

Doppler broadening of annihilation photons

Slovak University of Technology in Bratislava, Exercise STU-09

Main topic: Non-destructive material testing

Keywords: Doppler broadening of annihilation photons; material testing, non-destructive analysis

Purpose: The basic objective of the experiment is to develop a better understanding of the principles of the positron annihilation spectroscopy (PAS) method on the angle correlation apparatus, to measure the correlation curve and the Doppler shift of annihilation energy.

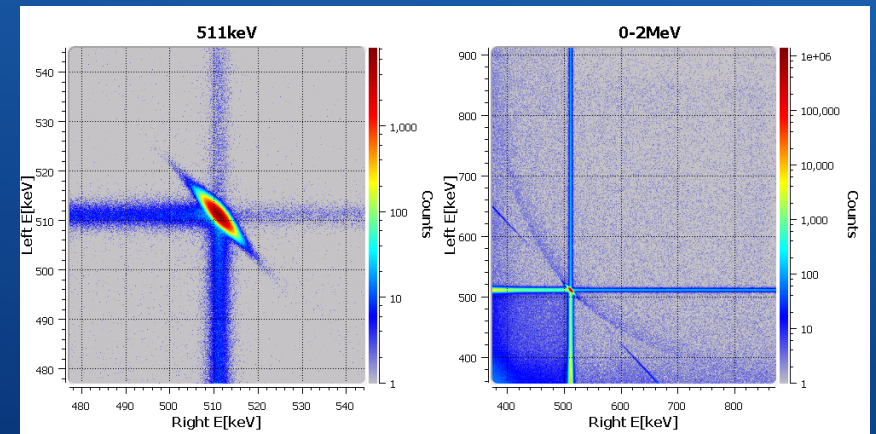
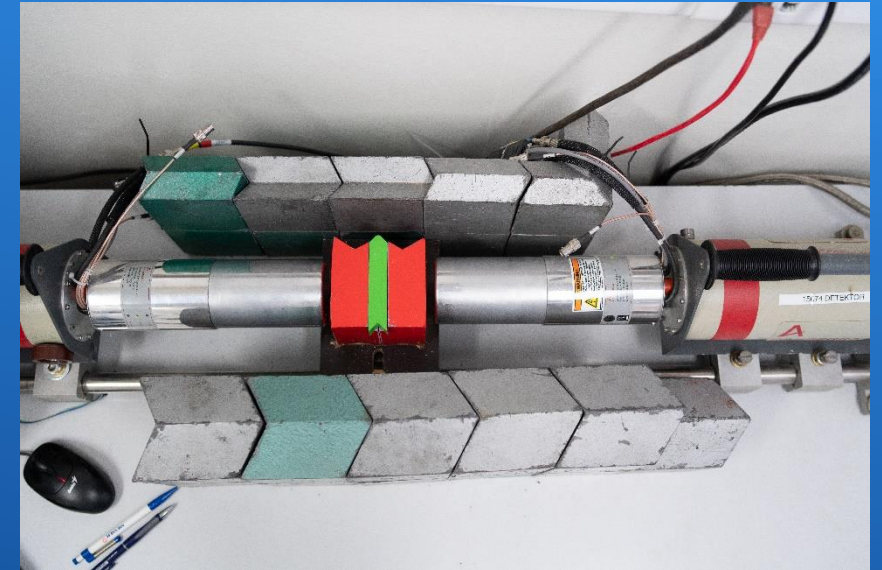
Level of exercise: Basic Advanced Complex
Level of education: BSc MSc PhD

What you will learn:

The students will learn the main principles of a positron annihilation spectroscopy, will understand the basic principles and will realize the PAS abilities for the industrial use.

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 radioactive decay law, sources, types and interaction of radiation with matter, material structures, detector types, trapezoidal filters and evaluation of uncertainties

Instruments required for exercise:

- Dual channel digitizer CTB and HPGe detector
- High voltage power supply-CDB and QtCDB2
- Na-22 positron source

Execution:

- A positron annihilates with an electron giving rise to two 511 keV photons in two opposite directions
- Due to the finite momentum of the electron-positron pair, the angle between the annihilation photons changes by ΔE
- Doppler Broadening Spectroscopy gives information on the electron momentum distribution in the sample. Since Doppler energy changes are small, one needs to use HpGe detector to measure the energy spectrum. For coincidence Doppler broadening system, two HpGe detectors are needed. The isotope of sodium (Na-22) is used as the source of positrons

Limitations:

Pregnant and breastfeeding women are not allowed to enter the controlled radiation area. Legal age (18) is required.

For more information on precoders please visit <http://www.ujfi.fei.stuba.sk/kontakt.php>

