Reaching degeneracy in two-quasiparticle chiral bands *

O. Shirinda[1,2], E.A. Lawrie[1]
[1]Department of Nuclear Physics, iThemba LABS, P.O. Box 722, Somerset West 7129, South Africa
[2]Department of Physics, University of the Western Cape, Private Bag X17, Bellville 7535, South Africa

Nuclear chiral symmetry is suggested to occur in the angular momentum space. The necessary condition for such a system to form is an aplanar orientation of the total angular momentum, i.e. the total angular momentum should point out of the planes defined by any two of the major nuclear axes [1, 2]. For a two quasiparticle configuration an aplanar orientation of the total angular momentum could be achieved if the nuclear shape is triaxial and if one of the quasiparticles has a predominant particle nature, while the second one – a predominant hole nature. In that case the angular momentum of the particle will be oriented along the short nuclear axis, that of the hole – along the long nuclear axis, and the angular momentum of the rotating core – along the intermediate axis. We have examined the properties of such systems using the two-quasiparticle-plus-triaxial-rotor model codes of P.B. Semmes and I. Ragnarsson [3].

We found that degeneracy in all properties of the chiral bands can be reached. However, it occurs only if the nucleon configuration is restricted to a pure particle and a pure hole occupying the highest and the lowest orbitals of a high-j shell. In real nuclei such a restriction on the nucleon configuration is unlikely. These results, obtained for a symmetric nucleon configuration in the 130 mass region, with both the proton and neutron occupying $h_{11/2}$ orbitals, were reported in Ref. [4].

In this contribution we will discuss: (i) conditions for reaching degeneracy in chiral bands not only in the 130, but also in the 100 and 190 mass regions, where the nucleon configuration is asymmetric, (ii) the impact of the change of the proton and neutron Fermi levels, and (iii) the effect of changing the nuclear γ deformation.

In summary it seems that degeneracy in two-quasiparticle chiral bands can be reached only for pure particle-hole configurations, for which the particle (hole) occupy the lowest (highest) orbitals in the high-j shell, and for which the individual angular momenta are strictly mutually perpendicular. Furthermore we found that the optimal conditions for chirality may require γ deformation slightly different from 30^{o}.

* This work is supported by the National Research Foundation, South Africa.

[1] S. Frauendorf and J. Meng, Nucl. Phys. **A 617**, 131 (1997)
[2] S. Frauendorf, Rev. Mod. Phys. 73, **463** (2001)
[3] P.B. Semmes and I. Ragnarsson, AIP Conf. Proc. **259**, 566 (1992)
[4] E.A. Lawrie and O. Shirinda, Phys. Lett. B **689**, 66-71 (2010)