

Standard Operating Protocol (SOP)

Class 3B and Class 4 Laser Systems

1. Purpose

This Standard Operating Protocol (SOP) establishes safety requirements and operating procedures for the safe use of Class 3B and Class 4 laser systems.

This SOP is intended to prevent injury to personnel, protect equipment, and ensure compliance with applicable laser safety regulations.

This SOP must be reviewed annually or whenever changes to laser configuration, operation, or personnel occur.

2. Scope

This SOP applies to all personnel who operate, align, service, or observe Class 3B and Class 4 lasers in designated laser-controlled areas. Laser Type refers to Class 3B or 4 lasers.

3. Responsibilities

Principal Investigator (PI): Ensures compliance with this SOP and authorizes personnel.

Authorized Laser Users: Follow all SOP requirements and report unsafe conditions.

Laser Safety Officer (LSO): Reviews laser use, determines eyewear requirements, and reviews incidents.

4. Personnel Authorization and General Safety

Only trained and authorized personnel may operate or align laser systems.

Authorization requires laser safety training, SOP review, hands-on training, and have documentation of these requirements.

Unauthorized personnel may not enter the laser-controlled area during operation unless escorted and wearing appropriate eyewear.

All visitors must be briefed on proper safety protocol and must wear appropriate laser protective eyewear.

5. Laser Hazards

Exposure to laser radiation hazards can cause severe eye injury, skin burns, and fire risk. These hazards can result from direct beam and specular reflections.

Electrical hazards include high-voltage power supplies and can result in shock or electrocution.

Secondary hazards may include chemical, pressure, and thermal hazards.

6. Hazard Controls

Only authorized personnel will operate lasers.

Laboratory doors will be closed and locked whenever a laser is operating.

Engineering controls include beam enclosures, beam blocks, interlocks, and warning signage.

Administrative controls include restricted access, alignment at lowest feasible power, and documented beam surveys.

Personal protective equipment includes wavelength-appropriate laser protective eyewear.

Ensure there are 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.

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

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

Pressure hazards can be mitigated by completing Compressed Gas Safety training.

7. Normal Laser Operation

Verify authorization and training status.

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 4.

Restrict access to laser areas while in use by enclosing the area with curtains ensuring no gaps or locking the door to the laboratory.

Remove reflective items from the laser use area. No jewelry or other reflective materials are to be worn while working with the laser, especially on the hands and neck.

Ensure warning signs and lights are activated.

Wear eyewear that is sufficient protection against (wavelengths used in nm). If there are multiple wavelengths being used in the location, multiple pairs of eyewear are required to be in the area appropriate for each wavelength. Make eyewear easily

accessible and in the location of the laser lab. Laser eye protection is required to be worn for all beam alignments/manipulations or anytime there is an open beam that exceeds the maximum permissible value.

Record laser energy in the logbook.

Specular and diffuse reflections will be controlled using beam stops, beam barriers, beam housings and enclosures. All control methods must be in place and inspected during normal operation.

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. Please indicate the method of documentation of the survey (checklist or log, etc.)

If the beam path must be changed significantly by relocating the laser or optics, all users must be notified of the change.

Personnel in the laser lab should avoid bending over or otherwise putting their eyes at the level of the beam path while the laser is in operation.

Energize and operate the laser according to approved procedures.

Log laser use and shut down the system properly.

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.

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. Appropriate tools such as IR sensitive cards or an IR viewer shall be used for locating the possibility of stray IR light.

8. Alignment Procedures

Verify authorization and training status.

Alignment should only be performed when there are at least two users present who have been trained.

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 4.

Pre-alignment safety: Post alignment signage stating "Laser Alignment in progress. Do not enter. Laser Eyewear Required."

Restrict access to the laser area while in use by enclosing the area with a curtain ensuring no gaps or locking the door to the laboratory.

Wear eyewear that is sufficient protection against (wavelengths used in nm). If there are multiple wavelengths being used in the location, multiple pairs of eyewear are required to be in the area appropriate for each wavelength. Make eyewear easily locatable and in the location of the laser lab. Laser eye protection is required to be worn for all beam alignments/manipulations or anytime there is an open beam that exceeds the maximum permissible value.

Remove reflective items from the laser use area. No jewelry, dangling badges or other reflective materials are to be worn while working with the laser, especially on the hands and neck. Do not use reflective tools during alignment.

Check for and remove any foreign objects in the beam path other than safety controls such as beam blocks. Remove all unnecessary equipment, tools, and combustible materials from the laser table and immediate area to minimize the possibility of stray reflections and non-beam accidents.

Personnel in the laser lab should avoid bending over or otherwise putting their eyes at the level of the beam path while the laser is in operation.

Always be aware of the full beam path. Never allow the beam to propagate beyond the point to which you have aligned.

Always block the beam upstream when inserting/removing anything into/from the beam path, such as alignment irises.

Use a pair of index cards when checking the alignment of the beam so that you never have to leave the beam unblocked to move a card past a mirror.

As alignment proceeds down the table, a beam block should always be placed downstream in a position to catch the beam directly after the pair of mirrors being aligned, preventing the beam from propagating through an unaligned path.

Perform alignment following the steps outlined in the Standard Operating Procedure, do not stray from the procedure.

General alignment safety: Use lowest possible power, block beams, track reflections, and control stray beams.

8.1 Internal Alignment - Mirrors

Ensure eyewear, signage, and enclosure status.

Turn on cooling systems and power supply.

Turn on the power supply, checking that the water light comes on.

Turn to current mode/ full power; turn on the laser and press start.

Adjust vertical and horizontal knobs back to maximum power.

Turn off the laser and power supply.

Take off the lid and screw on safety overrides.

Test the power again (after turning the laser back on). Adjust to full power.

Use a non-reflective 7/16 wrench. Turn the vertical front knob to ___ power and adjust the back vertical knob in the opposite direction to see if power increases past the original power. If so, repeat. If not, turn the front knob in the other direction and repeat.

When the power is maximized, turn off the laser.

Replace the laser covering and let the cooling water run for 30 minutes.

8.2 External Optics Alignment

Ensure that all users are wearing appropriate laser protective eyewear, warning signs are posted, and laboratory doors are closed. Check that the laser path will be blocked.

Turn on the cooling water.

Turn on the power supply, checking that the water light comes on.

Turn to current mode/full power; turn on the laser and press start. (LASER BEAM POWER SETTING-USE LOWEST POSSIBLE POWER FOR ALIGNMENT)

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.

Set up two targets in the beam path, unblock the beam, and center the beam using adjustments on the optic. Make sure that that beam does not "clip" (i.e. that part of beam does not go past mirror or strike the corner of another mirror and set sent off at unexpected angles. Use card held directly in front of mirror to determine that the beam is centered, and directly after the mirror to check beam profile for "clipping".

Continue until optics are set up properly. Check that all mounts are tightly in place and will not inadvertently shift, causing changes in alignment.

Check for stray beams at each step and again after completing all alignment steps, using IR viewer or IR card if necessary. Please indicate the method of documentation of the survey (checklist or log, etc.)

Check that ALL laser beam enclosure and /or beam stops are in place.

9. Procedure for Laser Accidents

Shut off the laser if safe to do so.

Ensure personnel safety and seek medical attention as needed.

If an eye injury is suspected, have the injured person keep their head upright and still to reduce bleeding in the eye. A physician should evaluate laser injuries as soon as possible.

Respond to fires appropriately. Do not fight the fire unless it is very small and you have been trained in firefighting techniques. If the fire cannot be controlled, pull the alarm, and contact the fire department by calling 911 from a campus phone, or 911 from a cell phone.

After the incident, do not resume use of the laser system until the Radiation Safety Officer has reviewed the incident and approved the resumption of research.

If there is a power outage, turn off the laser to avoid a hazardous situation when power is restored.

During Business hours

Call EH&S at **859-323-6276** or call UKPD at **911** or **859-257-UKPD (8573)**.

After Business Hours

For Emergencies call UKPD at **911** or **859-257-UKPD (8573)**.

Inform EHS, your PI and the current group safety officer as soon as possible. If there is an injury, your PI will need to submit a report of injury to the Worker's Compensation Office.

10. Training Requirements

Laser Safety Initial or Refresher Training is required.

Hands-on laboratory-specific training is required prior to independent operation.

11. Document Control

This SOP must be reviewed annually and updated as necessary.

This document must be available to all authorized laser users.

*See tables below for documenting inventory, users and training.

Laser Inventory

Laser Class	Manufacturer / Model	Wavelength (nm)	Output Power / Energy	Laser Type	Required Eyewear OD

Authorized Users

[illegible]

Training Documentation

[illegible]