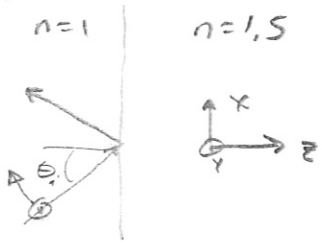
Example 2

Right hand circular polarized laser beam is incident from air onto a glass window with $n = 1.5$ at an incident angle of $55°$. Find the electric field phasor of the reflected beam.



RHC polarization

Break into 2 components

$\hat{a}_\perp = \hat{y}$

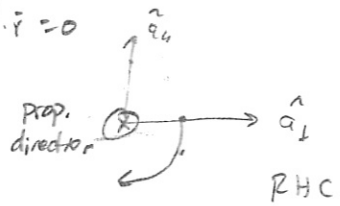
$\hat{a}_{\parallel} = \cos\theta_i \hat{x} - \sin\theta_i \hat{z}$

$\vec{E}_i = E_0 \left(\hat{y} + j\, \hat{a}_{\parallel}\right) e^{-j \vec{k}\cdot\vec{r}}$

$\vec{\xi} = E_0 \left(\hat{y}\cos(\omega t - \vec{k}\cdot\vec{r}) + \hat{a}_{\parallel} \cos(\omega t - \vec{k}\cdot\vec{r} + \pi/2)\right)$

ωt	$E_\perp$	$E_{\parallel}$
0	1	0
$\pi/4$	$1/\sqrt{2}$	$-1/\sqrt{2}$
$\pi/2$	0	-1

$\vec{k}\cdot\vec{r} = 0$



RHC

Calculate reflection coefficients

$\eta_1 = 377$

$\eta_2 = \frac{377}{1.5} = 251.33$

$\theta_i = 55°$

$\theta_t = \sin^{-1}\left(\frac{\sin 55°}{1.5}\right) = 33.1°$

$\Gamma_\perp = \frac{\eta_2 \cos\theta_i - \eta_1 \cos\theta_t}{\eta_2 \cos\theta_i + \eta_1 \cos\theta_t} = -0.3732$

$\Gamma_{\parallel} = \frac{\eta_2 \cos\theta_t - \eta_1 \cos\theta_i}{\eta_2 \cos\theta_t + \eta_1 \cos\theta_i} = -0.0133$

$\vec{E}_r = E_0 \left(\Gamma_\perp \hat{y} + j\, \hat{a}_{\parallel}\, \Gamma_{\parallel}\right) e^{-j\vec{k}\cdot\vec{r}}$

$= E_0 \left(-.3732\, \hat{y} + j(-0.0133)(\cos(55)\hat{x} - \sin(55)\hat{z})\right) e^{-j(\sin\theta_i y - \cos\theta_i z)}$

$= E_0 \left(-0.3732\hat{y} - j\,0.0076\,\hat{x} + j\,0.0109\,\hat{z}\right) e^{-jk_0(0.819y - 0.574z)}$

Still RH but now $E_\perp \neq E_{\parallel}$ so elliptical

ellipticity is $\frac{.3732}{.0133} = 28$