Contribution ID: **78** Type: **Invited Presentation**

Time-dependent Description Nuclear Collisions and Infinite Nucleonic Systems

Tuesday, 30 May 2017 16:50 (15 minutes)

Time-dependent nuclear density functional theory (TDDFT) is a tool of choice for describing heavy ion collisions. Here we present a study of nuclear focusing on the aspect of nucleonic clustering in the intermediate states. To visualize emergent clusters, we use the nucleonic localization function, which is based on the probability of finding two nuclei with same spin and isospin at a given point. This measure was shown to be an excellent indicator for clustering in time-independent DFT calculations. We show that the TDDFT solutions exhibit strong clustering especially in the collision of light nuclei. The nucleonic localization is also an excellent measure of clustering in time-dependent simulations and gives important insights into the reaction mechanism.
TDDFT can also be used to describe infinite systems such as nuclear pasta, which is present in the inner crust of neutron stars. Here we study the time-dependent modes of nuclear rods. To reduce finite-volume effects, we utilize the twist-averaged boundary conditions (TABC). We show that only with the help of TABC we can extract important information pertaining to the inner crust of neutron stars.

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Session Classification: Breakout 1