Bainbridge mass spectrograph:

In Bainbridge mass spectrograph, field particles of same velocity are selected by using a velocity selector and then they are subjected to a uniform magnetic field perpendicular to the velocity of the particles. The particles corresponding to different isotopes follow different circular paths as shown in the figure.

(1) Velocity selector : The positive ions having a certain velocity v gets isolated from all other velocity particles. In this chamber the electric and magnetic fields are so balanced that the particle moves undeflected. For this the necessary condition is

$$v=EB$$

and E, B and v should be mutually perpendicular to each other.

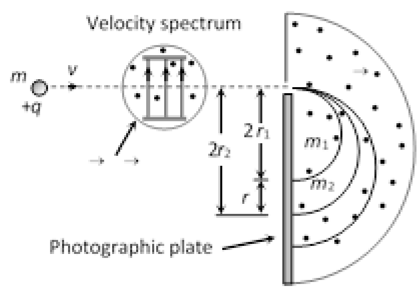
(2) Analysing chamber : In this chamber magnetic field B is applied perpendicular to the direction of motion of the particle. As a result the particles move along a circular path of radius

$$r=mEqBB' \Rightarrow qm=EBB'r$$

also

$$r_1 r_2=m_1 m_2$$

In this way the particles of different masses gets deflected on circles of different radii and reach on different points on the photo plate.

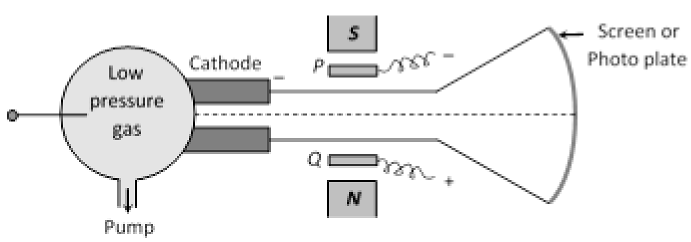


Separation between two traces

$$=d=2r_2-2r_1=2v(m_2-m_1)qB'$$

Thomson’s Mass Spectrograph:

It is used to measure atomic masses of various isotopes in gas. This is done by measuring q/m of singly ionised positive ion of the gas.



The positive ions are produced in the bulb at the left hand side. These ions are accelerated towards cathode. Some of the positive ions pass through the fine hole in the cathode. This fine ray of positive ions is subjected to electric field E and magnetic field B and then allowed to strike a fluorescent screen ($\vec{E} \parallel \vec{B}$ but $\vec{E}$ or $\vec{B} \perp \vec{v}$).

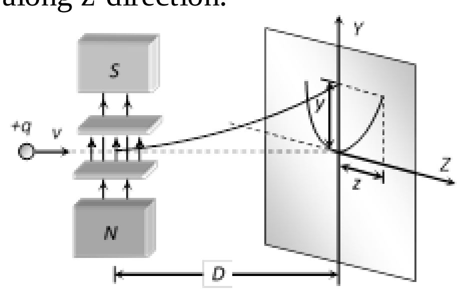
If the initial motion of the ions is in

$$+x$$

direction and electric and magnetic fields are applied along

$$+y$$

axis then force due to electric field is in the direction of y-axis and due to magnetic field it is along z-direction.



The deflection due to electric field alone

$$y=qELDmv^2$$

.....(i)

The deflection due to magnetic field alone

$$z=qBLDmv$$

.....(ii)

From equation (i) and (ii),

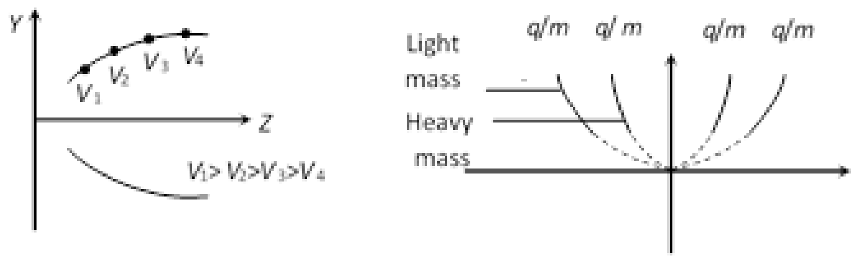
$$z^2=k(qm)y$$

where

$$k=B^2LDE$$

; This is the equation of parabola. It means all the charged particles moving with different velocities but of same q/m value will strike the screen placed in yz plane on a parabolic track as shown in the above figure.

All the positive ions of same. q/m moving with different velocity lie on the same parabola. Higher is the velocity lower is the value of y and z. The ions of different specific charge will lie on different parabola.



(A) (B)

The number of parabola tells the number of isotopes present in the given ionic beam.