

Report on the project “Nanostructures and Nanomaterials”

The project represents a continuation of the research activity within the JINR Theme 01-3-1137-2019/2023 “Theory of Complex Systems and Advanced Materials” in the Bogoliubov Laboratory of Theoretical Physics (BLTP) for the next five-year period 2024-2028. The main goal of the project is understanding of the fundamental properties of two-dimensional systems and structures with only a few atomic layers, including analysis of topological superconductivity and Josephson junctions in heterostructures.

The project specifies its scientific novelty and relevance in the analysis of wide variety of physical characteristics in order to identify the most prospective ones in view of their practical importance in the design of new electronic devices for storage, processing and transmission of information, different type of sensors and other equipment in the field of nano-electronics, spintronics, photonics etc. The project briefly describes 4 principal directions of their planned research.

It is important that the general approaches of the theoretical research are based on well-established concepts of quantum solid state and statistical physics, physical kinetics. The calculations will be carried out on the basis of standard computing packages in quantum chemistry, molecular dynamics and others.

In spite of relatively concise formulation the project outlines its scientific merits, elements of novelty, timely nature of the research. The continuity with the previously supported JINR Theme is evident. The project inscribes well in the Seven-Year Plan for the Development of JINR in 2024-2030 and should fully contribute to the general success of JINR.

The enlisted group of the researches to be involved in the project, including well-qualified staff and younger scientists and trainees, makes good impression on their expertise in the field. The available technical means in the BLTP secure the advances in the calculation domain of their research ensuring feasibility of the project within the proposed time-scale. The collaboration with several Laboratories at JINR is of helping assistance to the declared goals of the project. It only remains surprising that Frank Laboratory of Neutron Physics is not present among local collaborators despite clear expertise and interest of its scientists in the project area.

The planned combined effort with science centres in Russia and Belorussia, international cooperation with the institutions from the JINR member countries as well as with the other worldwide organizations will certainly augment confidence in the positive output of the project.

The project does not explicitly request excessive funds going beyond the listed personnel costs and existing computation resources so that its budget may be considered as fully compliant with the objectives of the project.

In view of important expected output and sound impact within the frame of general research at JINR in the next five-year period I can propose that the PAC-57 recommends supporting the present project that should be fully funded with adequate resources.

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