

Portable LaBr₃ Detector Characterization and Radioactivity Calculation using the InterSpec and GADRAS-DRF

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Introduction

- In the management of radiological crime scenes, it is important to quickly analyze unidentified sources.
- Mirion's In Situ Object Counting System (ISOCS) is leading in this field and has excellent performance, but software is expensive, and it takes a lot of time and money to create DCG.
- Introduced InterSpec and GADRAS-DRF, free software that enables simple detector characterization and activity calculation.

Method and Result

◆ Detection of gamma sources

- To obtain spectrum data, Mirion's SPIR-Ace LaBr₃(Ce) model was used in the experiment as shown in Fig. 1.

Table I. Data of gamma source used in the experiment. The activities were corrected to the experiment date.

Source	²⁴¹ Am	¹³³ Ba	⁶⁰ Co	¹³⁷ Cs	¹⁵² Eu
Activity (uCi)	50.754	8.129	3.869	9.177	19.274

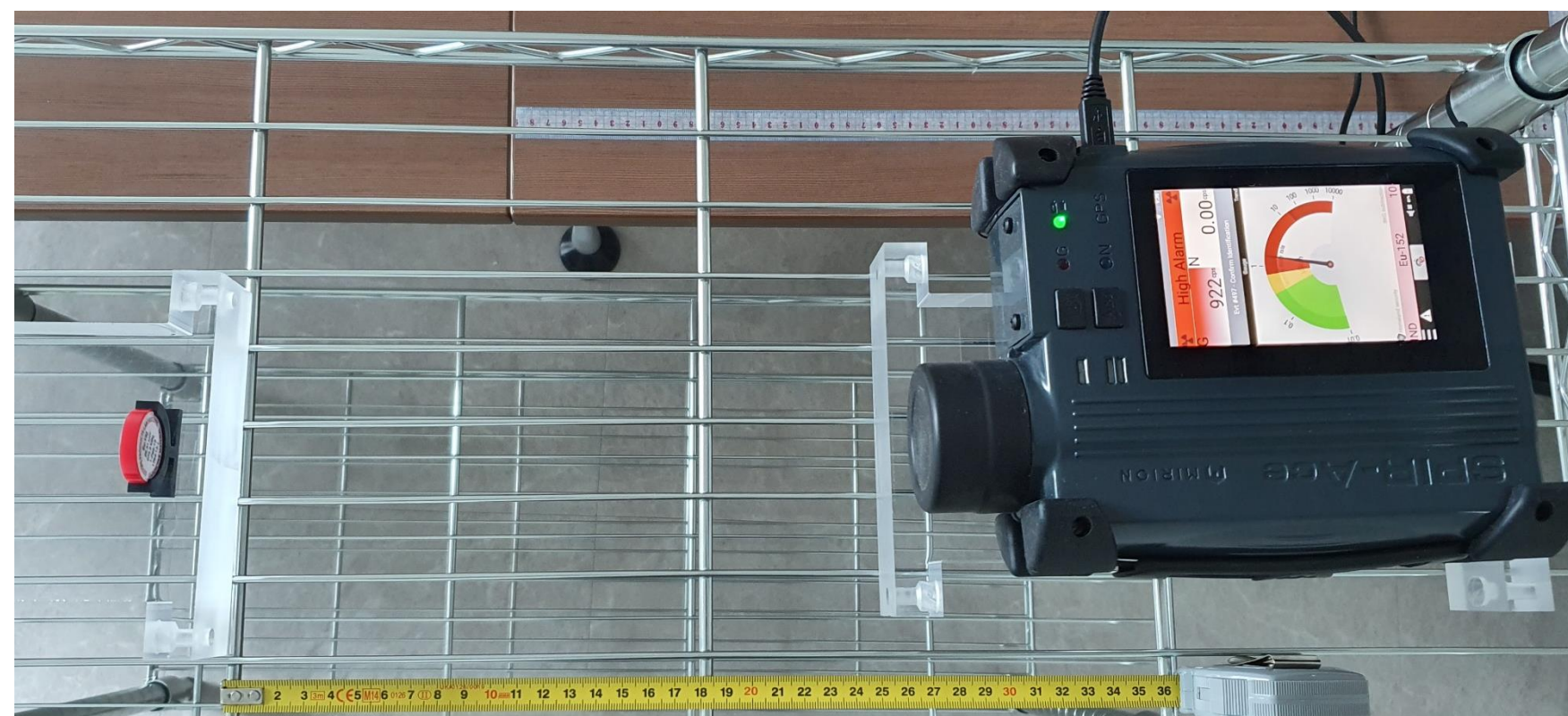


Fig 1. Instruments for experimental measurements : Bruker S1-Titan 600 (LaBr₃ scintillator size : 1" by 1.34")

◆ InterSpec

- Energy calibration** : The full energy peaks of the source (²⁴¹Am, ¹³³Ba, ⁶⁰Co, ¹³⁷Cs) were specified in the **InterSpec**.
- Make Detector Response** : Appropriate peaks and parameters, and activity of sources are entered **Intrinsic efficiency and FWHM** are fitted and displayed.

◆ Activity/Shielding Fit :

- Apply the response function of LaBr₃ detector previously made.
- Specify the peaks of the interested source (¹⁵²Eu) in spectrum.

◆ Calculated Activity of ¹⁵²Eu

→ 17.24 ± 0.033 uCi

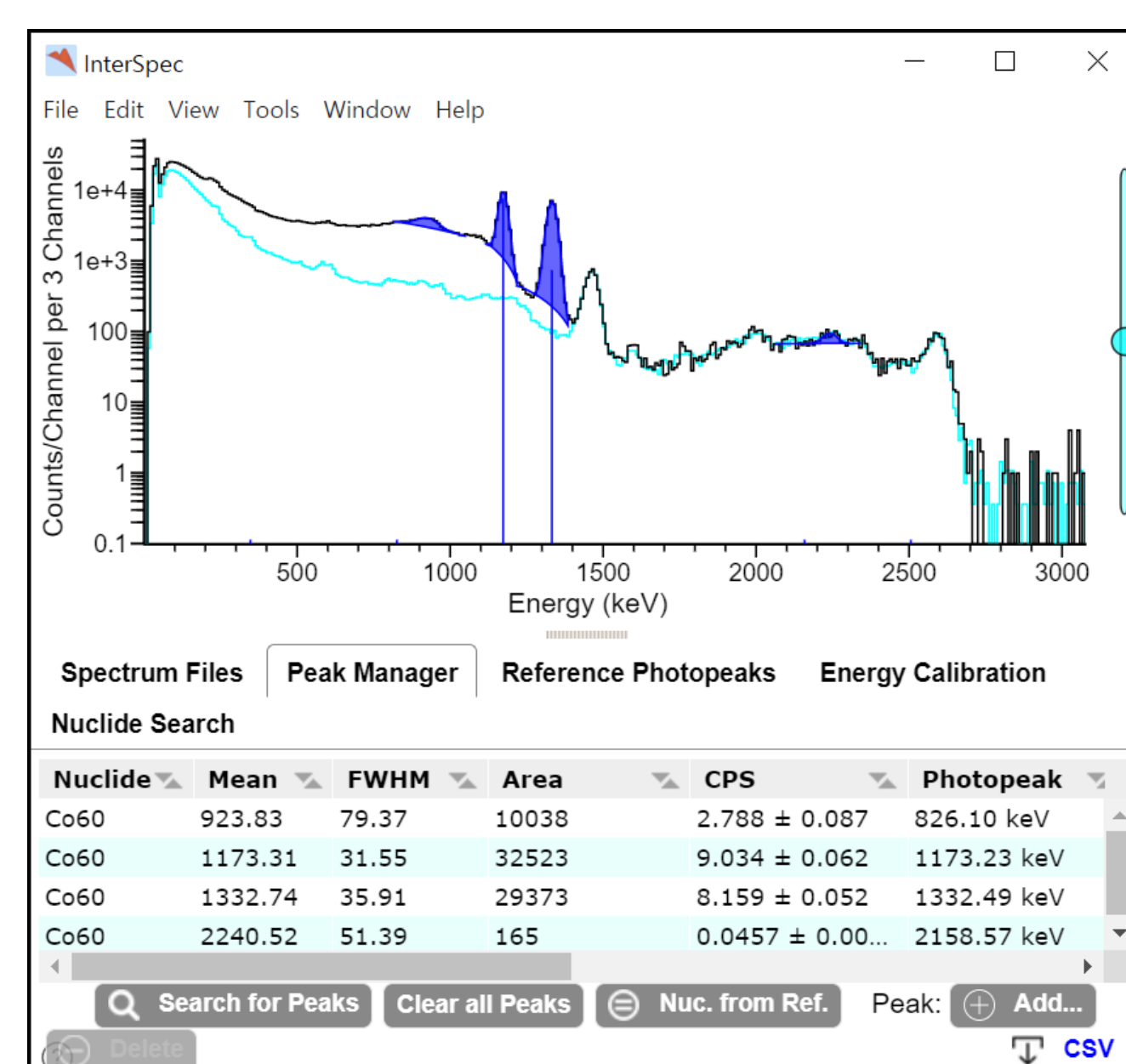


Fig. 2. The energy spectrum of ⁶⁰Co source and specified peaks

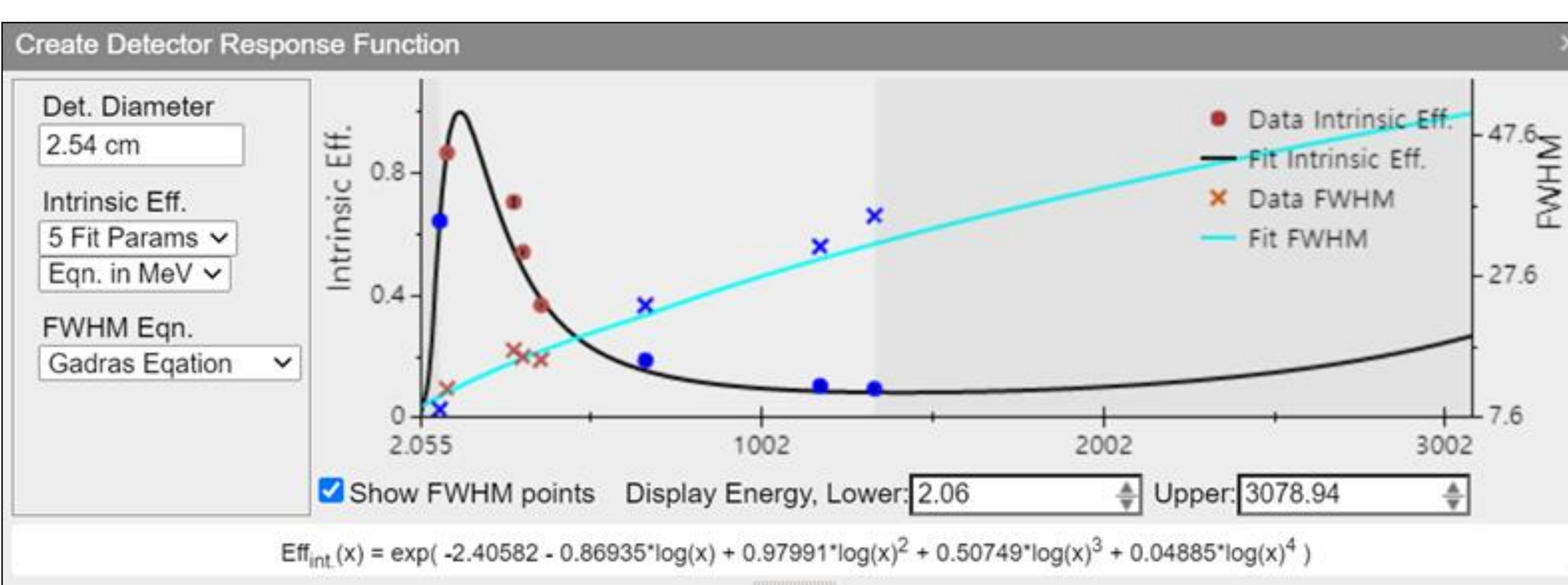


Fig 3. Create Detector Response Function window in the InterSpec.

◆ GADRAS-DRF

- Unlike **InterSpec**, the GADRAS-DRF uses pre-calculated and embedded detector efficiency and FWHM.

◆ Detector response function :

- Input various geometry parameters and types of detectors such as LaBr₃, NaI, and HPGe.
- The calculation is performed by applying the variable to embedded value.

◆ Activity calculation in Analyze tab :

Specify the location of source and additional shield, and the type of source

◆ Calculated Activity of ¹⁵²Eu → 18.23 ± 0.05 uCi

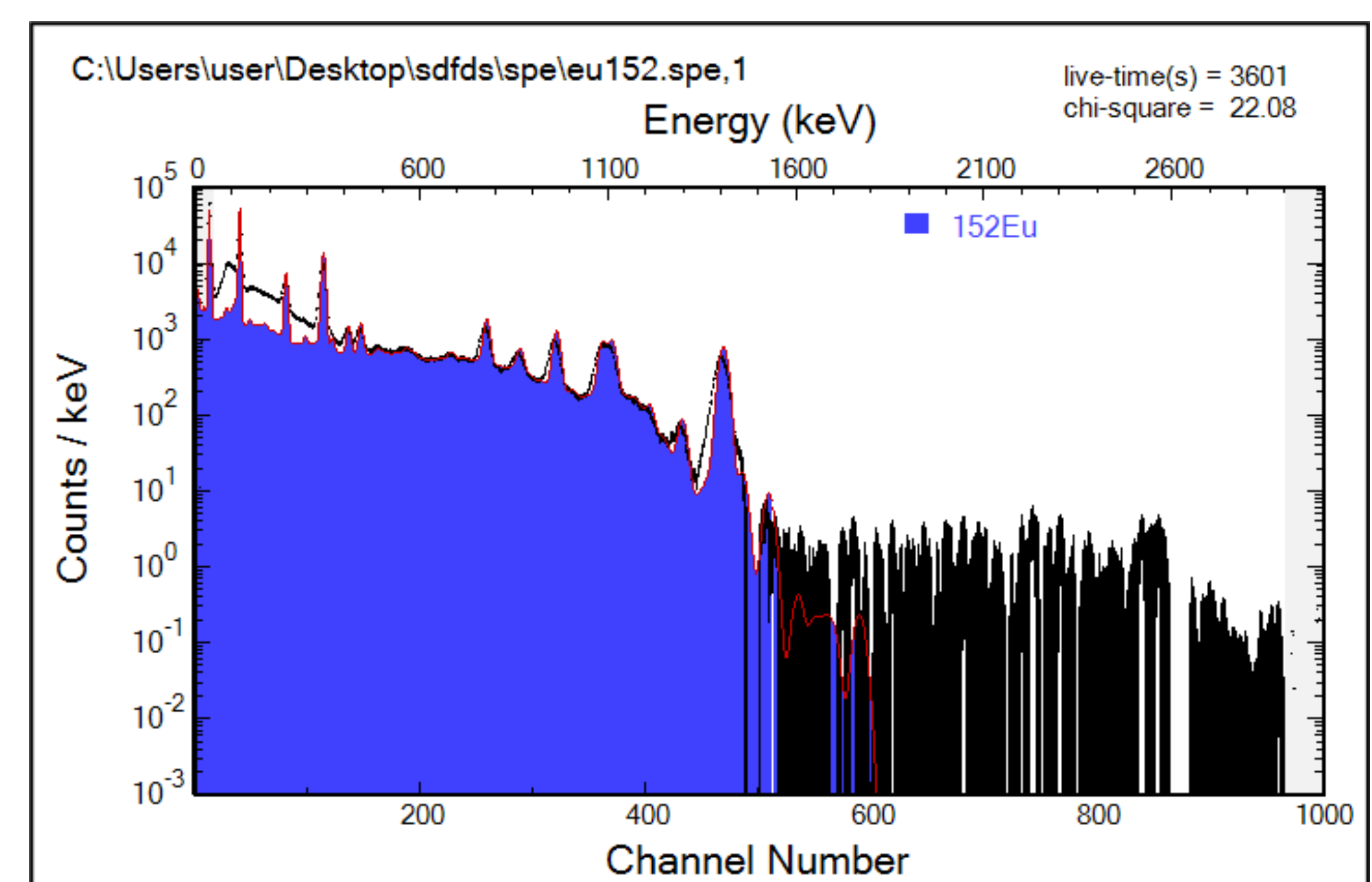


Fig. 4. Energy spectrum of ¹⁵²Eu from the experiment and calculation from GADRAS-DRF.

Conclusion

- The calculated values of activity of ¹⁵²Eu were 17.24 uCi and 18.23 uCi, respectively. The relative errors for the corrected activity of 19.274 uCi were 11.8% and 5.73%, respectively. More detailed settings of **GADRAS-DRF** made the calculations more accurate than **InterSpec**.
- The result of this study will be used as basic information for analysis of nuclear material.
- In the future, a technology optimized for preliminary characterization of unidentified nuclear materials using a portable gamma detector will be developed to maintain safety from nuclear accidents.

Acknowledgement

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