

# Physics 1200

## Interference and Diffraction

### Part I & II

#### Notes:

All of the interference and diffraction patterns were photographed adjacent to a scale that is in centimeters.

The distance from the Cornell Plate to the screen is  $200.0 \pm 0.1 \text{ cm}$

All the reported measurements taken from the Cornell Plate (slit widths and separation distances) have an absolute error of  $\pm 0.00002 \text{ cm}$ .

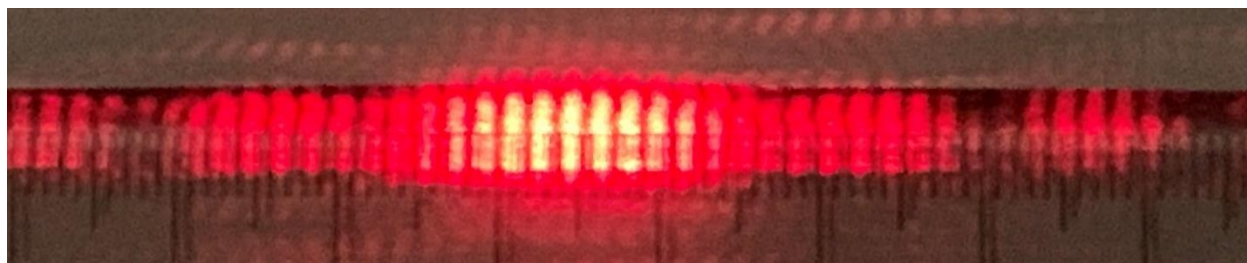
Not all Cornell Plate measurements that I included will be needed.

This lab uses a He-Ne laser with a wavelength of 632.8 nm

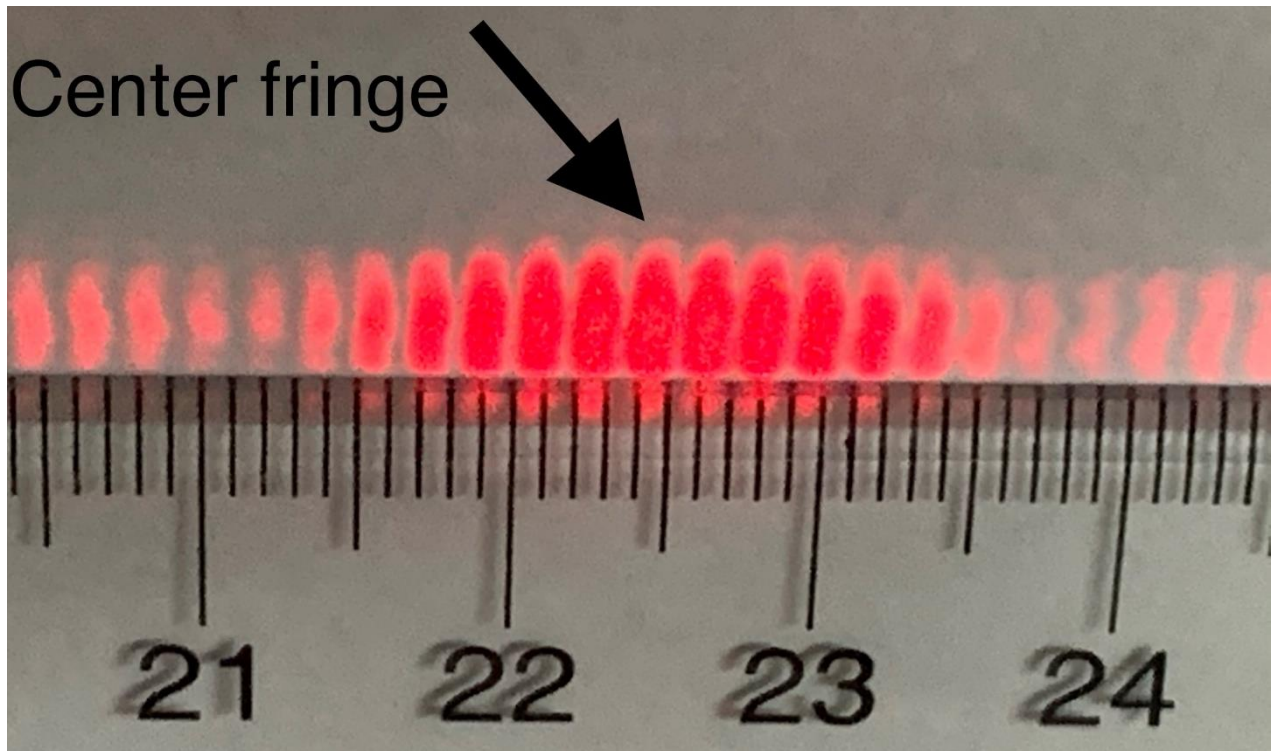
### 3.1 Interference from Multiple Slits

#### 3.1.1 Double Slit Patterns

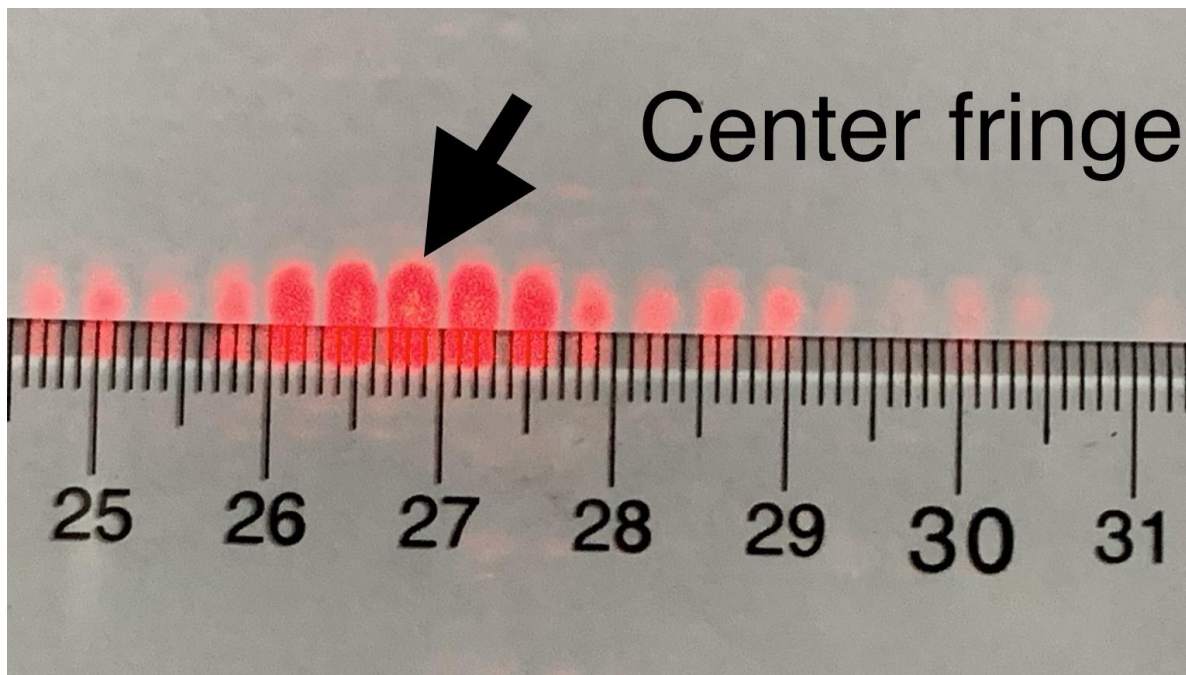
The following photograph illustrates interference from two slits. Don't bother trying to take measurements from this photo. It was taken in the dark to see more fringes.



Here is the same pattern taken with the lights on. Use this photo to take measurements. The width of each slit is 0.01000 cm. The slits are 0.07000 cm apart (center to center).

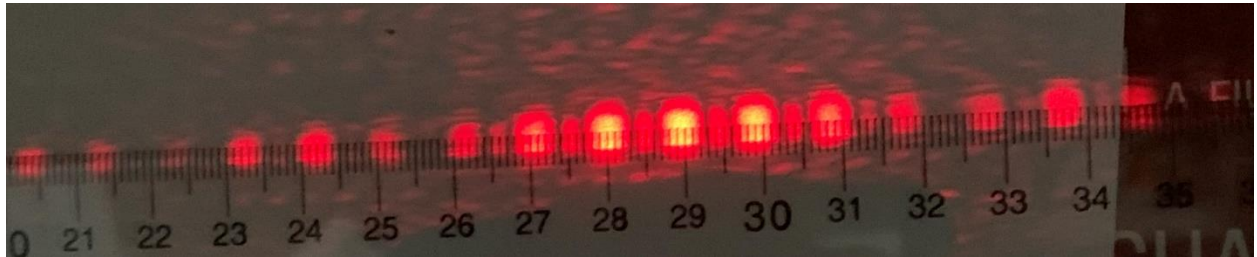


This is a photo of a different double slit interference pattern. The width of these slits are also 0.01000 cm, but with a center to center separation distance of 0.03500 cm.

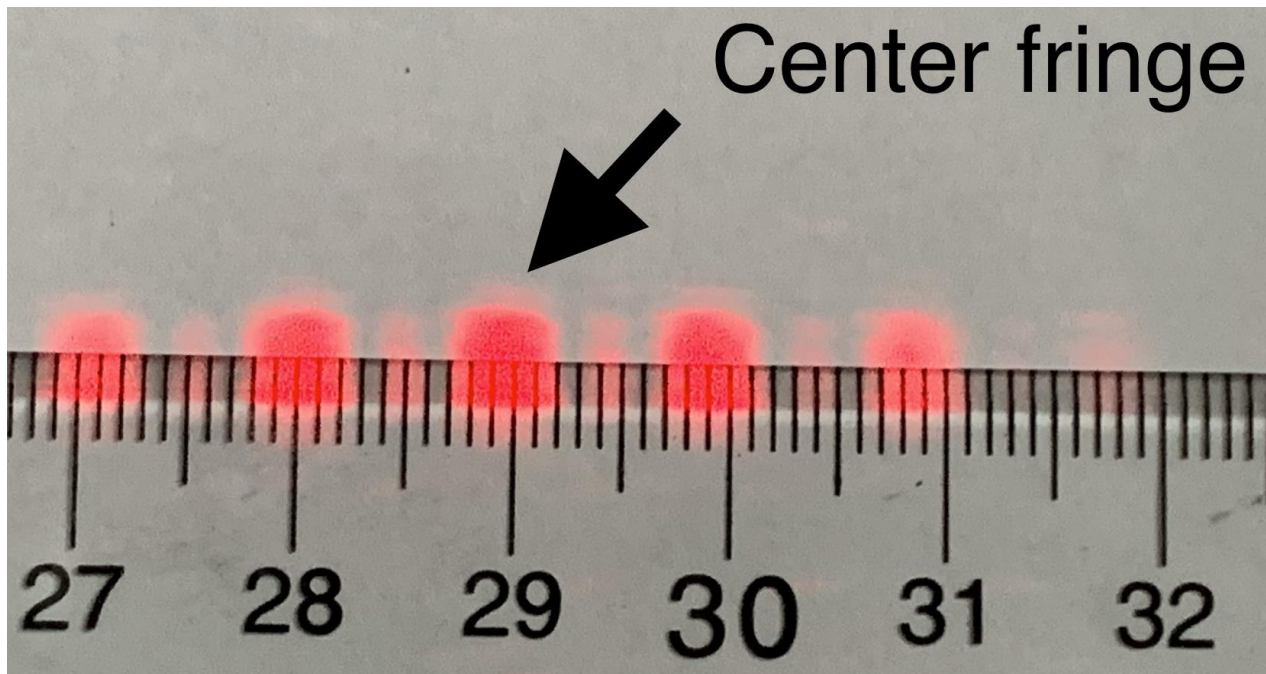


### 3.1.2 Multiple Slit Patterns

The following photograph illustrates interference from three slits. Don't bother trying to take measurements from this photo. It was taken in the dark to see more fringes.



Here is the same pattern taken with the lights on. Use this photo to take measurements. The width of each slit is 0.00500 cm. Each slit is 0.01320 cm apart from each other (center to center).

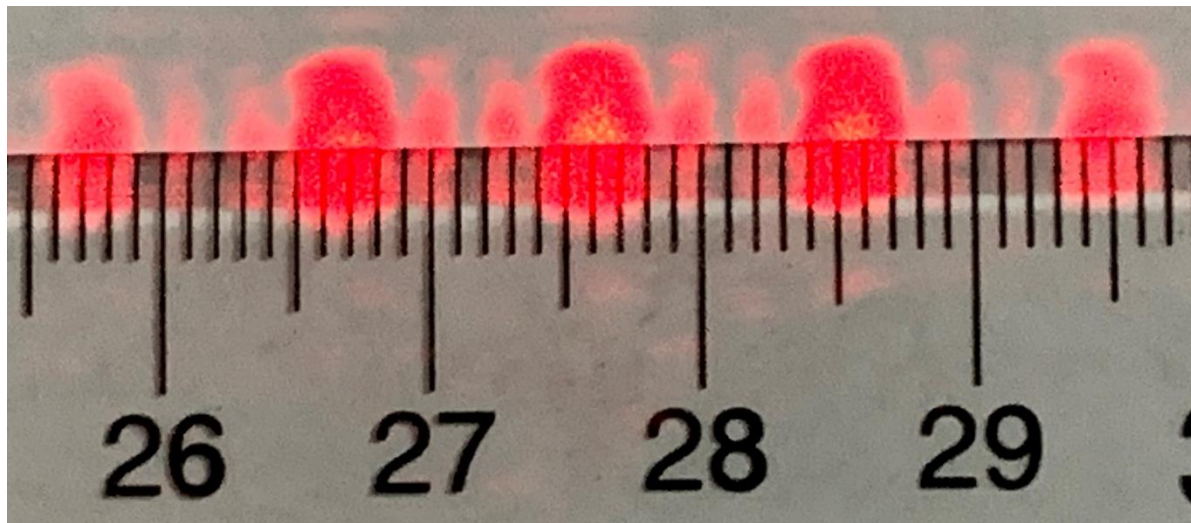


Here is a photo of a four slit pattern. It also was taken in the dark to capture more fringes.





Here is the same pattern taken with the lights on. Use this photo to take measurements. The width of each slit is 0.00500 cm. Each slit is 0.01320 cm apart from each other (center to center).



### 3.2 Newton's Rings

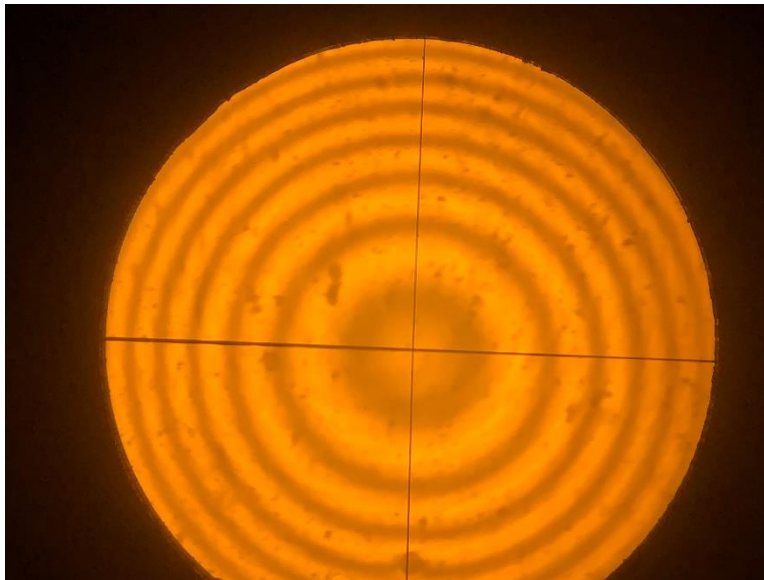
#### Notes:

Although the microscope's crosshairs may not look as though they are centered within a ring, they really are. This is just due to the camera angle.

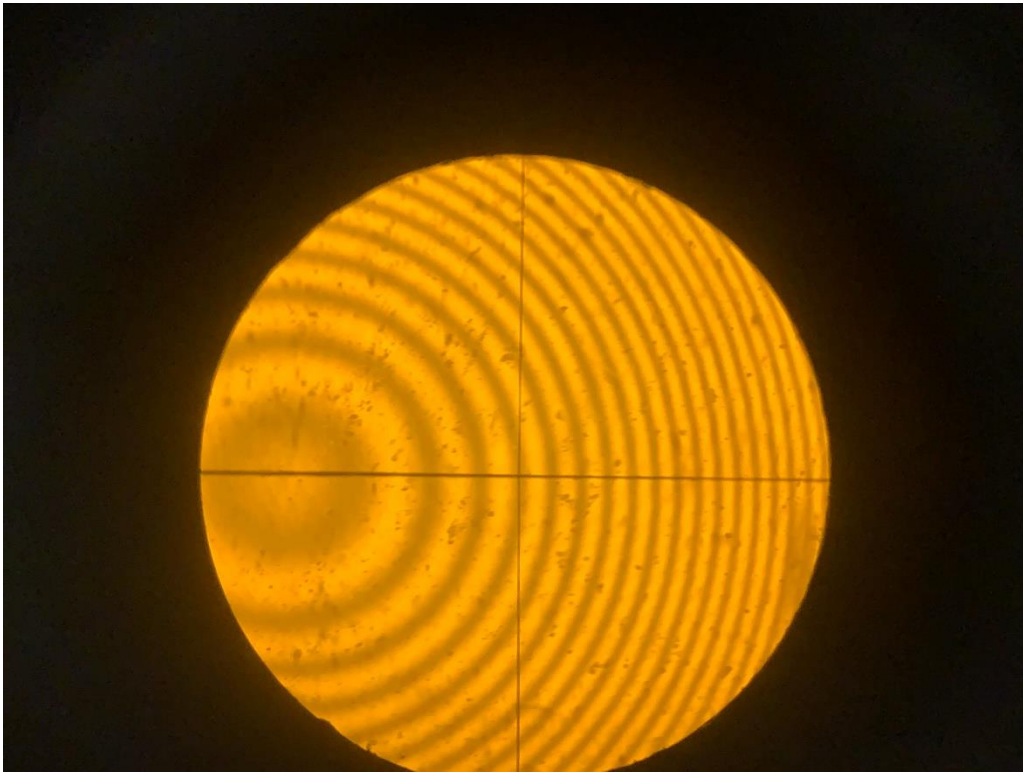
Our sodium light source has a wavelength of 589.3 nm.

Although I can read our instrument to  $\pm 0.00003$  cm, that would not be our accuracy. The limiting factor in our accuracy is "finding" the center of our rings. This is because the edges are not exactly well-defined. Based on the images we are trying to measure, the measurements will up to the ten-thousandths place with an error of  $\pm 0.0004$  cm.

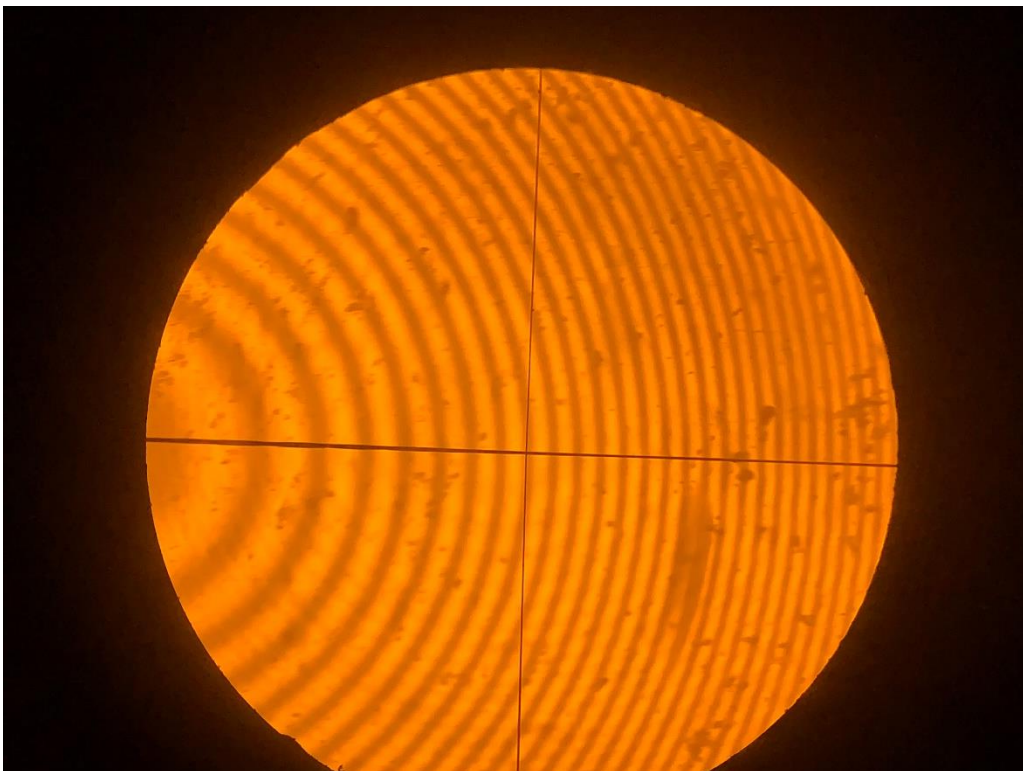
The vertical line in the photo is located at 0.0523 cm.



The vertical line in this photo is located at  $0.0660\text{ cm}$ .

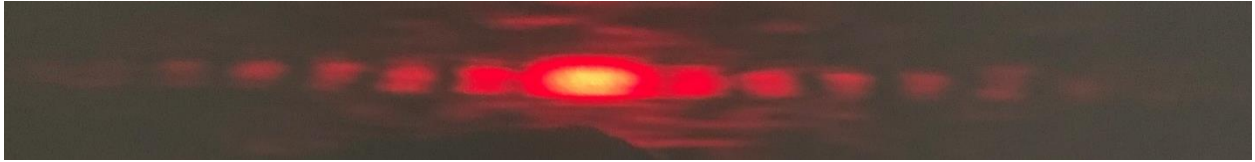


The vertical line in this photo is located at  $0.0741\text{ cm}$ .

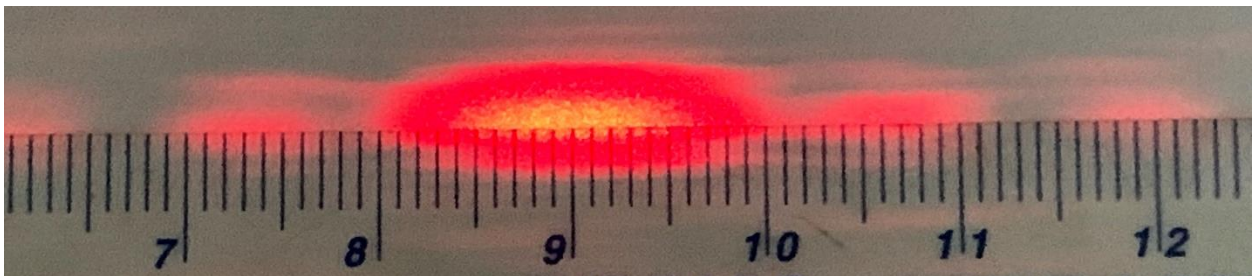


### 3.3 Diffraction from Varying Slit Widths

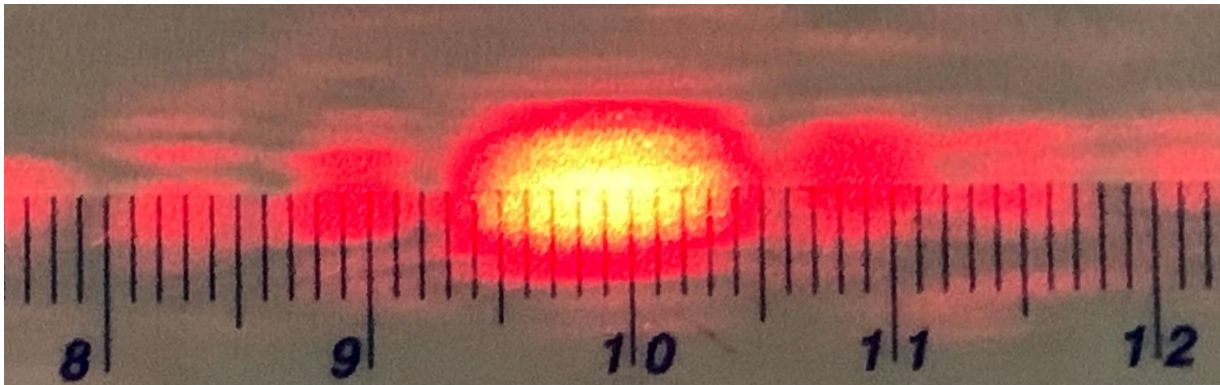
The following photograph illustrates diffraction from one slit. It was taken in the dark to see more fringes.



Here is the same pattern taken with the lights on. Use this photo to take measurements. The width of the slit is 0.01080 cm.

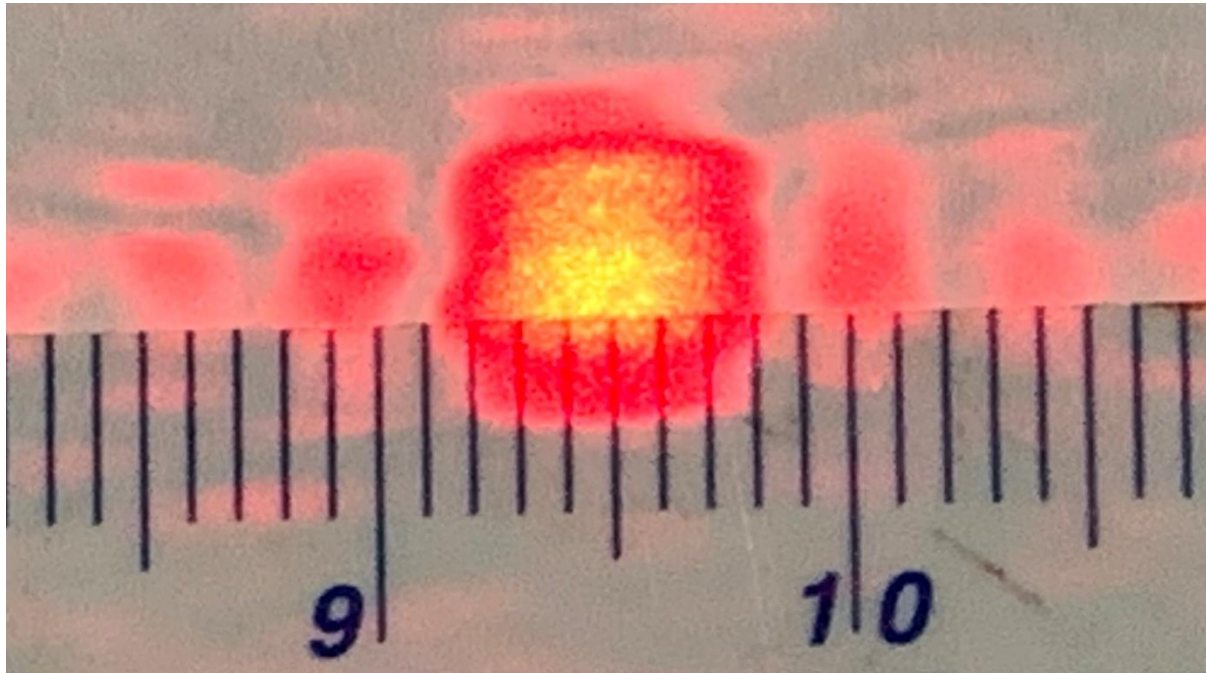


This photograph is a pattern from a different single slit. This slit's width measures 0.01950 cm.



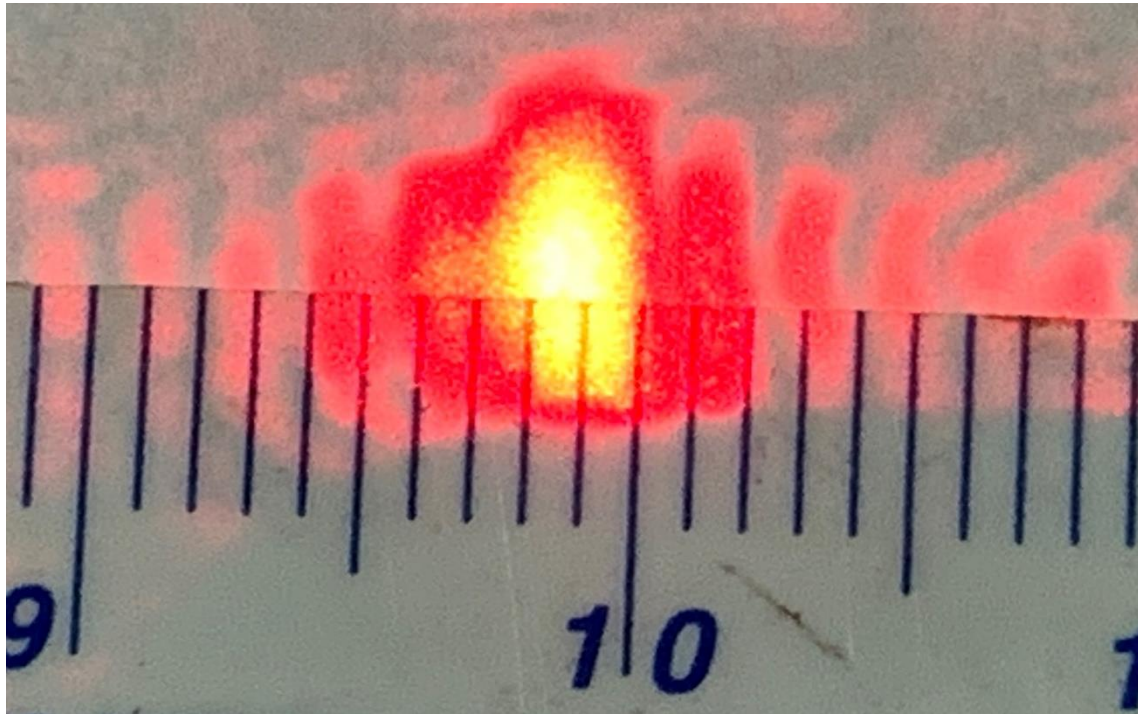


This photograph is a pattern from a third single slit. This slit's width measures 0.03450 cm. Because the fringes are becoming narrower, I've zoomed more in on the center to make reading the scale easier.





This photograph is a pattern from a fourth single slit. This slit's width measures 0.07550 cm. Notice how bright the center fringe becomes and how the various maxima and minima become more closely spaced as the slit width increases. In fact, keep this in mind during your measurements. The center maxima appears to overlap into its adjacent fringes.



Although your lab manual informs you that five single slits are available and that you should take measurements for all five, we will stop with the fourth single slit. Photographing the diffraction pattern from a larger slit for analysis is impractical. It begins to appear as a single bright spot.