Answers to the reviewer's questions and comments on the project "Development of a particle registration technique in future experiments with the participation of JINR"

We are grateful to Professor S. Kuleshov for reviewing the project and his questions and remarks. We tried to answer the questions posed.

The name of the Project/subproject of the LRIP

A: The proposed project may look quite extensive, but it includes activities in those areas where we have already been working in recent years and have a fairly high level. All non- DLNP project participants have previously collaborated with us for several years. Now they will participate with us in a common project. They all have 0.1 FTU. In the future, as the project develops and there is a need to use equipment in VBLHEP, their FTE may increase. Of course, not all detector experts from DLNP are involved in the project. In the future, as the project develops, other detector experts will be involved.

2.1 Annotation

A: It seems we have not clearly clarified the issue of the effectiveness of the use of human and material resources.

We roughly divided the project into 6 tasks. In each direction we have several people involved. At the same time, almost every project participant is involved in performing 2-3-4 tasks. We need fewer people to complete the project's tasks and less equipment, because 2-3 experimental stands will be used to work with all detectors.

2.2 Scientific justification

Purpose of the project

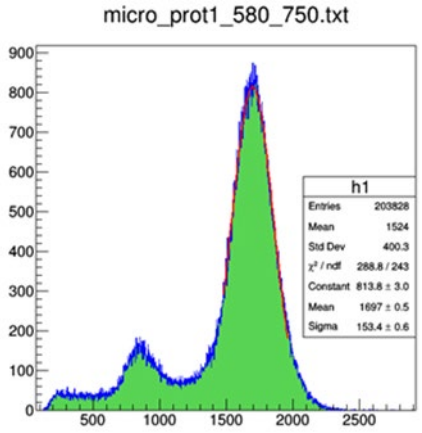
A: The tasks set in the project really correspond to the needs of the experiments. The problems of creating thin-walled straw detectors and comparing SRV systems based on scintillators of rectangular and triangular cross-sections were discussed at the Mu2e collaboration meetings and we stated that we plan to conduct R&D in these areas. The problems of modeling calorimeters for CEPC will be discussed with colleagues in the near future. Then, we think, new collaborating organizations will appear.

Methods and approaches, methodologies

I. Development of microstructure and straw gas detectors.

A: We have equipment for creating prototypes of short-length straw detectors. More advanced equipment is available from our colleagues at VBLHEP. We hope that this equipment, with minor modifications, will be sufficient for R&D. If, as a result of R&D, the question of mass production of detectors and new equipment arises, then this should be beyond the scope of this project

Micromegas and well-type detectors can operate in a quasi-proportional mode under certain conditions. The figure shows the spectrum from a small size well-type detector when irradiated with a ^{55}Fe X-ray source. Total absorption peak resolution (FWHM/E) is 21.2%.



II. Development, production and testing of prototypes of electromagnetic calorimeters.

A: Indeed, this part is not written entirely clearly. We plan to begin testing such a prototype on the Linac-200 electron beam and then on test beams at VBLHEP. We hope that test beams will be available at IHEP in Protvino. Currently we do not mention beams at CERN due to uncertainty.

Perhaps such a detector will be of interest for physical research on Linac-200 after its upgrade to 800 MeV. But it seems more likely that this type of detector will be in demand in experiments on CEPC.

III. Radiation resistance of materials and electronics

A: We worked closely with the CalTech team and now continuing to collaborate remotely. For several years, David Hitlin's group, together with JPL/FBK, has been trying to create a photodetector with reduced sensitivity to the slow component of BaF_2 luminescence. Several years ago we carried out two R&D projects for the same purpose. In one case, we used a multilayer filter on a quartz substrate to suppress the slow component, in the second, we used a photomultiplier with an AlGaN photocathode and microchannel plates for this purpose. However, we were not successful in this. Therefore, we returned to the well-known method of suppressing the slow component by doping BaF_2 crystals with rare earth elements, in particular yttrium. Such research

is also carried out by the group of Ren-Yuan Zhu from CalTech, we are in contact with him. We reported our results on the study of the radiation resistance of BaF_2 crystals at the "Workshop on the future muon program at FNAL" (CalTech, March 2023) and our result was mentioned in the summary talk.

IV. New scintillation materials for detecting thermal neutrons

A: Indeed, this activity somewhat falls outside the project's goals. This activity arose several years ago from a discussion of the possibility of reducing the sensitivity to gamma rays when detecting thermal neutrons. During this time, a small group performed a number of studies at low cost and published several journal articles. One of the group members has prepared a candidate of science thesis and plans to defend it by the end of this year.

The group plans to complete its activities in the field of composite scintillators within the next three years. Therefore, we proposed to include this activity in the project.

V. Optimizing the operation of scintillation detector systems

A: Indeed, many groups are interested in creating a scintillator+SiPM+front-end system with a time resolution of 40-50 ps. We are interested in this to solve our problems with crystals and plastics and WLS fibers. Some time ago, colleagues from the MPD approached us and asked us to join the work on creating a miniBB detector, which requires a time resolution of about 50 ps. We agreed to start this as R&D and this is an example of collaborative work.

VI. Development and application of Monte Carlo methods for modelling prototypes of electromagnetic and hadronic calorimeters

A: We are currently using our department's own computing capacity and we will be expanding the computing resources of the computer cluster. Of course, we have plans to use MLIT resources in the future.

Testing of calorimeter prototypes will be carried out in high-energy beams at VBLHEP and at IHEP in Protvino. If the cooperation between JINR and CERN continues further, we will also plan tests on beams at CERN.