Opinion on the project

"New Semiconductor Detectors for Basic and Applied Research"

Currently, semiconductor detectors are increasingly used worldwide for both fundamental and applied research in various fields of science, as well as in the production of equipment to be utilized in various areas of activities (for example, in engineering and medicine). However, in Russia there is a significant backlog in the use of semiconductor detectors for the development of domestic measurement systems and experimental stations, which is largely due not only to the backwardness in the elemental microelectronics base, but also to the lack of the necessary development of detectors adapted for various applications.

Over the past 20 years, JINR has accumulated considerable experience in the development and use of semiconductor detectors, mainly for conducting experiments in particle physics and nuclear physics. The accumulated experience is expressed in the appearance of new technical developments and the establishment of broad scientific and industrial contacts with many Russian and international organizations and enterprises. At the moment, in Russia a technological base for production of semiconductor sensitive elements from several semiconductor materials is established. These are silicon detectors of various topologies produced by the Institute of Materials Science (Zelenograd), gallium arsenide detectors of SPhTI (Tomsk), thallium bromide detectors from GIREDMET (Moscow), arsenide gaseous detectors doped with rare-earth elements of MIET (Zelenograd) and a number of other developments.

The proposed for prolongation Project, already during its implementation in 2015-2017, has made significant progress towards its goals. A wide range of scientific and methodological studies were carried out: systematic comparison of the radiation hardness of several semiconductor materials, the development of a procedure for the energy calibration of Timepix detectors, measurements of transport characteristics and long-term stability of GaAs:Cr sensors, study of the response of hybrid pixel detectors to the passage of heavy charged particles. Several scientific articles based on the results of these studies have been published, or are ready for publication. The research infrastructure of the DLNP JINR was substantially extended: a test bench was constructed on the basis of the Cascade Microtech probe station for measuring the properties of semiconductor materials, the Kalan measuring station for calibration and study of the response of X-ray detectors, a test station for measuring the charge collection efficiency, an ultrasonic micro-welding device for mounting detectors on printed circuit boards and their repair, and the MARS microtomograph (especially software) has been improved. Applied research was carried out, mainly with the use of the MARS microtomograph, in the field of medicine and geology: on the identification of radiocontrast substances, on the microstructure of atherosclerotic plaques and abdominal aortic aneurysms, and on the analysis of the composition of ores and minerals.

The project extension is focused on the further development of semiconductor technologies at JINR. Project program offers the openning of new trends in scientific and methodological studies (search for methods of increasing radiation hardness of detectors based on GaAs:Cr, particle identification in the pixel detector), the development of detector assemblies for new applications (registration of neutrons, a polarimeter for polarized deuteron source), the enlargement of the circle of investigations in applied studies (with creation of another microtomograph with a higher spatial resolution of 5-7 microns), the development of analytical software for the conducted studies. All the proposed areas of research and development are currently relevant and in demand.

The Project asks for the minimum necessary equipment to perform the work. The team of authors has good experience in precision calorimetry, coordinate detectors, X-ray microtomography and is quite capable of fulfilling the tasks set in the Project.

I recommend that DLNP Scientific and Technical Council support this Project in full as the JINR First Priority Project.

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