Study of the ^{122}Sn(p,α)^{119}In and ^{123}Sb(p,α)^{120}Sn Reactions

P. Guazzoni [a], L. Zetta [a], Y. Eisermann, G. Graw, R. Hertenberger, A. Metz, G. Staudt [b], and M. Jaskola [c]

[a] Dipartimento di Fisica dell'Università and I.N.F.N, I-20133 Milano, Italy
[b] Physikalisches Institut der Universität, D-72076 Tübingen, Germany
[c] Soltan Institute for Nuclear Studies, Swierk, Poland

In low resolution experiments the spectra of α particles emitted in (p,α) reactions on adjacent target nuclei, one with a magic neutron or proton shell and the other with one additional valence nucleon outside this shell, were measured and compared. The pairs of nuclei investigated were ^{90,91}Zr, ^{122}Sn and ^{123}Sb, ^{142,143}Nd, ^{208}Pb and ^{209}Bi. The experimental findings were the weak population of low energy levels of the residual nucleus for reactions from the target nucleus with the additional valence nucleon and the excitation of homologous states to those observed in the reaction from magic target nuclei, thus providing information on the spectator role of the extra unpaired nucleon [1].

In high resolution experiments at the Munich MP Tandem, at the same incident energy, a detailed comparison of the two pairs of reactions ^{90,91}Zr($\vec{p},\alpha$)^{87,88}Y and ^{208}Pb($\vec{p},\alpha$)^{205}Tl, ^{209}Bi($\vec{p},\alpha$)^{206}Pb was performed and spectroscopic studies on the ^{205}Tl, ^{206}Pb and ^{87,88}Y clearly displayed the validity of the concept of homology as a spectroscopic tool to identify spin and parity of highly excited states populated by the ($\vec{p},\alpha$) reactions on odd mass target nuclei [2–5].

To investigate the spectator role of an unpaired proton of the target nucleus in a different mass region the reactions ^{122}Sn($\vec{p},\alpha$)^{119}In and ^{123}Sb($\vec{p},\alpha$)^{120}Sn are now studied at 26 MeV with the Munich Tandem accelerator, using the polarized ion source, the Q3D magnetic spectrograph and the position and angle resolving light ion detector.

The energy resolution achieved is about 12 keV, mainly due to the target thickness.

In the figure, the spin-up and down polarized spectra are reported for the reaction ^{122}Sn($\vec{p},\alpha$)^{119}In at θ_{lab}=25^0, showing the low excitation energy levels and the unpolarized spectra (c,d) for the reaction ^{123}Sb($\vec{p},\alpha$)^{120}Sn, both at θ_{lab}=25^0, corresponding to two different magnetic settings of the spectrograph, up to an excitation energy of $\sim$ 6.5 MeV.

For this last reaction, the spectra clearly show the weak population of the low-lying levels of the ^{120}Sn residual nucleus up to an excitation energy strictly related to the energy gap in the nucleon state spacing at the filling of the magic shell (3.64 MeV).

References

[1] E. Gadioli *et al.*, Z. Phys. **A310** (1983) 43
[2] E. Gadioli *et al.*, Phys. Rev. **C43** (1991) 2572
[3] E. Gadioli *et al.*, Phys. Rev. **C47** (1993) 1129
[4] P. Guazzoni *et al.*, Z. Phys. **A356** (1997) 381
[5] P. Guazzoni *et al.*, Eur. Phys. J. **A1** (1998) 365