Chapter 8

CONCLUSIONS

This thesis presents the work done in association with the ATLAS experiment. The common theme is electrons, specifically improving the selection of signal electrons in SUSY searches. The main work is discussed in three chapters:

- Chapter 5 describes the estimation of the charge mis-identification rates for electrons by a likelihood function, the Poisson likelihood in particular. These rates are important for new physics searches in which the final state consists of a pair of same-sign leptons, where the leptons refer to electrons and muons. The method uses $Z \to e^+e^-$ events, which furnish a source of clean and high-statistics set of electrons. A Poisson likelihood function is constructed, taking into account the dependency of charge mis-identification rates on kinematic properties such as on p_T and on η of the electrons. The results showed that in most bins, simulation over-estimates the rates as compared to the data by 5-20%.

- Chapter 6 describes a SUSY search for gluino pair-production, which is highly motivated as gluinos are expected by naturalness to have a mass around the TeV scale, and moreover the production cross section is high at the LHC. The data is collected in the 2015-2016 data taking period, at center-of-mass $\sqrt{s} = 13$ TeV and corresponds to an integrated luminosity of 36.1 fb^{-1}. The final state consists of large missing transverse momentum and multiple jets, among which at least three must be b-jets. The thesis focuses on the leptonic final state, which requires in addition at least one lepton (either an electron or a muon). Following a lead from the $t\bar{t}$ resonance search, a boosted overlap removal procedure between jets and muons is introduced into the analysis, which is adopted for jets and elecrons in a subsequent version of the analysis. An optimization for the selection of the discriminating variables for the leptonic channel is also described. No excess relative to the Standard Model background is claimed. Model-independent limits are set on the visible cross-section for new physics processes, and model-dependent limits are set of gluino and neutralino masses. Gluino masses of less than 1.97 TeV for neutralino masses below approximately 300 GeV are excluded at the 95% CL, showing an improvement over the same analysis using the 2015 dataset alone.

- Chapter 7 describes the measurements of the identification efficiencies for elec-

trons found within $\Delta R = 0.4$ of high-p_T jets. The measurements are motivated by a considerable increase in signal acceptance seen in some SUSY searches (the SUSY search described in Chapter 6 is a particular example) when electrons overlapping with jets are selected, as well as by the fact that prior to the measurements only electrons non-overlapping with jets had been calibrated. The data used corresponds to an integrated luminosity of 36.1 fb^{-1}, collected at center-of-mass $\sqrt{s} = 13$ TeV. The measurements use a dilepton ($e\mu$) $t\bar{t}$ sample enriched in boosted top quarks. The results present the integrated efficiencies and the efficiencies as a function of the p_T of the electrons, $|\eta|$ of the electrons, ΔR between the electrons and the closest jets, and of the p_T of the closest jets.