Beam Studies

ANALYSIS AND EXPLORATION OF BEAM LOSS

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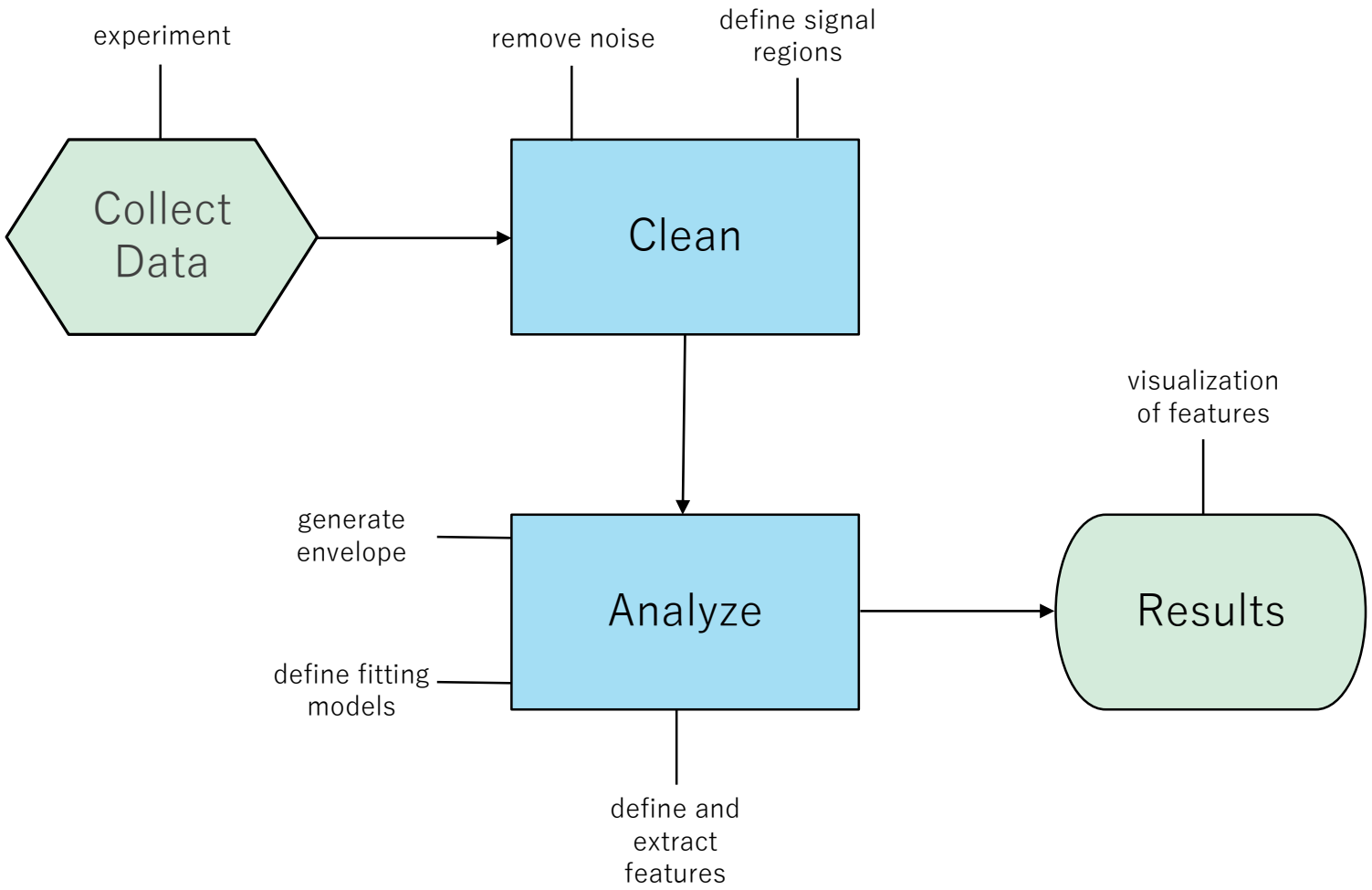
Overview

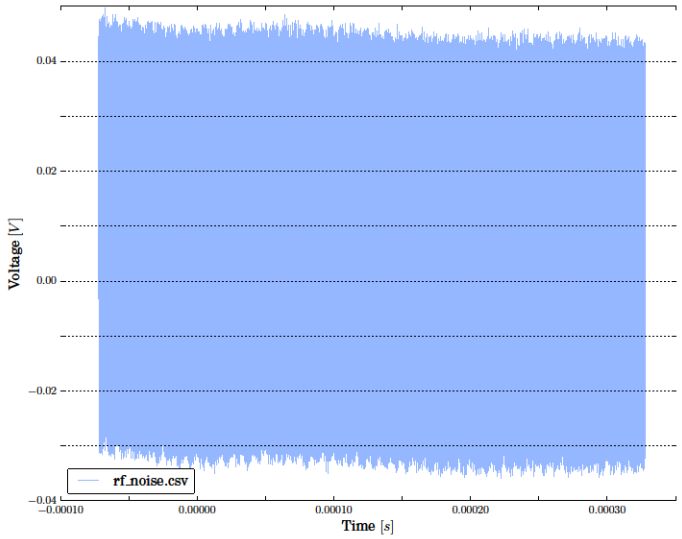
- Data was collected on 26-10-2015.
- Experimental parameters: **LINAC TRIGGER DELAY** and **PULSE WIDTH**.
- The flowchart outlines my analysis procedure of the data.

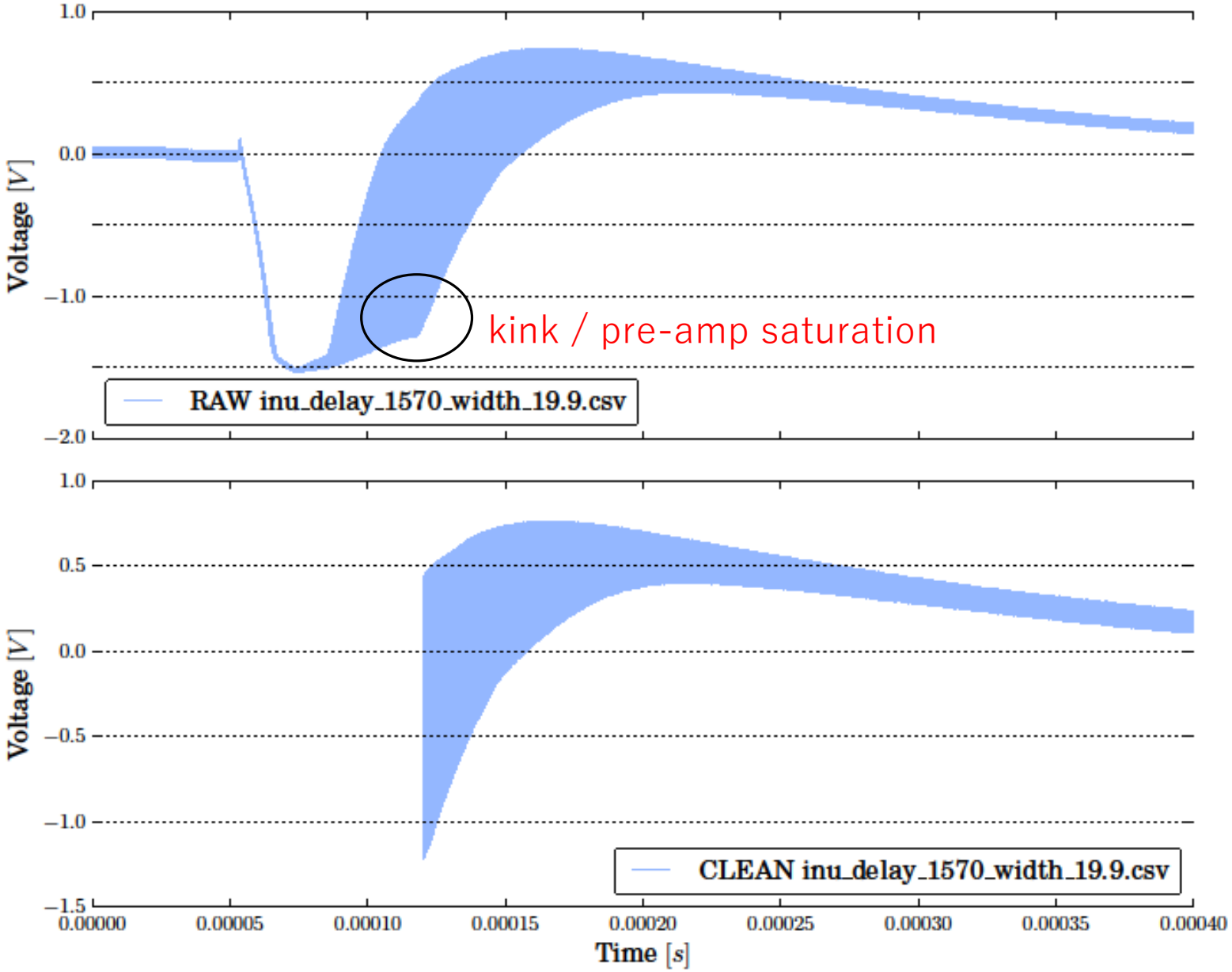


Cleaning

The plot to the right shows the raw data collected from the *INU* beam monitor, and the corresponding *clean* data.

The plot below shows the measured rf noise.





Analysis I

This illustration shows the envelope generation and corresponding residuals.

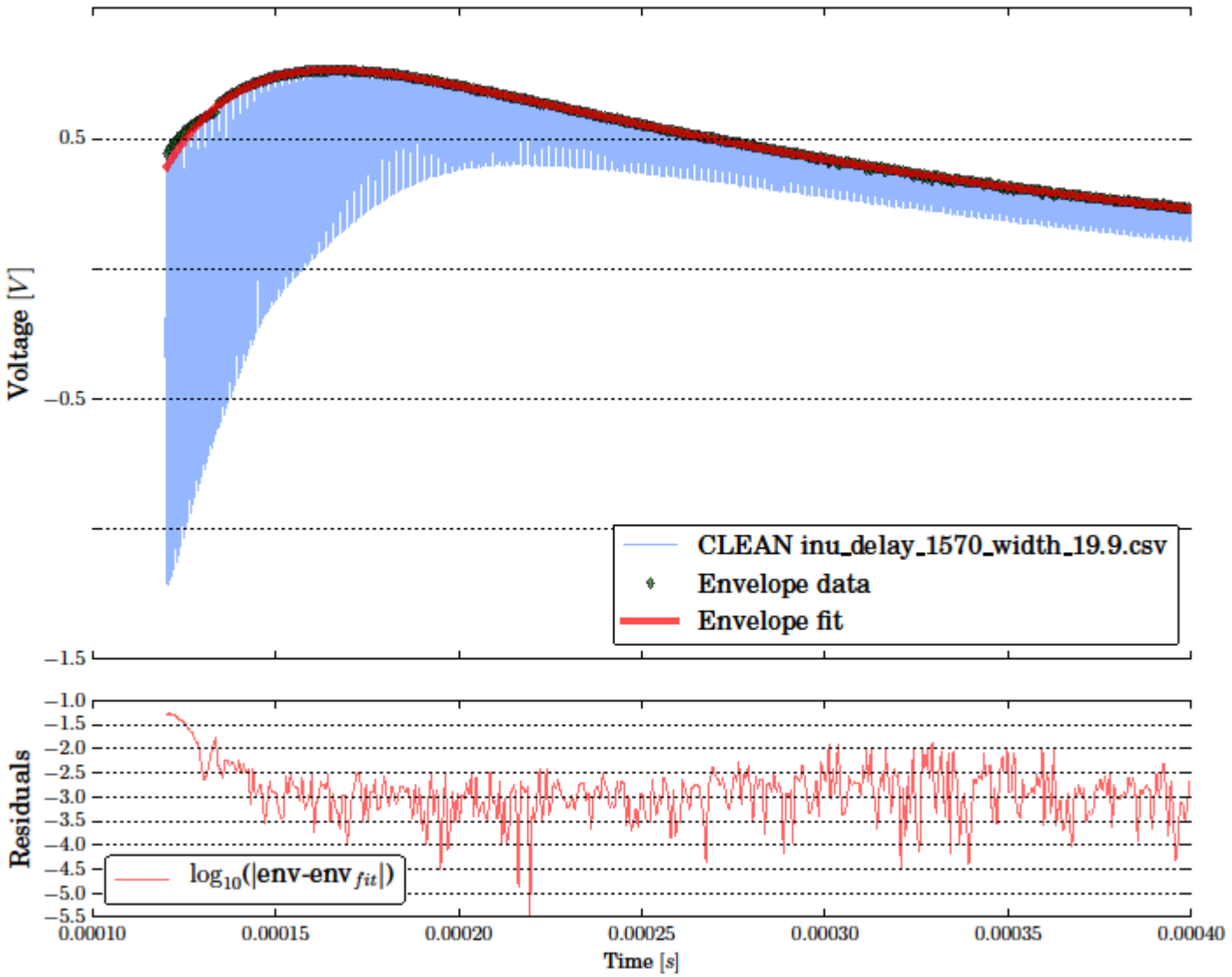
The model used for the fit is:

$$f(t) = V_0 + e^{-\alpha t}(a_0 \cosh \omega_d t + a_1 \sinh \omega_d)$$

The model is the analytical solution to a second order RLC circuit, with a step function as an input (overdamped).

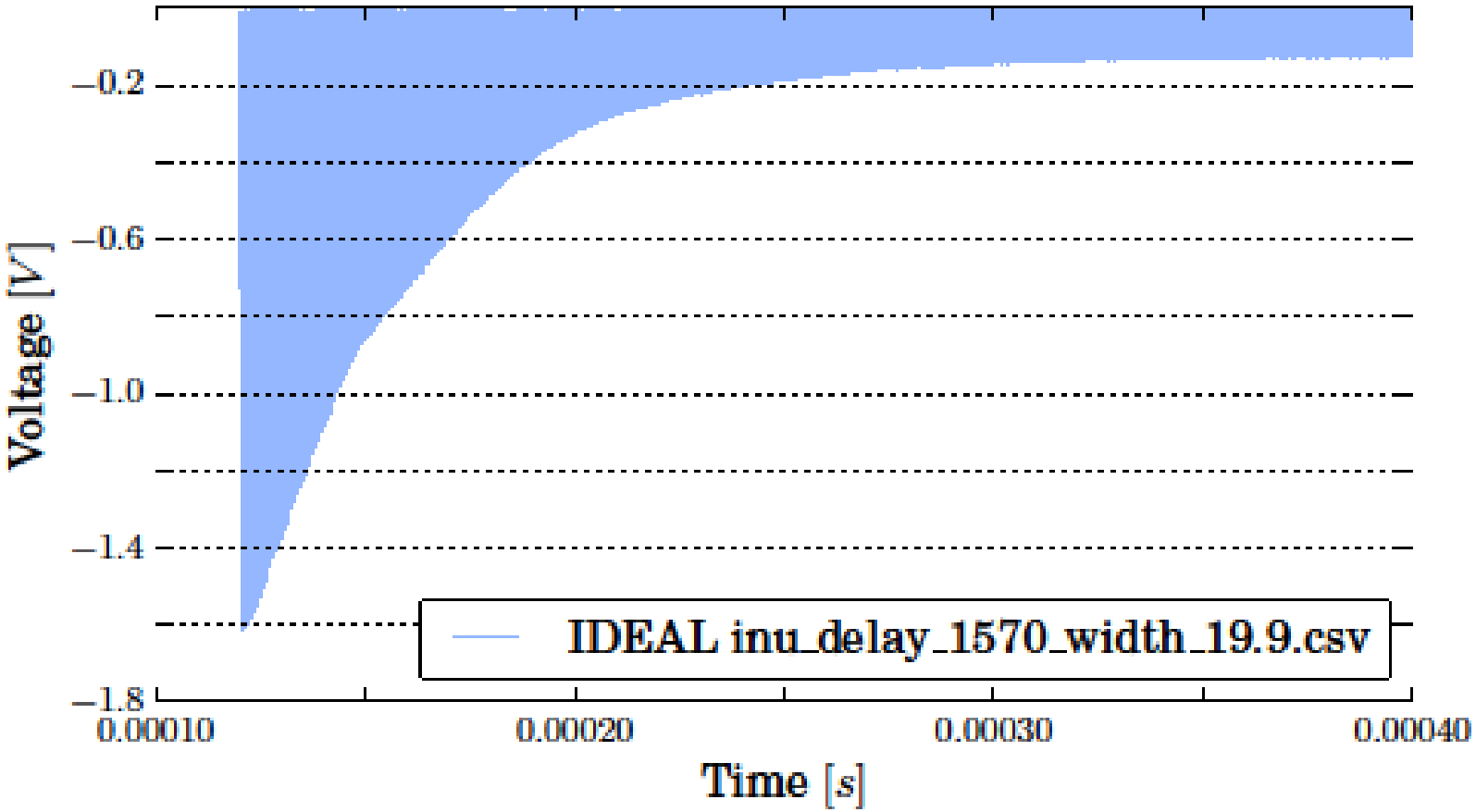
RLC circuit = monitor, BNC, etc..

Step function = beam



Analysis II

An illustration of the *ideal* waveform. All further calculations are done on the *ideal* data.



Analysis III

This illustration shows the following function:

$$\Delta(\mathrm{t_i}) = \int_{t_{i-1}}^{t_i} V_{ideal}(t')dt'$$

The model used for the fit is:

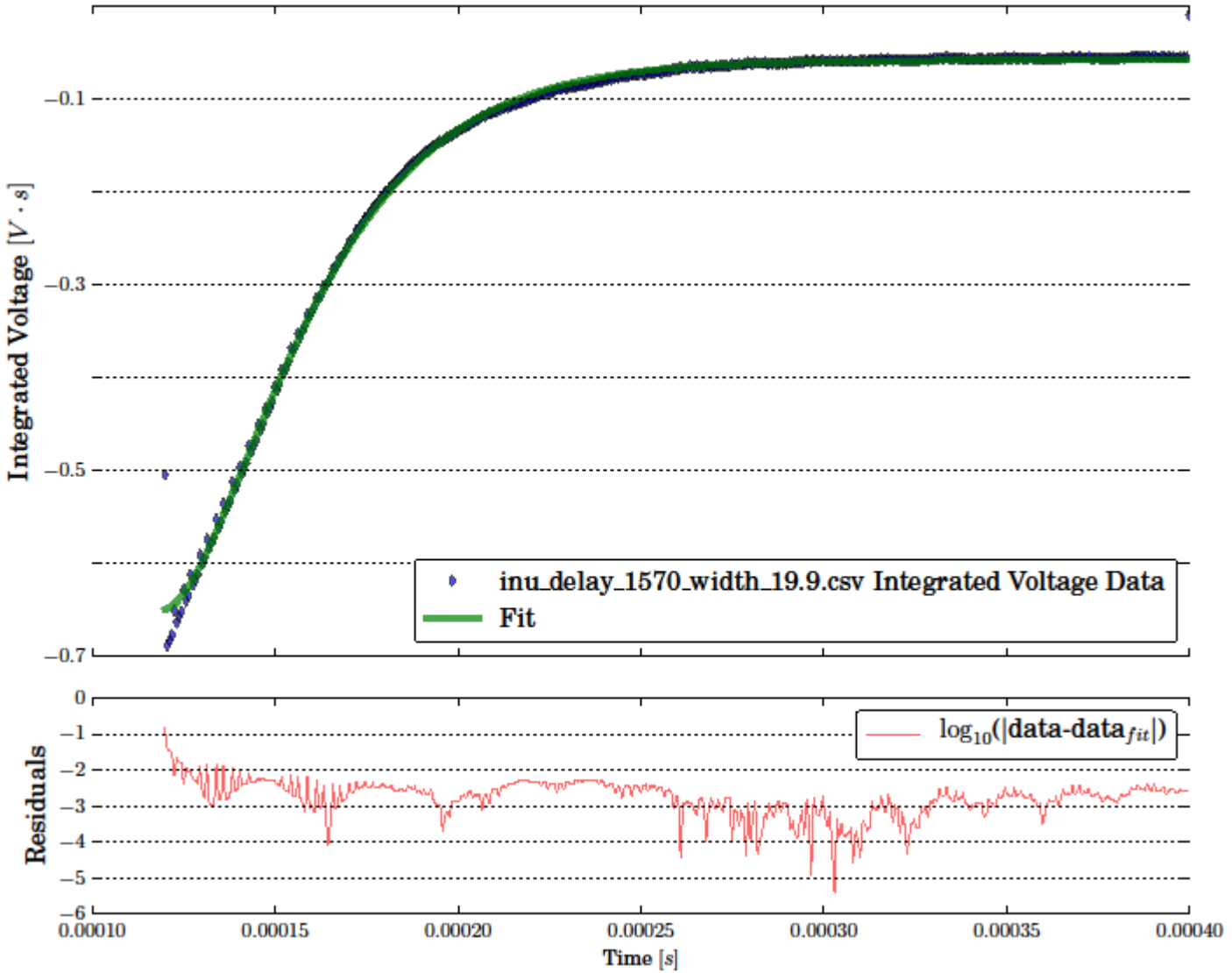
first feature

$$f(t) = V_0 + e^{-\alpha t}(a_0 \cos \omega_d t + a_1 \sin \omega_d)$$

The model is the analytical solution to a second order RLC circuit, with a step function as an input (*underdamped).*

RLC circuit = monitor, BNC, etc..

Step function = beam



Analysis IV

Here is an illustration of the spectrum of a single waveform.

The shaded area in the figure is:

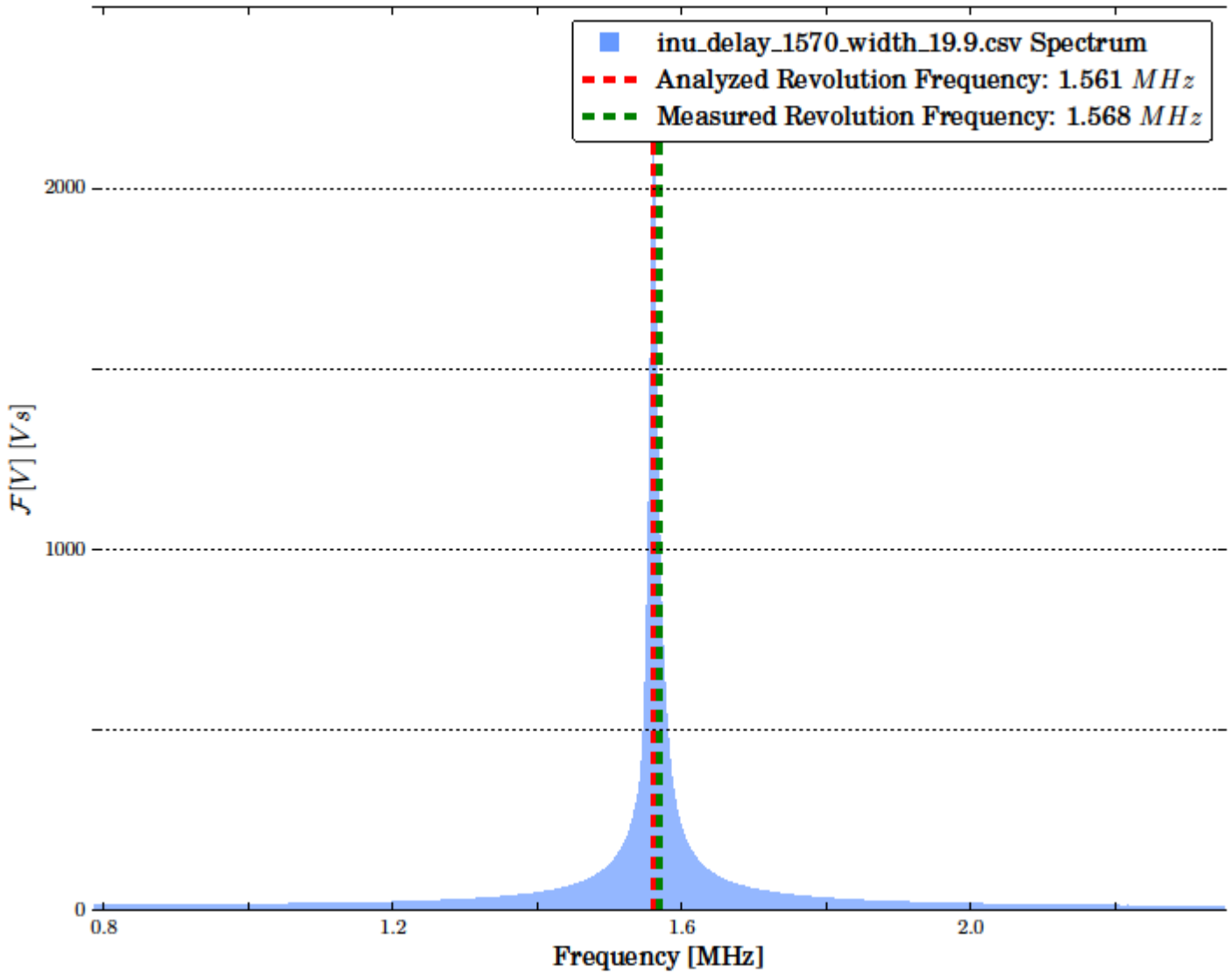
$$\text{P} = \int_{0.5 f_0}^{1.5 f_0} \mathcal{F}[V_{ideal}(t)]\,df$$

second feature

measured revolution frequency

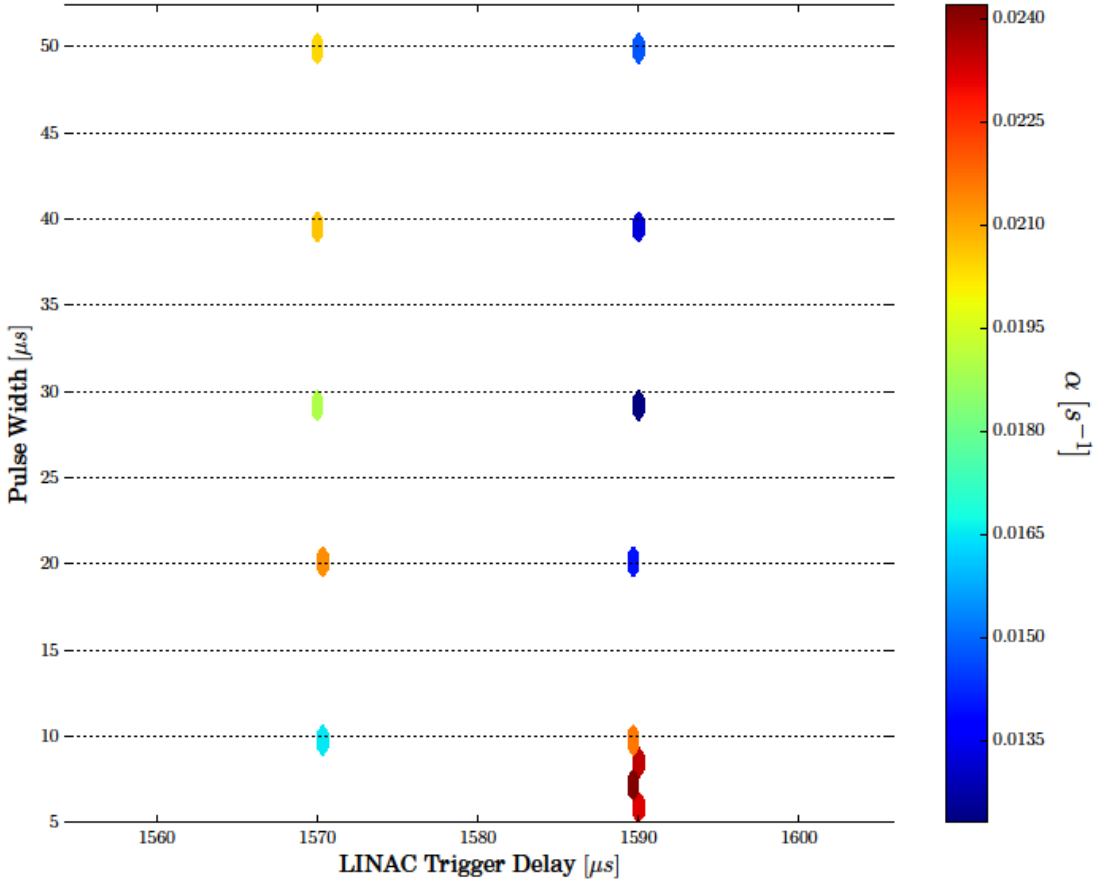
Measured revolution frequency = measured during experiment

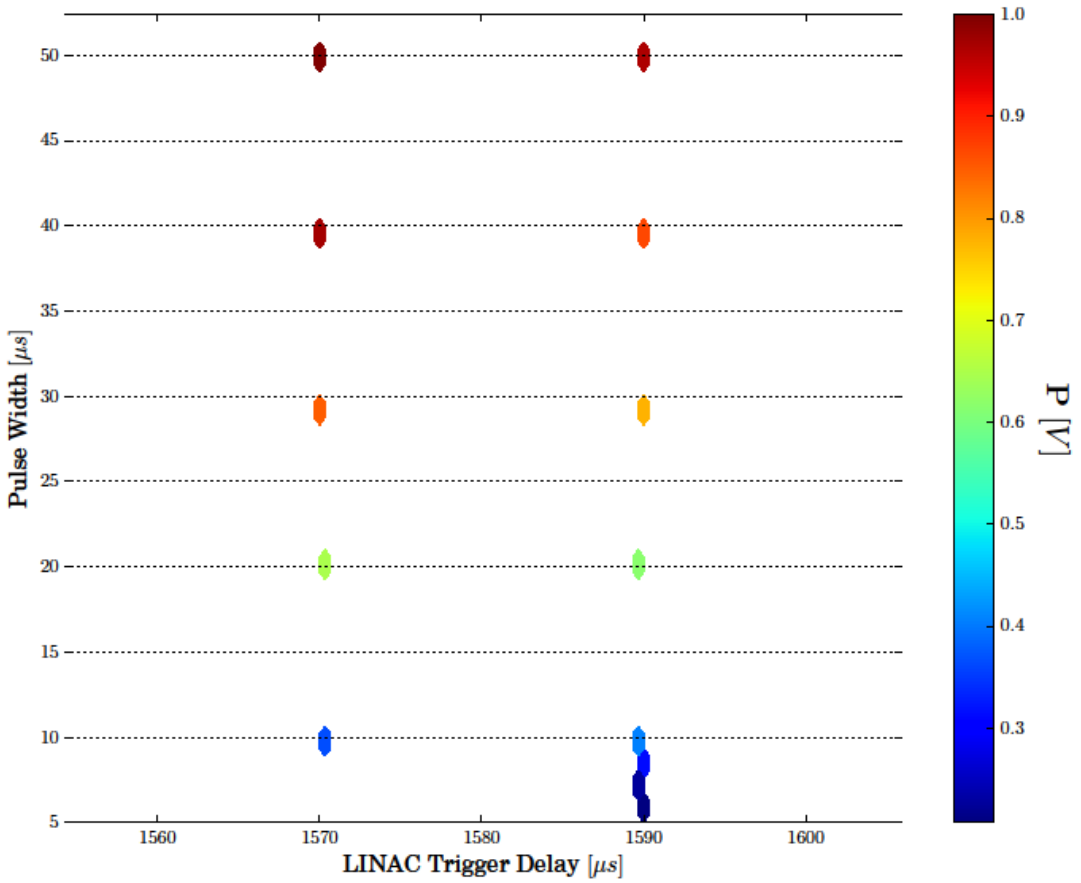
Analyzed revolution frequency = peak of Fourier transform from analysis



Results I

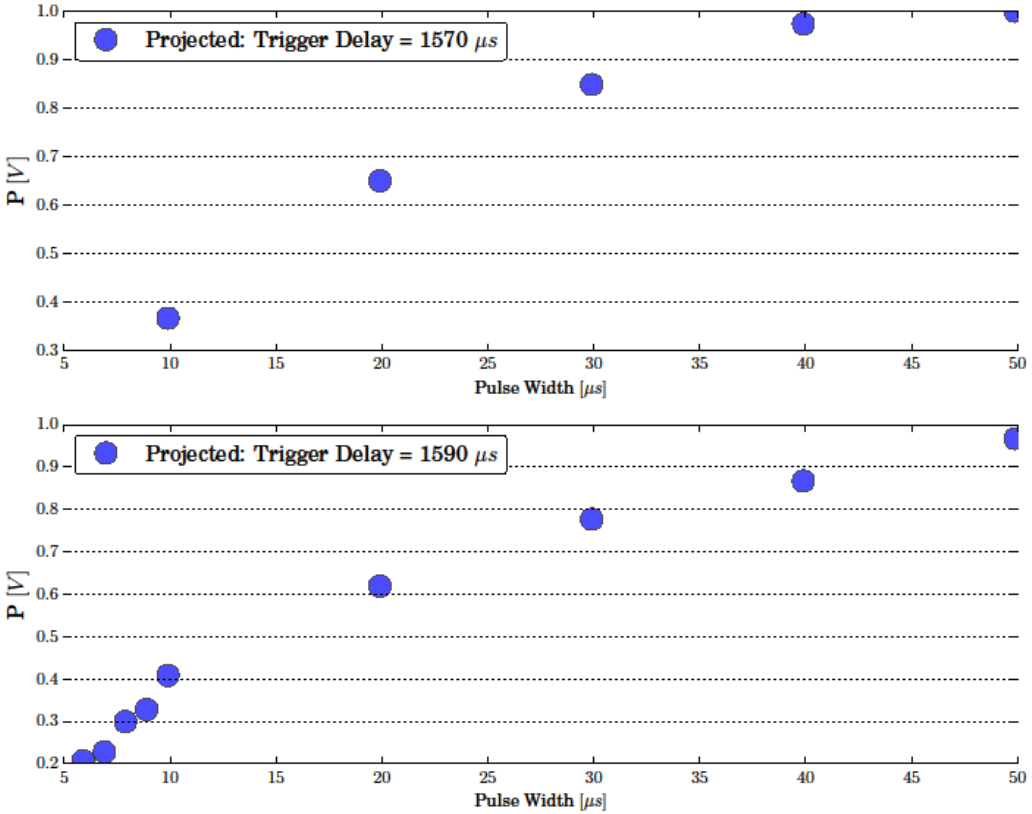
These figures are heat maps of the two features, α and P (normalized to max in data set).

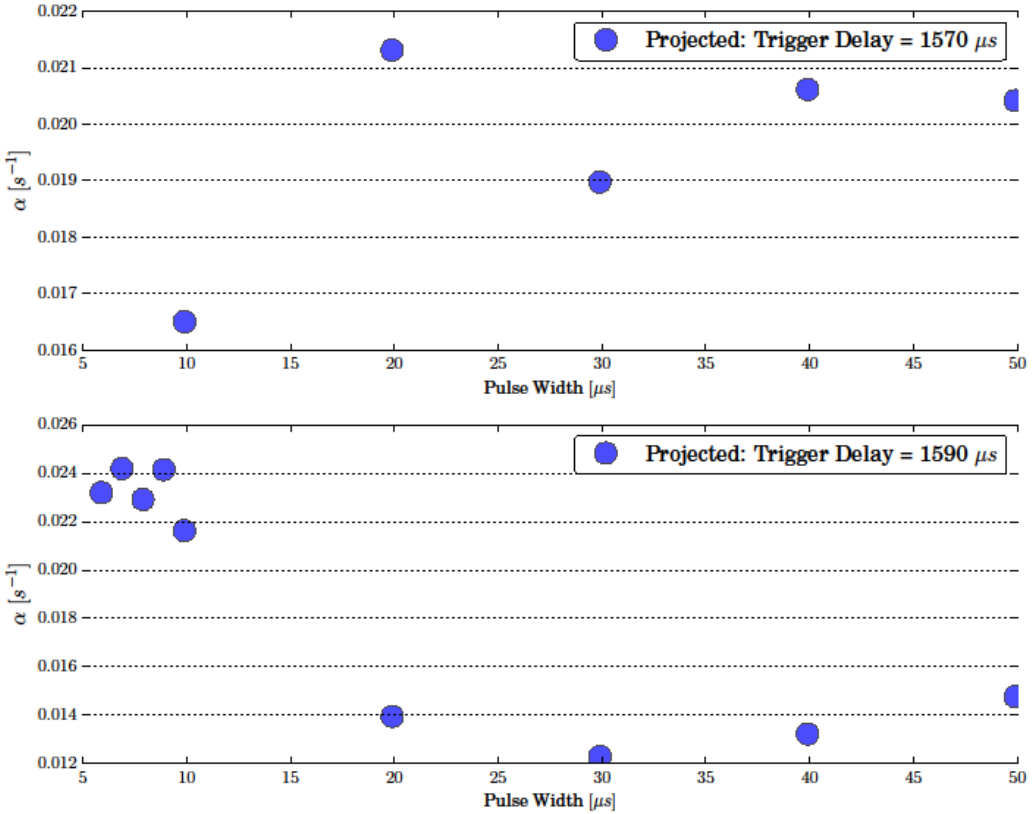




Results II

These figures are projections of the two features, α and P (normalized to max in data set) – projected on constant LINAC trigger delay.





Outlook

- Understand the circuitry before and after the pre-amp for better modeling and interpretation.
- Generalize the code to analyze different types of experiments.

Thank you for your attention!

All code, data, and the corresponding report can be found here!

If hyperlink is broken: https://github.com/kvmu/KURRI-workterm/tree/master/width_delay_beam_experiment