

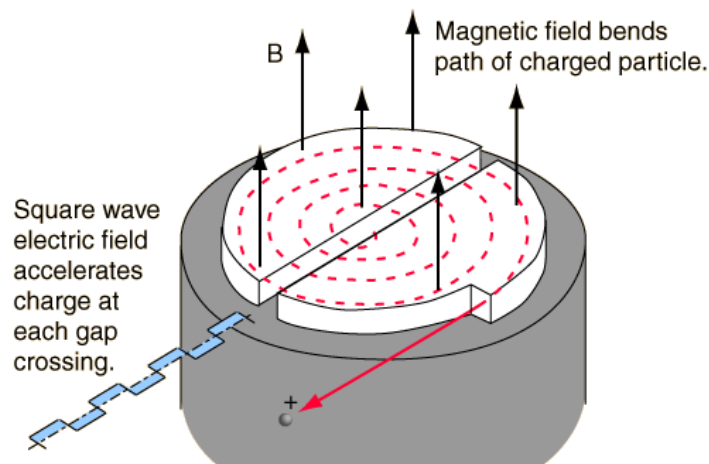
## Answer on Question #39737, Physics, Other

**Question:** State the principle of cyclotron.

**Answer:**

A cyclotron is a type of particle accelerator in which charged particles accelerate outwards from the center along a spiral path. The particles are held to a spiral trajectory by a static magnetic field and accelerated by a rapidly varying (radio frequency) electric field.

The applied electric field accelerates electrons between the "dees" of the magnetic field region. The field is reversed at the cyclotron frequency to accelerate the electrons back across the gap.



A moving charge in a cyclotron will move in a circular path under the influence of a constant magnetic field. If the time to complete one orbit is calculated:

$$T = \frac{2\pi r}{v} = \frac{2\pi m v}{q B v} = \frac{2\pi m}{q B}$$

it is found that the period is independent of the radius. Therefore if a square wave is applied at angular frequency  $qB/m$ , the charge will spiral outward, increasing in speed.

When a square wave of angular frequency

$$\omega_{cyclotron} = \frac{2\pi}{T} = \frac{q}{m} B$$

is applied between the two sides of the magnetic poles, the charge will be boosted again at just the right time to accelerate it across the gap. Thus the constant cyclotron frequency can continue to accelerate the charge.

*A particle's frequency of revolution depends only upon the strength of the magnetic field and the charge-mass ratio of the particle, not upon the radius of its orbit.* This is the **basic principle** of the cyclotron.