian physicist and a Professor at Tbilisi State University. Between 1925 and 1929, G. R. Khutsishvili lived in Paris, where his mother was an employee of the Soviet Trade Mission. He entered his first school in Paris. On completing his secondary school in 1937 he was admitted to the Physicomathematical Faculty of Tbilisi University, from which he graduated with honors in 1942. He completed his graduate training at Tbilisi State University in 1945 and, after a further year, defended his Candidate thesis.

In 1948, G. R. Khutsishvili began his scientific association with the eminent Soviet physicist, L. D. Landau, and became a distinguished member of his theoretical school. In 1955, he defended his Doctoral thesis in which he laid the foundation of modern ideas on the diffusion and relaxation of nuclear spins in solids. These fundamental studies are now generally accepted as classic.



GIVI RAZHDENOVICH KHUTSISHVILI (1921-1979)

In 1951, G. R. Khutsishvili joined the Institute of Physics of the Academy of Sciences of the Georgian SSR and, from 1958, was the Head of the Division of Theoretical Physics of this institute. He was elected Corresponding Member of the Academy of Sciences of the Georgian SSR in 1967 and, from 1956 until his death, was professor at Tbilisi University.

G. R. Khutsishvili's scientific interest covered an exceedingly broad range. However, his attention was concentrated on one of the topical problems in modern physics, namely the theory of magnetic resonance, magnetic relaxation, and nuclear orientation in solids. His work and that of his school led to many valuable results on the structure of solids, the magnetic structure of ferro- and antiferromagnets, intracrystalline fields, phase transitions, electronic structure of lattice defects, and so on.

G. R. Khutsishvili's work on diffusion and relaxation of nuclear spins in nonmetallic diamagnetic crystals containing magnetic impurities made him world famous. Spin diffusion is important in the relaxation and dynamic polarization of nuclei. In the course of relaxation, nuclei lying near magnetic ions rapidly assume equilibrium with the lattice. Because of spin diffusion, this is accompanied by the transport of equilibrium nuclear magnetization to distant nuclei. In the spin diffusion problem, which he solved as far back as 1954, he first showed that the nuclear spin system could be characterized by a single relaxation time. He emphasized the necessity for introducing a new parameter with the dimensions of length. Direct relaxation predominates at distances from the magnetic ion that are smaller than this parameter. At larger distances, spin diffusion predominates. This work, published 25 years ago, is still significant and is quoted in monographs on the theory of magnetic resonance in its original form. In 1971, G. R. Khutsishvili and his pupils generalized these results by including effects due to the heating of the dipole reservoir of magnetic ions, the phonon bottleneck, the inhomogeneous broadening of the EPR line, and the presence of rapidly relaxing exchange-coupled pairs of magnetic ions. These results are widely known and have been successfully used in the interpretation of experimental data.

G. R. Khutsishvili's paper on the quasithermodynamic theory of magnetic resonance is of fundamental impor-

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tance. In it, he pointed out that it is essential to divide the spin system of a solid into two subsystems, one of which combines the external (Zeeman) and the other the internal (spin-spin) degrees of freedom, G. R. Khutsishvili used this representation to investigate magnetic relaxation. Subsequently, it became clear that this subdivision was also of decisive importance in relation to the saturation of magnetic resonance, the dynamic polarization of nuclei, and so on. These ideas lie at the basis of modern theory of magnetic resonance.

All those concerned with radiospectroscopy were particularly interested in G. R. Khutsishvili's work during 1968–1970 on the spectroscopy of forbidden EPR transitions. If the energy of the hyperfine interaction of a magnetic center and a nucleus is of the same order as the nuclear Zeeman energy, the probability of "forbidden" EPR transitions, i.e., transitions in which there is a change in both the electron and the nuclear spins, is of the same order as the probability of allowed transitions. G. R. Khutsishvili developed the theory of forbidden EPR transitions with allowance for anisotropy effects and showed that these transitions could be used to explain the phenomenon of discrete saturation of inhomogeneously broadened EPR lines, which was discovered experimentally at Tbilisi State University. By comparing theoretical and experimental results on discrete saturation, it is possible to obtain information on the hyperfine interaction between a magnetic center and neighboring nuclei. For this work, G. R. Khutsishvili was awarded the Melikishvili Prize.

G. R. Khutsishvili was one of the originators of the method of polarizing the nuclei of ferromagnetic atoms. This method was put forward in 1955 independently by G. R. Khutsishvili and the British physicist, N. Kurti. G. R. Khutsishvili's work between 1966 and 1972 on the quantum-statistical analysis of the saturation of resonance and dynamic polarization of nuclei in the case of inhomogeneously broadened EPR lines is a significant contribution to science. These calculations took into account the dipole reservoir of spins and spectral diffusion along the EPR line. This work was rewarded in 1977 by the State Prize of the Georgian SSR.

G. R. Khutsishvili was the creator of the well-known theoretical school devoted to magnetic resonance in Georgia. He was the author of 70 papers, including 7 reviews devoted to nuclear orientation, the Overhauser effect, spin diffusion and nuclear relaxation.

The fundamental results obtained by G. R. Khutsishvili in the radiospectroscopy of condensed media attracted attention and made him known worldwide. He has close contacts with leading scientific centers in the USA, England, France, Holland, and Finland, where he frequently lectured. He was a member of the Coordinating Scientific Committees of the Academy of Sciences of the USSR on Solid State Physics, Radiospectroscopy of Condensed Media, and Low-Temperature Physics. He was Chairman of the Coordinating Committee of the Academy of Sciences of the Georgian SSR on the Problem of Solid State Physics and Chairman of the Specialist Committee of Tbilisi State University on the Award of Doctorates in Physico-mathematical Sciences. He also was an active member of the European AMPERE Society and a member of the Editorial Board of Physica.

G. R. Khutsishvili made an invaluable contribution to the education of scientists in Georgia. For many years, he worked hard and successfully at Tbilisi State University. Several generations of Georgian physicists have attended his lectures and seminars at which they learned the theoretical foundations of modern physics. He gladly shared his extensive and deep knowledge, and contributed extensively to the creation and development of many new branches of physics in the Georgian Republic.

Despite his heavy load, G. R. Khutsishvili found time to lecture at the pedogogical institutes at Telavi, Gori, and Batumi. It is difficult to overestimate the help he gave to secondary schools in many distant parts of Georgia by introducing talented youth to modern science. In the course of the last few years, G. R. Khutsishvili carried out a noble mission by becoming the scientific patron of the Kakhskaya and Alibegdoĭskaya secondary schools in Georgia.

The life of Givi Razhdenovich Khutsishvili was an example to us all. He played a major role in developing the attitudes and ways of thinking of his pupils and collaborators. He was a man of uncompromising principle, whose purity of thought and action led those surrounding him to regard him with great warmth and affection.

We have prematurely lost a remarkable man and scientist, who will be greatly missed.

Translated by S. Chomet