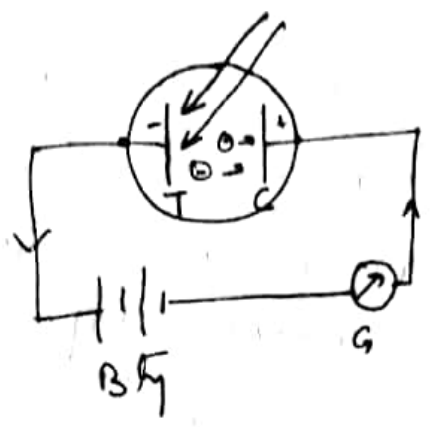
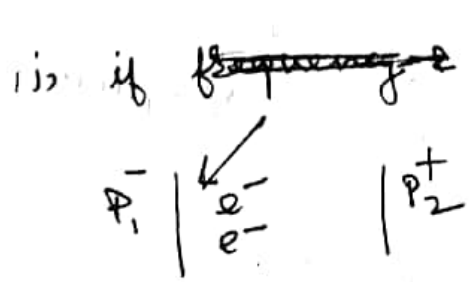


Photo Electric Effect

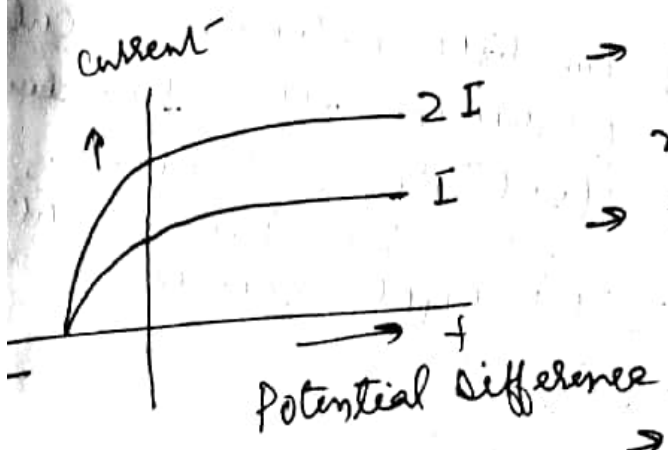


If a beam of light incident on a metal plate, it will cause e^- to leave the surface. This type of photoelectric effect is used in many devices like TV, cameras, NDA, etc.

Electrons emitted due to beam of light are known as photoelectrons. These e^- are being collected by collector plate C. So we get a current in circuit known as photoelectric current.



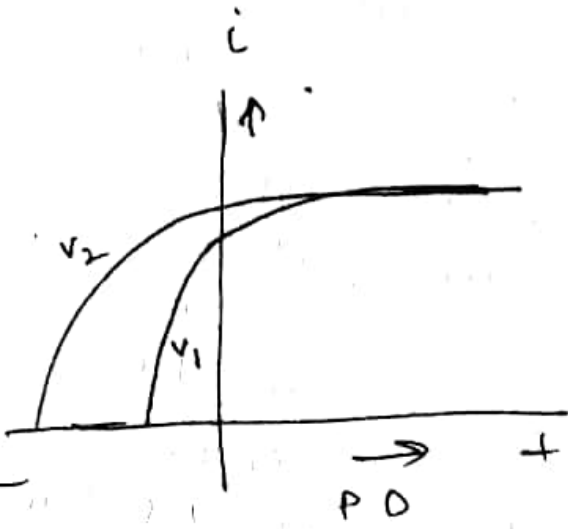
- 1) if ~~frequency~~ Intensity of light is const.
 - all photoelectrons received by P_2 & max current observed in the circuit
 - if P_2 potential increased ~~no~~ No change in current
 - If ~~Intensity~~ increase Intensity \propto Current



→ P_2 is -ive, ~~high~~ current decreases sharply but not zero. It means electrons has गतिज ऊर्जा
 अर्थात् -ive वोल्ट पर current = 0

Stopping Potential /
 Cut off cut off Potential
 + -ive P.D. at which we get 0 zero current

Relation with Frequency

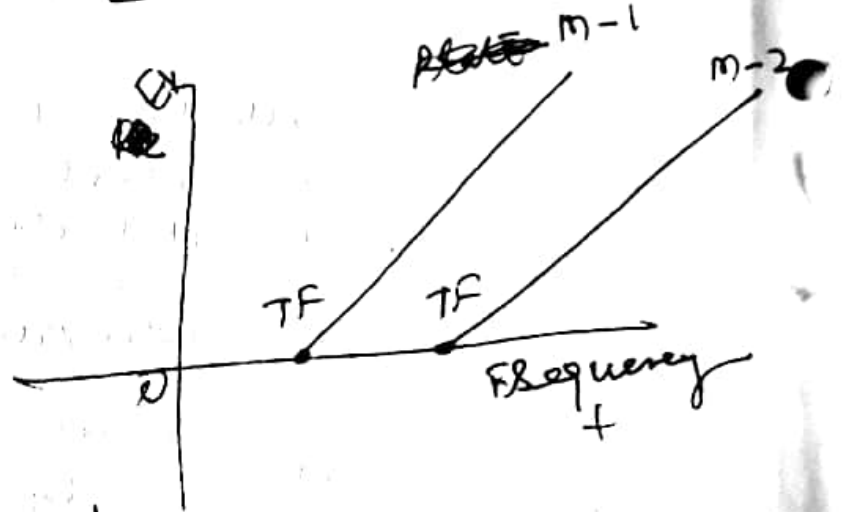


At cutoff potential

→ Frequency बढ़ते पर
Current- गिरता है

→ -ive PD of P_2 बढ़ा दे
 $\frac{d}{dt}$ Current slope

Frequency $\propto K_e$ of e^-



Threshold (रेडली आवृत्ति)
Frequency

A minimum frequency of
light which can eject
 e^- from the surface
is known as / called
TF.

एक सिद्धांत है

For light below TF/cutoff
frequency, the photoelectric
effect does not occur,
no matter how bright
the light source.

Einstein's Photo-Electric Equation

Concept of photons = $h\nu$

Energy of packets h is Planck const-
 ν frequency.

$$h\nu = W + E_k$$

$$E_k = h\nu - W \quad \text{--- (1)}$$

W is work function
 required energy for
 emitting e^- from
 the surface.

$E_k \rightarrow$ max kinetic energy of photo e^-

If $h\nu < W$ electrons
 उत्सर्जित नहीं होंगे

If $TF = h\nu$ तो photon की
 ऊर्जा e^- को
 बराबर से निकालती
 है ऊर्जा बिलग होती

मतः $W = h\nu_0$

$$E_k = h\nu - h\nu_0 = h(\nu - \nu_0)$$

$$\frac{1}{2} m v_{\max}^2 = h(\nu - \nu_0)$$

$$E_k = \frac{1}{2} m v_{\max}^2$$

Laser - Light Amplification by Stimulated Emission of Radiation.

Maser - Molecular Amplification by Stimulated Emission of Radiation

Spontaneous & Stimulated Radiation

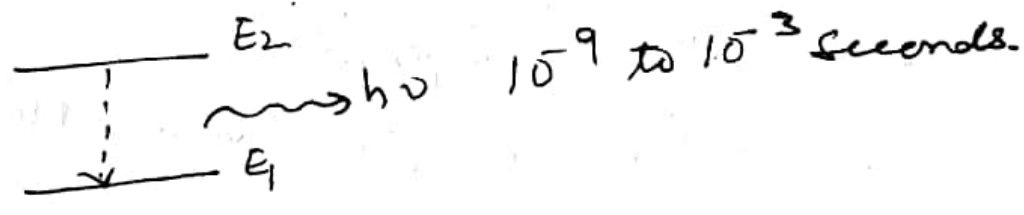


Absorption

If a photon incidents on any system at that time three transition processes take place

- (i) Absorption (ii) Spontaneous Emission
- (iii) Stimulated emission.

E_1 (ground state) & E_2 are two energy levels.



Spontaneous Emission

When an atom in an excited state E_2 falls to E_1 (ground state) by spontaneously emitting a photon of frequency $h\nu = E_2 - E_1$ (or $\nu = \frac{E_2 - E_1}{h}$) this is known as S Emission.

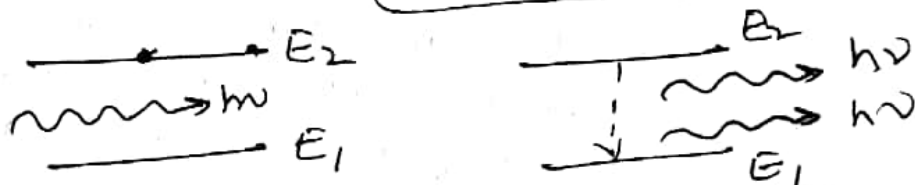
- i) The emitted photon has energy $h\nu$ and can move in any direction.

(ii) The rate at which e^- falls from excited level E_2 to lower level E_1 is at every instant proportional to the number of e^- in remaining E_2 .

STIMULATED EMISSION: -

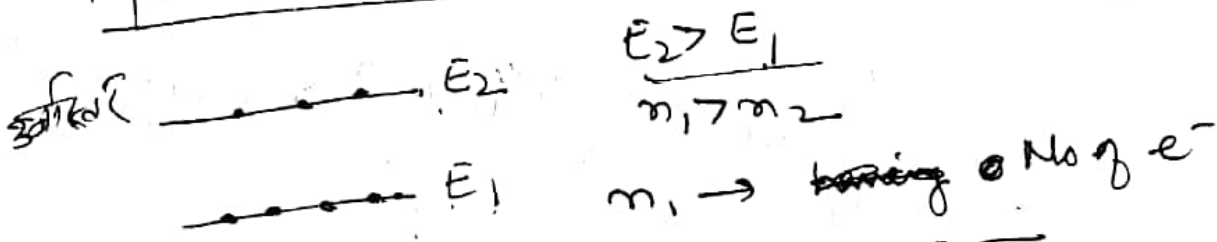
When a photon of frequency ν is incident on the atom in excited state (E_2), then it stimulates the atom to move to ground state E_1 by emitting a photon of same frequency ν . It is called stimulated emission.

$$\nu = \frac{E_2 - E_1}{h}$$



Stimulated Emission

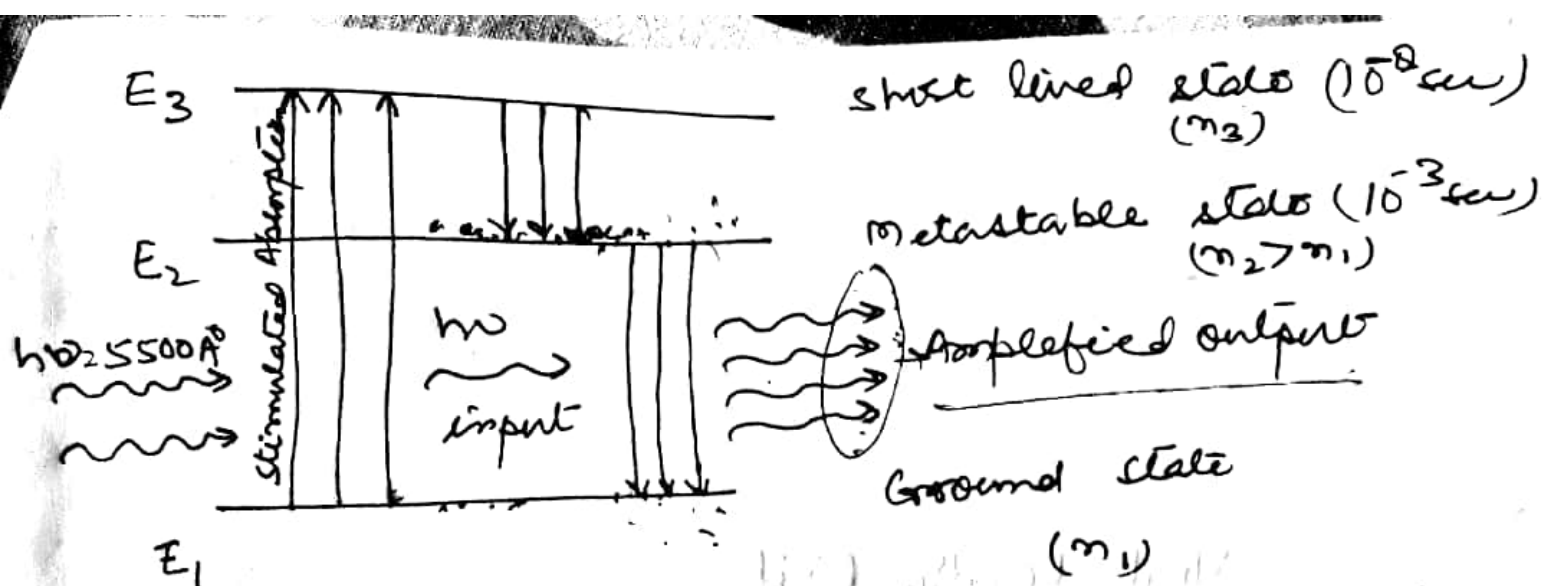
Population Inversion



This situation, in which the number of e^- in the higher energy state is greater than at the lower energy state is called population inversion.

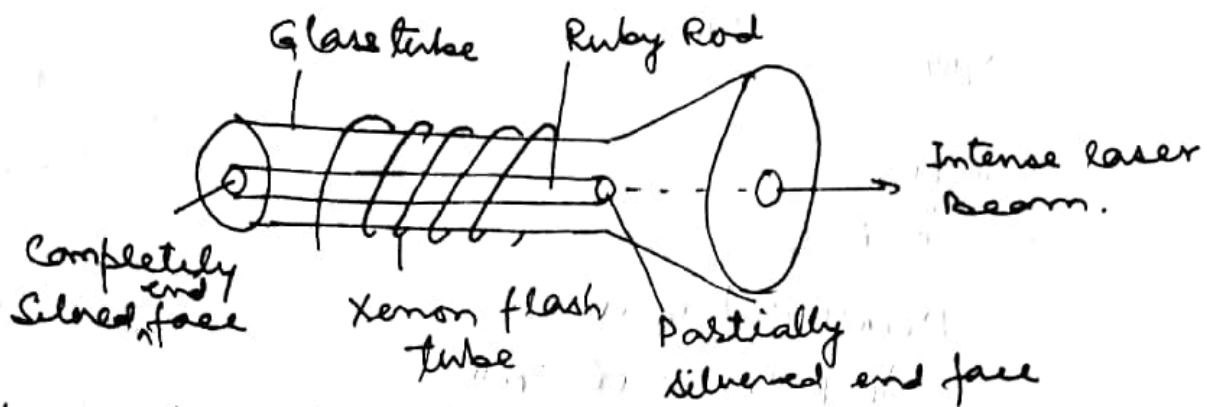
Pumping The process of achieving population inversion is called pumping.

There are many type of pumping process but most common is optical pumping used in ruby laser.



Avalanche Effect

Ruby Laser



Ruby is basically aluminium oxide (Al_2O_3). Al_2O_3 is doped with Cr_2O_3 Chromium oxide. Due to this its colour is pink.

A Ruby Rod of 20 to 30 cm with diameter .5 to 2 cm, is used. Last end is completely silvered and other end is partially silvered so that intense laser beam can emerge out of it.

Liquid Nitrogen filled tube of xenon tube is circulated around the Ruby Rod to keep cool the Rod.

The optical Pumping results when a flash of light from Xenon flash tube falls upon Ruby Rod. The Radiation of $\lambda = 5500 \text{ \AA}$ are absorbed by Chromium ions. ($E_1 \rightarrow E_3$)

E_3 is short lived state, Jump to metastable state E_2 has a very long life as compared to E_3 . Atoms at E_2 keep on increasing and exceed the E_1 . Hence Population Inversion is established between E_2 & E_1 , when an atom decays spontaneously from E_2 to E_1 , photon of red light $\lambda = 6943 \text{ \AA}$ is produced and chain reaction of Avalanche Effect is produced till intense beam emerge out.