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МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ

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# ВІСНИК



**Дніпропетровського  
університету**

**Серія «Фізика. Радіоелектроніка»**

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**Visnik Dnipropetrovs'kogo univrsitetu.  
Seriâ Fizika, radioelektronika**

**Вестник Днепропетровского университета.  
Серия «Физика. Радиоэлектроника»**

Дніпро

Дніпропетровський національний університет  
імені Олеся Гончара

*Друкується за рішенням Вченої ради  
Дніпропетровського національного університету імені Олеся Гончара  
згідно із затвердженим планом видань на 2016 р.  
(протокол № 7 від 24.12.2015 р.)*

Представлені результати досліджень із теоретичної фізики, що доповідались на Всеукраїнській науковій конференції “Принципові проблеми квантової теорії поля і гравітації”, яка відбулася в листопаді 2016 року в Дніпропетровському національному університеті імені Олеся Гончара з нагоди 85-річчя видатних учених і педагогів Володимира Ваняшина та Марії Коркіної.

Результати обіймають питання квантової теорії поля і фізики елементарних частинок – ефект Казимира для діраковської ґратки, космічні нейтрино та темна енергія, К та Ф резонанси у зіткненні важких іонів, намагнічування кварк-глюонної плазми, квантування чорних дір; гравітації – рух пробних частинок у метриці Коркіної–Григор’єва, акреція на супермасивній чорній дірі, великомасштабна структура всесвіту, роль просторової кривини в прискореному розширенні всесвіту, критерій космологічного розширення всесвіту; квантової статистики – новий метод у теорії релаксації в неоднорідних середовищах, квантовий конфайнмент у силіконових наноструктурах, нові аспекти моделі Дікке.

Для наукових, інженерно-технічних та науково-педагогічних працівників, аспірантів і студентів, які працюють (навчаються) в галузі фізико-математичних наук.

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імені Олеся Гончара, 2016

## Vladimir Stepanovich Vanyashin

Vladimir Stepanovich Vanyashin graduated from Dnipropetrovsk State University in 1953. All his scientific and teaching work was fulfilled at the Theoretical Physics Department of this University. At different periods of time, he occupied the positions: Senior Lecturer, Head of the Department, Associate Professor, and Senior Research Worker of Quantum Chromoplasma Laboratory. He founded a new for the University research field – quantum field theory and particle physics, which nowadays is a modern trend in fundamental physics. He also founded the educational principles based on maximal utilization of classical and quantum field theory in training for young theorists. This approach has introduced the Theoretical Physics Department into the acknowledged one among the world centers of theoretical physics. These principles are implemented in teaching for many years.

As researcher, Vladimir Vanyashin made a profound contribution in the discovery of the form of fundamental field interactions. In a series of papers, he worked out a relativistic and gauge invariant formalism, which allowed him to derive the structure of the electromagnetic interactions of charged vector fields and discover a yet unknown phenomenon – antiscreening of a charge due to vacuum polarization. The phenomenon is related with the specific property of charged vector fields – large magnetic moment – that results in weakening the force at small distances, strong fields or high temperature. Such type of behavior is the crucial feature of fundamental forces in Nature. This outstanding result is acknowledged in the world literature.

Vladimir Vanyashin has also made important contributions to the description of properties of  $W$ -bosons, electrons, axions under influence of various external conditions. Important results have been obtained in studying an axion as a possible candidate for dark matter widely discussed nowadays.

He was the supervisor of six PhD students who worked on topics of quantum field theory, super symmetry, scattering theory of hadrons, and Lee group theory. Four of them later have obtained the Doctor of Science degree.

Most people know Vladimir Stepanovich as devoted to science, qualified and principal expert, interesting interlocutor, person having various interests and mental outlook; we think much of his optimistic nature and friendly support in our life.

Head of Theoretical Physics Department  
Professor Vladimir V. Skalozub

## **Maria Petrovna Korkina**

In 1953, after graduating with honors from the Theoretical Physics Department of the Dnipropetrovsk State University, Maria Korkina, its best graduate, obtained the direction to work as a teacher of mathematics and physics beyond the Urals at Bogdanovich Mining and Ceramic College. Apparently, such assignment reflected the impact of the past. Maria's father, like many others, was repressed in the 30s, during the Great Terror. In the college the young physicist was tested by severe school of life as a form-master of the class in which eight people had already served the term of imprisonment. She demonstrated her best human qualities.

Then, linking life plans with theoretical physics, Maria Petrovna returned to the Department and started to master independently the quantum theory of the weak gravitational field. She successfully finished post-graduate courses, and soon, in 1963, defended her thesis entitled "The quantized interaction of electromagnetic and gravitational fields". Note that the topic is relevant today! And so, a new direction of investigations of the Theoretical Physics Department has arisen. Maria Petrovna actively worked in different sections of the general relativity, attracted youth to new problems, and also engaged in social activities. In particular, she was a member of the Council on Gravitation of the Ministry of Higher Education of the USSR (from 1974 to 1990) and an initiator of the Gravitational Association foundation. In 1988, Maria Petrovna defended her doctoral thesis "Spherical configurations in the general theory of relativity" in the Institute of Physics, Academy of Sciences of the Byelorussian SSR. As a result of investigations, about two hundred scientific papers have been published by M. P. Korkina. Under her supervision eight applicants have defended their candidate theses on gravitation.

Maria Petrovna has many achievements in different areas of the theory of gravitation, including generalizations of classical Tolman and Adler solutions for static configurations, studies of voids in cosmological models, the analysis of stability issues, T-regions, and new T-solutions, the development of methods for obtaining exact solutions of Einstein's equations for a spherically symmetric models, in particular, the method of mass function; studies on joining of solutions of general relativity equations, the construction of models with variable spatial curvature and Kantowski-Sachs model with magnetic field, the analysis of

physical properties of built static and non-static models, and many others. Many reviews on general relativity contain references to the solutions by Korkina and nonlinear scalar field. Note that the massless scalar field with the standard Lagrangian is not conformally invariant. Therefore, a physicist-theorist R. Penrose suggested supplementing the Lagrangian with a term proportional to the scalar curvature  $R$  that provides this invariance. Maria Petrovna went another way through offering the Lagrangian  $L = (\varphi_{,\alpha}\varphi^{,\alpha})^2$  (Korkina M. P. Proceedings of Higher Schools. Physics, 1978, No 12, P. 80) and constructing an appropriate solution. The behavior of a test particle and physical peculiarities of introducing such a scalar field have been analyzed. Note that in addition to ordinary matter the modern cosmological model includes dark matter and dark energy. The latter is associated with the cosmological constant. Maria Petrovna with her learners has made a significant contribution to the investigation of the cosmological constant effects on the course of various processes in the universe. Concerning dark matter, a scalar field with a non-linear kinetic part by Korkina is considered as a possible model. We can talk a lot on the pedagogical talent and human qualities of Maria Petrovna. As a lecturer, she is able to tell about the complex issues in a simple form, to highlight the main aspects, and draw attention to interesting places. Notes of Maria Petrovna's lectures are always structured, consistent, and complete. As an examiner, she is strict and fair. As a teacher for her graduate and post-graduate students, she is patient and sympathetic. She negotiated about places of practice and about seminars in other institutes and universities. Maria Petrovna has helped very many persons not only in their scientific work, but also in life. She helped with advices and in job search. The role of Maria Petrovna in the popularization of physics in Dnipropetrovsk region is invaluable. Concurrently, she was the Rector of the Popular University of Teachers of our region. In the framework of the Society "Knowledge" she gave lectures in rural areas. M. P. Korkina supervised Minor Academy of Sciences at the Physics Department and met the Halley's Comet with the children in 1986. She is a Distinguished Professor of Oles Honchar Dnipropetrovsk National University, a member of the Ukrainian and the American Physical Societies, the Gravitational Association, and editorial boards of specialized journals.

Professor Valentin D. Gladush  
Associate Professor Oleg Yu. Orlyansky