Search for t-tbar production via the dimuon decay channel in Run II at DØ

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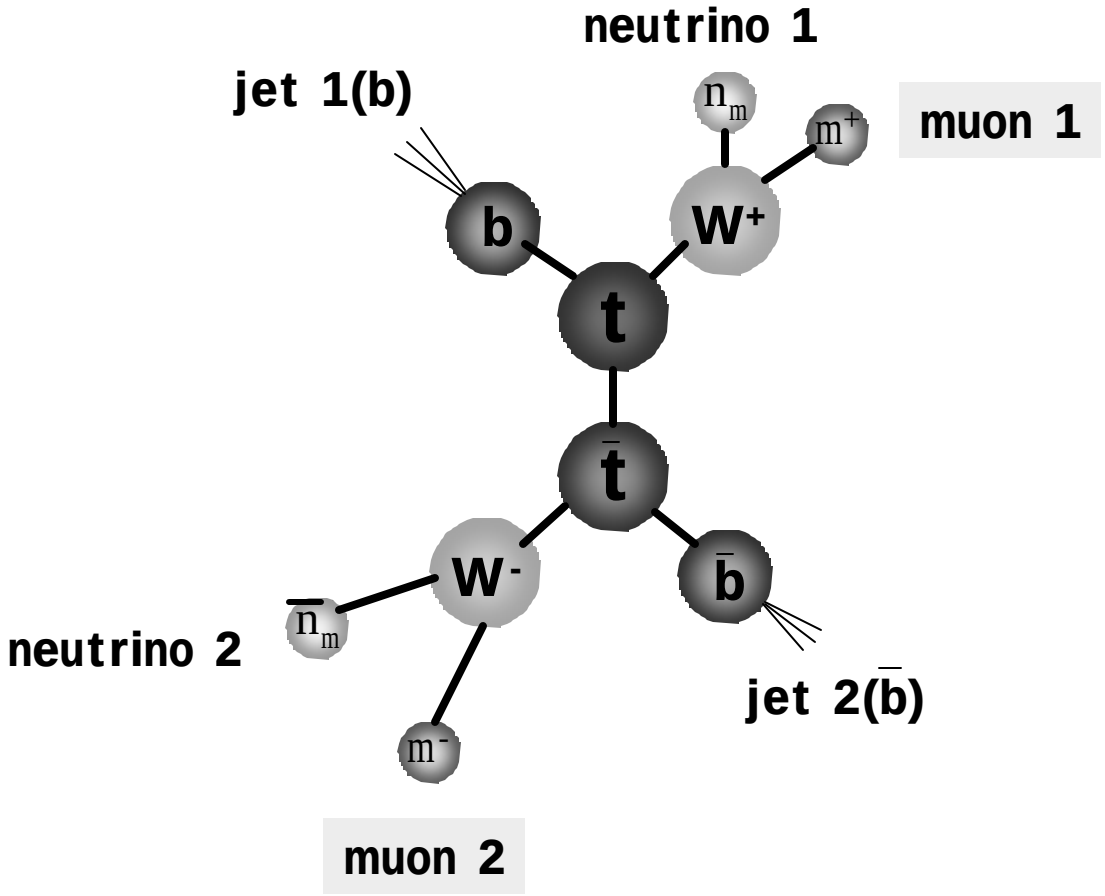
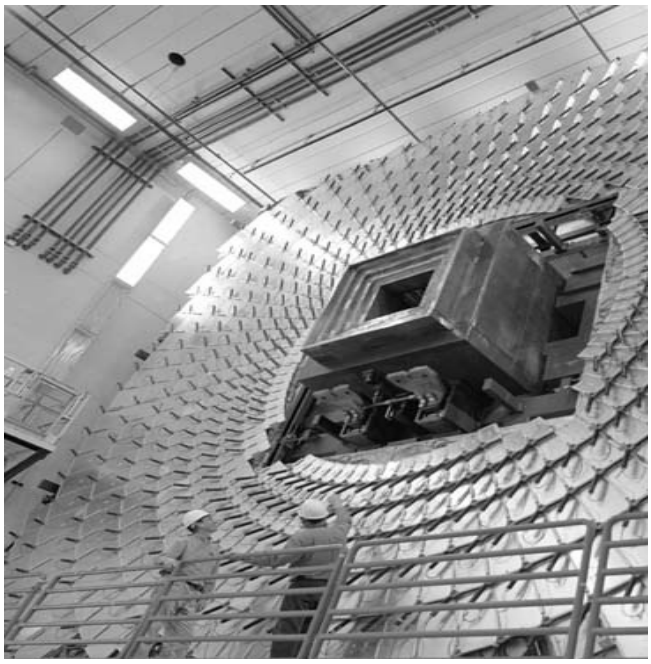
ttbar ? μμ signature

- 2 high-P_T muons
- 2 high-P_T jets
  - Isolated from each other and from the muons
- Significant missing transverse energy (MET) from neutrinos



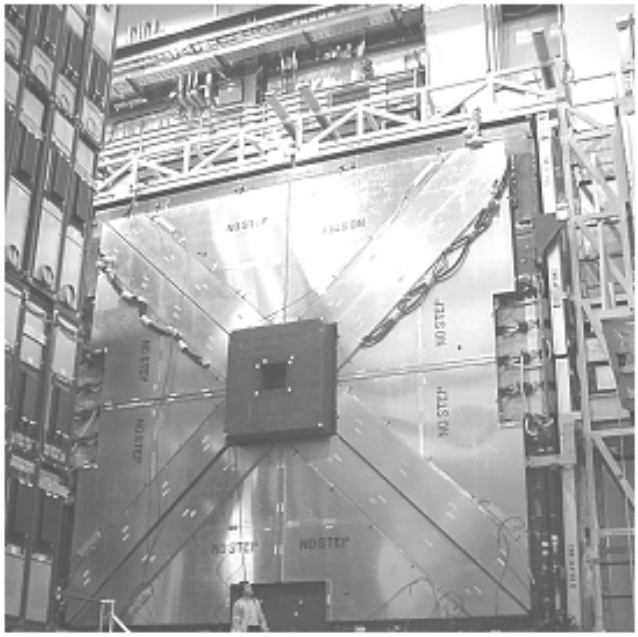
Triggering on Dimuons

Dimuons provide clean signal



Level 1

- each muon must hit scintillator layers inside and outside the toroid magnet
- muons must have minimum eta, phi separation



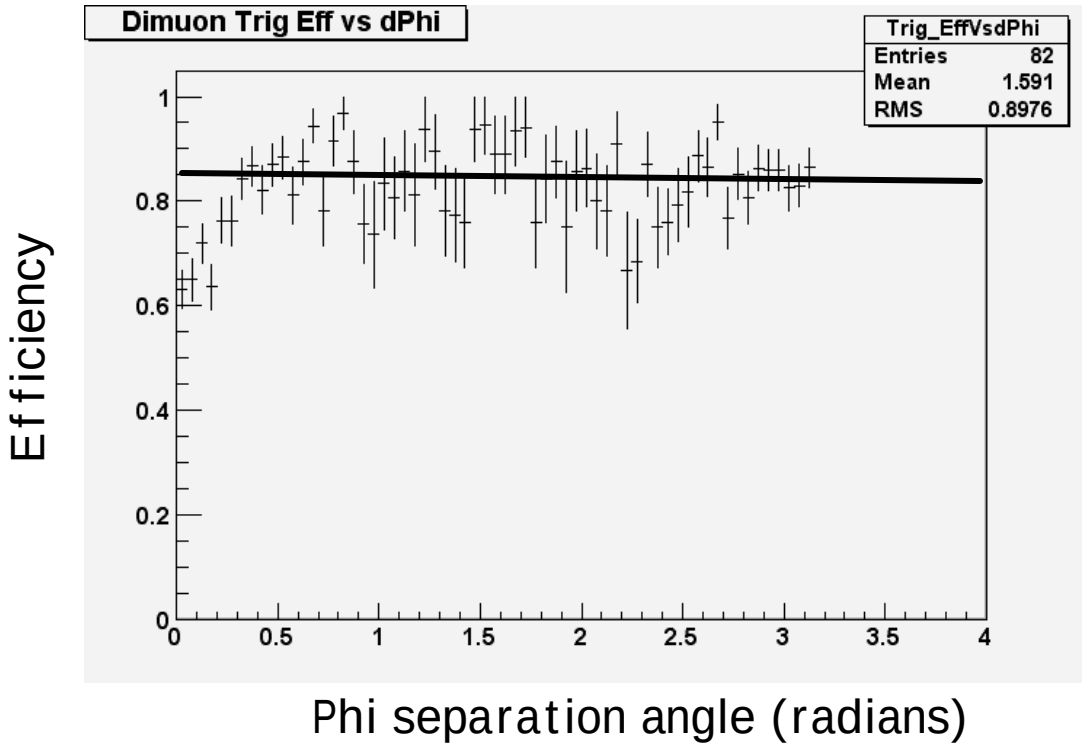
Level 2

- one muon must hit wires as well as scintillators, both inside and outside the toroid magnet

Trigger Efficiency

$$\text{Efficiency} = \frac{\text{reco'd muons with trigger}}{\text{reco'd muons}}$$

- **Level 1 efficiency: (87±2)%**
- **Level 2 efficiency: (97±1)%**



- **Net trigger efficiency: (85±2)%**

(DØ RunII preliminary)

Event Selection Criteria

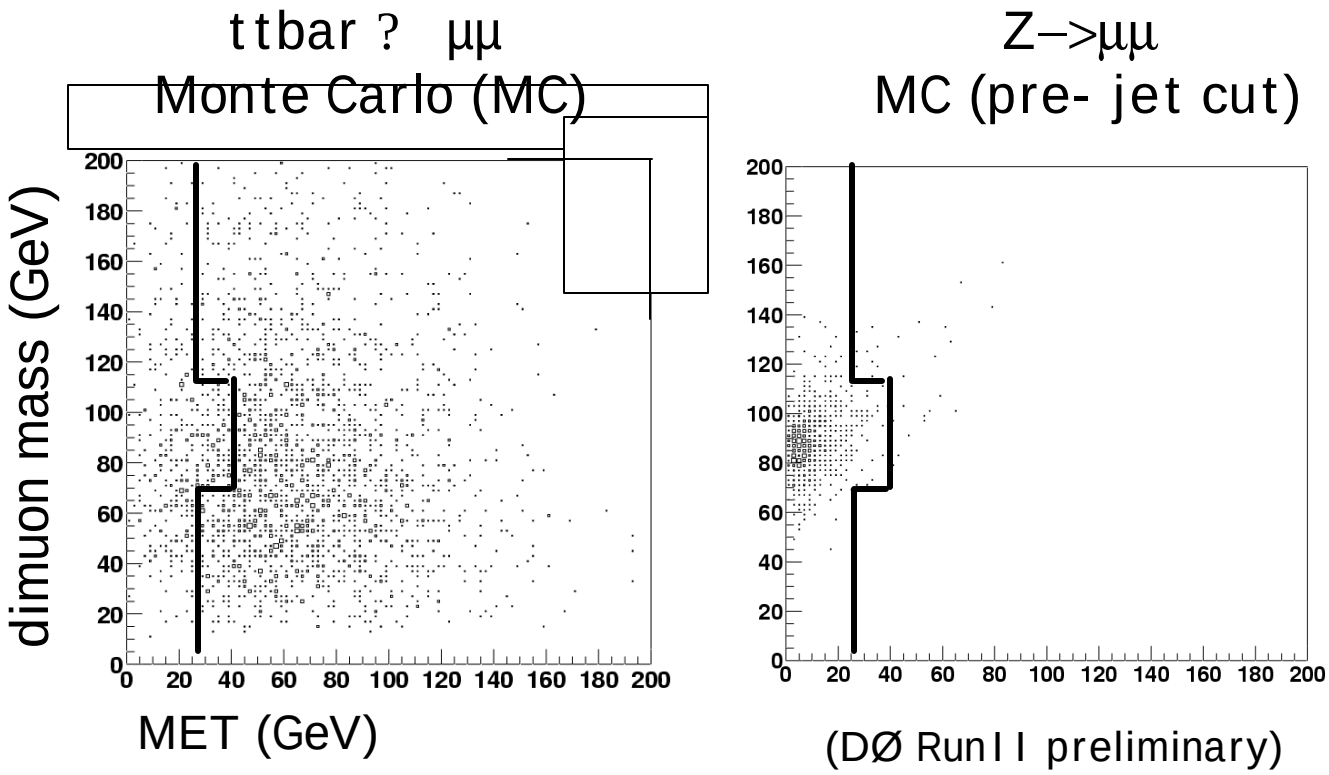
- **Muons**
  - Wire tracks confirmed by scintillator hits
  - Match wire track to central track
  - P_T = 15 GeV

- **Jets**
  - Jet quality cuts
    - Remove electrons
    - Noise reduction cuts
  - E_T = 20 GeV, |?|=2.5

- **MET**
  - Sum over all calorimeter cells
  - Correct for muon momenta

Kinematic Cuts

- **MET cut**
  - **40 GeV threshold in Z mass window (70-110 GeV)**
  - **25 GeV threshold outside window**



- **H_T cut**
  - **Sum of jets with P_T > 15 GeV, |?|<2.5**
  - **> 100 GeV**

Efficiencies

Category	Cut	Efficiency
Muon ID	Fiducial, Match (=2 μ's)	0.20
Dimuon Trigger	Level 1	0.87
	Level 2	0.97
Jet ID	Fiducial, Quality (=2 jets)	0.82
Event Selection	=2 μ's (P_T>15 Gev)	0.88
	= 2 Jets (E_T>20)	0.90
Kinematic Cuts	MET	0.85
	H_T	0.76

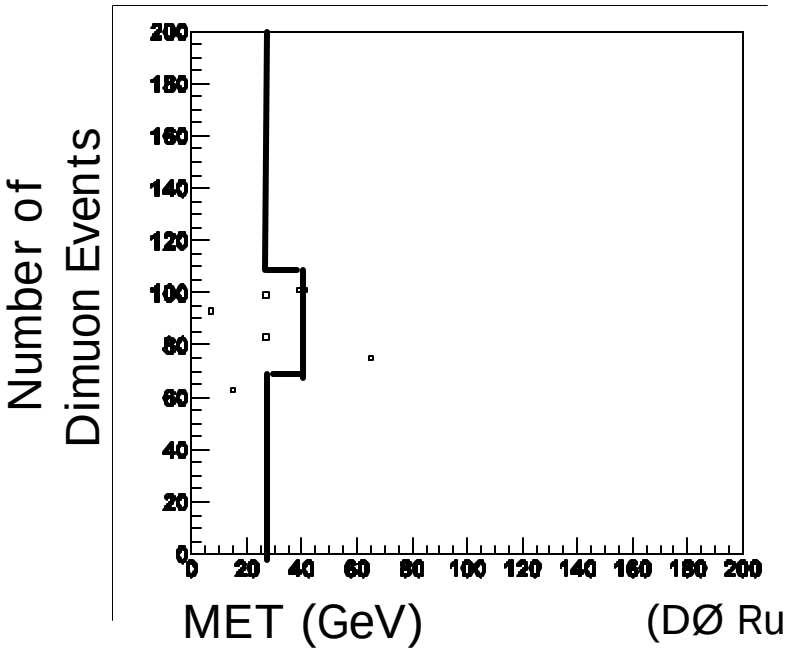
Total: $0.07 \pm 0.01 \pm 0.02$

(DØ RunII preliminary)

(Dominant systematic error comes from uncertainty in muon track matching)

Z ? μμ Background

- **No intrinsic MET**
- **MC does not fully model detector effects**
- **Use data instead**
  - **Use loose ee in Z mass window**
  - **Smear EM objects to match muon P_T resolution**
  - **Apply smearing to MET, use fraction of events that pass MET cut (~5%) to estimate background**



(DØ RunII preliminary)

4 events miss cut ? 0.20 background events

Other Backgrounds

- **Drell-Yan**
  - **No intrinsic MET**
  - **Estimated from data (similar to Z ? μμ)**

- **WW ? μμ, Z ? tt**
  - **Estimate from MC**
  - **Very small background**

- **QCD multijet, W? (mn) + jets**
  - **Both muons pass isolation cut**
  - **Measure 'fake isolation rate' from data**

Expected Yield

Integrated luminosity: 42 pb^{-1}

(from August 15, 2002 – January 12, 2003)

Expected Yield = Efficiency x

Branching Fraction x s_{prod} x Luminosity

» 7% x

1.2% x 7 pb x 42 pb^{-1}

» 0.2 event

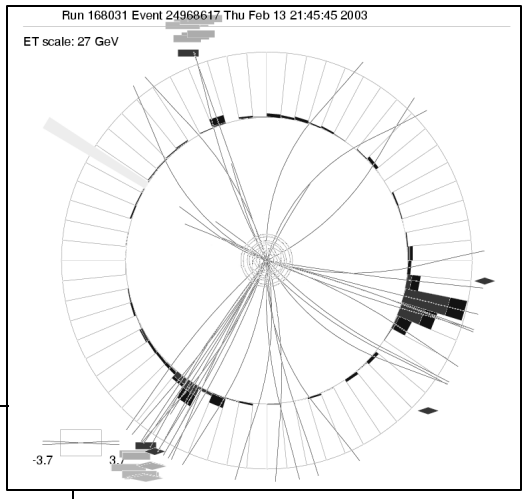
	Value	Stat. Error	Syst. Error
Selected Events	**2.000**	**1.414**	
Z->μμ	**0.200**	**0.110**	**0.040**
Drell-Yan ->μμ	**0.200**	**0.200**	**0.007**
WW->μμ	**0.001**	**0.000**	**0.001**
Z->ττ	**0.016**	**0.016**	**0.016**
QCD, W	**0.175**	**0.084**	**0.175**
Total Background	**0.592**	**0.244**	**0.180**
Subtracted Yield	**1.408**	**1.435**	**0.180**

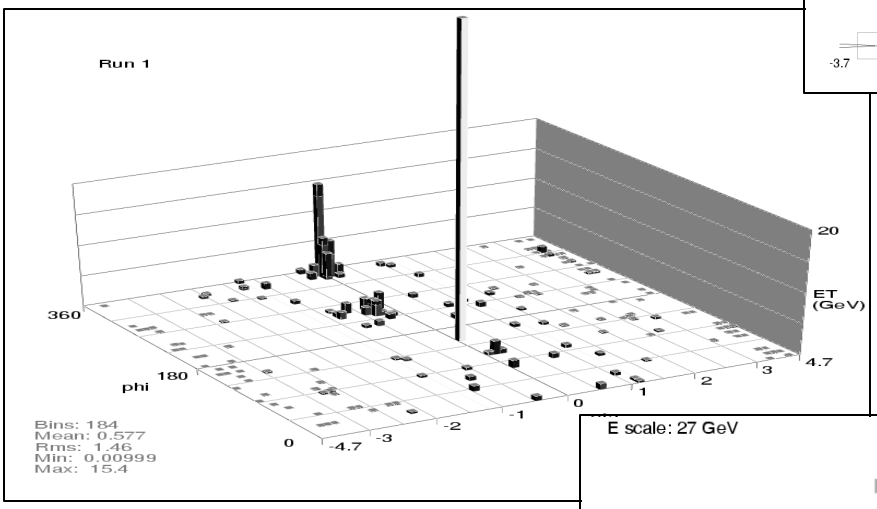
(DØ RunII preliminary)

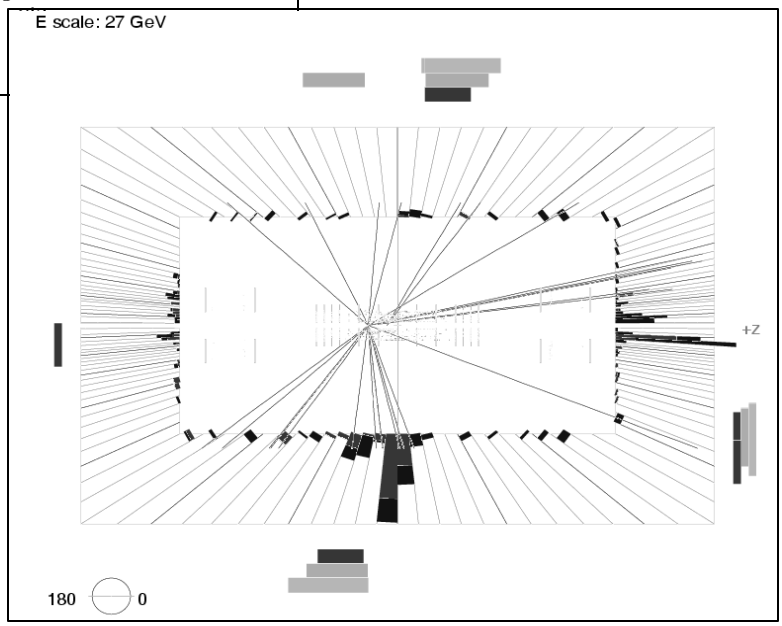
Event 1

Pt, j, ?

Mu1: 117.0 GeV, 1.9, 0.3
Mu2: 15.9 GeV, 4.2, 1.7
Jet1: 77.4 GeV, 6.0, 0.1
Jet2: 40.4 GeV, 4.1 -0.3
Pair mass: 101.9 GeV
MET: 41.4 GeV





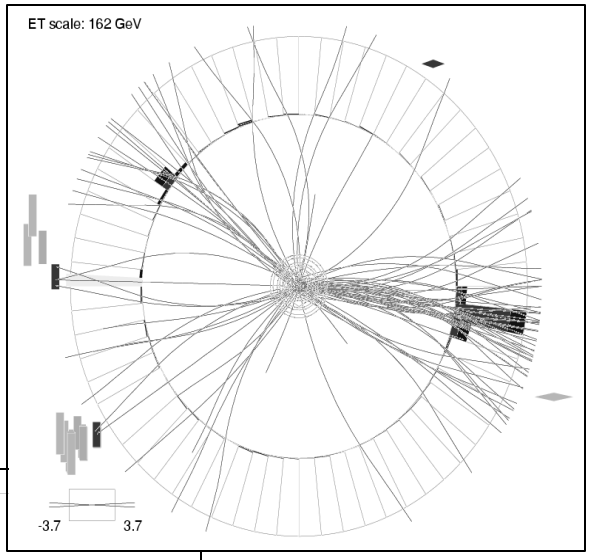


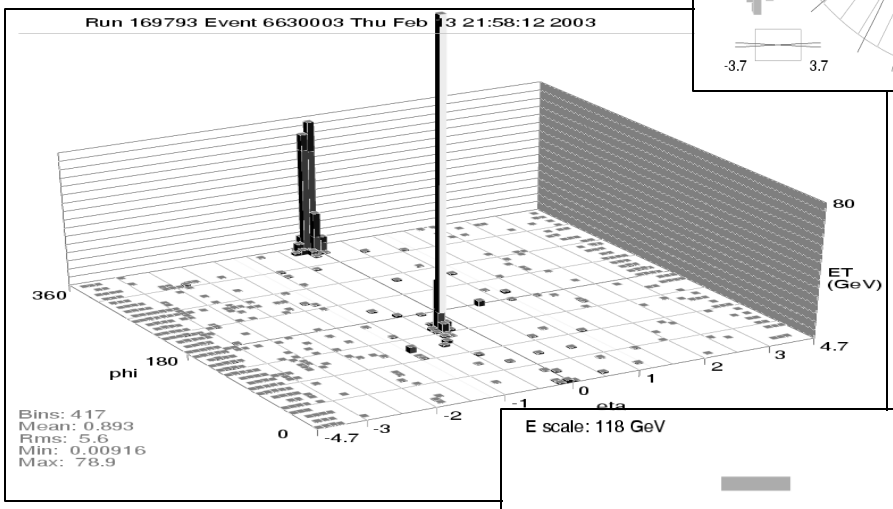
(DØ RunII preliminary)

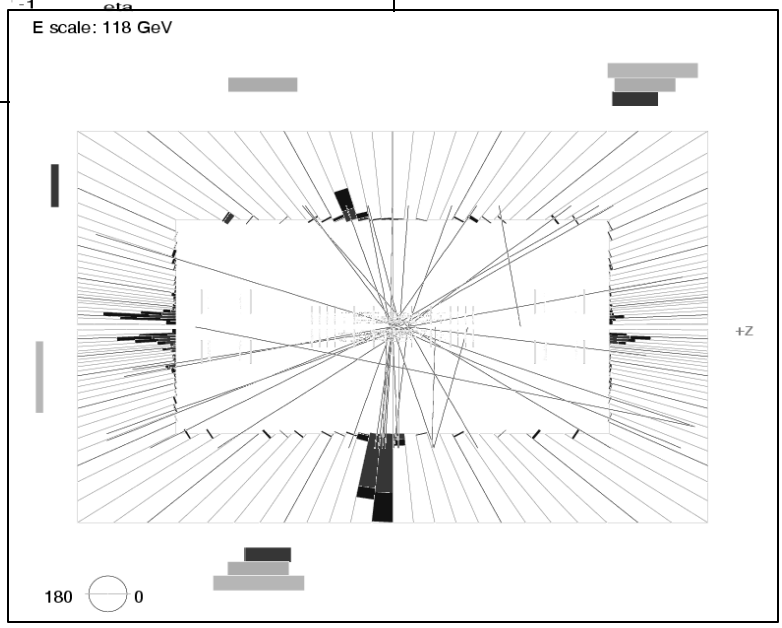
Event 2

Pt, j, ?

Mu1: 88.1, 3.1 0.6
Mu2: 47.6, 3.7 -0.3
Jet1: 274.0, 6.1 -0.1
Jet2: 81.6, 2.5 -0.4
Pair mass: 75.0
MET: 64.7







(DØ RunII preliminary)

Conclusions

- **Engaged in preliminary search for ttbar ? μμ events**
  - **2 candidate events observed**

- **Future Plans**
  - **Increase overall efficiency**
    - **Continue to improve particle ID & reconstruction**
    - **New Triggers**
  - **Continue to collect data**
    - **Larger luminosity stores**
    - **Expect to collect additional ~130 pb^{-1} by September**