Mapping quadrupole collectivity in the Cd isotopes: The breakdown of spherical vibrational motion

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The nuclear structures of the even-even Cd isotopes near stability, especially $^{110-116}$Cd, were long thought to be prime examples of low-lying vibrational motion. Their level schemes display a nearly harmonic spacing of one, two, and three-phonon levels. Due to their importance as paradigms of vibrational motion, their structures were previously investigated by a variety of reactions, such as a series of (α,2n) reactions and (n,n'γ) reactions. While these reactions were essential for establishing the location of levels and their main decay branches, and in most cases their lifetimes, they did not have the sensitivity to probe the weak low-energy branches that are necessary to assess the degree of collectivity possessed by low-spin states at high excitation energy.

In order to complement the data used to test the collectivity present in the Cd isotopes, we have initiated a programme of extensive beta-decay experiments using the 8π spectrometer at the TRIUMF radioactive-beam facility. The goal of these experiments is to achieve a sufficient sensitivity to weak, low-energy branches amongst the multi-phonon levels so that the collective branches would either be observed, or very stringent upper limits set. Thus far, we have examined the decay of ^{110}In to ^{110}Cd, and ^{112}In/^{112}Ag to ^{112}Cd. These experiments have allowed a nearly complete mapping of the *E2* strength in low-spin levels up to ~ 3Mev, and have revealed that the individual low-spin multi-phonon states do not decay in the expected manner. Further, and much more surprising, the missing *E2* strength is not due to fragmentation (i.e., mixing) amongst the levels below ~ 3 MeV. This lack of the *E2* strength has forced a re-evaluation of the structure, suggesting a more rotational picture rather than vibrational. This also raises the issue that if our long-standing paradigms of vibrations can no longer be considered as vibrational nuclei, are their any spherical vibrational nuclei?