

Paul Marlier

Agarose Gel Light Diffuser Experiment

Abstract

To be written at some later date

Introduction

To be written

Methods

All dishes used in the experiment were weighed. Four concentrations of Agarose Gel and titanium oxide were dissolved in 100 mL of water. The solutions were boiled and cast in four sets of four different culture dishes. The culture dishes were a 3.5 mm clear dish, 5 cm Black dish, 5 cm Mirror dish, and 5 cm clear dish. The 5 cm dishes are 1 cm deep. After all the castings had been made, (about 1 hour), and all the gels set, (about 1.5 hrs.) the power readings were taken. The 5 cm Clear dish with concentration 1 was leveled in the apparatus aligned with the fiber cable. A reading was taken by holding the power sensor in the middle of the dish. Then a reading was taken at the top of the dish, followed by left, right and bottom. This was repeated with the 5 cm Clear dish with concentration 2. Once all the Clear dishes and concentrations were complete, the Black dishes followed, then Mirror. The 3.5 mm dishes were then taken. A 5 cm clear dish with only air had readings taken as well. All the dishes were weighed again with them now having the gels inside them. The intensity of the light was measured in the Z axis at 1 cm, 2 cm, and 3 cm.



Figure 1 Agarose Gel Casting in Culture Dish Setup

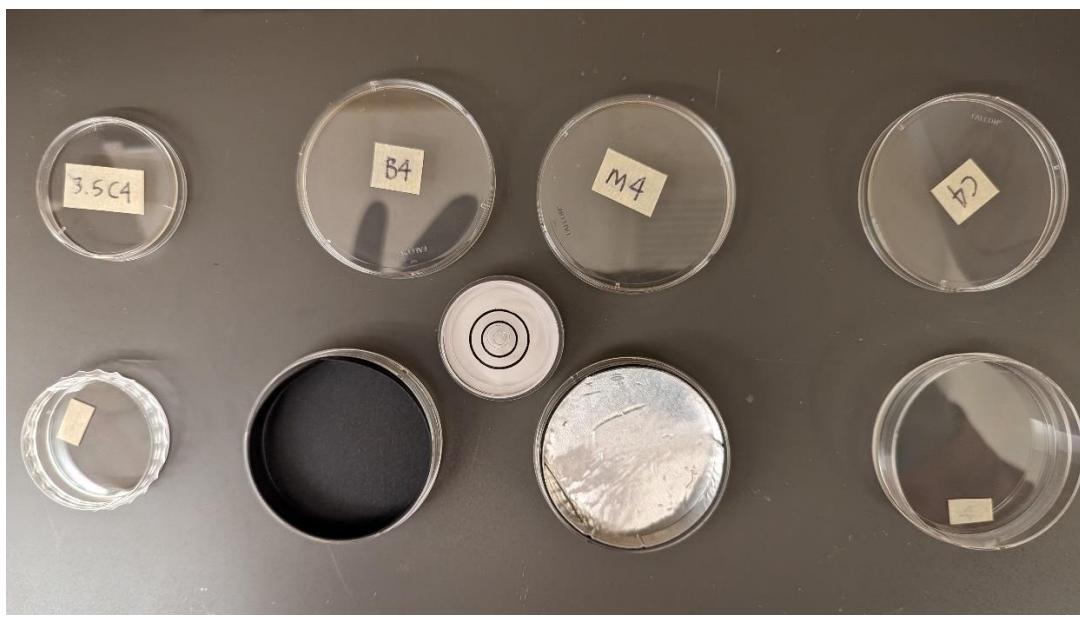


Figure 2 Culture Dishes from Left to Right. 3.5 cm clear, 5 cm Black, 5 cm Mirror, 5 cm Clear.

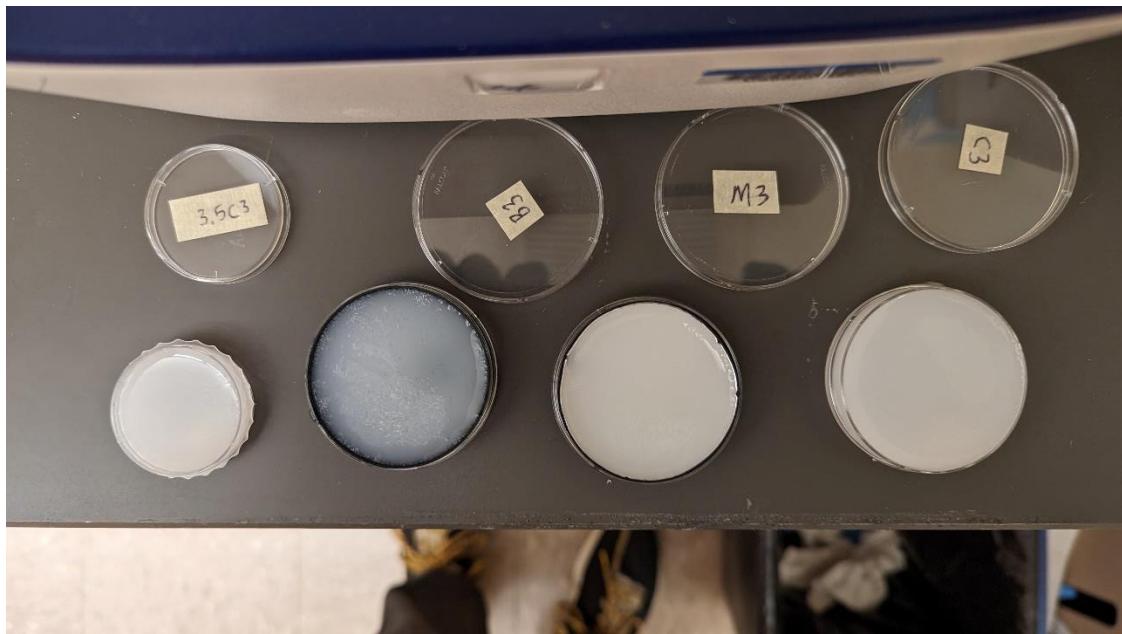


Figure 3 Culture dishes with Agarose Gel Concentration 1. Notice the darkening of the Black dish. This could be from the paper dye bleeding into gel.

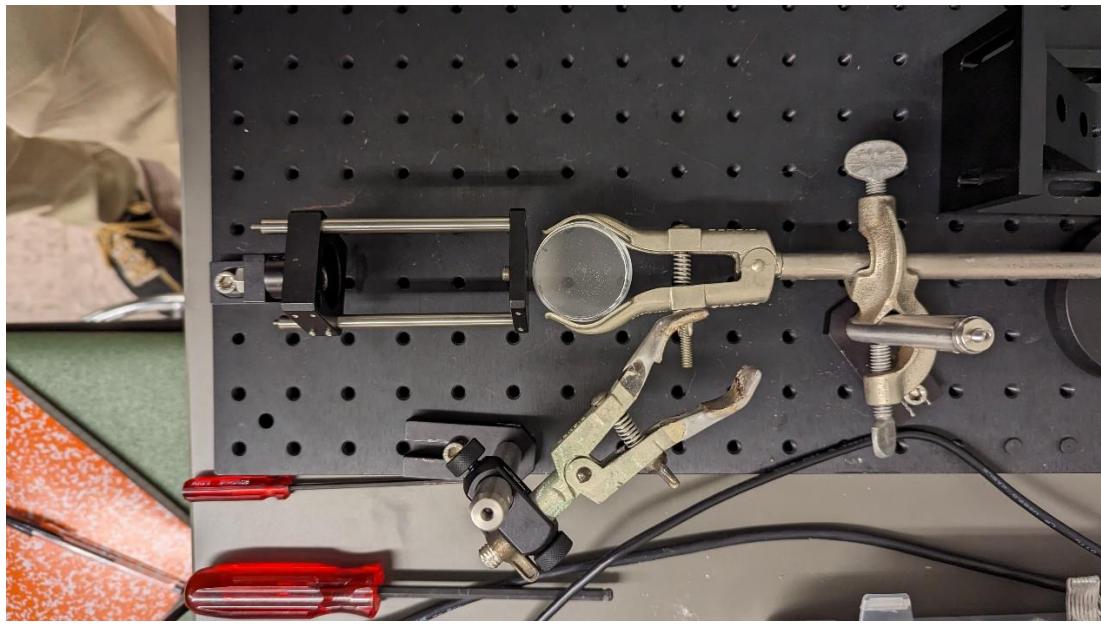


Figure 4 Optical bench set up for measuring power. The optical fiber is not shown attached as well as the power meter is not in clamp.

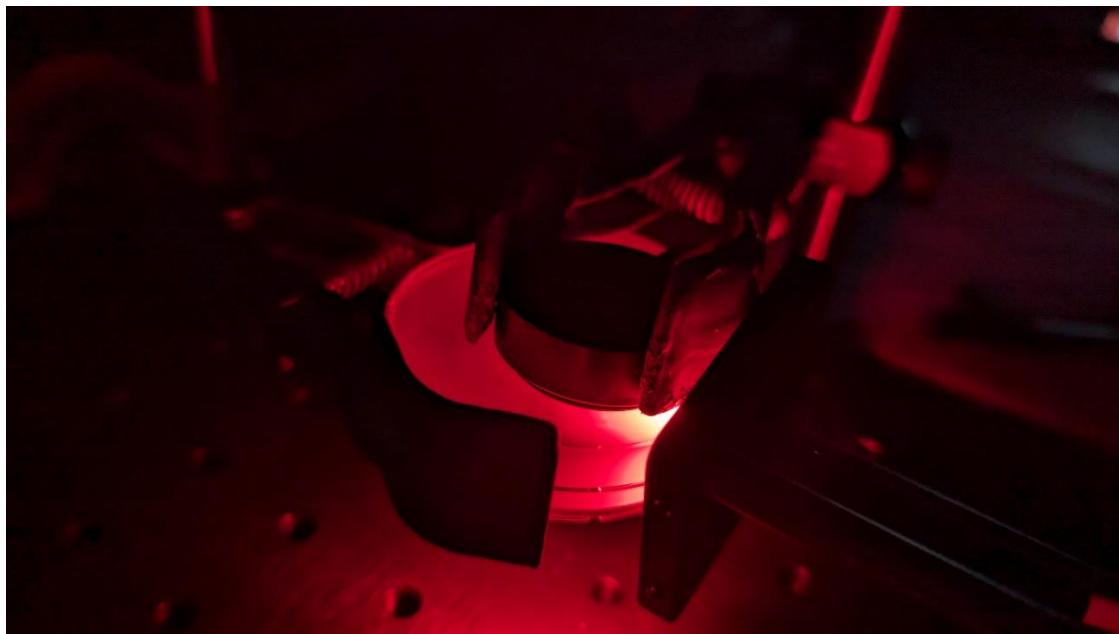


Figure 5 The Experiment Set up. However, the clamp holding the power meter sensor was not used. The power meter was held by hand to get closer readings and expedite the process.

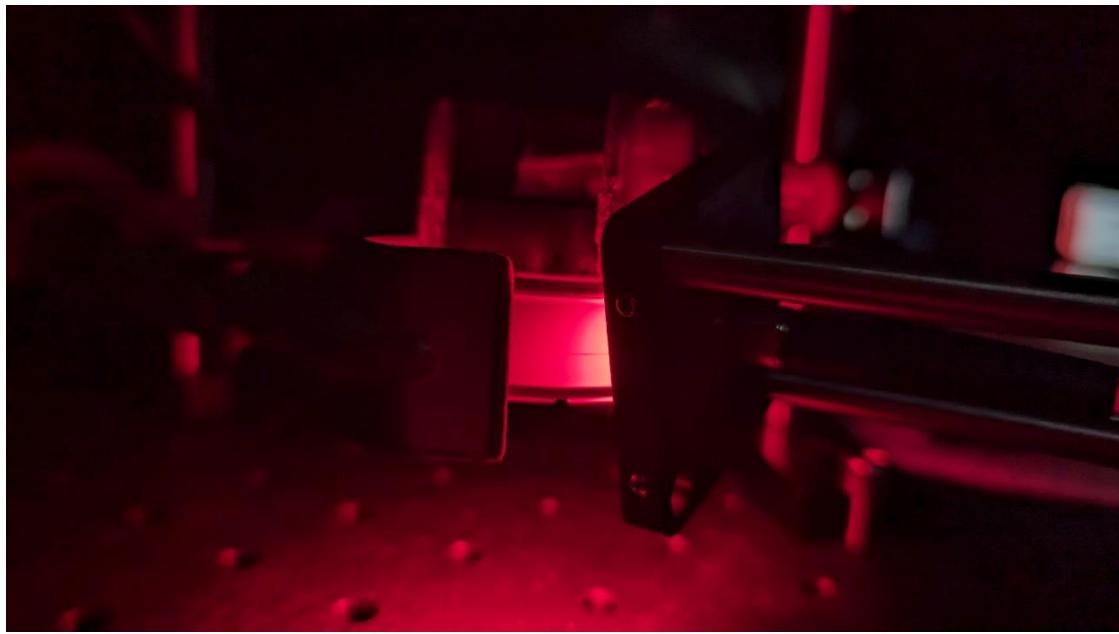


Figure 6 Side view of the experiment set up. In future experiments the dish should be on a tray. A lot of time was wasted aligning the fiber optic cable with the dish.



Figure 7 Each dish was leveled before taking power readings.



Figure 8 Image of the light travelling through the Agarose Gel medium. The photo is of concentration 4 in 5 cm Clear dish.

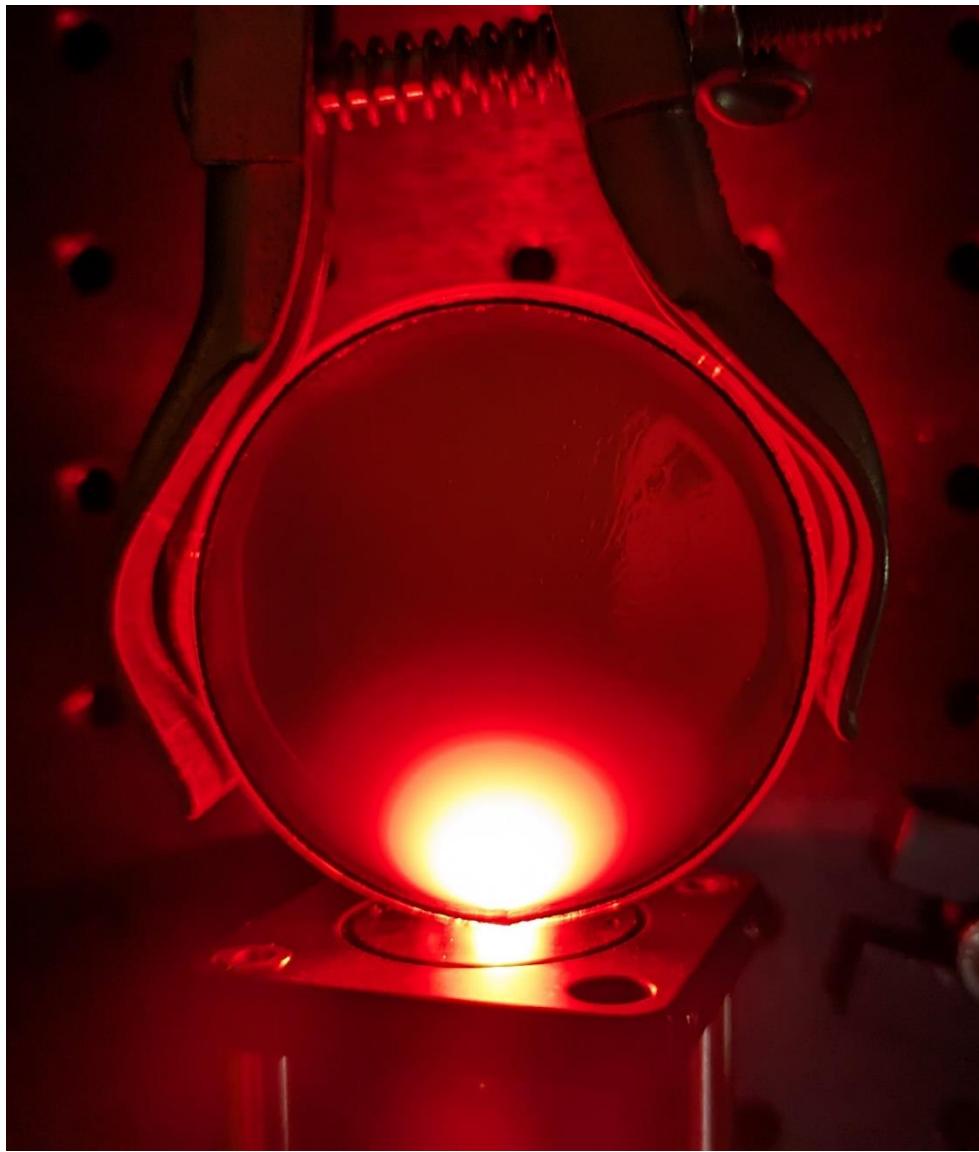


Figure 9 Image of light travelling through Agarose Gel. This is concentration 4 in the 5 cm Mirror dish. Notice the ability of the camera from the Pixel 7 phone to capture the "hot spot" near the fiber optic cable.

Results

Table 1. The concentrations of solutes in the solution.

	H2O (mL)	Agarose (g)	TiO2 (g)
1	100	1.5039	0.0578
2	100	1.4910	0.0284
3	100	1.5027	0.0175
4	100	1.5060	0.0000

Table 2. Experimental Data

Power Measurements					
	Center (mW)	Top (mW)	Left (mW)	Right (mW)	Bottom (mW)
Disk 5.0 cm					
C1	0.10	0.02	0.07	0.06	1.42
C2	0.16	0.04	0.12	0.09	1.64
C3	0.49	0.11	0.32	0.30	2.61
C4	0.83	1.53	0.55	0.40	1.46
B1	0.00	0.00	0.00	0.00	0.03
B2	0.02	0.00	0.01	0.01	0.63
B3	0.08	0.01	0.04	0.03	0.84
B4	0.13	0.06	0.09	0.14	0.57
M1	0.09	0.01	0.05	0.05	1.10
M2	0.33	0.04	0.14	0.13	1.20
M3	0.38	0.11	0.33	0.28	1.83
M4	1.60	1.19	0.91	1.04	2.46
Disk 3.5 cm					
3.5C1	0.26				
3.5C2	0.70				
3.5C3	0.96				
3.5C4	0.98				
Disk 5.0 cm					
Air (empty dish)	0.43	0.27	0.31	0.21	1.23

Discussion

Table 3. Attempts to use the Inverse Square Law to better understand the Data

r	Intensity Measured (mW)	Inverse Square Law (mW)
Measured Intensity in Z axis		
10	42.40	53281
20	19.30	97012
30	8.40	95002
Measured Intensity 90 deg from Z axis (AVG)		
12	1.32	2389
25	0.35	2749
38	0.26	4718
Measured Intensity 90 deg from Z axis (AIR)		
12	1.23	2226
25	0.43	3377
38	0.27	4899

I used the equation, $\text{Intensity Measured} \times 4 \times \pi \times r^2 = I_0$

However, I think we need to meet and talk about this because this is probably wrong. I also need to use another equation for diffraction.

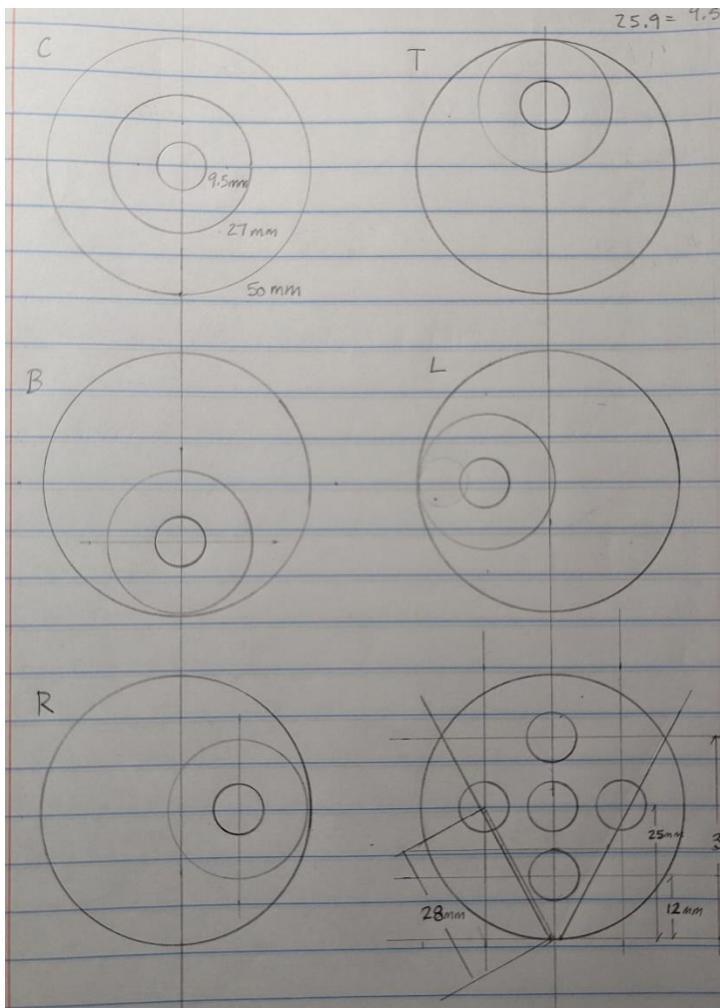


Figure 10 Sketches of the actual locations of each reading to scale. Close up of the bottom right sketch is below.

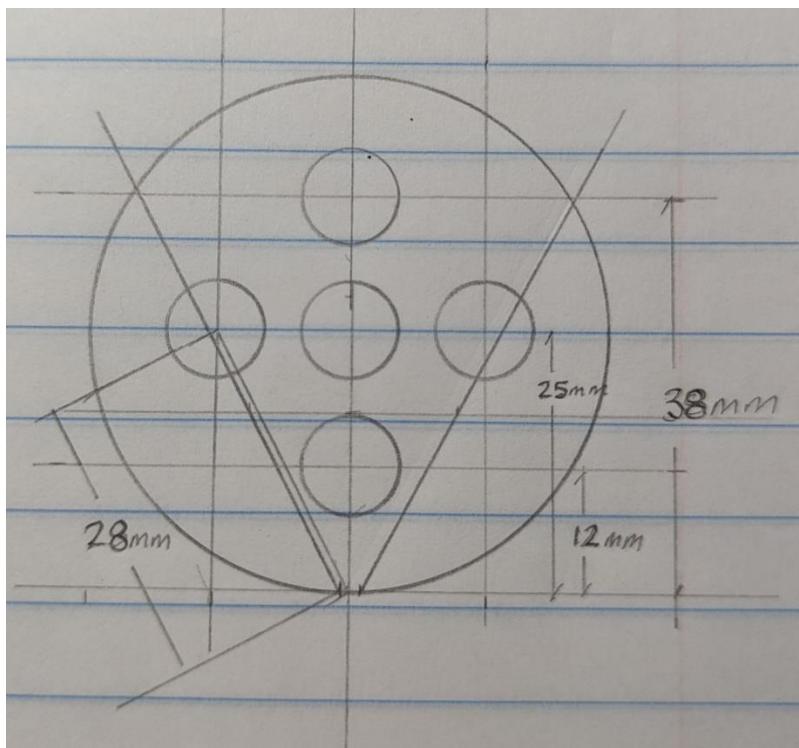


Figure 11 This is a sketch of each power meter reading location (the four small circles). The measurements are distance from the fiber cable to the middle of the circle of each reading location. The two lines radiating out of the bottom of the large circle is the perceived edges of the light emitting from the fiber cable unobstructed and only scattered by air. Notice the left and right power meter reading locations are not completely in the expected light path. These readings were not included in the calculations of intensity.

Conclusion

To be written