Numerical Study of the Non-Stationary Quantum Phenomena with Ultra-Cold Neutrons in 2D Dimension

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The report presents the results of theoretical study dedicated to the problem of ultra-cold neutron interaction with cylindrical potential well oscillating in space or moving with acceleration. A wave packet with parameters specific of ultra-cold neutrons was considered as a particle. The evolution of wave function was studied by numerically solving the time-dependent Schrödinger equation using the method of splitting the evolution operator. The spectra of the resulting state after the interaction of the packet with object were obtained.

In the case of an oscillating object, the calculation results show a pronounced splitting of the energy spectrum of the scattered state. The probability dependence of an energy quantum transfer on the direction of motion of scattered wave is demonstrated.

In the case of an accelerating object, calculations demonstrate a distinct change in the energy of the scattered wave, according to the description of the acceleration effect formulated as a general phenomenon in the work of A. I. Frank [1]. The obtained results can be the beginning of an approach to the theoretical study the problem of UCN dispersion in a medium moving with acceleration.

References:

1. A.I. Frank, Physics-Uspeckhi, 63, 500–502 (2020).