Radeo

New method for the characterization of γ spectrometry detectors

Fast and accurate method based on the use of a neural network and Bayesian inference

Benefits of this new multiparameter characterization method for gamma spectrometry detectors

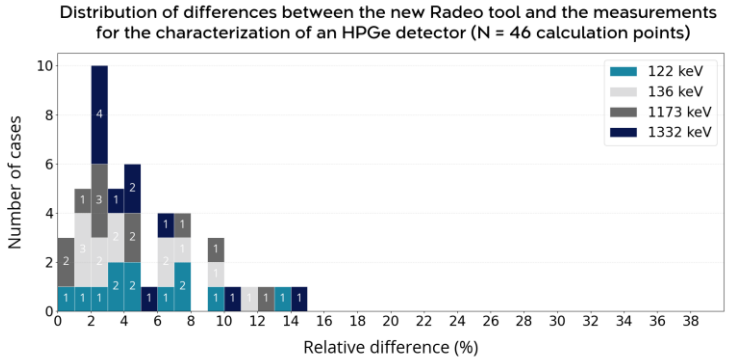
- **2 to 3 times faster** than the conventional manual method
- **Up to 10 parameters** can be adjusted simultaneously using Bayesian inference
- **Accurate uncertainty evaluation** for all parameters
- **Delivery of the MCNP model**

Performances

Use case: characterization of CZT and HPGe (high-purity germanium) detectors

Calibration vs. simulation: distribution of relative differences between measurements and models

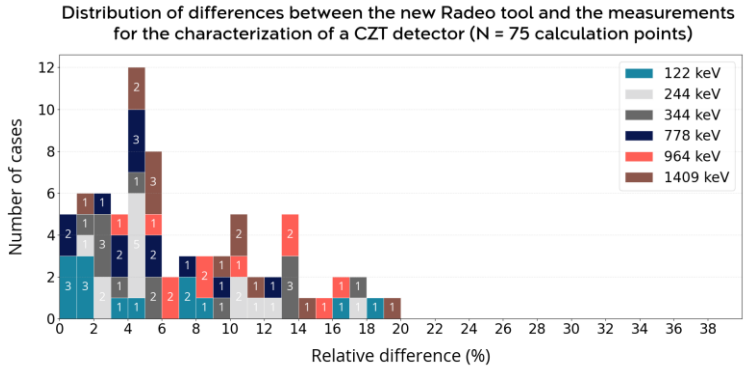
HPGe detector Sources : Co-57 & Co-60 (122–1332 keV) - 12 measurement configurations for 4 gamma energies



For an HPGe detector: all differences are **below 15%**

For a CZT detector: 90% of the differences are **below 15%**

CZT detector Sources : Europium-152 (122–1408 keV) - 13 measurement configurations for 6 gamma energies



Adjusted parameters :

- ✓ Dead layer dimensions
- ✓ Active crystal dimensions
- ✓ Crystal density
- ✓ Crystal chemical composition
- ✓ Entrance window thickness
- ✓ Air gap thickness between the window and the dead layer

y detector characterization

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Radeo, your single point of contact for:

- **Performing measurements** using radioactive sources suited to the detector
- Creating the detector's **MCNP model**
- **Adjusting the model's unknown parameters** and evaluating uncertainties

Your contact

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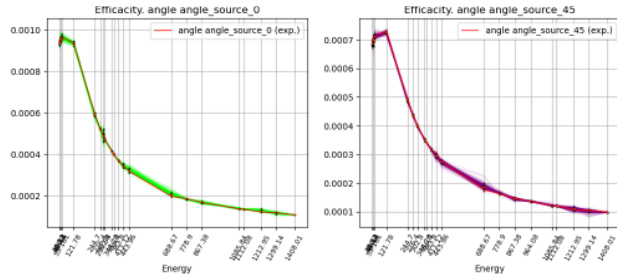
Radeo offers innovative measurement services based on highly mature prototypes developed in laboratories.

This characterization method is the result of a collaboration between Radeo and a public research laboratory.

Procedure

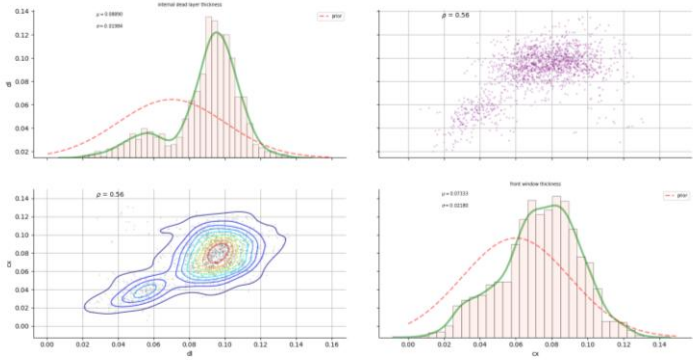
Multi-energy measurement	Source ^{152}Eu
Measurement grid	Over 20 measurements at different angles and distances
Creation of the MCNP model	Preliminary model of the geometry
Definition of nuisance parameters	Model input data with known uncertainties are fed into the software.
Definition of the unknowns in the model	AI adjusts for unknown model parameters
Automatic adjustment of the unknowns	AI adjusts for unknown model parameters

Goal: Reduce discrepancies between measured and modeled efficiency curves



Deliverables

- ✓ **Efficiency curves** associated with measurement configurations.
- ✓ **A comparative analysis** of modeled and measured efficiency curves
- ✓ **The adjustment value of the parameters** and their uncertainties
- ✓ **The MCNP model** of the detector
- ✓ **A technical characterisation report**



Example of statistical distributions of adjusted parameters and associated uncertainty (curves on the diagonal)