A New Measurement of the 60 keV Transition in the Am-241 Decay using Metallic Magnetic Calorimeters

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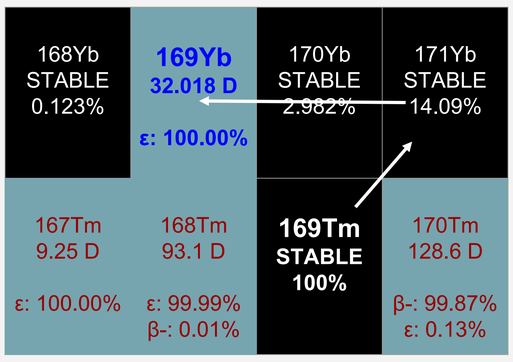
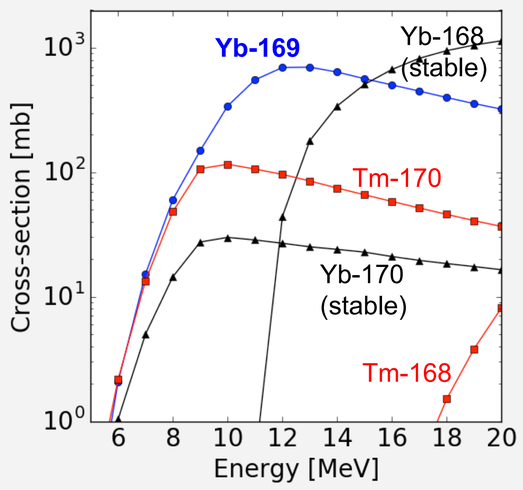
Why Am-241 60 keV?

- Important calibration standards for low energy γ
- Significant weight in cryogenic detector calibration [1].
- Current literature: 59.5409(1) keV (HPGe with Tb-161, 1993)
- Limited consideration of systematic errors.

Yb-169: Accurate Calibration Source



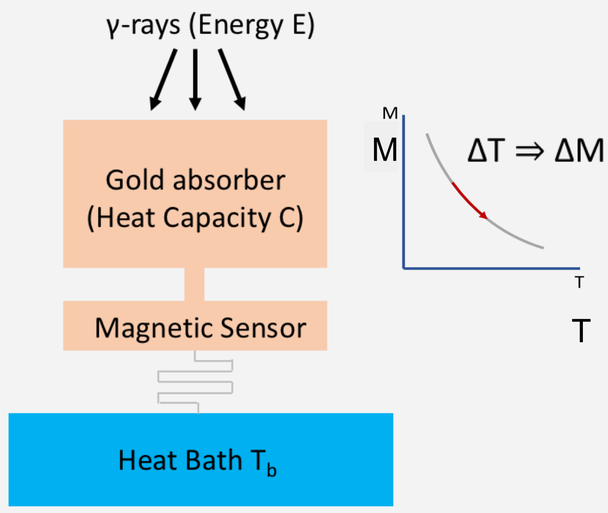


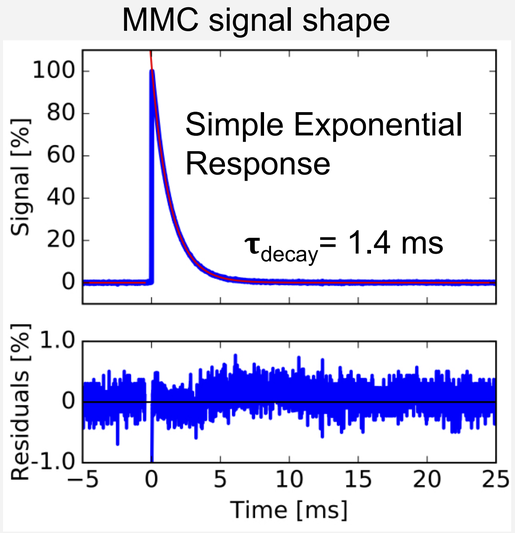
Produced at 88" Cyclotron at LBL by ^{169}Tm(d,2n)^{169}Yb

Energy [keV]	Intensity [%]	Energy [keV]	Intensity [%]
63.12044(3)	43.62(23)	130.52293(4)	11.38(5)
93.61447(7)	2.580(17)	177.21307(4)	22.28(11)
109.77924(3)	17.39(9)	197.95675(4)	35.93

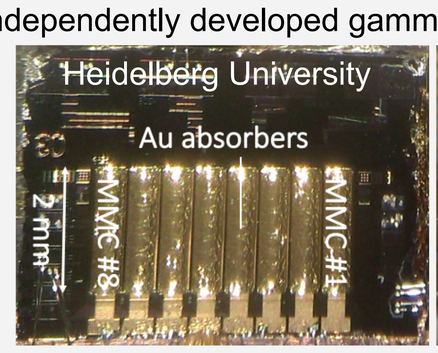
- Energies of Yb-169 γ-rays and Tm x-rays are measured with double crystal spectrometers at NIST
- Accuracy is < 0.1 eV

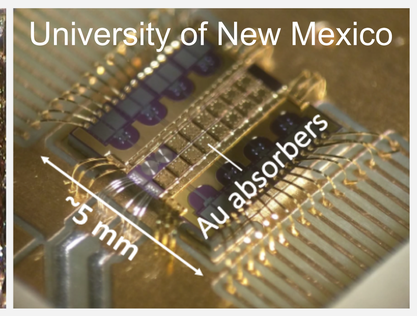
MMCs for Improving Nuclear Data



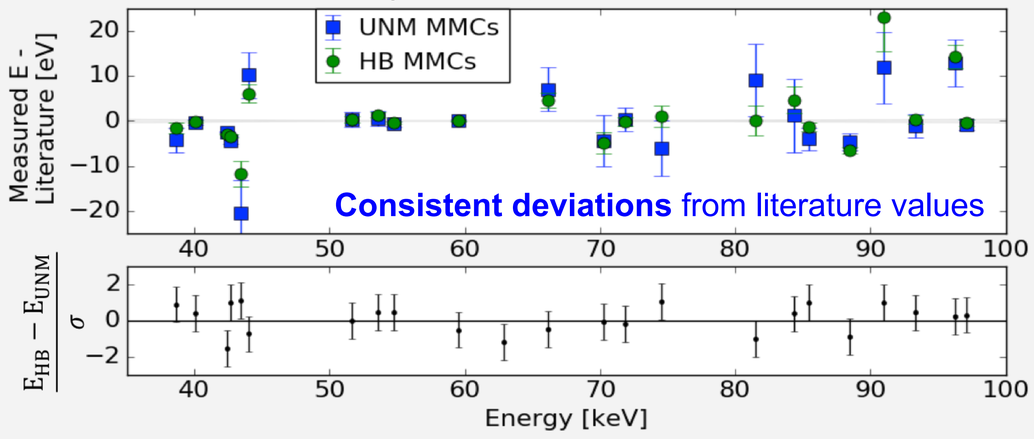


Two independently developed gamma MMCs

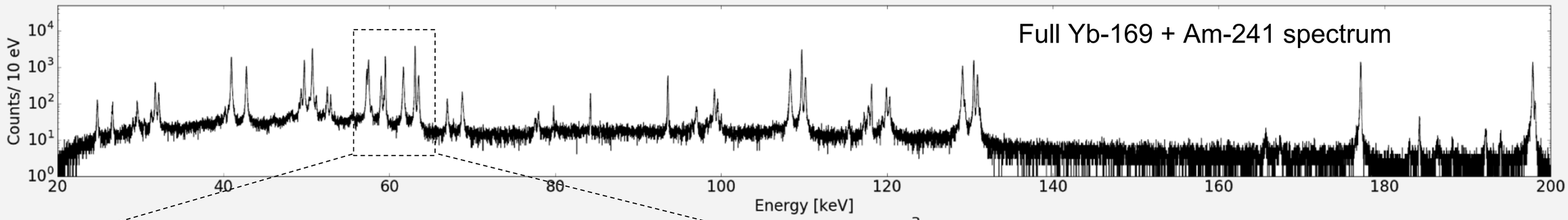


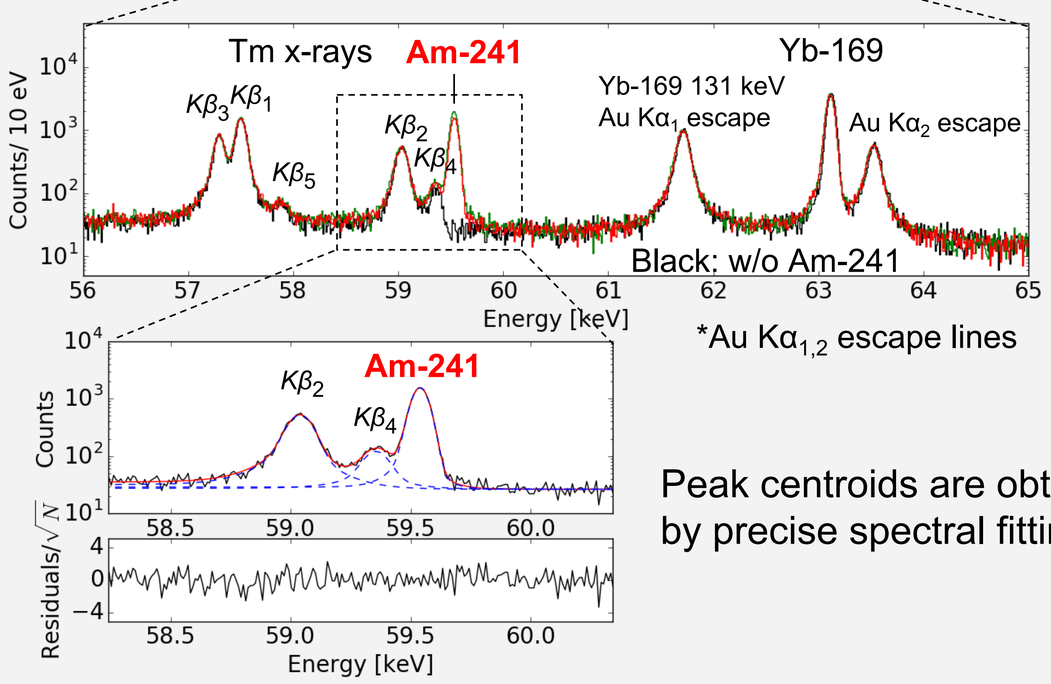


U-233/Pu-239 measurement: Different MMCs, different SQUIDs, different cooldowns and temperatures, but **SAME RESULTS.**



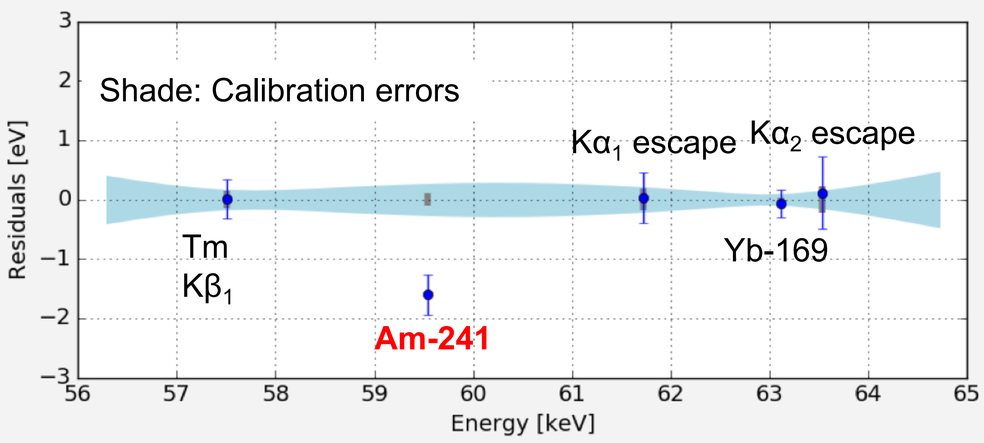
Accurate Measurement of Am-241 and Yb-169 with MMCs





*Au Kα$_{1,2}$ escape lines

Peak centroids are obtained by precise spectral fitting



Am-241 60 keV Energy

Current: 59,540.9 ± 0.1 eV

This work: 59,539.3 ± 0.3 (statistics) ± 0.4 (calibration) eV

[1] Kim, G. B., et al. "Development of MMC gamma detectors for precise characterization of uranium isotopes." *J. Low Temp. Phys.* 193.5-6 (2018): 1236-1242.

[2] Kim, G. B., et al. "Consistent measurements of 233 U gamma emissions using metallic magnetic calorimeters with ultra-high energy resolution." *J. Radioanal. Nucl. Chem.* 318.1 (2018): 803-808.

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