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Erasmus+ Programme  
of the European Union



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# MODULE 5

## Special methods of fusion welding

Laser welding



# laser principle

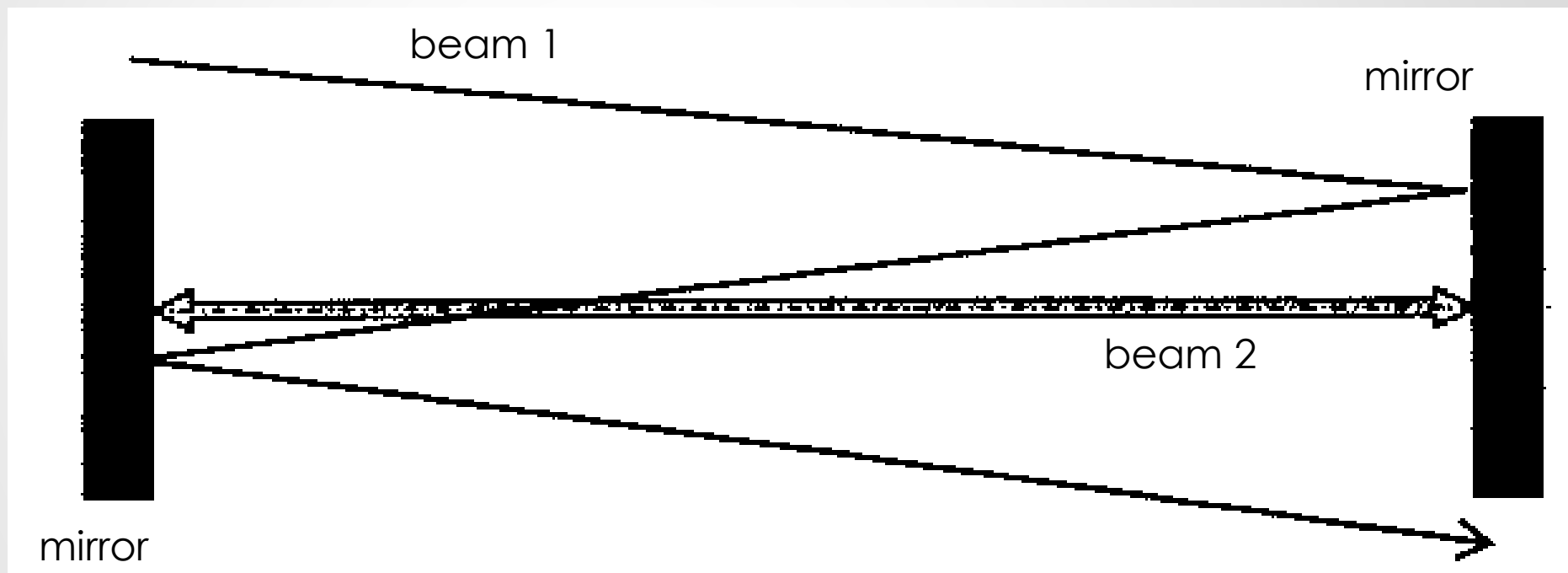
- The laser is a source of electromagnetic radiation, but which is different from conventional sources (e.g. incandescent, fluorescent

characteristic	classical source	Laser
directivity radiation	omnidirectional	collimated
spectral range	broad	narrowband
synchronization radiation	unsynchronised	synchronized waves

- Laser generally consists of two basic parts: an optical resonator and active medium.
- Optical resonator In its simplest form, consists of two planar, mutually parallel mirrors between which light may reflect the beam.



# Optical resonator with two variants of beam propagation





## Optical resonator with two variants of beam propagation

- The beam 1 after two reflections resonator leaves beam 2 propagating parallel to the optical axis of the mirror can oscillate between a theoretically infinite.
- Because however, the real mirror having reflectivity less than 100%, the intensity will fall exponentially in time.
- The second part is called a lasso. Active environment.
- At passing the light beam by that medium increases its intensity.
- This However intensification selectively - depending on the type of active medium - amplification occurs only at a certain wavelength (light color).
- Repeater effect is possible thanks to the phenomenon of stimulated emission. Each substance (consisting of atoms or molecules), can absorb the incident energy (radiation, kinetic energy of particles, etc..).
- Ordinarily however, immediately after spontaneous {occurs}, the emission of excess energy so that the particles forming the material returned to its basic energy level.



## Lasers according to type active environment

- ➡ Gas
- ➡ Liquid
- ➡ Solid-state
- ➡ Semiconductor



## Lasers by up type active environment

- ➡ Drawing electric discharge
- ➡ Optical pumping
- ➡ Absorption by chemical reaction

In addition, for lasers distinction pulse or continuous operation.



## Laser welding

- By this technique again uses a high density of radiation at the focus.
- At suitably combining the welding parameters (laser power, welding speed) leads to an effect called. "keyhole" (key sticks) overheated spot material was immediately removed (to an electrically conductive plasma), and a cavity filled with vapor of vaporized material, whose walls are formed by the molten material.
- At moving the laser beam along the weld surface occurs kvazistacionárnímu process in which the cavity is moving at the same speed as the laser beam.
- For then the cavity is formed weld area.
- Thanks This effect can generate a laser beam welds with a good ratio between the width and depth compared to other methods.
- To the weld is applied a protective atmosphere to prevent oxygenation and supported are weld seam site, choice of protective gas also affects the geometry of the weld (Ar, He, etc.).



## Laser welding

- The welding not do without additional materials.
- What It refers Weldability is similar to TIG.
- Content atoms must not be greater than 0.2%.
- Introduced heat in this type of welding is very small, therefore it is possible to achieve very high quality welds even in high-alloy steels.
- Successfully they are welded and materials having as high a melting point and thermal conductivity.





## Laser welding

- ▶ Laser welding can be used for all types of welds formed by other fusing techniques.
- ▶ One of the main advantages of laser welding can not be seen in the formation lap joints, where it is possible to weld several materials stacked on each other.
- ▶ Moreover appropriate power control is not completely provărit lower layer and the bottom side is then unbroken weld.
- ▶ Mondition is a perfect pressing of materials themselves.



# Welding equipment

- Because engineering practice, it is necessary to perform spatial welding, the welding head is positioned on multiaxial angular robotic arm.
- In if laser welding is a critical requirement for a precise adjusting positions welded parts to each other.
- In nowadays, there are additional systems to enable dynamic positioning of the welding head relative to the current position of the weld.
- At the use of welding power tens of kilowatts can perform penetration welds with over 25 mm - compared to arc welding, this means a huge leap in productivity.