Experiment 4

Back Scattering of Beta Particles

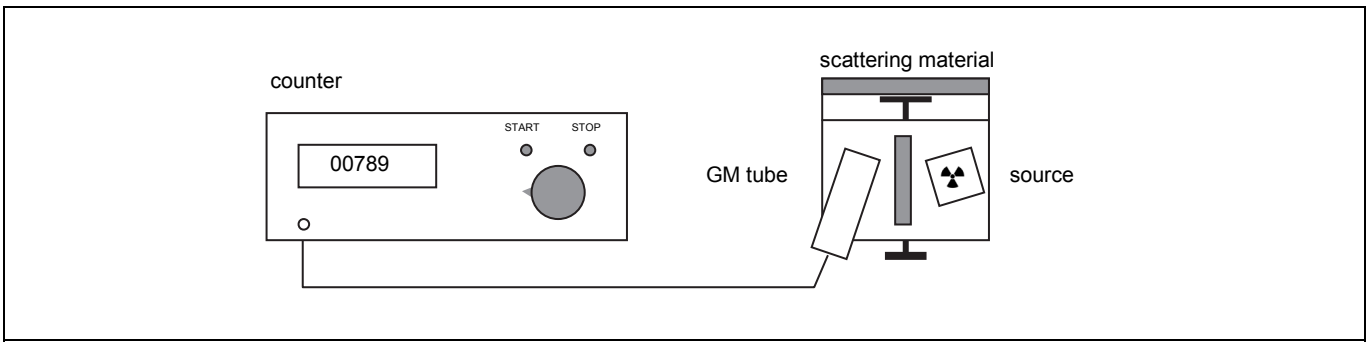
Name: ……...

Aim

To determine the relation between the number of back-scattered β particles and the atomic number of the scattering material.

Set-up

The set-up consists of a Geiger-Müller tube, a pulse counter, an apparatus to position sheets of different scattering materials, and a source of strontium-90 (^{90}Sr) that emits mostly β radiation.



Read the introduction on page 6 of the booklet *ISP Experiments* about scattering of β radiation.

Measurements

1 After removing the top cover, position the source in the set-up.

2 Measure the intensity I_0 (in pulses per 10 s) five times without the scattering material in the set-up, and record your measurements in the table below. Calculate the average intensity $I_{0,avr}$ (in pulses per 10 s), and record the result in the table below.

I_0 (pulses/10s)						$I_{0,avr}$ (pulses/10s)	

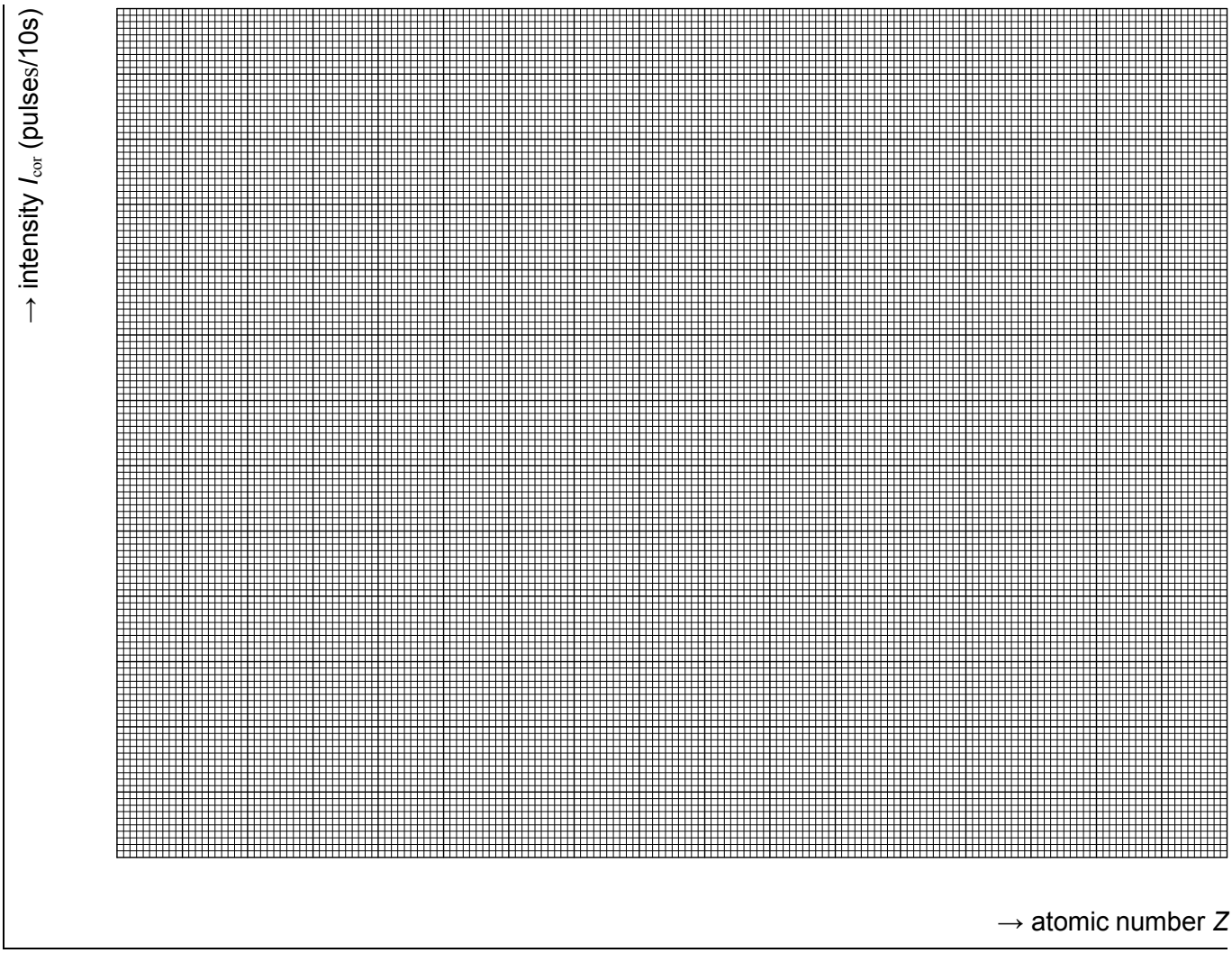
3 Measure the intensity I (in pulses per 10 s) five times with each of the different scattering materials in position, and record the results in the table below. For each scattering material, calculate the average intensity I_{avr}, and correct for the intensity without the scattering material in the set-up: $I_{cor} = I_{avr} - I_{0,avr}$. Record the results in the table below.

scattering material	atomic number Z	I (pulses/10s)					I_{avr}	I_{cor}
carbon	6							
aluminium	13							
iron	26							
copper	29							
tin	50							
lead	82							
unknown								

4 Take the source out of the set-up and put the lid back on.

Assignments

1 Plot the measurements (intensity I_{cor} as a function of atomic number Z) in the graph below.



2 Use this graph to determine the atomic number Z of the unknown scattering material. Then use the periodic system to determine what kind of material this unknown scattering material is.

Z = ……

Material: ……

The β particles have different ways of interacting with the material. The scattering can be a result of one or more collisions with the atomic nuclei or the electrons around these nuclei of the scattering material. The most important interaction is the collision with the atomic nuclei. Over a century ago the English physicist Ernest Rutherford discovered that scattering will occur as a result of electrical forces between the negatively charged β particles and the positively charged atomic nuclei. This interaction involves no loss of energy, and thus the speed of the particle does not change. However, as the mass of the β particle is very small, the particle's direction of motion will change considerably.

3 Most of the times, the atomic number found in assignment 2 is not the same as the atomic number of the unknown scattering material used in the set-up. The unknown scattering material is molybdenum. Explain this difference.

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