Referee report for the extraordinary session of the PAC for Condensed Matter Physics for the assessment of related JINR projects

**Project: "Construction of a wide-aperture backscattering detector (BSD) for the HRFD diffractometer".**
Theme 1143, Project Leader V.M. Milkov for the period 2021-2023

**Introduction:**

This project concerns itself with a detector upgrade of the HFRD diffractometer. The HFRD diffractometer is an important instrument for the IBR-2 instrument suite. It is a continuation of the first stage of the project 2018-2020, which was successful in developing the technology and method of assembly for this upgrade. The project concerns itself with the replacement of the current backscattering detectors with a new version, with a much increased angular coverage. The new detector will be based upon a a novel scintillator detector design developed by FLNP. This design represents state of the art. The upgrade will represent a gain of a factor of 10 in solid angle coverage.

**Novelty, scientific impact and timeliness:**

To fulfil its potential IBR-2 needs continuous investment in its instrumentation as highest priority, with competitive upgrades. This upgrade represents a factor of 10 in performance. A factor of 10 in performance is an appropriate degree of ambition for every such upgrade. This performance gain will also allow smaller samples to be investigated on the instrument.

Additionally this upgrade will open up a wider wavelength range of operation for the instrument. This is terms opens up new possibilities in terms of scientific performance of the instrument.

As reviewed previously, the detector design represents state of the art, and has been well - designed. There is little capacity worldwide for building neutron detectors, and the expertise in neutron detectors at FLNP is highly valuable strategically.

The majority of the scientific impact from this upgrade will come from the enhanced performance of the instrument (leading to more and higher impact scientific investigations through future user experiments).

There is a secondary impact from the dissemination of the technological advances during this project (as expounded in sections 2, 3, and 4 of the questionnaire). However, it should be noted that the enhanced scientific output of the instrument will dwarf this in the long run. The dissemination thus far has been appropriate to such an upgrade.

Given that the 1st stage of the project has just been done, it is essential that this project continues on from the results of the first project.

**Expertise of team:**

Constructing such scintillator detectors is delicate, skilled and artisan work, and needs a project team suited to such work.

Over the course of the previous project a suitable team has been formed, trained and is now suitably trained to carry out this project. Such skills are rare, and can only be brought on-board with in-house training. The capability of this team is impressive. The range of skills match those needed to successfully carry out this project.

Now that the team is formed, it is important to keep the project moving forward. Any pause in it risks loosing these hard-gained skills from the project.

**Proposed project plan:**

The project plan as presented in the questionnaire, and as reviewed previously is realistic. The requested budget is appropriate to the work and not excessive.

**Summary:**

In line with previous reviews of this project, this is a project with the right level of ambition and scope. It will make a significant scientific impact, and enhance the output from IBR-2 significantly. The project is well-thought through and the project plans realistic.

Importantly, the team is ready, trained and working and it is important that this is not delayed, as any delay would mean significant risk placed on the outcome, because scintillator detectors are very much artisan work.

**Therefore, I recommend ranking this in the category A: an excellent project, which should be fully funded with adequate resources and encouraged to continue and expand their impact.**

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