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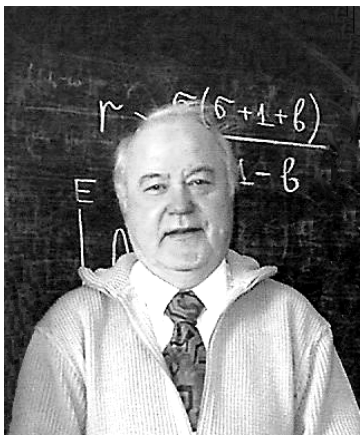
EDITORIAL



This memorial issue of the Journal of Russian Laser Research is dedicated to the 80th birthday of the prominent Soviet and Russian physicist Professor Anatoly N. Oraevsky (26.01.1934 – 04.07.2003). This issue consists of a collection of papers presented at the Joint Memorial Session of the Seminar on Theoretical Radiophysics and the oral issue of the Journal of Russian Laser Research held at the P. N. Lebedev Physical Institute in Moscow, Russia on January, 29 2014.

Professor Anatoly Nikolaevich Oraevsky made brilliant and outstanding contribution to the physics of lasers and masers, nonlinear dynamics and chaos, photochemistry and chemical lasers, semiconductor lasers, theory of laser–matter interaction, physics of low-dimensional structures, nanophotonics, physics of atomic Bose–Einstein condensate, etc. Anatoly N. Oraevsky was graduated from the Moscow Institute of Physics and Technology with the Diploma work "Some aspects of the theory of molecular generators" done in 1956 under the supervision of Prof. Nikolay G. Basov (Nobel Prize Winner of 1964, with the pioneering work done in the field of quantum electronics). Since that time up to the very last moment of his life, Professor A. N. Oraevsky worked at the P. N. Lebedev Physical Institute, where he founded first the Chemical Laser Laboratory and then the Theoretical Radiophysics Laboratory. For his pioneering work on chemical lasers, he was awarded the Lenin Prize of the USSR. Anatoly N. Oraevsky was a professor at the Moscow Engineering Physics Institute, where he lectured over 40 years.

Contributions to this memorial issue was written by colleagues and coworkers of A. N. Oraevsky in cooperation with other experimental and theoretical groups in Russia and abroad and cover some topics in the domain of his latest scientific interest. The order of the papers corresponds to the alphabetical order of the first author of the paper.

The propagation and amplification of electromagnetic radiation in a plasma are among the key topics of theoretical radiophysics for the decades. In the paper by A. V. Bogatskaya, A. M. Popov, and I. V. Smetanin, electrodynamic properties of the plasma produced in noble gases by an intense ultra-short laser pulse are investigated. It is shown that a time interval arises at which the plasma becomes an optically dense dielectric medium with negative electron mobility that provides channeling and amplification of sub-terahertz radiation. The interaction of laser radiation with a 2D electron–hole plasma is discussed in the paper by A. Boyarska et al., written in cooperation with an experimental group from Poland. The cavity-free lasing in optically excited GaN heterostructures is experimentally demonstrated and explained theoretically through the distributed feedback of the dynamical grating formed by the excited 2D plasma oscillation.

Two papers of this memorial issue are devoted to nanoplasmonics and photovoltaics. In the paper by S. V. Fedorovich and I. E Protsenko, the relaxation rate of an atom placed near a metal nanoparticle is considered from the aspect of a nanolaser. An important issue of photovoltaics is the problem of photoemission. In the paper by R. Sh. Ikhsanov et al., the authors calculated the internal quantum efficiency of photoemission from spherical metal nanoparticles embedded into a semiconductor matrix

taking into account the dependence of the height and shape of the Schottky barrier at the nanoparticle boundary on the nanoparticle radius. It is shown that the decrease in the nanoparticle radius and the increase in the matrix doping level lead to increase in the efficiency and photoemission threshold wavelength.

Anatoly S. Chirkin in his paper on the diffraction at parametric interaction in nonlinear photonic crystals demonstrates the incorrectness of the widely used approach based on taking into account only noncompensated quasi-phase mismatching. He develops a consistent theory that shows the dependence of the intensity of amplified waves and the parametric amplification bandwidth on the quasi-phase-matching order.

The paper by M. V. Gorbunkov et al. is devoted to the nonlinear dynamics in solid-state lasers. A laser system controlled by a combination of inertial negative and positive feedbacks demonstrates the nonlinear regular and chaotic dynamics on the time scale of the laser-cavity round-trip time and the lasing bursts with the much longer (submicrosecond) period.

Some theoretical aspects of quantum state properties are considered in connection with the recently suggested new formulation of quantum mechanics and quantum optics. In this formulation, the quantum states of photons or spins (qudits) are identified with fair probability-distribution functions called quantum tomograms. Tomograms are measurable probability distributions that provide complete information on the density matrices of quantum states. A new account of a particle moving in a potential described by the Dirac delta-function in the tomographic probability representation of the particle states is presented in the paper by I. V. Dudinetz and V. I. Man'ko, where the problem of excitation of the particle state by an instant change of the potential-well parameters is solved in view of the new approach to quantum-state description.

The problem of two-qubit state description by tomographic probability distributions and the connection of the quantum spin tomograms with discrete Wigner functions is studied in the paper by Peter Adam et al. We point out that this work is done within the framework of collaboration between the Russian and Hungarian Academies of Sciences initiated by A. N. Oraevsky together with A. V. Vinogradov and Jozsef Janszki (Wigner Center, Budapest).

In the other group of papers, new information and entropic inequalities are obtained for qudit states. The results are based on recently clarified properties of the density matrices of multi-qudit states and single qudit states, which turn out to be mathematically identical. In view of this identity, in the paper by V. N. Chernega et al., the property of nonnegativity of relative entropy known for bipartite quantum systems is extended to any density matrix, including the single qudit states. The property of the subadditivity condition, which is the entropic inequality known for composite bipartite systems, is shown to be valid also for generic noncomposite system states, and a new result is obtained also for the so-called q-deformed entropies in the paper by M. A. Man'ko and V. I. Man'ko. In this work, a new account of positive maps of density matrices is presented, where the construction of the hybrid positive maps is proposed to get new entropic inequalities. A concrete realization of this approach to X-states of the systems is presented in the paper by V. I. Man'ko and L. A. Markovich.

We hope that this memorial issue will help to continue the development of scientific ideas and results of Anatoly N. Oraevski.

Vladimir I. Man'ko and Igor V. Smetanin, Editors

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