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Title: NaI Measurements of Plutonium & Other Sources with the INL Coin

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NaI Measurements of Plutonium & Other Sources with the INL Coin

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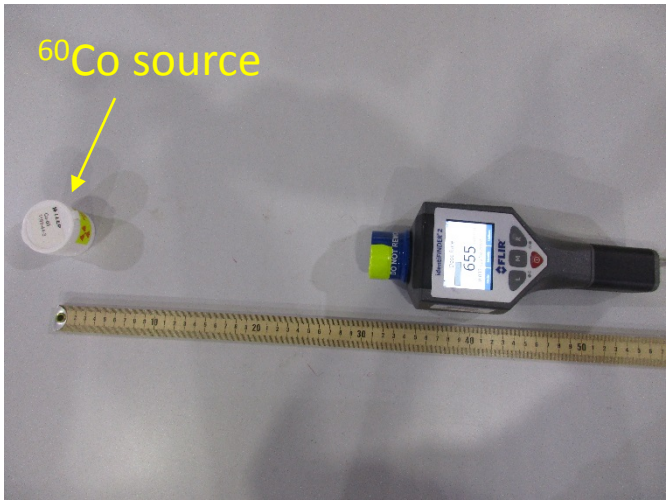
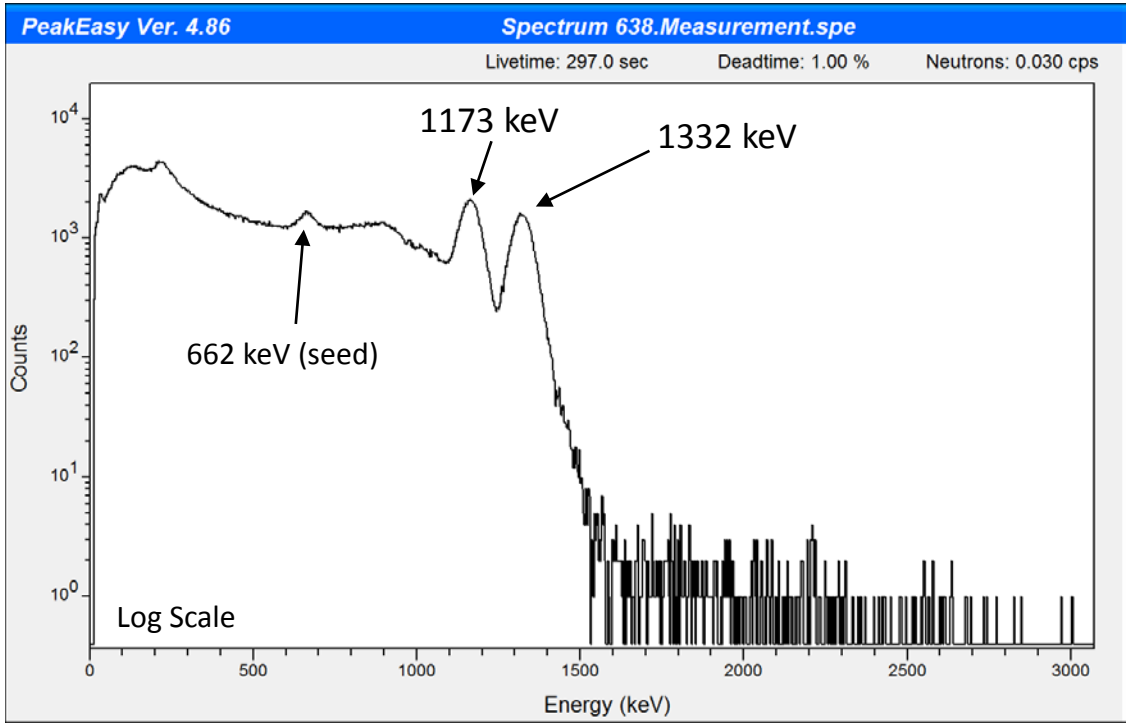
Introduction

- Several low-resolution (NaI) gamma-ray measurements were conducted with an IdentFINDER2 and the INL (dose ratio) Coin
- These slides summarize the effect of the INL Coin on gamma-ray spectra for ^{60}Co, ^{137}Cs, and plutonium.
- An investigation into gamma-ray scattering was also performed to explain a spectrum anomaly.

^{60}Co (bare) Baseline Spectrum

A bare 48 uCi ^{60}Co source was measured at ~ 30 cm from a NaI IdentiFINDER 2. ID was ^{60}Co.

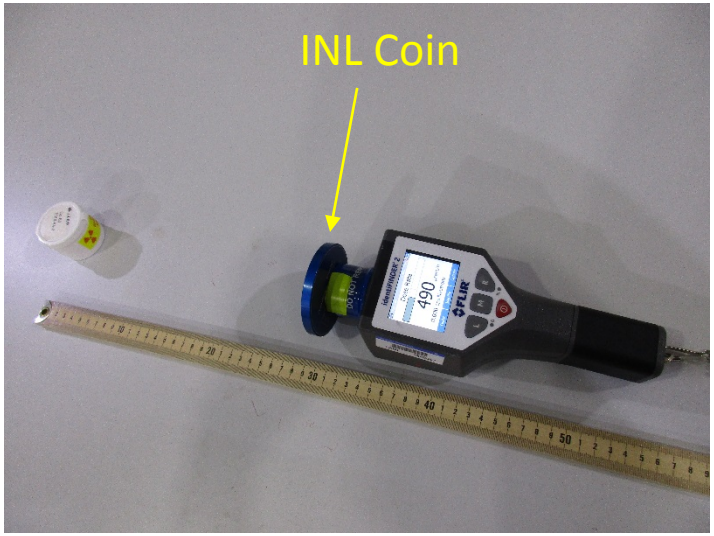


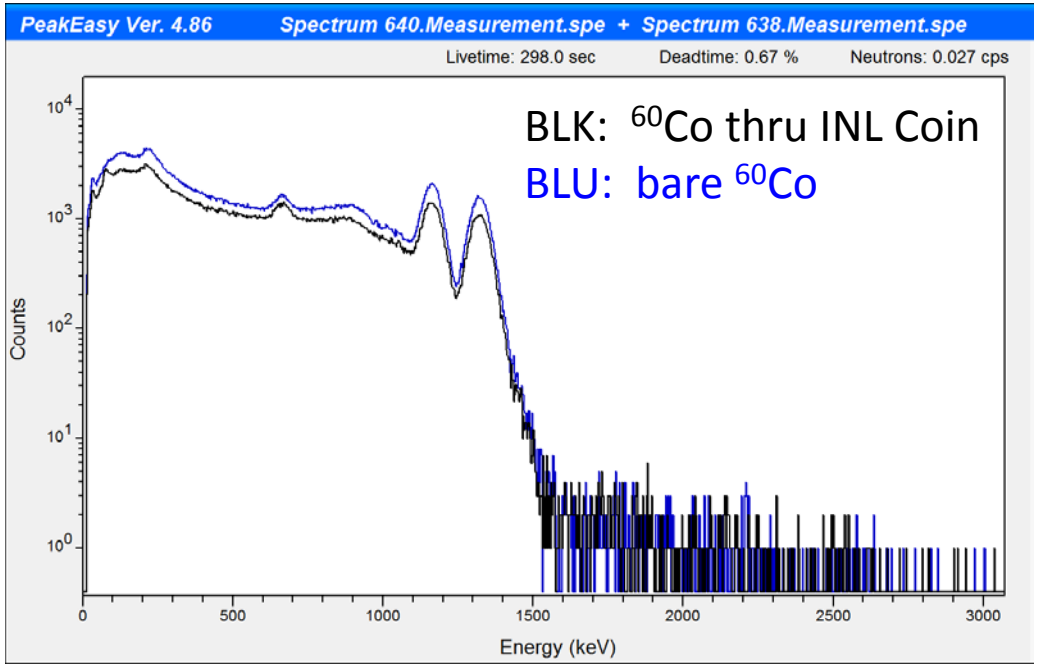


The two prominent gamma-ray peaks from ^{60}Co are at 1173 and 1332 keV. This is what we normally consider fairly high energy and the INL Coin will have only a slight effect on them.

^{60}Co + 1 INL Coin

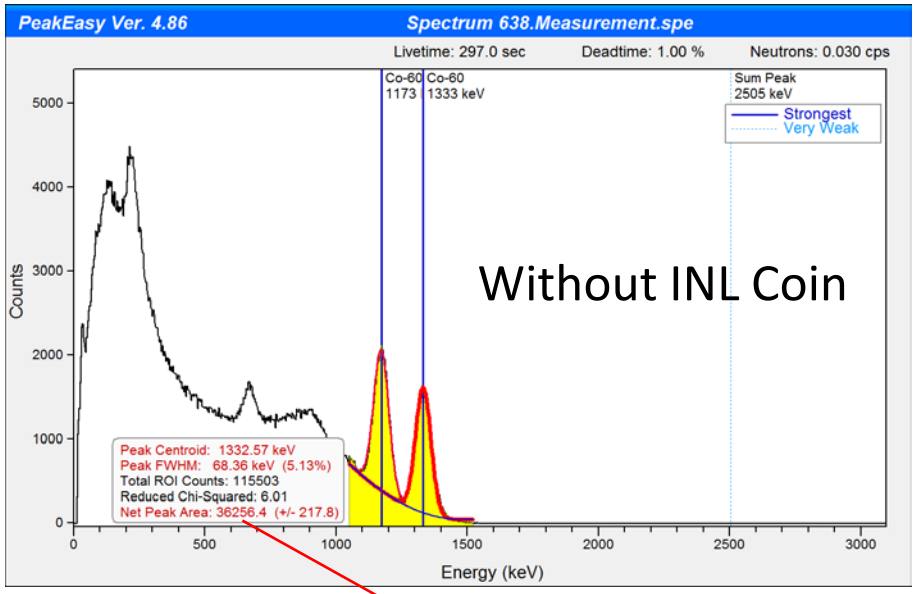
A single INL Coin was placed between the ^{60}Co source and the IdentiFINDER 2.
ID was ^{60}Co.

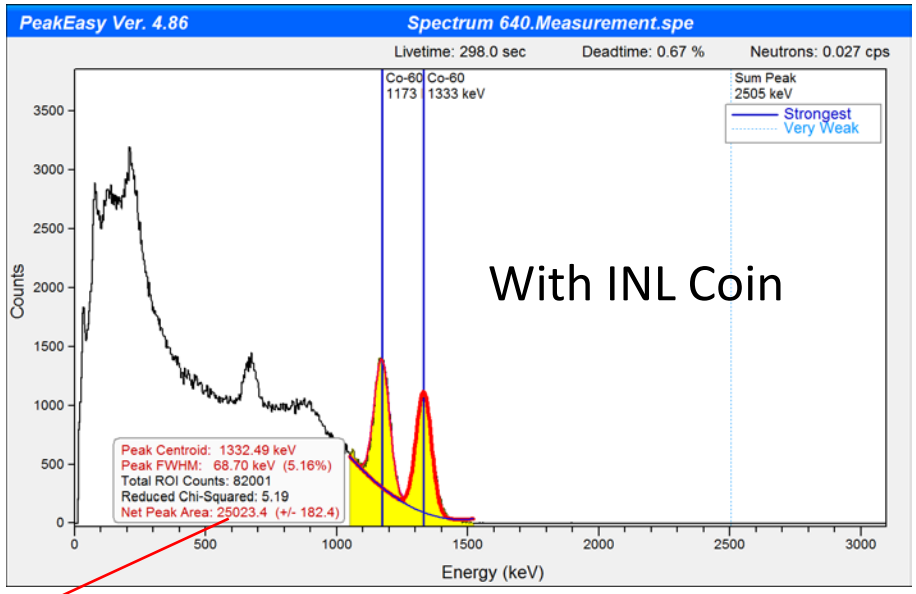




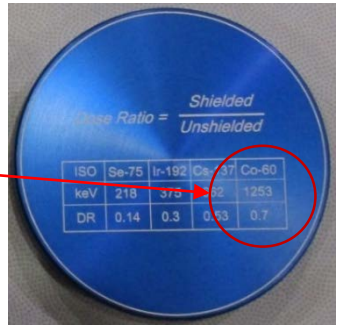
Effect of INL Coin on ^{60}Co Peak Area

Here we compare the **peak area** of the 1332-keV peak of ^{60}Co as measured with the INL Coin to that without.





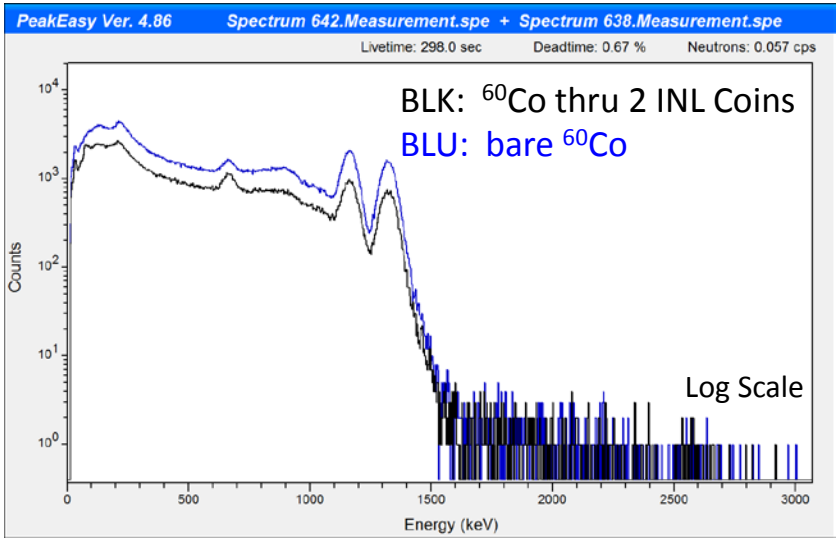
$$\mathrm{T} = \frac{I}{I_0} = \frac{25023}{36256} \approx 0.69$$

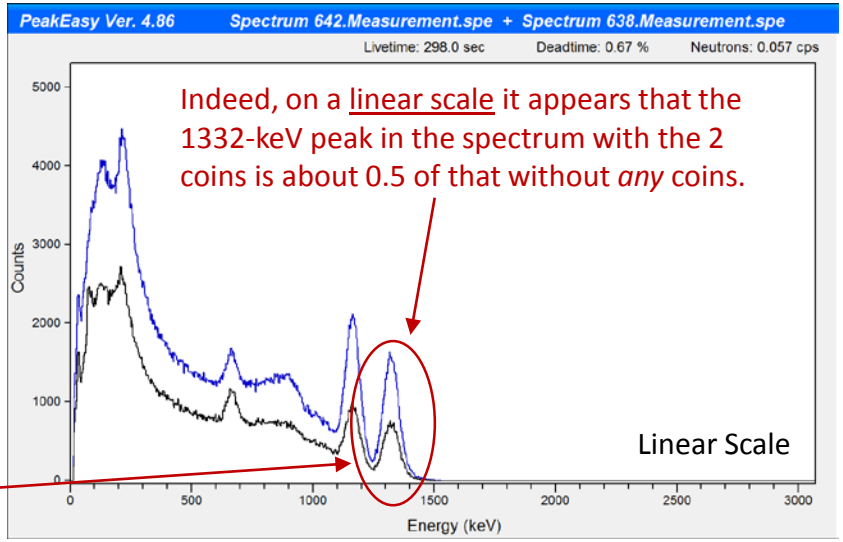


This is called the 'transmission'. It describes the fraction of gammas *at a specific energy that* get through an attenuator.

^{60}Co + 2 INL Coins

Two INL Coins were placed between the ^{60}Co source and the IdentiFINDER 2.
ID was ^{60}Co.



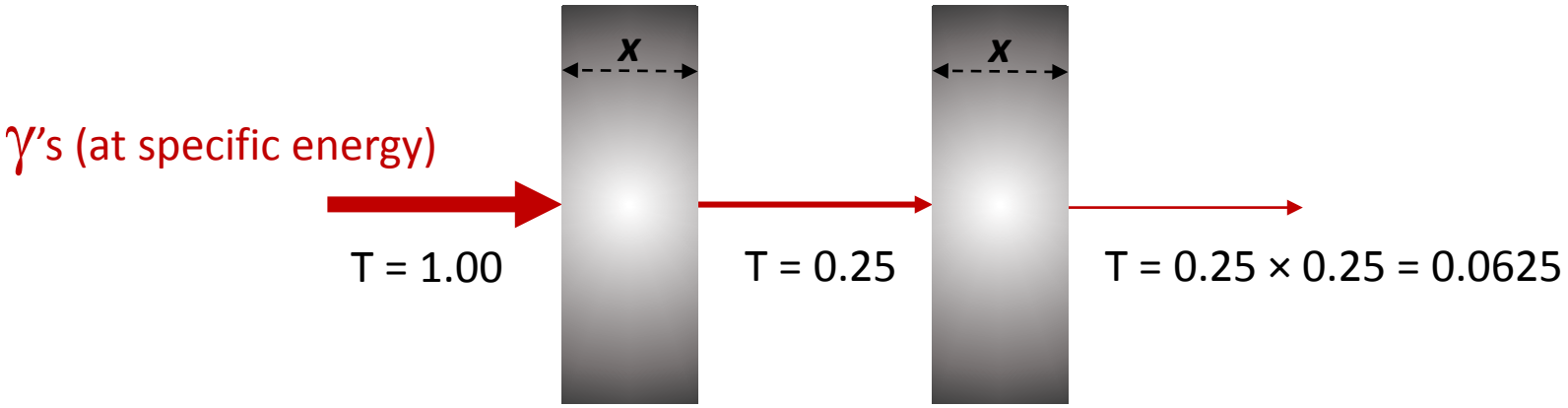


Transmission factors multiply, so since the transmission through 1 coin was 0.7, for two coins the transmission will be:

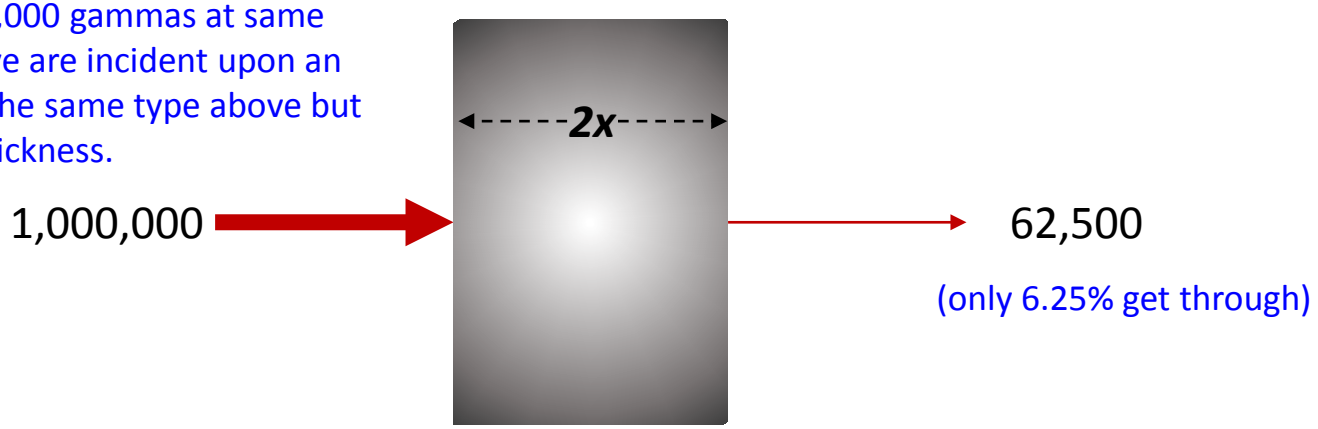
$$T = 0.7 \times 0.7 \approx 0.5$$

More on Transmission

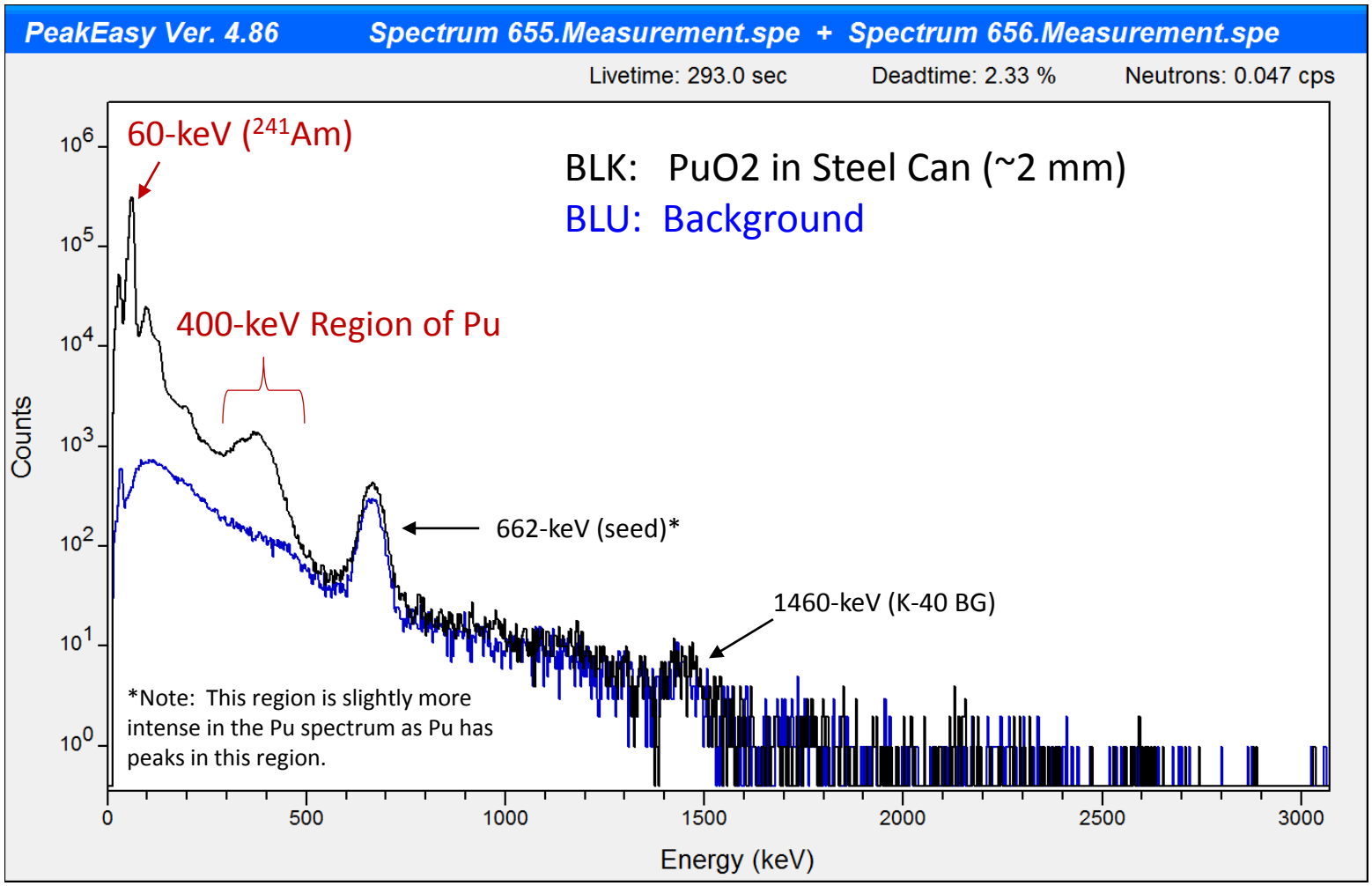
Shielding of the same type and thickness , ***x***



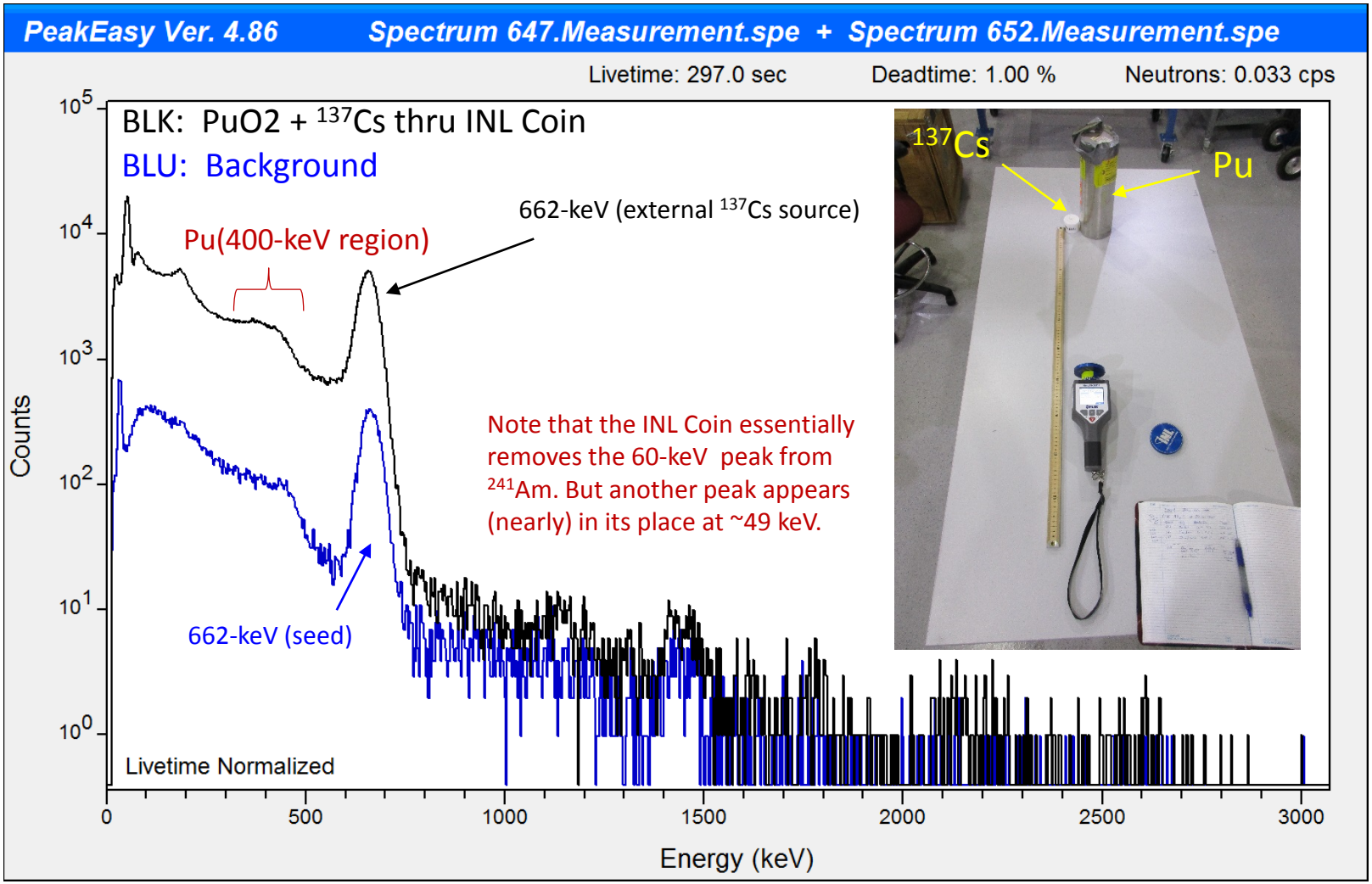
Let's say 1,000,000 gammas at same energy as above are incident upon an attenuator of the same type above but of twice the thickness.



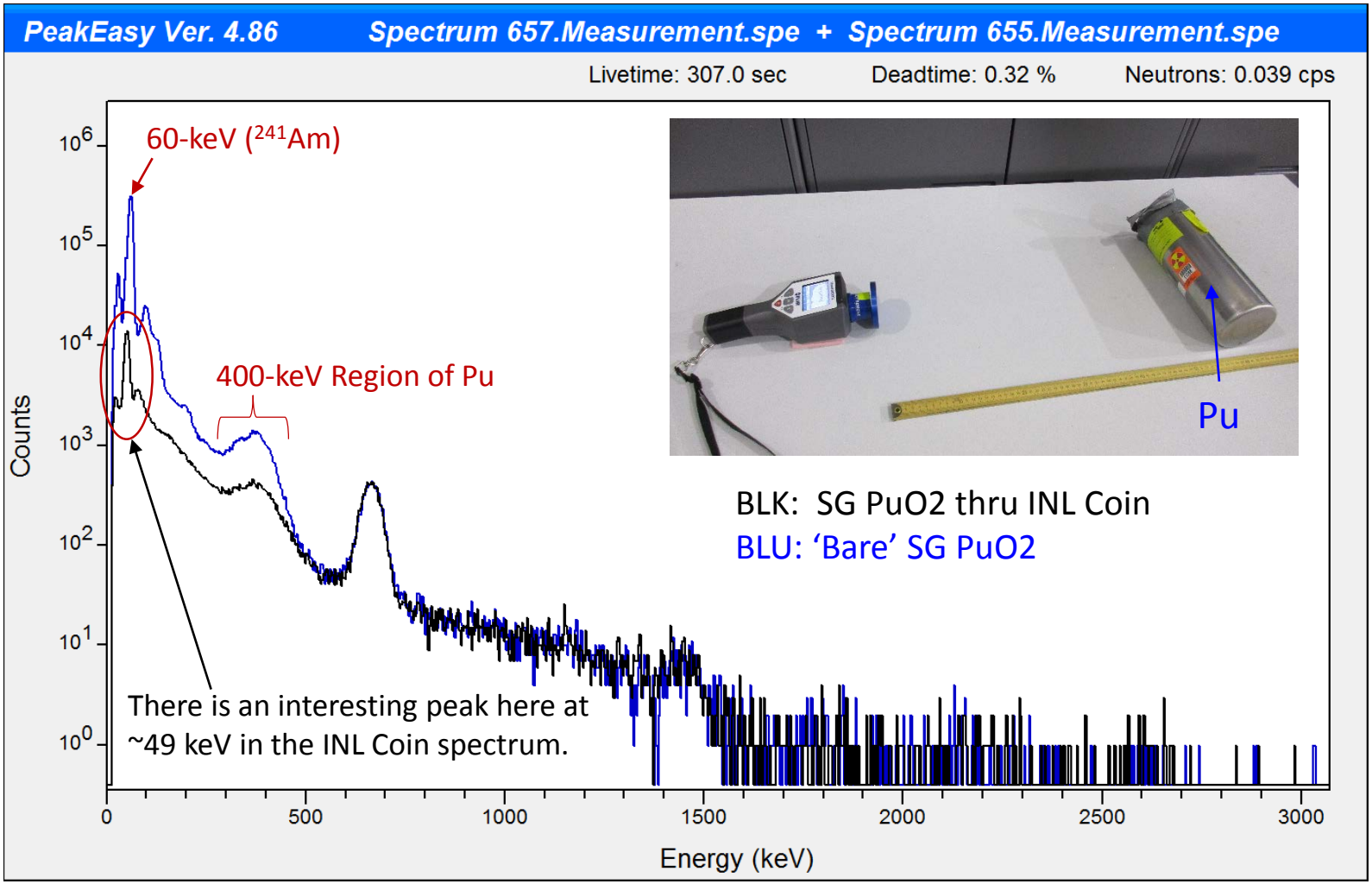
‘Bare’ Super-Grade (SG) Plutonium



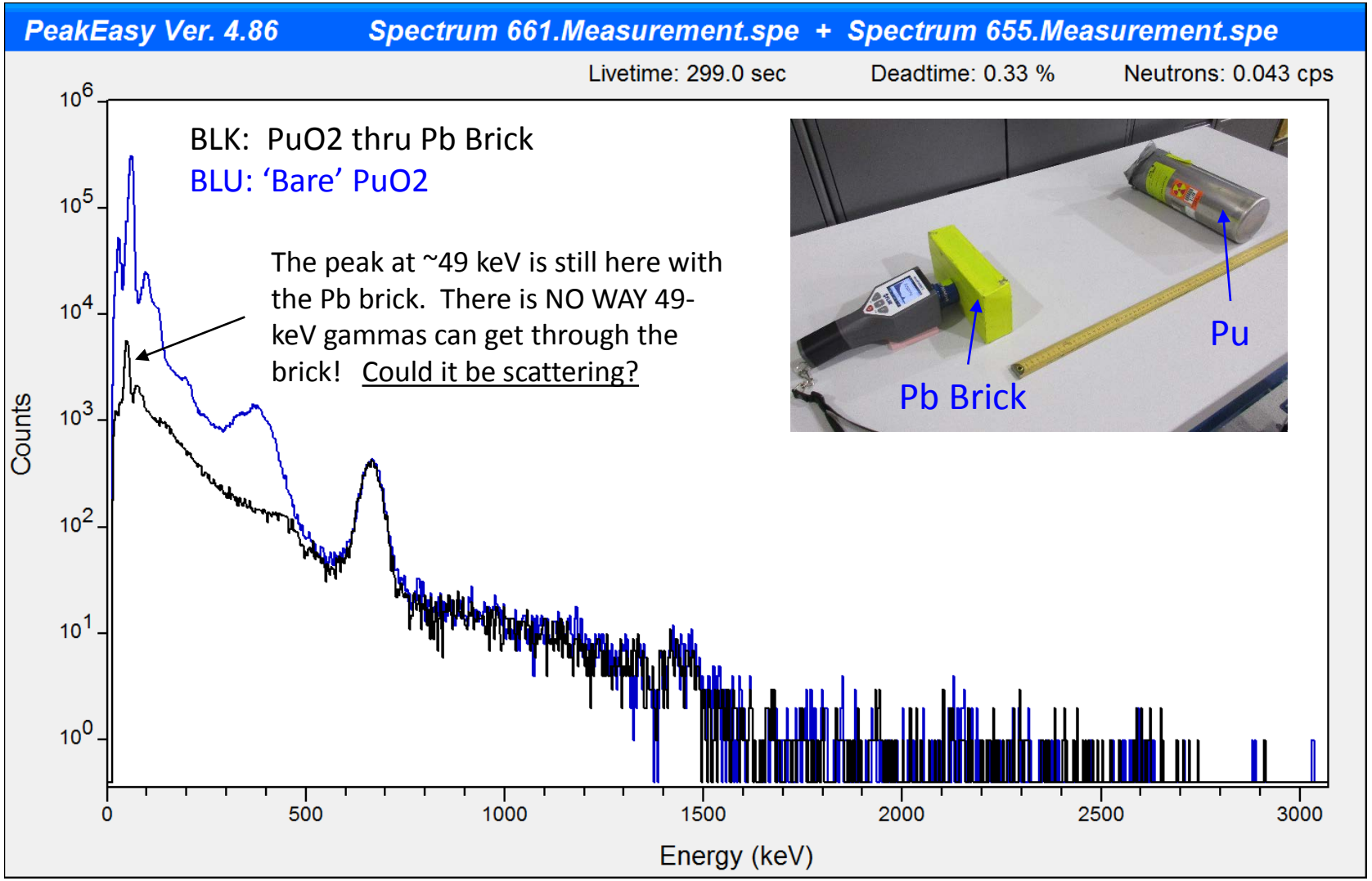
SG Pu + ^{137}Cs thru INL Coin



Bare Pu vs. Pu thru INL Coin

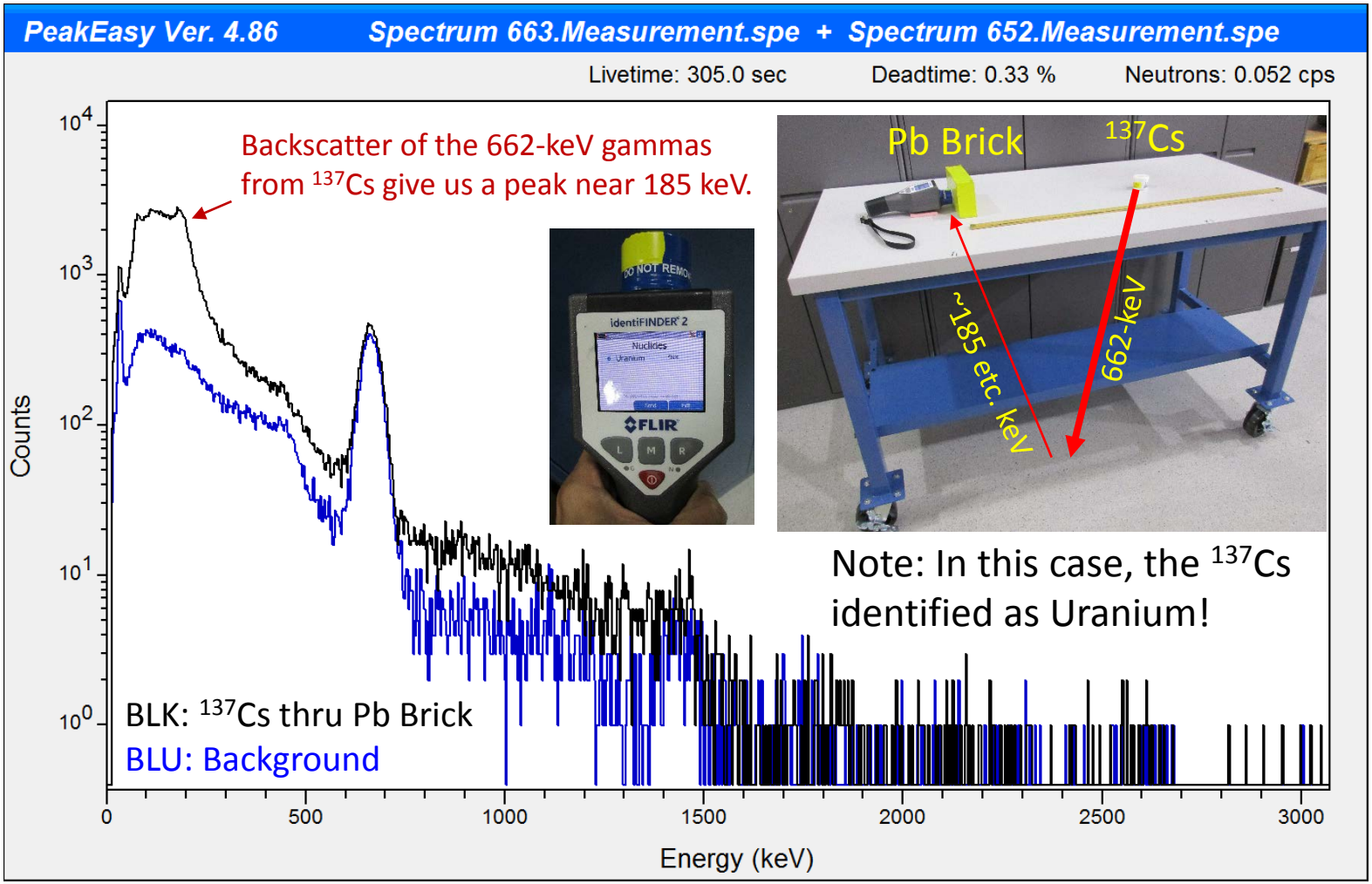


SG Pu thru 2” Pb brick

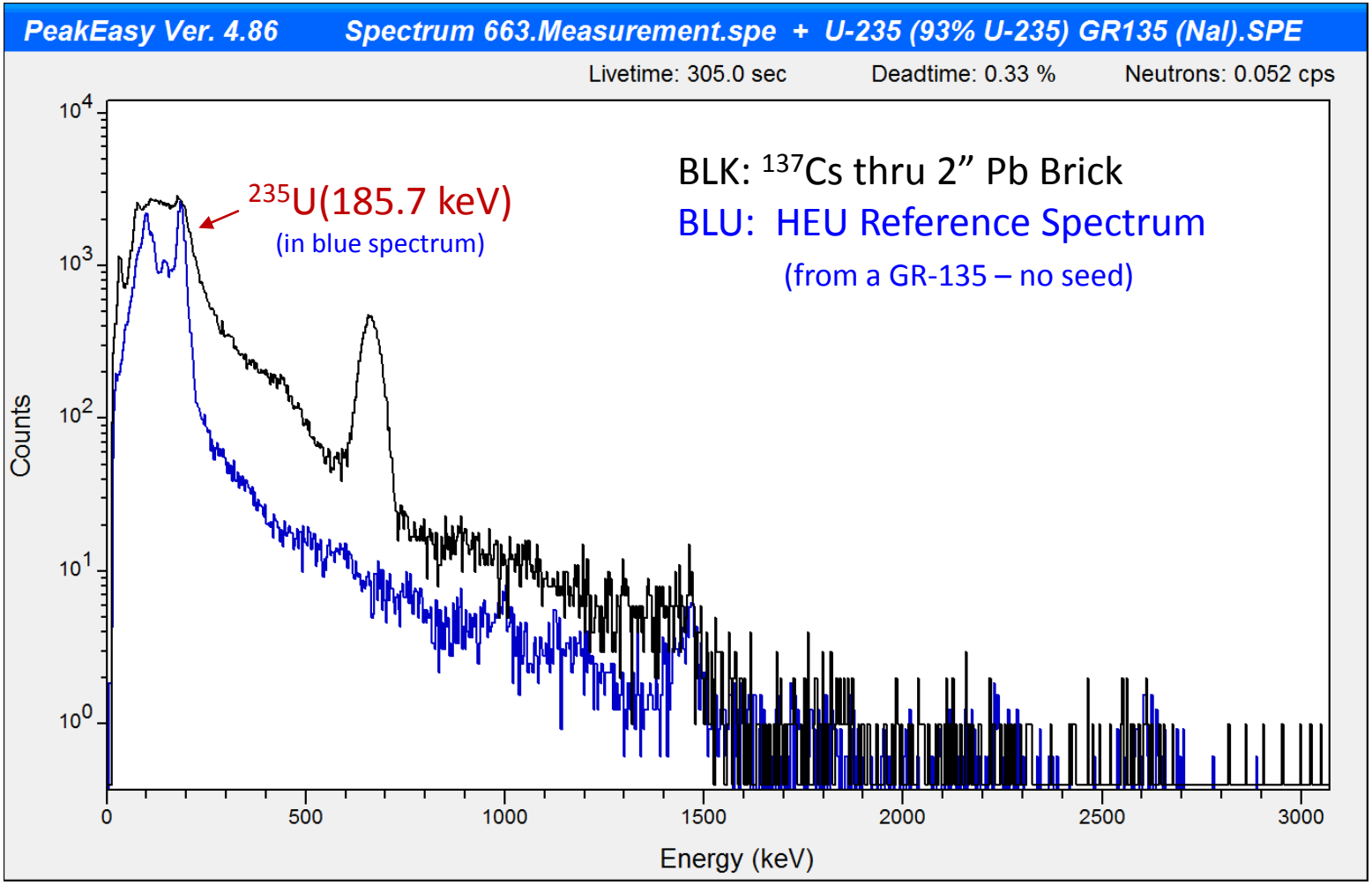


^{137}Cs Scattering Study

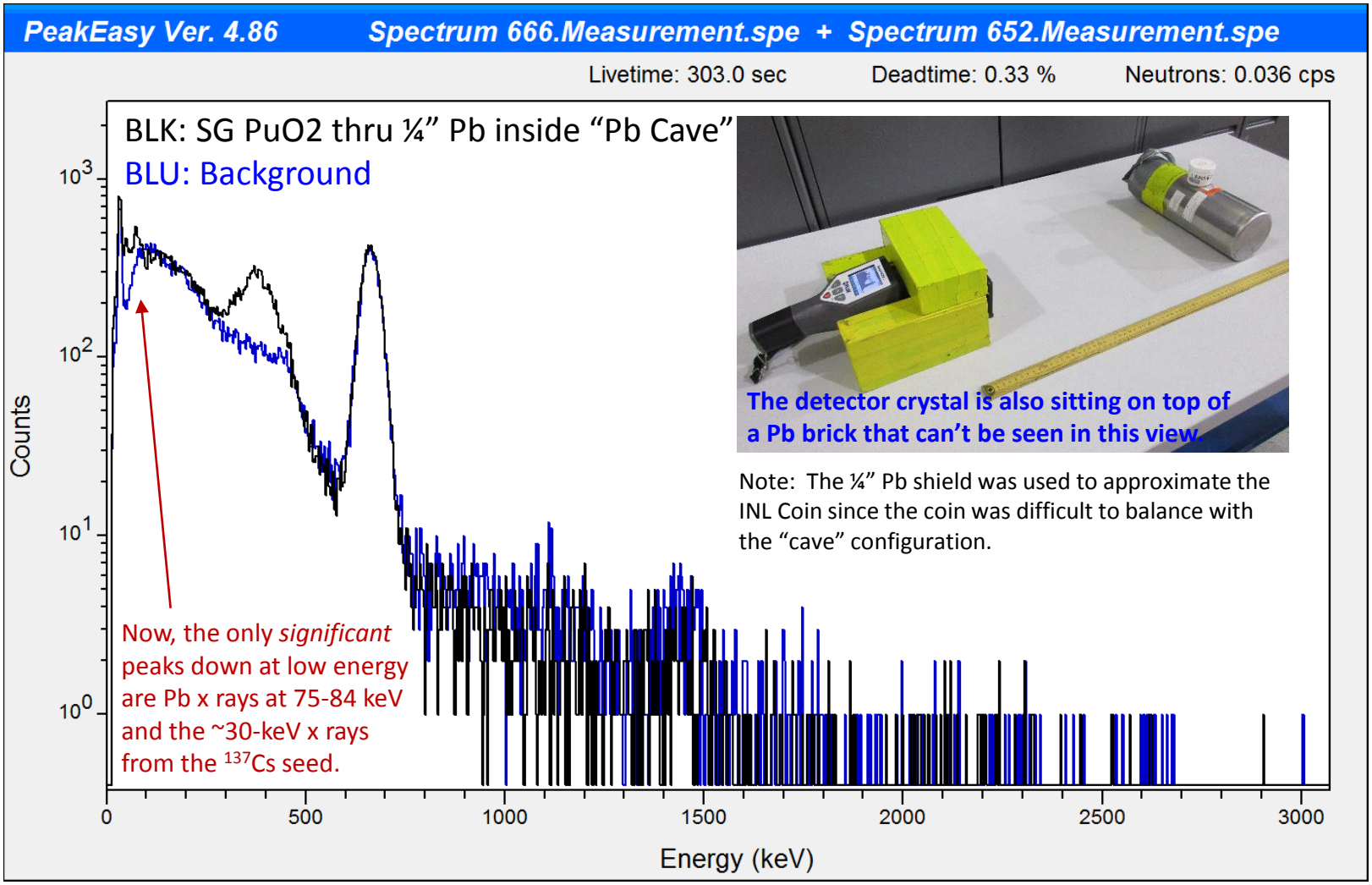
To study the possibility that the 49-keV peak is just scattering of the 60-keV peak of ^{241}Am we use ^{137}Cs (it has a simpler spectrum than Pu) with the Pb brick on the table.



Why does scattered ^{137}Cs ID as U?



Eliminating the Scattered Peak



Summary

- Spectra recorded with and without the INL Coin illustrate how transmission plays a role in the dose-ratio factors written on the coin
  - Note: the coin references dose ratios, which are not exactly the same thing as peak area ratios.
- Plutonium was measured through the coin with and without the presence of other nuclides
- Nuclide ID results vary greatly.
- The issue of unwanted scattering reinforces documenting (through photos etc.) the measurement geometry and environment.