Direct Neutron Capture in ^{129}Te and ^{131}Te ◇

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Strong correlations between (d,p) spectroscopic factors and primary (n,γ) intensities for Te isotopes were observed and can be explained in the framework of the Lane-Lynn theory of direct neutron capture [1,2,3,4]. In the present work experimental partial (n,γ) cross sections measured at the LWR-15 reactor in Řež near Prague are compared with spectroscopic data from (d,p) studies at the Q3D spectrograph.

The reaction ^{128}Te(d,p)^{129}Te was measured at 11 angles between 10 and 50 degrees with an unpolarized deuteron beam of 18 MeV and the 1.8 m long focal plane detector [5] between 2 and 5 MeV excitation energy. l-values and spectroscopic factors S_{jl} are derived from comparison with DWBA calculations. To assign the j-values, i.e. to distinguish between j=l±1/2, for example p1/2− and p3/2− (l=1), states, the same reaction was measured with polarized beam at 22 degrees, where the asymmetry effect is large especially for l=1. This measurement was done with our new focal plane detector [6,7,8]. All (d,p) measurements had a very good energy resolution of 3-4 keV FWHM, the target was 145 μg/cm^2 metallic ^{128}Te (99.5 % isotopic enrichment) evaporated on a 4 μg/cm^2 carbon foil.

Figures 1 and 2 show the comparison between cross sections of primary gamma transitions and calculated cross sections according to the Lane-Lynn theory for ^{129}Te.

Figure 3 shows this comparison for ^{131}Te. The (d,p) spectrum was measured with 18 MeV deuterons at the Munich Q3D spectrograph. The (n,γ) data were obtained at the Nuclear Physics Institute in Řež [9].

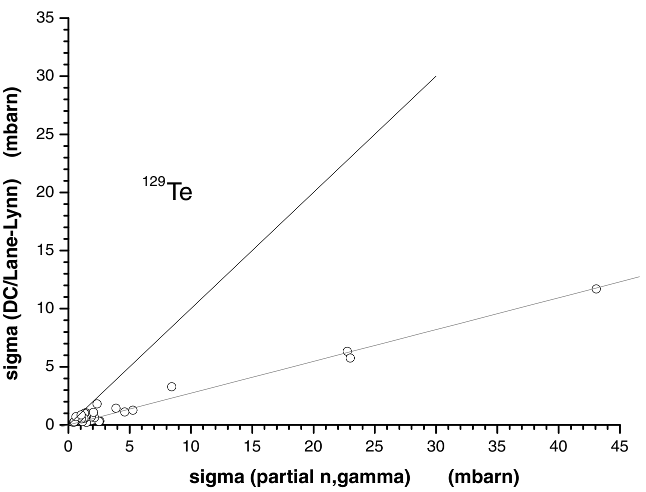

Fig. 1: Comparison between experimental values of the partial cross sections of primary γ transitions in the ^{128}Te(n,γ) reaction and values calculated with the Lane-Lynn theory of direct capture, which are directly proportional to (2J+1)$S_{(dp)}$, where $S_{(dp)}$ are the spectroscopic factors of the ^{128}Te(d,p) reaction. The ratio is not 1 like expected but a constant factor too low.

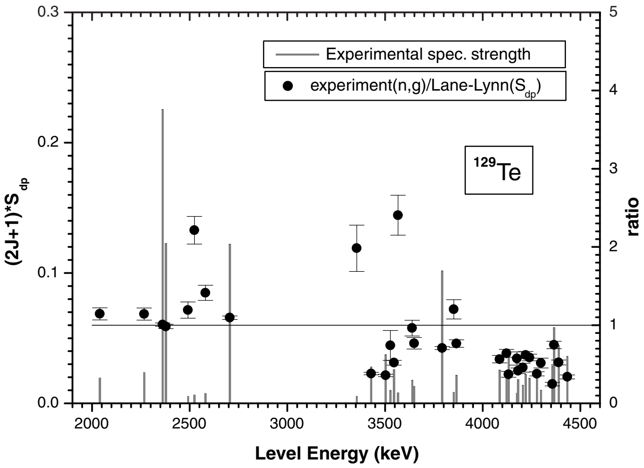

Fig. 2: The identified l=1 states in ^{129}Te. The left axis is the spectroscopic strength in the (d,p)-spectra, the axis on the right belonging to the points shows the ratio between partial (n,γ) cross section and cross sections calculated with the theory of Lane-Lynn. The ratio is normalized to 1 for the strongest line, compare Fig. 1 and the text.

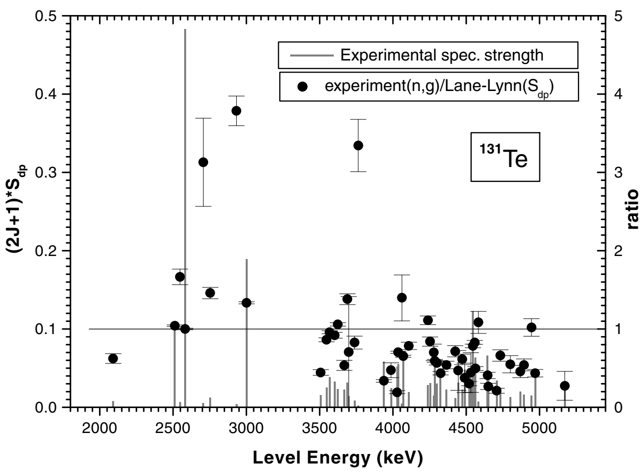

Fig. 3: The same Figure like Fig. 2 for ^{131}Te. Also here the ratio axis is normalized to 1 for the strongest line.

In both cases the ratio between cross sections calculated with the Lane-Lynn theory of direct capture and cross sections of primary γ transitions seems to be a constant factor too low. The reason for this will be investigated.

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◇ Supported by the DFG under IIC4-Eg 25/4-1.