

# PHY 427 Experiment #2: Gauss

→ February 7, 2023

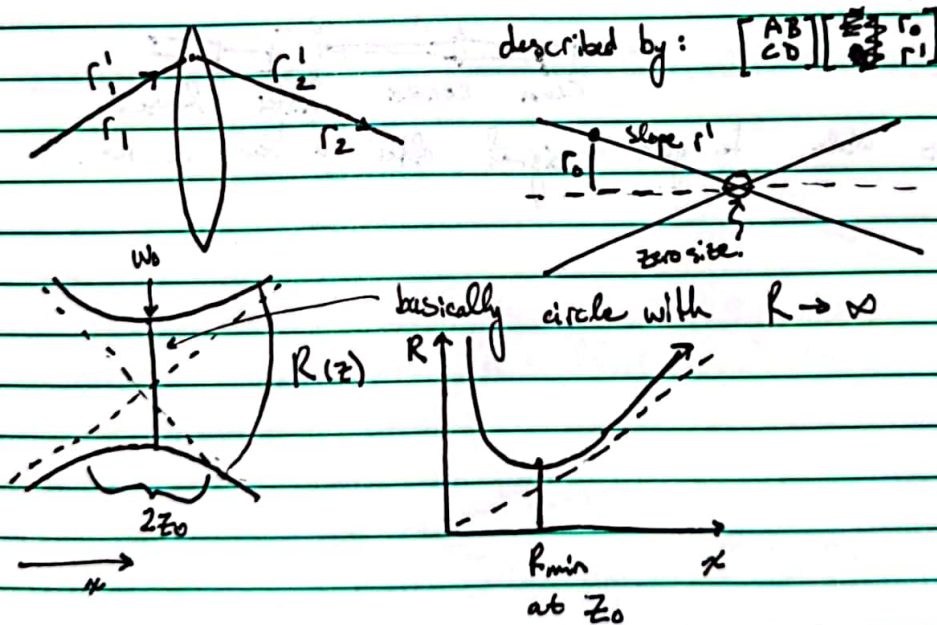
9:50 In lab.

just preparing my last session's lab notebook for submission.

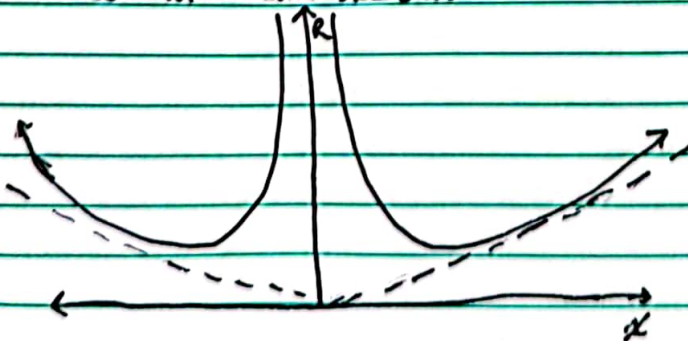
10:20 Robin came into the lab and talked to me for quite a while. We talked a lot about expectations and what I want from the Lab. Which was awesome I think will be a great supervisor.

Some things to think about: (from meeting)

look up ABCD matrix.



so for both sides...



10:55 I'm going to play w the laser setup for the remainder of the day!

11:00 Kevin came in and I talked to him for a few minutes, he said his biggest advice was to always plan everything out in my notebook before building it on the actual setup, and to keep everything at 90° angles so its easier to align everything.

11:20 to set up the camera, go into ImagesJ then Plugins → Webcam capture → IJ Webcam plugin and select UI154... as the camera.

11:30 set up camera with focusing lens.



was able to get signal after a few minutes.



→ February 10, 2023

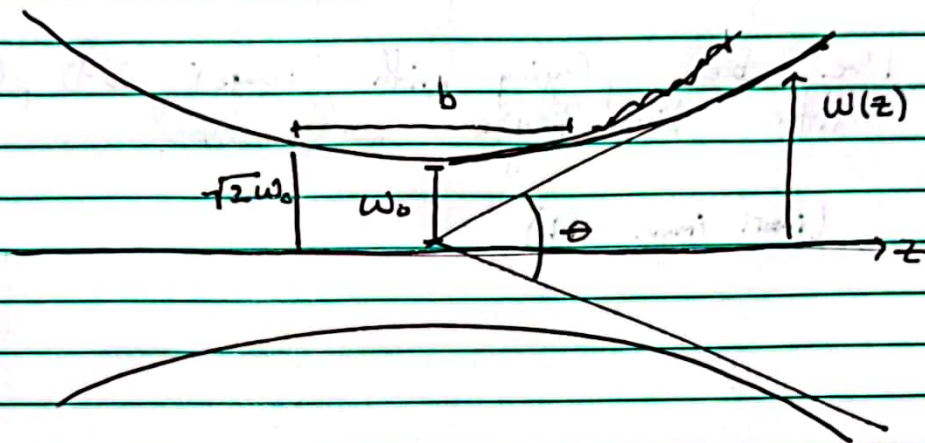
## Gaussian Beams (11:00 in lab)

Properties: beam has a Field and Intensity profile which are a gaussian of  $r = \sqrt{x^2 + y^2}$  (spot size)

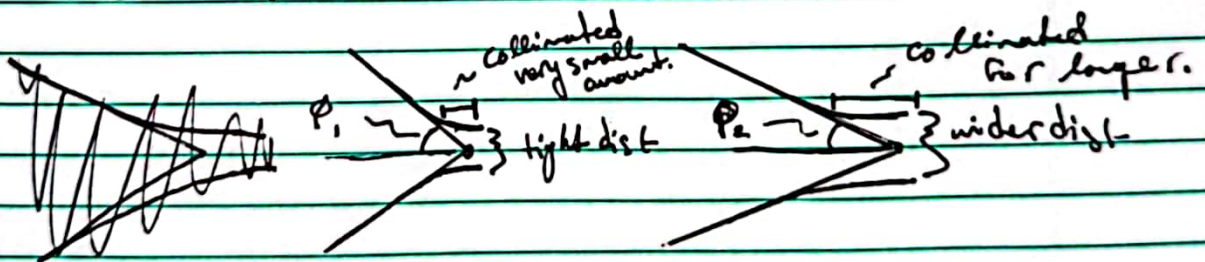
•  $w_0$  is the fundamental spot size (beam waist)

•  $z_0$  is the distance over which the spot size increases by  $\sqrt{2}$

$$\frac{r^2}{w_0^2 \left(1 + \frac{z^2}{z_0^2}\right)} = \text{constant}$$

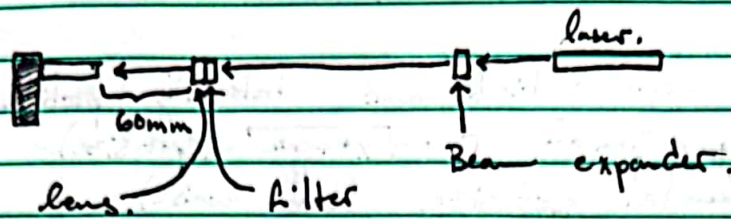


•  $z_0$  varies as  $w_0^2$ , so a more tightly focused beam will have a smaller depth where it appears collimated.



• In far field where hyperbolic surfaces approach asymptotes, uniform divergence rate can be calculated. For  $z \gg z_0$ ,  $w \gg z$  then if  $\theta$  is the full cone angle of the asymptotes  $\tan\left(\frac{\theta}{2}\right) = \frac{w(z)}{z} \approx \frac{\theta}{2}$  for small  $\theta / \pi w_0$

12:00 I'm going to see if I can align everything and see some really basic patterns on the camera.



1:00 See some rough circles, but I need to go through the thing more and plan out my optics setup for Beam profiling over the weekend!

1:30 I've been playing with ImageJ 3-D plots for a little bit. They're really cool.

(insert image #1)



February 14, 2023

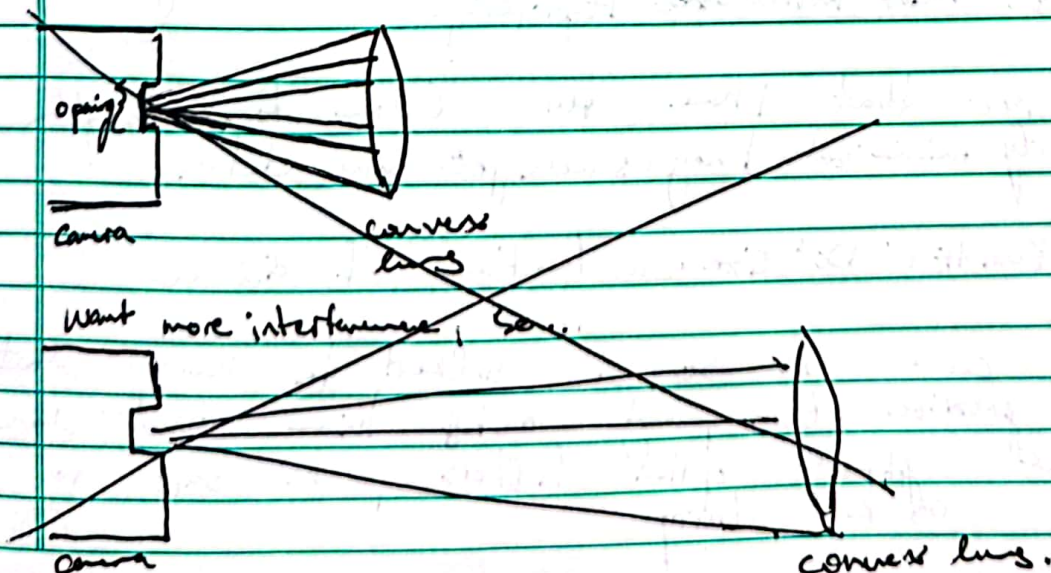
9:10 in lab

So I have my exp 1 interview at 11:00, so it will be a bit of a race against the clock today to see how much I can get done before then.

9:30 ~~the~~ I got everything working as I had yesterday, but I think the natural next step is for me to try and see more interference before I try to clean it up.

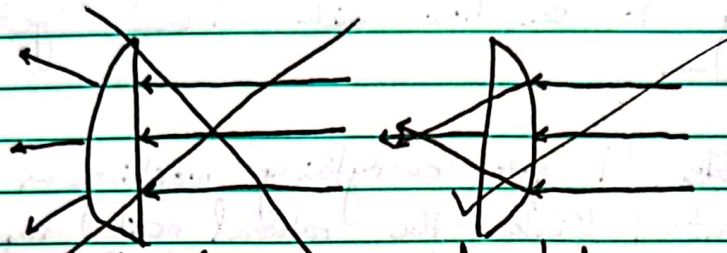
→ (insert image #2)

currently:

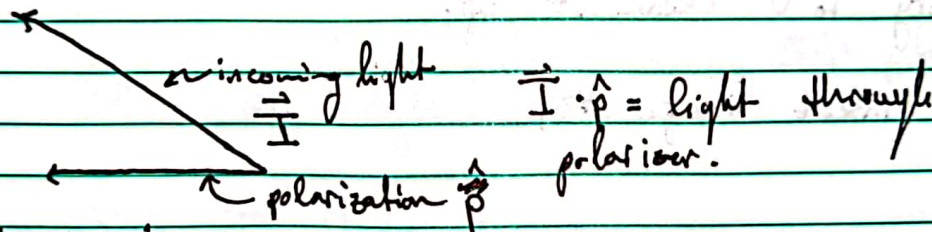


10:15 Robin in Lab

- start by measuring dot size as distance varies.  
(imaging intensity distribution.)
- always put filters before lenses.
- for a plano-convex lens, face ~~convex~~ side to incoming beam.



- think of polarizer as dot product.



$$\frac{1}{f} = \frac{1}{s_1} + \frac{1}{s_2}$$

10:35, I am able to see the dot, but it seems to be slightly bigger than the camera is able to see. I did that with the 30mm focal length lens, so I'm going to try with the 60mm to get a smaller dot.

10:55 okay I was just so wrong. I didn't have exactly the right focal length last time which is why the dot wasn't small enough. I just hadn't minimized it properly.

But now that I have the 60mm focal length properly minimized I may as well get some data.

Data Run #1: Dot size as a function of distance.

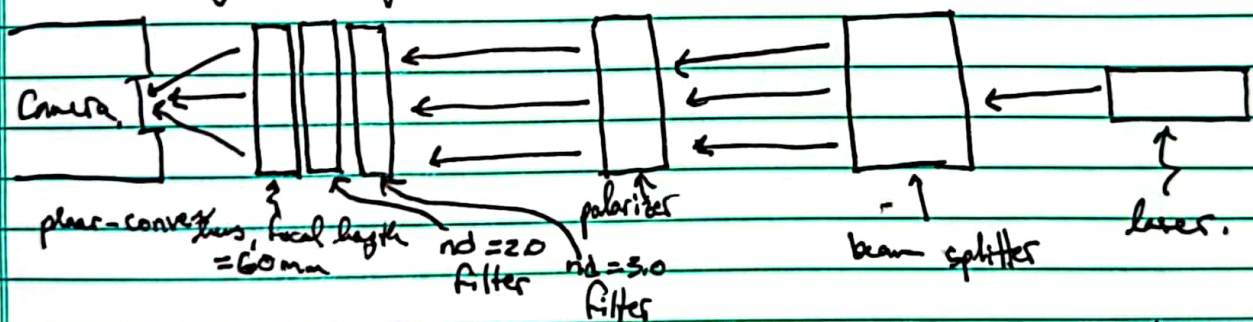
Kevin came in so I talked to him about the polarizer etc..., and asked him about where I could get more optical filters, he said to go ask Larry.



11:05 So I asked Larry, and he doesn't have any more optical filters, but I think Kevin manages most of the optics experiments so he might have other optics

oh, I never said why I wanted another filter! Since I'm imaging the intensity as a function of position, I'll need to filter the light more, as the intensity is currently at the max value for the whole position spectrum.

11:20 Kevin had an extra  $n_d = 3.0$  optic in another experiment, so this is the data gathering setup.



All data and the associated table have been uploaded to my github, and I will print it out eventually and add it in here.