Electroweak Analyses

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DZero Collaboration Meeting

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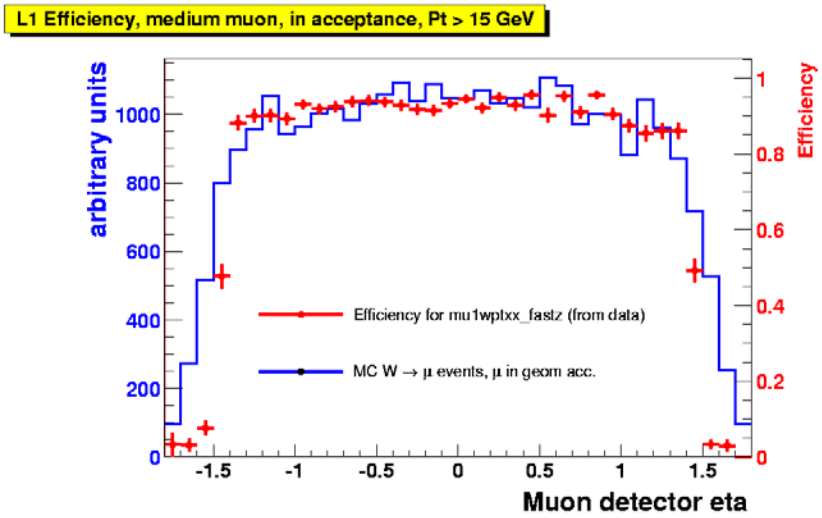
Analysis Strategy

- Electroweak group concentrating on W/Z cross sections in electron and muon channels for winter conferences
  - Other activities/analyses delayed and people moved from their primary interest
  - A large amount of work done in a short period of time by a small group of motivated of people

W→μν Cross Section Analysis

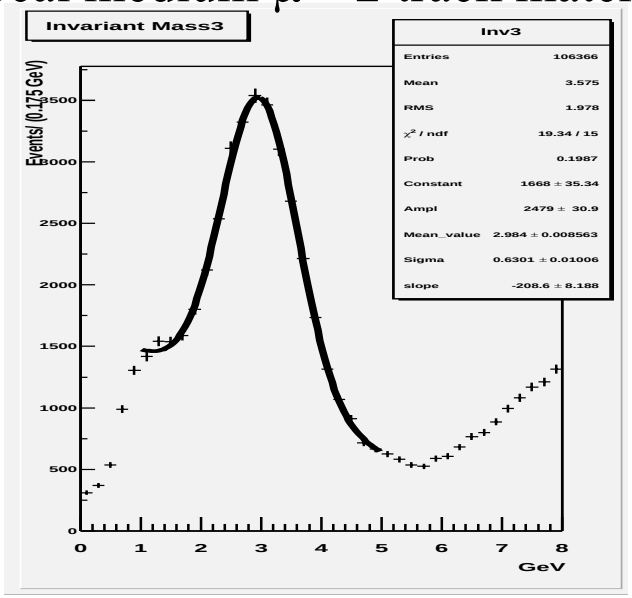
- 24.3 pb-1 (MU_W_L2M5_TRK10)
- Event Selection
  - 1 medium μ (trk match), $p_T > 20$ GeV, $|\eta_{det}| < 1.6$ (bottom hole removed), $\Delta\phi(\mu,\text{MET}) > \text{acos}(0.9)$
- Corrections for efficiencies applied in order (e.g. L3Track efficiency calculated for events passing offline cuts)

$$\sigma = \frac{1}{L\varepsilon}\left(N_{data} - N_{bkg}\right)$$



$\varepsilon_{L1} = 84.7 \pm 0.5\%$

2 local medium μ – 2 track matches

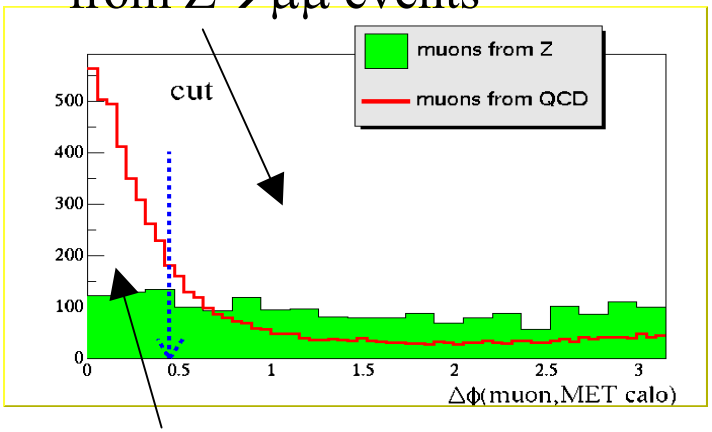


$\varepsilon_{\text{trk match}} = 78.5 \pm 0.6\%$

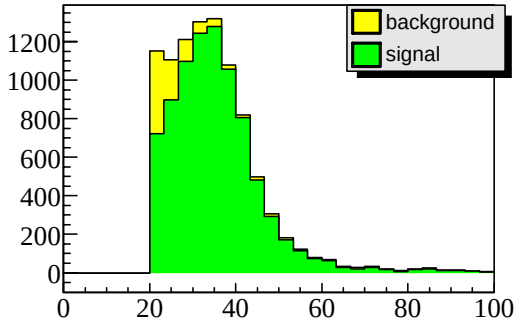
W→μν Matrix Method

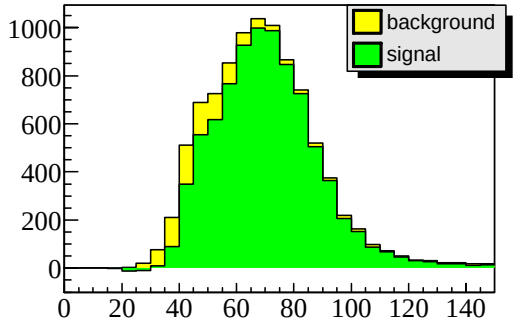
- Isolation used to separate signal/background in matrix method
  - Isolation requires $E_{T,cal}(0.1\text{-}0.4) < 2.5$ GeV, $p_{T,trk}(0.5) < 2.5$ GeV
  - Isolation efficiency and background fake probability from data

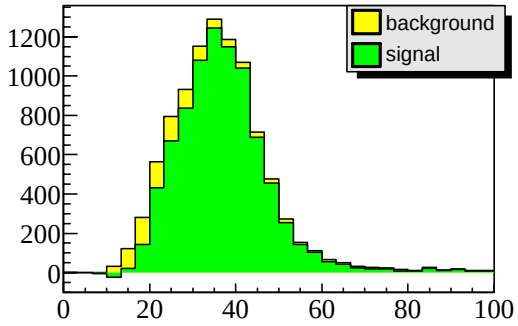
Find isolation efficiency from Z→μμ events

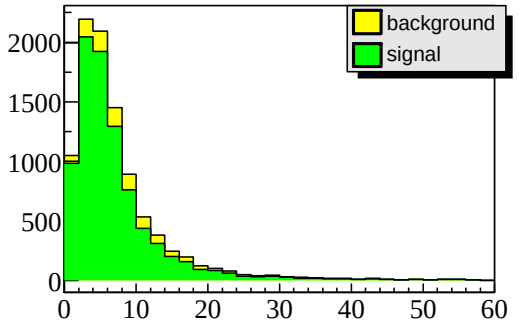


Find isolation fake probability from QCD single-μ events









$W \rightarrow \mu\nu$ Cross Section

Physics Acceptance	63.1%	±	0.5%
Pt cut (20 GeV)	84%	±	0.2%
Offline Medium Efficiency	70 %	±	2%
L1 Wide Efficiency	84.7%	±	0.8%
L2 Medium Efficiency	81.2%	±	0.5%
Tracking and Matching	78.1%	±	0.6%
L3 Tracking	74.1%	±	1.4%
$\Delta\phi$ cut	91%	±	1.5%
Isolation	90.3%	±	0.9%
Total efficiency	12.1%	±	0.6%

Luminosity $24.3 \pm 2.4\ pb^{-1}$

Matrix method: $\sigma = 2939.3 \pm 59.3 \pm 131.6 \pm 294$ pb

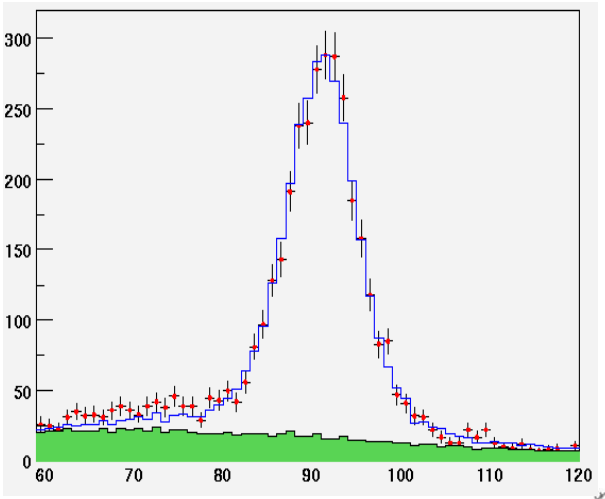
(bgk, efficiencies, lumi)

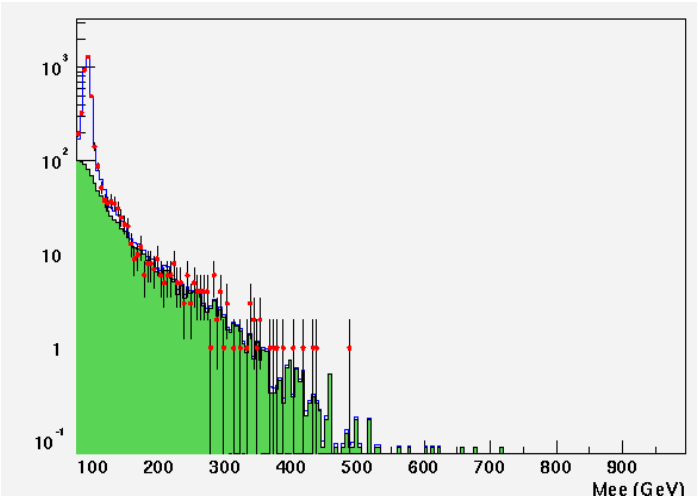
W→μν Outlook

- D0Note draft sent to EB 13 Feb
- Event counting method for background subtraction produces different number of events
  - Investigate p_T dependence of background
- Studying veto on more than one μ
  - remove Z→μμ

Search for Z'→ee

- 51 pb-1 (EM_MX_SH)
- Event Selection
  - 2 electrons, E_T > 25 GeV, EC: 1.5<|η|<2.5,
    CC: |η|<1.1& |phi-crack|>0.02,
    EMFrac > 0.9, Iso < 0.15, HM8 < 15 + slope*(E_T – 45 GeV)
    - Slope = 0.023 (CC), 0.043 (EC)
  - Efficiency from MC
- Background estimation
  - Drell-Yann and Z from MC smear/scaled to match Z peak, QCD background scaled to fit around Z peak.

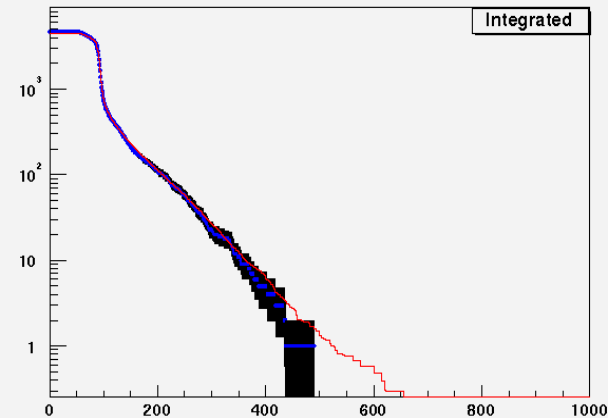


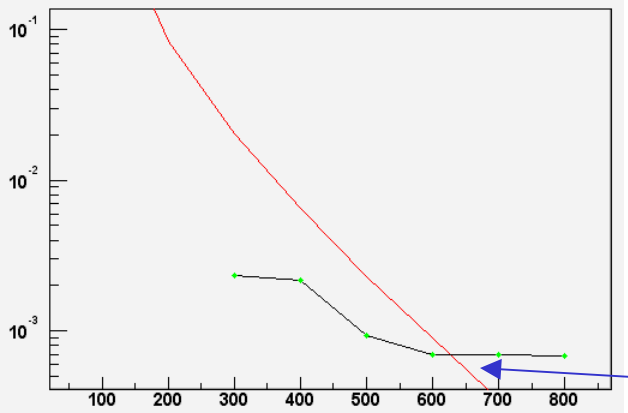


ee Invariant Mass

Z'→ee Mass Limit

- Limit is on Z'/Z cross section
  - Remove lumi error, $A_Z/A_{Z'}$ from PMCS





GeV	#expected	#observed
150-200	116 ±10	102
200-250	55 ± 5	53
250-350	45 ± 5	47
350-450	9.5 ± 1.1	10
450-550	2.0 ± 0.23	1
550-750	0.75 ± 0.09	0
750-1000	0.022 ± 0.002	0

95% CL Limit = 620 GeV

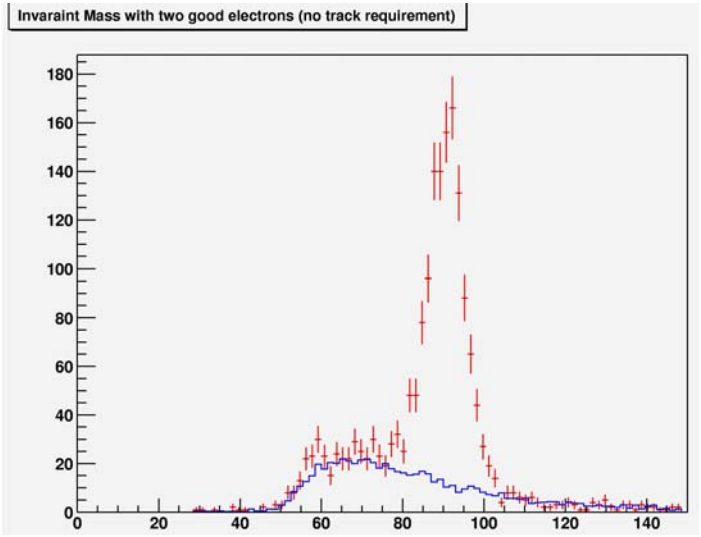
W→eν Cross Section Analysis

- 43 pb^{-1} (EM_HI_SH, EM_HI_2EM5_SH, EM_MX_HI)
- Event Selection
  - Electron:

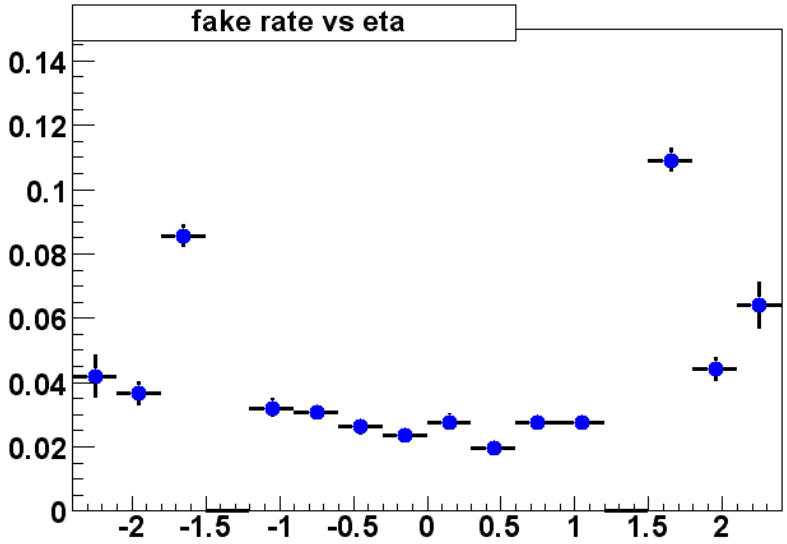
$$\sigma_Z = \frac{N_Z}{L}\frac{1}{A_Z}\frac{1}{1-(1-\varepsilon_{trig}^{EM})^2}\frac{1}{\varepsilon_{EMID}^2} \qquad \sigma_W = \frac{N_W}{L}\frac{1}{A_W}\frac{1}{\varepsilon_{trig}^{EM}}\frac{1}{\varepsilon_{EMID}}$$

    $p_T > 25$, $|\eta_{det}| < 1.1$, is_in_fiducial, EMFrac > 0.9, Iso < 0.15, HM8 < 20
  - 2 Electrons for Z candidates
  - 1 Electron, MET > 25 GeV for W candidates
- N_Z from invariant mass distribution, N_W from matrix method (track matching)

ee Invariant Mass

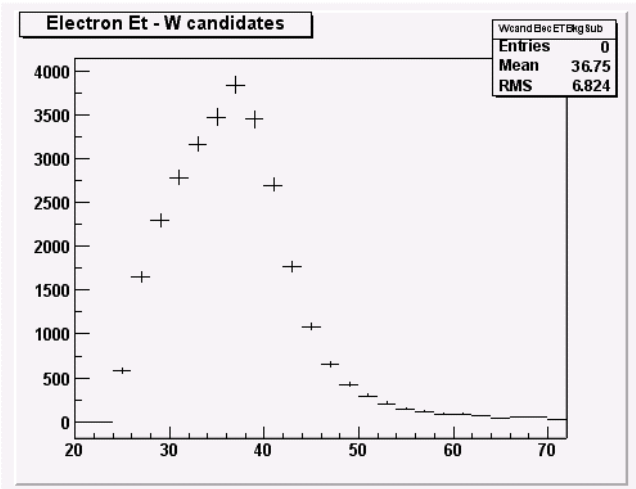


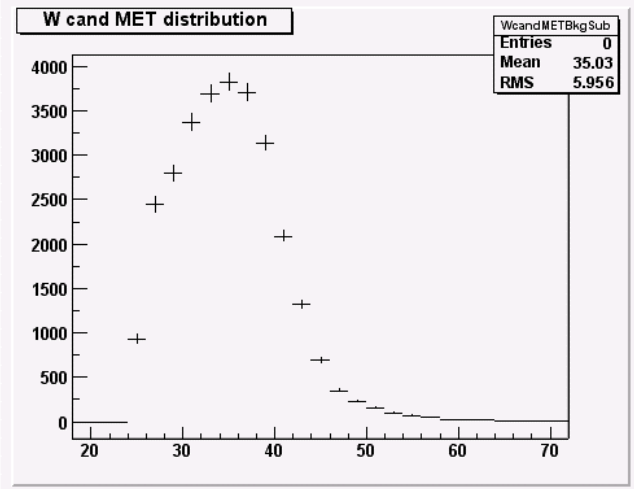
Track Match Fake Prob (QCD Data)

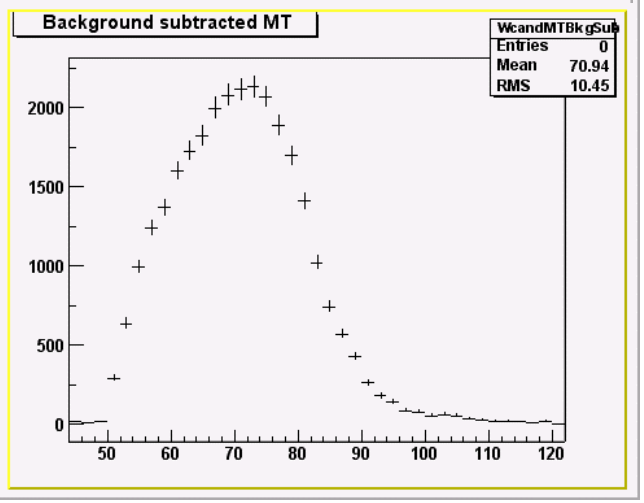


W→eν Matrix Method

- Matrix method uses track match
  - Track matching efficiency from Z data
  - Fake track matching probability from QCD data







$W \rightarrow e\nu$ Cross Section

A_W	=	$25.5 \pm 0.2\%$
A_Z	=	$13.2 \pm 0.1\%$
ε_{trig}	=	$91.2 \pm 1\%$
ε_{EMID}	=	$85.3 \pm 1\%$
ε_{track}	=	$72.9 \pm 1\%$
f_{QCD}	=	2.7%

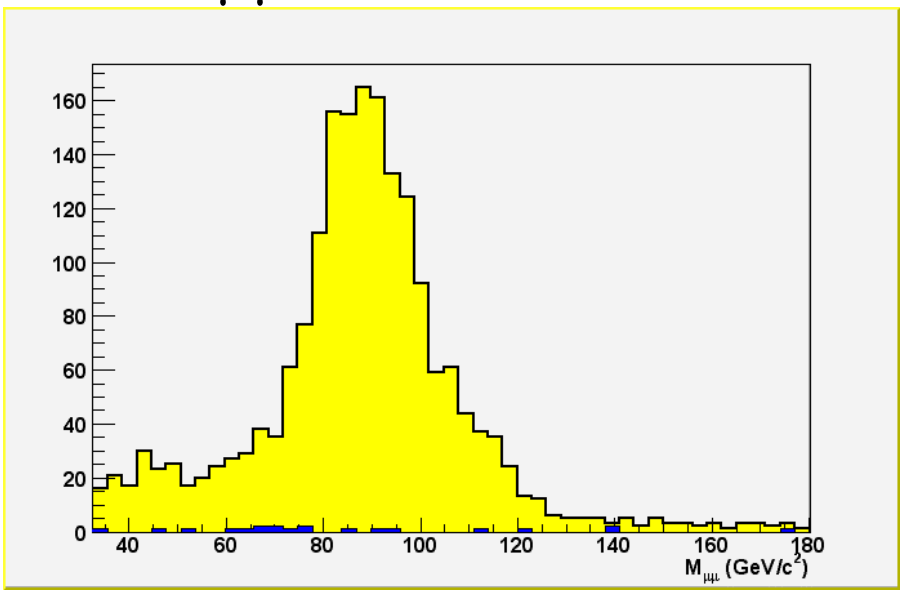
$N_Z = 1151$ $N_W = 29127$

- Cross checks and systematics under way

Z→μμ Cross Section Analysis

- Event Selection (di-m trigger)
  - Tune cuts for low background w/ good efficiency
  - 2 loose μ w/ track match, $p_T > 15$ GeV, $\Delta t_{A\ layer} < 9$ ns, $\Delta R(\mu\text{-}\mu) > 2$, 1 isolated μ, opposite charge

μμ Invariant Mass



Outlook

- All analyses trying for Moriond
  - If Moriond slips then DPF
- Begin di-boson and W asymmetry analyses mid-March
- W mass longer term
- Small number of students
  - Plenty of opportunities for new students!