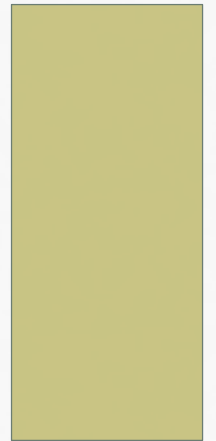


LASER SAFETY

DR MAZIN HAMID AYYASH



BIOLOGICAL EFFECTS OF LASER RADIATION

- Laser radiation is
- 1- Reflected
- 2-Transmitted
- 3-Absorbed

When incident on biological matter

Optical properties of matter determine the degree of each one

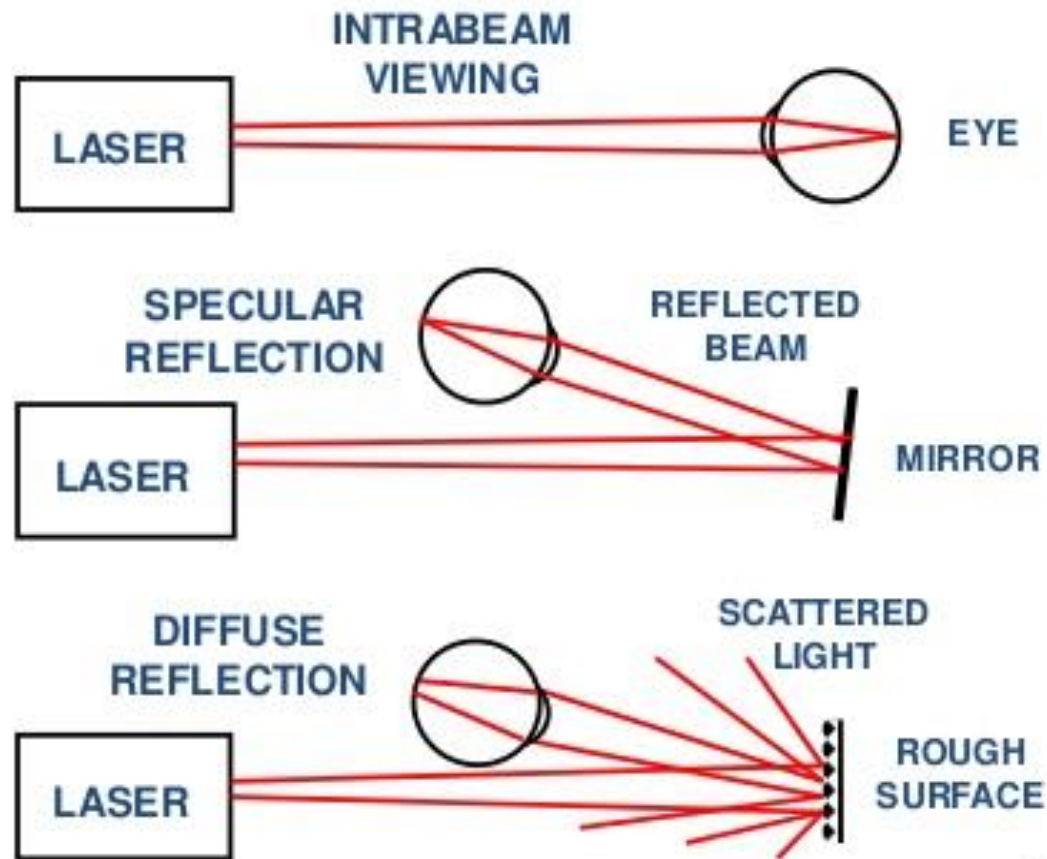
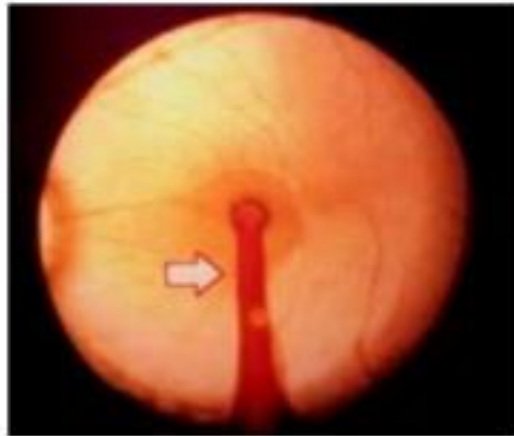
LASER BEAM INJURIES

- High power lasers can cause skin burns.
- Lasers can cause severe eye injuries resulting in permanent vision loss.

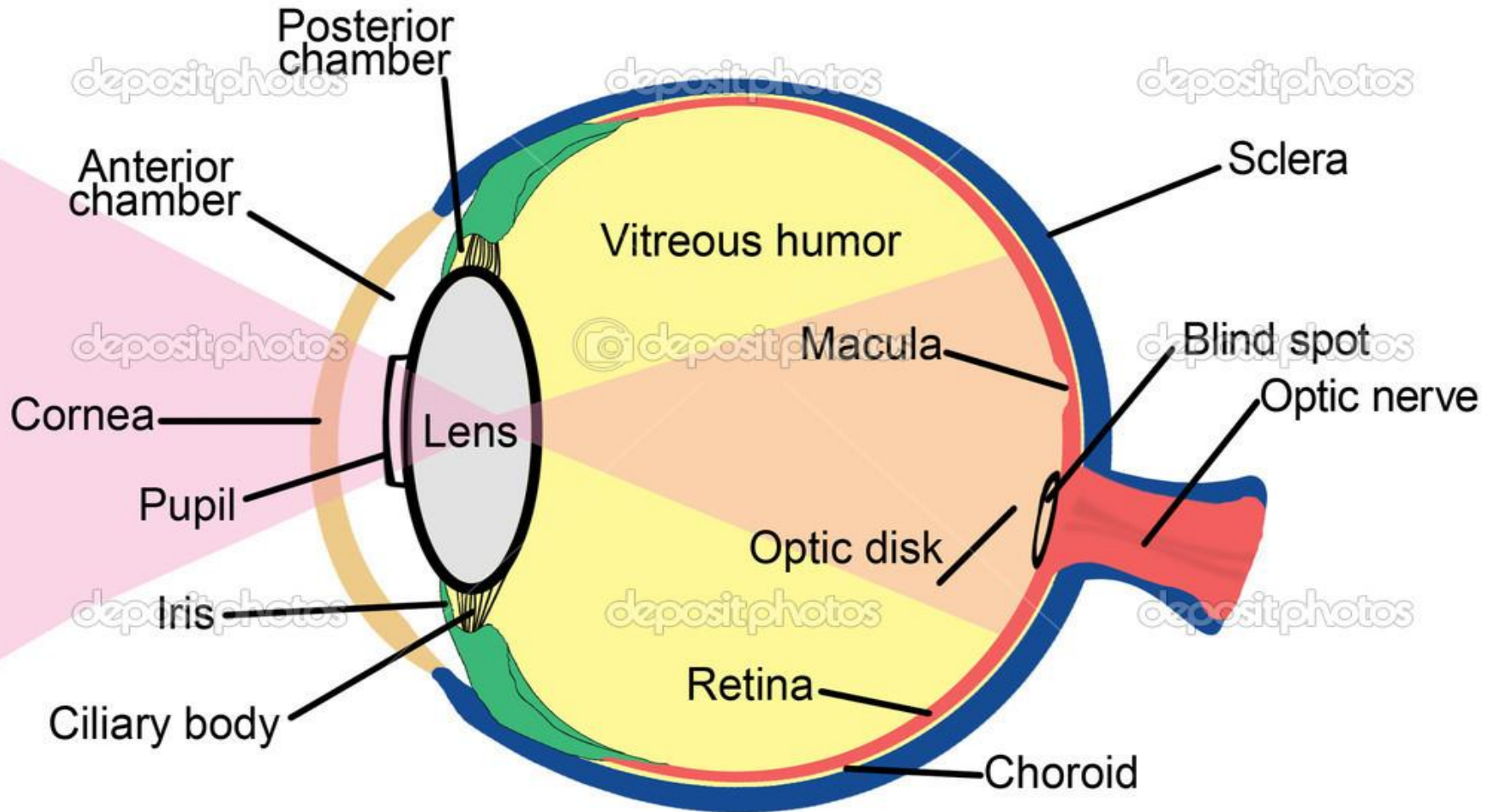
LASER SKIN INJURIES

- **THERMAL SKIN INJURIES**
(High power only)
 - Surface burns from high power beams
 - Deeper burn penetration at 1 μm wavelength
 - Tissue vaporization by focused beams
- **PHOTOCHEMICAL SKIN INJURIES**
 - Sunburn from scattered UV
- Possibility of skin cancer from long term UV exposure

TYPES OF LASER EYE EXPOSURE



HUMAN EYE



RETINAL EFFECTS

- Temporary change without pathological reactions; or it may be severe, varying from small indistinguishable lesions to gross damage of retina (simple reddening)
- With increasing energy, lesions may occur, progressing to charring with hemorrhaging and secondary effect about the lesion
- With very high energy, gases form which can be disrupted the retina and may create small explosions in the eye

RETINAL EFFECTS

- **Within the retinal area the most critical area for vision is the fovea (1mm in diameter and contains the highest density of cone cells, resulting in high image resolution of the eye)**

- **Minimal damage (smallest area of functional loss of vision) in peripheral field of the retina may go undetected since the brain compensates, up to a more susceptible to damage than the para-macular region of the retina, and even small area losses resulting in severe impairment of vision**
- **Thus damage to the fovea is always assumed when trying to establish safe exposure levels**

CAUSES OF LASER ACCIDENTS

- **Studies of laser accidents have shown that there are usually several contributing factors. The following are common causes of laser injuries:**
- **Inadequate training of laser personnel**
- **Alignment performed without adequate procedures**
- **Failure to block beams or stray reflections**
- **Failure to wear eye protection in hazardous situations**
- **Failure to follow approved standard operating procedures or safe work practices**

HAZARD EVALUATION AND CLASSIFICATION

- **3 concepts of laser applications influence the total hazard evaluation and there by influence the application of control measures, namely;**
 - **1- the laser or laser systems capability of injuring personnel**
 - **2- the environment where the laser is used**
 - **3- the personnel who may use or be exposed to laser radiation**

HAZARD EVALUATION AND CLASSIFICATION

- **Laser systems are classified according to their capability of injuring personnel (concept 1) in standard labeled with appropriate hazard classification**
- **Concept (2 and 3) vary with each laser application and can not be readily standardized**
- **The total hazard evaluation procedure must consider all the 3 concepts, although in most cases only concept (1) influence the control measures which are applicable**

NON-BEAM HAZARDS

- ☐ **Electrical Hazards**
- ☐ **Smoke & Fumes**
- ☐ **Mechanical Hazards**
- ☐ **Process Radiation**
- ☐ **Flashlamp Light**
- ☐ **Chemical Hazards**

LASER HAZARD CLASSES

**Lasers are classified according to the level of
laser radiation that is accessible during
normal operation**

CLASS 1

- Safe during normal use
- Incapable of causing injury
- Low power or enclosed beam



Label not required
May be higher class during
maintenance or service

CLASS 2

- Staring into beam is eye hazard
- Eye protected by aversion response
- Visible lasers only
- CW maximum power 1 mW



Laser
scanners

CAUTION

LASER RADIATION WHEN OPEN

**DO NOT STARE INTO BEAM OR
VIEW WITH OPTICAL INSTRUMENTS**



CLASS I LASER PRODUCT

CLASS 3R (FORMERLY 3A)

- laser pointers

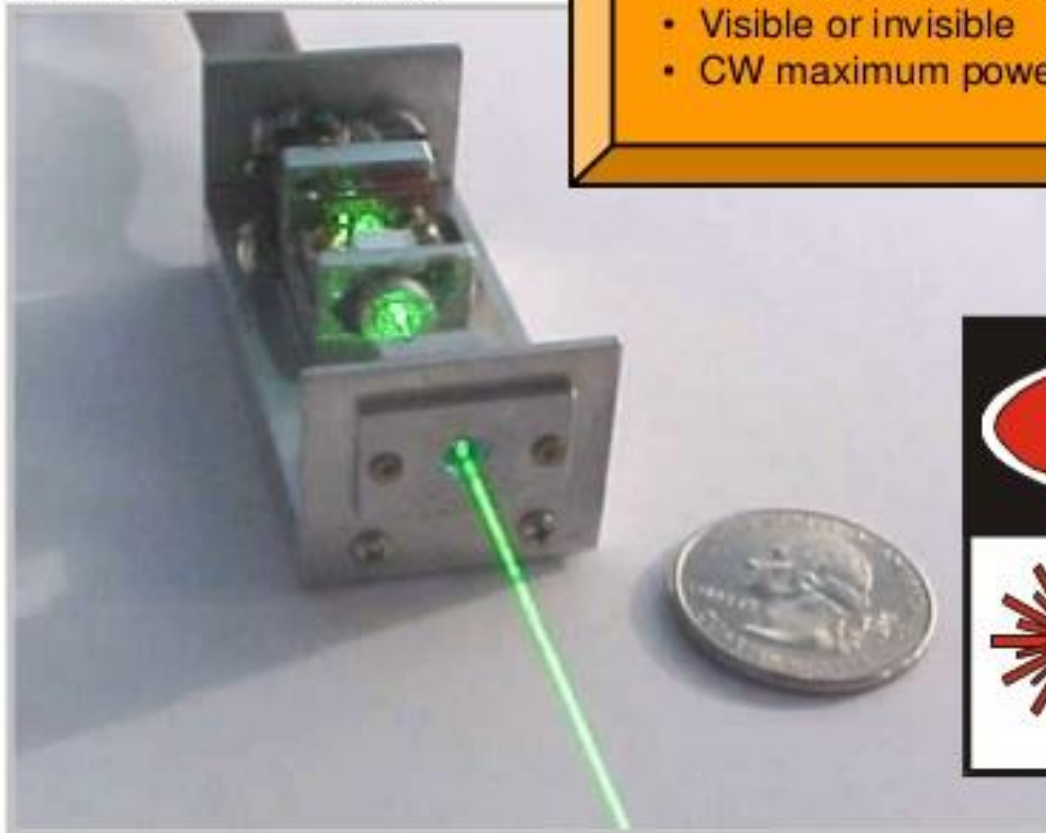


- Aversion response(0.25 sec) may not provide adequate eye protection
- CDRH includes visible lasers only
- ANSI includes invisible lasers
- CW maximum power (visible) 5 mW




CLASS 3B

DPSS Laser with cover removed



- Direct exposure to beam is eye hazard
- Visible or invisible
- CW maximum power 500 mW

DANGER

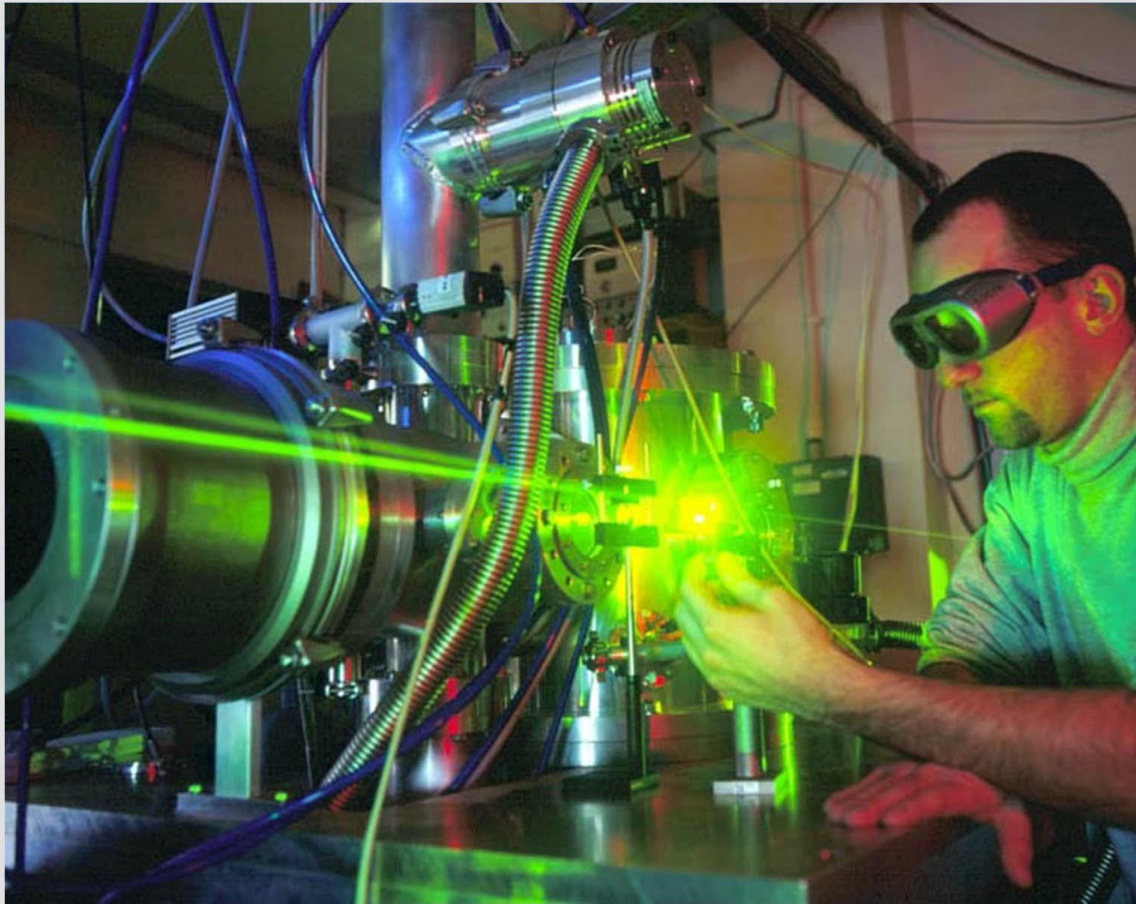


LASER RADIATION-
AVOID DIRECT EXPOSURE TO BEAM

2₀₀ ND:YAG Wavelength: 532 nm
Output Power 80 mW

CLASS II/b Laser Product

CLASS 4



Exposure to direct beam and scattered

light is eye and skin hazard

- Visible or invisible
- CW power >0.5 W
- Fire hazard



DANGER



VISIBLE LASER RADIATION-
AVOID EYE OR SKIN EXPOSURE TO
DIRECT OR SCATTERED RADIATION

2 ω Nd:YAG
Wavelength: 532 nm
Output Power 20 W
CLASS IV Laser Product

CLASS 1M & 2M

M is for magnification.

A class 1M laser is class 1 unless magnifying optics are used.

A class 2M laser is class 2 unless magnifying optics are used.

M classes usually apply to expanded or diverging beams.



Condition 1
Expanded Beam



Condition 2
Diverging Beam