



Development of measurement systems at STUK's gamma laboratory

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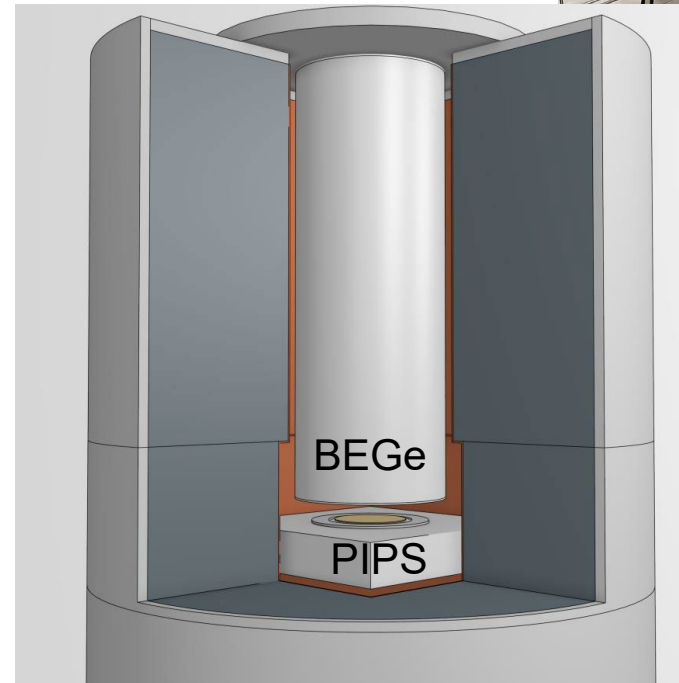
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Introduction

- Please see the presentation “STUK's new gamma-ray laboratory” by Roy Pöllänen.

MiniPANDA

- Detector system for alpha-gamma coincidence measurements.
 - The setup is built inside a compact cylindrical lead shield.
 - Electrically cooled high-purity germanium detector (Canberra BEGe, BE3820) and a thin radially mounted Passivated Implanted Planar Silicon (Canberra PIPS).
 - Operates under atmospheric pressure.
 - Fully digital readout, and data collected in list-mode with CAEN DT5780 MCA unit.
- Integrated into STUK's laboratory information management system NAMIT.
 - Final spectra (phd) to UniSampo-Shaman automatic analysis pipeline.
- MiniPANDA is best suited for thin samples and (stacks of) air filters.



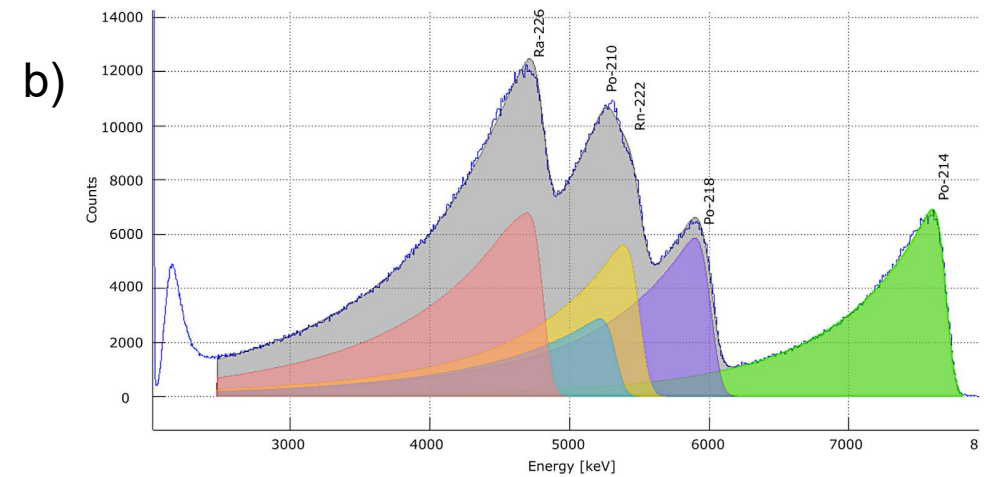
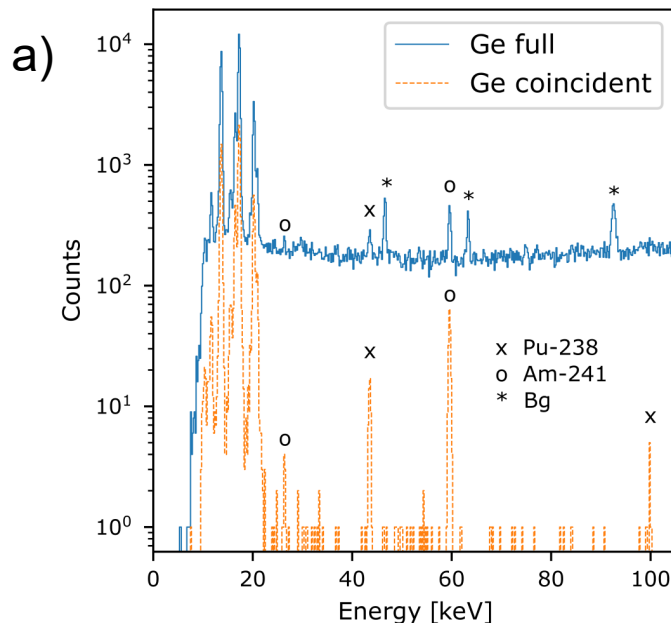
MiniPANDA

The MiniPANDA device and its performance with different sample types were demonstrated in:

- Hildén, T., Badran, H., Turunen, J., Peräjärvi, K., Pöllänen, R., 2022. MiniPANDA device for alpha–gamma coincidence measurements. Nucl. Instrum. Methods Phys. Res. A 1029, 166429. <http://doi.org/10.1016/j.nima.2022.166429>
- Examples 1 and 2 are taken from the article.

1. Analysis of a microscopic particle containing ^{238}Pu and ^{241}Am

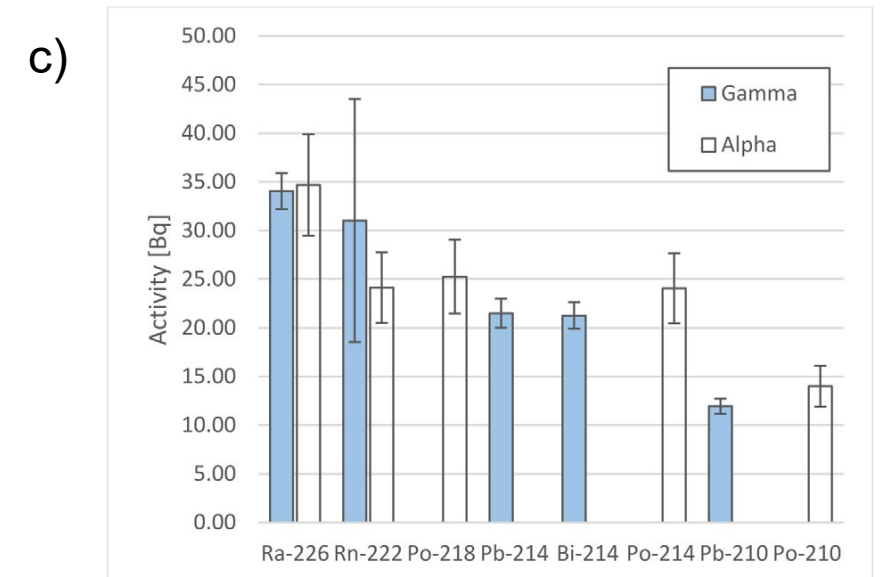
a) Gamma singles and coincidence energy spectrum of the ^{238}Pu and ^{241}Am sample.



2. Analysis of a sample containing ^{226}Ra (and ^{134}Cs)

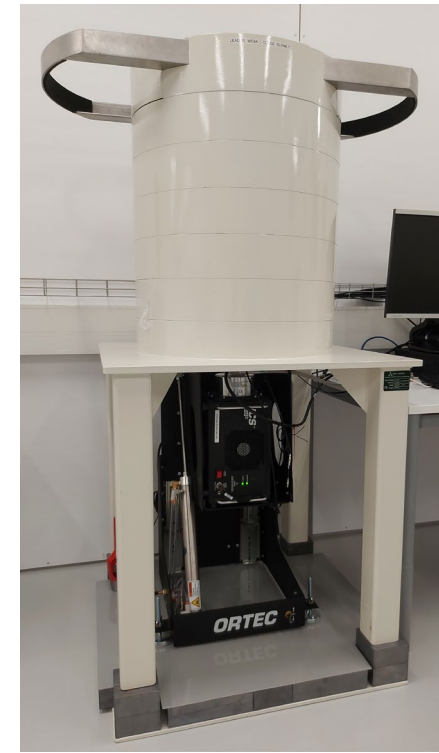
b) Deconvolution of the alpha spectrum. The x -axis is calibrated to the decay energy of the alpha particles.

c) Measured activities of the radionuclides in the ^{226}Ra decay chain by using alpha and gamma spectrometry.



COSSU

- COSSU = Compton Suppression Shield.
 - Built inside a cylindrical lead shield.
 - Main detector is a large volume electrically cooled coaxial HPGe (Ortec GEM-C120-ICS).
 - The active shield consists of two NaI(Tl) scintillators from Scionix: Annular detector surrounding the HPGe and plug detector on top of the HPGe.
 - Fully digital readout, and data collected in list-mode with CAEN DT5780 MCA unit.
- Integrated into STUK's laboratory information management system NAMIT.
 - Final spectra (phd) to UniSampo-Shaman automatic analysis pipeline.

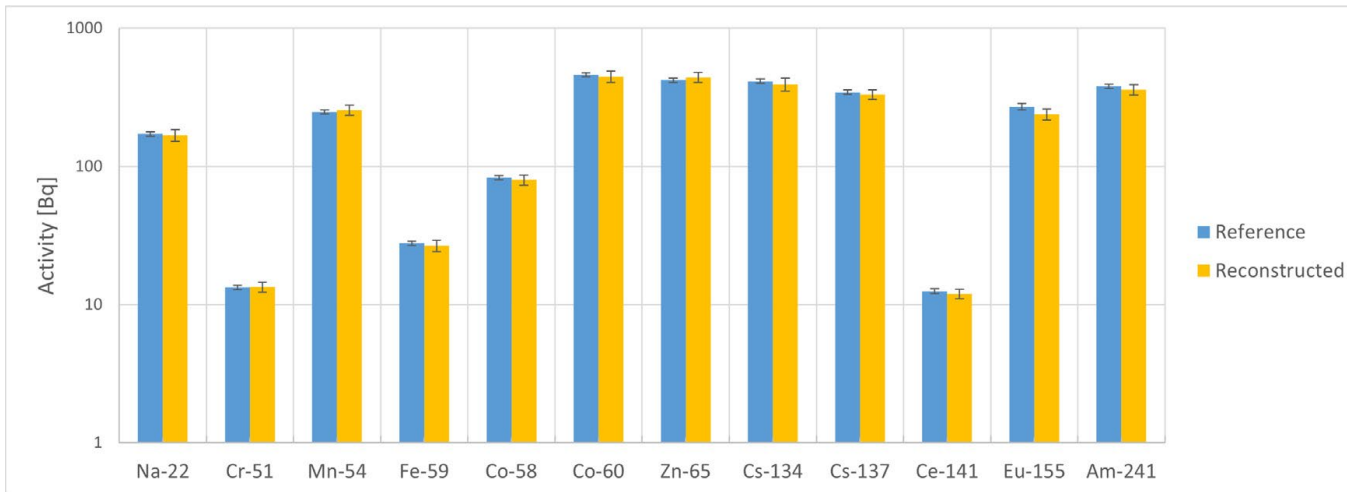


COSSU

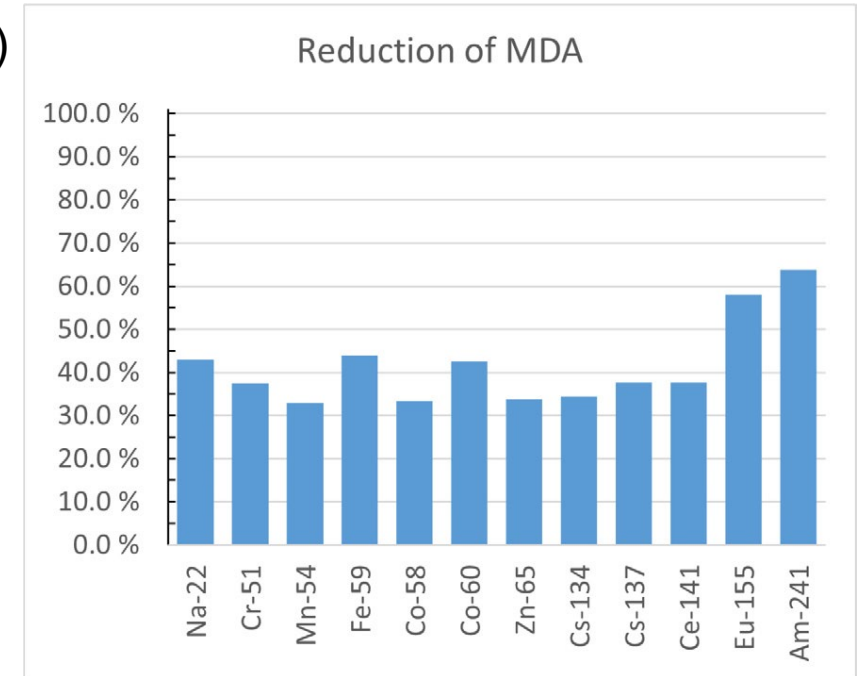
The COSSU device and the methods used with it were presented in:

- Hildén, T., Badran, H., Turunen, J., Peräjärvi, K., Pöllänen, R., 2023. Novel Compton suppression equipment in γ -ray spectrometry with list mode data acquisition. Applied Radiation and Isotopes 193, 110668.
<https://doi.org/10.1016/j.apradiso.2023.110668>
- Example 3 is taken from the article.

a)



b)



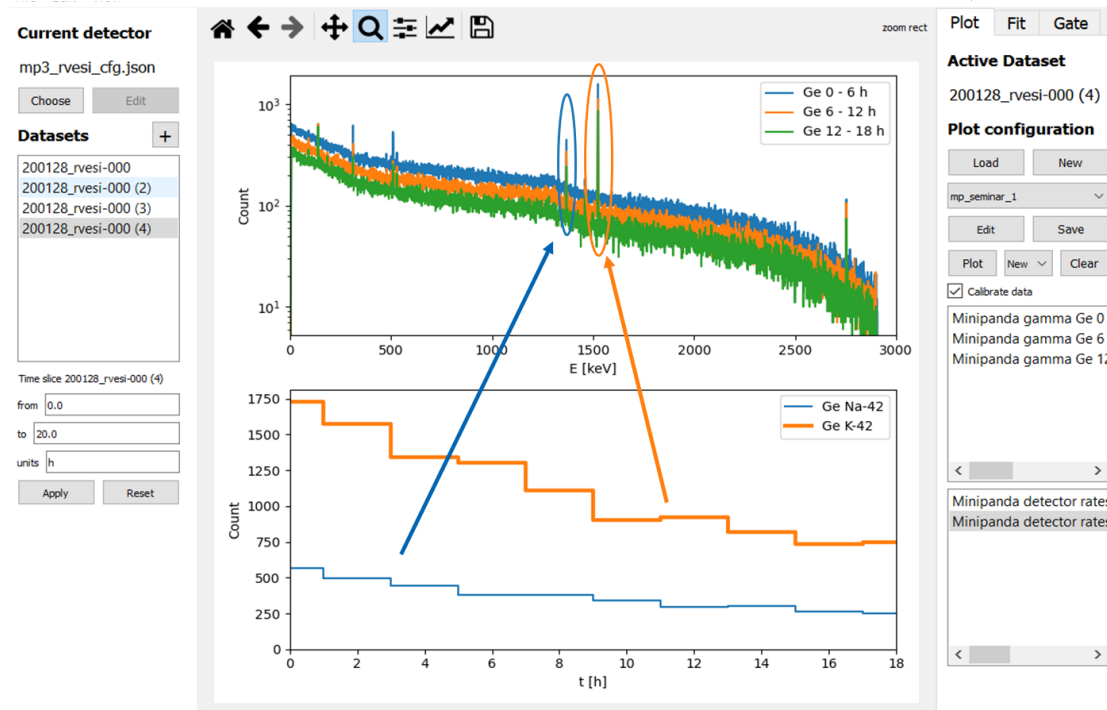
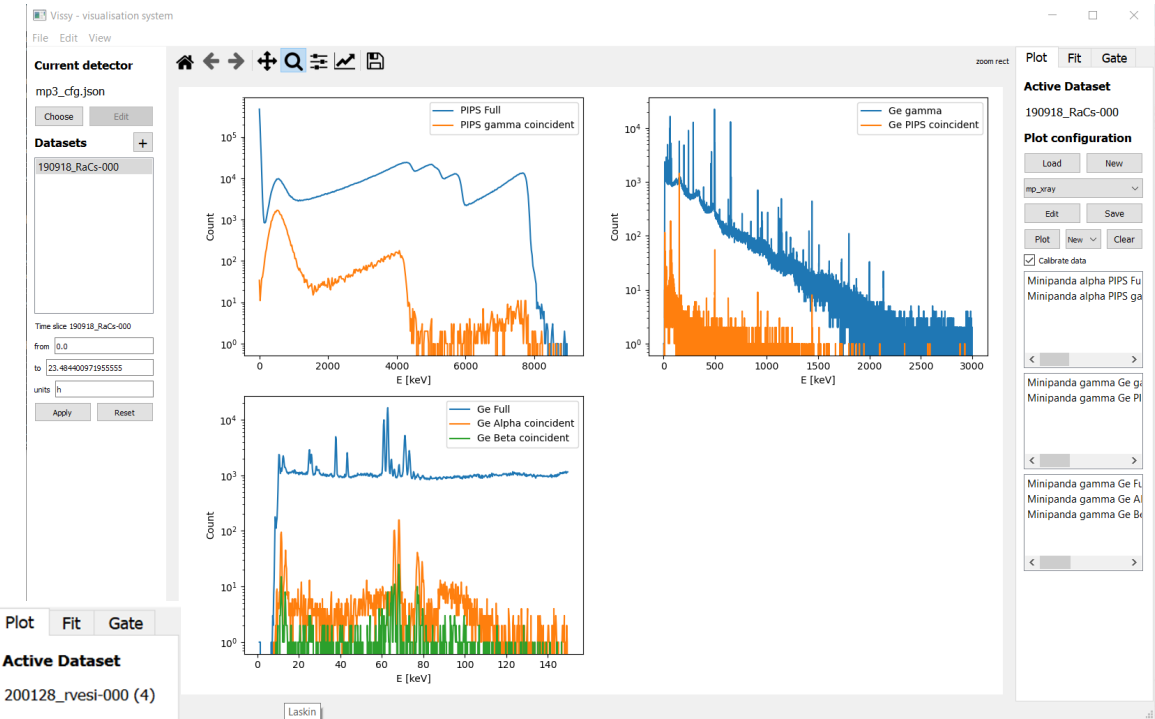
3. Certified reference source used to test COSSU

a) The reference sample activities by certificate (blue) and the measured activities from the reconstructed spectrum (yellow).

b) The MDA's from the reconstructed spectrum compared to the values determined from the singles spectrum for a 20.5 h measurement.

VISSY

- The data from MiniPANDA and COSSU are saved in list-mode.
- VISSY = Software developed at STUK to visualize, sort and analyse list-mode data.



COVERT

- COVERT = COsmic VEto for the Reduction of Total background.
- HPGe (BEGe, BE5030) inside a lead shield.
- Five plastic scintillator plates from Scionix.
 - One on the top and one on each side of the lead shield.
 - Signals are combined into one veto signal for the data acquisition.
- Note that, STUK's new laboratory facility has less concrete above the laboratory counting rooms than in the old facility.
- Tests of system planned for the end of 2023 and early 2024.
- If results are good, the system can quite easily be copied to other gamma spectrometers.

