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IN MEMORIAM

In the Memory of Boris Andreevich Volkov

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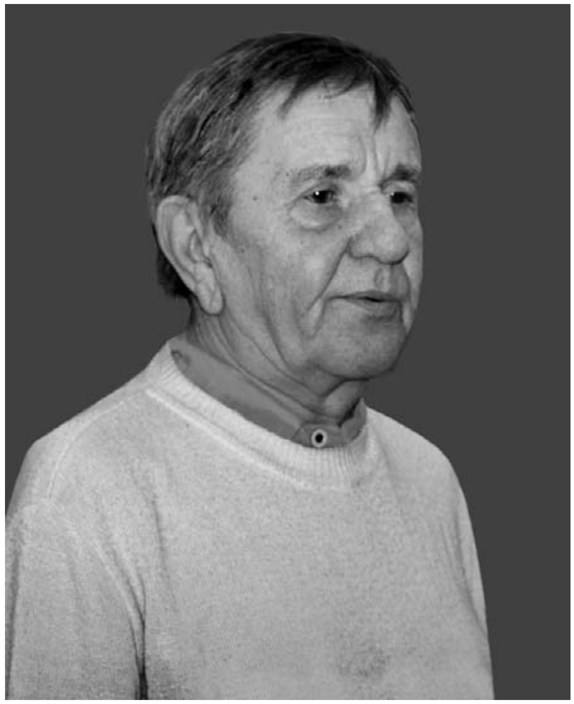

Boris Andreevich Volkov passed away on May 31, 2009. He was an outstanding scientist, doctor of physics and mathematics, and leading researcher at the Lebedev Physical Institute of Russian Academy of Sciences.

In 1964, B.A. Volkov graduated from Moscow Power Institute; in 1976, he defended his candidate thesis; and, in 1983, his doctorate thesis. From 1966 on, Volkov worked at the Department of Theoretical Physics (Lebedev Physical Institute, Russian Academy of Sciences); for many years, he was the head of the Department of Solid-State Theory within the Tamm Section of Theoretical Physics. The outstanding results obtained by Volkov were awarded the Soviet State Prize in 1985 and the Russian State Prize in 1995.

Volkov's scientific work was devoted to the quantum theory of solids and, in particular, to the physics of semiconductors. He was the author (or coauthor) of more than 100 scientific publications, among which there are six monographs (reviews). In the middle of the 1960s, Volkov suggested a model accounting for the causes of the decrease in the activation energy of impurities as their concentration is increased in classical semiconductors (silicon and germanium) under conditions of the band-related and hopping conduction. In the case of band-related conduction, this behavior is associated with an increase in the overlap of wave functions of impurities; in the case of hopping conduction, one has the effect of differences between polarizations of impurity pairs located far from or in the vicinity of a charged center. At the end of the 1970s and beginning of the 1980s, Volkov developed a theory of the origin of electron spectra and crystal structures of narrow-gap IV–VI semiconductors and Group-V semimetals. This theory made it possible to explain (from unified positions) the electrical, dielectric, and optical properties (considered previously as absolutely anomalous) of these materials; describe their phonon spectra; and reveal the cause of the ferroelectric phase transition in IV–VI semiconductors. Volkov used this theory to calculate the electron spectra and charge states of point defects (vacancies), which play a key role in controlling the electrical characteristics of these compounds. All these results were confirmed by experimental data. As a result of Volkov's studies, the physical properties of IV–VI semiconductors became as understandable as those of the classical diamond-like semiconductors germanium and silicon.

Publications by Volkov and his colleagues made it possible to gain insight into a completely new type of inhomogeneous semiconductor structures, i.e., inverse (supersymmetric) contacts, in the case of which inversion of the valence band and conduction band occurs at the interface between two IV–VI semiconductors with different compositions. In contrast to conventional quantum wells, the bound two-dimensional states appear in these contacts even if there is only a single interface between two media. These states are of interest due to the fact that they feature a Dirac spectrum, while the so-called “zero mode” existing in these states represents a massless neutrino-like state of the Weyl type. At present, interest in such states is stimulated by the discovery and studies of graphen. Unfortunately, only a few people know that many properties of these states and, in particular, their behavior in external electric and fields were studied long before graphen was discovered. It was also shown by Volkov et al. that a completely different type of dispersion-less two-dimensional electron states similar to heavy fermions can arise at domain walls in the ferroelectric state of IV–VI semiconductors. A number of interesting effects similar to those appearing in crystals with rare-earth atoms can be expected to arise in the above systems.

Recently, Volkov was actively engaged in the theory of Group-III impurities in IV–VI semiconductors and studied the phenomena of long-term relaxation of nonequilibrium charge carriers in these semiconductors. Volkov showed that there is a relation of these phenomena to the possibility of existence of two stable monovalent or trivalent states in chemical compounds of Group-III elements (indium, gallium). This scheme also makes it possible to naturally explain the nature of long-term relaxation of nonequilibrium charge carriers.

The overwhelming majority of Volkov’s studies were based on experiments and simulated further experimental studies.

Volkov was also engaged in scientific–organizational activity. He was the vice chairman of the Scientific Council of the Department of Theoretical Physics and a member of two councils of experts at the Lebedev Physical Institute (Russian Academy of Sciences). For a long time, he was the chairman of one of the most authoritative Moscow workshops dedicated to the solid-state theory at the Department of Theoretical Physics. Under Volkov’s guidance, nine candidate theses and two doctoral theses were defended.

Volkov’s devotion to science, broad scientific knowledge, willingness to render professional help, and benevolence brought him immense prestige and respect among his peers. Volkov possessed a remarkable ability to come to one’s aid in difficult circumstances.

May his memory live forever in the hearts of all his colleagues and pupils, and generally of all who knew him.

P.I. Arseev, M.A. Vasil’ev, L.V. Keldysh, Yu.V. Kopaev, E.G. Maksimov, M.V. Sadovskii, N.N. Sibel’din, R.A. Suris, L.A. Fal’kovskii, and D.R. Khokhlov

Colleagues and friends

The editorial board of the journal *Fizika i tekhnika poluprovodnikov*