

Analytical examination of Fano resonances in photonic crystal devices

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Many types of recently suggested photonic crystal devices display specific resonance transmission properties that can be associated with the existence of Fano resonances. The simplest class of such systems is a straight waveguide that is weakly coupled to a side-placed defect or cavity. We show that both linear and nonlinear transmission properties of a number of such optical devices can be accurately studied within the frameworks of the generalized Fano-Andersen discrete model with nonlocal coupling [1]. Based on analytical solutions of this model for several basic types of linear and nonlinear photonic crystal devices, we examine origins of different peculiarities observed in the resonance transmission spectra and emphasize importance of thought-out designs of such devices. We demonstrate how small modifications in the device design can lead to qualitative changes in the resonance transmission spectrum, significantly improving such features as resonance quality factors, bistability thresholds, and tolerances with respect to fabrication disorder.

[1] A. E. Miroshnichenko, S. F. Mingaleev, S. Flach, and Yu. S. Kivshar, *Phys. Rev. E*, in press (2005); arXiv:cond-mat/0412341.