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Spinor matter waves in optical lattices TRISTRAM ALEXANDER, BEATA DABROWSKA-WUSTER, ELENA OSTROVSKAYA, YURI KIVSHAR, ARC Centre of Excellence for Quantum-Atom Optics, Nonlinear Physics Centre, RSPhysSE, The Australian National University, Canberra, Australia — We study, within the framework of the Gross-Pitaevskii model, nonlinear properties exhibited by a spinor F = 1 Bose-Einstein condensate confined in a one-dimensional optical lattice. We show that the lattice modifies dynamical stability properties of both ferromagnetic and polar condensates with repulsive atomic interactions. This leads to modulational instability of three-component Bloch states of the spinor BEC at the edge of the first Brillouin zone regardless of the properties of the spinor ground state (ferromagnetic or polar). As a result, both ferromagnetic and polar-type nonlinearly localized states can coexist within the gap of the matter wave bandgap spectrum in the form of vector gap solitons with a small number of atoms and self-trapped gap waves containing a large number of atoms. We explore the variety of spatially localized states in the lattice potential and show that, in general, the localization properties and non-equilibrium dynamics of the spinor BEC in the lattice cannot be captured by the single-mode approximation, usually employed for the mean-field description of the spinor matter waves.

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