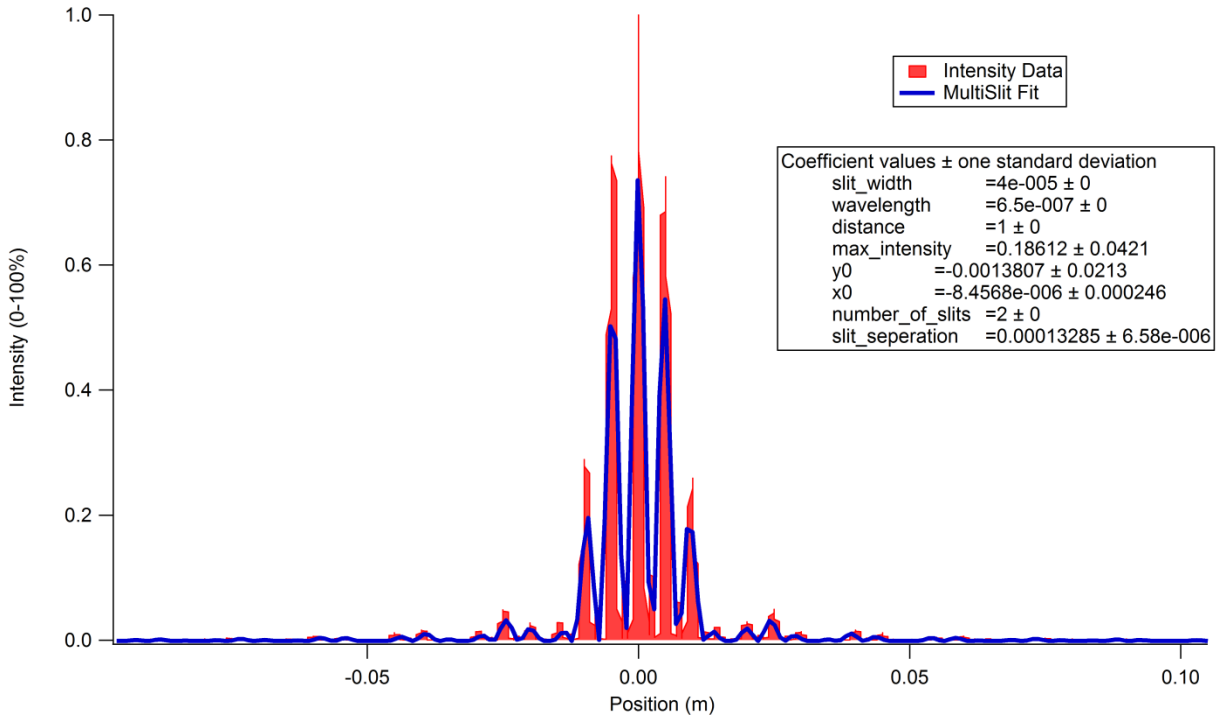



# PHY143: IGOR PRO ANALYSIS

## Contents

## INTRODUCTION

Igor Pro is a data analysis program (like excel) that can be used to process and display data. Unlike more general programs like excel, Igor Pro is specifically designed for processing scientific data. For example, Igor Pro has much more advanced fitting routines than excel, allowing it to fit custom functions. It can also easily display errors on data and takes these into account during fitting.

The basic units of Igor programs are 'waves[1]', which are lists of values. You will import data into waves, then the program to manipulate them. Graphs are made by choosing a wave of x-values and a wave of y-values.

Some of the utilities discussed in this manual are general features of Igor Pro, while others are part of the specific program written for the 143 labs. Specific functions will be labeled "custom" in the title in this manual.

## IMPORTING DATA (CUSTOM)

1) Go to the "PHY143 functions" menu on the tool bar and select "Load a data set."

2) Select which experiment the data is coming from; Single Slit diffraction, double slit diffraction, or blackbody radiation. This will be used to appropriately name the waves and set certain constants.

Give the data set a name or number: this will be appended to the end of a general name, ex. Intensity_1.

3) An open-file window will open. Navigate to the data set you want to import and open it.

4) Enter rough estimates for the errors requested. This value will be used to make an 'error wave' which will be taken into account during the fitting process.

The data will now be loaded.

## DELETING DATA (CUSTOM)

1) Go to the "PHY143 functions" menu on the tool bar and select "Delete a data set."

2) Enter the number of the data set you want to delete.

The dataset and associated error waves, etc. will then be deleted.

[1] Lists are called 'waves' because the company that produced Igor Pro, WaveMetrics, originally developed the program to analyze waveforms, such as oscilloscope data.

## GRAPHING DATA

1) Go to the "Windows" menu on the toolbar and select "New Graph"

2) Select a y-wave and an x-wave, then click "Do It."

The graph will now appear in a new window.

Several options including adding annotation and adding/removing traces can be found by right-clicking on the graph.

## CENTERING AND NORMALIZING DATA (CUSTOM)

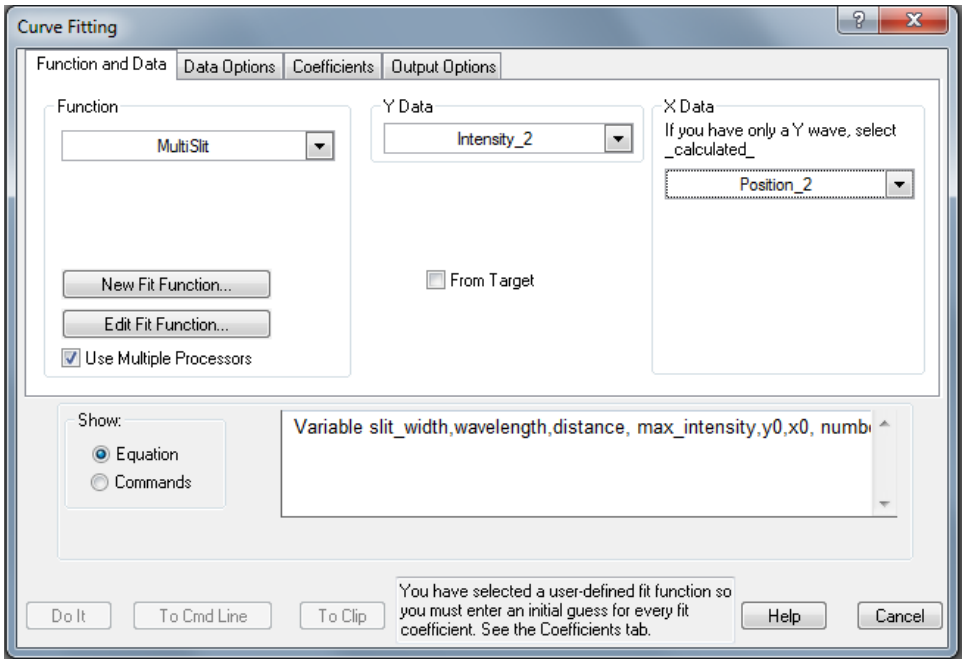
Depending on the experiment, you may want to center your data (shift it horizontally so that the highest point is at x=0) or normalize it (multiply it by a constant chosen so that its maximum amplitude is 1).

1) Go to the "PHY143 functions" menu on the tool bar. Depending what you want to do, select either "Center and Normalize" or "Normalize."

2) Select the x and y waves of the dataset you want to change.

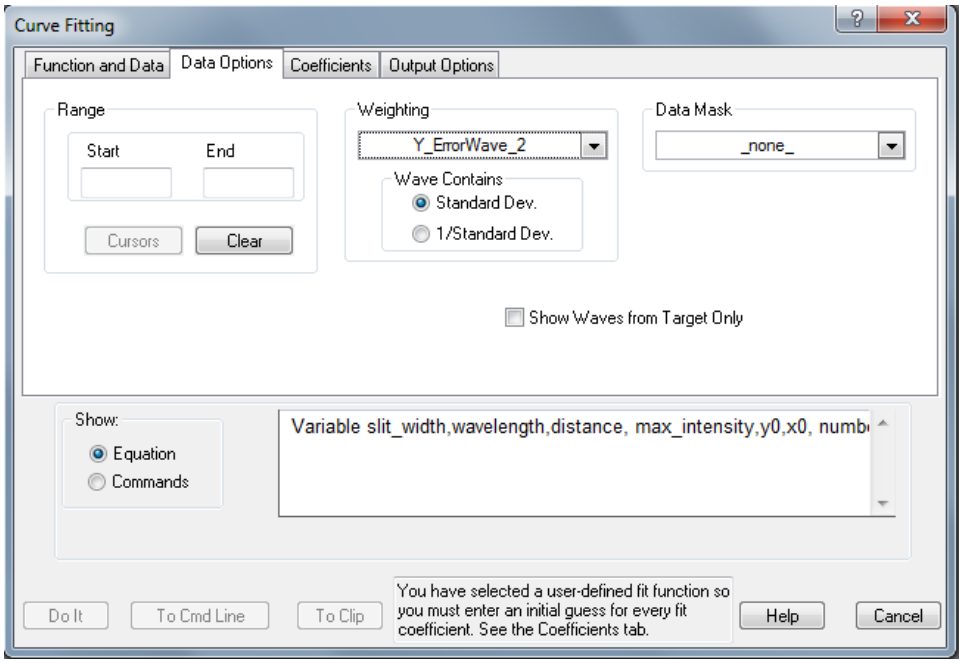
## CURVE FITTING

1) Go to the "Analysis" menu on the tool bar and select "Curve Fitting."



2) Select the appropriate fitting function from the function list. At the bottom of the list are three custom functions for the 143 labs for fitting single slit and multiple slit diffraction patterns and blackbody spectra.

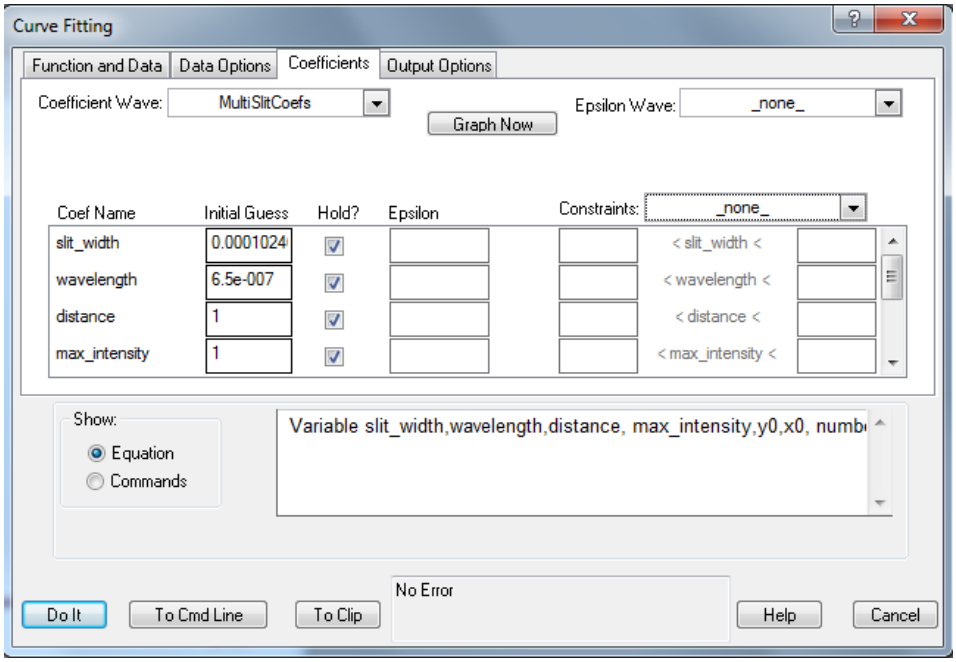
3) Select the Y and X waves for the data set you want to fit under "Y-Data" and "X-Data."




4) Select "Data Options" from the bar at the top of the window.

5) On the weighting menu, select the error wave with the same number as the data set you are fitting. This error wave was made from the error estimate you provided when you loaded the data.

6) Select "Coefficients" from the bar at the top of the window.




7) Set the coefficients for the fit and decide which variables to hold. A wave of default coefficients is included in the program and can be brought up by selecting the appropriate coefficients wave from the "Coefficient Wave" menu on this window. If you have made changes to the default coefficients and want to revert them to their default, run "Reset coefficients to default value" from the main "PHY143 functions" menu.

The fitting program will use the "Initial Guess" values as a starting point, and then will begin slowly changing them to fit the function. Values marked "hold" will not be changed. In order to make a successful fit, you should hold all but one of the values.

The exception to this rule is the constants max_intensity, x0, and y0. These constants allow the fitting program to shift the function slightly in case the normalization and/or centering was imperfect. You should not hold these variables so that the fitter can make these small adjustments.

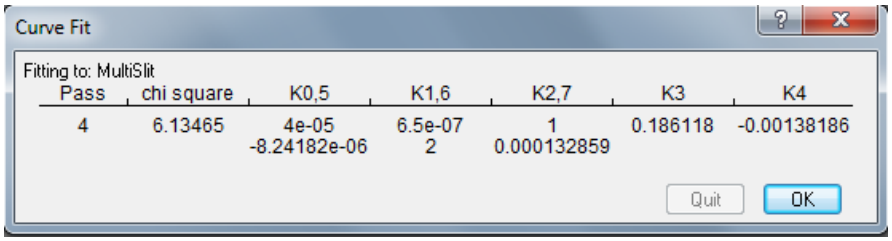
The default values for fitting are:

| **SingleSlit Default Values** | | |
|---|---|---|
| **Variable** | **Default Value** | **Notes** |
| slit_width (m) | .02 mm | |
| wavelength (m) | 650 nm | |
| distance (m) | 1 | |
| max_intensity (0-1) | 1 | These variables allow the fitting to make small shifts in case the normalization and/or centering was imperfect. They should not be held. |
| y0 | 0 | |
| x0 | 0 | |

| MultiSlit Default Values | | |
|---|---|---|
| **Variable** | **Default Value** | **Notes** |
| slit_width (m) | .04 mm | |
| wavelength (m) | 650 nm | |
| distance (m) | 1 | |
| max_intensity (0-1) | 1 | These variables allow the fitting to make small shifts in case the normalization and/or centering was imperfect. They should not be held. |
| y0 | 0 | |
| x0 | 0 | |
| number_of_slits | 2 | |
| slit_seperation | .125 mm | |

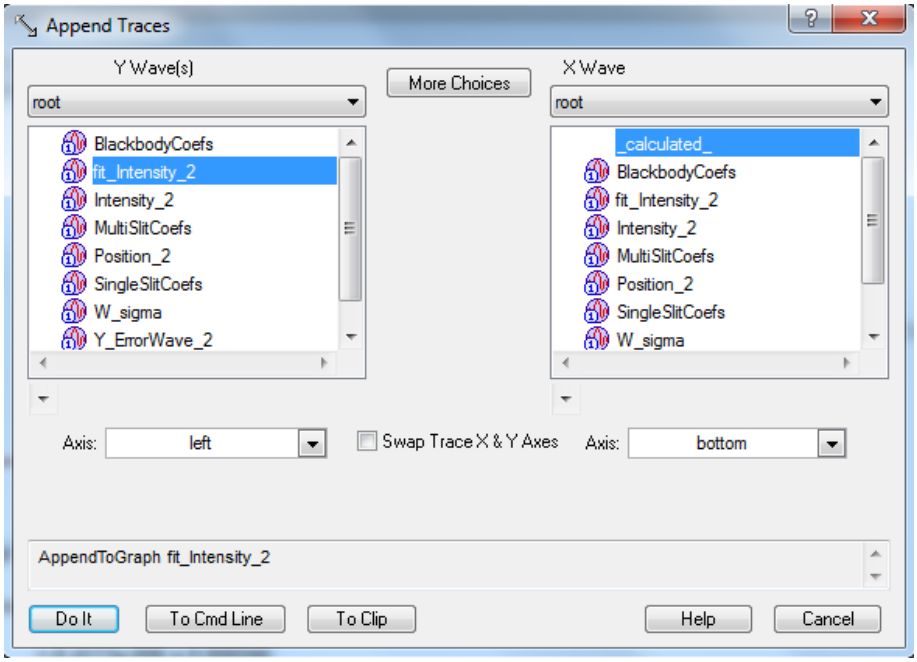
| Blackbody Default Values | | |
|---|---|---|
| **Variable** | **Default Value** | **Notes** |
| Temperature (K) | 5000 K | |
| I0 (0-1) | 1 | These variables allow the fitting to make small shifts in case the normalization and/or centering was imperfect. They should not be held. |
| y0 | 0 | |
| x0 | 0 | |

8) Press "Do It" to fit the function.




9) If the fit was successful, a window like the one above will pop up showing the values of some measures of the fit. If the fit did not converge, makes sure you have held enough values and check that the initial guesses are reasonable.

10) The results of the fit will output in the main Igor Pro command window.




11) The fitter has also created a new wave of the fit. This wave will have the name of the y-wave you fit, with "_fit" appended to the end. You can now plot this fit or append it to a graph of the data. However, the fit data has no associated x data, so you must select "_calculated_" as the x-wave as shown above.

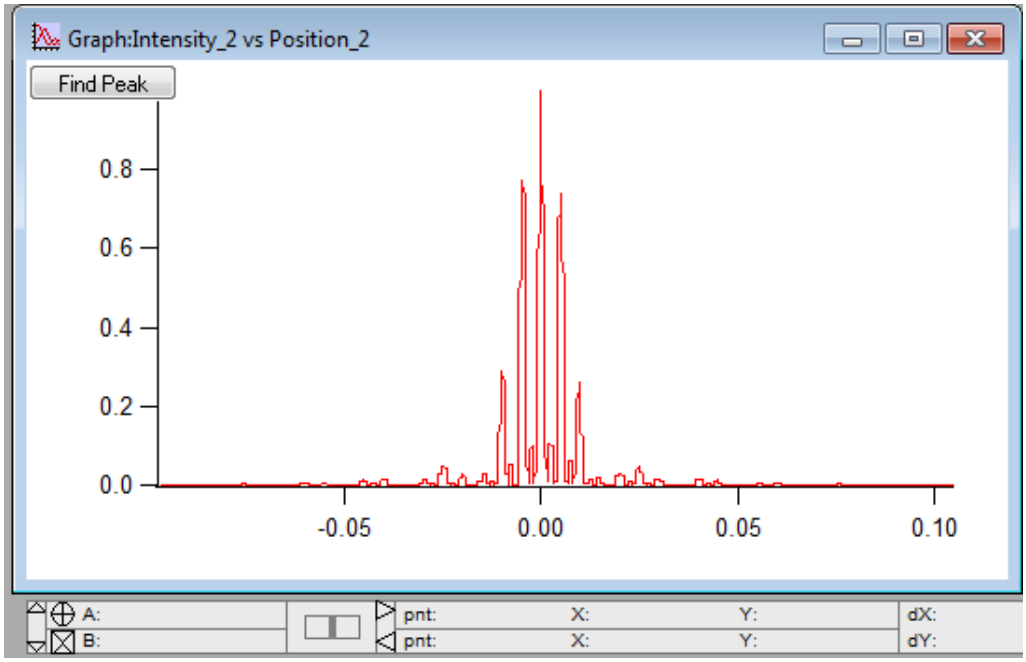
*Optional*

If you have a graph of your data open when you run the fitting program, you can automatically add a text box of your fit results to the graph. Go to the "Output Options" tab at the top of the fitting program window to enable this option and configure the textbox.

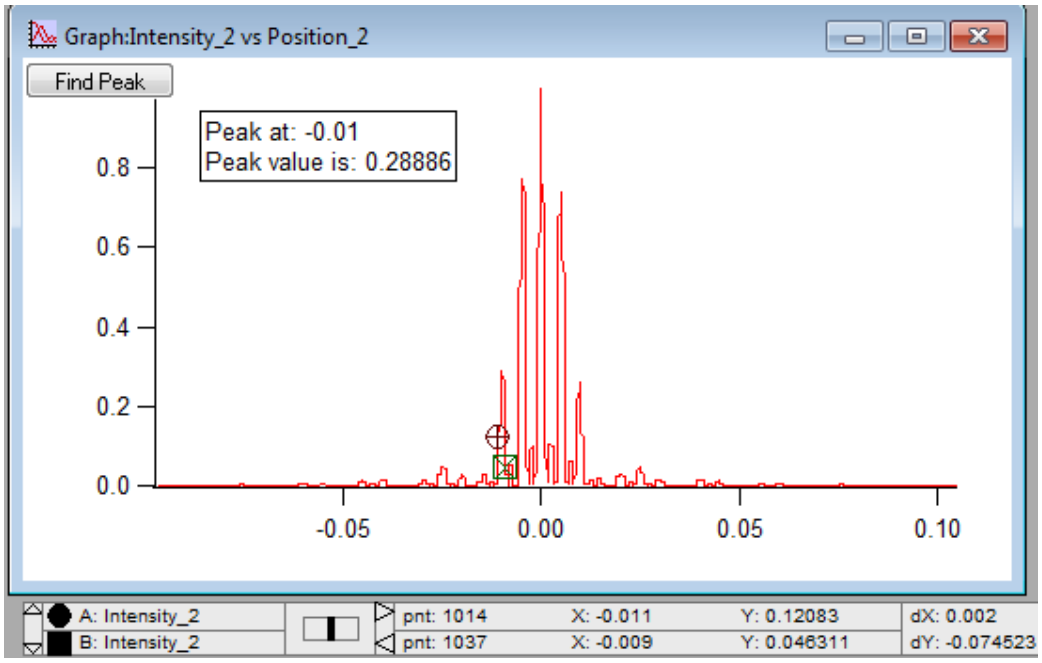
## PEAK FINDER (CUSTOM)

1) Go to the "PHY143 functions" menu on the tool bar and select "Peak finder."

2) Select the two y and x waves for the dataset you want to peak find.




4) A window like the one above will appear. Drag the circular (A) and square (B) cursors onto either side of the peak you want to select. Notice that when you place the cursor on the graph, its x and y coordinates are displayed at the bottom of the window.




5) Press "Find Peak". The peak's x-coordinate and height will appear in a text box on the graph.