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Improved modelling of nuclear fission with the TDGCM and projection techniques

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The demand for an accurate, predictive model of nuclear fission continues to grow today, driven not only by the development of new experimental facilities but also by the need to describe exotic reactions relevant to stellar nucleosynthesis or superheavy element formation. However, given the complexity of the fundamental quark-gluon interactions, theoretical attempts to simulate nuclear fission must apply approximations to strike a balance between computational feasibility and physical relevance.

This presentation introduces a new description of fission based on the Time-Dependent Generator Coordinate Method (TDGCM), formulated without the commonly-used common Gaussian Overlap Approximation with the aim of achieving enhanced accuracy and compatibility with future extensions. While development of the new model is ongoing, intermediate results suggest that the choice of generator states for the method affects the resulting dynamics in ways that have not been previously considered.

A notable drawback of TDGCM and fission models more widely is the breaking of symmetries of the nuclear system, resulting in uncertainties in observable quantities such as particle number and angular momentum. Projection techniques are typically used to restore these symmetries and observables. However, projecting instead onto one of the constrained dimensions of the system reveals some innovative new uses. Applications to improve the depiction of fission dynamics and to consistently modify the Hamiltonian of the system will be demonstrated. Furthermore, by extending the previous work of Scamps and Hagino (2017), projection can be used to implement an imaginary absorption potential which leads to a simple but effective calculation of spontaneous fission half-lives.

Type of contribution

Regular Abstract

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