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New mechanism of phase enhancement in neutron interferometry and "exotic" interactions VLADIMIR GUDKOV, University of South Carolina — The possibility to search for anomalous "gravitational" interactions in neuron interferometric experiments has been recently considered for cold [1] and ultra cold [2] neutrons, where it was shown a very large contribution to the phase of neutron wave function from these anomalous interactions. To understand the origin of this phase enhancement, we consider one dimensional Schrödinger equation which describes neutron propagation through materials. It is shown that in many cases this Schrödinger equation can be transformed into Hill's equation, and/or, under some conditions, into Heun's and Mathieu's equations. The asymptotic solution of the considered equations shows that the contribution of weak exotic interactions to the phase of propagated neutrons is accumulated with a distance exponentially rather than linearly. This can lead to rather large enhancement factor for a contribution of these interactions into neutron phase. Using perturbation theory approach, one can see that this enhanced phase is also proportional to the value of neutron wavelength. This explains why one can see the phase enhancement only with very cold neutrons.

[1] G. L. Greene and V. Gudkov, Phys. Rev. C 75, 015501 (2007).
[2] V. Gudkov, H. M. Shimizu and G. L. Greene, NIM A (2009), in press.

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