BETATRON

Betatron is a device for *speeding up electron to extremely high energies with the help of expending magnetic field*.

It was constructed in *1941* by *D.W.Kerst*.

Betatron Differs from cyclotron

- The *electrons are accelerated by expending magnetic field*.
- *The circular orbit has a constant radius*.

PRINCIPLE

The principle of the betatron is the same as that of *a transformer* in which an Alternating current applied to the primary coil induces an alternating current
In the secondary.

In betatron *secondary coil* is replaced by a *doughnut shaped* vaccum chamber.

When the electron is injected in doughnut, the alternating magnetic field has two effects :

- *An electromotive force is produced in the electron orbit by changing magnetic flux that gives an additional energy to the electrons.*
- *A radial force is produced by the reaction of magnetic field whose direction is perpendicular to the electron velocity which keeps the electrons moving in the circular part.*

Construction

- Betatron consists of highly evacuated angular tube D known as ***doughnut chamber***.

- The chamber is placed between the poles of an *electromagnet*

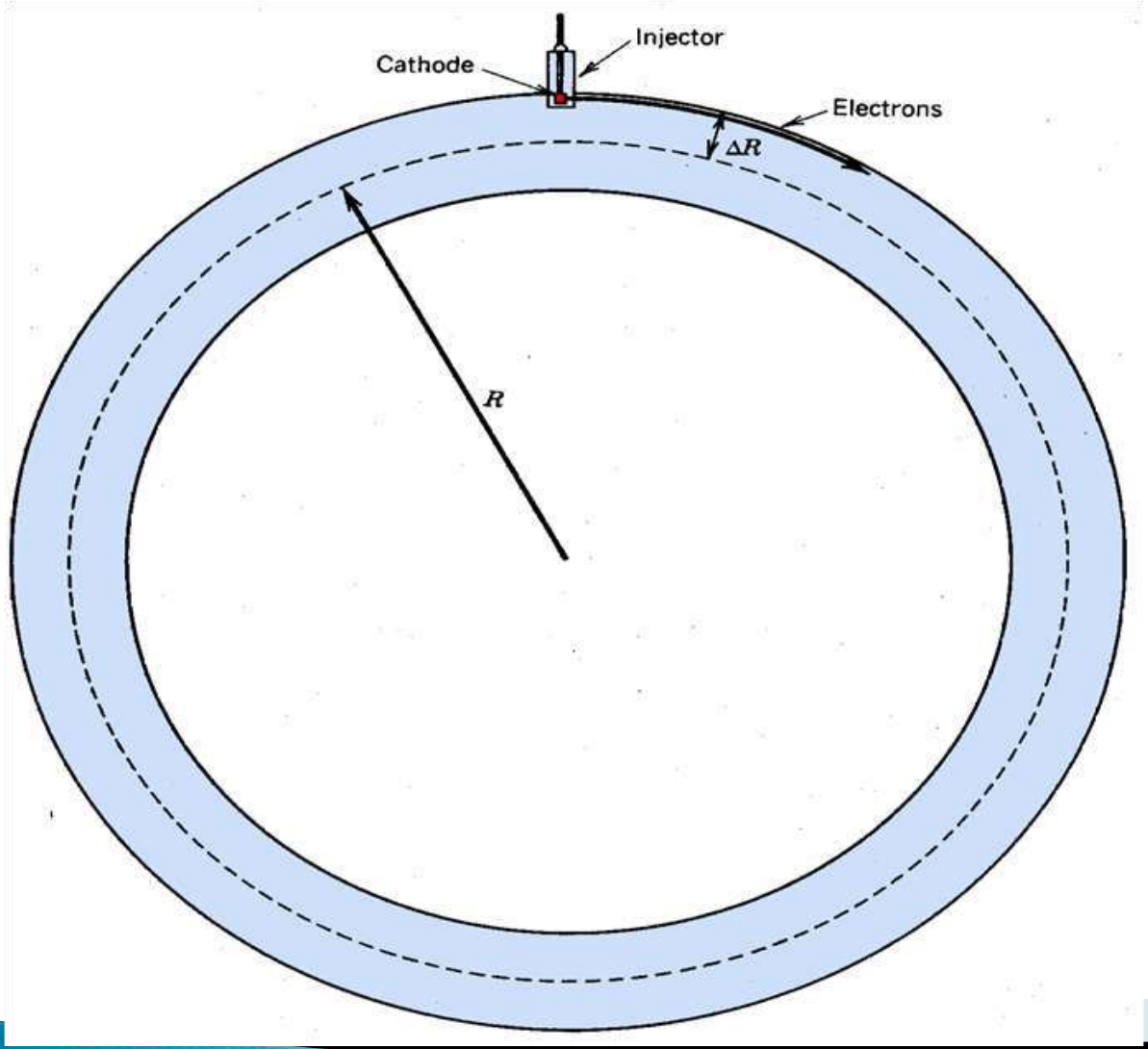
excited by an *alternating current* (frequency of *60* or *180* Hz)

- Electrons are produced by *electron gun* and are *injected* into doughnut at the *beginning* of each cycle of *alternate current*.

- The increasing magnetic flux gives rise to a voltage gradient(electric field) round the doughnut which accelerates the orbiting electrons

OPERATION

- Electrons from the electron gun are injected into doughnut shaped vacuum chamber when the magnetic field is just rising from its zero value in the first quarter cycle.
- The electrons now make several thousand revolution and gain energy.
- When the magnetic field has reached its maximum value, the electrons are pulled out from their orbit.
- Either they strike a target and produce X-rays or emerge from the apparatus through a window



Constant Radius of Betatron