Conclusion

The results of two analyses, both measuring the $t\bar{t}$ production differential cross section in the *lepton+jets* decay channel, have been described. The events considered have been collected at the LHC accelerator by the ATLAS experiment during *pp* collisions.

The first analysis has been performed with the full 2011 dataset corresponding to an integrated luminosity $\mathcal{L} = 4.7fb^{-1}$ at a center of mass energy $\sqrt{s} = 7TeV$. The backgrounds have been estimated via Monte Carlo simulation and by using *data*-driven techniques. The cut-based event selection requires one high p_T isolated lepton, the presence of significant missing transverse energy indicating the presence of a neutrino and at least four jets, one of which tagged as a b quark. A likelihood kinematic fit has been used in order to reconstruct the $t\bar{t}$ system. In order to further enhance the efficiency and purity of the reconstructed signal, a likelihood cut has been applied. The

single value decomposition (SVD) unfolding method has been applied to remove the acceptance and the resolution effects of the detector, giving the possibility to compare the results with the theoretical predictions, by unfolding data at the *parton level*. A detailed analysis of the sources of systematic uncertainties has been performed finding the Jet Energy Scale as the dominant one. The relative differential cross sections $\frac{1}{\sigma}\frac{d\sigma}{dX}$ have been measured as a function of the mass, p_T and rapidity of the $t\bar{t}$ system and of the p_T of the top quark. The results have been compared with NLO and NLO+NNLL theoretical calculations and MC generator predictions from Alpgen, MC@NLO and Powheg, finding a good agreement. In this measurement, I followed the whole analysis chain, specifically concentrating my efforts on the implementation of the unfolding techniques and the estimation of systematic uncertainties. The results have been already validated by the ATLAS collaboration and a public conference note has been published[76]; a paper is on the way for publication too[95].

The second analysis presented, exploited the full 2012 statistic ($\mathcal{L} = 20fb^{-1}$) collected at a center of mass energy $\sqrt{s} = 8TeV$ and was used to study the cross section behavior at high top quark p_T. The event selection was very similar to the one used for the 2011 data analysis; the most relevant change was the request of at least one *large-R jet* with specifically tuned cuts on jet substructure variables. This replace the usual request of at least four *small-R* jets applied in the 2011 data analysis. Only preliminary studies on the more sophisticated template overlap tagging algorithm (TOM), have been shown because its application to the analysis is still under investigation. The backgrounds have been evaluated both from MC simulation and *data-driven* results, as

in the W+jets channel. The QCD background contribution has been estimated to be about 1%. The selected events have been unfolded using the SVD method to the *particle level* that allows an easier and more model-independent result comparison with respect to the unfolding at *parton level*. The effect of the main systematic uncertainties has been estimated. The final differential cross section result as a function of the hadronic top p_T $\left(\frac{d\sigma}{dp_T^t}\right)$ has been compared with the MC prediction from the *Powheg+Pythia* generator, founding a discrepancy of the order of 20%. The source of this discrepancy is still under investigation and some attempts are ongoing to understand the discrepancy by changing the event selection requirements. I am currently the main code developer and analyzer for this measurements and I am performing all the analysis steps from the selection to the background estimates and the unfolding process. This analysis results are collected in an ongoing ATLAS note of which I am one of the editors; this will evolve in a public paper for this summer, including the total set of systematics involving the measurements, further investigation about the origin of the data/MC discrepancy and adding the measurements of the differential cross section at the parton level. I will continue my analysis work on these items and furthermore, I want to include in this study the results obtain by including the TOM tagger in the event selection chain and the cross section dependences from more top quark and $t\bar{t}$ kinematic variables.