Anomalous Shape Coexistence in ^{185}Hg

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The existing data [1] on $\nu i_{13/2}$ bands built upon shape-coexisting states in ^{185}Hg show two unusual features. (1) The $E2$ branching ratios imply a very small interaction between the prolate and oblate shapes [2]; this is inconsistent with the large values observed in ^{187}Hg [3] and the even-mass mercury isotopes [4]. (2) The $\frac{15}{2}^+$ and $\frac{17}{2}^+$ states are inverted in the prolate rotational band, contrary to the behaviour observed in the other odd-mass mercury isotopes [2]. It is important to re-examine the γ-ray spectroscopy of ^{185}Hg to resolve these problems, especially since information concerning the coexisting prolate and oblate rotational bands in odd-neutron isotopes in the Pt/Hg/Pb region, is limited to only ^{185}Hg [1] and ^{187}Hg [3], yet they show such significant differences.

We have performed a $\gamma-\gamma$ coincidence experiment using the 8π spectrometer and the ^{161}Dy(^{28}Si,4n) reaction at 142 MeV, with an 800 μg/cm^2 self-supporting target. With a sum energy (H) cut in the inner BGO ball to enhance the ^{185}Hg channel, a symmetrized matrix with 78×10^6 $\gamma-\gamma$ coincidence events was created, and, from this matrix, a level scheme for ^{185}Hg was constructed.

The previous level scheme in the region of the crossing of the prolate and oblate $i_{13/2}$ neutron bands has been significantly modified. Of particular note is that the prior observed $\frac{21}{2}^+ \rightarrow \frac{17}{2}^+$ transition in the oblate band cannot be confirmed. This means that out of the odd-mass mercury isotopes, only in ^{187}Hg are there well-developed bands built upon both prolate and oblate shape.

Also, a new $\frac{17}{2}^+$ state has been identified at low excitation energy in ^{185}Hg. Some of the evidence for this can be seen in Fig. 1, where the newly observed 151 and 206 keV transitions form an alternative $\frac{19}{2}^+ \rightarrow \frac{17}{2}^+ \rightarrow \frac{15}{2}^+$ decay path, parallel to the previously known 358 keV, $\frac{19}{2}^+ \rightarrow \frac{15}{2}^+$ transition. The presence of a third $\frac{17}{2}^+$ state has obvious implications for the mixing calculations which previously failed to describe the shape coexistence in ^{185}Hg.

Further work to try and understand the origin of the third $\frac{17}{2}^+$ state, as well as refine the band-mixing calculations, is in progress.

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Figure 1: Coincidence spectrum for the 451 keV, $\frac{23}{2}^+ \rightarrow \frac{19}{2}^+$ transition from the prolate $i_{13/2}$ band in ^{185}Hg.