The optical nonlinearity of the suspension is originated from the movement of particles in a field of gradient forces and, as a result, from gradient distribution of biopaticles in medium. This ensures the concentration nature of optical nonlinearity, acting similarly to Kerr nonlinearity and leading to self-focusing of radiation in the medium if the input power of laser radiation exceeds the threshold value. The threshold power is directly proportional to the square of the wavelength and inversely proportional to the square of the particle size. In a steady state, when the influence of diffusion is compensated by the action of gradient forces, soliton propagation of radiation in the biosuspension is possible. The shape of the soliton is determined by the polarizability of the particles, the diffusion coefficient, the mobility and size of the particles, their concentration in the suspension and the effective refractive index of the medium.

Modeling of coherently mode-locked lasers

Anton Pakhomov[1], Mikhail Arkhipov[2], Nikolay Rosanov[2] and Rostislav Arkhipov[1,2]
[1]St. Petersburg State University, [2]Ioffe Institute, St-Petersburg, Russia

Coherent mode-locking represents a promising approach for the generation of ultrashort pulses in lasers beyond the limitations of standard passive mode-locking. This approach is based on the coherent pulse propagation in a laser active medium what allows the production of pulses much shorter in duration than the medium dephasing time. We have performed the detailed modeling of the spatio-temporal dynamics of coherently mode-locked lasers in several arrangements. Besides the numerical solution of Maxwell-Bloch equations, the analytical approach based on the generalized area theorem was developed. Our analysis has demonstrated both the stability and self-starting properties of coherent mode-locking as well as achieving the pulse durations inaccessible by means of standard passive mode-locking.

Jones 4-Spinor and Partially Polarized Light

V.M. Red'kov[1], A.V. Ivashkevich[1], E.M. Ovsiyuk[2], V. Balan[3], A.V. Chichurin[4]
[1]B.I. Stepanov Institute of Physics, Minsk, Belarus
[2]Mozyr State Pedagogical University, Belarus
[3]University Politehnica of Bucharest
[4]The John Paul II Catholic University of Lublin

We shall present some facts of the theory of the Lorentz group which can be relevant for solving problems of light polarization in the frames of the vector approach by Stokes and Mueller, and by the spinor Jones formalism. A definite correlation exists between completely and partially polarizations of the light and the isotropic and time-like vectors of the Lorentz group.
It is known that for completely polarized light can be described by Stokes 4-dimensional vector or alternatively by Jones complex 2-dimensional vector. The Stokes 4-vector formalism may be extended to a partially polarized light, but Jones approach does not. In the present paper, starting with the Lorentz group theory, we introduce the concept of 4-dimensional Jones spinor, first for a completely polarized light. To such Jones bispinor, there correspond isotropic Stokes 4-vector, and antisymmetric Stokes tensor, the last is equivalent to isotropic complex 3-vector. This approach is extended to the partially polarized light as well. We introduce corresponding 4-spinor of Jones type and 4-vector and antisymmetric tensor of Stokes types. We have introduced the concept of minimal Jones-like 4-spinor, and have found relationships between the relevant Stokes vector and Stokes antisymmetric tensor in analytical form, which is studied numerically as well.

Tunneling times for electromagnetic pulses propagating through a plasma layer

D. Novitsky[1], M. Usachonak[1], I. Timoshchenko[2], O. Romanov[2],
L. Simonchik[1], S. Gaponenko[1]
[1]B.I. Stepanov Institute of Physics, Belarusian State University, Minsk, Belarus
[2]Belarusian State University, Minsk, Belarus

In present time, tunneling of electromagnetic radiation through media in which the propagation of homogeneous waves is impossible and electromagnetic oscillations are realized in the form of evanescent waves (e.g., through periodic media with photonic forbidden bands and narrowed