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V–21 E4 Moments in ^{152}Sm, ^{154}Sm by Coulomb Excitation

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Alpha particles with energies of 10–18 MeV and scattered at various backward angles were used to excite the lower members of the g.s. bands in ^{152,154}Sm. The scattered particles were detected in Silicon surface-barrier detectors and the spectra thus obtained were clean enough to resolve both the 2^+ and the 4^+ levels. The excitation probabilities were deduced from the spectra by a fitting technique developed for this purpose. A typical spectrum and the fit obtained by the fitting program are given in Fig. 1.

At bombarding energies lower than 13 MeV the excitation is purely electromagnetic and thus the E4 transition moment can be deduced by fitting both the 2^+ and 4^+ excitation probabilities to the prediction of the multiple Coulomb excitation theory and varying the B(E2; $0^+ \to 2^+$) and M(E4; $0 \to 4$) (M_{04}) as free parameters.[1] The ratio between B(E2, $0^+ \to 2^+$) and B(E2, $2^+ \to 4^+$) which plays a very important role in the analysis, was taken from other measurements[1] to be 0.529 ± 0.013 and 0.506 ± 0.013 for ^{152}Sm and ^{154}Sm, respectively. The theoretical calculations were performed by a Quantum-Mechanical Coupled channels program and thus all quantal corrections[2] were taken automatically into account. The effect of virtual excitation of higher levels were estimated from the classical Coulomb Excitation codes.

Figure 2 shows the plane of B(E2) and M_{04} in which lines of equal P_{2^+} and P_{4^+} are drawn. The hatched area is the domain consistent with the measured probabilities, and its projection on the B(E2) and M_{04} axes determine the results of this experiment.

The resulting B(E2) for ^{152}Sm and ^{152}Sm are 3.447 ± 0.059, 4.465 ± 0.079 e^2b^2 respectively while the M_{04} are 0.37 ± 0.09, 0.54 ± 0.11 eb^2 respectively. The quoted errors include the statistical uncertainties which amount to 0.6% for the B(E2, $0^+ \to 2^+$) and to 12% for the M_{04}, as well as those errors, which were introduced by the uncertainties in the bombarding energy and scattering angles. However, another large contribution to the error in M_{04}, namely, 11%, comes from the uncertainties in the ratio between B(E2; $0^+ \to 2^+$) and B(E2; $2^+ \to 4^+$). Our results for the B(E2) are consistently larger and the M_{04} are consistently lower than those of ref. 1, which brings the charge $\lambda = 4$ deformation to better agreement with the results of (α, α') scattering at higher energies.[3]

References

1) F. S. Stephens *et al.*: Phys. Rev. Letters **27** (1971) 1151.

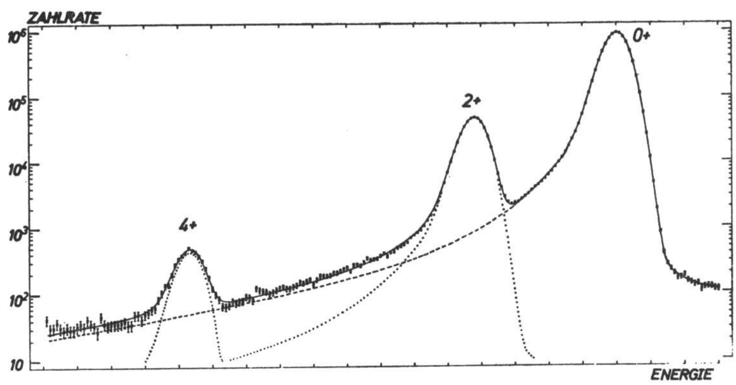

Fig. 1

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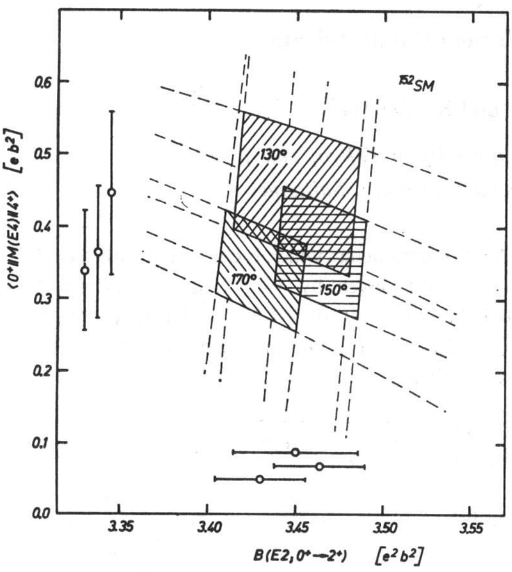

Fig. 2

2) K. Alder *et al.*: Phys. Letters **32B** (1970) 645.
3) D. L. Hendric *et al.*: Phys. Letters **26B** (1968) 127; A. A. Aponick *et al.*: Nuclear Phys. **A159** (1970) 367.