# The behavior of $\gamma$-rays in a magnetic field



The radioactive nuclei are frequently present in an excited energy state after a transition and emit this extra energy as $\gamma$-radiation after their transition to a more stable state. This is an electromagnetic radiation. The spreading of $\gamma$-radiation is not influenced while passing through a continuous magnetic field.
Since in this experiment only the absence of an interaction between the magnetic field and the $\gamma$-radiation is to be demonstrated, it will suffice to change the deflection angle in bigger steps or else to confirm that the count rate does not change in a direction, when the ray is lead through the magnetic field.

## Equipment

| | | |
|---|---|---|
| Support clamp for small case | 02043.10 | 1 |
| Clamp on holder | 02164.00 | 1 |
| Support rod, stainless steel | 02030.00 | 1 |
| Counter tube holder on fix. magnet | 09201.00 | 1 |
| Source holder on fixing magnet | 09202.00 | 1 |
| Plate holder on fixing magnet | 09203.00 | 1 |
| Deflection magnet for plate holder, 2 pcs | 09203.02 | 1 |
| Optical disc, magnet held | 08270.09 | 1 |
| Demo-board for Physics with stand | 02150.00 | 1 |
| Counter tubeType B | 09005.00 | 1 |
| Geiger-Müller-Counter | 13606.99 | 1 |
| Radioactive sources, set | 09047.50 | 1 |

## Set-up and procedure

Fig. 1

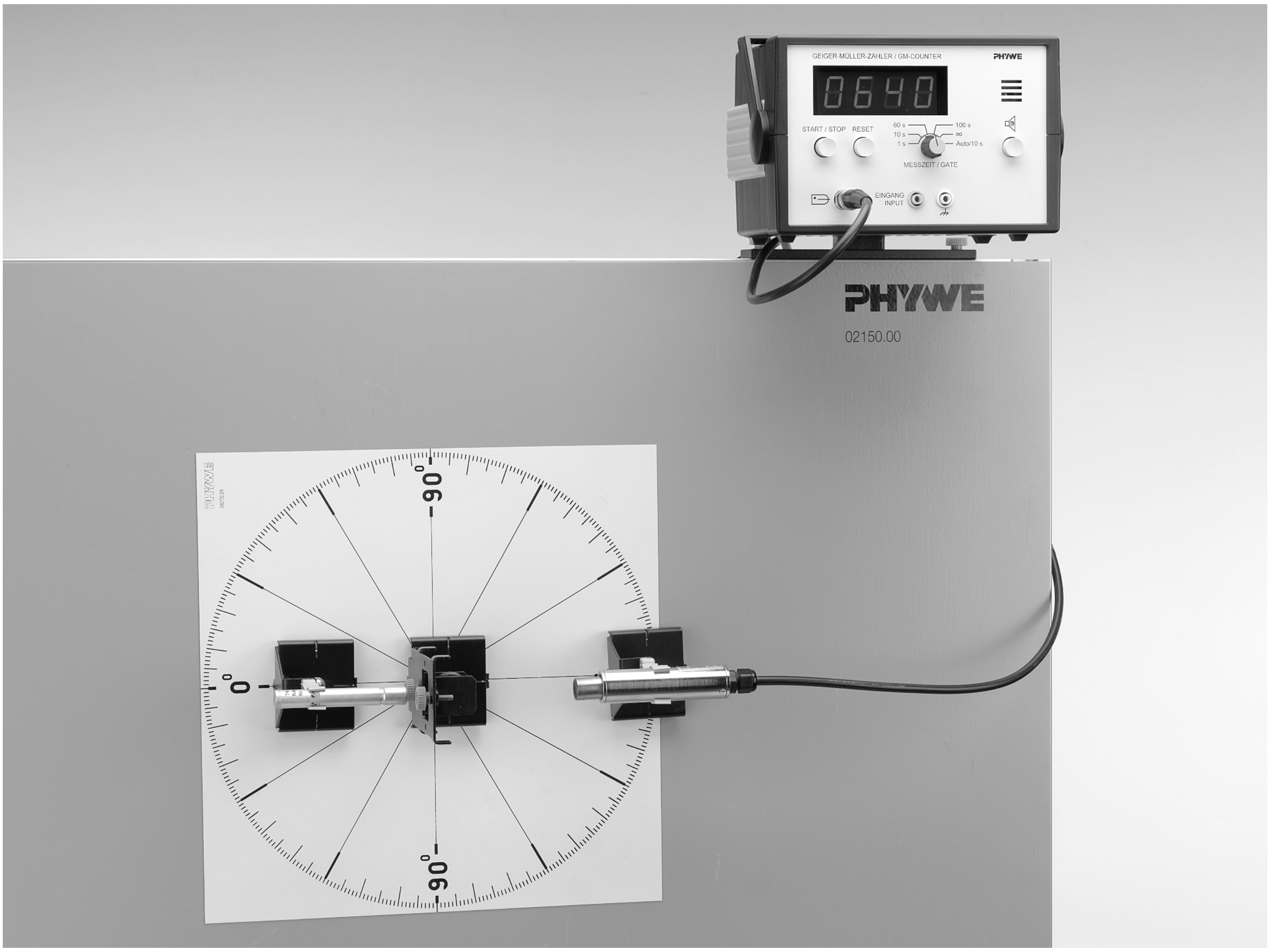
*Instruction:*

Since the $\gamma$-radiation is not absorbed by an aluminum container contrary to the $\beta$-radiation, the exit opening should not be considered as the source point of the radiation but the place of active substance, about 8 mm behind the exit opening. Hence, the $\gamma$-radiation source must be positioned in the source holder, such that the source point lies above the zero point of the angular scale. This avoids a change in the distance of the counter tube to the radiation source, when the angle of observation is changed.

— Place the optical disc on the demo board.

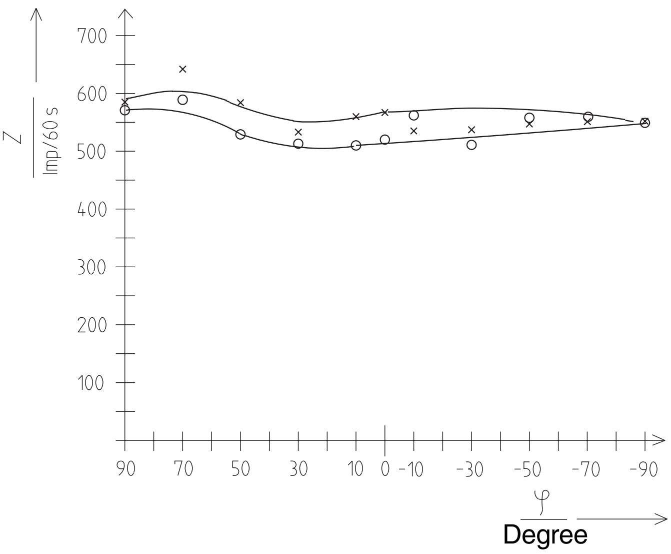
— Position the source holder with the $\gamma$-radiation source Co-60 on the demo board such that the source point of the radiation lies over the center point of the angular scale.

Fig. 1: Experimental setup



— Place the deflection magnet with a pole distance of 1.5 cm on the inner surface of the plate holder and position it such on the optical disc, that the center of the magnetic poles is present over the center of the angular scale.
— Set the counter tube along with holder without the protective cap on the 0°-line of the optical disc such that the rear pointed end of the holder lies exactly on the outer circumference of the optical disc; the counter tube window should be at a distance of about 5 cm from the deflection magnet; Align the longitudinal axis of the counter tube with the center of the angular scale.

Fig. 2: Behavior of γ-rays in a magnetic field
o - with magnetic field
x - without magnetic field



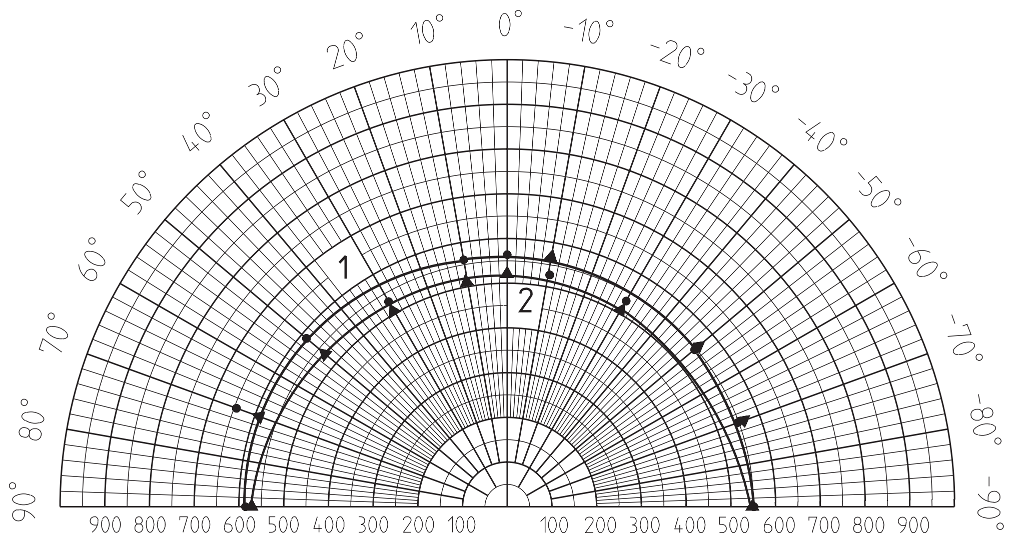

— Select the measurement time 60 s, determine the count rate and note the value in Table 1.
— Push the counter tube to the 10°-angle mark, such that the distance of the tube to the radiation source should not change
— Determine the count rates for this and for all other deflection angles in steps of 20° - in the range of +90° and -90° and enter the values in Table 1.
— Remove the plate holder with the deflection magnet from the demo board, the position of the radiation source should not change; repeat the complete series of measurements in the same way without the deflection magnet and note down all the values.
— After concluding the measurements keep the radiation source back in the protective container and place the protective cap again on the counter tube.

**Result**

Table 1

| φ/degree | with magnetic field $Z$ / Imp/60 s | without magnetic field $Z$ / Imp/60 s |
|---|---|---|
| 0 | 567 | 520 |
| 10 | 560 | 510 |
| 30 | 533 | 513 |
| 50 | 584 | 529 |
| 70 | 642 | 589 |
| 90 | 585 | 571 |
| -10 | 535 | 562 |
| -30 | 537 | 511 |
| -50 | 547 | 558 |
| -70 | 550 | 560 |
| -90 | 552 | 549 |

Fig. 3: Behavior of γ-rays in a magnetic field

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**Evaluation**

The count rates $Z$ are graphically displayed as a function of the deflection angle $\varphi$ in a rectangular coordinate system or in a polar diagram (see Fig. 2 and Fig. 3).

The graphic representation shows that the $\gamma$-radiation is not influenced by a magnetic field, since the path of both the curves is conforming within the measurement accuracy. As a result, the $\gamma$-quanta generated during the nuclear transition cannot have an electric charge.

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Room for notes