Half-Life of the 23.87 keV Level in $^{119}$Sn

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Received August 13, 1979

Measurements of the half-life of the 23.87 keV level in $^{119}$Sn have been performed by delayed coincidence technique. Two different types of sources have been used in experiments with various detector combinations. A very pure source was made by implanting $^{119m}$Sn in a plastic scintillator by an isotope separator. This source could simultaneously be used as source and detector. The other source was made by simple drying of a drop of solution.

The mean value of the half-life of the 23.87 keV level from 21 measurements is found to be $T_{1/2} = (18.03 \pm 0.07)\text{ns}$.

1. Introduction

The 23.87 keV transition from the first excited to the ground state in $^{119}$Sn is one of the most suitable nuclear transitions for Mössbauer spectroscopy. This is due to a convenient half-life of the level, the low transition energy, and a long lived parent nuclide. The extraction of physical information from measured Mössbauer spectra depends sensitively on decay scheme parameters such as the half-life of the level and the conversion coefficient of the transition. The half-life of the 23.87 keV level in $^{119}$Sn has been determined by several authors [1–7]. The results, however, scatter by more than 25%. Even if the most diverging result [3] is disregarded there is still a spread of about 4% among the results of the measurements performed since 1971. Therefore it seemed to be reasonable to remeasure the level half-life using different sources and various detector combinations.

2. Experimental Procedure

In the present study a solution of $^{119m}$Sn has been used as radioactive material. The isomeric level at 89.53 keV in $^{119}$Sn decays with a half-life of $T_{1/2} = (293 \pm 13)\text{d}$ according to the decay scheme [8] shown in Fig. 1.

The half-life measurements of the 23.87 keV level were performed with the delayed coincidence technique. Two different types of sources were used in the experiments. One type (drop source) was prepared onto 20 $\mu\text{g/cm}^2$ thick VYNS foils coated by about 15 $\mu\text{g/cm}^2$ gold on each side. The $^{119m}$Sn activity in a HCl solution was deposited by drying a drop of radioactive solution after adding a drop of a 0.01% CATANAC solution. The source strength was about 550 kBq.

The other type of source (ion implanted source) was made by implanting the $^{119m}$Sn activity in a 0.2 mm thick NE 102 A plastic scintillator using an isotope separator. The reasons were twofold: first to give a purer source and second to be able to use the plastic as a detector of the internal conversion electrons with close to $4\pi$ effective solid angle. The implanted dose...
Fig. 2. X- and gamma-ray spectra of $^{119m}$Sn sources measured with a Si(Li) detector: (a) drop source; (b) ion implanted source. The Au X-ray lines stem from the Au-layer on the VYNS foil.