LA-UR-19-29735
Approved for public release; distribution is unlimited.

Title: Summing Corrections For La-140 On Counter 137

Author(s): James, Michael R.

Intended for: Report

Issued: 2019-09-26

**Disclaimer:**
Los Alamos National Laboratory, an affirmative action/equal opportunity employer, is operated by Triad National Security, LLC for the National Nuclear Security Administration of U.S. Department of Energy under contract 89233218CNA000001. By approving this article, the publisher recognizes that the U.S. Government retains nonexclusive, royalty-free license to publish or reproduce the published form of this contribution, or to allow others to do so, for U.S. Government purposes. Los Alamos National Laboratory requests that the publisher identify this article as work performed under the auspices of the U.S. Department of Energy. Los Alamos National Laboratory strongly supports academic freedom and a researcher's right to publish; as an institution, however, the Laboratory does not endorse the viewpoint of a publication or guarantee its technical correctness.

# Summing Corrections For La-140 On Counter 137

Michael R. James

25-Sep-2019

Managed by Triad National Security, LLC for the U.S. Department of Energy's NNSA

# Abstract

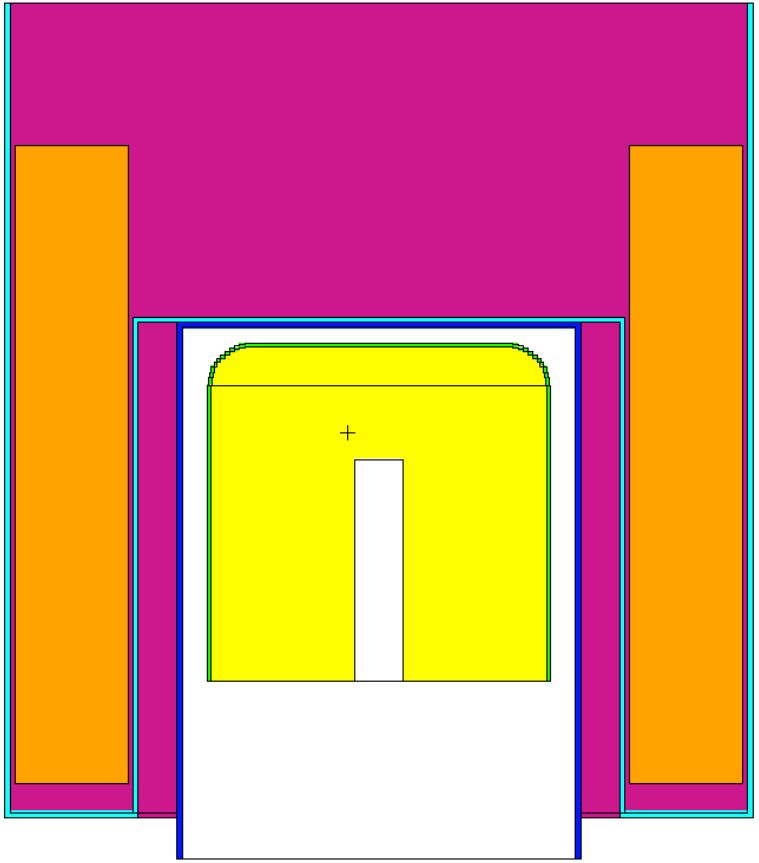
The counting of filters for gamma activity is often done with the sample situated very close or wrapped around the detector. This improves the counting statistics but can increase the probability of summing and affect the calculation of yield. An MCNP model of counter 137 (a 65% HPGe detector) was used to compute the total and peak efficiencies for two sample types, 40 and 20. The type 40 is a long filter strip wrapped in a Marinelli beaker which sits around the detector in an annular fashion. The type 20 is a 8.4 in radius filter, quarter-folded and placed flat on the detector face. A comparison of the peak efficiency computed in MCNP was compared to the measured efficiency to ensure consistency.
Using the measured peak efficiency and MCNP-computed total efficiency, the TrueCoinc program was run to estimate the summing values for La-140 peaks. The results showed the summing out of two peaks (487 and 1596 keV) was around 6-8% in for both sample types.

# Introduction

- MCNP models of Counter 137 were made with two sample types.
  - Type 40 – filter strip in a Marinelli container
  - Type 20 – Quarter-folder round filter.
- The peak and total efficiencies were computed and compared to the measured peak efficiency.
- The efficiencies were input to the TrueCoinc program and using the internal La-140 library, summing of the major peaks was computed.

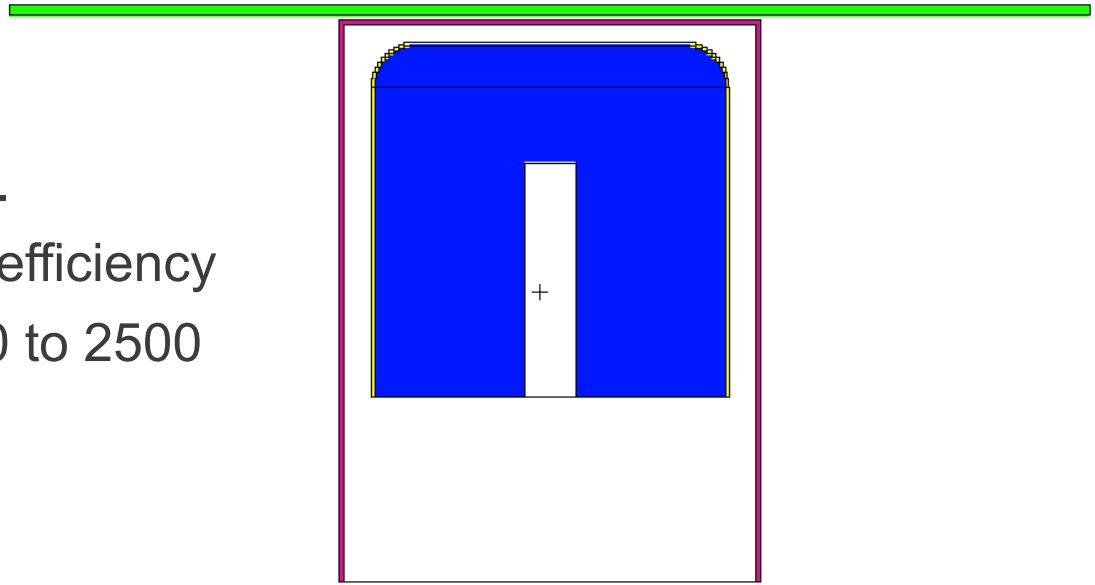
# MCNP Model – Type 40

- Filter and detector model.
- Tallies for total and peak efficiency.
- 28 energies used from 50 to 2500 keV



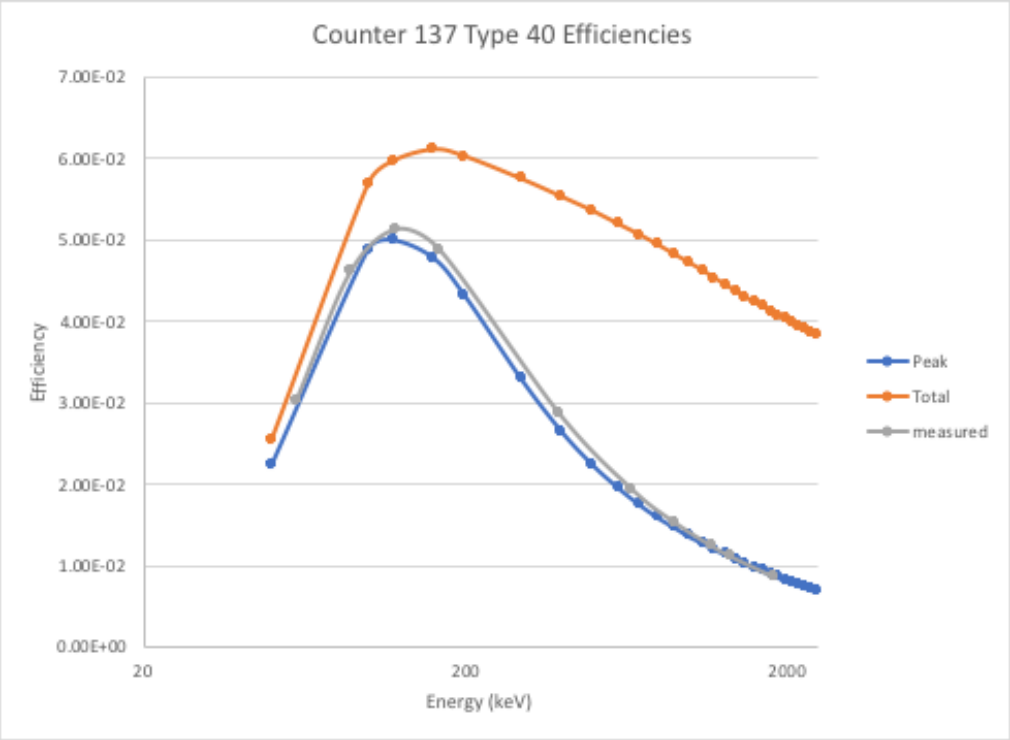
# MCNP Model – Type 20

- Filter and detector model.
- Tallies for total and peak efficiency
- 28 energies used from 50 to 2500 keV



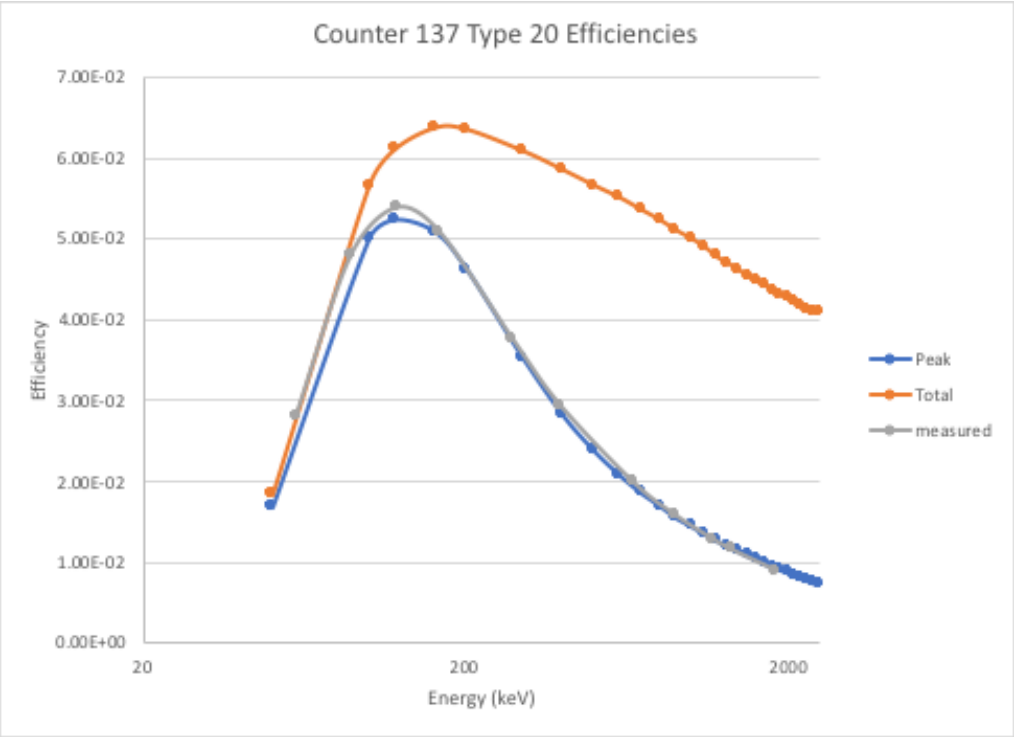
# MCNP Results – Type 40

- Peak and total efficiencies plotted and compared to the measured efficiency.



# MCNP Results – Type 20

- Peak and total efficiencies plotted and compared to the measured efficiency.



# TrueCoinc Results - Type 40, Select isotopes

| E[keV] | Rel.Int | err[%] | TrueCc | Eff | TotEff | TrueCLoss | TrueCGain | |
|---|---|---|---|---|---|---|---|---|
| 328.7 | 20.300 | 1.37 | 0.9064 | 3.11E-2 | 5.68E-2 | 0.9064 | 1.0000 | 140La B- 1.68 D g |
| 397.5 | 7.35E-2 | 6.49 | 1.114 | 2.67E-2 | 5.53E-2 | 0.9063 | 1.229 | 140La B- 1.68 D g |
| 432.4 | 2.900 | 0.98 | 0.9068 | 2.52E-2 | 5.47E-2 | 0.9068 | 1.0000 | 140La B- 1.68 D g |
| 438.5 | 3.91E-2 | 24.4 | 0.9068 | 2.49E-2 | 5.46E-2 | 0.9068 | 1.0000 | 140La B- 1.68 D g |
| 445.5 | 2.86E-3 | 33.36 | 0.9223 | 2.46E-2 | 5.45E-2 | 0.9223 | 1.0000 | 140La B- 1.68 D g |
| 487.00 | 45.500 | 1.25 | 0.9283 | 2.39E-2 | 5.38E-2 | 0.9283 | 1.0000 | 140La B- 1.68 D g |
| 556.00 | 1.17E-3 | 0.00 | 1.0000 | 2.08E-2 | 5.26E-2 | 1.0000 | 1.0000 | alias |
| 596.5 | 5.82E-3 | 0.00 | 1.0000 | 1.97E-2 | 5.200E-2 | 1.0000 | 1.0000 | alias |
| 618.1 | 3.72E-2 | 10.24 | 0.9238 | 1.92E-2 | 5.17E-2 | 0.9238 | 1.0000 | 140La B- 1.68 D g |
| 618.2 | 2.19E-2 | 0.00 | 1.0000 | 1.92E-2 | 5.17E-2 | 1.0000 | 1.0000 | alias |
| 729.00 | 1.77E-2 | 0.00 | 1.0000 | 1.7E-2 | 5.02E-2 | 1.0000 | 1.0000 | alias |
| 751.6 | 4.33 | 0.88 | 0.9561 | 1.67E-2 | 5.000E-2 | 0.9561 | 1.0000 | 140La B- 1.68 D g |
| 815.7 | 23.300 | 0.81 | 0.9941 | 1.57E-2 | 4.92E-2 | 0.9573 | 1.038 | 140La B- 1.68 D g |
| 867.8 | 5.500 | 1.21 | 0.9576 | 1.51E-2 | 4.86E-2 | 0.9576 | 1.0000 | 140La B- 1.68 D g |
| 919.5 | 2.66 | 1.07 | 0.9982 | 1.45E-2 | 4.800E-2 | 0.9576 | 1.042 | 140La B- 1.68 D g |
| 925.1 | 6.900 | 0.97 | 0.9597 | 1.44E-2 | 4.79E-2 | 0.9576 | 1.002 | 140La B- 1.68 D g |
| 950.9 | 0.51 | 1.31 | 0.9576 | 1.41E-2 | 4.77E-2 | 0.9576 | 1.0000 | 140La B- 1.68 D g |
| 992.9 | 1.34E-2 | 35.6 | 0.8781 | 1.37E-2 | 4.72E-2 | 0.8781 | 1.0000 | 140La B- 1.68 D g |
| 1045.1 | 2.48E-2 | 57.66 | 0.9152 | 1.32E-2 | 4.67E-2 | 0.9152 | 1.0000 | 140La B- 1.68 D g |
| 1097.2 | 2.29E-2 | 20.83 | 0.9238 | 1.28E-2 | 4.62E-2 | 0.9238 | 1.0000 | 140La B- 1.68 D g |
| 1234.6 | 1.08E-4 | 0.00 | 1.0000 | 1.18E-2 | 4.500E-2 | 1.0000 | 1.0000 | alias |
| 1259.2 | 1.47E-4 | 0.00 | 1.0000 | 1.16E-2 | 4.48E-2 | 1.0000 | 1.0000 | alias |
| 1303.5 | 4.2E-2 | 15.88 | 0.9576 | 1.14E-2 | 4.44E-2 | 0.9576 | 1.0000 | 140La B- 1.68 D g |
| 1405.2 | 5.91E-2 | 11.29 | 0.9662 | 1.08E-2 | 4.36E-2 | 0.9576 | 1.009 | 140La B- 1.68 D g |
| 1479.8 | 1.8E-4 | 0.00 | 1.0000 | 1.03E-2 | 4.31E-2 | 1.0000 | 1.0000 | alias |
| 1532.2 | 3.9E-4 | 0.00 | 1.0000 | 1.01E-2 | 4.27E-2 | 1.0000 | 1.0000 | alias |
| 1596.2 | 95.400 | 1.49 | 0.9377 | 9.78E-3 | 4.24E-2 | 0.9377 | 1.0000 | 140La B- 1.68 D g |

True Cc is fractional undercount due to summing.
Results show 6-7% correction needed to compute true activity level for 487, 1596 lines.

# TrueCoinc Results - Type 20, Select isotopes

| E[keV] | Rel.Int | err[%] | TrueCc | Eff | TotEff | TrueCLoss | TrueCGain | |
|---|---|---|---|---|---|---|---|---|
| 328.7 | 20.300 | 1.37 | 0.9011 | 3.33E-2 | 6.02E-2 | 0.9011 | 1.0000 | 140La B- 1.68 D g |
| 397.5 | 7.35E-2 | 6.49 | 1.116 | 2.84E-2 | 5.86E-2 | 0.9009 | 1.239 | 140La B- 1.68 D g |
| 432.4 | 2.900 | 0.98 | 0.9014 | 2.68E-2 | 5.800E-2 | 0.9014 | 1.0000 | 140La B- 1.68 D g |
| 438.5 | 3.91E-2 | 24.4 | 0.9014 | 2.65E-2 | 5.78E-2 | 0.9014 | 1.0000 | 140La B- 1.68 D g |
| 445.5 | 2.86E-3 | 33.36 | 0.9178 | 2.62E-2 | 5.77E-2 | 0.9178 | 1.0000 | 140La B- 1.68 D g |
| 487.00 | 45.500 | 1.25 | 0.9241 | 2.44E-2 | 5.69E-2 | 0.9241 | 1.0000 | 140La B- 1.68 D g |
| 556.00 | 1.06E-3 | 0.00 | 1.0000 | 2.21E-2 | 5.58E-2 | 1.0000 | 1.0000 | alias |
| 596.5 | 6.04E-3 | 0.00 | 1.0000 | 2.09E-2 | 5.52E-2 | 1.0000 | 1.0000 | alias |
| 618.1 | 3.72E-2 | 10.24 | 0.9193 | 2.04E-2 | 5.49E-2 | 0.9193 | 1.0000 | 140La B- 1.68 D g |
| 618.2 | 2.31E-2 | 0.00 | 1.0000 | 2.04E-2 | 5.49E-2 | 1.0000 | 1.0000 | alias |
| 729.00 | 1.9E-2 | 0.00 | 1.0000 | 1.81E-2 | 5.33E-2 | 1.0000 | 1.0000 | alias |
| 751.6 | 4.33 | 0.88 | 0.9536 | 1.78E-2 | 5.300E-2 | 0.9535 | 1.0000 | 140La B- 1.68 D g |
| 815.7 | 23.300 | 0.81 | 0.994 | 1.68E-2 | 5.22E-2 | 0.9548 | 1.041 | 140La B- 1.68 D g |
| 867.8 | 5.500 | 1.21 | 0.9551 | 1.6E-2 | 5.15E-2 | 0.9551 | 1.0000 | 140La B- 1.68 D g |
| 919.5 | 2.66 | 1.07 | 0.9984 | 1.53E-2 | 5.09E-2 | 0.9551 | 1.045 | 140La B- 1.68 D g |
| 925.1 | 6.900 | 0.97 | 0.9573 | 1.52E-2 | 5.09E-2 | 0.9551 | 1.002 | 140La B- 1.68 D g |
| 950.9 | 0.51 | 1.31 | 0.9551 | 1.5E-2 | 5.06E-2 | 0.9551 | 1.0000 | 140La B- 1.68 D g |
| 992.9 | 1.34E-2 | 35.6 | 0.8723 | 1.46E-2 | 5.02E-2 | 0.8723 | 1.0000 | 140La B- 1.68 D g |
| 1045.1 | 2.48E-2 | 57.66 | 0.9104 | 1.4E-2 | 4.97E-2 | 0.9104 | 1.0000 | 140La B- 1.68 D g |
| 1097.2 | 2.29E-2 | 20.83 | 0.9193 | 1.35E-2 | 4.91E-2 | 0.9193 | 1.0000 | 140La B- 1.68 D g |
| 1234.6 | 1.16E-4 | 0.00 | 1.0000 | 1.25E-2 | 4.76E-2 | 1.0000 | 1.0000 | alias |
| 1259.2 | 1.6E-4 | 0.00 | 1.0000 | 1.23E-2 | 4.74E-2 | 1.0000 | 1.0000 | alias |
| 1303.5 | 4.2E-2 | 15.88 | 0.9551 | 1.2E-2 | 4.700E-2 | 0.9551 | 1.0000 | 140La B- 1.68 D g |
| 1405.2 | 5.91E-2 | 11.29 | 0.9643 | 1.14E-2 | 4.63E-2 | 0.9551 | 1.0100 | 140La B- 1.68 D g |
| 1479.8 | 1.93E-4 | 0.00 | 1.0000 | 1.09E-2 | 4.57E-2 | 1.0000 | 1.0000 | alias |
| 1532.2 | 4.14E-4 | 0.00 | 1.0000 | 1.07E-2 | 4.53E-2 | 1.0000 | 1.0000 | alias |
| 1596.2 | 95.400 | 1.49 | 0.934 | 1.04E-2 | 4.49E-2 | 0.934 | 1.0000 | 140La B- 1.68 D g |

True Cc is fractional undercount due to summing.
Results show 7-8% correction needed to compute true activity level for 487, 1596 lines.