Concerning the possible observation of the Acceleration Effect with UCNs

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The development of the concept of an optical phenomenon, called the Accelerating Matter Effect [1], led to the emergence of a hypothesis about the existence of a very general Acceleration effect [2]. As applied to the physics of the microcosm, its formulation is that the result of the interaction of a particle with any object moving with acceleration should be a change in its frequency ω and energy $E = \hbar\omega$. This change in frequency is determined by a simple relation

$$\Delta\omega = ka\tau \,, \tag{1}$$

where k is the wave number, a is the object acceleration and τ - interaction time. As an estimate of the latter, we can probably use the so-called group delay time (GDT), [3, 4].

$$\tau = \hbar \frac{d\varphi}{dE} \,,$$

(2) where φ is the phase of the complex amplitude of the wave that has experienced an interaction, such as scattering.

The validity of the acceleration effect hypothesis in quantum mechanics was recently confirmed in [5], which was devoted to the numerical study of the problem of the interaction of ultracold neutrons (UCN) with potential structures moving with acceleration.

If these ideas are true, then they can be fully attributed to the case of neutron scattering on the atomic nuclei of accelerating matter. It is easy to show that the GDT at neutron scattering on the nucleus is determined by a simple relation

$$\tau = \frac{|b|}{v} \,, \tag{3}$$

where b is the scattering length, and v is the neutron velocity. In the case of UCN $\tau \approx 10^{-15} s$. Since the interaction time is very short, the observation of the acceleration effect in scattering by accelerating nuclei requires that the nuclei move with a very high acceleration. This goal can be achieved if centripetal acceleration is used as the latter. Some estimates of the experiment of this kind will be given in the report.

References

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