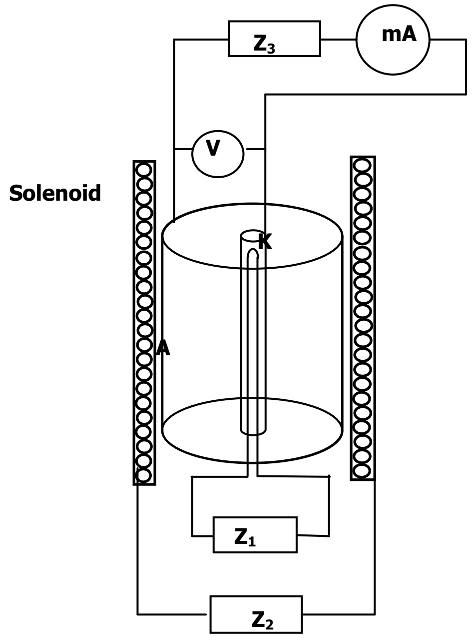
31 - ELECTRON MOTION IN ELECTRIC AND MAGNETIC FIELDS – EVALUATING THE e/m VALUE

I. Finding the e/m value with the application of a magnetron



Z1 – Power supply of the glowing unit of the magnetron cathode
5V DC power supply (adapter type, pluggable directly to the 230V AC power strip, output connected directly to "Żarzenie" ("Glowing") terminals at the magnetron unit)

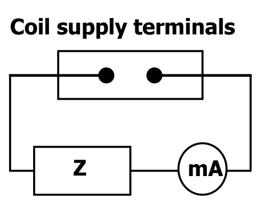
Z2 – power supply of the solenoid unit creating magnetic field
DF1730SL10A power supply (before powering on, turn all the control knobs to the LEFT till the resistance). During the measurement the current limit control knob has to be turned clockwise to the maximum position, the current is controlled with the voltage control knob. The current value has to be read on the integrated meter (**c_1=2% c_2=0,2%**). It is also possible to connect the LM3 ammeter in series.

Z3 – power supply of the magnetron anode circuit
Laboratory power supply 15V DC (set the anode voltage to approx. 3.5 V)
V640 voltmeter; measurement range 5 V
mA - Universal meter Sanwa RD700, range mA (c_1=2% c_2=0,5%). NOTE: Meter must be turned on rotating the selector knob to position „mA" BEFORE powering another parts of the circuit. Meter changes range accordingly to the current value (400 mA / 40 mA and so on). Meter powers off automatically after several minutes, you can turn it on again pressing the yellow key SELECT. Control knob of the laboratory power supply 15 Vdc must be rotated COUNTERCLOCKWISE completely.

Additional circuit data:
Cathode radius a=0.9 mm, anode radius b = 1.8 mm
Solenoid winding density N=3200 m^{-1}
Anode voltage U_a=3.5 V, glowing voltage $U_ż$=5 V
Range of changes of the solenoid current 0-5 A (the measurement has to be performed with a 0.1 A step)

1. Connect the measurement setup according to the diagram above.
2. Once all the electrical connections in the setup are checked and confirmed by the supervisor, turn on all the devices, starting from the power supply of the glowing circuit (a few minutes are needed to stabilize the anode current)
3. Perform the anode current measurement with relation to the coil current, at the constant anode voltage. Please pay a particular attention to the stability of the anode voltage during one measurement series. If at the moment of change of the coil current the anode voltage is changed, before each measurement, one has to correct it to the value chosen for this series.
4. Plot a graph of the anode current versus the solenoid current.
5. The critical current value and its uncertainty have to be found geometrically or in Origin software finding the inflection point of the plotted curve.

II. Finding the e/m value with the electron beam deflection method (magnetic field is perpendicular to the oscilloscope lamp axis)



Z – power supply of the coils creating the magnetic field (Zasilacz laboratoryjny –15 Vdc)
mA – mA - Universal meter Sanwa RD700, range mA (c_1=2% c_2=0,5%). NOTE: Meter must be turned on rotating the selector knob to position „mA" BEFORE powering another parts of the circuit. Meter changes range accordingly to the current value (400 mA / 40 mA and so on). Meter powers off automatically after several minutes, you can turn it on again pressing the yellow key SELECT. Control knob of the laboratory power supply 15 Vdc must be rotated COUNTERCLOCKWISE completely.

1. Connect the measurement setup according to the diagram above.
2. Once all the electrical connections in the setup are checked and confirmed by the supervisor, turn on the power supply of the oscilloscope lamp, and wait until the bright dot is seen on the screen.
3. Adjust the focus to see a sharp dot in the central point of the oscilloscope.
4. Turn on the power supply of the coil and increase the current flowing through the coil, causing the dot shift by 1, 2 … sections in vertical direction. Write down the current values. The measurements have to be done for both directions of the magnetic field vector tip. This can be obtained by changing the current polarity. **(One segment on the screen is 6 mm)**
5. By using the formulas given in the exercise manual and the formula defining B(I) that can be found on the instrument chassis, present the e/m as a function of magnetic field induction B.
6. Convert the obtained formula to the linear dependence in this way that the value e/m would be the relation factor (the slope) between the magnetic field function and the oscilloscope dot shift (how to do it – see exercise manual). **Calculate the e/m value with application of the least squares method using the Origin software.**