Studies of ^{235}U by Coulomb Excitation: Low Spin.

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The stucture of the nucleus ^{235}U is of interest from several viewpoints. An early spectroscopic study [1] was motivated to examine Coriolis interactions of bands built on the Nilsson j15/2 multiplet. Bands built on the 3/2, 5/2, 7/2(the ground state band), 9/2 and 11/2 members were identified. The 3/2 and 11/2 bands probably have a mixed gamma-vibrational character. The 1/2, 13/2 and 15/2 members have never been identified. A motivation for the present work was to extend the earlier study with modern techniques.

γ-γ coincidence techniques work poorly at low spins in ^{235}U; states of interest decay by one-step transitions to low-lying states of the ground band whose subsequent decays are largely converted. Fusion reactions with light contaminants in the target produce floods of high γ-ray-multiplicity cascades. Therefore, γ-γ coincidences make invisible the interesting transitions, whilst enhancing the background.

These problems have been solved with Gammasphere and the University of Rochester CHICO detector system. The ^{235}U target was thick enough to stop the 180 MeV incident ^{40}Ar beam, and CHICO detectors backward of 90 degrees registered scattered ions in coincidence with one or more γ-rays detected in Gammasphere. A portion of the spectrum is shown in Fig 1. The full spectrum contains approximately 300 resolvable lines in the energy range 150-1700 keV, most of which are assigned to ^{235}U.

Fig 1 shows one set of transitions $J^- \rightarrow (J+2)^-$ from the $K=3/2^-$ γ-vibrational band to the $K=7/2^-$ ground-state band. This band was known to spin 7/2 [1], and we have extended it to spin 13/2. In fact all the previously known bands have been extended. As shown in Fig 1, the positive-parity band, $[624]7/2^+$ is very strongly populated. This confirms our earlier experiments indicating that there must be a very large and unexpected E3 collectivity between two apparently ordinary Nilsson states.

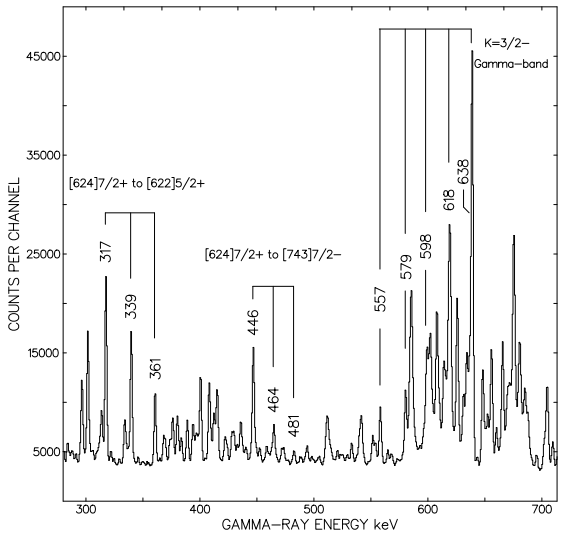

Figure 1: A portion of the γ-spectrum in coincidence with beam particles detected in CHICO. Note the strength of E3 excitation to the positive parity [624]7/2 state compared with a collective E2 excitation to the γ vibrational band. Almost all of the transtions in this complex spectrum can be assigned to ^{235}U.

References

[1] F.S.Stephens, M.D.Holtz, R.M.Diamond, and J.O.Newton. Nucl Phys. A115 (1968) 129.