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Title: Microscopic Calculation of Heavy-Ion Potentials Based on TDHF

Name: Umar, Sait

Affiliation: Vanderbilt University

The investigation of internuclear potentials for heavy-ion collisions is of fundamental importance for the study of fusion reactions as well as for the formation of superheavy elements and nuclei far from stability. Recently, we have developed a new method to extract ion-ion interaction potentials directly from the TDHF time-evolution of the nuclear system. In the DC-TDHF approach the TDHF time-evolution takes place with no restrictions. At certain times during the evolution the instantaneous density is used to perform a static Hartree-Fock minimization while holding the neutron and proton densities constrained to be the corresponding instantaneous TDHF densities. In essence, this provides us with the TDHF dynamical path in relation to the multi-dimensional static energy surface of the combined nuclear system. In this approach there is no need to introduce constraining operators which assume that the collective motion is confined to the constrained phase space. In short, we have a self-organizing system which selects its evolutionary path by itself following the microscopic dynamics. Some of the effects naturally included in the DC-TDHF calculations are: neck formation, mass exchange, internal excitations, deformation effects to all order, as well as the effect of nuclear alignment for deformed systems. The DC-TDHF theory provides a comprehensive approach to calculating fusion barriers in the mean-field limit. The theory has been applied to calculate fusion cross-sections for ^{64}Ni+^{132}Sn, ^{64}Ni+^{64}Ni, ^{16}O+^{208}Pb, $\mathrm{^{70}Zn}+\mathrm{^{208}Pb}$, $\mathrm{^{48}Ca}+\mathrm{^{238}U}$, and ^{132,124}Sn+^{96}Zr systems. In this talk we will outline the DC-TDHF method and give examples of its application to the calculation of fusion cross-sections for various systems.