

Review
of the new theme “Development of the Conceptual Design of a New Advanced Neutron Source at JINR” submitted for consideration to the PAC for Condensed Matter Physics

The purpose of the present Project is the study of conceptual questions in providing the beginning of works on creation of a new source of neutrons of JINR instead of the IBR-2M reactor which value by estimates is exhausted during 2035-2040. The solution of this task assumes preparation of both scientific justification, and the technical and economic assessment on a design of a new source of neutrons, including the neutron instrument park.

The essence of the problem at the moment is that two main types of modern neutron sources - stationary reactors and pulsed systems without fissile materials based on proton accelerators have practically exhausted the possibilities of increasing the neutron flux density, as one of the main factors determining the efficiency of a neutron source. Further growth of the neutron flux in the foreseeable future can be obtained by implementing one or another combination of reactor-accelerator technical solutions. Moreover, the experience of creating neutron sources of the latest modifications shows that the period from concept development to practical implementation, including the instrument park, can be more than a dozen years. Therefore, the formulation of the Project's task is highly relevant.

The spectrum of the considered solutions is quite wide, and the choice of the optimal one is rather difficult. This is due to the need to combine difficult-to-match, but of fundamental importance in terms of the essence of the scientific problems to be solved, the requirements for the source parameters. First of all, it is, on the one hand, the requirement of a high intensity of the neutron flux, and on the other hand, the provision of the possibility of obtaining a high energy resolution for neutron spectroscopy based on the time-of-flight technique. Spectroscopy, in turn, remains one of the “cornerstones” at the heart of the competitiveness of neutron methods in relation to techniques using synchrotron radiation.

Another fundamental point is the minimization of the background conditions; in the pulsed version of the source, this is just the minimization of the neutron flux emitted by target between periodic power pulses. This aspect is especially important if one considers that unique objects of research, or extreme conditions on a sample, assume its minimal geometrical dimensions, as it is realized naturally in experiments on the synchrotron radiation beams.

From the point of view of the efficiency of the neutron source, along with the circumstances noted, the timely study of the physical and technical parameters of the neutron moderators is important

All of the above aspects are well known to the theme leaders and key participants of the Project who have proved themselves as highly qualified specialists in this field of science. Without a detailed analysis of these and a number of other important aspects of the problem, it is difficult, if not impossible, to formulate the optimal technical solution for the design of a new neutron source. Thus, the volume and complexity of the work within the theme, i.e. the importance of its timely implementation and targeted funding in the framework of the proposed estimates is quite obvious.

It should be noted that for JINR, as an international organization in Europe and, in particular, Russia, the decision to create a neutron source of a new generation is inevitable and necessary. The launch, within the immediate historical perspective, of an international neutron center based on the PIK reactor in Gatchina (LD) requires consideration of the complementarity factor of pulsed and stationary neutron sources. Ultimately, the development of work on a new neutron source will strengthen the position of JINR among advanced research centres, both existing (ILL) and newly created (ESS project), in the field of neutron research in condensed matter physics.

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