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PERSONALIA

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In memory of Mikhail Veniaminovich Nezlin

Professor Mikhail Veniaminovich Nezlin, an outstanding physicist, the leading research scientist of the Institute of Nuclear Synthesis of the Russian Research Centre "Kurchatov Institute", DSc in physics and mathematics, corresponding member of the Russian Academy of Natural Sciences, died after a severe illness on January 1st, 1999.

Mikhail Veniaminovich was born on July 29, 1928 in Gomel', in a doctors' family. In 1930, the family moved to Moscow but in 1941 was evacuated to Alma-Ata, in Kazakhstan, where Nezlin graduated from school in 1944, having passed the examinations for the 9th and 10th forms without attending lectures. He graduated from the Moscow Power Engineering Institute in 1950 and then worked for 6 years as an engineer-physicist at one of the defence industrial bases in the Ural. In 1957, Lev A Artsimovich supported his invitation to work at the Laboratory of Novel Acceleration Techniques, which formed the Moscow nucleus of the Institute of Nuclear Physics of the Siberian Branch of the USSR Academy of Sciences that I V Kurchatov and G I Budker were organizing at the time. For forty very fruitful years from 1959 until his death Nezlin worked in the Department of Plasma Research of the Kurchatov Institute (later known as the department of plasma physics and now the Institute of Nuclear Synthesis).

M V Nezlin was a physicist of world renown with pioneering results in plasma physics and geophysical and astrophysical hydrodynamics.

In plasma physics, M V Nezlin and his colleagues investigated the strongest instabilities in plasma flows. Among other phenomena, they were the first to experimentally observe a novel object of plasma physics: the Langmuir soliton in a magnetic field.

In geophysical and astrophysical hydrodynamics M V Nezlin developed and successfully applied a new approach to laboratory simulation of vortex structures in planetary atmospheres and oceans, based on using free-surface rotating shallow water in a parabolic vessel as the model medium. For the first time in laboratory practice, the vortex Rossby soliton was created, a fundamental new object of nonlinear physics.

Nezlin demonstrated the physical similarity of the thus created vortex soliton (anticyclone) to the largest long-lived vortices that dominate in the atmospheres of the giant planets: the Jovian Great Red Spot, the Grand vortices of Saturn and Neptune and also the largest underwater vortices ('lenses') in terrestrial oceans. A laboratory experiment demonstrated for the first time the clearly pronounced cyclone-anticyclone asymmetry of Rossby vortices, which explained both the absolute dominance of anticyclones on giant planets and among the oceanic lenses, and the relatively rapid decay of cyclones. The self-organization of the natural vortices and their 'long life' in a system of unstable flows with velocity shift, similar to zonal flows in planetary atmospheres,

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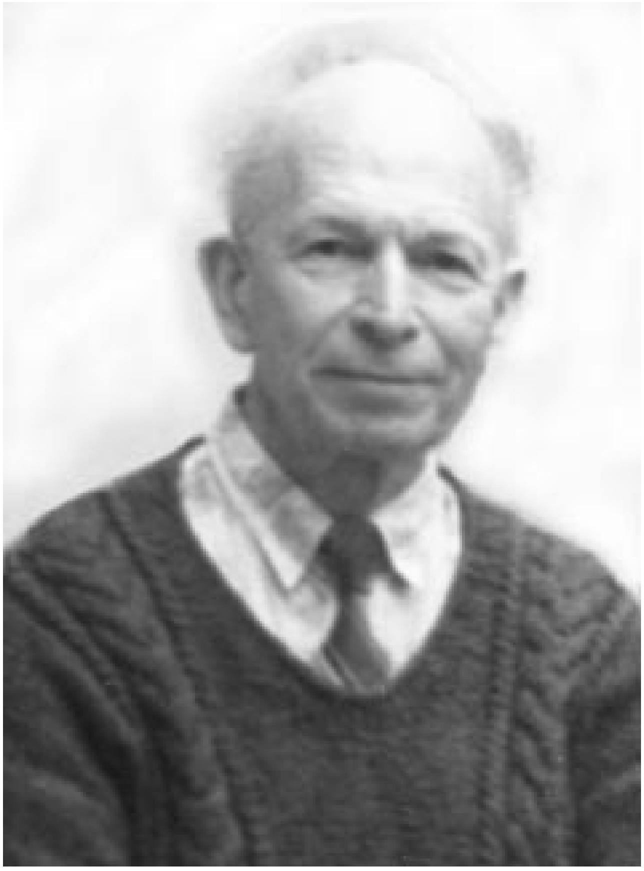

Mikhail Veniaminovich Nezlin
(29.07.1928 – 01.01.1999)

were successfully modelled; physical modelling showed that with the observed profile of zonal winds on Jupiter, only a single anticyclone is generated around the entire perimeter of a given parallel of the planet, which is similar to the Great Red Spot. These experiments stimulated the construction of a new theory of Rossby solitons (lone vortices), which gained wide recognition.

It is not surprising that experiments on rotating shallow water grew from Nezlin's plasma research. Indeed, the Lorentz force acting on particles of magnetized plasma corresponds, up to a coefficient of 1/2, to the Coriolis force in the system of coordinates of rotating shallow water, so that the essentially quasi-two-dimensional drift waves propagating through a nonuniform plasma are similar to Rossby waves in rotating and two-dimensional water (shallow by definition).

Furthermore, it was proved possible to simulate even such cosmic objects as galaxies in shallow water. Indeed, the nature of spiral arms in galaxies, which constitute density waves in rotating gaseous disks, is very similar to that of long waves in rotating shallow water. Experiments in differentially rotating shallow water on two 'Spiral' laboratory setups with an unstable rotation velocity profile (similar to rotation profiles of many galaxies) for the first time realized the generation of spiral structures that are physically similar to spiral arms in galaxies. The conclusions of the theory on the generation of spiral arms in galaxies in response to the buildup of a centrifugal instability due to the observed rotation velocity jumps in one half of galactic disks were experimentally confirmed; among other things, the number of spiral arms was found to be inversely proportional to the jump magnitude.

Also, the 'Spiral' setups helped to solve two classical problems that faced astronomers ever since spiral galaxies had been discovered more than a century and a half ago: how to explain the observed 'branching' of galactic spiral arms, and what causes the generation of rarely encountered 'leading' spiral arms in contrast with the classical 'trailing' arms? The same experimental setups also revealed new structures, never before observed in galaxies: large-scale vortices. The model experiment thus predicted the existence of new structures in spiral galaxies: giant anticyclones that had not been discovered during the 150 years of observations.

To search for the galactic vortices discovered in Nezlin's group model experiments, a unique electron-optic instrument was developed and installed on the 6-meter telescope of the Special Astrophysics Observatory of the Russian Academy of Sciences in Zelenchuk; the device made it possible to increase substantially the resolving power of the telescope in scanning the velocity field, otherwise the problem would not have been solved even today. A special method was also developed for the detection of anticyclones.

The predicted giant vortices were indeed discovered, and their sizes were found to be smaller than those of galaxies by only an order of magnitude. Therefore, the desktop laboratory experiment conducted by Nezlin's group gave a powerful stimulus for further development of observational astronomy. A A Boyarchuk, chairman of the National Committee of Russian Astronomers, commented that this discovery made on the basis of prediction was 'one of the very few cases in the history of astronomy'.

In 1995, M V Nezlin received the Lev Artsimovich Prize of the Russian Academy of Sciences for his work in geophysical and astrophysical hydrodynamics.

These outstanding scientific results are connected with Nezlin's name for a number of reasons. Being a good scientist is not enough for fruitful cooperation with a large and inhomogeneous group of theoreticians, experimenters, astronomers and engineers working on a common problem. Nezlin's unblemished scientific integrity and the toughest criteria he applied to himself both in his research projects and in the ethical problems which arose generated the deepest respect in people, who fairly recognized him as a very strong and competent physicist.

M V Nezlin wrote two profound books: *Physics of Intense Beams in Plasmas* and *Rossby Vortices and Spiral Structures*. Both were translated and published in the West, and both have well-deserved high reputations with the physics community.

The former of these monographs explains the physics of aperiodic instabilities and overstability of electron and ion beams and the consequences of these instabilities. The experimental data on beam instabilities and on the mechanisms of current restriction in beams are discussed. Nonlinear processes of modulation instability type are presented, which lead under certain conditions to the generation of lone waves — solitons. The Langmuir solitons are investigated in detail both in a plasma without a magnetic field and in an applied magnetic field.

The latter monograph presents the laboratory simulation of giant vortices in planetary atmospheres and in the oceans, and also spiral structures in galaxies, using rotating shallow water modelling.

Death has interrupted the vigorous creative activity, full of new ideas and incomplete projects, of an outstanding scientist, a true member of the intelligentsia, an excellent friend and an example for young scientists to follow. The memory of Mikhail Veniaminovich Nezlin will live in the hearts of those who had the luck of communicating with him in his work and beyond it.

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