MAPPING THE LIMITS OF CHIRAL STRUCTURE IN THE MASS A ∼ 130 REGION

A.A. Hecht[a,b,c], C.W. Beausang[c], H. Amro[a], D.L. Balabanski[d,e], C.J. Barton[c], Z. Berant[c,f,g], M.A. Caprio[c], F.R. Casten[c], J.R. Cooper[c], F. Donau[h], D.J. Hartley[d], R. Krucken[c], D.A. Meyer[c], H. Newman[c], J.R. Novak[c], E.S. Paul[i], N. Pietralla[c], J.J. Ressler[c], A. Wolf[c,f,g], N.V. Zamfir[c,j], Jing-Ye Zhang[d], and K.E. Zyromski[c]

[a] *Argonne National Laboratory, Argonne, IL 60439, USA*

[b] *University of Maryland, College Park, MD, 20742, USA*

[c] *Yale University, New Haven, CT, 06520, USA*

[d] *University of Tennessee, Knoxville, TN, 37996, USA*

[e] *St. Kliment Ohridsky University of Sofia, BG1164 Sofia, Bulgaria*

[f] *Clark University, Worcester, Massachusetts 10610, USA*

[g] *Nuclear Research CenterNegev, Beer Sheva 84190, Israel*

[h] *Forschungszentrum Rossendorf e.V., D01314 Dresden, Germany*

[i] *Oliver Lodge Laboratory, University of Liverpool, Liverpool L69 7ZE, United Kingdom*

[j] *National Institute for Physics and Nuclear Engineering, Bucharest, Romania*

Chiral symmetry breaking has been found in many nuclei in several mass regions, but none has been as intensively studied as the mass $A \sim 130$ region. Frauendorf and Meng [1] provided the theoretical framework for nuclear chirality, and presented the $\pi h_{11/2} \otimes \nu h_{11/2}$ band structure of ^{134}Pr as an example. For a triaxial nucleus, a coordinate system is created by the three distinct deformation axes, with right and left handed octants. With orthogonal proton and neutron angular momentum vectors, j_π and j_ν, and an orthogonal rotational angular momentum vector, R, the total angular momentum vector may be oriented in one of these left or righthanded octants, creating a handedness or chirality. Degenerate rotational bands are predicted for these different orientations. With a mixing of these orientations in the laboratory frame, a pair of rotational bands with a near degeneracy may be observed. If the arguments for chiral behavior in ^{134}Pr are valid, then neighboring oddodd nuclei, having similar particle numbers and deformations, should also show these chiral doublet bands.

Experimental work was performed on the neighboring $N = 75$ isotones ^{136}Pm and ^{138}Eu [2]. In context with results on other nuclei around $A \sim 130$ a region of chiral behavior has been determined. The exact limits of this region are difficult to predict, so to test these limits experiments were performed on the $N = 77$ nucleus ^{140}Eu [3]. Results from these nuclei are presented as part of a systematic analysis of the $\pi h_{11/2} \otimes \nu h_{11/2}$ bands in the region. Several properties, such as alignments and B($M1$)/B($E2$) values, are observed to behave similarly across the region for both the yrast and yrare chiral partner bands. Also, several trends emerge from the systematics, including characteristics which distinguish chiral behavior from both modeled and observed non-chiral behavior in neighboring nuclei. Calculations using 3D-TAC, and the particle + triaxial rotor model also support the chiral explanation.

[1] S. Frauendorf and J. Meng, Nucl. Phys. **A**617, 131 (1997).
[2] A.A. Hecht, *et al.*, Phys. Rev. **C** 63, 051302(R) (2001).
[3] A.A. Hecht, *et al.*, Phys. Rev. **C** 68, 054310 (2003).