Conclusion

The results of two analyses, both measuring the $t\bar{t}$ production differential cross section in the *lepton+jets* 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 $\mathcal{L} = 4.7fb^{-1}$ and a center of mass energy $\sqrt{s} = 7TeV$. The backgrounds have been estimated via Monte Carlo simulation or, for the $W + jets$ *and QCD* channels, 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, some constraints on the leptonic decaying W boson to reject QCD multi-jet background and at least four jets, one of which tagged as coming from 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 cut has been applied on the likelihood value. The application of the SVD unfolding method gives the possibility to remove the acceptance and resolution effects of the detector, giving the possibility to compare the results with the theoretical predictions; data has been unfolded to 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 the p_T of the top quark; these have been compared with NLO and NLO+NNLL theoretical calculations and MC generator predictions from Alpgen, MC@NLO and Powheg, finding a good agreement. 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]. 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 second analysis presented uses the full 2012 events statistic ($\mathcal{L} = 20fb^{-1}$) collected at a center of mass energy $\sqrt{s} = 8TeV$; such high luminosity and collision energy have been exploited to specifically look at the cross section behavior at high top quark p_T. The event selection has similar requirements with respect to the one used in the 2011 differential cross section data analysis; the most relevant change is the request for the presence of at least one *large-R jet* with specifically tuned cuts on jet substructure variables. This substitutes the usual request of at least four *small-R* jets applied in the

2011 data analysis. Only preliminary studies on the more sophisticated TOM tagging algorithm 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 is not still applied, but its 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 and included in the total uncertainty. 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 reduce the discrepancy by changing the event selection requirements. All the work done and the results obtained until now have been collected in an ATLAS note [77] of which I am one of the editors. I am the main code developer and analyzer for this measurements and I am currently performing all the analysis steps from the selection to the background estimates and the unfolding process. The work on this measurement is still ongoing, with the aim to further investigate the discrepancies with theoretical prediction, to include the missing uncertainty sources and the use of the TOM tagger for the event selection. Moreover the natural extension of this analysis will be the evaluation of the differential cross section as function of also other top and $t\bar{t}$ kinematic variables, as done for the 2011 data analysis.