Comment on "Landau-Zener Crossing in Superdeformed ^{193}Hg : Evidence for Octupole Correlations in Superdeformed Nuclei"

The discovery of "cross talk" between two superdeformed bands in ^{193}Hg , by Cullen *et al.* [1], is an important step in the progress of spectroscopy in the second well. However, the interpretation of the connecting transitions (not themselves observed) from "band 1" to "band 2" as being of electric dipole character, and the rejection of the magnetic dipole possibility, appears to overlook some basic aspects of conventional nuclear spectroscopy. It is the purpose of this Comment to point out that the connecting transitions could indeed be of $M1$ character, and the two connected superdeformed bands could be signature partners.

Consider first the K quantum number (i.e., the projection of the angular momentum on the nuclear symmetry axis). Between two signatures of a rotational sequence, the K value has a large effect on the connecting transitions, according to the well-known rotational model of Bohr and Mottelson [2], and there is also a simple expression for the g factor:

$$g_K - g_R = 0.93 E_1 Q_0 / \delta (I^2 - 1)^{1/2},$$

where E_1 is the $\Delta I = 1$ transition energy in MeV, Q_0 is the intrinsic electric quadrupole moment in e b, and δ is the quadrupole-dipole mixing ratio. In the case of ^{193}Hg , the spins are not well defined, but the lowest spin state fed by an observed γ -ray transition is probably, according to Cullen *et al.*, $I = \frac{15}{2}$. Using this, together with $Q_0 = 19 e$ b, and $K = \frac{9}{2}$ since the $\frac{9}{2}$ [624] Nilsson orbital is calculated to be close to the Fermi surface in the superdeformed well, it is straightforward to estimate with the rotational model the value of $|g_K - g_R|$, from the observed transition intensities. Only the modulus is obtained from γ -ray branching ratios, as the sign of δ is undetermined. If the observed 274 keV transition, for example, comes from an $I = \frac{27}{2}$ level, and the unobserved cross-band transition has an energy of 142 keV (with no signature splitting) and a branching ratio of 30%, in line with the observation of Cullen *et al.*, then $|g_K - g_R| = 0.84$ for $K = \frac{9}{2}$, compared to $|g_K - g_R| = 8.3$ for $K = \frac{1}{2}$. Clearly, the K value has a very large effect, but electron

conversion has not yet been allowed for.

Most of the cross-band transition intensity would be through electron conversion if it has $M1/E2$ character. For an energy of 142 keV, the $M1$ conversion coefficient is [3] about 3.1. The conversion of the $E2$ 274 keV transition must also be allowed for. The "experimental" estimate then becomes $|g_K - g_R| = 0.43$, which may be compared to a "theoretical" estimate for the $\frac{9}{2}$ [624] configuration (with a quenching factor of 0.6 for the intrinsic spin g factor, and with $g_R = 0.3$) of $g_K - g_R = -0.55$. Considering the unspecified uncertainties in the experimental data, the agreement between the two estimates is good, and in no way forbids an $M1$ interpretation of the cross-band transitions. It is not claimed here that a configuration assignment can be made on this basis, though the data are suggestive.

An explanation of the lack of cross-band transitions in the other direction (band 2 to band 1) could reside in a small signature splitting, but it is difficult to judge from the data presented by Cullen *et al.* if such transitions are indeed much weaker. The gate on the 295 keV transition in band 2 fails anyway to show the 353 keV transition in band 1, which would be expected on the basis of transitions going from band 1 to band 2. It appears that more γ -ray coincidence events are needed in the spectra to determine reliably the details of these cross-band transitions. Furthermore, if the γ -ray detectors were sensitive to transition energies down to 100 keV, any $E1$ transitions, with small conversion coefficients, should be clearly identifiable, whereas $M1$ transitions would be very highly converted.

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