Status of Coulomb Excitation Studies in ^{235}U

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We are analyzing data-sets from three complementary experiments performed to study the Coulomb excitation of 235U: namely gamma-ray spectroscopy with beams of 136Xe using (1) Gammasphere, and (2) the 8PI spectrometer and (3) an experiment with the University of Rochester's CHICO detector in conjunction with Gammasphere with an 40Ar beam. The bombarding energies were in the "safe" range for Coulomb excitation in all cases, and all experiments were performed at LBNL's 88 Inch Cyclotron. Further details may be found in the 2001 Annual Report.

We find that much of the earlier work on the high-spin spectroscopy of ^{235}U is incorrect. We have identified rotational bands built on the 3/2(39/2), 5/2(41/2), 7/2(57/2), 9/2(35/2), and 11/2(19/2) members of the j15/2 Nilsson multiplet, where (J) denotes the highest spin observed. The 3/2 and 11/2 members are expected to be strongly mixed with gamma-vibrational bands.

What is surprising is the number and intensity of positive parity bands seen, which in Coulomb excitation can only be reached by E3 excitations, and are intrinsically weak unless there are collective enhancements of the B(E3) reduced matrix elements. We have identified rotational bands built on the 3/2, 5/2 and 7/2 members of h11/2 multiplet: the 5/2, 7/2,and 9/2 members of g9/2 multiplet: and the 1/2 member of the d5/2 multiplet. The above-mentioned [631]1/2, and [622]5/2 bands are excited to spins 57/2 and 51/2 respectively.

The data from the CHICO experiment is suited to a quantitative analysis with the Winther-deBoer code to interpret the yields in terms of B(E2) and B(E3) matrix elements. This was not feasible for our other data sets because of the bias introduced by the gamma-ray trigger conditions. We find that the B(E3)-values are typically in the range 5-15 single-particle units.

There is evidence that the strong Coriolis effects in the j15/2 multiplet, evident at low spin, are beginning to damp at higher spins. We plan to relate this effect in a quantitative way to the strength of the octupole correlations, which are known to destroy the j-purity of intruder orbitals, thereby weakening the Coriolis matrix elements.

A typical Winther-deBoer calculation takes approximately 200 matrix elements (depending on the case) and these must be prescribed by models with a few free parameters. In our case the collective E2 matrix elements within any given band are assumed to be given by Clebch-Gordon coefficients (CG's) on an intrinsic moment, Q0 = 9.75 eb., known for the ground state band at low spin. The matrix elements between the ground-state band and excited bands are similarly given by CG's acting on an effective transition moments Qt(λ=2) and Qt(λ=3), to be determined from the experimental yields.

The variation of the observed yields with spin follows the calculations in most cases - supporting the choice of matrix elements. The most conspicuous failure is for the 11/2- band, who's structure is believed to be mainly a gamma-vibration of the 7/2- ground state. In this case the observed yields decrease much more rapidly than calculated, implying that the band is rapidly loosing collectivity. We have no plausible explanation for such an effect.

Footnotes and References

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