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V–16 Measurements of the Quadrupole Moments of ^{124,126,128}Te

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One of the most intensively studied regions of the nuclear chart, by means of the reorientation effect, is that around the closed proton shell at $z = 50$. Many of the values of the static quadrupole moments Q_{2^+} for the nuclei in this region are undergoing continual revision due to changing experimental techniques and improved theoretical interpretation of the data. With these considerations in mind we have applied the reorientation effect to the measurements of the Q_{2^+} of ^{124,126,128}Te. Unlike the original measurement[1] of ^{126,128}Te, in which a particle-γ technique was used, we have determined directly the excitation probabilities by resolving the inelastically and elastically scattered ^{16}O and ^{4}He projectiles.

The measurement was performed using the 9 to 10.5 MeV ^{4}He and 40 to 44 MeV ^{16}O beams of the Cologne FN Tandem. An annular surface barrier detector subtending a scattering angle of 176° and a solid angle of 40 mstr was used to detect the ^{4}He and ^{16}O backscattered particles. Targets were composed of ~10 g/cm^2 and ~50 g/cm^2 of the separated isotope evaporated onto ~10 g/cm^2 carbon backings for ^{16}O and ^{4}He respectively.

The beam and detector collimination consisted of thin highly polished Ta and Al orifices. With this experimental configuration it was possible to rather cleanly separate the inelastic (to the first 2^+ state) from the elastically scattered ^{16}O ions, as is shown in the Fig. 1. The contribution of the elastic tail, which for all spectra was less than 5% of the inelastic intensity, was analysed with the help of a line shape fitting program. The major correction applied to the data was the subtraction of the elastic and inelastic contributions of the other Te isotopes present in a given sample.

This correction amounted to 6.1, 1.3, and 0.5 per-

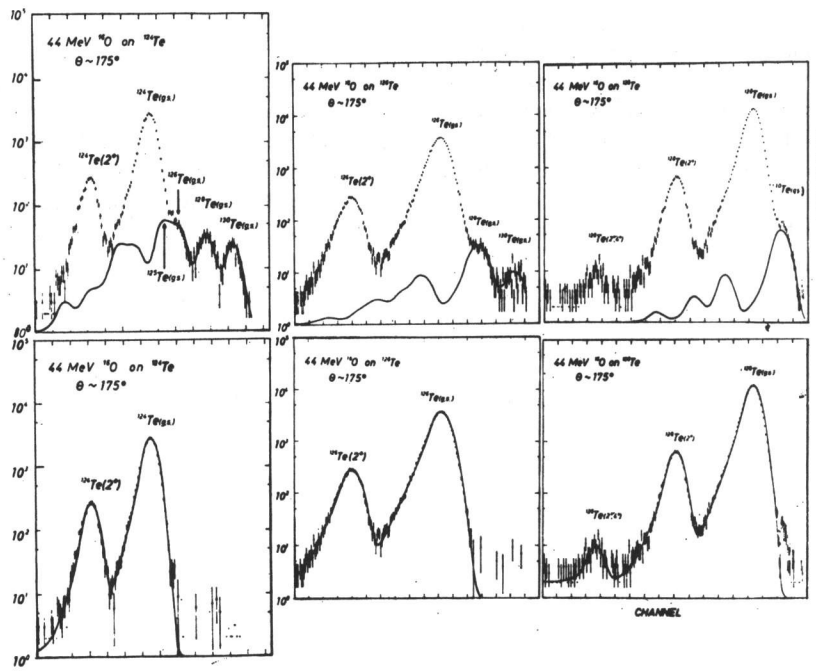

Fig. 1

cent for the 124, 126, and 128 cases respectively. The accuracy of the assay supplied by Oak Ridge is evident in the upper row of the figure where the raw spectra together with the underlying impurity contribution is shown. The spectra obtained after subtracting the impurities and performing the final fit are exhibited in second row of the figure. In comparison the analysis of the alpha spectra is quite straight forward, since the inelastic peak rests on a smoothly varying elastic tail whose contribution may be well represented by a straight line. The question of nuclear contributions to the alpha inelastic crossection was examined by measuring excitation functions from 9 to 17 MeV. Deviations from the pure electromagnetic crossection, outside of the statistical accuracy of the data points (1.5%), occurred at energies above 10.5 MeV, which was consequently adopted as a safe energy.

Final results for the $B(\mathrm{E2}, 0^+ \rightarrow 2^+)$ and Q_{2^+} for either choice of the interference sign are presented in the table. It should be noted that these values disagree with those issued in a preliminary report.[2] This is due to an error found in the analysis of the ^{4}He spectra in which the impurities were added (not subtracted), and hence the shift to more negative values of Q_{2^+}. Our Q_{2^+} values, however, are still about half the absolute value of the previous ^{126,128}Te results,[1] which for the negative sign of the interference term are -0.40 ± 0.09 e.b. and -0.27 ± 0.13 e.b. for ^{126}Te and ^{128}Te respectively. In a preliminary report of a measurement of ^{124}Te the authors of ref. 3 obtain values for Q_{2^+} of 0.20 ± 0.10 e.b. and -0.13 ± 0.10 e.b. for both signs of the interference term, which is in considerable disagreement with the present work.

Table I.

Isotope	Interference-sign	$B(\mathrm{E2}, 0 \rightarrow 2)$ (e^2b^2)	Q_2 (eb)	x^2/df
^{124}Te	+	0.477 ± 0.005	-0.50 ± 0.10	0.74
	−	0.479 ± 0.005	-0.27 ± 0.10	0.75
^{126}Te	+	0.454 ± 0.005	-0.20 ± 0.09	0.71
	−		$+0.00 \pm 0.09$	0.37
^{128}Te	+	0.370 ± 0.005	-0.07 ± 0.09	1.22
	−		$+0.12 \pm 0.09$	1.18

References

1) R. G. Stockstad and I. Hall: Nuclear Phys. **A99** (1967) 507.
2) A. M. Kleinfeld *et al.*: BAPS. **16** (1971) 643.
3) G. Lamoureux *et al.*: BAPS. **17** (1972) 536.