^{120}Sn(p,t)^{118}Sn and Shell Model Calculations

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The present shell model investigation of ^{118}Sn is a complement of the experimental work concering the study of the ^{120}Sn(p,t)^{118}Sn reaction [1]. Our shell model calculation for ^{118}Sn has been performed assuming ^{132}Sn as a closed core, with the 14 valence neutron holes occupying the five levels $0g_{7/2}$, $1d_{5/2}$, $1d_{3/2}$, $2s_{1/2}$, and $0h_{11/2}$ of the 50-82 shell.

The two body effective interaction has been derived from the CD-Bonn NN potential [2], the short-range repulsion of the latter being renormalized by integrating out the high-momentum modes down to a cutoff momentum Λ. This procedure leads to a low-momentum potential $V_{\rm low-k}$ [3] which can be used directly as input for the calculation of the effective interaction $V_{\rm eff}$ within a folded-diagram method [4]. A brief outline of our derivation of $V_{\rm eff}$ is as follows. We first construct the $V_{\rm low-k}$ using a cutoff momentum $\Lambda = 2.1\,{\rm fm}^{-1}$ and then calculate the so-called $\hat{Q}$-box including diagrams up to second order in $V_{\rm low-k}$. The computation of these diagrams is performed by using an harmonic-oscillator basis with $\hbar\omega = 7.88$ MeV and inserting intermediate states composed of particle and hole states restricted to the two major shells above and below the $Z = 50$, $N = 82$ Fermi surface. Finally, the effective interaction is obtained by summing up the $\hat{Q}$-box folded diagram series by means of the Lee-Suzuki iteration method [5] It is worth noting that in the present calculation the matrix elements of the hole-hole effective interaction are needed. In this case, the calculation of the $\hat{Q}$-box diagrams is somewhat different from that for particles.

Our adopted values for the single-hole (SH) energies are (in MeV): $\epsilon^{-1}_{g_{7/2}} = 2.8$, $\epsilon^{-1}_{d_{5/2}} = 2.155$, $\epsilon^{-1}_{s_{1/2}} = 0.85$, $\epsilon^{-1}_{d_{3/2}} = 1.2$, and $\epsilon^{-1}_{h_{11/2}} = 0.0$. They have been determined by reproducing the experimental yrast states in ^{119}Sn which have angular momentum and parity corresponding to the SH levels.

The energy matrices are set up and diagonalized by means of an approach which makes use of the seniority scheme and is based on a chain calculation across nuclei differing by two in nucleon number. Consistently with our previous study of ^{114}Sn and ^{120}Sn, we have included here states with seniority $v \leq 4$.

In the table, the excitation energies measured in the present experiment are compared with the calculated values. We have excluded the 3^- and 1^- states, for which the discrepancies between experiment and theory are well above 1 MeV. This is likely to be due to the significant role played by configurations outside the chosen model space. However, also for several other states, as we see from the table, the agreement between theory and experiment cannot be considered completely satisfactory. The discrepancies range from few tens of keV to about 1 MeV, the measured values being in almost all cases overestimated by the theory. The only exceptions are the first 7^- state, which is predicted however to lie at ~ 30 keV below its experimental counterpart, and the first 6^+ state at 2.900 MeV to be compared with the experimental energy 3.559 MeV. In this connection, it should be mentioned that a 6^+ state at 2.999 MeV is reported in [6]. As a general remark, we may recall that a down-shift of the calculated levels is generally produced by the inclusion of $v > 4$ components.

J^π	$E_{\rm calc}$ (MeV)	$E_{\rm expt}$ (MeV)	J^π	$E_{\rm calc}$ (MeV)	$E_{\rm expt}$ (MeV)
0^+	0.000	0.000	4^+	2.564	2.280
	1.805	1.758		2.855	2.489
	2.090	2.057		3.198	2.734
	3.077	2.497			
	3.385	2.930	6^+	2.900	3.559
	3.700	3.137			
	3.946	3.218	5^-	2.427	2.323
	4.215	3.237		2.728	2.879
	4.262	3.355		3.218	2.963
				3.388	3.375
2^+	1.641	1.230		3.720	3.395
	2.483	2.043			
	2.502	2.323	7^-	2.546	2.575
	2.895	2.403		3.245	3.108
	3.181	2.677			
	3.275	2.904			
	3.449	3.057			
	3.633	3.228			
	3.799	3.309			
	3.938	3.463			
	4.039	3.524			
	4.228	3.585			
	4.201	3.597			

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