Study of Low Spin States in ^{121}Te with the ($\vec{\mathrm{d}}$,t) Reaction ◇

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Our collaboration started a programme of studying in detail the low-energy, low-spin structures of the neutron deficient, odd-neutron tellurium isotopes. Along with their transitional character, the Te nuclei are particularly interesting due to the occurence of excitations of the core accross the Z=50 shell ('intruder' states) at low energies [1]. Such states may mix with the 'normal' ones (resulting from coupling the odd particle to collective vibrations of the core). For a better understanding of such a complex situation it is important to have a systematic experimental knowledge, as complete as possible, of the lower spin part of the level schemes.

The present study is an attempt to do this for ^{121}Te. The level scheme of this nucleus, known at present up to about 3 MeV excitation [2], is rather rich, and comes from β-decay study [3], $(\alpha, 2n\gamma)$ and (d,2nγ) reactions [4] (for the higher spins), and light particle induced transfer reactions. Both stripping (d,p) [5] and pickup (p,d) [6] and (^{3}He,α) [7] reactions have been studied. Although both the beta decay and the transfer reaction studies evidenced a large number of levels, most of them have only limited information on spin and parity, and this prevents a detailed comparison with nuclear model predictions.

In our experiment we performed measurements of the ^{122}Te($\vec{\mathrm{d}}$,t) reaction at E_d = 24.0 MeV. A polarized deuterium beam of the Munich Tandem Van de Graaff Accelerator was used (with a polarizaton of ≈0.60). The target consisted of 120 μg/cm^2 Te (91.2% enriched in ^{122}Te) evaporated on a 4.2 μg/cm^2 carbon backing. The reaction products were analyzed with the Q3D magnetic spectrograph and detected in the 1.8 m long focal plane detector described in ref. [8], which covered an excitation range up to almost 3 MeV with one magnetic setting of the spectrograph. The energy resolution of the experiment was around 5 keV FWHM. Spectra for the two orientations of the spin have been measured at 10 angles between 7.5° and 40°.

The outcome of this experiment, which is still under evaluation, is rather similar to our previous study of ^{129}Ba with the same reaction [9]. The good identification of the tritons in the detector resulted in virtually background-free spectra, thus allowing to evidence rather weakly excited states. Due also to the high energy resolution, about 100 levels have been observed up to about 2.6 MeV excitation, which might constitute a quasi-complete determination of the levels with spins up to 11/2. One hopes that the use of the polarized beam will allow unambiguous assignment of the J^π values for most of these levels. The attached fig. 1 is an example which demonstrates the power of this approach for two low-lying levels known from previous studies [2] but poorly characterized in what concerns their spin and parity values. The 594 keV level was given as $3/2^+$, $5/2^+$, whereas no J^π values were proposed for the 807 keV level [2]. In our experiment both levels are populated by a L=2 transfer (see the angular distributions of the cross section), whereas the measured asymmetries very clearly distinguish between the two possible J values (3/2 and 5/2), thereby leading to the unambiguous assignments of $5/2^+$ and $3/2^+$ for the 594 and 807 keV levels, respectively (note: the curves in the figure only join the experimental points).

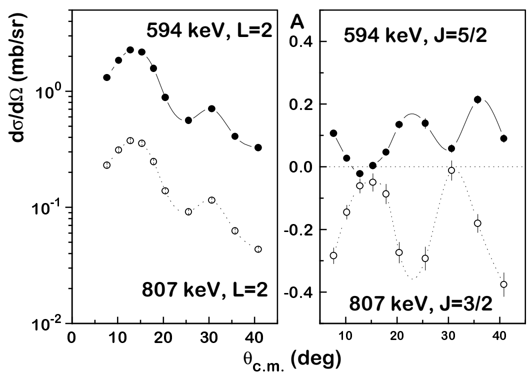

Fig. 1: Angular distributions and asymmetries of two transitions in ^{121}Te.

As shown in the recent studies of ^{129}Ba [9] and ^{125}Te [10], the Interacting Boson-Fermion Model is able to provide a reasonably good description of the one-quasiparticle excitations in such transitional nuclei. Similar calculations are being planned for ^{121}Te.

References

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◇ supported by the DFG (IIC4-Eg 25/4-1, Gr 894/2, 436 RUM 17/6/97)