RESONANCE AND BOUND STATES IN PHOTONIC CRYSTAL SLABS

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Abstract. Using boundary-integral projections for time-harmonic electromagnetic (EM) fields, and their numerical implementation, we analyze EM resonance in slabs of two-phase dielectric photonic crystal materials. We characterize *resonant frequencies* by a complex Floquet-Bloch dispersion relation $\omega = W(\beta)$ defined by the existence of a nontrivial nullspace of a pair of boundary-integral projections parameterized by the wave number β and the time-frequency ω. At resonant frequencies, the crystal slab supports a source-free EM field. We link *complex* resonant frequencies, where the imaginary part is small, to resonant scattering behavior of incident source fields at nearby real frequencies and anomalous transmission of energy through the slab. At a *real* resonant frequency, the source-free field supported by the slab is a *bound state*. We present numerical examples which demonstrate the effects of structural defects on the resonant properties of a crystal slab and surface waves supported by a dielectric defect.

Key words. Photonic crystal, boundary integral, Calderón projection, resonance, dispersion relation, bound state, scattering, surface wave.

AMS subject classifications. 78, 45, 65

SIAM J. Appl. Math., Volume 64, Number 1, pp. 322–342

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