DESCRIPTION OF THE WOBBLING MOTION THROUGH A BOSON METHOD

Robert Poenaru

DFT, IFIN-HH
Doctoral School of Physics, UB

November 23, 2022

Outline

Nuclear Deformation

Nuclear Radius

The **shape** of the nucleus is most generally described in terms of the *nuclear radius*:

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

- The $\alpha_{\lambda\mu}$ are collective coordinates $\Longrightarrow$ *vibrations of the nucleus*.
- Y_{λ}^{μ} are the spherical harmonics.

Nuclear shapes

Most nuclei are spherical or axially symmetric in the ground state.

Figure 1: **Spherical:** $\beta_2 = 0$; **Prolate:** $\beta_2 > 0$; **Oblate:** $\beta_2 < 0$

Quadrupole deformations

- Most relevant vibrational degrees of freedom in nuclei.
- Play a crucial role in the rotational spectra of nuclei.

Quadrupole radius

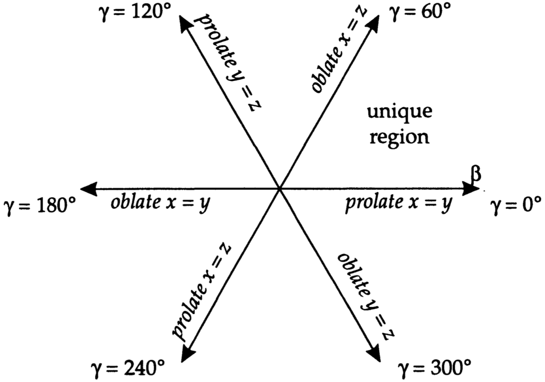
For pure quadrupole deformations:

$$R(\theta,\varphi) = R_0\left(1+\sum_{\mu}\alpha_{2\mu}Y_2^{\mu}(\theta,\varphi)\right)\ , \tag{2}$$

Using A. Bohr's description, the coordinates $\alpha_{2\mu}$ can be reduced to only two *deformation parameters*: β_2 (*eccentricity*) and γ (**triaxiality**).

Nuclear triaxiality

- Besides the axially symmetric shapes (i.e., spherical, prolate, and oblate), nuclei can be **triaxial** $\Longrightarrow$ lack of symmetry along any of the principal axes.
- The asymmetry is given by the non-zero value of γ.



Triaxial ellpsoid

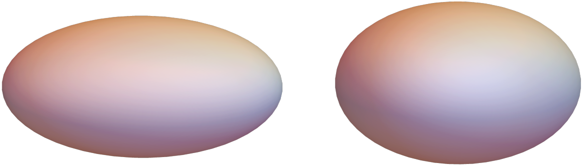


Figure 2: **Left:** side-view**Right:** top view