~~Fix up plots~~

~~✓ x-axis~~

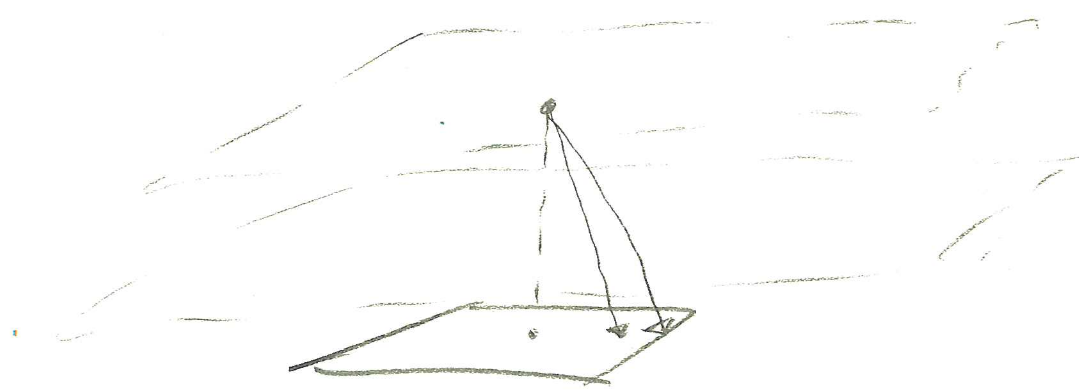
~~✓ y axis~~

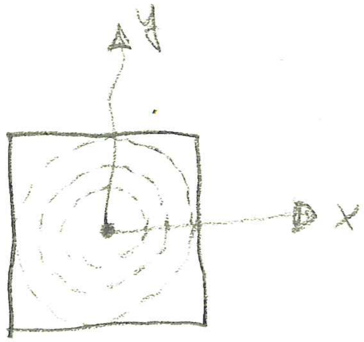
~~✓ colormap label~~

~~Detector Info~~

$\boxed{\text{Calc fraction of power collected by detector}}$

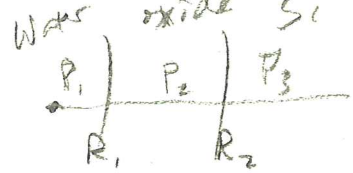
– Simple integration?



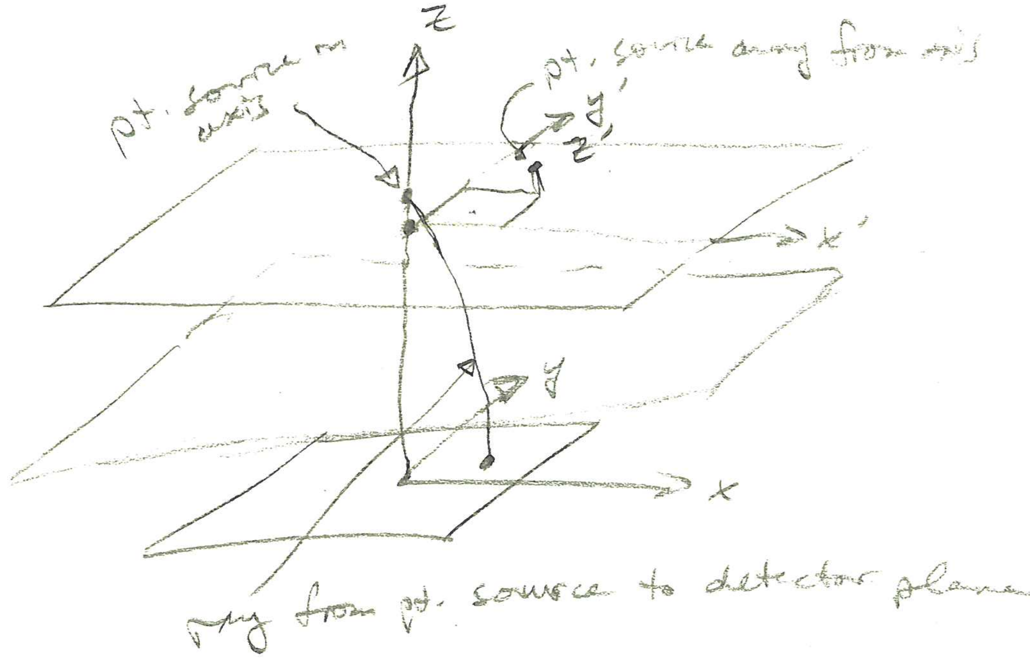


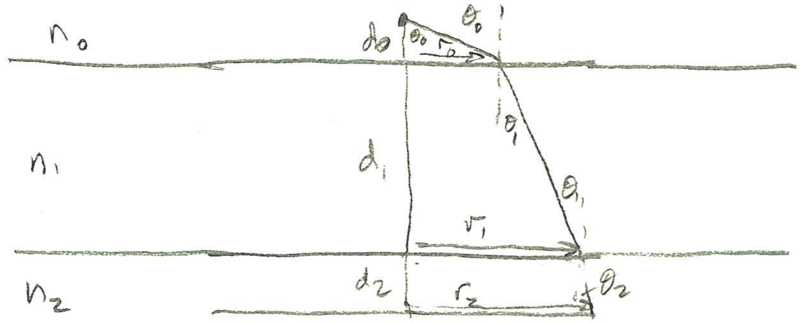
Source @ $(x, y) = (0, 0)$

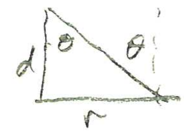
for $x = 0, y = 0$:



$$P_3 = \underbrace{(1-R_1)}_{T_1}\underbrace{(1-R_2)}_{T_2} P_1$$


z
pt. source on axis
pt. source away from axis
y'
z'
x'
y
x
ray from pt. source to detector plane





$$r_0 = d_0 \tan\theta_0$$

$$r_1 = r_0 + d_1 \tan\theta_1$$

$$r_2 = r_1 + d_2 \tan\theta_2$$

$$= d_0 \tan\theta_0 + d_1 \tan\theta_1 + d_2 \tan\theta_2$$

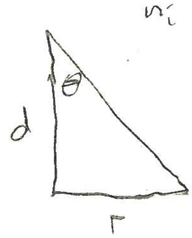
$$= \sum_{i=0}^{2} d_i \tan\theta_i$$

Objective:

For r_2, find θ_0, Then calc R thru each surface & calc power density at r_2 for pt. source at d_0

Given: $d_i = [d_0, d_1, d_2]$

$n_i = [n_0, n_1, n_2]$



$$\sin\theta = \frac{d}{\sqrt{d^2+r^2}} \qquad \tan\theta = \frac{r}{d}$$

$$n_0 \sin\theta_0 = n_1 \sin\theta_1 = n_2 \sin\theta_2$$

$$\Rightarrow \sin\theta_1 = \frac{n_0 \sin\theta_0}{n_1} \Rightarrow \theta_1 = \sin^{-1}\left(\frac{n_0 \sin\theta_0}{n_1}\right)$$

$$\tan\theta_1 = \tan\left(\sin^{-1}\left(\frac{n_0}{n_1}\sin\theta_0\right)\right)$$

$$\tan(\sin^{-1}(x)) = \frac{x}{1-x^2}$$

for n_1, n_0, θ all positive:

$$\tan\theta_1 = \tan\left(\sin^{-1}\left(\frac{n_0}{n_1}\sin\theta_0\right)\right)$$

$$= \frac{n_0 \sin\theta_0}{\sqrt{n_1^2 - n_0^2\sin^2\theta_0}}$$

$$\sin\theta_2 = \frac{n_0}{n_2}\sin\theta_0 \Rightarrow \theta_2 = \sin^{-1}\left(\frac{n_0}{n_2}\sin\theta_0\right)$$

$$\Rightarrow \tan\theta_2 = \frac{n_0\sin\theta_0}{\sqrt{n_2^2 - n_0^2\sin^2\theta_0}}$$

$$\Rightarrow r_2 = d_0\tan\theta_0 + d_1\frac{n_0\sin\theta_0}{\sqrt{n_1^2 - n_0^2\sin^2\theta_0}} + d_2\frac{n_0\sin\theta_0}{\sqrt{n_2^2 - n_0^2\sin^2\theta_0}}$$

$$= d_0\tan\theta_0 + n_0\sin\theta_0\left[\frac{d_1}{\sqrt{n_1^2 - n_0^2\sin^2\theta_0}} + \frac{d_2}{\sqrt{n_2^2 - n_0^2\sin^2\theta_0}}\right]$$

No way to solve for θ_0 given r_2. Instead, estimate the power density with a calculation algorithm:

1. Consider a 1D array of uniformly sampled angles from 0 to $90° - \epsilon$ where ϵ is small

2. Calculate the 1D density of where these rays land a distance $d_0 + d_1 + d_2$ away from the source (i.e., in the detector plane). Given the normalized power in each ray, calculate the linear power density as a function of r_2.

3. Use polar coordinates to transform this into a 2D power density.

4. Convert 2D power density to cartesian coordinates

5. Put this into a function (w/ lookup table?) + integrate over the detector area in r_2 plane

6. Now shift source pt. in x-y relative to detector + integrate over all source pts. from wh/ light is incident on detector. Power density function should go to zero when pt. source is shifted too far → double check that make function do this

- Plot power density "foot print" in detector plane → color variation in 2D plane or do a 3D plot

TOPS