Vibrational versus Rotational Sign Rule for the Mixing Ratio

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In the rotational limit, the well-known rule for the E2/M1 mixing ratio on the ground-state band in odd-A nuclei reads[1)]

$$\delta_{rot}\ (I\to I-1) \sim \frac{Q_o}{g_k - g_R} \ .$$

Here Q_o is the ground-state deformation.

We have derived the corresponding expression for the mixing ratio for the vibrational yrast band. Our result is

$$\delta_{VIB}(j+2N\to j+2N-1) = 0.835\ E_\gamma \frac{\sqrt{5}}{2j} \left(\frac{2j+4N+2}{2j+4N-2}\right)^{1/2} \frac{Q(j)}{g_j-g_R}$$

$$\delta_{VIB}(j+2N-1\to j+2N-2) = 0.835\ E_\gamma \frac{1}{3}(16\pi/5)^{1/2} \frac{\hbar\omega_2}{|a|}$$

$$\times \left(\frac{B(E2)\,(N,2N\to N-1,2N-2)}{N}\right)^{1/2} \frac{2j+2}{2j-1} \frac{2j}{((2j+4N)(2j+4N-4))^{1/2}}$$

$$\times \frac{1}{|Q(j)|} \frac{Q(j)}{g_j-g_R} \ ,$$

i.e. the sign rule is

$$\delta_{VIB}(I\to I-1) \sim \frac{Q(j)}{g_j - g_R} \ .$$

Taking into account the rotational formula

$$Q(k=j) = \frac{j(2j-1)}{(j+1)(2J+3)} Q_o \ ,$$

we see that the sign rule for nuclei with static deformation is the same as for spherical nuclei with dynamical vibrations.