

## In memory of Geliĭ Frolovich Zharkov

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Professor Geliĭ Frolovich Zharkov, a brilliant physicist, Doctor of Physicomathematical Sciences, Chief Research Scientist of the Division of Theoretical Physics at the P N Lebedev Physics Institute (FIAN), died on July 9, 2004.

Zharkov was born on December 19, 1926 in Chelyabinsk. His parents were CPSU functionaries. In 1934, the family moved to Moscow.

In June 1941, Nazi Germany attacked the USSR and the Great Patriotic War began. In the first months of the war Zharkov was evacuated to the city of Sverdlovsk in the Urals. By that moment the boy had completed six grades of school. In his two years in Sverdlovsk he taught himself the curriculum for the other four grades of high school (7–10), took the final exams, and received a high school graduation certificate.

In 1943, Zharkov enrolled in the Ferrous Metallurgy Department of the S M Kirov Sverdlovsk Industrial Institute. Having completed the freshman year, he returned to Moscow and was accepted into the sophomore year of the Department of Physics at Moscow State University. He graduated in 1948. The same year he took entrance exams to postgraduate courses of the P N Lebedev Physics Institute of the USSR Academy of Sciences and was accepted. His supervisor in the postgraduate years was M A Markov, who had earlier supervised his graduation thesis at the university.

In the first years of research work Zharkov worked on quantum field theory. His first paper [*ZhETF* 20 492 (1950) (*Sov. Phys. JETP*)] was devoted to the theory of the neutrino and antineutrino and the role that these particles play in beta-decay and other nuclear processes. He was able to show that double reflection for the fermion field can be considered an identity transformation and a rotation by  $2\pi$ , reducing to a reversal of sign. This led to four categories of spinors and to the possibility of formulating a theory of beta-decay in which there is no distinction between the neutrino and antineutrino.

In January 1952, Zharkov submitted and successfully defended his thesis for Candidate's degree entitled "Formation of a pair of  $\pi$ -mesons by a photon on nucleons". The purpose of the work was to interpret the experimental data already available at the time and to clarify a more general aspect of the convergence of higher-order approximations of the perturbation theory in the meson theory of nuclear forces. From 1952 onwards Zharkov worked in the Theoretical Physics Department of FIAN.

Over several subsequent years, Zharkov worked in various fields of quantum field theory and the theory of nuclear forces. His papers dealt with aspects of renormalization of divergent series, scattering of mesons and nucleons by nucleons, isobar theory, etc. These publications brought him recognition and respect from colleagues in the field.



Geliĭ Frolovich Zharkov  
(19.12.1926–09.07.2004)

However, approximately in the middle of the 1950s Zharkov began turning more and more to a very different branch of physics, namely, low-temperature physics and the theory of superconductivity. Beginning around the 1960 he switched completely to this field, which was a new area for him, and was again able to obtain many first-class results. We will mention some of them here. He carried out important research that allowed a description of the behavior of finite-sized superconducting systems in electromagnetic fields. Zharkov developed a theory describing hysteretic behavior of hollow superconductors in a magnetic field, constructed theories on finite-sized quantum interferometers and on weakly bound layered superconducting structures, proposed an explanation for the experimentally observed 'giant thermoelectric effect' in superconductors, and developed a theory on the interaction between nonequilibrium phonons and electrons in superconductors placed in a high-frequency external field. The monograph *Nonequilibrium Electrons and Phonons in Superconductors*, written by G F Zharkov and A M Gulyan, was devoted to nonequilibrium processes in superconductors. This book was also published in English.

Zharkov showed that in some cases experimentally established anomalies are caused by the finite size of real

superconductors. This conclusion proved to be very important for practical applications of superconductors.

The theory developed by Zharkov for the purpose of describing the properties of finite superconducting systems successfully explained a number of experimentally examined effects and has stimulated (and keep doing this) the staging new experiments. The brief summary of this phase of his research was recently published in *Phys. Usp.* 47 944 (2004).

The theory of finite superconducting systems proved mathematically much more complicated than the theory of infinite superconductors. Furthermore, a huge amount of computational work was needed to obtain descriptions of realistic specimens. Zharkov was one of the first in the Theoretical Physics Department of FIAN to learn to program and use the early mainframe computers, such as VAX, and later fast personal computers.

Zharkov occupied a very special place in FIAN's Theoretical Physics Department. The reason for this was his remarkable personality. He was a fairly laconic person, never used ornate eloquence as a tool, invariably focused on the gist of the subject under discussion. Being the deputy head of the department he was responsible for many aspects of department's daily life. His *modus operandi* was to execute all necessary actions in a way that would least distract colleagues from their work. The smooth working conditions in the department were thus to a high degree his achievement. Occasional disagreements among employees are nevertheless unavoidable, as different people have different interests and sometimes these interests clash. Zharkov possessed the skills required to help settle these disagreements, to help find solutions that would satisfy all parties. In the entire time of his work in the Theoretical Physics Department he was not known to have ever said anything offensive to any of his colleagues. And vice versa, nobody ever spoke ill of him. He was treated with love and respect.

The pre-Gorbachev Soviet Union was a country of rigid censorship. Each article sent for publication to a scientific periodical was to be accompanied with the censorship inspection sheet. This document certified that the article contained no data forbidden to appear in an unclassified publication. For this and only this purpose a commission composed of scientists of the department was set up, chaired by Zharkov. Without his signature, the inspection certificate would be invalid. As a rule, Zharkov signed the inspection sheet without as much as a glance at the text of the article and without removing his eyes from the computer monitor displaying the results of his computations. He regarded certification to be an unnecessary formality; however, the bosses demanded this formality and he complied but acted just as formally: you demand my signature — OK, here it is! No incidents ever arose due to this attitude.

For a long time Zharkov controlled the spending of a cash fund allocated to the department for urgent purchases. It happened sometimes that a colleague would approach him with a request to lend him some cash from this fund — typically not a very large sum, and as a rule for a short term only. Zharkov never refused; likewise, no-one ever let him down, even though Zharkov would not necessarily write down to whom he had lent the money and for how long.

In 1980, Andrei Dmitrievich Sakharov, also working in the Theoretical Physics Department, was exiled to Gorkii, a city on the Volga. Zharkov one day received a telephone call from a functionary of the personnel department of the Presidium of the USSR Academy of Sciences, who

demanded that he submit an official report to inform the personnel department that Sakharov had stopped coming to work. Such a report could be used as justification for dismissal — if a person failed to turn up for work, he was a shirker, and shirkers should be fired. However, Zharkov refused to write the report, supporting the refusal with the following argument: “Rules are in place that set down the daily routine throughout the Academy of Sciences. There is no rule stating that a Full Member of the Academy (Academician) should work in the office every day”. The functionary had nothing with which to counter the rebuttal.

Zharkov's work in the Theoretical Physics Department lasted for more than half a century. Whenever his age approached an ‘anniversary number’ — 50, 60, 70 — people would invariably start saying that the entire staff of the department should take part in a jubilee celebration. But each time this met with Zharkov's adamant objections, and each time he succeeded in avoiding the jubilee. Likewise, he invariably refused offers to nominate him as candidate for elections to the Russian Academy of Science.

His devotion to science was absolute — ‘body and soul’. He could always be found in his office — a small cramped room containing a desk, bookcases, a computer (two computers in the last years) and two chairs — one for himself, the other for a visitor. Nothing more, and no extra space for anything else. He never missed a departmental seminar. At seminars he was true to himself — listening silently; if he decided to say something, it was invariably a relevant and essential remark.

For many years Zharkov held the position of Executive Secretary of the Editorial Board of the *Journal of Experimental and Theoretical Physics*. The highest reputation of this journal is a measure of the success of its Editorial Board and of Zharkov as its member.

Zharkov's death was as painful a loss for physics as it was personally for many people. All of us grieve his departure with much sorrow. At the same time, the memory of Geliĭ Frolovich Zharkov, a warm and kind person so devoted to science, will strengthen us in these difficult times.

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