Reflection from a periodic array of resonant scatterers vs N.
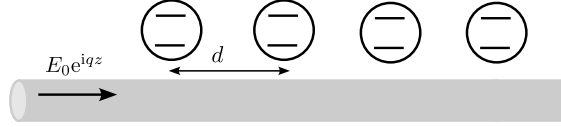
(Dated: February 11, 2025)

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

We consider wave reflection from a periodic array of scatterers, shown in Fig. 1. The amplitude light reflection coefficient $r_N(\omega)$ can be found from the following equations (Sheremet *et al.*, 2023):

$$r_N(\omega) = \frac{\widetilde{r}_1}{1 - \widetilde{t}_1 \frac{\sin(N-1)K}{\sin NK}} \tag{1}$$

where

$$\widetilde{r}_1 = \mathrm{e}^{\mathrm{i}qd} r_1, \quad \widetilde{t}_1 = \mathrm{e}^{\mathrm{i}qd} t_1, \quad t_1 = 1 + r_1, \quad r_1 = \frac{\mathrm{i}\gamma_{1\mathrm{D}}}{\omega_0 - \omega - \mathrm{i}(\gamma_{1\mathrm{D}} + \gamma)} \tag{2}$$

are the reflection and transmission coefficients from one emitter, $q = \omega/c$ is the light wave vector and

$$\cos K = \cos qd - \frac{\gamma_{1\mathrm{D}}}{\omega_0 - \omega - \mathrm{i}\gamma} \sin qd . \tag{3}$$

is the Bloch vector.

Goal: Plot the set of reflection spectra $|r_N(\omega)|^2$ vs normalized frequency $(\omega - \omega_0)/\gamma_{1\mathrm{D}} \in [-20 \ldots 20]$ for $\omega_0 d/c = \pi$, $\gamma = 0$, $\gamma_0/\omega_0 = 2 \times 10^{-2}$ and $N = 1, 2 \ldots 10, 20$ (spectra to be on the same plot).

Answer:

References

Sheremet, A. S., M. I. Petrov, I. V. Iorsh, A. V. Poshakinskiy, and A. N. Poddubny, 2023, Rev. Mod. Phys. **95**, 015002.
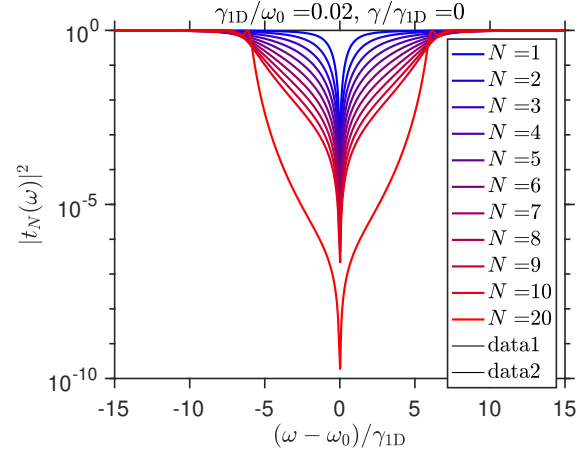
FIG. 2 Reflection spectra from a resonant periodic structure for different values of N. Vertical lines show the edges of the polariton band gap $\omega - \omega_0 = \pm\sqrt{2\gamma_0\omega_0/\pi}$.