

Investigating the absorption of α -particles, β -particles and γ -rays by appropriate materials

Introduction

In this experiment you will be using a Geiger-Müller tube and counter to take measurements of the absorption of radioactive particles or rays by differing materials or by various differing thicknesses of material.

Aim

- To obtain evidence to support a conclusion of the effect of materials placed between radioactive source and detector
- To use radioactive materials safely
- To use detectors of radioactive decay

Intended class time

- 45 to 60 minutes

TRADITIONAL METHOD

Equipment

- radioactive sources and associated stands and handling equipment
- Geiger-Müller (GM) tube
- counter
- materials to place between source and detector
- micrometer or Vernier calipers

Health and safety

Standard operating procedures, as detailed in CLEAPSS L93 (pages 21 to 23), should be issued to students. Staff should ensure students are responsible enough to follow them, that they have been shown how to use them, and that they have seen and understood the relevant standard operating procedures.

Procedure

1. Determine the intention of the investigation.
 - a) Changing the distance between source and detector
 - b) Changing the material between source and detector
 - c) Changing the thickness of material between source and detector
2. Set up the source and detector to allow suitable space for your investigation, with due regard for your own safety and the safety of those around you.
3. Ensure that the detector is giving a suitable range of readings
4. Take sufficient readings for your required investigation.
5. Present the data in such a way as to support your observations.

Extension Opportunities - Evaluating the Outcome

1. Detail the safety considerations taken in carrying out this activity
2. Make a written comment on your measurements
3. Can you observe or identify any pattern?
4. How have you taken into account the effect of background radiation on this activity?

Recording

As evidence for the Practical Endorsement you should have evidence of the data collected from your group in a clear and logical format. Additionally you should have created a graphical representation of the data and if relevant, then incorporated class data. All work should be clearly dated.

Having demonstrated an awareness of the safety procedures necessary when using radioactive materials you could make notes of what is advisable to reduce risk. This, along with your observations from the data, will support your preparation for the written examinations.

ALTERNATIVE METHOD

Equipment

- Gas mantle in plastic bag as a radioactive source
- Geiger-Müller (GM) tube
- counter
- aluminium foil to place between source and detector
- micrometer or Vernier calipers

Health and safety

Standard operating procedures, as detailed in CLEAPSS L93 (pages 21 to 23), should be issued to students. Staff should ensure students are responsible enough to follow them, that they have been shown how to use them, and that they have seen and understood the relevant standard operating procedures.

Procedure

1. Set up the detector vertically with the gas mantle resting on top of the GM tube and take an initial reading of activity.
2. Take readings with different numbers of sheets of, or different thicknesses of, aluminium foil between the mantle and detector.
3. Take sufficient readings for your required investigation.
4. Present the data in such a way as to support your observations.

[It may be necessary to remove the plastic cover from the GM tube very carefully (so as not to damage the mica window) to take the readings, after which it should be very carefully returned after the experiment. Follow the instructions given by your teacher]

Extension Opportunities - Evaluating the Outcome

1. Detail the safety considerations taken in carrying out this activity.
2. Make a written comment on your measurements.
3. Can you observe or identify any pattern?
4. How have you taken into account the effect of background radiation on this activity?
5. Are there any other factors affecting the validity of this experiment?

Recording

As evidence for the Practical Endorsement you should have evidence of the data collected from your group in a clear and logical format. Additionally you should have created a graphical representation of the data and if relevant, then incorporated class data. All work should be clearly dated.

Having demonstrated an awareness of the safety procedures necessary when using radioactive materials you could make notes of what is advisable to reduce risk. This, along with your observations from the data, will support your preparation for the written examinations.

Acknowledgement

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