Alpha- and photo detector

09099.00

PHYWE Systeme GmbH & Co. KG
Robert-Bosch-Breite 10
D-37079 Göttingen

Telefon +49 (0) 551 604-0
Fax +49 (0) 551 604-107
E-mail info@phywe.de
Internet www.phywe.de

Operating instructions

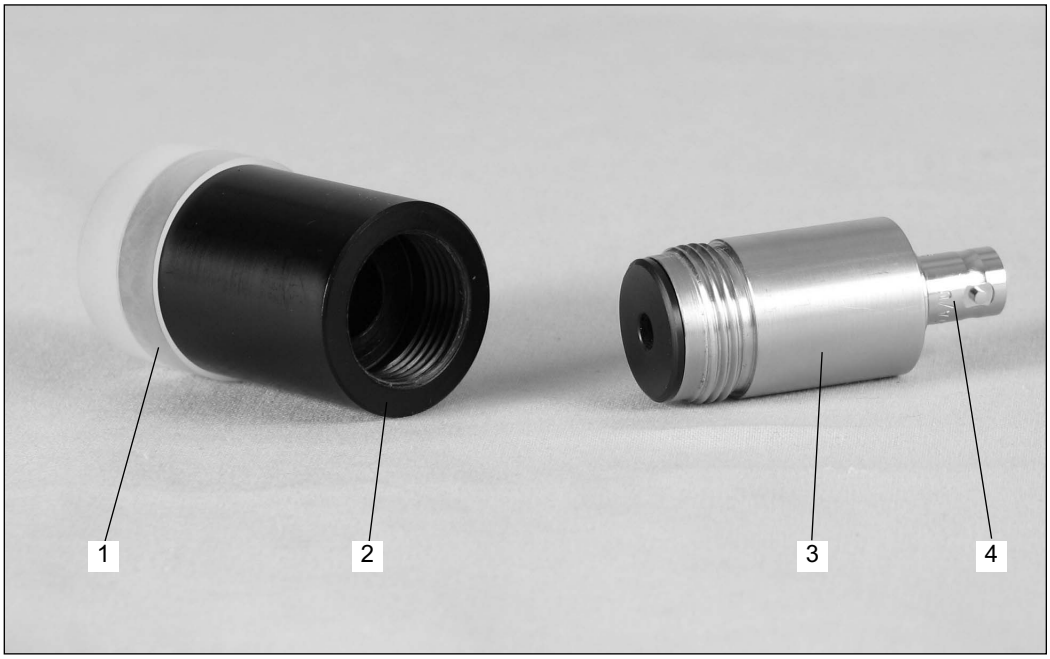

Fig. 1: Alpha detector (3) with shielding (2) and protective cap (1).

1 SAFETY PRECAUTIONS

- Carefully read these operating instructions completly before operating this instrument. This is necessary to avoid damage to it, as well as for user-safety.
- Only use the instrument for the purpose for which it was designed.

2 PURPOSE AND CHARACTERISTICS

The alpha detector serves for the energy-sensitive detection of alpha-radiation. Should an energy-sensitive radiation detection not be necessary, then it can also be used as a "counting tube" for the detection of beta-radiation.

The radiation-sensitive region of the detector consists of a large-area silicon photodiode that is operated in the barrier direction. An incident alpha particle gives its kinetic energy completely up to the material within the barrier layer by interaction with this material. In this process, the number of free charge carriers that are generated is proportional to the primary kinetic energy of the alpha particle. The resulting charge impulse is converted to a voltage impulse in the charge-sensitive preamplifier (09100.10) that is connected to the detector.

The maximum amplitude of the voltage pulse generated is proportional to the total charge of the charge impulse and so to the primary kinetic energy of the alpha particle.

The output signal from the preamplifier is passed to a multi-channel analyser (13726.99) or to a pulse height analyser (13725.93) for further processing and creation of a spectrum.

Prerequisite for the proportionality between the energy of the incident particle and the pulse height of the output signal of the preamplifier is that the incident particle passes the whole of its (kinetic) energy to the barrier layer. This is true for alpha particles, as they have only a small penetration depth into the material. It is not true for beta particles, however, as these would have to pass through a greater depth than that of the barrier layer to give up all of their energy. The detector can therefore detect the occurrence of beta particles but cannot be used to determine their kinetic energy.

3 HANDLING

3.1 General notes

The alpha detector (*3*) (see Fig. 1) is supplied complete with a protective cap (*1*) for protection during transport and storage and a shielding (*2*) for shielding against visible light. The detector can be screwed into the shielding on one side. The opening on the opposite side of the shielding serves to hold a 12 mm diameter radiation source tube (e.g. 09090.03, 09047.51, 09090.11). The BNC-socket (*4*) on the alpha detector serves, together with a BNC cable, to connect the alpha detector to the charge-sensitive preamplifier 09100.10 (see Fig. 1).

The alpha detector is an extremely sensitive sensor which must be protected from all rough impacts from the environment. These include in particular:

- Mechanical loads
- Reducing gases
- Moisture
- Oil vapours
- Strong UV-irradiation
- High temperatures and large temperature fluctuations
- Strong alpha and beta radiation

Caution!

Never let the detector drop!
Hard knocks can cause irreparable mechanical damage to the detector.

Should the detector be in a container for nuclear physics experiments (09103.00) with venting valve, then this is never to be air vented via an oil vacuum pump. Oil vapour deposits on the surface of the detector reduce the resolving power of it. It is therefore always necessary to close the hose between the pump and the container with a hose clamp before switching off the pump!

For protection, the front contact area of the radiation-sensitive barrier layer is approx. 6 mm below the opening in the alpha detector. When the detector is not in use, always keep it closed with the shielding and the protective cap (see Fig. 1).

The alpha detector should never be exposed to a strong radioactive irradiation for longer than necessary. This is also true for usage in experiments with preparations of weaker intensity, as here also, over a longer time, "radiation damage" effects can cause a deterioration in the properties of the detector, in particular in the resolving power.

3.2 Connection to peripheral equipment

The alpha detector can only be used in connection with a charge-sensitive preamplifier, for example, with the preamplifier for the alpha detector 09100.00.

For connection of the alpha detector to the input of the preamplifier, use as short a BNC cable as possible ($l \leq 300$ mm) which has contacts that are free from defects. The use of a cable that is defective or too long can significantly worsen the resolution of the measuring equipment! Container (09103.00) has a BNC-bushing which enables the detector to be fitted to it. The BNC-socket of the detector can be connected directly to this bushing. A BNC cable that is as short as possible should also be used for the connection of the preamplifier to the other side of the bushing. The connection of the cable must be fundamentally made before the operating direct voltage is switched on, as momentary abrupt voltage surges can damage the detector. For this reason, preamplifier 09100.00 has an integrated delay-circuit that ensures the necessary gradual increase in voltage on starting up.

The alpha detector is operated by - in relation to the housing mass - negative direct voltage. It can only carry out measurements with negative voltages of up to -38 V. The silicon photodiode is internally protected against higher negative voltages and against positive voltages. An operating voltage of -12 V can be drawn directly from preamplifier 09100.00 (Caution! The corresponding change-over switch must always be in the >> - << position!). Operating voltages from external voltage sources can also be looped through the alpha preamplifier to the detector. The multi-channel analyser (13726.99) and the pulse height analyser (13725.93) offer an operating voltage of -33 V for the alpha detector.
To exploit the high resolution power of the alpha detector, it must be used in a vacuum and be operated by an appropriately powerful evaluation circuit. It is therefore recommended that the container for nuclear physics experiments (09103.00) be used. With this, the detector is plugged directly to the BNC-socket in the container and is there also protected against damage and contamination when not in use.

3.3 Light sensitivity

As the radiation-sensitive component of the alpha detector is a silicon photodiode, it is clear that the detector is sensitive to direct irradiation by visible light. With such irradiation, no measurements or no measurements with high resolution of radioactive irradiation can be carried out. The shielding (see Fig. 1 (*2*)) that is standardly supplied serves to shield against visible light when experiments are carried out. It is to be screwed onto the detector. A 12 mm diameter radiation source tube can be fitted in the shielding opposite to the detector. This arrangement effectively screens the silicon photodiode from visible light during experiments.

4 TECHNICAL SPECIFICATIONS

Sensitive area	15 mm^2
Energy reolving power for alpha particles at 5.486 MeV	$\leq$ 30 keV
Required bias voltage	-8...-38 V
Dimensions, detector (length x diameter)	52 mm x 22 mm
Dimensions, shielding (length x diameter)	45 mm x 32 mm
Weight, detector	approx. 55 g
Weight, shielding	approx. 35 g

5 EXPERIMENTAL LITERATURE

Laboratory Experiments PHYSICS	16502.32

6 LIST OF EQUIPMENT

Pre-amplifier f.alpha detector	09100.10
Multi-Channel-Analyzer	13726.99
Pulse height analyzer	13725.93
Container f. nuclear phys. expts.	09103.00
Annular diaphragm with gold foil	09103.02
Annular diaphragm with alumin. foil	09103.03

7 NOTES ON THE GUARANTEE

We guarantee the instrument supplied by us for a period of 24 months within the EU, or for 12 months outside of the EU. This guarantee does not cover natural wear nor damage resulting from improper handling.
The manufacturer can only be held responsible for the function and technical safety characteristics of the instrument, when maintenance, repairs and changes to the instrument are only carried out by the manufacturer or by personnel who have been explicitly authorized by him to do so.

8 WASTE DISPOSAL

The packaging consists predominately of environmental compatible materials that can be passed on for disposal by the local recycling service.
Please contact your municipal administration for information on the disposal of instruments.