Supervisor's report on PhD thesis

Thesis name: Measurements of top-antitop quark pair differential cross-sections in the all-hadronic channel using highly boosted top quarks with the ATLAS detector
Author: Ing. Petr Jačka

This thesis deals with the study of differential cross-sections of the top-quark pair production in the ATLAS experiment at the LHC. Such precise measurement serves as the detailed test of quantum chromodynamics at the large energy scale and has a potential to see the physics beyond the Standard Model.

The author of this thesis contributed significantly to two physics analyses devoted to differential cross-section measurements of the top quark pair production in the all-hadronic boosted channel. In the first measurement (published in Phys.Rev.D 98 (2018) 1, 012003), the author contributed mainly with the development of the 'ABCD method' for the data-driven estimation of the major background. In the second measurement (published in JHEP 04 (2023) 080), which involved four times more data and numerous improvements, Petr was the leading analyzer. He contributed to almost all steps in the analysis chain, starting from the production of input samples, and continuing with the optimization of the event selection, performing the unfolding, estimating systematic uncertainties, and interpreting the measurement within an effective field theory framework. This measurement serves as the basis for this thesis. Within the analysis process, the author was very active and demonstrated his ability to solve problems independently and proactively.

Apart from the work on the physics analysis itself, the author of this thesis contributed significantly to the ATLAS experiment. Petr is the official member of the ATLAS collaboration. This was granted to him based on his work on the fast calorimeter simulation of the ATLAS detector. This also resulted in the public ATLAS note with Petr being one of the primary authors (ATL-SOFT-PUB-2018-002). Moreover, Petr contributed significantly to the service work within Top quark working group. He served there as the 'Analysis software manager' (taking care of the common software development), the 'Boosted jets liaison' (responsible for common software related to 'boosted top tagging'), and also as the 'MC production coordinator' (responsible for generation of simulated samples).

Petr presented his work at numerous meetings and conferences. Mostly, these were internal ATLAS meetings. Typically, this involved presentation of results at weekly analysis working meetings. However, there were also presentations at various ATLAS internal meetings with larger audience involving the top quark or jet experts. Moreover, Petr presented his work at a few international conferences and workshops, namely TOP2017(poster), LPCC Detector Simulation Workshop 2017(talk), LHCC2018(poster), LHCP2020(talk), and TOP2021(poster).

In summary, my assessment of the work of the author of presented thesis is very positive. I state that the goal of the thesis was met. I am deeply convinced that the author fulfilled the requirements which are placed on the submitter of the dissertation thesis. I recommend the author is granted with a PhD degree after a successful thesis defense.

Prague, 28.3.2024

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