REVIEW

on the prolongation of JINR Theme 04-4-1143-2021/ "Scientific and methodological research and developments for condensed matter investigations with IBR-2 neutron beams" for the period 2024–2025 y

It is known that neutrons are used for conducting research in various fields of physical, chemical, biological sciences, materials science, archeology, and so on. Neutron sources, such as nuclear reactors, are unique scientific facilities where various setups, equipments, and devices can be installed on research channels, enabling fundamental and applied research. The IBR-2 nuclear reactor is one such facility, but with a unique distinction that allows for the use of pulsed neutron beams in research. It is clear that the organization and conduct of research require continuous improvement of existing facilities, as well as the development and creation of new facilities for research in actual scientific directions. Therefore, the scientific theme within the framework of the JINR topical plan **"Scientific and methodological research and developments for condensed matter investigations with IBR-2 neutron beams","** is dedicated to improving parameters, performance, and expanding the scope of their applications, as well as the development of elements and components of experimental setups.

The scientific research theme "Scientific and methodological research and developments for condensed matter investigations with IBR-2 neutron beams"," consists of three interconnected projects.

The first project, "**Development of a wide-aperture backscattering detector (BSD-A) for the HRFD diffractometer**" (scheduled for completion in 2024-2025), consisting of 7 planned tasks. These tasks involve the dismantling of the existing detector installed on the high-resolution Fourier diffractometer and the installation of the newly developed wide-aperture scintillation detector, $ZnS(Ag)/^{6}LiF$, for backscattering. The use of such a detector will allow for obtaining structural data with higher accuracy by reducing background noise and increasing statistical significance. Moreover, it will increase the number of experiments conducted.

The second project **"Vector magnet for investigations with polarized neutrons"** aims to improve the characteristics, upgrade, and add new capabilities to the REMUR polarized neutron reflectometer. The implementation of this project is driven by the increasing demand for research conducted at very low temperatures (1.5 K - 0.5 K) and high magnetic fields (above 2 T), which allows for the study of various properties of superconductors, ferromagnetics, and so on. The existing REMUR reflectometer at IBR-2 does not enable research at temperatures below 1.5 K or magnetic fields exceeding 1.8 T, and it lacks the ability to change the direction of the magnetic field. Within the framework of this project, a temperature control device will be developed to achieve temperatures down to 1.5 K. Additionally, a vector magnet will be created to allow for varying the magnetic field up to 3 T in the vertical direction and up to 1 T in the horizontal direction.

The third project, **"Development and improvement of infrastructure elements for spectrometers at the IBR-2 reactor"** is primarily dedicated to ensuring the efficient and reliable operation of 15 installations at the pulsed IBR-2 reactor. The project consists of 16 tasks aimed at modeling neutron scattering setups, improving the organization and conduct of experiments, enhancing the system for generating and transporting thermal neutron beams (moderators, choppers, neutron guides), improving the neutron detection system (proportional counters, 3He detectors), refining the automation and control system of mechanisms, software development, and more. Alongside other expected outcomes, it is worth noting the modeling of neutron guides at the NEPTUN reactor, which will provide insights into the feasibility of using neutron-absorbing materials (borated polyethylene) in spectrometers at the NEPTUN reactor. Overall, the successful completion of this project will ensure uninterrupted functioning of the installations, equipment, and experimental activities conducted at the IBR-2 reactor.

To carry out the theme, highly qualified specialists, engineers, and scientific researchers from the Neutron Physics Laboratory will be involved.

Based on this, I support the extension of the theme **"Scientific and methodological research and developments for condensed matter investigations with IBR-2 neutron beams"** planned for 2024-2025. The implementation of works within this theme will enable research on neutron scattering using setups with improved characteristics in the field of condensed matter investigations utilizing the IBR-2 reactor neutron beam.

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