

**Measurement of $^{78\text{m}}\text{Br } 2^- \rightarrow 1^+$ Transition Half-Life by Self-Coincidence Analysis
in an Active Target $\text{LaBr}_3(\text{Ce})$ Detector**

Fondement, Valentin¹, Todd, Ethan², Jovanovic, Igor³

¹Department of Nuclear Engineering and Radiological Sciences, University of Michigan,

2355 Bonisteel Blvd, Ann Arbor, MI 48109, United States

²Department of Physics, University of Michigan, 450 Church Street,

Ann Arbor, MI 48109, United States

³Department of Nuclear Engineering, University of California, Berkeley,

4163 Etcheverry Hall, Berkeley, CA 94720, United States

The $^{78\text{m}}\text{Br}$ nuclear isomer can be produced with energetic neutrons *via* the $^{79}\text{Br}(n,2n)^{78\text{m,g}}\text{Br}$ reaction. $\text{LaBr}_3(\text{Ce})$ scintillators are well-suited for use as active-target detectors for this reaction due to their high bromine content, short fluorescence lifetime, and good energy resolution. By recording scintillation events between the 15 μs long bursts of a pulsed deuterium-tritium neutron generator, we tag the $4^+ \rightarrow 2^- \rightarrow 1^+$ cascade of $^{78\text{m}}\text{Br}$ in single waveforms. This allows for a self-coincidence analysis for measuring the half-lives of both 4^+ and 2^- states of $^{78\text{m}}\text{Br}$ to be $(118.45 \pm 0.72) \mu\text{s}$ and $(19.8 \pm 0.44) \text{ns}$, respectively. The latter value is 11.5σ above the adopted value in the Nuclear Data Sheets [1,2,3] ($11.3 \pm 0.3 \text{ns}$). The method is crosschecked with a measurement of the half-lives in the $5^- \rightarrow 2^- \rightarrow 1^+$ cascade for the $^{80\text{m}}\text{Br}$ nuclear isomer, leading to values compatible with the reported nuclear data [4,5] within 0.2σ . The new half-life of the $^{78\text{m}}\text{Br } 2^- \rightarrow 1^+$ transition indicates a 50% reduction in the associated reduced transition probability, which should motivate renewed theoretical studies of the composition of the wavefunction in the $A=78$ mass region.

References:

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