# Theory

## Paper references

## Nominal values for wire radius and wire tension, applied tension, sensitivity, wave speed, operating frequency

## Limiting factors being dispersion, wire droop, minimum wire distance

## Aligning wire in Undulator

# Setup

## Wire holders, fiducial monuments, pulley and weight

## Water damper

## Laser photodiode

### Sign convention

### Wire closest to slit

#### Want best relative change in voltage when scanning laser across wire.

### Photodiode gain

### Setup close to undulator

## Translation stages

### Setup so all stages move same direction with given rotation.

## Current Source

### Function generators

### Electrons travel from black to red connector.

### Use ICT as trigger for scope (50ohm impedance)

### Short pulse operation

#### Signal proportional to beam velocity

#### Signal deflection is limited

#### Need to increase voltage

### Long pulse operation

#### Signal proportional to

## Scope

### Trigger with ICT

### Zoom in on first reflection. But be check that ring down is complete. (Especially for strong deflections in signal!)

### USE OFFSET so that waveform remains centered when changing scale factor.

### Identify working region by scanning laser across wire.

### Code to read waveform data

## Initial Alignment

### Want to align with all stages near their middle position.

### Collars make aligning vertical direction easier for the 2” optics posts.

### Start with thicker wire that will not break and can easily be strung between ends.

### To get fine wire through undulator or other object, you can push a larger wire (or sauter) through, make a hook, feed the thin wire through the hook, them pull through.

#### Note this can cause kinks/imperfections on the wire. These are not only weaker points, but can alter the vibrational waves that we measure. Best to pull enough thin wire through so none of the used wire is damaged.

# Code (mostly for undulator)

## Code to retrieve waveform on trigger.

### Can verify shot manually or simply by checking if signal is clipping.

### Can reset channel offset to center next waveform

## Create\_Laser\_Calibration\_Curve

### Use short-pulse operation so waveform is flat.

### Run script, and turn move laser to fill in data on the scatterplot.

### Script only saves shot if not clipping and then repositions channel offset to track with the new signal.

### Larger waveform means better resolution.

### Be aware that operating the translation stage can give some noise to data. Move quickly after a shot is taken so the next moved waveform will clip and not be counted.

## Take\_Offset\_Measurements

### First you should have created a calibration curve. Put into given folder.

### Uses manual verification to save shots for a given wire offset to given folder.

## Get\_Signal\_Means\_and\_Amplitudes

### Brief overview. Look through code for details.

## Low\_Pass\_Filter

### Useful to remove high frequency noise. Especially important for Thorlabs laser (not sure where the 20us period/50kHz noise is coming from).

### Tune trajectory straight during wirescan measurements. Can always disregard angle in.