The University of Texas at Austin
Laser Safety Program

Laser Safety Standard Operating Procedure

Forward:

This procedure shall be reviewed annually by all persons who use Class 3B & 4 lasers or laser systems listed in this SOP. This procedure shall also be reviewed every two years by the Permittee or Laboratory Laser Safety Supervisor (LSS) to ensure it reflects the most current conditions. Changes in the operating procedure shall be forwarded to EHS – Laser Safety for review and approval.

Laboratory Information:

Laboratory PI Name:	Laser Staff	Date:	08/30/2023
Department:	EHS – Laser Safety	Revision #:	001
Building & Room #:	ECG 1.220	Author:	John Snow

Contact Information:

Laboratory LSS:	John Snow	Phone #:	512-471-2042
University LSO:	DeWayne Holcomb	Phone #:	512-471-2038
Maintenance/Repair:	Facilities Services	Phone #:	512-471-2020
Medical Emergencies	1. Call 911 for medical emergencies and shut down all laser operations. 2. Notify the Laboratory LSS and University LSO of all laser-related injuries and near misses as soon as possible.		

Laser Description: Describe the laser(s) setup and how it is used including general beam parameters, optics, and equipment. Include a diagram or picture with the beam path depicted. This may be included as an attachment if necessary.

In this experiment, two fiber DPSS lasers are used to gate synaptic connections between the basolateral amygdala (BLA) and medial prefrontal cortex (mPFC) in Long-Evans rats to study the relationship of fear and the decision-making process. The two lasers operating at 473nm, 16mW and 561nm at 16mW, are tethered to leads implanted in the subjects BLA to suppress synaptic activity to the mPFC while presented with a series of decision-making tasks. Prior to exposing he subject, both lasers are allowed to warm up and stabilize for 20 minutes before a power measurement is taken to ensure the correct exposure level. The subject is then attached to the fiber leads and the experiment is run over the course of roughly 1 hr. Laser exposure only occurs for brief moments (<1 sec) in response to the subject's choice in the decision-making task. The laser exposure is computer controlled and does not require user input. Both lasers are equipped with a standby mode which allows the laser to be 'On' but not emit laser energy from the fiber. The setup is housed in a locked (keypad entry) windowless room to which access is restricted to laser safety trained personnel only. The room is posted with laser safety signage that is turned around while the experiment is in progress.

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Laser Parameters: Complete the table below using the operating conditions (power output, pulse energy, duration, etc.) of the laser. If more than one laser is used, copy and paste this table to complete the laser parameters for the other lasers. Laser eyewear is to be inspected by the user for lens applicability and integrity prior to each use.

Make:	Laserglow	Wavelength (nm):	473 nm
Model:	LRS-0473-0100	Power Output (W):	16 mW
Serial Number:	EHS-JS-LAS1	Beam Diameter (mm):	2 mm
Class:	3B	Beam Divergence ($1/e^2$) (mrad):	1 mRad
Cont. or Pulsed:	Continuous Wave	Duration (ns) & Rate (Hz):	N/A
Eyewear Make:	Thorlabs	Eyewear Wavelength:	190-532
Eyewear Model:	LG10	Eyewear Optical Density:	7+

Make:	Laserglow	Wavelength (nm):	561 nm
Model:	LRS-0561-0100	Power Output (W):	16 mW
Serial Number:	EHS-JS-LAS2	Beam Diameter (mm):	2 mm
Class:	3B	Beam Divergence ($1/e^2$) (mrad):	1 mRad
Cont. or Pulsed:	Continuous Wave	Duration (ns) & Rate (Hz):	N/A
Eyewear Make:	Thorlabs	Eyewear Wavelength:	561 nm
Eyewear Model:	LG15	Eyewear Optical Density:	2+

Laser Safety Program Resources:

EHS has several resources on their website at: https://ehs.utexas.edu/programs/lasers/ including information regarding laser safety training and program requirements. The Laser Safety Program Manual can also be found here and should be referred to for:

- Lab PI roles and responsibilities
- Laser User roles and responsibilities
- Laser permits and registration
- Program requirements (SOP, Training, etc.)
- PPE requirements (eyewear and inspections)
- Signs and Labeling
- Non-Radiation Hazards
- Procurement and Disposal Requirements

Operating Procedures:

All Class 3B and 4 lasers and laser systems shall have a documented operating procedure that provides the end user the necessary instruction for completing their experiment safely. The operating procedure shall include instructions for all times it is necessary for the laser to be powered on including normal operation, alignments, service, and repairs as applicable. The procedure shall incorporate all safety measures including when to don/doff eyewear, room securement, signs and warning labels, housekeeping, and other control measures identified in the hazard section above. This procedure shall be updated to reflect current operations prior to commencing the experiment.

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A. Initial preparation of lab environment for normal operation (lab security, warning light on, keys, interlocks and guards, identification of personnel, etc.)
   1. On the lab entrance door turn the laser warning signage around to be visible, notifying personnel a laser experiment is in progress.
   2. Ensure the door is closed and locked behind you.
   3. Inspect the fiber cables for secure connection to the laser head and test chamber rotary joint. If any kinks or breaks in the fiber it must be discarded.
   4. Log into the computer control station and enter the 'Power Measurement' program. This will turn the laser to a continuous 'On' state but will not emit laser light until the key is switched to the 'On' position. A red indicator light to the right of the key switch will glow if laser light is being emitted.
   5. Allow 20 minutes for the laser to warmup and stabilize prior to taking a power measurement. Proceed to the prep the test chamber (Section B) during this time.
   6. After 20 minutes, obtain the laser keys from the lockbox and enter into the control panel. The laser will be in standby mode until the key is turned to the vertical 'On' position.
   7. Don the appropriate laser eyewear (Thorlabs LG10 - Orange for 473nm, Thorlabs LG15 -Purple for 561nm).
   8. Power on the laser power meter and set the wavelength to 473nm or 561nm depending on the laser being used. Place the power meter probe flat on the table with the window facing up.
   9. Remove the fiber dust cap and place the fiber in front of the power meter's probe window using two fingers. Use the palm of your hand to secure the power meter probe from moving.
   10. Using your free hand turn the key to the On position. The laser should now be emitting. Do not point the laser fiber towards yourself or any other person.
   11. Adjust the power output to reach 16 mW using the power settings entry field within the computer power measurement program.
   12. When the output is measured to be a stable 16 mW, turn the key to the off position (horizontal) to return the laser to standby mode.
   13. Tether the laser fiber to the top input connection of the rotary joint within the test chamber being used. Ensure the fiber is securely screwed in place.

B. Target area preparation
   1. Ensure the test chamber is free of all materials and has been cleaned since the last test.
   2. Ensure the test chamber closes tightly and is able to be secured via the latch.
   3. Ensure the rotary joint moves freely with 360º range of motion and that the fiber cable from the rotary joint to the subject connection is free of kinks, knots, or breaks and securely fastened to the bottom side of the rotary joint connection.
   4. Retrieve the test subject from the vivarium using the cart and leave outside the test room while the laser is brought to operating conditions.

C. Operation procedures are as follows:
   1. Enter the 'test protocol' program from the computer station.
   2. Retrieve the test subject from outside the test room.
   3. Securely connect the test chamber fiber cable to the subject.
   4. Place the subject in the test chamber and secure via the latch.

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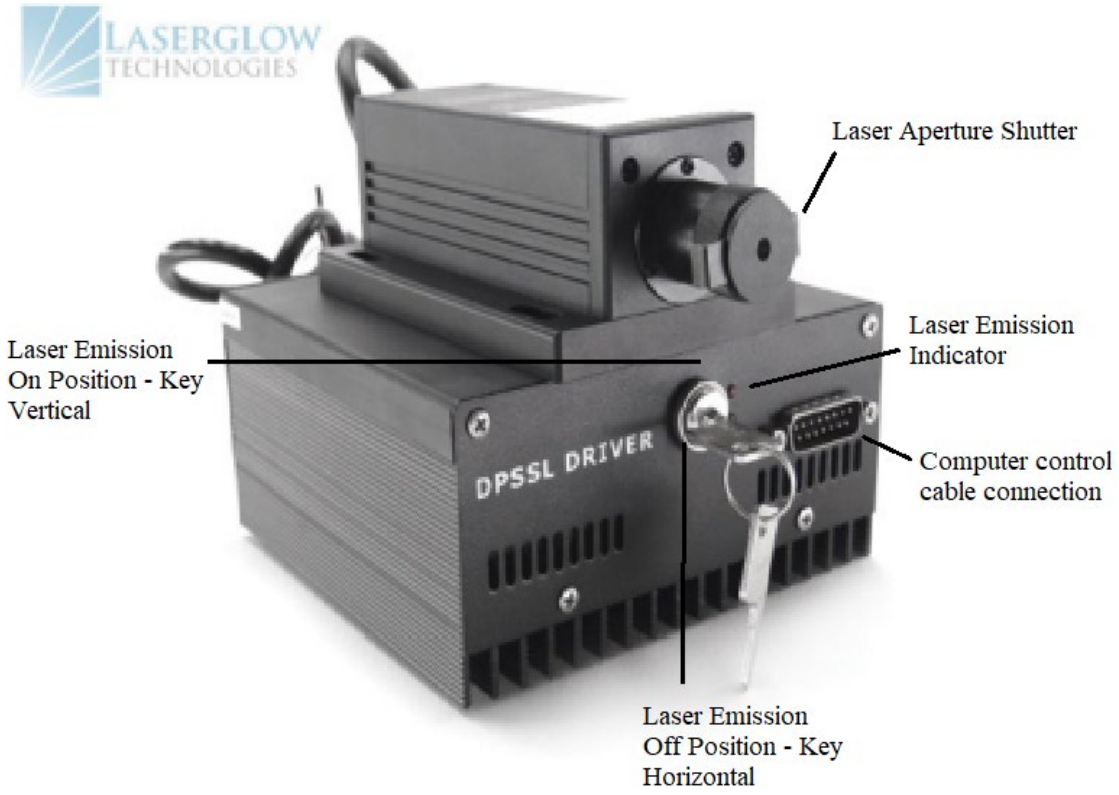
5. At the computer, select 'Run' on the test protocol program.
6. Turn the laser control panel key to the 'On' position to allow lasing. The computer will now control the emission of laser light in response to the subject's decisions.

D. Shutdown procedures for this laser are as follows:
1. Following completion of the test, select 'Stop' on the computer test protocol program.
2. Place the laser in standby mode using the control panel key.
3. Remove the key and place in the lockbox.
4. Using the computer power settings entry field, turn the power level to '0 mW' for 10 minutes to cool down prior to turning off the laser.
5. During the cool down period, remove the subject from the test chamber and disconnect the fiber cable lead.
6. Place the subject in the vivarium transport container located outside the test room.
7. Clean any debris or residue left being in the test chamber.
8. After the 10-minute cool down is complete, turn the laser off using the toggle switch on the control panel.
9. Return the dust caps to the fiber cables to prevent contamination.

E. Alignment procedures (describe the specific steps and settings needed to reduce power before interacting directly with the beam path. For example, shuttering the pump laser, using ND filters, etc.)
1. N/A



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Physical Controls: Describe the physical controls of the laser setup in the condition which the setup is intended to be operated. Edit the comment section as necessary to depict the lab specific controls implemented. EHS will review and approve the described control measures.

Check If Applicable:	Control:	Comments:
☒	Entryway (door) Interlocks or Controls	Entry to the lab is restricted to authorized and properly trained lab personnel only with an active keypad lock. The lab door is to remain closed at all times unless the laser is shutdown and under the direct supervision of an authorized person.
☐	Laser Enclosure Interlocks	Any laser enclosure interlocks will be engineered to fail safe and require manual re-activation if defeated.
☐	Laser Housing Interlocks	Fail-safe or redundant interlocks shall be provided if they can be removed or displaced during operation and still allow access to Class 3B or 4 laser radiation. Warning labels shall be provided near the interlock if it can be defeated or by-passed.

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☒	Emergency Stop	Laser emission can be stopped several ways. The preferred method is to turn the control panel key to the horizontal Off position to prevent damaging the laser. A manual shutter on the laser aperture is also available. The last method is to select 'Stop' on the computer test protocol program.
☐	Beam Stops	The beam terminates in an aluminum beam block capable of withstanding the heat from the laser setup without degradation.
☒	Master Switch	The laser is only operable via a switch key. When the key is in standby mode, the laser is inactive.

Hazards & Controls:

Check If Applicable:	Hazard:	Controls:
☒	Housekeeping	The beam path and surrounding areas will be kept free of clutter and obstructions. Hand clearing of clutter from the optical table and beam area will be performed prior to each laser operation.
☐	High Voltage	The building manager and facilities electrical shop shall be consulted prior to operation/maintenance involving high voltage exposure including any adjustments needed.
☐	Capacitors	Any capacitors will be enclosed within a protective panel during operation and fully discharged prior to maintenance.
☐	Unenclosed Beam Access to Beam	The beam is contained within a curtained area. The outside door will also be closed as a secondary protection. Appropriate laser eyewear protection shall be worn in all areas with open, accessible laser radiation.
☐	Fumes/Vapors	Any fumes/vapors generated during operation will be exhausted through a fume hood or local ventilation apparatus.
☐	Ultraviolet Radiation or Blue Light	Appropriate barriers and PPE to protect skin and eyes from UV and eyes from blue light will be in place upon consultation with EHS if needed. This may include lab coats, eyewear, gloves, fade shields or topical sunblock applications.
☐	Compressed Gases	Compressed gases will be properly secured and labeled. Safety caps will be in place for unused cylinders. Flammable and oxidizing cylinders shall be stored at least 20 feet apart unless specifically required for an experiment upon consultation with EHS. OH 204 compressed gas cylinder training from EHS should be taken and is available in UT Learn.
☐	Hazardous Chemicals/Waste	No hazardous waste is expected to be made during ordinary operation. If hazardous waste is generated, training course OH 202 should be taken (available in UT Learn) and all waste properly handled, labeled and stored per EHS guidelines.

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☐	Reflective Material in Beam Path	The open beam paths will be kept free of clutter to prevent inadvertent ignition of materials, specular and diffuse reflections, and laser generated airborne contaminants.
☐	Fire	A fire extinguisher is located within a few steps of the table. Laser operators will ensure familiarity with its location and complete FF 205 hands on fire extinguisher training from Fire Prevention Services. Beam blocks will be used to absorb laser energy capable of generating hazardous levels of heat.
☒	Fiber Optics	The laser is connected to a fiber optic cable. At no time is a user to look into the fiber cable while the laser is emitting. To check for light being stored in the cable, place the end of the fiber optic cable next to a flat white surface (wall or table top) and view any reflections being emitted onto the surface.
☐	Infrared Lasers	Invisible lasers will be properly blocked and attenuated. Adequate viewing equipment such as IR viewers, cards, cameras, etc. must be available to the end user to ensure reflections are minimized.
☒	Correct Eyewear	Appropriate EHS approved laser eyewear protection with labelling of wavelength and optical density will be present and worn by all lab personnel working in rooms with accessible laser radiation. The eyewear will be made readily available prior to entering a nominal hazard zone at the door or curtain entrance, properly maintained, cleaned, and stored per manufacturers recommendations.
☒	Secured Laser	Lasers shall be secured to the operating surface during operation to prevent movement of the beam while the laser is on. The method of securing should be robust enough that if the laser is incidentally bumped or contacted, the beam does not lose contact with the target surface.

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Operator Review:

By signing this form, I agree that I have read and understand the contents of this SOP and will adhere to it' instructions. Furthermore, I agree that I have successfully complete the University's Laser Safety Training and I am aware that it is my responsibility to operate in a safe manner.

Name:	EID:	Signature:	Date: