W/Z physics at DØ

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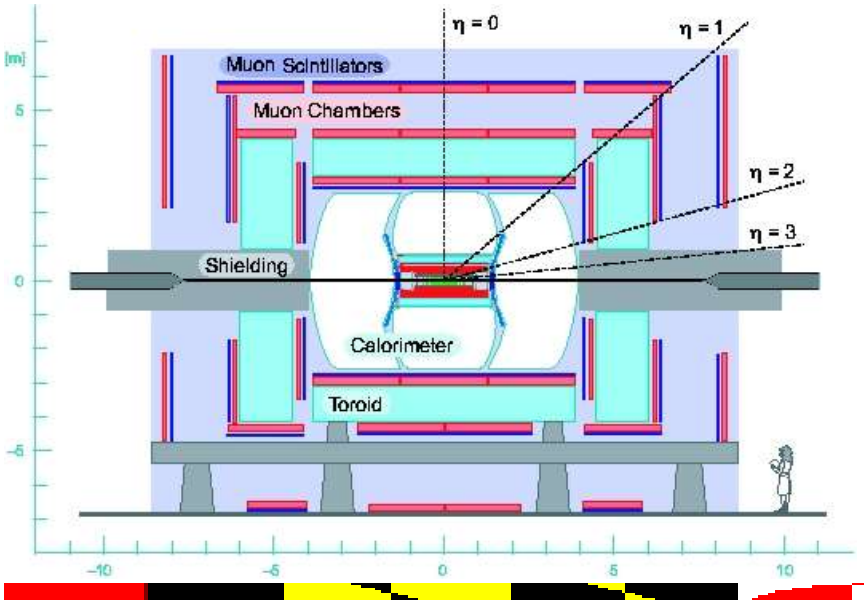
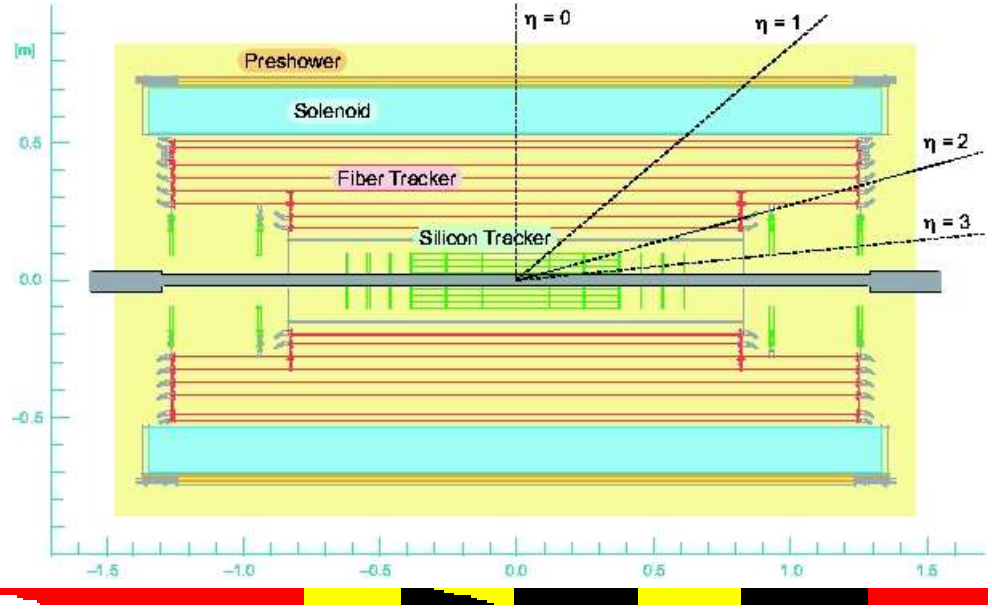
- **RunII detector and data**
- **How W/Z measurements are done**
- **Review W/Z cross section measurements at DØ**
- **Comparison with CDF**
- **Wγ production**
- **Future prospects**

All results are preliminary

The DØ detector for Run II

- **Build on strengths of Run I:**
  - **State of the art calorimetry, hermetic detector**
- **2T superconducting solenoid**
- **Inner tracker (silicon microstrips, scintillating fibers)**
- **Preshower detectors**
- **Increased shielding, upgraded muon system**
- **Faster readout electronics**
- **New trigger and DAQ**

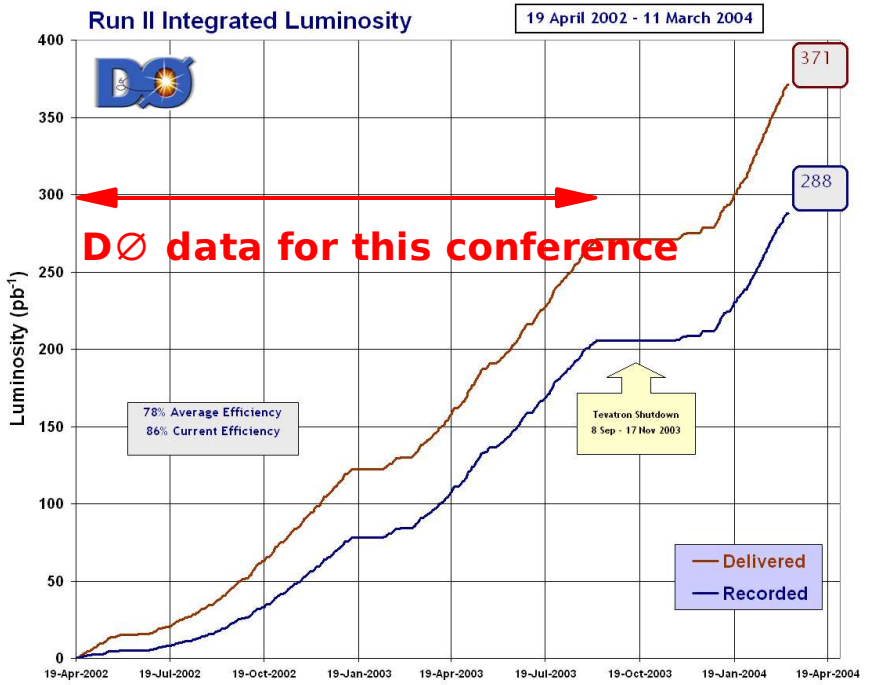


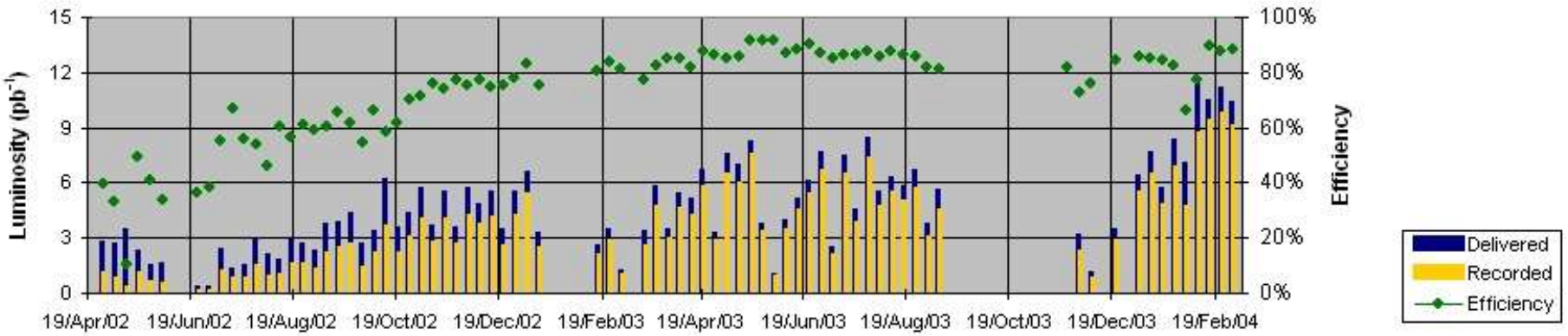


Data taking

Full data reprocessing of pre Sep 03 data finished Jan 15

Data taking efficiency routinely around 85% (and above) with full detector readout





Measurement strategy

- Reduce reliance on full detector simulation
- Data used to measure trigger,reconstruction and identification efficiencies
  - pure samples of $Z \rightarrow l^+l^-$ selected without applying tight selection criteria to both leptons
- Data derived parametrisation of efficiencies used in fast simulation of detector response for calculation of acceptance and overall detection efficiency
- Pythia used for event generation
  - cross checks performed using Resbos based event generator
- Backgrounds measured using data
- Full simulation used only as cross-check

Electron identification

Use calorimeter & tracking information:

- **large fractional energy deposit in EM sector**
- **isolation (fraction of energy in hollow cone between $\Delta R=0.2$ and 0.4)**
- **shower shape distribution**
- **track match (Δ , Δ and E/p_T)**

Efficiencies measured using $Z \rightarrow ee$ decays (trigger 100% above 30 GeV, ID >90%, track matching – include E/p_T - 75-80%)

Probability of misidentification measured using dijet events

Muon identification

Muon track measured twice:

- **toroidal spectrometer (position and timing information before & after magnet)**
- **precision p_T measurement in central tracker**
- **track match (position and momentum)**

Veto μ from jets (mostly b) using isolation (measured with calorimeter and tracks)

Veto cosmics using timing information, veto additional μ, tracker information

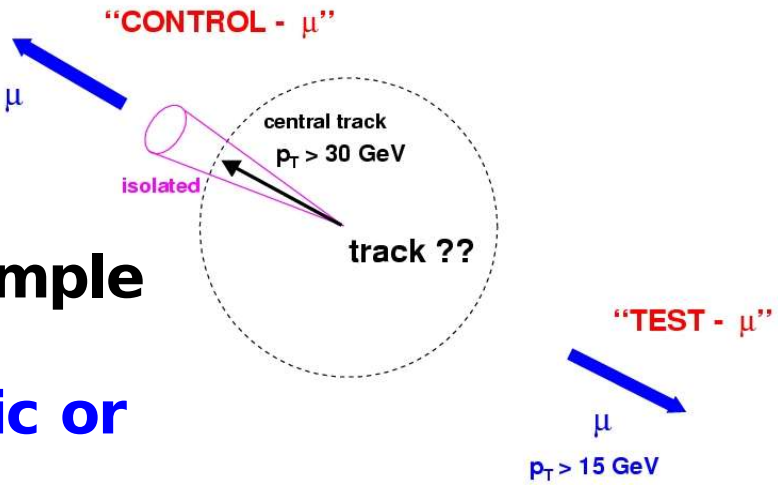
Trigger efficiency (single μ): 50 %

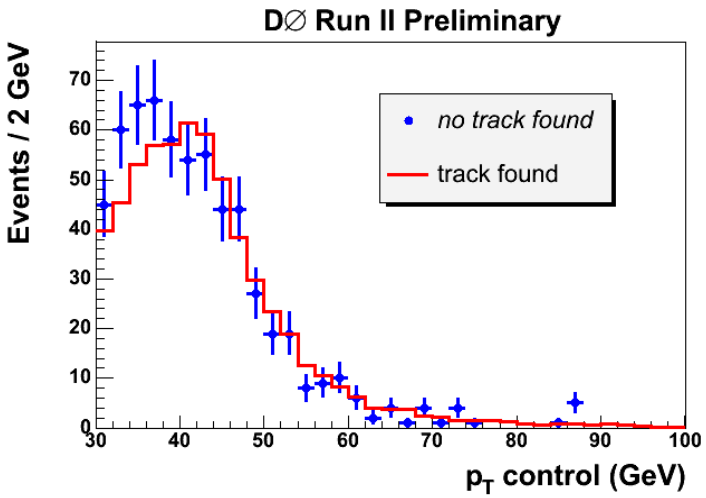
Tracking efficiency > 95% inside the acceptance

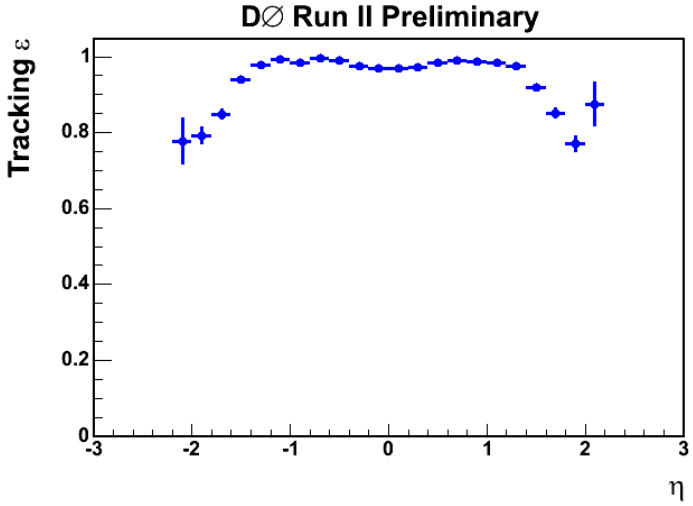
Isolation 91%

Measuring ID efficiencies

- Select pure Z sample with tight cuts on one lepton
- 2nd lepton provides unbiased sample for efficiency measurement
- only biases come from kinematic or geometrical correlations

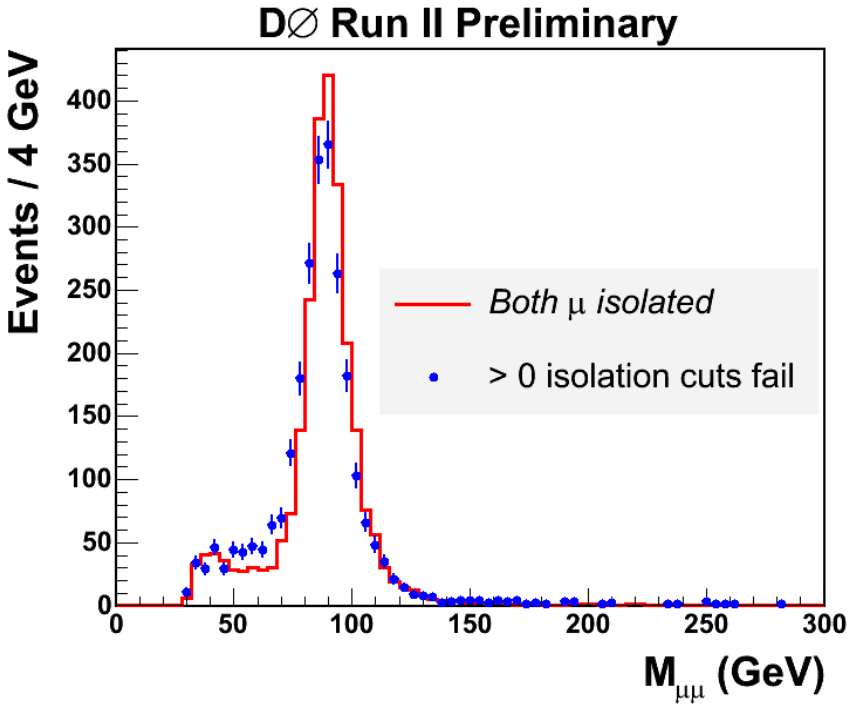






Select $Z \rightarrow \mu\mu$ events

- Select 2 opposite charge μ with p_T>15 GeV
- $|\eta|$<1.8
- Invariant mass > 30 GeV
- At least 1 μ pass isolation criteria
- Timing and distance of closest approach cuts to veto cosmics



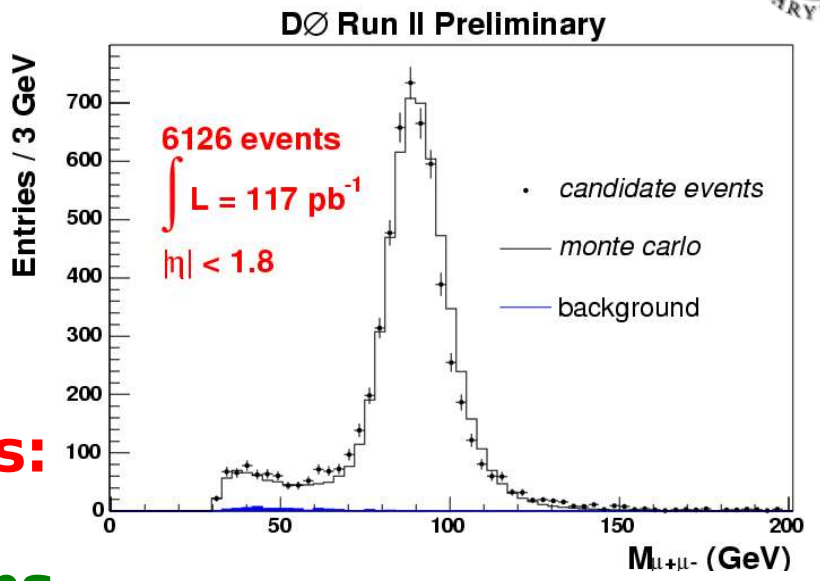
- Backgrounds:
  - $Z \rightarrow \tau\tau$ (use MC): (0.5±0.1)%
  - bb (use like-sign pairs): (0.6±0.3)%

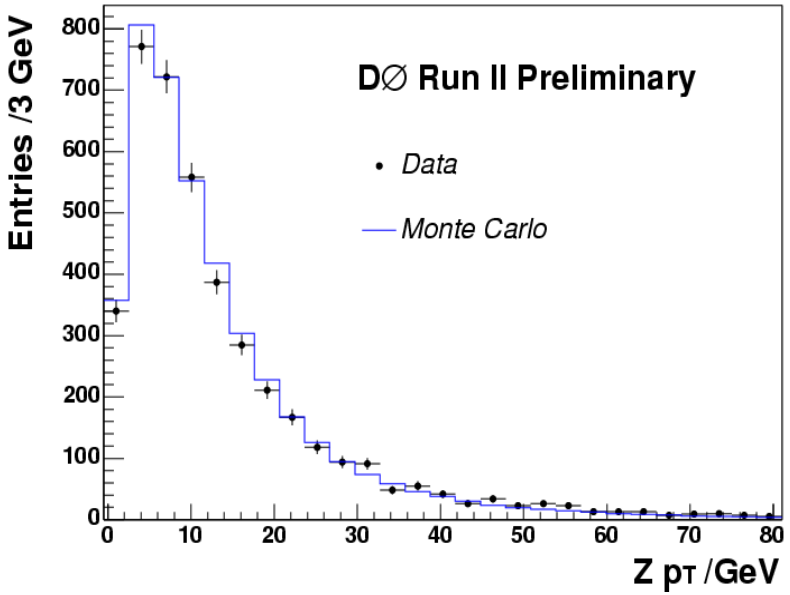
$Z \rightarrow \mu\mu$ events

- Correct from Z/ * to Z using MC
- σ= (261.8±5.0±8.9±26.2)pb

- Main systematic uncertainties:
  - Drell-Yan correction
  - Parton Distribution Functions (using CTEQ6)
  - Acceptance

- Also starting to measure WZ bosons differential cross sections

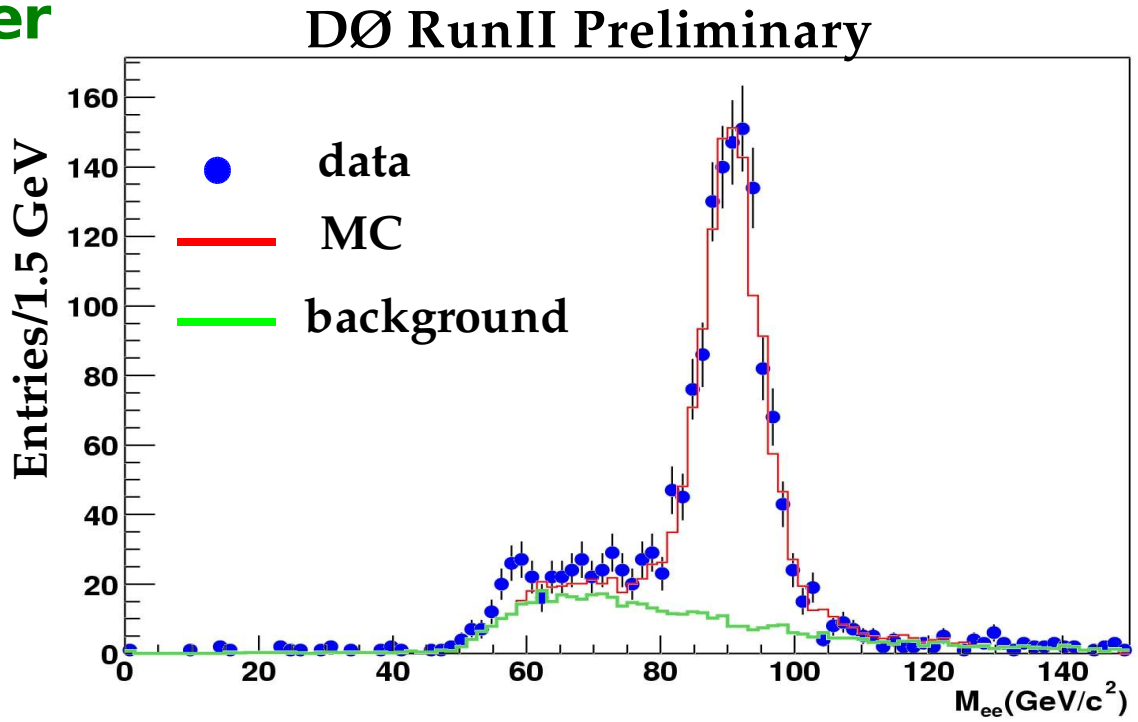




Z→ee events

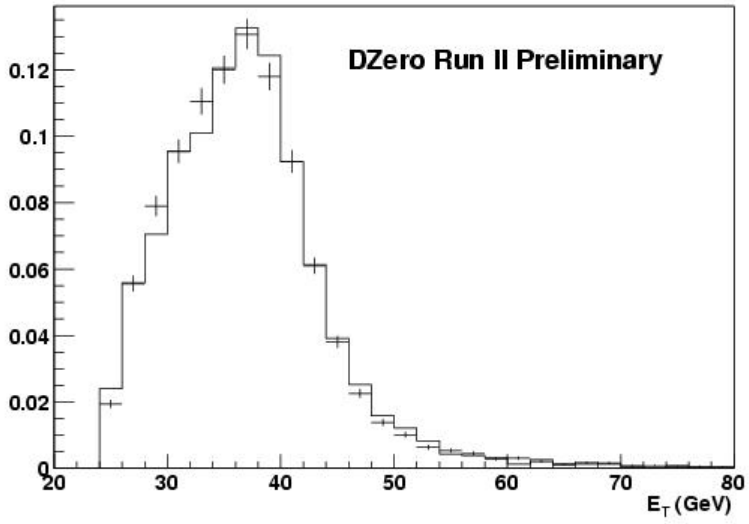
- 2 isolated electrons with E_T>25 GeV
- no track match requirement
- $|\eta|$<1.1
- 41.6 pb^{-1}
- 1139 candidates after bkgd subtraction
- Bkgd shape from data (dijet)
- σ= (275±9±9±28)pb

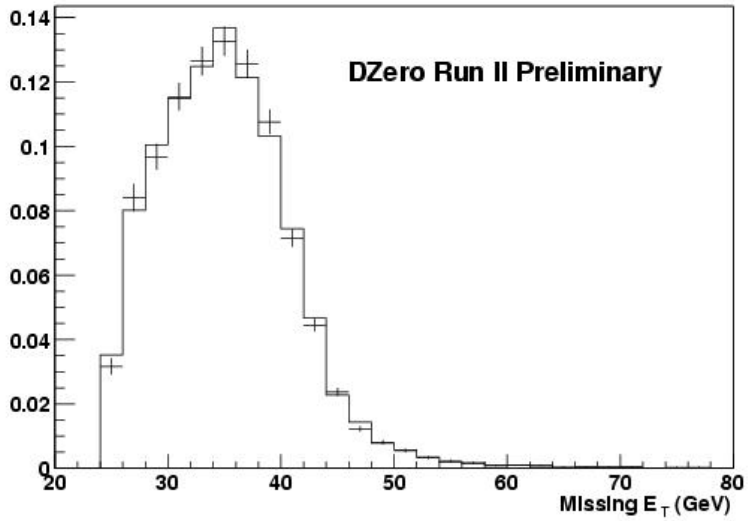
- Main systematics:
  - Emid
  - PDF
  - Background



W→eν events

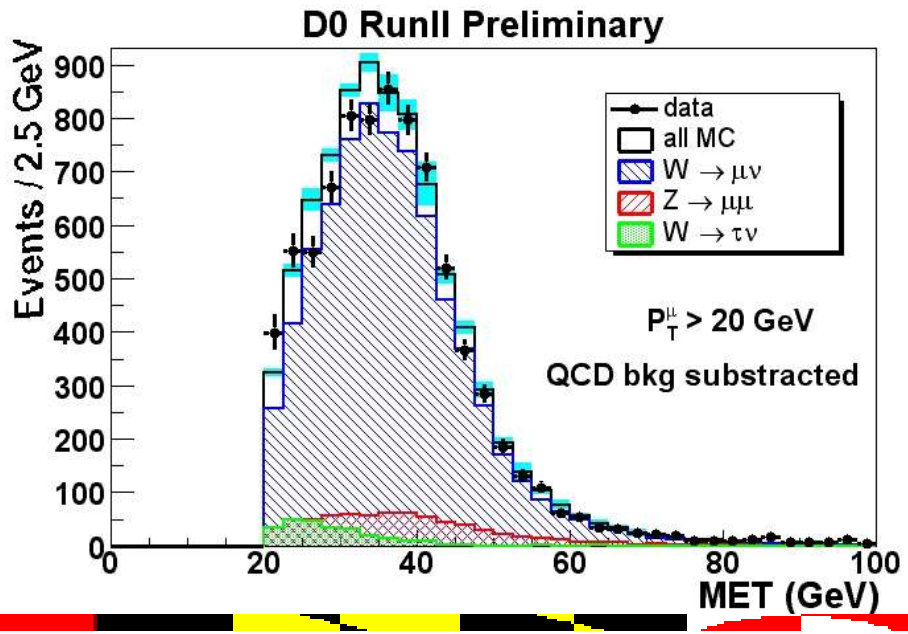
- 1 electron with p_T>25 GeV in $|\eta|$<1.1, $\not\!\!E_T$>25 GeV
- Determine and subtract QCD background using track match, residual background W→τν and Z→ee
- 27.4K candidates in 41.6 pb^{-1}
- σ= (2844±21±128±284)pb
- Main sources of syst uncertainties as for Z →ee

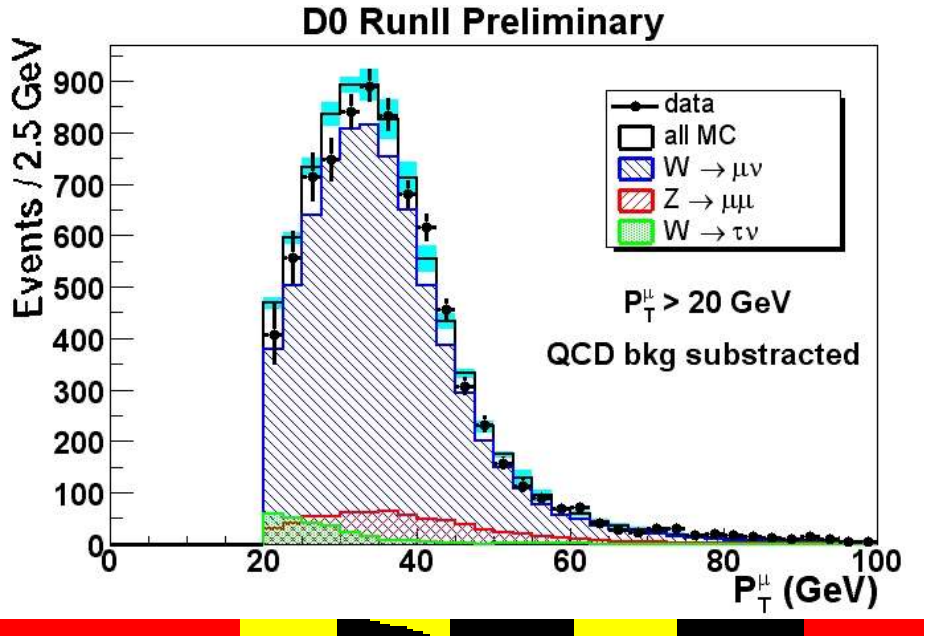




W→ events

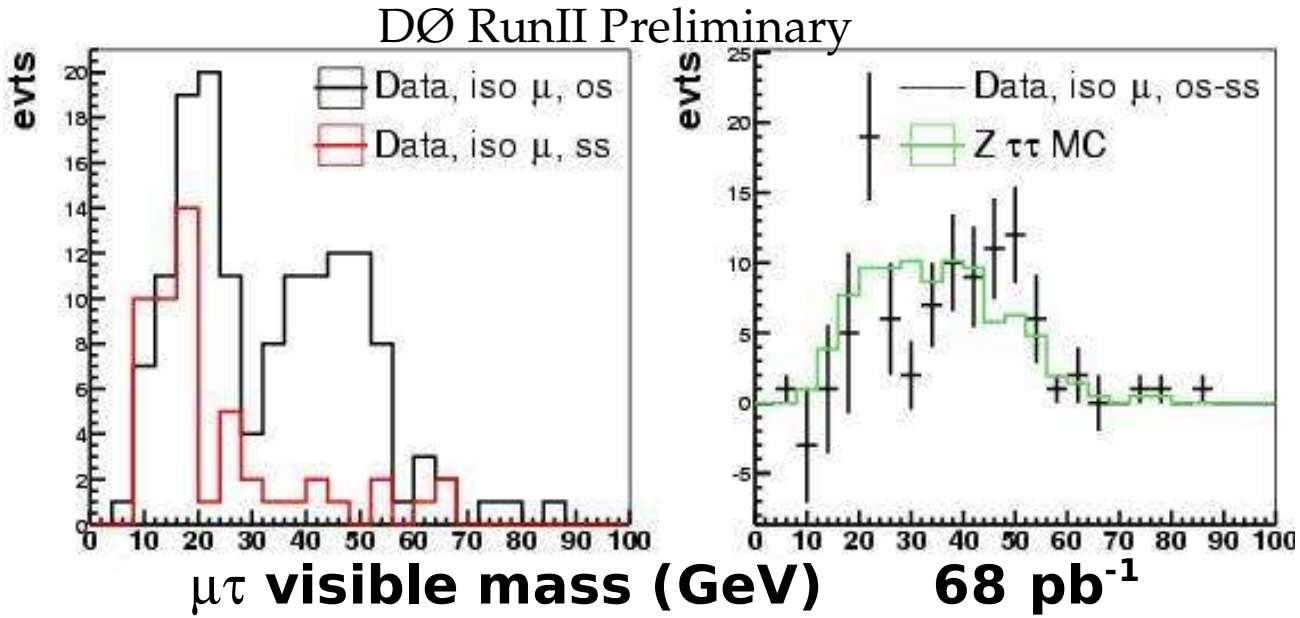
- 1 isolated μ with p_T>20 GeV in |η|<1.6, $\not\!\!E_T$>20 GeV
- veto additional muons
- 8305 candidates after bkgd subtraction in 17.3 pb^{-1}
- large (11.8%) contamination from W→τν and Z→μμ
- σ= (3226±128±100±322)pb
- understanding of QCD background main syst





Z→ events

- Proof of principle, can observe ττ resonances
- 1 τ decays into , other τ hadronic 1 prong decay
- Backgrounds: QCD with from bb or in flight decays, W→μν plus 1 jet, Z→μ
- Observe small number of events compatible with SM predictions

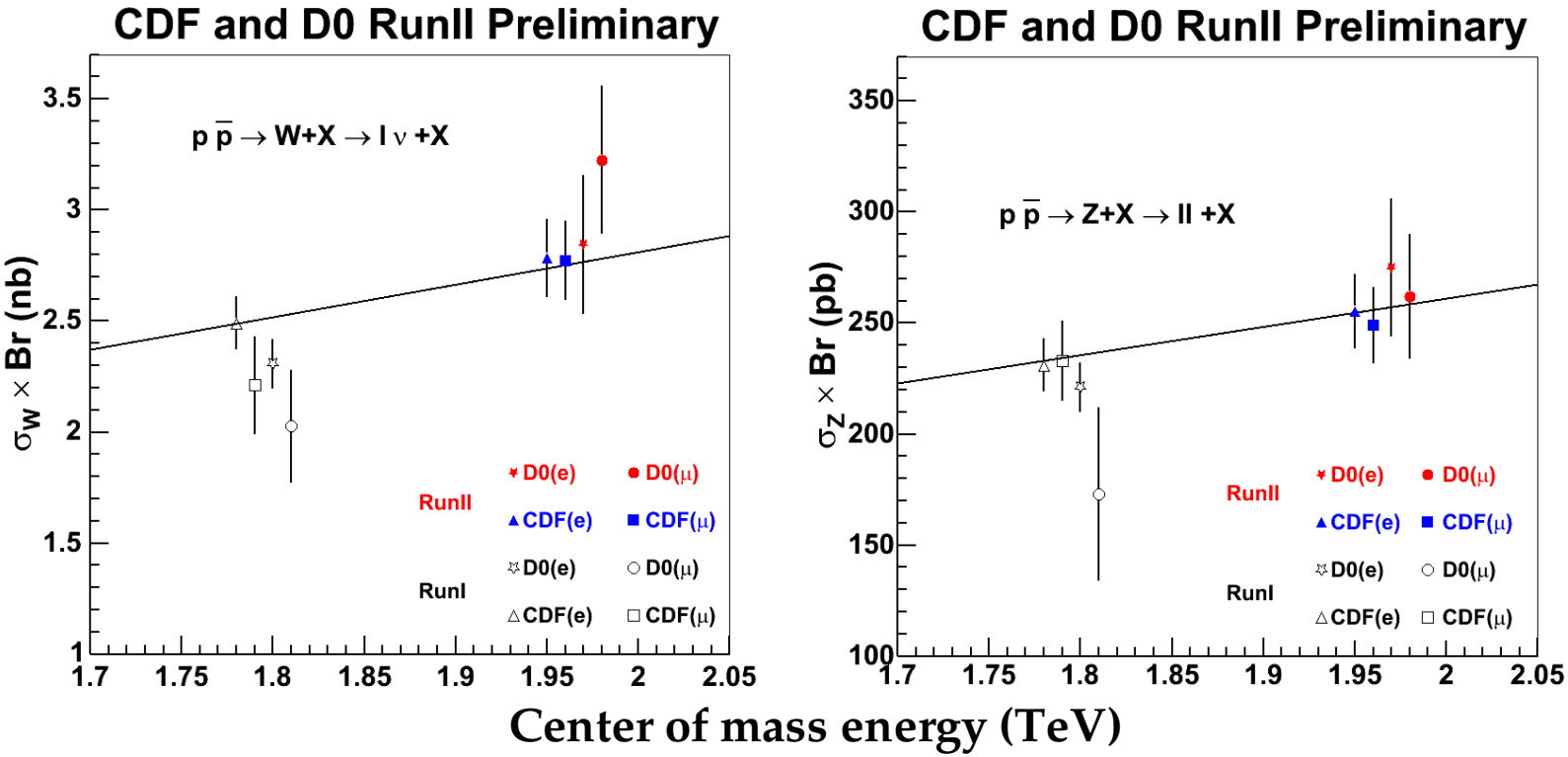


Cross section summaries

Last time you see this plot with different normalizations

CDF and D∅ have agreed to use a common normalization for Run II

CDF already uses it, new D∅ results will use it (already used for other results presented at this conference)



CDF/DØ comparison

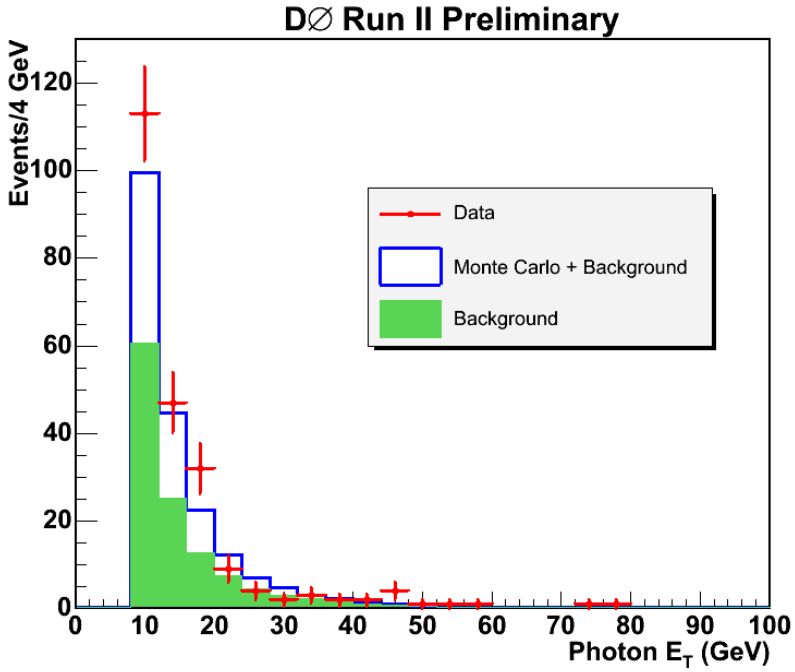
Channel	Candidates & purity	Integrated luminosity (pb^{-1})	Efficiency * acceptance
CDF W→eν	37.6K (95%)	72	14.39%
DØ W→eν	27.4K (98%)	41	18.40%
CDF W→μν	31.7K (90%)	72	17.94%
DØ W→μν	8.3K (88%)	17	13.20%
CDF Z→ee	4242 (1.5%)	72	22.74%
DØ Z→ee	1139 (-------)	41	9.30%
CDF Z→μμ	1785 (1.5%)	72	10.18%
DØ Z→μμ	6126 (1.1%)	117	16.40%

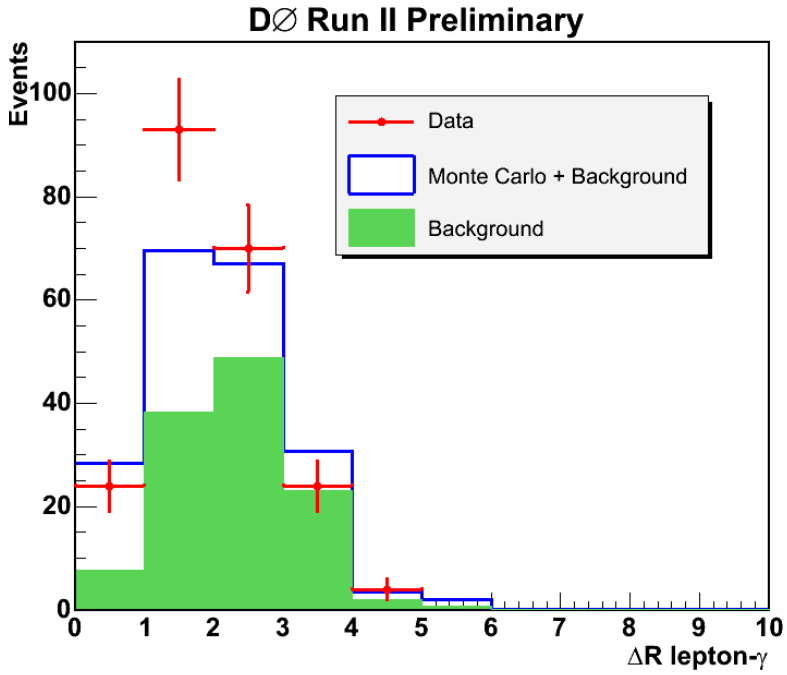
Photon identification

- **Photons are identified as electrons but:**
  - **Veto track(s) in cone around EM cluster**
  - **Require ΔR separation from lepton of 0.7**
  - **E_T>8 GeV (CDF 7 GeV, results not directly comparable)**
- **Efficiency measured from data using Wγ sample (and jet sample to simultaneously fit for Wj background): (47±13)% (largest systematic error in cross section measurement)**

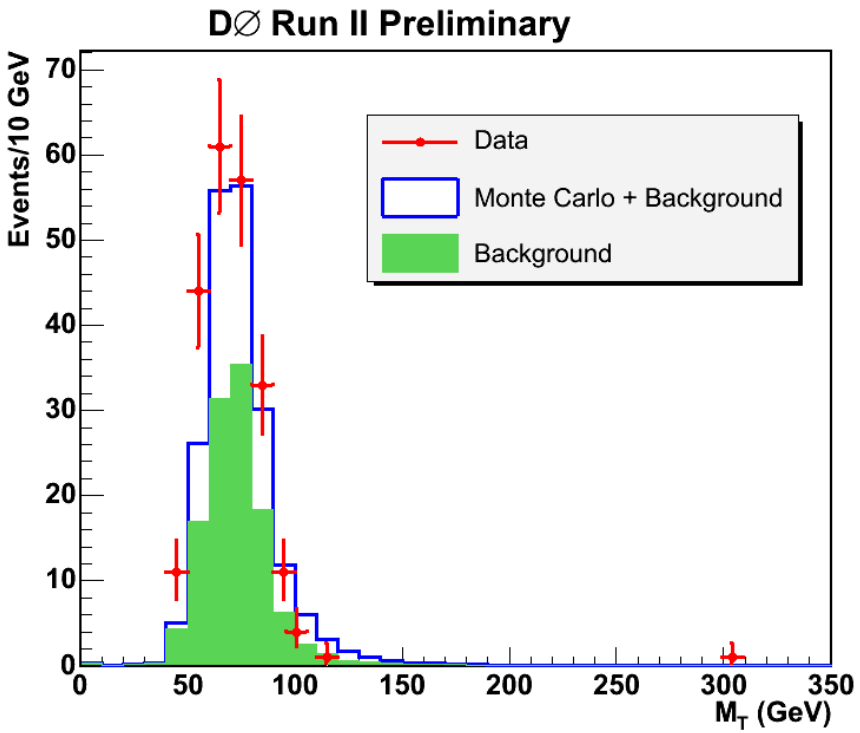
Wγ final state

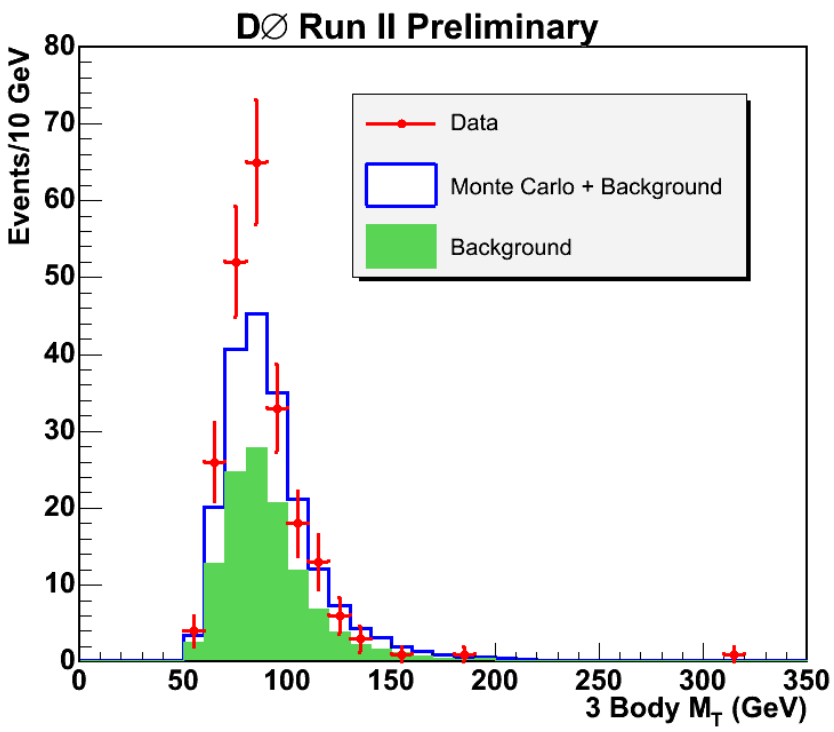
- **Electron channel: $|\eta|<1.1$ and $1.6<|\eta|<2.3$, $p_T>25$ GeV, $\not{E}_T>25$ GeV, $M_T>40$ GeV**
- **Muon channel: $|\eta|<1.6$, $p_T>20$ GeV, $\not{E}_T>20$ GeV**
- **Backgrounds: W+jets, lepton+electron+X, Zγ, $W\gamma\rightarrow\tau\nu\gamma$,**





Wγ cross section





- **Observe 146 candidates (e, 162.3 pb^{-1}),77 (μ, 82.0 pb^{-1})**
- **σ= (17.8±3.6±5.3±1.1) pb (electrons)**
- **σ= (22.0±4.2±7.3±1.4) pb (muons)**
- **σ= (19.3±6.7±1.2) pb**
- **Theory (Baur + K factor) : σ= (16.4±0.4) pb**

Future prospects

- **Expect first publications with O(200 pb-1) in the next months on:**
  - **W/Z cross sections using full angular acceptance**
  - **Universality tests in charged current interactions and indirect measurement of Γ_W**
  - **Wγ and Zγ cross sections (limits on anomalous couplings, search for radiation zero)**
  - **WW cross section evidence**
  - **Limit on WZ cross section in trilepton channel**
  - **Differential cross sections for Z/γ* and W (angular asymmetries, pT)**
  - **Direct measurement of Γ_W**