

Vitalii Dmitrievich Shafranov (on his sixtieth birthday)

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December 1, 1989 is the 60th birthday of Vitalii Dmitrievich Shafranov—one of the founders of the modern theory of high-temperature plasma and one of the pioneers of the problem of controlled thermonuclear fusion, Corresponding Member of the Academy of Sciences of the USSR, editor-in-chief of the journal "Fizika Plazmy" (Soviet Journal of Plasma Physics in AIP translation), head of the division of plasma theory at the I. V. Kurchatov Institute of Atomic Energy.

V. D. Shafranov was born in the village of Mordvinovo in Ryazan' region. In 1946 he entered the physics faculty of the Moscow State University. At the beginning of 1952 he was assigned to work at the laboratory for measuring instruments of the Academy of Sciences of the USSR (now I. V. Kurchatov Institute of Atomic Energy) in the then still quite small (six persons) theoretical sector of M. A. Leontovich and actively participated in the just recently initiated work on the "magnetic thermonuclear reactor" proposed by A. D. Sakharov and I. E. Tamm. The young theoretician V. D. Shafranov was soon fated to play a key role in these investigations.

In any large-scale "multicomponent" scientific problem there are always key components and decisive obstacles. For the controlled thermonuclear fusion problem the principal one of these was the creation of an entirely new artificial material object—a long-lasting high-temperature plasma filament stably confined by a magnetic field. The basic theoretical investigations which opened the path towards a successful solution of this most difficult problem—the creation of a toroidal "Tokamak" system was carried out by V. D. Shafranov. The development of the magnetohydrodynamic theory of the equilibrium and stability of plasma configurations in closed magnetic systems is one of the central areas of the entire modern physics of controlled thermonuclear fusion and it became the life work of Vitalii Dmitrievich and the main direction of the work of the scientific school guided by him.

In that amazingly beautiful world which was opened up by the physics of hot plasma the problem of guaranteeing equilibrium and stability of plasma configurations confined by a magnetic field has been and remains one of the fundamental problems. Among them the toroidal configurations are distinguished by their deceptive simplicity. In the analysis of specifically these systems which are most difficult to investigate Vitalii Dmitrievich succeeded in obtaining basic results. Among the investigations that have become classical are the Shafranov-Grad equation, that made possible the overview of the entire problem of symmetric plasma configurations, and the pioneering studies of the stability of a plasma filament that led to the very important Shafranov-Kruskal criterion which became the theoretical foundation of the Tokamak. For this work in 1958 Shafranov on defending his candidate's dissertation was directly awarded the degree of Doctor of Physico-mathematical sciences.



Vitalii Dmitrievich
Shafranov

For over thirty years Shafranov has been publishing investigations and reviews on the theory of equilibrium and stability of toroidal plasma systems that are both elegant in form and deep in content. Physicists all over the world participate in the elaboration of Shafranov's investigations often proceeding along the paths laid out by Shafranov. For them the methodology and the results of Shafranov's work retain their undiminished scientific significance. The physical richness of this direction at times appears to be simply inexhaustible. A very significant contribution to its development is also made by Shafranov's pupils.

It is very characteristic of the breadth and lack of bias of the scientific opinions of V. D. Shafranov that within the overall framework of the theory of confinement of plasma in toroidal magnetic systems he and his school have been developing in detail problems not only of "their own original" Tokamak, but also, and in ever increasing measure, of the initially "foreign" stellarator systems.

The range of Shafranov's plasma interests is not restricted to the theory of equilibrium and stability. He has also carried out important investigations on the propagation

of electromagnetic waves in plasma and is the author of one of the trail-blazing investigations on the structure of shock waves in plasmas, etc.

The fruitful work of Shafranov in the field of plasma physics has been acknowledged by the State (1971) and Lenin (1984) Prizes. In 1981 he has been elected a Corresponding Member of the Academy of Sciences of the USSR.

Shafranov has earned a high degree of authority by his scientific-social activity, and particularly by his editorial work. His work starting with 1983 as the editor-in-chief of the journal "Fizika Plazmy" has in many ways been responsible for the international popularity of this journal. This work is inseparable from Shafranov's knack, while always preserving scientific integrity, of patiently bringing into agreement different, and sometimes mutually contradictory positions of the authors. Within the framework of "Itogi nauki i tekhniki" (Achievements of science and technology) published by VINITI (All Union Institute of Scientific and Technical Information) Shafranov is the editor of the series "Fizika plazmy" (Plasma Physics). By now already 8 volumes of the series have been published each of which contains several fundamental reviews. Shafranov is also a mem-

ber since its foundation (1961) of the editorial board of the international scientific journal "Nuclear Fusion" published by the IAEA. His activity as a member of the Council of the Academy of Sciences of the USSR on the problem "The Physics of High-Temperature Plasma" and of the Science Council of the I. V. Kurchatov Institute of Atomic Energy has been both constant and significant.

V. D. Shafranov is a man of great erudition, of varied interests and talents. Suffice it to say that he is one of the originators of the very rich folklore in verse describing the complex crossroads of the controlled thermonuclear fusion problem ("... a brilliant physicist, a brilliant poet too—such union is magnificent indeed!"... this is about him).

And yet for Vitalii Dmitrievich—a hardworking, benevolent and unusually modest man—it is always science that remains the aim and the meaning of life.

In these anniversary days we from the bottom of our hearts wish for Vitalii Dmitrievich health, prosperity and new creative inspirations.

Translated by G. M. Volkoff