N-BODY CORRELATIONS IN EXOTIC NUCLEAR SYSTEMS

One of the most active fields of the modern nuclear physics is the investigation of exotic nuclear systems, like proton/neutron rich nuclei by using radioactive beams and fission, or superheavy elements through fusion and α-decay processes. Most of these nuclei are weakly bound systems of few nucleons, coupled to a relatively more stable core. Two-body strong interaction in a nuclear medium get transformed into a **few body correlation** of strongly interacting nucleons like **pairing (N=2)** or **quarteting (N=4),** playing an important role in nuclear stability. Another exotic nuclear system is stellar matter, constituting the major baryonic component of massive objects in the universe, as exploding supernovae cores and neutron stars.

These aspects are analyzed by our project within three main work-packages:

WP1. Clusterisation: from finite nuclei to stellar matter

a) The first goal is to confirm that the α-decay and electromagnetic transitions in heavy nuclei, in particular ^{212}Po, can simultaneously be explained by using an α-clustering component in the nuclear wave function. Then, we shall extend the analysis to other heavy and superheavy nuclei.

b) The second goal is the investigation of chemical and thermodynamical properties of clusterized nuclear matter with temperatures between 0 and 20 MeV, isospin asymmetries between 0 (pure neutron matter) and 0.5 (symmetric nuclear matter) and densities in between 10^6 g/cm^3 and the normal nuclear density, relevant for supernovae and neutron stars. We shall elaborate an analytical model and derive the associated equations of states over the whole validity range.

WP2. Pair correlations of fissioning scission configurations

Our next purpose is to investigate the behavior of effective matrix elements derived from realistic interaction in the pairing channel at hyper-deformations and scission configurations, i.e. for systems composed by nearly touching nuclei behaving as nuclear molecules. We shall search for a possible existence of the "pairing polarization" between two nuclei in contact. The phenomenon will be investigated using two formalisms: the G-matrix renormalization technique starting from a realistic interaction and the effective density dependent interaction. The wave function will be obtained within the realistic super-asymmetric Woods-Saxon two center shell model. New knowledge about the total energy partition during scission processes will be provided.

WP3. Probing nuclear correlations by ternary emission processes

Another objective is to investigate two-body correlations in light exotic nuclei, by using simultaneous two-particle (proton or neutron) emission process. To this purpose we shall develop a general method to estimate the angular distribution of the three-body decaying system, as the main tool to probe the two-body correlations on the nuclear surface, in particular pairing interaction. Our approach will open the possibility to probe the realistic pairing interaction and to use two-body wave function on the nuclear surface for two-particle transfer reactions.