ELECTRON CHARGE TO MASS RATIO

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Reference: Griffiths, David J. (2007) Introduction to Electrodynamics, 3rd Edition; Prentice Hall - Problem 5.3.

A classic experiment that is often done in undergraduate physics labs is the use of crossed electric and magnetic fields for determining the charge to mass ratio of the electron. The experimental setup involves electric and magnetic fields that are mutually perpendicular, and then firing a beam of electrons into these fields with a velocity that is perpendicular to both fields.

If the fields are adjusted so that the electrons don't deflect at all, then from the last post, we know that $v=\frac{E}{B}$.

If the electric field is removed at this point, the electron beam will be deflected into a circular path. The magnetic field provides the centripetal force, so

$$\frac{mv^2}{r}=qvB \tag{1}$$

If we measure the radius of the circle, then we get

$$\frac{q}{m} = \frac{v}{rB} \tag{2}$$

$$= \frac{E}{rB^2} \tag{3}$$

I can remember doing this experiment when I was an undergraduate back in the 1970s. They must have been on a fairly restricted budget since the method we used for measuring the radius of the circle was to take a piece of wooden dowelling and fiddle with the magnetic field until the electron beam matched the dowelling. We had to judge this by eye, so the resulting value for $\frac{q}{m}$ wasn't all that accurate. I always did prefer theoretical to experimental physics anyway.