Photonic eigenmodes in periodically patterned systems

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Photonic bands and optical response are computed for the case of a photonic crystal slab obtained with a 2D deep rectangular pattern and compared with 2-D photonic structure calculations.

The theoretical framework proposed is based on the electromagnetic field expansion in the orthornormal set of eigenstates of the 2D slab. The method allows one to obtain modes self-energy correction in its real and imaginary part since a complete basis set is used that includes also the leaky modes of the guide.

It goes beyond the commonly used methods for modes dispersion calculation. Respect to the supercell method[1] it avoids the use of very large plane wave expansion, while respect to perturbative approximations[2] (to include off-diagonal components of the dielectric tensor of the deeply patterned layers) or expansion on the basis of "effective" waveguide modes[3] it is not restricted to thin slabs.

Moreover, the possibility to obtain electric field distributions and to include a dispersive dielectric function, make this system very interesting to design the optical properties of microcavity array of quantum dots[4].

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2. S.G. Johnson et al. Phys. Rev. B 62, 8212 (2000)
3. L. C. Andreani, M. Agio IEEE Jour. of Quan. Electr. 38 (7), 891 (2002)
4. T. Gutbrod et al. Phys. Rev. B 57, 9950 (1998)