Spectroscopy of ^{129}Te via (d,p), ($\vec{d}$,t) and (n,$\gamma\gamma$) Reactions ◇

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A detailed investigation of the nucleus ^{129}Te was performed including the transfer reactions (d,p) and ($\vec{d}$,t), and (n,γ) reactions and γ-γ coincidences. The ^{128}Te(d,p)^{129}Te and ^{130}Te($\vec{d}$,t)^{129}Te measurements were performed at the Munich tandem accelerator with 24 MeV deuterons. The ^{128}Te and ^{130}Te targets were 100 μg/cm^2 and 165 μg/cm^2 thick, respectively, evaporated on 4 μg/cm^2 thick carbon backings. The enrichments were 99.3% (^{128}Te) and 99.5% (^{130}Te). The reaction products were analyzed with the Q3D magnetic spectrograph and detected in the 1.8 m long focal plane detector [1] which covered an excitation range up to 3.5 MeV. The energy resolution in both measurements was better than 6 keV FWHM. Ten angles were measured between 7.5° and 40° resulting in well structured angular distributions which allowed to determine unambiguously the angular momentum transfer and in the case of the polarized measurement also the J^π assignment for most of the levels. Fig. 1 shows an example of the power of the ($\vec{d}$,t) measurement. Both shown levels are populated by a L=2 transfer (see the angular distributions of the cross section), whereas the measured asymmetries distinguish very clearly between the possible J values (3/2 and 5/2).

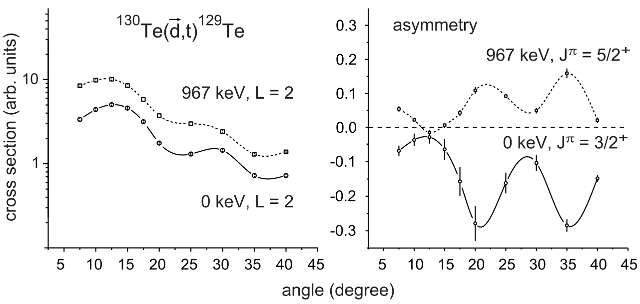

Fig. 1: Angular distributions and asymmetries of two levels of ^{129}Te. (Note: The curves only join the experimental points.)

Single γ-ray spectra and $\gamma\gamma$-coincidences following thermal-neutron capture in ^{128}Te were measured with semiconductor detectors at the light-water reactor LWR-15 at Řež near Prague. The target consisted of 1.7 g of metallic Te enriched in ^{128}Te to 99.3%. Single spectra and coincidence spectra were recorded using two 22% and 28% HPGe detectors with coincidence electronic described in Ref. [2]. Fig. 2 demonstrates the quality of the coincidence measurements. For the construction of the level scheme eight two-step cascade and almost 40 normal gate spectra were evaluated. A total of 181 out of 301 measured gamma lines belonging to ^{129}Te is so far placed in a level scheme of 58 levels with help of the program LEFIT of K. Schreckenbach.

The superb energy resolution of the transfer reactions measured at the Q3D magnetic spectrograph in Munich combined with the rich information of the γ-ray measurements in Řež near Prague allows to construct an elaborate level scheme. Besides some even isotopes our group investigated all accessible odd tellurium isotopes [3] except for ^{131}Te, whose study is planned for 1999. The stable tellurium isotopes with only two protons outside the closed Z=50 shell span the wide region of N=68-78 (A=120-130) nearly in the middle of the closed neutron shells N=50 and N=82. This allows to investigate the evolution of the main nuclear structure when the number of valence neutrons is gradually changed, e.g. the special population of the 11/2 isomer in the (n,γ) reaction [4]. Interacting Boson-Fermion Model (IBFM-1) calculations to describe mainly low-energy levels in the whole chain of the odd-A Te isotopes are in progress [5,6].

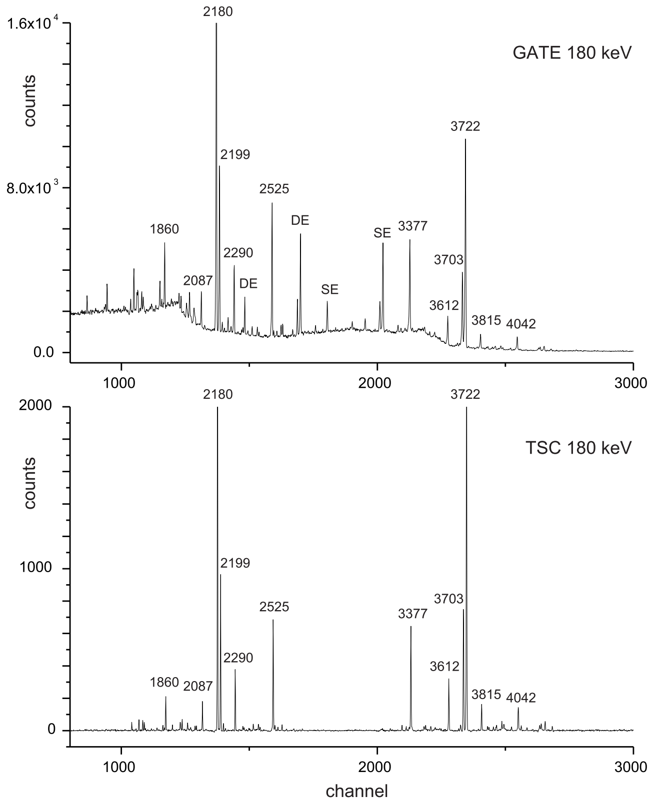

Fig. 2: Sections of (n,$\gamma\gamma$) coincidence spectra with gamma lines feeding the second excited state of ^{129}Te at 180 keV. The first spectrum is gated on the 180 keV γ-line. The second is a two-step cascade spectrum with gammas from the capturing state at 6082 keV to the state at 180 keV; the gate is the sum of the two feeding gammas of 5902 keV. Numbers: energies in keV.

References

[1] E. Müller-Zanotti *et al.*, Nucl. Instr. Meth. **A310** (1991) 706
[2] J. Honzátko *et al.*, Nucl. Instr. Meth. **A376** (1996) 434
[3] J. Honzátko *et al.*, Nucl. Phys. **A645** (1999) 331
[4] V. Bondarenko *et al.*, Phys. Rev. **C**, submitted.
[5] D. Bucurescu *et al.*, this report p.16
[6] D. Bucurescu, private communication (1999).

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