5.2.24-01/11/15 Energy loss of α-particles in gases

What you can learn about ...

- ➔ Range
- ➔ Range dispersion
- ➔ Mean free path length
- ➔ Mean ionization energy of gas atoms
- ➔ Mean energy loss of α-particles per collision
- ➔ Differencial energy loss
- ➔ Bethe formula
- ➔ Electron concentration in gases

Principle:

A study is made of the connection between the energy E of α-particles and the path x travelled by them in air at standard pressure. The measurements recorded enable the differencial energy loss dE/dx to be calculated as a function of x.

What you need:

Experiment P2522415 with MCA				
Experiment P2522411 with Cobra3				
Experiment P2522401 with xyt recorder				
Multi-Channel-Analyzer	13726.99			1
Software Multi-Channel-Analyzer	14452.61			1
Alpha- and Photodetector*	09099.00	1	1	1
Americium-241 source, 3.7 kBq	09090.03	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	
XYt recorder	11416.97	1		
Hand held measuring instrument Pressure, RS 232	07136.00	1	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	1	
Pinchcock, width 20 mm	43631.20	1	1	1
Glass stopcocks, 3 way, T-shaped	36731.00	1	1	1
Fine control valve for pressure bottles	33499.00	1	1	1
Compressed gas, helium, 12 l	41772.03	1	1	1
Compressed gas, nitrogen, 12 l	41772.04	1	1	1
Compressed gas, CO_2, 21 g	41772.06	1	1	1
Screened cable, BNC, l = 750 mm	07542.11	4	4	3
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 Universal recorder	14504.61		1	
Power supply 12V/2A	12151.99		1	
**Alternatively:*				
Alpha detector	09100.00	1	1	
Cable connector BNC, 75 Ω	07542.09	1	1	

Complete Equipment Set, Manual on CD-ROM included
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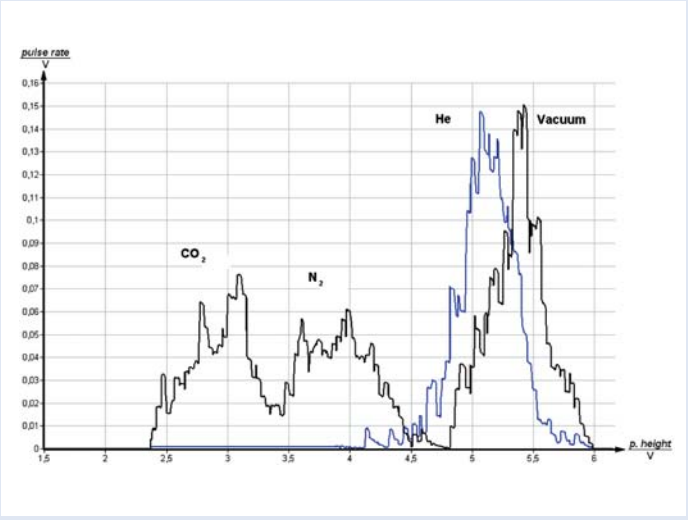

Influence of the type of gas on the energy loss of α-particles.

Tasks:

1. The spectrum of a covered ^{241}Am source is measured at a fixed distance s as a function of the pressure p. The distance s is selected in such a way as to correspond to the maximum range at the highest pressure measurable with the manometer used. The energy corresponding to the central points of the individual spectra are determined (after calibration of the measurement layout with an open ^{241}Am-emitter, see 3.) and plotted as a function of the distance x converted to a 1013 hPa basis. Using this function, the differential energy loss $(-dE/dx)$ is then calculated as a function of x and again plotted on the graph.
2. The spectrum of the source used in 1. is measured initially under the same geometric conditions under vacuum and subsequently with the vessel filled with helium, nitrogen or carbon dioxide, in each case under identical pressures. The different energy loss values are compared with the electron concentration in the particluar gas.
3. The mean energy with which the α-particles leave the covered americium source is determined by calibration against the open americium emitter (E = 5.485 MeV). (This value is required for the evaluation in 1.)