Electronic Supplementary Information (ESI) for Technical Note: An Alternative Method for Chronometric Determinations Involving Curium

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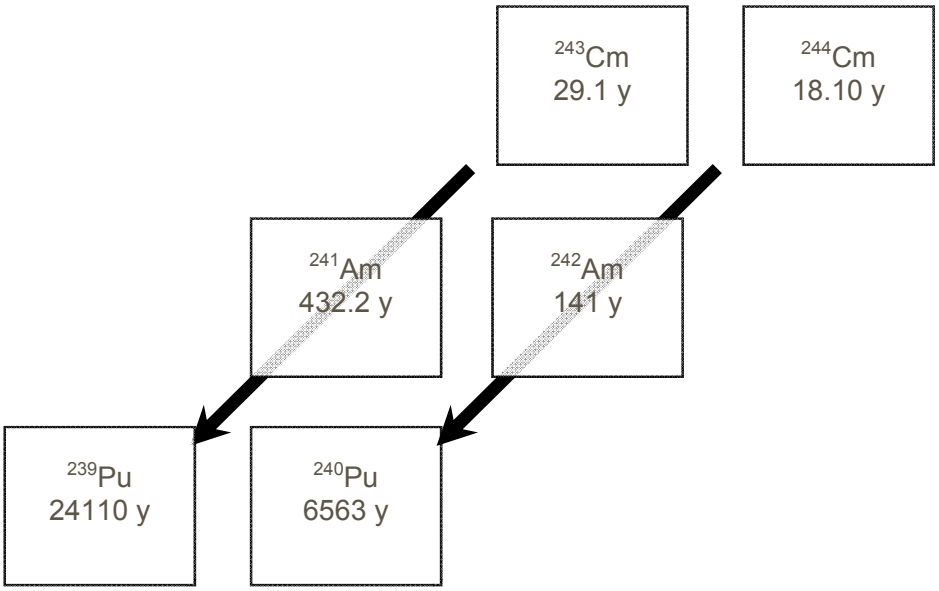
Historical Background

During the 1960's about five kilograms of ^{244}Cm were produced by high-flux neutron irradiation of ^{242}Pu at the Savannah River Site (SRS) in South Carolina.[1] [2] This isotope was evaluated as a potential thermoelectric heat source for space probes and as a possible intermediate target material for the production of ^{252}Cf for use as a neutron source. After chemical separation and purification by solvent extraction, ^{244}Cm targets were re-irradiated to produce several grams of ^{252}Cf.[3] The initial chemical separation process for curium used a liquid/liquid solvent extraction with a tertiary amine in an organic diluent from a chloride aqueous phase. Due to problems with corrosion from the chloride and radiolysis of the organic solvent, this process was replaced with an ion-exchange based separation. Research and development on the curium separation by pressurized ion-exchange chromatography continued at the Savannah River Laboratory (SRL) through the mid 1970's.[4] The last separations occurred before 1979 when glove boxes used in the processes were decontaminated and decommissioned. These processes resulted in the generation of waste solutions and other legacy materials that were stored for unknown lengths of time after shutdown of this process.

Figure ESI-1: Decay diagram and half-lives of ^{243}Cm and ^{244}Cm



$$^{244}Cm \xrightarrow[t_{1/2}=18.1y]{} {}^{240}Pu + {}^{4}_{2}He$$

$$^{243}Cm \xrightarrow[t_{1/2}=29.1y]{} {}^{239}Pu + {}^{4}_{2}He$$

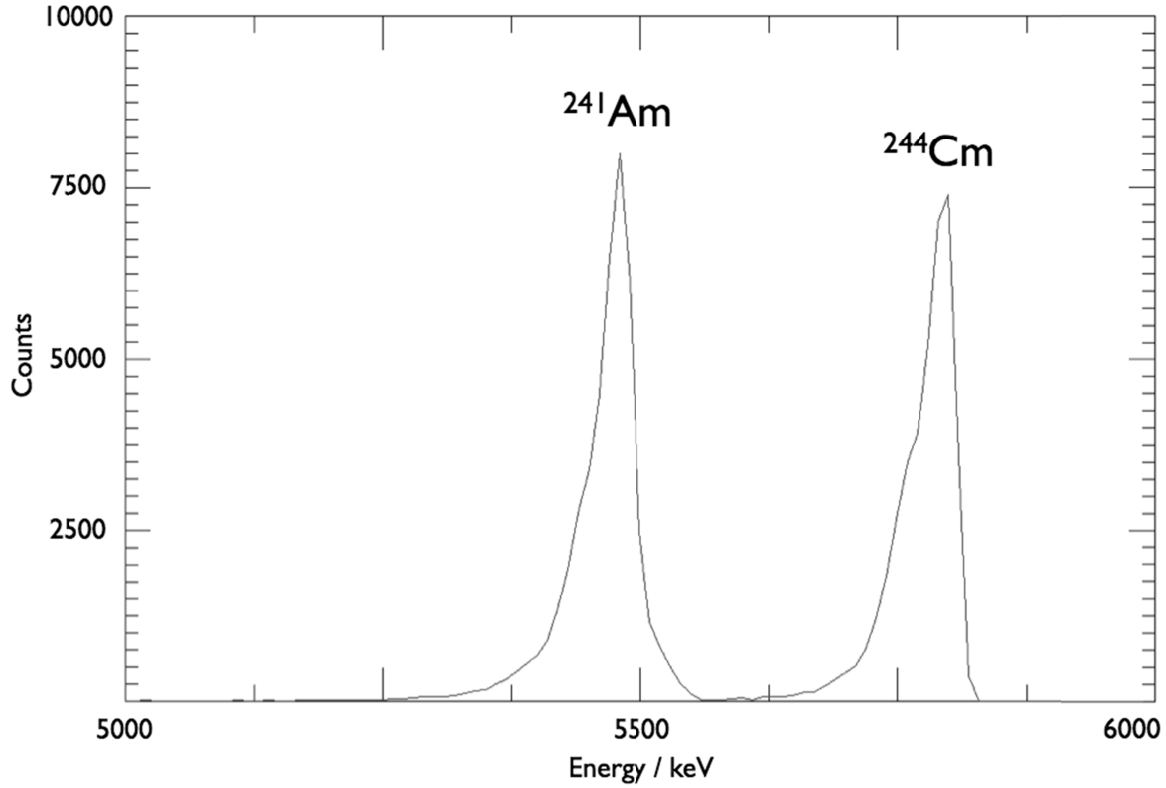


Figure ESI-2 a. Alpha spectrum of Cm fraction of standard ^{244}Cm solution. Note that the y-axis scale is linear. ^{241}Am was used as the chemical yield tracer of ^{244}Cm.

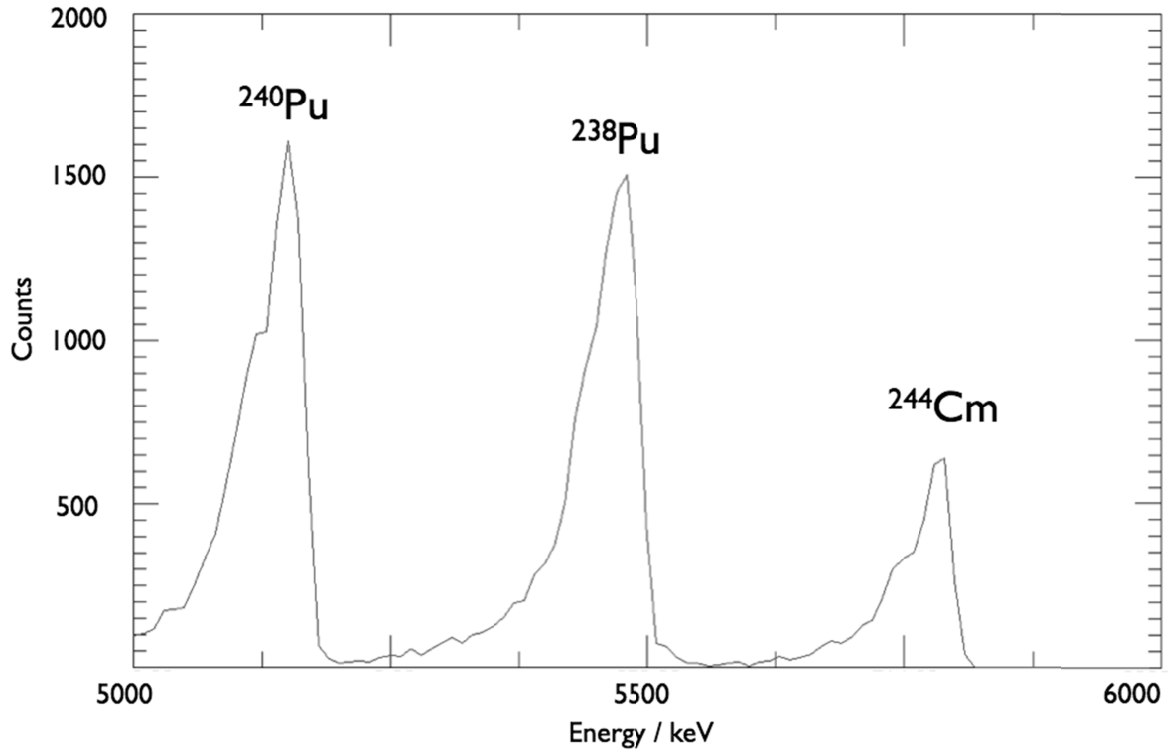


Figure ESI-2 b. Alpha spectrum of Pu fraction of ^{244}Cm standard solution. Note that y-axis scale is linear. ^{238}Pu was used as the chemical yield tracer of ^{240}Pu.

ESI References:

[1] Moyer, R. A., *Health Physics*, 1968, 15, 133-138.

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[3] Harbour, R. M., Ice, C. H., Hale, W. H., and Lowe, J. T., *DOE Report WSRC-MS-2000-00061*, 2000, pp.157-163.

[4] Lowe, J. T., Hale, W. H., and Hallman, D. F., *Ind. Eng. Chem. Process Des. Develop.*, 1971, 10(1), 131-135