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HIDDEN VARIABLES IN ANGULAR CORRELATIONS OF FISSION PRODUCTS

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The hidden-variables (HV) theory was once put forward by opponents of the probabilistic interpretation of the wave function (EPR paradox). It was assumed that the state of the system could be predicted with a less uncertainty than this is admitted by the Heisenberg uncertainty principle, if one knew additional, that is HV. This theory is rejected by the community. However, examples can be given of how HV suddenly appear, for example, in modern simulations of the angular distributions of gamma quanta or neutrons emitted from fission fragments. This happens if one considers the spin of each fragment to have a definite direction in the plane perpendicular to the fission axis, and then averages over the directions of the spin in the azimuthal plane. In this way, the well-known phenomenon of the alignment of the spins of fragments in a plane perpendicular to the fission axis might be erroneously treated. Then the supposed direction of the fragment's spin appears as a HV. Contrary, in a consecutive quantum-mechanical approach, the state of the fragment is characterized by two quantum numbers: the spin and its projection onto the quantization axis z, which is along the fission axis. Then the alignment of the fragments merely means that the projection of their spins onto this axis is close to zero. And in the general case of incomplete alignment, it is necessary to use the density matrix.
A comparative analysis of experiments [1,2] on studying the (n, f), on one hand, and (n, n), on the other hand, angular correlations in fission is carried out, based on the model proposed by muonic conversion in fragments of prompt fission of 238U with negative muons. Their fundamental difference is shown in the sense of the information that can be inferred from them. To show this explicitly, and for the purpose of testing the experimental method, I propose an experimental check of the empirical relation between the alignment and polarization parameters, respectively:
AnJ = 2 Anf .
Among the other examples of use of HV, I point out the use of the immeasurable parameter ξ in the method of specific differences for the elimination of the Bohr—Weisskopf effect in the study of the hyperfine splitting in heavy ions of 209Bi [3].

1. A. Chietera, L. Stuttge, F. Gönnenwein et al. EPJ A 54, 98 (2018).
2. I.S. Guseva, in Proceedings of ISINN-23, Dubna, May 25-29, 2015, JINR, E3-2016-12 (Dubna, 2016), p. 80.
3. L. V. Skripnikov, S. Schmidt, J. Ullmann et al. Phys. Rev. Lett. **120**, 093001 (2018).

The speaker is a student or young scientist

No

Section

1. Experimental and theoretical studies of nuclear reactions

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