$$m\ddot{\bar{r}} + k\bar{r} = q\bar{E}'$$

$$\bar{E}' = \bar{E}_0' e^{-i\omega t}, \quad \bar{r} = \bar{r}_0 e^{i\omega t}$$

$$\bar{r} = \frac{q\bar{E}'}{m(\omega_0^2 - \omega^2)} \qquad \omega_0 = \sqrt{\frac{k}{m}}$$

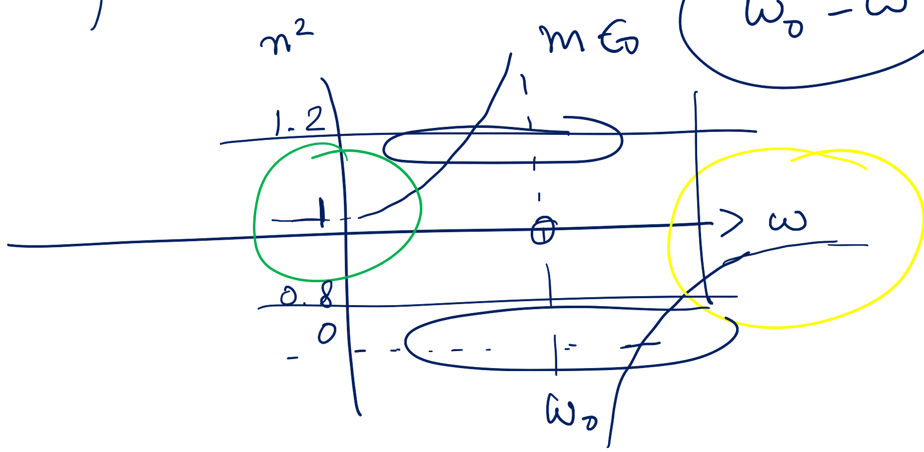
$$\bar{p} = q\bar{r} \overset{def}{=} \alpha E' \; ; \quad \bar{P} = N\bar{p} = \frac{Nq^2}{m}\frac{\bar{E}'}{\omega_0^2 - \omega^2} = N\alpha E$$

$$\bar{P} = \alpha E$$

$$\frac{n^2 - 1}{n^2 + 2} = \frac{N\alpha}{3\epsilon_0} = \frac{Nq^2}{3m\epsilon_0}\frac{1}{\omega_0^2 - \omega^2}$$

Example: $n \approx 1$, $n^2 + 2 \approx 3$

$$n^2 = 1 + \frac{Nq^2}{m\epsilon_0}\frac{1}{\omega_0^2 - \omega^2}$$

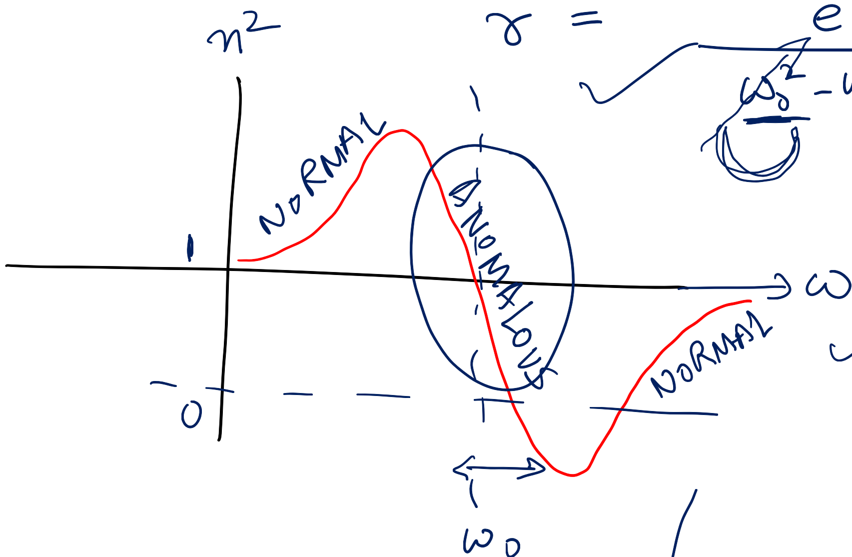


In real life, there is always dissipation

- emitted wave : loss of energy
- inter atom collisions

$$m\ddot{r} + m\gamma\dot{r} + Kr = qE'$$

$$r = \frac{eE'/m}{\omega_0^2 - \omega^2 - i\omega\gamma} \quad \Big\} \text{ LORENTZ}$$



"Drude model"

$$\epsilon = 1 - \frac{\omega_p^2}{\omega^2 + i\omega\gamma}$$

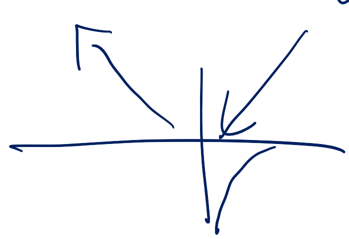
$$\omega_p^2 = Ne^2/m\epsilon_0$$

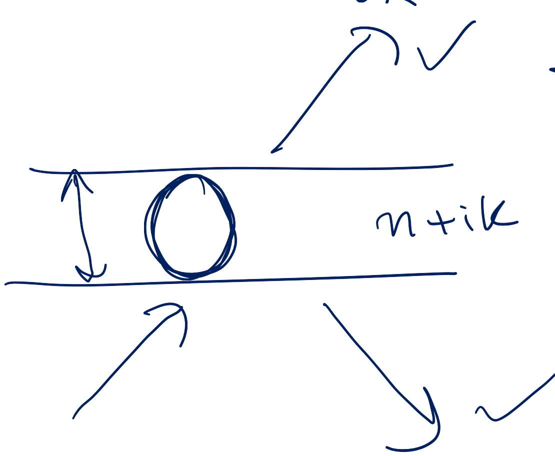
$$\epsilon_{tot} = \epsilon_{Drude} + \epsilon_{Lorentz}$$

$$\sum_{i=1}^{N} \frac{(\quad)}{\omega_{0i}^2 - \omega^2 - i\omega\gamma_i}$$

$$e^{i(kz-\omega t)} = e^{-Kz}\, e^{-i\omega t}$$

iK

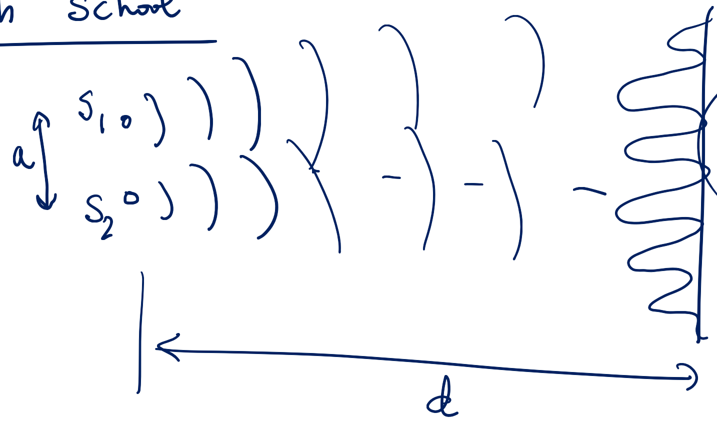




INTERFERENCE

$$\bar{E}_{tot} = \bar{E}_1 + \bar{E}_2$$

High school



screen

(1) $a \gg \lambda$

(2) d large

$\boxed{(3)\ \text{linearly}}$