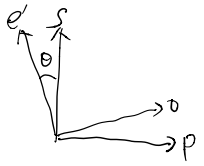
incident beam

$$\vec{E}_s = |E_s|\left[\cos\theta\cdot\vec{n}_{e'} + \sin\theta\cdot\vec{n}_o\right]e^{i\omega t}$$



$\Downarrow$ after reflection

$$\vec{E}_{refl} = |E_s|\left[\cos\theta\cdot\vec{n}_{e'}\cdot e^{i\omega t} + \sin\theta\cdot\vec{n}_o\cdot e^{i\omega t+\delta}\right]$$

$(\delta = \alpha_e - \alpha_o)$

How much power is still in S-pol?

$$\left(\text{Power in } S\right) = \left|\vec{E}_{refl}\cdot\vec{n}_s\right|^2$$

$$\left(\vec{n}_s = \cos\theta\cdot\vec{n}_{e'} + \sin\theta\vec{n}_o,\quad \vec{n}_p = -\sin\theta\cdot\vec{n}_{e'} + \cos\theta\vec{n}_o\right)$$

$$= |E_s|^2\left|\cos^2\theta + \sin^2\theta\cdot e^{i\delta}\right|^2$$

$$= |E_s|^2\left[\left(\cos^2\theta+\sin^2\theta\cos\delta\right)^2 + \left(\sin^2\theta\cdot\sin\delta\right)^2\right]$$

$$= |E_s|^2\left[\cos^4\theta + 2\sin^2\theta\cos^2\theta\cos\delta + \sin^4\theta\right]$$

$$= |E_s|^2\left[1 - \frac{1}{2}\sin^2 2\theta\left(1-\cos\delta\right)\right]$$

$$\therefore \left(\text{loss into p-pol}\right) = \frac{1}{2}\sin^2\theta\left(1-\cos\delta\right)$$