HIGH SPIN STATES IN LUTETIUM-163 AND LUTETIUM-165 AND BACKBENDING IN RARE EARTH NUCLEI

Marc Samuel Rosenthal

Since the observation of a band crossing at a rotation frequency of 0.27 Mev/(H/2PI) in the yrast cascade of several nuclei in the region of A = 160, much work, both experimental and theoretical, has been done to study this effect and its underlying cause. A second backbend has also been seen at around spin 28 (angular freuency 0.42 MeV/(H/2PI)) in the N = 90 even -Z isotones ('158)Er, ('160)Yb, and ('162)Hf, and is thought to arise from the breaking of an h(,11/2) proton pair and the subsequent alignment of the protons' angular momenta along the rotation axis.

In order to further understand the mechanism of the second backbend, a study of the odd - Z isotopes ('163)Lu (N = 92) and ('165)Lu (N = 94) was undertaken in order to (1) determine their level schemes, with the hope of getting to a high enough excitation energy so that the blocking of the second backbend might be observed, (2) determine the change in alignment at the first backbend and the amount of alignment of the S - band compared to the S - bands of the neighboring even - A isotones, and (3) compare these results with Cranked Shell Model (CSM) calculations on ('163)Lu and ('165)Lu with the hope of better understanding the cause of the second discontinuity.

('163)Lu and ('165)Lu were populated via the ('148)Sm(('19)F,4n(gamma)) and ('150)Sm(('19)F,4n(gamma)) reactions, respectively, at E = 80-105 MeV using standard gamme-ray spectroscopy techniques. In both ('163)Lu and ('165)Lu the yrast level scheme appears to be based on the 7/2- {523} Nilsson orbital, with a band crossing at 0.27 MeV/(H/2PI). Also, it is found that in these nuclei the band crossing is sharper than that seen in the N = 90 nuclei, indicating a smaller interaction of the ground state band with the S-band. The alignment of the S-band in these two nuclei is 6 (H/2PI) greater than in their isotones, which is also consistent with a smaller interaction between the crossing bands. Although we were not able to extend our measurements up to the region where the second backbend might be expected, we have found that the CSM calculations are in agreement with the experimental data further confirming the validity of the CSM model, and as a consequence thereby supporting a model in which the second backbend in the N = 90 nuclei is due to a pair of h(,11/2) protons.