Report on the project „Studies of Baryonic Matter at the Nuclotron“ (BM@N) for years 2022-2026

The study of heavy-ion collisions is a hot topic in particle physics, which examines the basic laws of the microworld. The obtained knowledge is increasingly interconnected and supplemented with new information gained in astronomy and cosmology. Extreme density nuclear objects are common in space. Neutron stars or the QGP in the early stages of the universe are special cases. The properties of dense and hot nuclear matter are analysed in the acceleration experiments, in heavy-ion collisions at high energies. These experiments aim to obtain the most accurate image of QCD dense mass in the representation of the equation of state (EOS) and the QCD phase diagram. This knowledge gained in terrestrial laboratories is of key importance for understanding the processes that are part of the evolution of the whole universe.

For these reasons, the study of heavy-ion collisions is a highly important topic, to which due attention is paid in the world's leading laboratories. CERN (SPS, LHC/ ALICE), USA (BNL/RHIC), Germany (GSI) and more are being prepared. It is a topic that has a strong tradition in Russian laboratories. The upgrade of the BM@N experiment in JINR is therefore an important step in obtaining new results at a beam energy of 2-4GeV / nucleon, which will significantly deepen our understanding of the processes in the nuclear matter under extreme conditions.

The annotation submitted by the PAC consists of several parts. The introductory chapters clearly and convincingly summarize the physical arguments for the experimental program. The main part (chapter 3) is devoted to a detailed description of individual components of the apparatus and the operation of all detectors, including simulation studies and software for physical analysis.

Technical runes in the years 2016-2018 with beams D, C, Ar, Kr and a set of nuclear targets were very successful and give a very good assumption of reliable operation of the entire apparatus with a high degree of kinematic resolution and identification of produced particles and nuclei.

In Chapter 4, the risks of problems that may occur during the project implementation are realistically evaluated. Some delays cannot be ruled out however, successful completion of the project is highly likely.

The estimated costs (Chapter 5) of 3670kUS $ for the years 2022-2026 are, in my opinion, reasonable and will ensure the continuation of the experiment.

It can be recalled that the experiment was already mentioned at previous PAC meetings with a very positive evaluation.

Another 12 laboratories, 8 Russian and 7 foreign are participating in the experiment designed and implemented at JINR. The project lists 115 participants from JINR, another 60

from Russia and 46 from other laboratories outside Russia. The successful implementation of the experiment can significantly increase the prestige of JINR.

Based on all the above arguments, I can recommend that the project be supported with the highest priority.

Petr Zavada

Prague, March 10, 2021