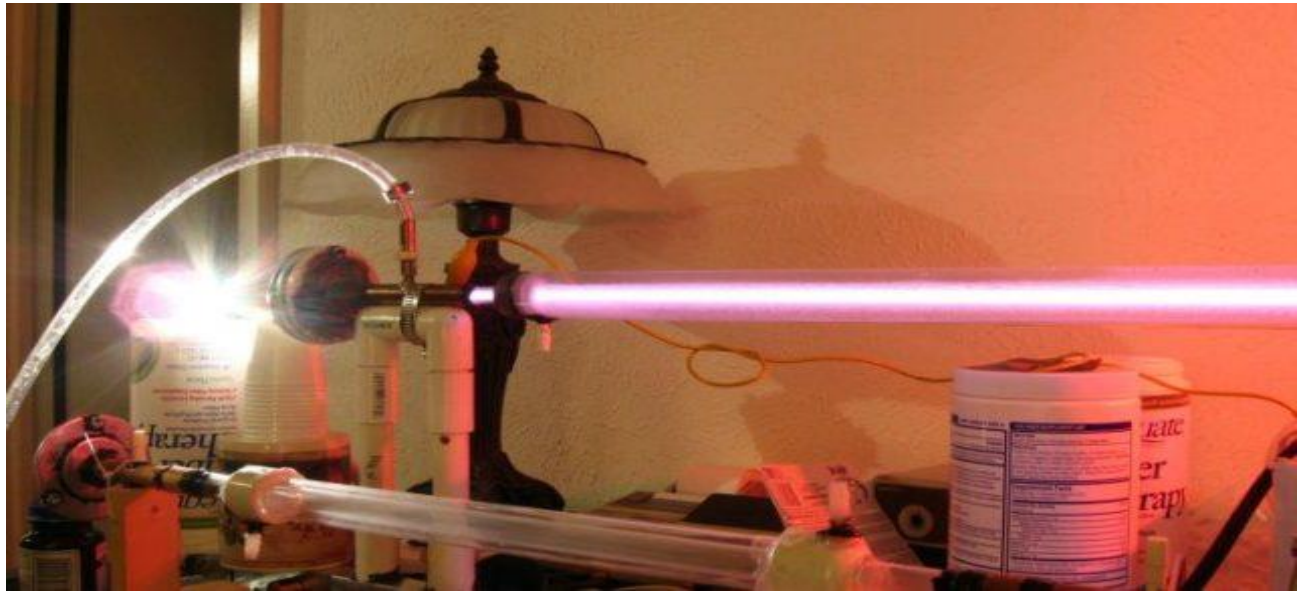
Carbon dioxide laser



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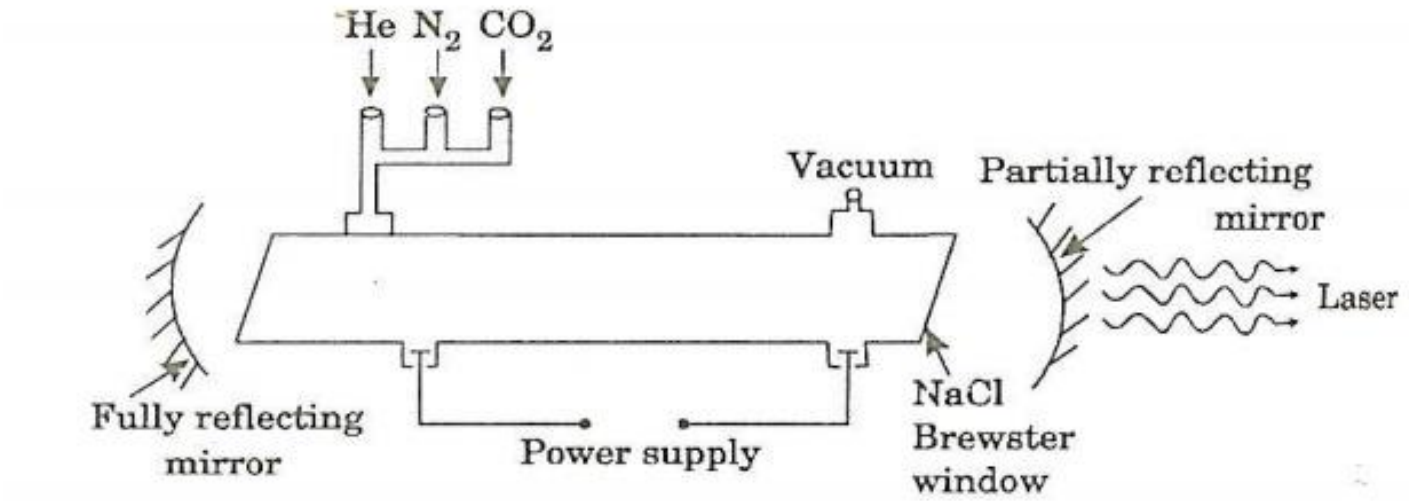
Lasers in Medicine

- Diode lasers
- Free electron lasers
- Semiconductor diode lasers
- Gas lasers
- CO2 lasers

Characteristics of CO2 lasers

- Active laser medium (laser gain/amplification medium): **carbon dioxide** (**CO_2**), Nitrogen (**N_2**) and Helium (**He**)
- invented by Kumae Patel of Bell Labs in 1964
- quite efficient: the ratio of output power to pump 20%
- infrared beam at 10.6 microns
- Beam divergence ➡ 1 to 10 milli radians
- Beam width ➡ 3 mm to 100 mm
- CW/Pulse mode
  - CW: few Watts to over 15,000 Watts
  - Pulsed mode: millions of Watts (peak power)

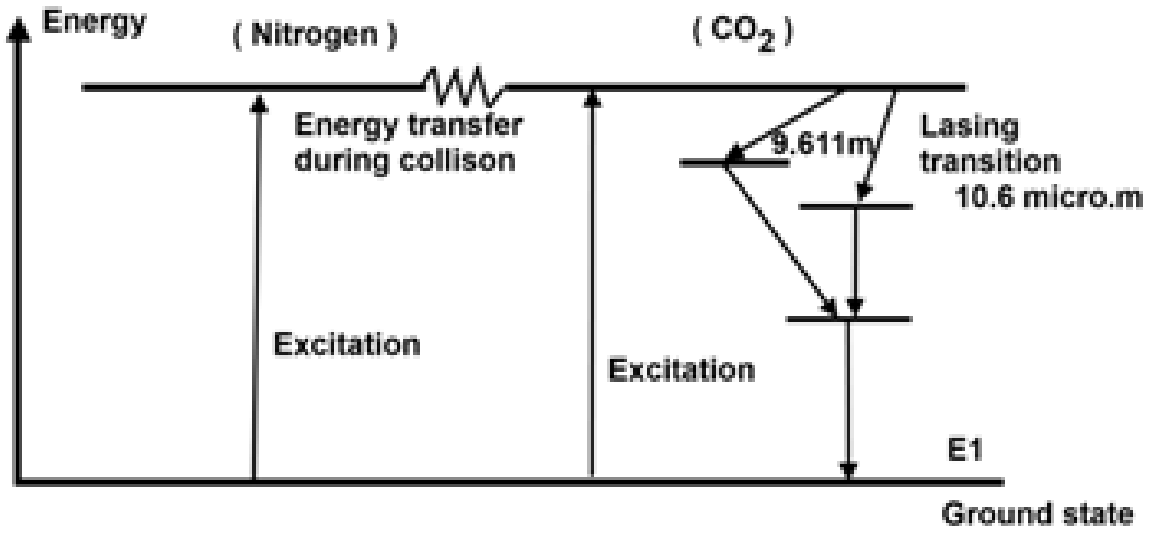
Construction



- a quartz tube 5 m long and 2.5 cm in the diameter filled with CO2(active medium), He and N2
- Terminals of the discharge tubes ➡ D.C power supply
- NaCl Brewster windows ➡ laser light generated will be polarized
- Two concave mirrors

http://www.brainkart.com/article/CO2-Molecular-gas-laser--Principle--Construction--Working--Characteristics---Advantages--Disadvantages-and-Applications_6884/

Function of CO2 laser



pumping energy from the current flow ➡ The Nitrogen gas ➡ CO2 molecule

Helium gas ➡ cool the gas to keep the lower lasing level depopulated

https://www.daenotes.com/electronics/microwave-radar/co2-gas-laser

Advantages

- ✓ Easy construction
- ✓High output power
- ✓ The output power can be increased by extending the length of the gas tube.
- ✓ High absorption of its output wavelengths by many materials
- ✓Wide variety of output waveform formats

https://www.daenotes.com/electronics/microwave-radar/co2-gas-laser

http://www.brainkart.com/article/CO2-Molecular-gas-laser--Principle--Construction--Working--Characteristics---Advantages--Disadvantages-and-Applications_6884/

Disadvantages

- The operating temperature plays an important role in determining the output power of laser.
- Accidental exposure may damage our eyes, since it is invisible (infrared region) to our eyes.
- Divergence of CO2 lasers approximately in all cases is greater than He-Ne and Argon laser.
- Beam width varies from 3 mm to 10 mm.

https://www.daenotes.com/electronics/microwave-radar/co2-gas-laser

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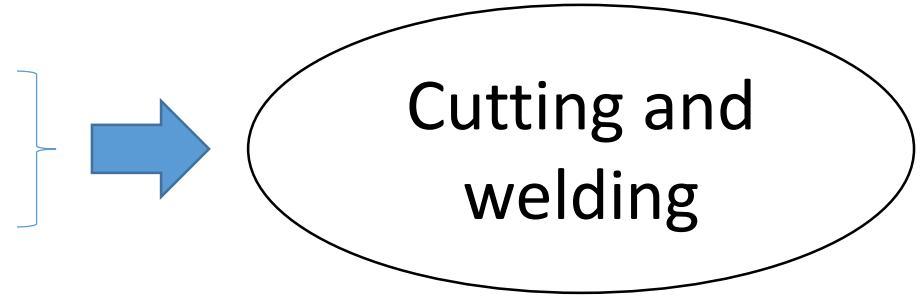
Applications

- **Industrial**

high power levels
reasonable cost



(lower power level lasers are used for engraving)

- **Medical (soft-tissue surgery)**
- Laser surgery
- skin resurfacing
- at 9.25 - 9.6 µm: dentistry for hard-tissue ablation.

A medical CO_2 laser

https://en.wikipedia.org/wiki/Carbon_dioxide_laser#/media/File:Sharplan_40C.jpg

- spectroscopy

Thank you