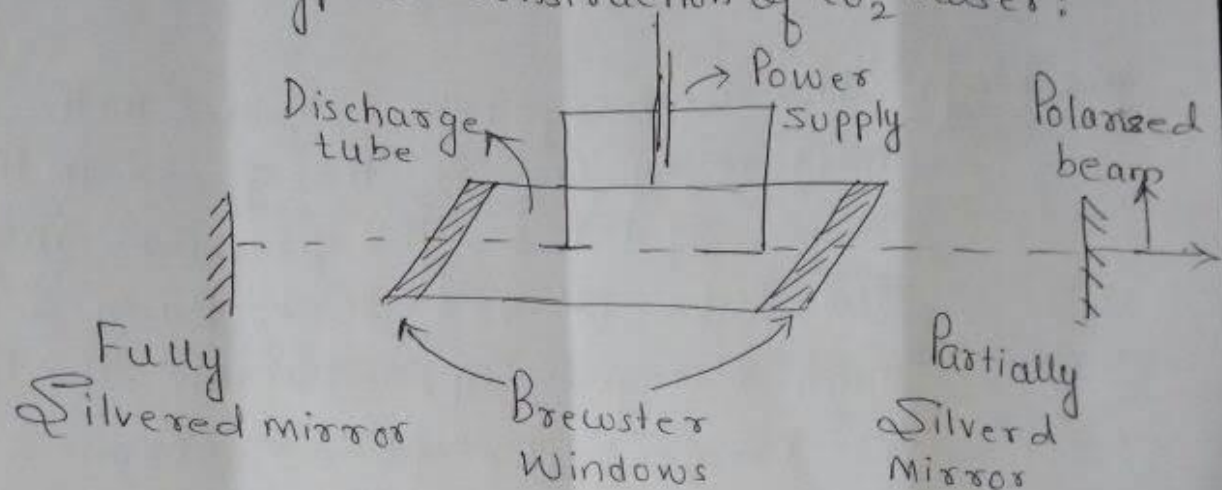


## —: CARBON DIOXIDE LASER: —

(1)

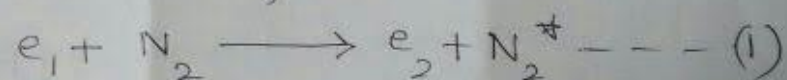
Typical construction of  $\text{CO}_2$  laser:



Set up:  $\text{CO}_2$  laser set up consists of a discharge tube of 2.5 cm in diameter and length of 5 m. The tube is water cooled. Power supply for achieving electrical pumping is used through the Electrodes. Two Brewster's windows are arranged at the two terminals of the discharge tube to polarize the emission coming out of the tube. Further two optically plane mirrors are fixed on either sides of the tube normal to its axis. One of the mirrors is fully silvered and can reflect all the incident light where as the silvering

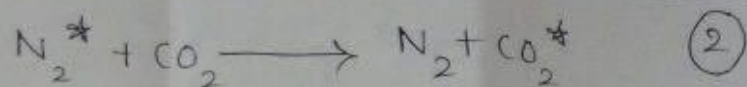
of the other is slightly less so that 1% of the incident laser beam could be tapped by transmission.

Working: The discharge tube is filled with mixture of  $\text{CO}_2$ :  $\text{N}_2$ : He gases in the ratio of 1:2:3. The pressure inside the tube is 6-17 torr. When a high voltage is applied across the two electrodes, The free electrons accelerate towards the (+)ve electrode during which they start colliding with  $\text{N}_2$  &  $\text{CO}_2$  in their path. This is type I collision,



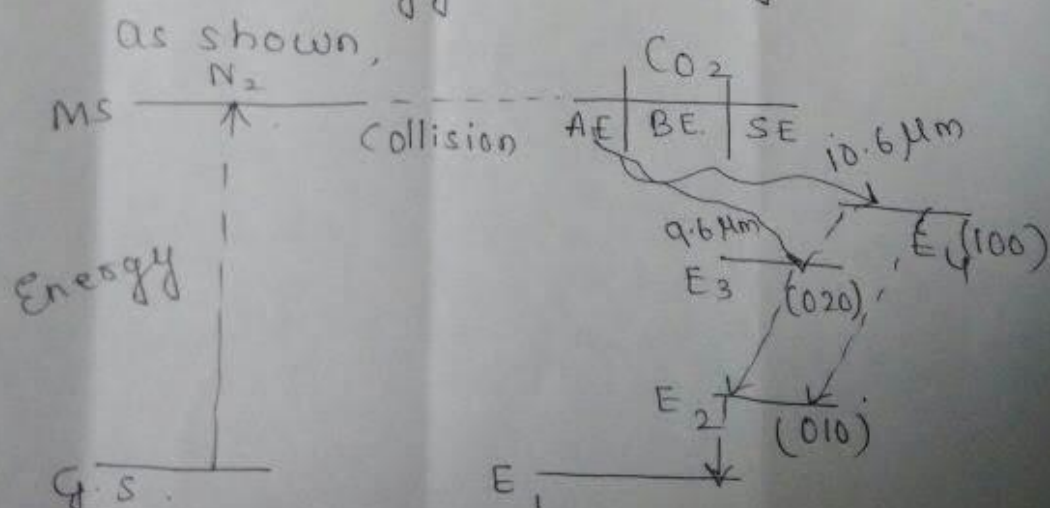
The  $\text{N}_2$  molecules are raised to metastable state.

Likewise many  $\text{CO}_2$  molecules will also be raised to a non metastable. Now for  $\text{CO}_2$  gas it so happens that there is a close coincidence in energy with  $\text{N}_2$  molecules in the ground & excited states. Here collision of Second type takes place,



Where  $\text{CO}_2$  &  $\text{CO}_2^*$  refer to the energies of  $\text{CO}_2$  molecules in ground & excited states respectively.

Hence in the excited states of  $\text{N}_2$  &  $\text{CO}_2$  there is population inversion with respect to the lower energy states. Once the population inversion is achieved, the transition from  $E_5$  to  $E_4$ ,  $E_5$  to  $E_3$  levels give rise to wavelengths  $10.6 \mu\text{m}$  &  $9.6 \mu\text{m}$  which are in the infrared region. The transitions from  $E_4 \rightarrow E_2$ ,  $E_3 \rightarrow E_2$  and  $E_2 \rightarrow E_1$  are all non-radiative but thermal energy of the set up increases due to such transitions. The energy level diagram is





The transitions are due to the  
Asymmetric stretch of  $\text{CO}_2$  molecules.

