Application of the anti-Compton shielding in the gamma spectrometer of the neutron explosives detector

on behalf of the team presented by dr Michał Gierlik

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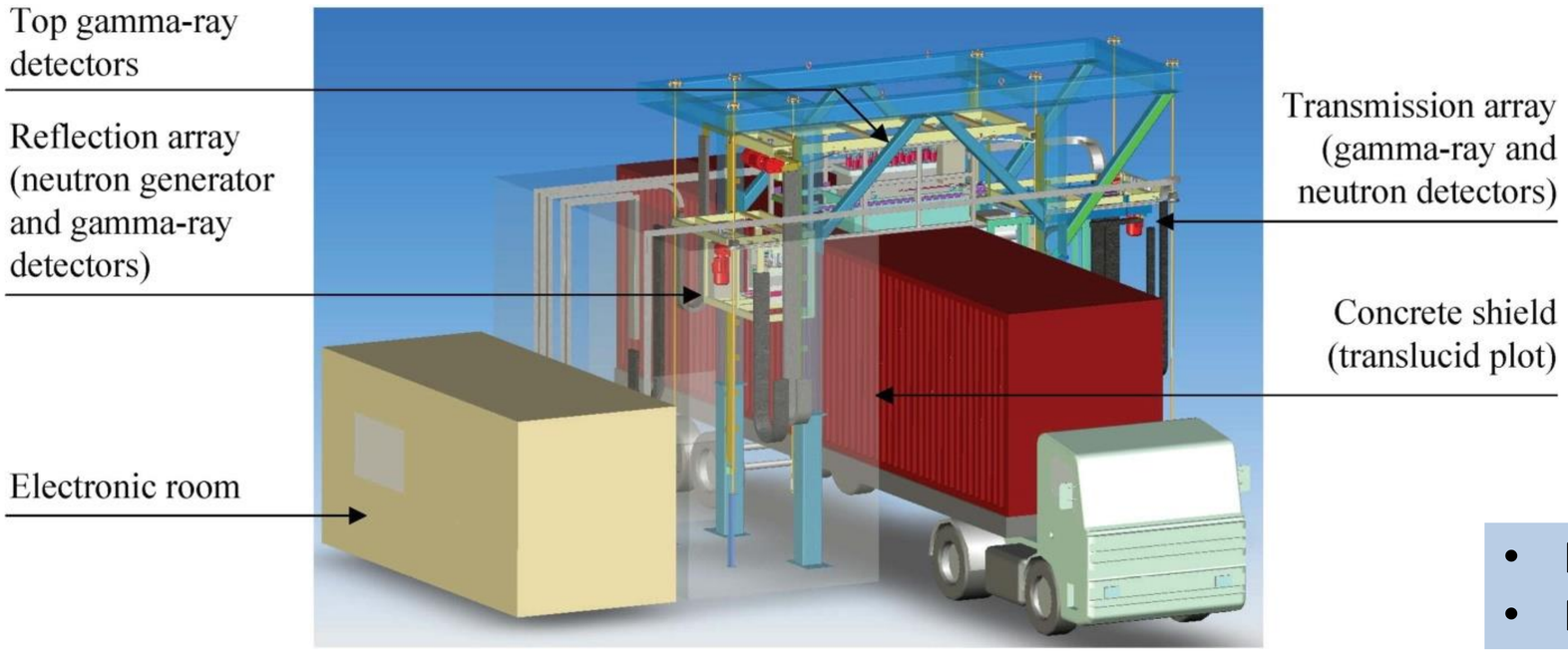
2nd Workshop on neutrons in medicine and homeland security
UJ, Kraków, 12-13 September 2019

Signposting – presentation plan

What I would like to present,
And what I am going to avoid.

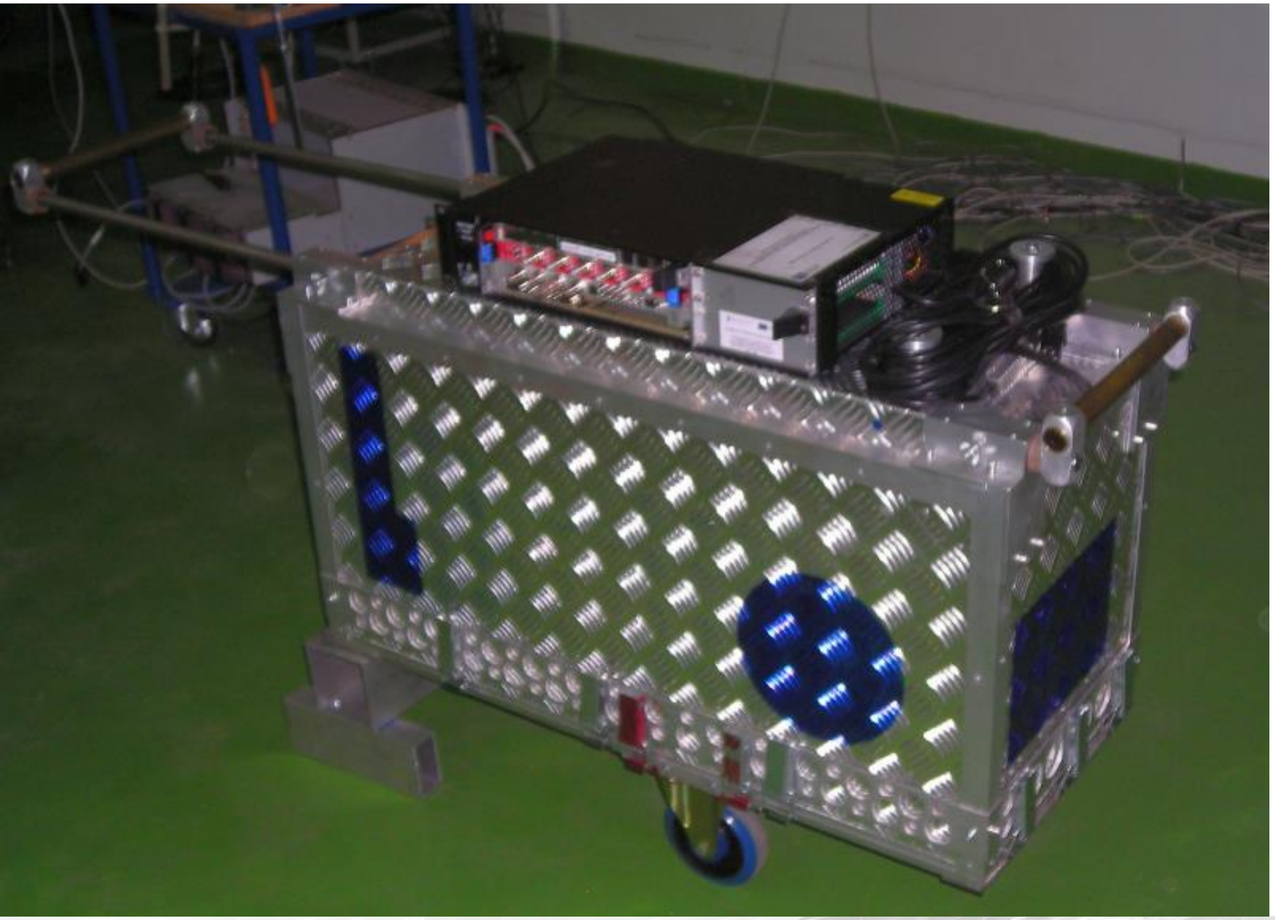
- The project, its origins and one of its fruits
- Neutron Activation Analysis
- Neutron interactions with matter
- Challenges of application
- Active shielding
- Performance of the anti-Compton guard detector
- Postscriptium

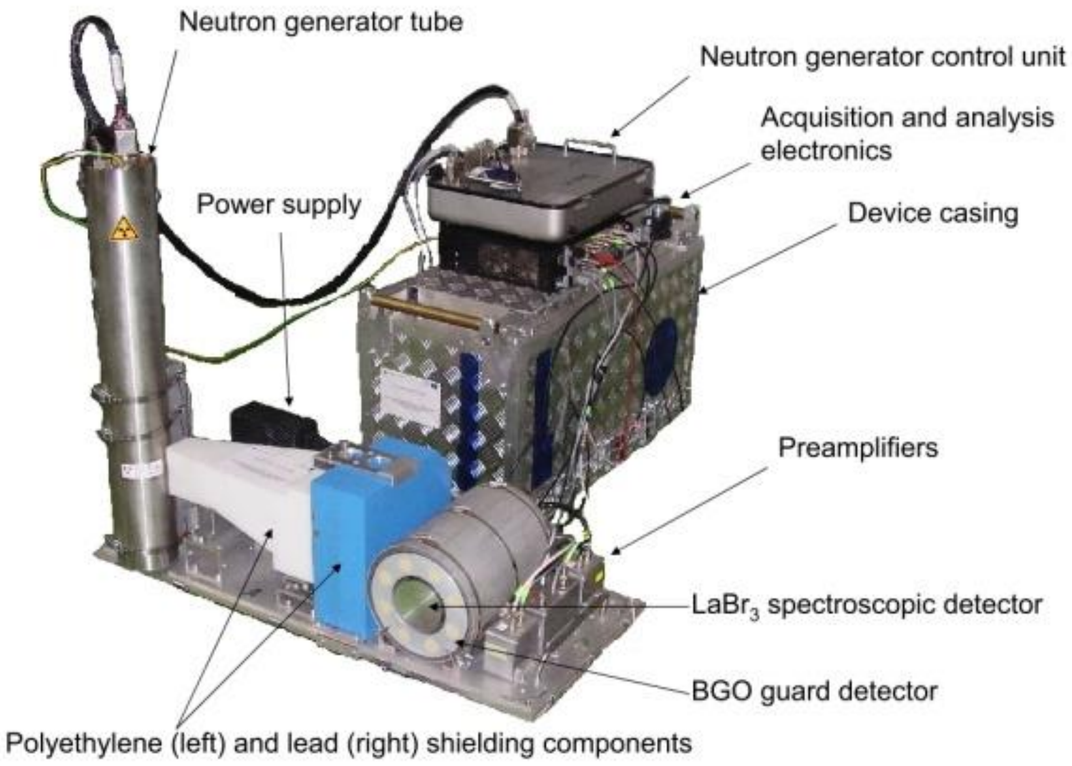
AiD – Accelerators & Detectors



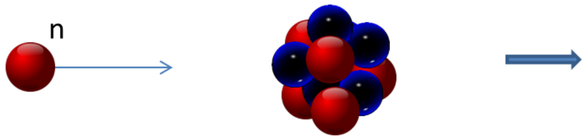
- From Euritrack to something smaller
- Preferably – other toxic/dangerous agents

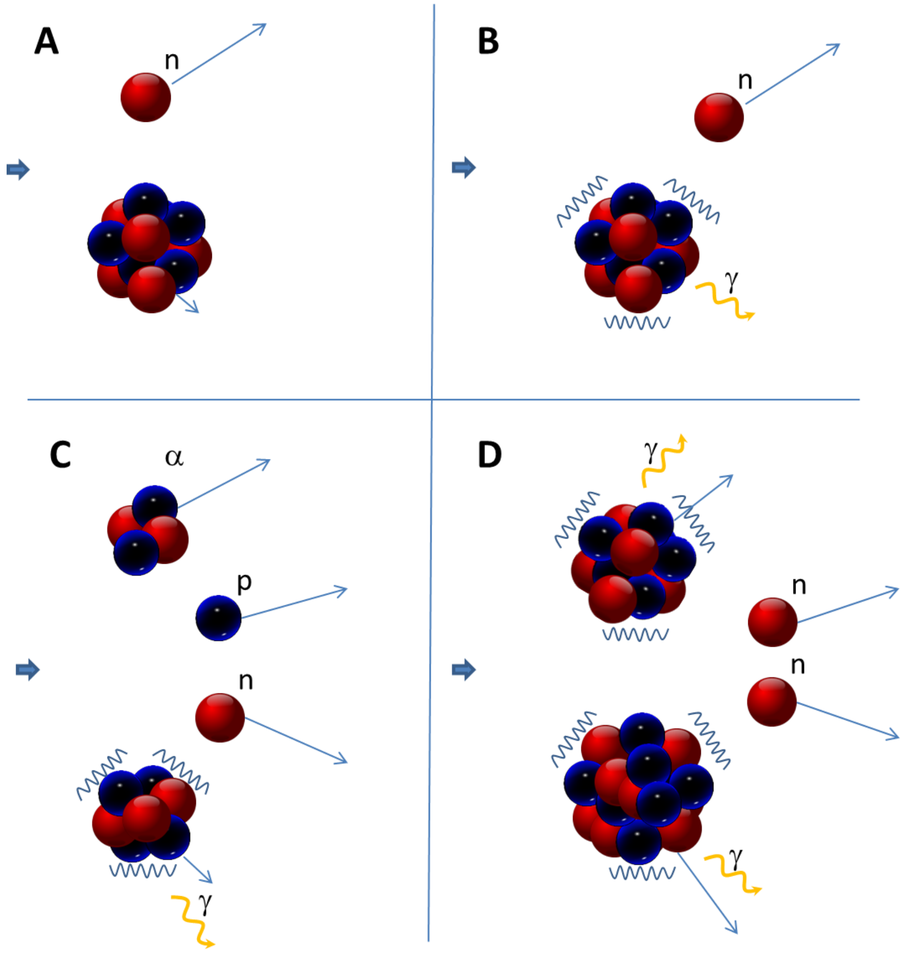
SWAN -
detection of explosives by means of Neutron Activation Analysis





Neutron interactions with matter

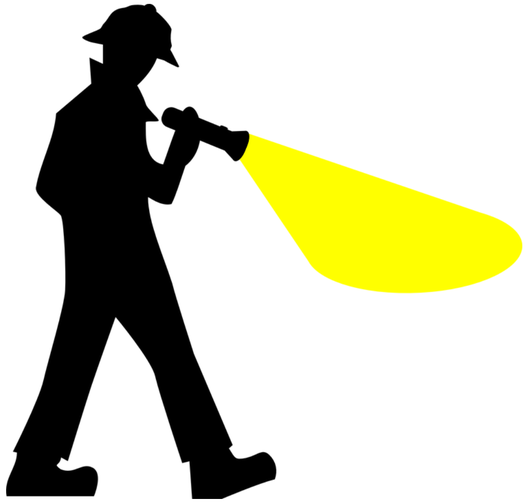




A. Elastic scattering
B. Inelastic scattering
C. Inelastic scattering with knock-out / stripping reactions
D. Fragmentation / fission
E. Neutron can also be captured

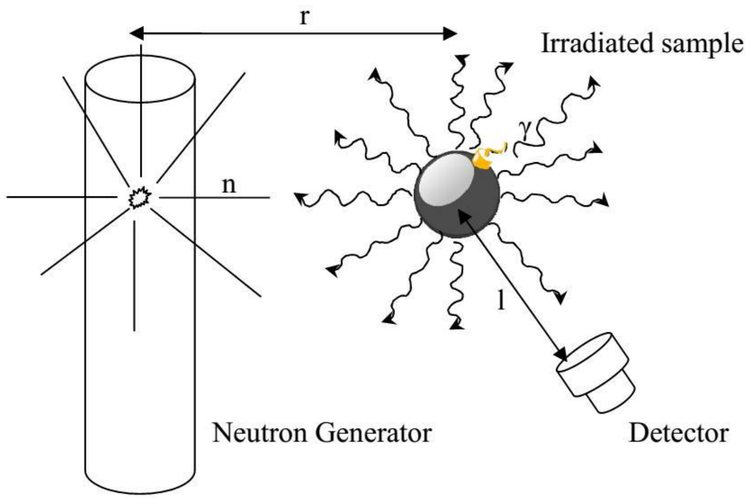
Barriers in applications

Lack of focus



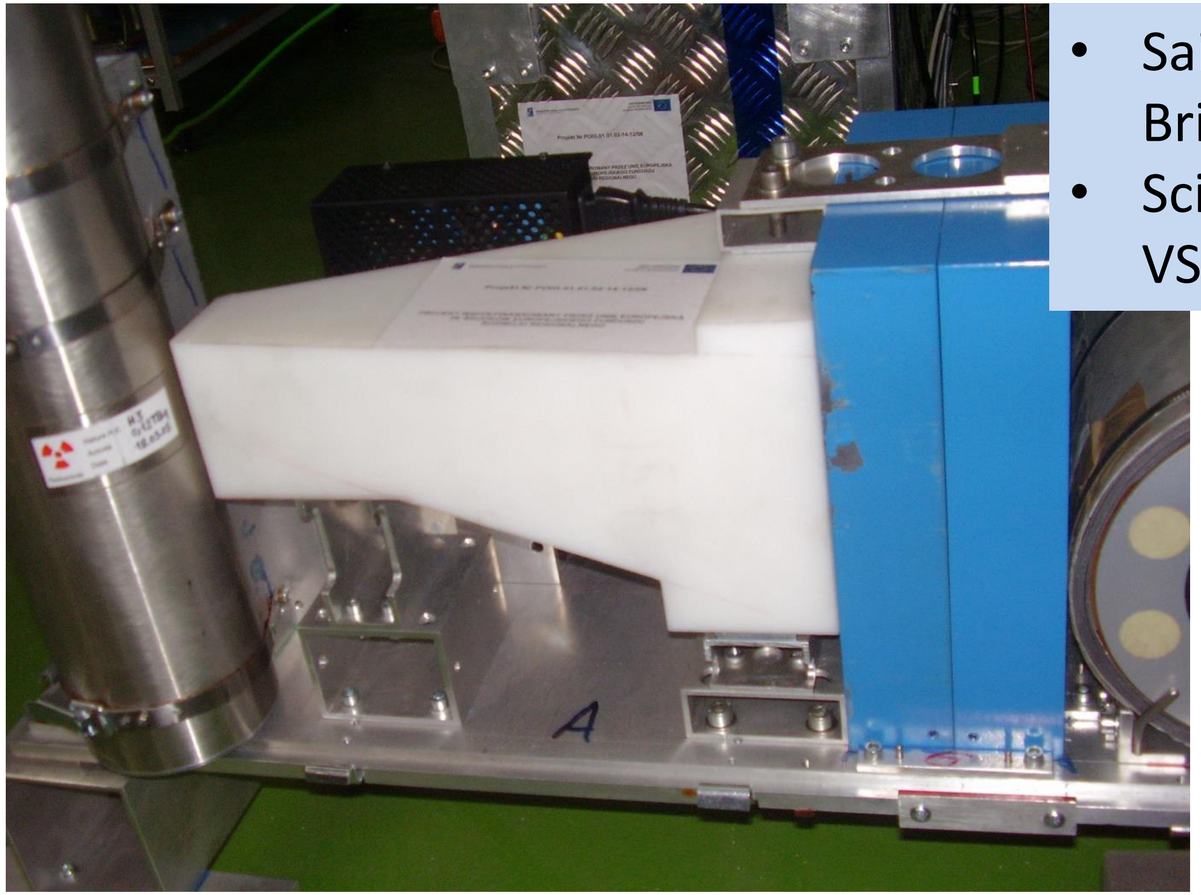
Matter activation
Secondary radioactivity

Dispersion

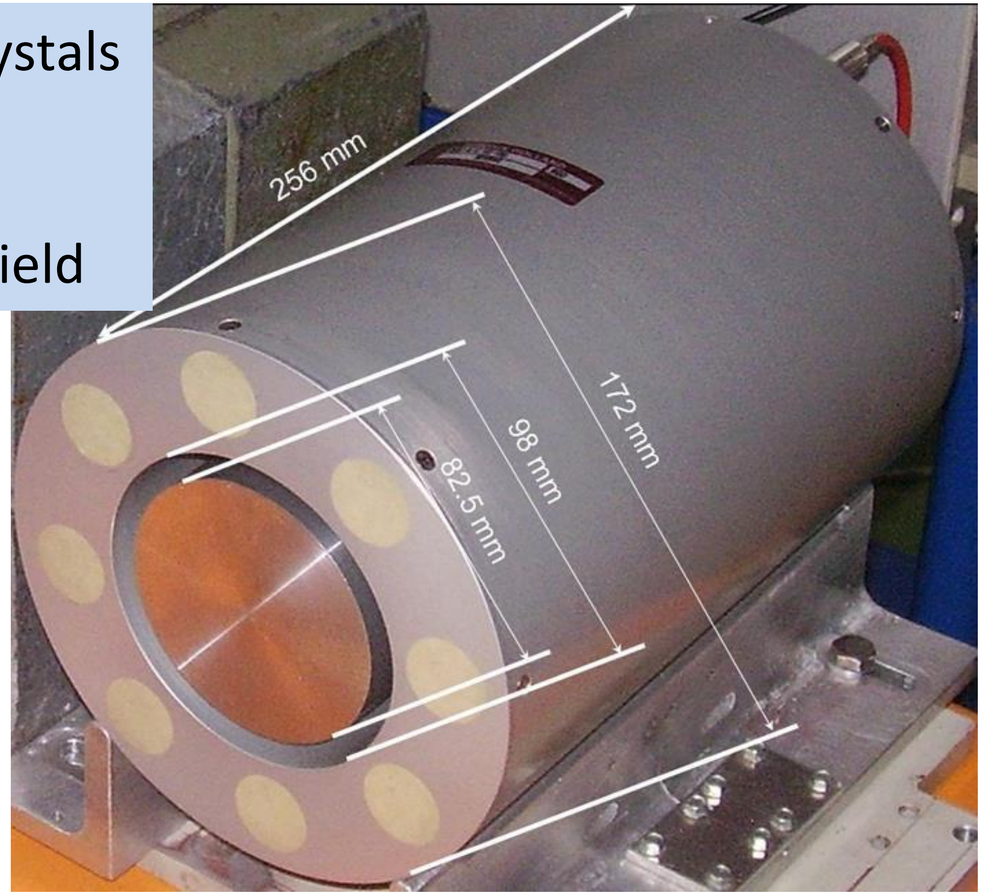


Excessive noise

Shielded detector - solution to the lack of focus



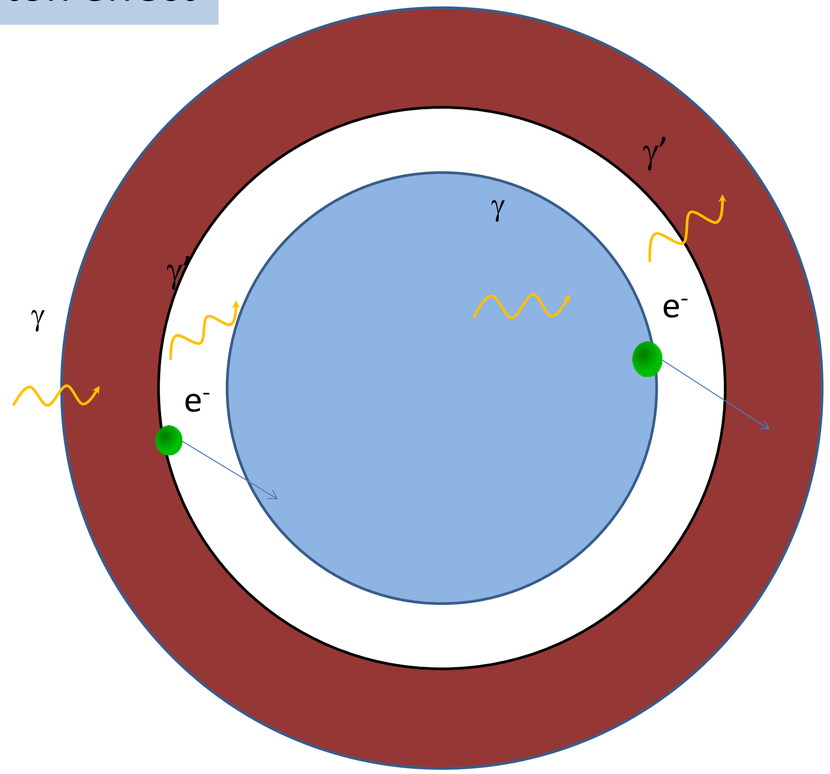
- Saint-Gobain Crystals BrilLanCe 380
- Scionix Holland VS-1110 BGO shield

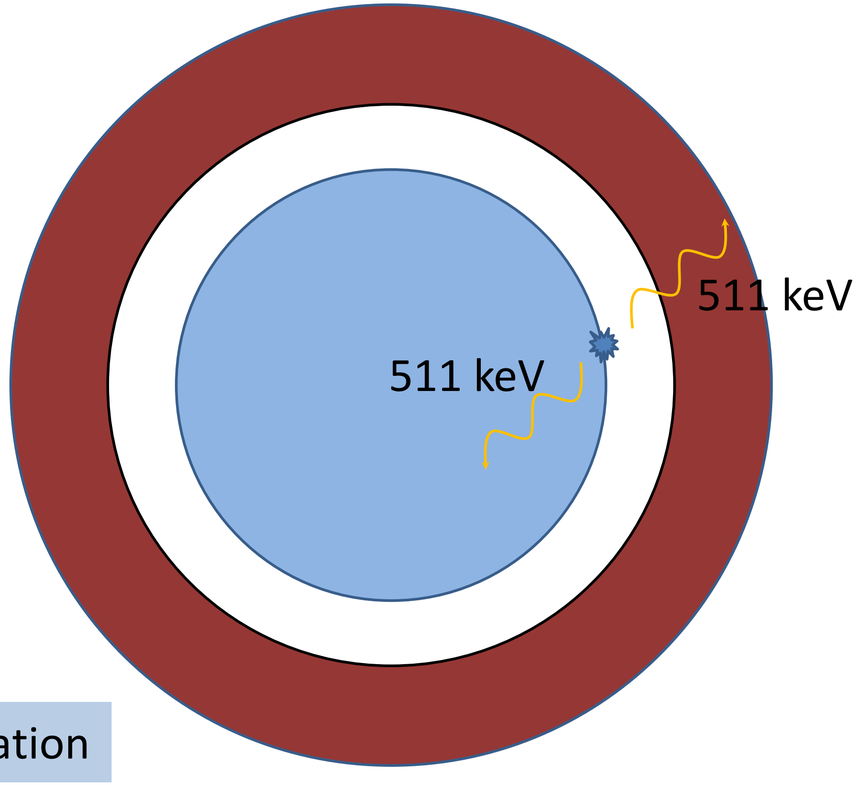


How does it work?

- It’s a collimator
- It’s the active collimator

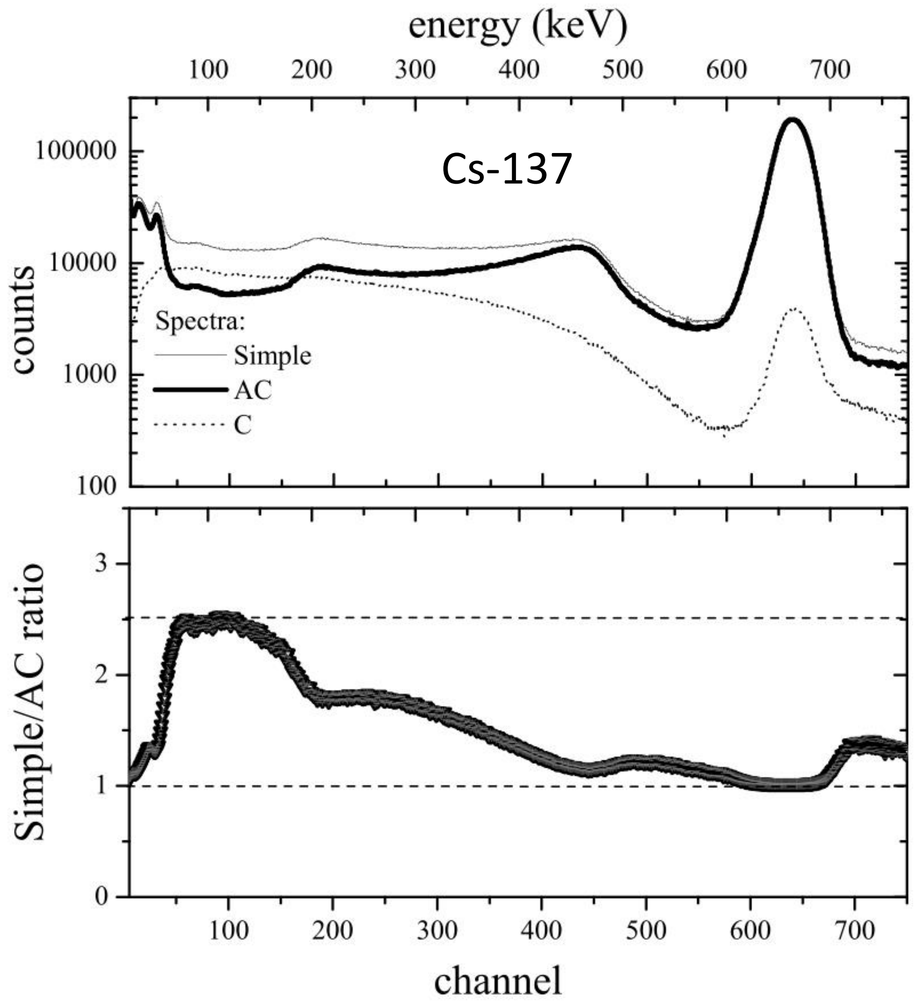
Compton effect





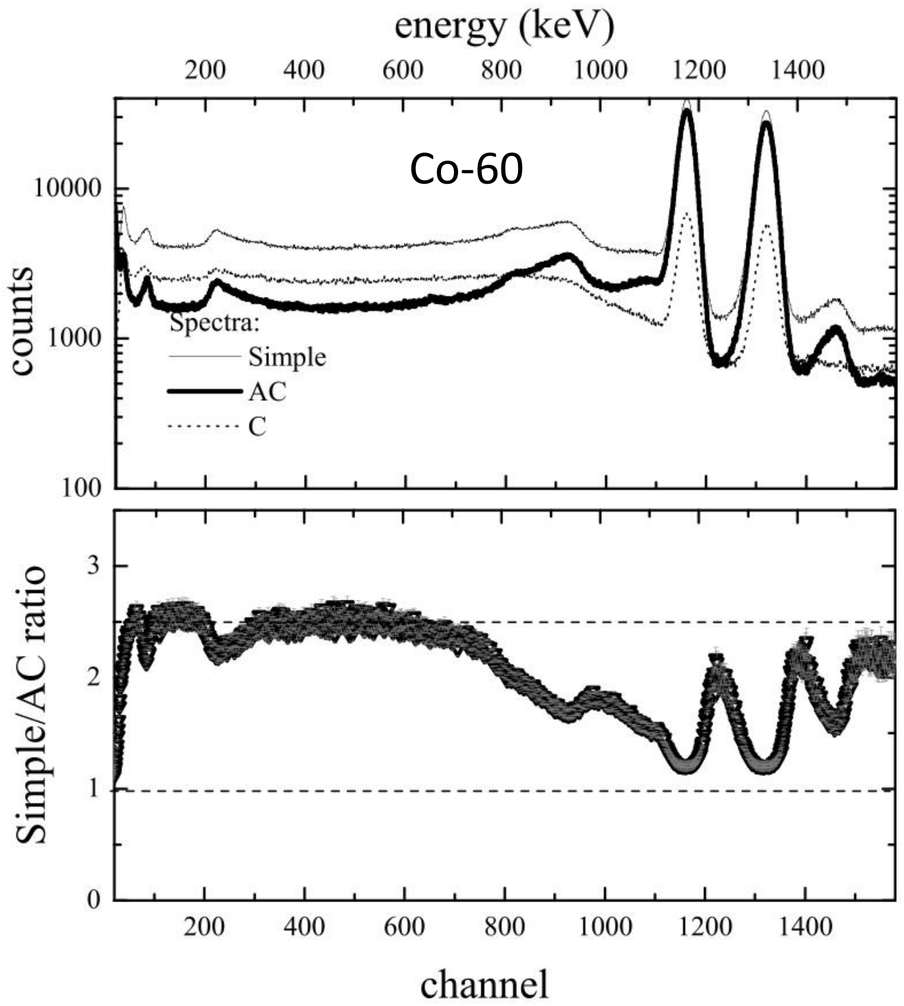
Pair creation

How efficient is this set-up?

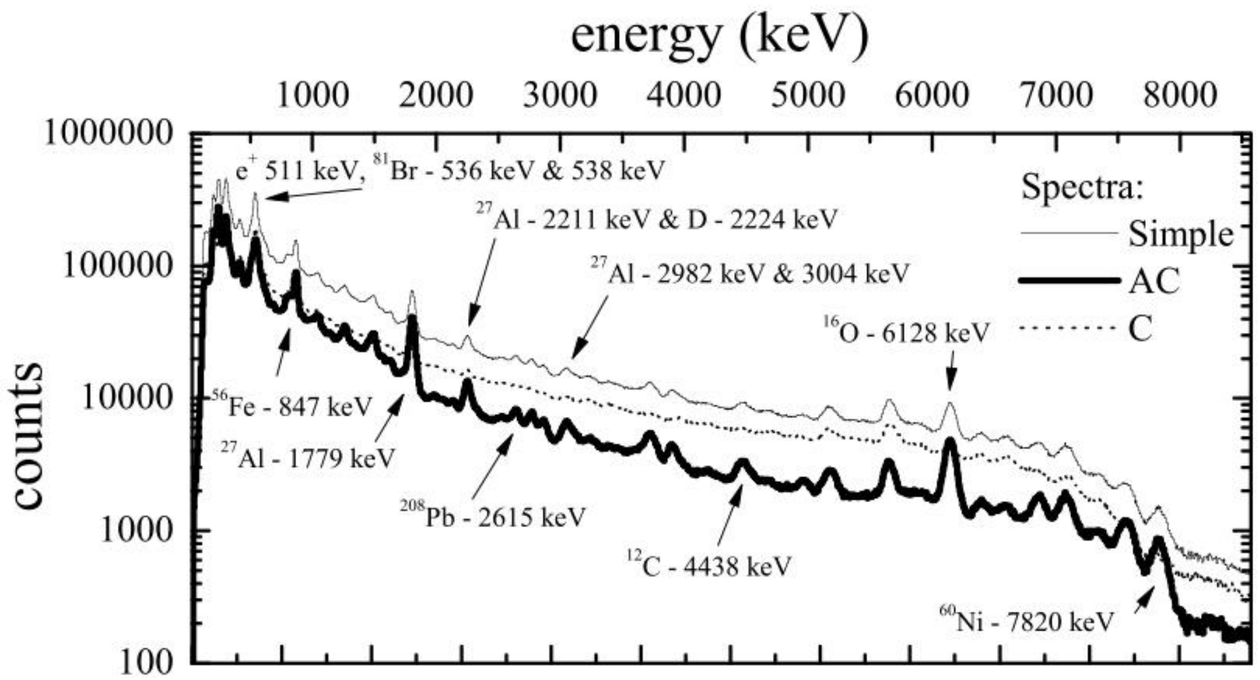


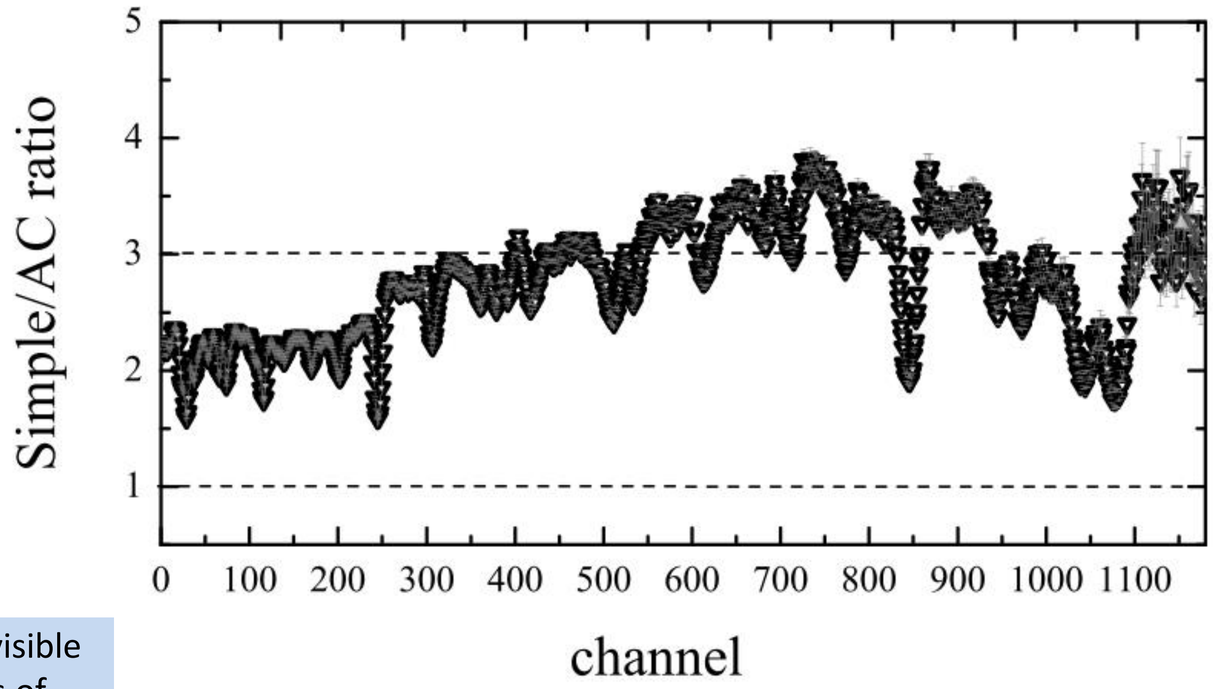
Parametrization:

- Easy to request
- Hard to define
- Even harder to measure



Real life performance

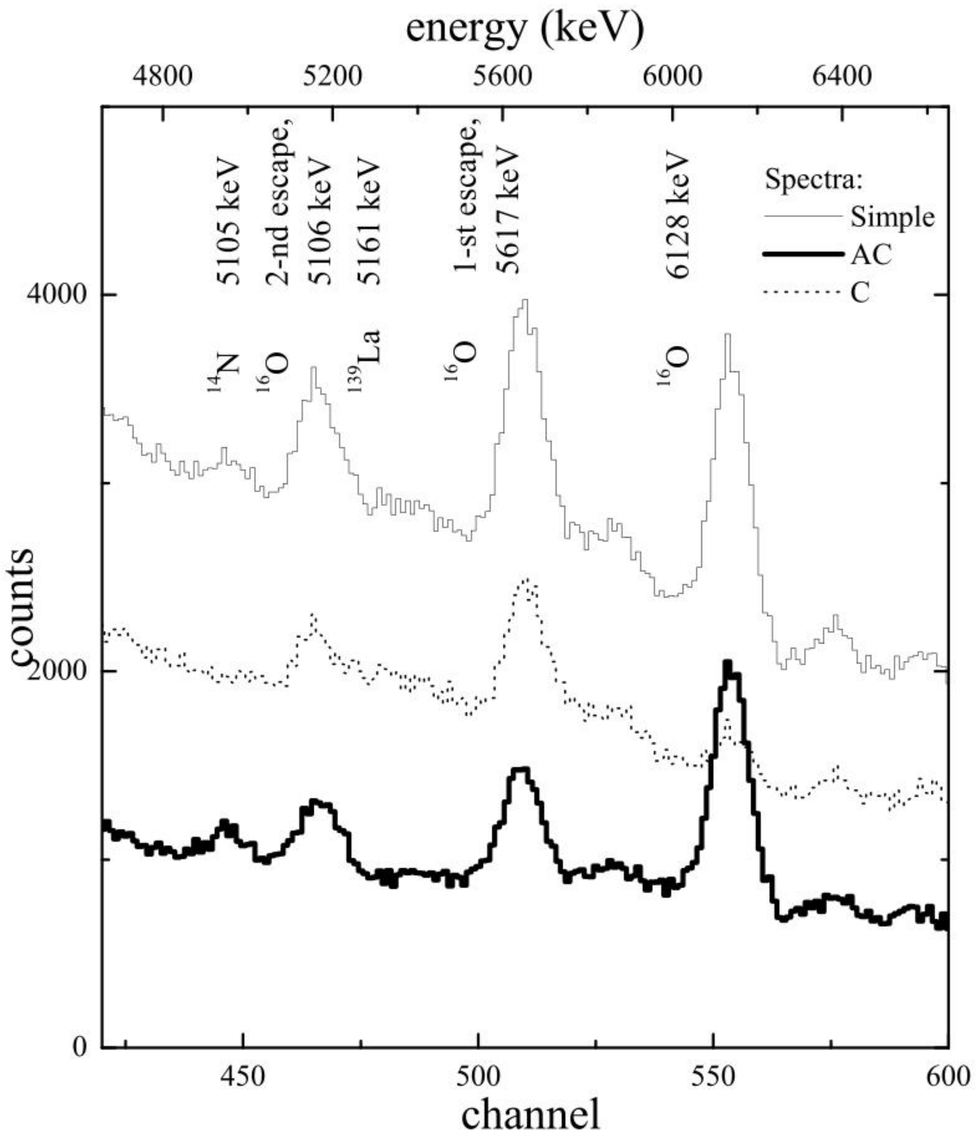




Laboratory background measured during neutron activation. The majority of the visible lines come from the neutron activated aluminum casing, ever-present compounds of carbon and oxygen, and the detectors.

Practical benefits

Elimination of the oxygen double escape peak reveals the signature of nitrogen

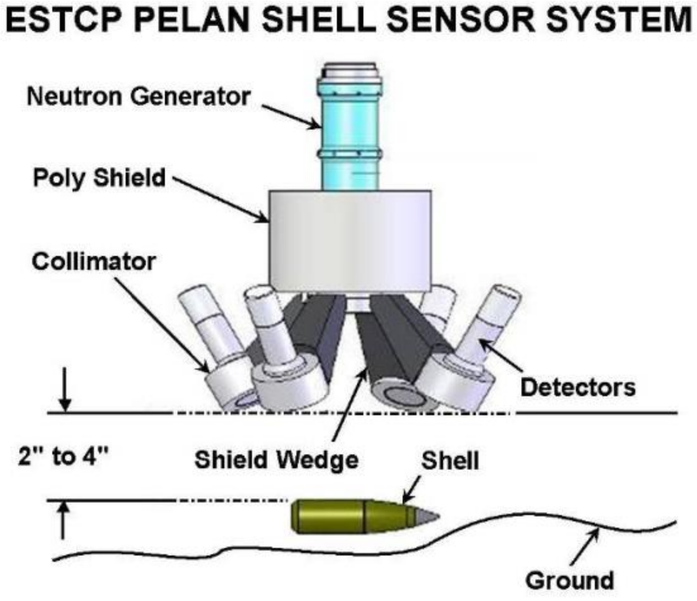


More about SWAN

- M. Gierlik, S. Borsuk, Z. Guzik, J. Iwanowska, Ł. Kaźmierczak, S. Korolczuk, T. Kozłowski, T. Krakowski, R. Marcinkowski, L. Swiderski, M. Szeptycka, J. Szewiński, A. Urban, **“Application of the Anticompton Detector in Neutron Activation Analysis Techniques,”** Nucl. Instr. Meth. A 788 (2015), 54–58
- M. Gierlik, S. Borsuk, Z. Guzik, J. Iwanowska, Ł. Kaźmierczak, S. Korolczuk, T. Kozłowski, T. Krakowski, R. Marcinkowski, L. Swiderski, M. Szeptycka, J. Szewiński, A. Urban, **“SWAN - Detection of explosives by means of fast neutron activation analysis,”** Nucl. Instr. Meth. A 834 (2016), 16–23
- Ł. Kaźmierczak, S. Borsuk, M. Gierlik, Z. Guzik, J. Iwanowska-Hanke, S. Korolczuk, T. Kozłowski, T. Krakowski, R. Marcinkowski, L. Swiderski, M. Szeptycka, J. Szewiński, and A. Urban, **“A Simple Approach to Data Analysis for the Detection of Hazardous Materials by Means of Neutron Activation Analysis,”** Acta Phys. Pol. A 127 (5) (2015) 1540–1542

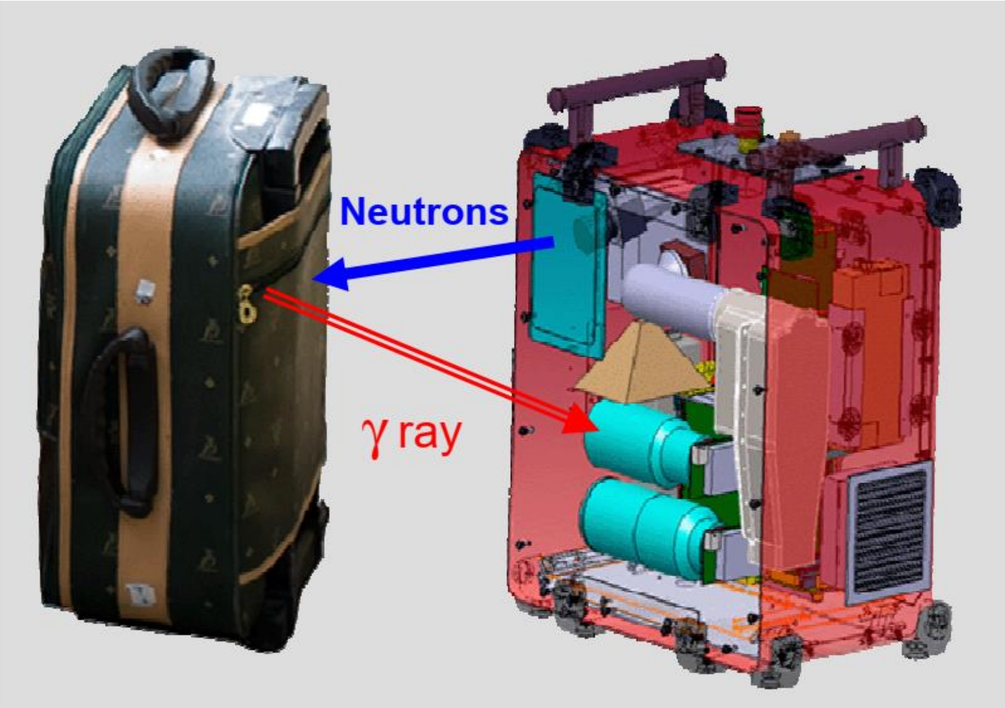
Postscriptum

Bruker
The Neutron Induced Gamma Spectrometer



Department of Defense
Environmental Security Technology Certification Program
And Advanced ESTCP PELAN System for Surface and Near-surface UXO Discrimination

Sodern
Unattended Luggage Inspection System for Homeland Security and Defense



Thank you for your attention

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