Collisions of Atomic Nuclei at Low Energies within Time Dependent Density Functional Theory.

Within this project we will apply fully microscopic methods to investigate collisions of two superfluid nuclei at low energies. We expect to reveal new phenomena related to solitonic excitations during collisions, which will manifest themselves in kinetic and excitation energies of the fragments and capture cross section.

The investigations we plan to perform, will be the first in which dynamics of Cooper pairs, responsible for nuclear superfluidity is taken into account and thus will provide an invaluable insight in the mechanism of nuclear collisions at low energies and in particular in the creation of superheavy elements.

It is of paramount importance to arrive at the unified description of the low-energy nuclear reactions, which play an important role in our understanding of the origin of the elements in Universe, the limits of nuclear chart, and also have crucial implications for energy production.

The problem will be studied within the framework of the Density Functional Theory (DFT), together with the best computer science solutions available today. This extensively tested software can solve numerically the equations for various nuclear systems making an efficient use of the largest supercomputers for open science (e.g. Titan at Oak Ridge National Laboratory, USA).

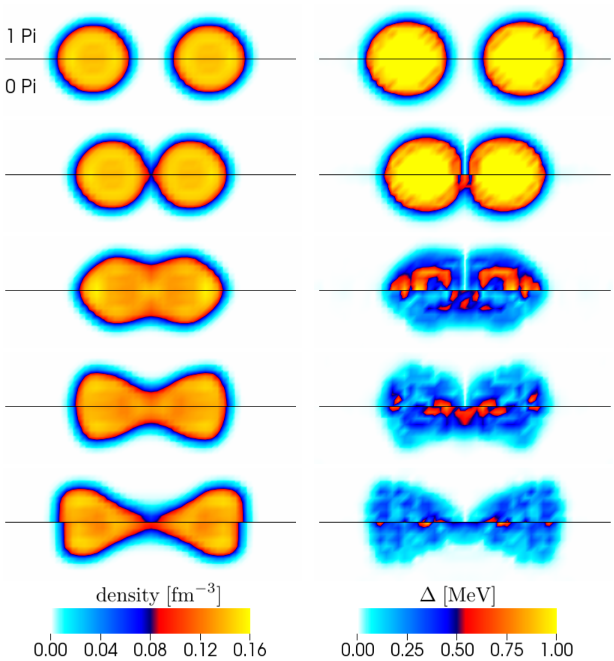

Figure 1: **Nuclear dynamics within TDSLDA:** Snapshots from the collision of ^{240}Pu+^{240}Pu at low energies. Left column displays the nucleon density distributions, whereas the right column shows the Cooper pair density distribution of two colliding nuclei. Top half of each snapshot corresponds to the collision with solitonic excitation created in the junction between two nuclei (right column).