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Study of fission dynamics at low excitation energies with the Langevin approach

The three-dimensional Langevin model is used to study the fission dynamics for uranium and plutonium isotopes at low excitation energies. Within the macroscopic-microscopic model, the potential energy surface is obtained by two methods which are that based on the two-center shell model and the finite range liquid drop model, and that based on the Fourier shape parametrization, the LSD model and the Yukawa-folded potential. The Werner-Wheeler approximation is used to calculate the inertia tensor and the wall-and-window model is applied to calculate the friction tensor. With the Langevin approach based on the two-center shell model, the influences of the nuclear dissipation and the neck parameter on the fission dynamics are studied, and then the mass distributions and the TKE distributions of the fission fragments for major actinide nuclei fission induced by neutron are calculated and the overall mass distributions are in agreement with the evaluated data from ENDF/B-VIII.0, which shows the predictive power of the model in the fission fragment mass distributions. In addition, the Langevin approach is extendedly applied to study the dynamical process of nuclear fission within the Fourier shape parametrization. The mass distributions and the TKE distributions in 14 MeV n + 233,235,236,238U and 239Pu fission are well described. Furthermore, the behavior of the correlation of the distance between the centers of mass of two fragments with the heavy fragment mass at the scission point is found to be consistent with that of the TKE distribution where the shortest R12 locates around Ah = 135 due to the influence of the shell effects.

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