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Title: “Fusion of neutron-rich nuclei using a Time-Dependent Density Functional Theory with density constraint”

Abstract: In connection with experiments at Radioactive Ion Beam Facilities, we study fusion reactions of exotic neutron-rich nuclei at energies in the vicinity of the Coulomb barrier. Dynamic microscopic calculations using time-dependent density functional theory are carried out on a 3D lattice. There are no adjustable parameters, the only input is an effective (Skyrme) NN interaction. While fusion cross sections above the barrier can be calculated with the standard Time-Dependent Hartree Fock (TDHF) method, calculations at sub-barrier energies require a new approach which we call the Density Constrained TDHF (DC-TDHF) method. This allows us to compute heavy-ion interaction potentials $V(R)$, mass parameters $M(R)$, dynamic excitation energies $E^*(R)$, and total fusion cross section $\sigma(E_{c.m.})$. Some of the effects naturally included in this dynamic approach are: neck formation, multi-nucleon transfer, internal excitations, deformation effects, as well as nuclear alignment for deformed systems. Results will be presented for the systems $^{132}\text{Sn}+^{40,48}\text{Ca}$, for the reactions $^{12}\text{C}+^{16,20,24}\text{O}$ which occur in the crust of neutron stars, and for “hot” and “cold” fusion reactions $^{70}\text{Zn}+^{208}\text{Pb}$ and $^{48}\text{Ca}+^{238}\text{U}$ in connection with superheavy element production.