A moving amplitude grating as time lens for novel UCN source

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The possibility of creating a new intense source of ultracold neutrons (UCN) on a periodic pulsed reactor was considered in [1]. It was shown that the implementation of the principle of time focusing [2], based on nonstationary neutron diffraction, in combination with neutron moderation, as well as the idea of pulsed filling of the UCN trap [3], make it possible to create a sufficiently intense UCN source. In [1], a phase diffraction grating moving across a neutron beam was proposed as a time lens.

Unfortunately, the diffraction efficiency of such a time lens decreases with increasing neutron energy. To increase the diffraction efficiency of the time lens for high neutron velocities (energies), we propose to use an amplitude diffraction grating instead of a phase grating. In our work, the diffraction efficiencies of an absorbing amplitude grating based on boron-10, natural gadolinium, and gadolinium-157 were calculated.

It was shown that in the case of using gadolinium-157 for neutrons with velocities higher than 14 m/s, there is a gain in diffraction efficiency of 2–3 times. The results of the calculations show that the gain in diffraction efficiency for neutrons with high velocities is possible with the use of isotopes with a large absorption cross-section.

References

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