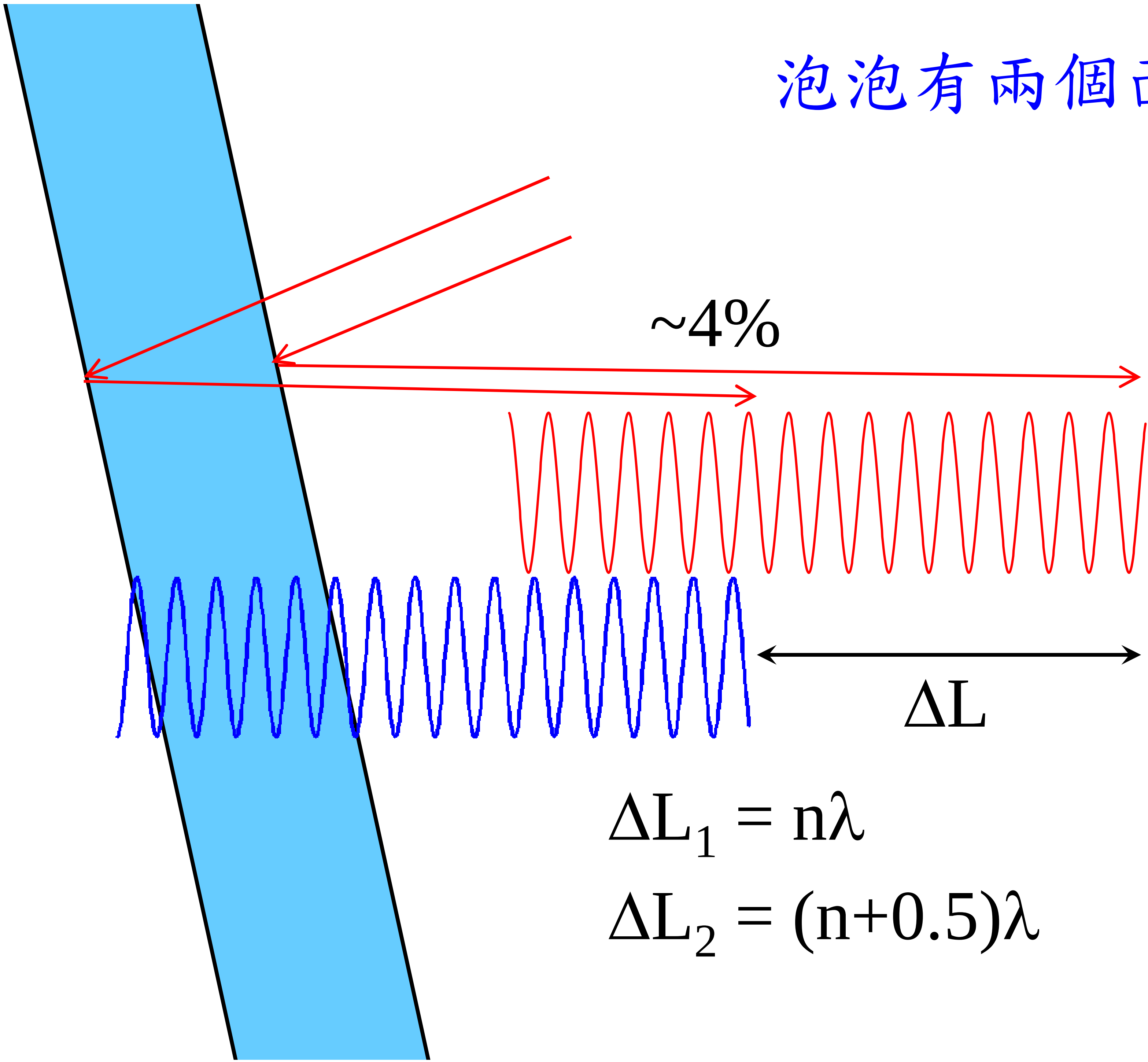
為什麼泡泡斑斕多彩?

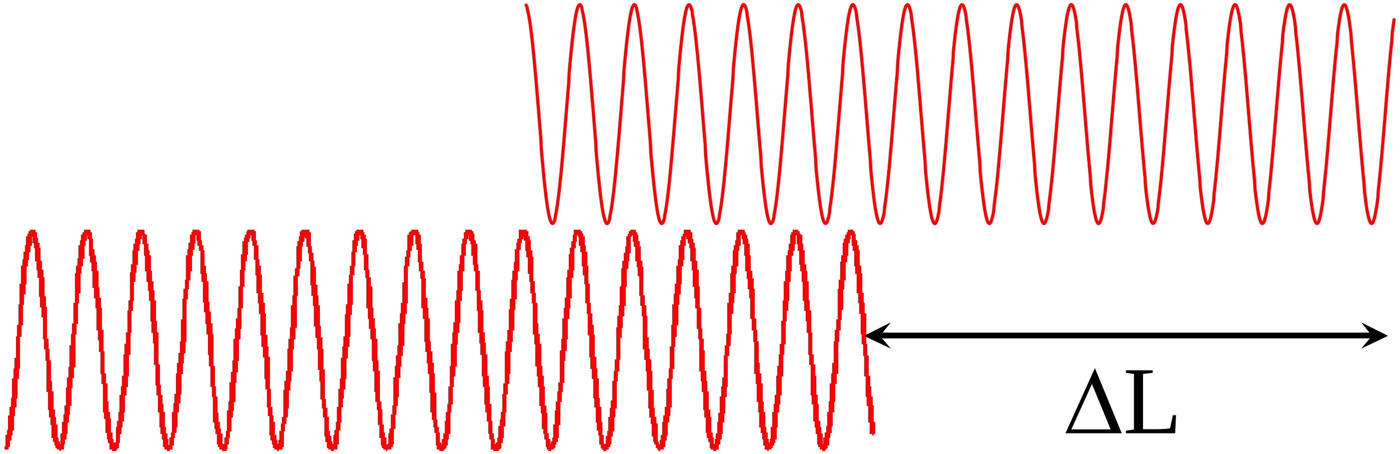
水面會反射光線

泡泡有兩個面



$$\Delta L_1 = n\lambda$$

$$\Delta L_2 = (n+0.5)\lambda$$

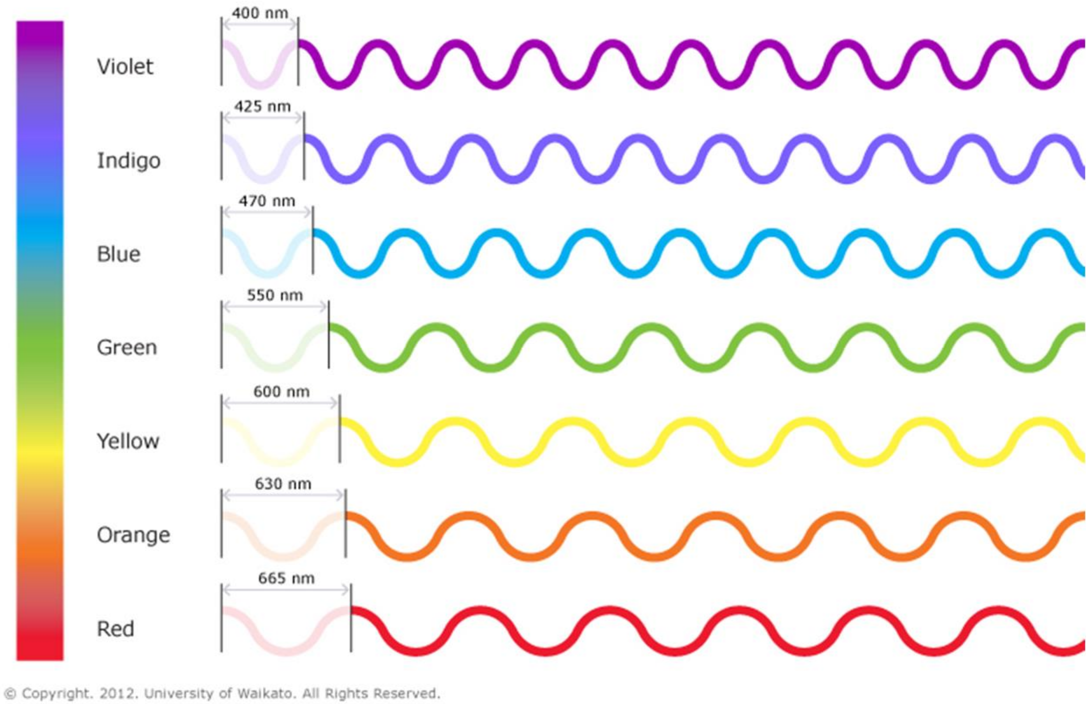


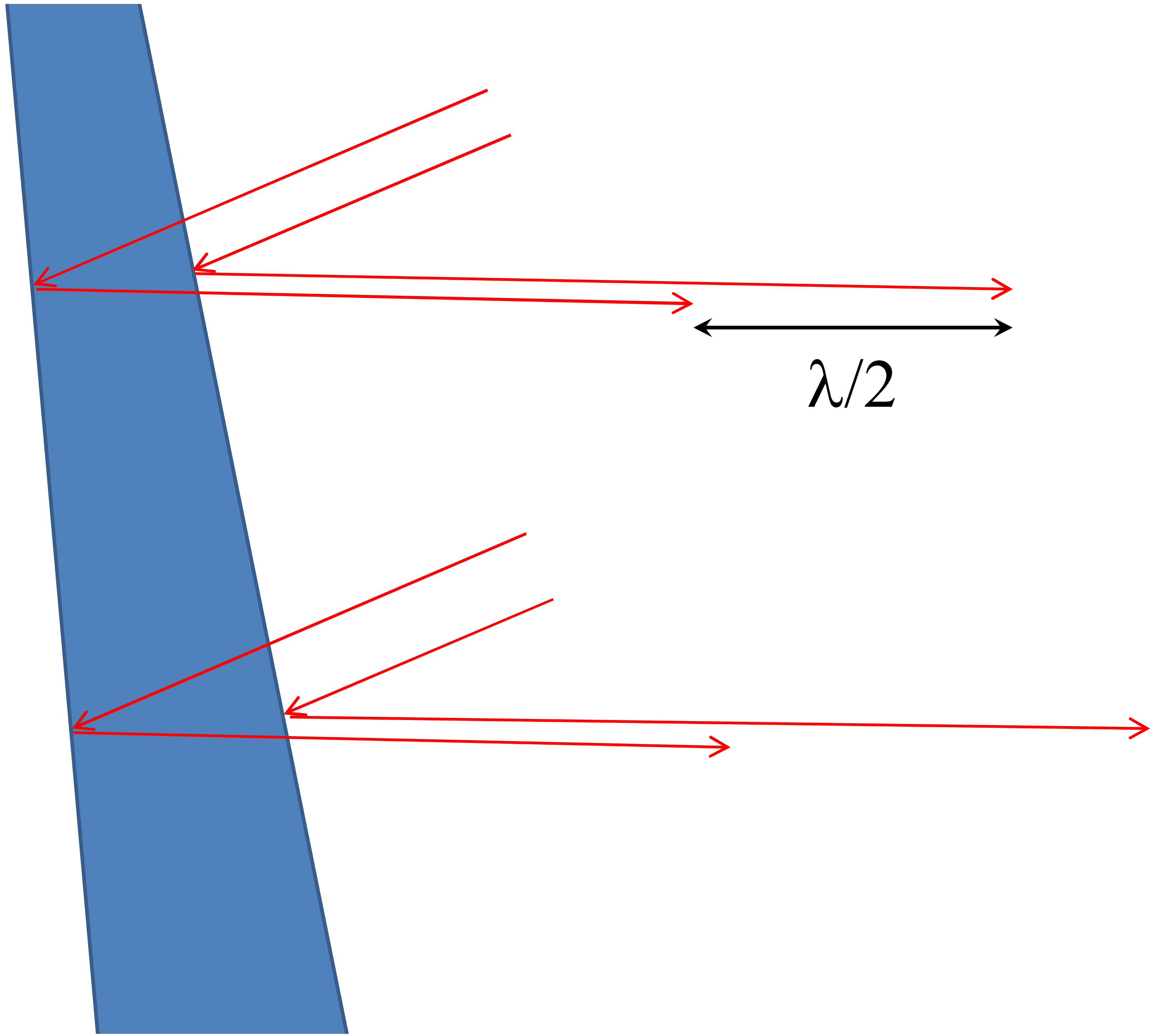
$$\left.\begin{aligned}\Delta L_1 &= n\lambda \\ \Delta L_2 &= (n+0.5)\lambda\end{aligned}\right\}$$ 不同厚度之干涉Ÿ 明暗交替

斑斕多彩

630 nm *1.5

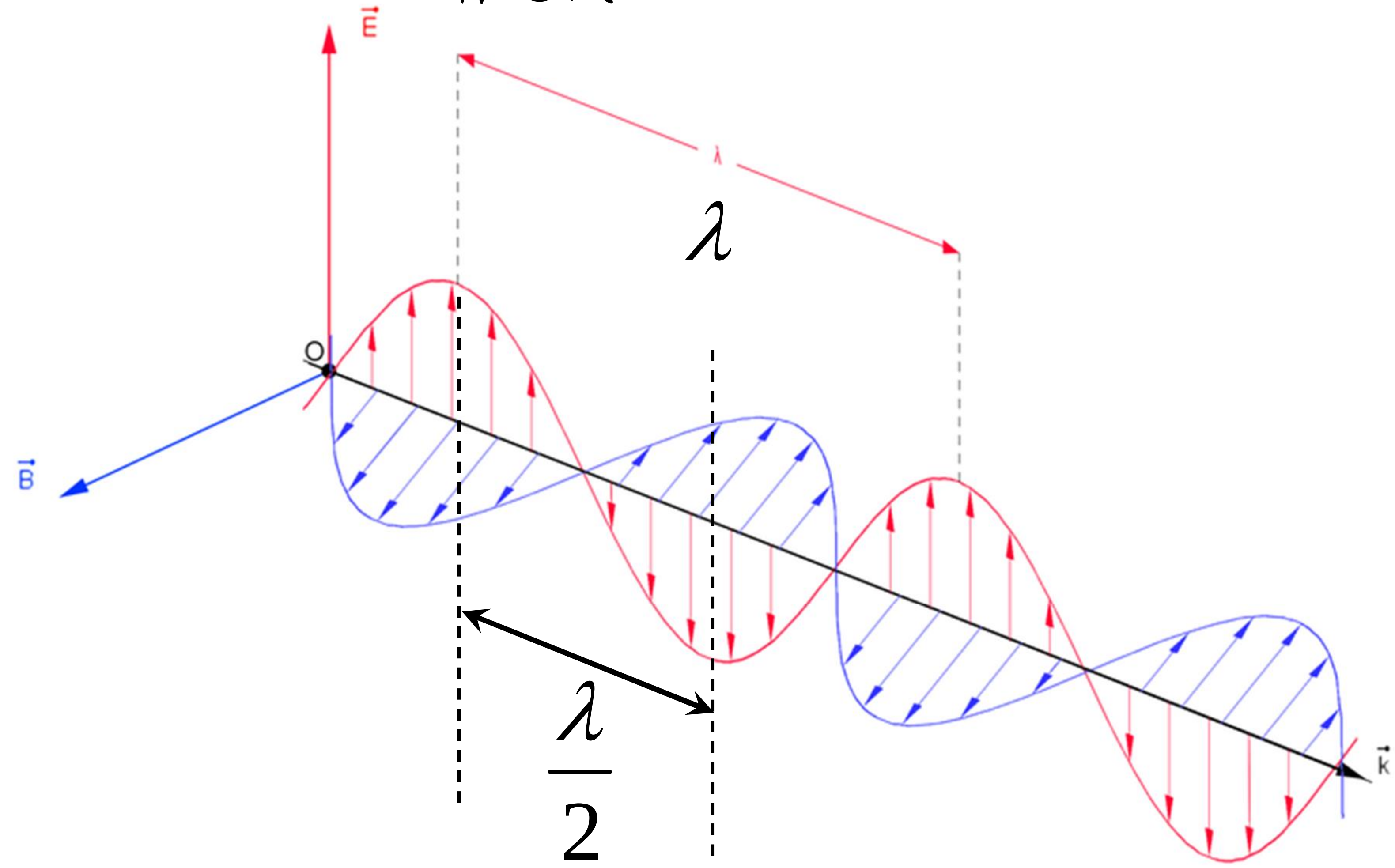
= 472 nm *2




λ/2

EM Wave & Polarization

林志民 Jim Jr-Min Lin



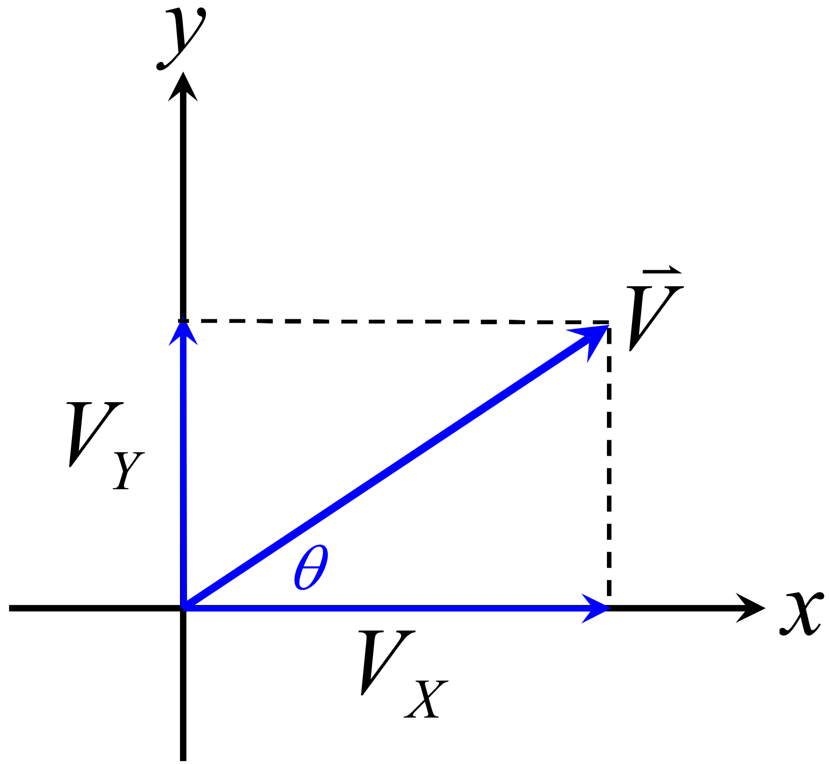
http://en.wikipedia.org/wiki/File:Onde_electromagn%C3%A9tique.png

Vector

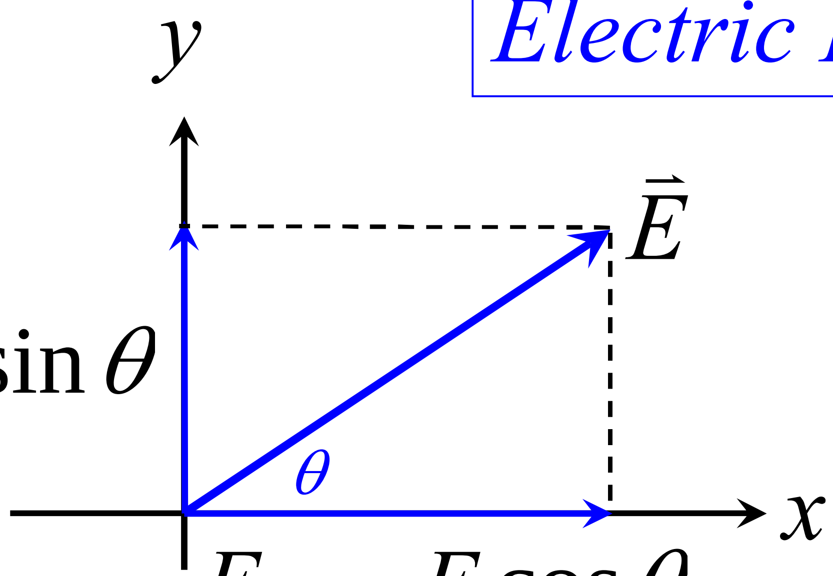
$$\vec{V} = \hat{x} V_X + \hat{y} V_Y$$

$$= \hat{x} V \cos\theta + \hat{y} V \sin\theta$$

$$V = \left|\vec{V}\right|$$

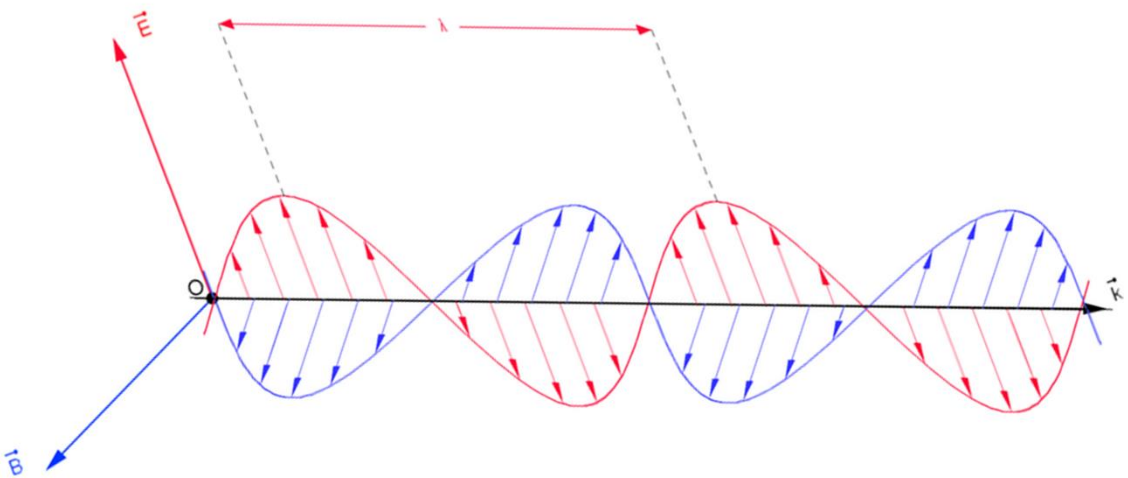


Electric Field is a Vector.



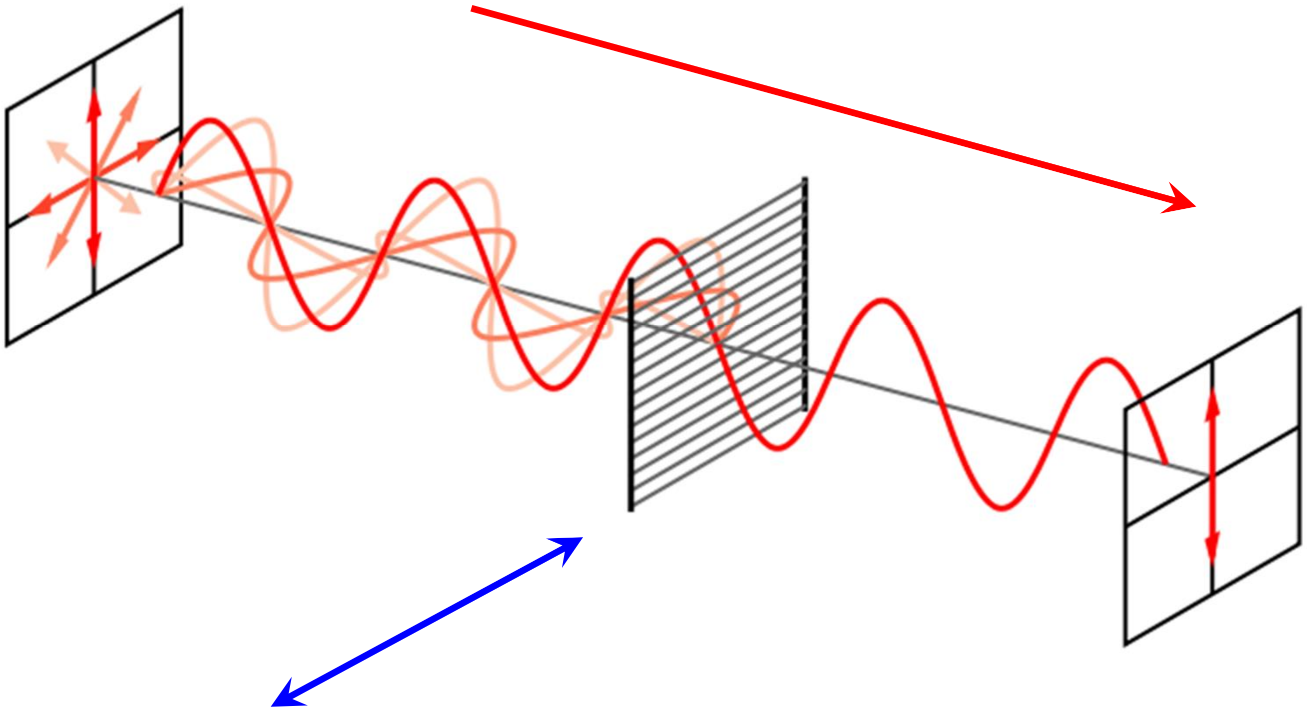
$$E_Y = E\sin\theta$$

$$E_X = E\cos\theta$$



Polarizer 偏振片

Only a certain direction of the *E* vector can transmit the polarizer, not the perpendicular one.

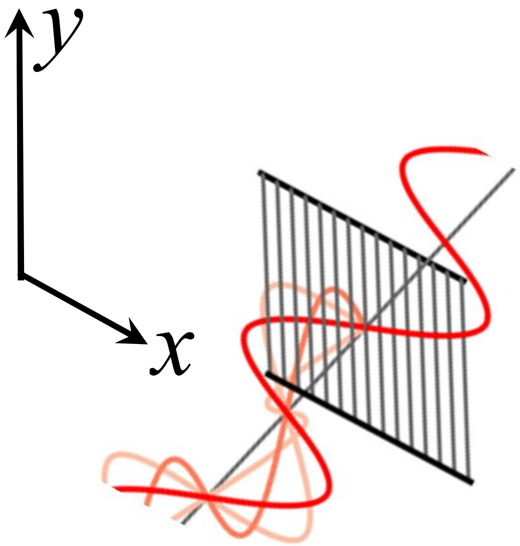


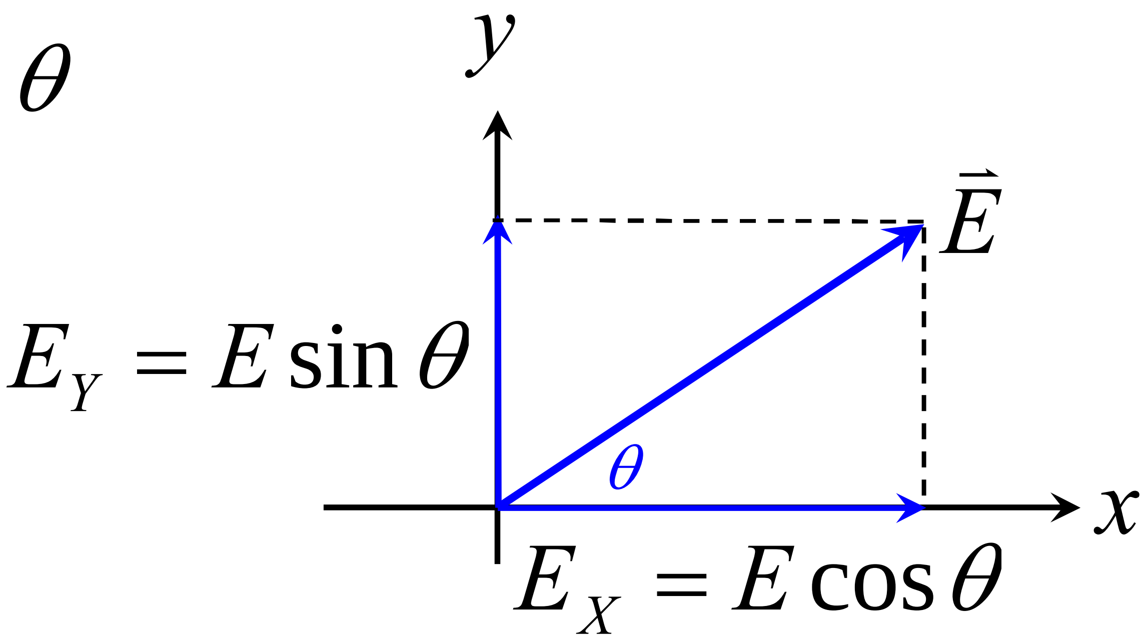
Conductive direction

If the transmitted direction is x, E_X component can go through, not E_Y.

The transmittance of an ideal polarizer is:

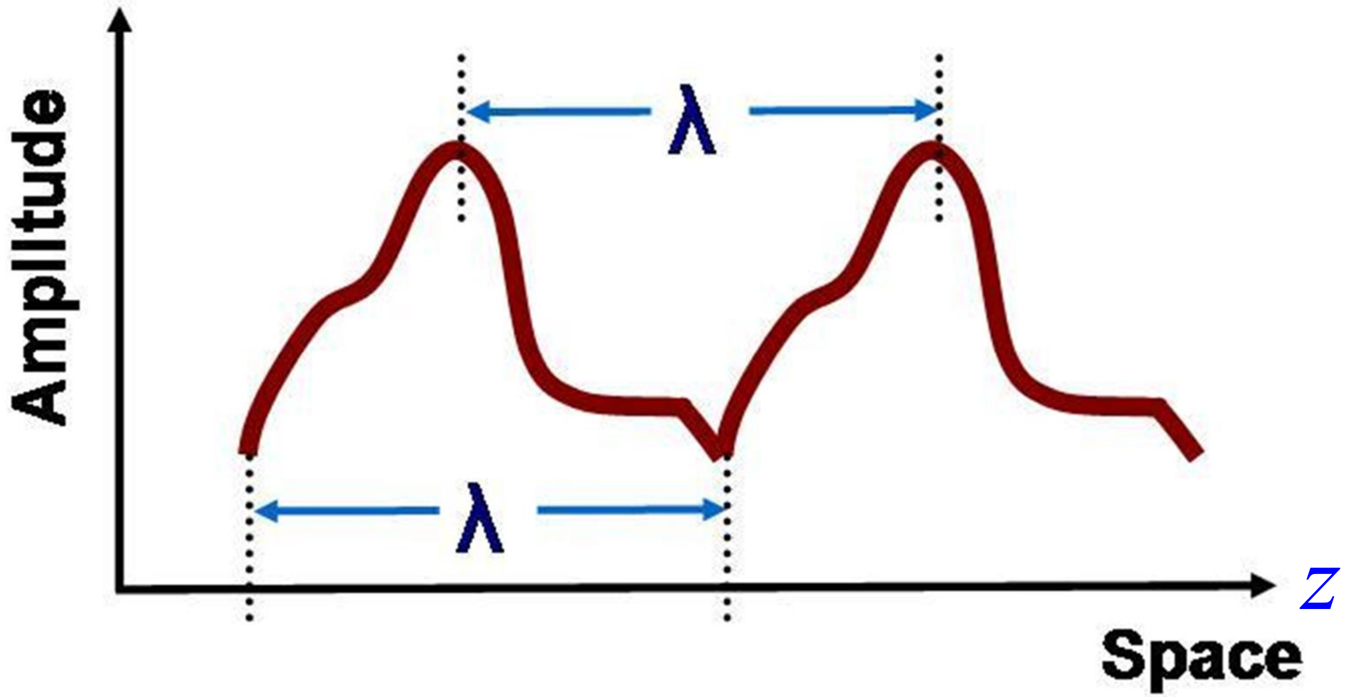
$$T = \left| \frac{E_X}{E} \right|^2 = \cos^2\theta$$



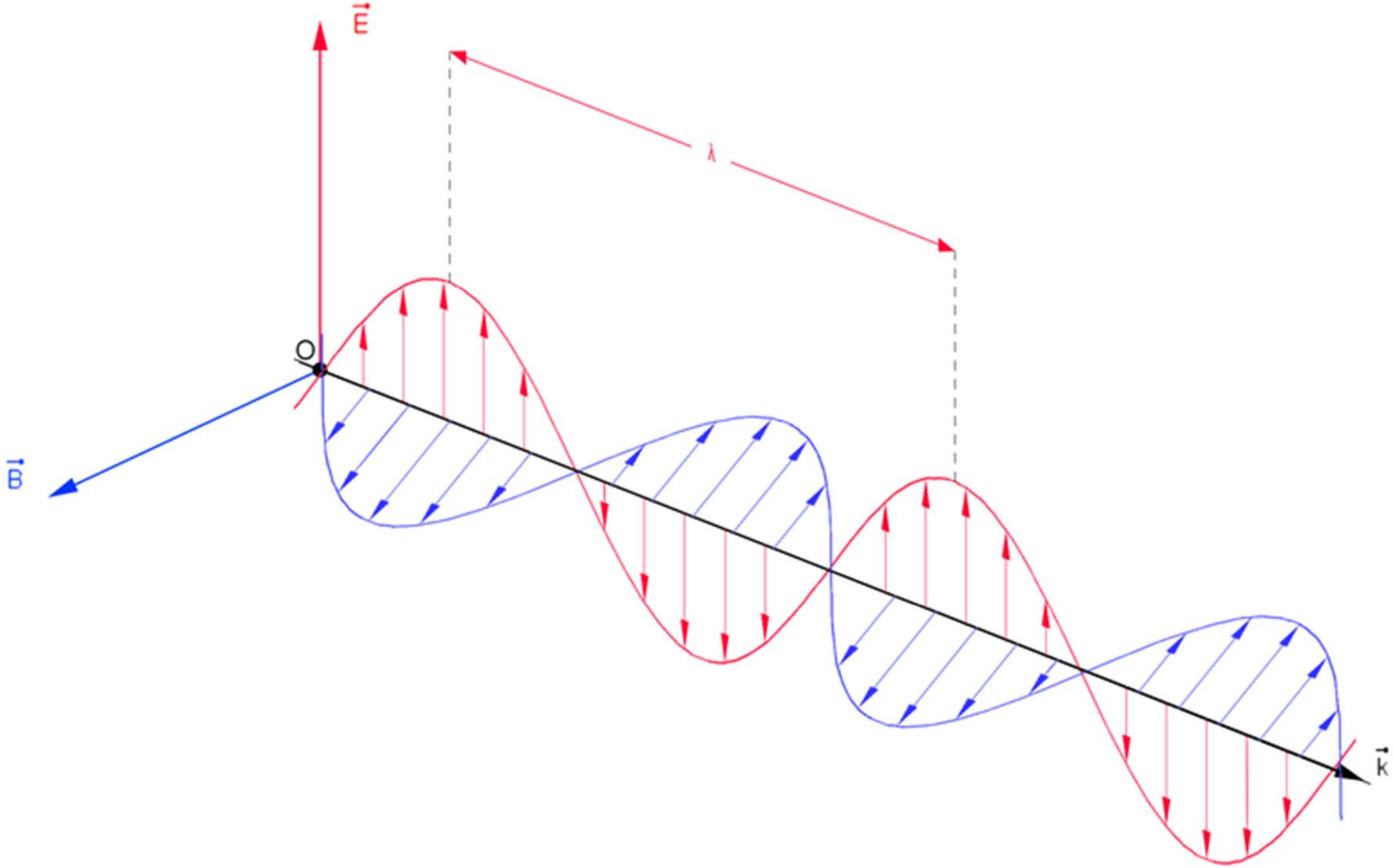


Wave

$$E(z,t) = f(z - vt) = g(\frac{z}{\lambda} - \frac{t}{T}), \quad v = \frac{\lambda}{T}$$

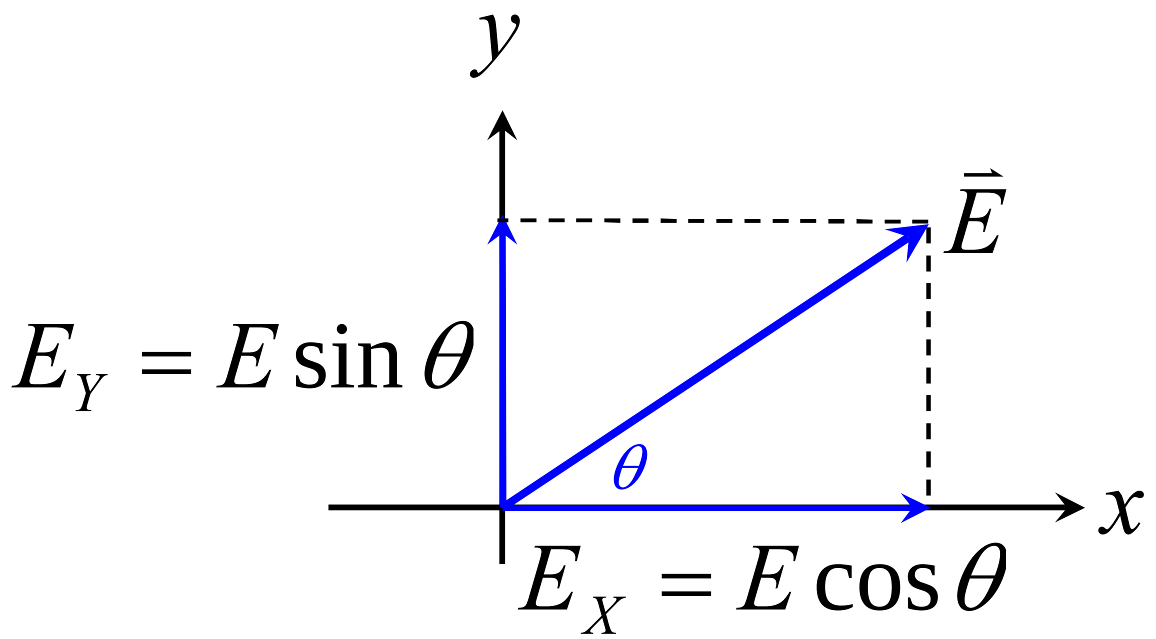


$$\vec{E}(z,t) = \vec{E}_0 \cos(2\pi \frac{z}{\lambda} - 2\pi f t)$$



$$\vec{E}(z,t) = \hat{x} E_X \cos(2\pi \frac{z}{\lambda} - 2\pi f t)$$

$$+ \hat{y} E_Y \cos(2\pi \frac{z}{\lambda} - 2\pi f t)$$



Number of Wavelength (# of wave)

$$\# of\ wave = \frac{L}{\lambda_0} \quad in\ vacuum$$

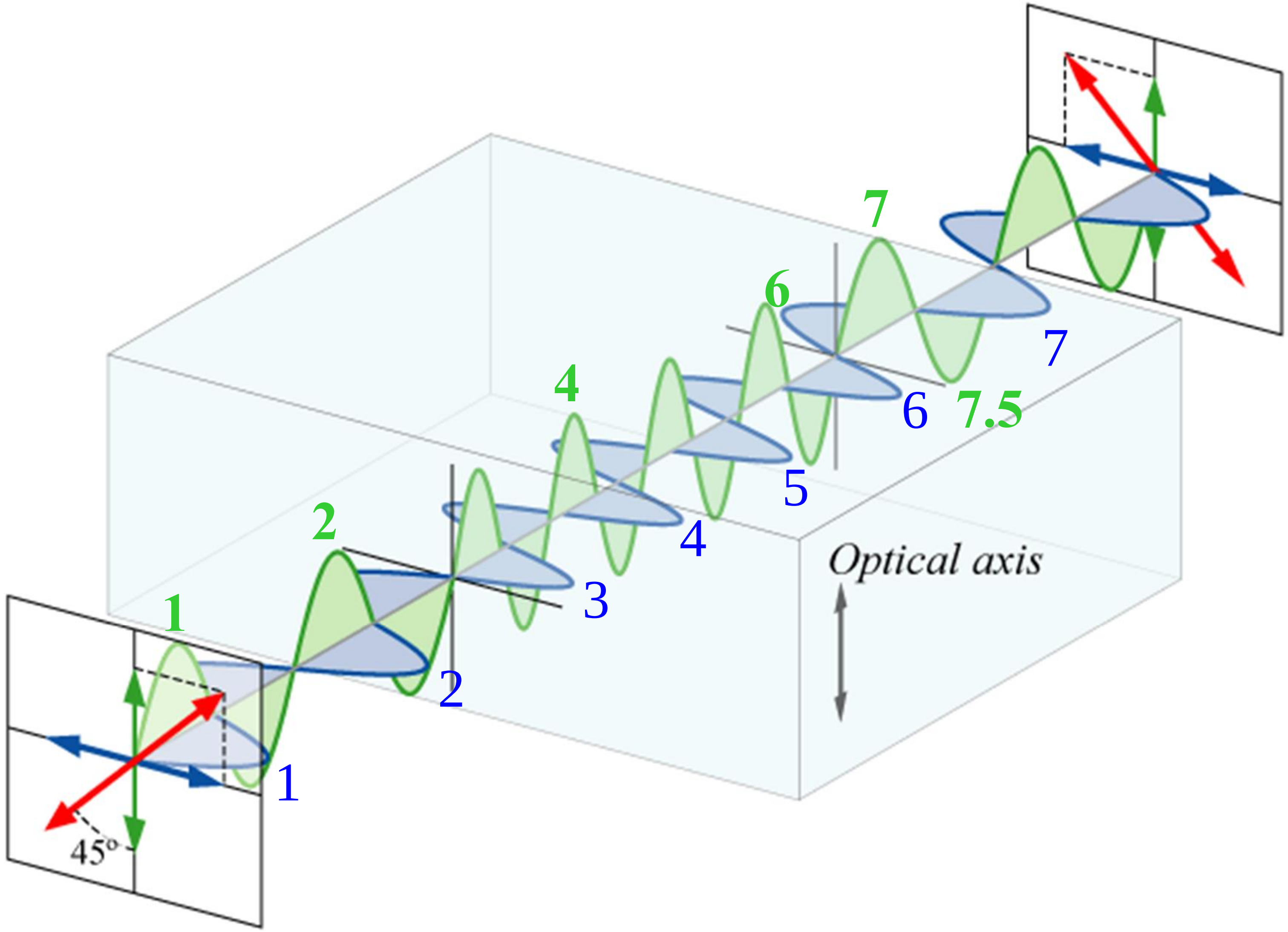
$$= \frac{nL}{\lambda_0} \quad in\ a\ medium$$

Birefringence 双折射

$$\boxed{n_X \neq n_Y}$$

$$(\#of\ \ wave)_X = \frac{n_X L}{\lambda_0} \qquad for\ E_X$$

$$(\#of\ \ wave)_Y = \frac{n_Y L}{\lambda_0} \qquad for\ E_Y$$



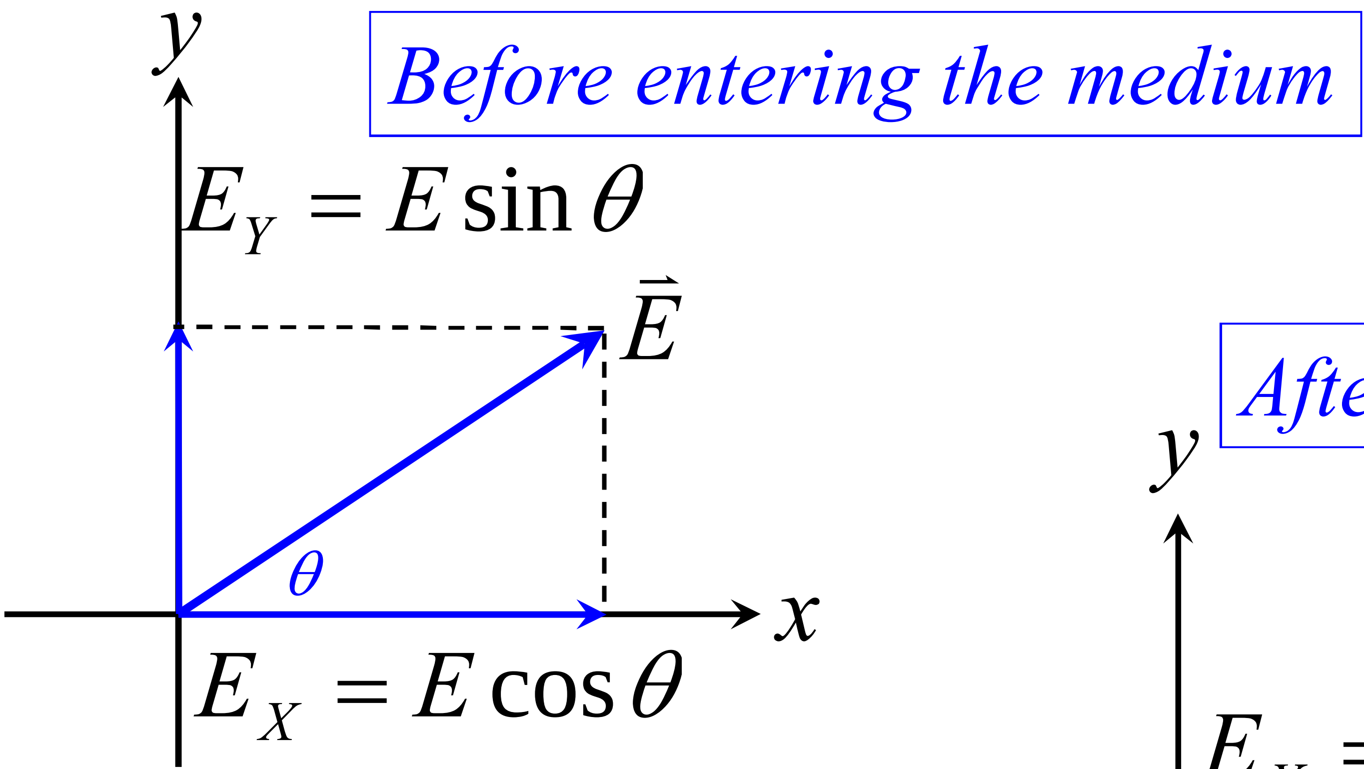
http://en.wikipedia.org/wiki/File:Waveplate.png

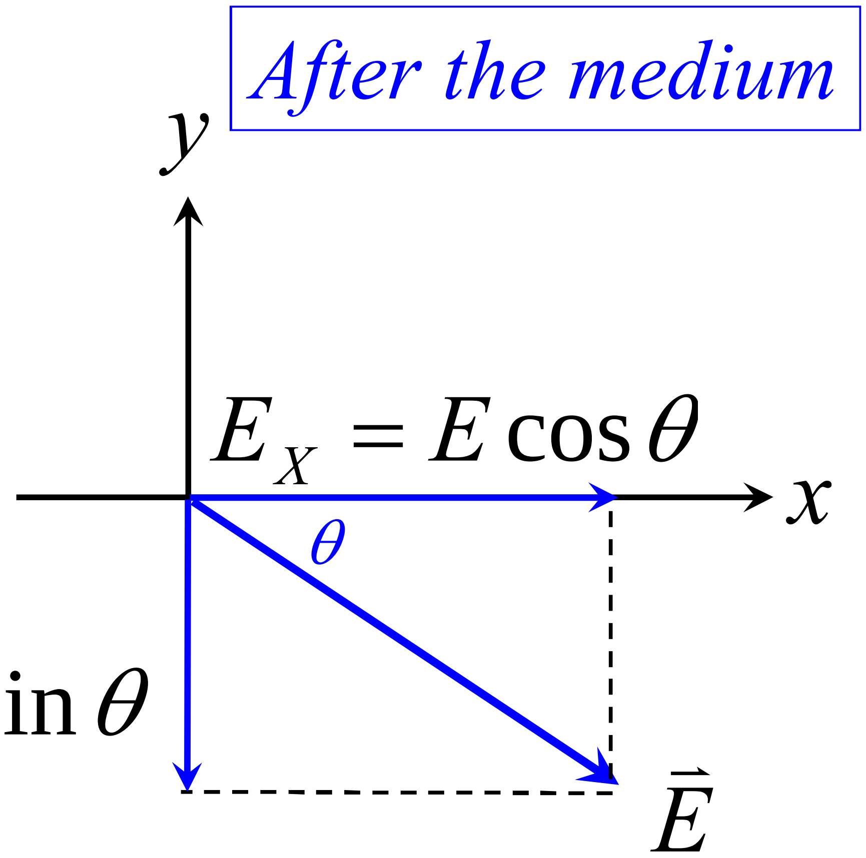
Half-wave plate

$$if\ (\#of\ \ wave)_Y = (\#of\ \ wave)_X + \frac{1}{2}$$

$$\frac{n_Y L}{\lambda_0} = \frac{n_X L}{\lambda_0} + \frac{1}{2}$$

$$\frac{n_Y L}{\lambda_0} - \frac{n_X L}{\lambda_0} = \frac{(n_Y - n_X)L}{\lambda_0} = \frac{1}{2}$$





$$E_Y = E\sin(\theta + \frac{2\pi}{2}) = -E\sin\theta$$