

Referee report on «**Research activities** in the framework of the theme **Investigations of Neutron Nuclei Interaction and Properties of the Neutron, Status and Prospects** ».

This presentation includes **new results** obtained by Frank Laboratory of Neutron Physics since the PAC-50 meeting and analysis of further **prospects**. It covers studies of quantum phenomena with ultracold and cold neutrons, fundamental properties of the neutron, neutron-induced nuclear reactions, and applied research. FLNP has obtained important results and it clearly projects its activities into the future.

Thus, novel physical approaches and technological solutions are being developed for some key components of the future DNS-IV neutron source. Theoretical and experimental studies of the method of so-called **time-focusing of neutron beams** are essential for the development of sources of ultracold neutrons (UCNs), which could profit from the highest phase-space density/brightness of DNS-IV. Using this method, UCN densities in a properly designed UCN source could significantly exceed those in steady-state nuclear reactors of larger mean power. The development of the novel method of **efficient nano-diamond reflectors** for slow neutrons is crucial for building sources of very cold neutrons (VCNs) with record flux and density, as well as for efficient extraction, delivery and focusing of cold neutrons (CNs). FLNP is a key member of the CREMLIN+ sub-project on the development of a prototype VCN source based on nano-diamond reflectors. Such **VCN and/or UCN sources** installed at DNS-IV in the future or better already now at the IBR-2 reactor would provide so much needed possibilities for the current research program of FLNP, but also for qualitatively new class of experiments.

Impressive results have been obtained in measurements of P-odd asymmetries in reactions of **polarized neutrons with light nuclei**: three non-zero asymmetries in such reactions have been measured for the first time. Reactions with light nuclei can be described from "first principles" thus providing information about weak nucleon-nucleon interactions. This experimental program must be further developed. Reactions with heavier nuclei in resonances provide complementary information. They are also of high interest and should be studied at IREN. Intense studies of **T-odd correlations in fission** are going on, with important results and achievements. These reactions are, in particular, a source of unique information about the fission process, not accessible for other methods. To enhance experimental capabilities in studies of P-odd, T-odd correlations and other nuclear reactions, FLNP plans to build a (cryogenic) polarized nuclear target. It is important to establish reliable project plan for target construction. Systematic studies of fission, (n,γ) , (n,p) , (n,α) reactions with fast neutrons are of importance, with numerous motivations coming from astrophysics, atomic energy, nuclear data-bases, applications. Neutron-activation analysis has ever-increasing range of interesting and useful applications and be supported.

In conclusion: the quality of research carried out at JINR on the topic "research of neutron interaction with nuclei and neutron properties" is high, the plan contains clear goals for the coming years and deserves full support.

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