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Evolution of Nuclear Shaps[1]

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The nucleus is one of the natures most fascinating quantal many-body systems. It exhibits several unique behaviors and is characterized by some fundamental properties, one of which is the shape. While closed-shell nuclei are commonly associated with spherically symmetric shapes, those in-between closed shells possess varying degrees of spheroidal deformation, with the quadrupole degree of freedom being the most common deviation from spherical symmetry. Nuclei with quadrupole deformation can either have axial symmetry, where one distinguishes between prolate and oblate shapes, or axially asymmetric shapes. In addition, nuclei can also adopt reflection-asymmetric or octupole-deformed shapes at low excitation energies and, in some cases, configurations corresponding to different shapes can coexist at similar energies. Moreover, nuclear shapes are sensitive to the underlying structure and thus, can change from one nucleus to another. Typically, these changes are a result of the rearrangement of orbital configuration of nucleons or the dynamic response to rotation. Predicting this coexistence phenomenon and shape evolution as a function of the nucleon number and angular momentum is extremely challenging from a theoretical point of view. Thus, determining nuclear shapes experimentally and tracking their evolution represents a stringent test of theoretical models and at the same time, constrains our understanding of the microscopic origin of nuclear shape changes. In this talk, I will present a general overview of how nuclear shapes are inferred and highlight recent experimental and theoretical progress towards understanding nuclear shape evolution in certain regions of the nuclear chart.

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