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INVESTIGATION OF THE XENON AND BARIUM ISOTOPES

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ABSTRACT

It was found that in conventional IBM, no permanent triaxial deformation is possible in any of the three limits: U (5), SU (3) and O (6). But in the O (6) limit, the energy functional is independent of ɤ. Such a system is gamma unstable and will execute large oscillations in gamma. The average value of the variable may not be zero. In this sense the O (6) limit of IBM is related to the occurrence of triaxialty. Besides, the O (6) nuclei belong to the transitional region and triaxiality is known to occur in this region. In 1956, wilets and Jean.[1] proposed a geometrical model of gamma unstable nuclei. Meyer-Ter-Vehn [2] showed that the O (6) limit of the IBM corresponds to the gamma unstable model of Wilets and Jean in the limit of infinite boson number. The two models yield identical BE (2) values for boson number N->∞. Thus, the nuclei belonging to the O (6) dynamical symmetry of IBM is of special importance in the study of triaxiality.

INTRODUCTION AND DETAIL

The experimental study of Zamfir et al have showed that the strong fragmentation of the low energy octupole Strength observed in $^{196'198}$ pt and considered to be a signature of O(6), does not occur in ^{134} Ba. Gh. Cata-Danil et al, on the other hand, have pointed out that the new experimented data obtained by them for the isotopes $^{132'134}$ Ba do not support the O (6), description uniquely. Also, theoretical investigations by Zamfir, Chou and Casten indicate description by Hamiltonians intermediate between O(6) and U(5) for Xenon and U (5) and SU(3) for Barium, isotopes.

Thus, there are two different approaches to O (6) symmetry breaking. On the one hand there are attempts to explain deviations from O (6) symmetry by the introduction of cubic terms. These improves agreement with experiments but gives rise to triaxiality. On the other hand there are attempts to describe O (6) symmetry breaking by the mixing of U (5) or SU (3) terms to the O(6) hamiltonian. In an earlier investigation by one group the second approach was taken. The isotopes of Xe and Ba were investigated by hamiltonian in which the O (6) symmetry was broken by a U(5) term. The O(6) + U(5) Hamiltonian was diagonalized using an O (6) basis and the spectra were fitted to the experimental energies. We investigate the isotopes of Xenon and Barium with some of the cubic terms obtained from the Casimir invariants of the subgroups of O(6). In particular we have investigated the seven isotopes of Xenon: $^{118-130}$ Xe and the Five isotopes of Barium:$^{126\ 134}$ Ba with hamiltonian, in which the O(6) symmetry is broken by the cubic terms $n^3{}_d$ L^2 n_d and.

$$C \equiv \frac{1}{2}\left[C_2(O6)n_d + n_d C_2(O6)\right]$$

The Hamiltonians have been diagonalised in an O(6) basis and the quality of the fits to the experimental data has been compared with one another and also with an O(6) + U(5) fit.

RESULT AND DISCUSSION

The first nucleus to be identified as an O (6) nucleus was ^{196} Pt. Later ^{198} Pt was also found to belong to the same category. In 1985, Casten and von Brentano [3] showed that an extensive region of O(6) nuclei exists in Barium and Xenon isotopes. But even in their original work they observed deviatios from the exact O(6) predictions and interpreted them in terms of triaxiality. They pointed out that the addition of a cubic term in the Hamiltonian can account for the deviations but will produce triaxiality.

Since the original work of casten and von Brentano, many more isptopes of Xe and Ba have been experimentally investigated. Besides, new data on energy levels and branching ratios for the old sets have accumulated. It is therefore natural to take a fresh look, at the O(6) symmetry breaking in these isotopes. Several recent investigations, both theoretical and experimental, have indicated that the issue of O(6) description of Xenon and Barium isotopes is far from settled.

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