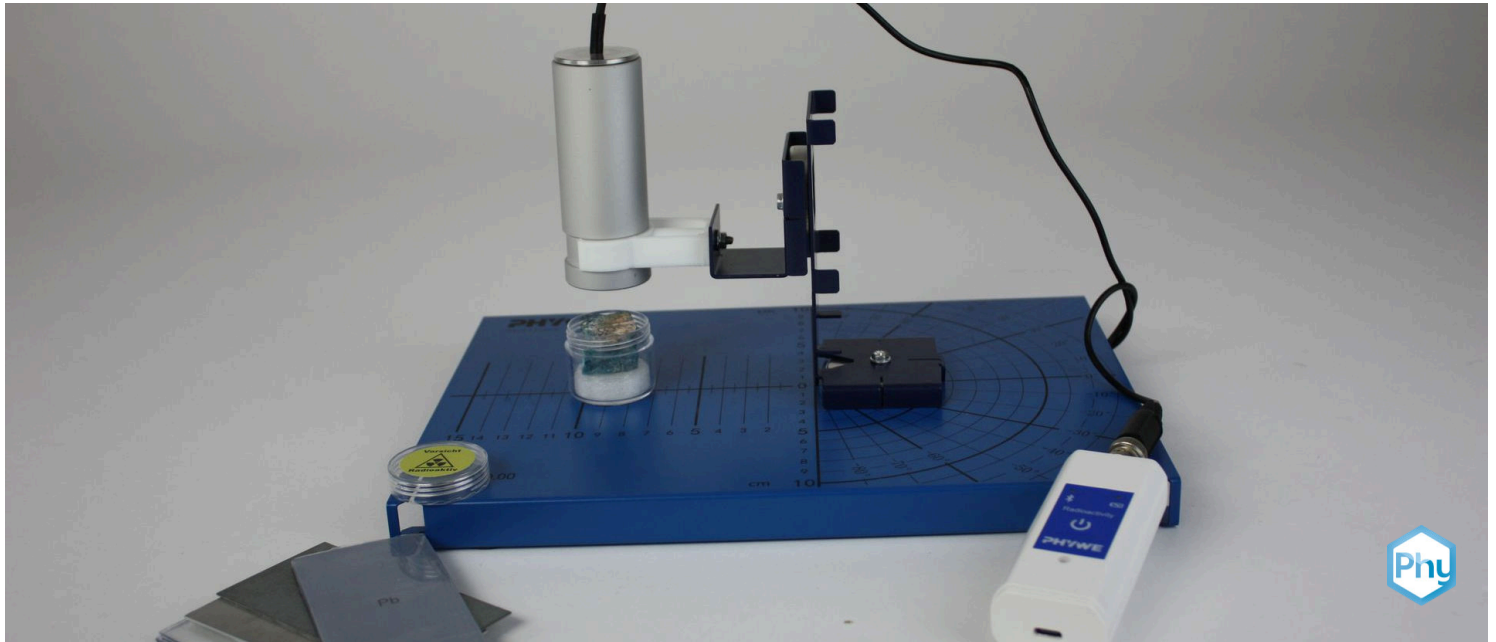


Radioactive minerals as sources of different types of radiation with Cobra SMARTsense



Physics

Modern Physics

Radioactivity



Difficulty level

medium



Group size

2



Preparation time

10 minutes



Execution time

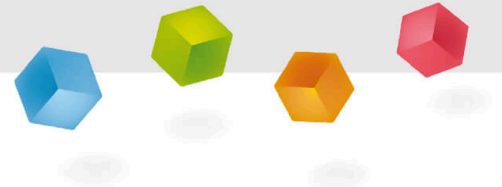
10 minutes

This content can also be found online at:



<http://localhost:1337/c/5f4becdd7b2768000356b74e>

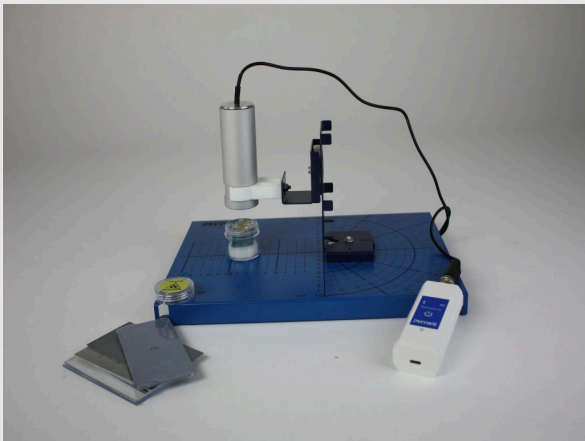
PHYWE



Teacher information

Application

PHYWE



Measurement of the radiation of a columbit sample with different absorber materials

The uranium contained in the columbit sample is the mother substance of the uranium decay series. With different half-lives, the subsequent products are transformed by α and β processes until finally a stable lead isotope is formed.

The radiation emitted during nuclear transformations can only be detected to a small extent with the experimental setup. Due to the low detection sensitivity of the counting tube, the γ radiation triggers only a small proportion of the counting pulses. The percentage of radiation types determined by the measurement therefore does not correspond to the actual proportions of the α and β transformations in the sample.

Other teacher information (1/2)

PHYWE

Prior knowledge



As previous knowledge, the students should have mastered terms such as counting rate, zero rate and the use of the Geiger-Müller counter. Furthermore, the students should be aware that radioactivity is a natural process and that it is a statistically fluctuating process. Furthermore, the different types of radiation should be known or worked out with the help of this experiment.

Scientific principle



The radiation types of the columbit sample are investigated by different shielding methods, such as lead or paper, using the Geiger-Müller counter tube.

Other teacher information (2/2)

PHYWE

Learning objective



In this experiment the students should apply their knowledge of the different properties of the different types of radiation and the methods to identify the types of radiation.

Tasks



With the help of this experimental setup, the students are to determine different types of radiation based on the various shielding options.

Safety instructions

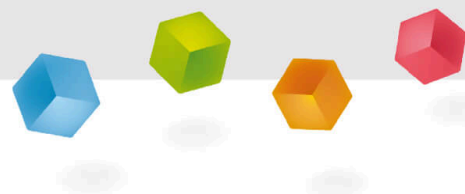
PHYWE



- The columbit sample remains in the container without a lid during the measurement, because the covering with paper or lead can be easily realized and in addition the sample can be brought more easily into the desired position.
- In order to obtain reliable test results, multiple repetition of the test series is suggested.
- The general instructions for safe experimentation in science lessons apply to this experiment.

PHYWE

Student Information



Motivation

PHYWE



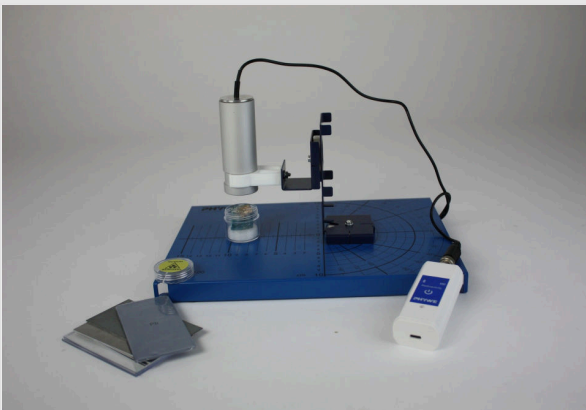
Low radioactive mineral columbitol

Very few substances decompose into a single decay product only through a decay path. Often substances decay over several paths and different types of radiation. In order to be able to detect these types of radiation, the type of radiation can be determined by means of shielding.

Columbitol is a weakly radioactive mineral whose activity is slightly above background radiation. In this experiment, the radiation is examined for its composition from the different types of radiation.

Tasks

PHYWE



Test setup with different absorption materials

- Record the zero rate, as well as the measured pulse rate for different absorber materials
- Determine the difference between the zero rate and the average of the pulse rates
- Determine the proportions of the different types of radiation in the total radiation

Equipment

Position	Material	Item No.	Quantity
1	Cobra SMARTsense- Radioactivity (Bluetooth + USB)	12937-01	1
2	Base plate for radioactivity	09200-00	1
3	Holder for SMARTsense counter tube on holding magnet	09207-00	1
4	Plate holder on fixing magnet	09203-00	1
5	Columbite, natural mineral	08464-01	1
6	Absorption material f.student exp	09014-03	1
7	measureAPP - the free measurement software for all devices and operating systems	14581-61	1

Set-up (1/3)

PHYWE

For measurement with the **Cobra SMARTsense sensors** the **PHYWE measureAPP** is required. The app can be downloaded free of charge from the relevant app store (see below for QR codes). Before starting the app, please check that on your device (smartphone, tablet, desktop PC) **Bluetooth is activated**.



iOS



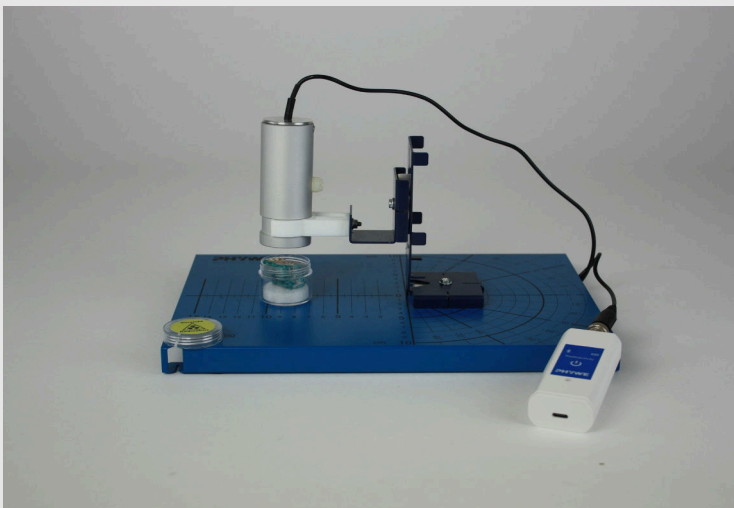
Android



Windows

Set-up (2/3)

PHYWE

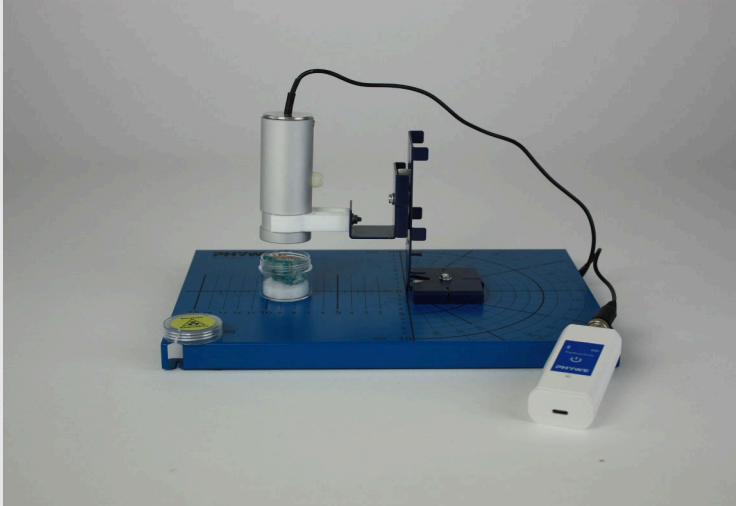


Mounting the Geiger-Müller counter tube

- Place the plate holder on the mounting plate.
- Clamp the Geiger-Müller counter tube into the counter tube holder, place it on the plate holder so that it is vertically above the mounting plate.

Set-up (3/3)

PHYWE

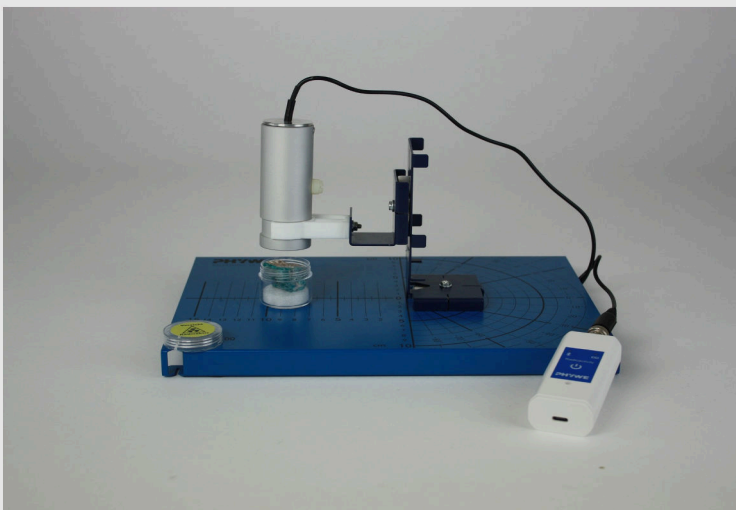


Connection of the Geiger-Müller counter tube to the sensor

- Connect the Geiger-Müller counter tube to the sensor unit.
- Connect the sensor to the PHYWE Measure app on the tablet by pressing the Bluetooth button for 3 seconds. Then the radioactivity sensor can be selected in the app.

Procedure (1/2)

PHYWE

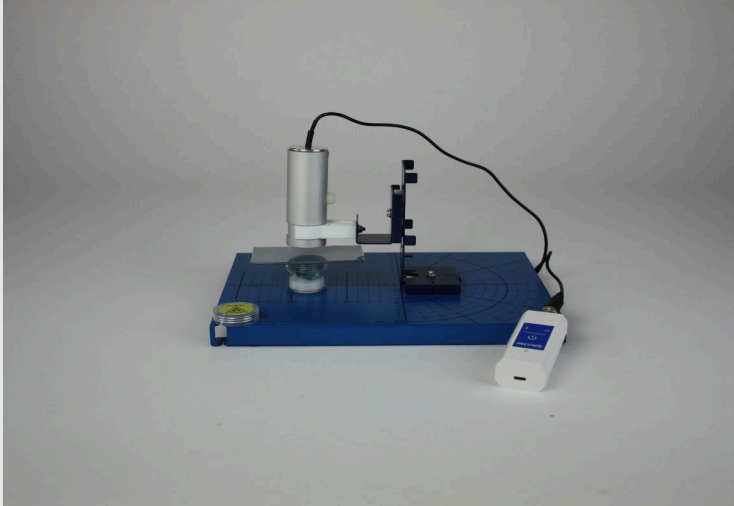


Experimental setup with Columbitprobe

- First determine the zero rate. To do this, read three measured values without the sample and enter them in the table in the protocol (slide 15).
- To examine the sample, push the columbit sample under the Geiger-Müller counter tube. Push the counting tube down until the distance to the columbit sample is about 1 cm.

Procedure (2/2)

PHYWE

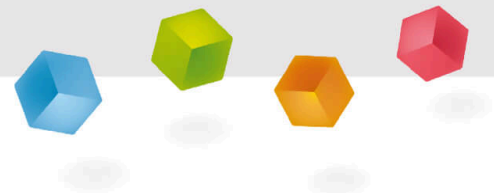


Structure with installed absorption plate

- Take three more readings and note them in the table (slide 15).
- Turn the Columbitprobe in its container and repeat the measurement.
- Cover the columbit sample with a sheet of paper and record the pulse rate three times and repeat this measurement with a lead plate instead of a sheet of paper. Note the measured values in the table.

PHYWE

Report



Monitoring

PHYWE

Note the measured values for the zero rate and the different sample materials. Then determine the mean value and the difference to the zero rate.

Measure	Z_0	Z_{up}	$Z_{backside}$	Z_{Paper}	Z_{lead}	in imp/min
1						
2						
3						
Average						
Difference						

Task 1

PHYWE

1. establish the relationship between the measurements with different absorption materials and the types of radiation

Without shielding are detected.

With shielding by paper only is detected.

With shielding by lead only is detected.

☒ Check

2. what are the main types of radiation emitted by the Columbitprobe?

☐ α-Radiation

☐ γ-Radiation

☐ β-radiation

☒ Check

Task 2

PHYWE

Complete the following sentences:

Paper shield reduces the pulse rate by [Imp / min]

Lead shield reduces the pulse rate by [Imp / min]

The proportion of α rays in the total radiation is (%)

The proportion of the β rays in the total radiation is (%)

The proportion of γ rays in the total radiation is (%)

Slide

Score / Total

Slide 17: Multiple tasks

0/5

Total amount

★ 0/5

Solutions



Repeat



Exporting text