



# Commissioning of the ASTA Laser Lab with UV Pulse Length Characterization

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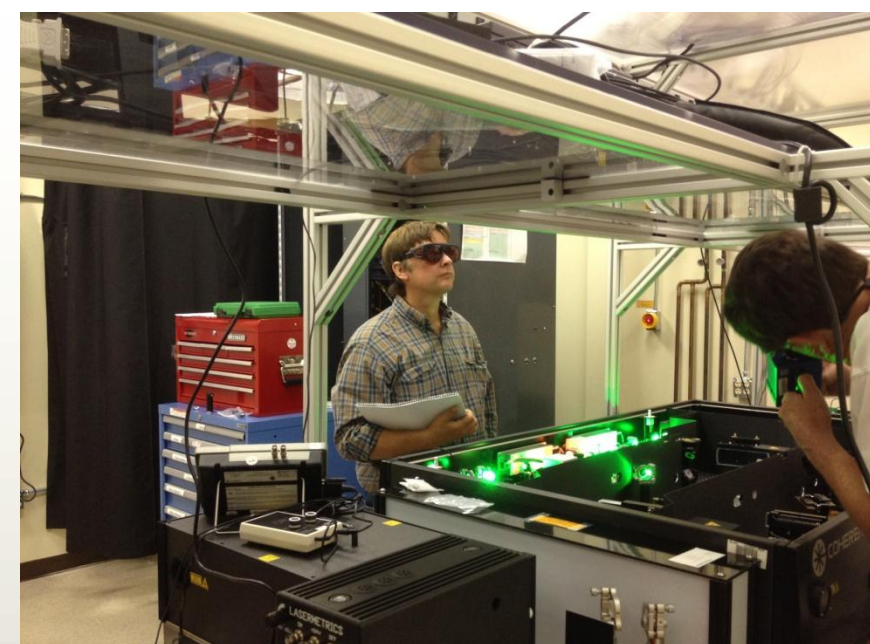
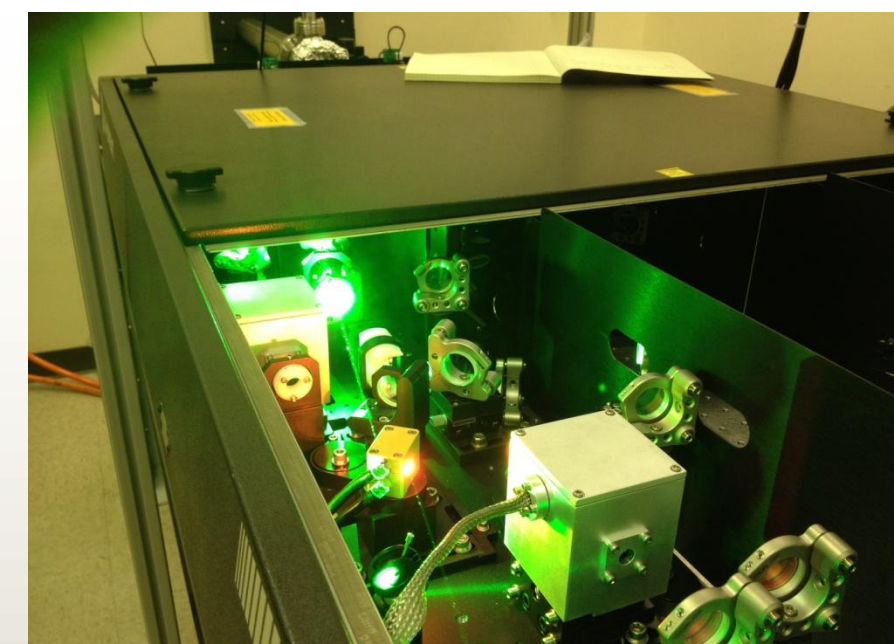
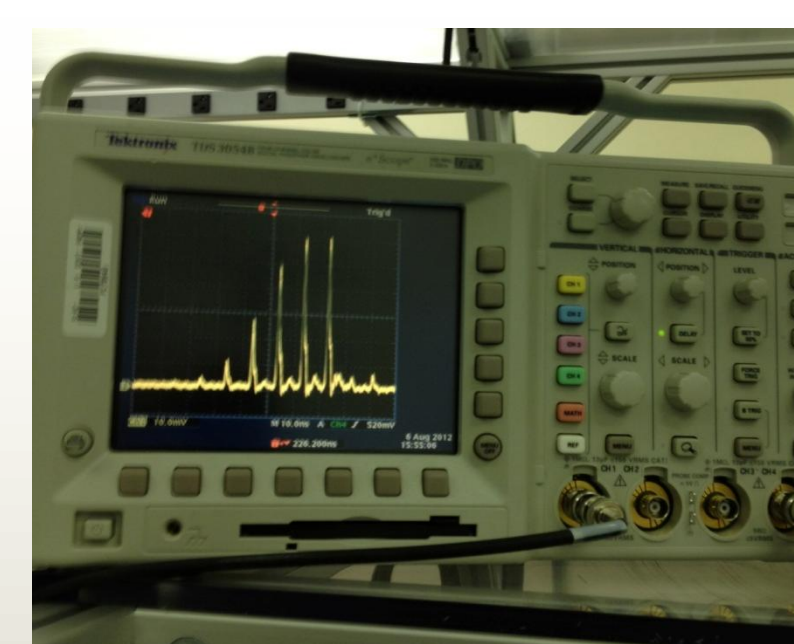
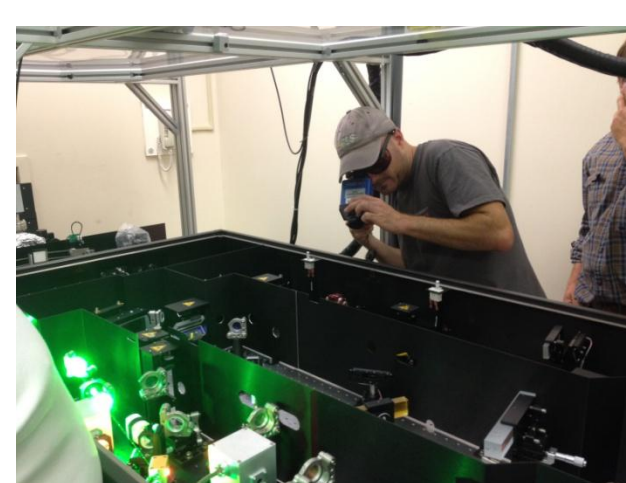
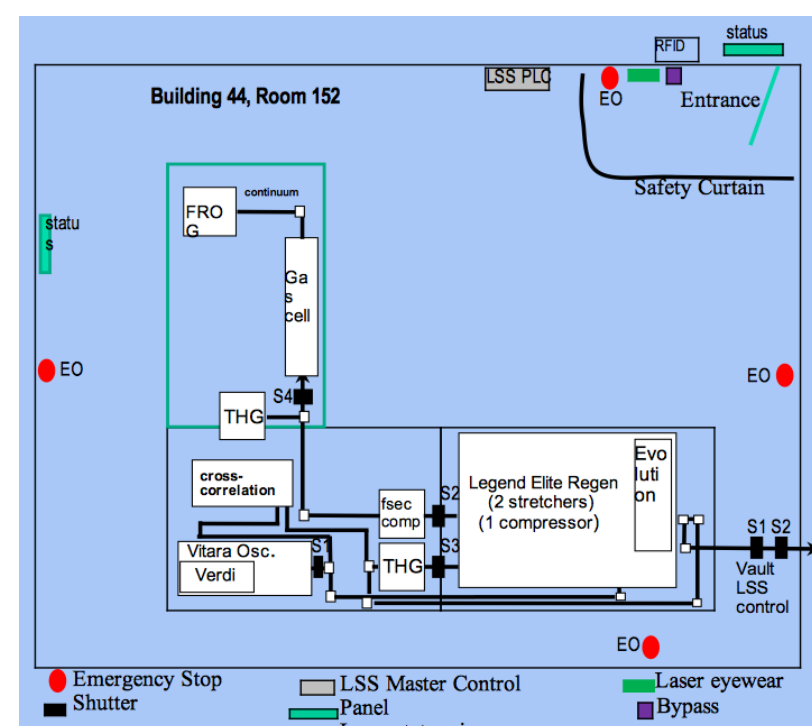
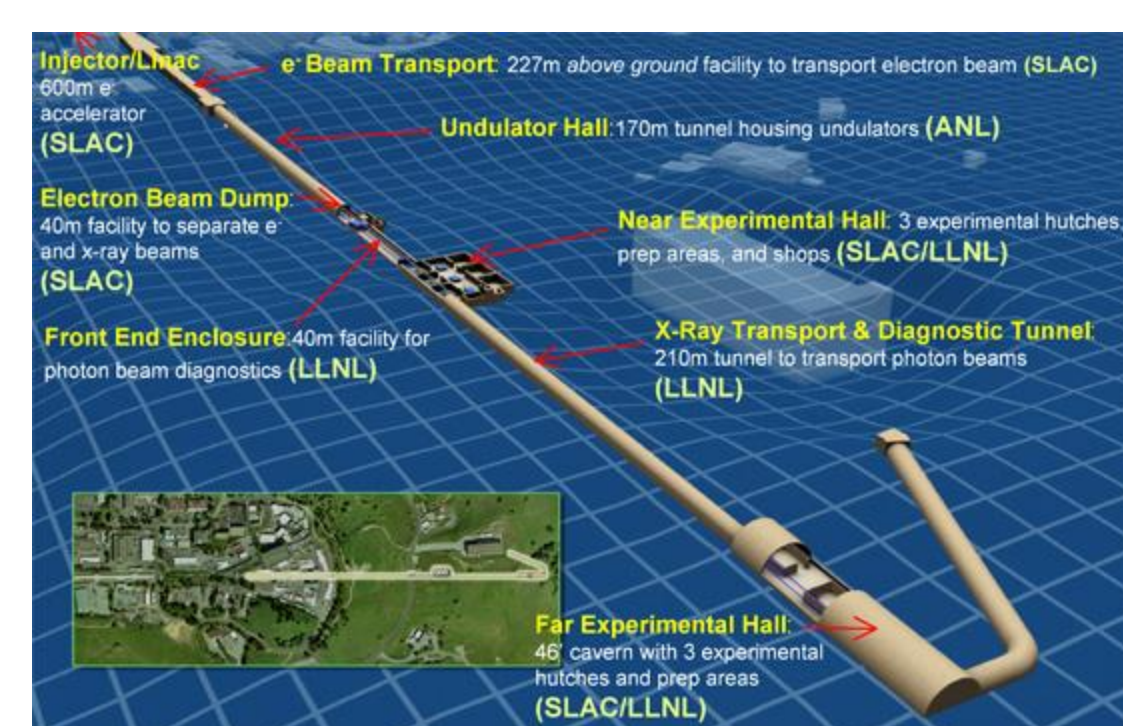


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## ASTA

- Replica of Linac Coherent Light Source (LCLS) Injector Lab
- Oscillator (OSC)
  - Seed laser for the system
  - 800 nm IR
  - Pulsed at 68 MHz
  - 35 fs pulse length
- Regenerative Amplifier (Regen)
  - Accepts IR seed pulses
  - Chirped Pulse Amplification
  - 120 Hz pulse rate output
- Third Harmonic Generation (THG)
  - Receives amplifier pulses
  - Frequency multiplication
  - 266 nm UV output at 120 Hz
- UV passed from Laser Lab to Electron Gun



## Outline of Work

- Construction of ASTA Laser Lab
- Installation and Alignment of Laser
- Design and Construction of Cross Correlator
- UV Pulse Characterization

## Abstract

The Linac Coherent Light Source (LCLS) at SLAC depends on a photocathode electron gun to provide the linear accelerator with the raw material – electrons – used for making X-ray laser pulses. The photocathode used in the LCLS Injector is a clean copper plate in high vacuum. When the cathode is struck with high energy UV light, electrons are liberated from its surface and then accelerated down the linac with radio-frequency electric fields. These fast-moving bunches of electrons are directed through an undulator magnet to radiate X-ray light.

The laser system in ASTA (and the LCLS Injector) uses a 68 MHz pulsed infrared beam to seed an amplifier, the output of which is then frequency multiplied into 266 nm UV. These UV pulses are the end product of the laser lab, and used for photo-emission in the electron guns. An important tool in these laser labs is a Cross Correlator. This optical system uses light – with known characteristics – from the 35 fs infrared seed beam to make a cross correlated measurement with the 2-3 ps UV pulses. With this technique, time characterization of the UV beam is achieved.

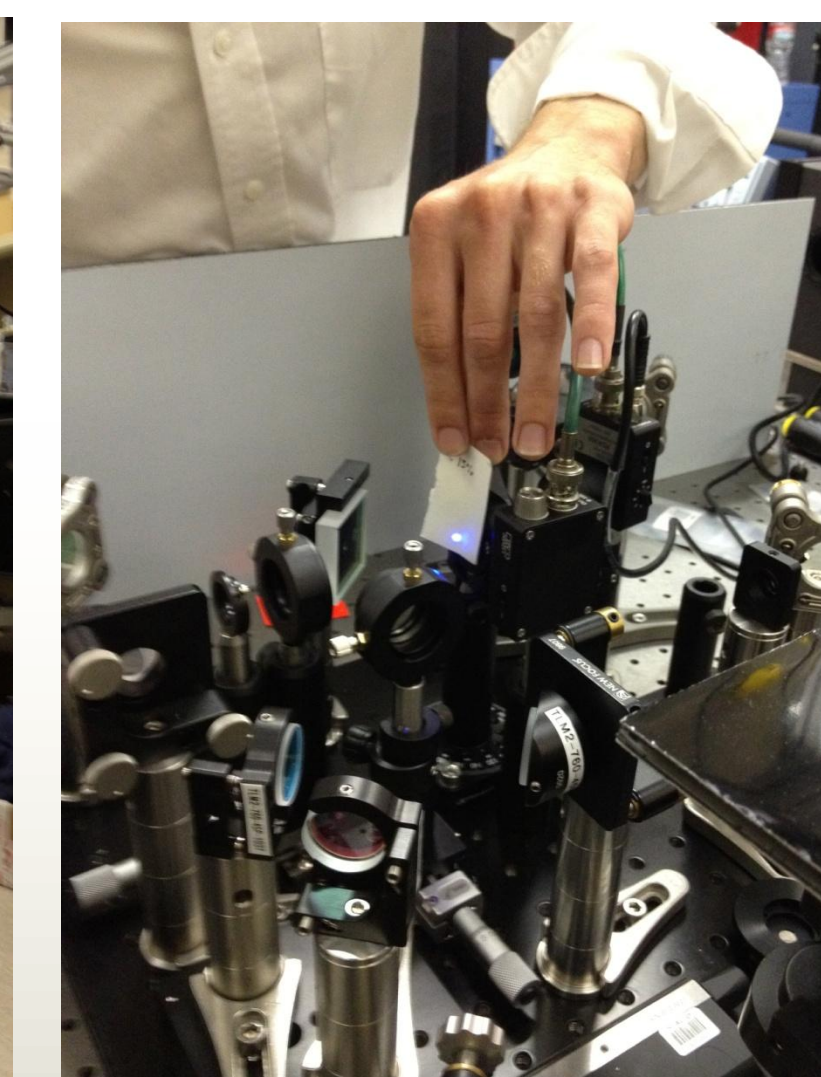
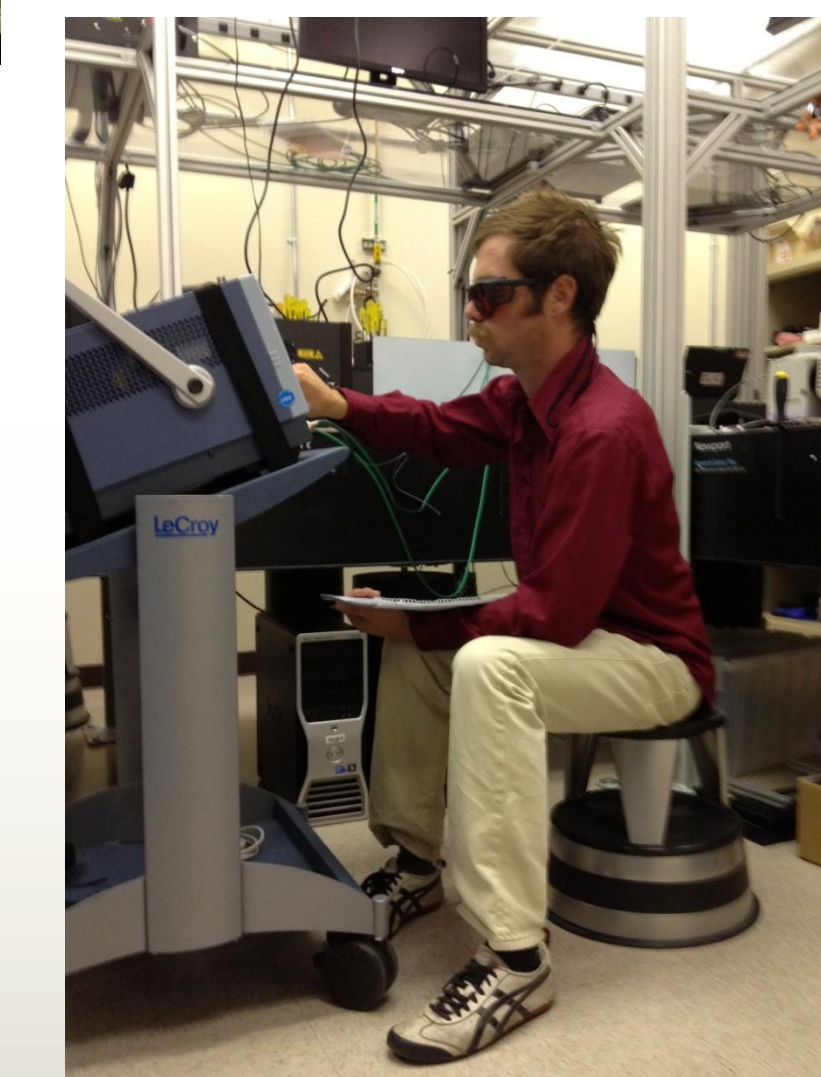
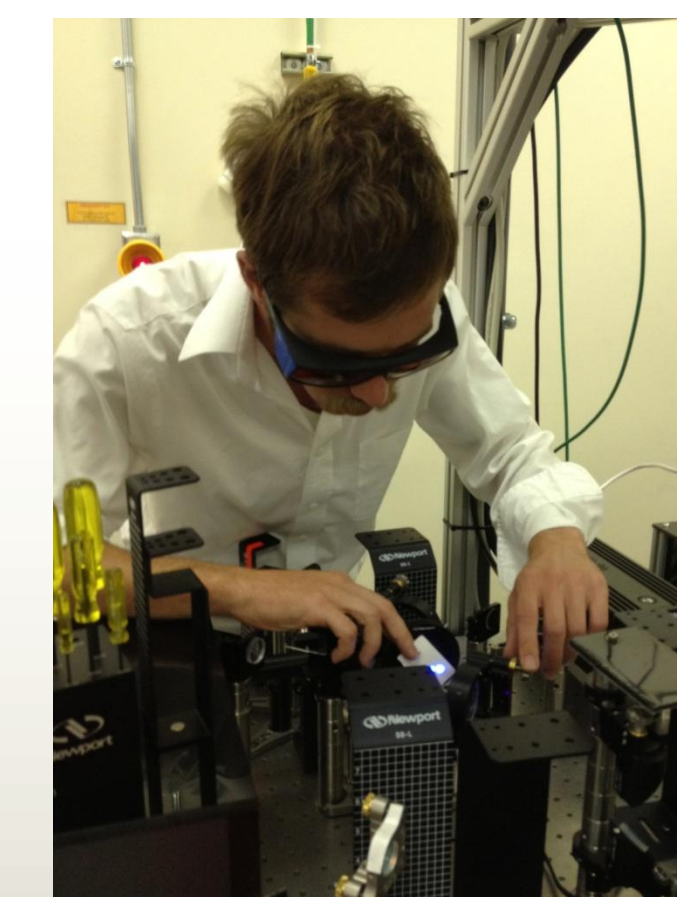
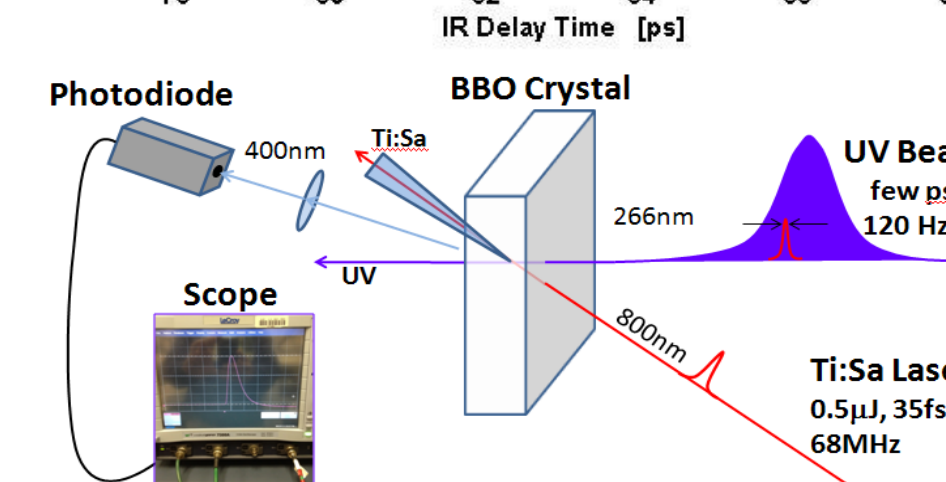
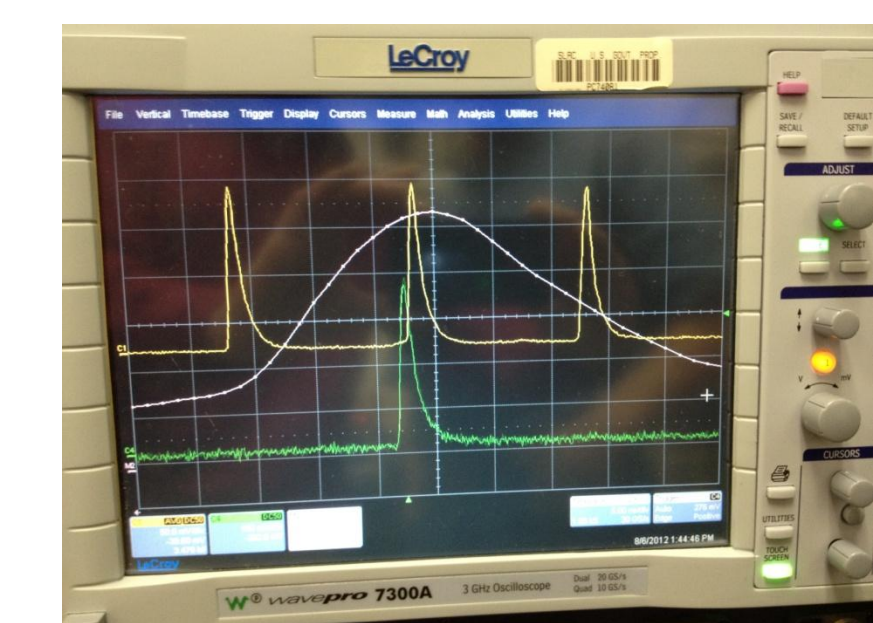
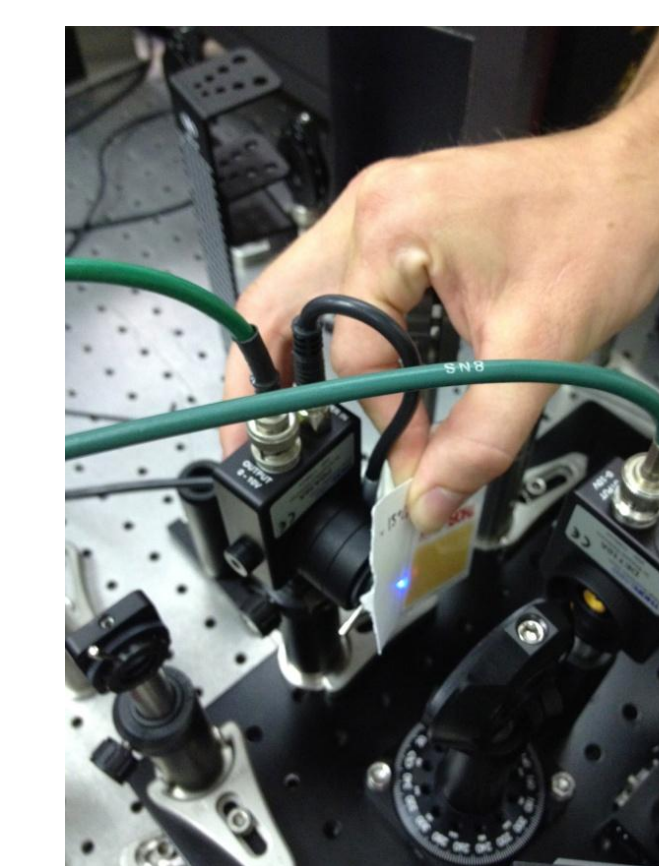
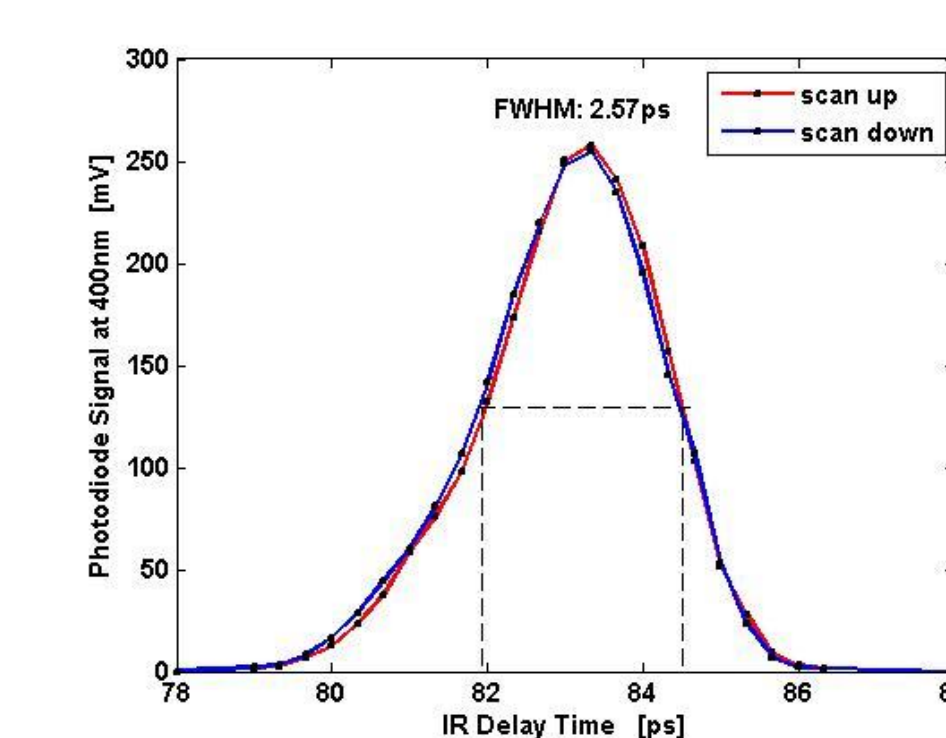
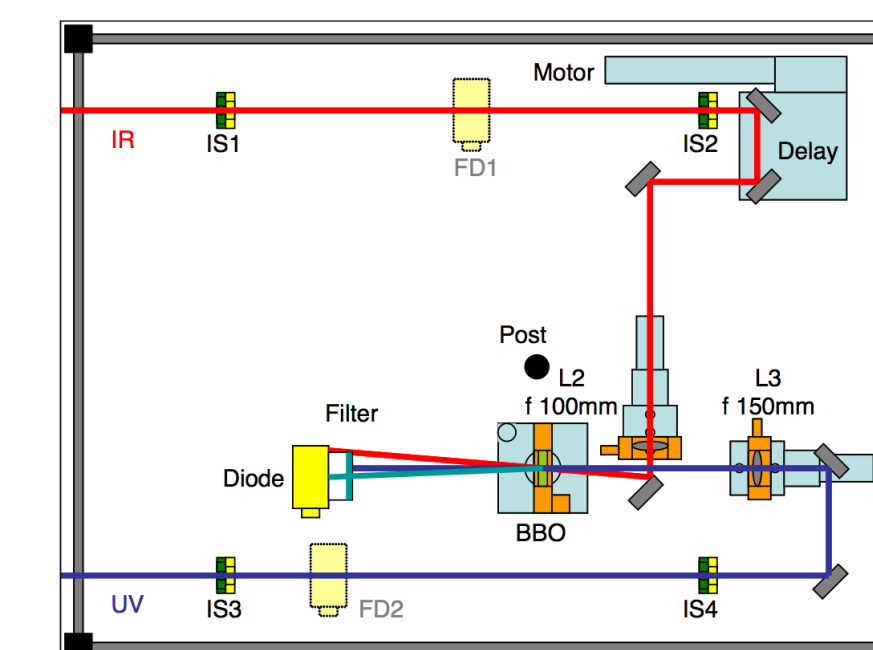
My work this summer involved the construction of the ASTA Laser Lab, the installation of the high powered laser system, and the redesign and implementation of a Cross Correlator for the new lab. This presentation includes Cross Correlator measurements as well as a larger introduction to the LCLS and Injector Laser Lab.

## Summary

Although scientists have been using photocathode techniques at SLAC for 25 years, some important aspects of the physics involved are not well understood. The ASTA Laser Lab and photo cathode gun is a replica of the Injector Lab at the LCLS. As such, ASTA now provides for experimental photocathode research with the potential to enhance operations at LCLS.

## Cross Correlator

- Instrument for measuring UV pulse length
- Femtosecond seed pulse and UV pulse are cross correlated
  - Mixed in BBO crystal
  - Spatial overlap
  - Time overlap
  - Difference frequency emitted from BBO crystal (400 nm)
  - Fast photo diode measures overlap
- 2.57 ps pulse length measured
- Cross Correlator is ready for automated control and data acquisition



LCLS Energy Flow

OSC

Regen

THG

Photo Cathode

RF acceleration

Undulator Hall

X-Ray Transport

Experimental Hall

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