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GAMMA SCANNING WITH A LITHIUM-DRIFTED
GERMANIUM ANTICOINCIDENCE SPECTROMETER*

By

Dale M. Holm and Wm. Mort Sanders

University of California
Los Alamos Scientific Laboratory
Los Alamos, New Mexico

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Despite the presence of a large number of gamma rays in gross fission products, the rather poor energy resolution of NaI detectors has limited the application of gamma scanning to the more prominent fission products. The advent of lithium-drifted germanium semiconductors makes it possible to perform more comprehensive analyses on these complex spectra. The high energy resolution of these detectors makes them attractive, despite their low efficiency.

Figure 1 shows some typical spectra taken with the small (3 mm x 2 cm²) lithium-drifted germanium detector system previously described.⁽¹⁾ The pronounced improvement in the signal-to-noise ratio by anticoincidence can easily be seen in the spectrum of the fuel element #1205. No significant loss in the full-energy peaks is observed.

Plutonium fuel elements, which had been irradiated while molten, were positioned with a precision scanner in front of a collimated anticoincidence spectrometer, permitting spectra to be taken at various positions along the element. Figure 2 shows a series of spectra taken in the gas phase (i.e., portion of an element above solidified fuel). This figure shows that, even with the high resolution of the semiconductor, it is still necessary to do spectral unfolding of overlapping peaks. This can be seen by observing the 0.364 Mev peak from I¹³¹ at position 1.60" and the changes that occur in the other spectra. The interference peak at 0.350 Mev has been tentatively identified as Ta¹⁸³ from double neutron capture of Ta¹⁸¹ in the fuel-container capsule. At position 1.95", near the fuel surface, Cs¹³⁶ and La¹⁴⁰ lines can be seen, along with the Ta¹⁸² activation of the container.

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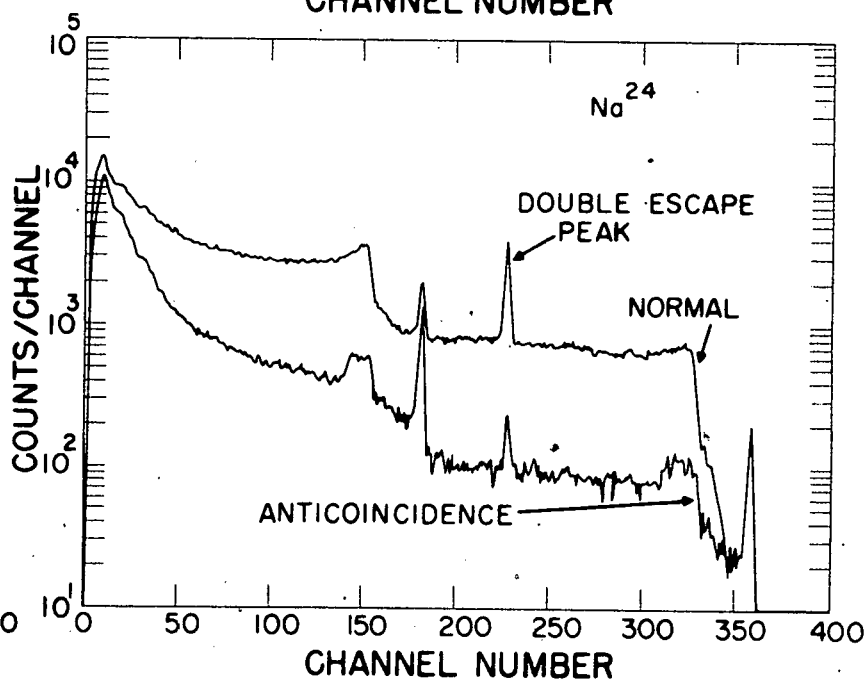
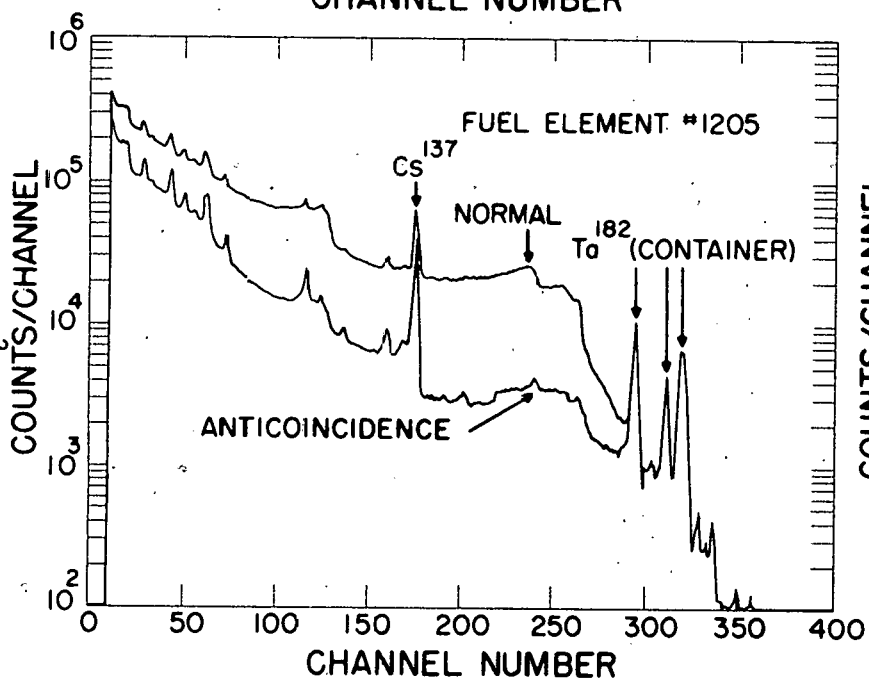
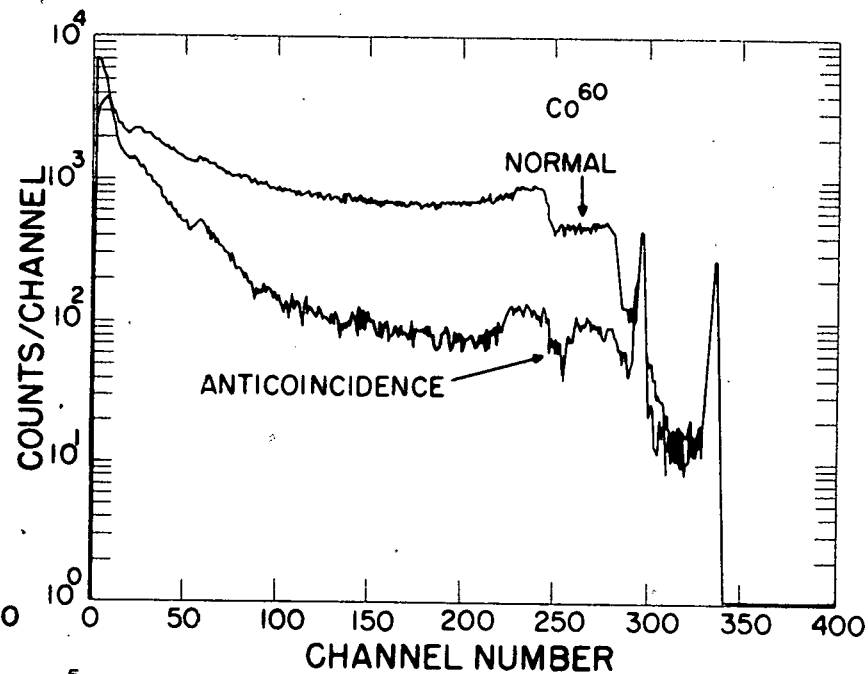
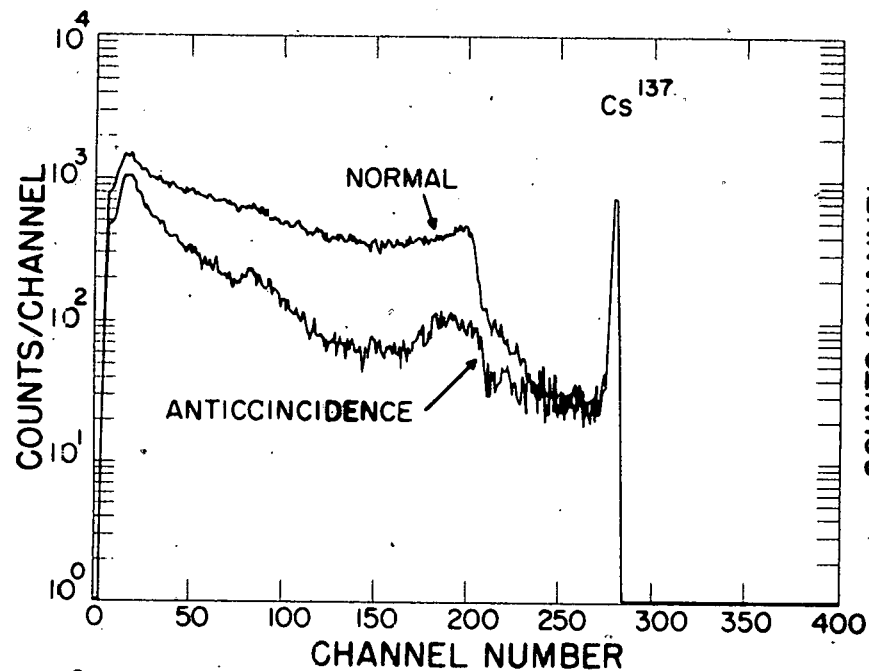
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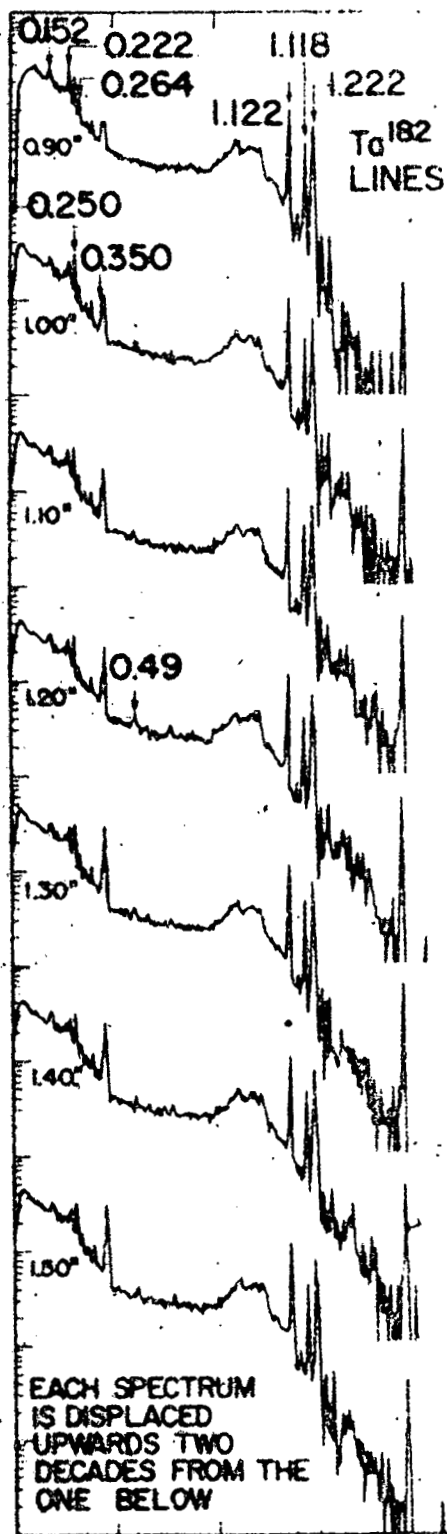
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Some Typical Spectra Taken with a Small (3 mm x 2 cm²)
Lithium-Drifted Germanium Detector System

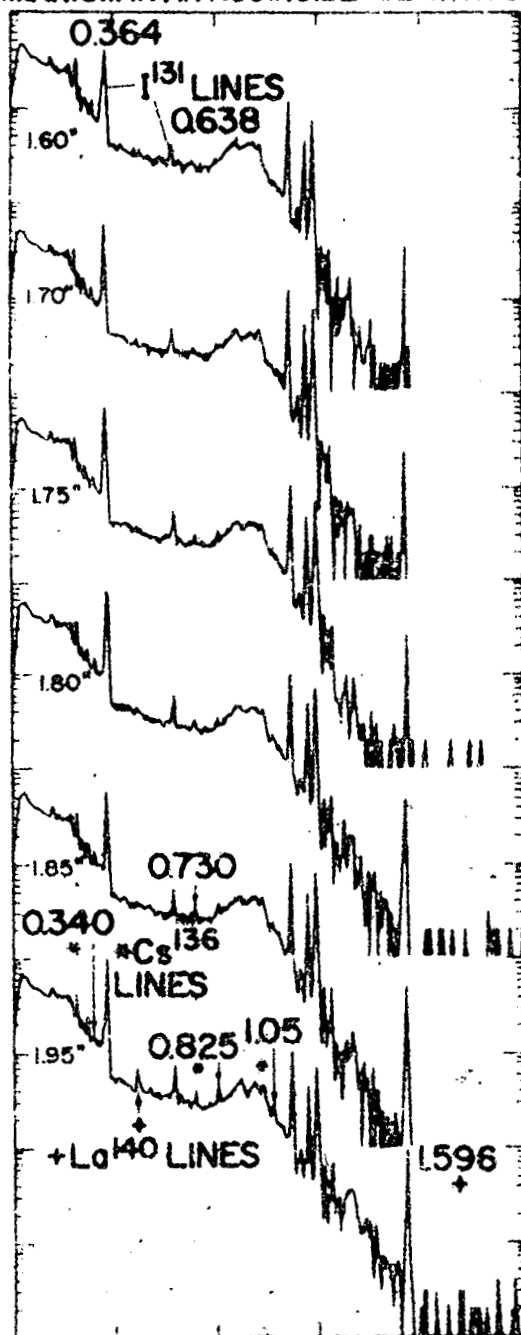
Fig. 1



LOG COUNTS PER CHANNEL PER MINUTE



GAS PHASE OF FUEL CAPSULE # 2239
IRRADIATED 11 DAYS IN O.W.R.
DATA TAKEN 5/28/65, 13 DAYS AFTER
SHUTDOWN. 10 MIN COUNTS WITH 0.004"
SLIT USING 6MMx6CM² LITHIUM DRIFTED
GERMANIUM IN ANTICOINCIDENCE WITH 8"x12" NaI



0 80 160 240 320 400 0 80 160 240 320 400
CHANNEL NUMBER

Figure 2 shows that I^{131} is localized in a region above the fuel, and the relative distribution can easily be seen. The high resolution of the anticoincidence lithium-drifted detector is required to obtain the detail and accuracy shown. In general, continuous scans are taken with NaI and single channel analyzers to determine regions of change, but the detailed analysis is done with semiconductors.

REFERENCE: D. M. Holm and W. M. Sanders, "A Semiconductor Anticoincidence Detector System", Radiochemical Methods of Analysis, Vol. II, I.A.E.A., Vienna, 1965