

RISKS POSED BY LASERS

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Description

A laser is **optical** (in the visible, infrared, or ultraviolet spectrums), **monochromatic** (only one wavelength), **consistent**, and **directional radiation**. It is defined by the following characteristics:

- Wavelength (λ),
- Emission temperature,
- Power (W),
- Frequency (Hz) in the case of repeated pulses,
- Diameter of the beam, and
- Divergence.

Regulations (UNE EN 60825-1/A2: 2002) define 7 classes of lasers:

Class 1	Laser safe for use under foreseeable conditions, including the use of optical instruments for direct viewing.
Class 1M	Lasers that emit between 302.5 and 4000 nm and are safe to use under foreseeable conditions, but could pose a danger if viewed directly with optical instruments (magnifying glasses, binoculars).
Class 2	Lasers that emit visible radiation (400-700 nm). Eye protection is achieved through aversion responses, including the corneal reflex, even when optical instruments are used.
Class 2M	Lasers that emit visible radiation (400-700 nm). Eye protection is achieved through aversion responses, but viewing the beam could pose a danger if viewed with optical instruments.
Class 3R	Lasers that emit between 302.5 and 106 nm. Directly viewing the beam is dangerous but poses less of a risk than class 3B lasers (they have fewer production requirements and less oversight).
Class 3B	Directly viewing the laser is always dangerous. Viewing diffuse reflections is usually safe.
Class 4	Direct exposure to eyes and skin is always dangerous, as are diffuse reflections. They can cause fires. Their use requires extreme caution.

Applicable regulations

- Law 31/1995, on the prevention of occupational hazards.
- Royal decree 486/2010, on protecting workers' health and safety against hazards related to exposure to artificial optical radiation.
- NTP-654 "New laser classification (UNE EN 60825-1 /A2: 2002)" (National Institute for Occupational Safety and Hygiene [*Institut Nacional de Seguretat i Higiene en el Treball*]).
- UNE-EN 12254:2010 "Screens for laser working places".
- UNE-EN 207:2010 and UNE-EN 208:2010 on personal eye-protection equipment against laser radiation (protective eyewear and laser adjustment glasses).

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Most common hazards

- **Effects of lasers on the eyes and skin:**
 - UV-C laser (180-280 nm): photophobia, tearing, and redness in the eyes. Melanoma.
 - UV-B laser (280-314 nm): photokeratitis. Increased skin pigmentation and burns.
 - UV-A laser (315-400 nm): photochemical cataract. Erythema and skin pigmentation.
 - Visible laser (400-700 nm): retinal burns. Skin pigmentation and burns.
 - Infrared A laser (700-1400 nm): damage to the retina, cornea, and lens. Skin burns.
 - Infrared B and C laser (1400-10⁶ nm): damage to the cornea and lens. Skin burns.
- **Fire.**
- **Electrical risk.**
- **Chemical risk** (some lasers utilize chemical products and gasses).

Preventive measures to follow

- Every laser device must have affixed, in a visible location, a **label** from the manufacturer indicating to which class the device pertains (1, 1M, 2, 2M, 3R, 3B, or 4) along with warning notices and information about preventing risks.
- Whenever possible, work should be done in rooms exclusively reserved for using lasers. Avoid having people present who are not involved with the laser work. If this is unavoidable, doors or screens must be set up to protect these people.
- A **sign indicating the risk** that is present must be put on the entrance door along with an explanatory text. Access to the laboratory shall be restricted to authorized personnel (door shall require a key).
- **Certified screens** must be installed to close off pathways to the laser risk and prevent reflection.
- Follow the **safety instructions in the device manual**.
- Use of certified **protective equipment** (with the CE seal) is required:
 - Laser safety eyewear and laser adjustment glasses (the eyewear must be appropriate for the power and wavelength of the laser),
 - Burn-resistant gloves, and
 - Clothing that covers the whole body.
- Make sure that the protective equipment is completely intact (no cuts or other defects) and ensure that it is clean and put back where it belongs when finished with it.
- Try to avoid having flammable substances or combustible materials present near the laser. Wear clothes and gloves that will not ignite easily.
- Remove or cover all **shiny surfaces** that could cause reflections. Do not wear rings, watches, or other objects that could reflect or scatter the laser.
- During alignment, use the lowest level of power possible; use targets to view IR/UV, and only look at diffuse reflections.
- Position the laser in such a way that the height of the beam is well above or below the eyes.
- Never aim a laser at the eyes, even with very low power. The laser should also never be aimed at windows or doors.
- All personnel and students that use laser devices must be **informed** of the hazards and receive **instructions** on how to work safely, especially when carrying out alignment, adjustment, and repairs.
- Personnel must submit to periodic **medical examinations**.

If, while working, you find a hazard that could affect you or anybody else, immediately inform the person in charge of the laboratory.

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GENERAL INSTRUCTIONS FOR WHAT TO DO IN CASE OF AN EMERGENCY

There is an emergency team and an emergency plan for every building, and drills are held yearly.

UIB TELEPHONE NUMBERS:

Porters' office in the Mateu Orfila building: 971 17 30 09

Operator: 971 17 30 00 / 17 30 01 (internal calls: 99)

Head of the laboratory and phone number: _____

Medical Service (08:00-20:00): 971 17 34 61

Prevention Services: 971 17 33 28 / 63328

Maintenance Services: 971 17 29 09

Security and campus surveillance services: 666 55 84 48

Outside assistance (firefighters, police, ambulance): 112

SAFETY RULES FOR AVOIDING FIRES

- Keep the area that you are using clean and tidy: dirtiness, flammable liquid spills, and the accumulation of combustible materials (papers, boxes, etc.) favour the creation of fires.
- If they are not essential, do not leave machines or lights on unless they are being monitored.
- Do not overuse multi-outlets as they can overload wiring systems and cause short circuits or fires.
- Do not use worn or non-certified (CE) multi-outlets or extension cords.
- Do not repair or modify electrical installations or machines: this is a job that is exclusively for technical services.
- Carefully handle flammable products and avoid placing them near heat sources.
- According to regulations, smoking is not permitted in teaching buildings. In places where smoking is permitted, do not throw butts into waste bins.
- Do not block emergency pathway or emergency exits. Do not leave boxes, furniture, or any other material in places that could obstruct an evacuation. Do not block access to fire extinguishing apparatus (extinguishers, fire hoses, etc.).



WHAT SHOULD YOU DO IF YOU ENCOUNTER AN EMERGENCY (smoke or fire, injured persons, gas leak, explosion, a suspicious package, etc.)?

1st. KEEP CALM.

2nd. NOTIFY a PORTER immediately so that he/she may implement the emergency plan. Porters can be notified by telephone or in person. Indicate to the porters the exact location and type of emergency (fire, injured persons, gas leak, explosion, etc.).

3st. TRY TO COMBAT THE EMERGENCY with your know-how and the tools available (extinguishers, fire blankets, etc.) without putting yourself in danger, and wait for help to arrive.

TOOLS FOR FIGHTING FIRES

a) Dry chemical ABC extinguisher: works for type A fires (solids such as paper, wood, etc.), type B fires (flammable liquids), and type C fires (gasses such as propane, butane, etc.). These extinguishers can be used in the presence of electrical installations, but the chemicals could ruin nearby equipment.



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b) Carbon dioxide (CO₂) extinguisher: appropriate for fires in the presence of electrical installations (breaker boxes, computer rooms, etc.). It contains a gas that comes out at -70 °C, and as such it should not be applied to people.

How to use an extinguisher: Get the right fire extinguisher and pull the pin. Aim at the base of the flames and move slowly from side to side to blanket all of the flames.

c) Installed fire hoses: water is appropriate for solid matter fires, but extreme care must be taken when electrical installations are present, given that there is a risk of electrocution.

d) Fire detectors and emergency buttons:

Emergency buttons send a signal to the fire alarm control panel when activated. After this, a porter will immediately go to see if an emergency situation actually exists. If an emergency button is activated when no porters are present (at night or on weekends, for example), the building alarms will be activated automatically.

Fire detectors will automatically send a signal to the control panel if there is a fire, and the porters will check to see if there is actually a fire.

f) Alarms: serve to signal to the people that they should evacuate the building.

Evacuation in case of an emergency

- When you hear the alarms in the building, turn off all machines and dangerous installations in your area (devices, water, gas, electricity, etc.) and leave the building, **without running**, following the signs to the nearest exit. Follow the instructions given by the person in charge of the evacuation, if there is one.
- If you work at night, at weekends, or over holidays, put your name in the register in the porters' office so that responders will be aware of your presence in case of an emergency.
- The **procedures that should be followed during an evacuation** are listed hereafter:
 - ☞ Do not waste time gathering personal items. Leave quickly but without running, the more orderly the better.
 - ☞ When leaving the room, close the door.
 - ☞ **Never go back** to get personal items or look for something.
 - ☞ If there is a fire that is giving off toxic gasses, evacuate the area in the direction that the gas cloud is moving. In the presence of smoke, breathe through a handkerchief (moistened if possible). If necessary, crawl to get yourself out of the building.
 - ☞ If the fire is blocking the exit of the building, go to a room with exterior windows. Close the door, and if possible put wet clothing against the bottom of the door. Signal for help from the window or make a phone call from inside the room.
 - ☞ Make your way to the **meeting point**, located at the **main entrance of the building**.
 - ☞ Wait until the authorities declare that the emergency has been resolved.
 - ☞ **Do not go to the parking lot to get your vehicle** as it could block access for firefighters and ambulances.
 - ☞ Collaborate with emergency personnel at all times, and participate in all of the drills organized by your building.



Laboratory emergencies

Protective measures available in all UIB laboratories include:

- Emergency shower and eyewash station,
- Fire blanket: useful for extinguishing small fires and protecting an injured person,

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- Materials for cleaning up chemical spills (vermiculite or similar),
- First aid kit, and
- Firefighting equipment: alarms, emergency buttons, extinguishers, etc.

You should locate and familiarize yourself with all of them.

What to do if you encounter an emergency situation (fire, explosion, gas leak, etc.):

1st. Notify laboratory personnel and/or the porters, they will, in turn, activate the emergency plan: finding the action team, those in charge of the building, medical services, firefighters, etc. You can notify the porters by telephone or by utilizing one of the alarms that are in the buildings' hallways. If you work at night or over the weekends, utilize the emergency buttons (which will activate the building's alarms) and call 112.

2nd. Try to combat the emergency, without putting yourself at risk, until help arrives.

What to do if you hear the building's alarms:

1st. Turn off machines and dangerous installations (gas, etc.).

2nd. Close laboratory doors and evacuate the building using the stairs, NEVER use the lift.

3rd. Wait outside of the building until permitted to go back inside.

What to do in case of:

1. Chemical spills: get an absorbent (vermiculite, sand, etc.; do not use sawdust or paper towels, as they could catch fire). Utilize protective equipment (mask, gloves, clothing, etc.) when cleaning the spill, and keep waste in a resistant container. If the aforementioned materials are not available, notify laboratory personnel and/or the porters; do not try to clean up the chemicals as things could go wrong. To avoid spills, do not leave chemical containers open, and make sure that when moving chemicals, you do so safely.

2. Accidents affecting individuals:

- Poisoning, cuts, falls, etc.: immediately notify laboratory personnel or the porters so that they may provide assistance and notify medical services if necessary.

- Electrocutation: disconnect the electricity before touching the victim. Immediately notify the porters or notify medical services directly. Do not give food or drink to the injured person.

- Chemical splash on the clothes or on the skin: rinse the affect area quickly with abundant water and take off any contaminated clothing. Splash in the eyes: flush the eye for 10 minutes at an eyewash station keeping the eye open to ensure that the underside of the eyelids are cleaned out.

- Cuts and wounds: clean the wound with water and soap for a few minutes, and disinfect it with iodine. Cover the wound before going back to work. If the wound is serious, seek medical assistance.

- Burns: flush the burned area with abundant cold water. If the burn is not serious, an ointment may be applied. If the burn is serious:

- ✓ Do not apply any ointment or disinfectant to the skin. Do not puncture or pop blisters.
- ✓ Do not over-cool the person or give him/her food or drinks.
- ✓ Do not remove clothing stuck to the skin.

Cover the burned area with a dressing or clean piece of clothing, then go to medical services.

You must notify the person in charge of the laboratory and Prevention Services of any accident or incident in order to avoid having it happen again.

