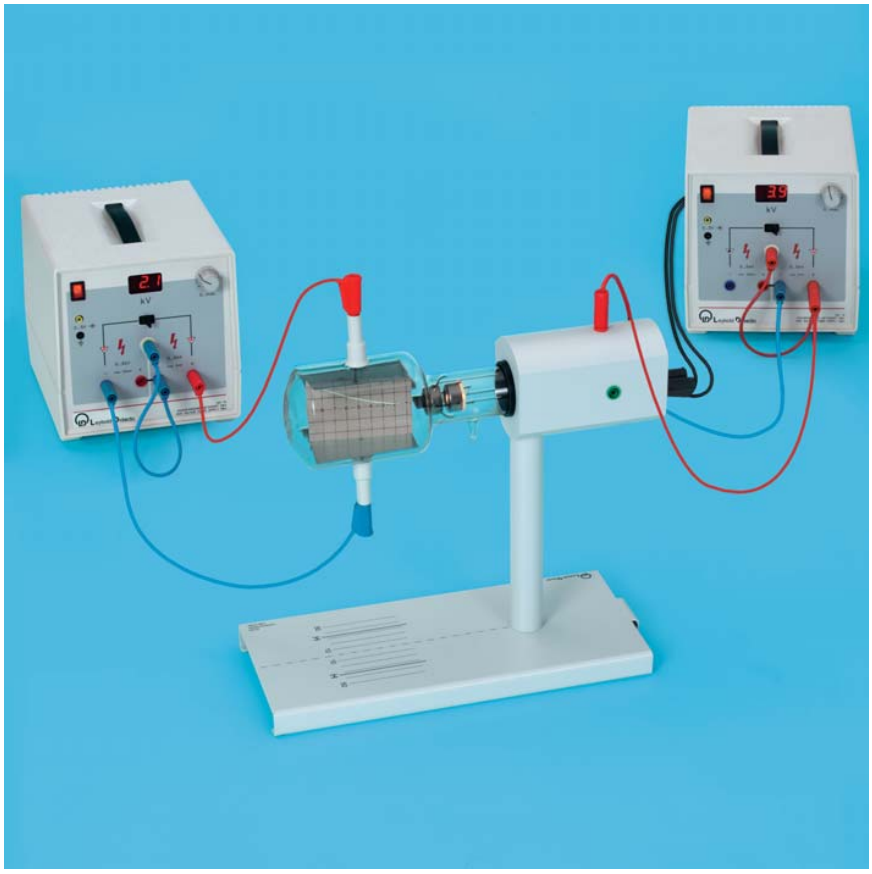
P 3.8.5

Thomson tube

P 3.8.5.1 Investigating the deflection of electrons in electrical and magnetic fields

P 3.8.5.2 Assembling a velocity filter (Wien filter) to determine the specific electron charge



Investigating the deflection of electrons in electrical fields

In the Thomson tube, the electrons pass through a slit behind the anode and fall glancingly on a fluorescent screen placed in the beam path at an angle. A plate capacitor is mounted at the opening of the slit diaphragm which can electrostatically deflect the electron beam vertically. In addition, Helmholtz coils can be used to generate an external magnetic field which can also deflect the electron beam.

The first experiment investigates the deflection of electrons in electric and magnetic fields. For different anode voltages U_A, the beam path of the electrons is observed when the deflection voltage U_P at the plate capacitor is varied. Additionally, the electrons are deflected in the magnetic field of the Helmholtz coils by varying the coil current I. When we insert the anode voltage in the following equation, we can obtain an experimental value for the specific electron charge

$$\frac{e}{m} = \frac{2U_A}{(B \cdot r)^2} ,$$

whereby the magnetic field B is calculated from the current I.

In the second experiment, a velocity filter (Wien filter) is constructed using crossed electrical and magnetic fields. Among other things, this configuration permits a more precise determination of the specific electron charge. At a fixed anode voltage U_A, the current I of the Helmholtz coils and the deflection voltage U_P are set so that the effects of the electric field and the magnetic field just compensate each other. The path of the beam is then virtually linear, and we can say:

$$\frac{e}{m} = \frac{1}{2U_A} \cdot \left(\frac{U_P}{B \cdot d} \right)^2$$

d: plate spacing of the plate capacitor

Cat. No.	Description	P 3.8.5.1-2
555 624	Electron beam deflection tube	1
555 600	Stand for electron tubes	1
555 604	Pair of Helmholtz coils	1
521 70	High voltage power supply 10 kV	2
521 545	DC power supply 0 ... 16 V, 5 A	1
500 611	Safety connection lead, 25 cm, red	2
500 621	Safety connection lead, 50 cm, red	1
500 622	Safety connection lead, 50 cm, blue	1
500 641	Safety connection lead, 100 cm, red	3
500 642	Safety connection lead, 100 cm, blue	3
500 644	Safety connection lead, 100 cm, black	2

Investigating the deflection of electrons in magnetic fields