

XI International Symposium „Optics and Biophotonics“ (Saratov Fall Meeting 2023), Saratov, 25–29 September 2023

Saratov Fall Meeting, the International School-Conference on Optics, Laser Physics and Biophotonics, has been held every autumn in Saratov on the venue of Chernyshevsky Saratov National Research State University for 27 years. During this time, the scientific symposium „Optics and Biophotonics“ was formed into a separate structure, which in 2023 was held for the eleventh time. The SFM-23 program can be found at the link

<https://sfmconference.org/files/23-sfm-program-25-09-23.pdf>

This issue of the Journal of Technical Physics includes selected articles based on scientific reports presented in seven of the twelve symposium events:

- Workshop on Laser Physics and Photonics XXIV
- Conference on Low-Dimensional Structures XIII
- Workshop on Electromagnetics of Microwaves, Submillimeter and Optical Waves XXII
- Conference on Spectroscopy and Molecular Modeling XXIV
- Conference on Terahertz Optics and Biophotonics VI
- Conference on Nanobiophotonics XIX
- Conference on Optical Technologies in Biophysics and Medicine XXV

Workshop on Laser Physics and Photonics XXIV is presented here by the largest number of works of both fundamental and applied character. In the field of quantum optics, the dynamics of thermal entanglement of pairs of qubits in the three-qubit Tavis-Cummings model has been theoretically studied, which is important for quantum information science (A.R. Bagrov, E.K. Bashkirov). The theoretical works of the participants in this seminar considered problems of both the interaction of laser radiation with matter and the dynamics of lasers and laser systems themselves. The first group includes studies of radiation in graphene within the framework of the kinetic approach (V.A. Tseryupa, D.V. Churochkin, V.V. Dmitriev, S.A. Smolyansky) and the evolution of circularly polarized laser pulses in atomic pairs, with the Λ diagram of degenerate levels (O.M. Parshkov, I.A. Plekhanova). In the second group of works, the generation of terahertz waves in a resonant cavity containing an asymmetric hyperbolic metamaterial was studied (O.N. Kozina, L.A. Melnikov). The dynamics of a wide-aperture semiconductor vertical-cavity surface-emitting laser (VCSEL) was theoretically studied and it was proposed to use the method of injection of external optical radiation to stabilize the dynamics of such a device (E.A. Yarunova, A.A. Krents, N.E. Molevich). Based on numerical modeling, the accuracy and features of the application of methods for determining acceleration from the spectrum of a laser autodyne signal in the presence of nonlinear effects caused by external optical feedback have been studied (M.G. Inkin, D.A. Yakovlev, S.Yu. Dobdin,

A.V. Skripal). The experimental work of the seminar participants included the study of problems of optical limitation of laser radiation power in the ultraviolet and visible ranges (M.S. Savelyev, P.N. Vasilevsky, A.A. Dudin, A.P. Orlov, Yu.P. Shaman, A.Yu. Tolbin, A.Yu. Gerasimenko, A.A. Pavlov), technological application of laser radiation, namely laser stimulation of metal-induced crystallization of silicon coatings (A.A. Serdobintsev, A. M. Kartashova, P.A. Demina, L.D. Volkovoinova, I.O. Kozhevnikov, V.V. Galushka).

Conference on Low-Dimensional Structures XIII in this issue significantly expanded the research topics compared to the work presented last year on graphene-nanotube carbon structures. Using the electron density functional method and the method of quantum equations of motion, the wave diffusion transfer of the HIF-1 α protein onto COOH-MWCNT and its regulation of oxygen in biocells were studied (N.G. Bobenko, V.V. Shunaev, V.E. Egorushkin, O.E. Glukhova), electrical properties of thin films of perforated graphene functionalized with carbonyl groups (P.V. Barkov, M.M. Slepchenkov, O.E. Glukhova) and quantum capacity of the graphene/Li₃V₂(PO₄) composite) 3 in the process of delithiation (V.V. Shunaev, A.A. Petrunin, A.V. Ushakov, O.E. Glukhova). Modeling by molecular dynamics methods is used to analyze acoustic waves in single-layer phosphorene (I.A. Shepelev, I.D. Kolesnikov, S.V. Dmitriev). Using quantum chemical modeling methods as part of the same density functional theory, optimized structures of endohedral fullerenes were obtained, and a conclusion was made about the opportunity of forming heterostructures based on some of these materials (A.R. El Zanin, S.V. Boroznin, I.V. Zaporotskova, N.P. Boroznina). It has been shown theoretically that the electronic properties of quasi-2D Van der Waals heterostructures borophene/GaN and borophene/ZnO can be controlled using deformations (M.M. Slepchenkov, D.A. Kolosov, O.E. Glukhova). The hope is desired to be expressed that the stated theoretical results in the near future will find not only experimental confirmation, but also practical application.

Workshop on Electromagnetics of Microwaves, Submillimeter and Optical Waves XXII is presented by four theoretical articles. In contrast to a number of works, surface plasmons (plasmon polaritons) along graphene sheets are considered taking into account the influence of spatial dispersion, while previously proposed approaches are generalized to multilayer structures with graphene sheets in several planes (M.V. Davidovich). Modeling the process of absorption of electromagnetic waves in a composite layer of nanotubes based on the phenomenological model of a composite layer of an anisotropic black body (A.M. Lerer,

P.E. Timoshenko) indicates the prospect of creating a new type of ultra-broadband absorbing coatings to improve the resolution of sensitive spectrometers, telescopes, microscopes, and optical sensing devices, where stray light can introduce significant noise into the signal at the detector. An effective combined method for synthesizing an L-band diplexer for operation at a high power level has been proposed, which is important for use in radar systems (K.V. Kobrin, M.B. Manuilov). As a result of a theoretical analysis of the synchronization of the gyrotron by an external harmonic signal, the optimal values of the parameters were found at which, in the synchronization mode, an efficiency close to the maximum possible for an autonomous gyrotron is achieved, and a wide synchronization band is also ensured (N.V. Grigorieva, A.G. Rozhnev, N.M. Ryskin).

The proceedings of the Conference on Spectroscopy and Molecular Modeling XXIV this year were published in a number of publications, including the journal „Optics and Spectroscopy“. In this issue, this conference is reflected in two articles. The first of the works was carried out by a large interdisciplinary collaboration of authors and is devoted to theoretical molecular modeling of processes leading to optical clearing of human skin, as well as experimental monitoring of these processes using optical coherence tomography (K.V. Berezin, E.V. Grabarchuk, A.M. Lichter, K.N. Dvoretzky, Yu.I. Surkov, V.V. Tuchin). The goal of another work is to perform a theoretical analysis of the electronic spectra of fullerene C₆₀ in the region 200–800 nm with the aim of classifying them as a monomer or dimer, as well as determining the conditions for increasing the intensity of the long-wave absorption band (G.N. Ten).

Conference on Terahertz Optics and Biophotonics VI is presented by a theoretical study of the transmission of terahertz radiation through samples of porous composite ceramics based on hydroxyapatite with additions of carbon nanotubes. The resulting optical parameters of the models are in qualitative agreement with experimental data, as well as with the literature parameters of bone tissue (A.E. Reznanova, B.S. Kudryashov, D.D. Skorobogatov, A.N. Ponomarev). From the results of the Conference on Nanobiophotonics XIX, the issue included an experimental study of the luminescence of calcium hydroxyapatite and tricalcium phosphate powders with an admixture of Eu³⁺. These research objects correspond to the mineral composition of bone, which is why they are of interest as the basis for materials for prosthetics and luminescent probes (I.D. Sidorov, T.M. Minnebaev, E.I. Oleinikova, A.S. Nizamutdinov, M.S. Pudovkin, M.R. Gafurov, Yu.O. Nikitina, A.Yu. Demina, N.V. Petrakova, V.S. Komlev). Finally, from the Conference on Optical Technologies in Biophysics and Medicine XXV, the issue included a message on the development of a new tunable infrared quantum cascade laser of the 9.6–12.5 μm spectral range, which is in demand in biomedical and spectroscopic research (D.R. Anfimov, I.S. Golyak, P.P. Demkin, E.N. Zadorozhny, I.B. Vintaykin, A.N. Morozov, I.L. Fufurin).

The multidisciplinary nature of the works presented in the special issue is the first thing that catches the eye upon a quick glance at its contents. Therefore, publication in the Journal of Technical Physics best suits the goals and spirit of our symposium. The organizers of the symposium express their deep gratitude to the editors of the journal for publishing the works and to all the authors for their active participation in the preparation of this issue. Separately, I would like to note the great work of the reviewers, whose informal comments helped to significantly improve the quality of the submitted manuscripts.

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