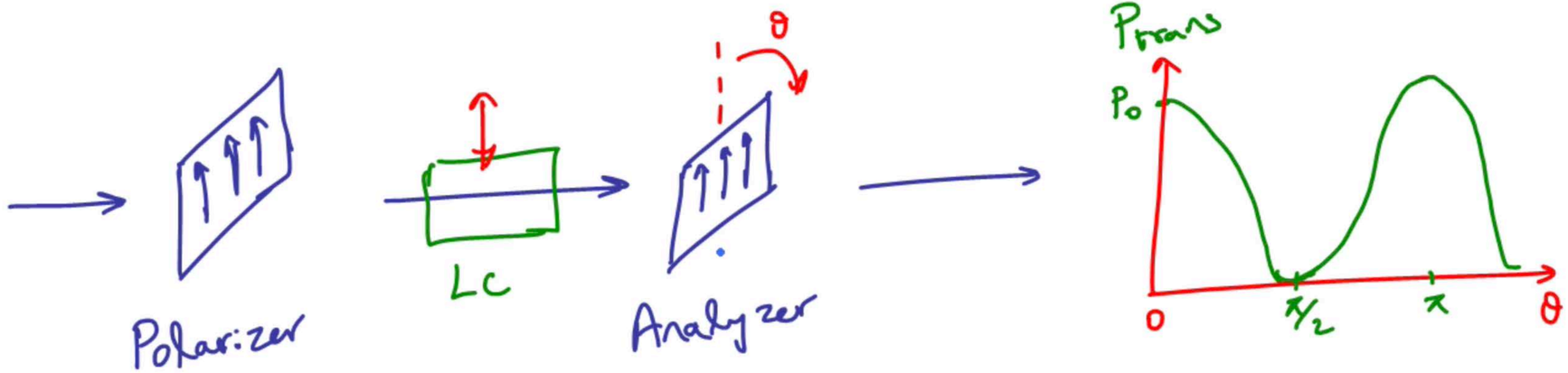
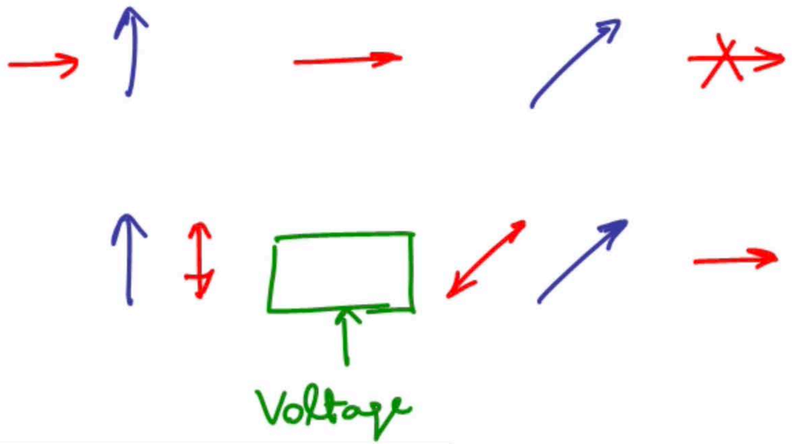


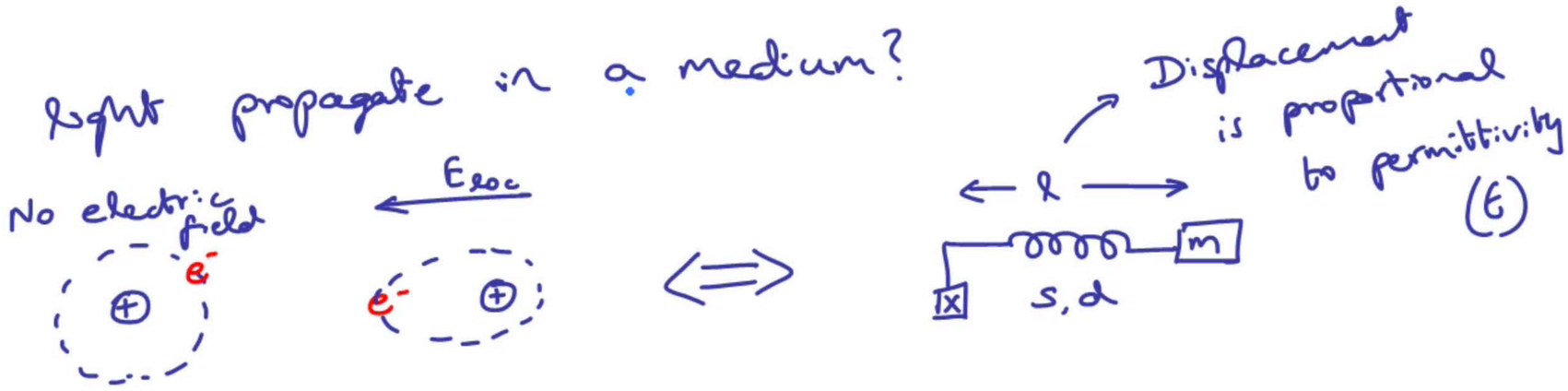
Malus's law

$P_0 \cos^2 \theta$



Learning Outcome: Identify the fundamental principles for photon / light manipulation

How does light propagate in a medium?



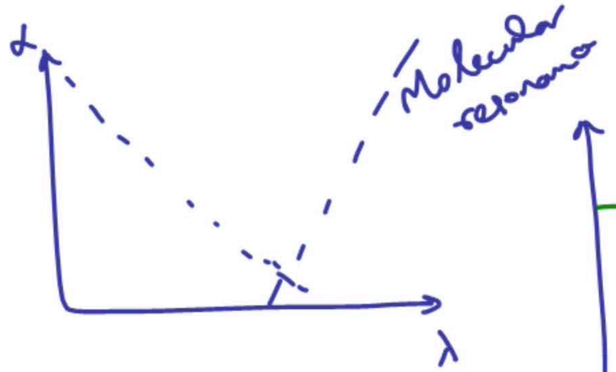
Equation of motion, $m \cdot \frac{d^2\ell}{dt^2} + d \cdot \frac{d\ell}{dt} + s \cdot \ell = -e E_{loc}$

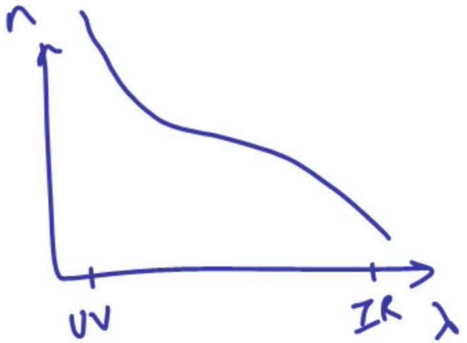
$\epsilon = \epsilon' - j\epsilon''$

For time-periodic excitation ($e^{j\omega t}$), $\ell = \frac{-e/m \; E_{loc}}{\omega_0^2 - \omega^2 + j\omega\Gamma}$

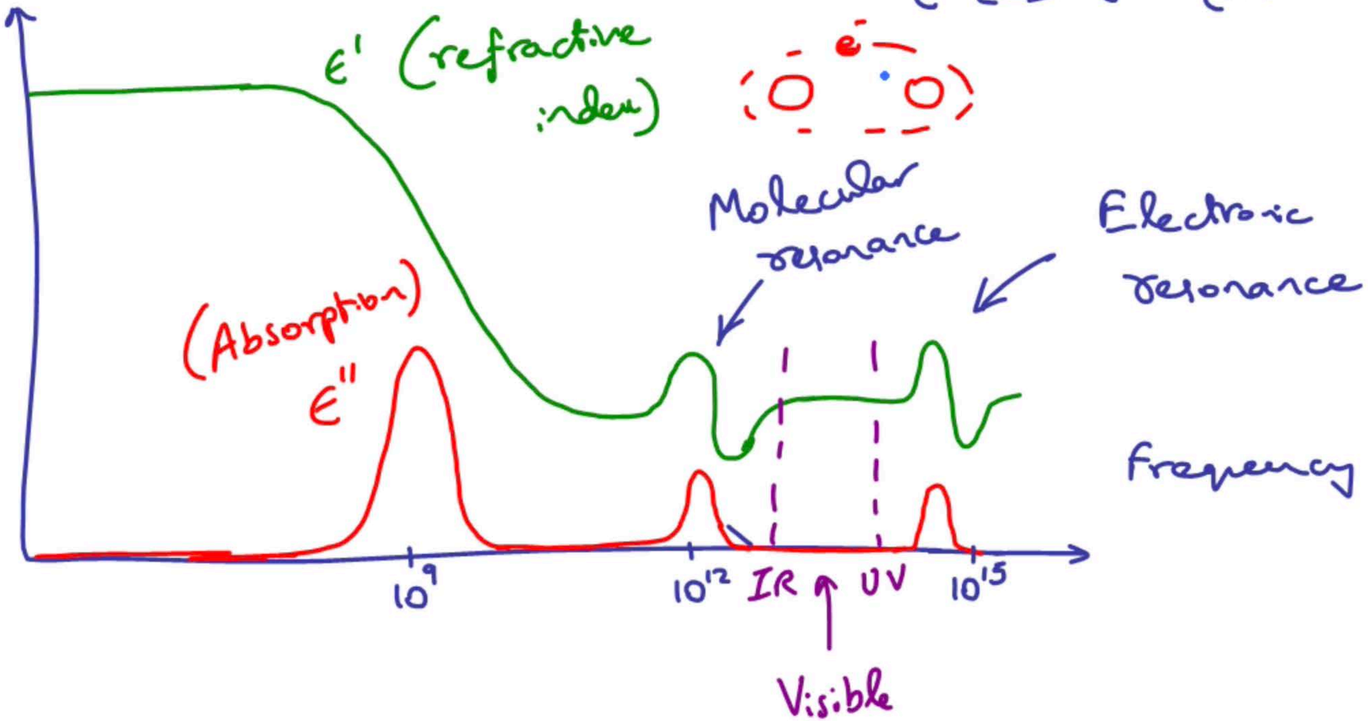
resonance freq. $\omega_0 = \sqrt{s/m}$ ← ω_0^2

damping coeff. d/m ← Γ





$\epsilon' \Longleftrightarrow \epsilon''$ (Kramers-Kronig relation)



$$\vec{D} = \epsilon_0 \epsilon_r \vec{E}$$

Electronic susceptibility

① **Polarization** : For an EM wave propagating in +z direction

$$\vec{E}(x, y, z, t) = \left(\hat{a}_x E_x + \hat{a}_y E_y e^{j\phi}\right) e^{j(\omega t - \beta z)}$$

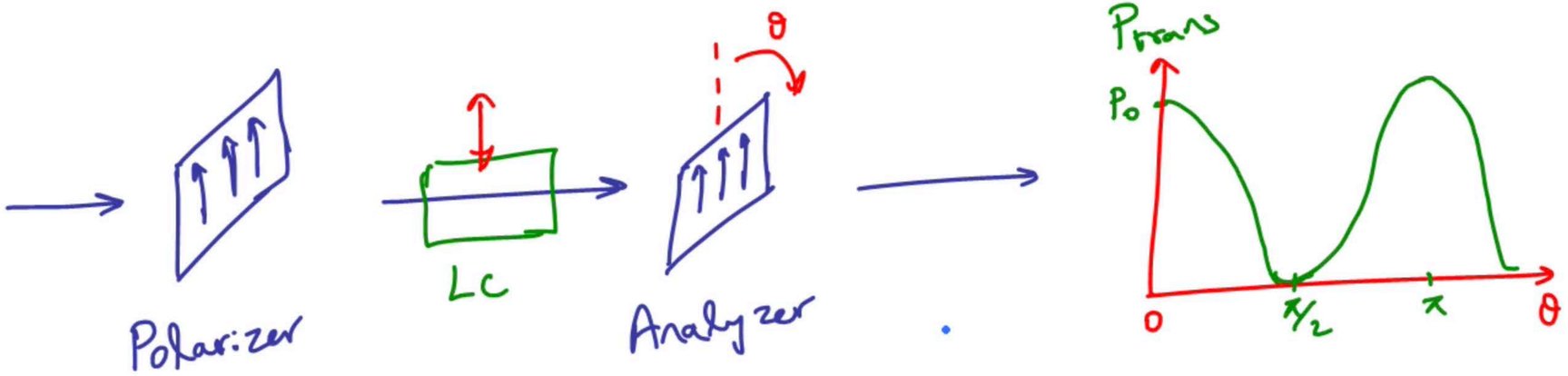
If $\phi = 0 \Rightarrow$ Linear polarization

$(E_x = E_y \Rightarrow \theta = 45^\circ)$

If $\phi = \pm \pi/2 \Rightarrow$ Circular polarization

$E_x = E_y$

Otherwise $\Rightarrow$ Elliptical polarization



Malus's law

$P_0 \cos^2 \theta$