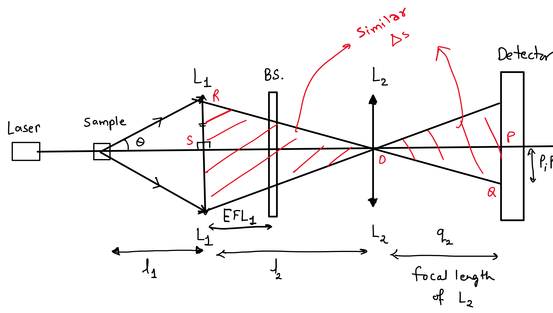


l_2

Using similarity of Δ's

$$\frac{PQ}{RS} = \frac{q_2}{l_2} \quad \Leftrightarrow \quad RS \approx l_1\theta \quad (\because \theta \text{ is small})$$

$$\tan\theta \approx \frac{RS}{l_1}$$

$$\Rightarrow \quad \frac{PQ \cdot l_2}{q_2} = l_1\theta .$$

$$\Rightarrow \quad \boxed{\theta = \frac{PQ}{q_2\left(\frac{l_1}{l_2}\right)} = \frac{P_iP_L}{q_2\left(\frac{l_1}{l_2}\right)}}$$

NOTES

1. $l_1 > EFL_1$ ∵ we want image bet^n f & 2f, and real.
2. BS should be at focus of L_1 to avoid main beam to interfare with scattered beam. At focus main beam will converge as it is close to principal axis hence parallel to principal axis.
3. $q_2 = EFL_2$ as to get properly focused image.

Now, what is θ_{max} possible ?

→ Just before focus of L_1, image will be real and between focus & curvature.

→ If object at focus of L_1, image will be at infinity.

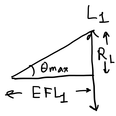
→ So $\theta_{max} \Rightarrow$ Object very close to focus (for simplicity at focus).

So, $l_1 \xrightarrow[\text{to}]{\text{change}} EFL_1$

$$\theta_{max} = \frac{P_iP_L}{EFL_2\left(\frac{EFL_1}{l_2}\right)}$$

q_2

OR



$$\theta_{max} \approx NA \approx \frac{R_{L_1}}{EFL_1} \approx 0.85$$

$0.85^c \approx 48.7°$

↓

I think they have wrong number in their paper.

Using their value

$\theta_{max} = 40° = 0.7^c$

for $P_iP_L = 600$ pixel

$EFL_1 = 15mm$

$EFL_2 = 25.43$ mm

$$\Rightarrow \quad \theta_{max} = \frac{P_iP_L}{EFL_2\left(\frac{EFL_1}{l_2}\right)}$$

$$\Rightarrow \quad l_2 = 92.71 \approx 92mm$$

Using our values.

$\theta_{max} = 48.7° = 0.85^c$

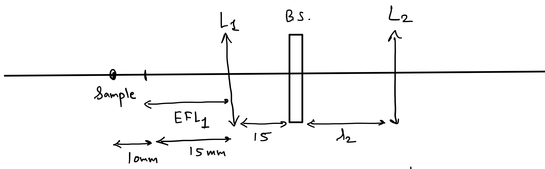
for $P_iP_L = 600$ pixels.

$EFL_1 = 15mm$.

$EFL_2 = 25.43mm$

we get, $\frac{1}{l_2} = \frac{600 \times 0.0048}{25.43 \times 15 \times 0.85}$ (0.0048: conversion factor they used)

$l_2 = 112.58$ mm ≈ 113mm.



$u = -25mm$

$f = +15mm$

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$$

$$\Rightarrow v = \frac{uf}{u+f} = \frac{(-25)(15)}{-25+15}$$

$= 37.5$mm.

$15 + l_2$ ↑

$\Rightarrow l_2 = 22.5$mm.