

## Atomic and nuclear physics

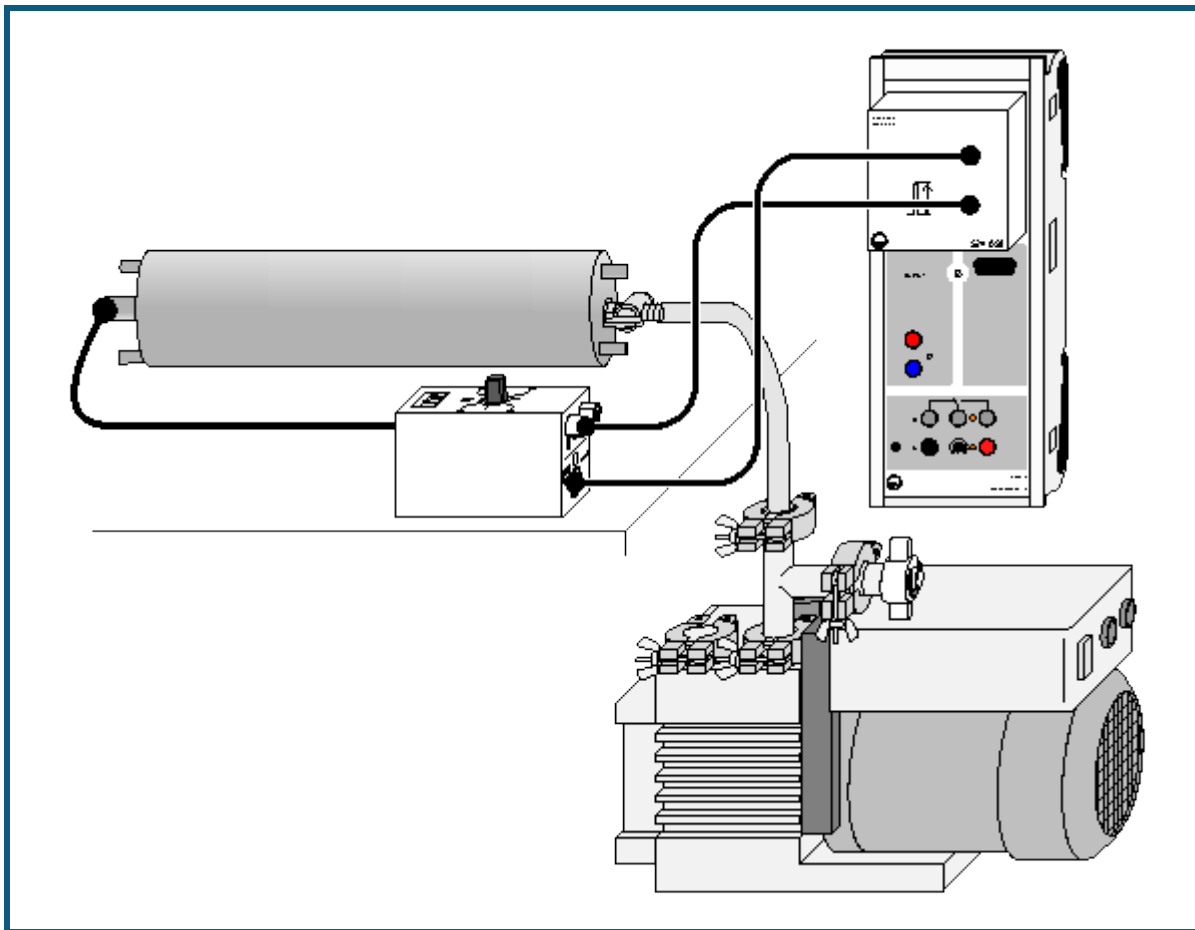
Nuclear physics  
 *$\alpha$  spectroscopy*

Determining age using a  
Ra-226 sample

### Description from CASSY Lab 2

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

## Determining the age of a Ra-226 sample



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 relative activity of the nuclides Ra-226 and Pb-210 in a Ra-226 sample is determined and used to determine the age of the sample.

### Equipment list

1	<a href="#">Sensor-CASSY</a>	524 010 or 524 013
1	<a href="#">CASSY Lab 2</a>	524 220
1	<a href="#">MCA box</a>	524 058
1	<a href="#">Ra-226 preparation</a>	559 435
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	

### Experiment setup (see drawing)

The preparation and the detector are placed in the 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 spectroscopy chamber.

### Carrying out the experiment

#### ■ Load settings

- Mount the [Ra-226](#) preparation in the spectroscopy chamber
- Evacuate the chamber, and record a spectrum with 
- Vary the gain of the MCA box until the spectrum covers all available channels. This typically occurs at gains around -3.
- Use the outer lines of the spectrum (4785 keV, 7687 keV) for the [energy calibration](#)

### Evaluation

The age of the preparation is calculated from the counting rates of the observed lines. The evaluation is complicated by the fact that the  $\alpha$  energies of Po-210 and Ra-222 are very close to one another so that the two nuclides contribute to one common peak (that in the middle of the group of three peaks). The counting rate for Rn-222 is therefore determined by a linear fit from the counting rates for Ra-226, Po-218 and Po-214. From the ratio of the counting rates for Po-210 and Ra-226 the age of the preparation can be calculated.

### Remarks

Due to the cover of the preparations, there is a strong offset in energy when the energy calibration is made with values taken from the literature. 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.