College: Marwari College, Darbhanga

Subject: Physics (Subs.)

Year: D-II

Paper: Subs.

Group: B

Topic: He-Ne Laser

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Lecture sequence number: 4

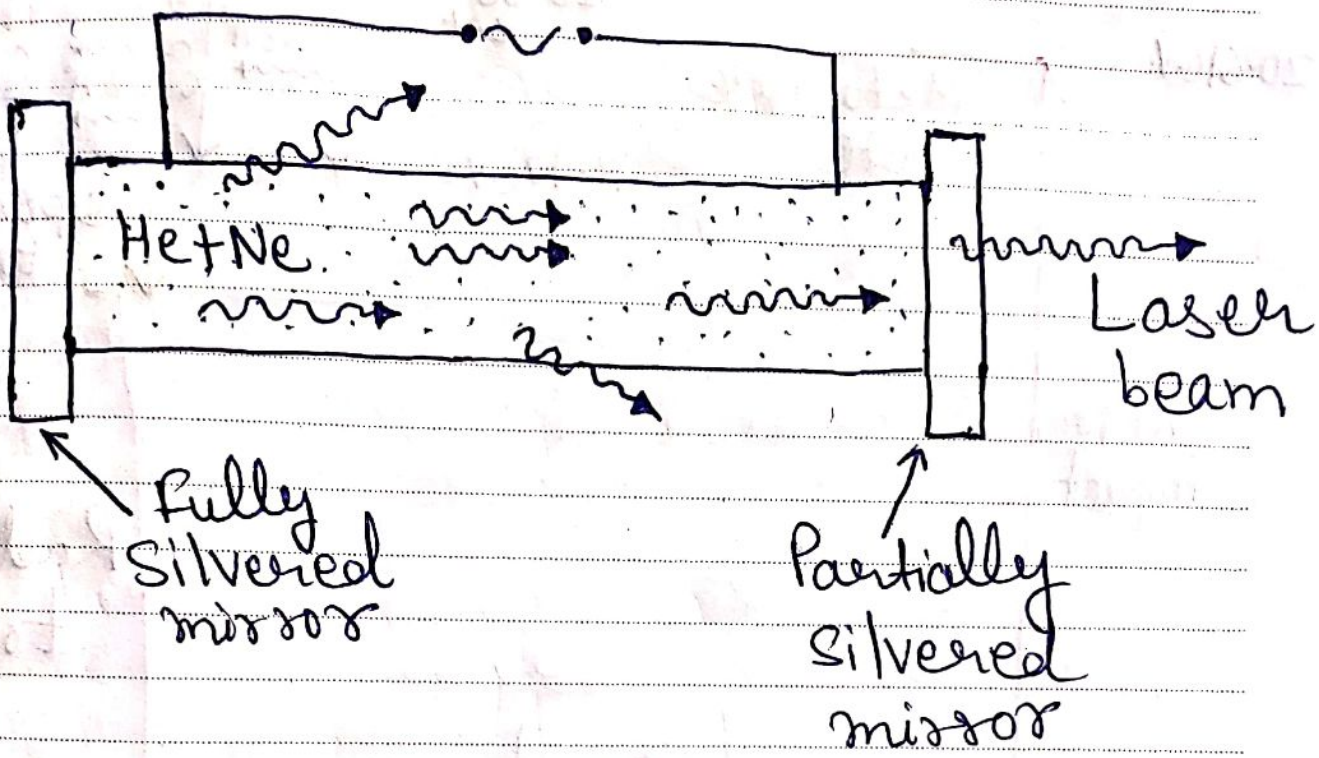
He-Ne Laser

The helium-neon (He-Ne) laser was the first gas laser. It was fabricated by Javan in 1961. It is a four level laser in which population inversion is achieved by electric discharge.

The He-Ne laser consists of a long and narrow discharge tube filled with a mixture of He and Ne in a ratio of about 10:1 at a pressure of about 1 mm of mercury. (fig. 1).

Thursday

The gas mixture (He+Ne) forms the lasing medium. It is placed between a pair of optically plane and parallel mirrors which form a resonant cavity. On of the mirrors is fully silvered and the other is partially silvered. The spacing of the mirrors is equal to an integral number of half wavelengths of the laser light. An electric discharge may be produced in the gas-mixture by electrodes connected to a high frequency electric source.



Saturday 6

Working: When a discharge is passed through the gas mixture, electrons are accelerated down the tube. These accelerated electrons collide with and "pump" (excite) the He and Ne atoms to metastable states 20.61 e.V. and 20.66 e.V. respectively, above their ground states (fig. 2).

Some of the excited He atoms transfer their energy to ground state

7 Sunday

Collision

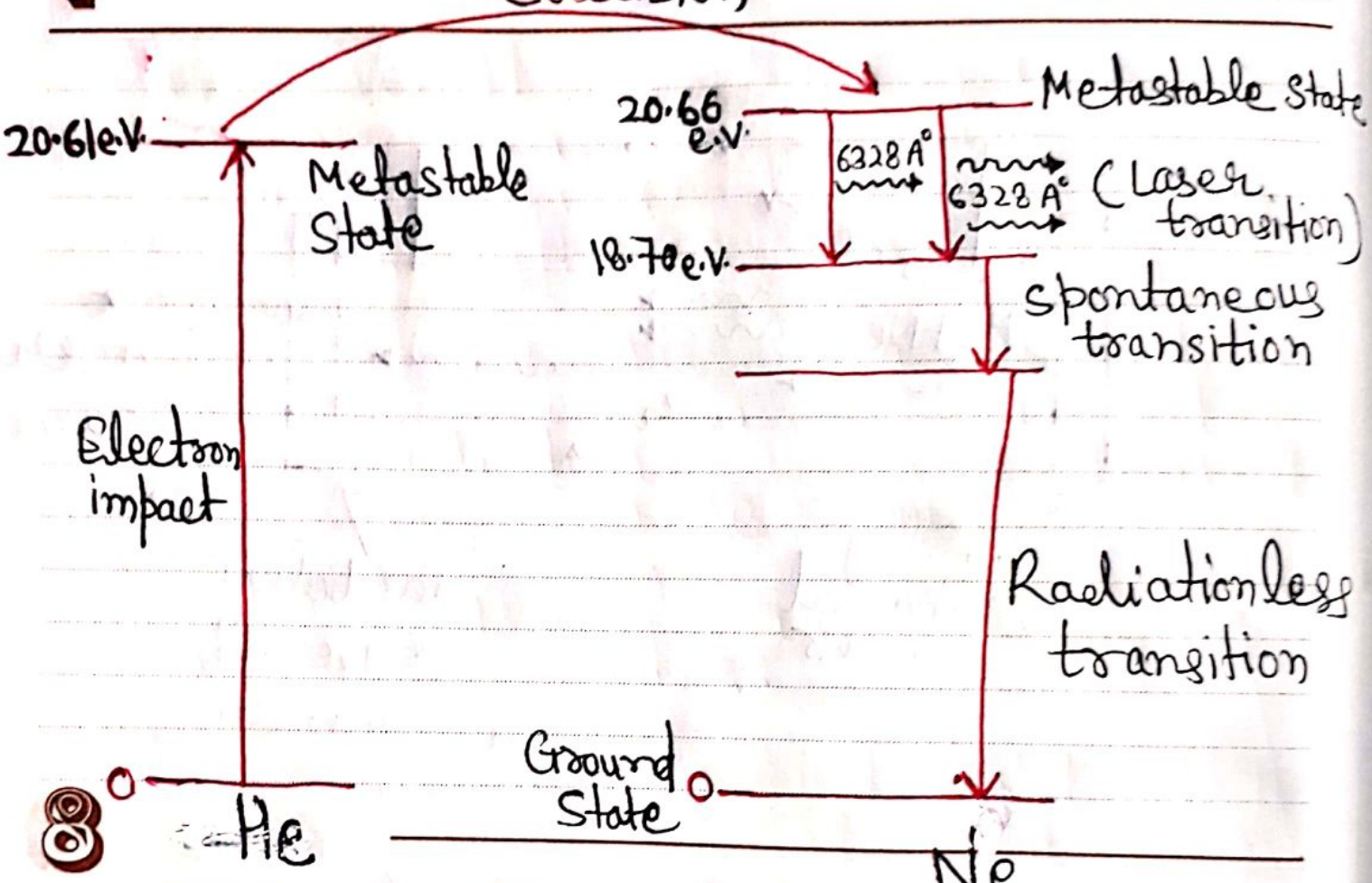


Fig: Four level Laser

Ne atoms by collisions with the 0.05 e.V of additional energy being provided by the kinetic energy of atoms. Thus He atoms help in achieving a population inversion in the Ne atoms.

When an excited Ne atom passes spontaneously from the metastable state at 20.66 e.V. to the state at 18.70 e.V., it emits a 6328 A° photon.

This photon ~~the~~ travels through the gas-mixture and if it is moving parallel to the axis of the tube, is reflected back and forth by the mirror-ends until it stimulates an excited Ne atom and causes it to emit a fresh 6328-A° photon in phase with the stimulating photon. This stimulated transition from 20.66 e.V. level to 18.70 e.V. level is the laser transition. This process is continued and a beam of coherent radiation builds up in the tube. When this red light beam becomes sufficiently intense a portion of it escapes through the partially-silvered end.

Wednesday 10

From the 18.70 e.V. level the Ne atom passes down spontaneously to a lower metastable state emitting incoherent light, and finally to the ground state through collision with the tube walls. The final transition is thus radiationless.

Actually, there are other energy levels between the 20.66 e.V. and 18.70 e.V. levels in Ne atom; and transition b/w

them result in the emission of radiation having wavelengths 3.39 μm, 1.15 μm. besides the visible radiation of wavelength 0.6328 μm. (6328 A°).

He-Ne gas laser is a "tunable" laser. This laser can be tuned to give radiation in any desired wavelength range.

Advantages of Gas Lasers over Solid-state Lasers:

(1) The gas lasers, emit light which is more directional and more monochromatic as compared to that from Solid-state lasers.

12 Friday

(2) Gas lasers are capable of supplying a continuous laser beam.

(3) The power needed for excitation is less than that in a three-level ruby laser.