Abstract of PhD thesis: Dynamic description of low and middle energy nuclear fission

This dissertation is devoted to the study of the dynamics of induced and spontaneous fission in heavy and superheavy nuclei. Despite tremendous progress in theoretical nuclear physics, the fission process still contains many unsolved problems, the ignorance of which leads to incomplete and/or inaccurate interpretation of the available experimentally measured properties.

In the brief review of available theoretical methods and approaches presented here, an effective model based on the solution of a three-dimensional stochastic system of Langevin equations coupled to the Master equation is developed, which provides a description of the evolution of the surface of a compound nucleus in a three-dimensional deformation space containing the elongation, mass asymmetry, and constriction parameters. The main purpose of the calculations was to obtain and compare with available experimental data the distributions of masses, charges and total kinetic energy of fission fragments. The overall agreement between the empirical and theoretical data allowed us to assess the applicability of the hypotheses put forward in this work.The geometry of the nuclear surface was defined using a recently proposed Fourie shape parameterization, while the potential energy surfaces were calculated using the well-known macroscopic-microscopic approach.

The extensive discussions in the pages of this thesis focused mainly on the dependence of the obtained distributions on the excitation energy and the broadly understood boundary conditions. The model was then generalized to take into account the charge equilibration between the fission fragments and the particle evaporation mechanisms from the compound nucleus and the two fission fragments formed after fission. The master equation for the neutron width is represented by a Weisskopf type expression.

The fission characteristics obtained by the developed approach are in satisfactory agreement with the available empirical data for nuclei with Z in the range [92, 104], indicating, in general, a correct treatment of the fission phenomenon.