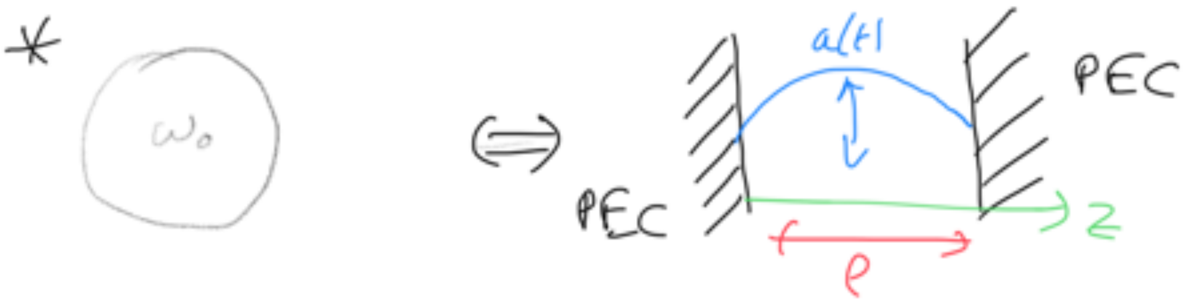
*



$a(t) = \sin\left(\frac{\pi z}{\ell}\right)\cos(\omega_0 t)$ real field ω_0?

$\ell = \frac{\lambda}{2} = \frac{c_0}{2f} \Rightarrow f = \frac{2\ell}{c_0} \Rightarrow \omega_0 = 2\pi f = 2\pi \frac{2\ell}{c_0}$

In CMT, "a" is the complex field amplitude A at $z = \frac{\ell}{2}$

$a(t) = \mathrm{Re}[A(t)] \Rightarrow A(t,z) = \sin\left(\frac{\pi z}{\ell}\right) e^{j\omega_0 t}$ complex field

$\Rightarrow A(t) = A_0 e^{j\omega_0 t}$ with $|A(t)|^2 \sim \int_V \frac{\varepsilon_0}{2} |E|^2$

$\Rightarrow \frac{dA}{dt} = j\omega_0 A(t) - \gamma A(t)$ $\qquad i \Leftrightarrow -j$

lossless $\quad \omega \neq \omega_0$

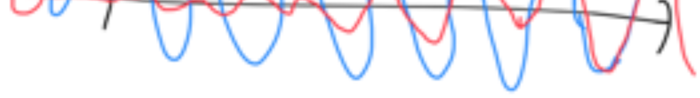
$\Rightarrow \vec{E} = 0$

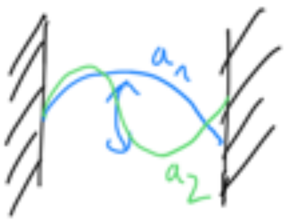
radiation losses

non ∞ # of images

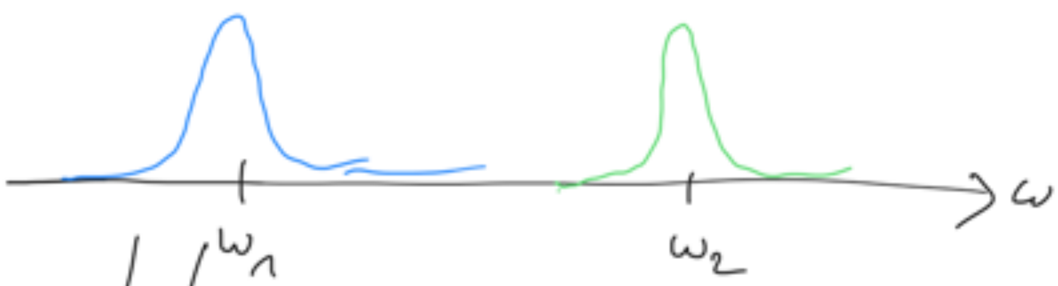
if $\omega \sim \omega_0$

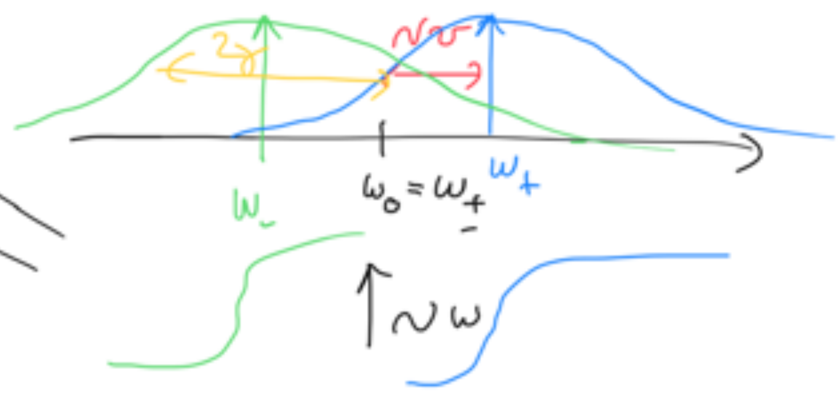
$S_1^+(t)$ $\quad S_2^-(t)$

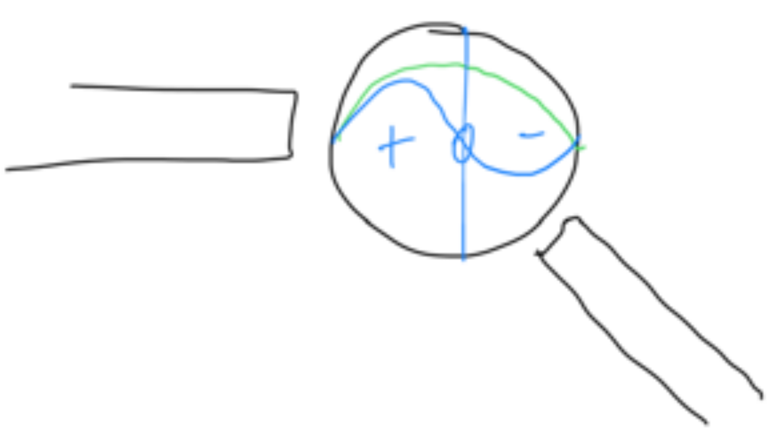


* 

$$\begin{cases}\dot{a}_1 = i\omega_1 a_1\\ \dot{a}_2 = i\omega_2 a_2\end{cases}$$







Next: acoustic analogue of graphene

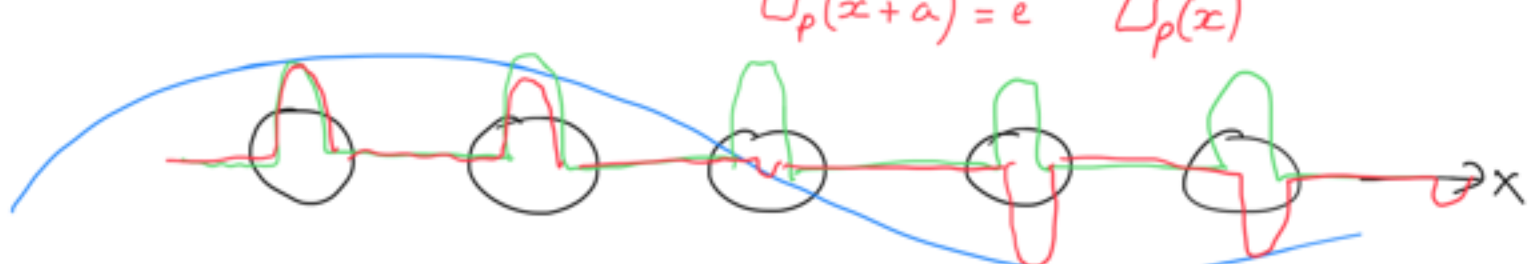
* Bloch theorem (Kittel "Introduction to solid state physics")

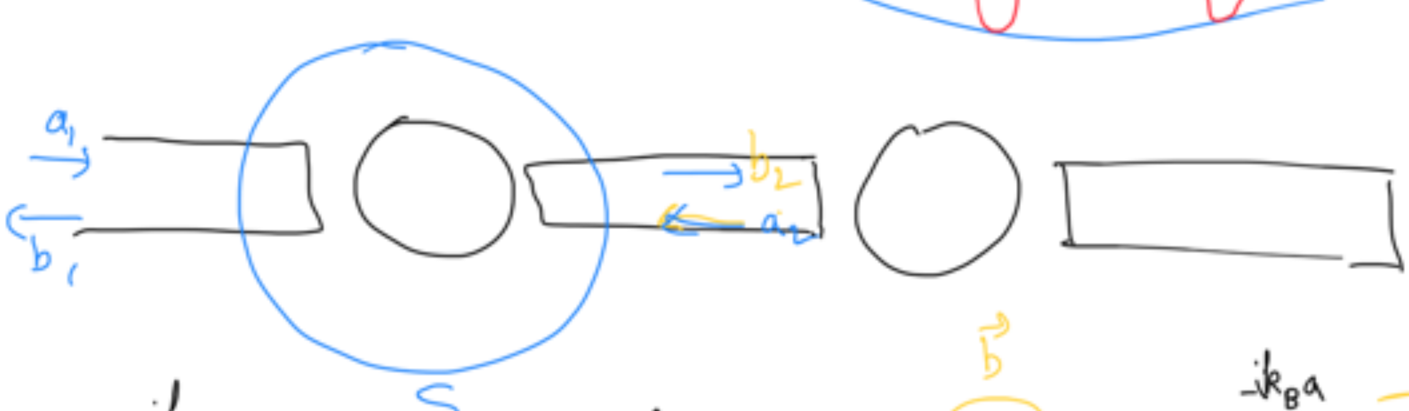
homogenous : $u(x,t) = u_0 \cos(\omega t - kx)$ plane wave

$$U(x) = u_0 e^{jkx}$$

Bloch wave number

periodic medium period a : Bloch $\underbrace{U_p(x) = e^{jk_B x}\, u_p(x)}_{U_p(x+a) = e^{ik_B a} U_p(x)}$ / $u_p(x+a) = u_p(x)$



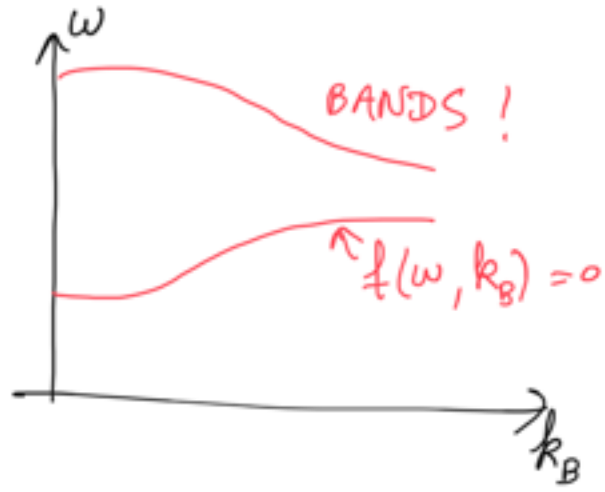
* 

$b_2 = e^{ik_B a} a_1$ $\quad a_2 = e^{ik_B a} b_1$ $\quad \overbrace{\begin{pmatrix} b_1 \\ \end{pmatrix}}^{\vec{b}} = \begin{pmatrix} 0 & e^{-ik_B a} \\ e^{ik_B a} & \end{pmatrix} \overbrace{\begin{pmatrix} a_1 \\ \end{pmatrix}}^{\vec{a}}$

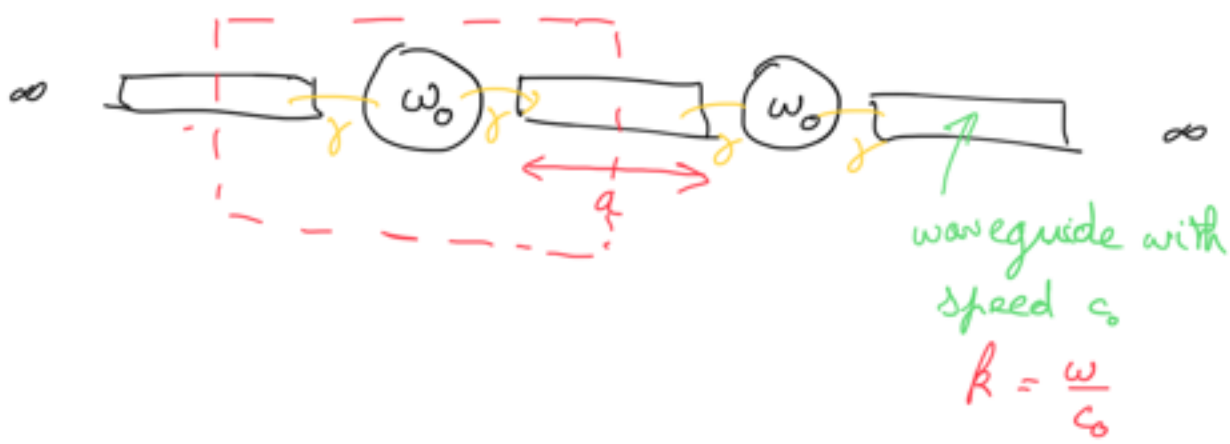
$$\begin{cases}\vec b = S\,\vec a\\ \vec b = \mathcal{B}\,\vec a\end{cases} \qquad \boxed{(\hat S - \hat{\mathcal{B}})\,\vec a = 0}$$

1) $\vec a = 0 \Rightarrow$ trivial

2) $\det \underbrace{(\hat S - \hat{\mathcal{B}})}_{f(\omega, k_B)} = 0 \quad \Rightarrow$



1) Assignment:



2) Reproduce fig 14 p51