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The Transition Between Symmetry Phases in Nuclei

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The understanding of collective nuclear structure often relies upon a set of benchmarks or symmetries which describe idealized limits. The three standard benchmarks of nuclear structure, the vibrator, rotor, and γ-soft structure have been known for decades. Few nuclei actually manifest these symmetries, however, and the range of structures between them is extensive. Until recently, transitional nuclei were traditionally described by numerical diagonalization of a multi-parameter Hamiltonian. However, newly proposed critical point symmetries, X(5) and E (5), can now describe nuclei at the point of a phase transition from spherical to deformed shapes. The success of these analytic models has generated considerable interest in developing other simple models to describe a wider class of transitional nuclei. These models in fact, now provide analytic solutions to describe the entire range of nuclei between spherical and deformed shapes. The predictions of these models, along with traditional descriptions, will be presented. They show both excellent agreement and striking discrepancies with the data on most transitional nuclei. This work was supported by the U.S. DOE Grant No. DE-F602-91-ER-40609.