

# New Data on Wobbling Motion for $A \approx 130$ Mass Region

Robert Poenaru<sup>1,2</sup>

<sup>1</sup>Doctoral School of Physics, UB

<sup>2</sup>Department of Theoretical Physics, IFIN-HH

May 26, 2023

# Outline

- 1 Nuclear Triaxiality
- 2 Wobbling Motion in Nuclei

# Nuclear Deformation

## Nuclear shapes

Most generally described in terms of the **nuclear radius**:

$$R(\theta, \varphi) = R_0 \left( 1 + \sum_{\lambda=0}^{\infty} \sum_{\mu=-\lambda}^{\lambda} \alpha_{\lambda\mu} Y_{\lambda}^{\mu}(\theta, \varphi) \right)$$

## Quadrupole deformations $\lambda = 2$

- Most relevant modes are the **quadrupole vibrations**  $\lambda = 2 \implies$  *Play a crucial role in the rotational spectra of nuclei*:
- $\alpha_{2\mu}$  reduced to only two *deformation parameters*:  $\beta_2$  (**eccentricity**) and  $\gamma$  (**triaxiality**) (*Bohr and Mottelson, 1969*).

# Axial shapes

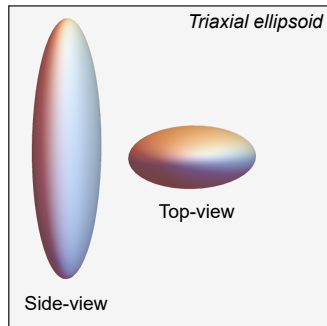
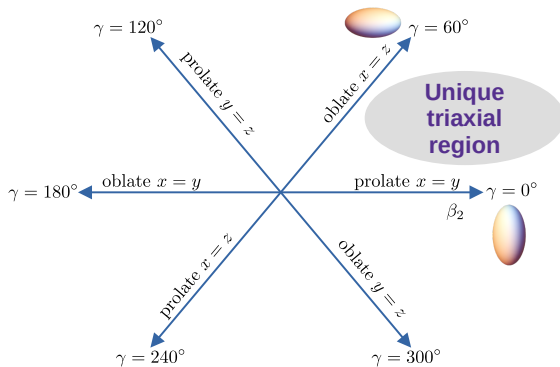
- Most of the nuclei are either **spherical** or **axially symmetric** in their ground-state.
- Nuclear moments of inertia  $\mathcal{I}_{1,2,3}$ : only two are equal.



Figure: **spherical:**  $\beta_2 = 0$  **prolate:**  $\beta_2 > 0$  **oblate:**  $\beta_2 < 0$ . ( $\gamma = 0^\circ$ ).

# Non-axial shapes

- The triaxiality parameter  $\gamma \neq 0^\circ$ : departure from axial symmetry.
- Moments of inertia:  $\mathcal{I}_1 \neq \mathcal{I}_2 \neq \mathcal{I}_3$ .

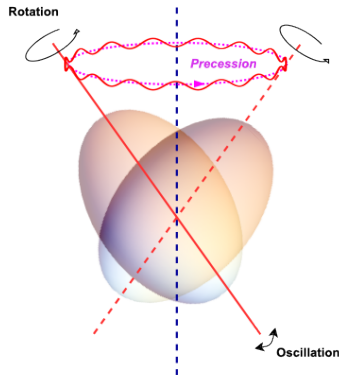


# Wobbling Motion

$$\gamma \neq 0^\circ$$

MOI anisotropy

*main rotation* around  $\mathcal{I}_{\max}$  is  
disturbed by the other two axes



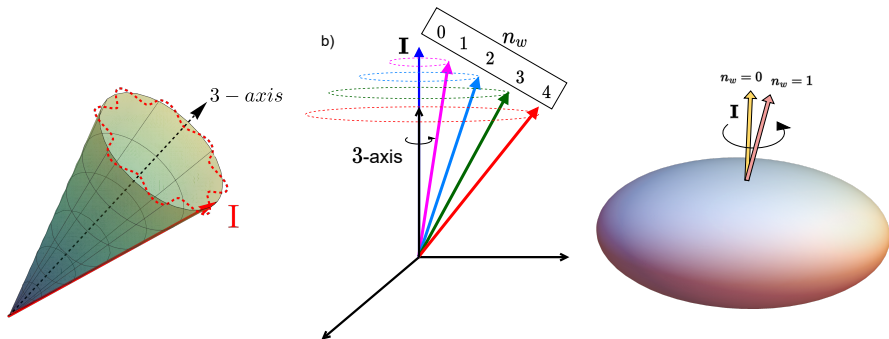
## Wobbling Effect

- The **total angular momentum** of the nucleus **precesses** and **oscillates** around  $\mathcal{I}_{\max}$ .

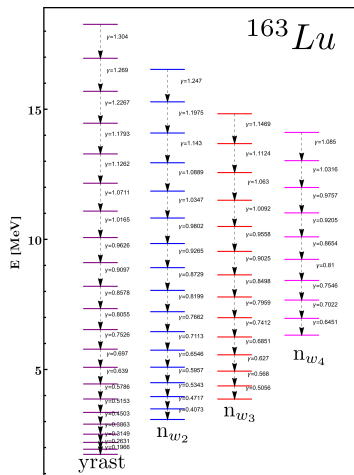
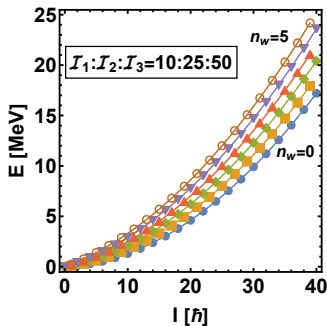
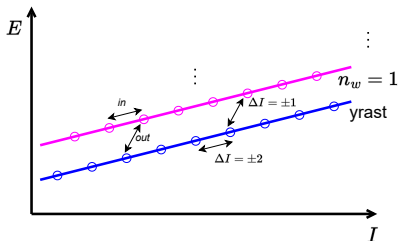
# Wobbling Motion

## Harmonic oscillation

- Precession of  $\mathbf{I}$  is affected by **rotational frequency** and/or **tilting**
- Tilting only by "specific" amount  $\rightarrow$  **harmonic character**  $\rightarrow$  **wobbling phonon**:  $n_w = 0, 1, 2, \dots$



# Wobbling Motion II

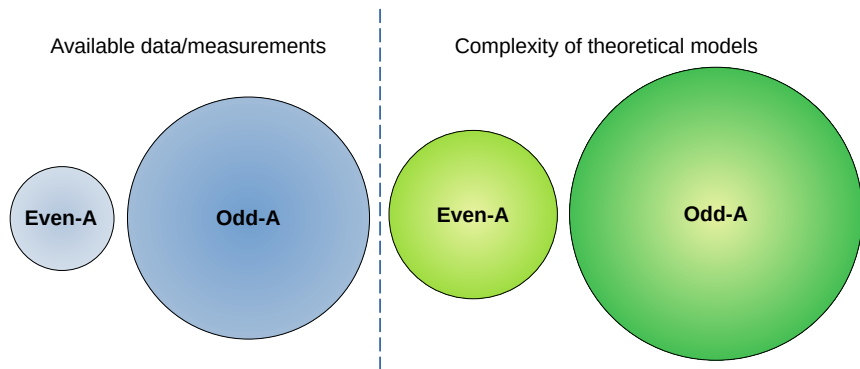


*R. Poenaru et. al., IJMPE, 2021..*



# Even-A vs. Odd-A Picture

- Predicted for even- $A$  nuclei more than 50 years ago.
- First experimental evidence:  $^{163}\text{Lu}$  (*Ødegård, 2001*).
- Current mass-regions for wobblers:  $A \approx [130, 160, 180]$ .



Thank you for your attention!