

LABORATORY LASER SAFETY PRACTICES

UNM PHYSICS and ASTRONOMY



UNDERSTANDING THE RISKS

- Eye injury
- Skin damage
- Starting fires
- Shock from high voltage
- Water damage from cooling system leaks

CLASSIFICATION OF LASERS

Class 1: Cannot cause damage. Exempt from control.

Class 2: Visible lasers that can cause skin or eye damage with exposure > 250 ms (human blink reaction time).

Class 3B: Direct or specular reflection is hazardous. Diffuse reflection is safe. Never a fire hazard.

Class 4: Diffuse reflection is hazardous. Can cause fire.

He-Ne lasers (< 1 mW) and laser pointers are **Class 2**

Everything else in PandA optics labs should be treated as Class 4

CLASS 4 LASERS REQUIRE PROTECTIVE EYEWEAR



Characterized by operating wavelength and optical density

Can be worn over prescription glasses

WHAT IS OPTICAL DENSITY (OD)?

Convenient method to quantify transmission (T) of laser safety glasses

$$OD = \log (1/T)$$

Similar to neutral density (ND) filters

TRANSMISSION	OD
0.1	1
0.01	2
0.001	3
0.0001	4

IMPORTANT: Unlike ND filters, OD is defined at specific wavelengths

Laser safety goggles must indicate wavelength range and OD

WHAT MINIMUM OPTICAL DENSITY IS NEEDED?

For a specified wavelength, use the following approximate guidance:

Pulsed	CW	Minimum OD
1–10 J; 2–20 J/cm ²	***	7
100 mJ; 1 J/cm ²	1 W; 2 W/cm ²	6
1 mJ; 20 mJ/cm ²	10 mW; 20 mW/cm ²	4

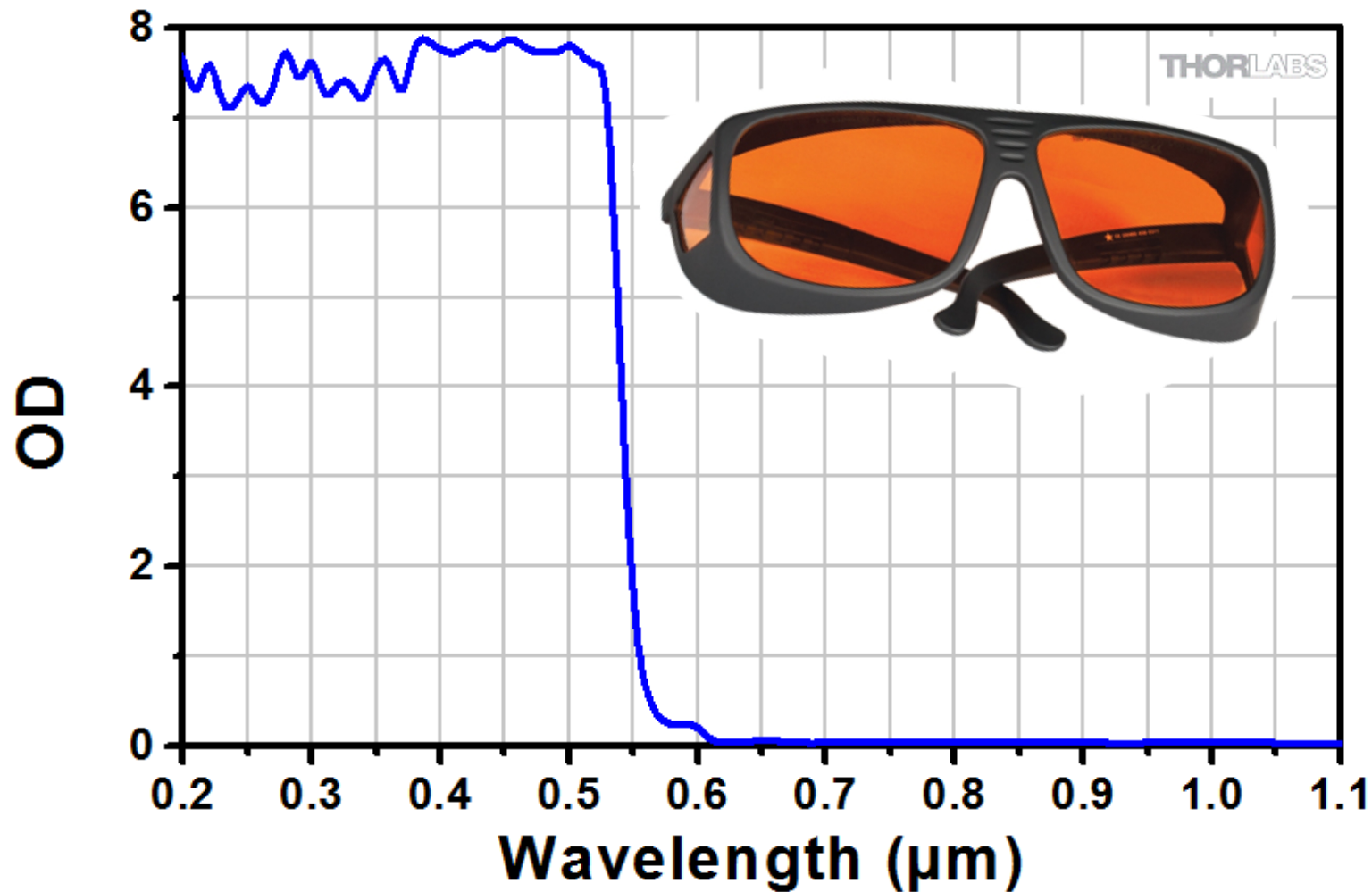
Care must be taken with multi-color experiments:

Optical pump wavelength much shorter than emission wavelength (eg. Ti:sapphire)

Nonlinear frequency conversion (eg. Second-harmonic generation, parametric generators)

WAVELENGTH RANGE IS CRITICAL!

These Thorlabs goggles give **ZERO PROTECTION** from Ti:sapphire laser beams



Warning lights outside lab

Appropriate signs at lab entrance



Laser safety curtains inside lab can be installed

SAFE LASER BEAM ALIGNMENT

Most accidents occur during alignment

Watches, rings, jewelry, phones
can accidentally reflect laser light



Laser beams should never
be placed at eye level

Bending over to pick up objects on floor
or to adjust equipment can be dangerous

Chairs in laser labs is a bad idea

Only one person should do the alignment

Protect skin when using UV lasers

Don't work with lasers when
excessively tired

SAFE LASER BEAM ALIGNMENT

It can be very difficult to perform alignment while wearing protective eyewear

A low-power laser can sometimes be used for alignment; propagates along same path as high-power laser

Infrared and ultraviolet beams are difficult to align; use phosphor cards or cameras/viewers

Pulsed lasers: if possible, reduce repetition rate and pulse energy

Use beam blocks and beam dumps to collect unwanted light

If impractical to turn laser off when not needed, block beam with a shutter

Where is nearest fire extinguisher?



THE **LASER OPERATOR** IS RESPONSIBLE
FOR **SECURING** THE WORKSPACE
AND **RESTRICTING** ACCESS



UNM Safety and Risk Services (SRS)

Organization separate from PandA

Perform periodic inspections of PandA labs

Maintains inventory of all of our lasers, including those not in use

Electrical Safety

Equipment power supplies may present electrical hazard

Shock and electrocution from high voltage

CAUTION: Capacitors can store dangerous amount of energy even when equipment unplugged from power source

CAUTION: Water condensation can dramatically reduce path insulation. Turn off circuit breaker before working on a water cooled system.



Electrical Safety



Make periodic inspection of power cords

Do not attempt equipment electrical repair unless trained

PandA electronics shop may be able to help

Shop hours M-W-F 730–1100 am

Expert technician available at \$25/hour

Large inventory of parts

Plumbing: Use the correct line fittings



Follow the equipment manufacturer guidelines

Make periodic inspections for brittle/cracked hoses

Improvising and substituting hose clamps may cause leaks

Water damage to equipment, electric shock



SEPARATE TRAINING COVERS OTHER CONCERNS IN THE LABORATORY WORK ENVIRONMENT

- **Fire Safety**
- **Chemical Safety**
- **Radiation Safety**

*Consult with the department's safety personnel
for guidance*