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MECHANISMS OF THE T-ODD ASYMMETRIES FORMATION IN REACTIONS OF TERNARY FISSION OF NUCLEI BY COLD POLARIZED NEUTRONS WITH THE EMISSION OF ALPHA PARTICLES

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It was proved [1] that P-even T-odd asymmetry in differential cross sections of nuclear ternary fission reactions by cold polarized neutrons with the flight of α-particles can be represented in common case through the sum of triple $\sigma_3(\Omega) = A_3(\theta)(\sigma_n[\mathbf{p}_{LF}, \mathbf{p}_\alpha])$ and quinary $\sigma_5(\Omega) = A_5(\theta)(\sigma_n[\mathbf{p}_{LF}, \mathbf{p}_\alpha])(\mathbf{p}_{LF}, \mathbf{p}_\alpha)$ scalar correlators, depending from spin σ_n of polarized neutron, oriented along the axis Y, momentum of light fission fragment $\mathbf{p}_{LF}$, oriented along the axis Z, and momentum of α–particle $\mathbf{p}_\alpha$ emitted in solid angle $\Omega(\theta, \varphi)$). Coefficients A_3 and A_5 are connected with sums of quantities $(\mathbf{p}_{LF}, \mathbf{p}_\alpha)^n = \cos^n(\theta)$ with even values *n*. For the case of α-particle emission in plane (Z,X) when $\varphi = 0$, this correlators are presented as $\sigma_3(\theta) \sim \sin\theta$ and $\sigma_5(\theta) \sim \sin\theta\cos\theta$ and satisfy the symmetry condition: $\sigma_3(\theta) = \sigma_3(\pi-\theta)$, $\sigma_5(\theta) = -\sigma_5(\pi-\theta)$. Then investigated correlators can be expressed through the coefficient of researched above asymmetry [2]: $D(\theta) = [\sigma_3(\theta) + \sigma_5(\theta)]/\sigma_0(\theta)$, where $\sigma_0(\theta)$ is the differential cross section of analogous reaction with cold polarized neutrons, as $\sigma_{3,5}(\theta) = 1/2\ [D(\theta)\sigma_0(\theta) \pm D(\pi-\theta)\sigma_0(\pi-\theta)]$ (1). Using experimental values $D^{exp}(\theta)$ and $\sigma_0^{exp}(\theta)$ for target nuclei ^{233}U, ^{235}U, ^{239}Pu and ^{241}Pu [2], the values of triple $\sigma_3^{exp}(\theta)$ and quinary $\sigma_5^{exp}(\theta)$ correlations were calculated. Taking into account the mechanism of the T-odd asymmetries formation, due to the influence of quantum rotation of the compound fissile system around an axis perpendicular to its symmetry axis on the angular distribution of fission fragments and α–particles, these correlators can be represented as $\sigma_3^{th}(\theta) = \Delta_3\left(d\sigma_{odd}^0(\theta)/d\theta\right)$, $\sigma_5^{th}(\theta) = \Delta_5\left(d\sigma_{ev}^0(\theta)/d\theta\right)$(2), where σ_{ev}^0 and σ_{odd}^0 are the components [1] of the differential cross section $\sigma_0(\theta)$, connected accordingly with even and odd orbital moments of α-particles, and Δ_3, Δ_5 are the effective rotation angles of $\mathbf{p}_\alpha$ relative to $\mathbf{p}_{LF}$. A comparison of the correlations from formulae (1), (2) allows to find the values of the angles Δ_3, Δ_5 by the χ^2-method, and using them to calculate the correlators σ_3^{th} and σ_5^{th}. The calculated angles Δ_3 are comparable with the angles obtained in the classical approach [2] and have a positive sign for all nuclei. At the same time, it is possible to achieve acceptable agreement between the correlators for ^{235}U, ^{239}Pu and ^{241}Pu, however, these correlators are very different from each other for ^{233}U. A reasonable agreement of $\sigma_5^{th}(\theta)$ and $\sigma_5(\theta)$ is observed for all nuclei, but the sign of Δ_5 is positive and coincides with Δ that is calculated in the framework of the classical approach [2], but when switching from ^{235}U, ^{239}Pu and ^{241}Pu to ^{233}U, the sign changes.The differences obtained above for the classical and quantum approaches of the studied T-odd asymmetries can be used in the analysis of the reliability of these approaches.

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