Boris Petrovich Zakharchenya (on his sixtieth birthday)

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The sixtieth birthday of Boris Petrovich Zakharchenya, a major Soviet physicist, Corresponding Member of the USSR Academy of Sciences, recipient of Lenin and State prizes, head of the department of electrical and optical phenomena in solids at the A. F. Ioffe Physicotechnical Institute of the USSR Academy of Sciences, was celebrated on May 1, 1988.

B. P. Zakharchenya was born in the town of Orsha (Belorussia) into a family of a military engineer. In 1932 his family moved to Leningrad, where Boris Petrovich completed high school in 1947 and entered the physics department at Leningrad State University. Already in his undergraduate years he became interested in optics. After graduating from university in 1952, B. P. Zakharchenya transferred to the Physicotechnical Institute where he began working in the laboratory of E. F. Gross, a Corresponding Member of the USSR Academy of Sciences, whom he considered his teacher. A year earlier, E. F. Gross and N. A. Karyev observed a hydrogen-like absorption line in cuprous oxide crystals, which Gross interpreted as the optical spectrum of an exciton—the quasiparticle predicted by Ya. I. Frenkel' in 1931. B. P. Zakharchenya actively joined in the research into the properties of this new semiconductor quasiparticle. In a short period of time he discovered a number of effects that elucidated the properties of the electron-hole pair bound by the Coulomb interaction and anticipated further developments in semiconductor optics and spectroscopy. In 1952 he observed two hydrogen-like series in thin cuprous oxide single crystals: this was the first experimental confirmation of valence band splitting in cubic semiconductors.

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In 1954 B. P. Zakharchenya discovered the exciton Stark effect and exciton ionization in weak external fields. These experiments, which proved the existence of weakly-bound quasiparticles in semiconductors, were the first to study the effect of external electric field on the optical spectra of semiconductors.

B. P. Zakharchenya was the first to observe the Zeeman splitting of exciton lines and (in 1956) their diamagnetic shift, consisting of the strong displacement of Zeeman components towards the ultraviolet spectral range. Normally this phenomenon is not observed in the spectra of isolated atoms, as the diamagnetic level shift is due to a relativistic correction and is consequently very small. Excitons states in semiconductors, on the other hand, can have radii of several thousand angströms and the shift is easily observed. In modern semiconductor optics this effect is so commonplace that the name of its discoverer has been forgotten.

In 1957, together with E. F. Gross, B. P. Zakharchenya discovered magneto-absorption oscillations in cuprous oxide. (This phenomenon was independently observed in germanium crystals by American physicists Lakes and Zwerdling, and in indium antimonide by Burshtein and Pikus.)

In 1961, simultaneously with and independently from the American physicists Thomas and Hapfield, B. P. Zakharchenya observed the phenomenon of magnetic field inversion in the exciton spectrum of a semiconductor without an inversion center of symmetry. This effect consists of the shift and the sharp intensity change of Zeeman components when the direction of the magnetic field is reversed and the magnetic field is perpendicular to the light beam. The inversion effect was the first convincing demonstration of exciton motion in crystals and played a major role in the development of theories on the spatial dispersion in crystals.

In the 1960s B. P. Zakharchenya conducted magnetooptic studies of excitons in his laboratory, employing diverse types of equipment, including strong pulsed magnetic fields. Together with R. P. Seisyan he carried out a series of studies of diamagnetic exciton spectroscopy. Simultaneousl, he worked on the experimental and theoretical foundations of Zeeman spectroscopy of ionic crystals doped with rare earth ions (lasing media).

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In 1970, on the initiative and with the personal participation of B. P. Zakharchenya, the Physicotechnical Institute embarked on a research program into the optical orientation of electronic and atomic spins in semiconductors. In the course of this research he discovered, together with V. G. Fleĭsher and others, many new physical effects: radiation cooling of nuclear spin systems, hole orientation, quadrupole interaction in semiconductors, multispin resonances, photocurrent due to asymmetric scattering of oriented electrons, etc. A new field of semiconductor physics came into existence—dynamics of the electron-nuclear spin system oriented by light. The concepts of optical orientation contributed to the development of new, sensitive experimental methods in the study of electronic processes in semiconductors and to uniquely promising methods of controlling multilayered device structures.

In 1976, together with D. N. Mirlin and others, B. P. Zakharchenya was the first to record luminescence spectra of hot photoelectrons in semiconductors. Further studies in this area and their theoretical development by V. I. Perel' and M. I. D'yakonov have led to the evolution of a new research field: the magnetooptic spectroscopy of femtosecond (10^{-15} s) processes in semiconductors. Hot luminescence spectroscopy opened up new horizons in the studies of semiconductor band structure and the precise determination of band constants of which only rough estimates were previously available. Research in this field was taken up by many scientists in large American, West German, and French laboratories.

From the early 1970s onwards, B. P. Zakharchenya, F. A. Chudnovskiĭ and co-workers have carried out detailed studies of the technological applications of metal-semiconductor phase transitions in transition metal oxides. They developed and constructed machines to visualize IR and UHF radiation, as well as optical correlators, electron beam-controlled spatial modulators for lasers, media for dynamic holography, and erasable disks that could be encoded using heterojunction lasers.

In recent years B. P. Zakharchenya's laboratory has successfully studied phenomena in high-temperature semiconductors.

In addition to intensive research, B. P. Zakharchenya has devoted much attention to teaching. He is a professor in the optoelectronics faculty of the V. I. Ul'yanov-Lenin Electrotechnical Institute in Leningrad. He is also the executive editor of Solid State Physics (Leningrad) and a member of a number of scientific councils at the USSR Academy of Sciences.

It would appear that the great scientific, pedagogic, and organizational workload would leave Boris Petrovich practically no time for other, leisure pursuits. And yet he has a lively interest in and a deep understanding of literature and art. His oral presentations devoted to older scientific colleagues and his articles on the history of physics are graced by acute observations and colorful, precise definitions.

On his sixtieth birthday, the colleagues, co-workers, and friends of Boris Petrovich Zakharchenya wish him good health and new successes for the good of Soviet physics.

Translated by Alexander Zaslavsky