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Sudden onset of deformation in A =150 mass nuclei

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Abstract : The nuclear deformation is noticed for A =150 mass nuclei. The Ba-Gd shows a sudden drop in ground state energy around N = 88-90. Around the neutron number N = 90 a sharp nuclear shape transition is noticed from spherical to prolate. It shows a new interpretation to existing knowledge about the behaviour of A~150.

INTRODUCTION

The deformations in nuclear structure [1,2] always have been important topics for the nuclear physicists, since the start of nuclear structure study. As we are going away from the magic numbers the evolution of collectivity is observed across the N–Z plane. The important here is p–n interaction which is responsible for development of deformed shape and rise of collectivity in nuclear structure. The first idea about the valence p–n interaction responsible for phase/shape transition was introduced by deShalit and Goldhaber [3], which were nicely extended by Talmi. I complete this introduction with the p-n interaction and introduce the important term NpNn scheme and the P-factor by stressing in the strongest terms that, while NpNn for study of nuclear shape deformation.

Present Approach

The aim of present work is to observe the change in ground state energy (2_1^+) for A~ 150 mass nuclei. we adopt a grouping based on valance particle and hole pair consideration. These nuclei lie at an abrupt transition between spherical and rotational nuclear shapes and because of this, have been the subjects of intensive study. The origin of the different deformations is attributed to a subshell closure at Z = 64.

RESULT AND DISCUSSION

The Ba-Gd, N>82 region

The nuclear region consider for the study is Z = 50-82, N = 82-126 subspace of particle like neutron bosons and particle like proton bosons (P-P subspace). The product of energy and transistion probability is plotted as a function of atomic number Z and NpNn. The data points connects the values of same neutron number N (Fig. 1). Then we observe that the energy product increases linearly with atomic number Z. The sudden change is observed for N =88- 90 isotones is noticeable in (Fig. 2), However the importance Z = 64 subshell effect should be visible here.

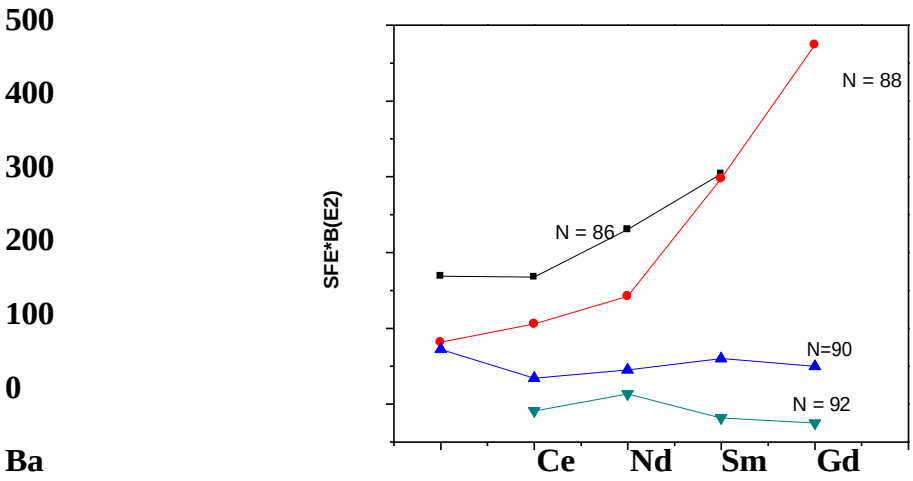

Fig. 1. The energy and B(e2) data points of Ba,Ce, Nd Sm and Gd linked for same neutron number for N>82.

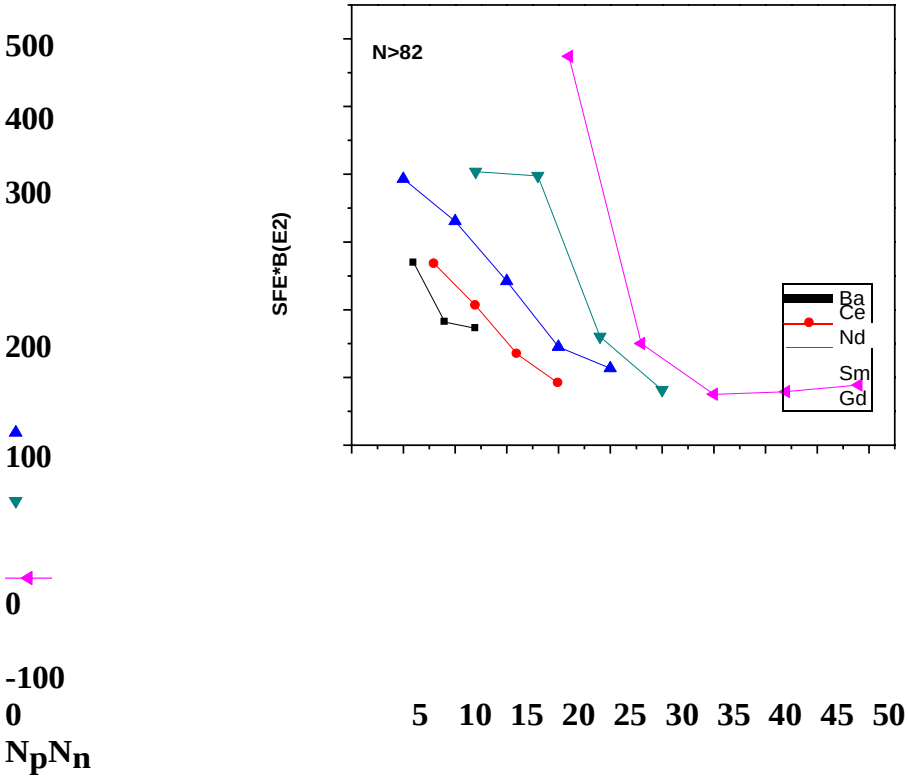

Fig.2 The energy and B(e2) data points of Ba,Ce, Nd Sm and Gd are studied with respect to p-n interaction.

This clearly suspect that vibrational fluctuation for the nuclear core is high around N = 88 - 90 isotones and responsible for deformation in the nuclear core.

Conclusion

The energy for A~150 mass nuclei around N = 88-90 shows significant low and negative values (see lower part of Fig. 1.) which indicate the shape phase transition from spherical to deformed is expected around this specific region.

References

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