

# LASER

## \* Basic Principle of Laser:—

The term Laser stands for Amplification by Stimulated Emission of Radiation. It is a device to produce a powerful monochromatic beam of light, which can travel over a long distance without much loss of Intensity.

## Basic Principle:—

1) Coherence:— Coherence is that property of electromagnetic wave which includes parallel and monochromatic waves having same amplitude, frequency and state of polarisation.

Ordinary light sources are incoherent and are incapable to supply much power at any particular frequency. The coherent beam of light can be generated by stimulated emission. It can be concentrated at a point and can travel long distance without loss of Intensity.

## 2) Stimulated Emission:—

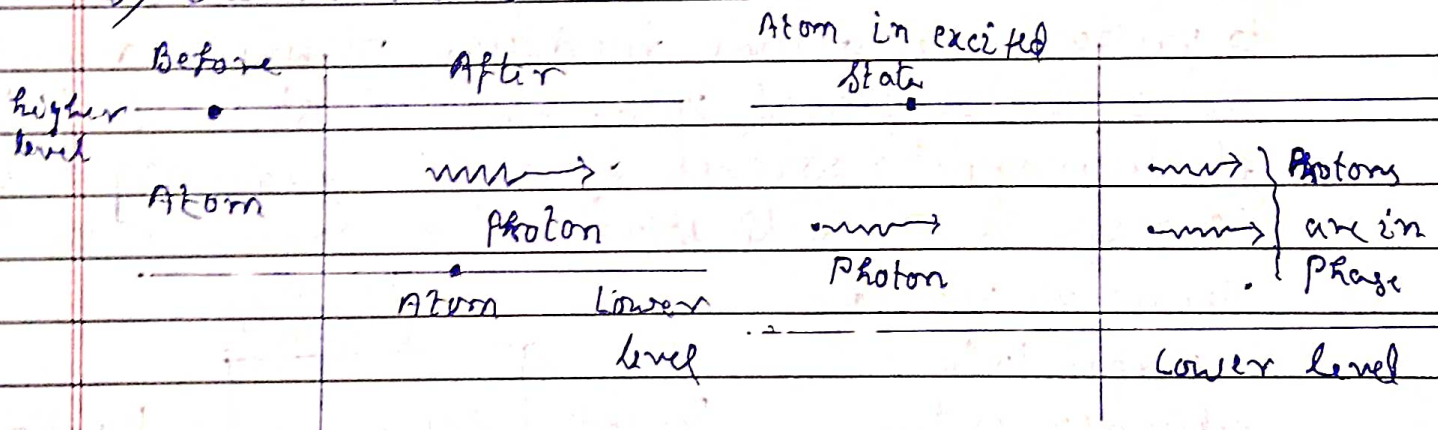


Fig - 1

Fig - 2

Figure - 1 shows an isolated atom in excited state (higher energy level). It can return to its normal state (lower level energy) by getting de-excited and emitting a photon. This constitutes spontaneous emission. Here different atoms emit



photons separately and thus spontaneous emission is incoherent.

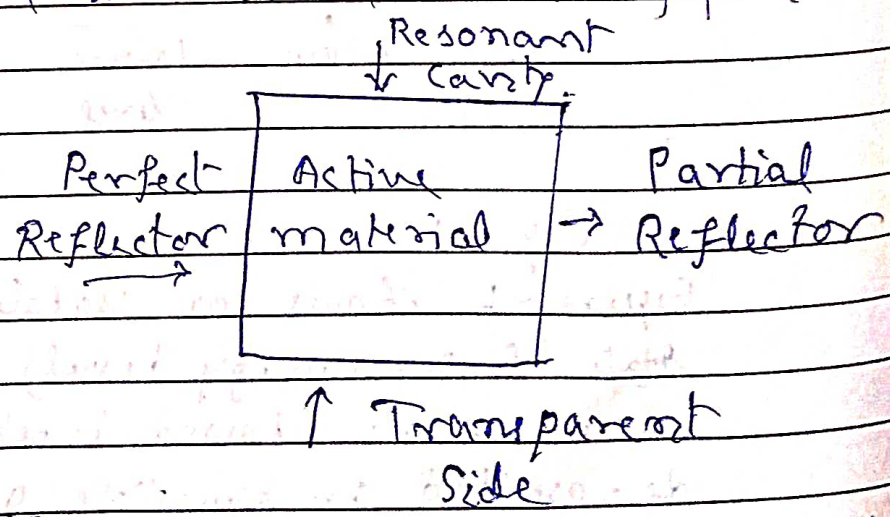
But if photons of suitable energy shower down on already excited atoms then each atom emits a photon of size identical to stimulating photon (fig-3). It results in the appearance of one additional photon and both fly off together in identical direction at same time with same phase. Thus stimulated emission is coherent.

### 3) Design by a laser: -

Now let us consider an assembly of the atoms are made to go into an excited state by pumping the matter by photons of suitable size. This is called population inversion. During the period in which the atom is excited, it can be stimulated to emit a photon if it is struck by an appropriate outside photon. The stimulated photon falls precisely in phase with stimulating photon and coherent radiation is known as laser.

Then in designing a laser we have to prepare an active medium in which most of atoms can be placed in an excited state so that an electromagnetic waves of right frequency passing through them will stimulate a cascade of photons.

The active material is shaped into a cylinder with parallel transparent sides and reflectors at both ends. Active material is energized by pulses of light from flash tube and spontaneous emission takes



place. Photon moving parallel to axis of tube will suffer several reflections between two reflectors and they produced more and more photons. Due to chain reaction of stimulated emission, intensity of photons parallel to axis grows on. If one of the reflectors is partially transparent then some of the coherent light would emerge through reflector which serves as output laser beam.