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From vibrations to multiple shapes: rewriting low energy nuclear structure

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The concept of vibrational modes of excitation of the nuclear surface, known as phonons, was developed in the early 1950s by A. Bohr and B. Mottelson within their collective model. The observed pattern of level excitation energies and spins for nuclei believed to have a spherical shape appeared consistent with the picture of multiphonon excitations. With the confirmation of the collective natures of these states, this picture of spherical nuclei possessing nearly harmonic multiphonon states become standard textbook material –a practice which continues to this day. Over the past couple of decades, we have performed very detailed spectroscopic studies of the cadmium isotopes that revealed serious discrepancies with the multiphonon picture, ultimately developing an alternative interpretation that the excited states were based on multiple deformed shapes that could rotate, rather than a spherical shape that vibrates. This has inspired investigations by many groups around the world to test our interpretation, and a realization that the simple picture presented in textbooks needs to be modified.

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