Referee report on the project

Compressed Baryonic Matter (CBM): JINR participation

One of the main scientific goals of FAIR (Facility for Antiproton and Ion Research) project is to study the nuclear matter properties at the high baryonic densities in heavy ion collisions. These investigations will be focused on the study of QCD phase diagram of strongly interacting matter in the region, where the coexistence phase of ordinary nuclear matter and quark-gluon medium is expected. The FAIR energy range corresponds to the high baryonic densities at moderate temperatures. Such conditions differ significantly from the conditions of LHC, where high temperatures at low densities in heavy ions collisions are reached. Therefore, the studies at FAIR will be complementary to the investigations at the existing colliders.

CBM (Compressed Baryonic Matter) experiment is devoted to the third generation of the experiments in heavy ions collisions. This experiment will concentrate on the high statistics measurements of the rare probes, such as open and hidden charm, dileptons, multi-strange particles etc., which can provide the information on the first stage of nuclear interaction. The "unlimited" statistics expected for nucleons, pions and strange particles will allow to obtain information on the bulk of observables with high precision. In this respect, the studies at CBM will be complementary to the investigations performed within BES-II at STAR at RHIC or planned at MPD at NICA.

For these purposes CBM collaboration proposed the fixed target experiment with large acceptance setup, which is able to measure different probes of nuclear interaction dynamics. The detector consists of superconducting (SC) dipole magnet, micropixel vertex detector (MVD), silicon tracker system (STS) , ring imaging cherenkov counter (RICH), muon system (MuCH), transition radiation detector (TRD), resistive plate chambers, electromagnetic and zero-degree calorimeters.

Within CBM project JINR takes the responsibility expertise of the Superconducting Dipole Magnet and magnetic and stresses calculations. JINR takes part in development of new methods and algorithms for simulations, processing and analysis of experimental data for different basic detectors of CBM as well as on the CBM data bases. JINR participates in the simulation of the physics processes in heavy ion collisions: light nuclei and hypernuclei production, charmonia production in di-electron and di-muon channels, pion spectra at high transverse momenta. JINR participates in R&D of straw detectors for CBM muon detector MUCH as well as of segmented scintillation detectors to improve the reaction plane determination.

JINR has already made a significant contribution at the first stage of CBM project in LoI, CDR, preparation of the TDRs on Superconducting Dipole Magnet and muon detector MUCH. 2021-2025 yy. is a period of CBM Construction, when the detector should be assembled and commissioning should started. On the

other hand, CBM has extended PHASE0 program with existing beams: participation in BES-II at STAR(RHIC), in RICH detector at HADES (GSI), in silicon detector at BM@N (VBLHEP-JINR). Mini-CBM setup is prepared at GSI for the beams in 2021-2023 yy. JINR physicists are also participate in the data taking and analysis of the obtained results within CBM PHASE0.

It is very important that CBM together with ALICE, NA61 and STAR experiments are included in the current 7-years plan for the development of JINR and in the perspective plan for the development until 2030 y. Such approach provides systematic study of the QCD phase diagram at different nuclear matter temperatures and densities. Close cooperation of CBM and BM@N/MPD in silicon trackers and software within Germany-Russia Road Map reflects the pragmatic approach in collaboration with FAIR. The key role of the Laboratory of Information Technologies in this project allows to follow high standards in the development of the algorithms for the fast event selection and data treatment as well as in the ability of JINR group to take a serious part in the future analysis of big data volume expected from CBM experiment.

The requested from JINR budget resources are reasonable. The qualification of the authors is high to fulfill the JINR obligations. It should be noted, that the active participation of JINR peoples in CBM project and their access to new hardware and software technologies is crucial for the realization of BM@N and MPD projects at NICA.

I strongly recommend to approve this project with the first priority for 2021-2025 yy.

Prof. Yu. A. Panebrattsev
E-mail: yuri@intergraphics.ru