Fundamental Differences in Theoretical Approaches to Describing of the Observed Characteristics of Spontaneous and Induced Binary and Ternary (with the Emission of Nucleons and Light Nuclei as Third Particles) Nuclear Fission

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Widely used theoretical approaches [1] to the description of the observed energy, spin and angular distributions of the products of spontaneous and induced binary fission of compound fissile nuclei (CFN), although they take into account quantum mechanical concepts associated, for example, with the use of transition fission states of these nuclei [2], are largely macroscopic in nature, associated with hydrodynamic (liquid drop model of the nucleus taking into account shell corrections) and thermodynamic (Gibbs distributions taking into account various temperatures) characteristics of fission fragments. The developed in [3–4] approach, based on quantum mechanical consideration [5] of collective transverse bending and wriggling vibrations for prescission configurations of CFN, makes it possible to successfully describe the observed characteristics of binary fission products of these nuclei. The practical value of this approach is due to the fact that it allows one to calculate the characteristics of nuclear fission reactions with thermal neutrons used in nuclear power plants.

To describe the observed characteristics of spontaneous and induced ternary fission of nuclei, the presentations are used about the mechanisms of the emission of the third light particle from the CFN, both due to the influence of the nonadiabatic motion of fission fragments in the prescission configuration of this nucleus [6], and due to taking into account the three-particle interaction potentials of fission fragments and third particle [7]. In [8–11], the virtual mechanism of ternary fission was proposed, considered as a two-stage process, when in the first stage the third light charged particle with kinetic energy T_3, close to the height of its Coulomb barrier, is emitted from the CFN, with the formation of the virtual state of the intermediate nucleus, which at the next stage undergoes binary fission. This mechanism made it possible to successfully describe the observed characteristics of ternary nuclear fission.

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