

Approved by Principal Investigator _____ Date: _____

Approved by Laser Safety Officer: _____ Date: _____

Standard Operating Procedure
Hildebrand, Rooms B49 & B74, and controlled access off-campus field sites
NO₂ LIF with NovaWave TFL2000 fiber laser system
(530 nm, 300 kHz, 1.5 μJ, S/N 0302) 10/28/2010 v.1

I. Purpose

This Standard Operating Procedure (SOP) outlines requirements to be considered by an authorized user of the 530 nm fiber laser system operated by the Cohen Lab as well as describes the normal operation of the laser and any hazards that may be encountered during normal operation as well as during alignment procedures. Finally, the SOP explains how to minimize any hazards and how to respond in an emergency situation. These laser systems are normally operated with completely enclosed beam paths and are only rarely opened for alignment. With a cover removed it is a class 3b laser system. This SOP applies to both circumstances but gives more attention to the operation as a class 3b system. Each system has a fixed optical design, with a beam path that is never modified. A new SOP will be created if significant changes to the optical layout are implemented. 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 530 nm fiber laser 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
 3. Take a baseline ophthalmologic examination
 4. Read and fully understand the SOP
 5. Receive training on the 530 nm fiber laser by an authorized user.
 6. Sign the authorized user sheet to affirm that the above steps have been completed.
- B. Unauthorized personnel: No unauthorized personnel may enter Hildebrand B49 & B74 or the field sites during class 3b laser operation unless accompanied by an authorized user. Field measurement sites are locked at all times unless authorized personnel are present. All visitors must be briefed on proper safety protocol and must wear appropriate laser protective eyewear located on the premises when class 3b operation is occurring.

III. Hazards

- A. Laser Hazards: The 530 nm fiber is a Class 3b laser, when operated with any cover removed. 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: no high voltage present. The fiber laser is commercial (NovaWave TFL2000) unit.
- C. Chemical:
- D. Pressure Hazards: Normal compressed gas cylinders are used for zeroing and calibration.
- E. Other:

IV. Hazard Controls

A. Lasers

1. The laser will only be operated as a class 3b system during alignment. At all other times it will be operated with fully enclosed beam paths.
2. Only authorized personnel will operate the laser .
3. The laboratory doors will be closed when the laser is operating as class 3b.
4. During class 3b operation, the laboratory doors will be closed and a sign posted stating "**Laser alignment in progress. Do not enter. Eye protection required.**"
5. Unauthorized personnel will be only allowed entry to the laboratory during class 3b laser operation with the supervision of an authorized user under the terms specified in section 2.
6. Laser protective eyewear for sufficient protection against 530 nm are available and are located in the cabinet over the counter in B49. **Laser protective eyewear must always be worn when the laser is in operation with any cover removed, except at the lowest possible power level when necessary to see the spot during alignment.** No filters or other optics will provide suitable protection; use only laser safety protective eyewear.

Note: Laser protective eyewear is wavelength-specific and proper selection is important.

7. 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 operation as a class 3b system.
8. Laser alignment must be performed only by following the steps outlined in the alignment procedure supplement or alignment section.
9. Perform physical surveys to determine if there are stray beams (specular or diffuse) emanating from each laser and its optics, and correct any problems by adjusting, cleaning, or replacing the affected optic. Enter any issues in the instrument notebook, and the adjustments made.

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 in class 3b operation, the new user must conduct a survey for unwanted stray or diffuse beams.

B. Electrical - no high voltages present.

C. Chemical

D. Pressure Cylinders to be chained in rack.

E. Other

V. Operation as a Class 3b System

- A. Inspect all electrical 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 current state of the laser should be noted in the instrument notebook. Log all use and add individual notes as necessary. Also, replacement of optics and other routine maintenance should be noted. Once the checklist is complete, the laser may be turned on.
- C. Turn the field instrument on with the laser power supply key(s), then the instrument program on its computer, and, when ready, the RUN LASERUP command.
- D. System alignment. See the attached alignment procedure supplement/alignment section for details.
- E. Shutdown system: for the field instrument use the RUN SHUTDOWN command. Turn off supplies when complete.
- F. After a run is finished, complete 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 supply key(s), photomultiplier(s), and computer, and close the gas cylinders to avoid a hazardous situation when power is restored.

Authorized Users

I have read and understood the Standard Operating Procedures for 530 nm fiber laser

Name (print)	Signature	Date	PI Initial
Browne, Ellie			
Cohen, Ron			
Wooldridge, Paul			
Min, Kyung-Eun			
Pusede, Sally			
Lee, Lance			
Charity Garland			

Appendix A – Checklist for using 530 nm fiber laser system if any cover(s) are removed.

Check in:

- Door is closed, signs are posted, and all personnel are wearing the proper safety eyewear.
- Inspect the apparatus for any blockages or apparent misalignment.
- Confirm that the beam path is set up to transverse the LIF cell(s) properly.
- Ensure that all enclosures and blocks are placed properly in the work area.
- During the run, ensure that the laser goes through the LIF cell(s) correctly.
- Record behavior in the instrument notebook.

Check out:

- Shut down the laser and turn power supply key(s) off.

also for field instrument:

- PMT(s) off
 - Vacuum pumps off.
 - Inlet heaters unplugged.
 - NO₂ standard cylinder and Zero Air source off.
- (generally leave computer and 28 Volt power supply on, unless system to be idle for days)

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
Laser Safety Officer	643-9243
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 Ron Cohen and the current group safety officer as soon as possible. If there is an injury, Ron Cohen 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" when practical.
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.
10. Align the laser system at the lowest power level practical. It is possible to perform most of the alignment at **the lowest possible** power level.

B. Internal alignment Mirrors - not applicable

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 laser power supply and start the instrument program. For the field instrument execute the RUN LASERUP command when the laser supplies are ready. (*LASER BEAM POWER SETTING-USE LOWEST POSSIBLE POWER FOR ALIGNMENT*)
3. Use the mirror adjustors to steer the beam properly through the multipass LIF cells. Remove the end caps and PMTs if necessary.
4. Check for stray beams at each step and again after completing all alignment steps.
5. Replace ALL laser beam enclosures/stops.