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PERSONALIA

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In memory of Aleksei Maksimovich Fridman

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Aleksei Maksimovich Fridman, Full Member of the Russian Academy of Sciences, died after a long illness on 29 October 2010 at the age of seventy.

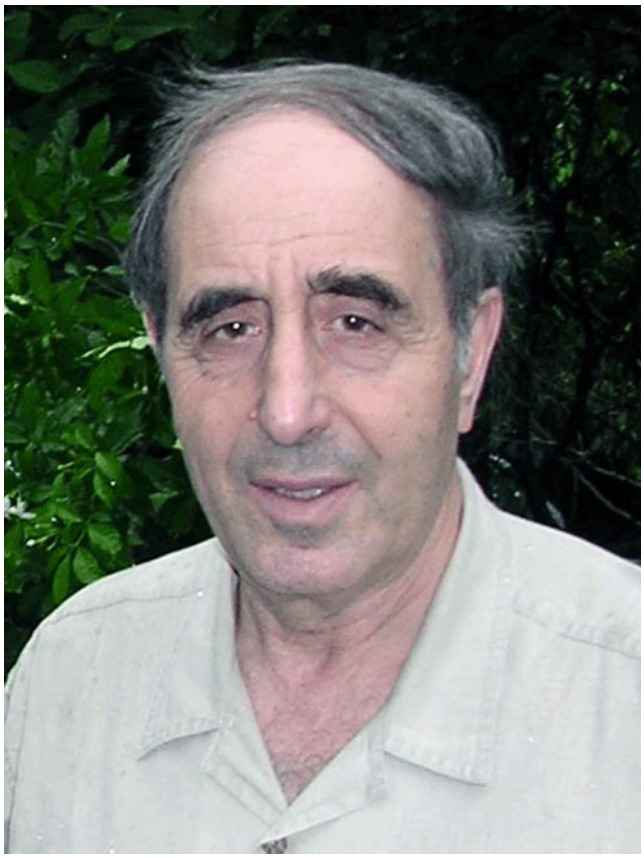
A M Fridman was born on 17 February 1940 in Moscow. In 1963, he graduated from Novosibirsk State University. In 1966, he defended his PhD thesis, ''Some aspects of stability theory for inhomogeneous plasma in a magnetic field'', and in 1972 his DSc thesis, ''The stability theory of the gravitating ionized phase''.

In 1976, A M Fridman was awarded the title of Professor, in 1994 he was elected a Corresponding Member of the Russian Academy of Sciences (RAS), and in 2000 he became a Full Member of the RAS.

Between 1966 and 1971, A M Fridman worked at the Institute of Nuclear Physics of the Siberian Branch of the USSR Academy of Sciences (Novosibirsk), between 1971 and 1979 he headed the Laboratory of Dynamics of Space Plasma at the Institute of Terrestrial Magnetism and Radio Wave Propagation of the Siberian Branch of the USSR Academy of Sciences (Irkutsk), and in 1979 he started working at the Institute of Astronomy of the RAS (Astronomical Council of the USSR Academy of Sciences, Moscow), where in 1986 he became Head of the Department of Physics of Stellar and Planetary Systems.

In recent years, Aleksei Maksimovich had also headed the Institute of the Physics of Stochastic Structures of the Russian Research Centre 'Kurchatov Institute', and was for a long time the scientific supervisor of the research station of the RAS Joint Institute for High Temperatures (Kyrgyzstan). He was professor at Moscow State University and the Moscow Institute of Physics and Technology, a member of the International Astronomical Union and other international scientific organizations, and Chairman of the Commission on Astrophysics of the International Union of Pure and Applied Physics. Among his students we find ten professors and DSc scientists and 26 PhD researchers.

A M Fridman published more than 250 papers on plasma physics, quantum solid-state physics, theoretical physics, cosmology, relativistic astrophysics, the general aspects of gravitational physics, the dynamics of stellar systems, gravitational hydrodynamics, nonlinear dynamics (solitons, shock waves, vortices, turbulence), the gas dynamics of galactic disks, the question of the formation of the spiral structure of galaxies, and the laboratory simulation of the formation of the spiral-vortex structure in a device with rotating shallow water; he also worked on the issues of the modeling of the Galaxy, the dynamics of accretion disks, cosmogony, the physics of planetary rings, the space dynamics of stretched structures, and terrestrial seismic activity. He is the author of eight monographic reviews and four monographs: *Equilibrium and Stability of Gravitating Systems* (Moscow: Nauka, 1976), the two-volume *Physics of Gravitating Systems* (New York: Springer-Verlag, 1984), *Physics of Planetary Rings* (Moscow: Nauka, 1994; New York: Springer-Verlag, 1999), and *Instabilities of Gravitating Systems* (Moscow: Akademiya, 1998).



Aleksei Maksimovich Fridman
(17.02.1940 – 29.10.2010)

A M Fridman together with his students created a linear theory of stability of classical equilibrium figures of collisionless stellar systems and laid the foundations of nonlinear theory of stability and the turbulence of a gravitating medium. As a result, the range of parameters has been defined in which stellar systems of different geometries may exist (and remain stable). In addition to the only previously known 'Jeans' type of instability of a gravitating medium, A M Fridman discovered a new class of multiple 'non-Jeans' instabilities; some of them evolve over times much shorter than the Jeans time, while others exist in Jeans-stable systems.

Contrary to the present-day opinion of the inevitable collapse of gravitational perturbations with wavelengths exceeding a certain critical value, A M Fridman (together with V L Polyachenko) discovered a new type of 'out-of-phase' natural oscillations existing in the real multicompo-

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nent gravitating medium in the form of noncollapsing waves with a wavelength longer than the critical one; this would be impossible in a one-component medium.

A M Fridman was the first to show that, in the presence of dissipation, gravitating systems allow for the existence of solitons which transform into 'gravitating' shock waves. Contrary to the traditional view of the impossibility of the existence of shock waves in stellar systems owing to their collisionless nature, A M Fridman proved the occurrence of 'collisionless' shock waves in rotating stellar disks where the size of epicycles plays the role of mean free path.

A M Fridman was the first to prove in his papers that the nonlinear Landau damping is, in principle, possible in stellar systems.

In the physics of planetary rings, A M Fridman (in collaboration with N N Gor'kavyi) developed the transport theory and theories of collective and resonance processes in the system of inelastically colliding gravitating particles, which enabled them to explain the hierarchical structure of Saturn's rings and the resonant nature of the rings of Uranus, and to predict the existence of a series of small satellites around Uranus. Later on, their theoretical predictions were confirmed during the flyby of Uranus by Voyager-2: nine of the ten satellites discovered by Voyager-2 were found in the region predicted by Fridman and Gor'kavyi; moreover, four of these were on the precalculated orbits (the deviations of the true orbits from the predicted ones were less than 0.5%).

A M Fridman and his colleagues derived a hydrodynamic theory of the generation of the spiral structure of galaxies. A M Fridman initiated the simulation of the process using dedicated facilities with rotating 'shallow' water and took part in this project at the Russian Research Centre 'Kurchatov Institute'. On the basis of this experiment, he (and colleagues) predicted the occurrence of giant anticyclonic vortices in the disks of spiral galaxies.

The predicted giant anticyclones were identified by A M Fridman and a group of astrophysicists using the 6-meter telescope (BTA-6) of the Special Astrophysical Observatory of the RAS (SAO RAS) on the galactic maps of radial velocities in the course of the observations program suggested by A M Fridman. To achieve this, he and his colleagues specially developed a method of determining the total (three-dimensional) vector field of velocities of galactic disks, using only one observational velocity component (along the line of sight). The researchers also predicted giant cyclones in galaxies, and they were indeed found with the SAO 6-m telescope applying the above technique.

A M Fridman and O V Khoruzhyi constructed the nonlinear dynamics of astrophysical disks, which implies both the formation of single and dipolar vortices in disks, and a new type of accretion, namely acoustic drift, whose main features have by now been discovered both in planetary rings and in the gas disk of our Galaxy.

A M Fridman developed the theory of weak turbulence for rotating gravitating systems, which implies observed correlations between the main parameters of gas clouds and their structures in the Galaxy, and the observed mass spectrum of the clouds.

Among the three strongest hydrodynamic instabilities, A M Fridman discovered two (the centrifugal and the overreflection instabilities). He also revised the third, the Kelvin–Helmholtz, instability for real systems.

A M Fridman supervised a series of experiments designed around an experimental pool at Tel Aviv University and aimed at simulating and preventing the destruction caused by tsunami waves on the ocean coast.

A M Fridman had predicted the existence of Alfven solitons, developed the theory of stability of thermonuclear plasma at finite and high pressures and the theory of gravitating systems, made important contributions to the theory of the three strongest hydrodynamic instabilities, predicted the existence and the basic parameters of new satellites of Uranus and new structures in galaxies, namely giant cyclones and anticyclones, discovered two components of terrestrial seismic activity, and proposed a method of protection of coastal zones from destruction by tsunamis.

A M Fridman's work brought him a number of Russian and foreign distinctions and awards:

the USSR State Prize for the "prediction of new satellites of Uranus based on the new theory of collective and collisional processes in planetary rings", 1989 (jointly with N N Gor'kavyi);

the RF State Prize in Science and Technology 2003 for the "prediction and discovery of new structures in spiral galaxies", 2004 (jointly with V L Afanas'ev, S N Dodonov, A V Zasov, V L Polyachenko, O K Sil'chenko, E N Snezhkin, O V Khoruzhyi);

the State Prize of the Russian Federation in Science and Technology 2008 (jointly with D A Varshalovich and A M Cherepashchuk) for fundamental discoveries in the physics of galaxies, the intergalactic medium and relativistic objects;

the Russian Independent Award Triumph for the important contribution to the progress of science in Russia and the world (2008), and

the Manas Order (the highest state award of the Kyrgyz Republic) in 2004.

Aleksei Maksimovich always had a phenomenal ability to work intensely and productively, as well as inexhaustible energy and a fanatical devotion to science. He was a charming and interesting person, was kind and attentive to people, and was a connoisseur of fine arts. Even in his last years, fighting a grave illness, Aleksei Maksimovich Fridman remained faithful to science and immersed himself with his usual passion into solving new problems in the physical sciences. His departure from life leaves a painful void for scientists in Russia and abroad. We shall always remember our colleague and friend with warmth and gratitude.

A F Andreev, S N Bagaev, A A Boyarchuk,
D A Varshalovich, E P Velikhov, N S Kardashev,
M Ya Marov, V A Matveev, G A Mesyats,
Yu S Osipov, A M Cherepashchuk, B M Shustov