

LCLS-II Injector Laser System

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Abstract

The Linac Coherent Light Source II (LCLSII) is a new Free Electron Laser (FEL) facility being built as an upgrade to the existing LCLS-I and is planned for early commissioning this year (2017) and full operation in 2020.

The injector laser which hits the cathode to produce the electrons for this FEL source is conceptually similar to LCLS-I, but will utilize an upgraded controls architecture in order to be compatible with the faster repetition rate (1 MHz) of the beam. This includes moving to industrial PCs from VME and utilizing SLAC designed PCIe timing cards and camera framegrabbers.

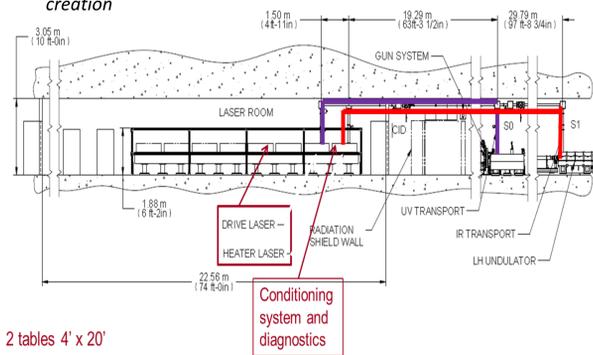
Photocathode Injector uses two lasers:

Drive Laser

- 257.5 nm (UV) pulsed laser incident on semi-conductor cathode to create electron beam

Laser Heater

- 1030 nm (IR) pulsed laser which co-propagates through heater undulator with e- beam
- Used to mitigate undesirable micro-bunching of e- beam before FEL creation



Requirements

- Automatically shut safety shutters and pulse picker (AOM) in event of MPS or BCS fault
- Ability to bypass beam permit faults locally if MPS shutter is inserted
 - Allows Laser Group to align and adjust beam while machine is down.
- Steering feedbacks (via EPICS) for position and angle of beam at various positions along paths.
- Measure drive and heater laser power non-invasively at various points along beam paths.
- Camera based transverse profile data at various points along paths.
- Read back of various Laser Room temperatures and humidity
 - Get status and temps of amplifier chillers into EPICS
 - Room thermocouples and HVAC read back (including room humidity) covered under temperature subsystem
- MPS protection for Laser Heater chicane alignment diagnostics (diode and OTR screens)

Hardware

Motors

Newport XPS-Q8 motor controller

- Stepper motors for mirror steering and linear stages
- Rotation stages for attenuation waveplates and collimation iris

Newport 8743-CL picomotor controller

- Steering mirrors in transport lines
- Local hand control

SmarAct MCS controller

- Controlling custom coarse cavity length control in oscillator



Cameras

AVT Manta G033B (Transport)

- Gig-E PoE

JAI CM-130CL (UV)

- Camera-Link

Basler acA2040-180kmNIR (IR)

- Camera-Link

Framegrabber

- SLAC designed for Camera-Link cameras
- Supports up to 8 cameras
- Built-in EVR for triggers and image time-stamping



Motor Extension Chassis

SLAC designed amplifier for motors and sensors

- Allows running Newport (and compatible) stepper and servo motors over long distances.
- Also supports LVDTs, potentiometers, encoders, and GPIO signals



Servers and I/O

Advantec Industrial PC

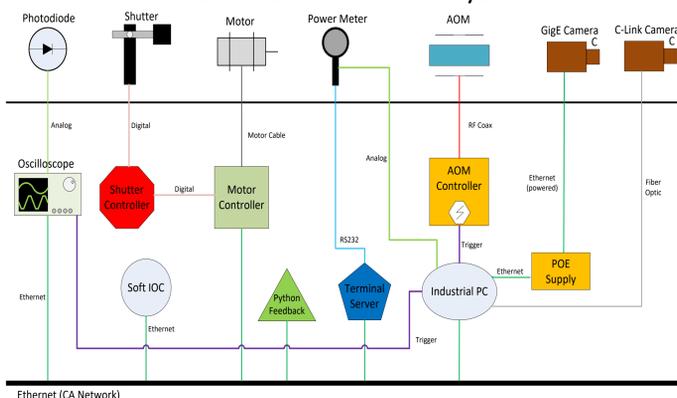
- Runs local Soft IOCs
- SLAC PCIe timing card for triggers
- Power meters
- SLAC framegrabber and/or Gig-E for cameras
- Acromag PCIe Industry Pack modules for I/O
- Power meter analogs (BSA data)
- Shutter microswitches and solenoid control



Software

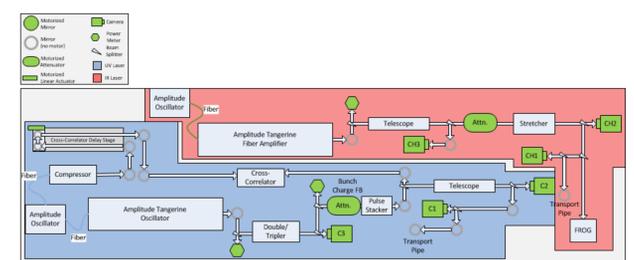
- EPICS IOC architecture based off of LCLS-I design and adapted for use on EPICS 3.15
- Integrated with SLAC's EPICS based distributed control and data archiving system
- Standard Motor record interface with Newport and SmarAct motor controllers over ethernet
- AreaDetector EPICS interface for Camera-Link and Gig-E cameras
- Sequencer State Notation feedback for maintaining beam alignment
- Python based feedback for RF locking/bucket jump detection
- Matlab scripts for automated maintenance tasks and diagnostic measurements (Cross-correlator, camera image analysis, etc.)
 - Repurposed from LCLS-I

Controls architecture layout

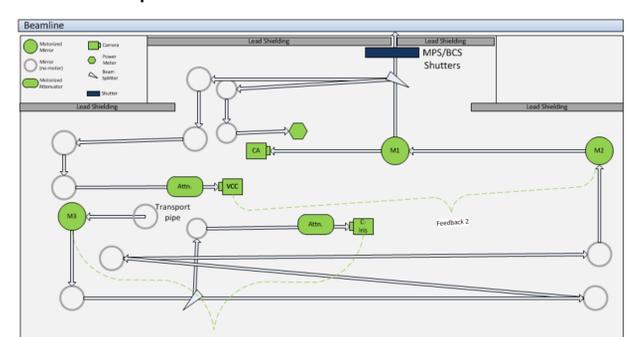


Layout

Laser Room



Gun Optics Table



Heater Optics Table

