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Helical modes generate anti-magnetic rotational spectra in nuclei

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A systematic analysis of the anti-magnetic rotation band using r-helicity formalism is carried out for the first time. The observed octupole correlation in a nucleus is likely to play a role in establishing the anti-magnetic spectrum. Such octupole correlations are explained within the helical orbits. In a rotating eld, two identical fermions (generally protons) with paired spins generate these helical orbits in such a way that its positive (i.e., up) spin along the axis of quantization refers to one helicity (right-handedness) while negative (down) spin along the same quantization-axis decides another helicity (left-handedness). Since the helicity remains invariant under rotation, therefore the quantum state of a fermion is represented by definite angular momentum and helicity. These helicity represented states support a pear-shaped structure of a rotating system having z-axis as the symmetry-axis. A combined operation of parity, time-reversal and signature symmetries ensures an absence of one of the signature partner band from the observed anti-magnetic spectrum. This formalism has also been tested for the recently observed negative parity DeltaI=2 anti-magnetic spectrum in odd-A ^{101}P d nucleus and explains nicely its energy spectrum as well as the B(E2)-values. Further, this formalism is found to be fully consistent with twin-shears mechanism popularly known for such type of rotational bands. It also provides signi cant clue for extending these experiments in various mass regions spread over the nuclear chart.

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