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GAP SOLITON-INDUCED TRANSPARENCY IN NONLINEAR KERR-METAMATERIAL HETEROSTRUCTURES

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In the last few years, many experimental and theoretical works have been devoted to the study of the physical properties of photonic crystals, which are artificial periodic arrays of materials with different refractive indices. This interest is motivated by the new perspective that such structures provide us in our ability to control the properties of light, leading to a new era of optical devices. The experimental realization of metamaterials, or left-handed materials, has opened up interesting possibilities in the study of photonic heterostructures. In this respect, periodic, quasiperiodic and disordered structures, made up of bilayers AB composed of materials with positive and negative indices of refraction, have been the subject of both experimental and theoretical investigations. Here, we present some recent results obtained within the Maxwell framework and using a transfer-matrix technique. A theoretical study of gap solitons in nonlinear Kerr-metamaterial heterostructures is presented and a switching from states of no transparency in the linear regime to high-transparency states in the nonlinear regime is observed for both $\langle n \rangle = 0$ and plasmon-polariton gaps. Moreover, a discussion is presented of recent results for the relativistic Fermi gas at finite temperatures, which is a candidate for nature's left-handed material, with application to condensed-matter systems leading to good agreement with experimental measurements of the plasmon energy in graphite and tin oxide, as functions of both the temperature and wave vector.

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