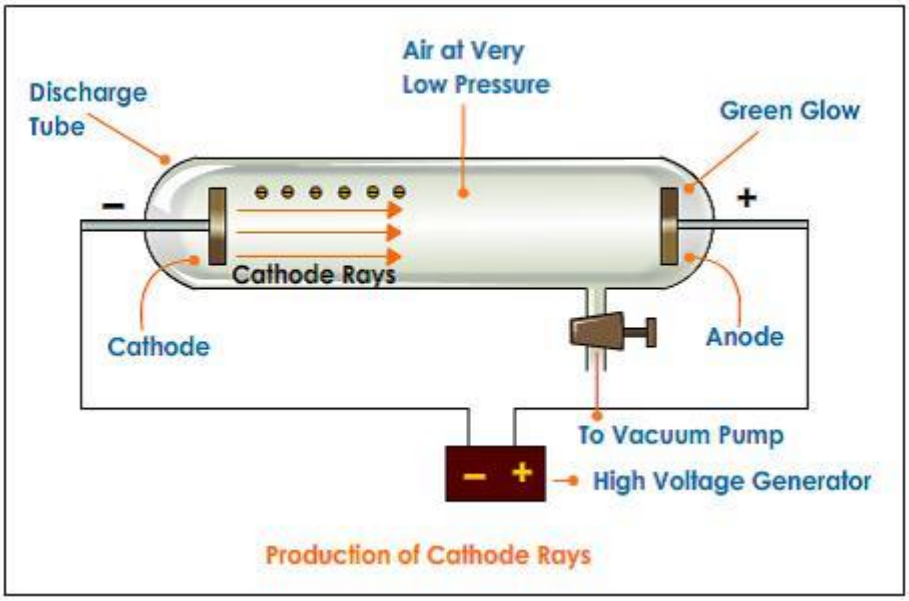
Answer on Question #42459, Physics, Electromagnetism

Discharge doesn't takes place at normal atmospheric pressure inside the discharge tube. Justify.

Solution:

Electrical discharge through gases is studied by using a specially designed glass tube commonly called as a discharge tube. It consists of a cylindrical glass tube having a side tube, and two metallic electrodes one at each end. These electrodes can be connected to the respective terminals of a high tension power supply. Air from inside the tube can be pumped out by connecting the side tube to a vacuum pump, and a desired pressure can be maintained inside the tube.



It was found that gases could not conduct electricity even when an electrical potential of about 10,000 volts was applied. But, it was discovered by William Crookes that gases could conduct electricity at low pressures. When, the pressures inside the discharge tube were reduced gradually, the following point was noted.

i) At about 10^{-2} atm pressure, a glow surrounding the cathode (negative electrode) leaves the electrode surface, and little space is left between it and the electrode. This is called Crooke 'mass dark space. At this stage, electric current begins flow from one electrode to other.

At sufficiently low pressure (about 10^{-3} atm), this glow fills whole the tube. The color of the glow depends upon the nature of the gas in the tube, and on the color of the glass used for making the discharge tube.

ii) When the pressure is lowered to about 10^{-5} atmosphere, lights emission by the residual air in the discharge tube opposite to the cathode start glowing. At this stage, a stream, called cathode rays is emitted from the cathode.

If the gas was at normal pressure there would be too much gas in the way and it would stop being a beam. The electrons in the beam can be deflected if they hit molecules of gas. if too many of them are deflected either none will rich the target or the spot on the target will be very diffuse.

Lowering the pressure means that there are less molecules to collide.

Answer.

If there were many, many air molecules (normal or high pressure) inside the tube, then the electrons would simple smash into them and the electrons would not be able to travel easily to the other end of the tube.