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Electron Gun - Effects of Electric Field

**Objective**- To observe the effects of an electric field on the motion of electron and to show a relation between the field strength and the distance the electrons are deflected.

**Procedure**- A Cathode Ray Tube (CRT) is attached to two voltmeters in such a way that the two inner combination of plates in CRT are connected to respective voltmeters. The Voltmeter connected to the plates with less separation distance is fixed and the voltmeter connected to the other plates is made to deflect. In the plates with more separation distance, one end is connected to positive terminal and other end terminal is connected to negative terminal of the meter. Three attempts with ten trials each are recorded. The volts feed from the deflection voltmeter is altered to get the desired deflection of the dot from the CRT.

The fixed voltages in the experiment are 250V, 375V and 500V respectively.

**Symbolic Notations**- ∆Va ­= fixed voltage for that trials in volts

∆Vd = Deflected voltage in volts.

**X** =(∆Vd/∆ Va)

∆y= distance the dot deflected in millimeters (mm)

K= ∆y/**X** in meters (m)

1). ∆Va=250V

|  |  |  |  |
| --- | --- | --- | --- |
| ∆y (mm) | ∆Vd (V) | **X** | K (m) |
| 20 | 16 | .064 | .312 |
| 14 | 12.7 | .048 | .291 |
| 10 | 9 | .036 | .2777 |
| 8 | 7.52 | .03008 | .2659 |
| 4 | 3.68 | .01472 | .2717 |
| 2 | 1.438 | .0057 | .3508 |
| 0 | 0 | 0 | 0 |
| -2 | -1.535 | -.006 | -.3333 |
| -4 | -3.59 | -.01436 | -.2785 |
| -8 | -7.54 | -.0301 | -.2657 |
| -10 | -8.5 | -.034 | -.2941 |
| -14 | -12.00 | -.048 | -.2916 |
| -20 | .16.29 | -.065 | -.3076 |
|  |  | K1 (average) | **.2951** |

2). ∆Va= 375V

|  |  |  |  |
| --- | --- | --- | --- |
| ∆y (mm) | ∆Vd (V) | **X** | K (m) |
| 20 | 25 | .066 | .303 |
| 14 | 18.84 | .050 | .280 |
| 10 | 13.86 | .036 | .277 |
| 8 | 10.5 | .028 | .2857 |
| 4 | 5.06 | .013 | .3076 |
| 2 | 3.2 | .008 | .250 |
| 0 | 0 | 0 | 0 |
| -2 | -1.65 | -.004 | -.500 |
| -4 | -4.08 | -.0108 | -.3703 |
| -8 | -9.00 | -.024 | -.333 |
| -10 | -12.8 | -.0341 | -.2881 |
| -14 | -21.29 | -.056 | -.250 |
| -20 | -25.4 | -.067 | -.2985 |
|  |  | K2(average) | **.3119** |

3). ∆Va= 500V

|  |  |  |  |
| --- | --- | --- | --- |
| ∆y (mm) | ∆Vd (V) | **X** | K (m) |
| 20 | 31.18 | .0623 | .3147 |
| 14 | 25.03 | .0506 | .2796 |
| 10 | 18.00 | .036 | .2777 |
| 8 | 14.50 | .029 | .2758 |
| 4 | 8.15 | .0163 | .2434 |
| 2 | 4.80 | .0096 | .2083 |
| 0 | 0 | 0 | 0 |
| -2 | -2.7 | -.0054 | -.3703 |
| -4 | -5.6 | -.0112 | -.3511 |
| -8 | -12.5 | -.025 | -.320 |
| -10 | -16.37 | -.0327 | -.305 |
| -14 | -22.82 | -.0456 | -.307 |
| -20 | -31.19 | -.0623 | -.321 |
|  |  | K3(average) | **.2980** |

K’=(K1+K2+K3)/3 = (.29512+.3119+.2980)/2 =.3016 m

K(the slope of the graph) = .3028 m

**Conclusion-** The electric field generated by the opposite polarized plates in CRT deflects the electron. The experiment proves that the higher the field strength, the greater the deflection. Hence we can conclude that the electric field is directly proportional to the distance the electron is deflected.

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