THz Lasers and S.C interactions

SLAC NATIONAL ACCELERATOR LABORATORY

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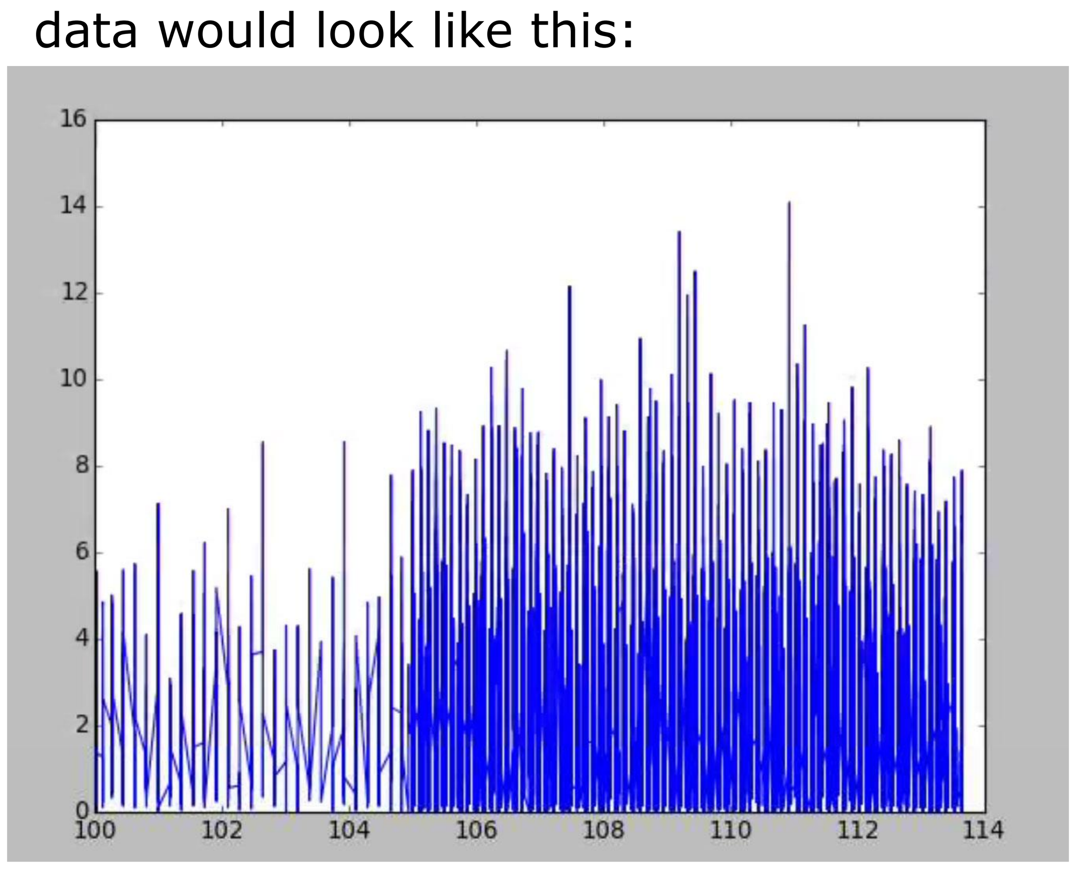
Introduction

This experiment will use a THz pump to disrupt the sample's superconducting condition and charged density wave. We will be looking for a difference in the peaks between the sample under an electric field and the sample at different temperatures in the superconducting phase. We suspect that this will disrupt the charged density wave and create a difference in the peak intensities and the charge orders.

We expect the THz disrupted sample to have a higher peak because the intensity is observed to drop as soon as the sample reaches superconductivity temperature.

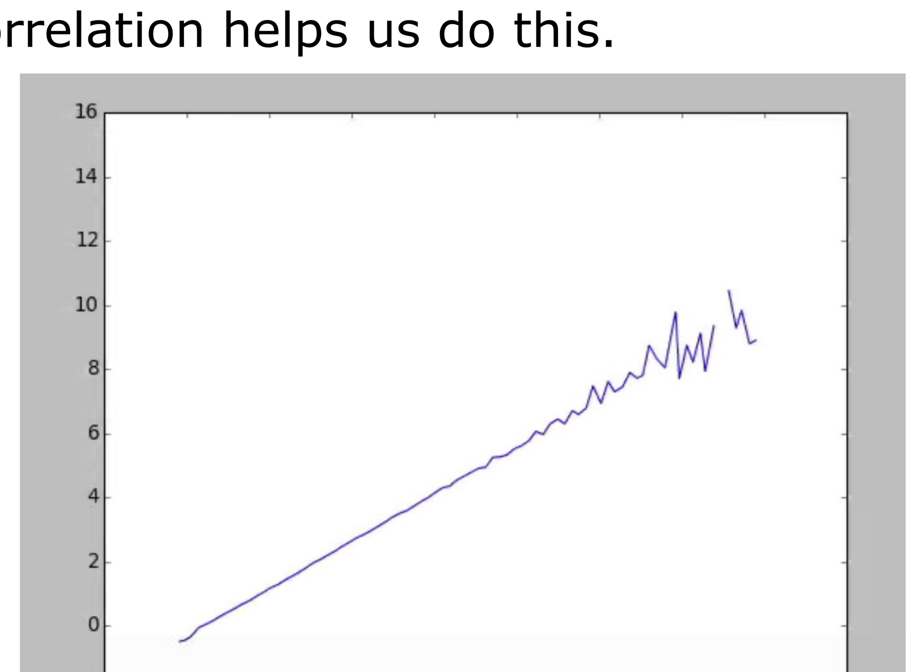
Research

First we find an experiment with good data to test our binning methods and sorting methods. Many of the runs ran without the theta pump on, which meant the sample was in more of a superconducting state than a charged-density wave state. Without bins, the data would look like this:



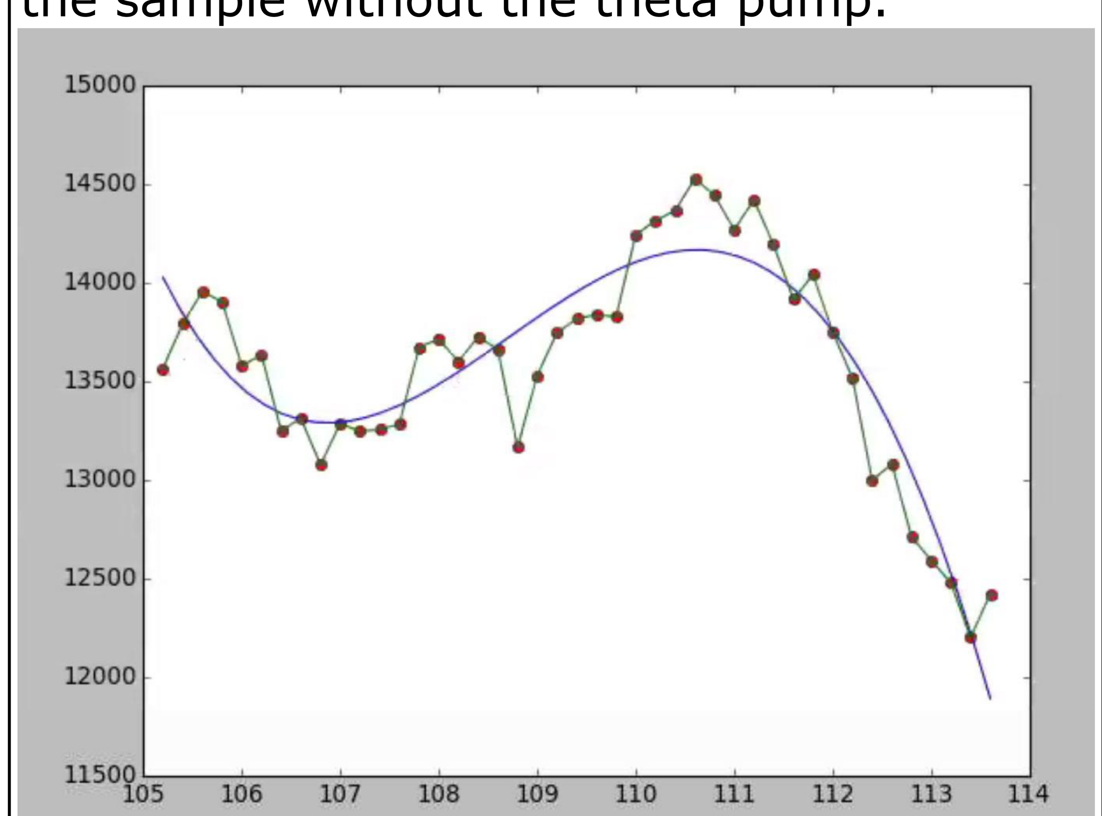
If we look at the angle motor's path, we see that the true scan starts at angle 105, which explains the lower density of data points on the left.

We first bin the values by angle position and then filter it by gmd because the pulses in LCLS are randomly intense. The APD-GMD correlation helps us do this.

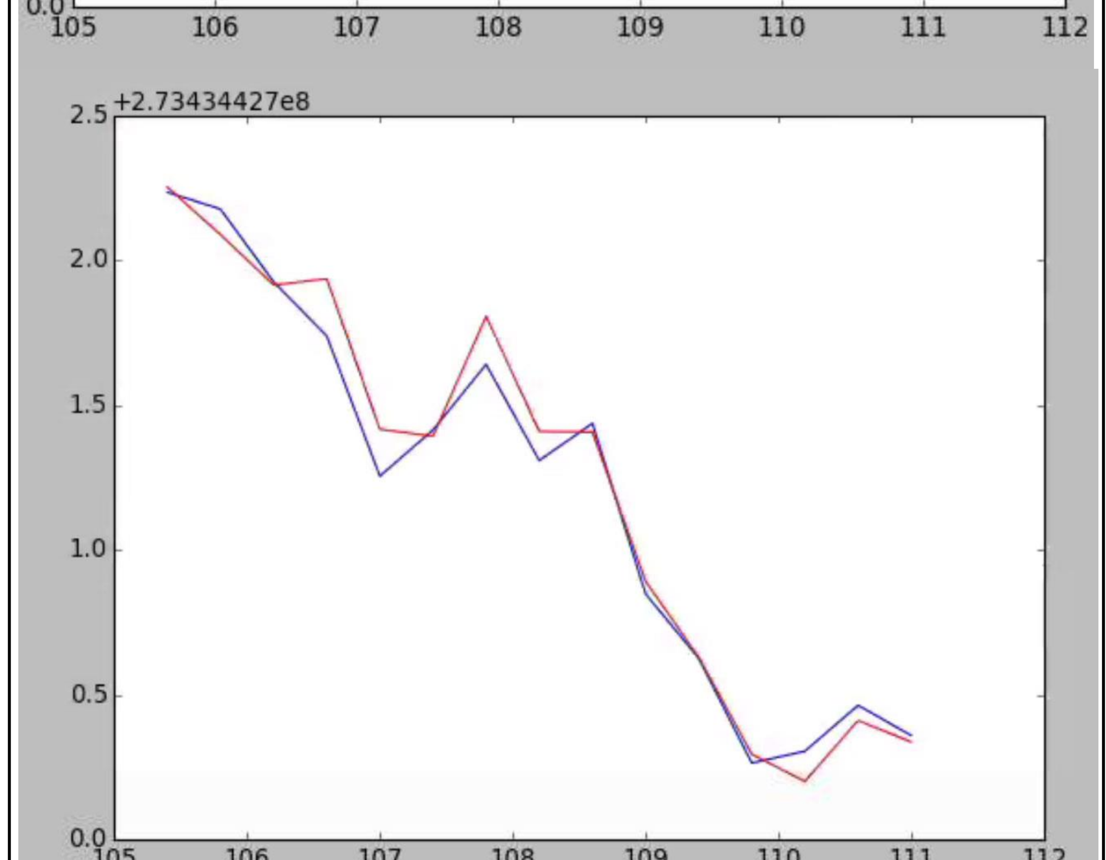


There is a noticeable amount of noise after about ~0.0005 intensity of a pulse. There are also values below 0, which are dropped shots. Since the gmd we fetched were not the relative pulse intensities, we can cut off everything below zero. In the figure, we can also see that that area is not along the same line as the majority of the data points, so we could cut it off as 'noise' too.

After filtering and binning, we are rewarded with a nice curve that we had predicted for the sample without the theta pump.



We then use this method on another run with the theta pump and chopper to see if there is a difference between the peaks.



Changing the amount of bins changes how 'nice' the curves look but there is a point where binning it this way obscures the data and is just an unjustifiable manipulation to make it look better. In this case, since the number of bins is less than 100, this may the case.

However, I refined the way I calculated the APD and synchronized all the values better by first testing if the values *existed* in the database before appending it and storing it in my user account. This is necessary because occasionally and randomly the detector does not record an event of data. I also calculated the acqiris waveform peak differently according to some code written previously.

This looks promising, with the difference in peaks, but now it doesn't look quite right: the form of the curve does not match with run 133 anymore.

Further analysis is required to draw a final conclusion from this data because a mismatch of our expectations and what we see creates uncertainty about the validity of the data.

Conclusions

It is hard to know the direction of your project when what you are proving is purely theoretical and seems intangible compared to other statistical things such as consumer preferences or manufacturing defects. However, this reinforces the necessity of processing the data in a way that preserves integrity, especially when future research may be based on it.

While we did find a promising dataset that agrees with our assumption, we need to determine why we are not getting the result we expected and why there are incongruities between similar methods of calculating the apd.

Acknowledgments

Use of the Linac Coherent Light Source (LCLS), SLAC National Accelerator Laboratory, is supported by the U.S. Department of Energy, Office of Science, Office of Basic Energy Sciences under Contract No. DE-AC02-76SF00515.

Date: 08/24/2017