Referee report on

«Научно-техническое обоснование на продление темы для включения в проблемно-тематический план ОИЯИ на 2020-2021 гг., шифр темы 03-4-1128-2017/2019; наименование темы «Исследования взаимодействия нейтронов с ядрами и свойств нейтрона», taking into account the reports on activities on this theme in 2017 and 2018.

The strengths of the scientific activities at JINR on the topic "Investigations of neutron interaction with nuclei and neutron properties" are the breadth of the spectrum of JINR facilities and methods, close cooperation with other leading scientific centers possessing commensurate capabilities, deservedly known in the world JINR achievements in this field, and well-founded and prepared future research and development plans.

Both the reports for 2017 and 2018, as well as plans for further research, combine, on the one hand, continuity of topics and approaches developed in previous years, on the other hand, reliance on new breakthrough methods and technologies that allow effective development. It is particularly interesting to consider this development in the context of the development of a new neutron source at JINR ("after IBR-2").

I recommend now, on the one hand, to pay special attention to research areas, which may be continued on a new neutron source and methodological developments that will be used building a new source (although I understand that forecasting in science for long time intervals is not always reliable), and, on the other hand, analyze how these research areas and methods may affect the design and parameters of the future neutron source.

More specific recommendations:

- IREN facility is going to meet important requests in the field of core activity at JINR, and significant efforts has been done to put this facility in operation. *It is important that the IREN accelerator starts working regularly on user experiments and interesting scientific results are obtained in the coming years;*
- JINR has proven the leadership in precision studies of the neutron beta-decay. Today, the emerging discrepancy between the results of "in-beam" and "storage" neutron lifetime experiments prompts new approaches and experiments. In this context, *it is important to make a reliable analysis of the advantages and drawbacks of the new proposed method for measuring the neutron lifetime and propose a realistic configuration for its implementation (probably with a significantly softer neutron spectrum).*
- JINR scientists first discovered UCN; also, JINR today has one of the best research teams in this field in the world. In this context, *it is important to do developments at JINR of UCN sources at IBR-2 both for IBR-2 and at the new projected neutron source.*
- Strong interest to sources of VCN and to experiments with VCN is observed in the world in the last few years. *A dedicated source of VCN based on the latest technologies in this field, developed with the active participation of JINR, can become the best in the world.*
- The study of nonstationary quantum phenomena by neutron-optical methods, as well as the study of the interaction of neutrons with accelerated matter and disordered nanostructures (nano-diamonds) can help develop key technologies for

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the design of a new JINR neutron source. *I recommend paying special attention to such applications*.

- The results of applied research carried out at JINR using a wide range of methods, starting with neutron activation analysis, produce a very deep impression. *I can only recommend them in every possible way to support and develop*.

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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Valery Nesvizhevsky,
Institut Max von Laue – Paul Langevin, Grenoble, France

6, Jules Horowitz - BP 156 - 38042 Grenoble Cedex 9 - France
tel: +33 (0)4 76 20 71 11 - fax: +33 (0)4 76 48 39 06
www.ill.fr - Siret 779 555 887 00016. NAF 731 Z. RCS Grenoble 79 555 887