



# LASER Risk GeePs













Extract from luc.martin@polytechnique.fr presentation



## Summary

- Lasers overview
- Beam Hazards
- Means of protection
- Good practices
- Other risks



### Lasers overview

Light Amplification by Stimulated Emission of Radiation spontaneous emission:

- independant energy
- No preferred direction
- no common phase relationship

Stimulated emission:

- same energy
- same direction
- same phase





### Lasers overview

### Operation principle:

- a gain medium
- a source of pumping
- a feedback loop

#### Laser characteristics :

- Wavelength
- Emission mode (pulsed, continuous)
- Intensity (power, energy)
- Divergence



### Lasers overview

Wavelength ( $\lambda$ )

- Nd:YAG : 1064nm (double : 532nm)
- He-Ne for alignment : 632nm
- Ti:Sa femtoseconde : 800nm
- CO2 : 10,6µm





### Lasers overview

Continuous :

- single-mode
- multimode

Pulsed :

- relaxed (ms-µs)
- Q-swittched (µs-ns)
- Mode-locked (ns-fs)
  - duration (s)
  - frequency (Hz)





### Lasers overview

Divergence :

- Affects all laser beam
- small angle
- mrd : 1mm to 1m



### **NOHD : Nominal Ocular Hazard Distance**

This is the distance from the source at which the intensity or the energy per surface unit becomes lower than the Maximum Permissible Exposure (M.P.E.) on the cornea and on the skin. The laser beam can thus be considered as dangerous if the operator is closer from the source than the N.O.H.D.



## Beam Hazards

Skin Risk

Photochemical injury (UV)

- erythema
- skin allergy
- skin tumour

Thermal injury (visible and IR)

- burn
- possibility of cumulative effects



### Beam Hazards

### Ocular risk

UV C 100-280nm	cornea : conjunctivitis, opacification	
UV A-B 280-400nm	eye's lens : cataract	
Visible-IR A 400-1400nm	retina : slight impairment, scotoma eye's lens : cataract iris : edema, paralysis, necrosis	
IR B 1400-3000nm	cornea : damage, burning	



### **Beam Hazards**

### Laser safety classification

	classification	1	1M	2	2M	3R	ЗB	4
without danger	Eye + optical device		×	*	×	xx	xx	xx
× danger potentiel	Direct exposure			*	*	×	xx	xx
* without danger if	Diffuse reflection						×	xx
t<0,25s	Skin						×	xx
×× dangerous	Burning							×



## Beam Hazards

Laser safety classification

- quick determination of the level of risk
- identified by a plate
- insufficient to size the good protections



For each class :

Maximum Accessible Emission Level Limit (AEL), norme NF EN 60825-1

## Means of protection

Collective protections:

- beam orientation (horizontal plane, not at eyes level)
- Opaque or filtering covers, with opening contacts
- interlock, door contact, airlock
- Room lightning (iris size)
- blocking reflections and leaks
- signage, access control
- training, accreditation

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Laboratoire **GeePs** 

## Means of protection



### Means of protection



#### 840-950+1070-1090 DIR L5

- Wavelength between 840-950nm and 1070-1090nm
- from continuous to 1ns
- attenuation of 10<sup>5</sup>

## Means of protection

### Initial medical visit

- visual acuity
- funduscopic examination, archive
- eye pressure measurement
- medical ability

Annual medical check-up

- in case of ocular gene,
- accident
- end of activity







## **Good practices**

#### To be done imperatively before the first use of the lasers:

 Read the documents displayed in the manipulation room, they present the risks and PPE necessary for the lasers of the room (see document "LISA")

#### To respect and enforce:

- remove reflective objects: jewellery, watches...
- check the marking of protective glasses
- align at reduced energy
- use alignment cameras
- block the beam to put a component in place
- use stable and fixed mechanical assemblies
- direct vertical reflections downward
- keep unnecessary objects out of the beam
- never look straight into the beam, even with glasses

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## Good practices

In case of injury :

- Neutralize the laser
- Calm the victim
- NEVER give up aspirin
- Refer the victim to a medical service
- Note the parameters of the laser source





## Other risks

### Electrical risk

- High voltage (flash sources)
- High current (diodes)
- Burning, electric shock or electrocution



### Fire

- flammable materials on the beam (paper, cardboard, PVC)
- electrical overheating (power supplies, discharge bench)
- burns, smoke poisoning





## Other risks

### Chemical risks

- solvents
- Lasing gases, filler or inerting gases
- anoxia, intoxication

### Miscellaneous risks

- non-coherent radiation(UV lamp)
- ionizing radiation
- magnetic fields
- irritations, irradiation, pacemakers...







### Other risks





# No laser accident listed with protective glasses...

