Level Structure of $^{120}\text{Sn}$ from the Decay of $^{120}\text{In}$ and $^{120}\text{Sb}$ Isomers

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Received October 26, 1970

Gamma rays in the decay of the 3.2 s (1+) and 44 s (4, 5+) $^{120}\text{In}$ isomers and the 15.9 min (1+) and 5.8 d (8-) $^{120}\text{Sb}$ isomers have been investigated using Ge(Li) spectrometers and prompt and delayed Ge(Li)-NaI(Tl) coincidence techniques. The constructed level scheme of $^{120}\text{Sn}$ contains 18 levels at the following energies (keV): 0 (0+), 1171.6 (2+), 1875.6 (0+), 2096.9 (1, 2, 3), 2160.7 (0+), 2195.0 (4+), 2284.8 (5-), 2355.6 (2+), 2421.2 (1, 2, 3), 2466.3 (4+), 2482.1 (7-), 2643.5 (4+), 3058.6 (4+), 3179.7 (4+), 3349.9 (3, 4+), 3440 (3, 4+), 3447.6 (5, 6+), and 3777 (4+). The levels are compared with the levels obtained from recent charged-particle reaction studies and the structure of $^{120}\text{Sn}$ is briefly discussed in view of the latest quasiparticle calculations.

1. Introduction

The levels of even Sn isotopes, especially those of $^{120}\text{Sn}$, have been widely investigated both experimentally and theoretically. From a large number of charged-particle reaction studies only the latest one of each reaction type is mentioned in this report. References and comparisons with earlier works can be found in these papers. The most recent inelastic scattering measurement is a comprehensive $^{116-124}\text{Sn}$ ($p, p'$) study with 24.5 MeV protons by Beer et al.\(^1\). The latest ($d, d'$) data concerning $^{120}\text{Sn}$ can be found in a work by Jolly\(^2\). The results by Norris et al.\(^3\) and by Schneid et al.\(^4\), who have investigated levels of $^{120}\text{Sn}$ with ($d, p$) reactions, are consistent and complementary to each other. In Copenhagen Bjerregaard et al.\(^4\) have studied levels of $^{118}\text{Sn}$ and $^{120}\text{Sn}$

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by using \((t, p)\) reactions, which Broglia \textit{et al}.\textsuperscript{5} have later analyzed by applying quasiparticle formalism and pairing vibrational model for superfluid nuclei to study the \(J^\pi = 0^+\) states.

In spite of the recent rich information of levels obtained from the different reaction studies, the latest study describing the decay of the 3.2 s \((J^\pi = 1^+)\) and the 44 s \((J^\pi = 4, 5^+)\) \(^{120}\)In isomers is already several years old. It was published by Kantele and Karras\textsuperscript{6} in 1964, who used scintillation counter techniques. Further studies of the electromagnetic transitions in the decay of \(^{120}\)In isomers were necessary for obtaining a more complete picture of levels in \(^{120}\)Sn.

The numerous scintillation detector studies\textsuperscript{7-11} published several years ago constitute a basis for the decay schemes of the 15.9 min \((J^\pi = 1^+)\) and the 5.8 d \((J^\pi = 8^-)\) \(^{120}\)Sb isomers. Due to the simplicity of these schemes, especially those describing the EC-decay of the 5.8 d \(^{120}\)Sb make the works very reliable. A few recent investigations of the \(^{120}\)Sb isomers using Ge(Li) techniques are those by Rahmouni\textsuperscript{12} (15.9 min and 5.8 d \(^{120}\)Sb), by Kiselev \textit{et al}.\textsuperscript{13} (5.8 d \(^{120}\)Sb) and by Kiselev and Burmistrov\textsuperscript{14} (15.9 min \(^{120}\)Sb). Especially the numerous new \(\gamma\)-transitions and levels of \(^{120}\)Sn reported by Rahmouni\textsuperscript{12} gave rise to the present reinvestigation. After our measurements of the \(^{120}\)Sb isomers were completed, an article by Pan \textit{et al}.\textsuperscript{15} was published in which the decay of the \(^{120}\)Sb isomers was also investigated with the purpose of clarifying the results reported by Rahmouni\textsuperscript{12}.

This work concerning the levels of \(^{120}\)Sn belongs to a larger project, in which levels of even Sn isotopes \(A = 118-124\) populated in the decays of In and Sb were investigated with Ge(Li) spectrometers\textsuperscript{16,17}. The level systematics of the tin isotopes will be treated later\textsuperscript{17}. 

\textsuperscript{17} Hattula, J., Kantele, J., Kukkonen, J.: To be published \((^{122}\)Sn and \(^{124}\)Sn).