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Precision Measurements of the Standard Model with the ATLAS Experiment

Abstract

Precision measurements with the ATLAS experiment at the LHC are used to determine fundamental parameters of the Standard Model, provide stringent tests of perturbative QCD, and are used to determine the parton distribution functions within the proton. In this talk, differential measurements of variables probing the properties of the multijet energy flow and the prompt inclusive photon production for two distinct photon-isolation cones are highlighted. The former is used to determine the strong coupling constant utilising state-of-the art theory predictions at NNLO. Furthermore, the measurement of the production of a W boson in association with D+ and D*+ mesons is presented. It provides information about the strange content of the proton. The production rate of Z+jet events with large missing transverse momentum is used to measure the decay width of the Z boson decaying to neutrinos. A search for exclusive hadronic decays of the W boson to single pions, Kaons or rho-mesons in association with a photon are highlighted, and provide a test bench for the quantum chromodynamics factorization formalism. Furthermore, extraordinarily precise double-differential measurement of the Z boson in the full phase space of the decay leptons at a centre-of-mass energy of 8 TeV are discussed. The results are compared to state-of-the-art predictions at third-order accuracy in perturbative QCD, supplemented by resummation of logarithmically-enhanced contributions in the small transverse-momentum region of the lepton pairs (N3LO+N4LL). The recoil of the Z-boson is sensitive to quark and gluon emissions and is used to determine the strong coupling constant in a novel approach. Measurements of the transverse momentum of the W and Z boson at 5 and 13 TeV from dedicated LHC runs with reduced instantaneous luminosity are also presented. Finally, the LHC pp collision data collected by the ATLAS experiment at sqrt(s)=7 TeV is revisited to measure the W boson mass. Improvements in the knowledge of the modelling of QCD effects allow for a reanalysis employing a powerful profile-likelihood fit technique.