

Atomic and nuclear physics

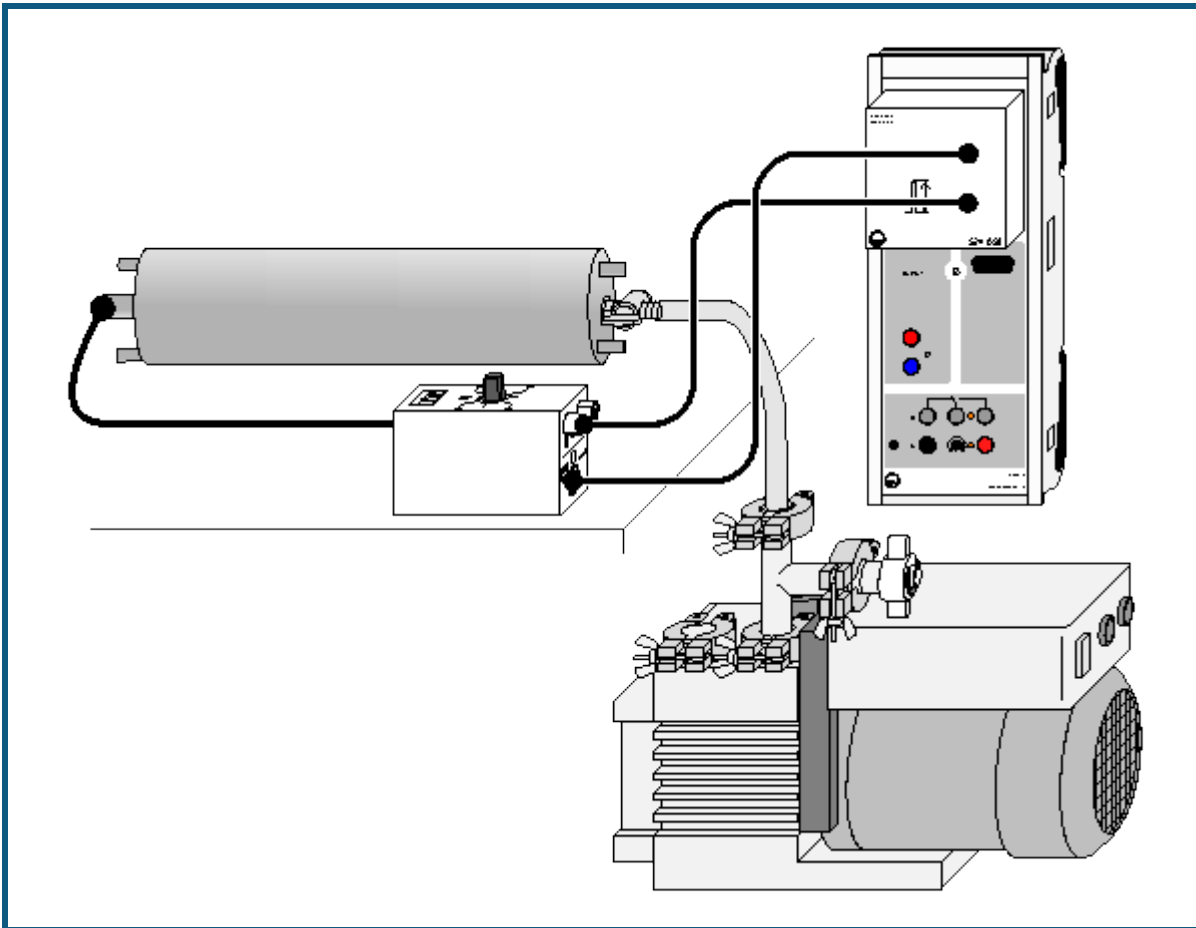
Nuclear physics
 α spectroscopy

α spectroscopy of
radioactive samples

Description from CASSY Lab 2

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

α spectroscopy of radioactive samples (Am-241)



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 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 α spectrum of the Am-241 preparation 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	Am-241 preparation	559 825
1	Alpha spectroscopy chamber	559 565
1	Semiconductor detector	559 921

1	Discriminator preamplifier	559 931
1	Multicore cable, 6-pole, 1.5 m	501 16
1	HF cable, 1 m	501 02
1	HF cable, 0.25 m	501 01
1	Rotary-vane vacuum pump	378 73
1	T-piece DN 16 KF	378 005
1	Centering ring DN 10/16 KF	from 378 040ET2
1	Air inlet valve DN 10 KF	378 771
1	Set of centering rings DN 16 KF	378 045ET2
2	Clamping rings DN 10/16 KF	378 050
1	Small flange DN 16 KF with hose nozzle	378 031
1	Vacuum tubing, 8/18 mm dia.	667 186
1	PC with Windows XP/Vista/7/8	

additionally recommended:



1	Two-channel oscilloscope 400	575 212
---	------------------------------	---------

Experiment setup (see drawing)

The preparation and the detector are placed in the alpha spectroscopy chamber. The detector is connected to the discriminator-preamplifier via the short BNC cable. The discriminator-preamplifier is connected to the MCA box. The pump is connected to the alpha spectroscopy chamber.

Carrying out the experiment

■ Load settings

- Evacuate the alpha spectroscopy chamber.
- Start the measurement with .
- Vary the gain of the MCA box until the spectrum covers all available channels. This typically occurs at gains around -3.
- After every change of the gain 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 isotope [Am-241](#) decays into Np-237 by emitting an α particle. As several excited states of neptunium are available, α particles of different energies are emitted in this decay. In 100 decays, 84 α particles with an energy of 5486 keV are emitted and 13 with an energy of 5443 keV. The energy difference between the two decay events is small but it can be resolved in the measurement if an open preparation without covering (e.g. 559 825) and the discriminator preamplifier (559 931) are used. A [covered preparation](#) such as 559 821 blurs the α -energies excessively when they pass through the covering.

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. When using open americium (559 825), a single-point calibration can be carried out making use of one of the americium spectrum lines. In the case of covered preparations, it is appropriate to use two lines in the Ra-226 (559 435) spectrum for the calibration. An energy calibration using only a covered americium (559 821) preparation is not sensible.

Remarks

Due to the [cover of the preparations](#) (e.g. 559 821), there is a strong offset in energy. The measured spectrum starts only at an energy of 1-2 MeV. Particles with lower energy are stopped before reaching the detector.

During the measurement, the vacuum pump can run either continuously or the valve of the spectroscopy chamber can be closed after a few minutes of evacuation and the pump can be switched off. The rubber tubing must be vented through the inlet valve (378 771) to prevent oil from the vacuum pump creeping back into the vacuum.