A SHAPE EVOLUTION OBSERVED FOR NUCLEI CLOSE TO ^{100}Sn * **

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The present contribution concentrates on the studies of shape evolution of very weakly deformed nuclei, in terms of a coexistence of spherical and deformed states near closed shells due to polarizing effects of the aligned particles on the originally spherical or slightly deformed core. Using the level schemes information, the different modes of nuclear behaviour are seen. The possibility of tracing the onset of collectivity when moving away from double magic structure is considered.

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There has recently been observed a considerable progress in the experimental investigation of excited states of the nuclei around the double magic ^{100}Sn. Attempt to approach this region were made by means of several "in-beam" spectroscopic studies using various target (^{106}Cd, ^{96}Ru, ^{92}Mo, ^{92}Zr, ^{76}Ge, ^{54}Fe, ^{50}Cr) and projectile (p, ^{3}He, α-particles, ^{19}F, ^{16,17}O, ^{58}Ni,) combinations (see *e.g.* [1–5]). The status of the shell model structure around $N = Z = 50$ nuclei basing on existing experimental data in the close vicinity of ^{100}Sn was summarized formerly in Ref. [4]. The p–n multiplets in the $A \sim 100$ region corresponding to the nucleon pairs with mixed configurations has been considered as a tests of the $T = 0$ and $T = 1$ parts of the effective interaction [5].

Another aspect — presently considered — is the coexistence of spherical and deformed states near closed shell ($\pm 1, 2$ nucleons) nuclei. The spherical shape is rather an exception because even a single nucleon added to a magic core nucleus tends to deform it [6, 7]. There are cases when a few particles move with their angular momentum aligned, so the increase of nuclei quadrupole moments is observed. One pictures this as a polarizing effect of the aligned particles on the originally spherical or *e.g.* slightly prolate (or oblate) core. One of the regions of interest to search for core-polarization effects [6, 7] is the considered here mass region ($A \sim 100$) near single-closed shell configurations, where the building up of the angular momentum is possible by alignment of individual particles. Assuming that the nuclei are slightly deformed one can convert (see *e.g.* Ref. [8]) the level scheme information (*i.e.* excitation energy as a function of I) to experimental energies in rotating frame (e') and aligned angular momentum ($i = -de'/d\omega$) versus $\hbar\omega$ (Fig. 1). The moment of inertia as a function of spin I, (Fig. 2), as well as the observed excitation energies E are plotted versus $I(I+1)$ (Fig. 3) relative to the rigid body rotation reference $\hbar^2/2J_{\rm rig} = 32.3A^{-5/3}$ MeV [9].

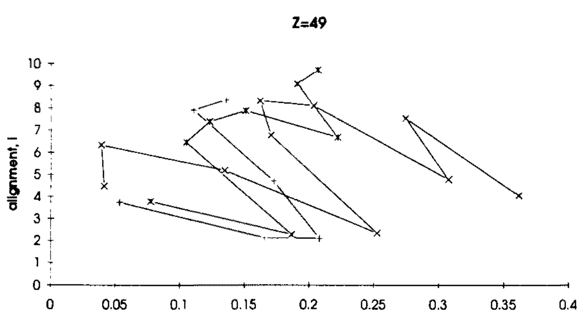

Fig. 1. Experimental alignments for different bands in $Z = 49$ nuclei — as an example of search for intruder rotational band in considered region.

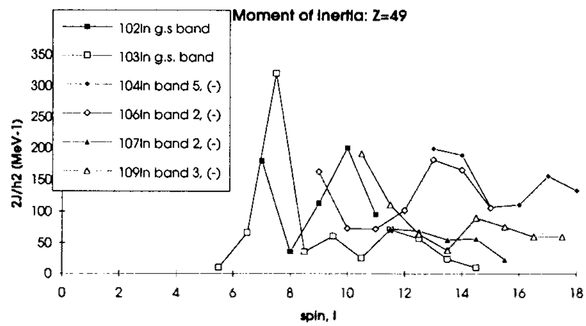

Fig. 2. The moment of inertia $2J/\hbar^2$ [MeV^{-1}] as a function of spin I, observed in light $Z = 49$.

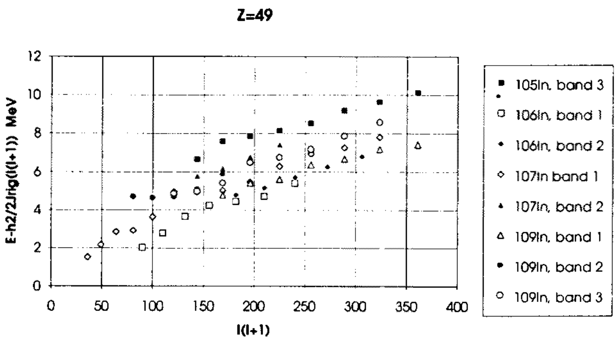

Fig. 3. The excitation energies plotted versus $I(I+1)$ relative to the rigid body rotation reference $\hbar^2/2J_{\rm rig} = 32.3A^{-5/3}$ MeV.

There is no simple theoretical relation between the moment of inertia J and deformation β. One can however, make use of the semi-empirical relations (based on assumption of axial symmetry) between J and β:

$$\frac{\hbar^2}{2J} \sim \frac{204}{\beta^2 * A^{7/3}} \tag{1}$$

known as a Grodzins formula (Fig. 4).

Inspecting figures 1, 2 and 3 one can clearly see the different modes of nuclear behaviour dependent certain spin values:

- The plot of excitation energy versus $I(I+1)$ showing the two different effective moments of inertia;
- For $Z = 49$ and spins I up to ~ 12 the yrast line is roughly reproduced

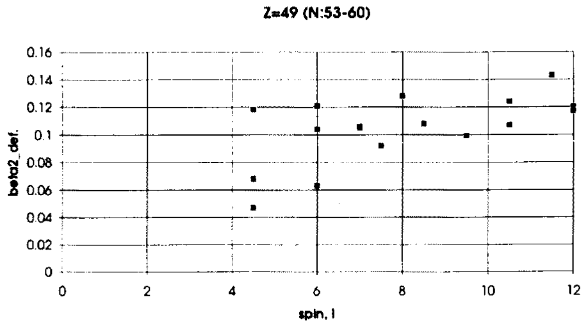

Fig. 4. The deformation β, plotted as a function of spin I, basing on the semi-empirical Grodzins formula.

using an effective moment of inertia of 30 MeV^{-1} whereas for $I \geq 13\hbar$ the yrast structure has $2J/\hbar^2 = 70\ \mathrm{MeV}^{-1}$. For $Z = 51$ (^{107}Sb and ^{108}Sb) two different J values can also be observed;

- The rapid variation of J with frequency decreases and it stabilizes to a value of about 50 MeV^{-1};
- The deformation parameter β increases smoothly as a function of spin both for $Z = 49$ and $Z = 51$ nuclei;

The above phenomena indicate that nuclei in the region close to ^{100}Sn are, as could be expected, spherical in their ground states and that collectivity sets-in not only when moving away from double magic nucleus but also at higher spin and excitation energy.

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