sample of 2 mm and is proportional to the sample length in all observable range. The value of splitting is independent on the incident power which confirms the optical linearity of the effect. For s-polarization of incident pulse the splitting value is 1.4 times less (theory) and 1.64 times less (experiment). This difference can be explained by different birefringence of materials of PhC layers. The porosity of PhC material gives a possibility to fill layers of the crystal with nonlinear substance (e.g. $NaNO_2$). Therefore nonlinear effects, such as selective focusing and compression can be observed in this structure.

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Spectral and temporal characteristics of resonant medium radiation excited at the superluminal velocity

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In the present work, spectral and temporal characteristics of the resonant medium radiation excited by an ultrashort light pulse propagating through the medium at the superluminal velocity are studied theoretically. The case is considered when the spatial density of atoms is modulated periodically along the direction of propagation of the superluminal excitation. The obtained results demonstrate that under the superluminal excitation in the linear case the spectrum of radiation of the medium, along with the fundamental frequency of the oscillators, possesses new frequencies that depend on the spatial frequency of oscillators' distribution and on the angle of observation. In nonlinear case, the solution of optical Bloch equations for two-level atom displays two short pulses of the medium radiation. The distance between two pulses in the time scale depends on the velocity of excitation and on the parameters of medium.

Optical pulse dynamics in case of the Laue scheme of Bragg diffraction in metamaterial photonic crystals

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We solve analytically the boundary problem of Bragg diffraction at the Laue scheme in a weakly modulated linear one-dimensional photonic crystal (PC) composed of metamaterial layers with the two-wave approximation. Contrary to conventional PCs, under certain conditions these structures display a new type of a photonic band gap, not related to the Bragg resonance, for both positive and negative refractive indices. We also consider optical pulses' dynamics and demonstrate such effects as diffraction-induced pulse splitting and chirped pulse compression or decompression in Borrmann and anti-Borrmann modes respectively. In negative-index PCs the latter effect is reversed in respect of the chirp sign.

Solitary waves in DNA and their excitation by terahertz radiation

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Several types of soliton-like excitations in DNA are considered on the basis of extended helicoidal nonlinear dynamical model. They include transverse and longitudinal vibrational excitations and proton tuneling motions withing DNA base pairs. On the basis of theoretical modelling it is demonstrated that terahertz radiation can influence both vibrational excitations in DNA and proton motion in hydrogen bonds. The thermally pre-generated low-amplitude soliton-like excitations can grow and develop into localized metastable conformational domains of DNA under terahertz irradiation.

The control of pulses parameters under Bragg diffraction in linear and nonlinear photonic crystals

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A theory for effect of the diffraction-induced pulse splitting (DIPS) under dynamical Bragg diffraction in photonic crystals (PC) in the Laue geometry has been developed. In this effect incident short laser pulse splits into two ones with different dispersion laws and spatial field distribution within the structure. In linear PC we demonstrated the way to control output pulses intensity and duration by changing a phase modulation of the incident signal. In PC with thin layers of cubically nonlinear impurities we predicted the possibility of the dispersion spreading compensation by nonlinear interaction and formation of soliton-like pulse with constant parameters.