Spectroscopy of $^{111}$Cd: Challenging the Particle-Vibration Model

B.J. Coombes,¹ A.E. Stuchbery,¹ M.W. Reed,¹ A. Akber,¹ J.T.H. Dowie,¹ M. Gerathy,¹ T.J. Gray,¹ T. Kibédi,¹ A.J. Mitchell,¹ and T. Palazzo¹

¹Department of Nuclear Physics, The Australian National University, ACT 2601, Australia

Quadrupole collectivity has traditionally been studied through the measurement of electric quadrupole moments. Recently it has been shown that $g$ factors can be sensitive to the nature of collective excitations in a way that electric quadrupole moments are not [1]. In this new investigation the $g$ factors of excited states in $^{111}$Cd were measured and compared with the predictions of particle-vibration and particle-rotor models. Particle-$\gamma$ angular correlations were also measured following Coulomb excitation with 90 MeV $^{32}$S beams from the ANU 14UD Pelletron accelerator. Particular attention was focused on the $5/2^+$ and $3/2^+$ states reported [2] at 752.8 and 754.9 keV, respectively. No population of the purported $3/2^+$ state was observed.

In the limit of a spherical nucleus with no vibration coupling and no deformation, the particle-vibration and particle-rotor models of $^{111}$Cd begin with the same $g$ factors. It was shown in a previous analysis that applying a small deformation provides a large change in the $g$ factors for low-lying excited states in $^{111}$Cd, bringing these values in line with measurements [1]. A puzzle for the particle-vibration model in the present data is the non-observation of a strongly Coulomb excited $3/2^+$ state with an excitation energy near the $2^+$ excitation energy of the core ($E(2^+) \sim 600$ keV), similar to the $3/2^+$ 681-keV level in $^{113}$Cd.

The new data will be presented and discussed in terms of particle-vibration versus particle-rotor interpretations of the level structure and electromagnetic properties of $^{111}$Cd.