The Concept of an UCN Source for Periodic Pulsed Reactor

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Since the discovery of ultracold neutrons (UCN) [1], a number of intense UCN sources have appeared in the world, and several more of them are under construction. There is no UCN source in Dubna, which is largely due to the peculiarities of the JINR IBR-2 pulsed reactor. Its average power of 2 MW is relatively low for creating a continuous UCN source. However, the pulsed thermal neutron flux of this reactor is very high, since the interval between pulses is hundreds of times greater than their duration.

Apparently, the only way to create a sufficiently intense UCN source at a pulsed reactor of moderate power is to implement Shapiro's idea of pulsed filling of a UCN trap [2] in combination with the principle of neutron focusing in time [3]. The first experience of the practical implementation of this idea is reported in [4].

Recently, the idea of pulsed filling of a UCN trap has been actively discussed in the literature. In recent works [5, 6], some approaches to the time focusing of neutrons and methods for deceleration very cold neutrons (VCN) to UCN energies have been analyzed. It was shown in [7] that when a flipper decelerator with a sufficiently high magnetic field is used, the resulting UCN flux should have a distinct pulsed structure even in the absence of a time lens.

The report discusses the concept of a UCN source based on a pulsed reactor based on a combination of a magnetic time lens and a magnetic resonance device that decelerate neutrons. Estimates of the expected neutron density in the trap are given. The proposed concept opens up the possibility of creating a UCN source at JINR with parameters corresponding to the modern world level.

1. V.I. Luschikov, Y.N. Pokotilovsky, A.V. Strelkov, F.L.Shapiro, JETP Letters 9 (1) (1969) 23–26.
2. F.L. Shapiro, PEPAN 2 (4) (1971) 975–979.
3. Frank A.I., Gahler R. Proc. of ISINN-4. Dubna (1996) 308; A.I. Frank and R. Gähler. Phys. At. Nuclei, **63** (2000) 545.
4. Y. Arimoto, P. Gertenbort, S. Imajo et al. Phys. Rev. A **86** (2012) 023843.
5. A.I. Frank, G.V. Kulin, N.V. Rebrova, M.A. Zakharov. Phys. Part. Nuclei **53** (2022) 33–44.
6. V.V. Nesvizhevsky, A.O. Sidorin. Phys. Part. Nuclei Letters **19** (2022) 162–175.
7. A.I. Frank, G.V. Kulin, M.A. Zakharov. JINR Comm. P3-2022-66, Dubna (2022).