Shell-model Study of ^{114}Sn

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The present shell–model study of ^{114}Sn complements the experimental work of Ref. [1], where the ^{116}Sn(p,t)^{114}Sn reaction has been studied. We have assumed that ^{100}Sn is a closed core and let the 14 valence neutrons occupy the five single-particle (s.p.) orbits of the 50–82 shell. Our calculations have been carried out by means of the chain–calculation method within the framework of the seniority scheme [2]. States with seniority up to 4 have been included.

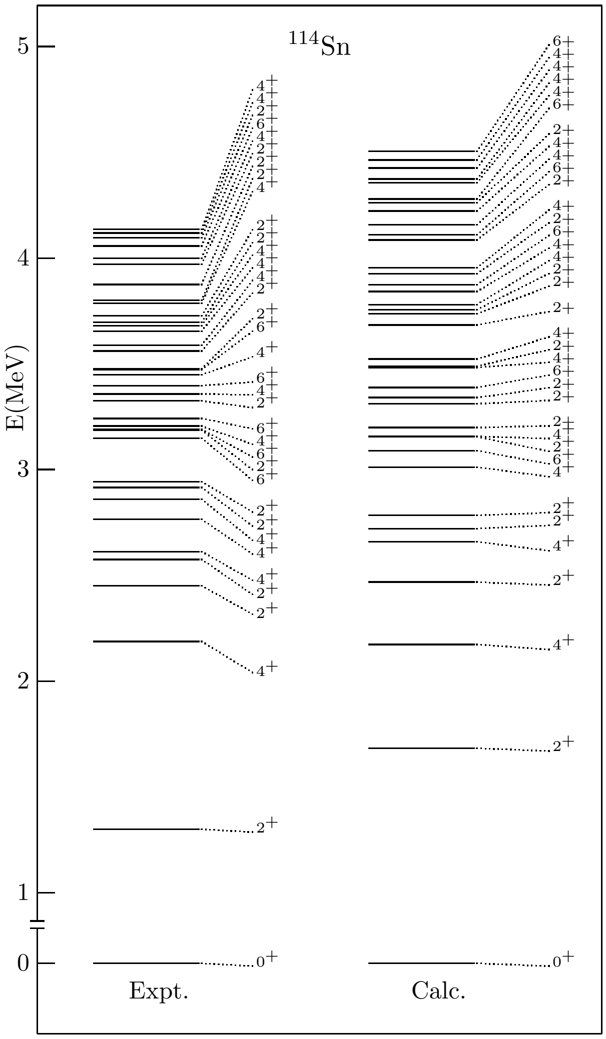

Fig. 1: Experimental and calculated positive–parity states in ^{114}Sn

The two–body interaction between the valence neutrons has been derived from the CD–Bonn nucleon-nucleon potential by way of a G–matrix folded diagram method [3]. However, this interaction represents the effective interaction between two valence neutrons and may not be completely adequate for systems with several valence particles. We have found that the agreement between theory and experiment is substantially improved when weakening the $J^\pi = 0^+$ matrix elements by a factor of 0.9. The adopted s.p. energies are (in MeV): $\epsilon_{g7/2} = 0.0$, $\epsilon_{d/2} = 0.35$, $\epsilon_{s1/2} = 2.10$, $\epsilon_{d3/2} = 2.40$, and $\epsilon_{h11/2} = 3.50$. These have been obtained by an analysis of the low-energy spectra of ^{113}Sn and ^{115}Sn.

The excitation energies measured in Ref. [1] refer to positive–parity states with $J = 0$, 2, 4 and 6 and to negative-parity states with $J = 3$, 5, 7 and 9. They are compared with the calculated values in Figs. 1 and 2, respectively. We do not include the 0^+ and 3^- states, for which any attempt to establish a correspondence between calculated and experimental levels may be misleading. In Fig. 1, we see that the observed level density is reproduced by our calculation for each angular momentum. Furthermore, the quantitative agreement is quite satisfactory up to 3.5 MeV, the experimental and calculated excitation energies differing by less than 300 keV in almost all cases. In the higher energy region larger discrepancies are found, which reach 600 keV for some states. These discrepancies may be partially attributed to the lack of configurations with $v > 4$. Fig. 2 shows that the excitation energies of the three yrast states as well as those of the three 5^- states lying above the yrast one are well reproduced by our calculations. For the second 7^- state and the two highest lying 5^- states, which all lie above 3.5 MeV, the discrepancies range from 300 to 600 keV.

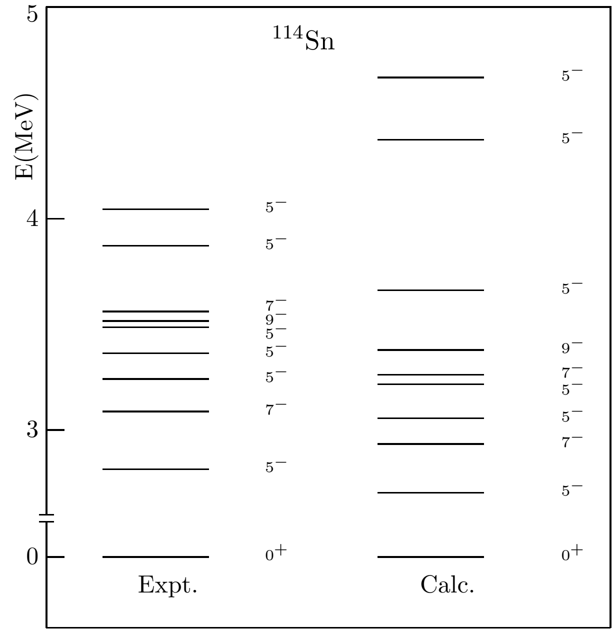

Fig. 2: Same as Fig. 1, but for negative–parity states.

References

[1] P. Guazzoni *et al.*, Annual report 2000, p. 10
[2] P. Guazzoni *et al.*, Phys. Rev. **C60** (1999) 054603
[3] F. Andreozzi *et al.*, Phys. Rev. **C54** (1996) 1636