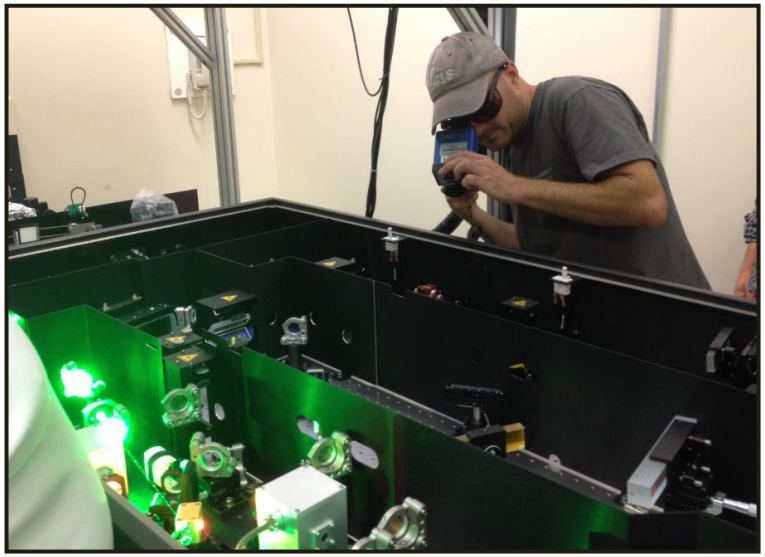
A PLC-based Laser Safety System at SLAC

Jeff Corbett, Perry Anthony and Mike Woods
SLAC National Accelerator Laboratory

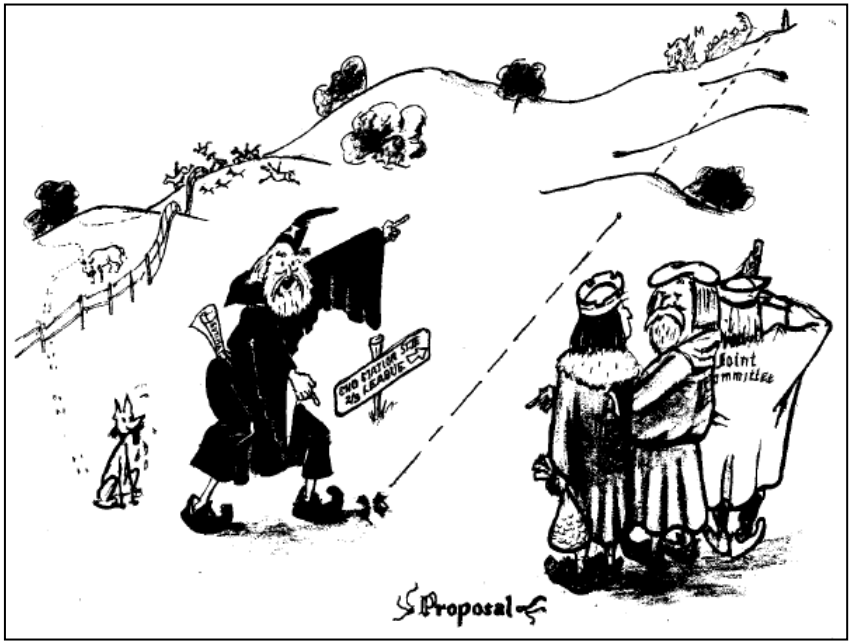
10th Annual DOE Laser Safety Officer Workshop
August 19-21, 2014
Lawrence Livermore National Laboratory

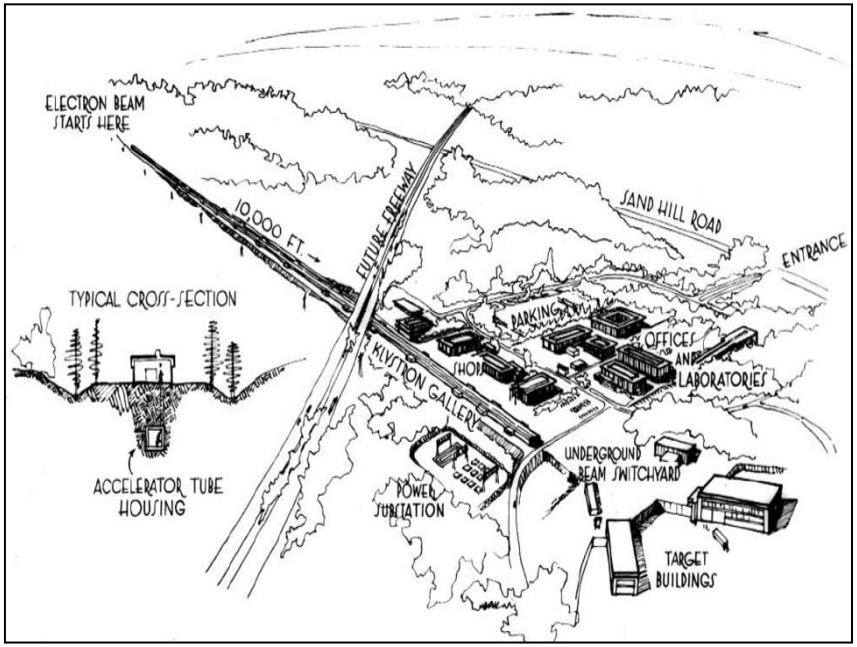
Outline

- A brief history of SLAC
- Electron gun test laboratory
- Laser bay safety system
- Gun vault safety system
- Documentation
- Some Lessons learned

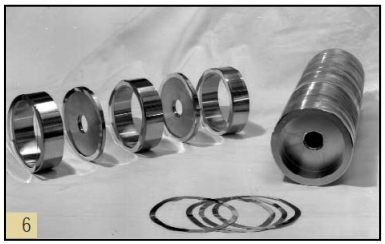


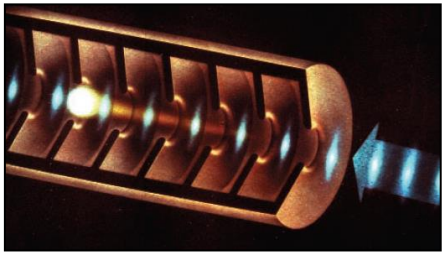
1962: 3km Linear Accelerator Construction





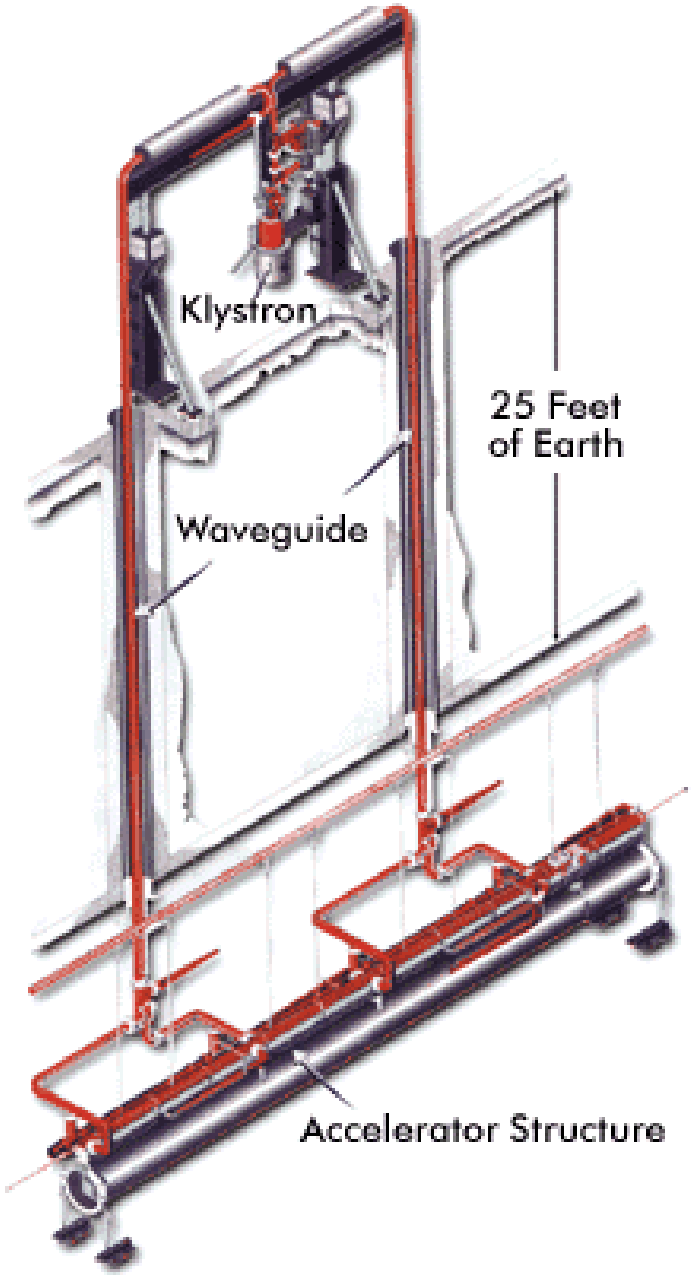
LINAC Section



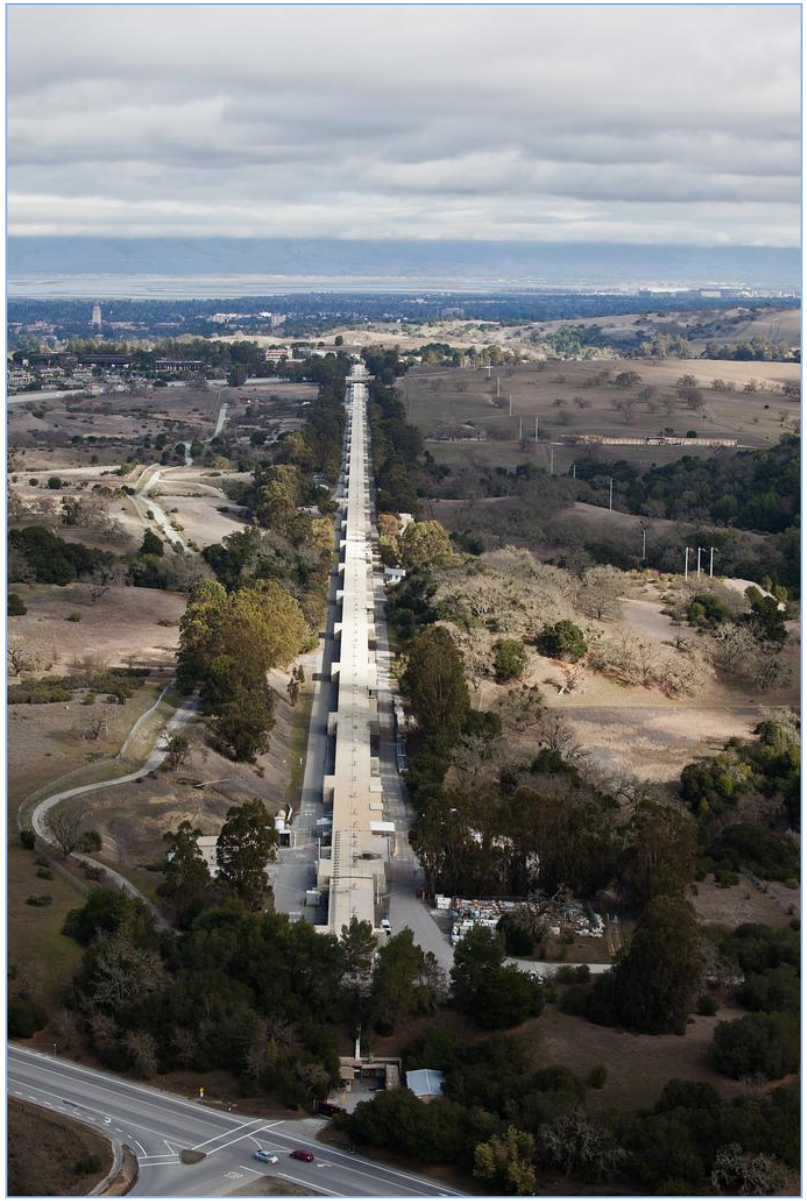


Hansen, Varian brothers

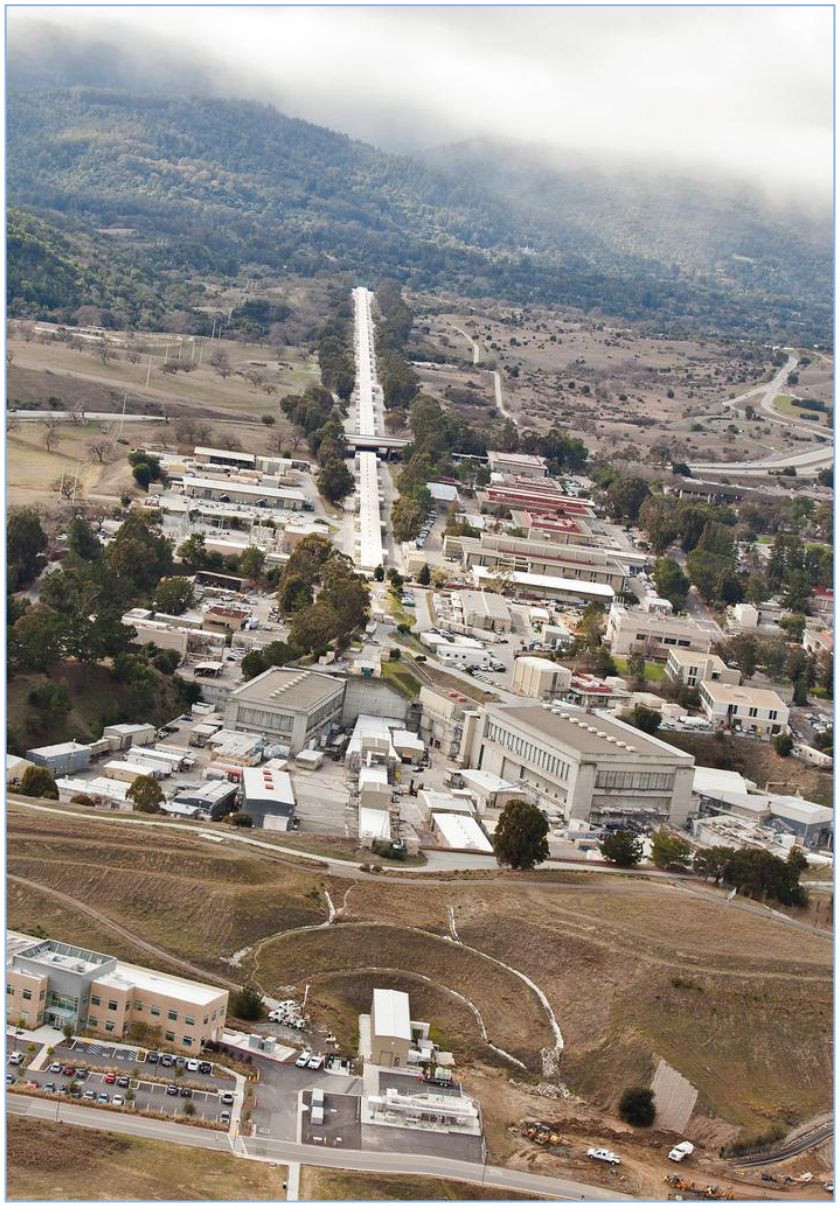
Accelerator Structure



View looking East

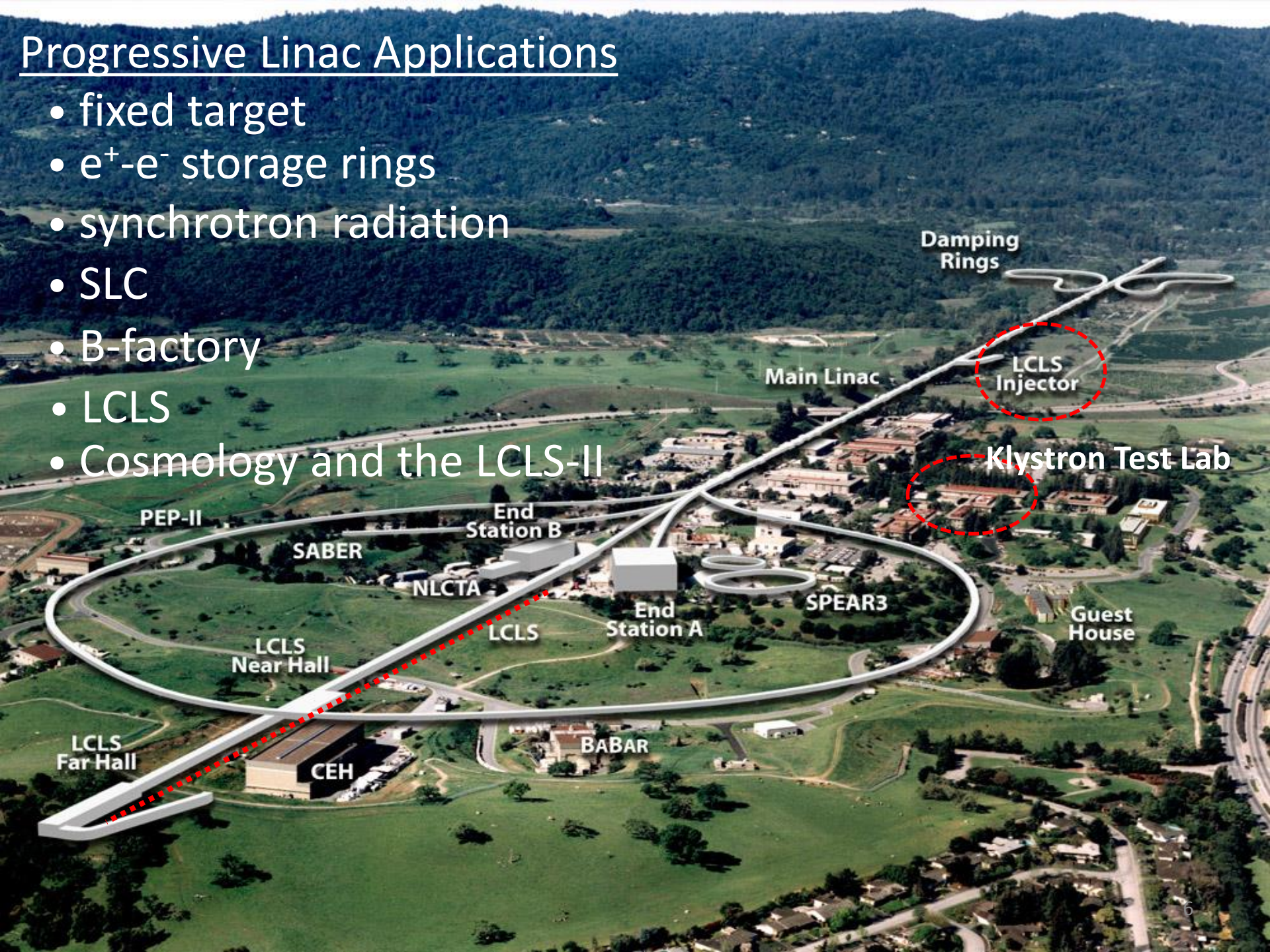


View looking West

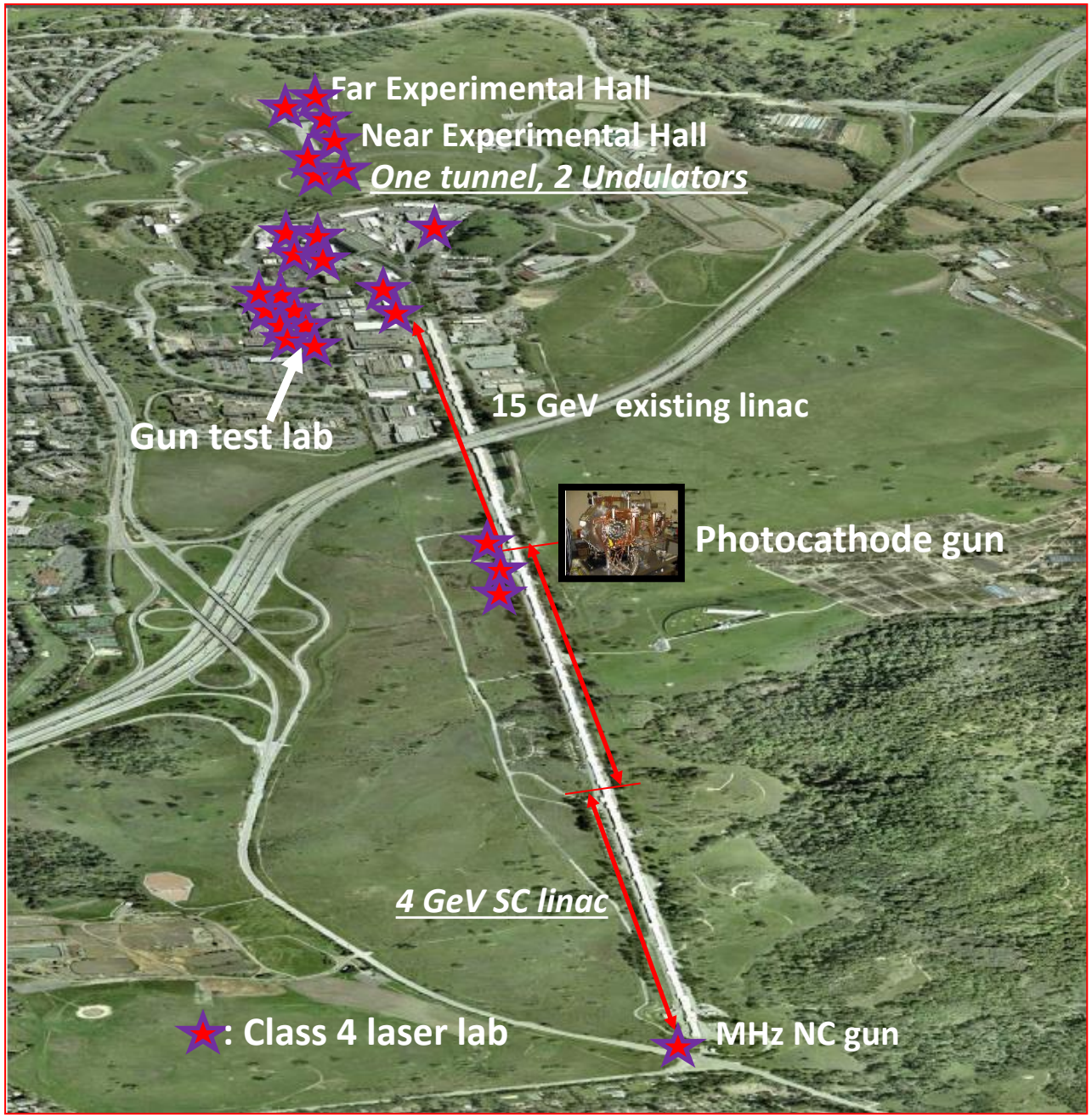


Progressive Linac Applications

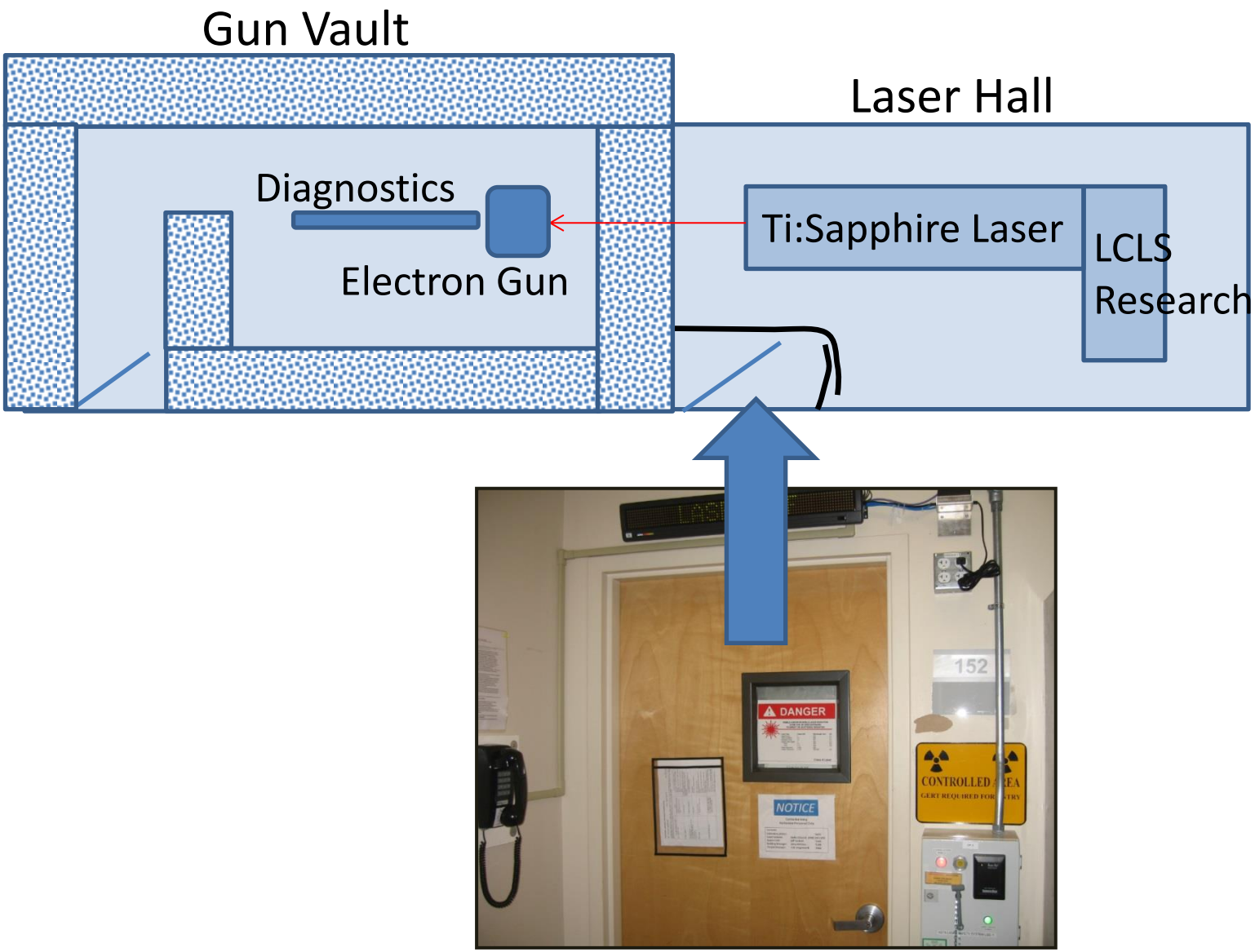
- fixed target
- e^+-e^- storage rings
- synchrotron radiation
- SLC
- B-factory
- LCLS
- Cosmology and the LCLS-II



LCLS-I and LCLS-II from above

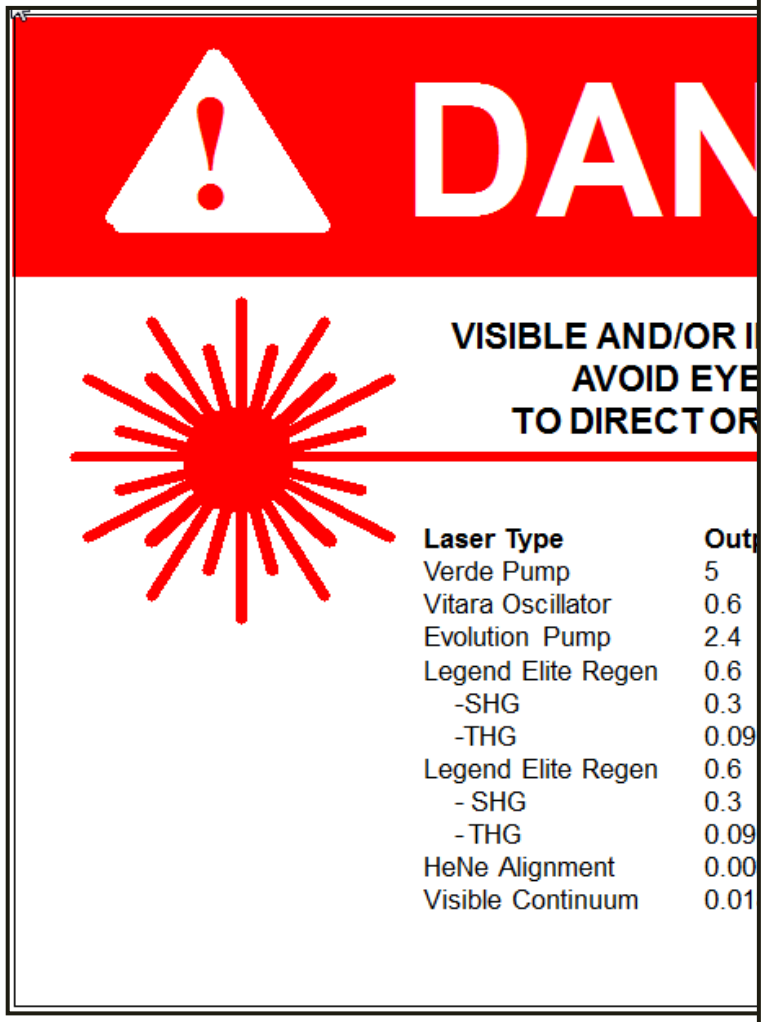


The ASTA Photocathode Gun Test Laboratory



The ASTA Laser Laboratory

Hazard Sign and Visitor Policy



Laser Visitor Policy

Laser Facility (name/location) _____**ASTA Laser Laboratory**_____
SLSO (print name) ____**Jeff Corbett**_____

Laser Visitors are personnel who have not been approved as a QLO or LCA Worker in a SLAC Laser Facility (does not include service subcontractors or the LSO). Visitors may be permitted access to this laser facility subject to the following conditions:

1. **In Laser OFF mode**, unescorted access is permitted. The SLSO, or their designee, is responsible for assuring that the facility's lasers are not operating.
2. **In Class 1 mode**, visitors must be escorted by one of the facility's QLOs or an LCA Worker. In this mode, lasers may be operating but the laser beams are fully enclosed in approved Class 1 enclosures, and there are no open beams. Laser eyewear protection is not required. The escorting QLO or LCA Worker is responsible for assuring Class 1 laser conditions during the visit.
3. **In Class 4 mode**, there may be accessible high power laser beams. Visitor access in this mode is discouraged, but may be permitted subject to the following conditions:
   i. The Visitor must wear the necessary laser eyewear protection, as specified by the QLO or LCA Worker, at all times while in the laser room.
   ii. Prior to entry, the visitor and QLO and/or LCA Worker will discuss the purpose and scope of the visit and plan a safe method of completing the task. The QLO and/or LCA Worker will explain relevant aspects of laser hazards and controls for the facility.
   iii. A QLO and/or LCA Worker must escort the visitor at all times in the laser facility.
   iv. Visitors are not allowed to operate or manipulate the laser beams.
   v. Visitors must be 18 years of age or older.
   vi. Prior to entry the QLO and/or LCA Worker escort will ensure the visitor wears appropriate laser eyewear protection, and will check the laser facility to ensure the laser system is in and will stay in a state of minimal hazard during the visit.

Policy for "Service" QLOs or in this Laser Facility

A SLAC QLO may enter and work in this laser facility in Class 4 mode without becoming a QLO for this facility, subject to the following conditions:

i. the visiting "Service" QLO must have approval from their administrative supervisor and the SLSO for this facility (or their designees),
ii. the visiting "Service" QLO must be escorted by one of this facility's QLOs, and
iii. there must be a pre-job briefing between the "Service" QLO and the escorting QLO for the work to be performed.

Notes: i. The intended purpose for "Service" QLOs is to permit short-term service work, measurements, or experiments.
ii. Unescorted work in Class 4 mode can only be done by this facility's QLOs.
iii. LCA Workers not authorized for this LCA are treated as 'Laser Visitors' (see above).

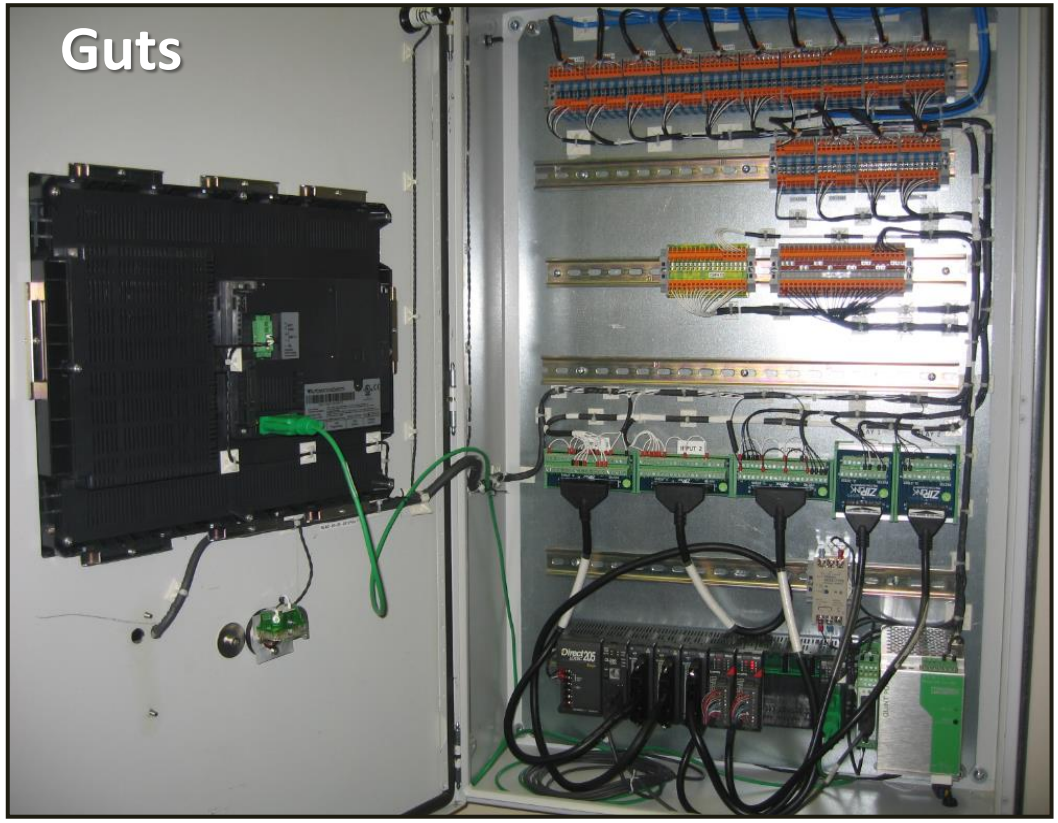
Eyewear Storage

NOTICE

Class 4 Eyewear Requirements

Operational Mode	Eyewear	OD
800/400/266nm →	Sperian 108	OD > 9 @ 190-420nm OD > 5 @ 770-810nm OD > 7 @ 810-1100nm
800/266nm + continuum →	LaserVision 133	see JSA
Maintenance →	KTI	OD > 7 @ 190-532 nm OD > 7 @ 750-820 nm

The Master Control Panel



Laser Safety System - Initial Acceptance Test

Stanford Linear Accelerator Center
Stanford Synchrotron Radiation Laboratory

Procedure Number: 262-100-26 Revision C02

ASTA Bunker Laser Safety System Checkout Procedure

Author: _____ Date: _____

Perry Anthony, PCDS Laser Safety System Engineer

Reviewed: _____ Date: _____

Jeff Corbett, ASTA Bunker Laser Safety Officer

Reviewed: _____ Date: _____

Mike Woods, SLAC Laser Safety Officer

Summary

This document specifies the process for verification of functionality of the Laser Safety System installed in the ASTA Bunker.

Rev. Number	Description	Date/Author
00	Original Version	Sept. 1, 2012 Perry Anthony
01	2013 re-certification including PPS E-stop and PPS door Emergency Entry.	Sept. 4, 2013 Corbett/Jobe
02	Explicit laser off test	June 12, 2014/Perry Anthony

Verify that the alarm terminates and verify that the Transport Tube shutters are closed. Verify at: • TouchPanel Display	
QLO keys into the RFID reader at the TouchPanel Display and issues command to open the Transport Tube Shutters	
After the shutters have opened, QLO keys into the RFID reader at the TouchPanel Display and sets to Laser Off mode	
Verify on the TouchPanel display that the Transport Tube Shutters have closed.	

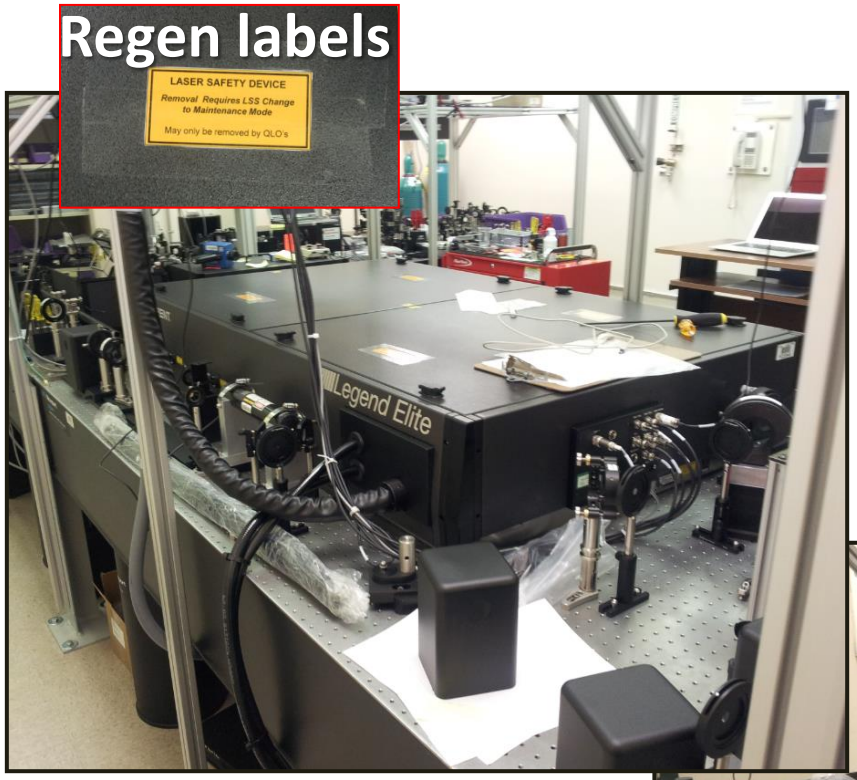
3.3 Interlock Function Checks

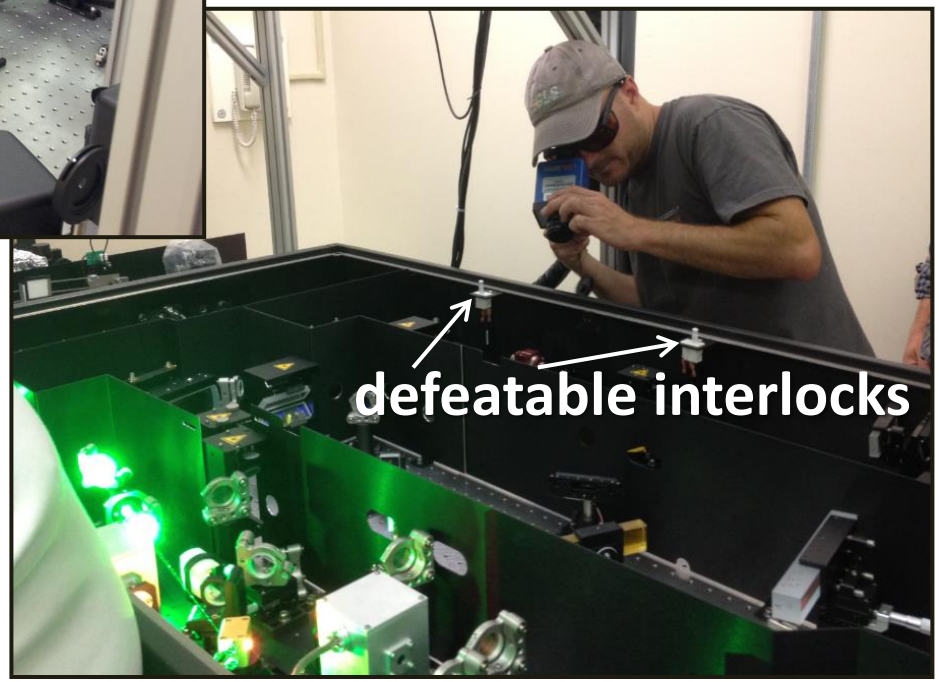
3.3.1 Shutter State Interlock

QLO Keys into RFID reader at MCP Display and resets interlocks and sets laser mode to CLASS 4	
QLO Keys into RFID reader and issues command to open Transport Tube shutters (if needed)	
Verify that only the Transport Tube shutters are open. Verify at: TouchPanel Display	
With the SLSO's permission, open the transport shutter enclosure in the ASTA Laser Room	
Physically move Transport Tube shutter 1 so that it is neither open nor closed and hold for 5 seconds.	
Verify at the MCP that the Shutter Enable interlock has tripped, and verify the audible and visual alarm.	
Verify that all shutters are closed. Verify at: TouchPanel Display	
QLO Keys into RFID reader at MCP Display and resets interlocks and sets laser mode to CLASS 4	
QLO Keys into RFID reader and issues command to open Transport Tube shutters	
Verify that only the Transport Tube shutters are open. Verify at: TouchPanel Display	
Physically move Transport Tube shutter 2 so that it is neither open nor closed and hold for 5 seconds.	
Verify at the MCP that the Shutter Enable interlock has tripped, and verify the audible and visual alarm.	
Verify that all shutters are closed. Verify at: TouchPanel Display	

Sign and countersign

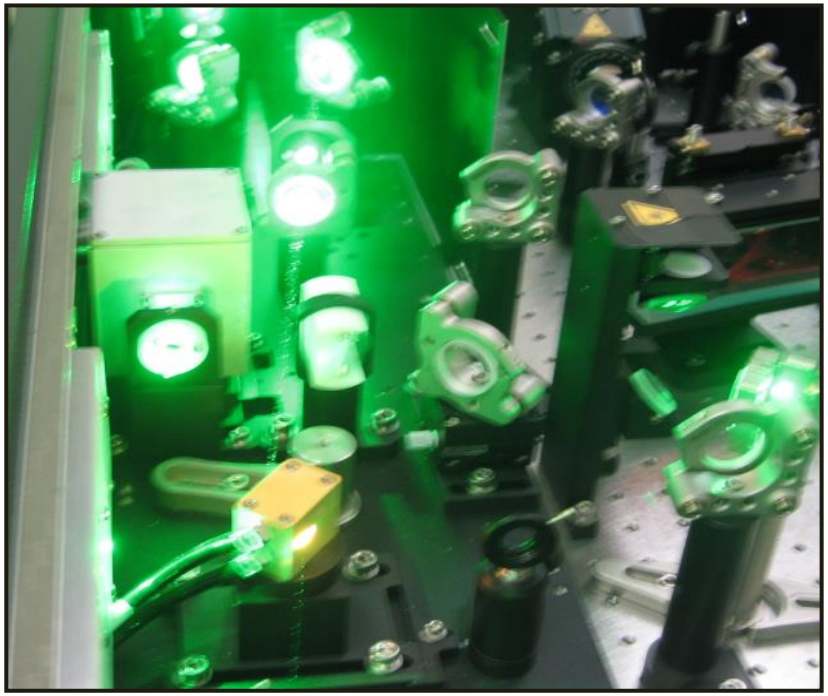
Class 4 Maintenance Mode





Maintenance Mode: Green Blockers

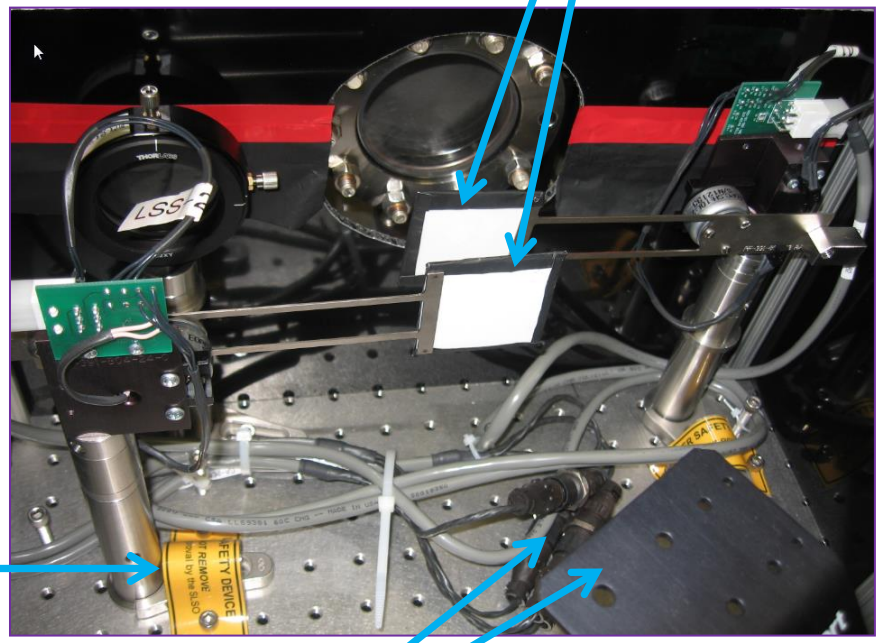
Googles Off



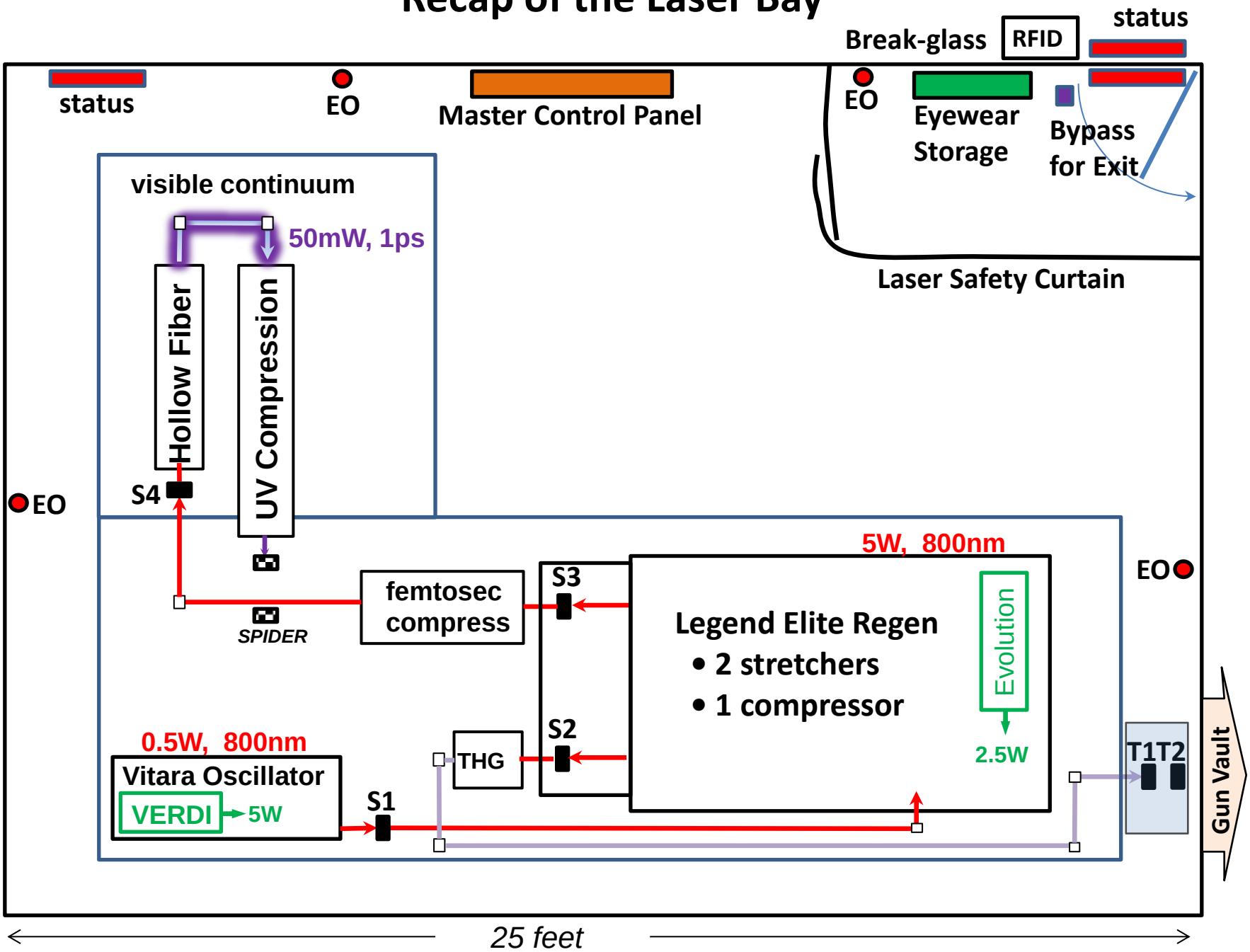
Googles On

'WEAR THY GOGGLES'

Transport Shutters leading to Gun Vault

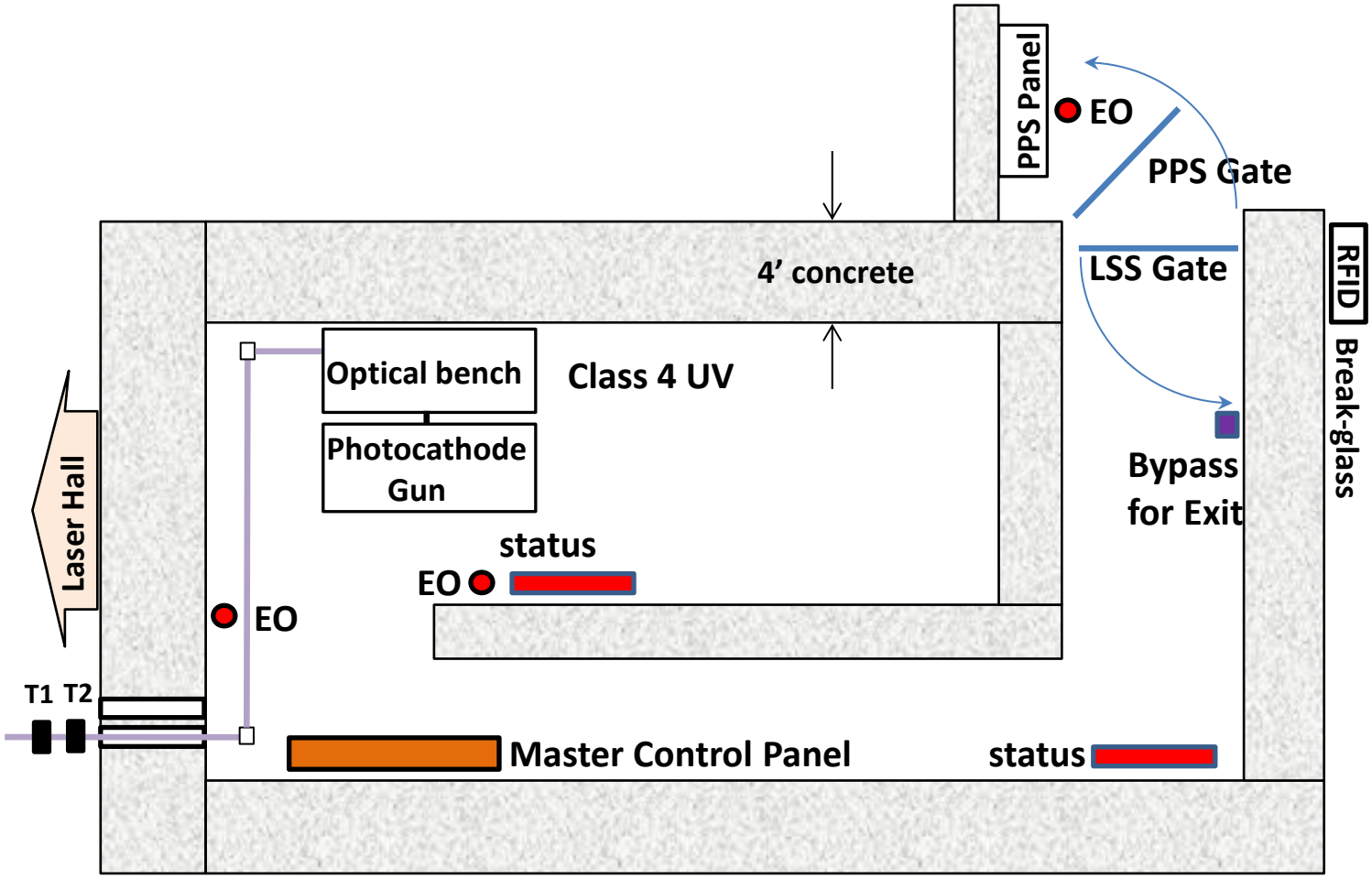


Recap of the Laser Bay



Room Exit Bypass (15 sec)

Photocathode Gun Vault



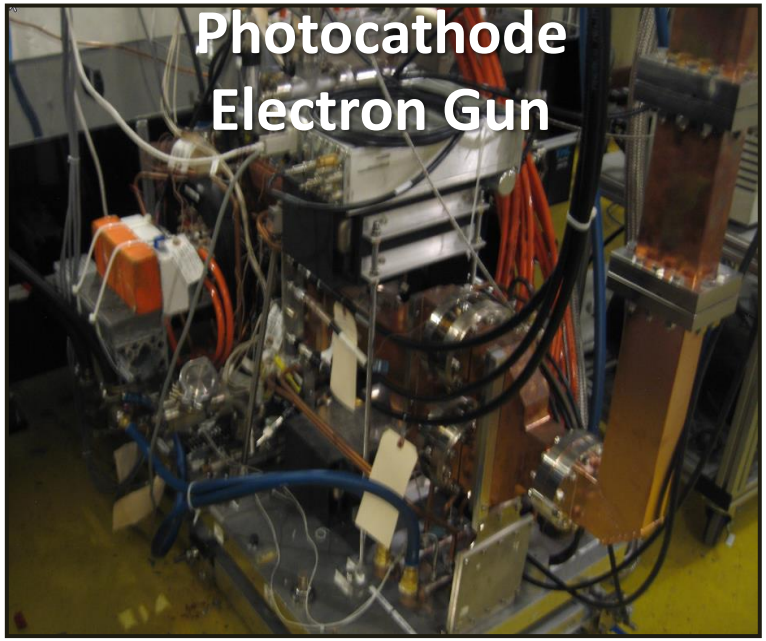
Electron Gun Vault Entrance

Badge
for Entry

Radiological control

Laser Safety in the Gun Vault

Transport Shutter Control Panel



Photocathode Electron Gun

Enclosed compressor, tripler, etc (not Class 1)

Main Documents, Authorizations, Inspections

Laser Safety Contract for the AST

SLAC
NATIONAL ACCELERATOR LABORATORY

Laser Safety Contr
for the ASTA Lase

Author: **Jeff Corbett**
Department: **SPEAR3 PCT**
Location: **Building 44, room 152 and**
Version: **1**
Date: **J**
Laboratory Phones: **x**

APPROVAL OF LAS

Jeff Corbett, ASTA S

~~Erik Jongewaard~~, AS
Stephen Weathers

Mike Woods, SLAC I

SLAC
NATIONAL ACCELERATOR LABORATORY
ENVIRONMENT, SAFETY & HEALTH DIVISION

Chapter 10: Laser Safety
Approval to Operate
Product ID: 101 | Revision ID: 1338 | Date Publishe
URL: http://www-group.slac.stanford.edu/esh/eshm

This form must be completed before operations begin using a Class 3B or 4 laser (see Operation Requirements).

Laser laboratory name and location: ASTA, Bld
Department and division: Accelerato
System laser safety officer (SLSO) name: Jeff Co
Standard operating procedure (SOP) version and date: v1.1, 9-4
Expiration date: 9-6-2014

Requirements

Authorization to operate this laser lab requires the following:

1. Approval that is current. (An approved, unexpired form must be on file and appro in order to continue laser operations.)
2. Laser safety officer (LSO) approval of the SOP document
3. Laser lab walkthrough and inspection checklist completed by LSO
4. Laser safety system (LSS) configuration and interlock checks completed by SLSO

Laser Safety: JSA Approval

Location: **Bldg 44, Rm152** (ASTA)
Department: Accelerator Test Facilities
SLSO: Jeff Corbett

JSA Memo Title and Date: Job Safety Analysis for continuum generation in sapphire; v2.2; Aug. 24, 2012

Expiration Date: July 20, 2013

Notes:

1. *Operation under this JSA is approved for the following Class 4 operation modes described in the ASTA Laser Safety Contract/SOP: Class 4 Normal 800nm and Class 4 Maintenance.*
2. *SLSO approval indicates that they have adequately reviewed and addressed safety issues relevant to this activity that are in addition to laser safety. The LSO is only approving the laser safety controls.*
3. *LSO approval indicates site inspection completed and all pre-start action items are complete.*

Date

Date

Laser Safety: LSO Laser Lab Visit Checklist

Department: Radiation Protection
Program: Laser Safety
Owner: Program Manager
Authority: ES&H Manual, Chapter 10, Laser Safety[1]

Introduction

This checklist is to be used by the laser safety officer (LSO) for conducting annual inspection audits of laser laboratories, for inspecting new laser labs, and for inspecting significant changes to existing labs. A completed checklist is required before authorizing new approvals to operate a laser lab. System LSOs (SLSOs) are required to keep a record of each checklist completed for their lab in their lab's laser safety binder.

SLSO name	Jeff Corbett
Laboratory visited	ASTA; Bldg 44 Rm 152
Visit date	August 9, 2013
SOP version number	1.0
SOP date	July 20, 2012
Authorization to operate expiration date	August 31, 2013
Laser system personnel present	Jeff Corbett

1 *SLAC Environment, Safety, and Health Manual* (SLAC-I-720-0A29Z-001), Chapter 10, "Laser Safety", http://www-group.slac.stanford.edu/esh/hazardous_activities/laser/policies.htm

Laboratory Personnel Records

SLAC NATIONAL ACCELERATOR LABORATORY

ENVIRONMENT, SAFETY & HEALTH DIVISION

Chapter 10: Laser Safety

Qualified Laser Operator Approval Form

Product ID: 544 | Revision ID: 1340 | Date Published: 22 July 2011 | Date Effective: 22 July 2011
URL: http://www-group.slac.stanford.edu/esh/eshmanual/references/laserFormApprovalQLO.pdf

This form is to be completed by the qualified laser operator (QLO) to be approved with required signatures indicated in Step 7. A copy must be on file in the laser safety binder at the laser laboratory. Class 3B or 4 lasers may only be operated by approved QLOs (see Laser Safety: Class 3B and Class 4 Laser Operation Requirements).

Operator: Alan Miahnahri (print and sign name and initials)

Laser laboratory name and location: ASTA

System laser safety officer (SLSO) Jeff Corbett (print name)

1. If already a QLO for another SLAC laser laboratory and all training is current, then skip steps 2 through 4; print laboratory name and location if already a QLO: Injector, RLL, NEH,.....
2. Required training completed
   a. Reviewed STA with supervisor. Date and initial: _____
   b. ESH Course 253, Laser Worker Safety Training (ESH Course 253). Date and initial: _____
   c. ESH Course 253ME, Laser Worker Baseline Medical Exam (ESH Course 253ME). Date and initial: _____
   d. ESH Course 131, Laser Accidents and Lessons Learned (ESH Course 131). Date and initial: _____
   e. ESH Course 120, Work Planning and Control Overview (ESH Course 120). Date and initial: _____
   f. ESH safety orientation (ESH Course 219 for SLAC employees or ESH Course 396 for non-SLAC employees). Date and initial: _____
   g. For QLOs who perform laser optics work: ESH Course 253PRA, Laser Alignment Safety Practical (ESH Course 253PRA), Date and initial: _____
3. Has read ESH Manual Chapter 10, "Laser Safety", and accepts roles and responsibilities described therein. Date and initial: _____
4. Students only: has read and agrees to comply with Laser Safety: Student Requirements. Date and initial: _____
5.
6.
7.

Training (OJT) Completion Form

aser Facility: ASTA Laser Labo
ocation: Building 44, Room 152
LSO: Jeff Corbett

ippe Hering (print)

aining described in Section 1 of the

T Provider t name + sign)	Date OJT Completed
Jeff Corbett	12-3-14 (Day Month)

entation OJT (as described in Section 4
(SLSO signature if approval given)

ser Safety Practices described in Sect
f approving the QLO to be able to wor
*d in the QLO Matrix in Section 3)***

T Provider t name + sign)	Date OJT Completed
Jeff UOC	12-3-14

ser Safety Practices OJT (as described
(SLSO signature if approval given)

g://slacspace.slac.stanford.edu/sites/esh/rp/laser

SLAC NATIONAL ACCELERATOR LABORATORY

Laser Facility: ASTA Laser Laboratory
Location:
SLSO: Jeff Corbett (print)

Qualified Laser Operator's Name: Philippe Hering (print)

3. The QLO completed OJT for the following activites described in Section 3 of the OJT Syllabus document:
(approval may also be given by the SLSO for the QLO to provide OJT for an activity, as described in Section 4 of the OJT Syllabus document)

Activity or System being aligned/ worked on	QLO (give initials or sign)	OJT Provider (print name)	Date OJT Completed	SLSO Approval (give initials or sign)	SLSO approval for QLO to provide OJT for this activity? (initial, if approval given)
1. Beam transport and delivery downbeam of regen	X PH	Jeff Corbett	12-3-14	UOC	UOC
2. Vitara oscillator					
3. Legend regen					
4. Pulse compressor					
5. UV harmonics					
6. Cross-correlator					
7. Continuum Generation					
8. Controls and DAQ					
9. Timing synchronization					
10. RF					

ASTA QLO Matrix June 4, 2014

	QLO Name	Home Institution	Student/ status	SLAC Badge Number	152 Main Door (y/n)	152 MCP (y/n)	Active? (y/n)	Approval Date	Last OJT Date	253 PRA (y/n)	253 Training Due	Core OJT – can work unsupervised (y/n)	Approved Operations: Osc (y/n)	Regen (y/n)	Harmonic + Cross (y/n)	Continuum (y/n)	Beam Delivery (y/n)
1	Sasha Gilevich	SLAC	n	9255	y	y	y	7/31/12	7/31/12	y	3/14/2016	y	y	y	y	y	y
2	Ryan Coffee	SLAC	n	10197	y	y	y	7/31/2012	10/20/2012	y	4/8/2016	y	y	y	y	y	y
3	Philippe Hering	SLAC	n	6473	y	y	y	8/1/2012	form pending	y	5/9/2016	y	y	y	y	n	y
4	John Sheppard	SLAC	n	8946	y	y	y	12/14/2012	12/14/2012	y	4/5/2016	y	y	y	y	y	y
5	Nick Hartmann	LCLS Visitor	grad	6898	y	y	y	8/17/2012	8/16/2012	y	3/23/2014	y	y	y	y	n	y
6	Jeff Corbett	SLAC	n	5272	y	y	y	7/31/2012	7/31/2012	y	3/18/2016	y	y	y	y	n	y
7	Stephen Weathersby	SLAC	n	10279	y	y	y	9/19/2012	9/19/2012	y	10/15/2015	y	y	y	n	n	y
8	Theo Vecchione	SLAC	n	5762	y	y	y	12/13/2012	12/12/2012	y	4/10/2016	y	y	y	y	n	y
9	Wolfi Helml	LCLS Visitor	postdoc	9316	y	y	y	1/17/2013	1/16/2013	y	5/16/2016	y	y	y	y	y	y
10	Alan Fry	SLAC	n	4231	y	y	y	5/9/2013	5/9/2013	y	7/12/2016	y	y	y	y	y	y
11	Anton Lindahl	LCLS Visitor	postdoc	7630	y	y	y	11/15/2013	10/4/2013	y	7/26/2016	y	y	y	y	y	y
12	Sharon Vetter	SLAC	n	8988	y	y	y	2/10/2014	2/10/2014	y	8/8/2016	y	y	y	y	n	y
13	Jim Lewandowski	SLAC	n	5268	y	y	y	6/3/2014	6/3/2014	y	7/29/2011	y	n	y	n	n	y
14	Alan Miahnahri	SLAC	n	5100	y	y	y	6/4/2014	6/4/2014	y	10/5/2009	y	y	y	y	y	y


Thank you!