LASER SYSTEMS ALIGNMENT PROCEDURE CHECKLIST

Date 9/22/04 Bldg 366 Room ANA Laser Room

Check YES or NO for each step. If YES, describe method. If NO, write a brief explanation of why control cannot be implemented. Attach additional sheets when further explanation is needed.

RECEIVED
SEP 22 2004

Will you be performing exposed laser beam alignments?

☒ YES ☐ NO (If YES, go to next question; if NO, go to END.)

Is a detailed alignment procedure included in your SOP?

☒ YES ☐ NO (If YES, go to #1; if NO, stop and develop a procedure.)

PER ESH MANUAL SECTION 6.2.11:

1. **Will a Class 2 laser be used for all beam alignments?**

☐ YES ☒ NO (If YES, skip to END; if NO, explain and go to #2.)

Alignment is done with actual class 4 laser (wavelengths from visible to UV), attenuated as much as possible

2. **Will alignment be with only visible CW wavelengths, and power less than 1 milliwatt (simulating a Class 2 laser)?**

☐ YES ☒ NO (If YES, skip to END; if NO, explain and go to #3.)

Alignment is done with actual class 4 laser (wavelengths from visible + UV) attenuated as much as possible

3. **Will alignment be performed with the exclusive use of remote viewing devices?**

☐ YES ☒ NO (If YES, describe and skip to END; if NO, explain and go to #4a.)

We use IR viewer + photodiode + power meter.

4a. **Does your procedure require beam path and target areas to be shielded and enclosed where possible?**

☒ YES ☐ NO (If YES, go to #4b; if NO, skip to #5.)

4b. **Does your procedure require the laser power or pulse energy to be reduced to minimum operable level?**

☒ YES ☐ NO (If YES, go to #4c; if NO, skip to #5.)

4c. **Does your procedure describe specific eye protection requirements during alignment?**

☒ YES ☐ NO (If YES, go to END; if NO, skip to #5.)

5. **Have you consulted with the Laser Safety Officer to determine alternative methods to achieve satisfactory personnel safety during beam alignment?**

☒ YES ☐ NO (If YES, go to END; if NO, consult with LSO.)

LCA Supervisor Li Gao

Approvals

ANL-649 (9-03)

Laser Safety office — Division Director

INTERVIEW QUESTIONS

1. Which portions of your system produce the greatest risk of accidental exposure?
2. Could any of these risks be reduced by additional engineering controls?
3. Do you have periscopic beam risers that are not covered?
4. Do you have rotatable beam splitter/polarizer/attenuators?
5. Do you have any other components that could produce upward directed beam?
6. Are all sources of potential upward beam shielded during alignment?
7. Do you have components that are rotatable but do not lock down?
8. Does your procedure require that only necessary portions of beam enclosure be removed during alignment?
9. Does your procedure require full eye protection at all times during alignment?
10. How do you qualify your users to perform alignment?
11. Do you monitor your users to assure safe performance of alignment?

Date of interview: 9/24/04

LCA in Bldg: 366

Room: AWA

LCA Supervisor: W. GAI Division: HEP

Conducted by: _____ 9/24/04
ANL-E LSO Division ESH/QA Coordinator

btm 9/2004

RECORD OF COMPLETION

LASER SYSTEMS ALIGNMENT SAFETY INITIATIVE

Description of Laser Controlled Area (LCA):

Building 366 Room AWA

LCA Custodian W. GAI Division HEP

ANL-649 submitted and approved:

ANL-E Laser Safety Officer	Division Director ES&H Administrator	9/24/04 Date

---

Interview with LCA Supervisor completed:

ANL-E Laser Safety Officer	Division Director ES&H admin.	9/24/04 Date

---

Laboratory inspection completed:

ANL-E Laser Safety Officer	Division Director ES&H Admin.	9/24/04 Date

---

btm 9/23/2004

Argonne National Laboratory

HEP Division

Standard Operating Procedure For
BLDG. 366 AWA Laser Room
Laser Controlled Area

Version 1.0

August 2, 2002

Prepared by: Wei Gai

LCA Supervisor:

Wei Gai 8/2/02
Name Printed Signature Date

ESH/QA Coordinator

Leon Reed 8/2/02
Name Printed Signature Date

Approval Recommended? (Yes) No

Bruce Murdoch LSO 8/2/2002
Name Printed Signature Date

Approved by High Energy Physics Division Director

Larry Price for Larry Price 8/2/02
Name Printed Signature Date

1. INTRODUCTION

The laser controlled area (LCA) is the AWA room in building 366. Only those specifically authorized by Wei Gai, group leader of the Accelerator Group in HEP, are to be permitted to operate the laser systems within this laser controlled area. The name of authorized users is listed in the Appendix B. There is one main laser system in the LCA. This laser system is comprised of several optical subcomponents whose function, maintenance, and operation are outlined in this SOP. Therefore, it is imperative that all users follow this SOP, any deviations must be approved by Wei Gai.

The AWA old laser system has been in operation for 10 + years and is being replaced with an all solid state laser system. This SOP is for this new laser system. The purpose of this laser is to use the UV output of the laser to generate photo electrons from the AWA RF phothocathode guns. The designed laser design output (248 – 266 2- 5 mJ, 744 - 800nm, 40- 80 mJ, 10 ps).

A diagram of the LCA floor plan is provided in Appendix A.

2. LCA SUPERVISOR

Name: Wei Gai
Badge: 34596
Phone: 2-6560
FAX: 3-5076
E-mail: wg@hep.anl.gov

1. SCIENTIFIC COLLABORATORS & SPECTATORS

This section addresses the safety of three classes of non-authorized users in the LCA - Scientific Collaborators, Spectators, and Visitors.

Scientific Collaborators:
Below are the responsibilities pertaining to Scientific Collaborators. A Scientific Collaborator is defined as someone who is not a laser user and has no direct control over the laser beam, but participates in the experiment in some other capacity.

Scientific Collaborator Responsibilities

1. A scientific collaborator shall not be permitted to control any laser beams (such as by an external optical element) and shall not handle or manipulate any laser in the LCA.

2. A scientific collaborator shall never be alone in the LCA. An authorized user shall be present and supervise all activities of the scientific collaborator within the LCA.

3. A scientific collaborator shall not be present while a laser is being aligned.

4. A scientific collaborator shall only be present in the LCA when the beam is enclosed and maximum protection, e.g., eyewear, is in use as designated in the SOP.

5. The actions and safety of a scientific collaborator within the LCA are the direct responsibility of the LCA supervisor.

6. Depending on the nature of their participation, and upon specific approval by the LCA supervisor, scientific collaborators may be offered the opportunity to take the ANL Laser Safety Training course.

Spectators:
A spectator is defined in the Laser Safety, Section 6.2 of the ANL ESH manual as an individual who observes or watches a laser or laser system in operation, and who may lack appropriate safety training or medical screening. The spectator will not be operating any laboratory equipment. The spectator will not be in close proximity to the beam. The spectator must be provided with protection, e.g. eyewear and laser enclosure. Only spectators approved by Wei Gai will be allowed in the lab. Spectators will be required to wear the maximum eye protection that is available at all of the laser wavelengths (248 – 266 nm and 532nm, 744 – 800 nm).

Spectator Responsibilities:

1. A spectator shall never be alone in the LCA. An authorized user shall be present and supervise all activities of the spectator within the LCA.

2. A spectator shall not be present while a laser is being aligned.

3. A spectator present in the LCA shall be provided maximum protection, e.g., eyewear and system enclosure, as designated in the SOP.

4. The actions and safety of a spectator within the LCA are the direct responsibility of the LCA supervisor.

Visitors:
A visitor is defined as any person who is not an authorized user, scientific collaborator, or spectator or any person who has no official need to see the laser system in operation. The visitor classification would apply to all individuals who are touring or inspecting laboratories. All lasers will be turned off or completely enclosed while visitors are present in the LCA.

Visitor Responsibilities

1. A visitor is allowed in an LCA only when the laser circuitry is disabled.

2. The actions and safety of a visitor within the LCA are the direct responsibility of the LCA supervisor.

Work performed by ANL-PFS in the LCA (plumbers, electricians, custodians, etc.) will be done with all lasers off.

4. NORMAL LASER OPERATION

The laser system is an amplified Ti:Sapphire system that is for use as a laser electron accelerator. It consists of a CW Nd:YVO (532nm, <5W CW) pumped Ti:Sapphire oscillator (100 fs, <5nJ, 80MHz, 744 or 800 nm) that is used to seed a three stage amplifier chain. Before the amplifiers the pulses are passed through an optical pulse stretcher that increases the pulse width to ~350ps. After amplification the laser is passed through an optical compressor that reduces the pulse width to less than 10 ps before entering a THG box, which has UV (248 or 266 nm) output of 2 –3 mJ/pulse. The entire laser system is contained in a light tight enclosure.

Normal laser operation is defined as operation with **NO** exposed IR and Green laser beams. This mode of operation of the laser system occurs after it has been warmed (or 'tweaked') up and all of the IR and Green beam enclosures have been sealed.

Prior to this state (i.e., during the tweak-up) it should always be assumed that there may be an exposed beam present and the appropriate eyewear is to be worn at all times by all persons in the LCA. No exceptions. During warm-up it is the responsibility of the laser operator to indicate the potential hazards to any other authorized users that are present. If an authorized user wishes to enter the LCA while the Laser Repair sign is posted they are to either ring the LCA doorbell (red button located ~1.5m to the right of the LCA door) or yell through the door. No entrance into the LCA is to be made until the laser operator informs the user of the work that is in progress. The specifics of the warm-up and alignment procedures will be discussed in Section 6.

Table 1 provides a list and pertinent characteristics of the commercial Class IV lasers that are present in the LCA. This is followed by a more detailed description of each laser, including eyewear to be worn. The specific types of eyewear are defined in Section 6. Appendix A shows how the lasers are arranged in the LCA.

Table 1. Commercial Active Type IV Lasers Present AWA Laser Room. Refer to figure in Appendix A for laser layout.

Laser	Manufacturer/Model	Function	Output

Ti:Sapphire#1 Oscillator	Spectra Physics Tsunami	Provide seed pulses for amplifier	~8 nJ, 30-50fs, 744 nm and 800nm, 80 MHz
CW YVO#2	Spectra Physics Millenia V	Oscillator Pump	5W, CW, 532nm
10Hz YAG#3	Spectra Physics LAB-170	Pump Amp#1 & Amp#2 for TSA 50	10Hz, 10ns, 532nm, 300mJ
10Hz YAG#4	Spectra Physics PRO-230	Pump Amp#3 for TSA 50	10Hz, 10ns, 532nm, 500mJ
10 Hz KrF #5 Excimer	Lambda Physik	Final Amplifier	10 Hz, 10 ps, 248 nm, 8 mJ

LASER SURVEY

LASER #1

Mfr. Spectra Physics Model Tsunami Class IV
ANL # P069239 S/N 1437GR Type Ti:Sapphire
IHID 10525

OPERATING PARAMETERS

CW Power:.5W (Normal):.5W(800nm) W (Max)
Pulse: Energy 5nJ Width 25fs
Peak Power 20MW PRF 100MHz
Beam Dia. 2.5mm Divergence .5 mr
Wavelength(s) 720-860nm

Use: seed for Ti:Sapphire amplifier system
Hazardous Materials: n/a
Enclosures/Shields: manufacturer's cover
Access Control: passive: pumped by Spectra Physics Millenia V
Eye Protection: Type C cover off (both 800nm and 532nm present) Type B cover on (only 800nm present)

LASER #2

Mfr. Spectra Physics Model Millenia V Class IV
ANL # P069238 S/N 1634R Type ND:YVO
IHID 10524

OPERATING PARAMETERS

CW Power: 5W (Normal): 5.5W(532nm) W (Max)
Pulse: Energy N/A Width N/A
Peak Power N/A PRF CW
Beam Dia. 2.5mm Divergence .5 mr
Wavelength(s) 532nm

Use: pump for a Tsunami Ti:Sapphire oscillator
Hazardous Materials: n/a
Enclosures/Shields: manufacturer's cover
Access Control: active coupled to door interlock system
Eye Protection: 532nm protection
Notes:

LASER #3

Mfr. Spectra Physics Model LAB170 Class IV
ANL # P069240 S/N 1961L Type ND:YAG
IHID 10522

OPERATING PARAMETERS

CW Power: 3W (Normal): 3.2W(532nm) W (Max)
Pulse: Energy 300mJ Width 10ns
Peak Power 30 MW PRF 10Hz (max)
Beam Dia. 10mm Divergence .5 mr
Wavelength(s) 532nm

Use: pump for a multipass Ti:Sapphire amplifier#1 and amplifier#2
Hazardous Materials: n/a
Enclosures/Shields: manufacturer's cover
Access Control: Active: Coupled to door Interlock system.

Eye Protection: 532nm protection
Notes: _____

LASER #4

Mfr. Spectra Physics Model LAB-230 Class IV
ANL # P069241 S/N 1960FR Type ND:YAG
IHID 10523

OPERATING PARAMETERS

CW Power: 5W (Normal): 5.5W(532nm) W (Max)
Pulse: Energy 500mJ Width 10ns
Peak Power 50MW PRF 10Hz (max)
Beam Dia. 10mm Divergence .5 mr
Wavelength(s) 532nm

Use: pump for a multipass Ti:Sapphire amplifier#2
Hazardous Materials: n/a
Enclosures/Shields: manufacturer's cover
Access Control: Active: Coupled to door Interlock system
Eye Protection: 532nm protection
Notes: _____

LASER #5

Mfr. Lambda Physik Model LPX 105 Class IV
ANL # P060938 S/N 9108E3370 Type KrF
IHID 10378

OPERATING PARAMETERS

CW Power: .0.08 W (Normal): 0.1 W (Max)
Pulse: Energy 8 mJ Width 10 ps
Peak Power 0.8 GW PRF 10 Hz
Beam Dia. 1cm Divergence .5 mr
Wavelength(s) 248 nm

Use: Amplify the output laser pulse from THG
Hazardous Materials: KrF premixed gas
Enclosures/Shields: manufacturer's cover
Access Control: Active: Door interlock
Eye Protection: UV Goggles, OD > 4.

Notes

Authorized laser users should avoid accidental contact (eye or skin) with laser radiation by closing the output beam shutters when the beam is not in use, by arranging the optics and beam blocks for a given experiment to keep all laser beams and reflections on the optical table and by wearing appropriate eye wear. Four sets of laser goggles are kept in the lab for protection against all wavelengths.

5. EYEWEAR SECTION

ANL-E laser safety officer has recommended that the following OD number for each laser described in this SOP.

Table 2. OD requirement for the AWA laser system

Type	Laser	Wavelength (nm)	OD
A	Lab 170, 230 Nd:YAG	532	6+
B	Ti:Sapphire	700-1200	3+
C	Millenium Nd:YVO	532	4+
D	THG UV	248-266	6+

Two types goggles are used in the AWA LCA:

1) LOTGYAGCO2 UVEX hard goggles (fits over glasses). OD=7@190-380 nm.
2) LOTGYAGKTP (hard goggles fits over glasses). OD=6@190-532, OD=3 @ 800 nm.

Eyewear should be inspected quarterly the LCA supervisor and record the results in the log sheet. Dispose any goggle that may potentially has defects (loose band, cracked frames, etc.)

6. ALIGNMENT HAZARD CONTROL

The type of alignment procedure used for the laser system development involves optimization of the laser output.

There are two main types of alignments.

1. Alignment/repair of the commercial lasers listed in Table 1.
2. Day-to-day optimization of the TSA 50 amplifier, this procedure uses 'minor' tweaks.

6.1 ALIGNMENT OF THE COMMERCIAL TYPE IV LASER SYSTEMS

All of the commercial systems listed in Table 1 require very little tweaking. All of these lasers are to be operated in accordance to their respective manuals. The manuals are located on the bookshelf shown in the figure of Appendix A. The Spectra Physics Millenia V requires no adjustments at all.

Occasionally it is necessary to check the output power of the pulsed Nd:YAG lasers. This is done by first putting on the appropriate eyewear (Section 5), placing a power meter at the laser output and then turning on the laser. When optimizing the laser output the eyewear described in section 5 must be worn. The output of the laser is to be monitored with a power meter and a photodiode, therefore, there is **no** need to 'see' the laser beam. Internal alignment (optimization) of each commercial laser is done according to the procedures in its respective manual, generally using a power meter. When the alignment is complete the laser covers are to be immediately replaced.

No spectators or collaborators are to be allowed in the LCA during an alignment.

6.2 DAY-TO-DAY ALIGNMENT (IR)

TYPE C GOGGLES SHOULD BE WORN FOR THIS ENTIRE PROCEDURE, 744 - 800NM BEAMS ARE TO BE OBSERVED WITH AN IR VIEWER

Under normal conditions a small amount of tweaking is required on a day-to-day basis. This is mainly involved in TSA 50, which is a passive amplifier. Each subcomponent of the laser system is to be aligned as instructed in the TSA 50 operation manual which is located in the laser room.

During the alignment, it is absolutely necessary for users to wear appropriate goggles.

6.3. DAY-TO-DAY ALIGNMENT (UV)

TYPE D GOGGLES SHOULD BE WORN FOR THIS ENTIRE PROCEDURE, 248 AND 266 BEAMS ARE TO BE OBSERVED WITH UV CARD

Some day to day alignment of the UV laser is required for the AWA experiments. The nominal laser output at 248 nm is 20 mW from THG and 80 mW from the KrF excimer laser. There are practical limitations of using remote sensing alignment method due to

difficult implementation and cost. Following procedure is to be followed:

Before any alignment work, a neutral density filter must be placed at the THG output window to cut the laser intensity < 1 mW or as low as possible. The same procedure aslo applies to the KrF excimer laser when it is in use. This procedure will ensure that minimal exposure of the UV beam during the alignment. Laser goggles (TYPE D) must be worn when performing this task.

When alignment is completed, make sure the laser beam enclosures are properly in place and secured. Then remove the ND filter and proceed with experiments.

7. LASER HAZARD CONTROL

A laser hazard warning light system at the entrance to laser room indicates the operating status of the laser system. This warning light shall be maintained in good operating order and the interlocks shall be quarterly tested to ensure good operating order and results recorded in the AWA laser log book..

The entrance to the LCA is interlocked so that unauthorized entrance causes all active laser systems to shut down automatically. The door interlock defeat switch shall be used only by authorized laser users and then only when it is essential to avoid interruption on an experiment and it has been ascertained that no hazardous light will be emitted from the laser controlled area when the door is opened. Emergency power shutoff switchs are located on the wall of the LCA.

When the interlock system is tripped, the Millennium, Pro 170, Pro 230 pump lasers and KrF amplifier are all shut off. Therefore there would be no more laser beam in the LCA.

The door interlock system should be tested quarterly, both doors need to be checked. Opening either door should cause laser stop lasing. With either door open, no laser would be able to turn on.

8. ADDITIONAL COMMENTS ON INTENSE IR LASER BEAMS

Some important points about working with the 744- 800nm light. It is outside the visible spectral range and is therefore only possible to view it at high powers. 800nm is considered outside of the human visible response region. It should always be treated as invisible, even though under the extremely high powers present with this laser system it is possible to see a dim red beam. The dimness of the beam is deceiving. It is extremely hazardous and should be treated as such.

The procedure for the insertion of new optical components is as follows.

First, the optics that are to be aligned should be pre-aligned with the laser blocked. With the proper eyewear and the IR viewer the beam should be unblocked and its trajectory determined. This process is then reiterated until the proper alignment is achieved.

Second, for those situations when one must be able to see the beam and simultaneously use two hands we propose to use a head mounted IR viewing device to assist in those alignments that would otherwise require the use of three hands. This will provide adequate eye protection while enabling the operator to see the IR laser beam.

Third, the use of latex gloves is important. When the proper eyewear is worn the user is blind to all of the laser beams. As a consequence of laser optimization the beams tend to pass rather close to each other. It is possible to burn skin rather easily under these

conditions. Latex gloves prevent this hazard. We use leather gloves with the finger tips cut off. This provides the necessary protection while maintaining the sensitive touch that is required for delicate adjustments.

9. CONTROL OF ADDITIONAL LCA HAZARDS

High Voltages: Life-threatening high voltages and /or currents are present in the laser power supplies and laser heads. These are interlocked for safety. Authorized users should always double check that the power is off before performing any repair work. If troubleshooting or maintenance requires defeat of the interlocks, two people must be present. In general all repairs performed on the lasers described in Table 1 will be done by field technicians from the respective laser companies.

10. ASSOCIATED CHEMICAL HAZARD CONTROL

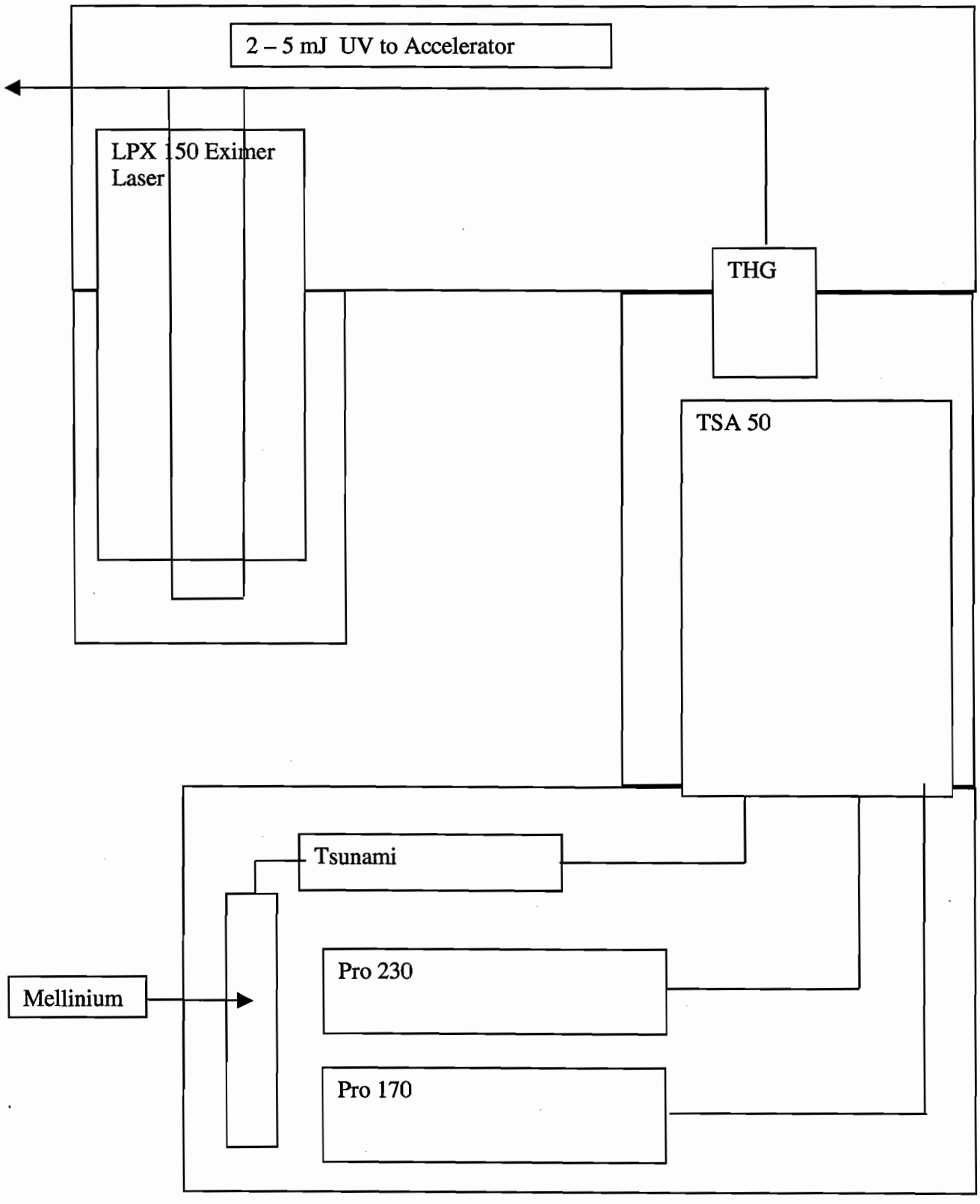
The Lambda Physik LPX 105 i uses premixed laser gas that contains a small percent (< 3%) of Fluorine. The laser has been in use in the last ten years and its gas cylinder is contained in a commercial gas cabinet with exhaust fan attached to it. The laser is also vented to outside the building to prevent any accidental leaks. If the fan stops, a buzzer will sound to alarm the user to check the system.

11. CONTROL OF EMERGENCIES & ABNORMAL SITUATIONS

In the case of an outbreak of fire, chemical spill, laser burn, etc., or any other abnormal emergency which constitutes an imminent danger to personnel within the LCA, immediately evacuate the area and call 911.

Unauthorized laser operation will be prevented by keeping the door to AWA control and laser room access locked when authorized users are not present. Key access to the AWA rooms is only limited to the AWA personnel.

APPENDIX A Diagram of AWA Laser Controlled Area 366



Appendix B:

AUTHORIZED AWA USERS

Name	Badge
Wei Gai	34596
J. Power	42699
M. Conde	47901
Filipe Franchini	52574

ARGONNE NATIONAL LABORA

HIGH ENERGY PHYSICS DIVISIO

AWA

ARGONNE WAKEFIELD ACCELERATOR

STANDARD OPERATING PROCEDURES

FOR LASER CONTROLLED AREA

AWA LASER ROOM

Reviewed: July 2001

Prepared: wg for pms **Date** 7/6

Paul Schoessow, HEP-AWA Group Rep

Approved: Don Jankowski **Date** 10-

Don Jankowski, HEP-ESH Administrator

ARGONNE NATIONAL LABORATORY

HIGH ENERGY PHYSICS DIVISION

AWA

ARGONNE WAKEFIELD ACCELERATOR

STANDARD OPERATING PROCEDURES

FOR LASER CONTROLLED AREA

AWA LASER ROOM

Reviewed: July 2001

Prepared: _____ **Date** 7/6/01
Paul Schoessow, HEP-AWA Group Rep

Approved: _____ **Date** 10-25-01
Don Jankowski, HEP-ESH Administrator

5. Other hazards associated with these lasers and the measure used to control them include:

    a. Hazardous high voltage exists in all the lasers in this Laser Controlled Area. A second knowledgeable person must be present while working on high voltage circuits.
    b. Consult the manufacturer's Material Safety Data Sheets (MSDS) for hazards associated with the laser dyes used. As a general rule, wear protective gloves and eyewear when handling dyes and avoid ingestion or inhalation of dyes.
    c. All the organic solvents used with the dye laser are flammable liquids with comparatively low threshold limit values. Keep ignition sources away from the dye solutions. Smoking in this Laser Controlled Area is prohibited.
    d. All the premixed excimer laser gas (XeCl and KrF) storage cylinders must be in a cabinet vented to external exhaust system. Pressure check the lines for the premixed excimer gases using a nontoxic alternative such as helium.

6. Methods used to control hazards associated with alignment of the lasers include:

    a. Follow the manufacturer's alignment procedures for all the lasers.

    b. In general, carry out at the lowest practicable laser power. Monitor laser power during alignment using power meter, if practical. Use wavelength converters such as fluorescent cards or phosphor cards to make UV and IR beams visible, (where practicable). Wear appropriate laser safety eyewear and use appropriate beam stops and beam shields.

    c. The output of 10 mJ, 1 ps laser pulses is transported to the Linac Tunnel for photoelectron production. To avoid accidental exposure of UV laser light, an interlock switch at the entrance of Linac tunnel is implemented that a beam stop shall be activated to stop the laser beam into the Linac Tunnel accidentally. This switch can only be by-passed when alignment of the laser beam to photocathode is in progress.

7. For general information concerning laser safety, consult the Laser Institute of America booklets and other laser safety information the black, three-ring binder, marked "LASER SAFETY AWA." The specific measures used to control laser hazards in this Laser Controlled Area, other than those associated with laser beam alignment (see above for alignment procedure guidelines), include:

    a. Laser hazard warning signs at both entrance doors.

    b. A laser hazard warning light system at the primary entrance door.

    c. Door interlocks on both doors that activate a beam shutter or power supply of the pumping lasers in the Laser Controlled Area.

    d. The use of non-combustible beam stops and beam shields.

e. Wearing appropriate laser safety eyewear.

f. The use of power meters to monitor laser levels.

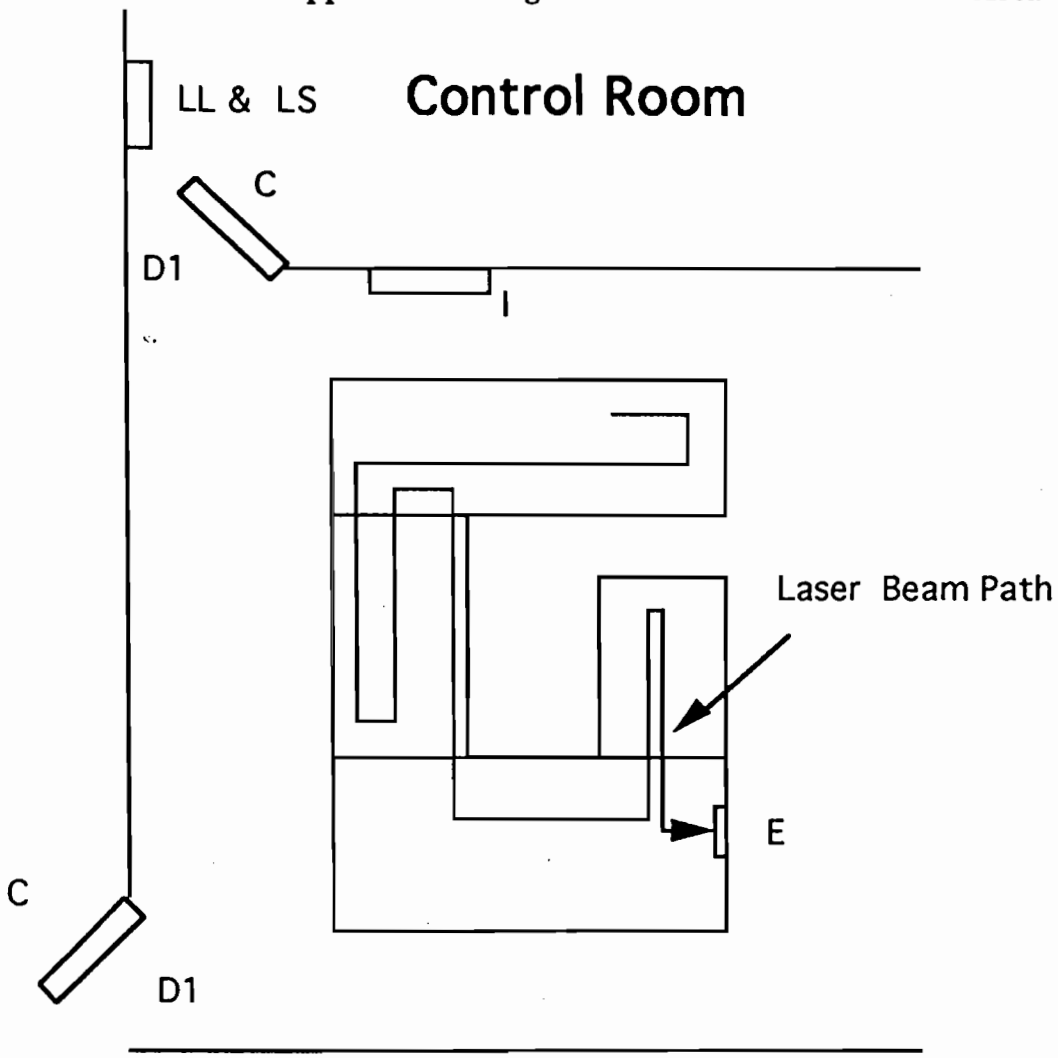
g. The containment of as much of the laser beam path as practicable.

h. The door interlock defeat switch with time delay shall be used only by authorized laser users of this Laser Controlled Area and then when it is essential to avoid interruption of an experiment and it has been ascertained that no hazardous light will be emitted from the Laser Controlled Area if the interlocked door is open.

8. Properly dispose of spent solvents and dye solutions. Enter into the log book in this Laser Room the volume and type of solvent, the amount and type of dye it contains, and the waste container into which it is placed when spent dye solutions are transferred into the spent solvent cans in Building 366. Complete form PFS-197 and submit it to Health Physics to initiate disposal of spent solvents.

9. The diagram of AWA laser controlled area is shown in Appendix A.

Appendix A: Diagram of AWA Laser Controlled Area



C= opaque, non-flammable covering, capable of withstanding direct irradiation by the laser beam. Install over all surfaces which would otherwise provide visual access into the LCA at the laser wavelength.

DI= door interlock switch.

I = Laser safety box. It connect to the door interlock switches and shut all the lasers off if unauthorized entry into the LCA occurs.

LL= Laser warning light system.

Ls= Laser hazard warning sign meeting ANSI Z136.1 requirements.

E = Laser beam enclosure to prevent specular or diffuse reflections at the entrance door of LCA.