$E0$ decay and Lifetimes of 0_2^+ States in the Rare-earth Region: the Case of ^{156}Dy and ^{160}Er

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The branching between the $E0$ $0_2^+ \rightarrow 0_1^+$ and the $E2$ $0_2^+ \rightarrow 2_1^+$ transitions in ^{156}Dy and ^{160}Er were measured following the ε decay of ^{156}Ho and the β decay of ^{160}Tm. A dynamic symmetry transition from a spherical harmonic vibrator to an axially deformed rotor, denoted $X(5)$ [1], is suggested to occur in this region and ^{156}Dy is considered to be a good candidate for the $X(5)$ symmetry [2]. It is interesting in this respect to investigate the $E0$ transition strength in the decay of the excited 0_2^+ state, because this quantity is known to have particularly large values in the transitional region between spherical and deformed nuclei [3].

The results are compared to calculations, using a potential in β of the form:

$$u(\beta) = V_0(\zeta\beta^4 - 2\zeta\beta_0\beta^3 + (1-\zeta)\beta_0^2\beta^2), \qquad (1)$$

with $0 \leq \zeta \leq 1$. This potential was chosen to describe the $U(5) - SU(3)$ first order shape phase transition, covering the whole transitional path. When $\zeta = 0$ there is a spherical minimum, at the critical point, $\zeta = 1/2$ there are two co-existing minima, one at $\beta = 0$ and the other at $\beta = \beta_0$, while for $\zeta = 1$ there is a unique deformed minimum for $\beta = \frac{3}{2}\beta_0$.

From the comparison of the measured excitation spectra with the calculations, one might conclude that ^{156}Dy is in the spherical region ($\zeta \sim 0.1$), while ^{158}Dy is just after the critical point ($\zeta = 0.54$), but the deformed minimum is winning. In the Er isotopes, ^{158}Er is close to the spherical limit ($\zeta = 0.06$), ^{162}Er is clearly deformed ($\zeta = 0.79$), while

^{160}Er takes a value $\zeta = 0.53$, which locates it quite close to the critical point.

Lifetime measurements of these states provide independent information for the $E2$ strength. A compilation of the measured values in the rate-earth region will be reported and a first results for such experiments in ^{156}Dy and ^{160}Er will be discussed.

References

[1] F. Iachello, *Phys. Rev. Lett.* **87**, 052502 (2001).

[2] M.A. Caprio et al., *Phys. Rev. C* **66**, 054310 (2002).

[3] K. Heyde and R.A. Meyer, *Phys. Rev. C* **37**, 2170 (1988).