

Chapter 3 - Discovery of X-rays

- X-rays discovered by W.K. Roentgen in 1895.
- Found accidentally while experimenting with Cathode tube
- Some "properties" of X-rays:
 - a) unaffected by gravity
 - b) unaffected by electric fields
 - c) unaffected by magnetic fields
 - d) travels in straight lines

~~X-ray Interact~~

- X-rays are produced by the interactions of electrons and matter. (In Roentgen's case, the electrons and the Anode)
- Two types of electron interactions:
 - 1) Collisional interactions
 - 2) Radiative interactions

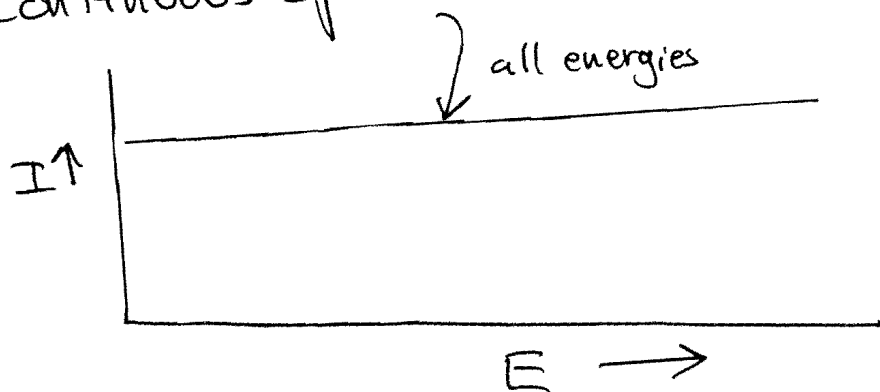
1) Collisional interactions:
either elastic (conserves energy) or inelastic (does not conserve energy)

Gives rise to Characteristic Radiation

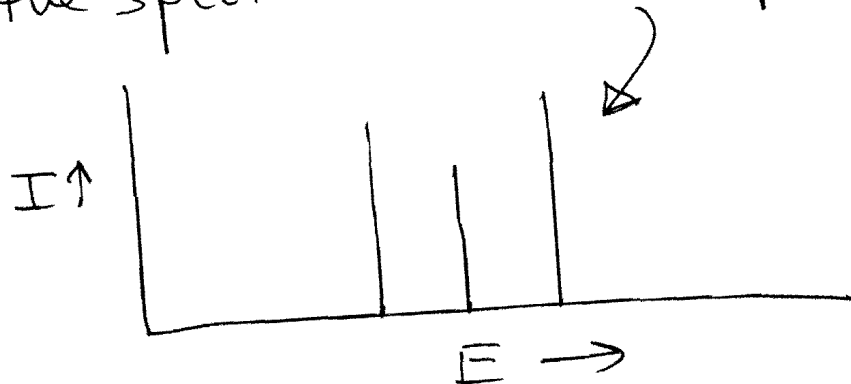
4a) Energy Spectra

- graph of # of photons versus energy of the photons.

Continuous Spectrum:



- For Characteristic Radiation, only a few discrete energies are given off, therefore the spectrum is a line Spectrum

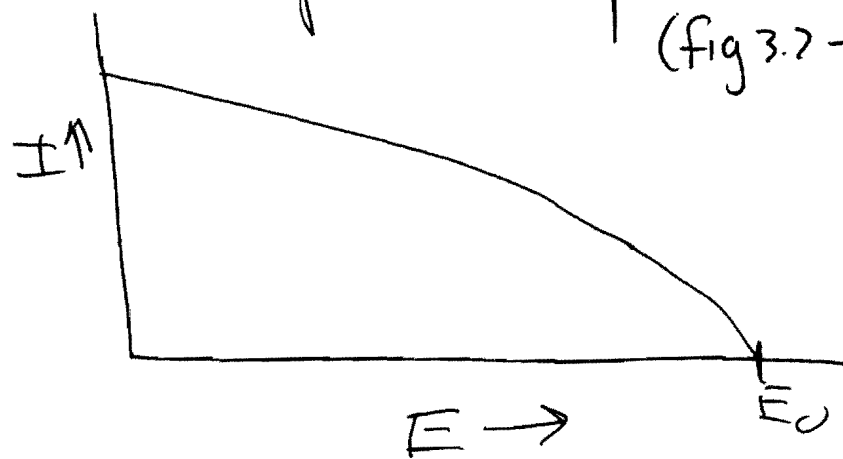


2) Radiative Interactions (Bremsstrahlung)

- When an electron interacts with the nucleus of an atom, it is decelerated or slowed
- ~~down~~ down, giving up energy.

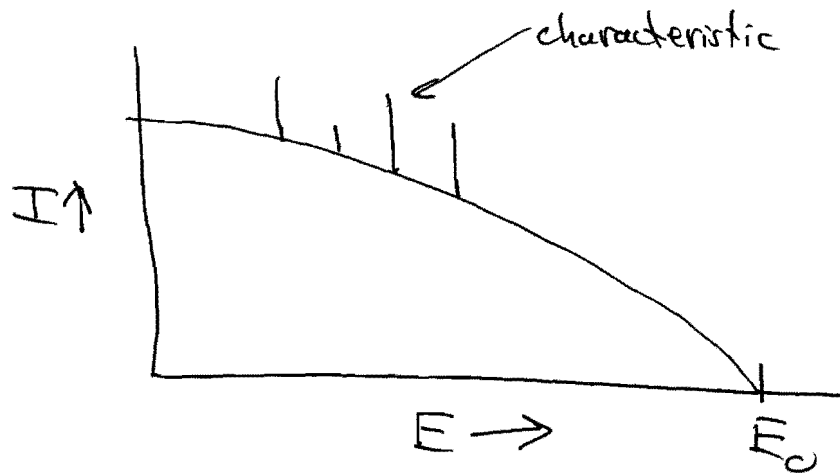
This energy is radiated out as a photon.

- Most of the x-rays produced are from Bremsstrahlung.
- Since the loss of energy of the incoming electron can be any value up to the actual energy of the electron, a continuous spectrum is produced (fig 3.7 - p24)

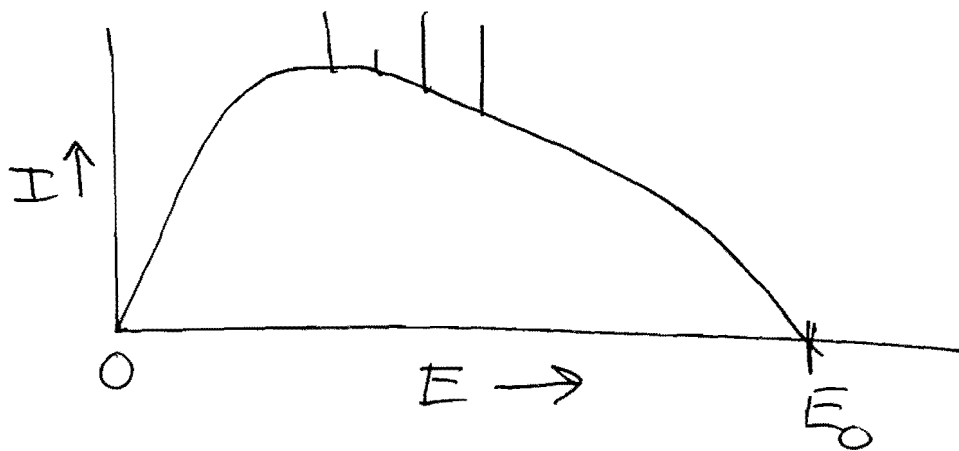


with a Maximum energy of E_0 , the initial electron energy.

The actual spectrum produced is a combination of collisional characteristic radiation and Radiative bremsstrahlung radiation.



On leaving the x-ray tube housing, many low energy photons are absorbed, yielding a spectrum.



Filters used in X-ray Therapy

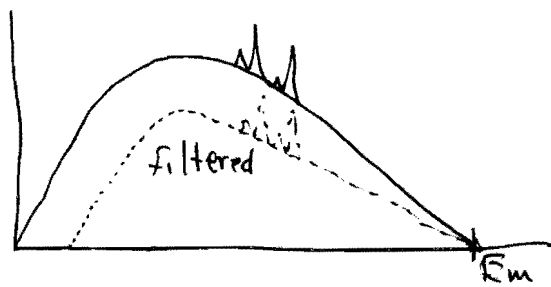
- Since an X-ray tube produces a Continuous spectrum of X-ray energies, We would like to remove most of the low energy photons that do not contribute to the therapy.
- Many of the low energy photons are absorbed by the glass tube or the target itself.
- Others may be removed by Filters

Filters can be of two types:

- ① General Filters (reduction of intensity)
- ② Selective Filters

If we place a filter of some type of material in the X-ray beam, of some thickness 'x', X-ray photons will be absorbed.

Although low energy photons will be absorbed more than high energy, overall the intensity of the beam is reduced



- This is because all photons interact with the material and are scattered & absorbed.
- As more & more filter material is added, more and more low energy photons are removed.
- This gives the beam an average higher energy.
- This is called "Beam Hardening"
- examples of this type of filtering is
 - 1) flattening filters
 - 2) Wedges

Selective Filtering:

- Certain materials have ~~characteristic~~ electron energy levels which correspond to the low energy x-rays we wish to remove.

Thoraeus Filter: Tin, Copper & Aluminum
order of the materials is important.