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# Study of Nuclear Structure by Electromagnetic Excitation with Accelerated Ions

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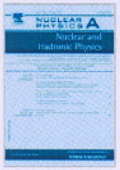

# Reorientation measurements in $^{116}Sn$ and $^{124}Sn$

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## Abstract

The first $2^+$ states of $^{116}Sn$ and $^{124}Sn$ have been studied by observing the γ-ray decay to the ground states, following Coulomb excitation with backscattered $^{4}He$, $^{16}O$ and $^{32}S$ ions. The static electric quadrupole moment $Q_{2^+}$ of the $2^+$ states and the reduced electric transition probability $B(E2, 0^+ \rightarrow 2^+)$ were obtained by interpreting the results in terms of the reorientation effect. The values of $Q_{2^+}$ found are +0.09±0.13 b for $^{116}Sn$ and -0.24±0.15 b for $^{124}Sn$. The measured $B(E2, 0^+ \rightarrow 2^+)$ values are 0.22±0.01 $e^2 \cdot b^2$ for $^{116}Sn$ and 0.19±0.01 $e^2 \cdot b^2$ for $^{124}Sn$.

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# Quadrupole moments of $2^+$ states of even tin isotopes*

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(Received 23 June 1975)

In high precision Coulomb excitation experiments $\alpha$ particles of 10.0, 10.5, and 10.6 MeV and $^{16}$O ions of 42.0 and 46.0 MeV were used to excite the first $2^+$ states in $^{112,116,118,120,122,124}$Sn. Static quadrupole moments $Q(2^+)$ and reduced quadrupole transition probabilities $B(E2; 0^+ \rightarrow 2^+)$ were extracted from intensities of particles elastically and inelastically scattered at angles near 173° into an annular detector. The values of $Q(2^+)$ are very small and consistent with 0.0 b. These results are in agreement with theoretical predictions based on pairing plus quadrupole forces.

[NUCLEAR REACTIONS $^{112,116,118,120,122,124}$Sn$(\alpha, \alpha')$, $E=10.0$, 10.5, 10.6 MeV, $^{112,116,118,120,122,124}$Sn$(^{16}$O, $^{16}$O$')$, $E=42.0$, 46.0 MeV, measured $d\sigma/d\Omega$ for $\theta$ near 173°, deduced $Q(2^+)$, $B(E2; 0^+ \rightarrow 2^+)$. Enriched targets.]

## I. INTRODUCTION

The discovery by de Boer *et al.*[1] of an unexpectedly large static quadrupole moment $Q(2^+)$ of the first $J^\pi = 2^+$ level in $^{114}$Cd stimulated extensive experimental efforts to measure quadrupole moments of excited states in other nuclei. Measurement of

then normalized the relative values to their absolute determination of $Q(2^+)$ for $^{120}$Sn from inelastic scattering and particle-$\gamma$ coincidence measurements. A fundamental difficulty in these measurements was the determination of the relative efficiency of the $\gamma$ ray detector as a function of $\gamma$ ray energy. Therefore, measurement of $Q(2^+)$ for the

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# Coulomb Excitation of $^8$Li

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We have observed the excitation of the first excited state ($E_x = 0.98$ MeV, $J^\pi = 1^+$) of the radioactive, neutron-rich nucleus $^8$Li ($J^\pi_{g.s.} = 2^+$) from its inelastic scattering on $^{nat}$Ni at $E(^8\text{Li}) \simeq 14.6$ MeV. Cross sections measured out to large $\theta_{c.m.}$ agree well with Coulomb-excitation probabilities and have been used to deduce an $E2\uparrow$ transition rate for the $2^+_{g.s.} \rightarrow 1^+$ excitation in $^8$Li*. The latter [$B(E2\uparrow) = 55 \pm 15$ $e^2$fm$^4$] is large relative to nearby stable nuclei, but comparable to the neighboring neutron-rich nucleus $^{10}$Be. The relevance of the data to predicted "neutron-halo" giant dipole resonances in unstable nuclear projectiles is considered.

PACS numbers: 25.70.Ef, 23.20.Ck, 23.20.Lv, 27.20.+n

# Coulomb Excitation of Radioactive $^{132,134,136}$Te Beams and the Low $B(E2)$ of $^{136}$Te

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The $B(E2; 0^+ \rightarrow 2^+)$ values for the first $2^+$ excited states of neutron-rich $^{132,134,136}$Te have been measured using Coulomb excitation of radioactive ion beams. The $B(E2)$ values obtained for $^{132,134}$Te are in excellent agreement with expectations based on the systematics of heavy stable Te isotopes, while that for $^{136}$Te is unexpectedly small. These results are discussed in terms of proton-neutron configuration mixing and shell-model calculations using realistic effective interactions.

RAPID COMMUNICATIONS

PHYSICAL REVIEW C **84**, 061306(R) (2011)

# One-phonon isovector $2^+_{1,MS}$ state in the neutron-rich nucleus $^{132}$Te

M. Danchev,[1] G. Rainovski,[1,2] N. Pietralla,[2,3] A. Gargano,[4] A. Covello,[4,5] C. Baktash,[6] J. R. Beene,[6] C. R. Bingham,[7] A. Galindo-Uribarri,[6] K. A. Gladnishki,[1] C. J. Gross,[6] V. Yu. Ponomarev,[2] D. C. Radford,[6] L. L. Riedinger,[7] M. Scheck,[2] A. E. Stuchbery,[8] J. Wambach,[2] C.-H. Yu,[6] and N. V. Zamfir[9]

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(Received 10 October 2011; published 27 December 2011)

The $2^+_2$ state in $^{132}$Te is identified as the one-phonon mixed-symmetry state in a projectile Coulomb excitation experiment presenting a firm example of a mixed-symmetry state in unstable, neutron-rich nuclei. The results of shell-model calculations based on the low-momentum interaction $V_{\text{low}-k}$ are in good agreement with experiment demonstrating the ability of the effective shell-model interaction to produce states of mixed-symmetry character.

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# Some predictions for $^{134}$Sn & $^{136}$Sn

| | $^{134}$Sn | | $^{136}$Sn |
|---|---|---|---|
| | Expt | Calc | Calc |
| $B(E2:2_1^+ \rightarrow 0^+)$ [in W.u.] | 1.4(2) | 1.6 | 2.8 |
| $B(E2:4^+ \rightarrow 2^+)$ | | 1.7 | 0.83 |
| $B(E2:6^+ \rightarrow 4^+)$ | 0.89(17) | 0.82 | 0.12 |
| $B(E2:2_2^+ \rightarrow 0^+)$ | | 0.35 | 0.06 |
| $B(E2:2_2^+ \rightarrow 2_1^+)$ | | 2.93 | 1.8 |
| $B(E2:2_2^+ \rightarrow 4^+)$ | | 0.23 | 1.0 |
| $B(M1:2_2^+ \rightarrow 2_1^+)$ | | 0.02 | $0.09 \times 10^{-2}$ |
| $Q(2_1^+)$ [in eb] | | -0.02 | -0.13 |
| $Q(2_2^+)$ | | -0.03 | +0.06 |
| $\mu(2_1^+)$ [in nm] | | -0.57 | +0.46 |
| $\mu(2_2^+)$ | | -0.25 | +0.54 |

" It does not make any difference how beautiful your guess is - if it disagrees with experiment it is wrong. In that simple statement is the key to science."

(Richard Feynman)

...although there's always the option of playing with parameters.

From: J. N. Orce, Measurement of the sign of the quadrupole moment for the 2+ in 10Be, ECT* – Trento – October 29, 2010