# Measurement of $\alpha_K$, the Internal Conversion Coefficient of $^{119m}$Sn

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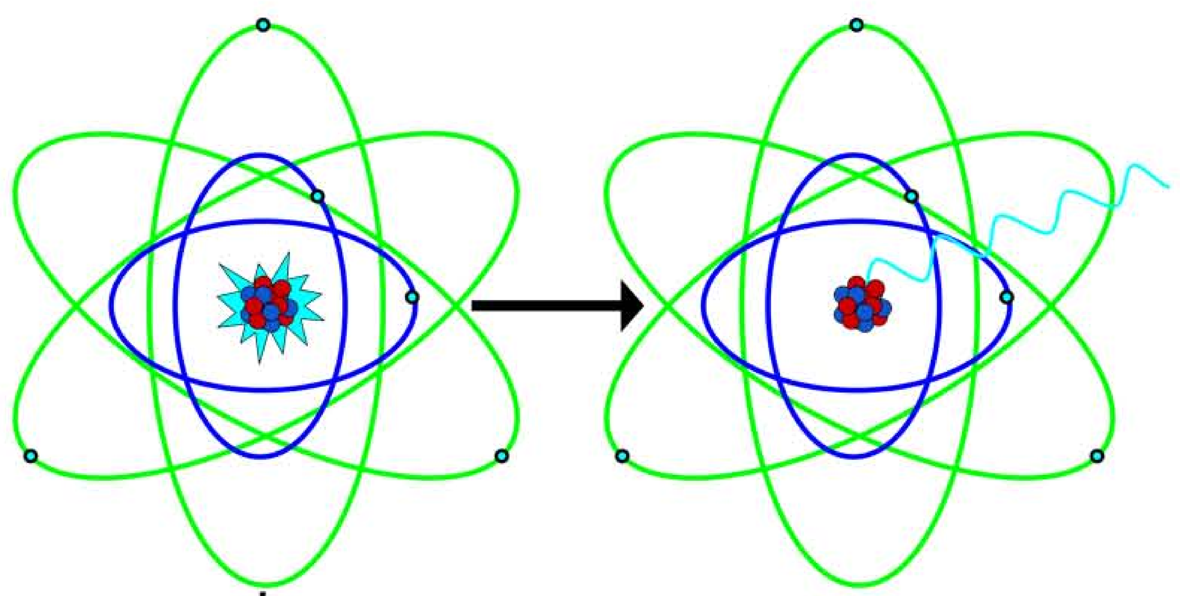
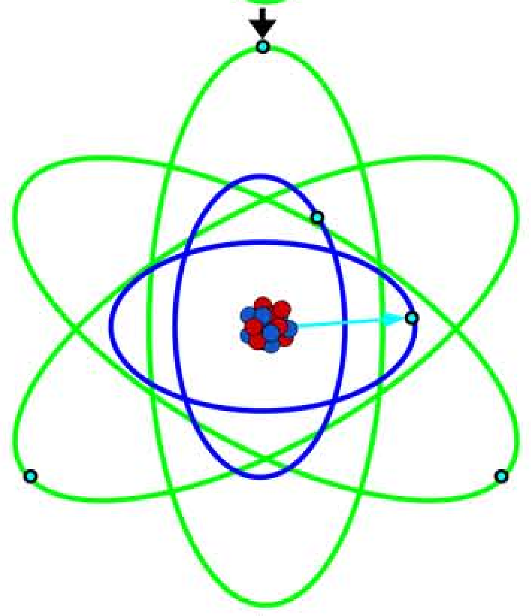
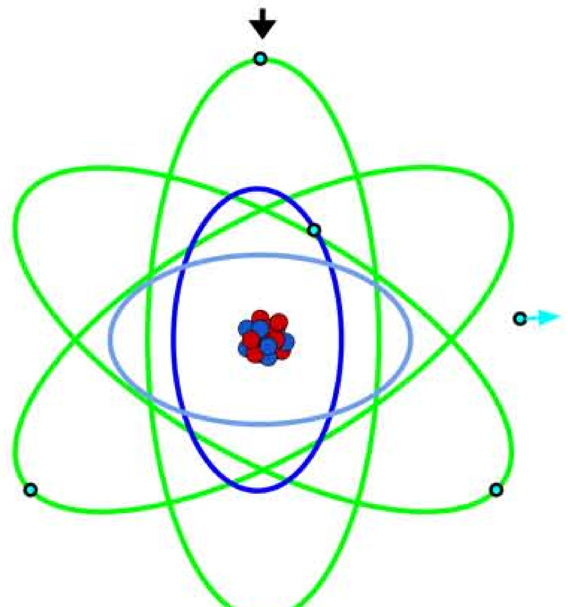
## What is Internal Conversion?

Internal Conversion is one way that an excited atom can decay. The more well-known form of decay is by $\gamma$-ray emission, but sometimes the energy from the nucleus is instead transferred to an inner-orbital electron. This process is Internal Conversion. The ratio between internal conversions and $\gamma$ emissions is called the Internal Conversion Coefficient, $\alpha_K$. We measured $\alpha_k$ to distinguish between two methods of calculating it.

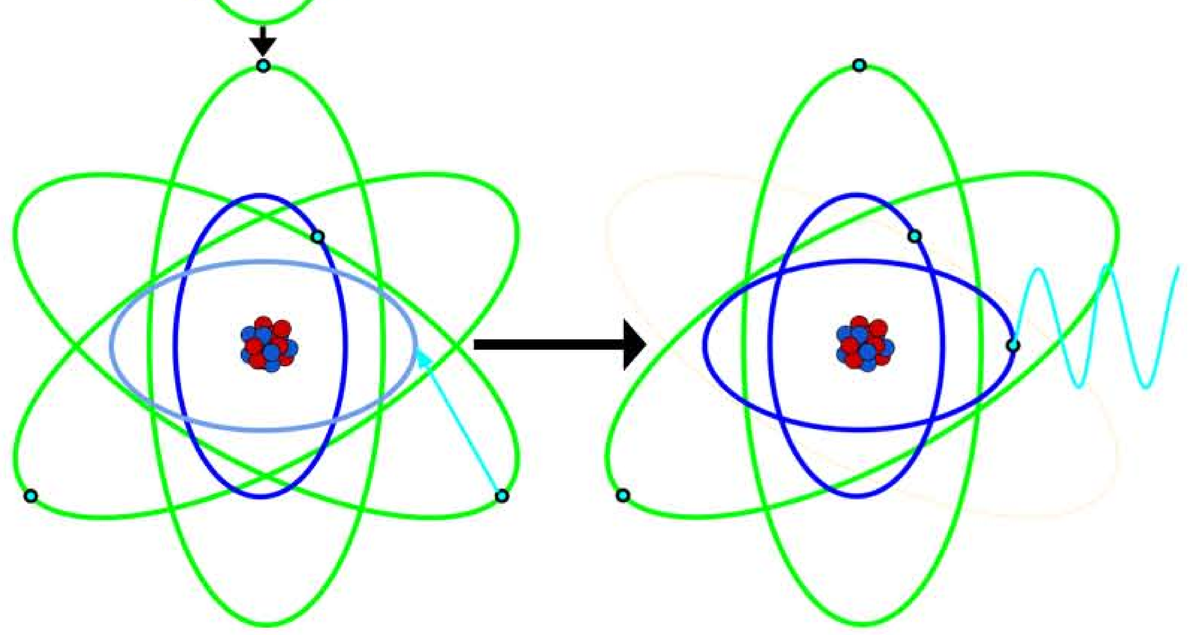




Above: energy in the form of a $\gamma$-ray, given off by excited nucleus.

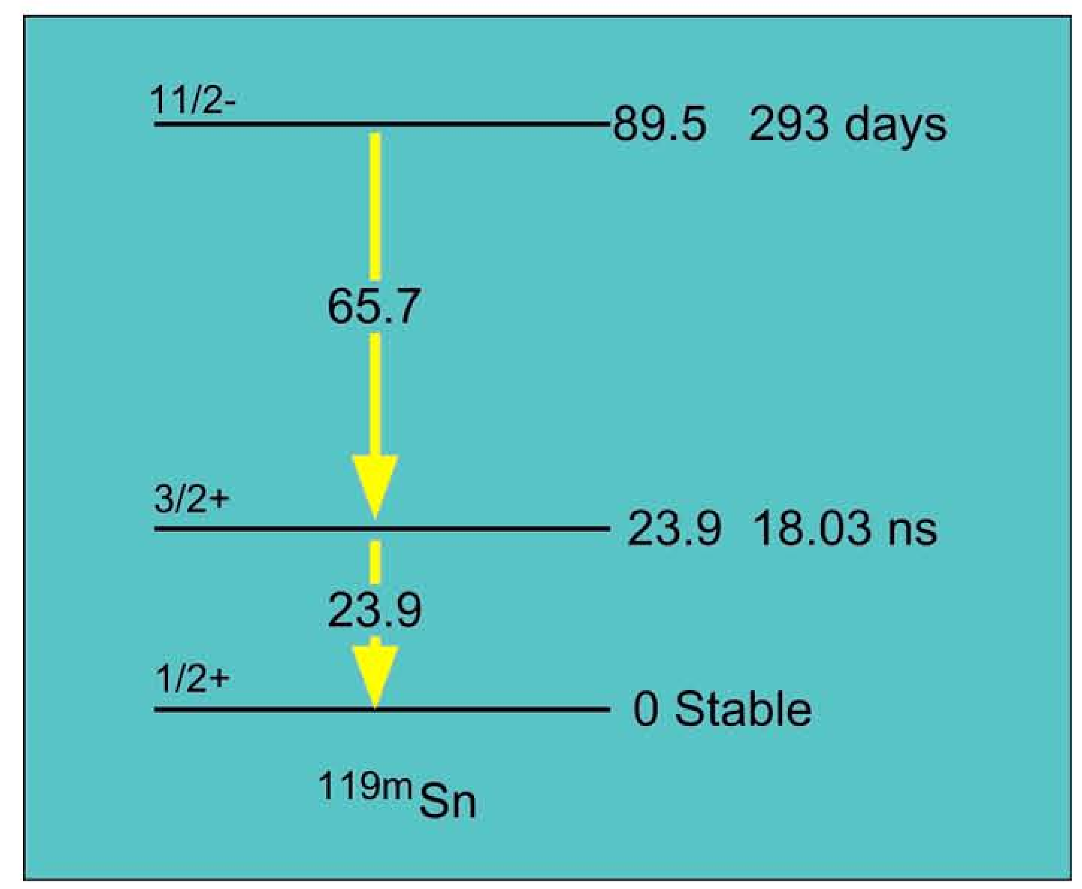


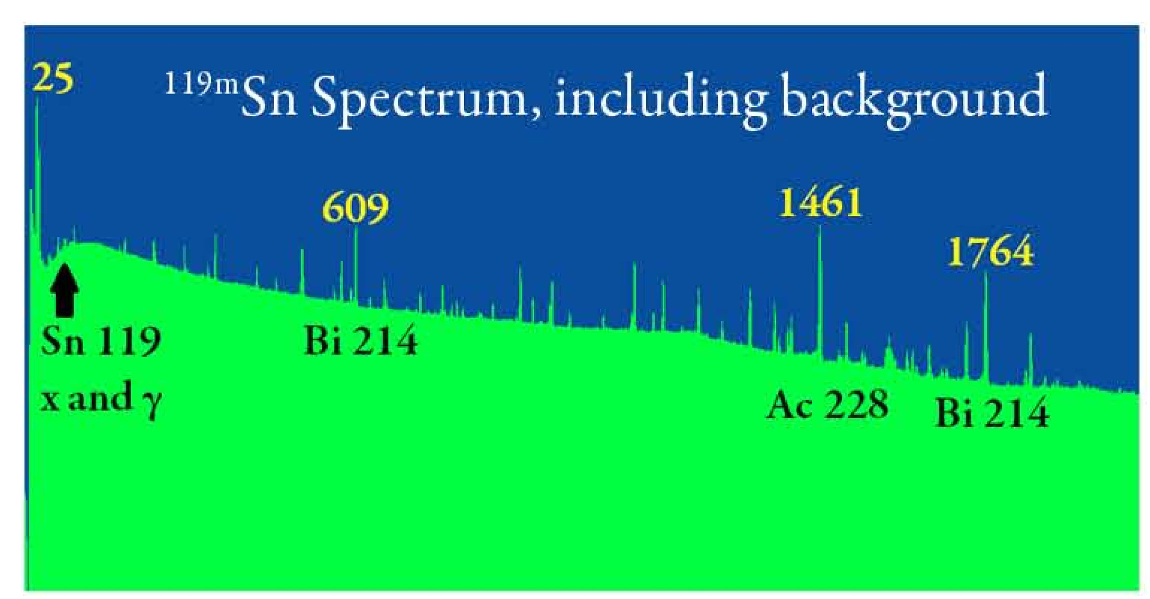
Left: energy is carried off by an electron, leaving a vacancy. When a higher-orbital electron drops to fill the vacancy, energy is released in the form of an x-ray (shown below).

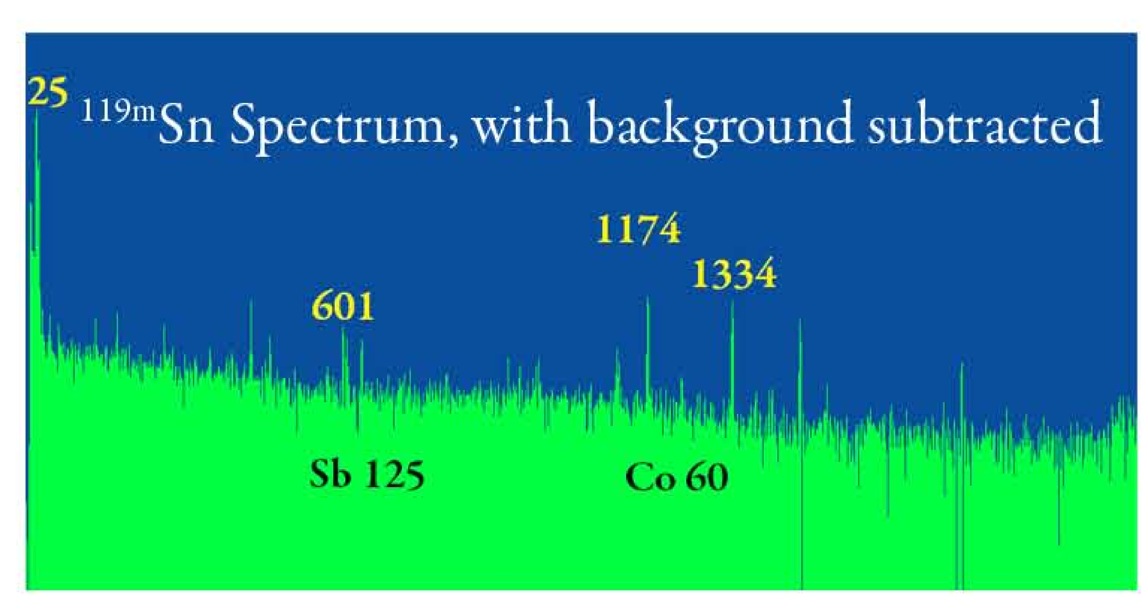


## Our Measurement

We began with a foil of $^{118}$Sn, enriched to 98.8%. The foil was irradiated with neutrons, producing $^{119m}$Sn. This was measured using a High-Purity Germanium detector, and the peaks fit with the program gf3 in the Radware package. The area of a peak corresponds to the number of events received by the detector. Shown below is the level scheme.

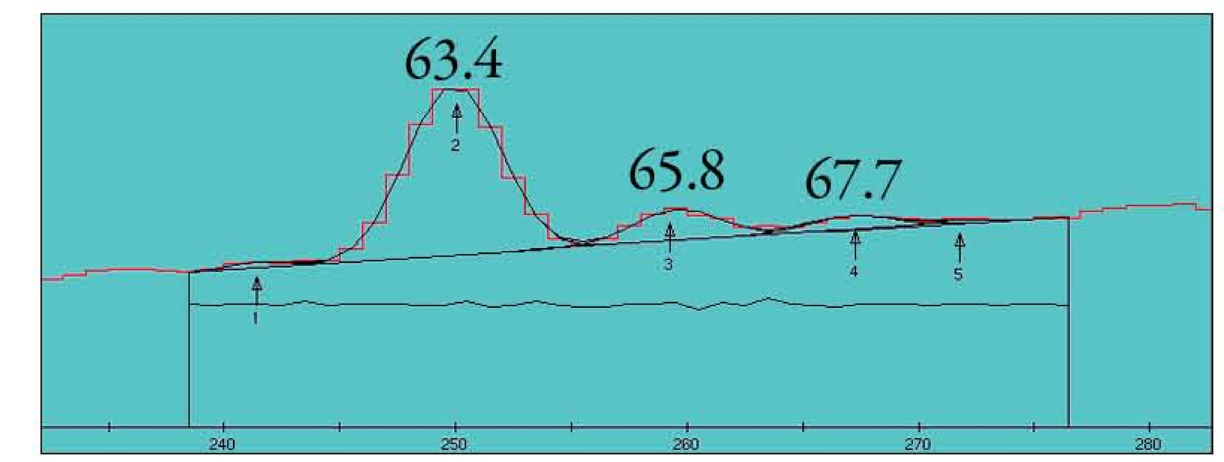


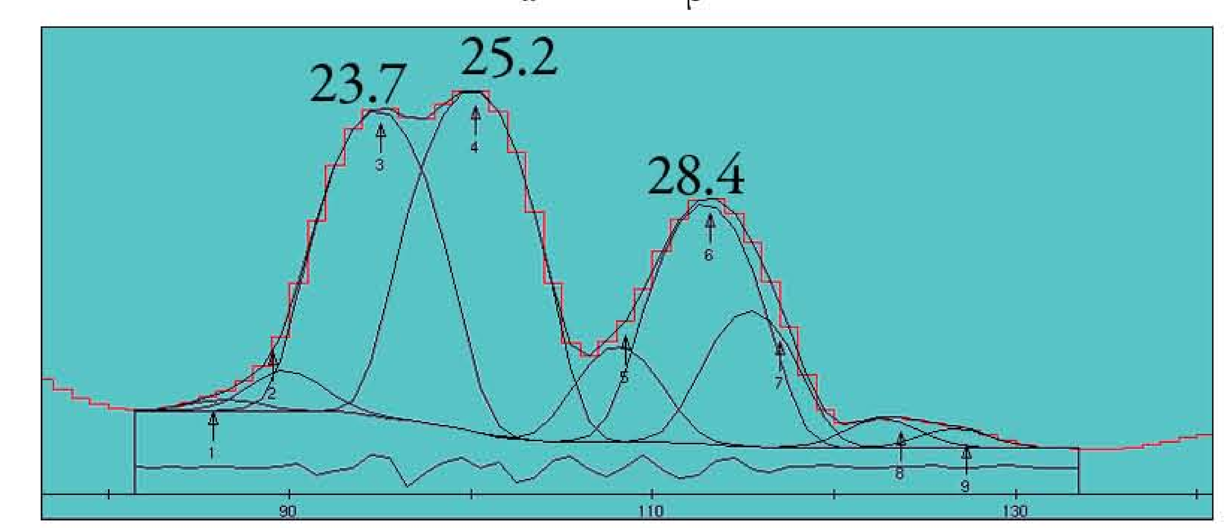




The background-subtracted sample has fewer peaks, and allows us to more easily identify the impurities in the sample. The main impurities were $^{60}$Co, $^{75}$Se, $^{113}$Sn, $^{125}$Sb, and $^{182}$Ta.

The $\gamma$-ray region. The middle peak, labeled 65.8 keV, is the $\gamma$-ray we are interested in from $^{119m}$Sn. The larger peak on the left comes from background radiation in the room, and the small peak on the right from $^{182}$Ta, a contaminant in the sample.




Below is the x-ray region. The peak labelled 23.7 keV corresponds to the 23.9 keV transition in $^{119m}$Sn. The other two peaks are $K_\alpha$ and $K_\beta$ x-rays.




$\alpha_K$ is calculated with the following formula, where $\omega_K$ is the fluorescence yield of Sn, $N_K$ and $N_\gamma$ are the number of K x-rays and gamma rays detected, and $\varepsilon_K$ and $\varepsilon_\gamma$ are the detector efficiencies at the energy of the corresponding peak.

$$\alpha_K \omega_K = \frac{N_K}{N_\gamma} \cdot \frac{\varepsilon_\gamma}{\varepsilon_K}$$

Because of contaminants in the sample, a significant task was determining $N_K$ and $N_\gamma$ using known peak ratios. Our preliminary result, after these subtractions, was $\alpha_K$=1645±27, which agrees with the Frozen Orbital value of $\alpha_K$=1618, as opposed to the earlier calculation of $\alpha_K$=1544.