Formulas for ξ and Θ

Definitions

J is the spin of the initial nucleus. J' is the spin of the β-decay daughter nucleus. J'' is the spin of the final nucleus. L is the angular momentum of the α particle with respect to the final nucleus.

As an example, consider the β-delayed α decay of ^{8}B:

$$^8\mathrm{B}(2^+) \rightarrow {}^8\mathrm{Be}^*(2^+) + \beta^+ + \nu \rightarrow 2\alpha + \beta^+ + \nu$$

Obviously, $J = J' = 2^+$. The final nucleus is an α particle so $J'' = 0^+$. Finally, in order to conserve angular momentum in the $^8\mathrm{Be}^* \rightarrow 2\alpha$ decay we must have $L = 2$.

Formulas

The formulas for the two coffiecients, ξ and Θ, that enter the expression for the β-ν-α triple-correlation amplitude (eq. (5) of ref. [1]) are:

$$\begin{aligned}\xi \; &= 10 \left[\frac{L(L+1)(2L+1)}{(2L-1)(2L+3)}\right]^{1/2} \\ &\times \left[\frac{(2J'-1)(2J'+1)(2J'+3)}{J'(J'+1)}\right]^{1/2} \\ &\times W(2J'LJ''; J'L)\,,\end{aligned}$$

where $W(j_1 j_2 J j_3; J_{12} J_{23})$ is Racah's W-coefficient (if necessary, consult Wikipedia), and:

$$\Theta \;=\; (-)^{J'-J} \left[\frac{30J'(J'+1)(2J'+1)}{(2J'-1)(2J'+3)}\right]^{1/2} \times W(J'1J1; J2)$$

. In the special cases where $J' = J$ or $J' = J \pm 1$, the coefficient Θ is given by:

$$\Theta \;=\; \begin{cases} -(J'+1)/(2J'-1) & ,\; J' = J+1 \\ 1 & ,\; J' = J \\ -J'/(2J'+3) & ,\; J' = J-1 \end{cases} .$$

Useful references

[1] E. T. H. Clifford *et al.*, Nucl. Phys. A **493**, 293 (1989).
[2] B. R. Holstein, Rev. Mod. Phys. **46**, 789 (1974).