

JINR Project
«Participation in CMS detector upgrade up to 2020»
Review.

JINR team (physicist and engineers) is taking part in Compact Muon Solenoid project (CMS project) for the last 25 years, from the very beginning of the experiment concept development. Collaboration includes a number of JINR member states including Russia (RDMS – Russia, Dubna member states). JINR is planning and coordinate the work of all the participants and institutions of RDMS. Forward Hadron Calorimeter (HE) and Forward Muon Stations (ME) were developed and put in operation. JINR team is fully responsible for maintenance and operation of these systems. JINR teams takes part in central shifts dedicated to data acquisition from beam-beam collisions at the LHC and remote shifts for Data Quality Monitoring. They are also performing data processing and physics data analysis. CMS detector allows for verification of physics theories and for searching of a new physics, which was not predicted by the theory. I would like to mention here main physics results where RDMS collaboration physicists were significantly involved in the analysis.

- A new particle with 125 GeV mass was discovered, which is Higgs boson.
- A searches for gravitons and new Z' (similar to electroweak Z boson) states were performed. A limit on possible masses of Z' particles was found to be: $M > 4$ TeV.
- A measurement of the Forward-Backward asymmetry (A_{FB}) value was performed.
- A limit on the masses of the microscopic black holes was found to be $M > 9$ TeV.
- Hardware element's radioactive hardness was studied.
- Experimental software was developed.

It is important to mention that Higgs boson observation is admitted by the scientific community to be an excellent result. It is frequently cited by the world wide media. CMS experiment has good hadron jets energy resolution and high hermeticity for searches of supersymmetric particles and physics beyond Standard Model.

JINR pledges for the Phase 1 upgrade are being successfully fulfilled and will be done by 2020.

After LHC Phase 2 upgrade in 2026 it will start working at high luminosity - $5 \times 10^{34} \text{ cm}^{-2} \text{ s}^{-1}$. Hardware loads and radiation doses will increase 5 times. Because of that a task to upgrade detector hardware was set for CMS and RDMS collaboration to be able to work at high luminosity.

In the JINR team application reviewed there are following tasks were set up for the R&D to be prepared to the phase 2 upgrade for the period of up to 2020.

- Cathode Strip Chambers upgrade.
- High Granularity Calorimeter and it's electronics development.
- Chambers and calorimeter radiation hardness studies.
- A study of the possibility to construct a set up to assemble scintillating modules by RDMS collaboration. A development of photodectors based on silicon PEM.
- Software development.
- Physics program development for the studies with HL-LHC.
- Detectors and electronics certification for work at high radiation loads.

JINR application approval will allow to prepare for the CMS systems upgrade if JINR will take responsibility for participation in Phase 2 upgrade (calorimeter and muon detector). It will enable to perform new important studies at high luminosities and nominal beam energies. The feasibility of the upgrade is obvious as in the long term it will bring new generation of physicists and young talented scientists and engineers and will allow them to make an important contribution to the science and technics development. It is important to mention that there are many JINR laboratories are involved in the project: LHEP, LNP, LIT, LTP and many JINR member states: Armenia, Belorussia, Bulgaria, Georgia, Ukraine.

Scientific importance and competitiveness of the project is high enough. Project authors qualification is confirmed by the successfully fulfilled obligations of the previous phase of the experimental program.

Resources requested by the JINR team are adequate to the tasks set up.

I recommend PAC to approve JINR project prolongation up to 2020 with first priority.

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