Interaction dynamics of nonlinear copropagating Airy beams in photoinduced waveguide arrays with defects

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ABSTRACT

We theoretically investigate the nonlinear propagation of two copropagating Airy beams in a defected one-dimensional photonic lattice. The combined action of lattice geometry and modulation strength, nonlinearity, and beam parameters enables the generation of up to ten distinct and symmetric output channels, with tunable intensity distribution and spacing. Introducing a relative phase between the beams provides an efficient control mechanism to break or restore symmetry while redistributing energy across the lattice. These results highlight a versatile platform for optical routing, spatial multiplexing, and all-optical switching, where reconfigurable and dynamically adjustable channels are essential. The demonstrated ability to achieve multiple high-intensity symmetric outputs also supports applications in beam splitting, shaping, and reconfigurable photonic circuits, offering new opportunities for active optical components in next-generation all-optical networks.

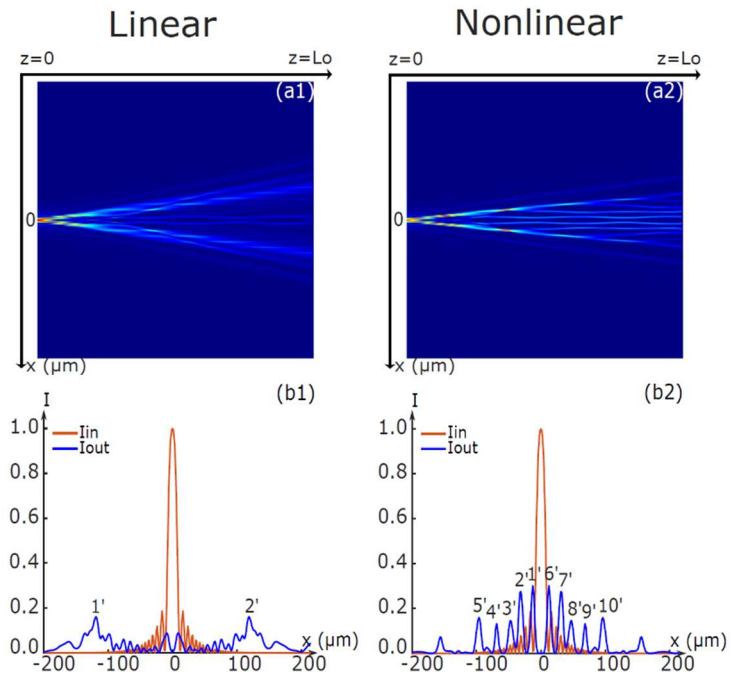

Figure 1. (a1), (a2) Intensity distribution for the negative defect case in the linear regime (Γ = 0) and nonlinear regime (Γ = 6) respectively. (b1), (b2) Corresponding transverse intensity profiles. Numerical parameters: L0 = 10 mm, x0 = 5μm, An = 1.5 × 10−4, δn = 2, δϕ = 0.