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Building Continuous Potential Energy Surfaces for Nuclear Fission Dynamics

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Nuclear fission is a complex many-body process involving a very large number of degrees of freedom. A widely used microscopic framework to describe this phenomenon is the Time-Dependent Generator Coordinate Method, where the generating functions are constrained Hartree-Fock-Bogoliubov states. In this context, elongation and mass asymmetry appear as essential collective degrees of freedom.

The restriction to a limited set of collective coordinates may induce discontinuities along the fission path, since continuity in energy does not necessarily imply continuity in the underlying nuclear structure obtained from constrained energy minimization. Recently developed methods based on wave-function overlap constraints [1] ensure continuity of both energy and structure from for the adiabatic and excited paths, from the ground state deformation up to scission and beyond, thereby enabling a consistent description of fission dynamics. These methods have been successfully applied to the one-dimensional fission pathway of 240Pu, yielding fragment properties in good agreement with experimental data.

In this presentation, we investigate the behavior of the standard and continuity-preserving protocols in the construction of potential energy landscapes for various heavy nuclei. The perspective of this work is to extend this framework to two-dimensional collective spaces.

[1] P. Carpentier, *Microscopic and dynamical description of the fission process including intrinsic excitations*, PhD thesis, Université Paris-Saclay (2024).

Type of contribution

Regular Abstract

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