

## **Review of the JINR Project**

“CMS Compact Muon Solenoid at LHC/ Upgrade of CMS Detector Through 2020”,

Topic 02-0-1083-2009/2022

CMS is large, general-purpose detectors for observation of very high-energy proton-proton collisions at the Large Hadron Collider (LHC). This facility is well operated at CERN, the European Laboratory for Particle Physics near Geneva, Switzerland.

The long-term activity of JINR (till 2019) within the CMS Project is focused on the design, construction, integration, and installation of new ME1/1 (First Forward Muon Station) electronics; start-up, maintenance, and development of ME1/1; construction, calibration and start-up new HE (Endcap Hadron Calorimetry) electronics and SiPM. This job is elaborated by the highly qualified team of JINR physicists at Dubna and by the well performed project. It is worthwhile noting that JINR in the frame of RDMS CMS collaboration participates in upgrade of detector sub-systems, where bears full responsibility since the very beginning of the CMS Project for Forward Muon Stations ME1/1 and endcap hadron calorimeters HE, and also participates in R&D necessary for preparation of further upgrade at Phase II. The ME1/1 Forward Muon Station of CMS is the most critical in the forward region that is necessary to enable the full performance of all the LHC discovery potential. ME1/1 operate in strong axial magnetic field and at highest in muon system background rate.

The program of JINR's researches in the CMS project is a very extensive and promising. The program envisage physics studies in various areas of particle physics: Standard Model and Beyond. Much of the investigation works are devoted to refining on the Standard Model parameters and to strong restriction of model parameters of so-called New Physics.

Top priority is given to systematic studies of processes with the hard muons in the final states that have a status of the first priority task of the Russia and Dubna Member States (RDMS) CMS Collaboration. This full-scale research covers the range of physics studies from verification of the Standard Model of fundamental interactions up to search for new physics phenomena beyond the Standard Model (signals from extended gauge models, physics scenario with extra dimensions, etc.).

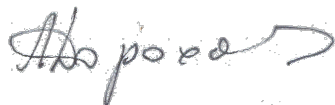
Continued participation in the advanced CMS research program, that necessary to maintain and increase, the physics potential of the experiment for operation at  $1-2 \times 10^{34} \text{cm}^{-2}\text{s}^{-1}$  and full energy of

LHC up to  $\sqrt{s} = 14$  TeV, provides for further development of research works, continuation of theoretical analysis and simulation of processes under study, development of data processing and analysis scenario, beginning the data taking, event reconstruction and data analysis with expected integrated luminosity up to  $300 \text{ fb}^{-1}$ . Also, the operation works to ensure the well-functioning of the detector system will remain active. Deep and careful analysis and consideration of all stages of the project as well as the involvement into the project of the physicists from almost all JINR Laboratories: VBLHEP, BLTPh, LIT, DLNP should be noted. It needs also to point out wide international cooperation, including Germany, Uzbekistan, Ukraine and other participants.

The quite important topic of the project is participation of the JINR and RDMS-DMS team in CMS Upgrade Phase 2. The physics reach of the LHC will be ultimately defined by the integrated luminosity delivered to the experiments. Exploiting the full potential of physics at the LHC, which includes upgrading its luminosity, is the highest priority of the CMS Collaboration. Development of CMS detector with valuable JINR team activity to be able to cope with the high luminosity running of LHC, luminosity leveling at  $4\text{-}5 \times 10^{34} \text{ cm}^{-2} \text{ s}^{-1}$ , and integrated luminosity up to  $1\text{-}3 \text{ ab}^{-1}$  (attobarn physics). The high luminosity running of LHC is expected to enter into operation after LS3, but R&D is required right now in order to develop adequate detectors for Endcap calorimetry at high luminosity.

Generally the JINR Physics Program in CMS is a very ambitious and of great importance for JINR participation in modern physics researches at the frontier. The financing resources requested for the realization of the proposed program will fit entirely the assigned task without any doubt. The project deserves every encouragement and complete approval. All planned tasks are carried out and the project is completely fulfilled.

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