
FOREWORD



This issues (numbers 8 and 8A) of *Ukrainian Journal of Physics* are dedicated to the 75th anniversary of the outstanding Ukrainian scientist

Victor Grigor'evich Bar'yakhtar,

who is famous for brilliant results in the fields of theoretical physics, solid state physics, magnetism, and post-Chernobyl ecological problems.

The scientific career of Victor Grigor'evich was started in Kharkiv at Physical-Technical Institute in 1954, where he joined the group of Professor A.I. Akhiezer, who was already well known to the world scientific community at that time. Very soon together with S.V. Peletminsky, he became one of the nearest co-workers of Prof. A.I. Akhiezer. The first works of V.G. Bar'yakhtar were devoted to the calculations of the gamma-quantum radiation processes during nucleus-nucleus and electron-nucleus collisions, as well as to the problem of vacuum polarization. At that time, these problems were among the most important ones in quantum electrodynamics. In the mid-1950s, Prof. A.I. Akhiezer, V.G. Bar'yakhtar, and S.V. Peletminsky studied the spectra of coupled magneto-elastic waves in ferromagnets and obtained world-level results. It has been shown that there is a significant modification of magnon and phonon branches of the spectrum in the vicinity of the magneto-acoustic resonance, where the oscillation frequencies of magnons and phonons and their wave vectors coincide. Following the personal Lev Landau's suggestion, they modified the Landau—Lifshitz phenomenological theory of ferromagnetism: they improved the Landau quasiequilibrium potential for the case of finite longitudinal susceptibility, found the expression for the energy flux density, and formulated the boundary conditions for coupled magneto-elastic oscillations. The basics of this theory were presented in monograph "Spin Waves" by A.I. Akhiezer, V.G. Bar'yakhtar, and S.V. Peletminsky which became a classic one in the field of theory of magnetism and still is in active use by researchers over the world.

The interest in magnetic phenomena in general and in magneto-elastic processes in particular is shown by Victor Grigor'evich up to now. Together with D.A. Yablonsky, he demonstrated that the appearance of a magneto-elastic gap is connected with the spontaneous violation of symmetry. Together with V.M. Loktev and S.M. Ryabchenko, he proved that magneto-elastic interactions can significantly influence and modify the

oscillation spectra of thin magnetic films. Together with I.M. Vitebsky, U.G. Pashkevich, V.L. Sobolev, and V.V. Tarasenko, Victor Grigor'evich developed the theory of bounded magneto-elastic oscillations in the vicinity of magnetic spin-orientation phase transitions.

In the 1960s, Victor Grigor'evich and S.V. Peletminsky together with their teacher A.I. Akhiezer developed the macroscopic theory of magnetic moment relaxation in ferromagnets. In the 1980s, he formulated a generalized approach for the construction of relaxation terms in the Landau—Lifshitz magnetization motion equation, which gives the possibility to take the symmetry of a crystal into account. On the basis of this approach, he constructed an exchange relaxation term that is named “Bar'yakhtar's relaxation term” among the “magnetic” community. This theory helped Victor Grigor'evich to explain the reason for a significant difference in experimental data on the magnetization relaxation in thin ferromagnetic films with domain structure, in particular the difference between the method of ferromagnetic resonance and the method involving the motion of domain walls.

A special attention was paid by Victor Grigor'evich to the static and dynamic phenomena in inhomogeneous ferro-, ferri-, and antiferromagnets. First of all, we would like to mention the study of the so-called intermediate state in antiferromagnets in the vicinity of the first-order phase transition. It was described in the cycle of classical publications by Victor Grigor'evich together with O.O. Galkin, A.E. Borovik, G.O. Popov, E.P. Stefanovsky, V.F. Klepikov, and others.

Victor Grigor'evich together with Yuri Gorobets paid a great attention to the study of thin magnetic films with perpendicular anisotropy. Bubble domains that can exist in these films are similar in most cases to two-dimensional particles. The high mobility of bubble domains was used in data storage systems. Victor Grigor'evich organized a group of enthusiasts in Donetsk that made a significant progress, under his supervision and with his participation, in the field of physics and the application of the films with bubble domains.

The studies of magnetic solitons carried out by Victor Grigor'evich with B.A. Ivanov and O.L. Sukstansky were really pioneering. Their theory of Cherenkov's radiation of phonons generated by domain boundaries moving with high velocities should be mentioned as one of the most important results in this area.

Together with Igor Victorovich Bar'yakhtar, Victor Grigor'evich was the first who had formulated the idea to describe a gas of magnetic domain boundaries in the frame of non-equilibrium thermodynamics. They have also developed the kinetic theory of a soliton gas, which is undoubtedly an outstanding scientific achievement in the modern nonlinear physics.

In general, the scientific activity of Victor Grigor'evich is broad and manifold. Together with his teacher A.I. Akhiezer and his students, he made a significant contribution to various areas in physics. In addition to the already mentioned achievements, we have to list some other bright results: the method for the calculation of collision integrals for a plasma in high magnetic fields; microscopic theory of transport phenomena of metals and semiconductors; thermodynamic properties of certain superconductors (thallium, indium, rhenium) at a second-order phase transition due to the peculiarities of electron state density as a result of a modification of the Fermi surface topology; further development of the pseudopotential conception for normal and superconductive metals; relaxation processes in superconductive metals; and theory of cylindrical domains (bubbles) in ferrofluid films. And these results are just a small part of his activity. It is difficult not to mention his well-known contributions to the investigation of ecological problems of the Chernobyl zone, study of the corrosion of metals in electrolytes in a magnetic field, and many, many other brilliant works.

The scientific work of Victor Grigor'evich is tightly connected with his pedagogical activity. He always combines research with teaching at universities; first in Kharkiv, then in Donetsk and Kyiv. Now he is lecturing at National Polytechnic University of Ukraine “KPI”. V.G. Bar'yakhtar has realized his pedagogical ideas through the activity of the Department for Special Training of Taras Shevchenko Kyiv National University at the National Academy of Sciences of Ukraine. It has been established under his supervision 15 years ago. He developed an efficient system of the selection of talented students, which involves them into scientific work from the first years of their study at the University. Starting from the third year, the students are proposed to pass the so-called “Landau's theorem minimum” (to take an exam on selected chapters of the Landau—Lifshitz books: Mechanics, Quantum Mechanics, Field Theory, Statistical Physics). After that, he gives them to solve some real problems of modern physics, which require some knowledge beyond

the regular courses. This approach gives a possibility to attract students to serious research projects in short terms. The best evidence for the efficiency of this way is the fact that many of his students (several tens of professors and more than 50 PhDs) attained outstanding scientific results during their youth years. The atmosphere of kindness and creativity is always accompanying scientists who are working with Victor Grigor'evich Bar'yakhtar.

The activity of V.G. Bar'yakhtar obtains a wide recognition: he has been awarded many times in Ukraine and worldwide; he has received a lot of honor titles and positions. Victor Grigor'evich is meeting his anniversary

in the excellent physical shape, being full of new ideas and plans.

This special issue of Ukrainian Physical Journal is one more demonstration of love and respect to Victor Grigor'evich. It contains the papers of his colleagues, students, and friends. The variety of covered areas reflects the wide scientific interests of Victor Grigor'evich. This issue is much superior to a regular one in volume, but even this extended book cannot include all the articles submitted by his friends, students, and colleagues.

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