PETRO IVANOVYCH FOMIN
(on his 75th birthday)

The 20th of June of this year marked the 75th birthday for Petro Ivanovych Fomin, a Corresponding member of the National Academy of Sciences of Ukraine, Honored Scientist of Ukraine, Professor, Doctor of physical and mathematical sciences, Head of the Department of Astrophysics and Elementary Particles of the Bogolyubov Institute for Theoretical Physics of the National Academy of Sciences of Ukraine, a prominent theoretical physicist in the fields of astrophysics, quantum field theory, and particle physics.

Petro Ivanovych Fomin was born in 1930 at the Zhykharevo village of the Orel region (in Russia). In 1953, he successfully graduated from the Kharkiv State University and entered the post-graduate courses of the same University. His scientific supervisor was the world-famous theoretical physicist Academician Oleksandr Illich Akhiezer. The beginning of the 1950s was the time of triumph in quantum electrodynamics: the appearance of the technique of Feynman diagrams together with the renormalization theory made it possible to get rid of divergences in these diagrams and enabled one to perform the meaningful calculations of the parameters of physical processes with high precision. It is these discoveries that substantially influenced the Fomin's choice of the direction of his scientific activity in the fields of quantum field theory and, later on, the theory of gravity and astrophysics.

Beginning from 1957, P.I. Fomin works at the Kharkiv Physical and Technical Institute, where he defends his candidate and doctoral theses. Since 1972 till now, his scientific career is connected with the Bogolyubov Institute for Theoretical Physics in Kyiv. In 1990, Doctor of physical and mathematical sciences, Professor P.I. Fomin was elected a Corresponding member of the National Academy of Sciences of Ukraine.

P.I. Fomin is the author of widely known fundamental works in quantum field theory and particle theory, astrophysics, and cosmology, in which he put forward a number of deep physical ideas and obtained the outstanding results.

The works of P.I. Fomin in the area of particle physics and quantum field theory are devoted to the investigation of both the structure of the physical vacuum and the manifestations of its properties in various physical processes. In quantum electrodynamics, he obtained the important results concerning the radiation effects in high-energy scattering processes studied in high orders of perturbation theory. Together with his collaborators, he was the first to show the existence of solutions of the "superconducting type" for the fermion spectrum in quantum electrodynamics, which allowed them to give a purely dynamical explanation of the origin of fermion masses, a phenomenon which turns out to be similar to the appearance of the energy gap in the theory of superconductivity. The ideas and results obtained in quantum electrodynamics were further developed and applied to the theory of strong interactions, namely, to quantum chromodynamics. For the first time, P.I. Fomin proposed a mechanism of the dynamical origin of the masses of quarks and hadrons which turns out to be connected with the formation of a quark-antiquark vacuum condensate at the expense of the relativistic analog of the Cooper pairing in the regime of the strong (supercritical) quark-gluon interaction. This approach and its consequences have received a remarkable resonance in the world's scientific literature.

The work devoted to the coherence effects in the bremsstrahlung observed in monocrystals, which was performed by P.I. Fomin together with O.I. Akhiezer and M.F. Shul'ga, has initiated a new approach to the description of coherence phenomena at high energies which is fruitfully developed at present.

In 1973, for the first time in the world's literature, P.I. Fomin predicted the phenomenon of the gravitational instability of the vacuum by basing on the principles of general relativity theory and quantum field theory, which opens up a general possibility for the spontaneous quantum creation of a spatially closed universe. This theory supplemented by the idea of cosmological "inflation" solves the important problem on the origin of the hot expanding Universe and sheds light on the nature of the so-called Big Bang. The quantum-field-theory approach to cosmological problems initiated by P.I. Fomin gave foundation to a new direction which is now rapidly developing, namely, quantum cosmology.

In the theory of gravity, P.I. Fomin found the important properties of the Schwarzschild surface and investigated a number of physical effects connected with the existence of the event horizon. The obtained axisymmetric solution of the equations of general relativity describing a configuration with zero total mass and nonzero quadrupole moment is worthy to supplement the arsenal of the classical solutions of the general relativity theory. In his works of the latest period, P.I. Fomin has developed the theory of gravitational quantization of space-time, which has led to the new ideas of the structure of space-time at small distances and of the nature of the physical mechanism of the avoidance of divergences in quantum field theory.

In modern astrophysics, P.I. Fomin proposed an original solution of one of the hottest problems, namely, the physical nature of the high-energy activity of quasars, radiogalaxies, and nuclei of active galaxies, in particular, the nature of their characteristic activity in the form of relativistic jets. To solve this problem, the conclusion of modern particle physics about the existence of quantum field condensates in the vacuum similar to the quantum condensates in a superfluid was used. This approach leads to a quantitative theory that successfully describes the whole power range of the jet activity of the observed cosmic objects, from the famous object SS433 to quasars and radiogalaxies.

In a number of works, P.I. Fomin together with scientists of the Main Astronomical Observatory of the National Academy of Sciences of Ukraine have investigated certain high-energy effects in astrophysical systems. In particular, they proposed the explanation of the observed ring-like waves which are propagating in a number of galaxies from the center due to the influence of a train of powerful shocks on the interstellar medium generated by the explosive activity of galactic nuclei.

One of the recent results obtained by P.I. Fomin in modern astrophysics (together with V. M. Mal'nev and A. P. Fomina) is the explanation of the phenomenon of overpowerful radio-frequency radiation of the Jupiter–Io system which remained mysterious for a long time. It turns out that this phenomenon is one of the versions of the so-called superradiation, a collective coherent spontaneous radiation that occurs, in this case, in the system of electrons on high Landau levels in the Jupiter's magnetic field.

P.I. Fomin is the author of over 170 scientific papers. His papers in quantum cosmology, relativistic astrophysics, and theory of elementary particles are the important contribution to the development of these branches of science. For the works on the physics of the vacuum and quantum cosmology, he together with V. A. Miransky was awarded the Barabashov prize of the National Academy of Sciences of Ukraine.

During many years, P.I. Fomin is the Head of the Department of Astrophysics and Elementary Particles of the Bogolyubov Institute for Theoretical Physics of the National Academy of Sciences of Ukraine. Among his disciples, there are five doctors and sixteen candidates of sciences who are working fruitfully both in Ukraine and abroad. He is the President of the Ukrainian Gravitational Society, a member of the Council for defence of doctoral theses of the Institute for Theoretical Physics, and the Chief Editor of the journal "Herald of the Astronomical School."

The versatile talent, great creative inspiration, optimism, and high humanity won for Petro Ivanovych the authority and respect among the colleagues and disciples, for whom he is the example to follow in the scientific research.

Cordially congratulating Petro Ivanovych with his 75th birthday, we wish him good health, creative longevity, new ideas, and successes in his multifaceted scientific activity.

V.G. Bar'yakhtar, V.P. Gusynin, V.M. Loktev, V.A. Miransky, I.M. Neklyudov, O.S. Parasyuk, S.V. Peletminsky, E.G. Petrov, Yu.V. Shtanov, M.F. Shul'ga, Yu.O. Sitenko, K.M. Stepanov, A.G. Zagorodny