Lasers in the Lab

Lasers emit light (visible and invisible) through optical amplification, and are used for many purposes, including medical, cutting, measurements, and communication.

Hazards of Lasers

Eye damage – The primary hazard of working with lasers is the potential for eye damage. When a laser beam strikes the eye, damage to the cornea, lens, or retina can occur, depending on the output wavelength. This can cause damage ranging from temporary effects, such as dark spots in vision and flash-blindness to long term effects including permanent blindness, blurry vision, or other permanent visual problems.

Skin burns and fire – Lasers can burn skin, some severe enough to leave permanent scars. There is also a risk of developing skin cancer if exposed to certain UV lasers. High-power lasers may also be able to ignite combustible materials.

Other Physical Hazards – Many lasers use high voltage power sources. Because of this, there is a hazard of electrical shock. This can cause serious burns, long-term damage, or death. Other systems use high-pressure arc lamps, which can cause explosions. Lasers also often have many cords, which can create a tripping hazard

Chemical and Inhalation hazards – Some lasers use toxic gases or dyes as part of their systems. If you are using lasers to cut or burn material (inorganic or biological), it can generate air contaminants that may also be harmful.

Laser Classification

	Eye Hazard	Description	Example
Class 1	No possibility of harm.	Very low power or fully enclosed	CD player
Class 2	Damage possible but unlikely because of blink reflex	Output power < 1 mW. Staring into the beam for a long period could cause damage	Laser pointer or barcode scanner
Class 3R (3A)	Damage after 2 min of eye exposure	Output power < 5 mW	Alignment laser, garage door sensor
Class 3B	Permanent eye damage in < 1/100th of a second	5mW ≤ Output power ≤ 500 mW (CW) < 125 mJ in less than 0.25 sec. (Pulsed)	Research lasers, e.g. spectrometers
Class 4	Severe permanent damage without optics in short exposures	"High-powered" Output power > 500 mW (CW) -or- > 125 mJ (pulsed)	Used in research, industry and medicine

Optical instruments that focus light make lasers more dangerous. Reflections can be dangerous as well.

Class 3B and Class 4 lasers are hazardous

New laser systems should be evaluated by the University Laser Safety Officer (Brian Andersson, ander213@umn.edu).
SOPs are needed to identify appropriate eye protection, signage, and for any laser activities, including alignment and cutting.

Revised: Nov 2022

Class 3B or Class 4 Requirements

Signage

All labs with Class 3B or Class 4 lasers must post appropriate laser signage at entrances. Best practice is to also post additional signs to indicate when the laser is powered up or active (required for Class 4 laser labs), so others entering the area are aware that it is in active use. (Figure1)

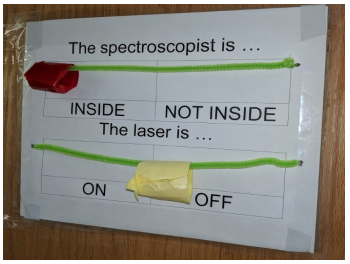

Figure 1—Door sign

Training

- Users must complete the General Laser Safety online training course available through Radiation Safety. https://training.umn.edu/courses/10170
- **ALL** lab personnel must be offered lab-specific laser training at least annually
- Non-users should be trained to knock on the door of all laser spaces before entering

Figure 2- eye protection

Eye Protection

- All laser users must wear the eye protection specified by the signage, SOPs, and training specific to the laser you will be using. Do not assume the protection provided by the laser vendor is the proper type. The correct type is determined by the wavelength, viewing conditions, and the power/energy of the laser.
- All eye protection (ANSI Z136) must be labeled with the optical density and wavelength that it protects against (Figure 2)
- Note- Different lasers may need different types of eyewear. Even the same laser can require different types of glasses, if it operates at more than one wavelength. You may not be able to use the same glasses you used with another laser, or in another lab.

Work Area

- Remove all reflective materials. Check yourself for any rings, watches, earrings, or other shiny/reflective jewelry. Check the optical table itself for laminated paper, metal parts, glassware, goggles, or tools.
- Remove combustible materials, like paper and cardboard, that could be ignited by the laser.
- Check that all controls are working properly. This includes any safety interlocks, beam enclosures/covers, beam stops, and other safety mechanisms.
- The laser beam should be positioned below eye level for people who are standing or seated.
- All elements on the optical table must be secured. If the table is bumped, or something is dropped on it, the beam may become misdirected potentially causing harm.

Using Lasers

- Always check your eye protection is the correct optical density for the laser wavelength you are using. Do not rely on the lens color.
- Move carefully when adjusting any part of the laser setup during work to avoid misalignment.
- Active adjustment of the laser's position or Alignment is the most common cause of laser injuries. Use a lower class laser or the lowest power settings possible and viewing cards, IR viewers or burn paper.