APPENDIX A

PIP_DECOMP USER GUIDE

The underlying software used to fit the radio spectra in this dissertation is PIP_Decomp a python based GUI for fitting curves with up to 4 Injections and Decays (as described in Chapter 4).

This is a User manual for the software (as of July 2025)

A.1 Quick Start Guide

A.1.1 Formatting data

PIP_Decomp expects spectra to be input as a single Numpy .npz file or IDL .sav file that contains 3 arrays of name and dimension

- m_s = [0:f, 0:t] (measured signal)

- m_s_e = [0:f, 0:t] (measured signal errors)

- freqs = [0:f] (table of frequency labels)

(Where f is the total number of frequency windows and t is the total number of time samples in the spectrogram)

for example

- m_s = [1, 2, 3; 4, 5, 6]

- m_s_e [0.1, 0.2, 0.3; 0.4, 0.5, 0.6]

- freqs = [1,2]

- save, filename='2024_05_07_int.sav', m_s, m_s_e, freqs

or

- np.savez('2024_05_07_int.npz', m_s = m_s, m_s_e = m_s_e, freqs = freqs)

A.1.2 Downloading and startup

The current application is available at the link attached.// If an updated version of the Application/ or this guide exist, they will stay at that link.


Figure A.1 PIP_Decomp Fitter App Download Link

After downloading the Fitter_App Folder will contain the multiple files. Compiling this folder in your python compiler of your choice, then the running PIP_Decomp_Fitter.py, you will launch the GUI.

Note: Start up requires PyQT5, matplotlib, and scipy installed

A.2 General Use

Once you have a spectrum prepared for PIP fitting, it can by loaded by pressing the "New File Button" (A.2a) to be used as a basis to plot and fit.
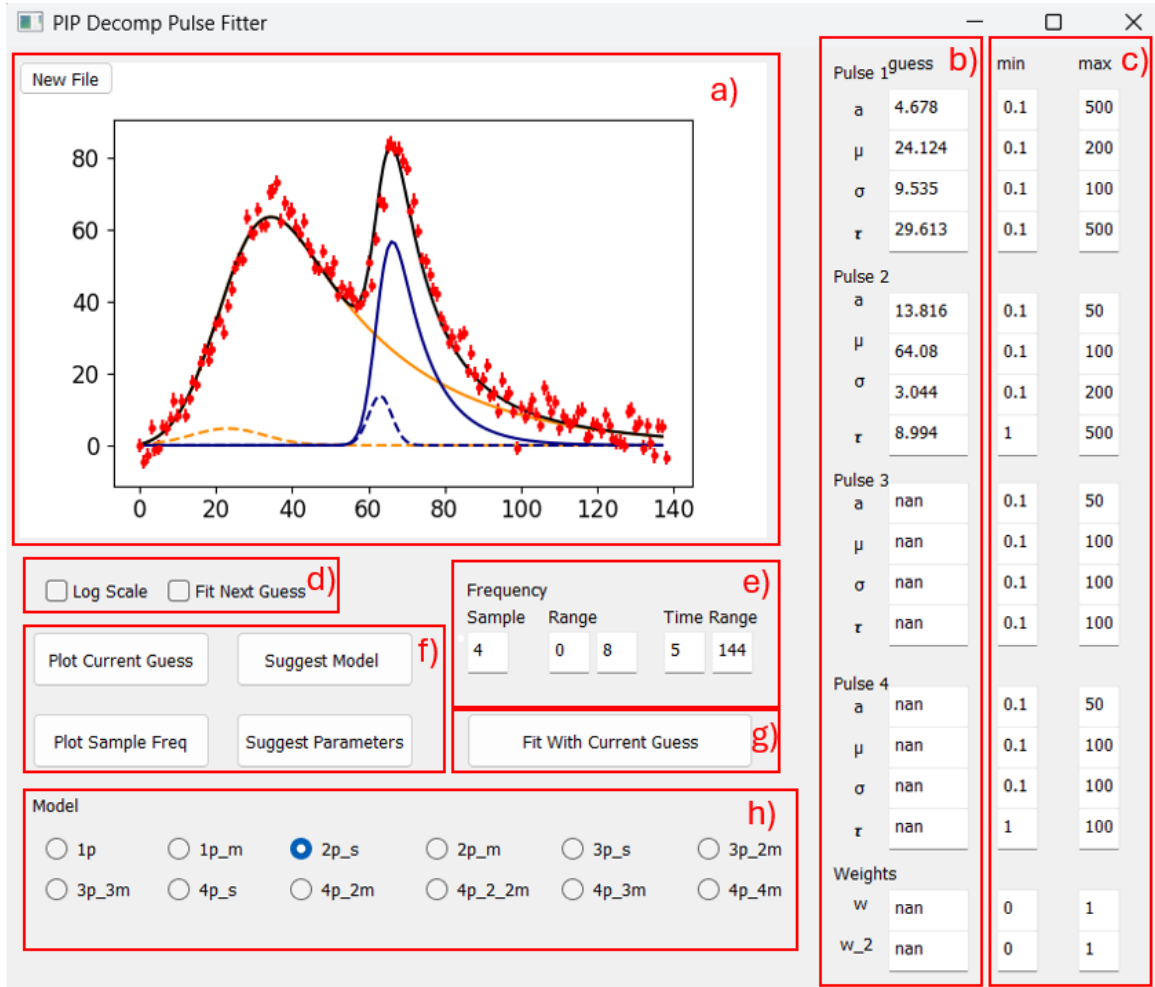
Figure A.2 PIP_Decomp Fitter App In Use Fitting Simulated 2 Injection Data.

A.2.1 Plotting

The plotting window A.2a) defaults to linear-linear scale, but can be set to log-linear scale with the "Log Scale" check box in A.2d)//

To plot loaded data, select a Sample Frequency and a Time Range in A.2e) and click "Plot Sample Freq" in A.2f).//

To plot a model light curve, select a model with the radio buttons in A.2h), input parameters in the "guess" column A.2b) and click "Plot Current Guess" in A.2f)//

These model functions can be used outside of the PIP_Decomp GUI. Plotting with PIP model functions is accessible from the command line through the call of Fitter_ App's internal functions. For example a two injection mixed decay model can be called with ./pulses2_2mixed.model(t, a1, mu1, sig1, tau_fast, a2, mu2, sig2, tau_slow, w). However, these functions are designed for and are most efficiently used in the PIP_Decomp GUI.

A.2.2 Model and initial parameter selection through fitting sample frequencies

Upon finding a worthwhile initial guess to compare the model to the lightcurve, the "Suggest Model" function A.2f) is used to loop through all models (using the A.2b) "guess" row for initialization of fits for each model, bounded by the min and max rows in A.2c). This produces parameters for each model, and automatically presents the model with the lowest χ^2. The guess for other models are stored and can be seen through selecting a new models radio button and using the "Suggest Parameters" button in A.2f) button. This will both re-plot the data with the new model fit.

A.2.3 Fitting all frequencies with selected model

Upon arrival on a sensible model for the sample frequency the full spectrum can be fit as a series of lightcurves fit with physically similar models, this is accomplished by pressing the "Fit with Current Guess" button A.2g). These fits are locked into the model selected by A.2h) and bounded by the min/max inputs in A.2c)

One can either fit each frequency in the spectrum using the displayed "guess" as the IC for fitting, or it can use that guess just for the first frequency and then use the previous frequencies fit as it's new initial guess. These modes can be swap by selected the "Fit Next Guess" checkbox in A.2d)

A.3   Data Products

Upon the use of the of the main fitting function through the "Fit with Current Guess" button a full data block is produced in the Fitter_App folder. Parameter fits of the current model will be automatically produced as a csv file and are plotted as a png. Png images produced are also of the full fit spectra, frequency by frequency fits, separated spectra for each injection, and of the χ^2.

example data products for a 1 pulse fit (in folder ../Fitter_App/1_pulse_fit/)

- parameter data spreadsheet ./1_params.csv

- parameter data plots ./1__1_pulse_Parameter_Panels_

- injection spectra ./1__Pulse_1_spectrum

- flux spectra ./1_Pulse_1_spectrumflux_

- individual frequency fits ex. ./1_40.9GHz

- fit errors ./1_Reduced_XiSq_

Note that sample parameters for other models are never stores, and nothing is saved "Fit with Current Guess" is not used.