

Experiment - 9

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Title :- Interaction of charged particle with magnetic

field :- Estimation of e/m by Thomson method

Objective :- Determining the value of specific charge ($\frac{e}{m}$) of an electron by Thomson method

Tabular form :-

Polarity	y	Deflection Voltage	Position of magnet (r_1)	Position of magnet (r_2)	Reading of magnetometer (θ_1)	Reading of magnetometer (θ_2)
Positive	1cm	$V_1 = 7.5 \text{ V}$	$r_1 = 10.7 \text{ cm}$	$r_2 = 10.8 \text{ cm}$	$\theta_1 = 70^\circ$	$\theta_2 = 70^\circ$
Negative	1cm	$V_2 = 7.4 \text{ V}$	$r_1' = 8.9 \text{ cm}$	$r_2 = 8.9 \text{ cm}$	$\theta_3 = 70^\circ$	$\theta_4 = 70^\circ$

Calculations :-

① first calculate the 'B' using equation

$$B = \mu \tan \theta$$

$$\theta = \frac{\theta_1 + \theta_2 + \theta_3 + \theta_4}{4}$$

$$= \frac{70 + 70 + 71 + 72}{4}$$

$$= \frac{283}{4} = 70.75$$

$$\text{Put } \mu = 0.3 \times 10^{-4} \text{ T}$$

$$B = 0.3 \times 10^{-4} \times \tan(70.75)$$

$$B = 0.3 \times 10^{-4} \times 2.86$$

$$B = 0.85 \times 10^{-4}$$

② Now, using the value of B, calculate e/m ratio

$$\frac{e}{m} = \frac{v_y}{B^2 l^2 d}$$

$J = 3.23 \text{ cm}$ (length of the plates)

$d = 1.4 \text{ cm}$ (distance b/w plates)

$L = 14.5 \text{ cm}$ (distance b/w screen and plates)

$y = 1 \text{ cm}$ (Deflection of beam)

$$V = \frac{V_1 + V_2}{2} = \frac{7.5 + 7.4}{2}$$

$$= \frac{14.9}{2}$$

$$\boxed{V = 7.45}$$

$$\frac{E}{m} = \frac{7.45 \times 1}{(10.85 \times 10^{-4})^2 \times 3.23 \times 14.5 \times 1.4}$$

$$\frac{E}{m} = \frac{7.45}{(0.85 \times 10^{-4})^2 \times 65.569}$$

$$\frac{E}{m} = 1.501 \times 10^8 \text{ C/kg}$$

③ finally find the error

$$\text{Error} = \frac{\text{Standard Value} - \text{Calculate value}}{\text{Standard Value}} \times 100$$

$$= 14.6$$