Answer on Question #61565-Physics -Mechanics

The isotope 35Cl has a mass of 5.80X10^-26kg and a negative charge of 1.60X10^-19C. It is accelerated, and passes through a velocity selector where the electric field is 5.85X10^4V/m, and the magnetic field is 0.275T. The ion is deflected by magnetic field of 2.00T.

a)What is the radius of curvature of this ion?

b) If a heavier isotope of chlorine is used but one with the same charge, would the radius of curvature be larger or smaller? Explain your reasoning by referring to the equation you used to determine the mass.

Solution

a) In the velocity selector only ions with a particular velocity pass undeflected through the combined electric and magnetic fields of the selector.

The magnetic and electric field forces on the ions are equal and opposite

$$B_0 q v = E q$$

Selected velocity

$$v = \frac{E}{B_0}$$

The radius of curvature is given by the formula:

$$r = \frac{mv}{qB} = \frac{m}{qB}\frac{E}{B_0} = \frac{5.80 \cdot 10^{-26}}{1.60 \cdot 10^{-19}(2)}\frac{5.85 \cdot 10^4}{0.275} = 0.0386\, m = 3.86\, cm.$$

b) The radius of curvature is given by the formula:

$$r = \frac{m}{qB}\frac{E}{B_0} \sim m.$$

So, the radius of curvature would be larger.