# Recent Electroweak and Top–Physics Results from D0

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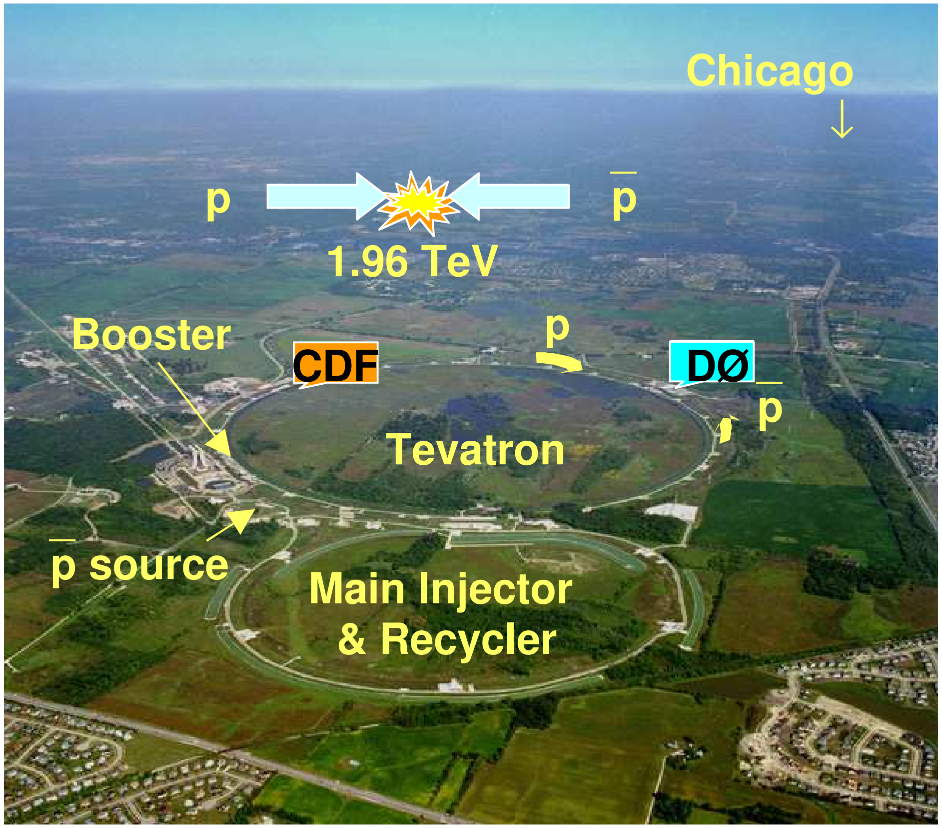
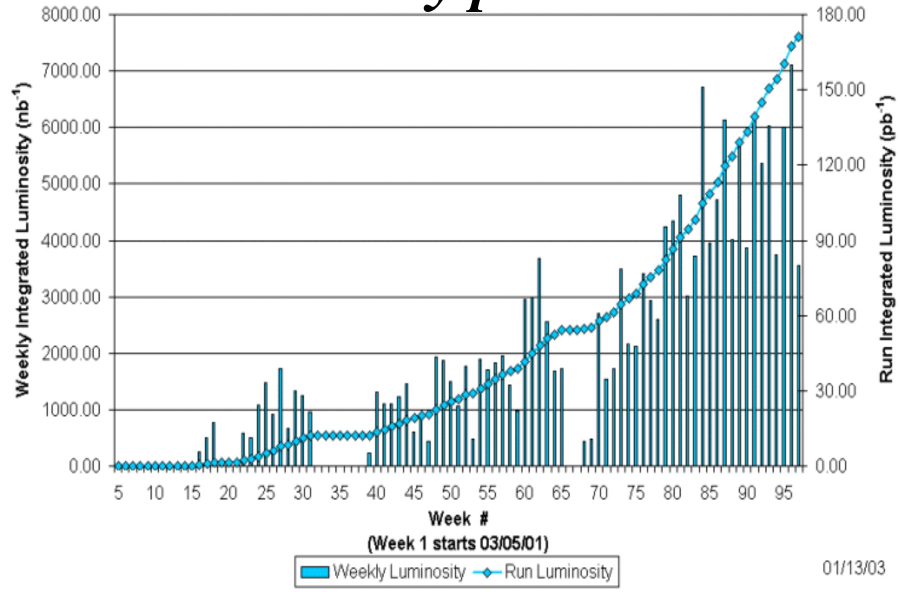
*Introduction*
*Results in Electroweak Physics*
*Progress in Top Physics*
*New Top Mass Measurement (RunI)*
*Summary*

# Introduction




***RunII integrated luminosity per week***

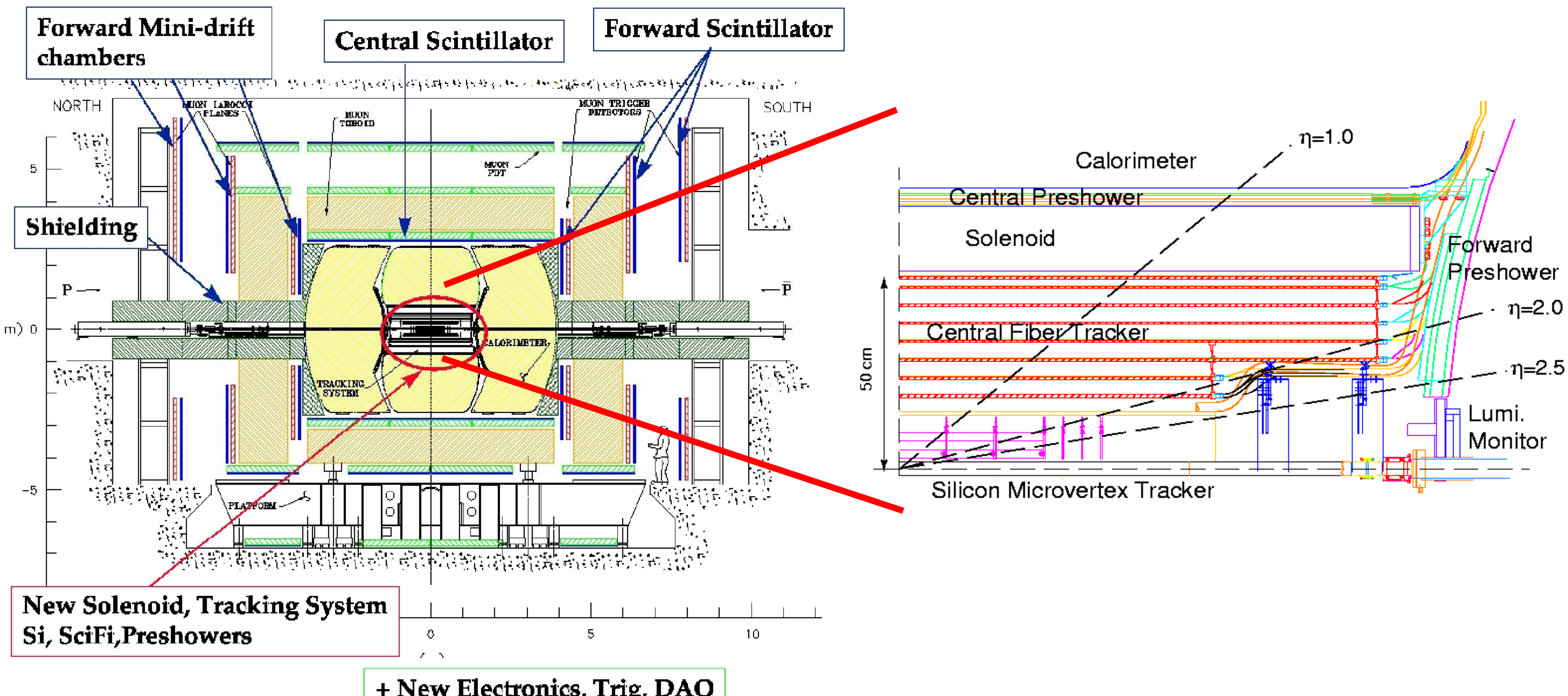



*RunII peak luminosity* $3.54 \cdot 10^{31} cm^{-2} s^{-1}$

*RunI: 1992–1995* $L_{int} \sim 100\ pb^{-1}$

*RunII: 2001–...* $L_{int} \sim 50\ pb^{-1}$ *used for physics in DØ*

# Introduction




*D0 Run II detector is built on strength of the Run I detector:*

*LAr Calorimeter*

*Lepton Id over large η range*

*2T superconducting solenoid*

*Inner tracker (silicon microstrips, scintillating fibers)*

*Preshower detectors*

*Increased shielding, upgraded muon system*

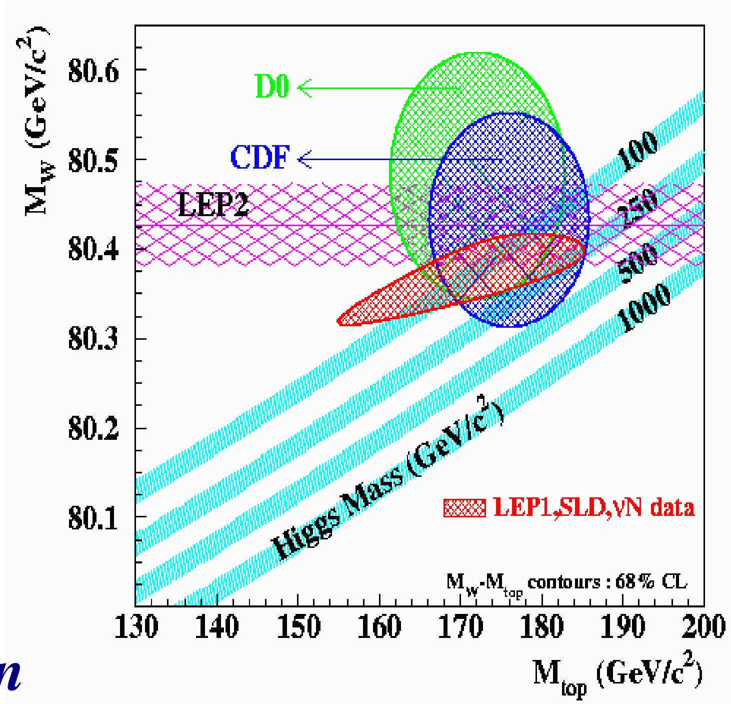
*Faster readout electronics*

*New trigger and DAQ*

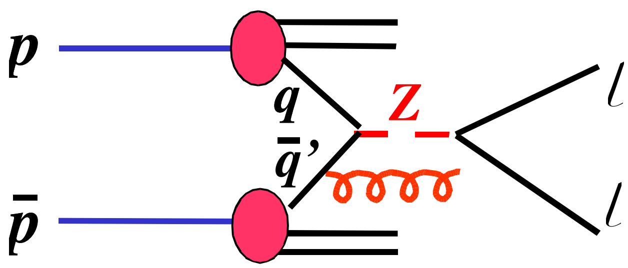
# Electroweak Physics

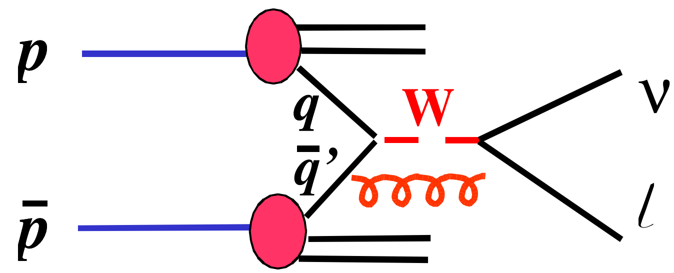
## Why do we study W's and Z's?

- Offer many tests of the standard model.
- Precision measurements with high statistic samples ( W rate ~ 1 Hz at $2 \cdot 10^{32} cm^{-2} s^{-1}$)
- W mass constrains Higgs mass.
- Understanding of W / Z + jets is crucial for $t\bar{t}$, single top and Higgs physics.
- W's and Z's are great objects for calibration and reconstruction efficiency measurement.
- Reduce systematic uncertainties in other measurements.

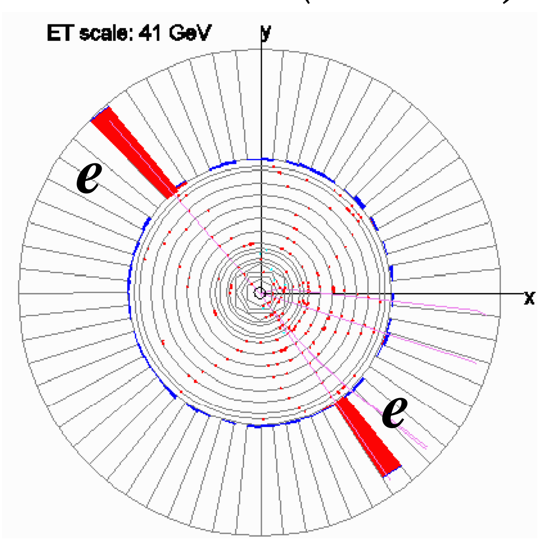


# Electroweak Physics



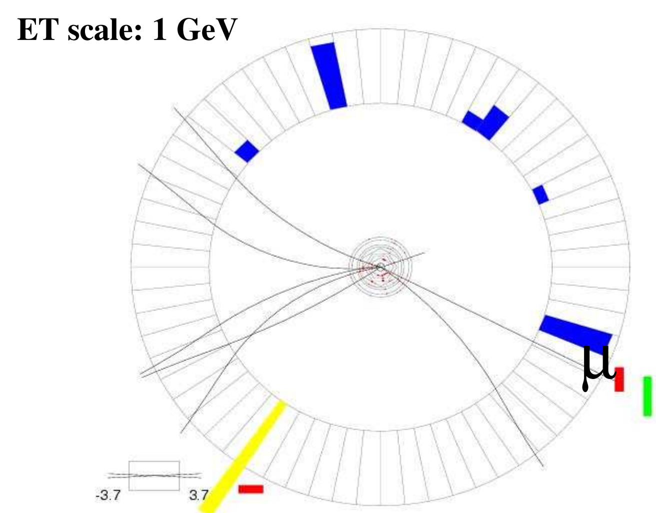




*Z –> $e^+e^-$ (3% BR)*




2 high pT isolated leptons

*W –> μ ν (11% BR)*

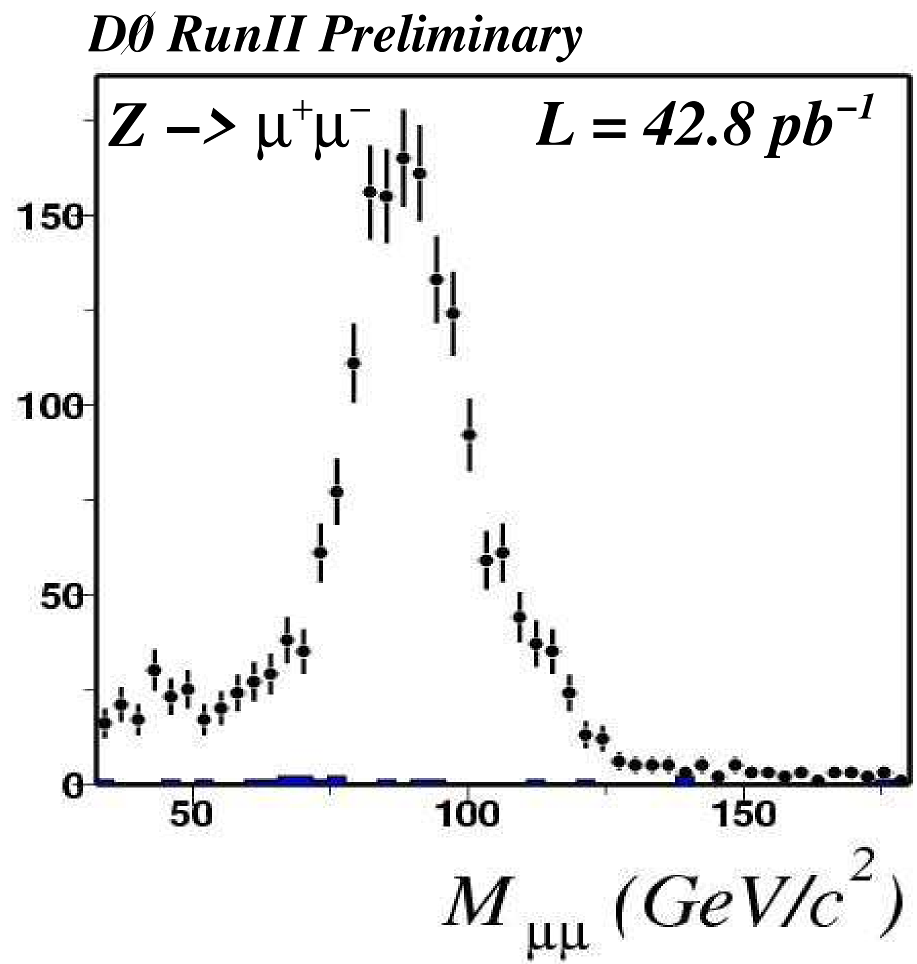



*1 high pT isolated lepton*
*Missing Et*

# Electroweak Physics

*selection:*
*2 μ's*
*μ pt > 15 GeV*
*one μ is isolated*

*use Z –> $\mu^+\mu^-$ sample*
*to measure reconstruction efficiencies and calibrate simulation*

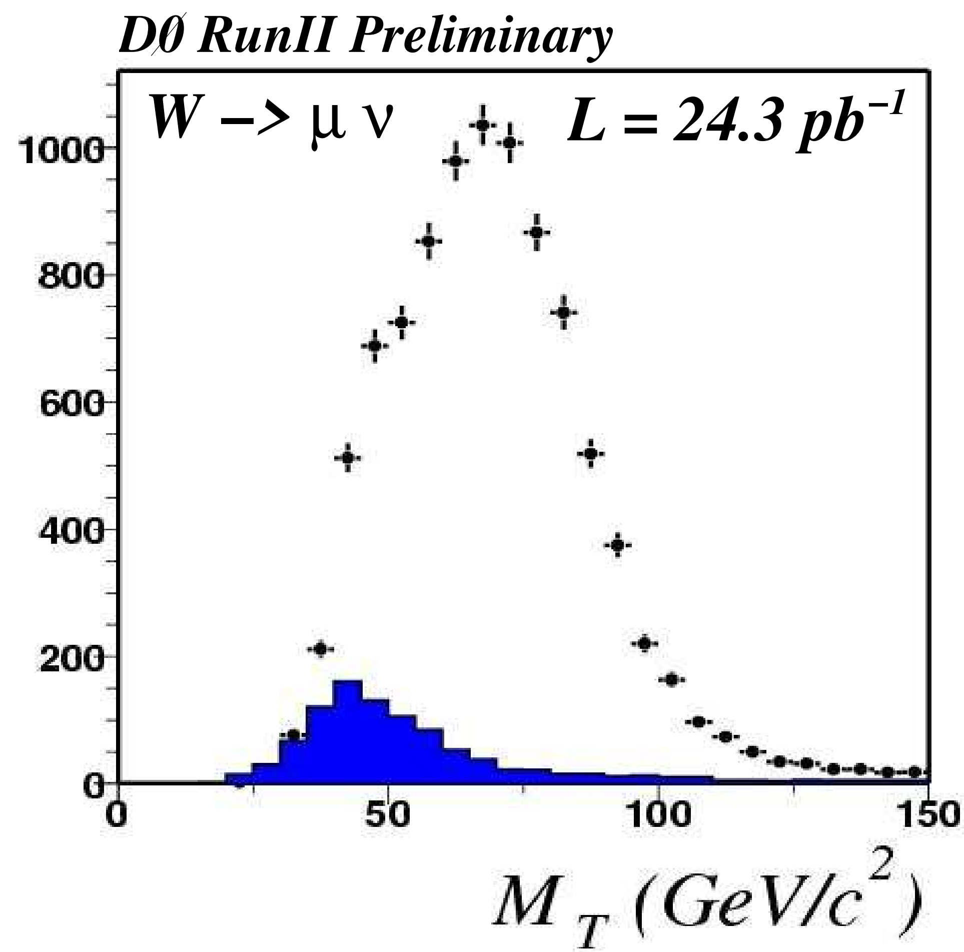



*Cross section measurement is being finalized*

# Electroweak Physics

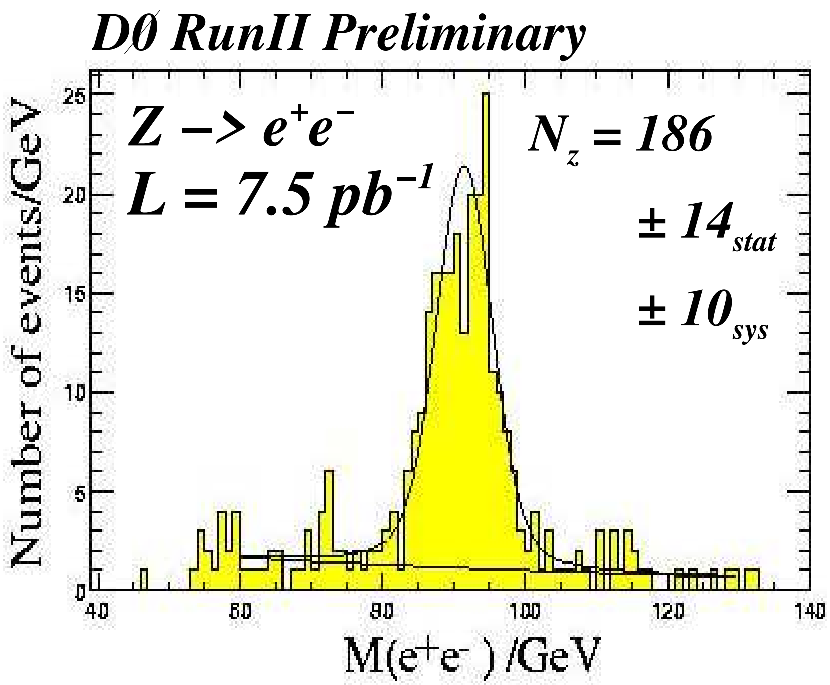
*selection:*
*μ pt > 20 GeV*
*μ is isolated*

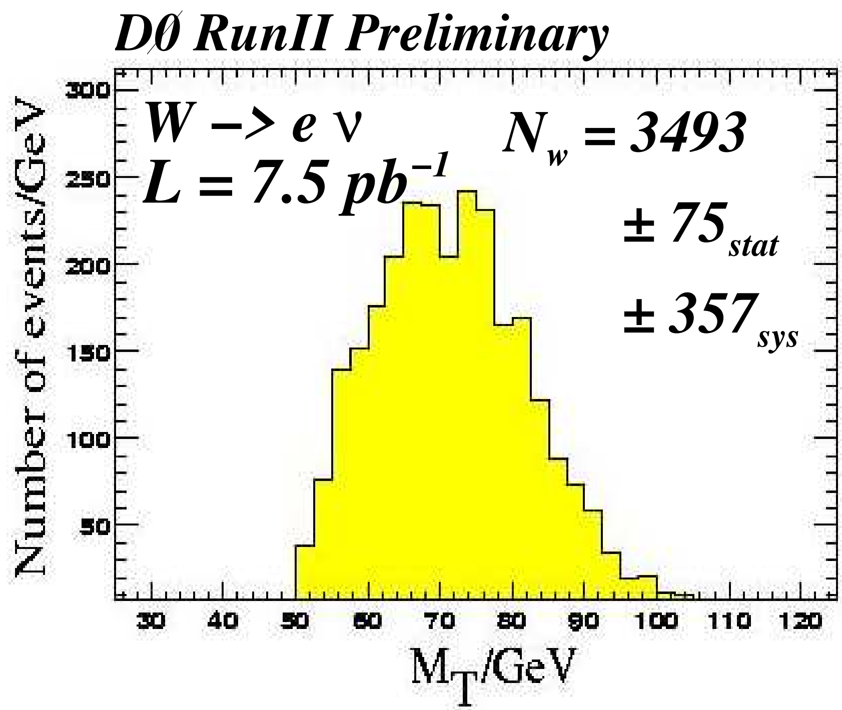
*Background estimation from data (blue histogram)*




*Cross section measurement is being finalized*

# Electroweak Physics




- *2 electrons pt > 25 GeV*
- *Sample of 328 events in only 7.5 $pb^{-1}$*
- *206 in 80−100 GeV mass window*
- *Estimated background: 20 events*

*(from fit to Breit−Wigner convoluted with gaussian plus exponential)*

- *electron pt > 25 GeV*
- *missing Et > 25 GeV*

# Summary / Future Prospects in EW physics

## Summary

- $\sigma_Z \cdot BR = 266 \pm 20_{stat} \pm 20_{sys} \pm 27_{lum}$ pb
- $\sigma_W \cdot BR = 2.67 \pm 0.06_{stat} \pm 0.33_{sys} \pm 0.27_{lum}$ nb

  $R = 10.0 \pm 0.8_{\ stat} \pm 1.3_{sys}$

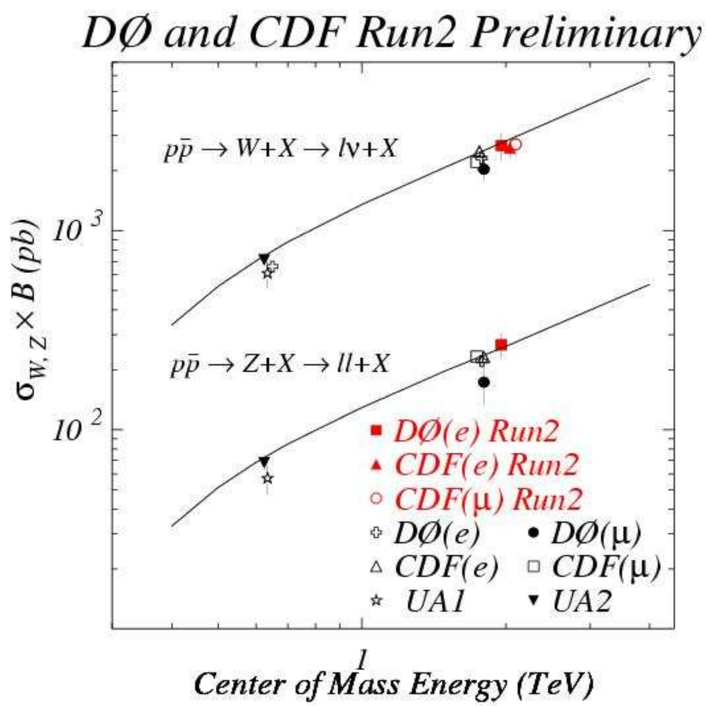
  $\Gamma_W = 2.26 \pm 0.18_{\ stat} \pm 0.29_{\ sys} \pm 0.04_{\ theory}$ GeV

  *first 7.5 $pb^{-1}$ in electron channel only*

$$R \equiv \frac{\sigma(p\bar{p} \to W + X) \times BR(W \to l\upsilon)}{\sigma(p\bar{p} \to Z + X) \times BR(Z \to ll)} = \frac{\sigma(W)}{\sigma(Z)} \times \frac{\Gamma(Z)}{\Gamma(Z \to ll)} \times \frac{\Gamma(W \to l\upsilon)}{\Gamma(W)}$$

## Future Prospects

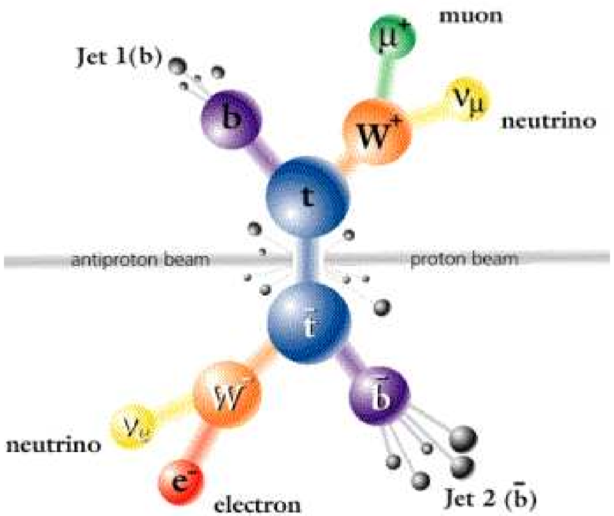
- W mass ( ~ 30 MeV)
- W width
- Triple gauge couplings Wγ, Zγ
- W asymmetry (PDF's)
- Z' search

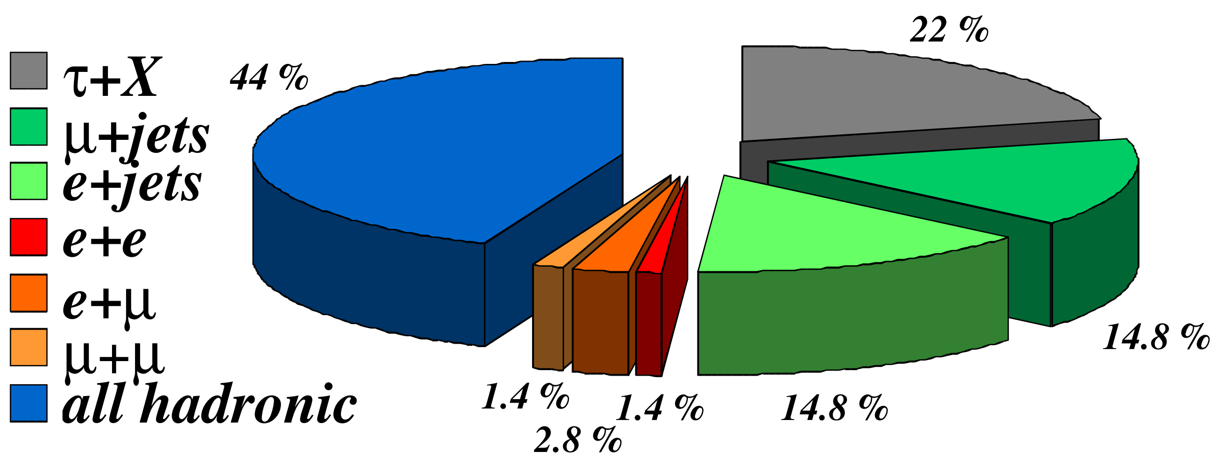


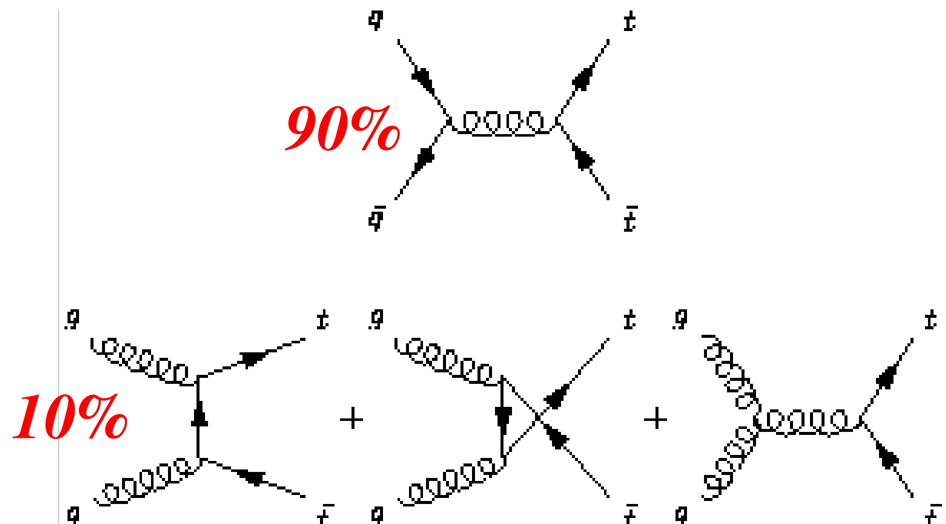
# Top Physics

*BR(top –> Wb) ~ 100%*

*W –> qq or W –> l±ν*



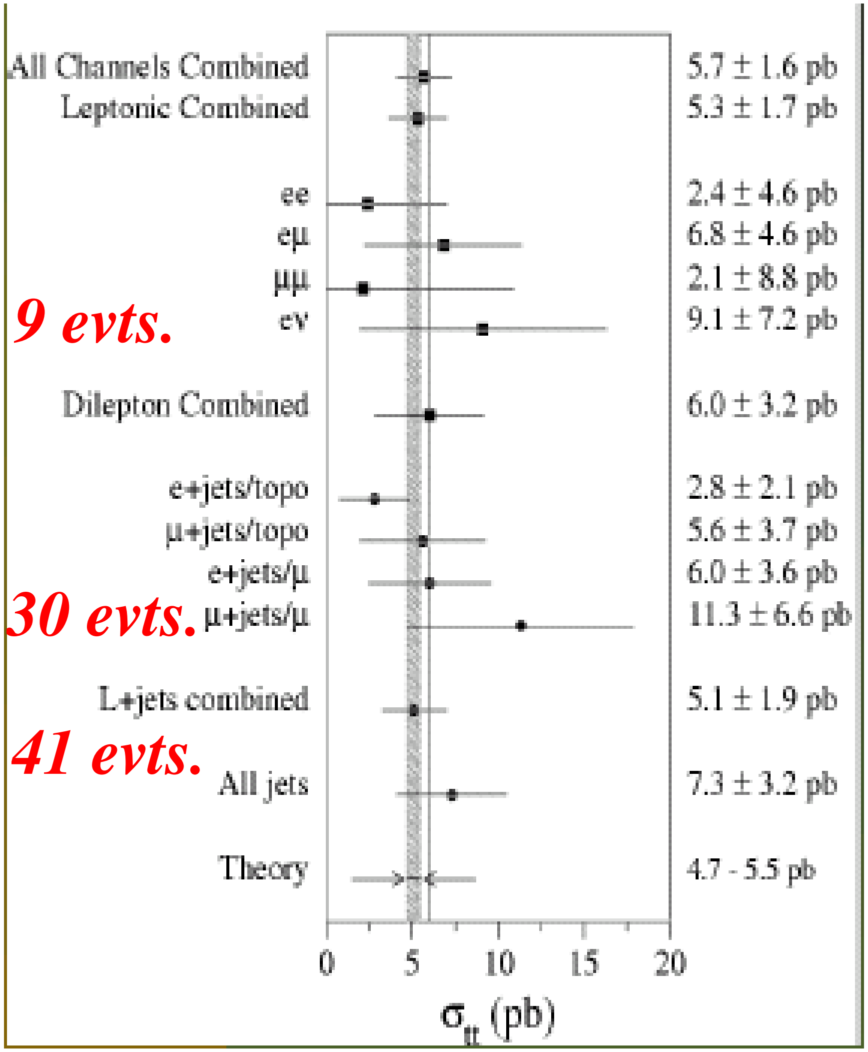

*Top events should have either*

- *2 jets, 2 charged leptons, 2 neutrinos*
- *4 jets, 1 charged lepton, 1 neutrino*
- *6 jets from quarks*

*2 jets come from b quarks*

# Top Physics

*D0 RunI Result*



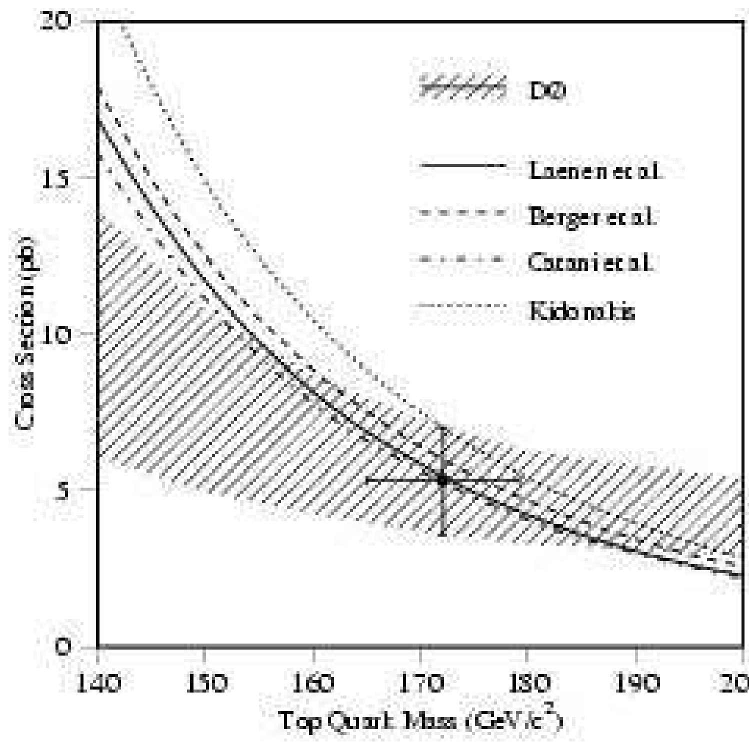

**9 evts.**

**30 evts.**

**41 evts.**

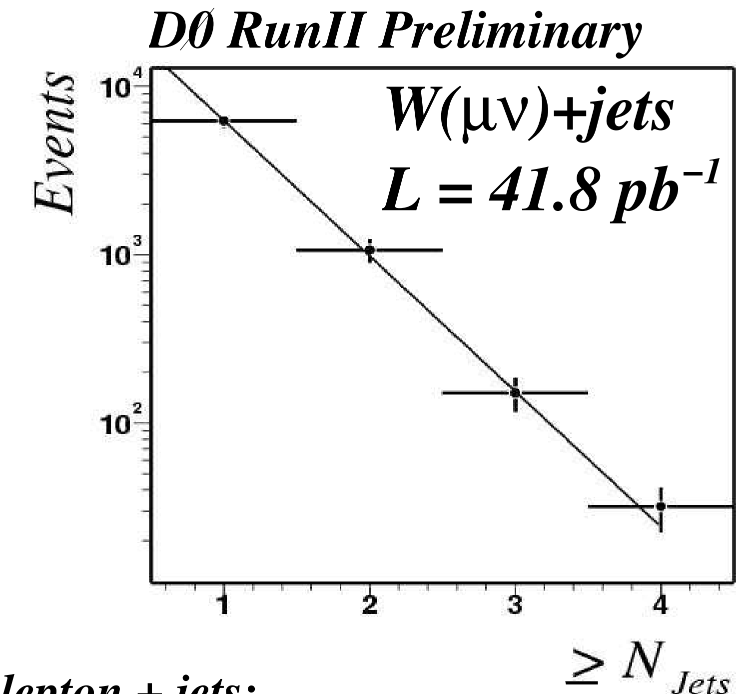
$\sigma(t\bar{t}) = 5.69 \pm 1.21_{stat} \pm 1.04_{sys}$ pb
*all channels*

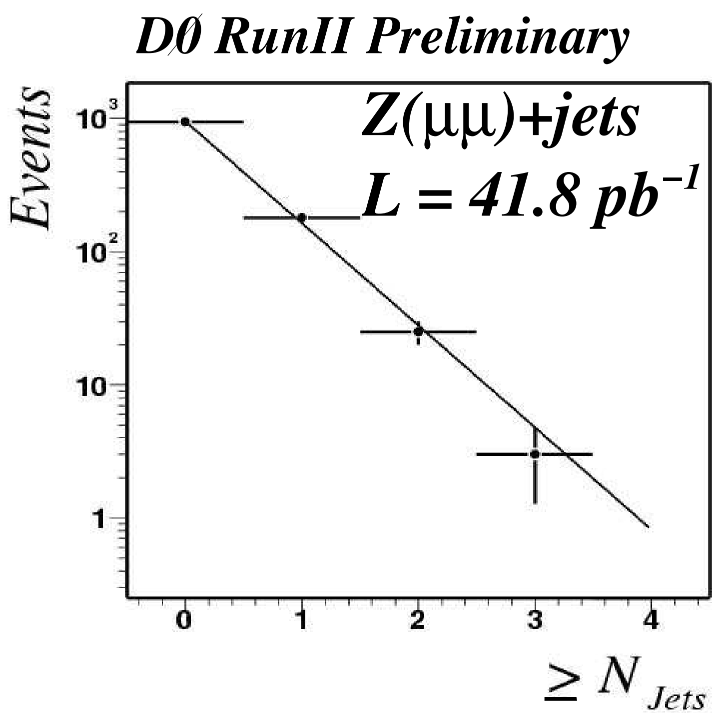
$\sigma(t\bar{t}) = 5.31 \pm 1.34_{stat} \pm 1.08_{sys}$ pb
*leptonic channels*



# Top Physics

*W+jets and Z+jets are primary backgrounds to Top (and Higgs) physics.*




***For lepton + jets:***

*Inclusive jet multiplicity in background subtracted $W \rightarrow l\nu$ sample — Berends scaling.*

*Enhancement at W+4jets after further selection indicates ttbar$\rightarrow l\nu j$+jjj contribution.*

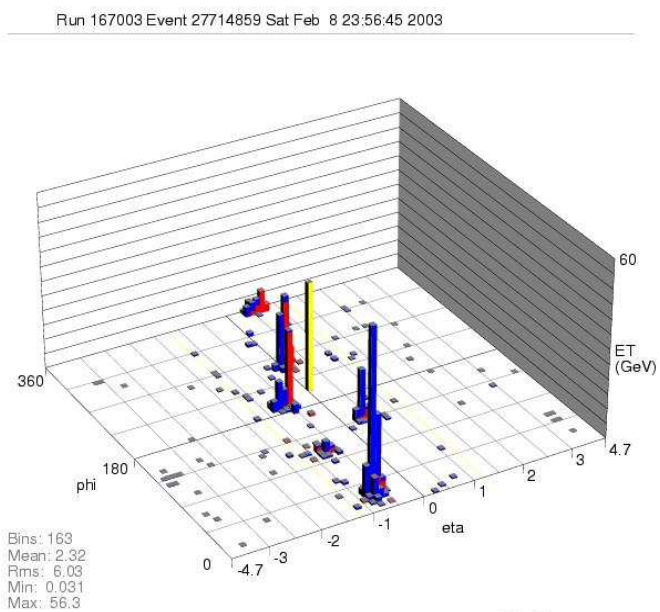
*Event topology or b–tagging separate ttbar contribution from W+4jets and remaining QCD background.*

*First RunII cross section measurement is being finalized*

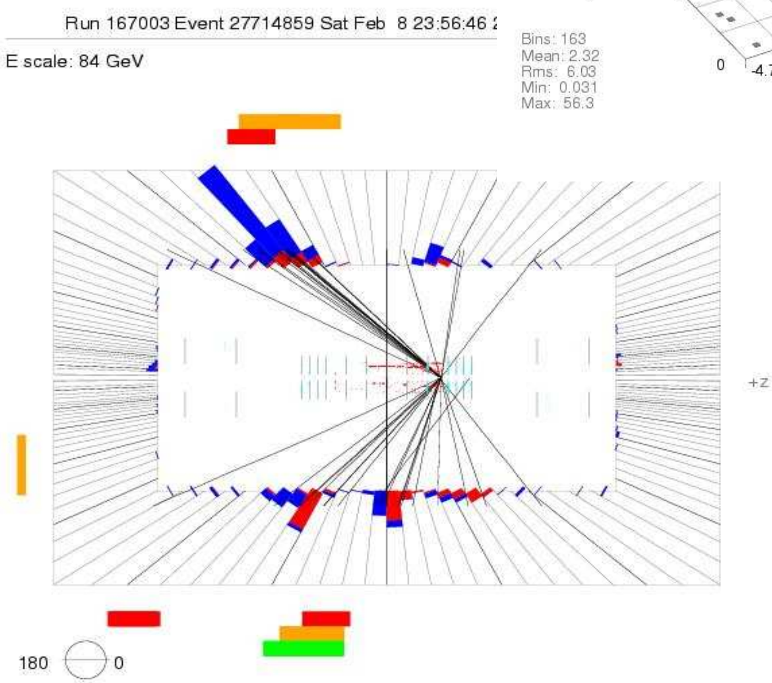
# Event Display

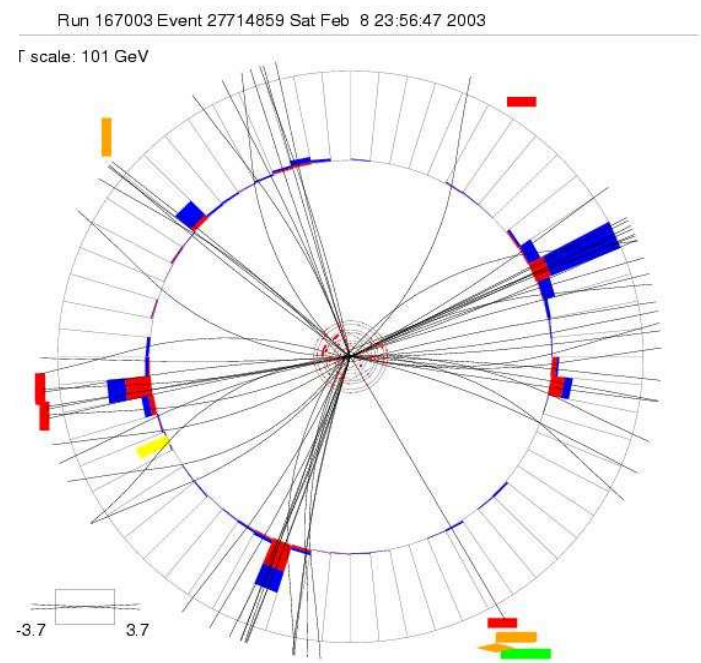
***ttbar→μν jjbb candidate***

| | |
|---|---|
| *μ pt* | *48 GeV* |
| *MEt* | *55 GeV* |
| *W pt* | *51 GeV* |
| *JetEt* | *154 GeV* |
| *Apla* | *0.160* |
| *Ht* | *517 GeV* |



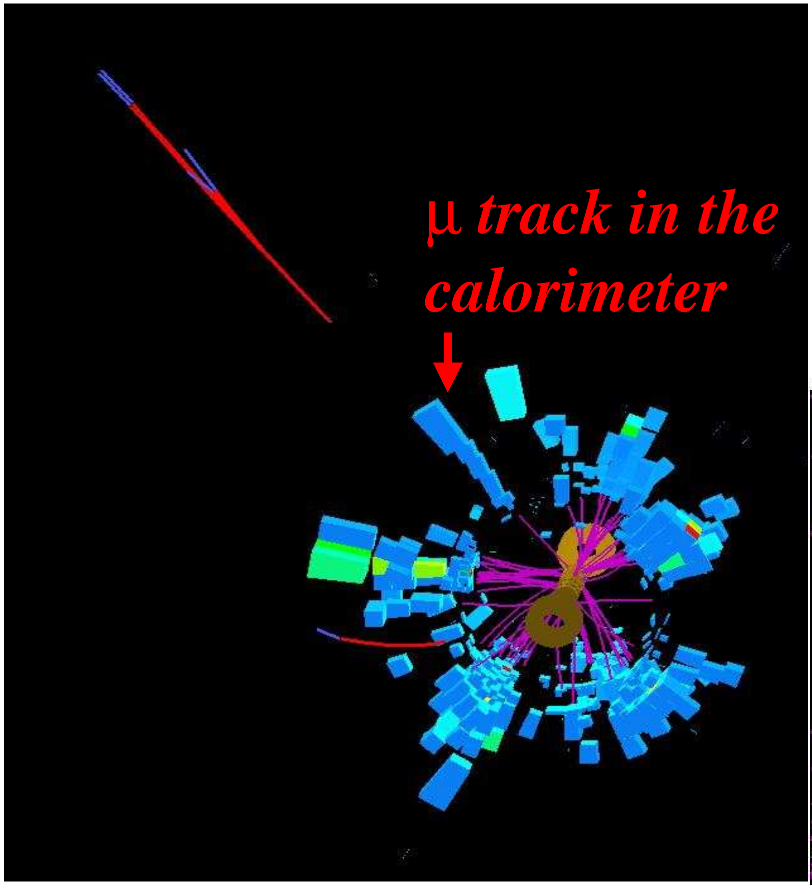

*2 jets are tagged as b –jets & passes topological selection*

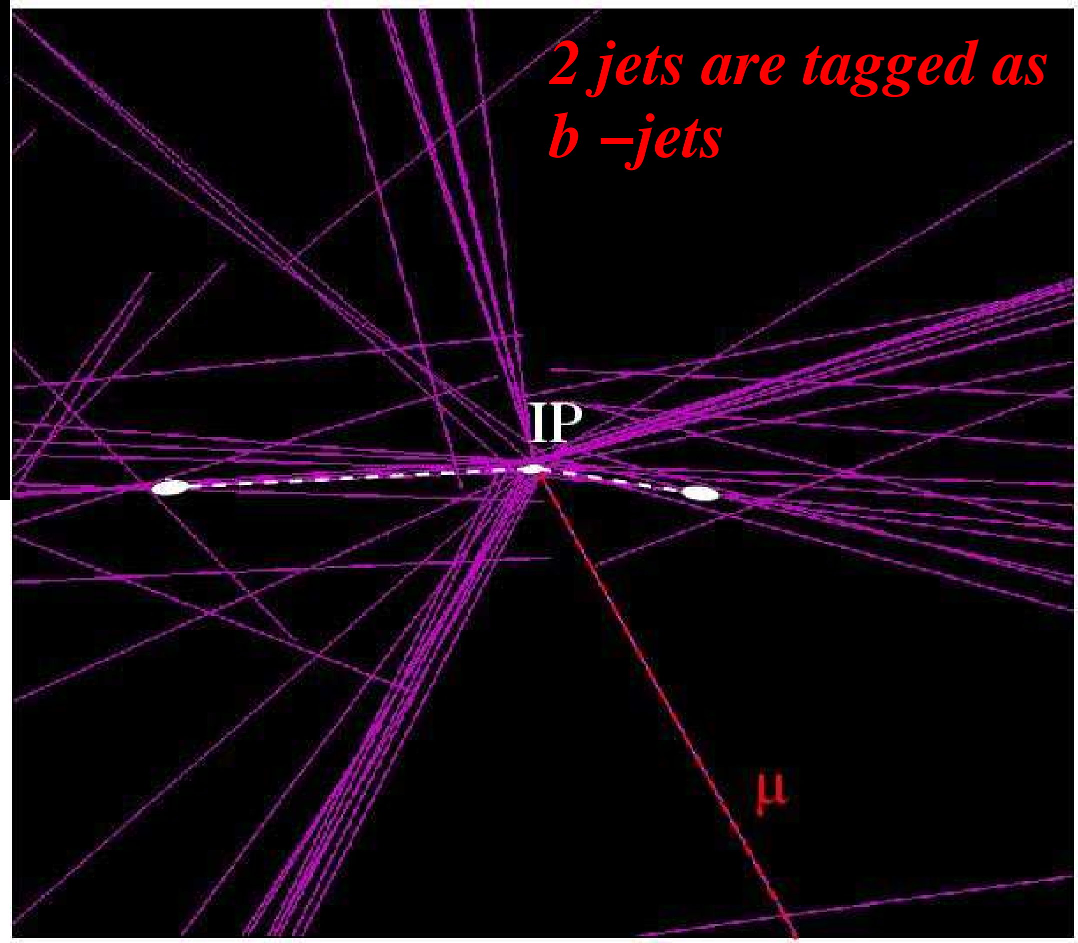


# Event Display

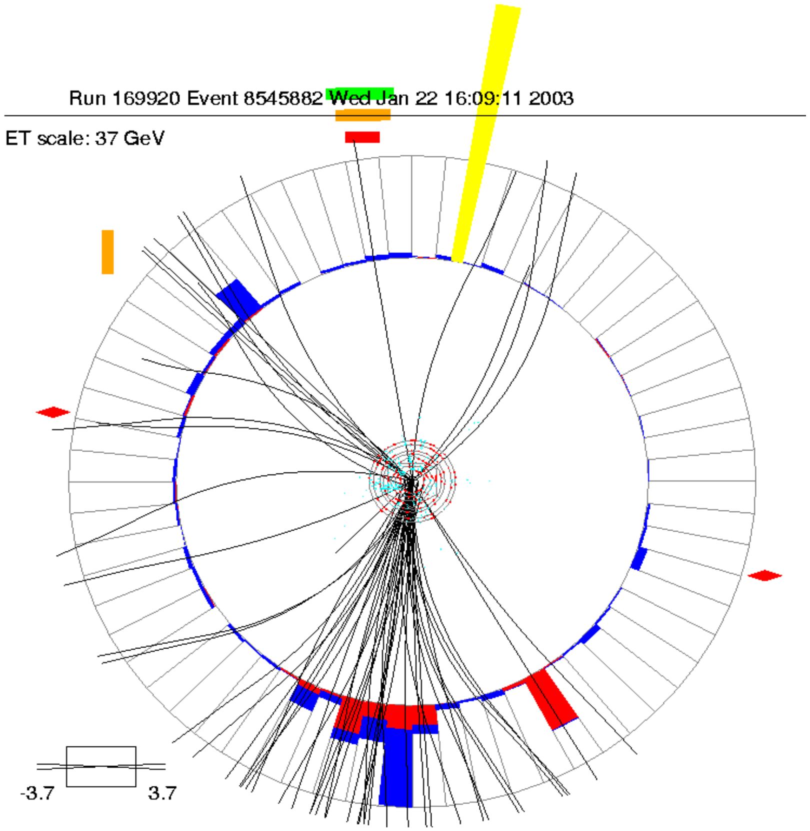
*ttbar→μν jjbb candidate*

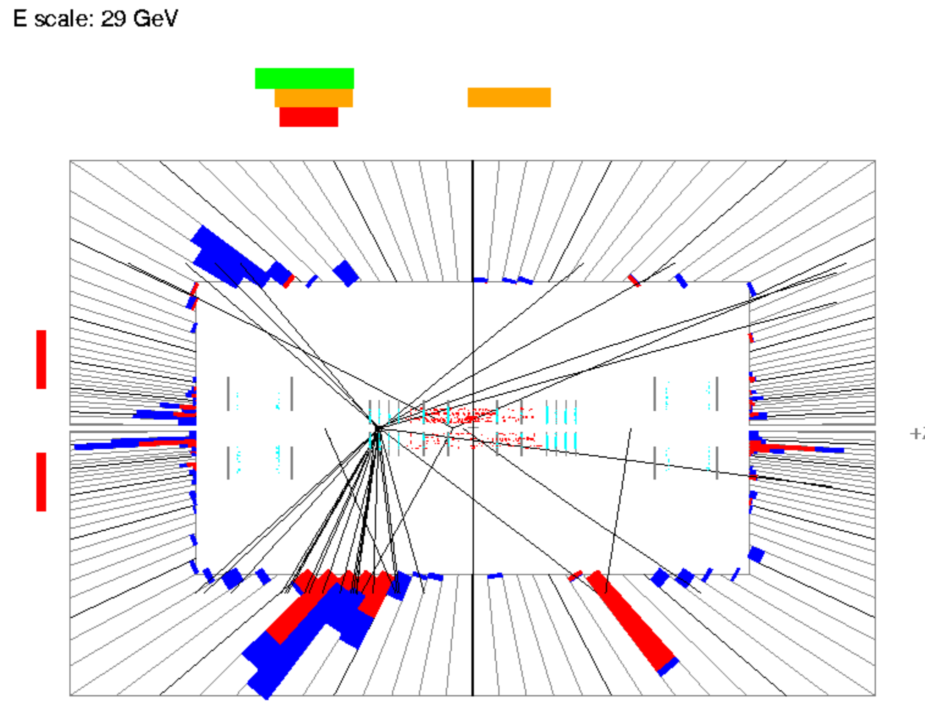


# Event Display

*ttbar→μν eν jj candidate*

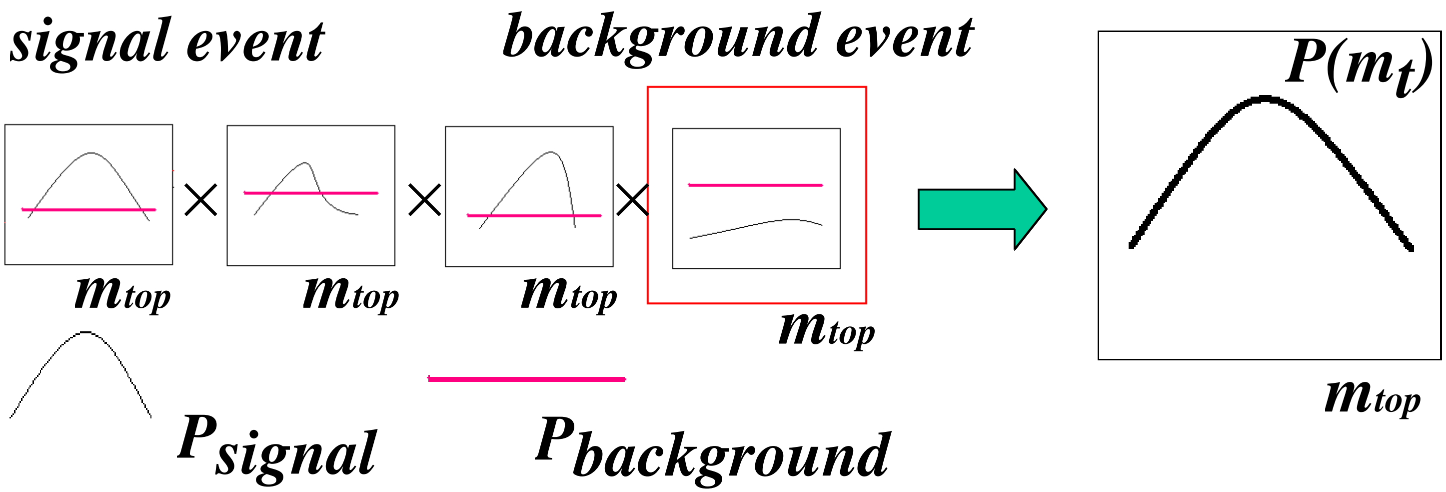



| | |
|---|---|
| *μ pt* | *58 GeV* |
| *e pt* | *20 GeV* |
| *Jet pt* | *141 GeV* |
| *Jet pt* | *55 GeV* |

# New Top Mass Measurement (RunI data)

*For each event the full kinematic information is used to build a likelihood function. The differential cross section of ttbar and W+jets production convoluted with the detector response is used to assign an event signal/background probability as a function of* $m_{top}$ *.*




*The goal was to reduce the statistical uncertainty of the measurement and test the new method for RunII data.*

# New Top Mass Measurement (RunI data)

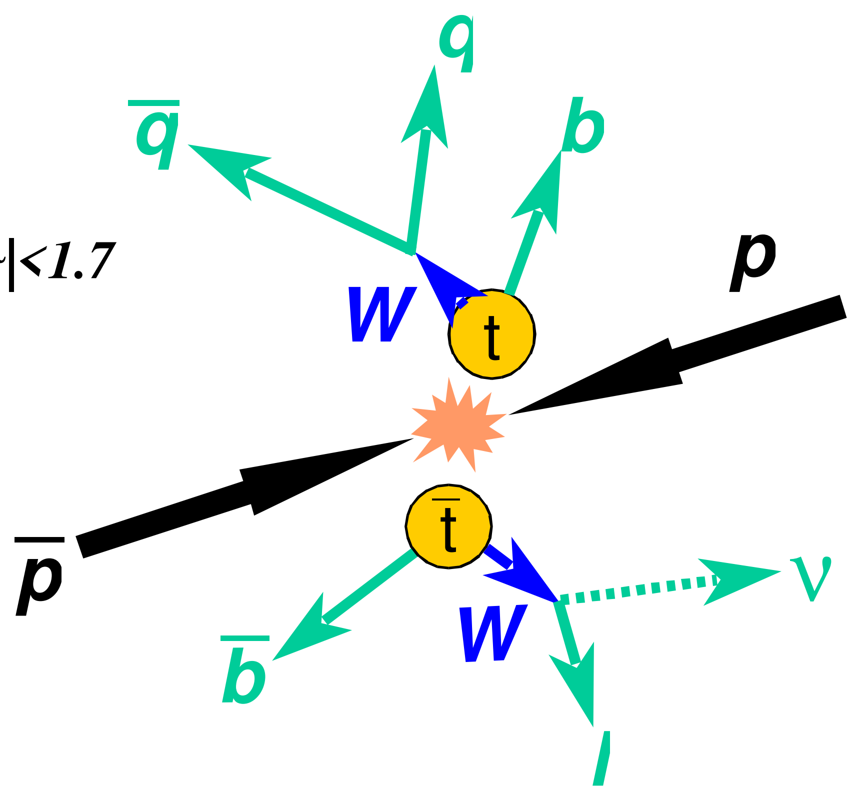
*DØ Statistics RunI (125 $pb^{-1}$)*
*Standard selection for l + jets channel:*

| | | | | |
|---|---|---|---|---|
| *Lepton:* | *Et>20 GeV* | *N=1* | $\lvert\eta^{e}\rvert<2$ | $\lvert\eta^{\mu}\rvert<1.7$ |
| *Jets:* | *Et>15 GeV* | *N>=4* | $\lvert\eta^{j}\rvert<2$ | |
| *Missing* | *Et > 20 GeV* | | | |
| *EtW* | *60 GeV* | | | |

*91 events selected*

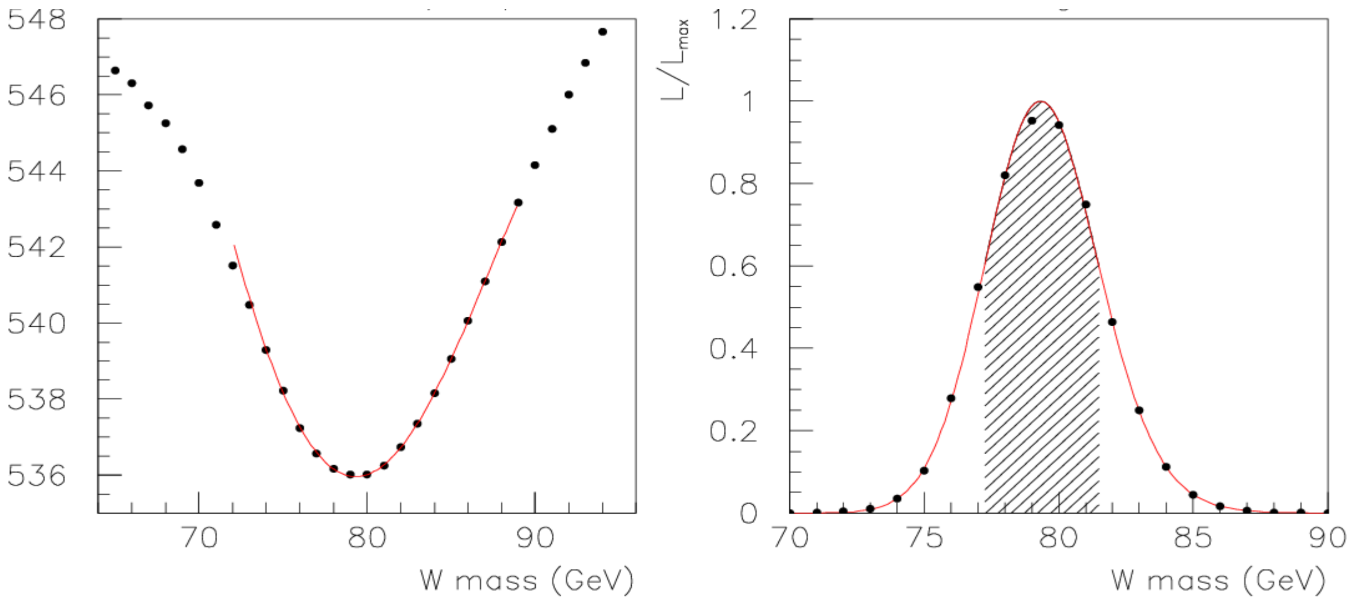
*Ref. PRD 58 (1998), 052001:*
*(After $\chi^2$ cut gives 77 events)*

*Additional cuts for this analysis:*
*only events with 4 jets: 71 events*
*background prob. : 22 events*




*12 jet permutations / event*

# New Top Mass Measurement (RunI data)

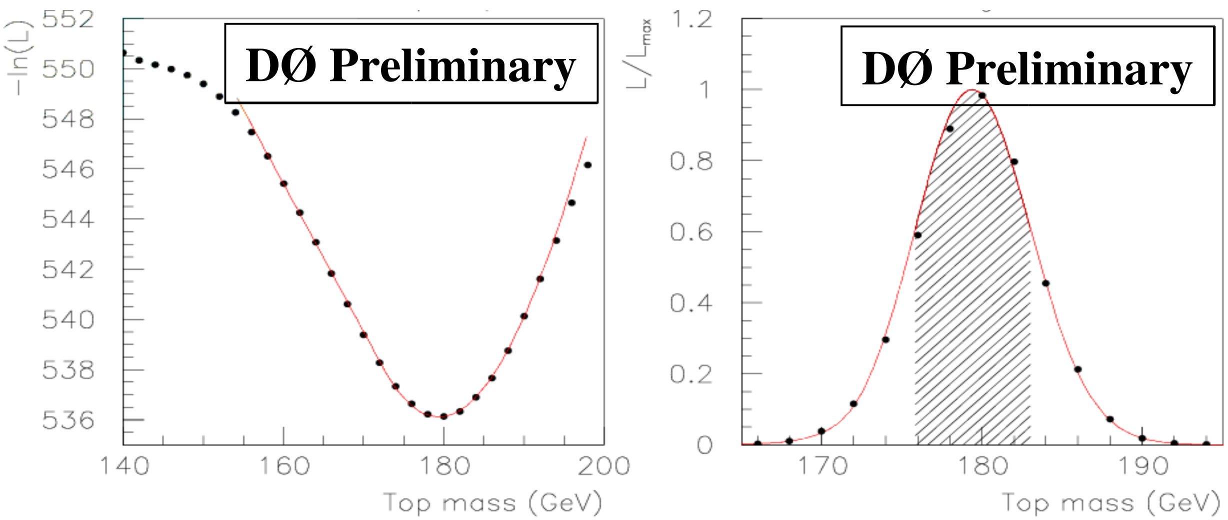



***Largest systematic uncertainty: Jet energy scale $\Delta m_{top} = 5.6$ GeV***

***The possibility of checking the value of the W mass in the hadronic branch on the same events provides a new handle (currently under study).***

***In RunII Z→ bb decays can be used to limit JES.***

# New Top Mass Measurement (RunI data)




***$m_{top}$ = 179.9 GeV***
***± 3.6 (stat.) GeV***
***± 5.9 (syst) GeV***
***(Preliminary)***

***Improvements to previous D0 measurement with:***

***$m_{top}$ = 173.3 ± 5.6 (stat.) ± 5.5 (syst.) GeV***
***[PRD 58 52001, (1998)]***

- *the correct permutation is always considered*
- *all features of individual events are included, thereby well measured events contribute more than poorly measured events.*
- *discrimination of signal to background improves*
- *systematic uncertainty can be reduced by checking the W mass in hadronic decays*

***all channels combined CDF+D0:***
***$m_{top}$ = 174.3 ± 5.1 GeV***
***D0:***
***$m_{top}$ = 172.1 ± 7.1 GeV***

# Summary

*We continue to take advantage of the well understood RunI data to improve methods and measurements ( $m_{top}$ & top properties).*

*The exciting era of Run II has started. Performance of upgraded DØ detectors are close to expectations, with many improvements relevant to top physics.*

*We analyzed about 50 $pb^{-1}$ and much more data is to come...*

*We see candidate events in all ttbar channels.*

*Tevatron Run II will allow to precisely measure W, Z and top quark properties. Signs of new physics could well show up first in these measurements.*