# LCLS-II Injector Source Controls and Early Injector Commissioning (EIC)

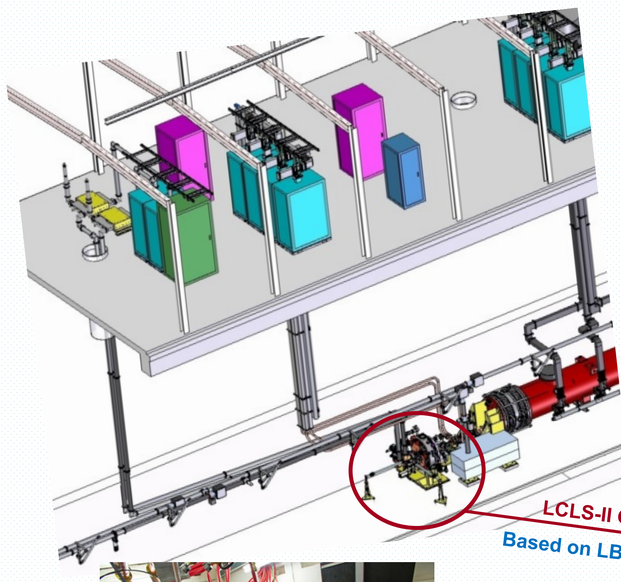
D. Rogind#, M. Boyes, H. Shoaee

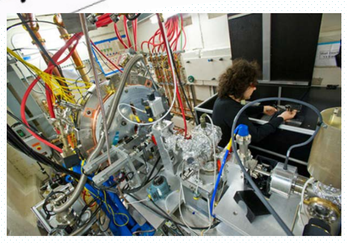
SLAC National Accelerator Laboratory, Menlo Park, CA 94025 USA

**Acknowledgements:** **SLAC** Controls Teams; **JLAB** LLRF Group; **LBN**L APEX Controls + LLRF Groups; **FNAL** LLRF Group + Resonance Control Team. (Individual names are too numerous to mention.)

## Abstract

LCLS-II is a superconducting upgrade to the existing Linear Coherent Light Source at SLAC with a continuous wave beam rate of up to 1 MHz. Construction is underway with first light planned for 2020. The LCLS-II Injector section that comprises low energy from the gun up to the location of the first cryomodule is based on the LBNL Advanced Photo-Injector Experiment (APEX), and is being provided by LBNL. In 2015, responsibility for **controls** design and fabrication was transferred to SLAC from LBNL to promote commonality with the rest of the LCLS-II control subsystems. Collaboration between the LBNL APEX controls community and SLAC LCSL-II EPICS controls teams proved vital in advancing the controls architecture toward standardized implementations integrated with the rest of LCLS-II. An added challenge is Early Injector Commissioning (EIC), ~1.5 years ahead of the rest of LCLS-II, in Jan. 2018. EIC **controls scope, approach, and advantages** are discussed.

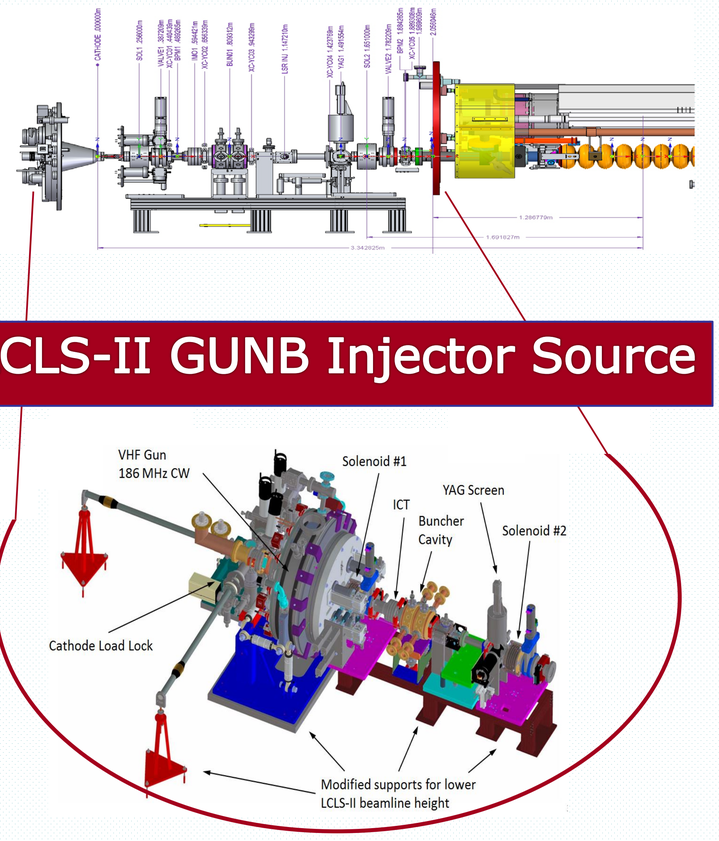




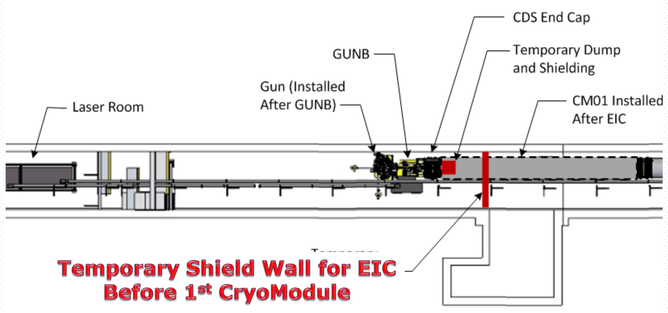
APEX prototype at LBNL

LCLS-II GUNB Based on LBNL APEX

## LCLS-II GUNB Injector Source




## What is EIC Scope?




## EIC Controls

Brand new!

**GUNB Controls:**
- Gun LLRF
- Gun RF Cavity Motion
- Buncher LLRF
- LLRF Interlocks
- Solenoid Motion

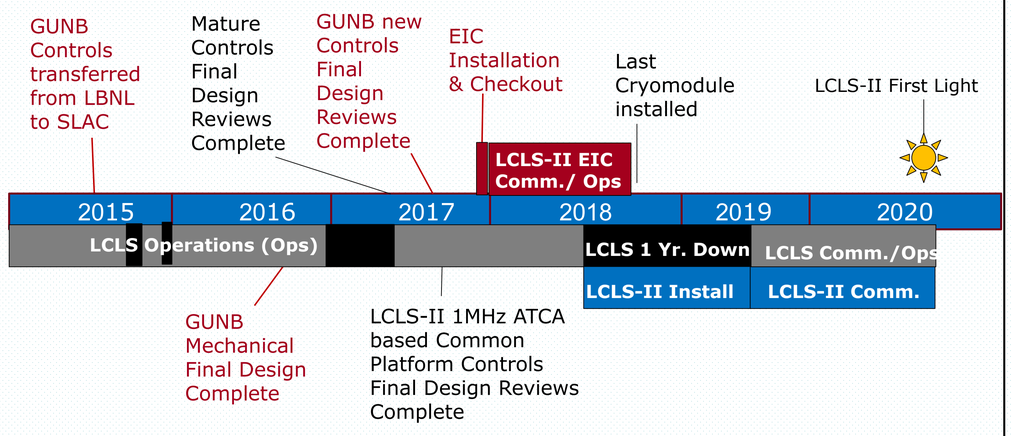
**Mature Controls*:**
- Drive Laser
- Network & Computing
- Vacuum
- Personnel Protection
- Profile Monitor
- Racks & Cables

**Based largely on LCLS*

Brand new!

**1MHz Controls:**
- Based on ATCA Platform
- Timing
- Machine Protection
- Beam Position Monitor
- Bunch Charge Monitor/ Faraday Cup

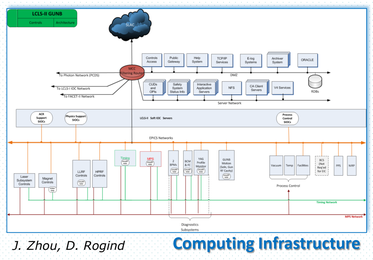
## LCLS-II Timeline




## EIC Approach

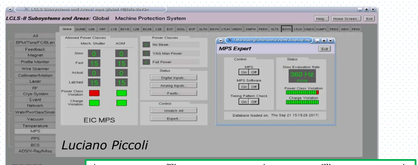
- ❑ Appointed SLAC GUNB / EIC Project Lead
  - ❖ Create comprehensive Interface Control Doc (ICD)
  - ❖ Create Partner Lab Scope Handoff Agreements
  - ❖ Weekly EIC dedicated meetings
- ❑ GUNB: Collaborate between the LBNL APEX & SLAC mechanical / controls communities
  - ❖ Design & incorporate LCLS-II standard controls for use with GUNB Injector Source
    - Only Motion and Interlocks are unique designs for GUNB
    - Use SLAC BPM stripline, YAG screen design & controls
    - LLRF controls remain Partner Lab scope
    - 1MHz-based control systems incorporated
- ❑ EIC: Advance schedules for "warm" LCLS-II Controls Subsystems by ~ 1 year:
  - ❖ Drive Laser (only), Vacuum, PPS, BPM, BCM, YAG, MPS, Timing
  - ❖ Gun & Buncher LLRF
  - ❖ No requirement for Beam Containment; no cryogenics
- ❑ Some temporary / basic solutions will exist:
  - ❖ Computing Infrastructure uses LCLS infrastructure
  - ❖ Basic: Timing, Machine Protection Systems
  - ❖ FCUP temporary location on temporary shield wall
- ❑ Some first article "prototypes" will be fielded:
  - ❖ Gun & Buncher LLRF controls
  - ❖ Racks, shorter Phase Reference Line

## EIC Interim Solutions

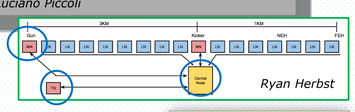


J. Zhou, D. Rogind — Computing Infrastructure

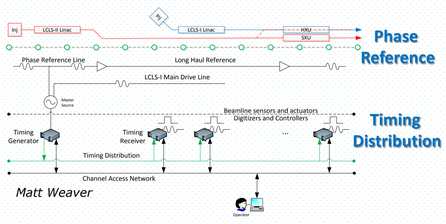
Basic Machine Protection



Luciano Piccoli — EIC MPS



Ryan Herbst

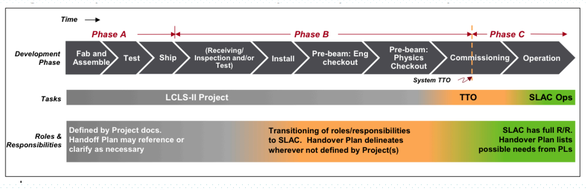


Matt Weaver — Phase Reference / Timing Distribution

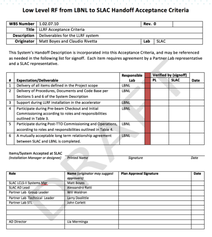
Carolina Bianchini — EIC Basic Timing

SLAC ATCA Common Platform

## Partner Lab Handoff Agreements

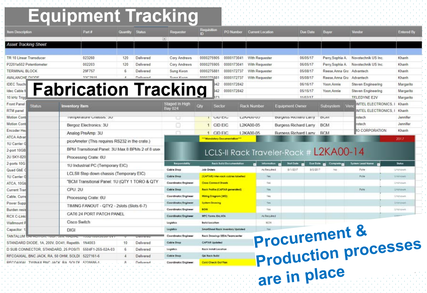



Based on Lead –Mentor –Consult Concept



Low Level RF from LBNL to SLAC Handoff Acceptance Criteria

## EIC Production & Rack Loading




- Procurement Process & Tools refinement
- Rack Loading In house and Out-Sourced
- Dedicated space for racks loading
- Supply chain process to include:
  - Procurement, Receiving, Inventory, Tagging, Inspection, QC
- Storage space for components set up
- Supplementing available staff with contract hiring
- In future, expand to ~20 racks/month over a one year period

## EIC Pay-Offs

Brand new! Debut LCLS-II 1MHz ATCA Common Platform based controls & integrate

Brand new! Debut Partner Lab Gun & Buncher LLRF Controls
- ❖ Integrate SLAC EPICS Controls including Gun Resonance Motion

Brand new! Debut Particle Free Vacuum (new to SLAC)

Brand new! Debut EPICS 3.15.5 & git version control; Software Global Controls Integration

Brand new! Lock down Procurement and Asset tracking process & tools

Brand new! Qualtiy Control (QC) Controls Subsystems Hardware drawing packages

Brand new! QC Production & Rack Loading processes

Brand new! QC Controls check-out procedures; both Pre-beam and with beam

Brand new! QC ARR, Commissioning, support processes

Brand new! QC Partner Lab Scope Hand-off agreements

***All activities for LCLS-II Controls will benefit from experiences gained by EIC***

*Work supported by the U.S. DOE Contract DE-AC02-76SF00515 #drogind@SLAC.Stanford.EDU