Dispersion equation in a periodic array of resonant scatterers.

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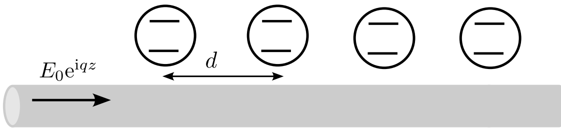

FIG. 1 Periodic array of resonant scatterers coupled to the waveguide.

We consider wave propagation in a one-dimensional periodic array of scatterers, shown in Fig. 1. The dispersion law for the propagating waves with the wave vector K is given by the equation

$$\cos K = \cos qd - \frac{\sin qd \gamma_{1D}}{\omega_0 - \omega} \,. \tag{1}$$

where $q = \omega/c$ is the wave vector of light at the frequency ω , γ_{1D} is the radiative decay rate, d is the array period, ω_0 is the emitter resonance frequency.

We consider a special case of resonant Bragg structure, satisfying the additional condition $\omega_0 d/c = \pi$.

This answer has been obtained in (Ivchenko, 1991) for the array of quantum wells.

Goal: Simplify the dispersion equation in the vicinity of the Bragg band gap using the condition $\omega_0 d/c = \pi$ and assuming assuming that $\gamma_{1D}, \gamma \ll \omega_0$. Find analytically the band gap width Δ. Plot on the same graph the disperison law $\mathrm{Re}\, K(\omega)$ found from the exact equation and for the simplified one for $\gamma_0/\omega_0 = 10^{-2}$.

References

Ivchenko, E. L., 1991, Sov. Phys. Sol. State **33**(8), 1344.