

## **DESCRIPTION FOR THE GENERAL PUBLIC (IN ENGLISH)**

The CMS (Compact Muon solenoid) experiment is one of two general purpose experiments at the Large Hadron Collider (LHC) at CERN, near Geneva, Switzerland. Due to high energy provided by the accelerator and high beam intensity it is necessary to select events for further analysis with a trigger. In the CMS there is a two level trigger. The Level-1 trigger is implemented in customized hardware devices. It selects high-energetic events using the coarse data from the muon system and calorimeters. The maximal event rate provided by this selection step must not exceed 100 kHz. Selected events are forwarded to large computer farm where the data from the whole CMS are reconstructed with full granularity. The selected events are stored for physics analyses performed offline.

The most important result provided by the CMS, so far, is the discovery (shared with ATLAS experiment) of mysterious Higgs particle, which was hunted for half of the century. The discovery of the Higgs particle is a milestone for understanding how the fundamental particles acquire a mass. In the current year the LHC accelerator, after two years of maintenance, was put back into operation. The higher energy provided by LHC and the expected large increase in provided luminosity since 2016 give CMS a possibility for the realization of ambitious and wide physics program, provided the existing trigger system is deeply modernized. Clean and effective triggering on muons is one of biggest assets of CMS. The Polish group from Warsaw, as a constructor of one of Level-1 trigger subsystems (PACT), is playing an important role in CMS trigger community. The PACT was working smoothly in 2010-2013 and in 2015.

Currently Warsaw Group is taking part in the upgrade of the muon trigger system, providing important contribution to the physics potential of the CMS experiment. Warsaw Group is responsible for the modernization of the overlap region, placed at the boundary of CMS barrel part and endcaps. Under the support of Polish NCN research grant (ID 240373) "New muon trigger for Compact Muon Solenoid (stage 1, 2014-2016), which ends in July 2016, we have built the first version of the trigger. The system has already properly registered first muons. Within the scope of this proposal we are asking for the funds for the second stage of the project. In particular we would like to purchase the remaining missing components of the equipment, optimize the system performance by further development of algorithms defined during stage 1 of the project and, first of all, to apply the constructed system for realization of CMS scientific plans.

New muon trigger system in the overlap region will use signals from all types of muon detectors in CMS. The developed algorithm compares the registered muon track in the event with the prepared set of predefined patterns, what allows us to assign kinematics to the registered muon track. The most important element of the built system is the trigger board, equipped with the high capacity programmable processor, in which the algorithm is implemented. Preparation and optimization of algorithms consists of the simulation task, implementation in firmware and tests of the system. For the proper operation of the system the online software is needed in order to configure it, and monitor its performance. Furthermore recorded data must be analyzed. While the data taking will take place in the CMS experimental environment, the further system development and tests should take place in dedicated test framework in CMS test hall.

The discussed new muon trigger system should replace the legacy system, including PACT, already in 2016. The project proposed here supports the continuation of active participation of Polish group in the CMS trigger system project. The system developed by us has direct impact on CMS data taking, improving the selectivity and efficiency of the CMS trigger in more rigorous environment given by the upgraded LHC. The newly constructed system will select data used by all muon-based analyses of rich CMS physics program. The developed algorithms will allow a collection of much cleaner sample, and consequently will increase the relevance of the experiment results. This has particular meaning for Higgs particle studies. The significance and novelty of the issues for fundamental research, which the elementary particles physics is a part of, is emphasized again by the award of this year Nobel Prize. Proposed studies enable the Polish group to participate in pioneering discoveries and highlight the important contribution of Polish science to international research cooperation.