Review of the JINR project
"Development of detector systems and particle identification methods for accelerator experiments"

The development of experimental particle physics occurs in two main directions: increasing the energy of particle beams (the energy frontier) and their intensity (the intensity frontier). These conditions lead to the requirements to use a new approach in the design of the particle detectors and detection methods, as well as the development of new data analysis methods. The main goal in the design of modern particle detectors is to ensure reliable operation and to provide necessary characteristics in very high very high luminosity conditions and in the presence of high magnetic field and high radiation background. The use of innovative construction materials is an important requirement that allows to achieve necessary performances in the particle detectors design.

The project under consideration is aimed specifically at the development of promising detectors and innovative approaches to detecting and identifying particles. Thus, the main goals of this project are both the development of detector systems for accelerator experiments and the creation of new innovative approaches to particle detection and identification. The project goals are aimed to solve current problems that exist both in experiments at colliders (NICA, HL-LHC, HE-LHC, and CEPC) and at accelerators fixed-target experiments at high and medium energies. In both cases the design of detectors should be radiation-hard to provide robust and effective operation in harsh radiation conditions. In addition, special requirements are imposed on detectors planned for use in conditions of high luminosity and/or high-energy beams.

The creation of new innovative electromagnetic calorimeters for modern experimental facilities is an urgent task in particle physics. The variety of searches in modern physics requires the development and creation of the new calorimeters that meet experimental requirements for the accuracy of reconstructing the energy as well as coordinates of particles and showers.

One of the most important parts of this project is also the detailed Monte Carlo simulation of electromagnetic calorimeters in various configurations in order to optimize their parameters. The development of this task is of great interest for various experiments, including the SPD experiment at the NICA collider and experiments at the future CEPC collider (China). Another important task is the development of precision analysis methods and the creation of software for studying polarized proton-proton, proton-deuteron, and deuteron-deuteron interactions, which are of direct interest for experiments at the NICA collider.

The presented project also involves solving important tasks at the stage of design and prototyping of detectors and readout electronics. In particular, within the framework of the project, it is planned to carry out work on the development of innovative gas detectors and the study of their parameters. Prototypes of electromagnetic calorimeters will be created using both organic scintillators and crystals. The front-end electronics for SiPMs will be developed and optimized for working with scintillators. The systematic study of detectors characteristics will be carried out in cosmic rays as well as in the charge-particle beams of the JINR and other HEP centers accelerators.

The project participants have extensive experience in designing calorimeters, performing simulations, and studying calorimeter parameters. The group members also have significant experience working with gas and scintillation detectors and front-end electronics. There is no doubt that the qualifications of the project participants correspond to the assigned tasks.

The financial request is adequate for the tasks set out in the project.

I recommend approving the project for five years, 2025–2029, with a high priority.

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18 April 2024