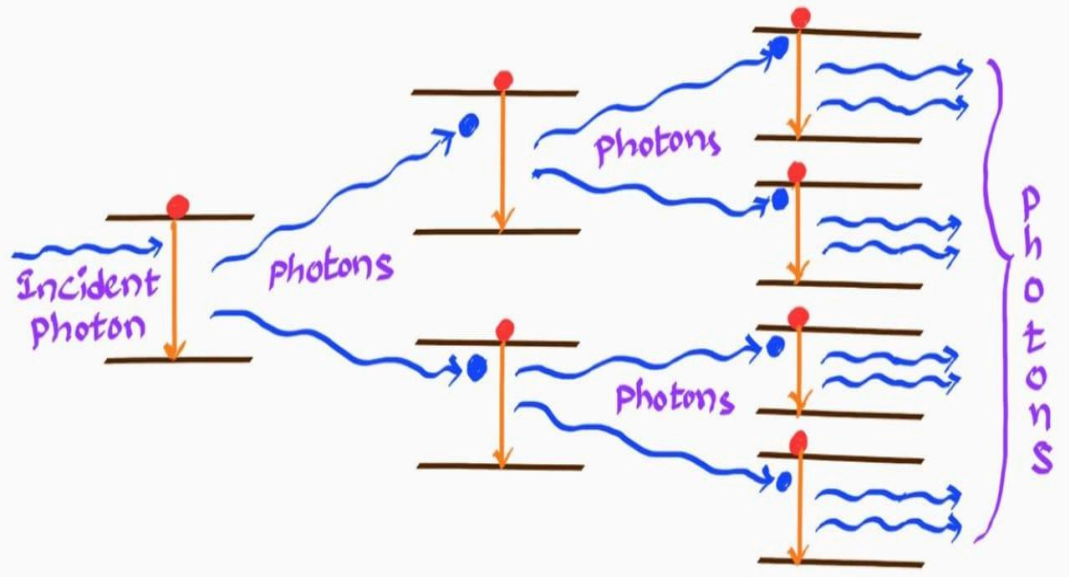
LASING ACTION OR PRINCIPLE OF LASER

❖ LASING ACTION:

- ❖ Continuous emission of Laser light without stopping is called Lasing action.
- ❖ Let us consider an electron in the excited state is stimulated by a photon, which makes a stimulated emission and generates two coherent photons.
- ❖ These two coherent photons stimulate two electrons in the excited state to make emission of 4 photons and so on.
- ❖ This process continues to increase the number of stimulated emissions by increasing coherent photons to continue an intense beam of LASER and this process is called Lasing action.



- ❖ Light is amplified in the medium by photon multiplication.

❖ CONDITIONS FOR LASING ACTION

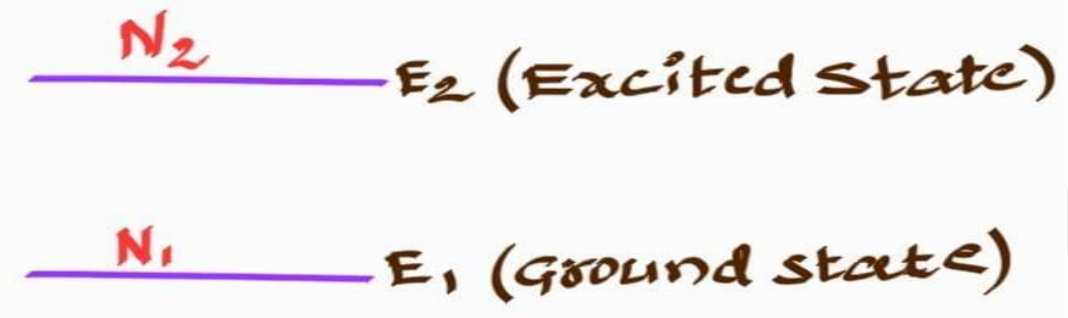
- ❖ For Lasing action, the no. of stimulated emissions must be more when compared to induced absorption and spontaneous emission. This is possible by
  - a) Population inversion
  - b) Pumping and
  - c) Metastable state.

❖ a) Population inversion

- ❖ Population inversion is the condition in which the number of electrons in the excited state is greater than the number of electrons in the ground state i.e., $N_2 > N_1$.

❖ **Explanation:**

❖ Let N_1 be the no. of electrons in the Ground state(E_1) and N_2 be the number of electrons in the excited state(E_2).



❖ **From Boltzmann factor:** $N_1 / N_2 = e^{(h\nu/\lambda kBT)}$

$$N_2 / N_1 = e^{-(h\nu/\lambda kBT)}$$

❖ **Where:** k is the Boltzmann Constant = 1.38×10^{-23} JK^{-1}

T is the absolute temperature in kelvin.

❖ b) Pumping:

❖ The process of achieving population inversion by supplying energy is called pumping and the source of energy required for this process is called pumping source (or) excitation source or external energy.

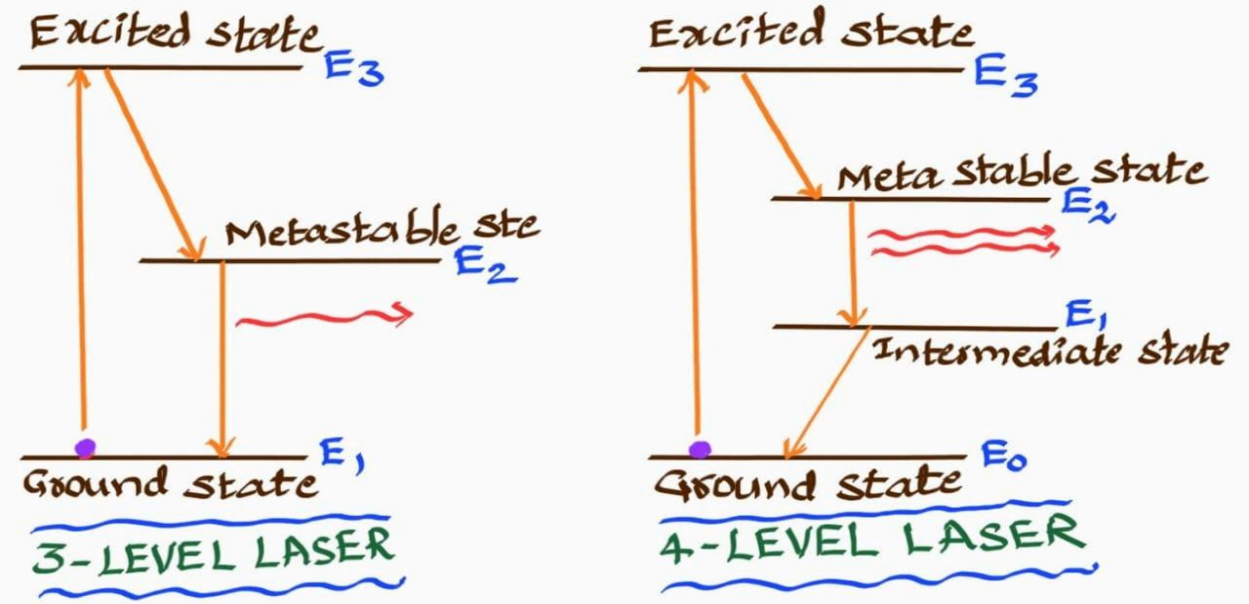
❖ The most commonly using pumping methods are

* Optical pumping
* Electric discharge/Electrical pumping
* Chemical pumping/Chemical reaction
* Direct conversion/Direct pumping
* Thermal pumping.

❖ c) Metastable state:

❖ Metastable state is an intermediate energy state present between an ordinary excited state and the ground state, where the electrons stay for a longer duration of the order of 10^{-3} seconds to achieve population inversion.

❖ Hence population inversion could be achieved with the help of 3 or 4 or 5 states with one of them being a metastable state.



- In 3-energy levels, the population inversion is achieved between metastable state (E_2) and Ground state (E_1).
- In 4-energy levels, the population inversion is achieved between metastable state (E_2) and intermediate state (E_1).