EDITORIAL

**INTERNATIONAL
YEAR OF LIGHT
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This issue of the *Journal of Russian Laser Research* is dedicated to The International Year of Light and Light-based Technologies announced by the UN General Assembly for 2015. The first article of the issue by I. Ya. Doskoch and M. A. Man'ko presents historical aspects of the light study performed during several centuries along with modern results in the area of both fundamental research of quantum phenomena in photon systems and applications of laser technologies. In fact, the fundamental ideas that form the basis in the understanding of the properties of light are combinations of classical picture of light as the manifestation of electromagnetic field waves and quantum laws interpreting light as quantum vibrations, propagating in space, of the electric and magnetic fields observed as photons of different colors corresponding to different frequencies of the vibrations. The light and its quantum properties can be used in quantum information technologies providing the possibilities to construct quantum computers and quantum communication devices of the future.

The notions of qubits, qudits, and entanglement phenomena are the subjects of comprehensive researches of the light features. The classical and nonclassical lights like squeezed light and the possibility to generate the squeezed light by recently experimentally discovered dynamical (nonstationary) Casimir effect are important problems of modern theoretical and experimental works.

Quantum correlations in qubit systems characterized by different kinds of entropic and information equalities and inequalities are new aspects of photon and spin system considerations. The recently found new formulation of quantum mechanics, where the quantum states of atoms, nuclei, photons, and qudits are described by standard probability distributions called the quantum state tomograms, provided the possibility to obtain new relations between the physical characteristics like energy, entropy, and information, which can be checked experimentally in quantum optics and applied in the technology of superconducting circuits based on Josephson junction devices.

The quantum uncertainty relations, which are at the heart of the quantum picture of physical phenomena and processes, were recently generalized taking into account the purity of the photon quantum states. The very mixed quantum states as well as strongly correlated coherent states have specific properties. The systems in such states have very strong fluctuations of their properties and, due to this, the possibility of existence of unusual reactions (chemical, nuclear) can appear, which opens up new perspectives for quantum technologies in the domain of new energy sources.

The impressive achievements in using light during the last 50 years were possible due to the application of the principle of stimulated radiation in optical diapason and different kinds of lasers constructed on the basis of this principle. Lasers with different regimes of light generation, including continuous and

pulse regimes of generation, with the pulse duration equal to several oscillation periods, were constructed. Also, sources of single photon generation and superpower light field lasers were constructed. Such light fields, quite different in intensity, are interesting not only from the practical point of view but also in view of the fundamental physical laws of quantum electrodynamics. For example, superpower laser pulses are important for studying inertial thermonuclear laser fusion. The study of the interaction of superstrong light fields with matter induced the development of relativistic optics.

Superweak light fields (single photons) and entangled photon states are a key resource for quantum information and quantum computing; they are used to check the principles of quantum mechanics. The nonclassical light fields created in nonlinear optical processes can be used to solve the problem of gravitational wave detection. In general, the development of laser technology and sources of coherent optical radiation stimulated the creation of several new branches of physical investigations. One of them is nonlinear optics.

During the last decades, a new direction, the interdisciplinary combination of physics and technology, called photonics, appeared. Using the advances in photonics, researchers plan to create in the future a new element base for information–telecommunication systems.

We hope that the papers presented in this issue provide some novel results and directions in the study of light and its applications.

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