

Abstract for general public of the project proposal *Generic searches for the extended scalar sector with the ATLAS experiment at the LHC*

The proposed project aims at conducting searches for physics phenomena from beyond the so-called Standard Model (SM) of elementary particles. SM is a physics theory that governs the subatomic world of fundamental constituents of the Universe and their interactions and has proved to describe most of the experimental results over the last 50 years. However, the current state of knowledge indicates that some processes from beyond the SM should occur at very high energies, although their expected rates are low and hence easy to miss in the overwhelming spectrum of phenomena that are currently experimentally accessible. The Higgs boson postulated by the SM was discovered in 2012 by the ATLAS and CMS experiments. However, theories that go beyond the SM typically require an extended Higgs sector implying existence of additional scalar bosons.

Within the proposed project we plan to search for those additional Higgs bosons which can be electrically neutral or charged. The project will be carried out with the ATLAS experiment at the Large Hadron Collider (LHC) at CERN. LHC is the largest experimental device ever constructed. It consists of a 27-km long underground tunnel which contains a ring of superconducting magnets with a number of accelerating structures. Its main goal is to accelerate proton beams to unprecedented energies and to collide them in four designated points, instrumented with devices measuring basic properties of outgoing particles. Data collected by one of them, the ATLAS detector, will be used in this project.

The amount of already-collected data gives a unique opportunity to search for processes occurring with very low probabilities. The possible extension of the SM examined in the current project assumes the existence of additional Higgs bosons, two heavy neutral counterparts to the already-observed SM one and two charged ones. Such hypothetical bosons will be searched for in their decays into tau-tau, b-b and tau-neutrino pairs. Another possible but still unobserved process, to be examined in this project is the production of pairs of SM Higgs bosons. Observation of such events may suggest the existence of an exotic object, such as an additional scalar or a graviton, which would decay into the Higgs boson pair and enhance the production rate over the very small one predicted by the SM.

The expected results of the proposed project depend on the actual properties of the Universe. Finding evidence for an extended Higgs sector would make an outstanding discovery. On the other hand, excluding ever larger areas of parameter space available to beyond SM scenarios is of paramount importance. In either case, the boundaries of our knowledge are extended.