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V.f′. Excited State Quadrupole Moments by Inelastic Electron Scattering

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Inelastic electron scattering from low-lying states of vibrator-spectrum nuclei gives detailed information on the structure of these state. Recently, Lightbody[1] observed that good fits to electron scattering form factors could be obtained using an anharmonic model whose essential feature is that the wavefunction of the first and second 2^+ states are orthonormal combinations of one-and two-phonon model states. Figure 1 shows typical form-factor data in the case of ^{48}Ti.

We have used the best-fit wavefunction to calculate the static quadrupole moments of the first 2^+ state in a number of nuclei. The procedure is described in reference.[1] Table I summarizes all the results we have obtained to date.[2] Because of uncertainties about the validity of the model, and because the best fits were done in corrected Born approximation, the values given should be regarded as preliminary. The errors quoted in the table are statistical in origin. However, in spite of the crudeness of the model, the agreement of our data with published results obtained in the Coulomb reorientation effect is excellent.

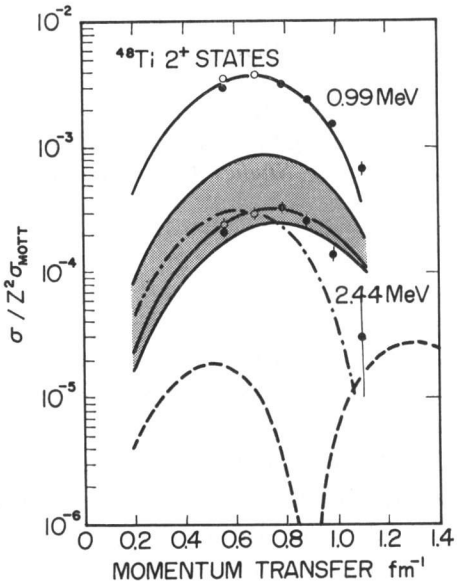

Fig. 1. Electron scattering form factors for the lowest two 2^+ states in ^{48}Ti. Solid lines were calculated using a best-fit admixture and phase of the one-and two-phonon harmonic vibrator model wavefunction. The dashed line represents the pure harmonic two-phonon form factor. The dot-dashed curve represents a best-fit attempt using the opposite phase admixture. The shaded area was determined using an admixture which fits the measured branching ratio for the γ-ray decays of the second 2^+ state.

Table I. First excited state static quadrupole moments.

Nucleus	Q, barns	
	Electron scattering	Reorientation effect
^{48}Ti	-0.177 ± 0.008[b]	-0.22 ± 0.08[c] -0.135 ± 0.082[d] -0.38 ± 0.13[e]
^{52}Cr	-0.082 ± 0.016[a]	-0.07 ± 0.13[f]
^{60}Ni	-0.104 ± 0.018[b]	0 ± 0.13[g]
^{64}Zn	-0.135 ± 0.016[b]	
^{70}Zn	-0.21 ± 0.03[b]	
^{110}Pd	-0.28 ± 0.03[a]	$(-0.27$ or $-0.48) \pm 0.05$[h] $(-0.45$ or $-0.72) \pm 0.12$[i]
^{114}Cd	-0.29 ± 0.03[a]	-0.32 ± 0.08[j]
^{116}Sn	-0.14 ± 0.03[a]	$+0.09 \pm 0.13$[k]

a) New preliminary values.
b) From ref. 1.
c) O. Hausser *et al.*: Nuclear Phys. **A150** (1970) 417.
d) P. M. S. Lesser *et al.*: Univ. of Rochester annual report, 1970 (unpublished).
e) N. V. deCastro-Faria *et al.*: Nuclear Phys. **A174** (1971) 37.
f) D. Cline: University of Rochester Report UR-NSRL-40, 1971 (unpublished).
g) D. Cline *et al.*: Nuclear Phys. **A133** (1969) 445.
h) R. Beyer *et al.*: Phys. Rev. **C2** (1970) 1469.
i) R. P. Harper *et al.*: Nuclear Phys. **A162** (1971) 161.
j) Z. Berant *et al.*: Phys. Rev. Letters **27** (1971) 110.
k) A. M. Kleinfeld *et al.*: Nuclear Phys. **A154** (1970) 499.

References

1) J. W. Lightbody, Jr.: Phys. Letters **38B** (1972) 475.
2) S. Penner *et al.*: "Electron Scattering Studies of Vibration-Spectrum Nuclei" submitted to *Intern. Conf. on Nuclear Structure Studies Using Electron Scattering and Photoreaction Sendai, Sept. 12, 1972.*

Discussion

SORENSEN: The method for analyzing electron scattering data is difficult to extend to a larger number of states than just the one- and two-phonon states, since a wavefunction with several adjustable parameters must be assumed.

T. TAMURA (Univ. of Texas): I would like to make a comment on the contribution of Dr. Penner. When we analyzed (p,p′) data, *e.g.* ^{114}Cd(p,p′), we introduced a similar admixture of one-phonon amplitude to the 2^+ state, which was so large that the B(E2) of the crossover transition was overestimated. In the (p,p′) case we had an excuse in that we could say that nuclear and electromagnetic phenomena are different. In your case such an excuse dose not exist. However, I don't mean that your analysis is wrong. Rather I want to emphasize that your result has added another difficulty for theoreticians.