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TDRPA Calculations for Mass and Charge Fluctuations and Correlations in 144,154Sm+144,154Sm reactions

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Time-dependent mean-field approaches, such as time-dependent Hartree-Fock (TDHF) or time-dependent density functional theory (TDDFT), have shown remarkable successes in describing nuclear excitations and dynamics microscopically. Especially, recent TDHF (with or without addition of pairing correlations) calculations have shown that the main (or average) reaction outcomes can be described quantitatively without adjustable parameters on reaction dynamics (see, *e.g.*, Ref. [1]). Further developments of the theoretical framework and its applications can thus be considered to be promising to develop our understanding of complex reaction mechanisms in low-energy heavy-ion reactions.

However, there is a well-known, longstanding drawback inherent in the standard TDHF approach, that is, it severely underestimates width of fragment mass and charge distributions. Recent theoretical efforts have shown that this drawback can be overcome by incorporating one-body fluctuations and correlations on top of the average (TDHF) trajectory, based on, *e.g.*, time-dependent random phase approximation (TDRPA) (see, *e.g.*, Ref. [2] and references therein) or stochastic mean-field theory (SMF) [3]. Although those approaches have shown successful reproductions of existing experimental data (see, *e.g.*, Refs. [4, 5]), we need further systematic calculations in comparison with available experimental data, to unveil underlying reaction mechanisms.

To this end, we have conducted TDRPA calculations for ^{144}Sm+^{144}Sm (spherical+spherical) and ^{154}Sm+^{154}Sm (deformed+deformed) systems for which old, yet great experimental data are available [6]. For the latter deformed system, several relative orientations were investigated. From the results, we have found that total kinetic energy loss (TKEL) as a function of fragment mass dispersion agrees quantitatively with experimental data. On the other hand, TDRPA tends to overestimate charge dispersion, which may be improved by refining the energy density functional (EDF). Moreover, we have performed systematic analysis of mass and charge dispersion with Ni+Ni, Sm+Sm, Yb+Yb, Pb+Pb systems (and some others will be added) to seek for a universal behavior of fragment mass and charge fluctuations. In this talk, we will present the latest TDRPA analysis of fragment mass and charge fluctuations and correlations and discuss the physics behind the dissipative collisions of heavy nuclei.

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