Levels of $^{118}$Sn Populated in the Decay of $^{118}$In and $^{118}$Sb Isomers

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Gamma-rays in the disintegration of 5.0 s (1$^+$), 8.5 s (7$^-$, 8$^-$), and 4.4 min (4$^+$, 5$^+$) $^{118}$In isomers and of 3.5 min (1$^+$) and 5.1 h (8$^-$) $^{118}$Sb isomers have been investigated using Ge(Li) detectors and Ge(Li)-NaI(Tl) coincidence spectrometers. The decay schemes of these isomers have been constructed incorporating 17 levels in the product nucleus, $^{118}$Sn, at the following energies (in keV): 0 (0$^+$), 1229.5 (2$^+$), 1757.5 (0$^+$), 2043.1 (2$^+$), 2056.4 (0$^+$), 2280.3 (4$^+$), 2321.3 (5$^-$), 2326.4 (1$^+$, 2$^+$), 2402.7 (4$^+$), 2488.8 (4$^+$), 2496.5 (0$^+$), 2575.2 (7$^-$), 2677.3, 2733.7 (2$^+$), 2929.8, 2963.5 (4$^+$), and 3137.1 (0$^+$). The structure of $^{118}$Sn is briefly discussed in view of results from recent quasiparticle-model calculations.

1. Introduction

This work is a continuation of a previous study$^1$ of $^{118}$Sn levels populated in the decay of some of the $^{118}$In and $^{118}$Sb isomers, which was carried out several years ago using scintillation detector techniques. Our first experiments on the decay of $^{118}$In isomers employing Ge(Li) detectors$^2$ revealed the existence of a new 8.5 s isomeric state in this nuclide. In the present paper, we give a more complete account on our results on the decay of all known $^{118}$In and $^{118}$Sb isomers.

The only recent investigations of these isomers that we know of are those by Rahmouni$^3$ on the $^{118}$Sb isomers and by Schwartzbach and Münzel$^4$ on the 5.0 s and 4.4 min $^{118}$In isomers. Our data do not agree with all of the results of the former work; in the latter one, little additional information was obtained, because only scintillation detectors were used. Recently, detailed information on the structure of a large number of levels in $^{118}$Sn has been gathered in many charged-particle reaction and

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scattering experiments. However, electromagnetic transitions in $^{118}$Sn and the structure of the $^{118}$In and $^{118}$Sb isomers have not been investigated in these experiments, so that further disintegration studies were necessary for obtaining a more complete picture of the $^{118}$In, $^{118}$Sn and $^{118}$Sb isotopes.

Most of the recent calculations of the level structure of the even tin isotopes are based on the quasiparticle method in its various forms. However, since mainly qualitative agreement between theory and experiment is generally achieved, and only relatively few of the theoretical results can directly be compared with the available experimental data on $^{118}$Sn, we shall only briefly discuss our data in view of the quasiparticle models.

2. Experimental Procedure

Source Preparation

The $^{118}$In activities were produced by bombarding an enriched (96.6%) metallic $^{118}$Sn sample* weighing 500 mg with 14–15 MeV neutrons from the Sames Model T 400 kV neutron generator at the Physics Department of the University of Helsinki. The neutron flux was typically about $10^{10}$ neutrons/cm$^2$ s. For fast transportation of the 5.0 and 8.5 s $^{118}$In sources, a pneumatic rabbit system having a transfer time of less than 50 ms was employed.

The 3.5 min $^{118}$Sb isomer was studied using a source containing its parent, 6.0 d $^{118}$Te, produced by bombarding natural antimony metal with 90 MeV protons from the synchrocyclotron of the Gustaf Werner Institute, Uppsala, Sweden. After a chemical separation, the tellurium fraction was mass-separated at the Physics Department of the University of Helsinki. The mass-separated sources of $^{118}$Te contained only small amounts of impurities, mainly 4.7 d $^{119}$mTe. However, since the decay of this activity is well established, it presents no difficulties in this work.

* Obtained from Stable Isotopes Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee.