Static chirality and chiral vibration of atomic nucleus in the triaxial particle rotor model

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Chirality is a common property in chemistry, biology and particle physics, etc. In nuclear physics, Frauendorf and Meng first pointed out that the rotation of triaxial nuclei may attain the chiral character and give rise to pairs of identical I = 1 bands with the same parity —— chiral doublet bands. So far, candidate chiral doublet bands have been proposed in quite a number of atomic nuclei in the A ~ 100, 130, 190 mass regions. This spontaneous broken chiral symmetry appeared in atomic nucleus has attracted lots of attention both experimentally and theoretically during the last decade.

A particle rotor model is developed which couples several valence protons and neutrons to a rigid triaxial rotor core. It is applied to investigating the chiral doublet bands in odd-*A* nucleus ^{135}Nd with $?h^2_{11/2}(?h^{-1}_{11/2}$ configuration with remarkable agreement to the observed energies and the B(E2) and B(M1) transition probabilities. Chirality is found to change from a soft chiral vibration to nearly static chirality at spin $I = 39/2$ and back to another type of chiral vibration at higher spin, in consistent with the former semi-classic TAC investigation.

The electromagnetic transitions of the doublet bands with different triaxiality parameter ? are discussed in the particle rotor model with $?h_{11/2}(?h_{11/2}$ configuration. It is found that B(M1) staggering as well as the resulting B(M1)/B(E2) and $B(M1)_{in}/B(M1)_{out}$ staggering associate strongly with the characters of nuclear chirality, i.e., the staggering is weak in the chiral vibration region while strong in the static chirality region.

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