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BRIEF REPORTS

ROTATIONAL BAND STRUCTURE IN ODD-ODD ^{132}La

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Abstract:

High spin states in ^{132}La have been excited by (^{10}B,4n) and (^{11}B,3n) reaction on ^{125,124}Te targets. Excitation functions, angular distributions and γ-γ coincidences were used. A rotational band, possibly básed on a ($\pi h_{11/2} \otimes \nu h_{11/2}$) configuration, has been observed for the first time.

NUCLEAR REACTIONS ^{126}Te + ^{10}B, E = 40 - 48MeV, measured excitation function; γ-γ coinc. I_γ, $I_\gamma(\theta)$; ^{124}Te + ^{11}B, E = 48MeV, measured I(γ). ^{132}La deduced decay scheme, γ multipolarities. Enriched targets, Ge detectors.

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A recent surge of interest in the odd-odd transitional nuclei, around mass A~130[1-4], has prompted us to publish our preliminary results on the band structure of ^{132}La. The doubly odd nuclei in this light rare-earth region present a singular situation, created by the competition between the driving forces caused, on the one hand, by the neutron quasiparticle situated in the upper part of the high j-shell and on the other, by the proton quasiparticle at the bottom of the same high j-shell, thus producing non-axial deformations.

We present here the results of an investigation of in-beam spectroscopy of ^{132}La, using fusion-evaporation reactions with beams provided by the Pelletron Tandem Accelerator of the University of São Paulo. Prior to our investigation, there was no available information on the level structure of ^{132}La, except for beta decay[5]. Thus, cross-beam reactions, namely, ^{124}Te(^{11}B,3n)^{132}La and ^{126}Te(^{10}B,4n)^{132}La, and excitation functions for the second reaction, were used to identify the gammas belonging to ^{132}La. The targets were prepared by pressing enriched tellurium powder (96.21% of ^{124}Te and 98.69% of ^{126}Te) onto a lead foil, forming targets 10 and 4mg/cm^2 thick, respectively. In the second experiment, two GeHp detectors were used at 55º for the γ-γ-t coincidences, which were stored in event mode and sorted, into a 1024x1024 symmetrized E_γ x E_γ array. The coincidences and the angular distributions were measured using the ^{126}Te(^{10}B,4n)^{132}La reaction at a beam energy of 45 MeV. The gamma intensities, taken from the singles spectra, and corrected for detector efficiency and electron conversion, are shown in Table 1. A typical spectrum, gated by the 294 keV gamma, is shown in fig.1. There are three self-coincident gammas: 294, 161 and 455 kev. The placement of these and the other gammas in the decay scheme was made on the basis of relative intensities in the gated above and gated below spectra, the energy balance, cross-over transitions and the measured multipolarities. The observed band consists of strong M1 transitions and much weaker E2 cross-overs. A partial decay scheme is presented in fig. 2 together with the recent results of other isotones[2], ^{134}Pr and ^{136}Pm, showing a striking similarity between the bands in these three nuclei.

In the neighboring N-odd and Z-odd nuclei, the observed Yrast bands are built on $\nu h_{11/2}$ and $\pi h_{11/2}$ respectively, suggesting thus a configuration of $[\pi h_{11/2} \otimes \nu h_{11/2}]$ for the doubly odd ^{132}La band. The assignment of 8^+ to the spin and parity of the band-head, populated by the 161 kev transition in ^{132}La, is consistent with the assumption of a $[\pi h_{11/2} \otimes \nu h_{11/2}]$ configuration. The observed bandhead belongs to the unfavored component of the band, which for the above configuration, corresponds to the signature $\alpha = 0$, confirming an even spin ($I = \alpha \mathrm{mod} 2$). No transition $8^+ - 7^+$ was observed, probably due to the high Compton background.

The experimental alignment i_x and the Routhian e', shown in fig.3, were extracted from the data, using the procedure described in ref.(6). The angular momentum alignment $i_x = 5.6\hbar$ shows good agreement with the other isotones and is comparable with the sum of alignments in neighboring nuclei of odd-Z ($\approx 4.5\hbar$) and odd-N ($\approx 1.8\hbar$). The observed signature splitting $\Delta e' \approx 25$keV, is about half the value seen in ^{134}Pr and ^{136}Pm[2].

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REFERENCES

1) E.S.Paul et al., Phys. Rev. C 36, 1853(1987).

2) C.W.Beausang et al., Phys. Rev. C 36, 1810(1987).

3) P.J.Nolan et al., J.Phys. G 13, 1555(1987).

4) Y.S.Chen et al., Phys. Rev. C 28, 2437(1983).

5) B.Harmatz and T.H.Handley, Nucl. Phys. A191, 497(1972).

6) R.Bengtsson and S.Frauendorf, Nucl.Phys. A327, 139(1979).

Table Captions:

Table 1. Relative intensities and multipolarities of γ-transitions in ^{132}La from the $^{126}Te(^{10}B,4n)^{132}La$ reaction at E_{LAB} = 45 MeV.

FIGURE CAPTIONS:

Fig.1. A typical γ-γ coincidence spectrum used to determine the decay scheme of ^{132}La, gated by the 294 keV transition. The data are from the ^{126}Te(^{10}B,4n)^{132}La experiment at a beam energy of 45 MeV.

Fig.2. A partial decay scheme of ^{132}La together with the yrast bands of the ^{134}Pr and ^{136}Pm isotones.

Fig.3. (a) The angular momentum alignment and (b) experimental Routhians for the yrast band of ^{132}La. The closed and open circles are, respectively, the favored (α = -1) and unfavored (α = 0) components of the [$\pi h_{11/2} \otimes \nu h_{11/2}$] configuration. The Harris parameters for the reference configuration used are $_0 = 11.3\hbar^2$MeV^{-1} and $_1 = 41.7\hbar^4$MeV^{-3}.

Table 1.

E(KeV)	I_{pol}(%)	Multip.	a_2/a_0	a_4/a_0
151.0	14.3 (1.2)	dipole	-.314(70)	+.008(80)
161.1	108.8 (7.9)	M1	-.329(56)	-.030(49)
169.3	100.0 (7.2)	dipole	-.576(54)	-.005(40)
202.7	82.4 (5.9)	dipole	-.580(82)	-.0046(50)
227.3	22.0 (1.6)	dipole	-.060(10)	+.030(80)
230.6	11.8 (1.1)	dipole	-.035(11)	+.090(11)
232.6	15.7 (1.3)	dipole	-.051(10)	+.072(85)
279.0	43.8 (3.1)	quadrupole	+.290(17)	-.073(21)
289.0	12.0 (3.0)			
293.8	69.4 (4.9)	M1	-.392(24)	-.026(20)
312.4	15.5 (1.2)	quadrupole	+.290(31)	-.018(36)
320.2	21.1 (1.6)	quadrupole	+.216(31)	+.001(37)
351.5	19.6* (2.6)			
380.4	4.1 (0.7)	M1	-.318(57)	-.259(66)
386.5	9.2 (1.1)			
392.6	13.9 (1.2)	M1	-.513(74)	+.052(72)
396.0	6.8 (1.0)			
454.6	5.9 (0.6)			
481.7	24.5 (1.8)	M1	-.226(59)	-.037(56)
516.0	26.0* (3.0)	quadrupole	+.119(85)	-.031(99)
587.9	4.5 (1.7)			
669.8	24.0* (2.9)	quadrupole	+.052(20)	-.045(23)
687.0	1.4 (0.54)			
778.0	<1			
840.0	<2			

* Intensity uncertain due to presence of a contaminant.

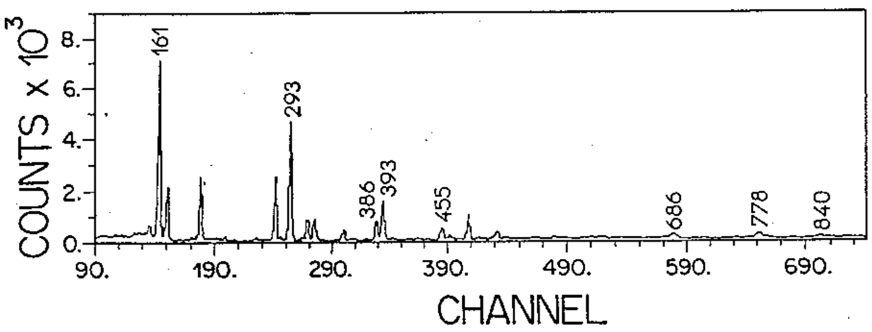
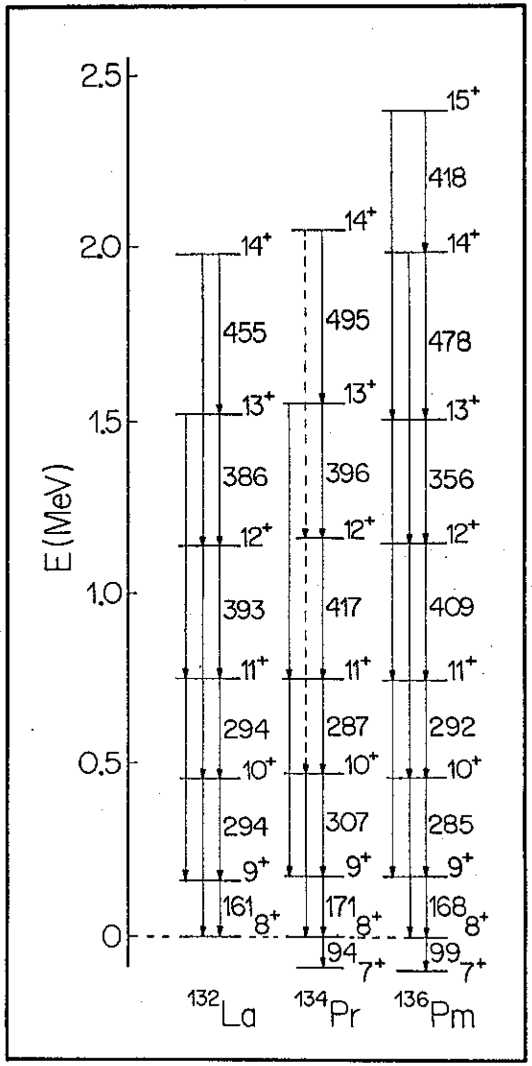


FiG. 1

FiG. 2



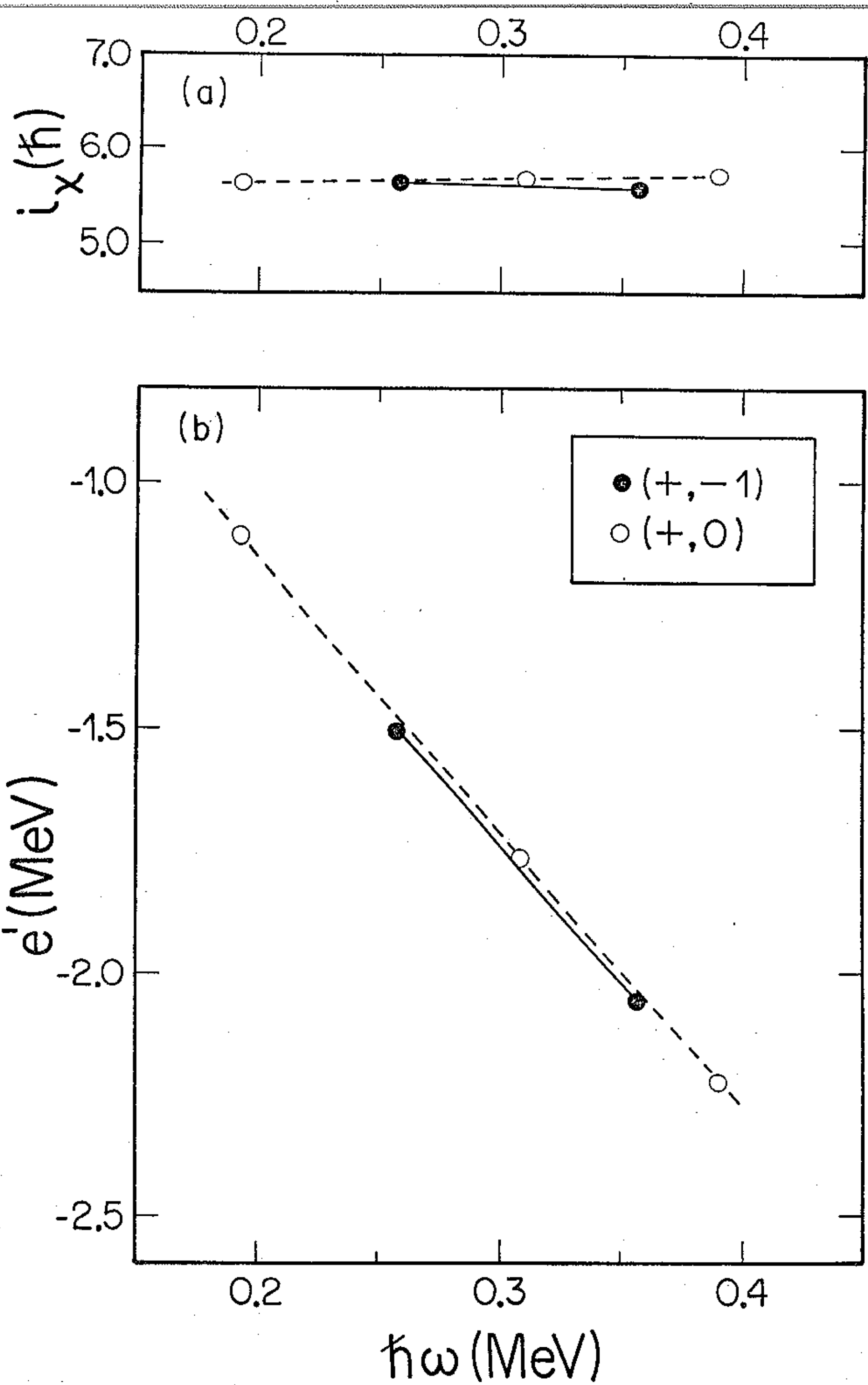


FiG. 3