Defectoscopy measurement by gamma radiation

Slovak University of Technology in Bratislava, Exercise STU-05

Main topic: Non-destructive material testing

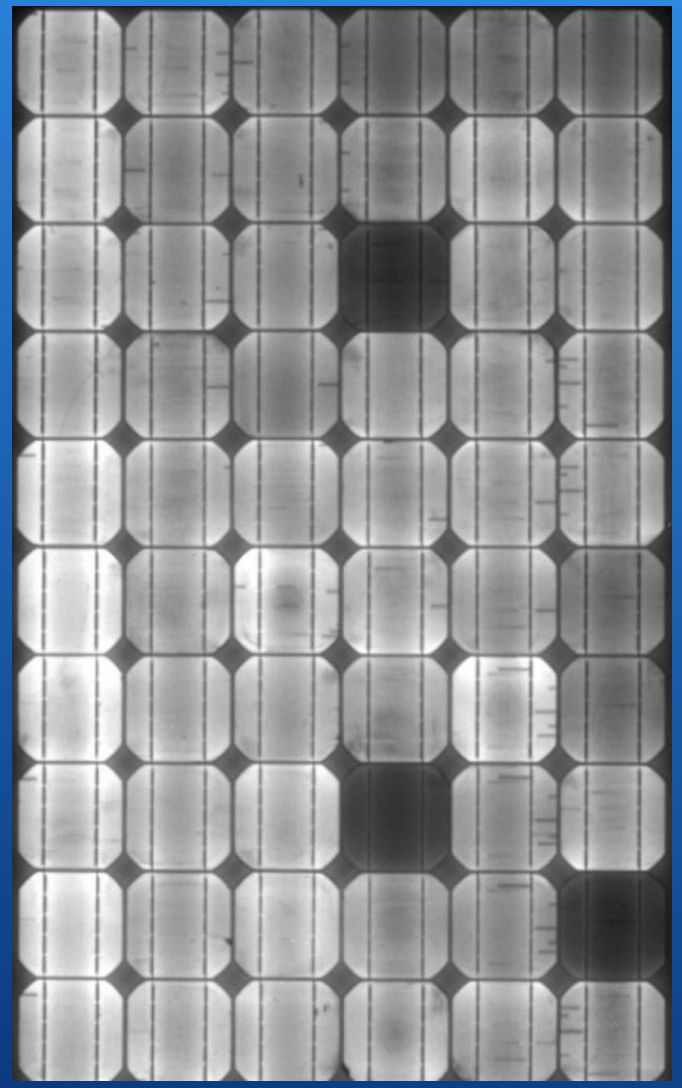
Keywords: Defectoscopy, gamma radiation, measurement attenuation, photo effect, Compton effect, pair production, scintillation detector, shielding

Purpose: The purpose of this exercise is to understand the mechanism of gamma interaction with matter through a simple practical example. The mechanism of gamma interaction with matter is determined by three processes, photo effect, Compton effect and pair production that lead to exponential decrease of the intensity of radiation. The goal of this exercise is to reconstruct the shape of an unknown defect by measuring the absorption of gamma radiation in two perpendicular directions.

Level of exercise:	☐Basic	☒Advanced ☐Complex	
Level of education:	☐BSc	☒MSc	☐PhD

What you will learn:
The students will better understand the mechanism of interaction of gamma radiation with matter and will be able to perform simple experiments to identify unknown defects in materials.

Important information:
- Minimal size of student group: 2
- Maximal size of student group: 4
- Overall duration of the experiment (in wall clock hours): 2



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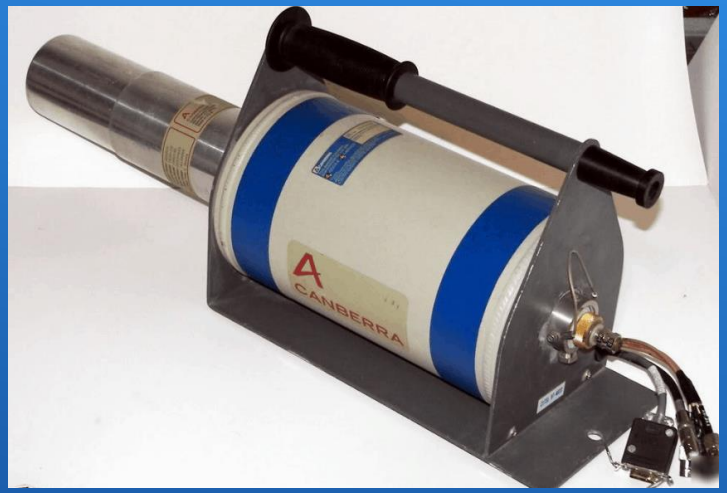
Possibility to perform experiment on demand: ☒ Yes ☐ No
Frequency of occurrence: 2-3 times per year
Examination modalities: report
Teaching languages: English, Slovak



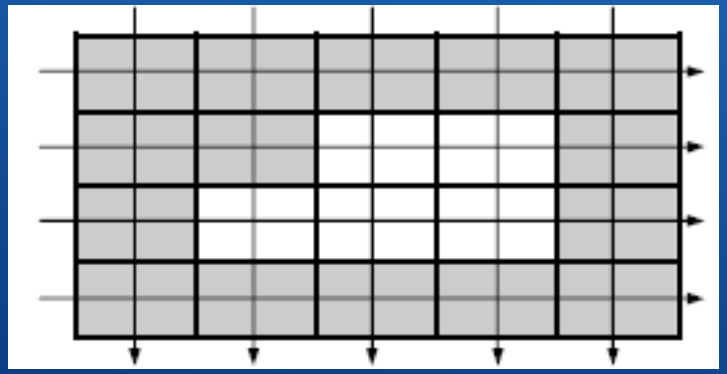
Pre-knowledge required: Knowledge of types, sources, interaction detection and shielding of radiation, statistics, measurement techniques and evaluation of uncertainties

Instruments required for exercise:

- NaI(Tl) scintillation detector
- Calibration gamma sources
- Shielding equipment and box of shielding cubes with spacer grid

Execution:

- Measurement of the linear attenuation coefficient from the intensity of radiation (Cs-137661 keV) as a function of thickness
- The linear attenuation coefficient is determined from the slope of the measured data
- Calculation of the specific weight of the shielding material from the probabilities of gamma reactions
- Demonstration of the defectoscopy method by using the same source of radiation and a box of cubes distributed on a spacer grid where defect is created by omitting several cubes in a closed box



- **Limitations:**

Pregnant and breastfeeding women are not allowed to enter the controlled radiation area. Legal age (18) is required. Fore more information on precoders please visit http://www.ujfi.fei.stuba.sk/kontakt.php