Low-energy nuclear processes within Time Dependent Density Functional Theory

The project aims at the description of two types of nuclear processes within the fully microscopic method. The first one is the **nuclear induced fission of heavy nuclei**, which is an example of a complex process involving dynamics of hundreds strongly interacting, superfluid nucleons. The detailed understanding of the mechanism of this process and providing its microscopic description, capable of generating quantitative predictions concerning total kinetic energies and excitation energies of the fragments, fragment mass distribution and neutron emission, is crucial for energy applications and will shed light on origins of elements in Universe as well as the structure of the stars. The second kind of processes, which will be studied within the project comprise of various aspects of **nuclear dynamics in the neutron star crust**. It will allow for microscopic underpinning of large scale models of neutron stars, providing a better insight into such phenomena as glitch phenomenon, oscillation modes of neutron stars (e.g. r-modes) and dynamics of neutron star mergers.

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. Piz Daint at CSCS, Switzerland, Titan at Oak Ridge National Laboratory, USA).