

Atomic and nuclear physics

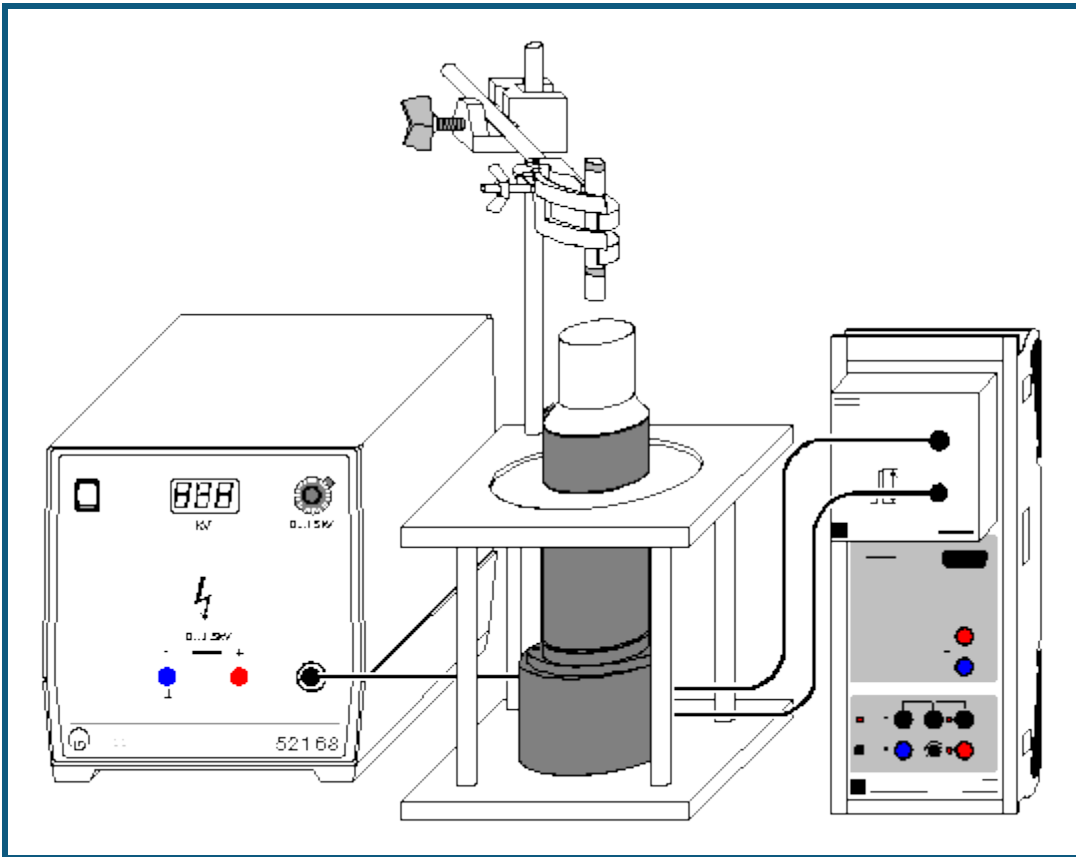
Nuclear physics
 γ spectroscopy


Detecting γ radiation with a
scintillation counter

Description from CASSY Lab 2

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

Detecting γ radiation with a scintillation counter (Cs-137)



 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. The preparations used in this experiment are type approved according to StrlSchV (2001). For this reason handling without express permission is possible.

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 preparations 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 γ spectrum of the mixed preparation (Cs-137, Am-241, Sr-90) is recorded, and an energy calibration is carried out with known lines.

Equipment list

1	Sensor-CASSY	524 010 or 524 013
1	CASSY Lab 2	524 220
1	MCA box	524 058
1	Mixed preparation α, β, γ	559 845 or 559 835
1	Scintillation counter	559 901
1	Detector output stage	559 912
1	High-voltage power supply 1.5 kV	521 68

1	Socket for scintillator screening	559 891
1	Stand rod, 47 cm	300 42
1	Leybold multiclamp	301 01
1	Universal clamp, 0...80 mm	666 555
1	PC with Windows XP/Vista/7/8	

additionally recommended:



1	Two-channel oscilloscope 400	575 212
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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 preparation is placed a few centimeters above the scintillation counter with the stand material. In order to prevent the scintillation counter from toppling over, it is recommended to use the socket (559 891) for the setup. This socket is provided with a fixture for the stand rod.

Carrying out the experiment

■ Load settings

- Set the high-voltage power supply to zero, and switch it on.
- Start the measurement with .
- Without high voltage, no pulses should be counted at the scintillation counter.
- Slowly increase the high voltage until the spectrum covers the available channels at a voltage of 700-900 V.
- Each time when the high voltage is changed the measured spectrum should be deleted with  to avoid mixing of different spectra. The measurement goes on then, and the measuring time is restarted.
- When the set measuring time is over, the measurement is stopped.

Evaluation

The two isotopes [Cs-137](#) and [Am-241](#) in the mixed preparation emit γ radiation, which is registered by the scintillation counter. Am-241 emits one line at 59.5 keV and Cs-137 one line at 662 keV. The measured spectrum exhibits some more [details](#) between these two lines. They arise because of the [Compton effect](#) taking place in the preparation and in the detector.

After the measurement the spectrum is not yet calibrated. An [energy calibration](#) has to be carried out in order to display it as an energy spectrum. For this the two known lines in spectrum are used (59.5 and 662 keV).

Remark

For the measurement the preparation should not be put directly onto the detector but placed at a distance of a few centimeters. If the preparation is too close to the detector, the counting rate will be so high that individual pulses add up. This addition with the rest of the previous pulse shifts the lines towards higher energies.

The NaI(Tl) crystal at the end of the scintillation counter is sensitive to mechanical damage. The NaI(Tl) crystal is also sensitive to quick changes in temperature, which can occur, e.g., on unpacking after transport. In both cases cracks in the crystal arise and lead to a reduced sensitivity and, above all, to a worse energy resolution because of scattering.