Physics 375 - Prelab 2

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Pre-Lab A

S ince you want to measure the width of the beam, the optimal iris size would be large. Perhaps you can make the argument that the optimal iris size would be the maximum possible, this way you know for sure you are recording the entire profile of the beam. This can work with smaller iris sizes, but it would make things more complicated with no particular gain in accuracy.

Pre-Lab B

For 2x beam expander

$$\begin{aligned} \frac{f_2}{f_1} &= 2 \\ f_2 &= 2f_1 \end{aligned} \tag{1}$$

F rom this relationship I would conclude that using the lenses with focal lengths of $25mm$ and $50mm$ would be most appropriate. Given the constraints of our optical table at $60cm$, the lenses with focal lengths of $100mm$ and $200mm$ would also work, but would leave us with a limited space and probably would not be ideal. We know this because we can estimate the distance between the two lenses as $f_1 + f_2$. This would give us $30cm$, nearly half our board.

For 3x beam expander

$$\begin{aligned} \frac{f_2}{f_1} &= 3 \\ f_2 &= 3f_1 \end{aligned} \tag{2}$$

F rom this relationship I would conclude that using the lenses with focal lengths of $50mm$ and $150mm$ would be most appropriate. These would be the only combination we could use to achieve our desired beam expander.

Pre-Lab C1

$$\begin{aligned} 40mm &= m * 25.4mm \\ \frac{40}{25.4} &= m \\ 1.575 &= m \end{aligned} \tag{3}$$

$$
\begin{aligned}
d &= \frac{mf}{1+m-\frac{L}{f}}(1-\frac{L}{f}) \\
&= \frac{40}{1+1.575-\frac{L}{25.4}}(1-\frac{L}{25.4}) \\
&= \frac{40}{2.575-\frac{L}{25.4}}(1-\frac{L}{25.4})
\end{aligned}
\tag{4}
$$

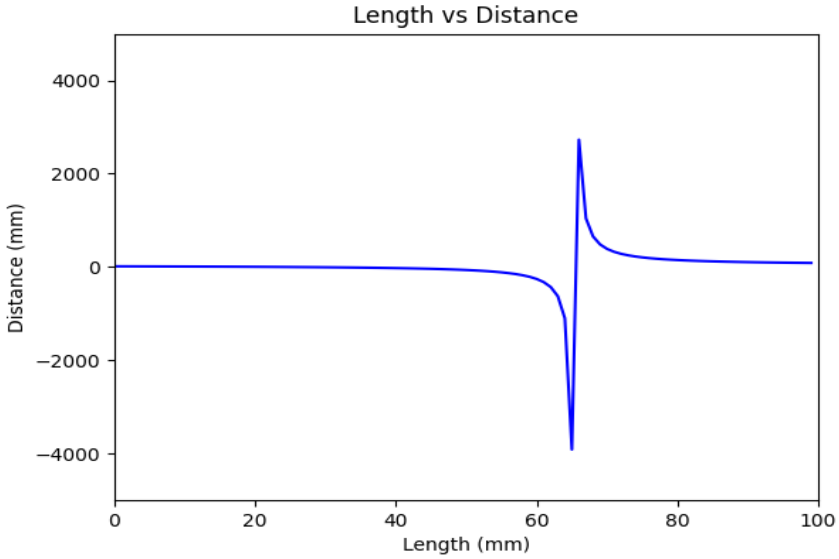

Figure 1: Graph of d as a function of L

Pre-Lab C2

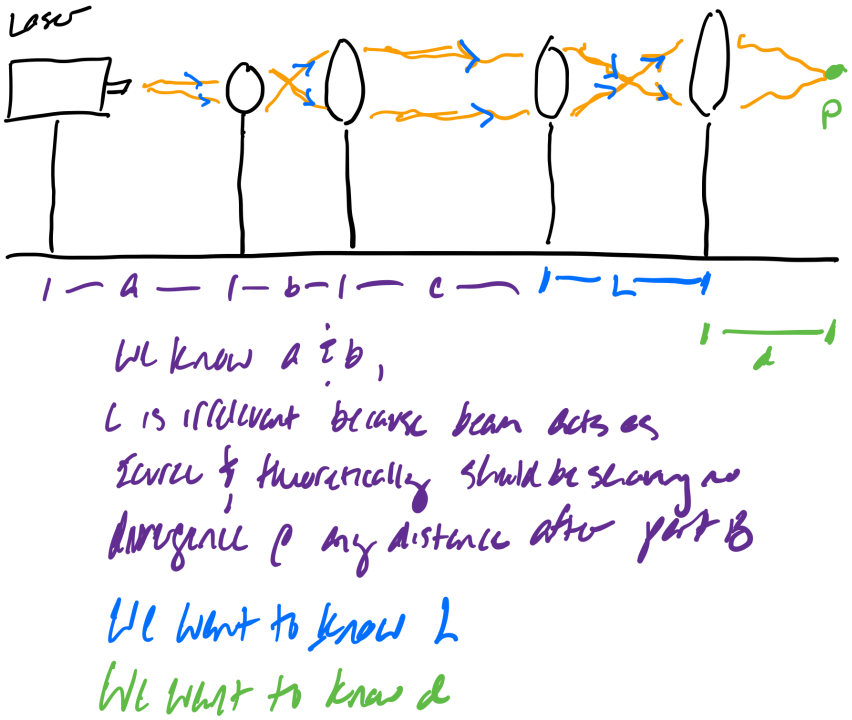

Figure 2: Sketch of setup for part C

I n the setup sketched above, the lengths of a and b do not matter much. We want to know L for different values of d. We will look to minimize c in order to give ourselves enough room to find d. I expect us to place the first lens about $10mm$ away from the beam expander. Smaller c the better.

Pre-Lab D

L ooking at the lab sheet, I believe I will need to use equation [5] to calculate d, which is the focal point. I would in this case need to be measuring L, the distance between my $100mm$ lens and the second lens in the beam expander. Further, I would need to calculate m, which will be deduced from the ratio of the $100mm$ lens in the beam expander over the second lens in the beam expander. L would be varying, m would be constant.