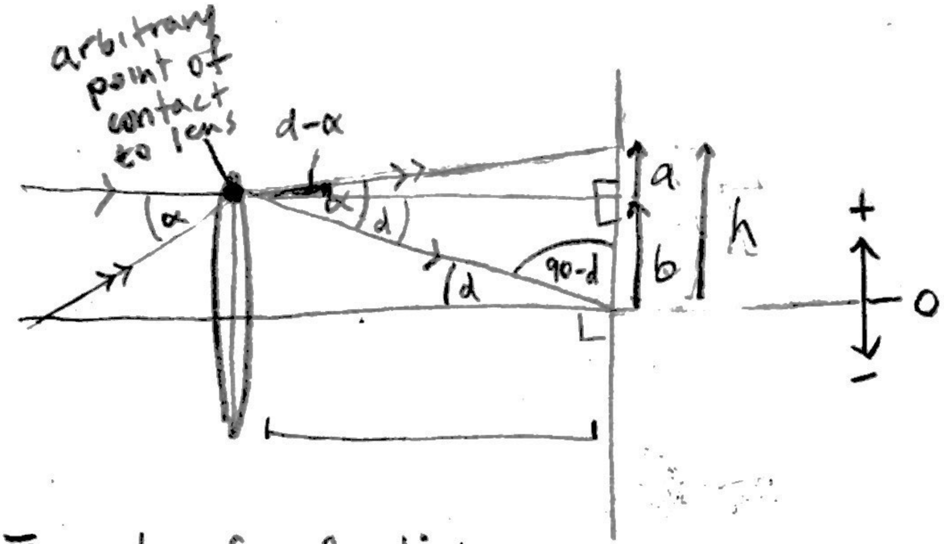
SURP week 7

Preventing spectrum overlap part 2



focal plane

$d \equiv$ angle of refraction for a fixed point of contact to the lens

$\alpha_i \equiv$ angular difference between ray i and the ray $\perp$ to lens

$h \equiv$ displacement of focal point from center

from the figure,

$$\tan(d-\alpha) = \frac{\vec{a}}{f} \Rightarrow \vec{a} = f\tan(d-\alpha)$$

$$\tan(d) = \frac{\vec{b}}{f} \Rightarrow \vec{b} = f\tan(d)$$

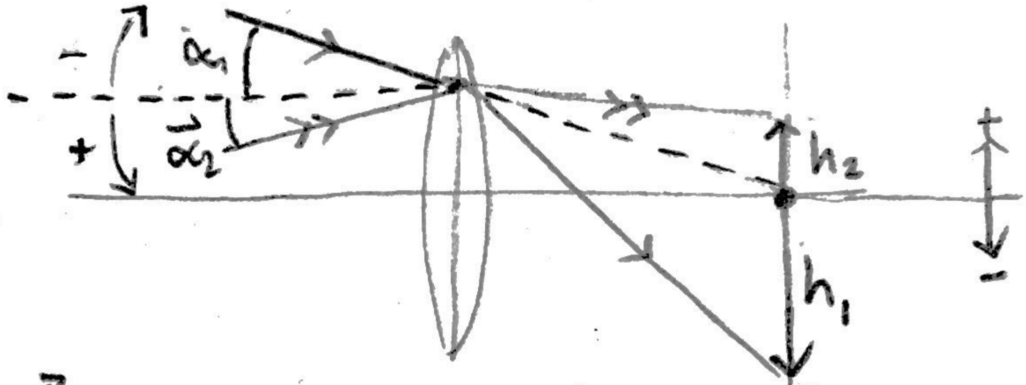
$$h(\alpha) = a+b = f(\tan(d-\alpha) + \tan(d))$$

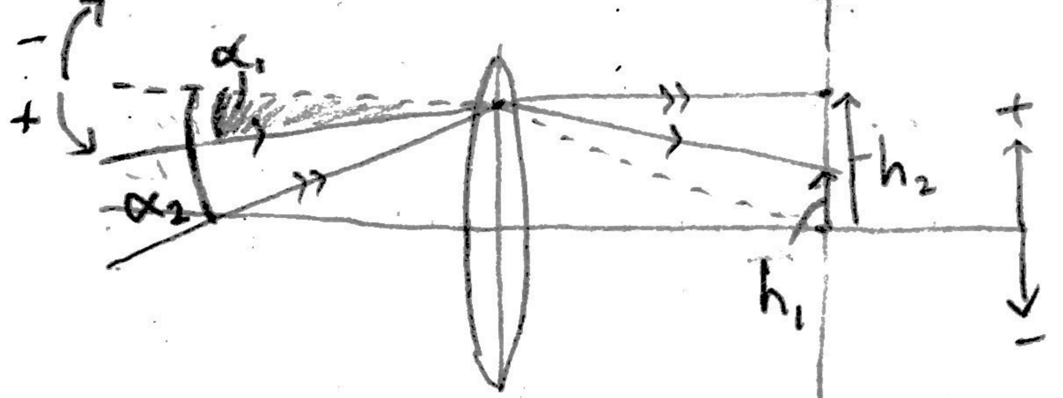
Inverting this, $\alpha(h) = \arctan\left[\frac{h}{f} - \tan(d)\right] + d$

Scanned with CamScanner

Now the next step is to find the separation $s = |h_1 - h_2|$ for any two angles α_1, α_2.

For this to work, we must set a positive/negative angular directionality with respect to the dashed ray.





Notice that the sign of the angle α_i corresponds to the sign of h_i.

Amending the function $\alpha(h)$ to reflect this,

$$\alpha_i(h_i) = \frac{h_i}{|h_i|} \arctan\left[\frac{|h_i|}{f} - \tan(d)\right] + d$$

Thus, the total angle $\Delta\alpha = |\alpha_1 - \alpha_2|$ cast by any arbitrary source separation $s = |h_1 - h_2|$ becomes

$$\Delta\alpha = |\alpha_1 - \alpha_2|$$

$$= \left[\frac{h_1}{|h_1|}\arctan\left[\frac{|h_1|}{f} - \tan(d)\right] + \cancel{d}\right]$$

$$- \left[\frac{h_2}{|h_2|}\arctan\left[\frac{|h_2|}{f} - \tan(d)\right] + \cancel{d}\right]$$

$$\boxed{\Delta\alpha = \frac{h_1}{|h_1|}\arctan\left[\frac{|h_1|}{f} - \tan(d)\right] - \frac{h_2}{|h_2|}\arctan\left[\frac{|h_2|}{f} - \tan(d)\right]}$$

The next step is to try and find $\Delta\alpha$ as a function of s directly, rather than h_1 and h_2 as separate variables