TRACKING THE EMERGENCE OF NUCLEAR COLLECTIVITY THROUGH MOMENTS AND MONOPOLES

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The emergence and evolution of collective excitations in complex nuclei remains a central problem in the nuclear many-body problem. Nuclear quadrupole collectivity is usually investigated via electric quadrupole observables. In a recent paper study [Phys. Rev. C**93**, 031130(R) (2016)] we measured the *g* factors (magnetic moments) of low-excitation states in ^{111}Cd and ^{113}Cd and showed that they are sensitive to the nature of the collectivity in these nuclei in ways that the electric quadrupole (E2) observables are not.

Whereas E2 properties are vital for signalling the onset of collectivity, and can distinguish between alternative collective models, they give little insight into the under-lying single-nucleon behaviour. On the other hand, M1 observables such as magnetic moments, which arise from nucleonic currents, uniquely expose the single-particle motion. Thus they can expose the microscopic structures underlying the onset of nuclear collectivity. In parallel, it is evident that the spectra of many weakly-collective nuclei are complicated because the nucleus can take different shapes at nearly the same excitation energy - so-called shape coexistence. Quantum states associated with the two shapes mix, affecting the energy spectrum and the decay patterns of the states, potentially confusing our interpretation of their behaviour and the emergence of nuclear collectivity. Electric monopole (E0) transitions are a very sensitive probe of shape coexistence, thus their observation is vital to unravel the effects of shape co-existence.

Progress in measurements of moments and monopoles at the Australian National University will be outlined with a focus on opportunities to study the origins and evolution of nuclear collectivity.