

Referee report about Proposal for Project Extension during 2018-2020

Nikolay Kardjilov

Helmholtz-Zentrum Berlin, Germany

Proposal details

Title: "Novel semiconductor detectors for fundamental and applied research"

Proposed by: Dzhelepov Laboratory of Nuclear Problems (DLNP)

Project leader: G. Shelkov

Status: Suggested for extension till the end of 2020

Introduction

The proposal presents very successful collaboration between the DLNP at JINR and the Laboratory of Functional Electronics at Tomsk State University for developing and optimization of new type of position sensitive semiconductor detectors used in a wide range of fields of science and technology, from high-energy physics to computed tomography. The subject of the proposal is very general and it has an impact over a large number of scientific units like instrumental groups, large scale facilities, institutes and even international communities overcoming the borders of a local institutional project.

Nowadays the continuous development and optimization of hardware tools with outstanding parameters for experimental purposes is essential for meeting the demands of the scientific community. Sensors with larger areas, higher sensitivity and faster output contribute to the progress of different experimental methods and provide advantages in many scientific and industrial fields. In some cases the development and optimization of one single component is sufficient to influence a wide range of experimental methods. A good example for this is the subject of the current project where a semiconductor detector with improved characteristics is developed for multipurpose utilization in beams of different elementary particles like electrons, protons, heavy ions, neutrons and photons.

The main impression from the proposal is that it closely follows the criteria of evaluation as discussed below.

Criteria 1: *Scientific merits, elements of novelty, timely nature of the research*

- The Project aims at carrying out paramount advanced developing work in the field of semiconductor detectors for elementary particles, directed to the creation of new type of detectors which allow for position sensitive registration of radiation fluencies with a high spatial and temporal resolution under a high dose. The combination of all these features makes the new type of detector unique in the field of high-energy physics and related applications.
- By its very nature, the Project is multidisciplinary. Its subject area includes a wide spectrum of investigations underway at JINR because the institute possesses a large number of installations that allow testing of detectors in beams of different particles, from protons and neutrons to heavy ions. The close scientific relations with almost all world centers of high-energy physics allow, if necessary, to carry out such beam tests at any accelerator in the world.
- The unifying features of all experimental methods using the new detector system are benefiting from the high readout speed, excellent spatial resolution and enormous radiation hardness of the innovative sensor.
- The definition of the problem-oriented applications and tests of the new detector is done in agreement with the leaders of research groups in the collaborating JINR Laboratories, both as it concerns the in-house research and the participation in outer large scale experiments.
 - o Striking examples concerning condensed matter physics and medicine are related to microtomography applications for analysis of composition of ores and minerals, abdominal aortic aneurysms and atherosclerotic vascular damage.
 - o Examples related to high-energy physics where pixel detectors were applied in experiments with hypernuclei and relativistic ions on the Nuclotron.
 - o The DLNP participation in the Medipix-4 collaboration which currently includes the Berkeley National Laboratory, CEA, CERN, the Czech Technical University, DESY, the Diamond Light Source, JINR, NIKHEF, the universities of Houston, Canterbury and Maastricht gives the chance to be prepared in advance for the development of future applications using chips from new generation of microcircuits based on technological process of 65 nm.
- Of special concern within the Project will be the creation of efficient infrastructure at JINR for assembly and testing of the detector modules. Important parts of this infrastructure are the existing already Station for detector calibration “Kalan”, Probe station based on EPS150TESLA, Station for measuring charge collection efficiency, Installation for ultrasonic microwelding and Station for assembling of hybrid pixel detectors. For the next term of the Project (2018-2020) this infrastructure will be extended by Site for characterisation of hybrid pixel detectors and Site for microtomography.

- By completing of the initiated infrastructure at DLNP it would be possible to implement the complete technological chain for the production and test of such detectors on the territory of the Russian Federation

Criteria 2: *Expertise of the group and technical feasibility of the project within the proposed timescale*

- The existence of adequate expertise of the basic staff of the Project is probed by the existing high level of qualification of the DLNP personal, the established infrastructure and the archived excellent results in the first term (2015-2017) of the project.
- The planned goals in the second term of the project (2018-2020) are realistic and correspond to the expertise of the DLNP staff.

Criteria 3: *Compliance of the requested financial resources with the objectives of the project/theme*

- The requested financial resources fully comply with the objectives of the Project.

Criteria 4: *Availability of human resources at JINR and in the collaborating institutions*

- The existing human resources are of good quality, the DLNP is an attractor for young talents, both from Russian institutions and from JINR Member State institutions.

Conclusions

- In conclusion, I estimate that the proposed tasks are well formulated, are ambitious, they are directed to the development of unique equipment for the needs of the JINR and external outstanding scientific partners, they are feasible.
- I propose the CMP-PAC to approve the support of the Project extension on 2018-2020 with the first priority.

Date

08.06.2017

Signature


Dr. Nikolay Kardjilov