

## Rutherford experiment 5.2.21-01/11/15



Set-up of experiment P2522115 with MCA

## What you can learn about ...

- Scattering
- Angle of scattering
- Impact parameter
- Central force
- Coulomb field
- Coulomb forces
- Rutherford atomic model
- Identity of atomic number and charge on the nucleus

## Principle:

The relationship between the angle of scattering and the rate of scattering of  $\alpha$ -particles by gold foil is examined with a semiconductor detector. This detector has a detection probability of 1 for  $\alpha$ -particles and virtually no zero effect, so that the number of pulses agrees exactly with the number of  $\alpha$ -particles striking the detector.

In order to obtain maximum possible counting rates, a measurement geometry is used which dates back

## What you need:

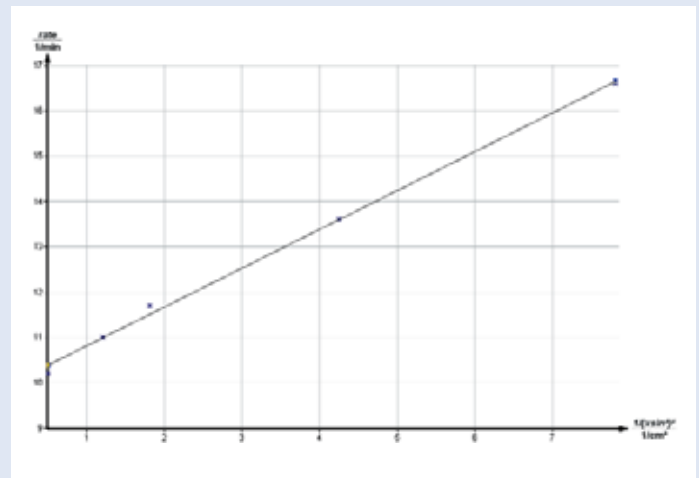
## Experiment P2522115 with MCA

## Experiment P2522111 with Cobra3

## Experiment P2522101 with digital counter

Multi-Channel-Analyzer	13726.99	1		
Software Multi-Channel-Analyzer	14452.61	1		
Alpha- and Photodetector*	09099.00	1	1	1
Annular diaphragm with gold foil	09103.02	1	1	1
Annular diaphragm with aluminium foil	09103.03	1	1	1
U-magnet, large	06320.00	1	1	1
Americium-241 source, 370 kBq	09090.11	1	1	1
Container for nuclear physics experiments	09103.00	1	1	1
Pre-amplifier for alpha detector	09100.10	1	1	1
Pulse height analyser	13725.93	1	1	
Digital counter, 4 decades	13600.93	1		
Hand held measuring instrument Pressure, RS 232	07136.00	1	1	
Pressure sensor, 1.0...1300 hPa	07136.01	1	1	1
Diaphragm pump, two stage, 220V	08163.93	1	1	1
Rubber tubing/vacuum, $d = 6$ mm	39286.00	3	3	3
Tubing connect., Y-shape, $d = 8-9$ mm	47518.03	1	1	1
Oscilloscope 30 MHz, 2 channels	11459.95	1		
Pinchcock, width 20 mm	43631.20	1	1	1
Screened cable, BNC, $l = 750$ mm	07542.11	4	4	3
Adapter BNC socket/4 mm plug pair	07542.27	1	1	
Connecting cable, 4 mm plug, 32 A, red, $l = 75$ cm	07362.01	2	2	
Connecting cable, 4 mm plug, 32 A, blue, $l = 75$ cm	07362.04	2	2	
Data cable 2 x SUB-D, plug/socket, 9 pole	14602.00	1	1	
Cobra3 BASIC-UNIT	12150.00	1		
Software Cobra3 Radioactivity	14506.61	1		
Power supply 12V/2A	12151.99	1		
PC, Windows® 95 or higher				
* Alternatively:				
Alpha detector	09100.00	1	1	1
Cable connector BNC, 50 $\Omega$	07542.09	1	1	1

Complete Equipment Set, Manual on CD-ROM included  
Rutherford experiment P25221 01/11/15



Counting rate for gold as a function of  $\frac{1}{(\frac{\theta}{2})^2 \sin^4(\frac{\theta}{2})}$ .

to Chadwick. It is also possible in this case to shift the foil and source in an axial direction (thus deviating from Chadwick's original apparatus), so that the angle of scattering can be varied over a wide range.

In addition to the annular diaphragm with gold foil, a second diaphragm with aluminium foil is provided in order to study the influence of the scattering material on the scattering rate.

## Tasks:

1. The particle rates are measured at different angles of scattering between about  $20^\circ$  and  $90^\circ$ . The measurements are compared with the particle rates calculated by means of the Rutherford theory for the measurement geometry used.
2. The particle rates are measured in the case of scattering by aluminium and gold with identical angles of scattering in each case. The ratio of the two particle rates is compared with the particle rate calculated from Rutherford's scattering equation.