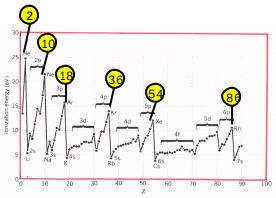
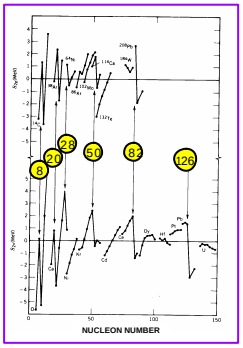
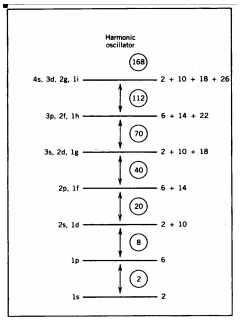




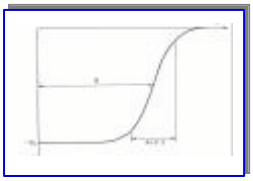
$$S_{2n} = \left[m(^{A-2}_{Z}X_{N-2}) - m(^{A}_{Z}X_{N}) + 2m_n\right]c^2$$

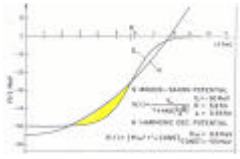
Harmonic oscillator potential

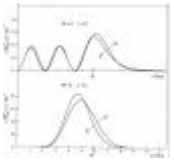


$$V(r) = \frac{1}{2}kr^2 - V_0$$

Degeneracy: $2(2\ell+1)$







$$\propto D\ell^2$$

Spin-orbit interaction

$$V_{SO}(r)\ell\cdot s$$

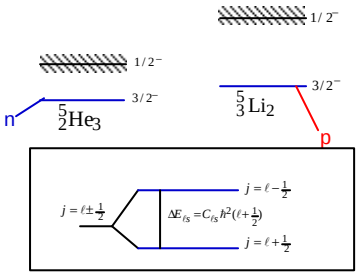
$$j = \ell + s$$

$$\langle \ell\cdot s\rangle = \tfrac{1}{2}\left[j(j+1) - l(l+1) - s(s+1)\right]\hbar^2$$

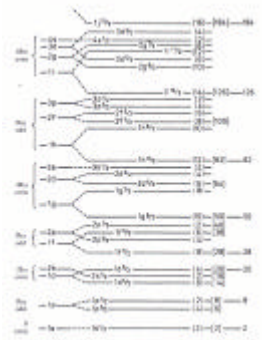
$$\langle \ell\cdot s\rangle_{j=\ell+\frac{1}{2}} - \langle \ell\cdot s\rangle_{j=\ell-\frac{1}{2}} = \tfrac{1}{2}(2\ell+1)\ \hbar^2$$

$$\ell\cdot s\left|a,\ell,s,j\right\rangle = \tfrac{1}{2}\hbar^2\ell\left|a,\ell,s,j\right\rangle \qquad j=\ell+\tfrac{1}{2}$$

$$\ell\cdot s\left|a,\ell,s,j\right\rangle = -\tfrac{1}{2}\hbar^2(\ell+1)\left|a,\ell,s,j\right\rangle \qquad j=\ell-\tfrac{1}{2}$$



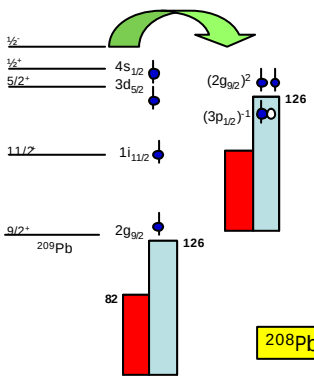
The Shell Model

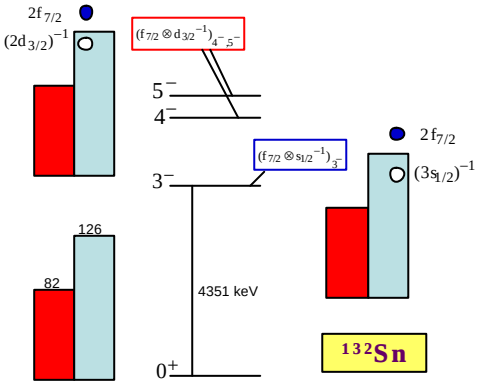


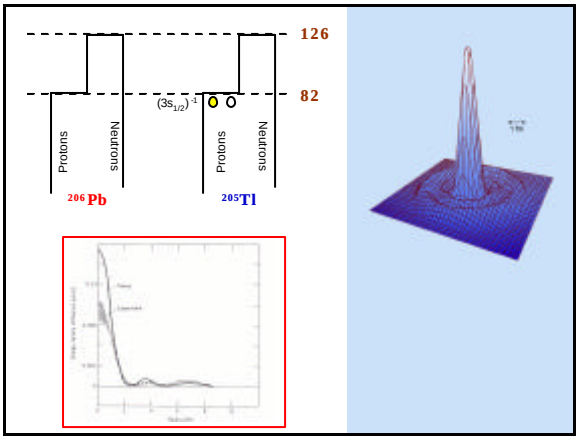
"for their discoveries concerning nuclear shell structure"

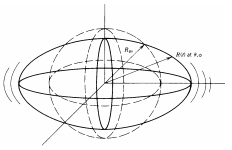
Maria Goeppert-Mayer

J. Hans D. Jensen



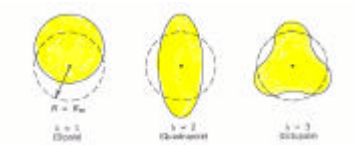


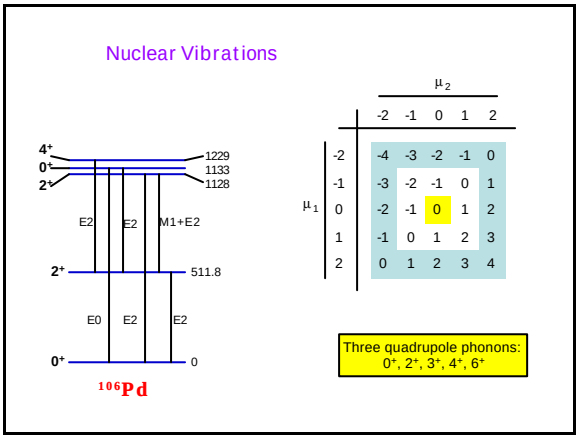


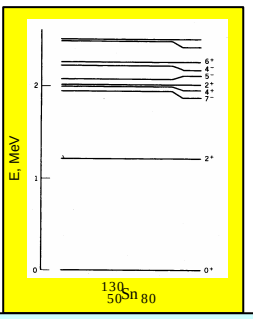


$$R(t) = R_{av} + \sum_{l \geq 1} \sum_{m=-l}^{+l} a_{lm}(t) Y_{lm}(q, f)$$

$$a_{lm} = a_{l-m}$$

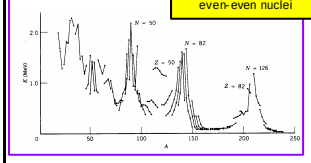




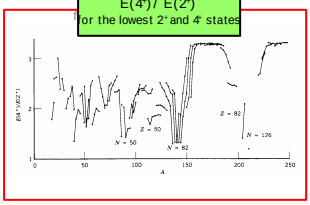


$$y(2^+) = a\,y(n\,h_{11/2} \otimes n\,h_{11/2})_{2^+} + by(n\,d_{3/2} \otimes n\,d_{3/2})_{2^+} + cy(n\,d_{3/2} \otimes n\,s_{1/2})_{2^+} + \ldots\ldots$$

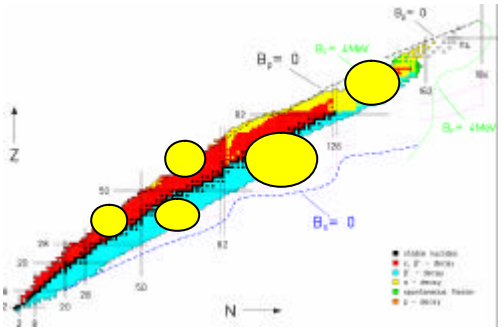
Lowest 2+ states of even-even nuclei



E(4+) / E(2+)
for the lowest 2+ and 4+ states



Regions of deformation

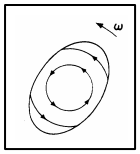


The Nobel Prize in Physics 1975

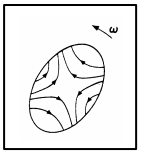


Aage Niels Bohr
Ben Roy Mottelson
Leo James Rainwater

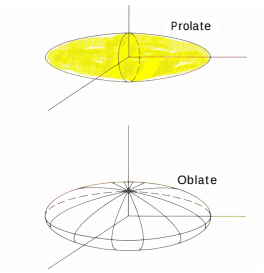
"for the discovery of the connection between collective motion and particle motion in atomic nuclei and the development of the theory of the structure of the atomic nucleus based on this connection"

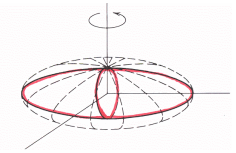


Rigid rotation



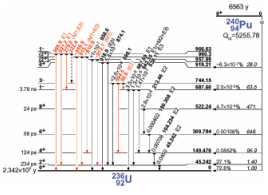
Irrotional flow of an ellipsoidal fluidrotation





Permanent deformations

$$E = \frac{\hbar^2}{2\Im} I(I+1)$$

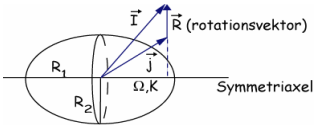


$E(4^+)/E(2^+) = 3.33$

Exp. $149.476/45.242 = 3.30$

$E(6^+)/E(2^+) = 7$

Exp. $309.784/45.242 = 8.85$



$$E_{rot} = E^{(0)} + \frac{\hbar^2}{2\Im}\left[\, I(I+1) - K^2 \right]$$

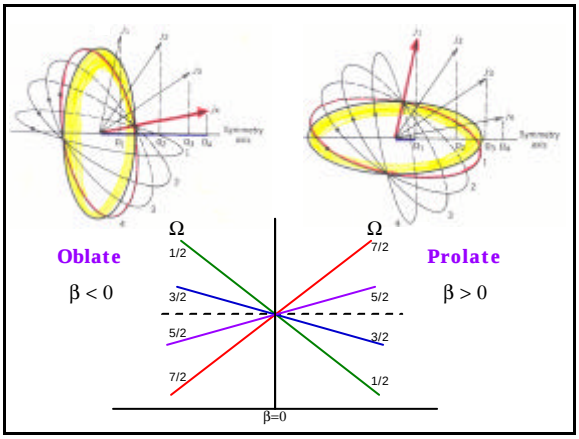
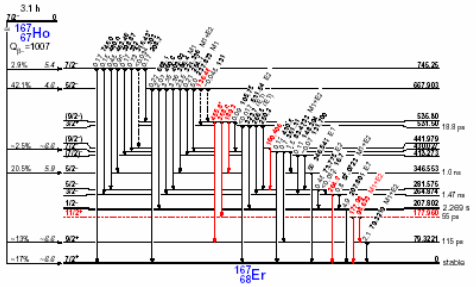
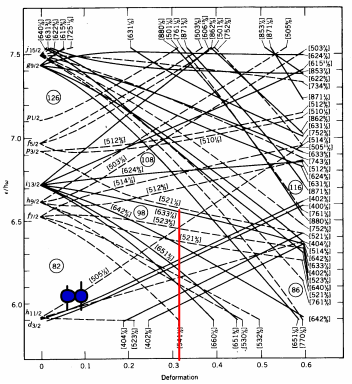
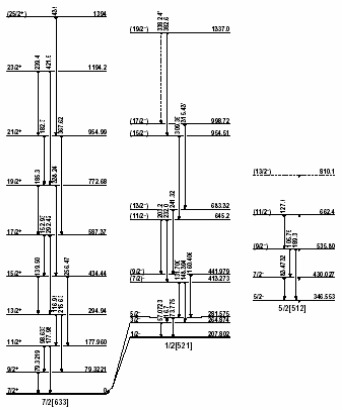


Table of Isotopes







$$E_{rot} = E^{(0)} + \frac{\hbar^2}{2\Im}[I(I+1) - K^2]$$

$$E(\tfrac{9}{2}) - E(\tfrac{7}{2}) = \frac{\hbar^2}{2\Im}\left(\frac{9\cdot 11}{4} - \frac{7\cdot 9}{4}\right) = 79.32$$

$$\Rightarrow \frac{\hbar^2}{2\Im} = 8.81$$

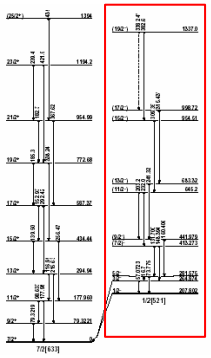
$$E(\tfrac{11}{2}) - E(\tfrac{7}{2}) = 8.81\cdot\left(\frac{11\cdot 13}{4} - \frac{7\cdot 9}{4}\right) = 176.2$$

$$E(\tfrac{13}{2}^+) = 290.84$$

$$E_{\exp.}(\tfrac{9}{2}) = 79.32$$

$$E_{\exp.}(\tfrac{11}{2}) = 177.96$$

$$E_{\exp.}(\tfrac{13}{2}) = 294.94$$



Coriolis Force

$$E_{rot} = E^{(0)} + \frac{\hbar}{2\Im}[I(I+1) - \partial_{K,1/2}\ (-1)^{I+1/2}(I+1/2)]$$

E(9/2)=538 keV

SUMMARY