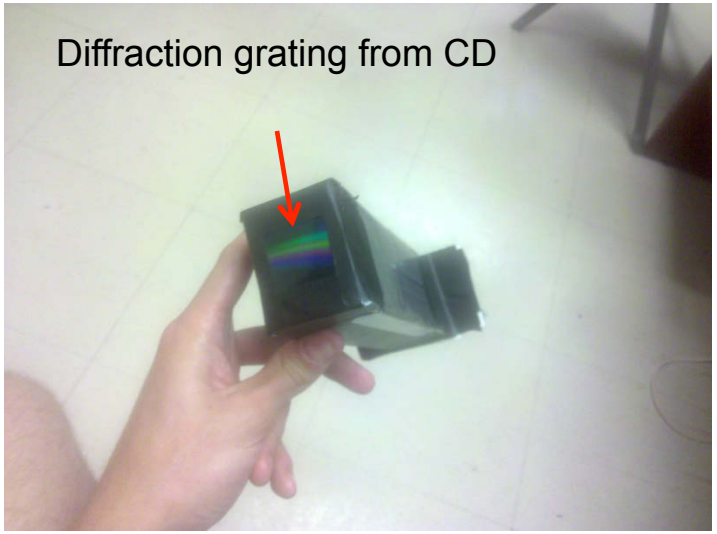
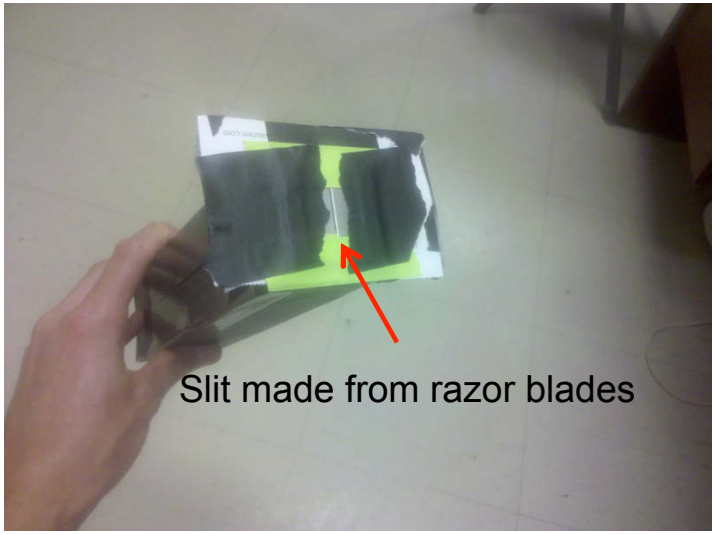
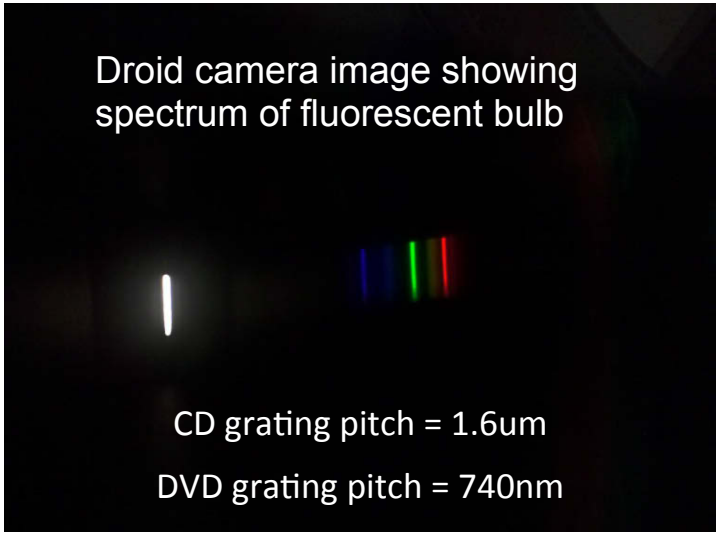
Sneak Peak (Lab #1 Spectrometer)

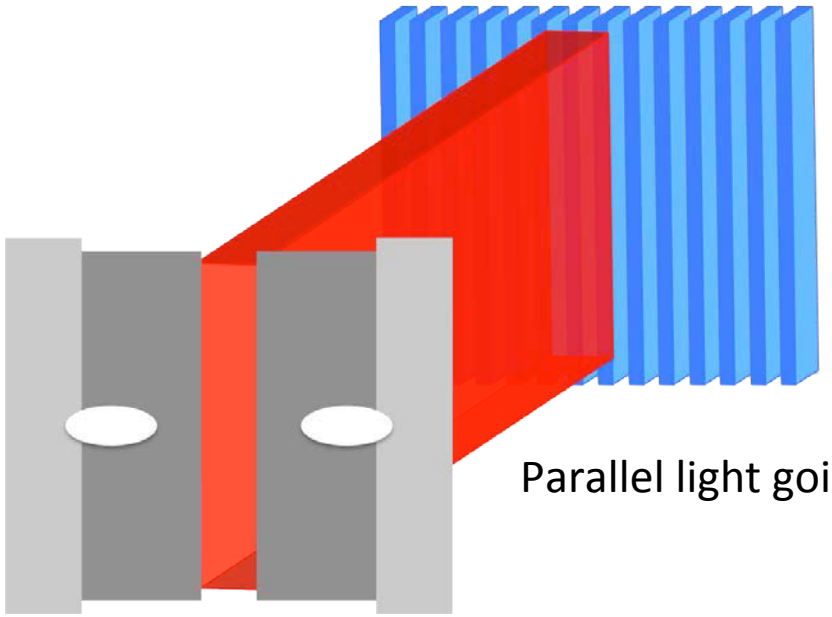
Homemade Spectrometer







Homemade Spectrometer



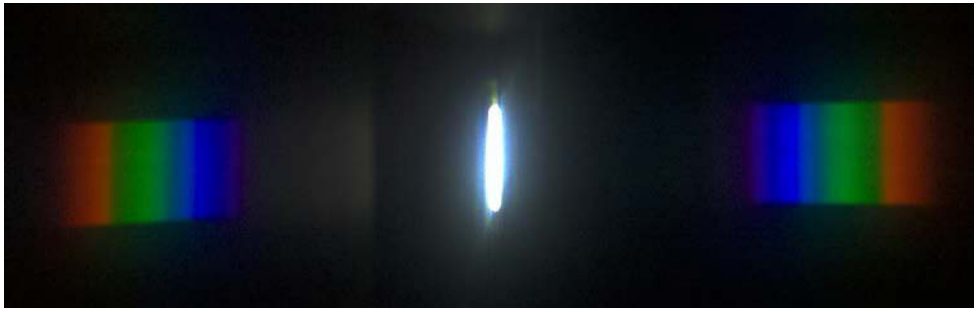
1. How does the slit width influence the resolution?
2. Why should the diffraction grating be in parallel with slit?
3. What do we need a tube in between?

Difference Spectra

This image is in the public domain.

This image is in the public domain.

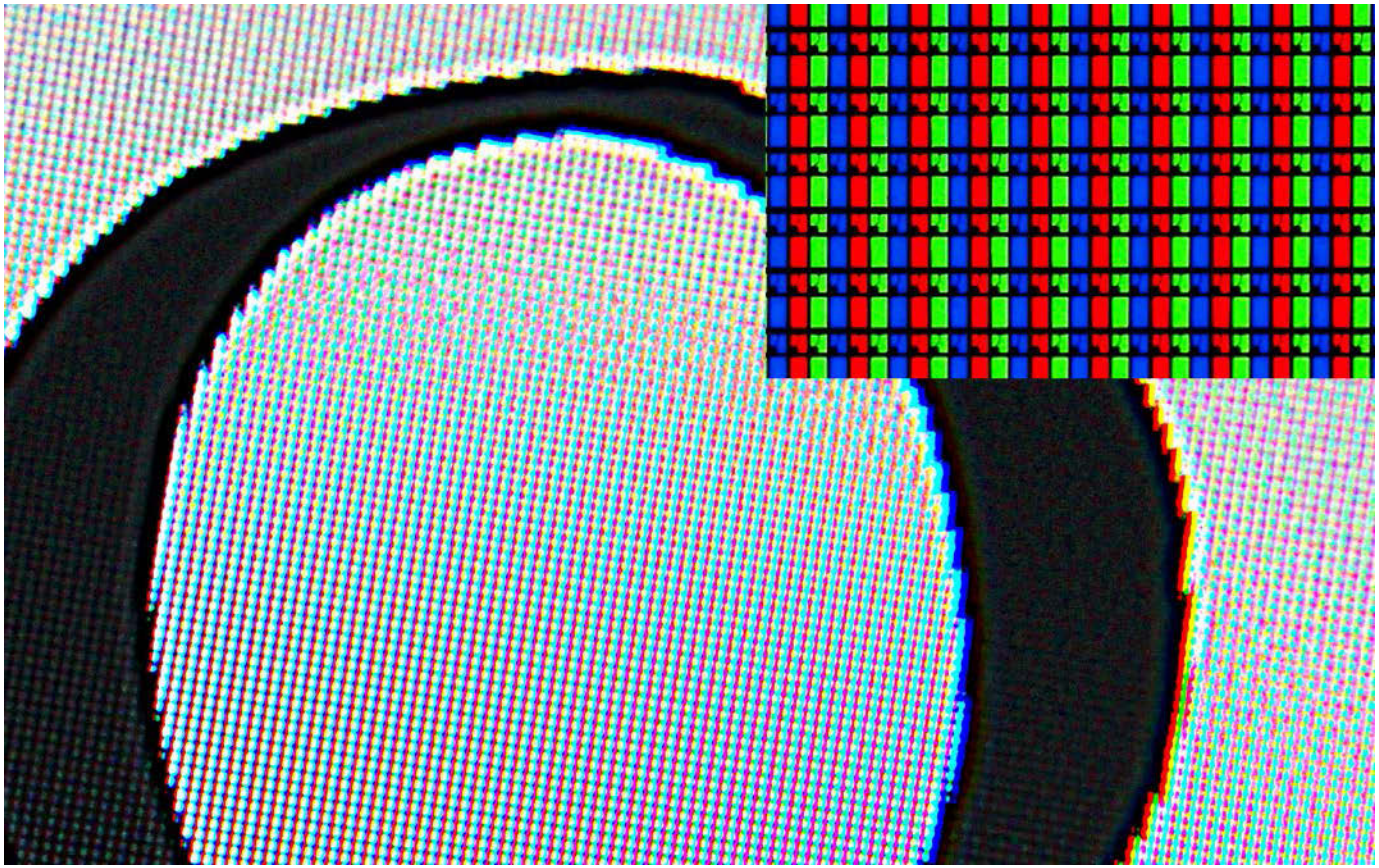
incandescent



fluorescent

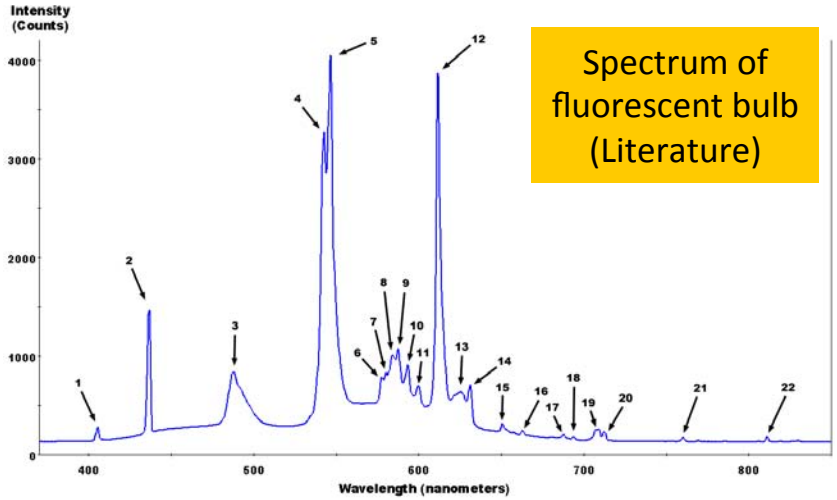
What Color?

LCD Pixels



Calibration - Ruler

Spectrometer Calibration

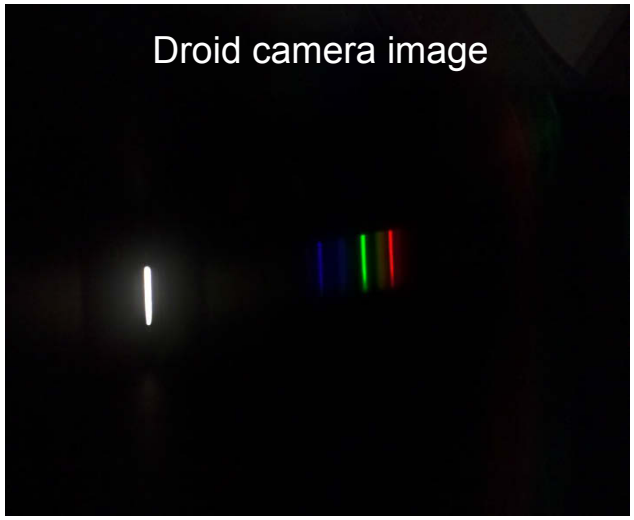


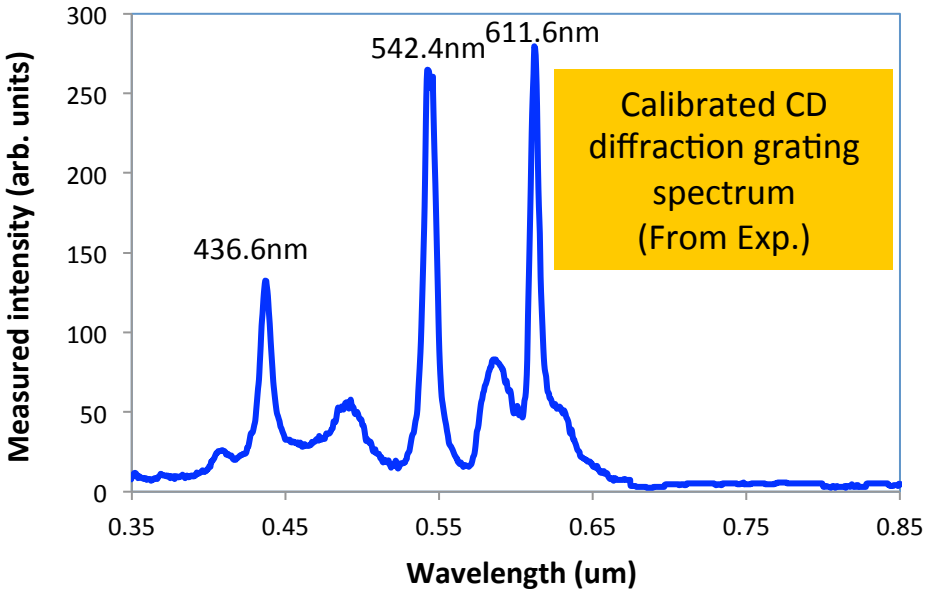
Spectrum of fluorescent bulb (Literature)

The three large peaks allow simple wavelength calibration. (the linear fit)

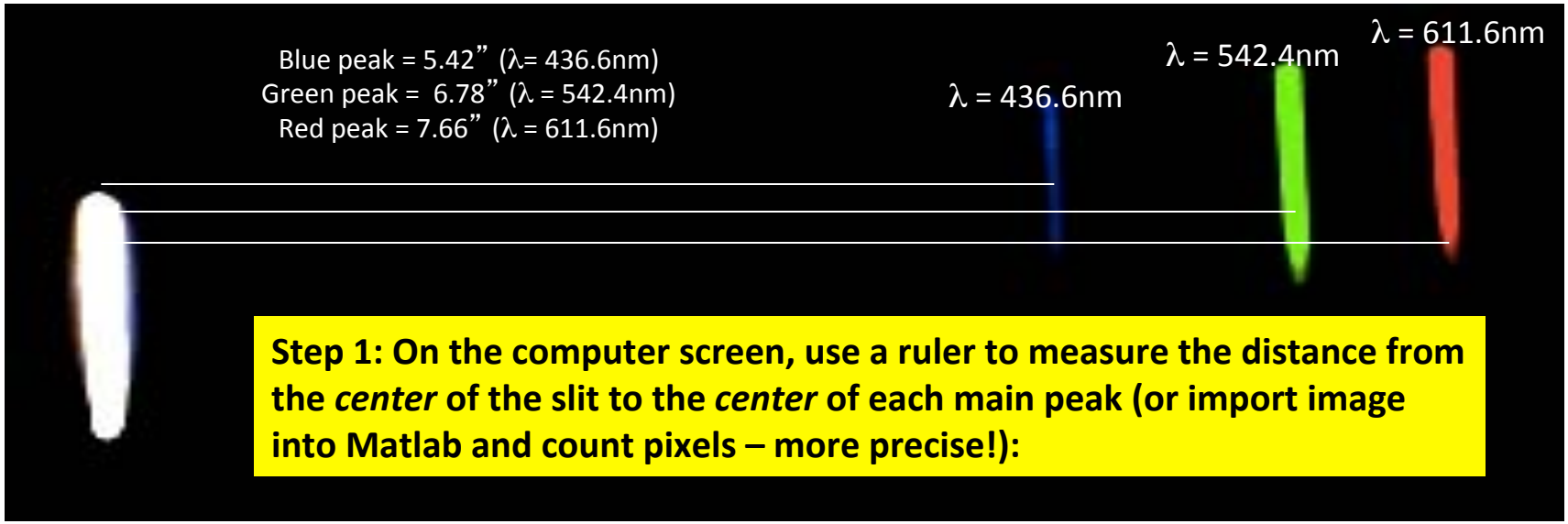
As long as the camera remains flush against the grating, shifts in the camera position and spectrum between measurements can be accounted for by measuring the shift in the position of the slit.

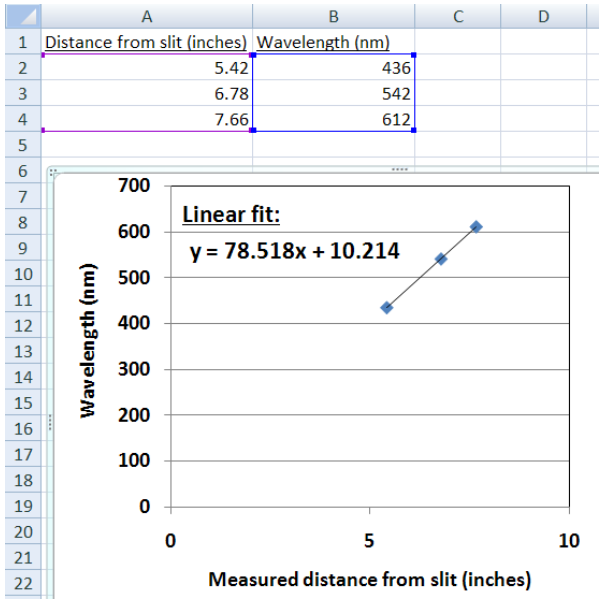
Thus, there may be a horizontal DC offset between measurements, but the wavelength/pixel scaling should stay the same.





Calibration Using Ruler & Fluorescent Bulb

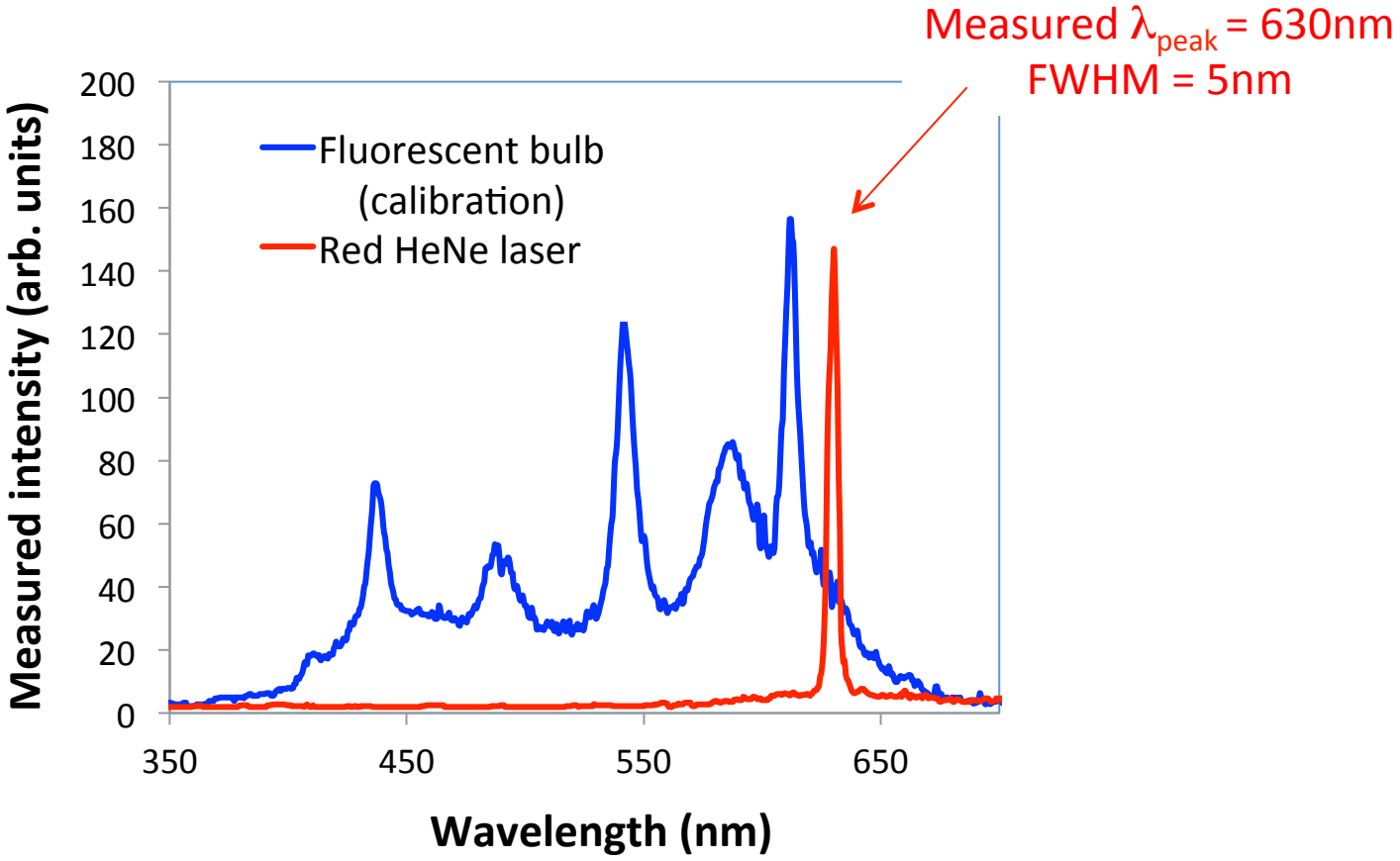




Step 2: In Excel, create a plot to determine the relationship between distance and wavelength:

1) Enter data in two columns and insert Scatter Chart
2) Right-click on a data point in plot and select "Add trendline"
3) Choose "linear fit" and choose "display equation on chart"
4) You'll see y=mx+b. The offset (b) is due to refraction from the CD

Accuracy & Resolution



HeNe laser peak was within 1nm of the expected value (631nm)
FWHM of 5nm (could likely be improved using a smaller slit)

Calibration - Matlab

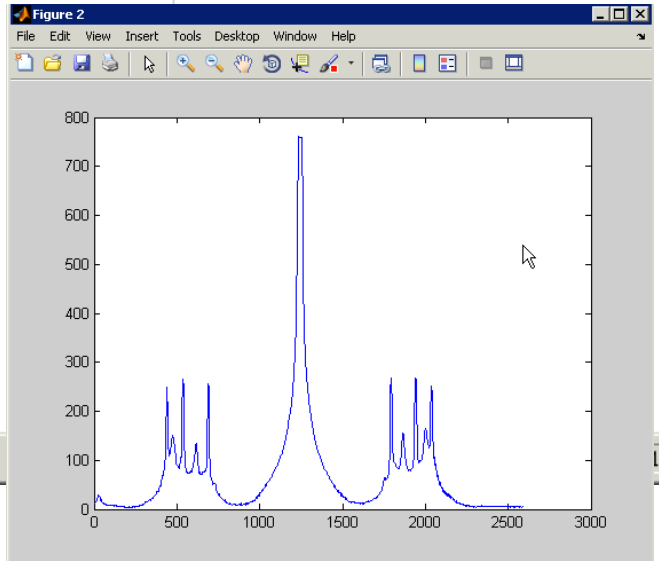
Editor - C:\Documents and Settings\Administrator\Desktop\spectrum_calculate.m

File Edit Text Go Cell Tools Debug Desktop Window Help

```
% Simple spectroscope script - imports image and converts to intensity vs. wavelength

% Joe Summers, 6/18/2010

%---Import JPG Image
    raw_image=imread('fluorescent.jpg');  %import JPG image
    %raw_image=imread('incandescent.jpg');  %import JPG image
    raw_image=double(raw_image);

%---Add up 3 color channels
    total_intensity=raw_image(:,:,1)+raw_image(:,:,2)+raw_image(:,:,3);
    figure(1)
    pcolor(total_intensity), shading flat, colormap(gray)
    figure(2)
    plot(mean(total_intensity(750:850,:,:)))
```

File Name

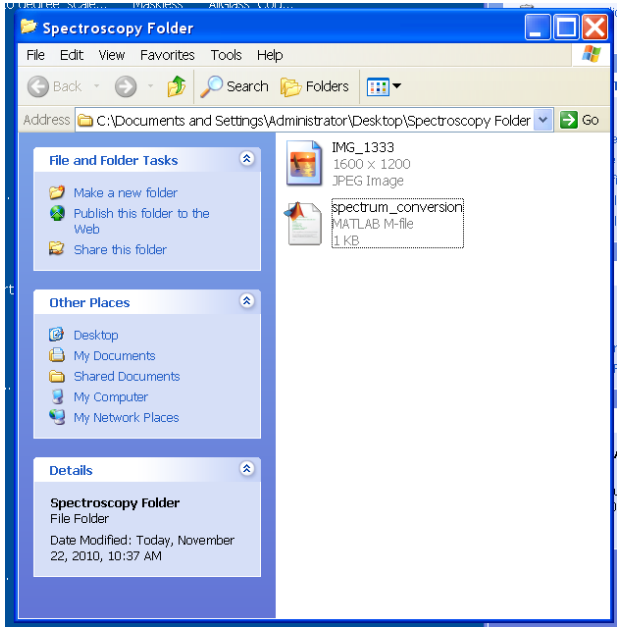
Location



Steps

1) Create a New Folder

2) Put your spectrum image file and MATLAB file in the folder (on the website under Lab #1)



3) Double-click on the MATLAB file. This will open it!

The MATLAB File

You should see this.

C:\Documents and Settings\Administrator\Desktop\Spectroscopy Folder\spectrum_conversion.m

```
1   % Imports an image and plots the average of several rows
2
3   %---Import JPG Image
4       raw_image=imread('IMG_1333.jpg');  %import JPG image from the same directory
5       raw_image=double(raw_image);
6
7   %---Add up 3 color channels
8       total_intensity=raw_image(:,:,1)+raw_image(:,:,2)+raw_image(:,:,3);
9       pcolor(total_intensity), shading flat, colormap(gray)
10      figure(1)
11      pcolor(total_intensity), shading flat, colormap(gray) %plots the total intensity image
12      figure(2)
13      row_avg=mean(total_intensity(455:465,:)) %plots the average of rows 455 through 465
14      plot(row_avg)
15      dlmwrite('spectrometer_output.txt',row_avg','newline','pc'); %writes avg to the file "spectrometer_output.txt"
16
17  %{
18  You can open up the spectrometer_output.txt file and copy and paste into a column in Excel.
19  Use the magnifying glass tool to zoom in on Fig 1 and figure out the rows to average
20  }%
21
```

Change the name of the file on line 4 to match the name of your spectrum image file. Hit F5 to run the script…

Two Figures Pop Up

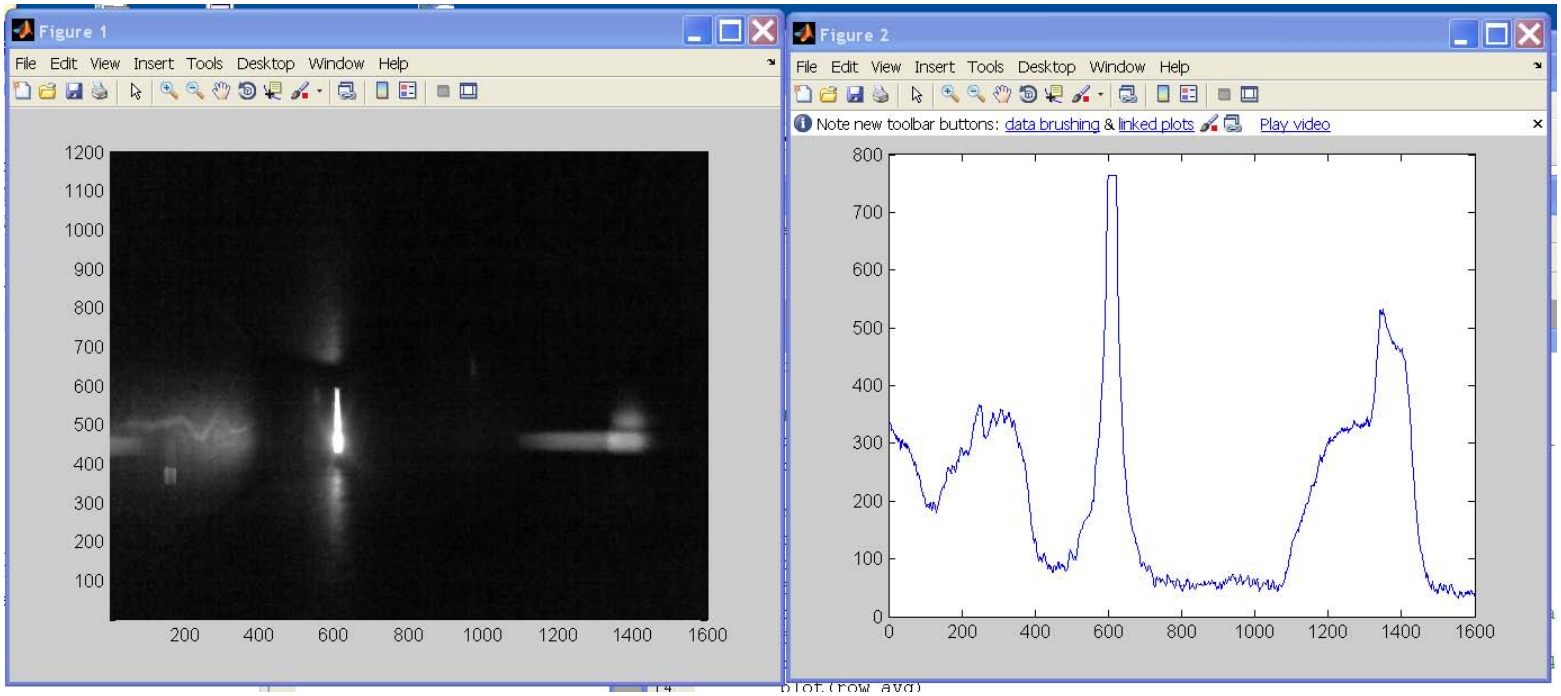
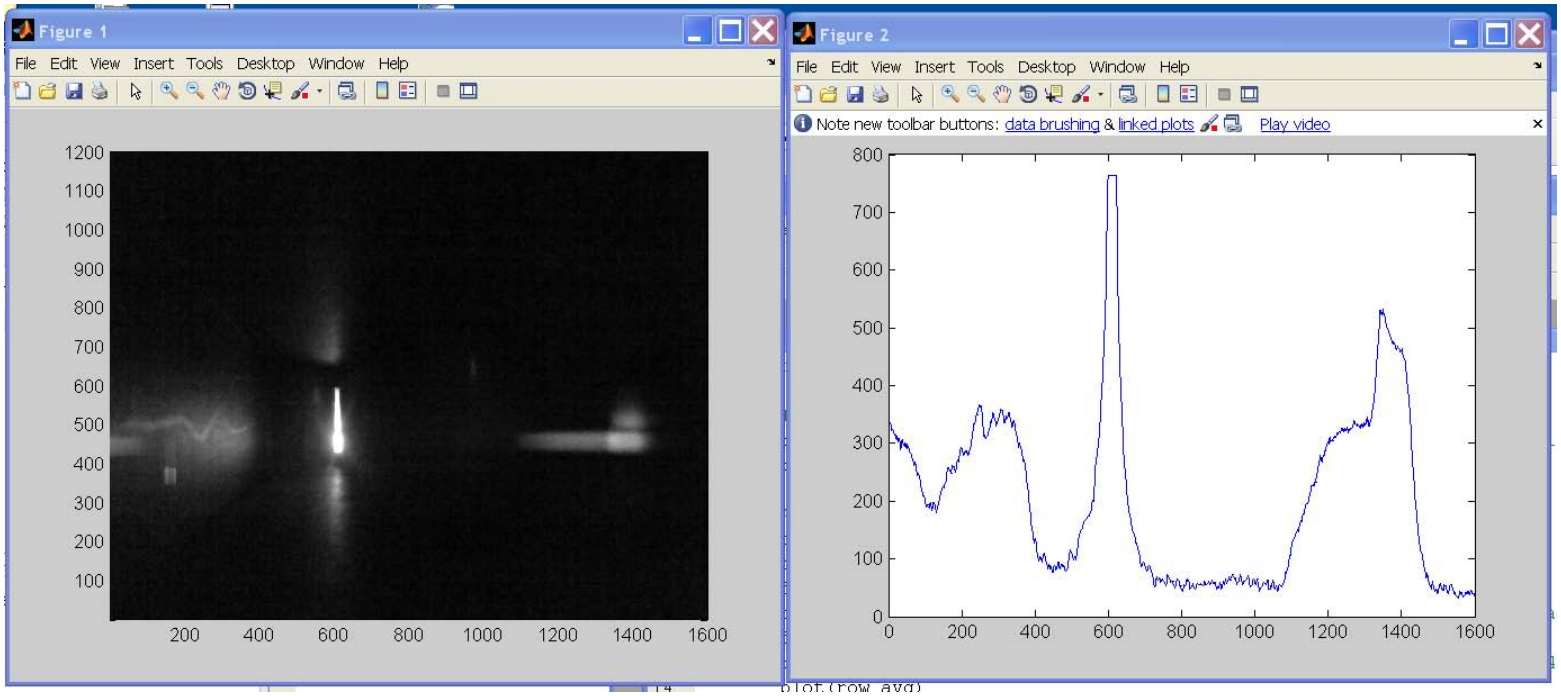


Figure 1: B&W image of your spectrum

Figure 2: Average of rows 455-465 in your spectrum

The data from Figure 2 is written as a single column to the file "spectrometer_output.txt" in the same folder

Helpful Pointers



1) Choose the rows you want to average by using the magnifying glass tool and zooming in on Fig. 1
2) The slit is the brightest part of your image. The center of the slit should be the origin of your spectrum

6.S079 Nanomaker

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