Under- and superluminal parametric Doppler and Bragg effects in nonlinear dielectrics

N.N. Rosanov
Institute for Laser Physics, Vavilov State Optical Institute, Saint-Petersburg, Russia, e-mail: nrosanov@yahoo.com

Considered is propagation of probe radiation through a medium with cubic optical nonlinearity perturbed by CW- or pulsed strong pump radiation with orthogonal polarization (1D-geometry). With respect to the probe radiation, the pump radiation induces in the medium inhomogeneities propagating with under- or superluminal velocity. It is shown that in the case of superluminal propagation, reflected probe radiation has conjugated phase and Doppler-shifted frequency.

Forward and backward optical waves in metamaterials: nonlinear interaction

A.I. Maimistov, I.R. Gabitov, E.V. Kazantseva
Solid State Physics and Nanostructures Department, National Nuclear Research University MEPhI, Moscow, Russia, e-mail: aimaimistov@gmail.com

Rapid progress of recent years in nanotechnology has led to the fabrication of new nanostructured materials (metamaterials) with unusual properties not observed in nature. Within these metamaterials, special attention is given to those so called "left-handed materials". The main property of left-handed metamaterials consist in negative sign of the index of refraction (NRI), when the real parts of the permittivity and of the magnetic permeability are simultaneously negative in a certain frequency range. Unusual properties of negative refractive index materials manifest themselves when a wave passes through the interface between such medium and a conventional dielectric. On the other hand, the refractive index for the same material can be positive in one spectral region and negative in another. Such material can be referred to as negative-positive refractive index materials. The new features of the wave propagation phenomena in negative-positive refractive index materials are considered. In particular, the parametric interaction of the waves under the slowly varying envelope pulses approximation in a quadratic or cubic nonlinear NRI materials is considered. Second and third harmonic generation is discussed in details. Electrodynamics of a simple device, which is nonlinear coupler, is also studied. In this case, signs of the refraction index of coupled waveguides assumed to be opposite. It is demonstrated that opposite directionality of the phase velocity and the energy flow in the NRI channel facilitates an effective feedback mechanism that leads to optical bistability and gap soliton formation.