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HIGH-SPIN STATES AND TRIAXIAL SHAPE IN NEUTRON-DEFICIENT ODD-A Ba NUCLEI

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HIGH-SPIN STATES AND TRIAXIAL SHAPE IN NEUTRON-DEFICIENT ODD-A Ba NUCLEI

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High spin levels in odd-A $^{123-133}$Ba nuclei excited by Sn(^{12}C,3nγ) reactions have been studied. Negative parity and positive-parity states respectively generated from holes in the $h_{11/2}$ and $g_{7/2}$ neutron-shells are discussed in the frame of the triaxial-core model.

A systematic study has been undertaken on odd-A nuclei in the 50 < N,Z < 82 transitional region to know how level structures and nuclear properties change when going to more neutron-deficient nuclei i.e. when the Fermi surface penetrates inside a shell.

1. EXPERIMENTAL RESULTS

The experiments were carried out with the Grenoble variable energy cyclotron. The levels of Ba nuclei were excited through Sn(^{12}C,3n) reactions. The classical methods of in-beam γ-ray spectroscopy have been used.

1.1. Negative-parity levels - A perturbed rotational band $^{1)}$ is developed on the 11/2$^-$ isomer in $^{133}_{56}$Ba$_{77}$. A similar band structure based upon a 9/2$^-$ isomeric state is found in ^{127,129,131}Ba and appears much more complex $^{2)}$ in ^{129}Ba. Indeed, several ΔI = 2 sequences parallel to the yrast cascade are observed and the whole band structure can be separated into two subsystems based upon the first 9/2$^-$ and 11/2$^-$ levels. In ^{123,125}Ba, the basic state becomes a 7/2$^-$ isomer. A systematics of this odd-parity level system is presented in fig. 1.

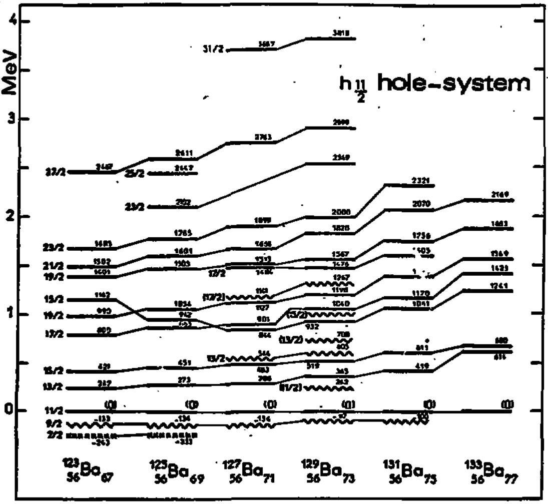

Fig. 1 : The $h_{11/2^-}$ system in odd-A Ba nuclei

1.2. Positive-parity levels - Another set of strongly populated levels shows up in ^{129}Ba. Its base state was assigned as a 7/2$^+$ level from polarization measurement of γ-rays $^{3)}$. This ΔI = 1 band is also strongly excited in ^{125,127}Ba but too weakly in ^{123}Ba to be unambiguously identified.

2. DISCUSSION

Taking into account the success of the triaxial-core model [4] in the A ≈ 190 mass region, it seems evident to apply it in the $50 < Z,N < 82$ transitional region.

2.1. The $h_{11/2}$ hole-system - It is produced by the coupling of an $h_{11/2}$ neutron-hole with a prolate-type triaxial core.

For a given nucleus, the main features of the experimental energy spectrum are reproduced by the model : i) the level structure is made of $\Delta I = 2$ and $\Delta I = 1$ bands resulting of rotations around axes parallel and perpendicular to $\vec{j}$ (angular momentum of the particle). The de-excitation goes through the yrast band and parallel cascades. ii) the existence of $\tilde{\Omega} = j, j-1, \ldots$ subsystems has been experimentaly confirmed for the first time. iii) Most of the experimental branching and mixing ratios are in agreement with the theory.

Some trends are similar in both experiment and theory : i) For $\gamma \lesssim 25°$, the energy of the $11/2 \rightarrow 9/2$ and $15/2 \rightarrow 13/2$ transitions are nearly constant. ii) The position of the second $I = 15/2$ level is very sensitive to the γ deformation.

2.2. The $g_{7/2}$ hole-band - This band is generated from a neutron-hole in the $g_{7/2}$ shell. Because of the reduction of the Coriolis interaction, it becomes more regular for lighter isotopes. The same behaviour is observed in Ce isotopes [5]. However the level energies and branching ratios are well reproduced when considering a triaxial core.

Inclusion of core softness improves the agreement between experiment and calculation [6]. Similar band properties could perhaps be obtained by anharmonic vibrator model [7] but such a treatment has not yet been made in the Ba region.

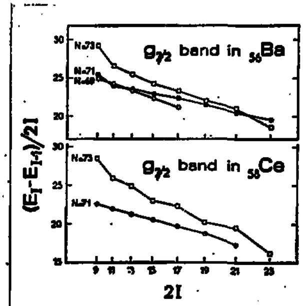

Fig. 2 : $g_{7/2}$ bands in Ba and Ce isotopes

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