Referee report on the project

Upgrade of the ATLAS Detector

Theme 02-0-1081-2009/2019

The scientific programme of the LHC will continue up to 2035 and include an ambitious series of upgrades that deliver instantaneous luminosity about L=5–7.5×10^{34} cm^{-2} s^{-1}. This will allow ATLAS detector in turn to enhance the ability to measure the properties of the Higgs boson, improve the measurements of other Standard Model (SM) processes, and extend the potential for discovery of physics beyond the SM.

Such a scientific program requires higher statistics and improved detector characteristics allowing operation at a harsh radiation environment. In addition, it is also worth noting that many of the detectors are already old and will be approaching the end of their lifetimes.

The JINR team has well defined responsibilities in the Phase-I detector upgrades, which include the replacement of chambers in the forward muon spectrometer, the upgrade of the calorimeter trigger electronics and the installation of new Level-1 trigger processors.

The existing LAr calorimeter trigger information based on the concept of a “Trigger Tower" that sums the energy deposition across the longitudinal layers of the calorimeters in an area of Δη×Δφ=0.1×0.1 will be changed by a new finer granularity scheme based on so-called “Super Cells", which provide information for each calorimeter layer for the full η range of the calorimeter, as well as finer segmentation (Δη×Δφ=0.025×0.1).

Now, a much larger number of signals are transferred from the Front-End Boards to the LAr Trigger Digitizer Boards than are currently used in the trigger chain. Several prototypes of the Hadronic Endcap Calorimeter shaper were made based on CMOS technology and during preliminary tests show good non-linearity behavior.

Upgrade of the ATLAS Muon Spectrometer consists in replacing the Small Wheel with a New Small Wheel (MicroMegas detectors) due to a serious limitation on the ATLAS performance beyond design luminosity: reduced acceptance of good muon tracking, and an unacceptable rate of fake high pT Level-1 muon triggers coming from the forward direction.

The JINR team is responsible for the production and testing of the 64 (+4 spares) RO panels and 32 (+2 spares) quadruplets. By November 2019, 45 RO panels and 12 Quadruplets have been produced and its geometrical characteristics (thickness and planarity) of each panel tested, PCB top-bottom alignment measured, gas tightness and basic electrical tests also performed. Unfortunately beam tests not yet performed. Ten Quadruplets were sent to CERN.

The radiation hardness tests of the multilayer PCB's made of different materials including G10, FR4, Rogers, Arlon 85N and Kapton were continuing successfully at the IBR-2M reactor.

The project presents a well-balanced plan with clearly defined responsibilities of the JINR team in key aspects of the ATLAS upgrade program. The requested resources are adequate to the planned tasks.

Therefore, I would like to support continuation of the JINR team participation in the Upgrade of the ATLAS Detector for the next 3 years.

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