Orbital Momenta of Fragments in Binary Asymmetric Fission of Actinide Nuclei

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The question of describing the orbital momenta of fission fragments (FDs) requires the use of quantum concepts about the dynamics of the fission process. This process always begins with the formation of thermalized excited states of a fissile compound nucleus in the first well of its deformation potential. The multiquasiparticle wave functions of these states include components associated with collective deformation vibrations of the fissile nucleus and the corresponding O. Bohr's transition fission states. It was demonstrated that during spontaneous and low-energy induced binary fission FDs near the scission point should be in cold nonequilibrium states. For the construction of FDs angular distributions, it is necessary to take into account only zero transverse wriggling – and bending – vibrations of the fissile nucleus [1]. The directions of FD emission from the fissile nucleus, according to O. Bohr's hypothesis, are close to the symmetry axis of the nucleus, which makes it possible to represent the amplitude of the angular distribution of fragments in the form of a smeared delta function determined by the coherent superposition of large relative orbital momenta of these fragments. The appearance of this superposition can be associated with the occurrence of zero collective transverse vibrations of pre-fragments in the vicinity of the scission point of the fissile nucleus, which leads to large values of the relative orbital momenta of the FD. It was obtained an analytical formula for estimating the average value and distribution of orbital momentum:

$$\overline{L} = 1/2\sqrt{\pi C_w}\,, \quad P(L) = (1/\pi C_w)\exp\left(-L^2/C_w\right),$$

where C_w is the coefficients of wriggling -vibrations [1]. Comparison of the distributions and average values of orbital momenta with the results of [2] gives reasonable agreement for the spontaneous fission of ^{252}Cf nuclei.

1. J.R. Nix *and* W.J. Swiatecki, Nucl. Phys. A 71, 1 (1965).
2. A. Bulgac, *et al.*, Phys. Rev. Lett. 128, 022501 (2022).