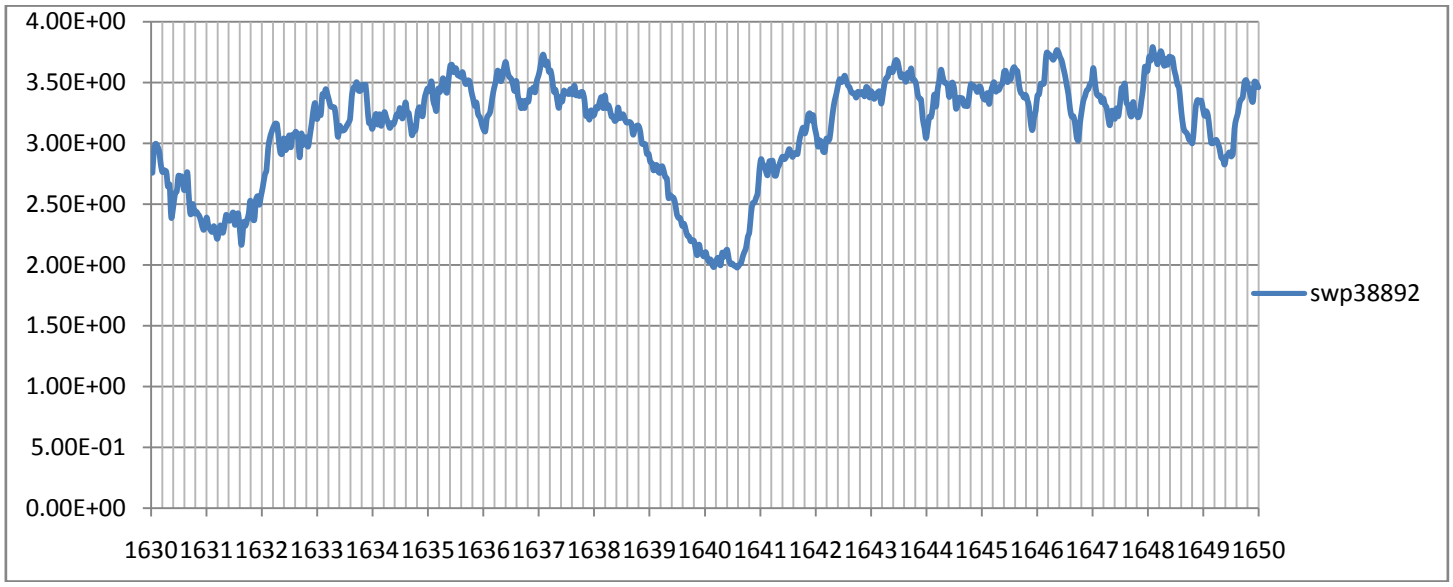
PHY 466. Introductory Astrophysics

Numerical Integration of the Equivalent Width of a Spectral Line.

This document outlines the procedure for computing the equivalent width of an absorption line profile for a given set of spectrophotometric data.

1. Plot the spectrophotometric data for a given spectral interval with EXCEL. When plotting the data, select the panel under "scatter diagram" that connects the data points with a curve and does not plot symbols for each data point. Also edit the x-axis format by having it print the wavelength value every Angstrom and include a vertical x-axis line every 0.2 Angstroms as shown below. However, in landscape mode, the wavelength numbers would not be overlapping as they are below. In this way you will be able to determine the line width more precisely.



2. Examine the spectral line profile and make an estimate of the continuum flux, the central wavelength, λ_o, the line depth, D, and the FWHM. Set the continuum sufficiently high so that no data points within the line profile are higher than the continuum. Higher rather than lower is always best. Then put the EXCEL window to sleep.

3. Write a Fortran program that generates a line profile such as that used for problem No. 80 and 88. Don't divide the Depth by the width as previously. In the program, have the above input data read from a text file that you conveniently change without changing the program and thereby obviate the need to always type in the values during execution time. Put the input data on one line such as the following:

WLI, WLF, DelWL, CFlx, CenWL,HW, Depth

1630, 1650, 0.10, 3.65, 1640.2, 0.53, 0.80

Have the program write the values for WL and Flux to the screen and to an output file named Profile.txt. This will be done in a Dos window. Keep the Force and Dos windows open.

4. Wake up the EXCEL window, by clicking on its tab on the bottom menu bar. In the main EXCEL menu, click on DATA. Then click on just column C so that it is highlighted all the way down. Then click on the icon for getting data from a text file; this will be over to the far left of the top menu bar. A window now opens for you to change the path until you find the output file, Profile.txt, from your program, highlight the name of the file and then click on import.

A window then opens and select "fixed field." Then click on ***next, next***, and then ***finish***. A small window then opens titled "Import Data." Click on OK and the WL data should then be automatically loaded into column C and flux values into column D.

5. Right click anywhere within the plot area of the graph and a window opens. Then click on the "select data" icon. In the new window, click on "add" In the Edit Series window box, type a name that you wish to give to the data series, such as "Profile Fit." Then click on the square button at the end of the row window and then click it again.
Now click on the button to the right for the x-axis and then click on the letter of the column of data containing the x-axis data. Click on the button again and repeat for the y-axis data. If there is another column of y-axis data to be added, repeat all of the above. Then click on "ok" twice and the profile fit data should be over-plotted on the graph.

6. Examine your fit and estimate new values for the input file. Click on the tab for the input file which should be on the bottom menu bar. Change the input file accordingly. Save but don't close the file.

7. Click on the tab for the Dos window and then close it. This should bring back the Force window with your program. Click on the green execute button and the program should run.

8. Click on the EXCEL tab in the bottom menu bar. Click on columns C and D to highlight all the data. This will light up the "Refresh" icon on the top menu bar. Click on this. If you have done everything correctly and not closed any windows, a window returns with the path correctly set to retrieve your output data. Click on the name of the file and then click on import. The new data should then be loaded into columns C and D and be automatically plotted.

9. Continue this iterative fitting of the profile until you have the best fit. None of data points from the spectrum should be higher than your fit. Print this graph and submit it in your report. Make sure the graph is full page and in landscape format with the axes correctly labeled as shown above. Select the wavelength scale so that numbers don't overlap the way I did in the above diagram. Also, I did not include a title for the graph but you should.

10. Go back to your program and modify it to find the equivalent width. Since some of the data points will still be above the continuum outside the line profile you will have to include an algorithm for summing up only over the bandpass of the line. To do this, first inspect your plot to see where the line begins or ends. Define this as the total width. Then do and "If" logic at every wavelength to see if the absolute value of WL-CenWL exceeds the total half width. If it does then the increment in the equivalent width is zero at that wavelength.
Have the running sum of the equivalent width printed to the screen in addition to the wavelength and flux. Save the program under a different name. When you run the program, the equivalent width should be the last value on the last line. Scroll up on the Dos widow showing your output to

make sure the equivalent width is zero until you get to the WL where the line begins and that it no longer changes after the wavelength where the profile ends.

11. Draw the equivalent width profile centered on your line profile in the graph and color the area under the line. Use a different color for the area in the profile outside the EW bandpass. Format of presentation will determine your grade.

12. Submit (1) the graph, (2) your two program source codes, (3) a professional looking table that gives the input data and equivalent width in one column and the identification of these values in a second column, preferably typed in WORD, and (4) a cover sheet. No need to submit pages and pages of output data. Save a tree.

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