Z39(X2) - Compton Effect

Physics Laboratory II – academic year 2017/2018
Faculty of Physics, Astronomy and Applied Computer Science, Jagiellonian University

The aim of the exercise is to measure the angular dependence of the differential cross section for Compton scattering. The dependence of energy of scattered radiation as a function of the scattering angle is also investigated. Using a variety of X-ray tubes one can also examine the dependence of the Compton effect on the initial radiation energy.

Preparatory questions

1. X-ray sources, X-rays production mechanism [1, 2, 3].
2. Spectral lines of atoms and their relation to electron shells [1, 3].
3. Compton effect: the dependence of the energy of the scattered radiation as a function of scattering angle, differential cross section [1, 3].
4. Semiconductor detectors – characteristics, construction, energy resolution [2].
5. Multi-channel analyser – energy calibration [2].

Computational assignments

Calculate the maximum electron energy in the Compton effect.

Apparatus and materials

Experimental setup is presented in figure 1. It consists of:

- X-ray unit with with replaceable X-ray tubes made of Cu or Mo.
- Goniometer mounted inside the X-ray unit is used to change the silicon detector angle.
- Silicon detector for measurement of energy of scattered X-rays.
- Scattering target made of acrylic glass.
- Multi-channel analyser with power supply and amplifier.
- Computer.

Experiment

1. Energy spectra calibration using direct X-rays from Cu and Mo X-ray tubes.
2. Measurement of the intensity of scattered X-rays as a function of scattering angle.
3. Simultaneously with point 2, the X-ray energy dependence on the scattering angle is measured.

Data analysis

1. For all obtained spectra fit Gaussian function with a linear background for all visible peaks.
2. Perform energy calibration.
3. Plot the energy dependence of the scattered X-rays on the scattering angle and compare with predictions obtained under the assumption that the scattering occurred on a free electron.
4. Plot the dependence of the number of counts in peaks normalized to measurement time as a function of scattering angle. Compare the result with theoretical predictions.

References

[1] K. S. Krane, *Introductory Nuclear Physics*, John Wiley & Sons.

[2] W.R. Leo, *Techniques for nuclear and particle physics experiments*, S.-Verlag 1987.

[3] repository.phywe.de/files/versuchsanleitungen/p2546001/e/p2546001e.pdf

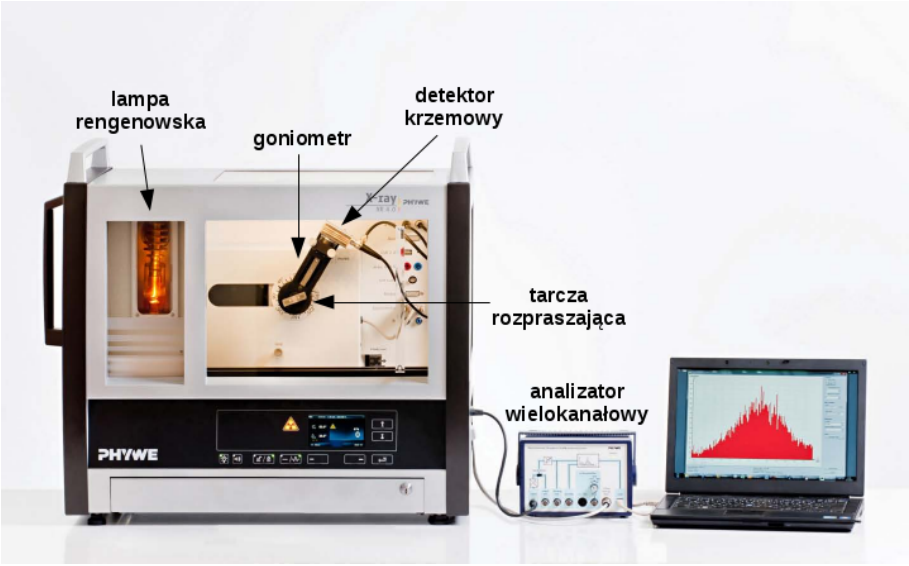

Figure 1: Experimental setup

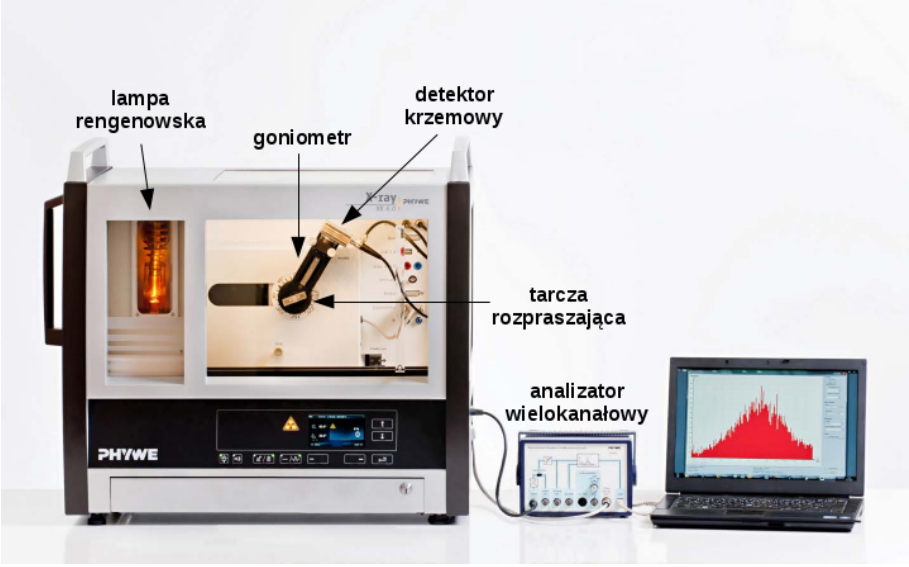

Figure 2: Experimental setup