

3.8 Compton Scattering – Safe Operating Procedures

3rd Year Experiment

Hazards

Categories R5, R7: A sealed radioactive source where a beam is produced.

For more detailed information see the related Risk Assessment.

Associated Risks

“External Exposure Hazard” to the whole body due to leakage radiation from the source container or secondary radiation from the beam striking an object (e.g. the collimator).

“External Exposure Hazard” to the fingers and hands from the beam.

For more detailed information see the related Risk Assessment.

Safety Procedures and Training

Training

- Before starting this experiment you **must**:
 - **have read and understood the Risk Assessment for this experiment.**
 - **receive a safety briefing which includes going through this document.**
- While carrying out this experiment **you must follow the procedures** in this document, which must be close at hand along with the Risk Assessment (if you cannot find either of these documents you must consult laboratory staff).

Monitoring Radiation Exposure

- While working with this apparatus **you must wear a dosimeter issued by lab staff.**
- There is a radiation monitor near the apparatus that must be checked before you use the apparatus and checked periodically when using the apparatus.

Minimising Radiation Exposure

Your radiation exposure can be minimised by:

- **Minimising your exposure time:** plan your experiment so that you spend a minimum amount of time with the beam ON and a minimum amount of time near the source e.g. do not place any of your belongings on the same bench as the source, carry out theoretical work away from the apparatus.
- **Maximising your distance from the source:** even when the beam is OFF stand away from the apparatus unless you are making adjustments.
- **Use shielding:** The source is within a shielded container, Figure 1a, (orange container to left of image). However, a small amount of radiation escapes from the container. Additional lead shielding surrounds the container (Figure 1b, labelled A); you should have this shielding between you and the source as much as possible (if you cannot see the orange container, then the radiation source cannot “see” you).

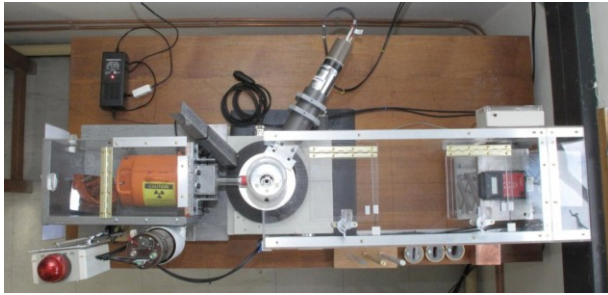


Figure 1a Top view of the apparatus

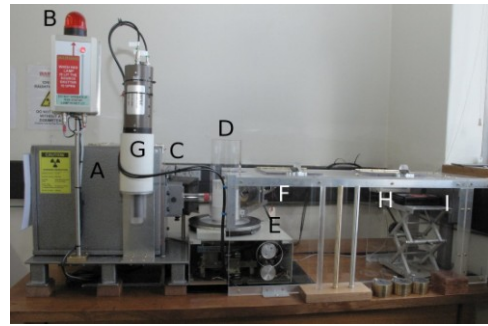


Figure 1b Side-view of the apparatus.

Beam ON/OFF

- This experiment uses gamma ray source enclosed in a container with a shutter. Opening the shutter allows a collimated beam of gamma rays to escape from the container. There is an orange beam-control dial (Figure 1) which controls the opening and closing of the shutter and hence the status of the beam (ON or OFF). There is a mirror to help view the status of the dial.
 - If the dial is in the OFF position it means the shutter is closed and hence the beam is OFF.
 - If the dial is in the ON position it means the shutter is open and hence the beam is ON.
 - There is a warning lamp (Figure 1b, labelled B) for which lamp ON means beam ON lamp OFF means beam OFF – there is also an indicator light that should be on if the lamp is working.
 - **When the apparatus is not in use the beam must be OFF and the dial secured, with a padlock, so its status cannot be changed.**
- It is possible to turn the dial to an intermediate position between ON and OFF. **Do not leave the dial in this position it must always be ON or OFF.**
- When the apparatus is to be used the demonstrator will remove the padlock, allowing the beam to be turned ON.
 - **The beam should only be turned ON to collect data. When data collection has finished, turn the beam OFF.**
 - **While the beam is ON**
 - **DO NOT** adjust the apparatus.
 - **DO NOT** open the doors in the Perspex screen that covers the beam
 - **STAND BACK** from the apparatus.
 - **When the apparatus is not to be used any further inform the demonstrator and they will lock the shutter in the OFF position.**
- To operate the beam-control dial:
 - Open the door.
 - Use your left hand.

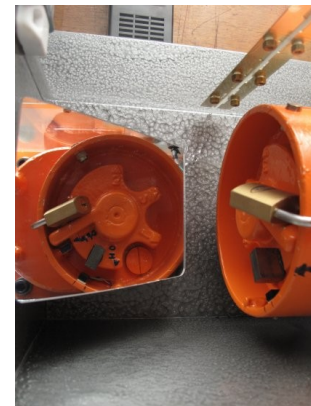


Figure 2 Shutter dial

- Place your fingers on the orange handle.
- Place your thumb on the orange lug on the dial (not on the black magnet).
- Rotate the dial.
- Remove your hand and close the door.

Emergency procedures

The following outlines possible situations that might arise and the actions that should then be taken:

- **Situation 1:** You enter the laboratory and somebody has left the beam ON and the logbook entry or signage does not indicate an experiment in progress.
 - **Action:** Report the incident to lab staff or the Radiation Safety Officer (RSO). They will take corrective action.
- **Situation 2:** You notice that a safety device has failed (e.g. the indicator light on the warning light is out, or shielding has been removed).
 - **Action:** Report the incident to lab staff immediately. They will take corrective action.
- **Situation 3:** The source holder has been damaged and/or the electronic dosimeter shows a reading in excess of 50uSv/hr at <10 cm from the source, with the beam OFF.
 - **Action:** Contact lab staff immediately (or the RSO/deputy RSO, in that order). Keep yourself and others away from the area. They will take corrective action.
- **Situation 4:** You notice unusually high readings (in excess of 100uSv/hr) at >10cm from the source. You've checked your radiation monitor and it indicates <2uSv/hr elsewhere in the lab.
 - **Action:** Keep yourself and others away from the area. Contact the RSO and lab staff immediately.
- **Situation 5:** You have any other concerns about the safety of this experiment.
 - **Action:** You must notify lab staff, the RSO or DRSO.