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Description of fission process including intrinsic excitations - Application to Pu240

Fission is one of the most complex nuclear physics phenomenon whose modeling requires a priori the introduction of collective, individual and dynamical degrees of freedom. In the context of TDGCM, the adiabatic approximation is widely common as it simplifies greatly the description with the limitation that the scission area is hardly reachable with standard constrained Hartree-Fock-Bogoliubov (HFB) calculations. Besides, it is well-known that intrinsic excitations play a non-negligible role from the saddle point to the scission area. In this talk, I will present new protocols (Link, Drop and Continuous Deflation) based on HFB calculations augmented with overlap constraints [1]. The first advantage is the control of the continuity of the HFB solutions that allows in particular to connect the fission and Coulomb valleys in a continuous way with a non-ambiguous description of the scission. The second advantage is to build continuous excited states orthogonal to the lowest energy path.

Then, I will discuss the application to Pu-240 with a 1D implementation of the Schrödinger Collective-Intrinsic Model [2,3]. I will discuss in particular the characteristics of the new HFB paths obtained with the Link and Drop protocols, the nature of the excited states generated by the Continuous Deflation, their role in the dynamics from saddle to scission and an energy balance at scission including intrinsic excitation energy.

[1] P. Carpentier et al., Phys. Rev. Lett. 133, 15201 (2024)

[2] P. Carpentier, PhD thesis, Paris-Saclay University, 27th November 2024.

[3] R. Bernard et al., Phys. Rev. C 84, 044308 (2011).

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