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Vladimir Sergeevich Imshennik (on his 80th birthday)

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September 27, 2008 was the 80th birthday of Corresponding Member of the Russian Academy of Sciences (RAS), Professor Vladimir Sergeevich Imshennik, an outstanding specialist in astrophysics, plasma physics, and thermonuclear fusion. V S Imshennik's present research is focused on physical processes in stars, their internal structure and hydrodynamic evolution, including gravitational collapse and supernova explosions, and radiative and neutrino hydrodynamics.

Vladimir Sergeevich was born on September 27, 1928 in the city of Debal'tsevo (Ukraine). His farther, Sergei Vladimirovich Imshennik, worked there as an engineer at a mechanical factory; his mother, Antonina Aleksandrovna Imshennik, was a housewife. Later his family moved to the Ural, and in 1932 to Moscow.

His scientific activity began in the first years after the Great Patriotic War. At the end of the war, VS (as colleagues and pupils of Vladimir Sergeevich have called him already for many years) was recruited into the army, but never participated in battles because of the end of the war.

In 1946, he graduated from school No. 150 of the Leningrad district of Moscow with gold medal distinction and enrolled (without entry exams) in the Department of Physics of Moscow State University, which he graduated from in 1951. It was an outstanding graduation. Vladimir Sergeevich studied together with G A Askaryan, S S Gershtein, B B Kadomtsev, A A Logunov, Yu K Pozhela, L N Rykunov, S I Syrovatskii, V D Shafranov, and I F Shchegolev. After having graduated from the university, VS took a position within the state project on constructing a thermonuclear weapon. He started his scientific activity in Obninsk in the group headed by D I Blokhintsev and then was moved to Chelyabinsk-70 (presently the city of Snezhinsk). During his work on the thermonuclear project, he was lucky to collaborate with outstanding physicists Ya B Zel'dovich, D A Frank-Kamenetskii, and A D Sakharov. The astonishing atmosphere of creative scientific competition, responsibility, and high moral norms helped to develop VS's talent as a theoretical physicist.

Virtually simultaneously with his teachers, and guided by his heart and soul, he made the 'underbarrier' transition from 'Arzamas' to stars, from bringing the death and devastation of nuclear explosions on the Earth to stellar explosions which send us invaluable information on the fundamental properties of matter under extreme physical conditions.

For almost 18 years (from the beginning of the 1960s), VS worked at the Institute of Applied Mathematics of the USSR Academy of Sciences, then headed by M V Keldysh. There, VS studied the structure of collisional shock waves in plasmas, the theory of radiation transfer in moving media, and magnetohydrodynamic (MHD) plasma cumulation. In particular, he performed numerical simulations of plasma dynamics in *Z*-pinches and in the plasma focus in the framework of one- and two-dimensional MHDs, which was unique at that time, while also using the Vlasov kinetic equations. Research carried out by VS at that time laid the foundation for the theory of computer plasma physics. To this day they serve as a source of new ideas and underlie separate areas of theoretical research.

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In parallel, VS and his pupils and colleagues studied hydrodynamic processes and neutrino transport in stars. They founded the basics of the hydrodynamic theory of optical light curves of supernovae (1964 – 1971) and the neutrino burst accompanying a supernova explosion (1969 – 1978). The theory was developed to the point where a detailed comparison with observations was made possible. It became clear why supernovae shine for such a long time (several dozens of days) and are so bright (as all the stars in the Galaxy taken together!). It was also predicted that supernovae from the explosions of stars with a compact structure must be much fainter than those from explosions of giant stars. Foreign astrophysicists came to the same conclusions only 10 years later. Methods of radiative gasdynamics developed by VS

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were applied to studies of the interaction of neutrino emission with the superdense matter of collapsing stellar cores. He laid the foundation for a new field of theoretical physics — neutrino gasdynamics.

Observations of a nearby supernova in the Large Magellanic Cloud that exploded on February 23, 1987 and is catalogued as SN 1987A successfully confirmed the theory. A detailed description of the bulk of astronomical observations of SN 1987A and their comparison with the theory are presented in a review written by V S Imshennik and D K Nadyozhin for *Usp. Fiz. Nauk* **156** 561 (1988) [Translated into English in *Soviet Scientific Reviews*, Ser. E Astrophysics and Space Physics, Vol. 7, p. 75 (1989)]. Due to the proximity to the Solar System, the supernova appeared very bright, but in absolute units was significantly fainter than many supernovae detected in remote galaxies — the result of the compact structure of the star before the explosion. Theoretically predicted cooling and hydrogen recombination waves in the expanding supernova shell were also registered. Underground neutrino detectors registered a neutrino burst with integral characteristics similar to those evaluated theoretically. However, it was unclear why the neutrino signal from SN 1987A included two pulses separated by a time interval of 4.7 hours, which is enormously long in comparison with the characteristic cooling time of a neutron star, which is close to 10 – 20 seconds. In 1992, VS began developing a theoretical model capable of answering this question. In the subsequent series of papers written in collaboration with his colleagues, it was shown that the problem could be tackled by taking into account the rapid rotation of the collapsing stellar core, which results in its splitting into two neutron stars. The time interval of 4.7 hours must thus be the characteristic time of the evolution of such a binary neutron star system driven by the energy and orbital angular momentum loss due to emission of gravitational waves.

In 1979, VS moved to work at the Institute for Theoretical and Experimental Physics (ITEP) as the head of the recently organized Laboratory of Inertial Thermonuclear Fusion (which was later renamed the Laboratory of Plasma Physics and Astrophysics), where he works up to now and divides his interest between 'terrestrial' and 'space' physics. Since 1979, VS has led theoretical studies at ITEP on targets of heavy-ion nuclear fusion and physical processes in dense nonideal plasma. The method of mathematical modeling of physical processes in the thermonuclear target was developed under his leadership.

The above-mentioned scientific results produced by V S Imshennik demonstrate the wide field of his scientific interests and the top level of research. Some scientific results obtained by VS and his collaborators are published in the monograph *Radiative Relativistic Gasdynamics of High-Temperature Phenomena*, written together with Yu I Morozov (Moscow: Atomizdat, 1981) and in the book *Dynamics of Collisional Plasma*, co-authored by N A Bobrova (Moscow: Energoatomizdat, 1997).

Results obtained by V S Imshennik on cosmic plasma MHDs were applied to the theory of solar flares. They were included in the series of papers under the leadership of S I Syrovatskii, which were awarded in 1982 the USSR State Prize.

In 2001, V S Imshennik was awarded the A D Sakharov Gold Medal of the RAS, and in 2007 he was awarded the V Struve Medal of the Pulkovo Observatory of the RAS. In 2003, Vladimir Sergeevich was elected an RAS Corresponding Member.

Vladimir Sergeevich is carrying out with enthusiasm much pedagogical and social work as the Head of the Theoretical Astrophysics and Problems of Thermonuclear Physics Chair at the Moscow Institute of Physics and Technology (MFTI). He is a member of the editorial board of the journal *Astronomy Letters* and of several scientific councils. About two dozen of his students have become candidates and doctors of sciences. So it is quite natural that when the system of support of the leading scientific schools in our country was initiated, the scientific school headed by Vladimir Sergeevich Imshennik was among the first to receive state support.

There is a special attitude toward VS among the people who closely know him or have met him at conferences or read his papers. This especially respectful attitude towards him stems not only from the high estimation of his scientific activity, but also from the astonishing combination of his human qualities. His co-workers highly value the extremely helpful climate he created among the staff.

VS is a master storyteller. One can listen to him for hours. In his stories, the trustful, objective, exciting history of science emerges. When listening to VS's stories, Alexander Pushkin's phrase comes to mind: ''History is alive in the fables of gentle families.''

VS has immense respect for the work of other scientists, his evaluation of scientific papers being based exclusively on the impact and quality of the results, so his high estimation of the work of colleagues is akin to a high award from the scientific community. But he is the strictest regarding his own work.

Let us wish Vladimir Sergeevich further successful scientific and pedagogical activity.

S I Blinnikov, N A Bobrova, D A Varshalovich, S S Gershtein, G T Zatsepin, V A Matveev, D K Nadyozhin, L B Okun, O G Ryazhskaya, P V Sasorov, R A Sunyaev, V P Utrobin