For near-barrier collisions of heavy nuclei it is very important to perform a combined (unified) analysis of all strongly coupled channels: deep-inelastic scattering, quasi-fission, fusion and regular fission. This ambitious goal has now become possible within our new approach. The standard (most important) degrees of freedom are used and a unified potential energy surface is derived determining evolution of the nuclear system in all the channels. This potential has also appropriate values of the Coulomb barriers in the entrance channel and proper values of the fission barriers in the exit one. A unified set of dynamic Langevin type equations is proposed for the simultaneous description of deep-inelastic and fusion-fission processes including nucleon transfer at all reaction stages. For the first time, the whole evolution of the heavy nuclear system can be traced starting from the approaching stage and ending in deep-inelastic, quasi-fission, and/or fusion-fission channels. The calculated mass, charge, energy and angular distributions of the reaction products agree well with available experimental data. Satisfactory agreement of the first calculations with experiments gives us hope to clarify much better than before the mechanisms of quasi-fission and fusion-fission processes. Also the determination of such fundamental characteristics of nuclear dynamics as the nuclear viscosity and the nucleon transfer rate is now possible.

Within the proposed model rather accurate and successful predictions have been made for the probabilities of superheavy element formation in near-barrier fusion reactions induced by $^{48}$Ca. This means that we understand correctly the main mechanisms of formation and decay of superheavy nuclear system. Prospects of forthcoming experiments with $^{50}$Ti beam on trans-actinide targets will be discussed in the talk as well as symmetric fusion reactions ($^{Xe}+^{Sn}$, $^{Xe}+^{Xe}$) bearing in mind future experiments with accelerated fission fragments.

Low energy collisions of very heavy nuclei (such as U+Cm) have been also studied within the proposed dynamical model. The multi-dimensional potential energy surfaces of the systems are rather complicated due to the shell effects and dynamic deformations, even if there is no distinct potential pocket. We found that at low near-barrier collision energies these very heavy nuclei, after touching their surfaces, may remain in contact rather long time. This time delay (up to $10^{-19}$ s) could significantly increase the yield of the so-called spontaneous positron emission from super-strong electric field of quasi-atoms by a static QED process (transition from neutral to charged QED vacuum). This effect was searched sometime ago at GSI but no clear evidences of it have been found. New experiments may be performed now based on our new knowledge of collision dynamics of these nuclei. Attempts to use the damped collisions of very heavy nuclei for production of chemically separated long-lived actinides have been also made about twenty years ago (Schädel, Gäggeler et al). The cross sections were found to be exponentially decreasing with increase of a charge number of heavier fragment, up to the level of 0.1 μb for production of Md isotopes in U+Cm collisions. A new effect, which we found here, is the inverse (anti-symmetrizing) quasi-fission process. In this process a superheavy nuclear system, say Th+Cf, travelling over the multi-dimensional potential energy surface, changes its mass asymmetry and may fall into the so-called lead valley. If Th comes to Pb, then Cf grows to the element 106. In spite of rather high excitation energy and low survival probability of residual fragments, this effect significantly increases the yield of nuclei complementary to lead and give us a new way for production of neutron rich (more close to the island of stability) superheavy elements in addition to the extensively used complete fusion reactions. These and some other prospects of subsequent theoretical and experimental studies will be discussed in the talk.