Project review

" Novel Semiconductor Detectors for Fundamental and Applied Research"

(*Project Leader: G. Shelkov, DLNP-JINR)*

The proposed project is aimed at solving methodological and technological problems associated with the development and creation of a new type of coordinate ionizing radiation detectors – hybrid pixel devices (sensors). The sensitive elements of those are made of silicon (Si), gallium arsenide doped with chromium (GaAs: Cr) and telluride cadmium (CdTe).

The relevance of the project was due to the fact that at present, on the basis of hybrid pixel detectors, calorimetric and coordinate systems of experimental facilities are being created with high energy and spatial resolutions, as well as with good speed. In addition, detectors developed for experiments in particle physics also find application in medicine and applied research. So sensors based on wide-gap semiconductors (GaAs: Cr, CdTe), which have high detection efficiency of γ-quanta with energy of ~ 50 keV, can be used to visualize X-ray images (X-ray tomography). Due to the small pixel size and single photon counting mode, these detectors make it possible to determine the structures of various objects with high spatial resolution (< 1 mm) at a low noise level.

In fulfilling of the complex of studies in 2017-2020 the team obtained the following main results:

- The radiation hardness of GaAs: Cr and Si detectors was studied on electron beams with an energy of 20 MeV (LINAK-200 JINR accelerator). It was shown that at room temperature GaAs:Cr detectors retain their operating characteristics at absorbed dose of 1.5 MGy, while Si detectors almost completely degrade.

- As part of the FCAL international collaboration, the work on creation of compact electromagnetic calorimeters capable of performance in fields of high radiation burden near a high-luminosity beam. Interest in these studies resulted from structural plans of future electron-positron colliders (ILC, CLIC, etc.). The JINR DLNP group is developing a calorimetric module based on Si sensor and readout electronics, as well as testing electron beam equipment in DESY.

The authors' achievement is the development of a detection devices that consist of a GaAs:Cr sensor and unique hybrid pixel chips as part of the international Medipix collaboration. As mentioned above, such devices make it possible to obtain coordinate, energy, and timing information about the registered particle in accelerator experiments with high accuracy, and they can also be widely used in the development

of medical equipment. It must be pointed out that participation in the Medipix collabration allowed the JINR DLNP group to access the technical documentation that is necessary for conducting its own development using such registration systems based on the latest chip of this series - Medipix4. The most important planned results of the project should include the development of a prototype computer medical tomograph (MT) based on hybrid pixel detectors, also the creation of a complete set of software for controlling the operation of the MT, processing and visualization of scan results.

The results within the context of the work are widely known to the Russian and foreign scientific community. The project has high scientific and practical importance and makes a significant contribution to the development of a semiconductor nuclear radiation detection technique.

Based on the foregoing, I believe that the presented project could be successfully implemented, the financial costs of the project are justified, and it certainly deserves full support and extension.

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