to have some resemblance to a proposed $(g_{9/2})^{-1}$ band in $^{113}$In [4]. This non-observation is, most likely, a result of these structures not being populated with any discernible strength in the reaction employed in this work (because of the rather low maximum angular momentum at the beam energy needed for maximizing the p2n reaction channel) rather than an indication of any changes in the nuclear structure.

Theoretical calculations were performed in the framework of the particle+core coupling model wherein the odd particle (hole, or quasiparticle) motion is coupled to the collective surface vibrations of the core. The details of the model and the calculations are provided in Ref. [6]. For this nucleus, the theoretical levels were obtained by coupling a proton $g_{9/2}$ hole to a Sn (Z=50) core. Agreement between the experimental results and theoretical predictions is quite reasonable for the low-lying levels (up to spin 17/2), for both positive- and negative-parity levels. For states above the $19/2^+$ level, however, the deviations between experimental and theoretical levels become large. This discrepancy between theory and experiment could be due to the restrictions imposed by a mainly harmonic vibrational core. For example, in the Sn nuclei [7], high-spin, broken-pair states appear at excitation energies of 2.0 - 2.5 MeV and these non-collective, one-broken pair states are expected to play a major role in determining the nuclear structure in the odd-A In nuclei at high spins. Therefore, the comparison between the calculations presented here and the experimental level energies becomes less valid at those spins.

To summarize, an extensive level scheme in the high-spin regime has been constructed for the first time for $^{115}$In. While the overall structure of the level scheme is similar to that of the lighter-mass, odd-A In nuclei, no "intruder" structures analogous to those recently observed therein have been identified in this nucleus. The low-lying, high spin levels of $^{115}$In could be characterized by the particle+core model.

[1] A.Galindo-Uribarri, Prog. Part. Nucl. Phys. 28 (1992) 463
[2] D.C.Radford et al., Nucl. Instr. and Meth. A361 (1995) 297
[3] V.Sergeev et al., Nucl. Phys. A202, (1973) 385
[4] S.Naguleswaran et al., BAPS 37 (1992) 1280; ibid. 39 (1994) 1251; and, to be published
[5] S.M.Mullins et al., Phys. Lett. B318 (1993) 592
[6] K.Heyde et al., Phys. Rep. 102 (1983) 291
[7] A.Van Poelgeest et al., Nucl. Phys. A346 (1980) 70

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## 2.6 Detailed investigation of superdeformation in $^{149}$Tb

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To extend our investigation of the superdeformation (SD) phenomenon in the neutron gap N = 86, we have performed an experiment to study in detail the superdeformed bands in $^{149}_{65}$Tb$_{84}$, the (p,n)-exchange counterpart of the widely studied nucleus $^{149}_{64}$Gd$_{85}$. Our aims for this experiment were to: search for SD bands in $^{149}$Tb; measure lifetimes to determine quadrupole moment $Q_0$ and, hence, the deformation $\beta_2$ associated with the observed SD bands in this nucleus; compare the observed properties of these bands with predictions of Hartree-Fock-Bogolubov cranking calculations in order to identify the intruder configurations associated with these bands in $^{149}$Tb and explore their "identical-band" relationship with bands in its isotope $^{150}$Tb and isotone $^{149}$Gd; and look for evidence (or lack thereof) for the $C_4$ symmetry.

The experiment was performed at GAMMASPHERE, which, at that time, comprised 90 Compton-suppressed Ge detectors. The $^{128}$Te($^{27}$Al, 6n) reaction was employed at a beam energy of 155 MeV from the LBNL cyclotron in Berkeley. The target was enriched $^{128}$Te (1.0 mg/cm$^2$ thick) and evaporated onto a sandwich of Al and Au foils to facilitate DSAM measurements. Only quadruple and higher-multiplicity coincidences were registered with event rate of about 14,000/sec. Thirty five high-density EXABYTE of tapes containing the data events and an additional two tapes with calibration data have been recorded during 8 shifts (64 hours) of experiment.

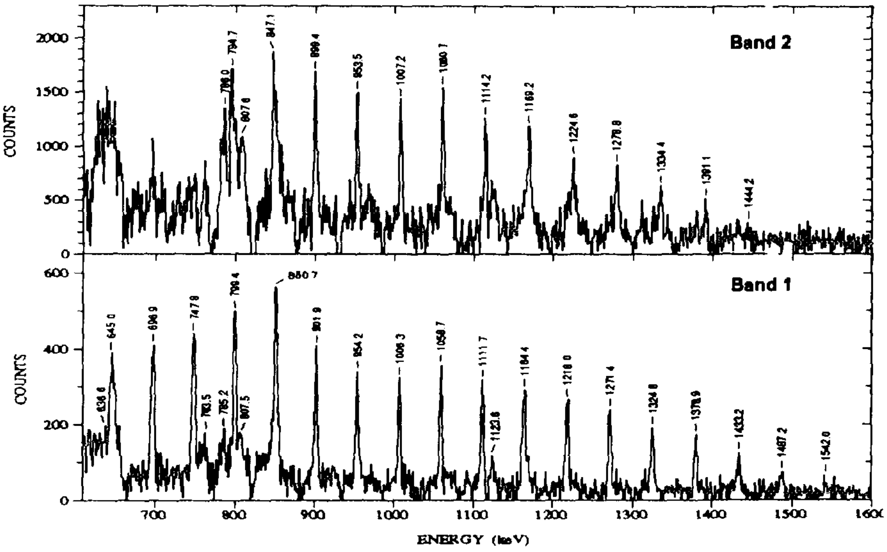

**Fig.1** SD bands 1 and 2 in $^{149}$Tb.

Prior to this study no SD band was known in $^{149}$Tb. We have observed two superdeformed bands in this nucleus for which the observed coincidence relationships between the known $\gamma$-rays in $^{149}$Tb and SD intra-band transitions make the assignment of these band unambiguous. These SD bands are shown in figure 1. In addition, three more SD bands have been observed which can also be assigned to this nucleus (detailed studies are still in progress). The newly found band 1 in $^{149}$Tb and previously observed band 1 in $^{150}$Tb nucleus have nearly equal transition energies (and, therefore, similar $\mathfrak{J}^{(2)}$ ) over a large range of rotational frequencies - they are so called "identical bands". This occurrence suggests that band 1 in $^{149}$Tb has a configuration involving a hole in the [651]1/2 neutron orbital ($\alpha$ = -i), and one neutron in the N = 7 intruder orbital. Band 2 in $^{149}$Tb is also "identical" to these two bands, except that the highest transitions begin to shift toward higher energies. A possible explanation might be that this band is the signature partner of the yrast band (band 1), involving a hole in the positive parity branch of the [651]1/2 neutron orbital. Other multi-particle excitations involving a proton and/or neutron are also expected in $^{149}$Tb and may explain the existence of the remaining three bands. The search for additional SD bands is in progress.

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## 2.7 Investigation of high spin isomers in $^{180}$Os

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It is well known that for deformed, axially-symmetric prolate nuclei, the projection K of the total angular momentum on the symmetry axis is approximately conserved. This leads to the existence of isomeric states when the angular momenta of a few valence nucleons are aligned along the symmetry axis forming an excited state with a sufficiently high K quantum number. Half-lives of isomers with relatively low excitation energies with respect to the yrast line are found to increase approximately by two orders of magnitude for each degree of K-forbiddenness defined as $\nu = |\Delta K - \lambda|$, where $\lambda$ is the multipolarity of the de-exciting $\gamma$-transition [1]. Thus, high-K isomers decay preferentially via small changes in K, eventually reaching the K≈0 states of the ground band at low spins. According to the rule mentioned above, the direct decay from an isomeric state with a K quantum number of the order of 20 to an yrast band state (K=0) via a single transition of low multipolarity would violate the K-selection rule by many orders of magnitude, leading to partial half-lifes of the order of the age of the Universe. Unexpectedly, such direct decay paths have been found [2], indicating the breakdown or inapplicability of the K selection rule. One of the