Opportunities for collective model and chirality studies at TRIUMF

Krzysztof Starosta

Department of Chemistry, Simon Fraser University,
8888 University Drive, Burnaby BC V5A1S6, Canada

In the last decade nuclear chirality resulting from an orthogonal coupling of angular momentum vectors in triaxial nuclei has been a subject of numerous experimental and theoretical studies. Three perpendicular angular momenta can form two systems of the opposite handedness, the right-handed and the left-handed system; the time-reversal operator, which reverses orientation of each of the components, relates these two systems. The underlying mechanism for generating chiral geometry of angular momentum coupling emphasizes the interplay between single-particle and collective degrees of freedom in nuclear structure physics. In the simplest case of odd-odd nuclei, two out of three mutually orthogonal angular momenta are provided by the high-j valence proton and neutron quasiparticles, which are of particle and hole character as defined by the respective position of the Fermi level within the intruder subshell. The single-particle contribution to the total energy is minimized when the angular momenta of the particles and holes align along the short and the long axis of the core, respectively. The third angular momentum component is provided by the collective core rotation and aligns along the axis of the largest moment of inertia; this is the intermediate axis for irrotational flow-like moments of inertia for a triaxial body. This simple picture leads to prediction of distinct observables manifesting chirality in rotational structures, most notably to the doubling of states.

I will start my talk with a review of predictions of the particle-hole-core coupling model which points towards existence of stable chiral geometry in specific configurations involving high-j orbitals. I will then review experimental information on doublet bands built on unique parity, intruder states in the A~130 and A~104 region; I will concentrate on the observed disagreements between electromagnetic transitions within the doublet structures which is inconsistent with simplest models. Next, I will present the unique experimental infrastructure developed at the Tri-University Meson Facility, TRIUMF, Canada's National Laboratory for Particle and Nuclear Physics, which includes the Isotope Separator and Acceleration ISAC-II facility providing a wide range of beams produced by the isotope separation on-line method (ISOL), the TRIUMF-ISAC Gamma-ray Escape Spectrometer (TIGRESS), and the TIGRESS Integrated Plunger (TIP) device. I will discuss the range of isotopes in the mass 130 region that are accessible as beams at TRIUMF and which can possibly yield significant new information in investigations of nuclear chirality. I will end with the discussion of experiments which can be pursued with the ISAC beams at TRIUMF to examine chirality, and more general, predictions of the nuclear collective model in the transitional, gamma-soft regions.