Beam Splitting at Normal Incidence in a 2D Photonic Crystal

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The conventional optical passive devices such as waveguides and cavities are usually made by introducing defects in a photonic crystal (PhC). However, to construct a highly compact as well as multi-functional photonic integrated circuit (PhIC), we may need to use the anomalous refractive behaviors in a PhC. Here, we study the anomalous photon behavior, so called beam splitting [1] in a 2D PhC, which may provide greater flexibility in the design of the PhIC. For our 2D photonic crystal, the calculated equi-frequency surface seems to initially indicate a self-collimating beam propagation for normal incidence. However, by performing the finite-difference time-domain (FDTD) simulations, we observe the wave front of normal incidence beam appears to split and eventually to form a symmetric Y-branch (See Fig. 1). Further quantitative analysis on this anomalous beam splitting behavior will be discussed.

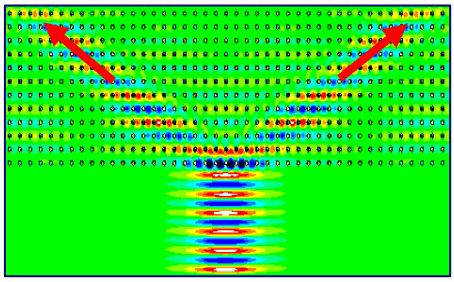

Fig.1. FDTD simulation result of beam splitting at normal incidence.

[1] Y. Luo, W. Zhang, Y. Huang, J. Zhao, and J. Peng, *Opt. Lett.,* **29**, 2920 (2004).