

## NUCLEAR DYNAMICS FROM NEUTRON STARS TO SUPERHEAVY ELEMENTS

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### Abstract

Radioactive Ion Beam Facilities have opened up new opportunities in the areas of nuclear structure physics, nucleosynthesis, nuclear astrophysics, and tests of fundamental symmetry principles. These experimental developments have sparked renewed interest in quantum theories of many-body systems capable of addressing large amplitude phenomena observed in low-energy nuclear reactions.

It is generally acknowledged that the Time-Dependent Hartree-Fock (TDHF) theory provides a unified fully microscopic description of nuclear dynamics, and is closely related to time-dependent density functional theory (TDDFT). In recent years, aided by advances in computational tools and methods as well as improvements achieved in obtaining better effective interactions, TDDFT has emerged as a powerful tool to provide a microscopic description of low-energy heavy-ion reactions. These calculations can now be done without making any simplifying assumptions about the effective interactions and the reaction geometry and with unprecedented numerical accuracy. More importantly, new techniques allow us to extract more information that can be directly compared with experiment.

In this talk I will review some of the recent advances in TDDFT calculations for the study of reaction phenomena ranging from light systems important for astrophysics to very heavy systems. These include, the microscopic calculation of fusion barriers and cross-sections, dynamics of quasifission and fission, and deep-inelastic collisions.