Quadrant II – Transcript and Related Materials

Notes

Programme :	**Bachelor of Science (Second year)**
Subject :	**Physics**
Semester :	**IV**
Paper Code :	**PYC104**
Paper Title :	**Optics and Modern Physics**
Name of the Unit :	**6 – X-Rays**
Module Name :	**Coolidge tube generator, Continuous X-ray spectra and its dependance on voltage, Duane and Hunt's law.**
Name of the presenter :	**Dr. Bhargav K. Alavani, Assistant Professor of Physics, Ganpat Parsekar College of Education**

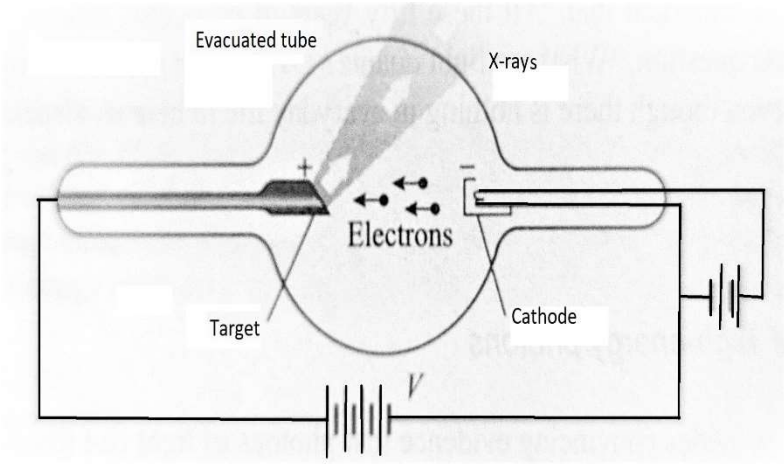
X-Rays

•In 1895 Wilhelm Roentgen found that highly penetrating radiation of unknown nature is produced when fast electrons impinge on matter. He named these rays as “X-rays”.

• X-Rays are a form of an electromagnetic radiation. Their wavelength ranges from 0.01 to 10 nano meters. They travel in a straight line and do not carry an electric charge. They are capable of travelling in a vacuum.

Generation of X-rays

•The Coolidge tube was the first type of practical x-ray tube which employed thermionic emission.

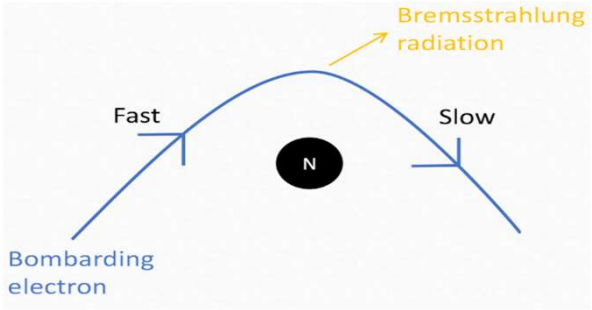


•A Cathode, heated by a filament through which an electric current is passed, supplies electrons by thermionic emission.

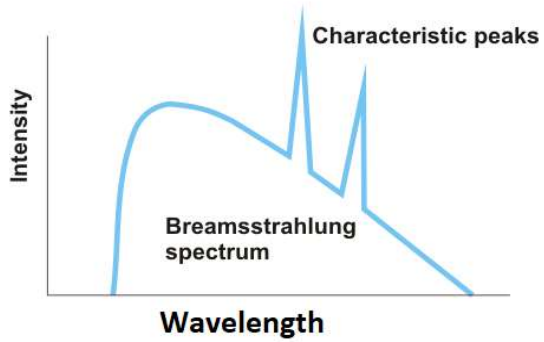
• High potential difference *V* maintained between the cathode and a metallic target accelerates the electron towards the target.

Generation of X-rays

• When electron is incident on target atoms two things are possible.



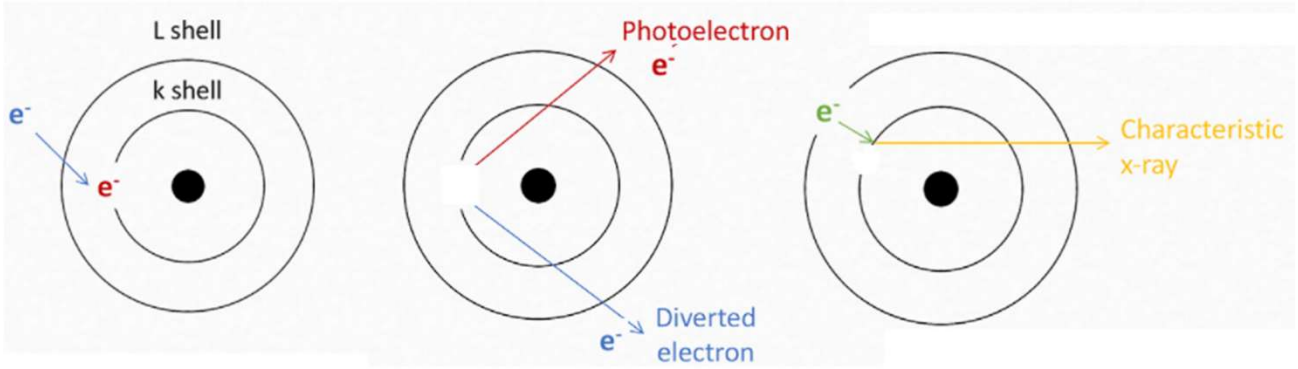
•The incident fast moving electron slows down near the target nucleus. i.e it decelerates. The energy lost from this diversion is released as a X-ray photon.



•This X-ray radiation is called as **Bremsstrahlung radiation** (meaning braking radiation in German).

Generation of X-rays

• The fast incident electron can knock off the core electron of target atom. The electron from higher energy level will jump into the vacant low energy level releasing a **Characteristic X-Ray** photon.



Duane-Hunt law

•The Duane–Hunt law, named after the American physicists William Duane and Franklin L. Hunt gives the minimum wavelength of X-rays that can be emitted by Bremsstrahlung in an X-ray tube by accelerating electrons through an excitation voltage V into a metal target.

• The kinetic energy attained by the electron due to accelerating potential V is

• $K.E = Ve$. If this entire K.E is given up by the electron to form a single Bremsstrahlung X-ray photon, we have $Ve = \frac{hc}{\lambda_{min}}$

•i.e $\lambda_{min} = \frac{hc}{Ve} = \frac{1.24\times10^{-6}}{V}$V.m