Measurement of the lepton charge asymmetry in inclusive $pp \to W + X$ production at $\sqrt{s}$= 7 TeV at the CMS experiment

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1 Introduction

In pp collisions at the LHC, W^+ is produced more abundantly than W^- because of the presence of two u valence quarks in the proton. Measurement of this asymmetry can be used to test SM predictions with high precision. The experimentally accessible quantity is the lepton charge asymmetry, defined to be:

$$A(\eta) = \frac{d\sigma/d\eta(W^+ \to l^+\nu) - d\sigma/d\eta(W^- \to l^-\nu)}{d\sigma/d\eta(W^+ \to l^+\nu) + d\sigma/d\eta(W^- \to l^-\nu)} \quad (1)$$

where l is the daughter charged lepton, η is the charged lepton pseudorapidity in the CMS lab frame ($\eta = -ln[tan(\theta/2)]$ where θ is the polar angle with the beam) [1], and $d\sigma/d\eta$ is the differential cross section for charged leptons from W boson decays. In CMS the measurement is performed in both $W \to e\nu$ and $W \to \mu\nu$ final states using a dataset corresponding to an integrated luminosity of 36 pb^{-1} collected by CMS in March-November 2010 [2].

2 Asymmetry measurement

In this measurement, the $W \to e\nu$ candidates are selected by requiring electrons to be isolated, to have $p_T > 25$ GeV/c, $|\eta| < 2.4$, and have fired an electron trigger. No selections on missing transverse energy (E_T^{miss}) are applied. A binned extended maximum likelihood fit is performed over the E_T^{miss} distribution to estimate the W $\to$ eν signal yield for electrons (N^-) and positrons (N^+) in each pseudorapidity bin. The charge asymmetry is obtained from $(N^+ - N^-)/(N^+ + N^-)$. The W $\to \mu\nu$ candidates are selected by further requiring the muon p_T to be greater than 25 GeV/c, $|\eta| < 2.1$, and that the candidate matches one of the muon trigger candidates. No isolation selection is applied. To reject the background, there is a veto on the presence of other

muons having $p_T > 15$ GeV/c and $|\eta| < 2.4$. The $W \to \mu\nu$ signal estimation is done by fitting the distribution of an isolation variable $\xi = \Sigma(E_T)$ defined as the scalar sum of the transverse momenta of silicon tracks (excluding the muon candidate) and energy deposits in both ECAL and hadronic calorimeter (HCAL) in a cone $\Delta R < 0.3$ around the muon direction. An unbinned extended maximum likelihood fit to the ξ distribution is performed simultaneously on the $W^+ \to \mu^+\nu$ and $W^- \to \mu^-\nu$ candidates to determine the total $W \to \mu\nu$ signal yield and the charge asymmetry in each pseudorapidity bin.

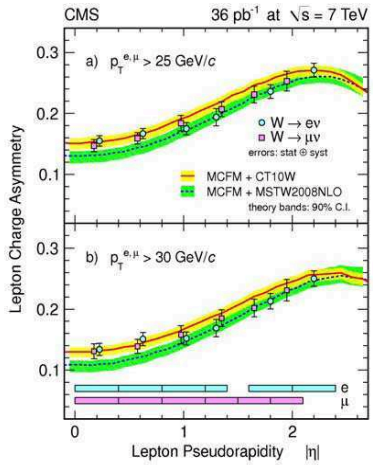

Figure 1: Comparison of the measured lepton charge asymmetry to different PDF models for a) lepton $p_T^l > 25$ GeV/c and b) lepton $p_T^l > 30$ GeV/c.

and the MSTW2008NLO PDF model. Our data suggest a flatter pseudorapidity dependence of the asymmetry than the PDF models studied.
The total error is less than 1.6% in each pseudorapidity bin for both electronic and muonic channels. This high precision measurement of the W lepton charge asymmetry at the LHC provides new inputs to the PDF global fits.

References

[1] CMS Collaboration, JINST **3**, S08004 (2008).

[2] CMS Collaboration, JHEP **04**, 050 (2010), and references therein.