



Elementary Particle Physics

has the honor to invite you to the public defense of the PhD thesis of

Shimaa Abdelwahed Abuzeid Hassan

to obtain the degree of Doctor of Sciences

Joint PhD with Ain Shams University

Title of the PhD thesis:

Search for top quark Flavour Changing Neutral Couplings
with the CMS Experiment at the LHC

Curriculum vitae

Shimaa obtained her master degree in experimental nuclear physics from Ain Shams University in 2011. With an Erasmus Mundus grant, she started her PhD study in elementary particle physics at the VUB in 2013. At the LHC she performed the first analysis on top-FCNC at 13 TeV for the search of the tqH coupling with di-lepton final states. Beside this she was involved in the b-tagging group of the CMS collaboration where she shared work in developing algorithms used for b-quark identification. This work is published. Also she became a technical shifter at the CMS detector with the responsibility to control CMS subsystems during the operation time of the LHC machine.

Promotors:

Prof. Jorgen D'Hondt
Prof. Magda Abd El Wahab (Ain Shams University)

The defence will take place on

Wednesday June 27 2018

at the Ain Shams University (Egypt)

Members of the jury:

Prof. Freya Blekman (chairman)
Prof. Alberto Mariotti (secretary)
Prof. Manal Mahmoud Sirag (Ain Shams University)
Prof. Pascal Vanlaer (ULB)
Prof. Benjamin Fuks (Sorbonne University, France)

Abstract of the PhD research

The top quark plays a key role to search for new physics phenomena beyond the standard Model of particle physics. Being the heaviest particle in the Standard Model (SM), physicists believe that it has an enhanced sensitivity to various new particles and interactions suggested by theories Beyond the Standard Model. One of interesting possibilities is the presence of flavour-changing neutral current (FCNC) interactions between the top quark and the Higgs boson. The observation of a SM-like Higgs boson by the ATLAS and CMS experiments in 2012 initiated the study of these FCNC interactions.

In the SM, FCNC interactions of the top quark are suppressed. However, many theories beyond the SM predict the existence of these processes with higher branching ratios, where some are within the reach of the current experiments. This thesis concerns an experimental research at the Large Hadron Collider at CERN for FCNC interactions involving a top quark and a Higgs boson with a signature of two leptons in the final state with equal electric charge. The analysis is done using data of proton collisions collected in 2016 by the CMS experiment at a center-of-mass energy of 13 TeV and an integrated luminosity of 36fb^{-1} . We probe for the FCNC interactions in top-quark pair decays as well as in the single top quark production through Hqt-couplings, where the quark q is either an up-quark or charm-quark. No significant deviation with respect to the predicted SM background is observed. The expected (observed) upper limits at 95% CL on the branching ratio are $B(t \rightarrow cH) < 7.0 \times 10^{-3}$ (6.8×10^{-3}) and $B(t \rightarrow uH) < 6.7 \times 10^{-3}$ (6.1×10^{-3}). These thesis results have been endorsed by the CMS collaboration.