# Atomic and nuclear physics

Nuclear physics

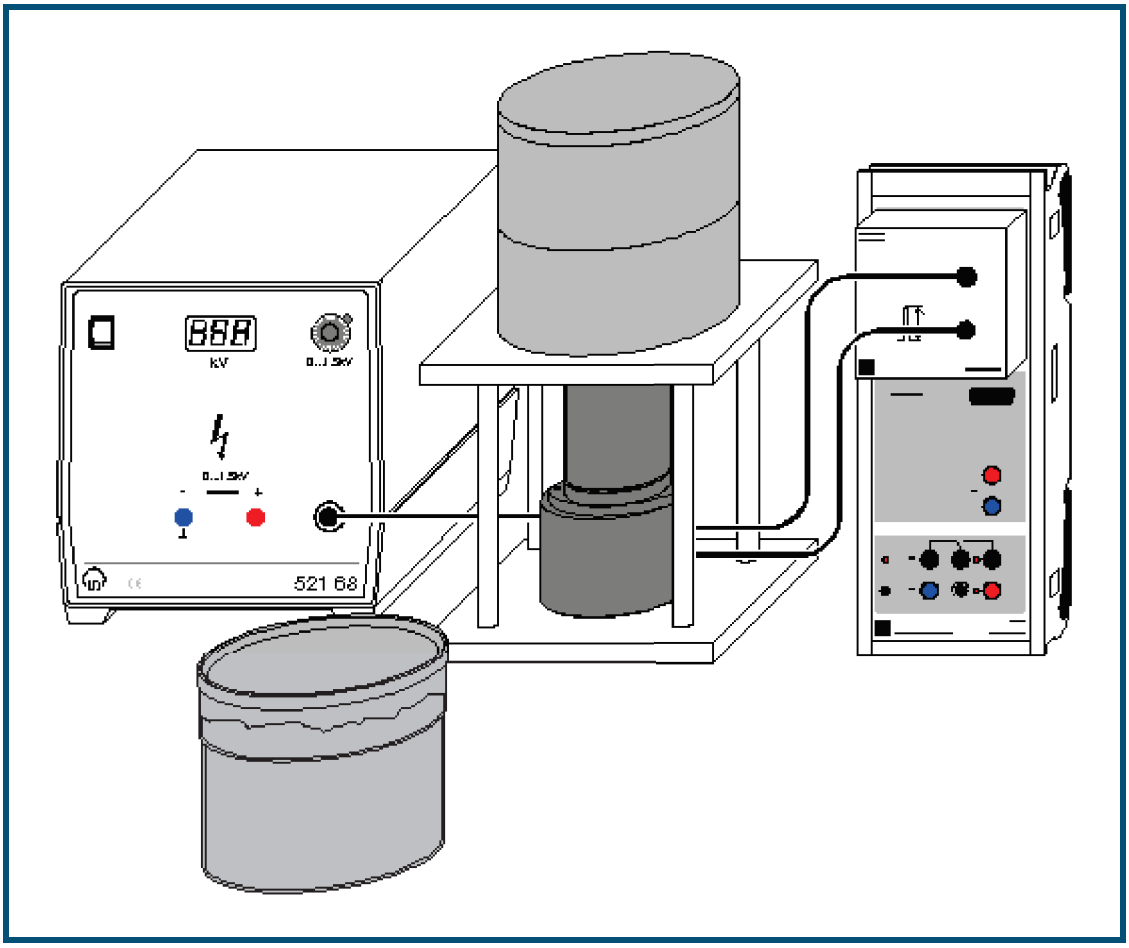
*γ spectroscopy*

## Identifying and determining the activity of radioactive samples

**Description from CASSY Lab 2**

For loading examples and settings, please use the CASSY Lab 2 help.

# Identifying and determining the activity of weakly radioactive samples




can also be carried out with Pocket-CASSY

**Safety note**

When handling radioactive preparations, in addition to the radiation protection regulations, state-specific requirements and the regulations of the educational authorities are also to be observed, e.g. in the Federal Republic of Germany at the very least the radiation protection regulations (StrlSchV - Strahlenschutzverordnung) and the directives on safety during school lessons. This applies even in cases where the preparation used in this experiment in itself does not require the nomination of a trained radiation officer.

Since the used preparations produce ionizing radiation, the following safety rules must nevertheless be kept to:

- Prevent access to the preparations by **unauthorized persons**.
- Before using the reparations make sure that they are **intact**.
- For the purpose of **shielding**, keep the preparations in their safety container.
- To ensure **minimum exposure time** and **minimum activity**, take the preparations out of the safety container only as long as is necessary for carrying out the experiment.
- To ensure **maximum distance**, hold the preparations only at the upper end of the metal holder.

## Experiment description

The detection probability of the scintillation counter is determined at several γ energies with calibrating preparations. The γ spectrum of a weakly radioactive sample is recorded, and its radioactive components are determined.

## Equipment list

| | | |
|---|---|---|
| 1 | Sensor-CASSY | 524 010 or 524 013 |
| 1 | CASSY Lab 2 | 524 220 |
| 1 | MCA box | 524 058 |
| 2 | Marinelli beakers | 559 88 |
| 1 | Calibrating preparation Cs-137, 5 kBq | 559 885 |

| | | |
|---|---|---|
| 4 | Potassium chloride, 250 g | 672 5210 |
| 1 | Scintillation counter | 559 901 |
| 1 | Detector output stage | 559 912 |
| 1 | High-voltage power supply 1.5 kV | 521 68 |
| 1 | Scintillator screening | 559 89 |
| 1 | Socket for scintillator screening | 559 891 |
| 1 | PC with Windows XP/Vista/7 | |

### Experiment setup (see drawing)

The output stage of the scintillation counter is connected to the MCA box and to the high-voltage power supply. The scintillation counter is mounted in the socket from above with the lead screening. The preparation in the Marinelli beaker is placed above the scintillation counter.

### Carrying out the experiment

- Load settings
- Fill 1 kg of potassium chloride into a Marinelli beaker and place it above the scintillation counter.
- Record the spectrum with varying the high voltage until the full range of measurement is covered.
- Remove the Marinelli beaker and insert the calibrating preparation Cs-137
- Record the spectrum
- Make an energy calibration using the lines at 1460 keV and 662 keV in the two spectra.
- Remove the preparation
- Equally distribute the test substance in a Marinelli beaker, place the beaker above the scintillation counter, and record the spectrum of the sample.
- Make a background measurement without preparation. The measuring time should be equal to that with the sample.

### Evaluation

The activities of potassium chloride (17 kBq/kg) and the Cs-137 calibrating preparation (approx. 5 kBq, see calibration certificate, mind the half-life) are known. From the integrated counting rate below the lines of the two spectra the detection probability of the scintillation counter at 1460 keV and 662 keV can be determined for this particular geometry.

The background spectrum is subtracted from the spectrum of the sample. From the resulting spectrum and the previously determined detection probability the radioactive contamination of the sample can be determined. The observed energies enable the radiating isotope in the sample to be determined, and with the detection probabilities just determined, the quantity can be estimated.

### Remarks

The NaI(Tl) crystal at the end of the scintillation counter is sensitive to mechanical damage. Be careful when inserting the Marinelli beakers and when setting up the lead screen.

When making measurements with strongly radiating samples heed the display of the dead time and, if necessary, dilute the sample.