Laser Standard Operating Procedure
University of California, Berkeley (BNC)

Lasers: 532nm, 633nm, 785nm, Lasers, VersaLaser  
Date: 05-01-2010

Department/Division: Biomedical Engineering  
Location: Stanley Hall 127D, 442

This procedure shall be read and signed annually by all persons who use lasers listed in this SOP.

Approved by Principal Investigator _____ Luke Lee __________ Date: ___2010 April 01___

Approved by Laser Safety Officer: _____ Paul Lum ___________ Date: ___2010 April 01___

I. Purpose
This Standard Operating Procedure (SOP) outlines requirements to be considered by an authorized user of the 532nm, 633nm, 785nm lasers or VersaLaser as well as describes the normal operation of the laser and any hazards that may be encountered during normal operation. Finally, the SOP explains how to minimize any hazards and how to respond in an emergency situation. This document is to be reviewed one year from the date of approval or as conditions warrant, whichever is the shorter time period.

II. Personnel
A. Authorized Personnel: The 532nm, 633nm, 785nm lasers or VersaLaser may be operated only by authorized personnel who are fully cognizant of all safety issues involved in the operation of such a device. These personnel are to ensure that the laser is only operated in the manner laid out in this document. To become an authorized user, one must:
   1. Complete Environment, Health & Safety (EH&S) training class.
   2. Take a baseline ophthalmologic examination
   3. Read and fully understand the SOP
   4. Receive training on the 532nm, 633nm, 785nm lasers or VersaLaser by an authorized user.
   5. Sign the authorized user sheet to affirm that the above steps have been completed.

B. Unauthorized personnel: No unauthorized personnel may enter 127D Stanley Hall during laser operation unless accompanied by an authorized user. All visitors must be briefed on proper safety protocol and must wear appropriate laser protective eyewear located on the premises.
III. Hazards

A. Laser Hazards: The 532nm, 633nm, and 785nm lasers are Class 3b lasers. Another 532nm laser is a Class 4 laser. Severe eye damage (including blindness) and skin damage can result from direct beam and specular reflections. Eye damage can also result from diffuse reflections.

B. Electrical Hazards: electrical shock or electrocution could result from direct contact with high voltage. Be careful to make sure no liquids are on your gloves or hands when plugging laser power cords into power supply.

C. Chemical: Keep flammable solvents out of beam path.

D. Pressure Hazards: None.

E. Other: None.

IV. Hazard Controls

A. Lasers

1. Only authorized personnel will operate lasers.

2. The laboratory doors will be closed when the laser is operating.

3. During alignments, the laboratory doors will be closed and a sign posted stating “Laser alignment in progress. Do not enter. Eye protection required.”

4. Unauthorized personnel will be only allowed entry to the laboratory during laser operation with the supervision of an authorized user under the terms specified in section 2.

5. Laser protective eyewear for sufficient protection against 532nm, 633nm, 785nm are available and are located in the cabinets across from the optical table in room 127D. Laser protective eyewear must always be worn when the laser is in operation. No filters or other optics will provide suitable protection; use only laser safety protective eyewear. PLEASE NOTE: Laser protective eyewear is wavelength specific and proper section is important.

6. Specular and diffuse reflections will be controlled using apertures, beam housings and enclosures, and optics. All of these control methods must be in place during normal operation.

7. Laser alignment must be performed only by following the steps outlined in the alignment procedure supplement or alignment section.

8. Perform physical surveys to determine if there are stray beams (specular or diffuse) emanating from each laser and its optics, and then document the beam surveys noting the location of stray beams and the measures taken to control them. Methods of documentation of survey may be recorded on the BioPOETS wiki under “Laser Safety.”
9. If the beam path must be changed significantly by relocating the laser or optics, all users must be notified of the change.

10. The same precautions that are taken for safe operation of the laser must also be followed when adjusting any of the optics in use with the apparatus.

11. When a new principal researcher/experimenter takes over use of the laser system, the new user must conduct a survey for unwanted stray or diffuse beams.

B. Electrical

1. Enclosures for protection against the high voltages of the laser power supply or laser head may only be removed after the power supply has been unplugged from the outlets and after following the safety procedures outlined in the safety and operations manual provided by the manufacturer.

2. Only qualified personnel may perform all internal maintenance to the laser and more than one user must be present when performing said maintenance.

3. Every portion of the electrical system, including the printed circuit cards, should be assumed to be at dangerous voltage level.

C. Chemical

1. Always check that any flammable solvent placed under the laser beam does not ignite or combust by referencing the flash point of the chemical and the temperature increase of the chemical under laser exposure.

D. Pressure

E. Other

1. Always view the laser beam with either the CoolSNAP or QImaging CCD cameras. Make sure proper optical filters are in place so damage to the CCD cameras does not occur.

V. Normal Operation

A. Inspect all electrical and water connections for damage and connectivity.

B. Complete the “check-in” portion of the checklist included in this document as Appendix A. The checklist serves to confirm that all basic systems are operating within expected parameters and that basic safety mechanisms are in place. The laser run log is a set of forms adjacent to the
experimental set up and is used to ascertain the current state of the laser. Log all use and add individual notes as necessary. Also, replacement of optics and other routine maintenance should be noted in the log. Once the checklist is complete, the laser may be turned on.

C. Turn laser system on.

D. System alignment. See the attached alignment procedure supplement/alignment section for details.

E. Shutdown laser system.

F. After a run is finished, complete the log entry and the checkout portion of the checklist in Appendix A.

VI. Emergency Procedures

A. Laser accidents: Follow the steps outlined in the Procedure for Laser Accidents in Appendix B.

B. Power outage: If there is a power outage, turn off the laser to avoid a hazardous situation when power is restored.
**Authorized Users**
I have read and understood the Standard Operating Procedures for the 532nm, 633nm, and 785nm lasers.

<table>
<thead>
<tr>
<th>Name (print)</th>
<th>Signature</th>
<th>Date</th>
<th>PI Initial</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix A – Checklist for using Type OF LASER OR EXPERIMENT

Check in:
-Ensure that the laser hazard warning signs are posted outside of the door to room 127H.
-Door is closed and all personnel are wearing the appropriate laser protective eyewear.
-Inspect the apparatus for any blockages or apparent misalignment.
-Confirm that the beam path is set up to hit the sample properly.
-Ensure that all aluminum enclosures are placed properly in the work area.
-Record laser energy in the logbook.
-During the run, ensure that the laser is hitting the sample correctly.
-Record any anomalous behavior in the logbook.

Check out:
-Shut off the laser.
Appendix B – Procedure for Laser Accidents

In the event of a laser accident, follow the procedure below:

1. Ensure that the laser is shut off.

2. Provide for the safety of the personnel (first aid, evacuation, etc.) as needed. Note — if an eye injury is suspected, have the injured person keep his/her head upright and still to reduce bleeding in the eye. A physician should evaluate laser injuries as soon as possible.

3. Obtain medical assistance for anyone who may be injured.

| UC Optometry Clinic (Normal Hours)                  | 642-2020 |
| UC Optometry Clinic (24 Hour Emergencies)          | 642-0992 |
| University Health Services (Emergency)             | 642-3188 |
| Ambulance (urgent medical care)                    | 9-911    |

4. If there is a fire, pull the alarm, and contact the fire department by calling 9-911. Do not fight the fire unless it is very small and you have been trained in fire fighting techniques.

5. Inform the Office of Environment Health, & Safety (EH&S) as soon as possible.

6. During normal working hours, call the following:

| EH&S Office                                      | 642-3073 |
| BNC Laser Safety Officer (Paul Lum)              | 666-3356 |
| EH&S Health & Safety Manager                     | 642-3073 |

After normal working hours, call 642-6760 to contact the UC Police Department who can contact the above using their emergency call list.

7. Inform Luke P. Lee and the current group safety officer as soon as possible. If there is an injury, Luke P. Lee will need to submit a report of injury to the Worker’s Compensation Office.

8. After the incident, do not resume use of the laser system until the Non-Ionizing Radiation Safety Committee has reviewed the incident and approved the resumption of research.
Appendix C - Alignment Procedures

A. Procedural Considerations
1. To reduce accidental reflections, watches, rings, dangling badges, and other reflective jewelry must be taken off before any alignment activity begins.
2. Use of non-reflective tools should be considered.
3. Access to the room/area is limited to authorized personnel only.
4. Perform alignments with a colleague or “buddy.”
5. Review alignment procedures.
6. Identify equipment and materials necessary to perform alignment.
7. Remove all unnecessary equipment, tools, and combustible materials to minimize the possibility of stray reflections and non-beam accidents.
8. Persons conducting the alignment have been authorized by the PI.
9. A ‘Notice” sign is posted at the entrance when temporary laser control areas are set up or unusual conditions warrant additional hazard information.

B. Internal alignment Mirrors

There are no internal alignment mirrors.

C. External Optics

1. Ensure that all users are wearing laser protective eyewear, warning signs are posted, and laboratory doors are closed. Check that the laser path will be blocked.
2. Turn on the power supply.
3. Turn power supply to voltage mode. Typically 5V is ideal for 532nm, 20V is ideal for 785nm. For the 633nm, turn supply I/O knob. (LASER BEAM POWER SETTING-USE LOWEST POSSIBLE POWER FOR ALIGNMENT)
4. Set up the first optic, block the beam path optic, and carefully release the original block to ensure that the beam will hit the center of the mirror.
5. Set up two targets in the beam path, unblock the beam, and center the beam using adjustments on the optic.
6. Continue until optics are set up properly.
7. Check for stray beams at each step and again after completing all alignment steps. Please indicate method of documentation of survey (checklist or log, etc.) See section IV.A.8
8. After the alignment is complete, turn off the laser.