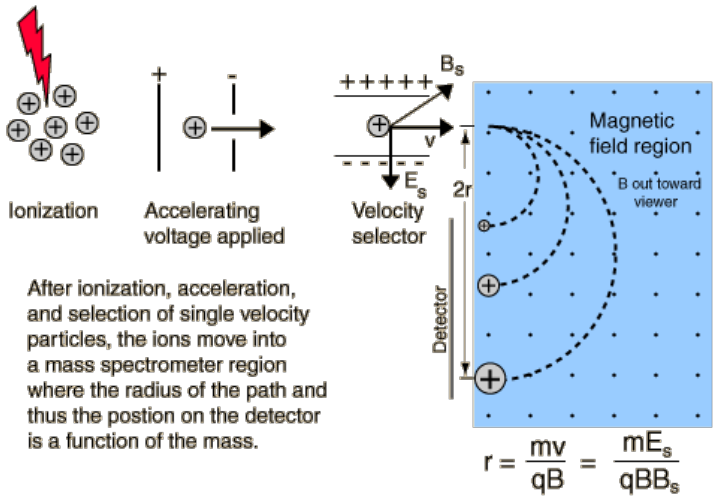
1 Mass Spectrometer

The mass spectrometer is an instrument which can measure the masses and relative concentrations of atoms and molecules. It makes use of the basic magnetic force on a moving charged particle.



2 Circular Path from Magnetic Field

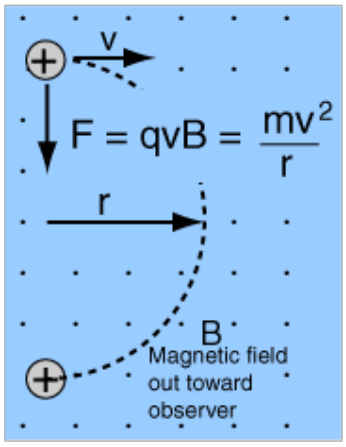
$$r = \frac{mv^2}{qvB} = \frac{mv}{qB}$$ Radius of path produced by magnetic field

If the velocity v is produced by an accelerating voltage V:

$$\frac{1}{2}mv^2 = qV \; ; \quad v = \sqrt{\frac{2qV}{m}}$$

Substitution gives:

$$r = \frac{1}{B}\sqrt{\frac{2mV}{q}}$$



3 Simulation

$$r = \frac{mv^2}{qvb} = \frac{mv}{qB}$$

ratio

$$\frac{m}{q} = \frac{rB}{v}$$

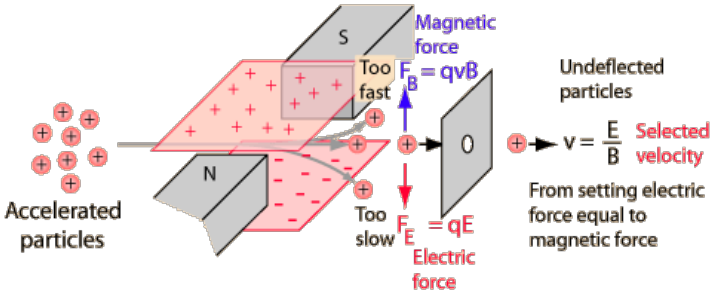
Consequently the solution

$$mv^2 = rqvB$$

$$\frac{m}{q} = \frac{rvB}{v^2} = \frac{rB}{v}$$

4 Velocity Selection

A velocity selector is used with mass spectrometers to select only charged particles with a specific velocity for analysis. It makes use of a geometry where opposing electric and magnetic forces match for a specific particle speed. It therefore lets through undeflected only those particles with the selected velocity.



5 Applications of Mass Spectrometers

Mass spectrometers are sensitive detectors of isotopes based on their masses. They are used in carbon dating and other radioactive dating processes. The combination of a mass spectrometer and a gas chromatograph makes a powerful tool for the detection of trace quantities of contaminants or toxins. A number of satellites and spacecraft have mass spectrometers for the identification of the small numbers of particles intercepted in space. For example, the SOHO satellite uses a mass spectrometer to analyze the solar wind. Mass spectrometers are used for the analysis of residual gases in high vacuum systems.

References

Mass Spectrometer. (n.d.). Retrieved October 26, 2015.