

Abstract

This thesis contributes to the area of top physics with the measurement of the top pairs (t-tbar) production cross-section via strong interaction in proton-proton collisions at the LHC.

The aim is to measure the t-tbar production cross-section in the semi-leptonic decay channel with in the final state a hadronically decaying tau lepton (t-tbar \rightarrow τ + jets). This represents one of the most challenging experimental final state, due to the difficulty of reconstructing and identifying the hadronically decaying τ and due to the presence of more than one neutrino as the source of missing transverse energy (E_{miss}^T). The final state contains various additional jets, two of them originating from a b -quark. Jet reconstruction with precise jet energy scale estimation and efficient and well calibrated tagging of b -quark jets constitute other challenging experimental issues.

The measurement is done using 2.05 fb^{-1} of LHC data produced at the center-of-mass energy of $\sqrt{s} = 7$ TeV, collected by the ATLAS detector during 2011.

The cross-section is extracted with a profile likelihood fit of the transverse mass of the leptonically decaying W, combining the information of the 1-prong tau, 3-prong tau and electron channels. The cross-section in the tau and electron channel can vary independently. Systematic uncertainties are implemented as nuisance parameters in the fit and are constrained by the data improving the precision of the measurement

The result of the t-tbar \rightarrow τ + jets cross-section measurement is :

$$\sigma_{\text{t-tbar} \rightarrow \tau + \text{jets}} = 205 \pm 11 \text{ (stat)} \pm 39 \text{ (syst) pb.}$$

It is compatible with the result of another measurement of the t-tbar \rightarrow τ + jets cross-section at $\sqrt{s} = 7$ TeV done with a with a sample of 1.7 fb^{-1} and based on a very different technique. Our measurement achieves a better precision with a relative error about 30% smaller. Both measurements are compatible with the theoretical calculation. We measured also the cross-section in the t-tbar \rightarrow e + jets channel, which resulted in the value of

$$\sigma_{\text{t-tbar} \rightarrow \text{e} + \text{jets}} = 178 \pm 14 \text{ (stat+syst) pb ,}$$

in good agreement with the ATLAS combined measurement in the electron and muon channels. The ratio of the t-tbar cross-section in the electron and the tau + jets channels is measured to be $0.86^{+0.13}_{-0.11}$ compatible with 1 as expected in the Standard Model.

As future perspective, we discussed possible improvements of the method developed in this thesis that could be achieved with a higher statistics sample like the 25 fb^{-1} of 8 TeV data.