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1.21 SCATTERING OF POLARIZED PROTONS FROM Sm AND Cd NUCLEI *

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An analysis of the elastic and inelastic scattering of polarized protons from ^{148,150,152,154}Sm at 20.4 MeV and from ^{112,114,116}Cd at 22.3 MeV is presented as a part of a larger program to obtain information on nuclear structure of medium-weight and heavy nuclei. The specific interest of the Sm isotopes lies in the transition they show from the spherical (^{148}Sm) to a deformed (^{154}Sm) shape [1]. As for the Cd isotopes, the collective character of the positive parity two-phonon states will receive our attention.

Theoretical calculations (CC) were performed with the code ECIS79[2]. The optical model (OM) parameters were fitted in the generalized OM frame[3] including coupling of the g.s. with the strongest excited levels (2^+-4^+ for a rotator, and 2^+-3^- for a vibrator). The β strengths were obtained first in a classical way from a simultaneous fit to the three states. A fine readjustment was then performed by fitting in the same CC scheme the OM parameters to the elastic data and thereafter the β's to the inelastic data. Results of these analyses can be found in Tables I and II.

Some typical features did receive our attention:

i) The ^{150}Sm nucleus is described in the literature as a transitional nucleus, but still analyzed for (p,p') data in the vibrational frame[4]. Our experimental 2^+ data show (Fig. 1) that the rotational frame should be more appropriate when extracting deformation strengths and OM parameters.

ii) The two-phonon states with negative parity in ^{148}Sm exhibit a different character, i.e. whereas the 1^- is better described (Fig. 2) in the first-order anharmonic (with mixing) vibrator model, the description of the 5^- needs second-order coupling terms. We have noticed these differences already in the harmonic-vibrator model.

iii) The positive two-phonon states of the Cd isotopes show similar discrepancies, i.e. a second-order vibrator model describes the 4_1^+ better than a first-order, but the second order gives for the 2_2^+ inferior results. Points ii) and iii) make the interpretation in terms of a less probable simultaneous excitation of two bosons for positive parity levels in contrast to easier superposition of phonons for negative parity levels rather difficult.

iv) It should be noted that the difficulty to reproduce the 3^- of the Cd isotopes (out of phase) may be attributed to an inaccurate form factor[5].

Table I. Optical-model parameters obtained in the generalized OM frame in the first-order vibrational (V) or rotational (R) picture.

		V_o	r_o	a_o	W_s	r_i	a_i	V_{so}	r_{so}	a_{so}
^{148}Sm	V	54.480	1.186	0.746	9.910	1.263	0.725	5.721	1.187	0.593
^{150}Sm	V	55.046	1.184	0.725	9.645	1.245	0.776	5.656	1.159	0.588
^{150}Sm	R	56.705	1.166	0.738	9.904	1.260	0.766	5.689	1.127	0.622
^{152}Sm	R	52.132	1.222	0.691	11.653	1.214	0.697	6.065	1.106	0.515
^{154}Sm	R	53.860	1.210	0.667	10.465	1.211	0.822	5.155	0.931	0.489
^{112}Cd	V	56.557	1.147	0.693	8.189	1.267	0.751	6.057	1.065	0.602
^{114}Cd	V	56.575	1.144	0.710	8.493	1.265	0.756	6.152	1.067	0.640
^{116}Cd	V	55.523	1.166	0.676	8.729	1.239	0.762	5.869	1.015	0.695

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Table II. Deformation strengths for the 2^+ and 3^- states.

		β_2	β_3	β_4			β_2	β_3
^{148}Sm	V	0.120	0.133		^{112}Cd	V	0.176	0.163
^{150}Sm	V	0.153	0.115		^{114}Cd	V	0.190	0.157
^{150}Sm	R	0.155		0.039	^{116}Cd	V	0.189	0.140
^{152}Sm	R	0.225		0.077				
^{154}Sm	R	0.284		0.055				

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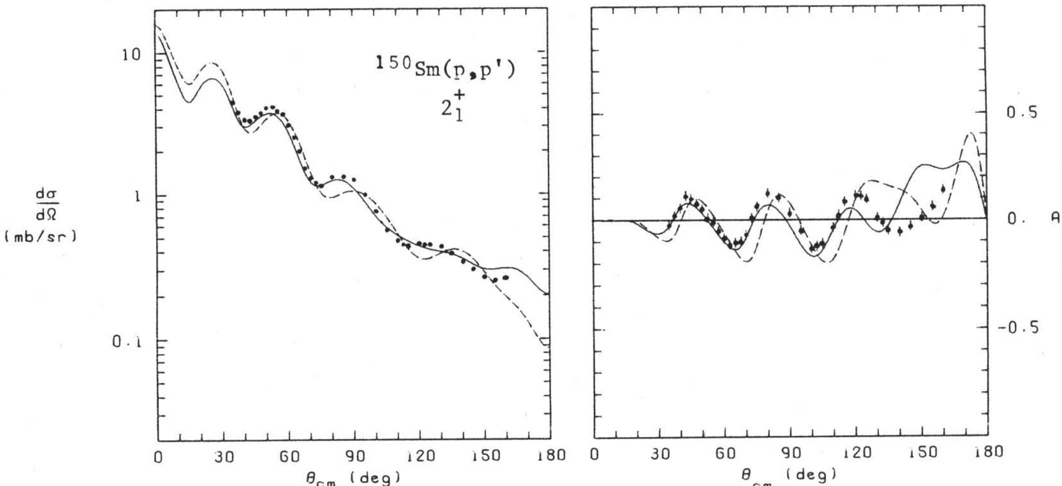

Fig. 1. CC calculations for the 2_1^+ state of ^{150}Sm in the second-order vibrational model (dashed line) and the rotational model (full line).

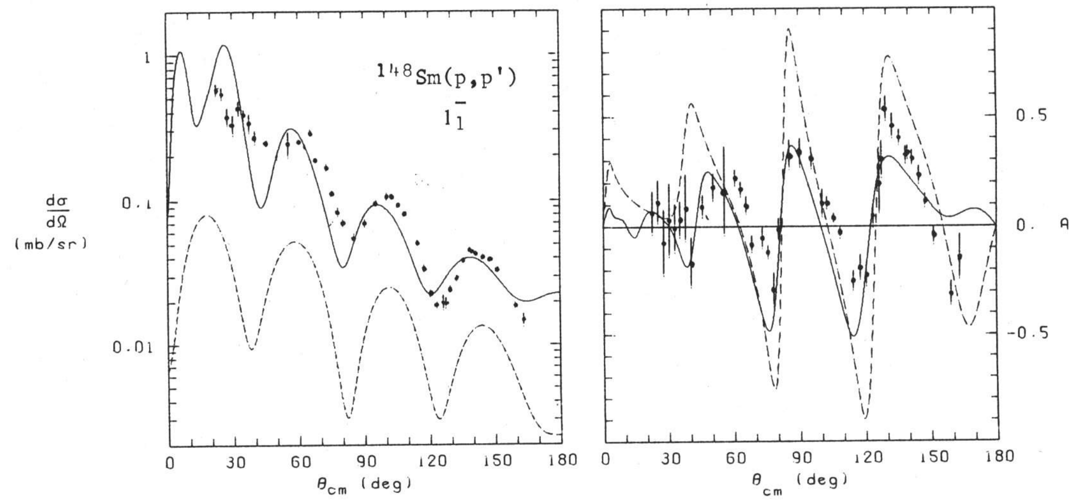

Fig. 2. First-order CC calculations for the 1_1^- state of ^{148}Sm in the harmonic vibrational frame (dashed line) and the anharmonic model (full line).