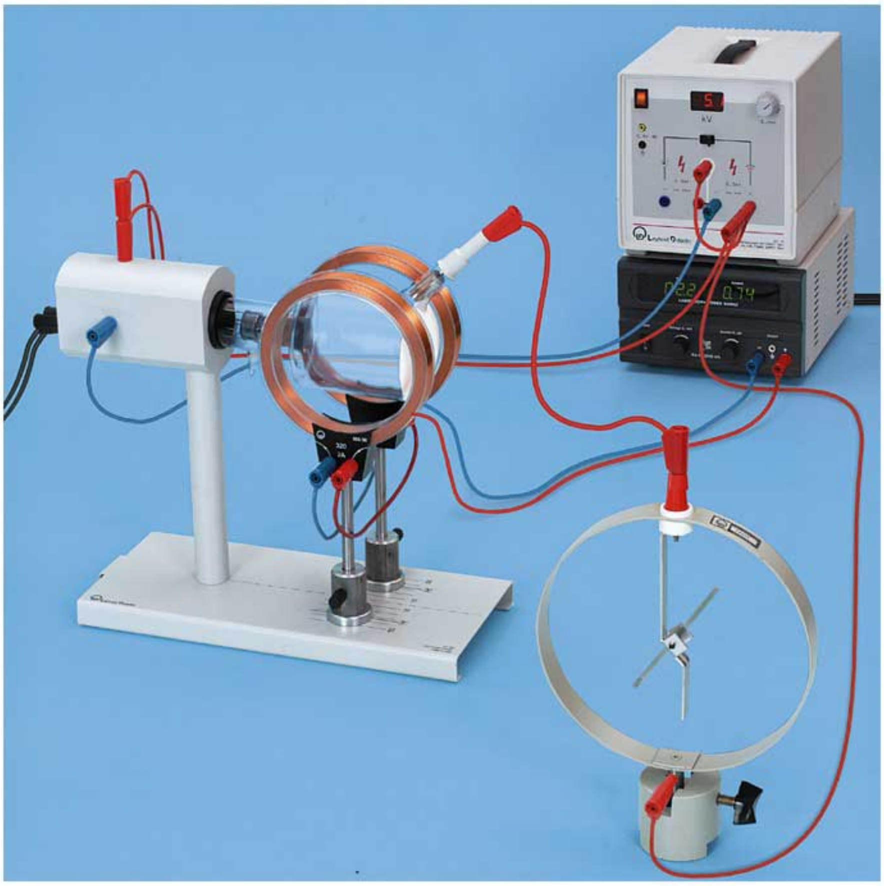

Hot-cathode emission in a vacuum: determining the polarity and estimating the specific charge of emitted charge carriers (P 3.8.4.1)

P 3.8.4

Perrin tube

P 3.8.4.1 Hot-cathode emission in a vacuum: determining the polarity and estimating the specific charge of the emitted charge carriers

P 3.8.4.2 Generating Lissajou figures through electron deflection in crossed alternating magnetic fields

Cat. No.	Description	P 3.8.4.1	P 3.8.4.2
500 622	Perrin tube	1	1
500 600	Stand for electron tubes	1	1
500 604	Pair of Helmholtz coils	1	1
562 14	Coil with 500 turns		1
521 35	Variable extra low-voltage transformer S		1
521 70	High voltage power supply 10 kV	1	1
521 545	DC power supply 0 ... 16 V, 5 A	1	
522 621	Function generator S 12, 0.1 Hz to 20 kHz		1
540 091	Electroscope	1	
300 11	Saddle base	1	
300 761	Support blocks, set of 6 pcs		1
500 611	Safety connection lead, 25 cm, red	1	1
500 621	Safety connection lead, 50 cm, red	2	2
500 622	Safety connection lead, 50 cm, blue	1	1
500 641	Safety connection lead, 100 cm, red	4	3
500 642	Safety connection lead, 100 cm, blue	2	3
500 644	Safety connection lead, 100 cm, black	2	2

In the Perrin tube, the electrons are accelerated through an anode with iris diaphragm onto a fluorescent screen. Deflection plates are mounted at the opening of the iris diaphragm for horizontal electrostatic deflection of the electron beam. A Faraday's cup, which is set up at an angle of 45° to the electron beam, can be charged by the electrons deflected vertically upward. The charge current can be measured using a separate connection.

In the first experiment, the current through a pair of Helmholtz coils is set so that the electron beam is incident on the Faraday's cup of the Perrin tube. The Faraday's cup is connected to an electroscope which has been pre-charged with a known polarity. The polarity of the electron charge can be recognized by the direction of electroscope deflection when the Faraday's cup is struck by the electron beam. At the same time, the specific electron charge can be estimated. The following relationship applies:

$$\frac{e}{m} = \frac{2U_A}{(B \cdot r)^2} \qquad U_A\text{: anode voltage}$$

The bending radius r of the orbit is predetermined by the geometry of the tube. The magnetic field B is calculated from the current I through the Helmholtz coils.

In the second experiment, the deflection of electrons in crossed alternating magnetic fields and in coaxial alternating electric and magnetic fields is used to produce Lissajou figures on the fluorescent screen. This experiment demonstrates that the electrons respond to a change in the electromagnetic fields with virtually no lag.