Complex Study of Magic ^{125}Sn via ($\vec{\mathrm{d}}$,p) and (n,γ) Reactions ◇

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Our systematic study of the long chain of the Te isotopes from ^{119}Te up to ^{131}Te (see previous Jahresberichte) brought many results concerning various nuclear properties. The IBFM symmetry, the fragmentation of $3p_{3/2}$ and $3p_{1/2}$ strength, the anomalous feeding of the isomeric $11/2^-$ state, and the direct capture mechanism of the (n,γ) reaction were disclosed in this systematic study.

The present work has the aim to investigate how these properties change going to the magic even-odd ^{125}Sn isotope. In addition, a change of the nuclear level structure between the neighboring even-odd Te isotopes and the magic even-odd ^{125}Sn isotope is of our interest. To study this change a rather complete level scheme is needed.

To obtain an essentially complete level and decay scheme we used the complementary reactions ($\vec{\mathrm{d}}$,p) and (n,γ).

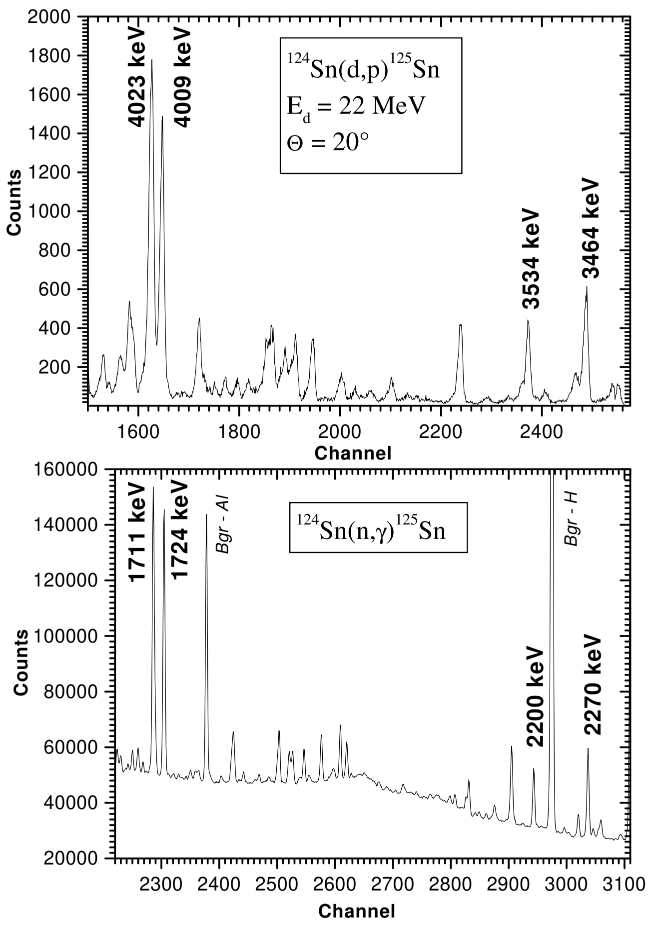

Fig. 1: Fragments of spectra from the ^{124}Sn(d,p)^{125}Sn reaction and the ^{124}Sn(n,γ)^{125}Sn reaction. Note that the upper spectrum is a sum of both polarisation measurements at this angle. Some peaks with l=1 assignments in the (d,p) reaction are labeled in the upper part of the figure by the corresponding level energies. In the bottom part, the corresponding primary γ transitions from the capturing state at 5733 keV to these levels are identified by the γ transition energies. The correspondency in the strength is clearly visible and is a hint for the direct capture mechanism in (n,γ).

The ^{124}Sn($\vec{\mathrm{d}}$,p)^{125}Sn reaction was studied using a 22 MeV polarized deuteron beam from the Stern-Gerlach ion source. Outgoing protons were analyzed with the Q3D magnetic spectrograph and detected by the 89 cm long focal plane detector with cathode-strip readout [1]. The target consisted of 143 μg/cm^2 ^{124}Sn evaporated on a 9 μg/cm^2 thick carbon backing. Measurements were performed at 8 scattering angles (from 10° to 45°) and within the excitation energy range up to 5 MeV.

The (n,γ) and (n,$\gamma\gamma$) reactions were measured at the Nuclear Physics Institute Řež [2] (near Prague). Preliminary results have shown a correlation between l=1 peaks in the proton spectra and low-energy primary γ transitions in the (n,γ) reaction. This correlation is documented in Fig. 1. Like in the thermal neutron capture at the heaviest tellurium isotopes, ^{126}Te,^{128}Te, and ^{130}Te, this correlation can be explained within the framework of the direct capture mechanism of the (n,γ) reaction.

References

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