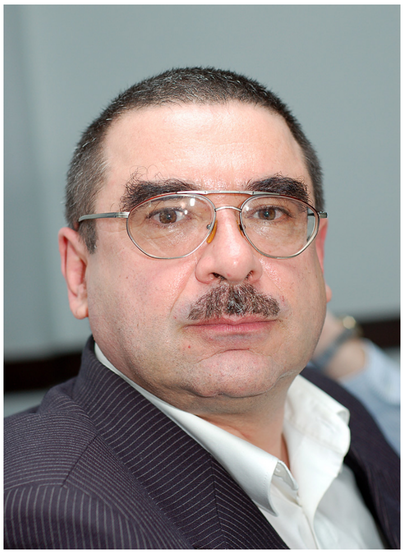
Condensed Matter Physics, 2011, Vol. 14, No 4, 47001: 1–2

http://www.icmp.lviv.ua/journal

CONDENSED MATTER PHYSICS

Personalia

50$^{\rm th}$ birthday of Ihor Omelyan



These days a renowned Ukrainian scientist, leading researcher of the Department of Nonequilibrium Processes of the Institute for Condensed Matter Physics (ICMP) of National Academy of Sciences of Ukraine, doctor of physics and mathematics Ihor Omelyan celebrates his 50th birthday.

Ihor Omelyan was born on December 20, 1961 in the city of Lviv. In 1979 he entered the Physics Department of Ivan Franko Lviv State University. Having graduated from the University in 1984, he started his scientific activities in the Lviv Division of Statistical Physics of the Institute for Theoretical Physics (in 1990 this Division was transformed into the ICMP).

Early studies of Ihor Omelyan dealt with the statistical theory of metal systems. In particular, at that time, he developed in collaboration with Prof. Markiyan Vavrukh the method of calculating the equilibrium structure distribution functions of electrons in metals taking into account the effects of polarization. New fruitful period in Ihor Omelyan's research activities started in 1986, when he together with Mykhailo Tokarchuk started the investigations of nonequilibrium processes in dense gases and liquids based on a model kinetic equations of the revised Enskog theory. In 1988 Ihor Omelyan together with D. Zubarev, V. Morozov and M. Tokarchuk proposed the concept of a consistent description of kinetic and hydrodynamic processes in dense gases and liquids within the framework of nonequilibrium statistical operator method. Based on it, the kinetic equation of the revised Enskog theory for hard spheres system and the kinetic Enskog-Landau equation for charged hard spheres system were derived consistently for the first time. The normal solutions of these equations were found as well. These results are of great importance in modern statistical theory of nonequilibrium processes. In this approach, Ihor Omelyan together with Mykhailo Tokarchuk proposed the kinetic equation for the system of particles with the multistep potential of interaction, for which the Boltzmann H-theorem was also proved. For the case of weak nonequilibrium processes, the normal solutions of this equation were found and analytical expressions for transport coefficients were obtained. A number of these results underlay the Ph.D. dissertation by Ihor Omelyan entitled "Transport coefficients and correlation functions in dense gases and liquids" (under the supervision of V. Morozov and M. Tokarchuk), which he successfully defended in 1991.

Starting from the 90-ies Ihor Omelyan works intensively in the field of development of computer calculations methods (molecular dynamics, Monte Carlo simulations) and its applications to the study of structural and dynamic properties of liquids. During 1993–1994 Ihor Omelyan and Ihor Mryglod developed a computer-adapted version of a generalized collective modes approach for simple fluids. For the first time, numerical calculations of generalized coefficients of bulk and shear viscosity, heat conductivity as well as the dynamic structure factor and "current-current" time correlation functions were carried out for Lennard-Jones liquid within a wide region of values of wave-vector and frequency using a higher-mode approximations and taking into account both hydrodynamic and kinetic modes. Nowadays these fundamental investigations have become a standard in calculating the dynamic characteristics of simple liquids within the framework of generalized molecular hydrodynamics. Ihor Omelyan extended the concept of computer-adapted theory and the approach of generalized collective modes to the investigation of dielectric properties of polar liquids. Simultaneous presence of translational and orientational degrees of freedom in polar liquids leads not only to the appearance of additional correlations, consideration of which is indispensable for describing the dielectric properties, but to essential changes in the behaviour of transport coefficients. Ihor Omelyan showed that new types of collective excitations, for instance, dipolarons for dipolar liquids, as well as optic-like librational modes appear in complex polyatomic models of polar liquids. In 1997 I. Omelyan together with R. Zhelem and M. Tokarchuk developed the generalized hydrodynamics of polar liquids with regard to electromagnetic fields. The basic hydrodynamic, polarization and kinetic modes for TIP4P model of water were studied. Herewith, generalization of the response field and the Ewald summation for the atomic models of polar liquids, which explicitly take into account spatial distribution of charges within the molecule, was implemented. The computer-adapted fluctuation formulas were derived for several statistical ensembles and the dielectric permittivity along with magnetic susceptibility for atomic models of water were computed within a wide range of wave-vectors and frequencies.

Using the methods of decomposition, Ihor Omelyan carried out a complete classification and suggested a detailed derivation of all the self-conjugated schemes for integration of the equations of motion in a computer experiment up to sixth-order accuracy in the time step. Optimal algorithms were found, which permit to improve the accuracy of integration by several orders of magnitude with the fixed computer time used.

Ihor Omelyan together with I. Mryglod and R. Folk (Austria) developed the computer-adapted theory for the study of equilibrium and dynamical properties of magnetic liquids. To quantitatively describe the phase diagrams, they evolved the method of integral equations for the Ising and XY spin fluids.

In collaboration with F. Hirata (Japan) and A. Kovalenko, I. Omelyan obtained important results for spatially-inhomogeneous systems. Within the method of inhomogeneous integral equations, the gas-liquid profiles for a simple liquid were calculated, being in good agreement with the results of computer experiment.

In due time, Ihor Omelyan suggested the generalization of the method of integro-differential equations for investigation of microscopic structure of interphase boundaries in magnetic liquids. In collaboration with I. Mryglod, R. Folk (Austria) and A. Kovalenko (Canada), I. Omelyan established a possibility of the existence of liquid-liquid surface interface in the Ising fluid. The phases have the same density as well as the same magnetization in absolute value, but opposite in sign. The dependence of the structure of interphase boundary for a gas-liquid transition and of the surface tension coefficient on the external magnetic field were studied as well. It was shown that this dependence for the XY model can be nonmonotonous due to a nonmonotonous dependence of the critical temperature on the field.

Most of these fundamental scientific results mentioned above underlay the doctoral thesis in theoretical physics entitled “Statistical-mechanical modeling of properties of polar and magnetic fluids” (scientific advisor I. Mryglod), which Ihor Omelyan successfully defended in 2010.

I. Omelyan carried out a number of important applied investigations related to the problems of diffusion of radionuclides at Chornobyl region. In particular, I. Omelyan together with I. Yukhnovskii, M. Tokarchuk and R. Zhelem developed a statistical theory for description of radionuclides migration in soils and subsoil waters. Besides, Ihor Omelyan in collaboration with I. Yukhnovskii, and I. Mryglod developed new methods for the study of submicron radioactive dust dynamics in the air medium. Appropriate algorithms and programs suitable for obtaining the long-term predictions were elaborated. It was shown that submicron dust radioactive particles can remain in the air for years and are capable of migrating at distances of thousands of kilometers before settling down.

Nowadays, Ihor Omelyan and Andrij Kovalenko, friend from the University times, work together on solving complicated problems of multiscale dynamics in complex fluids at the Institute of Thechnology, Edmonton, Canada.

Editorial board of the CMP, colleagues and friends cordially congratulate Ihor Omelyan with his first jubilee and wish him to stay in a good health, good mood, to enjoy solving the puzzles of nature and of computer programs which he has been doing with great success up to now!