

Referee report

on the project

Upgrade of the ATLAS detector

(within the JINR theme 02-0-1081-2009/2023)

The ATLAS detector has been developed and constructed with large scientific, technical and budget investments from the JINR side. The important contributions were done in different detector systems: muon detector, liquid-argon and tile calorimeters, in development of trigger, DAQ and other systems. Since the start of the measurements, excellent performance of the detector made it possible to obtain outstanding world-wide known physics results.

CERN has approved the staging of the LHC upgrade program, with Phase-I in 2019-2020 and Phase-II in 2024-2026. The LHC upgrade requires a relevant upgrade of the ATLAS detector in order to conform to conditions of much higher luminosity leading to increasing detector rates and occupancy. Besides, irradiation of some parts of the detector during the years of the ATLAS operation results in partial degradation of their performance.

The JINR group actively participates in the ATLAS upgrade. In the project under consideration, the authors report on results obtained in 2017-2019 and present their further plans in the ATLAS upgrade program. These plans include mainly upgrade of the Calorimeters and the Muon Spectrometer.

Works on calorimetry.

Most of works on upgrade of the calorimeters concerns its electronics. The new finer granularity scheme of the LAr calorimeter required an upgrade of the calorimeter trigger electronics. A baseplane for the Hadronic Endcup Calorimeter (HEC) readout crate was developed and produced. The JINR team also participated in the development of the Trigger Digitizer Boards and digital processing system.

A test bench was created for testing the HEC analog schemes and production of the prototypes. Two other test benches will be built in the forthcoming years for Phase-II upgrade of the LAr readout electronics: one is for testing of the “cold” preamplifier prototypes, another one is for optical and mechanical tests of the optical fiber patch cords.

The JINR group is involved also in development of the new readout electronics for the Tile hadron calorimeter. There was produced so-called Demonstrator – a prototype with full-featured upgraded electronics. It passed a series of improvements and finally showed a good performance.

Many different tests were fulfilled using the beams of U-70, CERN, DESY as well as multiple important irradiation tests at the IBR-2M reactor.

Another big field of activity is upgrade of the ATLAS Muon Spectrometer.

The JINR group has constructed the workshop for production of Micromegas detectors and for the quadruplet assembly. Micromegas detectors will be used in the New Small Wheels in the endcup Muon Spectrometer. Since 2017 mass-production of the Micromegas chambers has started. Up to now 45 readout panels and 12 quadruplets have been produced (out of 64 and 32, respectively, for which the JINR group is responsible) and partly delivered to CERN. After the production, the geometrical parameters are measured, gas tightness checked and electrical tests performed.

Another line in the created workshop comprises a complete cycle of Micromegas chamber production of size up to 55x80 cm². This line is used for R&D and may be utilized for production of the detectors for other experiments in the Institute.

It is worth to mention that the JINR team participates in development of safety and radioprotection technology. The GaAsPix monitors allow to measure the neutron induced activity and the neutron fluence at the ATLAS detector. With the new GaAsTPX detectors, new background parameters will be accessible.

Concluding, the JINR group has done already a big job on upgrade of the ATLAS detector. The project participants have great experience and good reputation among the physics community. That leaves no doubt that further plans of upgrade presented in the project will be fulfilled.

The request for resources seems reasonable.

I recommend approving the project “Upgrade of the ATLAS detector” with the first priority.

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