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Theory of Light Refraction at a Surface of a Photonic Crystal WEI JIANG, RAY T. CHEN, Microelectronics Research Center, University of Texas at Austin — In past studies on photonic crystal refraction, how the surface orientation affects refraction was largely unexplored. In this work, a general, analytic theory of light refraction is developed for a photonic crystal (PC) that has an arbitrary lattice type and surface orientation. A simple topological argument is presented to prove the equal partition of forward and backward propagating modes by an arbitrary plane in any periodic optical media. Furthermore, we have discovered the surface-dependent degeneracy of crystal modes. The current theory addresses light refraction by a *natural* quasi- periodic surface, in addition to an ordinary periodic surface. Particularly interesting is the transition from a periodic surface to a quasi-periodic surface, which could happen upon a slight change of surface orientation. Such a transition could lift the surface-dependent mode degeneracy, which can be observed as a small number of refracted beams split into an essentially infinite number of beams. Harnessing such an extremely sensitive phenomenon could lead to interesting applications in optoelectronics.

Wei Jiang
University of Texas at Austin

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