Lab Safety Course
PHYS (200)

6- general precautions when using lasers

What is a laser?

a special form of light. Laser light does not exist in nature.

Only human technology can create laser light.

Uses of laser:

- CD and DVD players
- Bar code readers in stores.
- in delicate surgery, such as eye surgery.

- Lasers carry TV and telephone signals over special cables.
- Metal workers use lasers to cut and weld metal into everything from street light poles to cars.
- Workers in clothing factories use lasers to cut through hundreds of layers of fabric at once.

Laser light is monochromatic: the light from a laser contains exactly one color or wavelength.

Laser light is coherent: all the wavelengths are in phase. That is, they are all "waving" together. All the wave crests (high points) and troughs (low points) are lined up.

Laser light is collimated. laser light waves all travel in the same direction, exactly parallel to one another. This means that laser light beams are very narrow and can be concentrated on one tiny spot.

Laser Hazards

The hazards may be separated into two general categories – beam-related hazards to eyes & skin and non-beam hazards, such as electrical & chemical hazards.

Beam-Related Hazards:

- Effects can range from mild skin burns to irreversible injury to the skin and eye.
- The biological damage caused by lasers is produced through thermal, acoustical and photochemical processes.

- **Thermal effects** are caused by a rise in temperature following absorption of laser energy.

- The severity of the damage is dependent upon several factors, including:

exposure duration,

wavelength of the beam,

energy of the beam,

the area and type of tissue exposed to the beam.

- **Acoustical effects** result from a mechanical shockwave, propagated through tissue and damaging the tissue.

  - This happens when the laser beam causes localized vaporization of tissue, causing the shockwave analogous to ripples in water from throwing a rock into a pond.

- **photochemical effects:** Beam exposure may also cause photochemical effects when photons interact with tissue cells.

  - A change in cell chemistry may result in damage or change to tissue.

  - Photochemical effects depend greatly on wavelength.

EYE:

- The major danger of laser light is hazards from beams entering the eye.

- The eye is the organ most sensitive to light.

- The lens in the human eye focuses the laser beam into a tiny spot than can burn the retina.

- Per the law of the conservation of energy, the energy density (measure of energy per unit of area) of the laser beam increases as the spot size decreases.
- This means that energy of a laser beam can be intensified up to 100,000 times by focusing action of eye.
- Thus, even a low power laser in the milliwatt range can cause a burn if focused directly onto the retina.
- ***NEVER point a laser at someone's eyes no matter how low the power of the laser.***

Skin:

- Lasers can harm the skin via photochemical or thermal burns.
- Depending on the wavelength, the beam may penetrate both the epidermis and the dermis. The epidermis is the outermost living layer of skin.

Non-Beam related Hazards

In addition to the hazards directly associated with exposure to the beam, ancillary hazards can be produced by compressed gas cylinders, cryogenic and toxic materials, ionizing radiation and electrical shock.

- Electrical Hazards
- Fire Hazards
- Compressed Gases
- Laser Dyes

Eye Protection:

1) Protective eyewear appropriate to the laser system in use should be worn if there is any eye hazard.

2) The filter or filters in the protective goggles should be matched to the wavelength of the emissions of the laser. Since some lasers emit radiation at more than 1 wavelength, it may be necessary to have filters to cover each range of frequencies.

3) Eye examination on a 3- to 5-year schedule to determine if there are subtle changes occurring in the various systems of the eye.

Protective Procedures for Lasers:

1) The laser Danger sign for higher powered lasers should be set up in an area to which access can be controlled.

2) When no responsible person is in the room, the room should be locked to prevent others from entering the room and changing the physical configuration, or accidentally exposing their eyes to the laser beam.

3) Entrance to the facility by unauthorized personnel or unexpected entry by laboratory employees should be prevented by safety interlocks while the laser is in an operating condition, i.e., when it is on and in a condition to emit radiation.

4) A warning light should be placed at the entrance.

5) Guests or visitors should be allowed in the controlled area during operations only under carefully controlled conditions.

6) All lasers are required to be in a protective housing, but safety interlocks should be provided on any portion that could be removed when the unit is operating.

7) Some powerful laser systems should be required to be within enclosures, including the target or irradiation area, to protect personnel.