New Results Concerning Collective Motion in Triaxial Nuclei

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1 Nuclear Shapes

Nuclear Deformation

Most of the nuclei are either *spherical* or *axially symmetric* in their ground-state.
Deformation parameter β (*Bohr, 1969*): preserves axial symmetry

Figure 1: **spherical:** $\beta = 0$ **prolate:** $\beta > 0$ **oblate:** $\beta < 0$

Nuclear Triaxiality

Non-axial shape

Deviations from symmetric shapes can occur across the chart of nuclides $\rightarrow$ **triaxial nuclei**.
The triaxiality parameter γ (*Bohr, 1969*): departure from axial symmetry

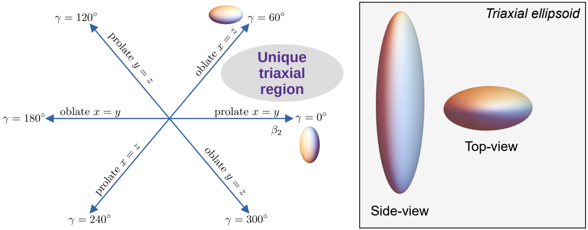


Figure 2: The (β, γ) plane divided into six equivalent parts, depicting nuclear surfaces.

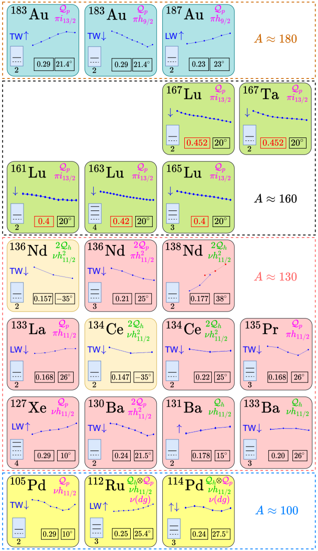
Fingerprints for Triaxiality

- Experimentally, stable triaxial nuclei represent a real challenge
- Clear signatures for confirming stable triaxiality in nuclei
    1. Chiral symmetry breaking (*Frauendorf, 1997*)
    2. **Wobbling motion** (*Bohr & Mottelson, 1975*)

Wobbling Motion (WM)

- Unique to non-axial nuclei
- Predicted 50 years ago for even-A nuclei
- First experimental evidence for ^{163}Lu (*Ødegård*, 2001)
- Currently: confirmed wobblers within the mass regions $A \approx [100, 130, 160, 180]$.

Experimental Evidence



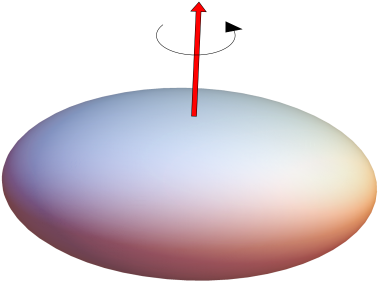
Wobbling nuclei (up to date)

Poenaru, 2022, in progress

Energy of Deformed Nuclei

Collective Motion

- A nucleus - *droplet* - can generate angular momentum from the rotation and vibration of the droplet itself
- Each individual nucleon contributes to the total angular momentum → *collectiveness*



Triaxial Rotor Energy

- a triaxial nucleus can rotate about any of the three axes
- rotation about the axis with *the largest moment of inertia* (MOI) is energetically the most favorable: $E_{\text{rot}} \propto \frac{\hbar^2}{2\mathcal{I}_{\text{max}}} I(I+1)$
- MOI anisotropy $\rightarrow$ the *main rotation* around $\mathcal{J}_{\text{max}}$ is disturbed by the other two axes $\rightarrow$ *total motion has an oscillating behavior*