READ ME – SELFiE.py

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Introduction

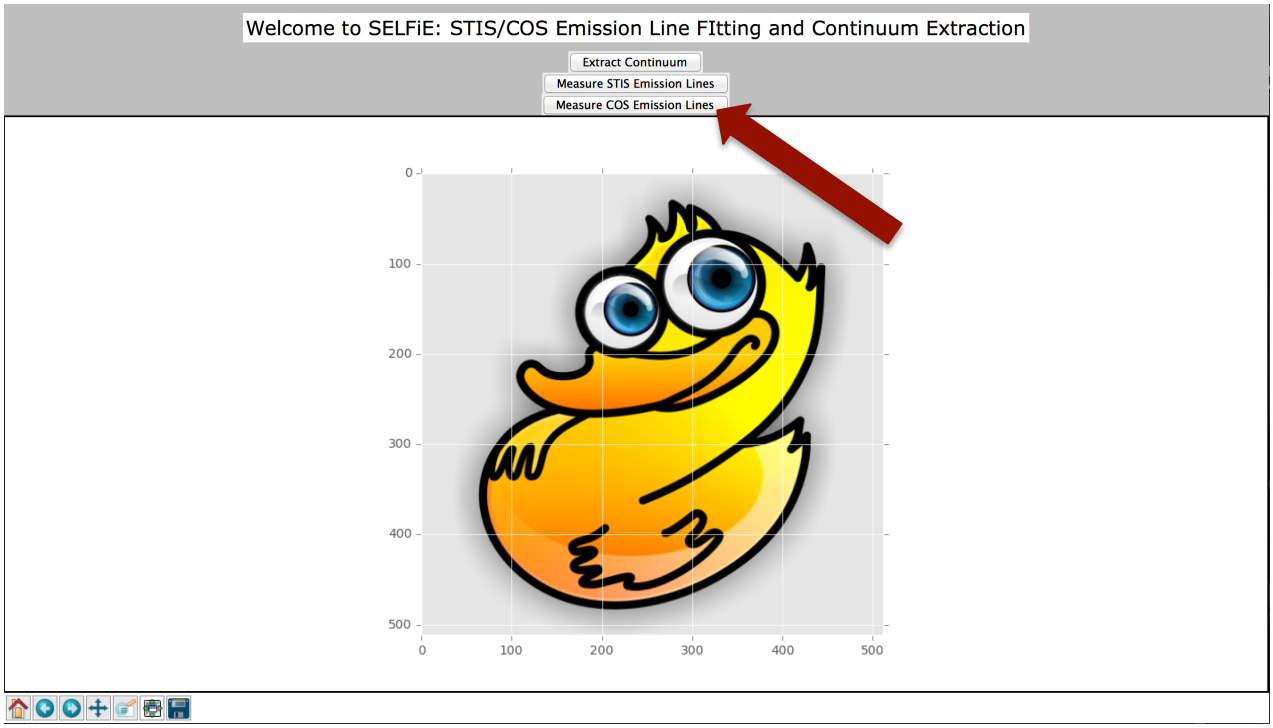
SELFiE.py (written for Python 3) was developed for the purpose of fitting emission lines in spectra from the Cosmic Origins Spectrograph (COS) onboard the *Hubble Space Telescope (HST)*. Wavefront errors from the primary mirror on HST cause the spectrograph to redistribute flux from the peaks of the emission line profiles to the wings. To account for this, the fitting routine in SELFiE takes a Gaussian profile and convolves it with the instrumental line-spread function (LSF). The LSFs are dependent on the lifetime position of the instrument, although deviations between the functions for lifetime positions 1, 2, and 3 are not significant for our purposes. The fluxes that are output by the GUI are calculated from the best-fit parameters corresponding to the underlying Gaussian. The tool does not currently have the capability to fit Lorentzian or Voigt profiles to data but can easily be adapted to do so.

Additional Code/Text File Requirements

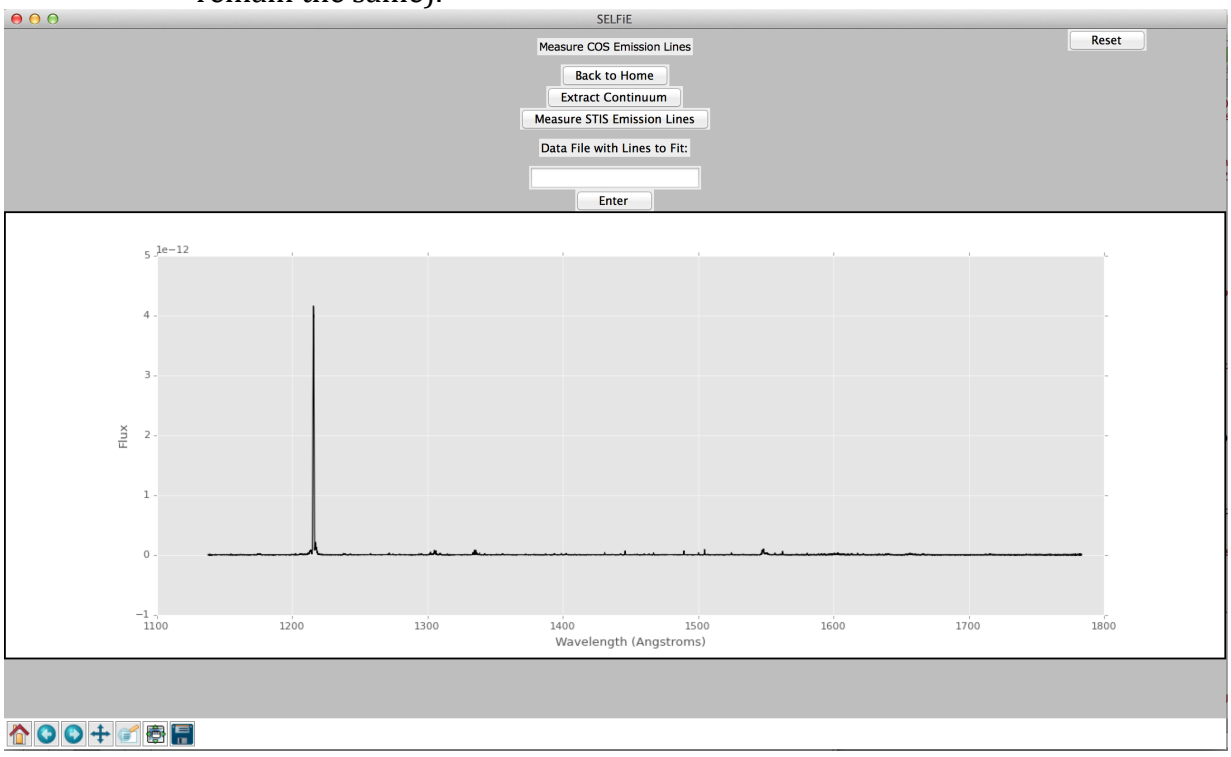
The underlying fitting functions that are used in the GUI can be found in ***linefittingfunctions.py***. These include a multi-Gaussian+continuum fitting function (fcosx_function) that was originally written by Kevin France in IDL and was converted to Python by me. The line-spread functions for each lifetime position ***(cos_lsf_ltp1.idl, cos_lsf_ltp2.pickle, cos_lsf_ltp3.pickle)*** are included in the repository – the paths to each of these files will need to be changed in the ***cos_lsf_arulanantham*** function in ***linefittingfunctions.py***.

Example: Using SELFiE to Fit UV-H_2 Emission Lines

1. Start the GUI by typing “python3 SELFiE.py” into the command line. Once the home page loads, click the button that says “Measure COS Emission Lines”

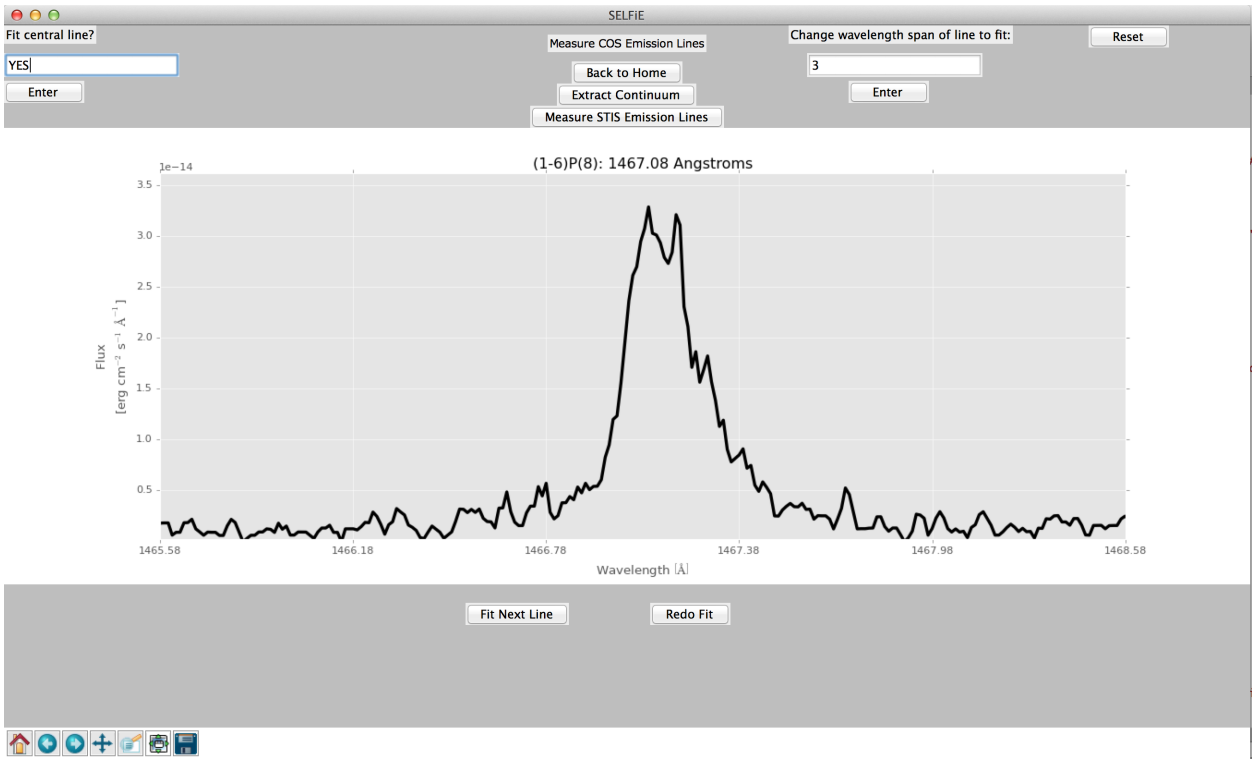


2. Next, you will be prompted to enter the filename for your spectrum. For this example, I'm looking at the G160M data for the young system RY Lupi (PID: 14469, PIs: C.F. Manara, P.C. Schneider)
    a. Your spectrum should be a text file with three columns (wavelengths, fluxes, flux errors) – column headings should be removed
    b. The GUI will read the text file and plot the full spectrum. You will then be prompted to enter the name of a .csv file with a list of lines to fit (see France2012_Table2.csv for an example – column headings should remain the same).



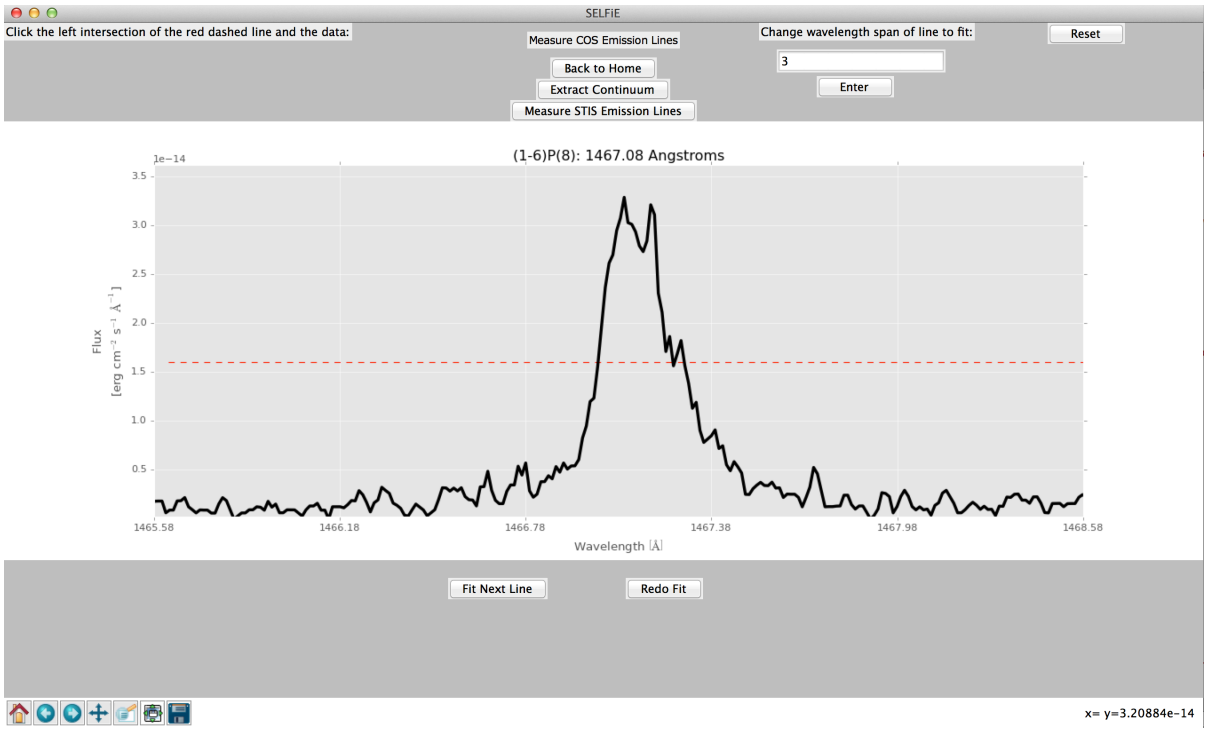
3. Once the line list has been accepted, two buttons will appear below the full spectrum: “Fit Next Line” and “Redo Fit.” Click “Fit Next Line” to start!

4. The GUI will navigate to the first line in the list and will plot a 3 Angstrom range around line center (this range can be modified – see below). If the emission line is clearly distinguishable from the continuum, type “yes”, “YES”, “y”, “Y”, “True”, “T”, or “TRUE” into the box in the top left corner of the screen.



5. Next, you will be prompted to enter the number of lines to fit. For this example, there is only one prominent emission line, so I’ll enter “1.”

6. Now the GUI will walk you through the process of setting the initial conditions for the Gaussian fit. First, you’ll be prompted to click the peak of the emission line, which will set the amplitude and central wavelength of the Gaussian. A red, dashed line will appear at half of the peak value you select – you’ll then be prompted to click the left and right intersections of the red line with your data. These values will be used to set the width of the Gaussian.



7. Finally, the GUI will find the best-fit Gaussian for the data (after convolving the model profile with the line-spread function – lifetime position 1 is the default, can be changed on line 759). A plot showing the best-fit Gaussian (dashed, purple line) and the Gaussian convolved with the LSF (solid, blue line) will be saved in the directory where you're running the code.
    a. If you're happy with the fit, click the "Fit Next Line" button
    b. To re-do the fit, click "Redo Fit." The line counter will be rolled back one, and the same feature will be pulled up again when you click "Fit Next Line"

8. The GUI will continue moving through the features in the line list. When it reaches the end, the parameters will be saved to a text file in the directory where you're running the code!
    a. Fits that were re-done will still be reported in the text file but will have a flag to note that they were sub-optimal