^{117}In and ^{118}Sn Homologous State Identification via the ^{120}Sn($\vec{p}, \alpha$)^{117}In and ^{121}Sb($\vec{p}, \alpha$)^{118}Sn Reactions

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The ($\vec{p}, \alpha$) reaction on nuclei around singly or doubly magic shells displays properties that make it a useful spectroscopic tool for supplementing level structure information obtained by other charged-particle reactions. Of particular interest is the occurrence of the corresponding homologous states in neighboring systems, which imply the persistence of preferred structures that survive after the addition of one particle that behaves as spectator, as we already tested in Z=40, Z=50 and Z=82 regions [1,2,3,4,5].

In order to further investigate the spectator role of the $1g_{5/2}$ unpaired proton outside the Z=50 closed shell, and to test the validity of the homology concept in the ^{121}Sb nucleus, the reactions ^{120}Sn($\vec{p}, \alpha$)^{117}In and ^{121}Sb($\vec{p}, \alpha$)^{118}Sn are currently under study. High resolution experiments were performed with the 23 MeV proton beam of the Munich MP Tandem accelerator, using the Stern-Gerlach type polarized hydrogen ion source, the Q3D magnetic spectrograph and the light ion focal plane detector with cathode strip readout. High resolving power of the spectrometer, favorable peak to background ratio, and large solid angle define the quality of the spectra. Transitions to final states of ^{117}In up to an excitation energy of 2000 keV and ^{118}Sn up to 5100 keV were studied.

A DWBA analysis of angular distributions of cross sections and asymmetries for the ^{120}Sn($\vec{p}, \alpha$)^{117}In reaction [6] has been carried out in finite range approximation assuming a semimicroscopic triton pickup mechanism. For this even-even target nucleus only one transferred orbital and total angular momentum, l and j, contribute to the excitation of a given final state, greatly simplifying the theoretical calculations.

In the case of an odd mass target nucleus as ^{121}Sb and for transitions to states with spin values different from 0, several l and j may contribute to each transition, which have to be added incoherently in a DWBA calculation. Due to the high number of three-particle configurations involved, the analysis may be quite complicated and spectroscopic information less accurate and more difficult to deduce. On the contrary, in the case of homologous states, populated in the reaction on a near-magic target nucleus having one proton outside a completely filled magic shell, one has unique l-transfer, that is given by the transition to the corresponding parent state.

Our aim in studying the ^{120}Sn($\vec{p}, \alpha$)^{117}In reaction is to obtain accurate measurements of angular distributions of cross sections and asymmetries for comparison with those measured for the ^{121}Sb($\vec{p}, \alpha$)^{118}Sn reaction. In this case one expects that the proton outside the magic proton shell acts as spectator so that only rather high-energy states of ^{118}Sn are excited. These homologous states arise from the coupling of the $1g_{5/2}$ unpaired proton with the configurations excited in ^{117}In. The homology between the low lying states of ^{117}In and the higher energy states of ^{118}Sn allows us to attribute spin and parity to these latter states, fulfilling the expectation of the weak coupling model.

The identification of homologous states in ^{118}Sn is in progress. In Fig. 1 the angular distributions of cross sections and asymmetries for the 4.045 MeV 3^- and 4.121 Mev 2^- states homologous to the 0.315 MeV $1/2^-$ ^{117}In parent state are reported. The solid lines represent the angular distributions of cross sections and asymmetries of the parent state.

References

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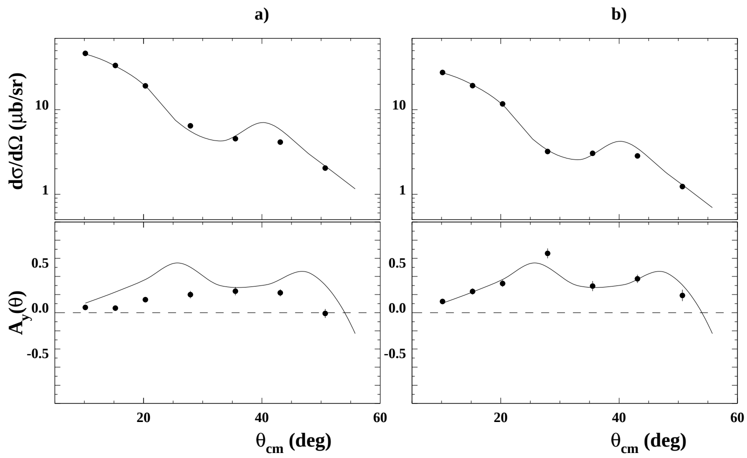

Fig. 1: Angular distributions of cross sections and asymmetries for the 4.045 MeV 3^- (a) and 4.121 Mev 2^- (b) states, homologous to the 0.315 MeV $1/2^-$ ^{117}In parent state