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Axially asymmetric nuclear shapes

The rotation of deformed nuclei generates easily recognizable patterns of excited nuclear states, called rotational bands. If the nucleus has axial asymmetry, the rotational bands are more complex, for instance, in addition to the ground-state band of an even-even nucleus, excited γ bands occur. These sets of bands are formed because the nucleus rotates simultaneously around its three axes, a motion that looks like tilted precession (TiP) of the total angular momentum around the axis with largest moment of inertia (MoI) similar to the precession of a rotating top.

The most unambiguous way to establish the axial asymmetry of the nuclear shape are direct Kumar-Cline measurements carried out within multi-step Coulomb excitation experiments. While such an analysis is model-independent and in general is the most robust proof of stable axial asymmetry, the technique is experimentally challenging and have been carried out only for a small number of deformed nuclei. Thus, the axial asymmetry of the nuclear shape is often derived based on observed features of rotational bands and on theoretical expectations, for instance energy staggering in the γ band of even-even nuclei, tilted precession and wobbling in odd-mass nuclei, chiral bands, and others. In this presentation an alternative way of deducing axial asymmetry will be presented and discussed.

Chiral bands observed in the Tl isotopes with the Afrodite array at iThemba LABS will be summarized, [1], in particular new results on chiral structures in ^{195}Tl will be presented.

In addition, the terminology of "wobbling" [2] and "tilted precession" [3] will be discussed. Wobbling was introduced by Bohr and Mottelsson as a harmonic vibration coupled to a simple one-dimensional rotation, and the excited bands were labelled by the number of excited wobbling phonons. They used a harmonic approximation of the three-dimensional rotational Hamiltonian at high spins. However, lately, bands at low spins, where the harmonic approximation does not hold were also associated with wobbling [3]. The terminology issues will be discussed briefly, and a way forward will be proposed [5].

References:

[1] R.A. Bark, E.A. Lawrie, C. Lui, and S.Y. Wang, Frontiers of Physics, 19 (2024) 24302

[2] A. Bohr and B. Mottelson, Nuclear Structure Volume II, (W. A. Benjamin, New York, 1975).

[3] E. A. Lawrie, O. Shirinda, and C. M. Petrache, Phys. Rev. C 101, 034306 (2020).

[4] S. Frauendorf and F. Dönau, Phys. Rev. C 89, 014322 (2014)

[5] E.A. Lawrie, Chapter 6 in "Chirality and Wobbling" by C. M. Petrache, Edited by Taylor & Francis Group, 2024

Notes

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