

(6.8) The observed quadrupole moment of ^{59}Co is 0.40 barn. (a) What is the deformation value β ? (b) What spin value is expected from the Nilsson diagram?

(a) $Q_{\text{obs}} = Q \cdot (I-1/2)/(I+1)$, $Q = 2 \cdot Z \cdot (a^2 - c^2)/5$ and $\beta = 2 \cdot (a-c)/(a+c)$: Dimension of Q_{obs} is m^2 .

$$Q_{\text{obs}} := 0.40 \cdot 10^{-28} \cdot \text{m}^2 \quad Q_{\text{obs}} = 4 \cdot 10^{-29} \cdot \text{m}^2 \quad I := \frac{7}{2} \quad Q := Q_{\text{obs}} \cdot \frac{I+1}{I-\frac{1}{2}} \quad Z := 27$$

We will use the identity: $(a-c)/(a+c) = (a^2 - c^2)/(a+c)^2$, and then approximate $(a+c)$ by $2 \cdot r_{\text{average}}$.

$$Q = 6 \cdot 10^{-29} \cdot \text{m}^2 \quad a2mc2 := \frac{5}{2} \cdot \frac{Q}{Z} \quad a2mc2 = 5.556 \cdot 10^{-30} \cdot \text{m}^2 \quad A := 59$$

$$r_0 := 1.3 \cdot 10^{-15} \cdot \text{m} \quad apc := 2 \cdot r_0 \cdot A^{\frac{1}{3}} \quad \beta := 2 \cdot \frac{a2mc2}{apc^2} \quad \beta = 0.108$$

(b) We have an odd proton as number 27. Then Fig. 6.8 indicates spin 7/2.