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Addition of PHX Electrons to the Dilepton Analysis using the Tight Lepton and Isolated Track Sample

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Abstract

In this note we describe steps taken to include PHX electrons in the track-lepton data sample. We present measured efficiencies, scale factors, charge fake-rates and systematic uncertainties. We have calculated PHX W and Z cross-sections. We find results that are consistent among themselves, and with that of the other tight leptons utilized in this analysis.

1 Introduction

This note describes the inclusion of PHX electrons as an additional tight lepton in the tight lepton + isolated track sample. PHX electrons are forward electrons with a cluster in the PEM calorimeter and a silicon track reconstructed with the calorimetry-seeded "phoenix" tracking algorithm described in detail elsewhere[1].

2 Data and Monte Carlo Samples

The PHX+tl data sample is composed of the *bpel08* and *bpel09* datasets. The `MET_PEM` trigger path is required. These data were processed with 4.11.2 production. We require good runs for silicon (`SVX_STATUS` = 1 and `ISL_STATUS` = 1). The full sample up to the September shutdown (runs 141544-168889) is analyzed. The integrated luminosity for this sample is 180 pb^{-1}.

The Z Monte Carlo sample used is 300,000 events from the Top Group's standard *ztop0e* sample, reconstructed with CDF offline version 4.11.2. This sample consists of $Z/\gamma*$ events, with invariant mass > 30 GeV. There are 221,849 events generated with an invariant mass between 76 and 106 GeV. The W Monte Carlo used is a subset of 436,000 events from the standard *wtop0e* sample, generated and reconstructed with the standard top group prescription (4.9.1 generation + 4.8.4 production)[1].

3 Reconstruction Efficiency

3.1 Plug Calorimeter Electron ID Efficiency

In this section, we describe the selection criteria for PHX electrons used throughout this note and in the top dilepton analysis with the tight lepton + isolated track sample. PHX electrons are required to pass the baseline cuts for a tight plug electron recommended by the ETF. These are a combination of calorimetric and phoenix track quality cuts, described in detail elsewhere[2]. Additionally, we restrict PHX electrons to have $|\eta| < 2.0$. We make this cut because the phoenix charge-fake-rate increases substantially beyond $|\eta| = 2.0$ as will be demonstrated later in this note. We note that this cut has negligible impact on the acceptance for $t\bar{t}$ as illustrated by Figure 1. The cuts are summarized in Table 1.

We measure the efficiency of the plug electron identification cuts in data and Monte Carlo using Z bosons where one leg has been reconstructed in the CEM with a COT track and the other leg has been reconstructed in the PEM. The data used are the top group inclusive high-pt lepton samples (*btop0g* and *btop0j*). The `ELECTRON_CENTRAL_18` trigger path is required. These data were processed with 4.11.2 production. This data sample is used instead of the PHX+tl sample described above because the `MET_PEM` trigger path requires the presence of missing energy and thus excludes a majority of events containing a Z boson. In order to increase the purity of the sample, the di-electron invariant mass is required to be between

[1] As this sample was only used for the W cross-section study detailed later in this note, the time-consuming processes of running 4.11.2 production was deemed unnecessary.

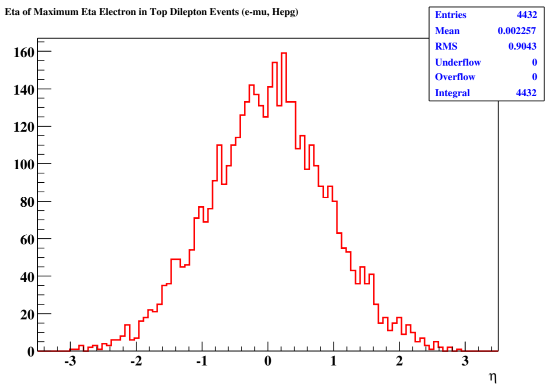

Figure 1: *Pseudo-rapidity distribution of electrons in dilepton $t\bar{t}$ Monte Carlo events.*

Variable	Cut
Pes2dEta	$1.2 < \|\eta\| < 2.0$
Had/Em	< 0.05
Pem3x3FitTow	$\neq 0$
Pem3x3Chisq	< 10
Pes5by9U	> 0.65
Pes5by9V	> 0.65
Isolation	< 0.1
E_T	> 20 GeV
ΔR	< 3.0 cm
PhxMatch	TRUE
N_{hits}^{Si}	≥ 3
$\|z_0^{PHX}\|$	≤ 60 cm

Table 1: *PHX selection cuts. These are the baseline ETF tight plug electron cuts with the additional restriction that $|\eta| < 2.0$.*

81 and 101 GeVand the central leg must pass the following additional cuts beyond those recommended by the ETF for a tight central electron:

- Lshr < 0.1
- Isol < 0.05

The following minimal cuts on the plug leg are also imposed:

- $E_T \geq 10$ GeV
- Had/Em ≤ 0.125

We define the efficiency (ϵ) as the number of events passing all plug electron id cuts divided by the number passing only the minimal cuts outlined above. We find non-negligible disagreement between data and the simulation, measuring $\epsilon_{data}^{PEM} = 0.828 \pm .006$ and $\epsilon_{MC}^{PEM} = 0.904 \pm .002$.

In order to illustrate which plug id variables are most poorly modeled by the simulation, we calculate "$N-1$" efficiencies for a given cut by counting the number of events that pass all cuts, and dividing by the number that pass all but that cut. $N-1$ efficiencies are calculated for both data and Monte Carlo for all plug electron identification cuts that are independent of phoenix tracking. Results are tabulated in Table 2 which identify the largest single source of discrepancy as the `Pem3x3Chi2` variable. The same results are displayed graphically in Figures 2 and 3. *N.B.* Cuts on the `Delta R` and the `Pes5by9` variables (which have significantly different core distributions[2] between data and Monte Carlo) are placed on the tails of the distributions where the agreement is good such that there is not a large discrepancy in the integrated efficiency.

cut	ϵ(data)	ϵ(Monte Carlo)
Had/Em	0.994 ± 0.002	0.991 ± 0.001
Pem3x3FitTow	1.000 ± 0.000	1.000 ± 0.000
Pem3x3Chisq	0.916 ± 0.005	0.954 ± 0.001
Pes5by9U	0.990 ± 0.002	0.996 ± 0.001
Pes5by9V	0.989 ± 0.002	0.996 ± 0.001
Isolation	0.985 ± 0.002	0.992 ± 0.001
E_T	0.974 ± 0.003	0.979 ± 0.001
Delta R	0.984 ± 0.002	0.991 ± 0.001

Table 2: *N-1 Efficiencies of the Plug Electron ID cuts in data and in Monte Carlo.*

3.2 Phoenix Efficiency

Phoenix tracking efficiency is also measured in data and Monte Carlo. This efficiency is defined as the number of events passing all plug electron ID cuts *and* having a phoenix track, divided by the number of events passing all plug electron ID cuts. Phoenix tracking efficiencies are measured to be $\epsilon_{data}^{phoenix} = 0.832 \pm 0.007$ and $\epsilon_{MC}^{phoenix} = 0.858 \pm 0.002$. Figure 4 shows this tracking efficiency for both data and Monte Carlo as a function of pseudo-rapidity.

The total PHX efficiency is the product of the measured plug electron identification efficiency and the measured phoenix tracking efficiency, $\epsilon^{PHX} = \epsilon^{PEM} \times \epsilon^{phoenix}$. We calculate $\epsilon_{data}^{PHX} = 0.69 \pm 0.01$ and $\epsilon_{MC}^{PHX} = 0.78 \pm 0.01$. These results are summarized in Table 3.

3.3 Data/MC Scale Factors

The disagreement between PHX efficiency in data and in the simulation is absorbed into a scale factor, SF_{PHX}. We find $SF_{PHX} = 0.89 \pm 0.01$.

[2] For the case of the `Pes5by9` this is a known feature of the PES detector which is not accounted for in the simulation. See [2] for a more detailed discussion

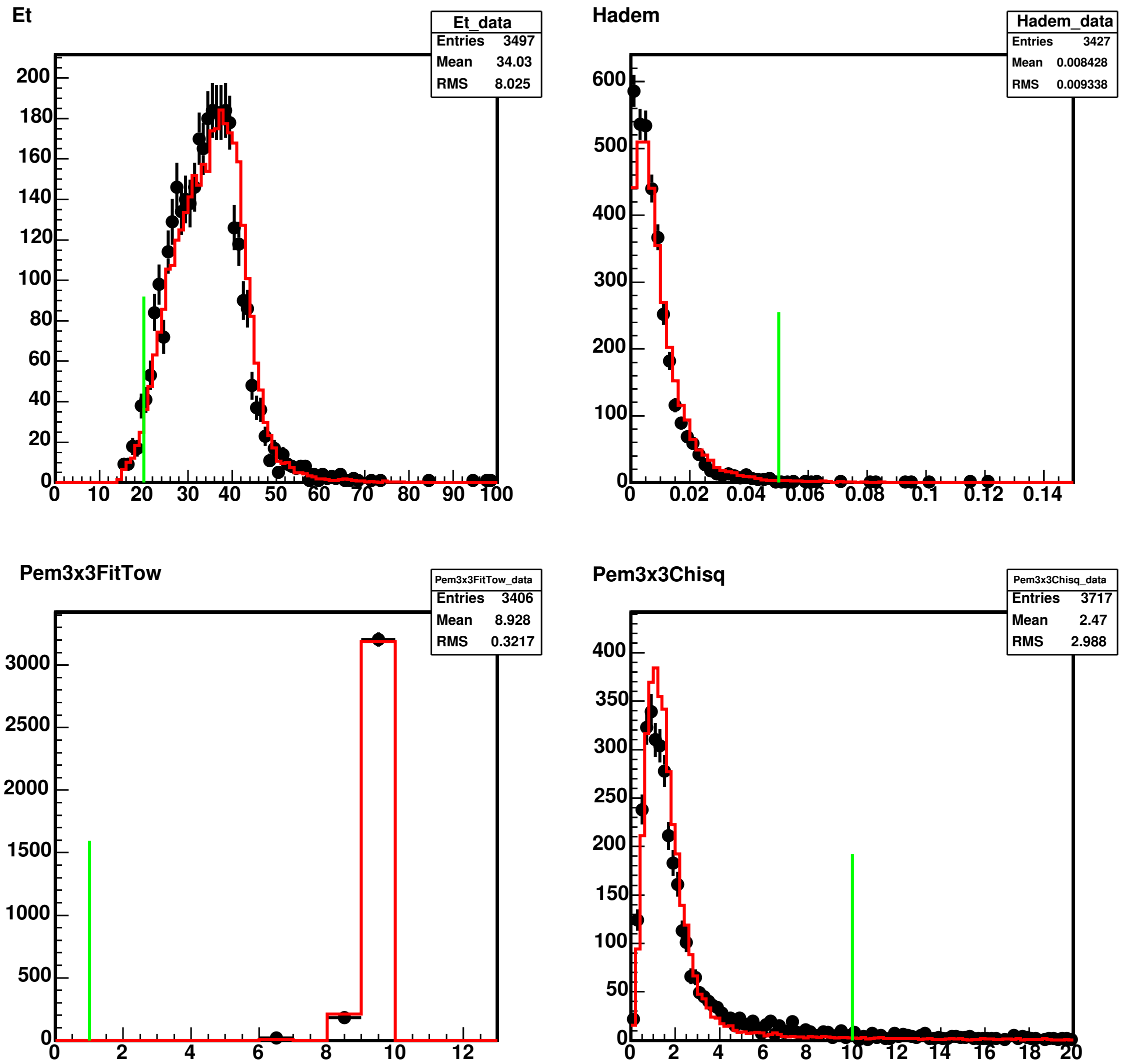

Figure 2: *N-1 Efficiencies for plug electron ID variables in data (points) and Monte Carlo (histograms). Cut values are indicated by a vertical line.*

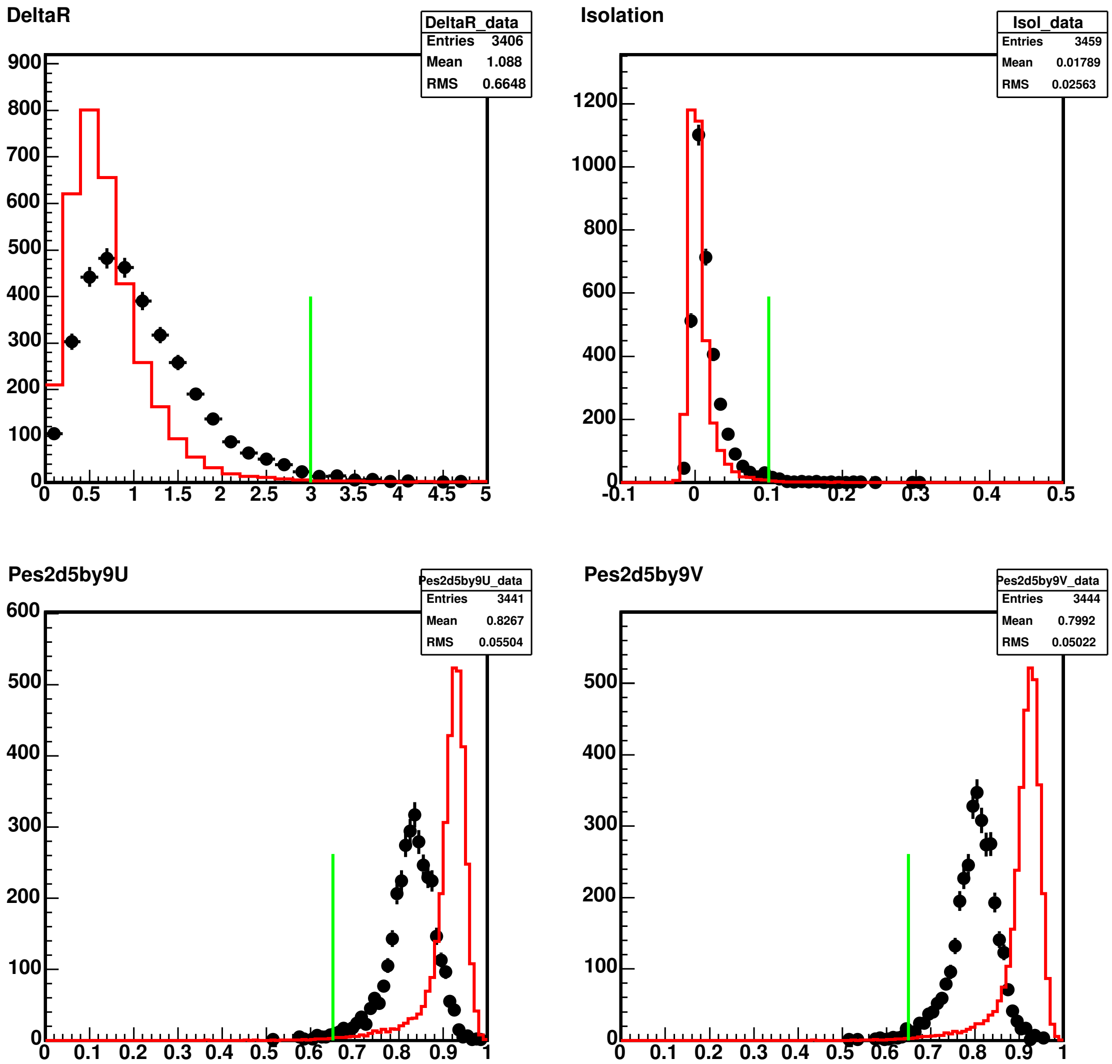

Figure 3: *Additional N-1 Efficiencies for plug electron ID variables in data (points) and Monte Carlo (histograms). Cut values are indicated by a vertical line.*

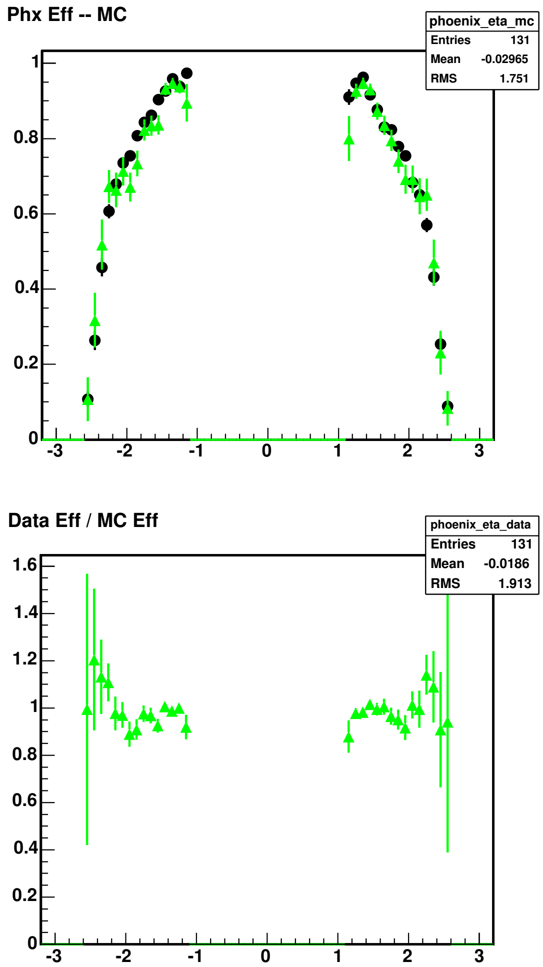

Figure 4: *Tracking efficiency for PHX electrons in data (points) and Monte Carlo (triangles) as a function of pseudo-rapidity.*

Efficiency	ϵ(data)	ϵ(Monte Carlo)
Calorimetry	0.83 ± 0.01	0.90 ± 0.01
Phoenix tracking	0.83 ± 0.01	0.86 ± 0.01
Total PHX	0.69 ± 0.01	0.78 ± 0.01

Table 3: *Efficiency summary table for PHX electrons in data and Monte Carlo.*

4 Charge-Fake-Rate

Since PHX electrons are tracked in the silicon only, they have a shorter lever arm with which to determine the curvature of a given track. This leads to an eta dependent charge mis-identification rate for PHX electrons. This problem can be made worse by relative misalignments of the PES with respect to the silicon. With 4.11.2 production, however, the latest available PES alignment constants have been properly taken into account. We measure this charge-fake-rate (CFR) in data and Monte Carlo using Z bosons where one leg has been reconstructed in the CEM with a COT track and the other leg has been reconstructed in the PEM as was done in determining the reconstruction efficiency. The central leg's COT track, having a negligible CFR, is used to deduce what the correct sign of the charge is for the plug leg. The phoenix charge-fake-rate is computed as the number of central plug Z events where the PHX track in the plug has the same sign as the COT track in the central divided by the sum of same-sign and opposite sign events. Written symbolically: $f^{Q_{wrong}} = SS/(OS + SS)$. Table 4 lists PHX charge-fake-rates measured in data and Monte Carlo. These results are plotted as function of pseudo-rapidity in Figure 5.

	$f^{Q_{wrong}}$(data)	$f^{Q_{wrong}}$(Monte Carlo)
Charge-Fake-Rate	0.126 ± 0.008	0.075 ± 0.003

Table 4: *Charge-Fake-Rate for PHX electrons in data and Monte Carlo.*

4.1 Charge-Fake-Rate Data/MC Scale Factor

The disagreement between PHX charge-fake-rate in data and in the simulation is absorbed into a scale factor, $SF_{Q_{wrong}}$. To correct for the overestimate in the MC acceptance, we compute $SF_{Q_{wrong}} = 1.0 - (0.126 \pm 0.008 - 0.075 \pm 0.003) = 0.95 \pm 0.009$.

4.2 Reduction in Charge-Fake-Rate

Studies were undertaken to understand the source of charge mis-identification in the phoenix algorithm, and to look for ways to improve the performance. These studies are ongoing, but one conclusion that has been taken from this work is that a cut on the chi-squared of the phoenix track would help to reduce charge mis-identification as can be seen in Figure 6.

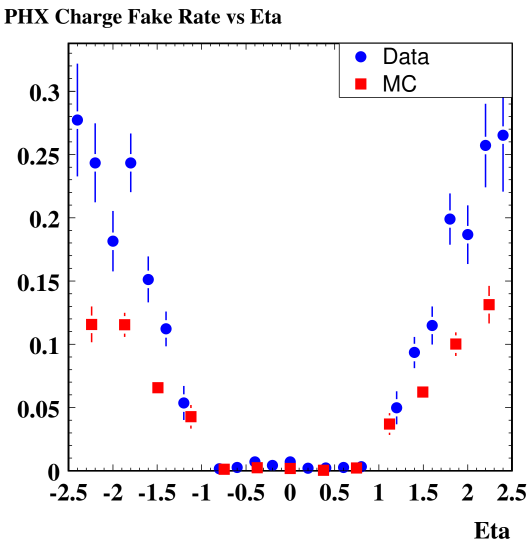

Figure 5: *Charge-Fake-Rate for PHX electrons in data and Monte Carlo as a function of pseudo-rapidity.*

N.B. Given that the expected PHX-tl contribution to the lepton + isolated track sample is only 2.4 events, we have concluded that that the CFR measured above is adequate for the track-lepton analysis and have not implemented a chi-squared cut at this time.

5 Trigger Efficiency

The efficiency of the `MET_PEM` trigger path has been measured in the context of a W cross-section measurement by Chiarelli *et al*[3]. It is necessary, however, to slightly modify this measurement to obtain the efficiency of this trigger path for the lepton+track $t\bar{t}$ cross-section analysis. The modification pertains to the calculation of the `L1_EM8_MET15` efficiency. One modification arises from the fact that the efficiency in [3] is measured for uncorrected $\not\!\!E_T > 20$ GeV, whereas the relevant efficiency in the lepton+track analysis is for corrected $\not\!\!E_T > 25$ GeV. We make the assumption that 25 GeV is sufficiently far away from trigger turn on effects that the `L1_EM8_MET15` efficiency is 1.000 (denoted ϵ^{25}_{L1}) instead of 0.955 as measured in [3]. A second modification arises from the fact that the efficiency in [3] is measured using plug electron W events containing one neutrino and no muons whereas dilepton top events will contain two neutrinos and may contain a muon, which at L1 is an additional source of missing energy. These additional sources of missing energy can conspire vectorially to produce less net missing energy thereby making this trigger less efficient for dilepton $t\bar{t}$ than for W bosons. We study this effect using $t\bar{t}$ Monte Carlo. We select PHX-tl candidates passing all analysis cuts and count how many of these events have raw (not muon corrected) missing energy greater than the trigger threshold of 15 GeV which we denote $\epsilon_{t\bar{t}}$. The resulting distribution is plotted in Figure 7. From this we extract $\epsilon_{t\bar{t}} = 0.984 \pm 0.006$. We obtain a modified `L1_EM8_MET15` efficiency as $\epsilon^{25}_{L1} \times \epsilon_{t\bar{t}}$ and compute a modified `MET_PEM` trigger efficiency of 0.945 ± 0.01. This

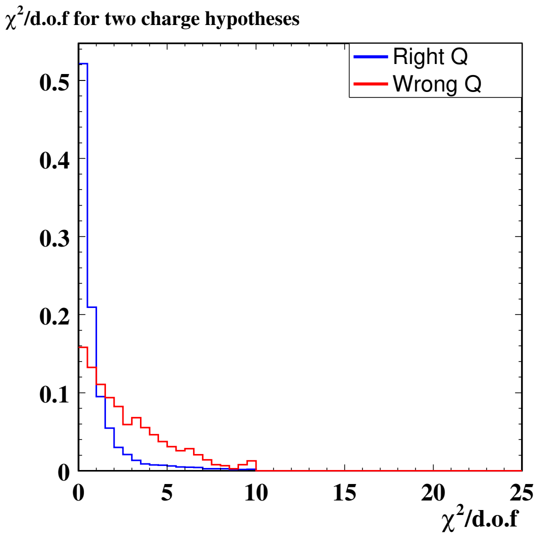

Figure 6: *Chi squared per degree of freedom for the tracks corresponding to the two charge hypotheses used in the phoenix algorithm.*

calculation is presented along with the unmodified numbers from [3] in Table 5. A systematic uncertainty on the trigger efficiency is assigned equal to the difference between our calculation and that in [3].

Trigger	CDF 6535 Efficiency	Lepton+Track Efficiency
L1_EM8_MET15	0.955 ± 0.005	0.984 ± 0.006
L2_PEM20_L1_EM8_MET15	0.96 ± 0.004	0.96 ± 0.004
L3_PEM_20_MET15	1.00 ± 0.01	1.00 ± 0.01
Overall	0.917 ± 0.01	0.945 ± 0.01

Table 5: *Trigger Efficiencies for `MET_PEM` trigger path for W to plug electrons analysis in [3] and the lepton+track $t\bar{t}$ dilepton analysis.*

6 Removal of PHX and *tl* overlap

There is a small region of the CDF detector in which an electron in the PEM calorimeter can be reconstructed twice, with a COT track and a phoenix track. This leads to a situation whereby a PHX electron is identified as the TPL and a *tl* is found which is actually the same physics object. These events are effectively removed with negligible impact on acceptance by requiring $\Delta R > 0.1$ between PHX and *tl*.

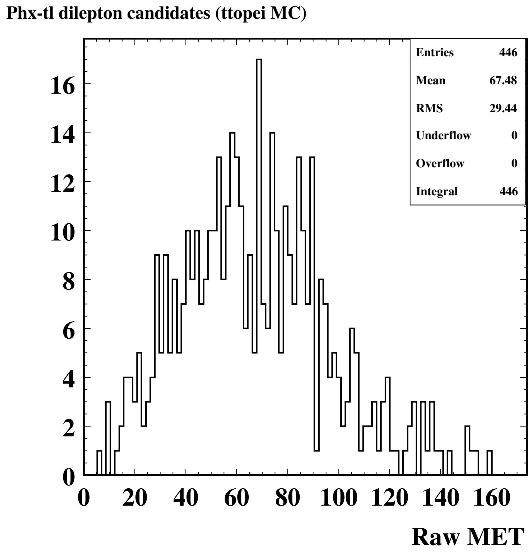

Figure 7: *Missing Energy (uncorrected for muons) for PHX-tl candidates from $t\bar{t}$ Monte Carlo.*

7 PHX Systematic Uncertainties

PHX systematic uncertainty has three components described in the preceding sections:

- An uncertainty on the PHX efficiency scale factor of 1.9%
- An uncertainty on the PHX CFR scale factor of 0.9%
- An uncertainty on the `MET_PEM` trigger efficiency of 4.3%

Combining these in quadrature yields a total PHX systematic error of 4.8%. This value is weighted by the PHX fractional acceptance and combined with the uncertainties associated with the TCLs to obtain the total systematic error quoted in [4]. These results are summarized in Table 6.

Uncertainty	Relative Systematic Error
PHX efficiency	1.9%
PHX charge-fake-rate	0.9%
Trigger efficiency	4.3%
Total PHX	4.8%

Table 6: *Systematic uncertainties associated with PHX electrons.*

8 Data Validation

8.1 $W \to e\nu$ Cross-Section using PHX electrons

In order to validate the plug electron identification and associated efficiencies described in the previous sections we measure $\sigma_W \times Br(W \to e\nu)$ from the plug electron datasets *bpel08* and *bpel09*. Additionally this measurement serves to validates the `MET_PEM` trigger path of the *bpel08/9* dataset, which is one of the three primary data samples we use in the lepton+track analysis.

8.1.1 Selection

We require for each candidate:

- Exactly one PHX electron, selected as described above
- At least 25 GeV of corrected $\not\!\!E_T$.
- Run must have been a silicon good run.
- Event must have come in on the `MET_PEM` trigger path.

8.1.2 Results

We use the following formula to calculate the cross-section, where $A\epsilon$ is determined from Monte Carlo:

$$\sigma = \frac{N_{obs} - N_{bkg}}{(\prod_i SF_i) A\epsilon \int \mathcal{L} dt}$$

The components of the calculation and the resultant cross-section are itemized below:

- $N_{obs} = 36,662$
- $N_{bkg} = 1,283$
- $A\epsilon = 0.16$
- $SF_{PhxEmObject} = 0.95$
- SF_{PhxEff}[3] $= 0.95$
- $\epsilon_{\mathrm{trig}} = 0.92$
- $\int \mathcal{L}$ dt $= 108$ pb^{-1}
- $\sigma = 2.5 \pm 0.1$ nb for 108 pb^{-1}

[3] The value of this scale factor is different than the 0.89 presented previously in the text because the Monte Carlo used in this study only was reconstructed with 4.8.4 instead of 4.11.2.

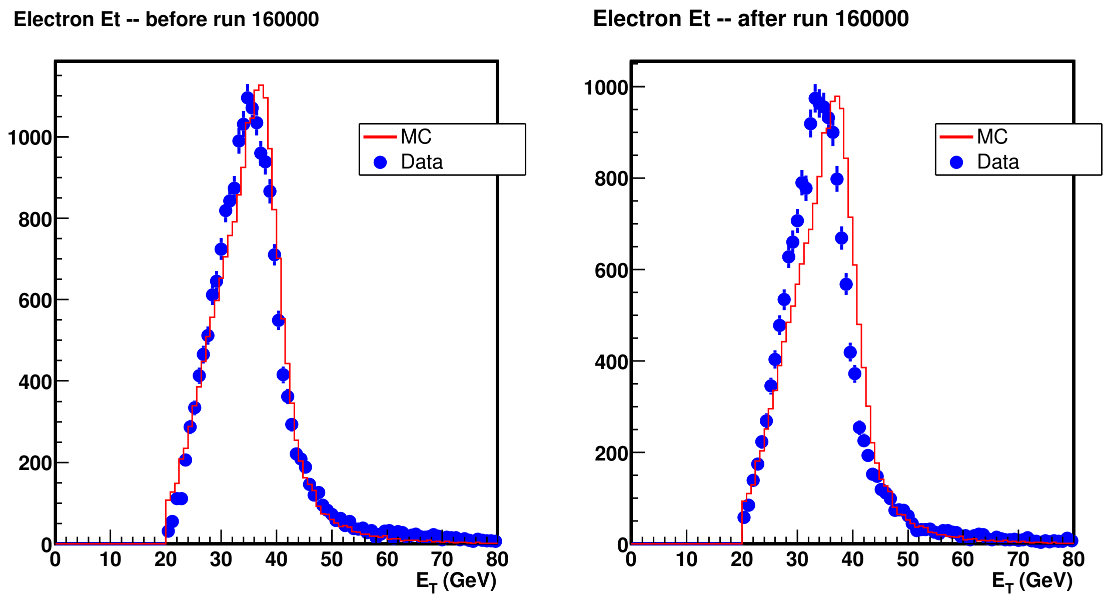

Figure 8: *E_T spectra of W candidates in plug before and after run 160000 for data (points) and Monte Carlo (histograms).*

The acceptance used is calculated from the $W \to e\nu$ Monte Carlo sample described in Section 2. The background rate of 3.5% is taken from supporting documentation for the W charge assymetry analysis using PHX electrons [5]. It is a QCD estimate based on the distribution of electron isolation vs. $\not\!\!E_T$ in the event. The `MET_PEM` trigger efficiency for plug W events is taken from [3].

The central value of this result is lower than the central value in [3] of 2.81 $\pm$ 0.39 nb. Although these results are consistent within the quoted uncertainties, we hypothesize that there is a systematic effect due to a time-dependent energy response of the plug calorimeter. This effect can be seen in Figure 8 which plots the E_T spectra of W candidates in the plug before and after run 160000. We compensate for the observed energy shift and subsequently find 39,818 candidates in the data, with a the background of 1,394 events, giving a cross-section of 2.7 $\pm$0.1 nb.

8.2 Central-Plug $Z \to ee$ Cross-Sections

Having measured a W cross-section consistent with expectations, we extend our validation procedure to measurements of $\sigma_Z \times$ Br(Z $\to$ ee) where one of the electrons is a central and the other a plug electron. As a means of validating the additional data collected after the "LP03" dataset was frozen in June 2003, we compute these cross-sections separately for the two data taking period and compare the results. Central-plug (CP) Zs may be triggered on either the central or the plug leg or both. As a means of validating these trigger paths and their associated efficiencies, we calculate cross-sections separately for both trigger paths and compare the results. Finally, a CP Z may be reconstructed in different permutations of tight and loose lepton selections. As an means of validating our lepton identification, we compute cross-sections separately for several different selections and compare the results.

8.2.1 Selection

As mentioned above, several variations of CP $Z \to ee$ selection are performed which we define here. PHX electrons are selected as described in the preceding sections. PEM electrons are those satisfying the loose plug electron requirements of the ETF, *i.e.* a PHX electron without the requirement of a phoenix track. CEM electrons are those satisfying the tight central electron requirements of the ETF and *tls* are isolated track lepton selected as outlined in [6]. Events are selected with an invariant mass of $76 < M_{ee} < 106$ GeV. A silicon good run is required and the trigger path is enforced. *N.B.* For the plug dataset, the `PLUG_ELECTRON_20` trigger path must be used because the analysis (`MET_PEM`) trigger path includes a missing energy requirement making it inefficient for Z bosons. This trigger path requires only a PEM cluster with transverse energy greater than 20 GeV, but applies a pre-scale of 1/10.

8.2.2 Backgrounds

Backgrounds are estimated by taking the events in the high-mass sideband to be background and assuming that the background rate is the same inside and outside the mass window. Since this technique is overly simplistic a conservative systematic uncertainty of 100% on the estimate is assigned.

8.2.3 PHX-CEM (Central and Plug datasets) Results

In this section, we measure a PHX-CEM cross-section for both central and plug triggered datasets. The plug trigger efficiency is taken to be the pre-scale. The central trigger efficiency has been measured in [7] to be 0.97. The PHX electron efficiency scale factor calculated in Section 3.3 is applied. Note that this scale factor accounts for the plug energy scale shift discussed in Section 8.1.2. A CEM electron efficiency scale factor of 0.96 is computed elsewhere[6]. An additional scale factor of 0.95 is applied to account for an inefficiency in the creation of a PhxEmObject in the phoenix algorithm. This efficiency is defined as the number of CdfEmObjects in the DefEmObject collection passing all PEM cuts, divided by the number of CdfEmObjects in the PhxEmObject collection passing all PEM cuts. In the data, this efficiency is 0.91 $\pm$0.01, and in the Monte Carlo it is 0.96 $\pm$0.001. The components of the calculation and the resultant cross-section are itemized below:

- Central dataset: $N_{obs} = 2644$ in 112 pb^{-1}, $N_{obs} = 1569$ in 67 pb^{-1}
- Plug dataset: $N_{obs} = 276$ in 112 pb^{-1}, $N_{obs} = 156$ in 67 pb^{-1}
- Background rate: 1%
- $A\epsilon = 0.129$
- $SF_{PhxEmObject} = 0.95$

- $SF_{PhxEff} = 0.89$
- $SF_{CemEff} = 0.96$
- Central $\epsilon_{\rm trig} = 0.97$, Plug $\epsilon_{\rm trig} = 0.1$
- $\int \mathcal{L}$ dt $= 112$ pb^{-1} + 67 pb^{-1} = 180 pb^{-1}
- Central dataset: $\sigma = 228 \pm 4$ pb for 180 pb^{-1}
- Plug dataset: $\sigma = 227 \pm 11$ pb for 180 pb^{-1}

Consistency between these results demonstrates that the trigger efficiencies in the plug and central datasets are well understood..

8.2.4 CEM-PEM (Central dataset only) Results

Next we calculate a CEM-PEM cross-section. This measurement differs from the CEM-PHX described above only in the requirement of a phoenix track and as such it provides a cross-check on this tracking efficiency. The calculation proceeds as for CEM-PHX except that the PEM electron scale factor is 0.90. The components of the calculation and the resultant cross-section are itemized below:

- $N_{obs} = 3387$ in 112 pb^{-1}, $N_{obs} = 2012$ in 67 pb^{-1}
- Background rate: 2%
- $A\epsilon = 0.162$
- $SF_{PhxEmObject} = 0.95$
- $SF_{PemEff} = 0.91$
- $SF_{CemEff} = 0.96$
- $\epsilon_{\rm trig} = 0.97$
- $\int \mathcal{L}$ dt $= 112$ pb^{-1} + 67 pb^{-1} = 180 pb^{-1}
- $\sigma = 224 \pm 6$ pb for 180 pb^{-1}

Consistency between this and the previous results demonstrates that phoenix tracking efficiency is well-understood.

8.2.5 PHX-tl (Plug dataset only) Results

Finally, we calculate a PHX-tl cross-section as a cross-check. This selection is most similar to the selection that will be used for the lepton-track analysis. In addition to the scale factors derived previously, this cross-section also includes a 0.85 scale factor to correct for the differing efficiency of the mass window cut in the data from in the Monte Carlo (see figure 9). The mass peak in this case is not as narrow because calorimetry information is not available for the tl. Instead, the momentum information of the track is combined with the measured PDG electron mass to infer the particle's energy. This broadens the mass distribution in a way that is not well-modeled in the Monte Carlo. In deriving the above scale factor, we have attempted reasonable background subtraction in the data by examination of the high-mass tail. The components of the calculation and the resultant cross-section are itemized below:

- $N_{obs} = 323$ in 112 pb^{-1}, $N_{obs} = 172$ in 67 pb^{-1}
- Background rate: 3%
- $A\epsilon = 0.161$
- $SF_{Mass} = 0.85$
- $SF_{PhxEmObject} = 0.95$
- $SF_{PhxEff} = 0.89$
- $\epsilon_{\rm trig} = 0.1$
- $\int \mathcal{L}\ {\rm dt} = 112\ {\rm pb}^{-1} + 67\ {\rm pb}^{-1} = 180\ {\rm pb}^{-1}$
- $\sigma = 232 \pm 13$ pb for 180 pb^{-1}

8.2.6 Summary of Results

Results for the various cross-section measurements described above are summarized, broken down by different data collection periods, in Table 7.

	112 pb^{-1}	67 pb^{-1}	180 pb^{-1}
CEM-PHX (central data)	230 ± 5 pb	228 ± 6 pb	228 ± 4 pb
CEM-PHX (plug data)	233 ± 14 pb	220 ± 18 pb	227 ± 11 pb
CEM-PEM	226 ± 6 pb	224 ± 7 pb	224 ± 6 pb
PHX-tl	243 ± 16 pb	217 ± 18 pb	232 ± 13 pb

Table 7: *Summary of Central-Plug $Z \to ee$ cross-sections.*

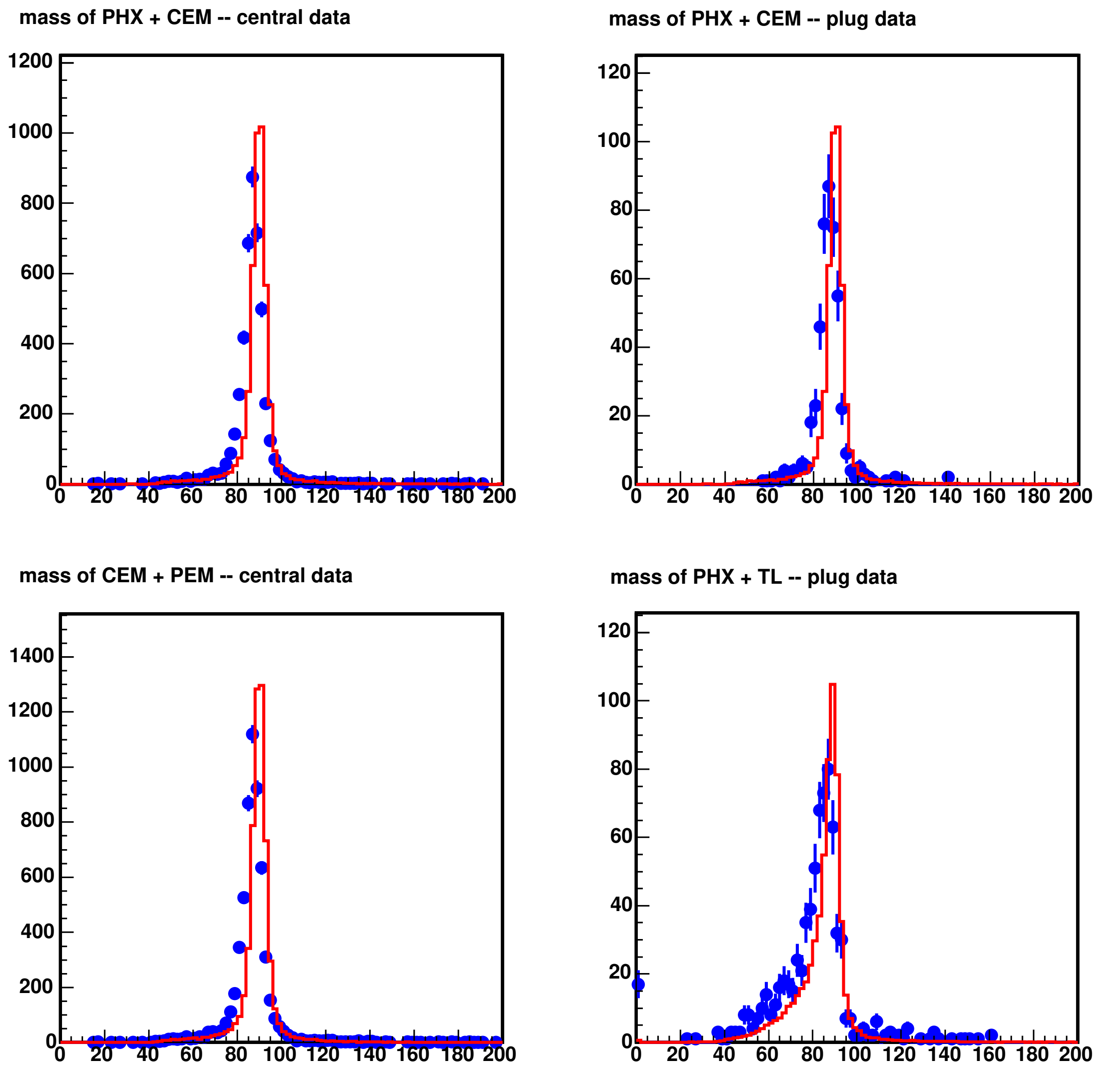

Figure 9: *Invariant mass distributions comparing data (points) to Monte Carlo (histograms) for CEM-PHX in central electron data , CEM-PHX in plug electron data, CEM-PEM in central electron data, and PHX-*tl *in plug electron data. All plots are made with 180* pb^{-1} *of data. Notice that the mass peak is broader in the PHX-*tl *distribution because no calorimetry information is available for the* tl, *and that the distribution is broader in the data than in the Monte Carlo (See section 8.2.5).*

9 Conclusion

We have included PHX electrons in the track-lepton data sample. This data was reconstructed with 4.11.2 production. We have re-measured efficiencies, scale factors, and fake-rates with this new reconstruction code and estimated associated systematic uncertainties. We have calculated W and Z cross-section as a means of data and code validation. The numbers are consistent among themselves, and consistent with the expected value of 250 pb. This exercise establishes consistency between our central and plug data samples, as well as between the data used in the Summer 2003 conference results and the data taken between June and September 2003.

References

[1] J. Goldstein et al, *Silicon Tracking for Plug Electrons*, CDF note 5970.

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[3] G. Chiarelli et al, *Measurement of the $\sigma_W \times \mathrm{Br}(\mathrm{W} \rightarrow \mathrm{e}\nu)$ in the Plug Region using Calorimetric and Forward Tracking*, CDF Note 6535.

[4] D. Glenzinski et al, *Signal and Background Acceptance for the Tight Lepton and Isolated Track Sample*, CDF Note 6532.

[5] C. Issever et al, *Background for W's in the Plug*, CDF Note 6412.

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[7] Y-K Kim et al, *Trigger Efficiencies for High P_T Electrons*, CDF Note 6234.