

# Physics of laser (Laser operation)



What is laser?

**L** ight

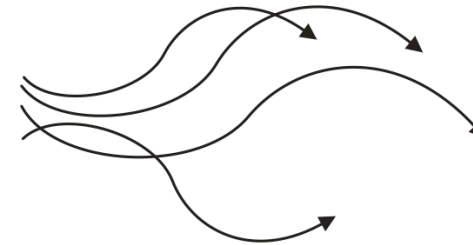
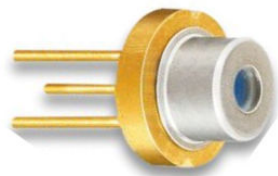
**A** mplification (by)

**S** timulated

**E** mission (of)

**R** adiation

# Laser light characteristics



- **Monochromatic**
- **Directional**
- **Coherent**

- **Many wavelengths**
- **Multidirectional**
- **Incoherent**

# Laser sources

## **Lasing medium (active material):**

- **Solid state (ruby, Nd:YAG)**
- **Gas (He, HeNe, CO<sub>2</sub>)**
- **Liquid (organic dye)**
- **Semiconductor (laser diodes)**

# Laser applications in medicine

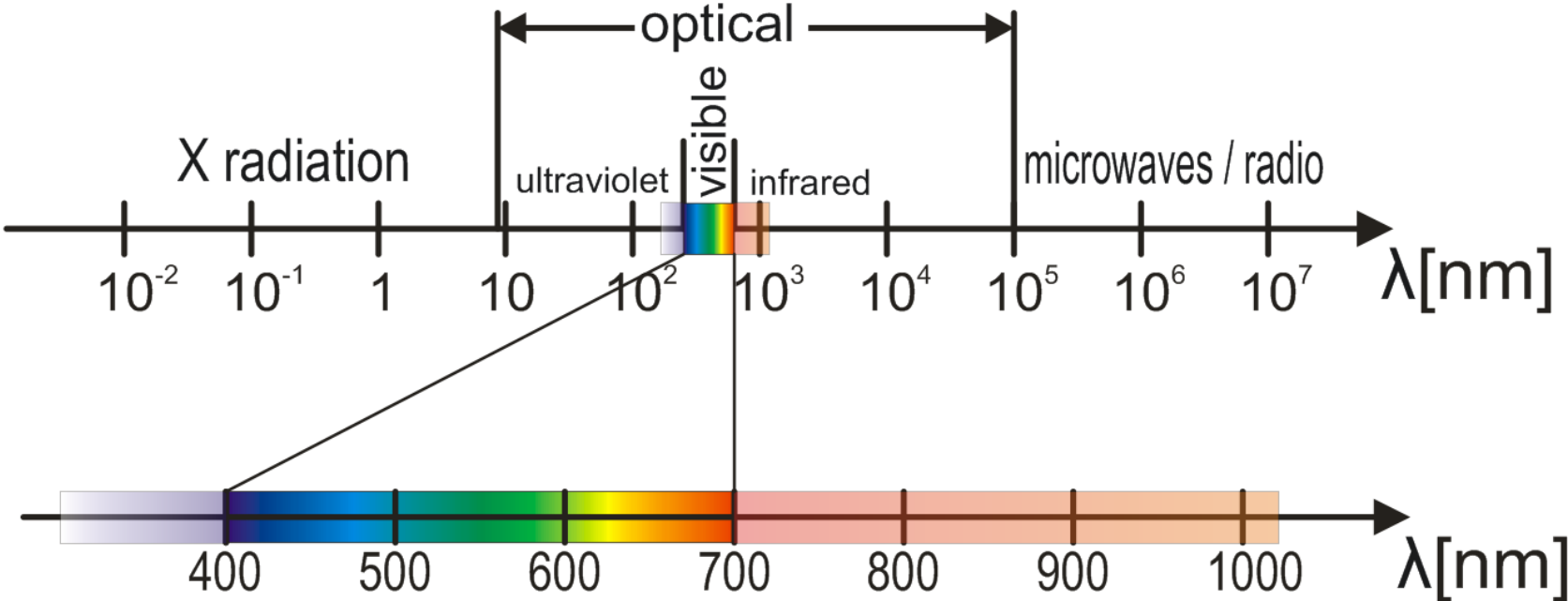
- **Surgery**
- **Ophthalmology**
- **Dentistry**
- **Cosmetology**
- **Biostimulation**

# Laser parameters

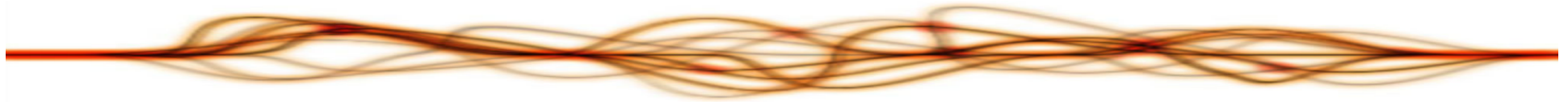
- Wavelength [nm]
- Power [mW]
  - peak, average
- Energy (dose) [J]
  - Energy density (dose per line) [J/cm]
  - Energy density (dose per surface) [J/cm<sup>2</sup>]
- Mode of work (CW or Pulse)

# Laser parameters - wavelength

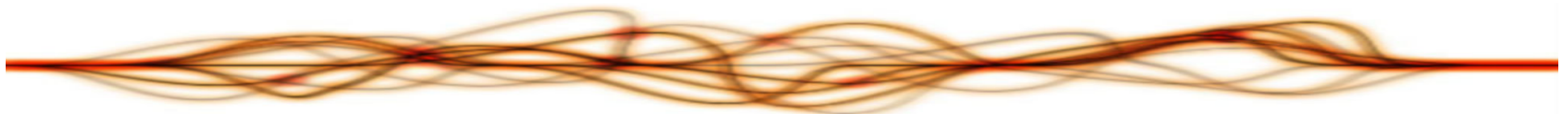
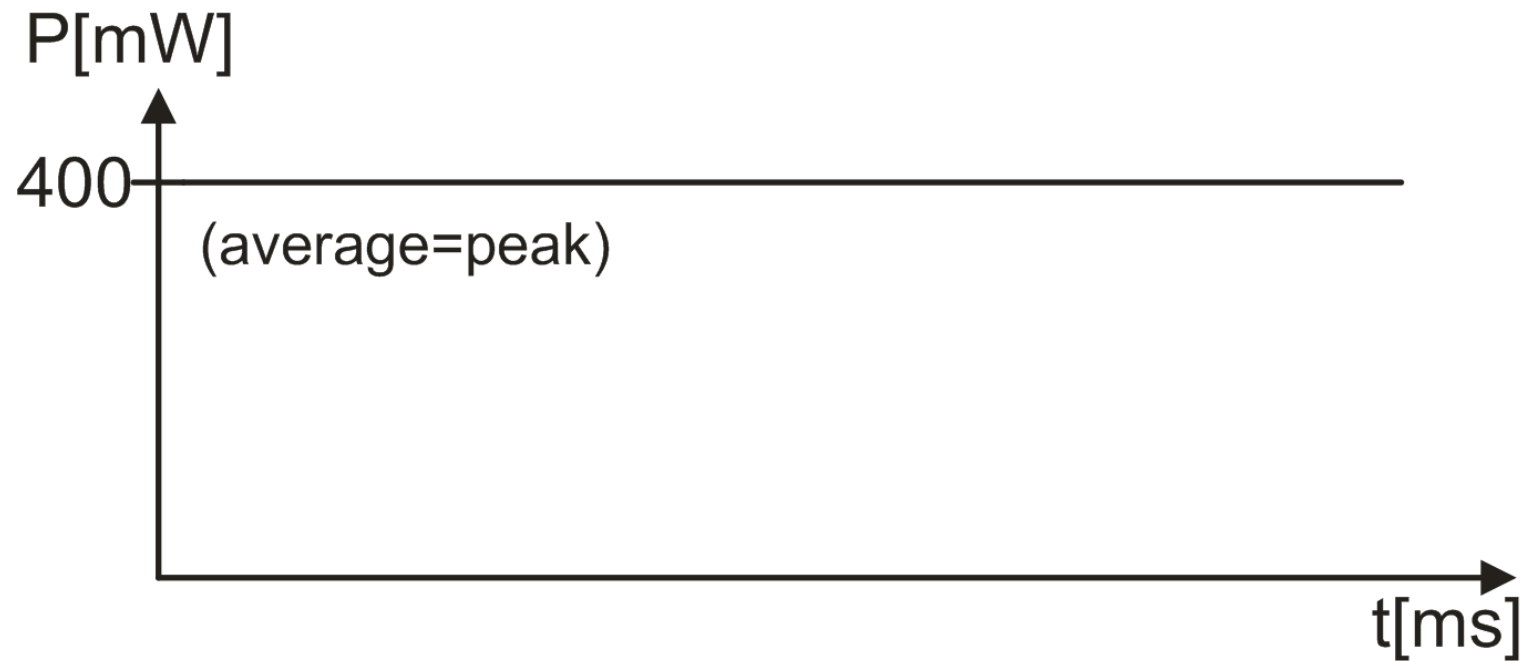
$1\text{nm}=10^{-9}\text{m}$ ;  $1\mu\text{m}=1000\text{nm}$



# Laser parameters – work mode (CW)



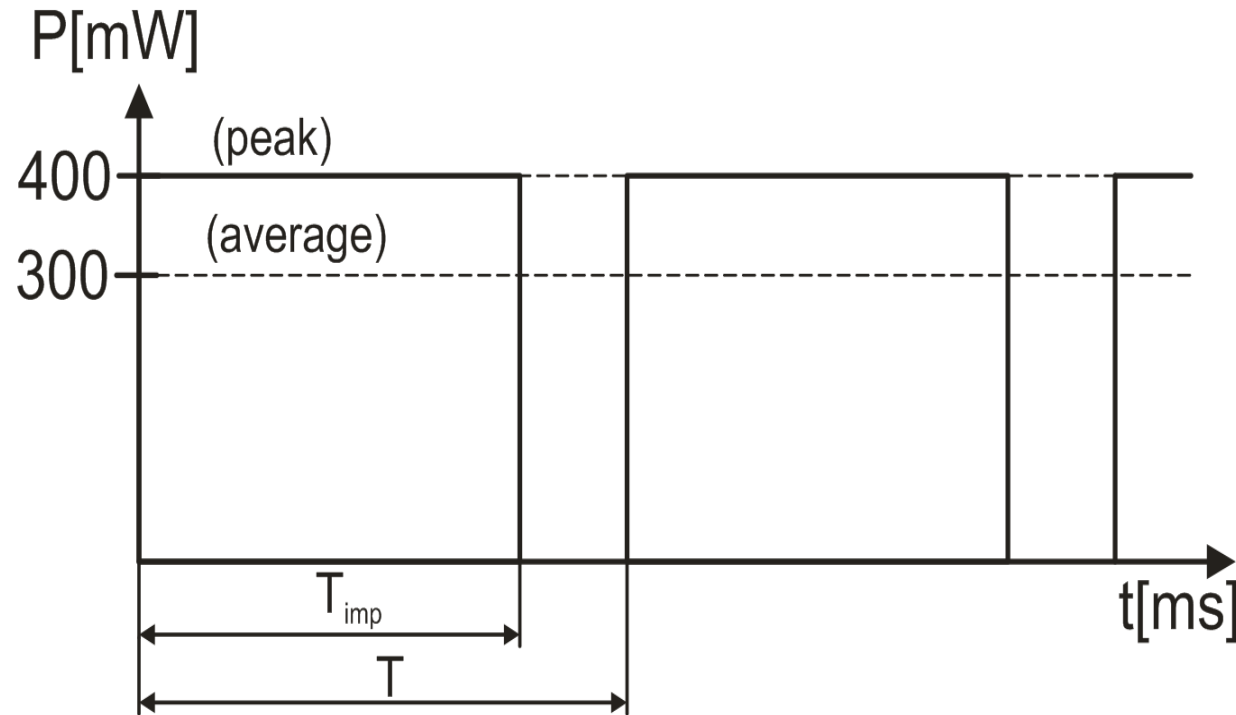
CW=Continuous Work





# Laser parameters – work mode (CW)

## Continuous Work, modulated

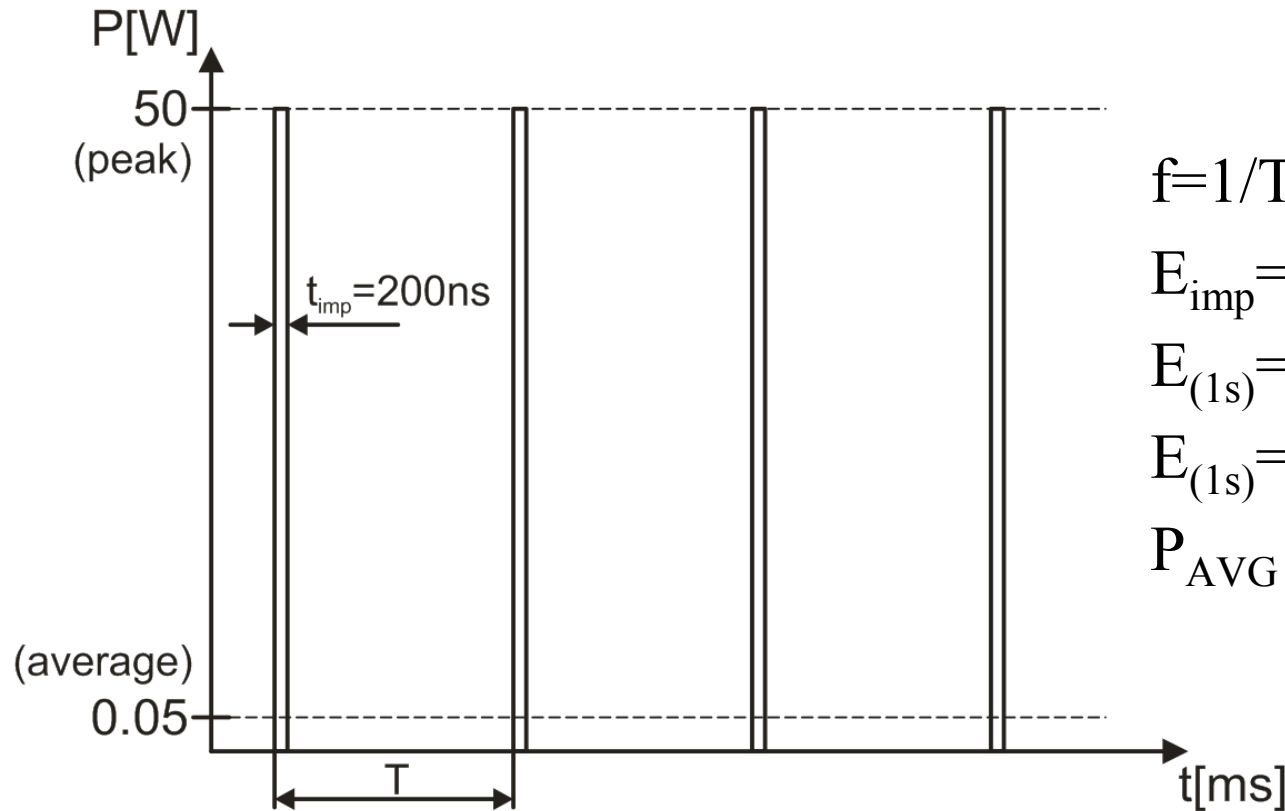


$$T_{imp}/T = \text{duty cycle}[\%]$$
$$P_{AVG} = P_{PEAK} * \text{duty cycle}$$

for 75%:

$$P_{AVG} = 400\text{mW} * 0,75$$
$$= 300\text{mW}$$

# Laser parameters – work mode (pulse)



$$f = 1/T; 5..5000 \text{ Hz}$$

$$E_{imp} = 200 \text{ ns} * 50 \text{ W} = 10 \mu\text{J}$$

$$E_{(1s)} = E_{imp} * f$$

$$E_{(1s)} = 10 \mu\text{J} * 5000 \text{ Hz} = 50 \text{ mJ}$$

$$P_{AVG} = 50 \text{ mJ} / 1 \text{ s} = 50 \text{ mW}$$

## Types of laser applicators

- **Point (single diode)**
- **Cluster (multi diode)**
- **Scanning (moving beam)**

Conclusion

**Thank you!**