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*Electronic Access:* [www-h1.desy.de/h1/www/publications/conf/conf\\_list.html](http://www-h1.desy.de/h1/www/publications/conf/conf_list.html)  
[www-zeus.desy.de/physics/phch/conf/eps09/index.html](http://www-zeus.desy.de/physics/phch/conf/eps09/index.html)

H1prelim-09-161  
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# **Isolated Leptons and Missing Transverse Momentum and Measurement of $W$ Production at HERA**

## **The H1 and ZEUS Collaborations**

### **Abstract**

The search for events containing isolated leptons (electrons or muons) and missing transverse momentum produced in ep collisions is performed with the H1 and ZEUS detectors at HERA in the period 1994 – 2007. The analysed data sample corresponds to an integrated luminosity of  $0.98 \text{ fb}^{-1}$ . The observed event yields are compared to the prediction from the Standard Model. In general good agreement is found, where the SM prediction is dominated by  $W$  production. The total and differential cross section of this process is measured in a common phase space. The total single  $W$  boson production cross section is measured as  $1.07 \pm 0.16$  (stat.)  $\pm 0.08$  (sys.) pb, in agreement with the Standard Model expectation of  $1.26 \pm 0.19$  pb.

<b>H1+ZEUS Preliminary</b> 1994-2007 $e^+p$ 0.59 fb <sup>-1</sup>		Data	SM Expectation	SM Signal	Other SM Processes
Electron	Total	37	38.62 ± 4.71	28.89 ± 4.42	9.73 ± 1.40
	$P_T^X > 25$ GeV	12	7.41 ± 1.01	5.96 ± 0.94	1.45 ± 0.33
Muon	Total	16	11.20 ± 1.62	9.86 ± 1.56	1.34 ± 0.33
	$P_T^X > 25$ GeV	11	6.62 ± 0.98	5.85 ± 0.94	0.77 ± 0.22
Combined	Total	53	49.82 ± 6.18	38.75 ± 5.92	11.06 ± 1.51
	$P_T^X > 25$ GeV	23	14.02 ± 1.94	11.81 ± 1.86	2.22 ± 0.43

<b>H1+ZEUS Preliminary</b> 1998-2006 $e^-p$ 0.39 fb <sup>-1</sup>		Data	SM Expectation	SM Signal	Other SM Processes
Electron	Total	24	30.58 ± 3.60	19.42 ± 2.97	11.16 ± 1.94
	$P_T^X > 25$ GeV	4	5.62 ± 0.76	3.99 ± 0.63	1.63 ± 0.42
Muon	Total	4	7.43 ± 1.08	6.57 ± 1.04	0.86 ± 0.26
	$P_T^X > 25$ GeV	2	4.34 ± 0.66	3.92 ± 0.63	0.42 ± 0.17
Combined	Total	28	38.00 ± 3.40	25.98 ± 3.40	12.02 ± 1.97
	$P_T^X > 25$ GeV	6	9.96 ± 1.34	7.91 ± 1.24	2.06 ± 0.45

<b>H1+ZEUS Preliminary</b> 1994-2007 $e^\pm p$ 0.98 fb <sup>-1</sup>		Data	SM Expectation	SM Signal	Other SM Processes
Electron	Total	61	69.19 ± 8.18	48.31 ± 7.38	20.88 ± 3.19
	$P_T^X > 25$ GeV	16	13.03 ± 1.70	9.95 ± 1.55	3.08 ± 0.65
Muon	Total	20	18.62 ± 2.69	16.43 ± 2.60	2.20 ± 0.51
	$P_T^X > 25$ GeV	13	10.96 ± 1.62	9.77 ± 1.56	1.19 ± 0.32
Combined	Total	81	87.82 ± 10.55	64.74 ± 9.88	23.08 ± 3.32
	$P_T^X > 25$ GeV	29	23.99 ± 3.24	19.71 ± 3.09	4.27 ± 0.77

Table 1: Summary of the H1+ZEUS results of searches for events with isolated electrons or muons and missing transverse momentum for the  $e^+p$  data (0.59 fb<sup>-1</sup>, top),  $e^-p$  data (0.39 fb<sup>-1</sup>, middle) and the full HERA data set (0.98 fb<sup>-1</sup>, bottom). The results are shown for the full selected sample and for the subsample at large hadronic transverse momentum  $P_T^X > 25$  GeV. The number of observed events is compared to the SM prediction. The SM signal (dominated by single  $W$  production) and the total background contribution are also shown. The quoted errors contain statistical and systematic uncertainties added in quadrature.

<b>H1+ZEUS Differential Single <math>W</math> Production Cross Section (Preliminary)</b>		
$P_T^X$ [GeV]	Measured $\pm$ stat. $\pm$ sys. [fb / GeV]	SM NLO [fb / GeV]
0 – 12	$34.0 \pm 12.3 \pm 5.0$	$62.7 \pm 9.4$
12 – 25	$20.8 \pm 5.9 \pm 1.8$	$20.7 \pm 3.1$
25 – 40	$12.9 \pm 3.6 \pm 0.9$	$9.8 \pm 1.5$
40 – 100	$1.4 \pm 0.6 \pm 0.1$	$1.5 \pm 0.2$

Table 2: The differential single  $W$  boson production cross section  $d\sigma_W/dP_T^X$  measured by H1 and ZEUS in a common phase space, with statistical (stat.) and systematic (sys.) errors, derived from the electron and muon channels as a function of the hadronic transverse momentum  $P_T^X$ . Also shown are the expectations including the theoretical uncertainties for the Standard Model calculated at next to leading order (SM NLO). In the phase space where  $P_T^X < 12$  GeV, the electron measurement is used to estimate the muon cross section under the assumption of lepton universality.

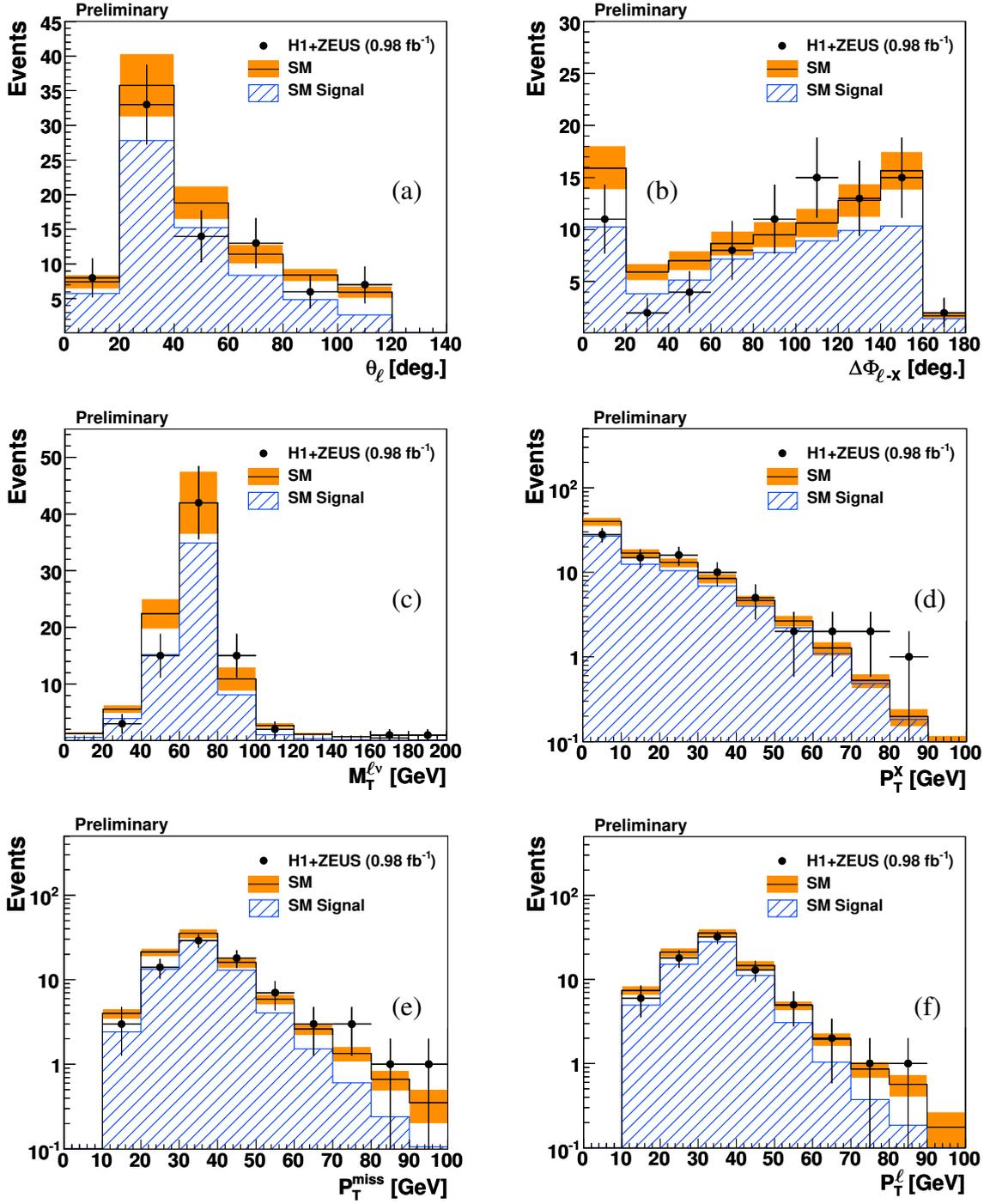


Figure 1: Distributions in the combined electron and muon channels for the  $e^\pm p$  data sample. Shown is the polar angle of the lepton  $\theta_\ell$  (a), the lepton–hadronic system acoplanarity  $\Delta\phi_{\ell-X}$  (b), the lepton–neutrino transverse mass  $M_T^{\ell\nu}$  (c), the hadronic transverse momentum  $P_T^X$  (d), the missing transverse momentum  $P_T^{\text{miss}}$  (e) and the transverse momentum of the lepton  $P_T^\ell$  (f). The data (points) are compared to the SM expectation (open histogram). The signal component of the SM expectation, dominated by real  $W$  production, is shown as the hatched histogram. The total uncertainty on the SM expectation is shown as the shaded band.

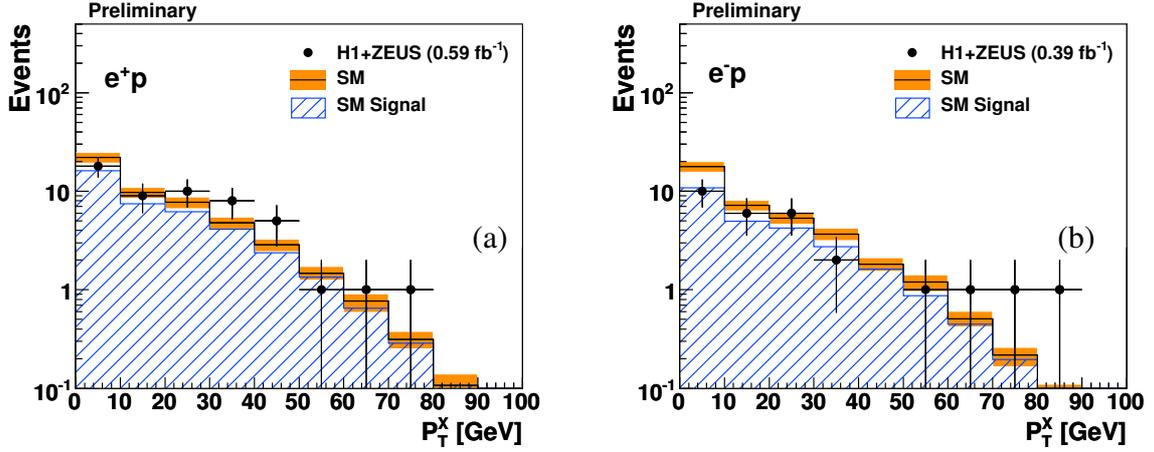


Figure 2: The hadronic transverse momentum  $P_T^X$  distributions in the combined electron and muon channels for the  $e^+p$  (a) and  $e^-p$  (b) data samples. The data (points) are compared to the SM expectation (open histogram). The signal component of the SM expectation, dominated by real  $W$  production, is shown as the hatched histogram. The total uncertainty on the SM expectation is shown as the shaded band.

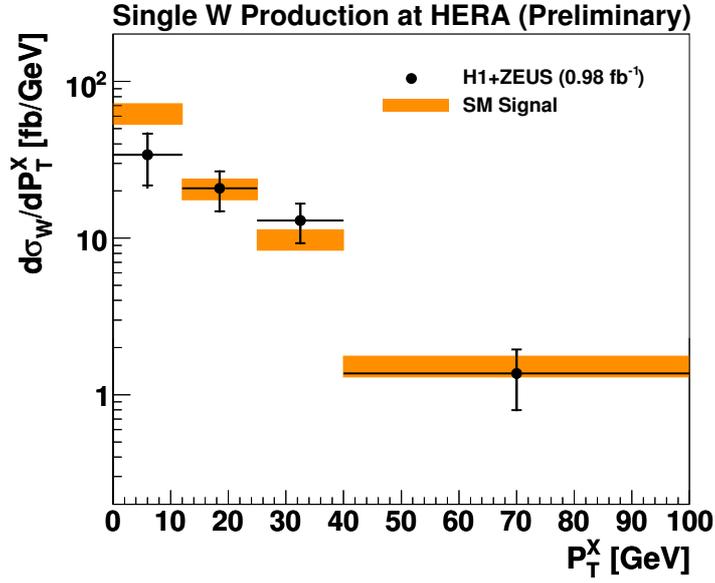


Figure 3: The single  $W$  production cross section, measured by H1 and ZEUS in a common phase space as a function of the hadronic transverse momentum,  $P_T^X$ . The inner error bar represents the statistical error, which dominates, and the outer error bar indicates the statistical and systematic uncertainties added in quadrature. The shaded band represents the one standard deviation uncertainty in the SM prediction.