LASER TECHNOLOGY PART --III

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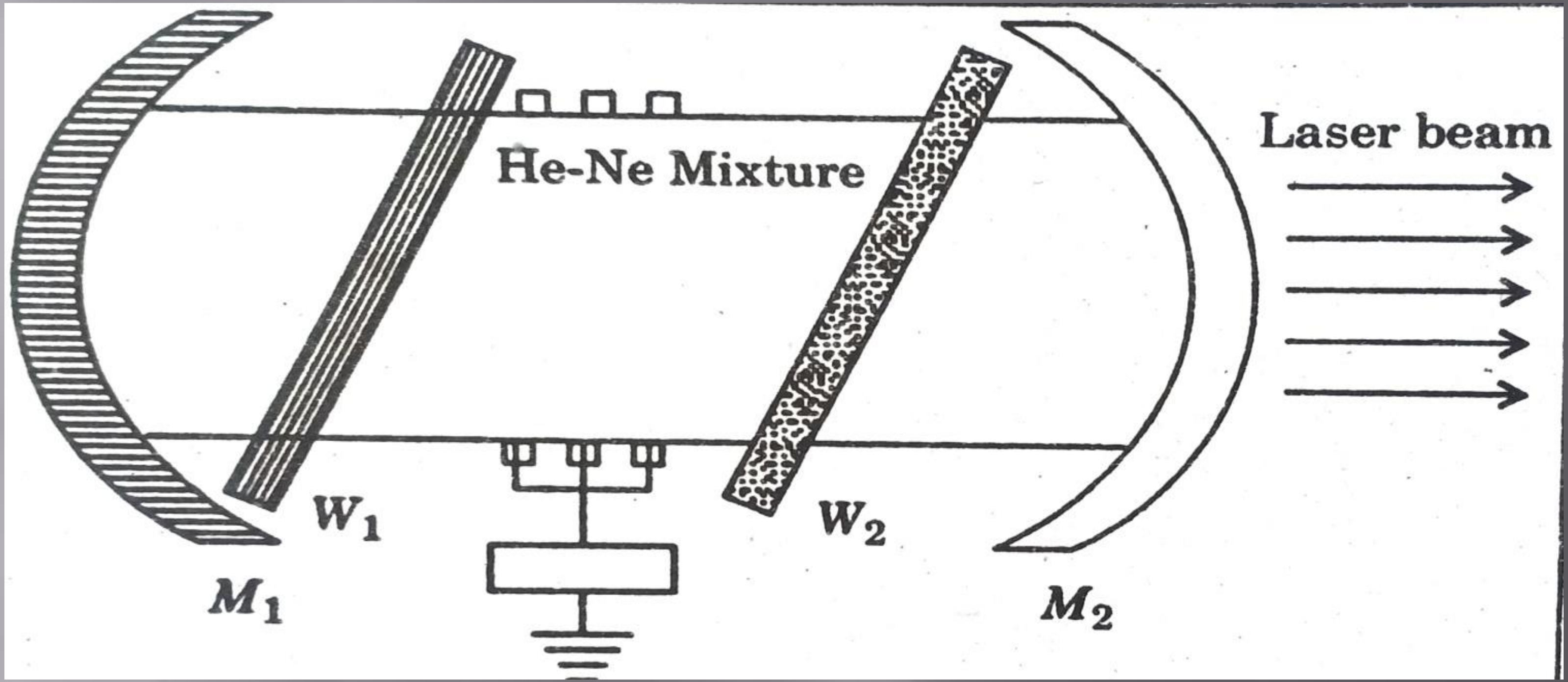
GASEOUS LASER (HE-NE LASER)

- Ruby laser does not generate a continuous laser beam; so Javan, Bennett and Harroit in 1961 reported a gas laser which emits continuous laser beam rather than in pulses.
- Uses mixture of Helium (He) and Neon (Ne) gases.
- Involves four energy levels; three in neon and one in helium.
- Excitation to higher energy states is performed by means of radio (high) frequency electromagnetic field.

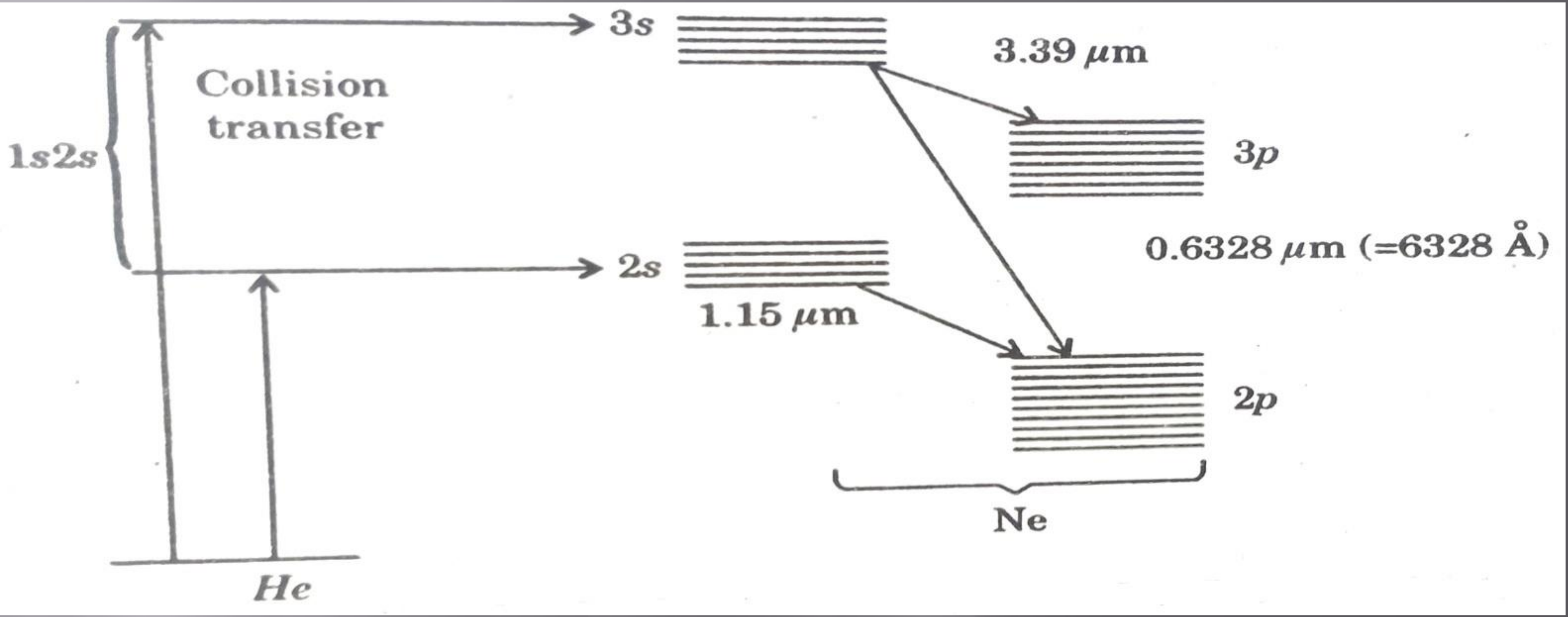
Construction

- Working substance: mixture of helium and neon gases in the ratio 7:1 at pressure of 1 mm of Hg.
- A resonant cavity of quartz tube.
- Two windows made optically flat and cemented at Brewster's angle to the tube axis for specific wavelength.
- Ends of cavity are enclosed by two concave mirror; one is perfectly reflecting and other partially reflecting.
- An exciting source for creating a discharge in the tube.



Operation

- When electromagnetic energy is injected into the tube through metal bands by means of a radio frequency high voltage source, He atoms get excited to metastable state.



- ❑ Excited He atoms collide with unexcited neon atoms and resonant energy transfer takes place so that neon atoms get excited to a specific energy level.

- ❑ He atoms after transferring energy return to the ground state.

- Laser action takes place only in neon atoms while He in the mixture serves the only purpose to enhance the exciting process (+ve catalyst).
- When population inversion has occurred in Ne atoms, they return to lower energy states emitting the photons.
- The photons emitted parallel to the axis of tube bounce back & forth between polished mirrors and stimulates emission of the same wavelength from other excited Ne atoms.
- Thus, the photons get multiplied & powerful, coherent, parallel laser beam emerges from the partially reflecting end of the tube.

Advantage

- Compact, efficient & fabricated with ease.
- Their monochromaticity coherence and directionality are inferior to those of other lasers.

Characteristics of Laser Rays

- Completely coherent
- almost perfectly monochromatic
- Laser rays are directional. Hence, a laser beam is very narrow.
- Go to long distances without absorption.
- They are not absorbed in water.
- Very intense
- Vaporise even the hardest metal
- Color can be changed.
- If laser light be passed through quartz strips, the color of light will change.

APPLICATIONS OF LASERS

Lasers are sources of light with very special properties. For that reason, there is a great variety of laser applications.

- Manufacturing

- For cutting, drilling, welding, cladding, soldering (brazing), hardening, ablating, surface treatment, marking, engraving, micromachining, pulsed laser deposition, lithography, etc.
- For alignment purposes. Alignment lasers may simply emit a Gaussian laser beam, forming a circular spot on a workpiece, a line, a cross, or some other pattern.

- ## Medical Applications
- Eye surgery and vision correction (LASIK)
- Dentistry, dermatology (e.g. photodynamic therapy of cancer)
- Various kinds of cosmetic treatment such as tattoo removal and hair removal.

- ## Meteorology
- For extremely precise position measurements and optical surface profiling.
- For long-distance range finding and navigation.
- Read bar codes or other graphics over some distance, characterization of fast electronic microcircuits, microwave photonics, terahertz science, optical clock.

Other Applications

- **Laser Spectroscopy**
- **Various Scientific Applications**
- **Communications & displays**
- **Data storage**
- **Energy technology**
- **Military applications**

THANK YOU