Referee report on the project

ATLAS detector upgrade and physics at LHC

JINR staff members have been actively involved in the ATLAS experiment since the very beginning of its planning and operation. During the period 2019-2025, within the framework of the implementation of the ATLAS experiment physics program, a number of results were obtained and published with the defining contribution of JINR staff members. In particular, a new upper limit on the Higgs boson coupling with charmed quarks was established, high-precision measurements of the Higgs boson production cross-section in gluon fusion and vector boson fusion channels were carried out, new constraints on possible masses and cross-sections of quantum black holes were obtained, the parameters of pentaquark states with hidden charm were measured etc.

In 2019-2025, JINR employees took an active part in the creation of various subsystems of the ATLAS detector, in particular, 32 quadruplets of the small muon wheel were manufactured and put into operation, infrastructure for the new Micromegas technology was built, trigger electronics units were developed, a prototype of an instrumental stand for the new High Granularity Timing Detector (HGTD) was manufactured, prototypes of strip panels for Resistive Plate Chamber (RPC) were manufactured as well. JINR employees took an active part in the development and support of the experiment software and operation of the facility.

In the proposed project “ATLAS detector upgrade and physics at LHC” in the period 2026-2030, it is planned to continue the participation of JINR employees both in the program of upgrading the detector, its individual subsystems, and in data analysis and writing articles on behalf of the collaboration.

In 2026-2030, the work on the detector upgrade in Phase-2 is expected to be completed. The JINR group plans to manufacture four instrumental stands for HGTD. The development and creation of service communications and a control system will be continued for this subsystem. More than 300 patch cords for LAr (Liguid argon calorimeter) will be manufactured and tested. The obligations for the RPC system to create gas supply system and low-voltage power supply will be fulfilled.

In 2026–2030, it is planned to continue studying the physics of the Higgs boson, in particular, to obtain new constraints on the anomalous Yukawa interactions of top quarks, measure the coupling constant of the Higgs boson with charmed quarks, and carry out new precision measurements of cross sections in various Higgs boson

production channels. The JINR group also plans to perform a number of measurements of the properties of heavy mesons and new exotic hadrons with four and five quarks, as well as obtain new results on the violation of CP invariance in the decays of heavy mesons. It is also planned to expand participation in software development.

There are some concerns about the further development of participation in CERN experiments. These concerns are related to the restrictions currently adopted by CERN for JINR in terms of registering new users, fully involvment of young employees and students in work and research. Positive shifts in resolving these issues would be very useful.

There are also difficulties with the export and transfer of equipment to CERN, additional efforts are required for its customs clearance. Bank transactions have become seriously complicated. It is desirable to have more certainty in terms of payment of obligations.

The funding request for the project under consideration for 2026–2030 is based on the estimated cost of the authorship fee, the costs of fulfilling the obligations under the Memorandum of Understanding signed in 2019, and the costs of staff visits to ensure that the institute fulfills its obligations under the collaboration. Thus, the request for funding is well-justified.

In my opinion, the project under consideration allows JINR to continue its participation in the ATLAS project at a significant level both in terms of contributions to the modernization of subsystems and in performing experimental data analysis. The financial request is duly justified.

Therefore, I recommend the proposed project for implementation with the first priority.

Professor Eduard Boos,
Member of PAC