

## **Supervisor's opinion on the dissertation**

Author of thesis: Mgr. Babar Ali

Title of thesis: „Search for the Standard Model Higgs boson produced in association with a top quark pair in multilepton final states at  $\sqrt{s} = 13$  TeV with the ATLAS detector“

Supervisor: doc. Ing. Ivan Štekl, CSc., IEAP CTU in Prague

Supervisor-specialist: doc. Dr. André Sopczak, IEAP CTU in Prague

The dissertation deals with a very important issue of today's particle physics, a search for the Standard Model Higgs boson produced in association with a pair of top quarks in multilepton final states using dataset (an integrated luminosity of  $36.1 \text{ fb}^{-1}$  from period of 2015-2016) collected by the ATLAS detector at a center of mass energy of  $\sqrt{s} = 13$  TeV.

In introductory part author precisely defined the aim of dissertation such as performing a search for the  $t\bar{t}H$  production in multilepton final states from data set of 2015-2016, estimation of the tau trigger performance in Run-2 (author's qualification task for ATLAS experiment) and luminosity study using ATLAS MPX network based on pixel detectors.

Thesis is divided into 7 chapters and 6 annexes. First chapter gives a brief overview of the Standard Model, Higgs boson and top quark. Second chapter covers the Large Hadron Collider and the ATLAS detector including the reconstruction and identification of physics objects in ATLAS. Third chapter presents the study of the Medipix-2 silicon pixel devices used for luminosity monitoring in the ATLAS. Next chapter (No. 4) provides the performance of the ATLAS tau trigger in Run 2. Fifth chapter described the main topic of this thesis, the search for the  $t\bar{t}H$  production in multilepton final states including background estimation and study of systematic uncertainties. The results of the analysis performed in previous chapter are summarized in chapter 6. The results obtained by author of dissertation are included in chapters 3, 4, 5 and 6. In annex (page 165) the author's contribution is explained.

The obtained results are based on the data from the ATLAS experiment, on activities of author's qualification task to ATLAS community (performance of the ATLAS tau trigger) and on data processing provided by the ATLAS MPX network.

The dissertation is performed on an excellent level. I appreciate the combination of tasks of different types, such as application of phenomenological models, data processing from experimental devices, software development, simulations, statistical analysis and physical interpretation of results. I would like to highlight the fact that the results obtained by the author in chapter 4 were the basis of his admission to the ATLAS collaboration as a full author. The formal layout of the dissertation is fine, the language level (thesis is written in English) is very good. Babar Ali proved independence in solving assigned tasks and fulfilled all goals of the dissertation. The results obtained have the potential for long-term use in LHC experiments.

Babar Ali is listed as an author or co-author in 4 articles in prestigious journals that are listed in the WOS database. Furthermore, the author of 1 paper at international conference.

Finally, I note that the professional work of PhD student Babar Ali in solving the scientific issue is at a high level, the subject of thesis is highly up to date in both theoretical and practical terms. On the basis of the facts mentioned above, I recommend to award Mgr. Babar Ali by Ph.D. degree.

9. 1. 2020

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Doc. Ing. Ivan Štekl, CSc.