Lab Notebook

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Day 1 2018 02 06

Figuring out Reflection and Transmission Coefficients:

We want to first characterize the first mirror by measuring it's transmission and reflection coefficients. We can do this by directly measuring the incident beam intensity, reflected beam intensity and transmitted beam intensity using a power meter.

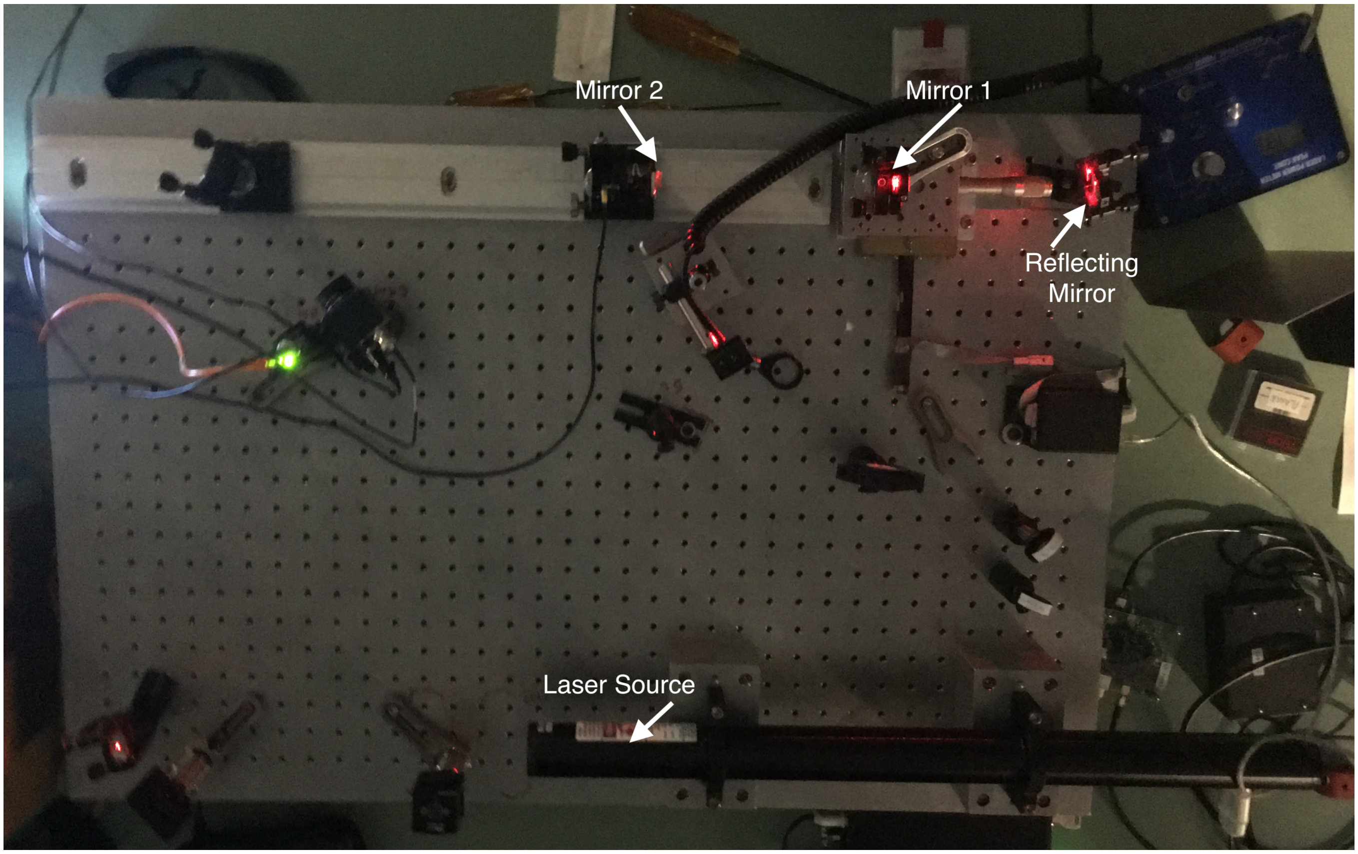


Figure: Optical Bench Setup

Mirror Reflectivity

Transmission and Reflection Coefficients of the both mirrors involved in the optical cavity

M_1 Characteristics

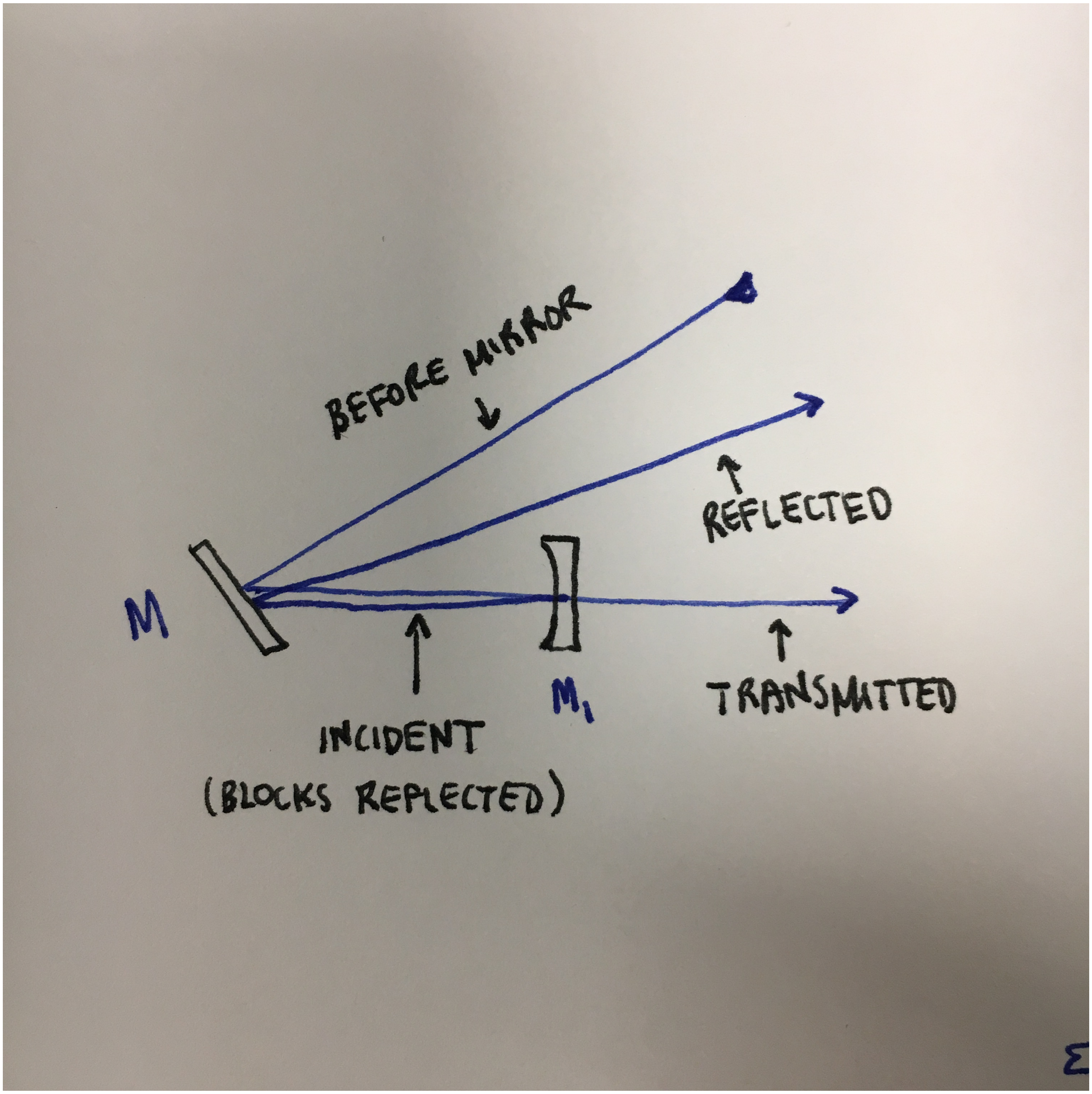


Figure: Measuring M1 Characteristics

Reversed M_1

Incident Beam:

(18.08 ± 0.05) mW

Transmission:

(0.200 ± 0.001) mW

Reflected:
(16.34 ± 0.02) mW

Reason for losses in this case: we had to reflect it off an additional mirror in order to take this measurement. We find the power loss of this additional mirror

Power before Additional Mirror
(19.51 ± 0.01) mW
Loss of about 1.5 mW into M_1
Then out of the M_1 another loss of 1.5

M_2 Characteristics

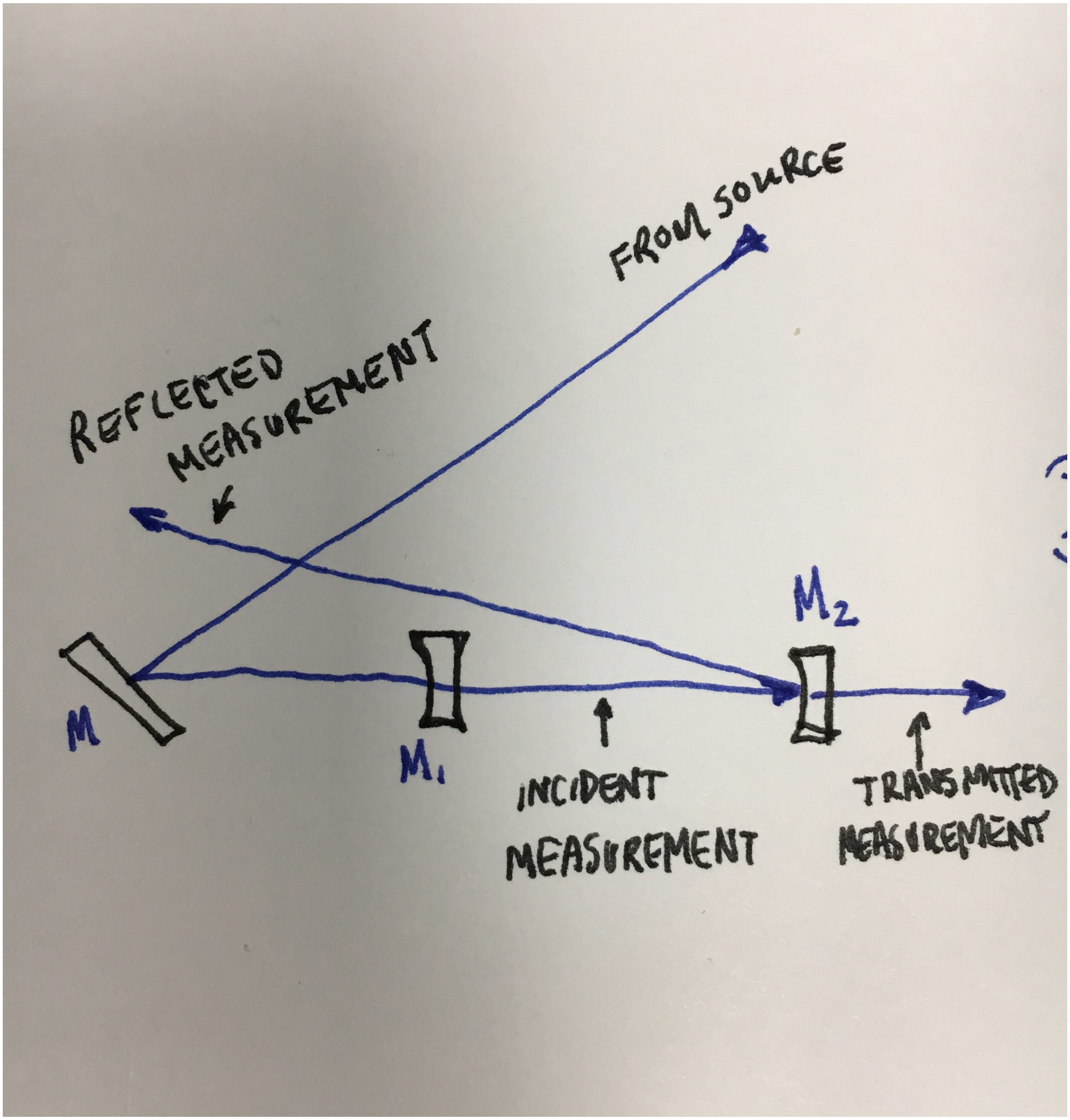


Figure: Measuring M2 Characteristics

Incident for M_2:
(0.345 ± 0.005) mW

Transmission for M_2:
$(1.05 \pm 0.05) \mu$W

Reflection for M_2:
(0.338 ± 0.005) mW

Mirror	Reflection	Transmission	Sum
M_1	0.986 ± 0.004	0.0111 ± 0.0001	0.998 ± 0.004
M_2	0.98 ± 0.02	0.00304 ± 0.00005	0.98 ± 0.02

Both mirrors are very close to one having a unity sum of the reflection and transmission coefficients, which is what we would expect. Incorporating the loss in the first mirror was important in order to correct the original reflection coefficient from ~0.904 to the more realistic value of 0.986.

Theoretical Finesse, Free Spectral Range, and Line-width

Finesse

Now we can calculate the finesse with cavity length L = 15cm and wave number k = 9.85nm

$$I = \frac{I_{max}}{1 + \frac{2\mathscr{F}}{\pi}^2 \sin^2(kL)}$$

$$\mathscr{F} = \sqrt{\frac{\pi(\frac{I_{max}}{I} - 1)}{2\sin^2(kL)}}$$

$$\mathscr{F} = \frac{\pi\sqrt{r}}{1-r}, \ \ with \ \ r = \sqrt{R_1 R_2}$$

$$r = \sqrt{R_1 R_2}, \delta r = r\sqrt{(\frac{\delta R_1}{R_1})^2 + (\frac{\delta R_2}{R_2})^2}\ , \ \ r = 0.98 \pm 0.02$$

$$\delta\mathscr{F} = \frac{\pi(1+r)}{2 * (1-r)^2\sqrt{r}} * \delta r, \ \ \mathscr{F} = 185.55 \pm 23.2 \approx 186 \pm 23$$

Free Spectral Range

$$\nu_F = \frac{c}{2L} = (1.0 \pm 0.2) \times 10^9 Hz$$

Line-width (Spectral Width, Full Width Half Max)

$$\nu_{FWHM} = \frac{\nu_F}{\mathscr{F}} = (5.38 \pm 0.265) \times 10^6 Hz \approx (5.4 \pm 0.3) MHz$$

If we flipped the cavity and used the low reflectivity mirrors than there would be not very much power transmitted ~0, and the finesse would also be ~0. Line width would exceed the free spectral range meaning resonance is not possible.

Knife-edge Measurement for Beam Waist

With the aforementioned setup the first mirror, M_1, was removed and the knife edge was placed in it's spot.
For a Optical Cavity length of 24.31 cm:
Unblocked Laser Starting power

Power (mW)	Knife Position (mm)	Percent Power
18	4.7807	100%

Move/jog the knife edge to 90% of the full power (around 16.2 mW)

Power (mW)	Knife Position (mm)	Percent Power
16.25	9.5621	90.27%
16.13	9.5721	89.61%

Next, move/jog the knife edge over until 10% of the full power is transmitted (around 1.8 mW)

Power (mW)	Knife Position (mm)	Percent Power
1.85	9.9346	10.28%
1.83	9.9445	10.17%

Linearly Interpolated Values

Power (mW)	Knife Position (mm)	Percent Power
1.8	9.95935	10%
16.2	9.56627	90%

Beam Waist = 0.393 ± 0.019

This experiment was repeated for a different optical cavity length

Now at 25.2 cm

17.98 mV 6.3538 ~100%

16.2 mV 9.5624 ~90%

1.77 mV 9.9366 ~10%

Beam Waist = ~0.3742 mm

This value has not changed significantly and is with in the error of the previous measurement.

The beam fronts look this

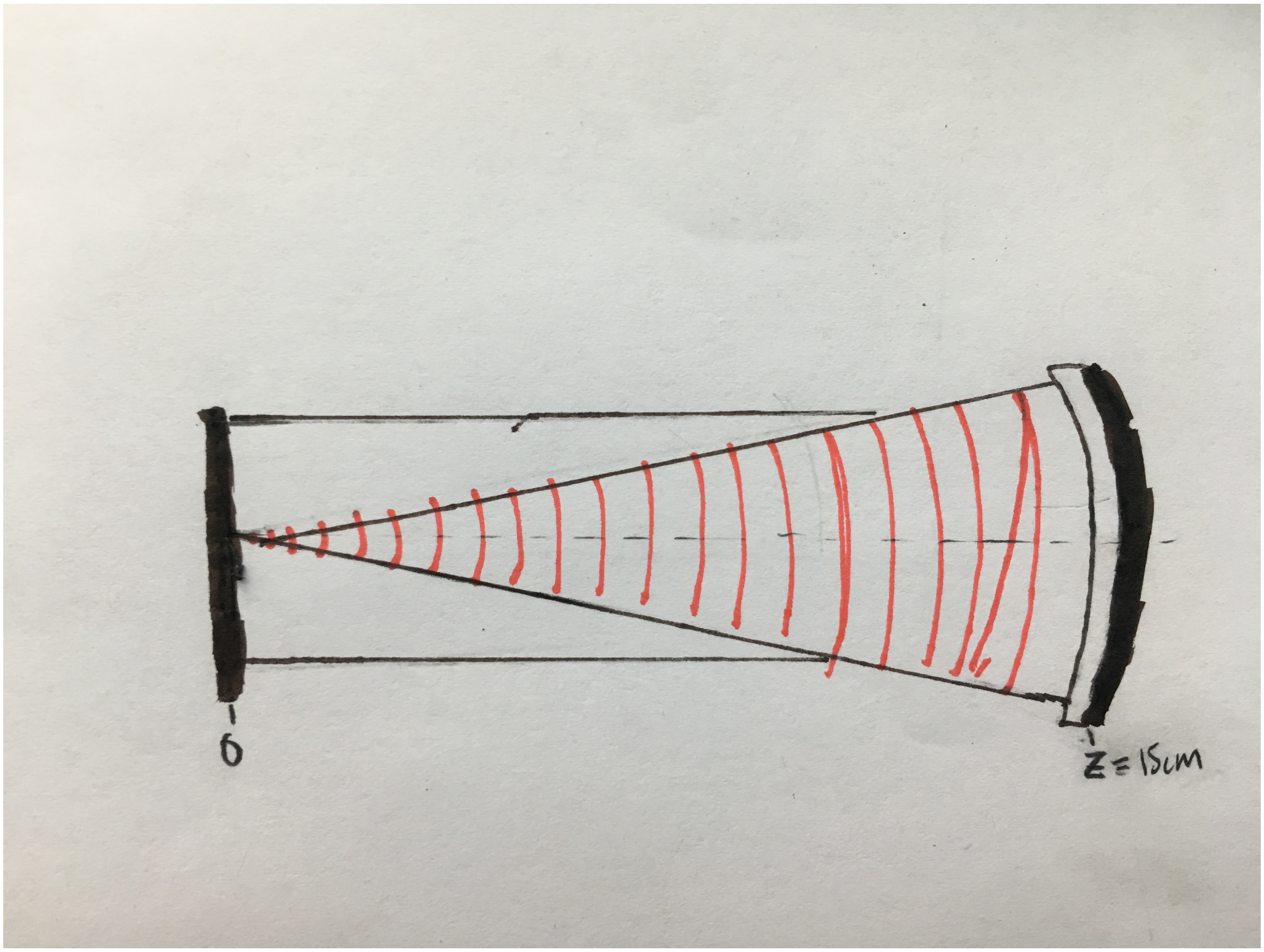


Figure: Beam waist inside confocal planar cavity

$$W_0 = 1.2mm, \;\; \lambda = 632.8nm, \;\; R_2 = 30cm$$

For the focal length of the concave mirror we get:

$$r_0 = \frac{\lambda}{\pi}\sqrt{L(R_2 - L)} \approx 0.174mm$$

Given that our coupling lens has a focal length of 50cm, and the optical path to the first mirror is almost 50cm, we expect the beam to come to a focus just inside the cavity. We can solve for a focal length given our beam parameters. Using the fact that the light coming into the coupling lens has a much longer coherence length than the focal length of the lens we get that:

$$r_0^2 = \frac{\lambda}{\pi * r_{laser}} * f \implies f = 51.77cm$$

Unfortunately, no such focal length lens exists in the lab. We live with the imperfect mode match of 50cm.

We looked to measure the beam waist around 25cm, we recalculate a theoretical beam waist for this distance.

$$W^2/2 = \frac{\lambda}{\pi}\sqrt{L(R_2 - L)} \implies W = 0.30mm$$

In reality we get values ranging from 0.393mm to 0.374mm, which gives us a percent difference of ~28%. While this is a large difference, we expect the beam in reality to be more spread out than predicted in theory. Overall the beam is not being focused exactly where it should be, its passing through non thin elements, and the beam is not being focused exactly. Lastly there are significant measurement uncertainties related to the knife edge measurements.

We can back calculate the ideal cavity length based on our 50cm focal length. Doing this we get L = 9.6, 20.4 . This is the cavity that would best match the beam radius. This is best cavity length for mode matching the focal length. This is length that corresponds with beam waist of 0.348mm.

Day 2 2018 02 13

Optical Cavity Set-up and Piezo Calibration:

We aligned the laser to set up the optical cavity in the following way:

- Removed the first mirror M_1. Aligned the mirrors so that the beam was parallel to the optical table surface throughout the setup.
- Added the 50 cm lens to the beam path and centered the laser spot on it.
- Reinserted the first M_1 mirror into the setup on the micrometer stage at about 50 cm from the lens.
- Set the second mirror, M_2, to be 15 cm from the first mirror as to create a resonant cavity with a length of 15 cm.
- Observed the oscillating/changing time-dependent modes of the resonating beam with the CCD camera.

When only M1 is placed in the beam path, it dramatically reduces the intensity that was going to the end of the optical path.

When we add the second mirror and if it is misaligned, there is practically no transmission. Any light which survives is likely being bent around the central path, so there is much lower intensity than with the single mirror.

Once we correctly align the cavity, the intensity goes back up. In fact the cavity becomes much more intense as the cavity begins to resonate. The cavity pulse brightly, and during those pulse the intensity is significantly higher than the M1 intensity. Outside of those pulse, the cavity transmission is fairly anemic.

Piezo Calibration:

For the piezo actuator we want to find the calibration of the device, that is to say we want to investigate and find any relationship between the frequency or voltage and travel of the piezo when it vibrates. We can do this by looking at the resulting laser beam when the piezo is excited and the cavity length changes with time due to controlled vibrations.

This setup took the longest time and the majority of our time, which was what we expected to take the longest in our lab outline. Our major difficulty was getting a periodic signal that we were able to measure from the

These measurements are very sensitive to noise and disturbances caused by sounds and other vibrations picked up and conducted by the table (walking/breathing).

Using λ = 632.8 μm

Datasheet Calibration term: 0.116 $\mu m/V$

We apply a ramp function from the signal generator into the piezo controller.

Optical cavity Length: 150 $\pm$ 1 mm

Frequency (Hz)	**Voltage Peak-to-peak** (V)	Δ**Time or Period** (ms)	**Slope** (V/s)	Δ**Voltage** (V)	**Piezo Calibration** $(\mu m/V)$
22.14 $\pm$ 0.01	47.8 $\pm$ 0.2	2.10 $\pm$ 0.02	2117 $\pm$ 8.9	4.44 $\pm$ 0.046	0.07118 $\pm$ 0.00074
22.14 $\pm$ 0.01	25.1 $\pm$ 0.3	1.895 $\pm$ 0.075	1111 $\pm$ 13	2.11 $\pm$ 0.087	0.150 $\pm$ 0.0062
22.14 $\pm$ 0.01	10.2 $\pm$ 0.3	2.00 $\pm$ 0.02	452 $\pm$ 13	0.903 $\pm$ 0.028	0.35 $\pm$ 0.011
223.7 $\pm$ 0.1	48.0 $\pm$ 0.1	0.236 $\pm$ 0.024	21500 $\pm$ 45.8	5.07 $\pm$ 0.516	0.0624 $\pm$ 0.00635

Frequency	Voltage Peak-to-peak	Time or Period	Slope	Voltage	Piezo Calibration
1018 ± 1	48.0 ± 0.1	0.0428 ± 0.0036	97700 ± 225	4.18 ± 0.352	0.0756 ± 0.0064

Optical cavity Length: 295 ± 1 mm

Frequency (Hz)	Voltage Peak-to-peak (V)	ΔTime or Period (ms)	Slope (V/s)	ΔVoltage (V)	Piezo Calibration $(\mu m/V)$
186 ± 1	48 ± 0.2	1.08 ± 0.022	17900 ± 121	19.4 ± 0.414	0.016 ± 0.00035
22.38 ± 0.01	48 ± 0.2	8.55 ± 0.29	2150 ± 9.0	18.4 ± 0.63	0.017 ± 0.00059
1867 ± 1	48 ± 0.2	0.0512 ± 0.004	179000 ± 753	9.18 ± 0.72	0.034 ± 0.0027
22.41 ± 0.01	26.6 ± 0.3	4.08 ± 0.46	1190 ± 13.5	4.86 ± 0.55	0.065 ± 0.00737
22.43 ± 0.01	9.6 ± 0.2	6.32 ± 1.68	431 ± 9.0	2.72 ± 0.73	0.116 ± 0.031

Optical cavity Length: 200 ± 1 mm

Frequency (Hz)	Voltage Peak-to-peak (V)	ΔTime or Period (ms)	Slope (V/s)	ΔVoltage (V)	Piezo Calibration $(\mu m/V)$
22.51 ± 0.01	48 ± 0.1	2.69 ± 0.13	2160 ± 4.6	5.81 ± 0.28	0.054 ± 0.0026
228.8 ± 0.1	48 ± 0.1	0.275 ± 0.029	21960 ± 46.8	6.04 ± 0.637	$0.052 \pm 0.0055 \pm$
1047 ± 1	48 ± 0.1	0.051 ± 0.0002	101000 ± 230	5.13 ± 0.023	0.0617 ± 0.00028
22.7 ± 0.1	29.7 ± 0.2	2.74 ± 0.22	1350 ± 10.9	3.69 ± 0.30	0.0856 ± 0.0069

Frequency (Hz)	Voltage Peak-to-peak (V)	Time or Period	Slope	Voltage	Piezo Calibration
22.7 $\pm$ 0.1	9.7 $\pm$ 0.2	2.495 $\pm$ 0.135	440 $\pm$ 9.3	1.1 $\pm$ 0.06	0.288 $\pm$ 0.0167

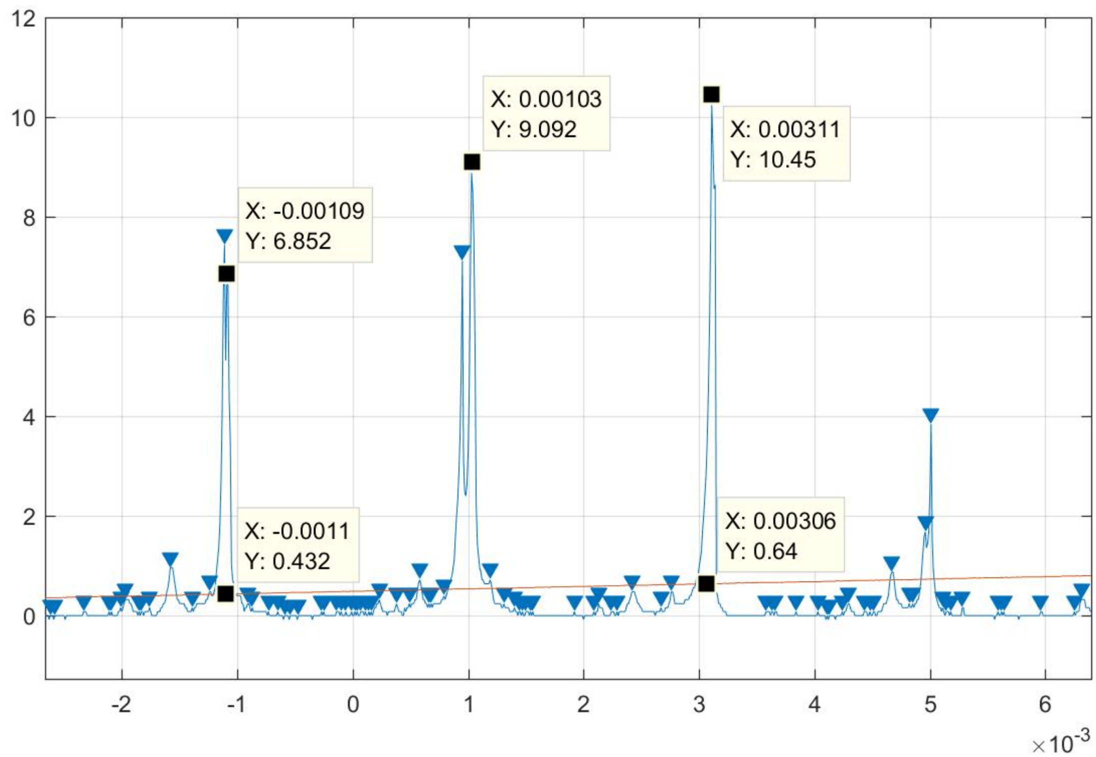


Figure: For finding the piezo calibration the free spectral range was found as the difference in time between periodic peaks. This allowed us to calculate the calibration constant. Also seen here is the ramp voltage that was recorded, which should range from 0 V to 47.8 V but instead varies from -0.1 V to 0.92 V. Because of this the ramp data was not used and a new linear line was used based off the recorded applied voltage

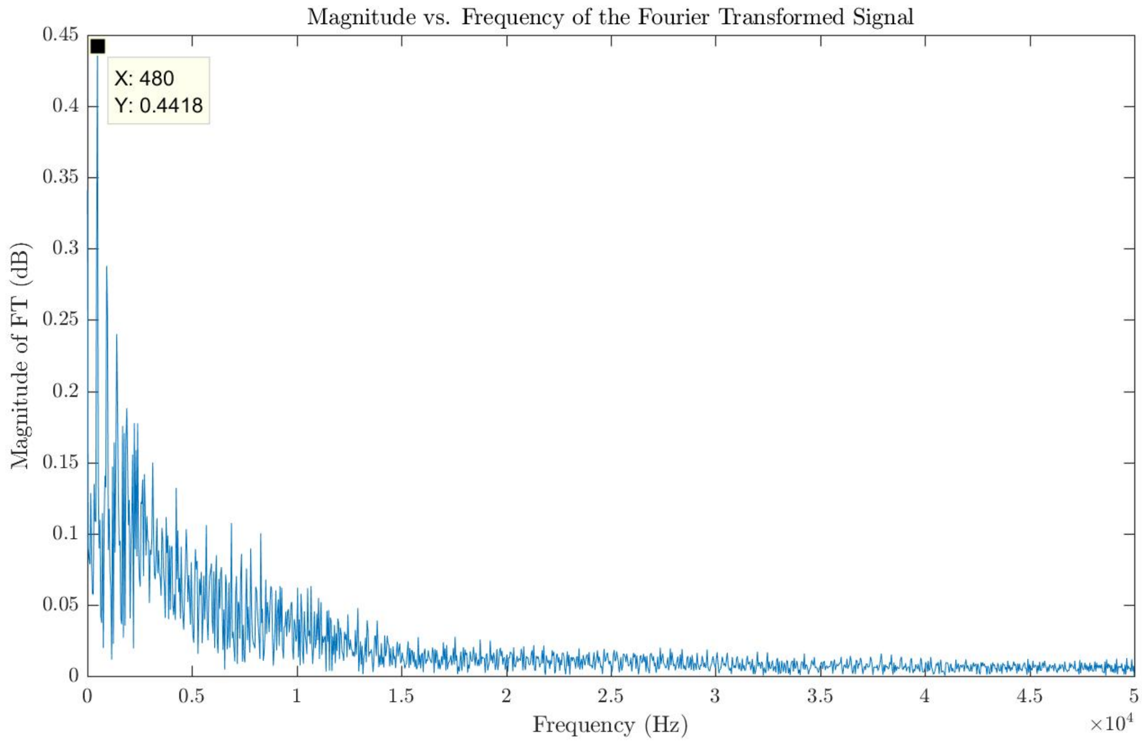


Figure: We chose to try to find the periodicity of the the graph by taking the fast fourier transform (FFT) of the data and finding the fundamental frequencies. For the first graph we found that the frequency found was 480 Hz and was comparable to the measured frequency of 476 Hz. We went against this method however because the resolution in frequencies was very broad and gave us very little variability.

We find that the piezo calibration is a a function of the peak to peak driving voltages. This is likely due to some sort of non-linear response in the controller piezo stack. Ideally, this calibration would be constant and independent of all variables that may change in the experiment. In general, we find that the calibration is significantly lower than Thor Labs specification. For low voltages however, we get values close to or at least on the order of the calibration value. This leads us to believe that specification is probably given for a driving voltage around 0V.

Day 3 2018 02 27

Piezo Calibration Analysis and Q-Factor (Finesse):

Cavity Observations

We start by creating a very short cavity of length 1.5cm then we adjust the alignment of the cavity to maximize power in the 0,0 mode. The 0,0 mode has the most power transmitted through it.

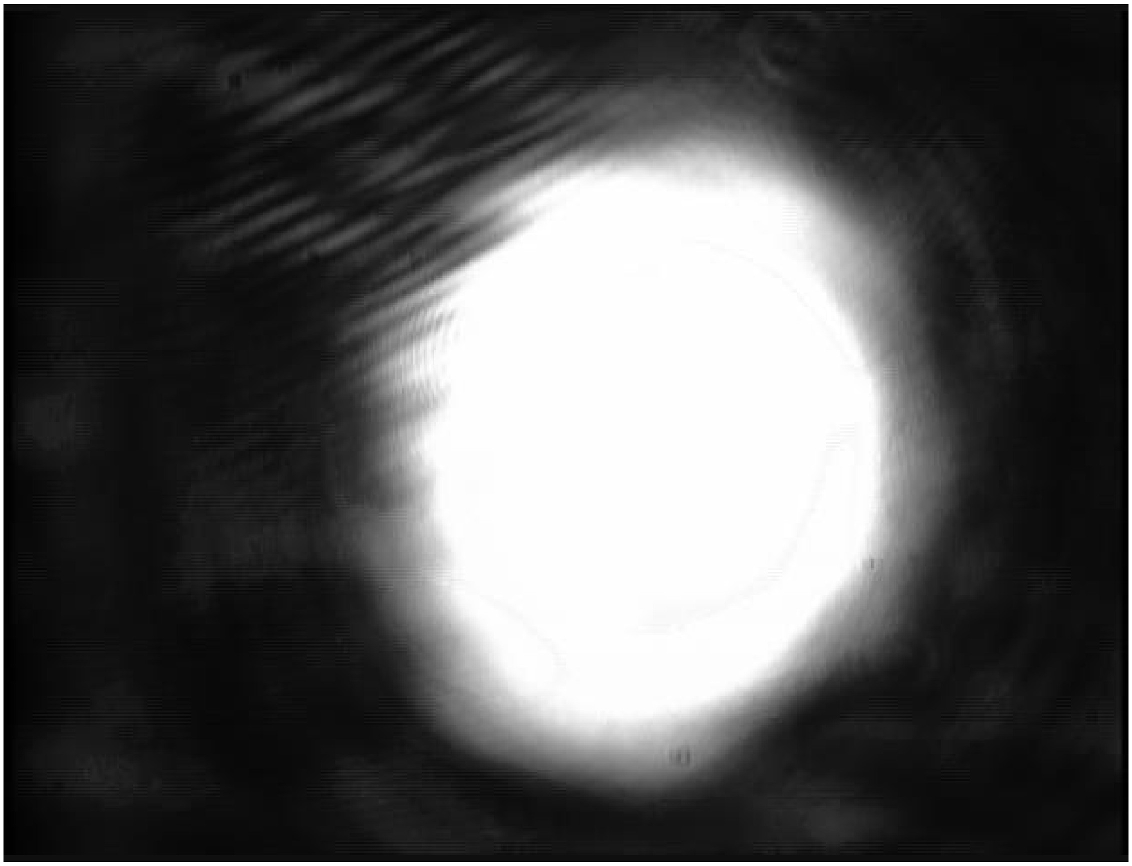


Figure: TEM 0,0 Mode Picture

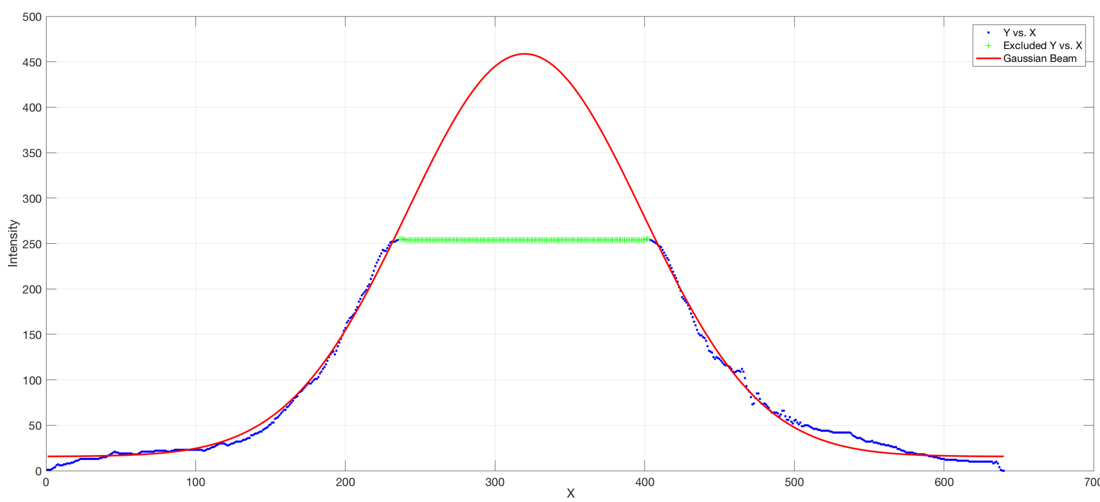


Figure: Here it is fairly clear that we have close to a pure Gaussian beam, but we managed to saturate the sensor making it hard to distinguish the top of the curve. These points were removed from the plot prior to curve fitting in MATLAB

Then we adjust the M_2 mirror to put the cavity into a mode match for the TEM 1,0 and 0,1 modes

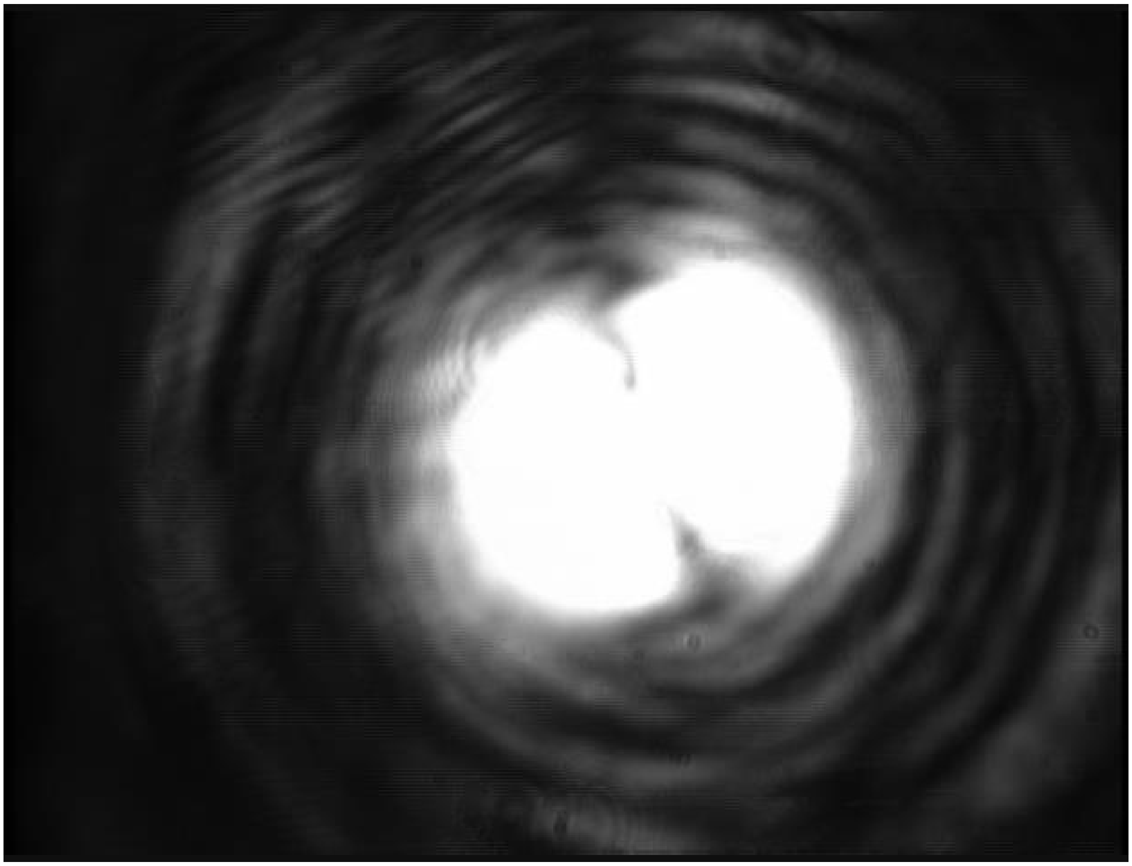


Figure: TEM 1,0 Mode Picture

Because it is hard to maintain this exact cavity length the optical cavity occasionally goes into 2,0 mode.

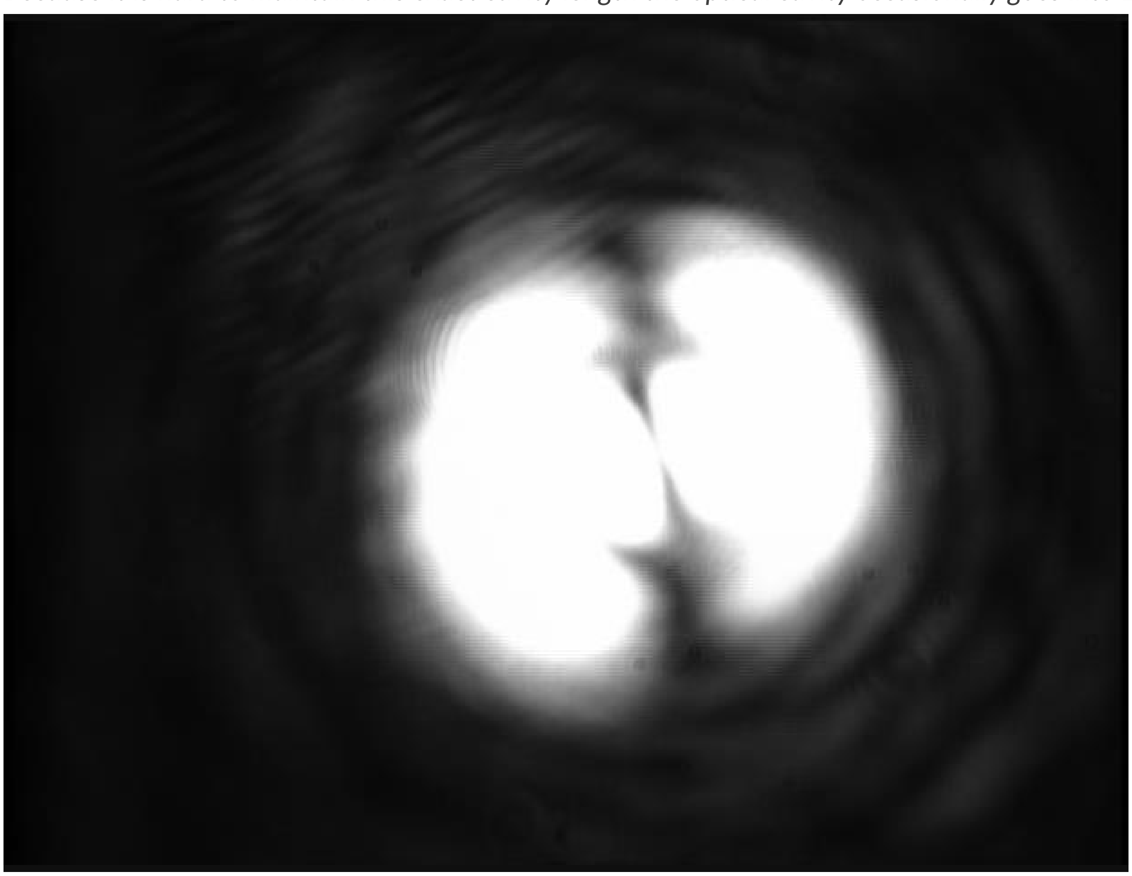


Figure: TEM 0,1 Mode Picture

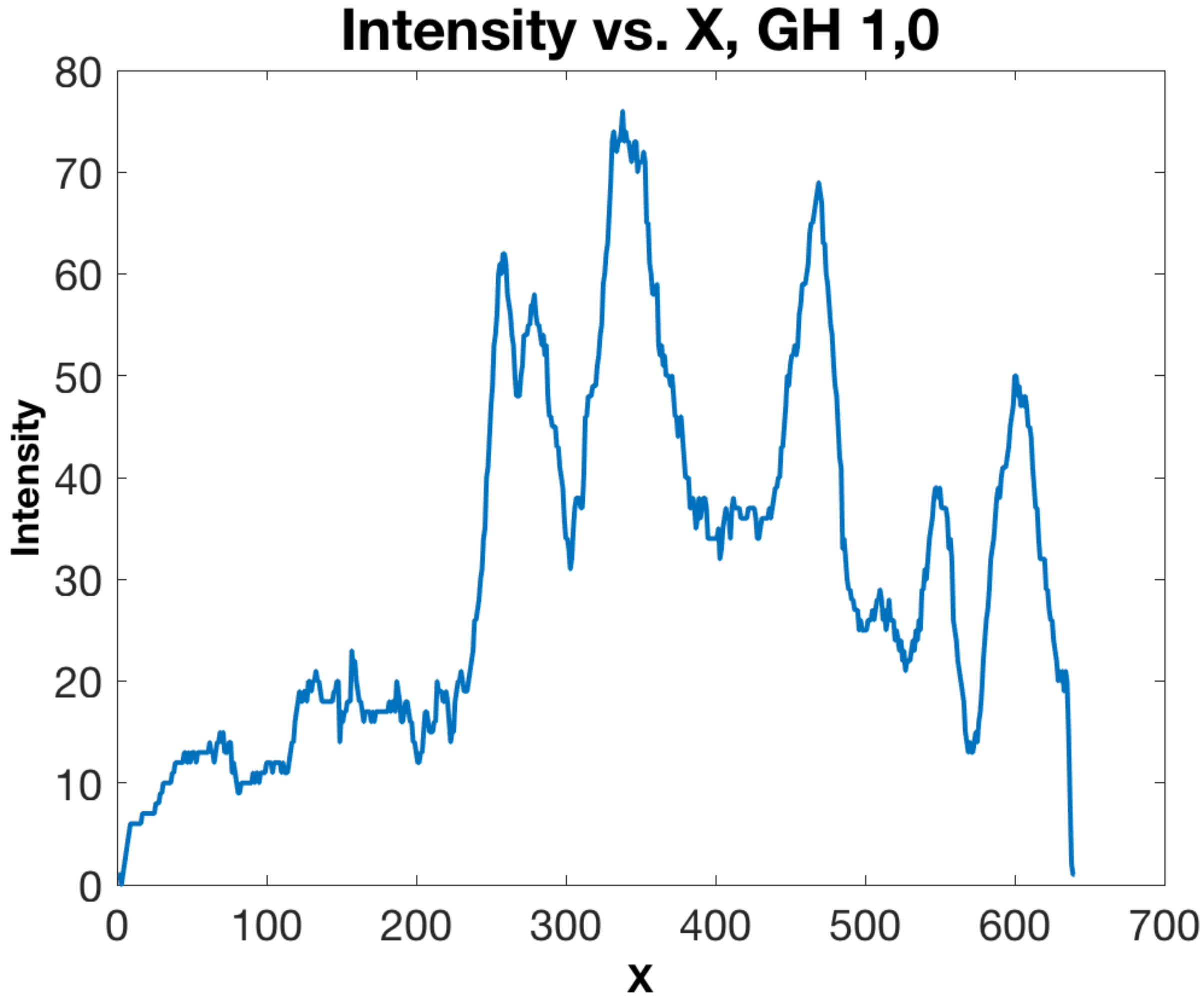


Figure: Cross-sectional pixel analysis. Here we see that the intensity clearly tracks the expected power distribution.

At this distance the modes are all primarily Hermite-Gauss Polynomial solutions.

By applying a significant voltage, we can get a mixed mode between 2,2 and 0,0 for the HG polynomial.

Now we set the cavity 15cm, here there are far more mode possible modes available.
We found that we primarily we got Laguerre–Gaussian modes
First we got to a 2,4 mode

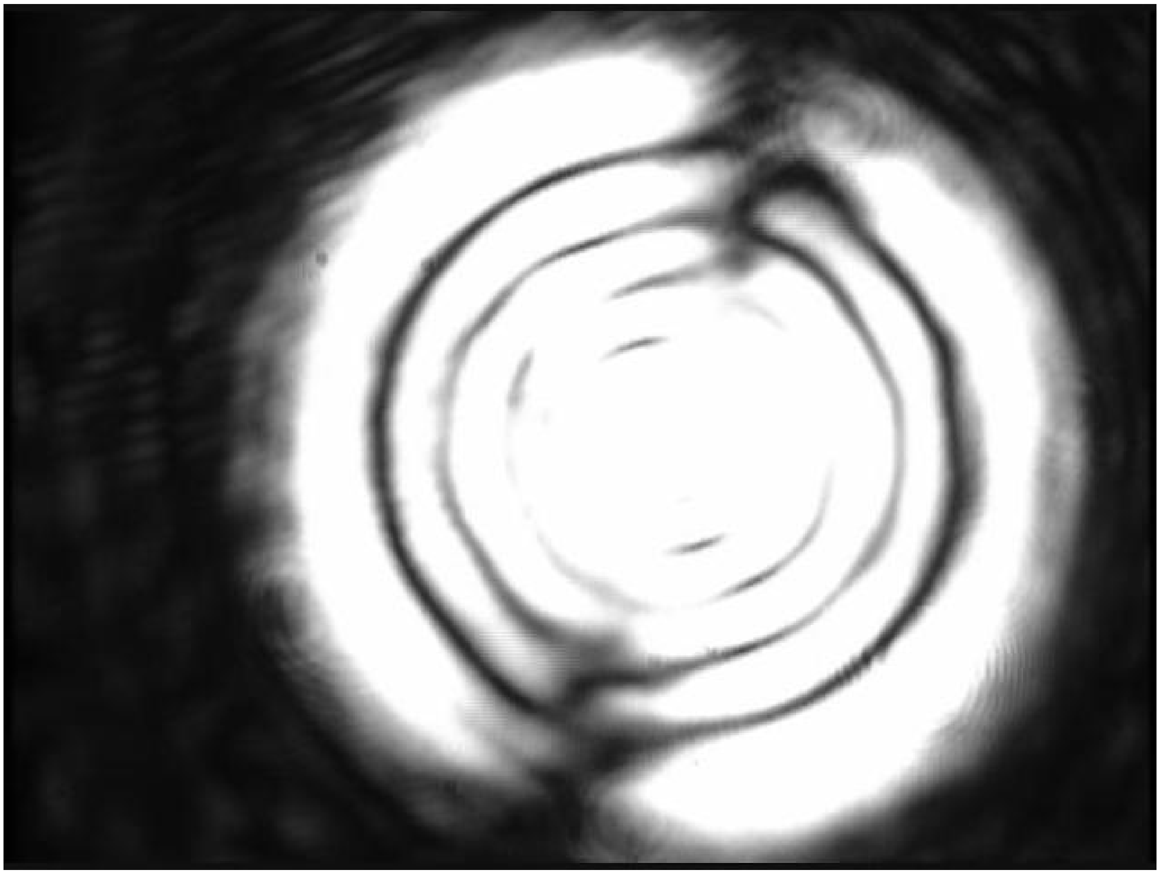
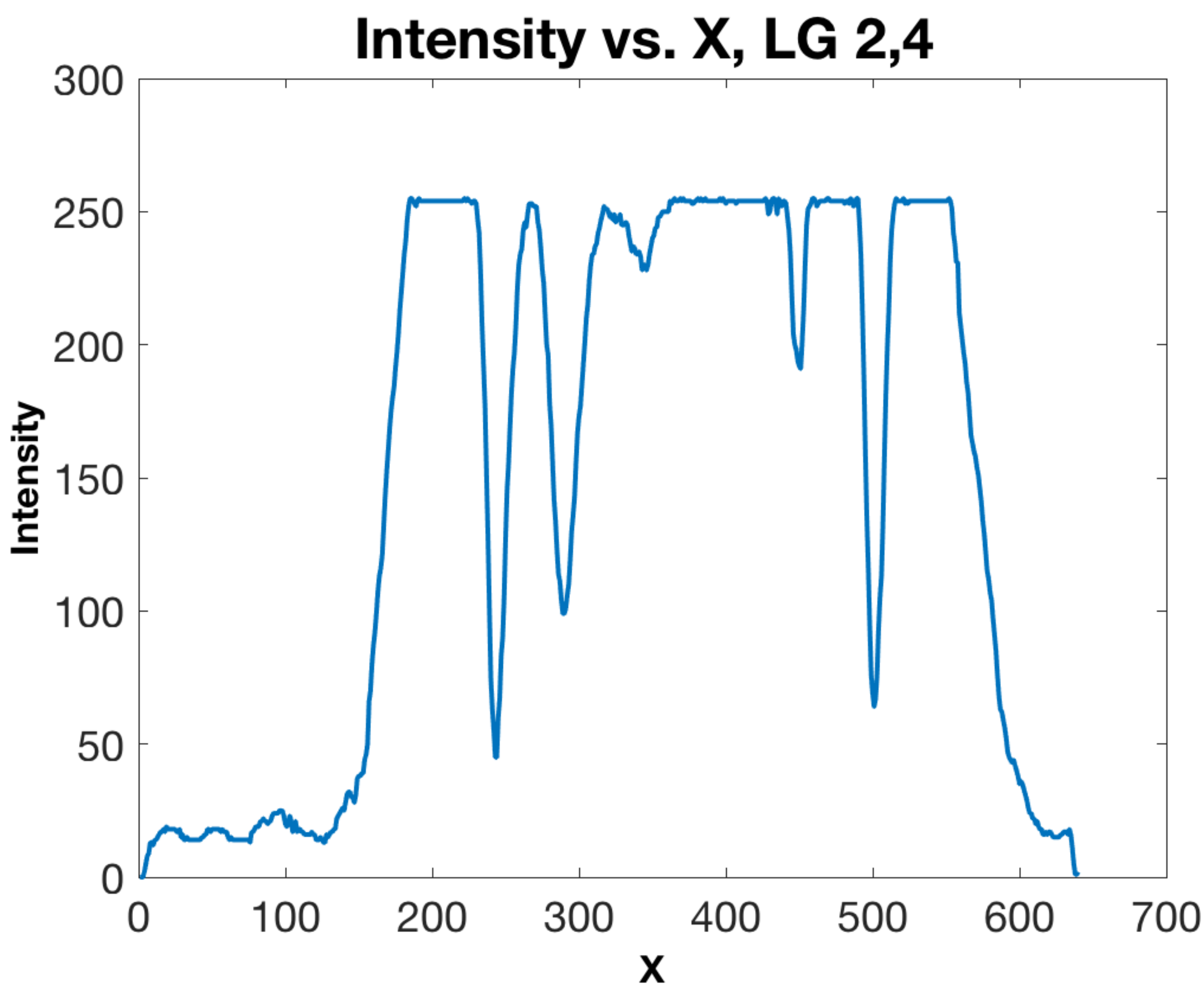


Figure: TEM LG 2,4 Mode



Then by increase the path length very slightly(~0.25mm) we got the cavity into a 7,1 LG mode.

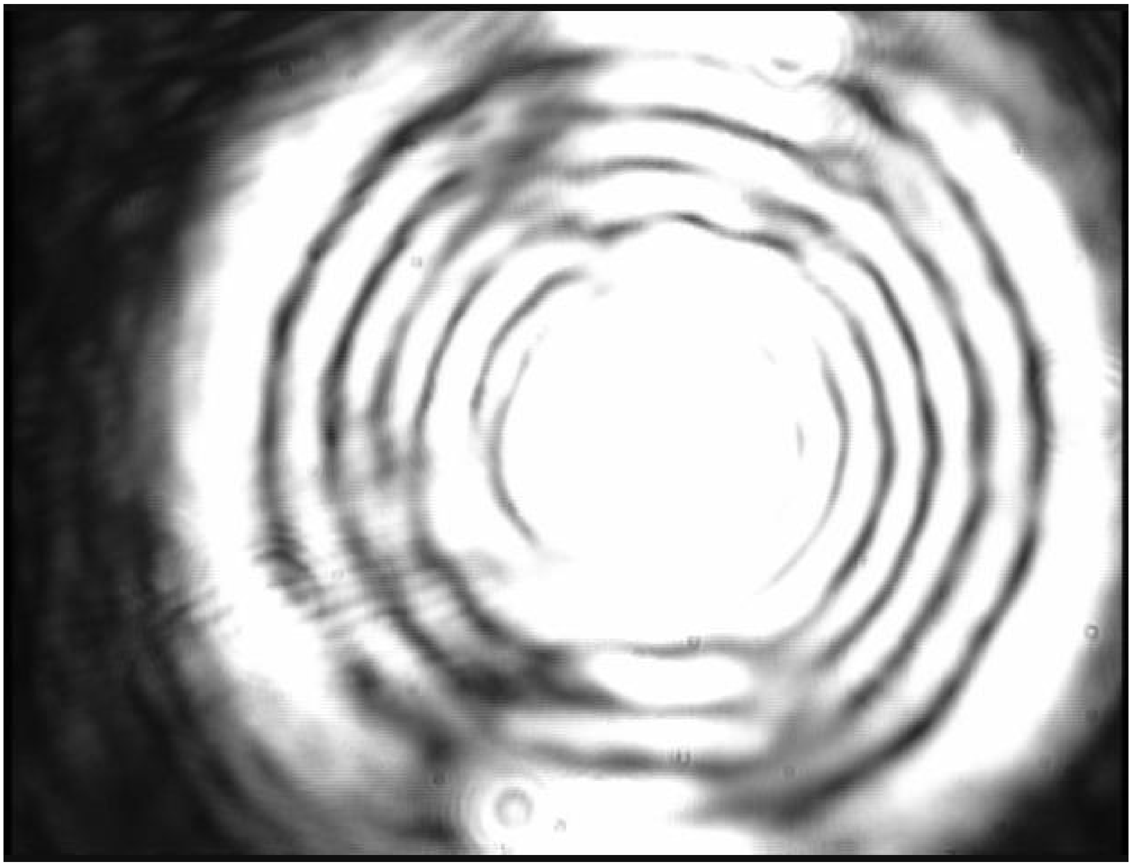


Figure: TEM LG 7,1 Mode

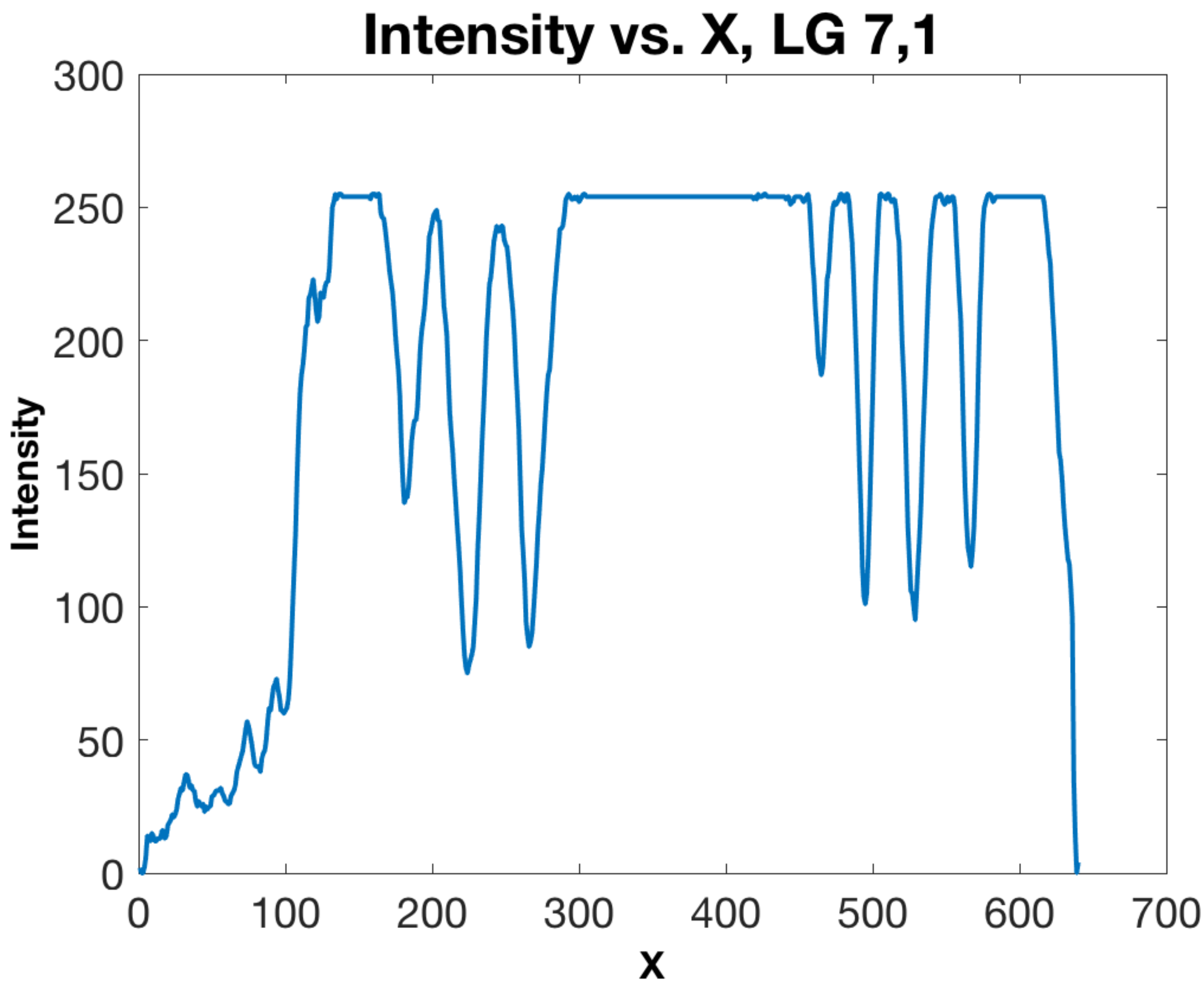


Figure: Using the intensity curves we can clearly see that the intensity is correlated strongly with the modes. This also helps us look at the power transmission inside the cavity for various modes.

Long cavities allow to get far more modes, of higher order than are possible at short cavity lengths. This is primarily related to the beam waist at the M_2 mirror. Having a more diffuse beam on a curved mirror affects the path length seen by the photons on the outskirts of the beam compared to the middle. This means that they will be diffracted by different amounts on every trip through cavity producing the kind of spherical symmetry we see in the cavity observations. In the limit where the cavity is of size 0, we expect to see just the 0,0 mode corresponding to a pure Gaussian beam.

The laser is not actually perfectly monochromatic (single mode), so the different photons have slightly different integer wave-paths inside the cavity. This explains why the 0,0 mode carries the most power because none of those photons are being diffracted away, out of the cavity.

Tune the optical cavity to find the max power when the laser is in the TEM_{00} mode. After >25 cm of cavity length the transmitted laser seems to become marginally unstable.

Last point of resonance is when the optical cavity length is 29.75 cm. This measurement leads us to believe that the max cavity length is at or around 30 cm.

Set the cavity length to 1.5 cm and record the optical power transmitted as measured by the photo-diode (PD). This plot has several peaks that occur in a period pattern.

Resonator Finesse

The optical cavity length was set to multiple different lengths and the optical power transmitted was measured using the photo-diode.

Optical cavity Length (mm)	Frequency (Hz)	Finesse
15 ± 2	73.4 ± 0.1	151.85 ± 35.77
50 ± 2	73.4 ± 0.1	242.36 ± 93.46
100 ± 2	73.4 ± 0.1	121.64 ± 44.02
150 ± 2	73.4 ± 0.1	42.81 ± 10.53
200 ± 2	73.4 ± 0.1	54.56 ± 15.11
250 ± 2	73.4 ± 0.1	19.44 ± 5.3
300 ± 2	73.4 ± 0.1	133.35 ± 53.70

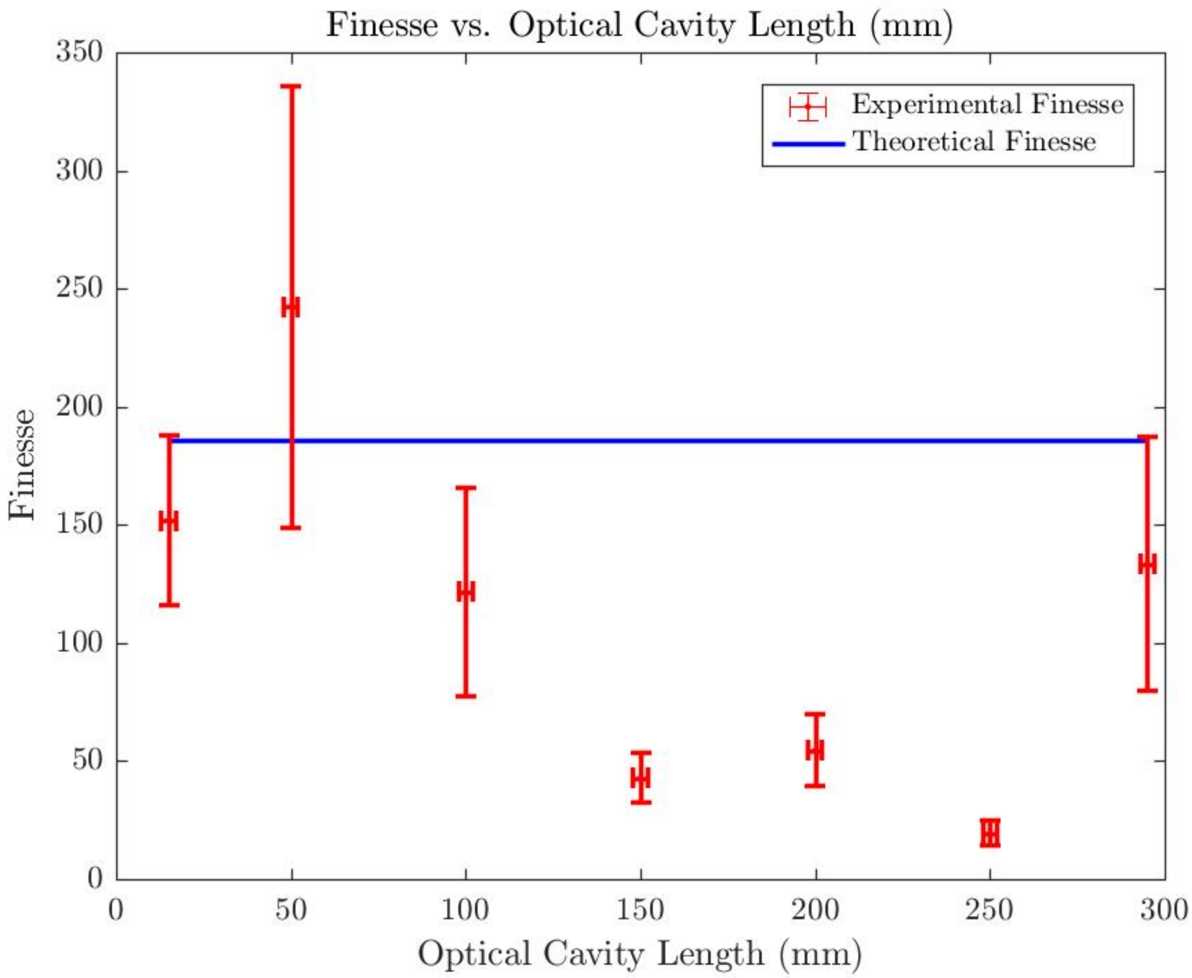


Figure: This plot shows the relation between the optical cavity length and the finesse of the cavity. Here we see that the theoretical finesse is a constant at 185.55 and that our experimental finesse varies for different optical cavity lengths.

The 150 mm Optical Cavity length gave the clearest signal for the transmitted optical power. The signal did not fluctuate as much as other measurements and the periodicity of the signal was very clear. This was the recommend length to use as it is the focal length of the mirror used. This is because the optical cavity consist of two mirrors: one flat, and one with a radius of curvature of 30 cm. Also, $F = ROC/2$, so a ROC of 30 cm gives us the 15 cm focal length.

We expect that the line width of the HeNe Laser, to be significantly larger than the linewidth of cavity. This is clear from the linewidth data we collected.

The Q-factor

$$Q = qF, \;\; q = \frac{L}{\lambda}$$

Optical cavity Length (mm)	**Q Factor ($\times 10^7$)**
15 ± 2	0.4 ± 0.1

Optical cavity Length (mm)	Q Factor ( )
50 ± 2	1.9 ± 0.8
100 ± 2	1.9 ± 0.7
150 ± 2	1.01 ± 0.3
200 ± 2	1.72 ± 0.3
250 ± 2	0.77 ± 0.2
300 ± 2	6.32 ± 2.5

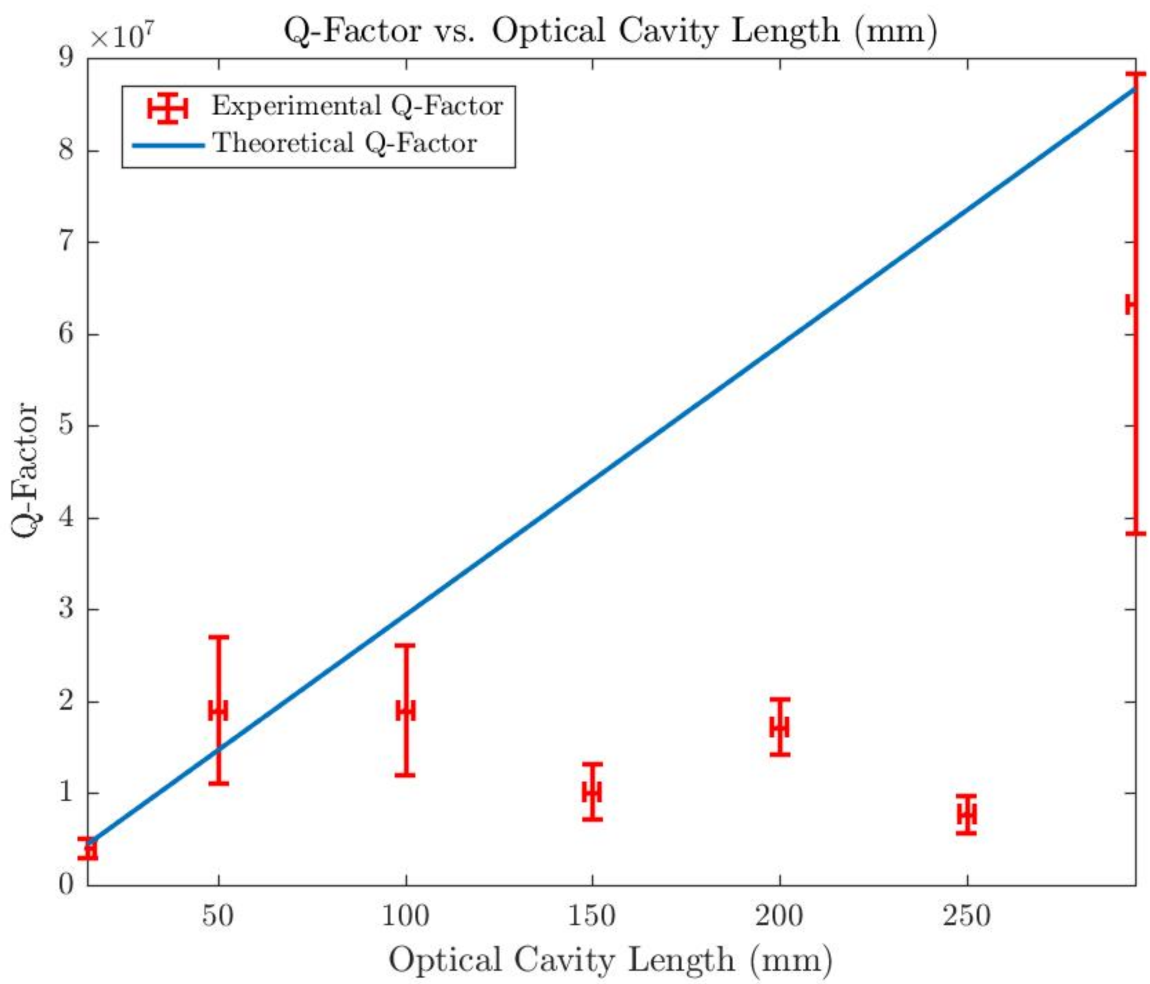


Figure: This plot shows the relation between the optical cavity length and the Q-factor of the optical cavity. Theoretically, the Q-factor should increase proportionally to the optical cavity length, but here we see that the experimental Q-factors found are almost constant for varying optical cavity length. It should also be noted that the very first point for the Q-factor aligns very well to the expected value. We suggest that for the very small cavity length we were only able to get low order modes that isolate the laser and provide less variability in signal.

How long would a tuning fork need to ring out at 440Hz to have the same quality factor?

$$\tau = \frac{Q}{2\pi\nu} = \frac{1.92 \times 10^7}{2\pi * 440 \text{ Hz}} = 1.93 \text{ Hours}$$

Clearly, this is unreasonable. Typically tuning forks become imperceptibility loud in a matter of seconds, not hours.

Confocal Cavity

Experimentally the cavity will not resonate if $L \geq 30cm$
If we create the ABCD matrix for a wavefront taking a round trip through the cavity [M] is as follows

$$[M] = [M_1][FreeSpace_{Cavity}][M_2][FreeSpace_{Cavity}]$$

$$[M] = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & L \\ 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 \\ -2/30 & 1 \end{bmatrix} \begin{bmatrix} 1 & L \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 - \frac{2L}{30} & 2L - \frac{2L^2}{30} \\ \frac{-2}{30} & \frac{-2L}{30} + 1 \end{bmatrix}$$

We get valid cavities if $Cx^2 + (D - A)x - B = 0$, has real solutions so we find a bound on L to keep x real.

$$\frac{-2}{30}x^2 + (\frac{-2L}{30} + 1 - 1 + \frac{2L}{30})x - 2L + \frac{2L^2}{30} = 0$$

$$\frac{2}{30}x^2 = -2L + \frac{2L^2}{30} \implies x = \sqrt{L^2 - 30L}$$

So valid cavity lengths have

$$L^2 \leq 30L \implies L \leq 30$$

which matches our experimentation.

Similarly we can think through the stability conditions of the cavity in terms of the $g_1 g_2$, factors. We know from Steck, that a cavity is stable and has non degenerate modes exactly when, $0 \leq g_1 g_2 \leq 1$. Thus:

$$0 \leq (1 + \frac{L}{\infty})(1 + \frac{L}{-30}) \leq 1$$

This has solutions when $L \leq 30cm$, which we also see experimentally, in that the modes become degenerate as the cavity becomes unstable.

Initial Cavity Length: 292.5 mm (From Surface of Both Mirrors)
Readings taken as absolute numbers off of Z dial
Initial Z-Stage Dial Reading:

Optical Cavity Length Change (Δmm)	**Power (μW)**
16.34 ± 0.01	210 ± 10
16.00 ± 0.01	210 ± 10
15.09 ± 0.01	208 ± 20
15.03 ± 0.01	203 ± 20
14.50 ± 0.01	200 ± 20
14.00 ± 0.01	197 ± 10
13.50 ± 0.01	189 ± 10
13.00 ± 0.01	186 ± 10
12.50 ± 0.01	184 ± 10
12.00 ± 0.01	179 ± 10
11.50 ± 0.01	174 ± 10
11.00 ± 0.01	166 ± 10
10.50 ± 0.01	156 ± 10
10.00 ± 0.01	149 ± 10
9.50 ± 0.01	128 ± 10
9.00 ± 0.01	115 ± 10
8.50 ± 0.01	90 ± 10
8.00 ± 0.01	58 ± 5
7.50 ± 0.01	45 ± 5
7.00 ± 0.01	41 ± 5
6.50 ± 0.01	40 ± 5
6.00 ± 0.01	38 ± 5

Optical Cavity Length Change ( )	Power ( )
5.50 ± 0.01	37 ± 2
5.00 ± 0.01	36 ± 2

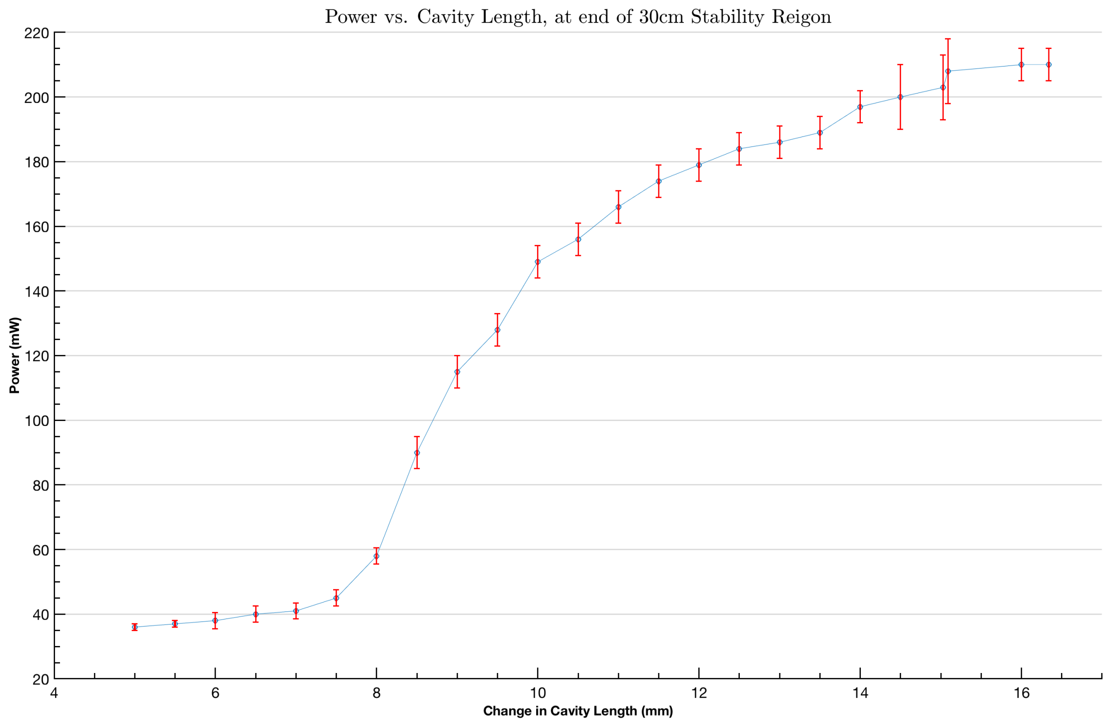


Figure: This plot showcases the drop of power as the cavities modes become degenerate. As the cavity passes out of a stability region the power drops back to the misaligned baseline.

The most challenging part of this lab was interpreting and then processing the finesse data. The issue was we didn't have a complete understanding of the underlying physics when we took the data, which made it hard to make extra measurement to ease some the data processing. If we had an extra lab section after we did some of the analysis, we could have taken oscilloscope cursor data, to speed up the finesse calculations. We thought that actually building and aligning the cavity would be the most challenging, but this turned out to be relatively easy.

File Directory Log

Each data file is time stamped with when it was collected.
Each data file is in placed in the directory where it belongs depending on which part of the experiment it was collected for.

Piezo Calibration

15cm

```
2018-2-13-12.47-47.6V-48V-22.14Hz-OC15cm.csv
2018-2-13-12.51-24.8V-25.4V-22.14Hz-OC15cm.csv
2018-2-13-12.54-9.9V-10.4V-22.14Hz-OC15cm.csv
2018-2-13-12.55-223.7Hz-48V-OC15cm.csv
2018-2-13-12.58-1018Hz-48V-OC15cm.csv
```

20cm

```
2018-2-13-13.35-22.51Hz-48V-OC20cm.csv
2018-2-13-13.36-1047Hz-48V-OC20cm.csv
2018-2-13-13.36-228.8Hz-48V-OC20cm.csv
2018-2-13-13.38-29.7+-0.2V-22.7Hz-OC20cm.csv
2018-2-13-13.40-9.7+-0.2V-22.7Hz-OC20cm.csv
```

30cm

```
2018-2-13-13.11-186Hz-48V-OC30cm.csv
2018-2-13-13.12-1867Hz-48V-OC30cm.csv
2018-2-13-13.12-22.38Hz-48+-0.2V-OC30cm.csv
2018-2-13-13.17-26.6+-0.3V-22.41Hz-OC30cm.csv
2018-2-13-13.22-9.6+-0.2V-22.43Hz-OC30cm.csv
```

Finesse Measurements

```
2018-2-27-11.56-73.4Hz-50.6V-OC1.5cm.csv
2018-2-27-12.03-73.4Hz-50.6V-OC5cm.csv
2018-2-27-12.04-73.4Hz-50.6V-OC5cmZoomedIn.csv
2018-2-27-12.11-73.4Hz-50.6V-OC10cmZoomedIn.csv
2018-2-27-12.12-73.4Hz-50.6V-OC10cm.csv
2018-2-27-12.13-73.4Hz-50.6V-OC15cm.csv
2018-2-27-12.14-73.4Hz-50.6V-OC15cmZoomedIn.csv
2018-2-27-12.17-73.4Hz-50.6V-OC20cmZoomedIn.csv
2018-2-27-12.18-73.4Hz-50.6V-OC20cm.csv
2018-2-27-12.20-73.4Hz-50.6V-OC25cm.csv
2018-2-27-12.22-73.4Hz-50.6V-OC25cmZoomedIn.csv
2018-2-27-12.25-73.4Hz-50.6V-OC29.5cm.csv
2018-2-27-12.26-73.4Hz-50.6V-OC29.5cmZoomedIn.csv
```

Cavity Stability Measurements

```
2018-2-27-12.52-73.4Hz-50.6V-Shorter than 30.csv
2018-2-27-12.52-73.4Hz-50.6V-approx30.csv
```

```
2018-2-27-12.52-73.4Hz-50.6V-justPast30.csv
2018-2-27-12.52-73.4Hz-50.6V-well Past30.csv
```

Matlab Code

All code and raw data is publicly available here: https://github.com/akshivbansal/phys408OpticalCavity and is distributed under the GPL 3.0 license.

Files of relevance to the data processed are:

```
correctTimeSeries.m
fastFourierTransform.m
finesseCalc.asv
finesseCalc.m
lengthVsPower.m
```