Title
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Publication Date
1990-05-01

LBL-29160

Lawrence Berkeley Laboratory

UNIVERSITY OF CALIFORNIA

Presented at the Conference on Nuclear Structure
in the Nineties, Oak Ridge, TN, April 23–28, 1990,
and to be published in the Proceedings

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NUCLEAR SCIENCE DIVISION

Prepared for the U.S. Department of Energy under Contract Number DE-AC03-76SF00098.

DISCLAIMER

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This work was supported by the Director, Office of Energy Research, Division of Nuclear Physics of the Office of High Energy and Nuclear Physics of the U.S. Department of Energy under Contract DE-AC03-76SF00098

SUPERDEFORMED BANDS IN ^{194}Tl

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1. INTRODUCTION:

Superdeformation was first observed in the mass-190 region[1] in ^{191}Hg. Since then, SD bands have been found in $^{190-194}$Hg nuclei. Here we report the discovery of two such bands[2] in ^{194}Tl which are the first SD bands found in this mass region that are not in Hg nuclei. Subsequently, bands have been found [3,4] in two Pb nuclei.

2. EXPERIMENT:

Three stacked thin targets, totaling 1.6 mg/cm^2, of enriched ^{176}Yb were bombarded with 116- and 122-MeV ^{23}Na ions from the LBL 88-Inch Cyclotron to produce $^{193-195}$Tl via the 4n, 5n and 6n fusion evaporation reactions. Three similar stacked targets of ^{181}Ta were irradiated with 95-, 100- and 104-MeV ^{18}O to produce the same Tl isotopes. The γ-rays were recorded in the 20 Compton-suppressed Ge detectors of the HERA array, and in a central ball of 40 BGO detectors which was used to select desirable events by its summed energy (H) and detector multiplicity (K). Only events for which at least three Ge detectors fired or for which two Ge together with at least six central-ball detectors fired were recorded on magnetic tape. Thus, totals of 125- and 175-million events were recorded at the two energies for the ^{23}Na induced reactions and totals of 235-, 230-, and 200-million for those produced at the three different ^{18}O beam energies, of which 20% were triple- or higher-coincidence events.

Searches for SD bands were first made on double-coincidence matrices with various K and H requirements. Using gated projections of the matrices, searches for regularly spaced coincident transitions characteristic of superdeformed bands were made both by gating channel by channel and by using an automated search program which makes use of the regularity in energies of the coincident transitions.

3. RESULTS:

Two different SD bands have been identified. Most of the individual members of each of the bands are masked by the very strong low-lying cascades. Only three clean gates were found in the first band and two in the second band. To confirm the existence of a band, we used triple coincidences where the two gates were on the band members. Figure 1 shows the resultant spectra for the two SD bands obtained by adding several of the double-gated spectra for the combined 100- and 104-MeV ^{18}O on ^{181}Ta data. The peaks that were used as gates are marked with asterisks (*). For these spectra K was required to be greater than 15 and H to be greater than 5 MeV. These spectra are clearly characteristic of a SD band, and angular correlation data are consistent with at least the strongest of these lines being of stretched quadrupole character.

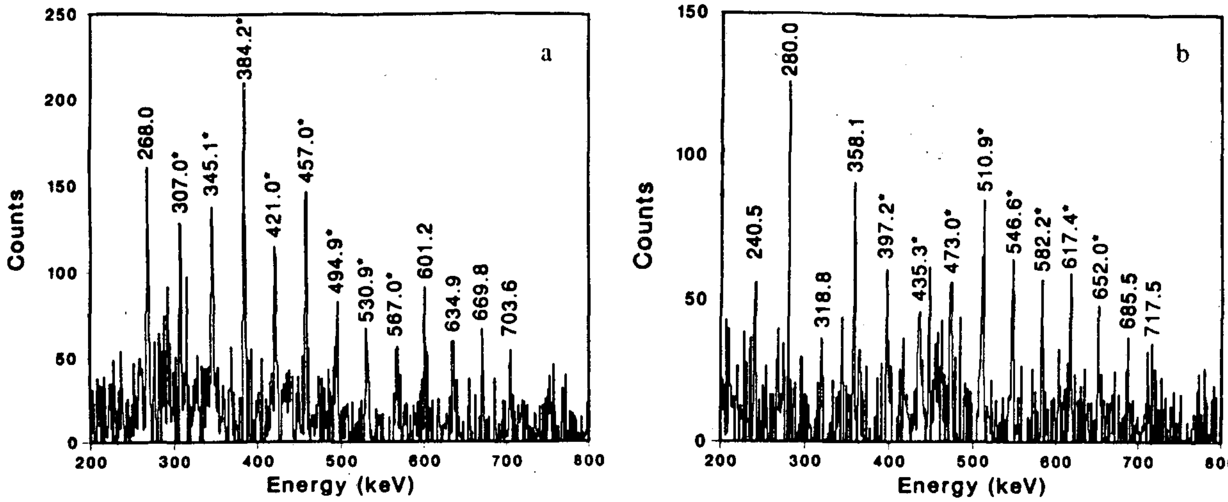

FIGURE 1 : a) Triple-coincidence spectrum of the first SD band in Tl,obtained by adding spectra from all double-gate combinations of the starred peaks b) Same as a) for the second band. The uncertainties in the transition energies range from 0.3 to 1.0 keV.

Considerable difficulties were experienced from interferences with most of the SD band transitions by the stronger normal transitions. Even in the triple-coincidence spectra, no known line of Tl nuclei could be clearly identified in coincidence with the SD transitions, perhaps due to the large background subtraction involved and/or to isomers. However, yields from elements other than Tl were very low, so we conclude that these bands are in Tl. The isotope assignment of these bands is based on excitation functions, obtained from triple-coincidence data. For both SD bands, the excitation functions were found to follow those of ^{194}Tl rather than those of ^{193}Tl. For example, in the ^{18}O data, the ratio of the yields at 104- to 100-MeV(for K>15) is 1.2 ± 0.3 for the first band and 1.3 ± 0.3 for the second, compared to ratios of 1.0 ± 0.2 for the known lines of ^{194}Tl and 3.5 ± 0.5 for the known lines of ^{193}Tl. We conclude that these two SD bands belong to the ^{194}Tl nucleus.

While the first band was found in the studies with the 116- and 122-MeV ^{23}Na on ^{176}Yb,it was weaker (0.5% of the ^{194}Tl yield) than in the data obtained with ^{18}O (1.5%). The second band had an intensity of 60% of the first band in the ^{18}O data and was very difficult to see in the ^{23}Na data. The probable reason is that the ^{18}O beams brought in more angular momentum than the ^{23}Na beams at the same excitation energy.

The spacings of the transition energies in these two SD bands vary in a similar way, decreasing from 38 keV for the lowest transitions to 34 keV for the highest ones. The transition energies of the second band (in the upper part of that band) fall close to the mid-point of two consecutive transition energies in the first band, suggesting that they are signature partners. However, the spins determined for these bands, using the method developed in ref. 5, do not confirm this; we find that the lowest state in the first band has spin 12 and in the second band has spin 10.

4. REFERENCES:

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This work was supported by the Director, Office of Energy Research, Office of High Energy and Nuclear Physics, Nuclear Physics Division of the U.S. Department of Energy under contract: DE-AC03-76SF00098.