DØ Status and First Results from Run 2

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On behalf of the DØ Collaboration

OUTLINE

- Tevatron Run 2
- The upgraded DØ Detector
  - Status
  - Performance
- First Physics Results
- Outlook

The Tevatron Run 2

Tevatron upgrade:

- Increased energy
  1.8 TeV → 1.96 TeV
- Increased luminosity
  0.1 fb^{-1} → 2 fb^{-1} → 15 fb^{-1}
  (Run 1) (Run 2a) (Run 2b)

Detector upgrades:

- Higher event rates and backgrounds (electronics, DAQ, trigger)
- Considerable expansion of the physics capabilities

Physics opportunities:

- Top
- Higgs
- New Phenomena
- Electroweak
- Beauty
- QCD

	Run 1b	Run 2a	Run 2b
#bunches	6x6	36x36	140x103
√s (TeV)	1.8	1.96	1.96
typ L ($cm^{-2}s^{-1}$)	1.6×10^{30}	8.6×10^{31}	5.2×10^{32}
∫ Ldt (pb^{-1}/week)	3.2	17.3	105
bunch xing (ns)	3500	396	132
interactions/xing	2.5	2.3	4.8

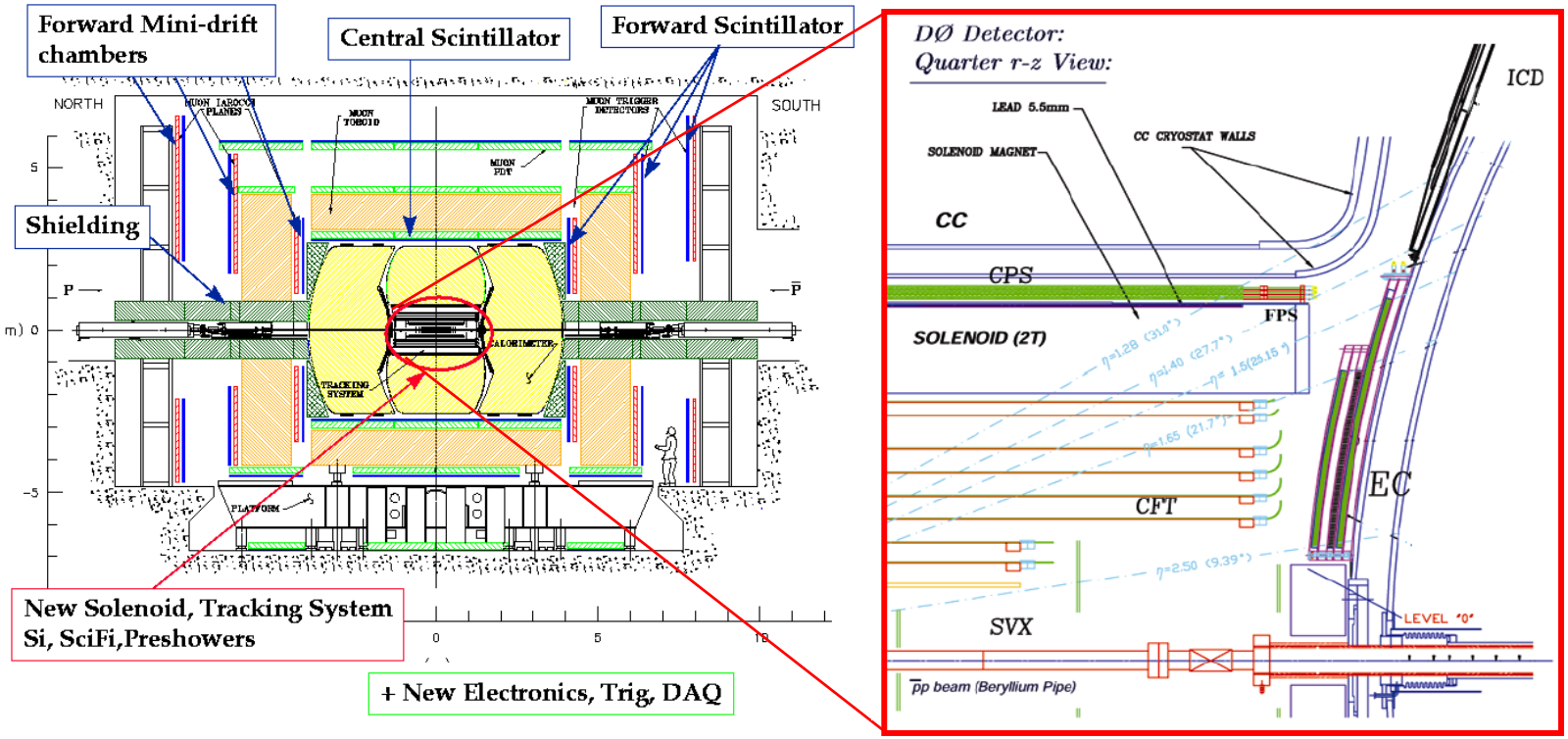
The Upgraded DØ Detector

Builds on the strengths of DØ:

- Excellent calorimetry with faster readout
- Upgraded muon system for better μ-ID

Augments its tracker and trigger capabilities:

- Inner tracking (silicon tracker, fiber tracker) with 2T superconducting solenoid
- Preshowers
- Pipelined 3-level trigger

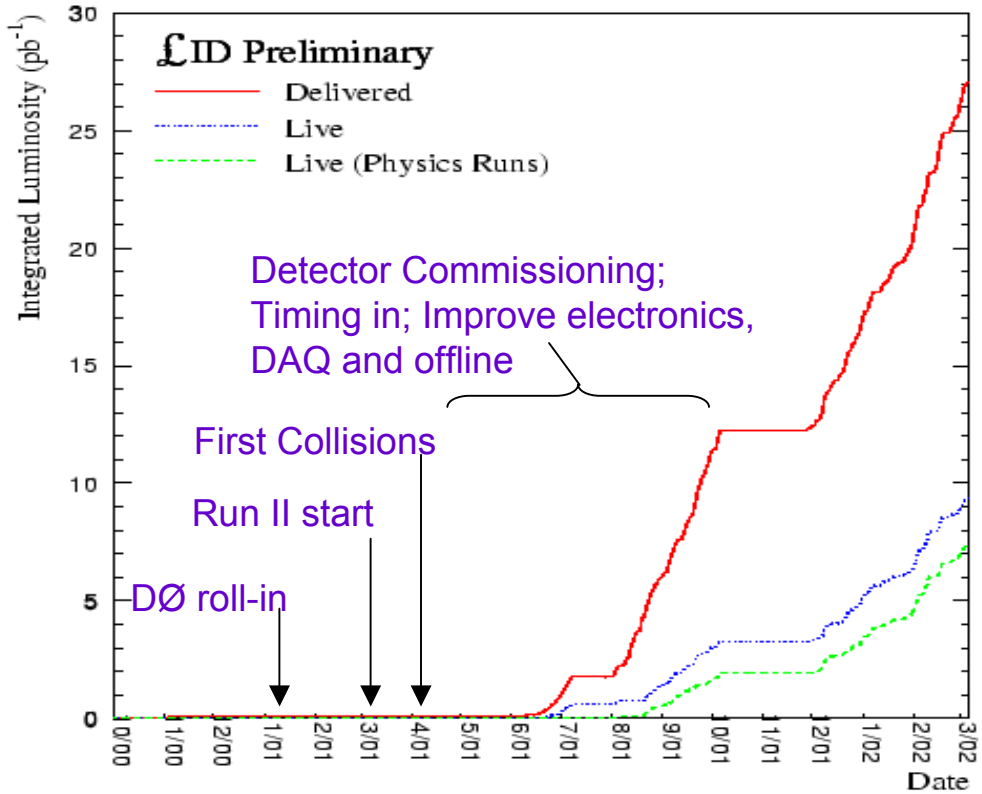


The Upgraded DØ Detector

Inside collision hall before putting the wall

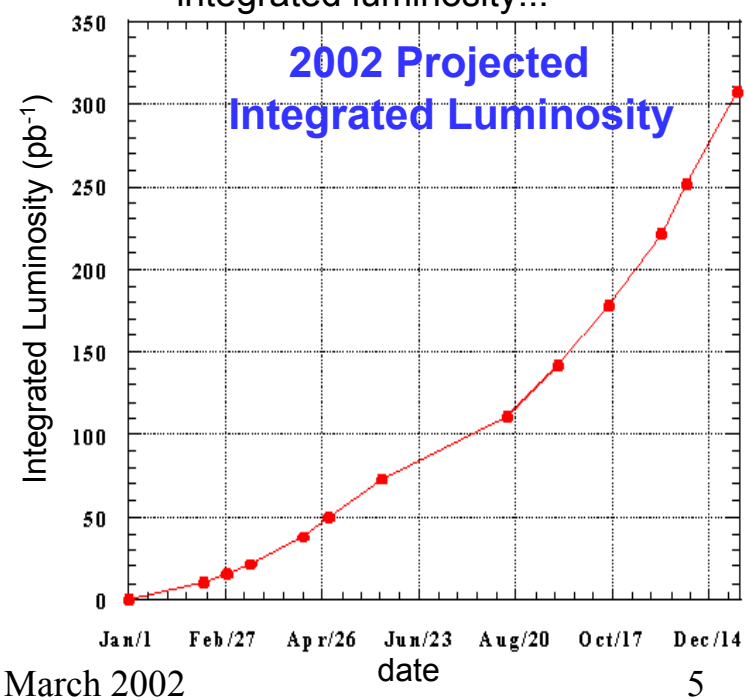
Run 2 in 2001... and 2002 plans

- Considerable fraction (~25%) of collected luminosity devoted to detector commissioning.
- Significant progress in identification of "physics objects": e, μ, jets, electromagnetic and jet energy scales, etc.

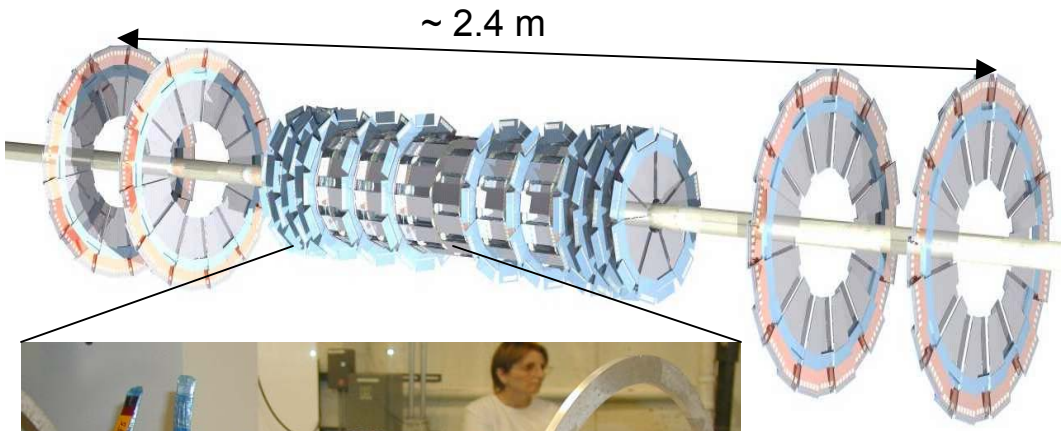


In the next few months:

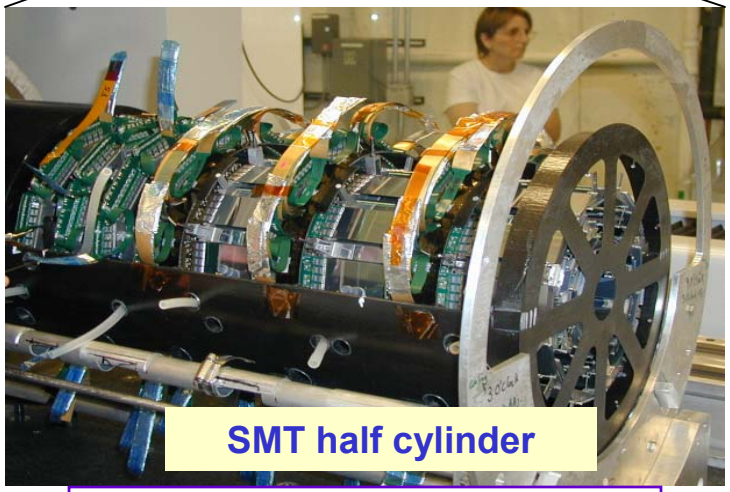
- Finish detector commissioning
- Complete triggers and improve DAQ
- Debugging, calibration, alignment
- Refine reconstruction algorithms
- …
- Also looking forward to more integrated luminosity!!!



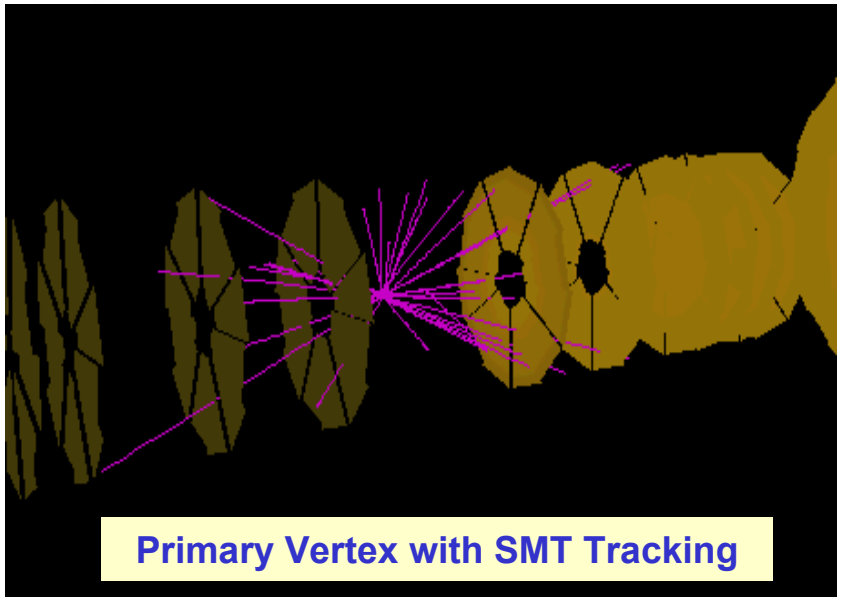
Silicon Microstrip Tracker (SMT)



- ~800,000 readout channels
- 6 barrels (4 layers) with interspersed (F-)disks
- 4 external large area (H-)disks for forward tracking ($2 < |\eta| < 3$)
- Single (axial) and double sided (axial+stereo) detectors
- 3D track reconstruction capabilities



SMT half cylinder

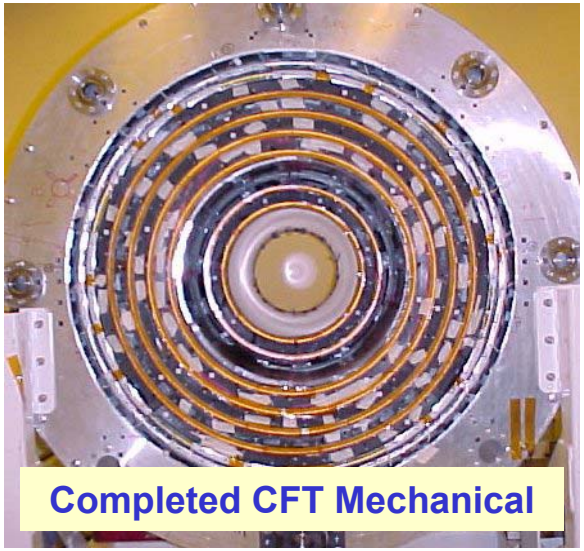


Primary Vertex with SMT Tracking

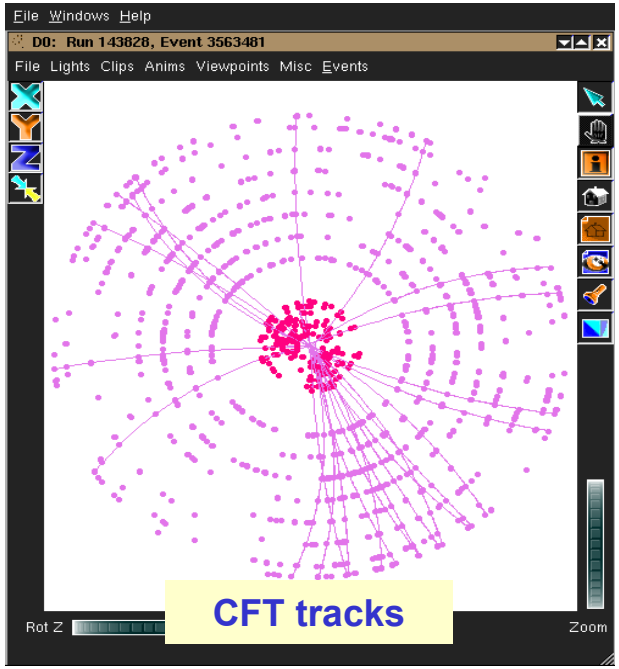
100% commissioned

Barrels: 95.2% operational
F-disks: 95.8% operational
H-disks: 86.5% operational

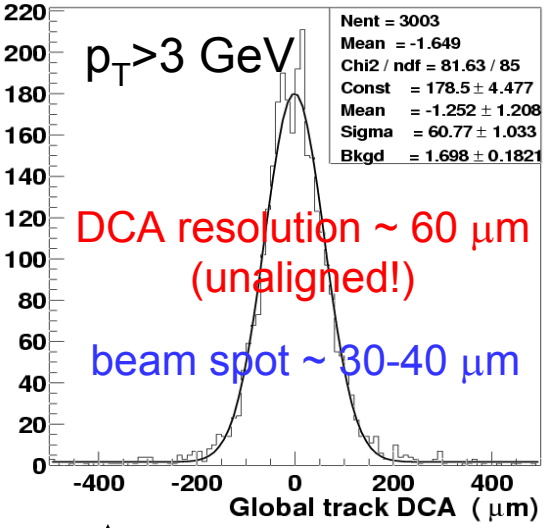
Central Fiber Tracker (CFT)

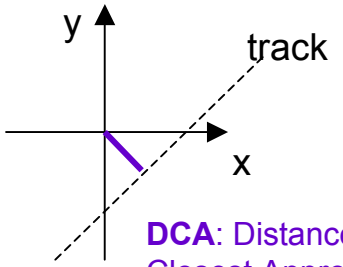


- 20 cm < r < 51 cm
- 8 layers of axial and stereo 830 μm ∅ scintillating fibers
- ~12m long clear wave-guide to Visible Light Photon Counter (VLPC)
  - 9K operating temperature
  - 85% QE, excellent S/N
- ~77k readout channels
- Fast pick-off for trigger



(SMT+CFT) Global tracks





DCA: Distance of Closest Approach

axial: 100% readout

stereo: 52% readout

Fully commissioned by mid-April

Calorimeter

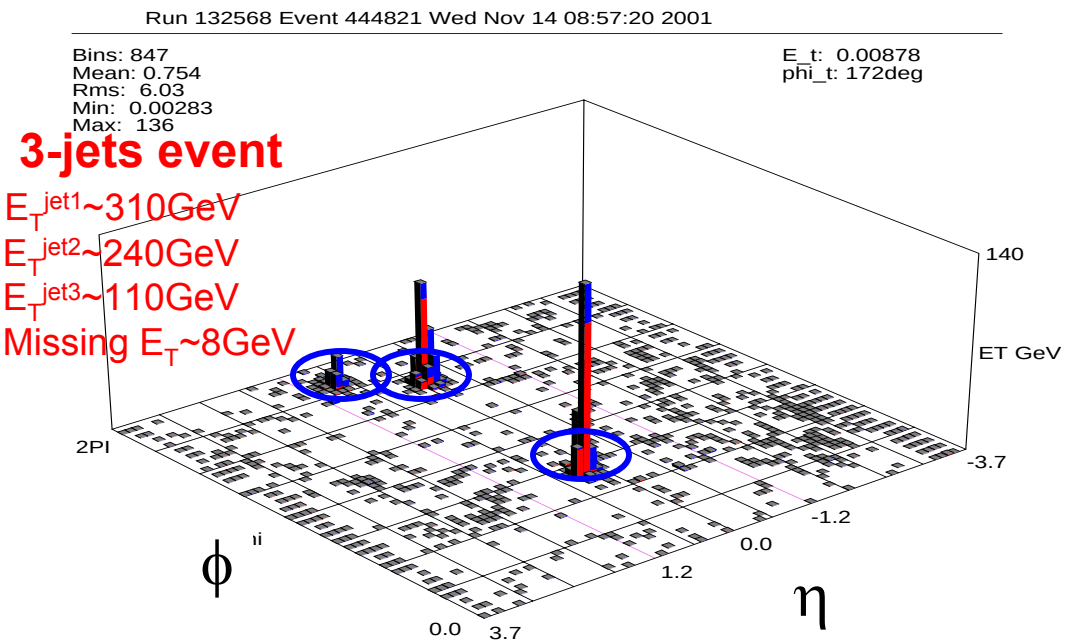
Preserve excellent Run 1 calorimetry:

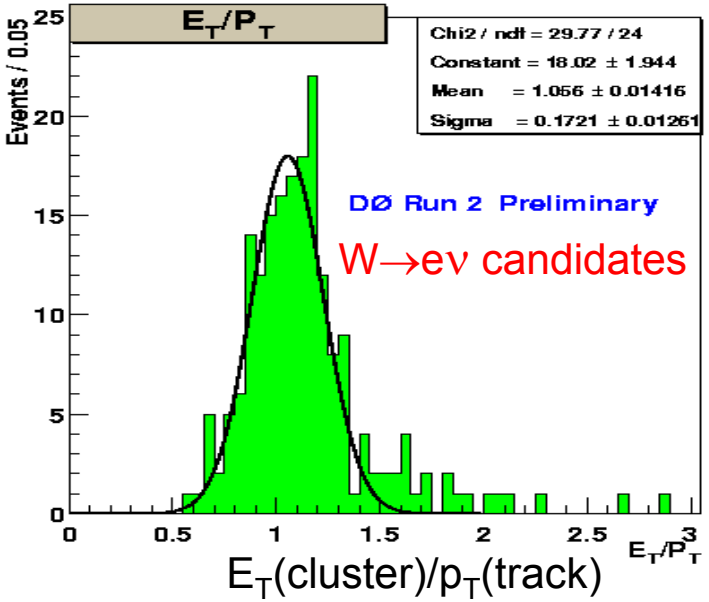
- LAr sampling: stable, uniform response, rad. hard., fine spatial segmentation
- U absorber (Cu/Steel for coarse hadronic)
- Uniform, hermetic, full coverage ($|\eta| < 4.2$)
- Compensating ($e/\pi \sim 1$)
- Good energy resolution

… and upgrade electronics:

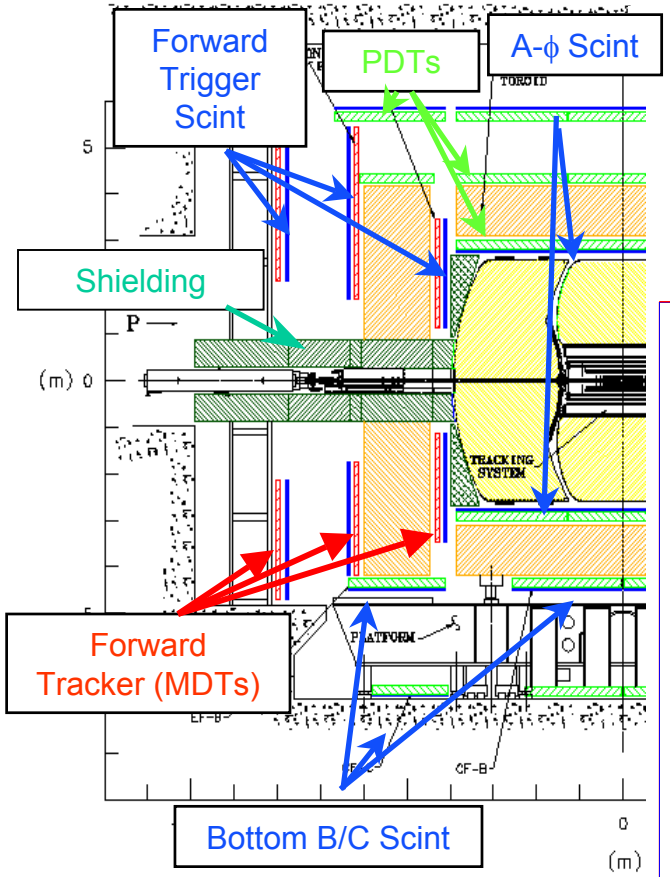
- Reduced bunch spacing
- L1 trigger
- Preserve noise performance

100% commissioned
~55K readout channels
~0.1% dead/noisy

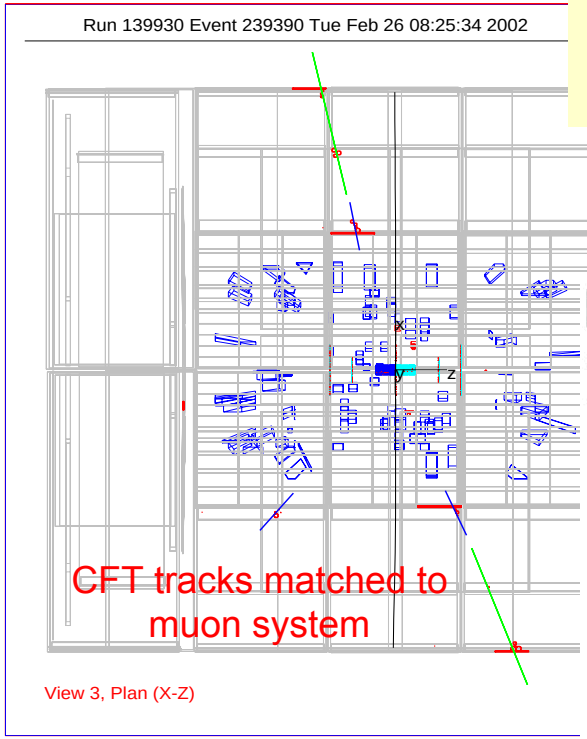




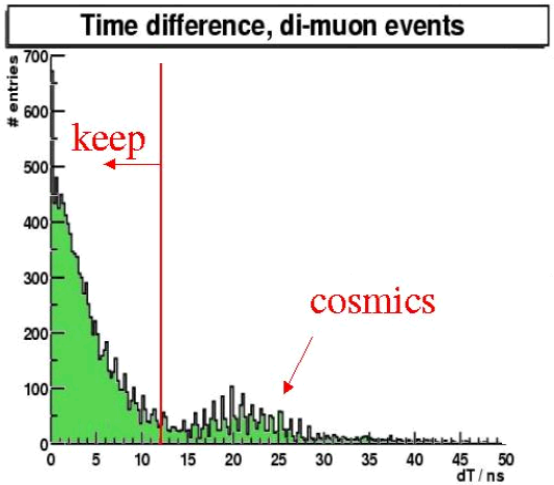
Muon System



- Coverage to $|\eta|<2$
- Emphasize μ-ID at all trigger levels
- Momentum determination not precise (use inner tracking)
- Good time resolution (~2.5 ns) of trigger scintillators to remove out-of-time background (cosmics)



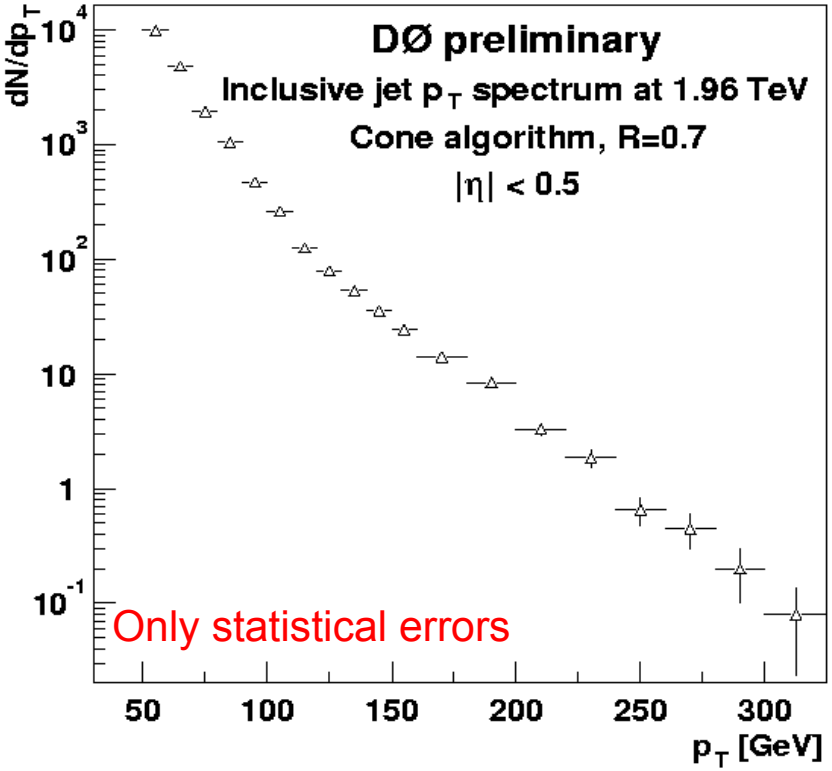
$Z \rightarrow \mu^+\mu^-$ candidate event
$m_{\mu\mu}$ ~ 103 GeV

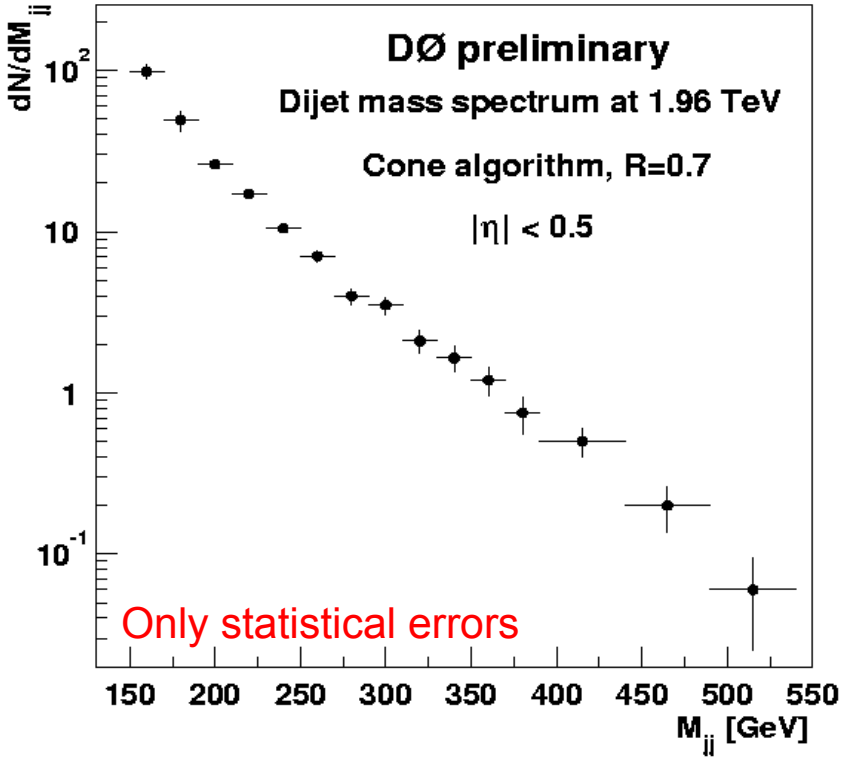


100% commissioned

QCD Physics

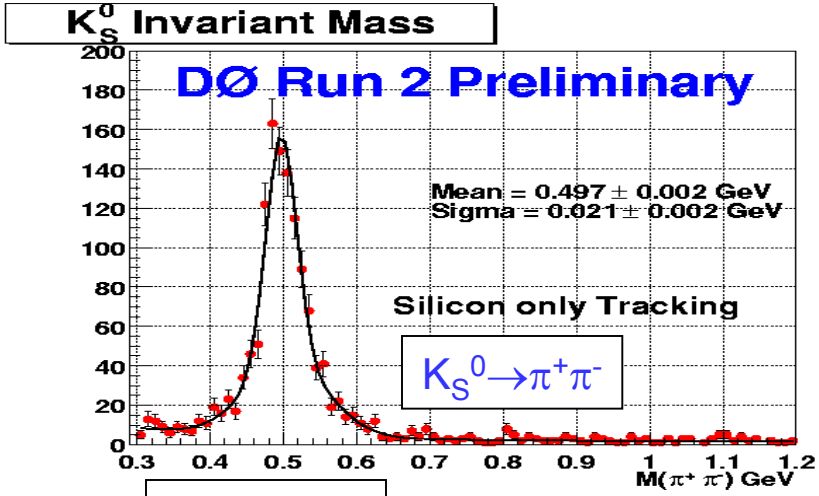
- Integrated luminosity: ~1 pb^{-1}

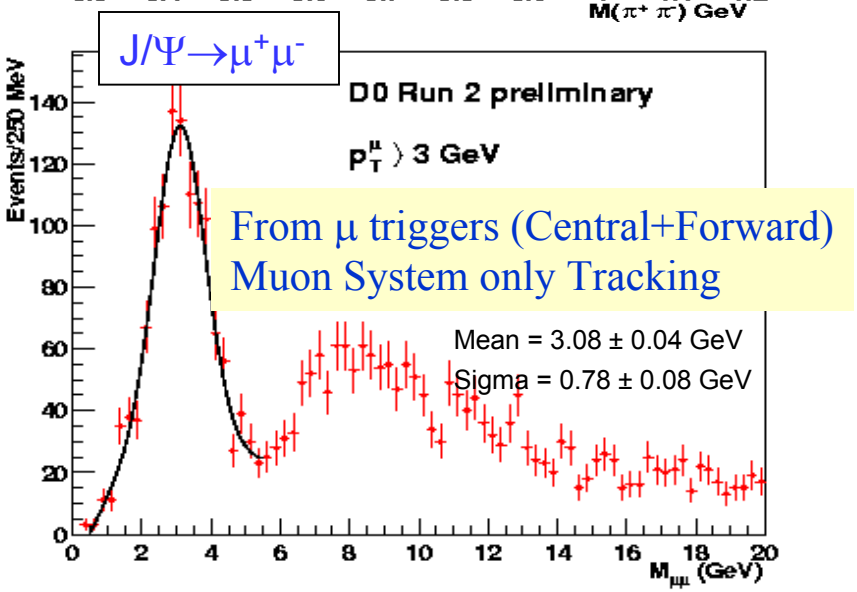


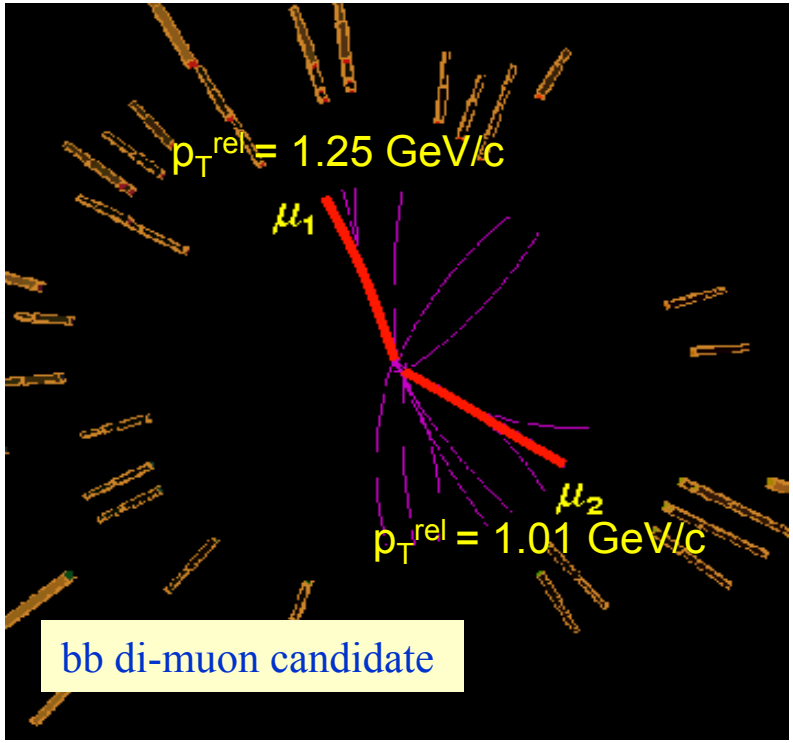


- Not fully corrected distributions:
  - Preliminary correction for jet energy scale (but no unsmearing of resolution effects)
  - No correction for trigger (small kinks) or selection efficiencies

B-Physics

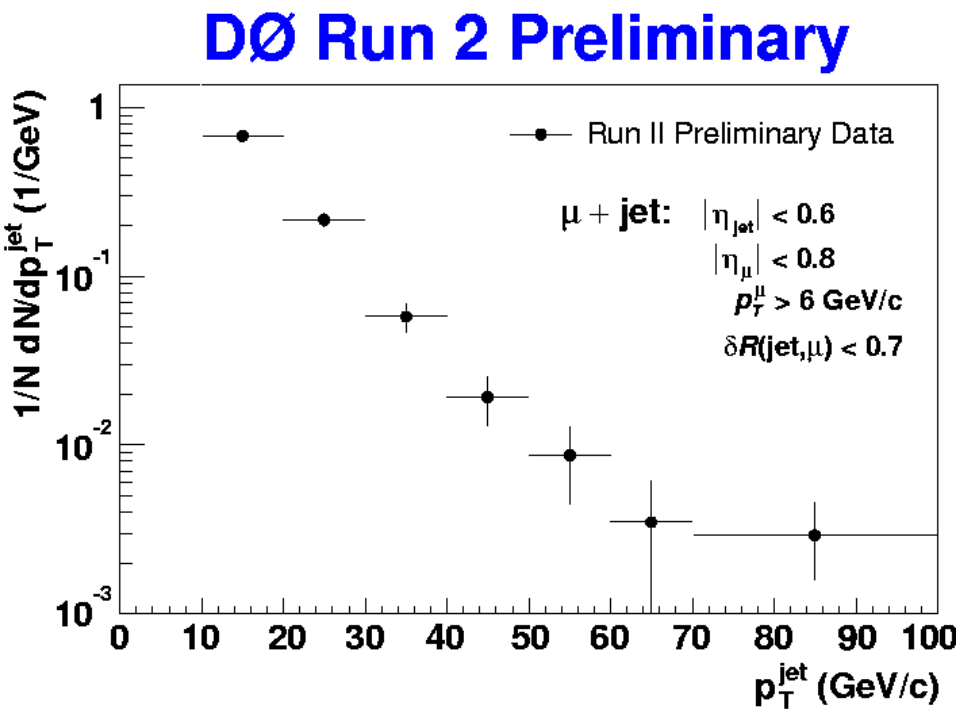

K_S^0 Invariant Mass
DØ Run 2 Preliminary
Mean = 0.497 ± 0.002 GeV
Sigma = 0.021 ± 0.002 GeV
Silicon only Tracking
$K_S^0 \rightarrow \pi^+\pi^-$
$M(\pi^+ \pi^-)$ GeV


$J/\Psi \rightarrow \mu^+\mu^-$
D0 Run 2 preliminary
$p_T^\mu \rangle$ 3 GeV
From μ triggers (Central+Forward)
Muon System only Tracking
Mean = 3.08 ± 0.04 GeV
Sigma = 0.78 ± 0.08 GeV
Events/250 MeV
$M_{\mu\mu}$ (GeV)


p_T^{rel} = 1.25 GeV/c
μ_1
μ_2
p_T^{rel} = 1.01 GeV/c
bb di-muon candidate

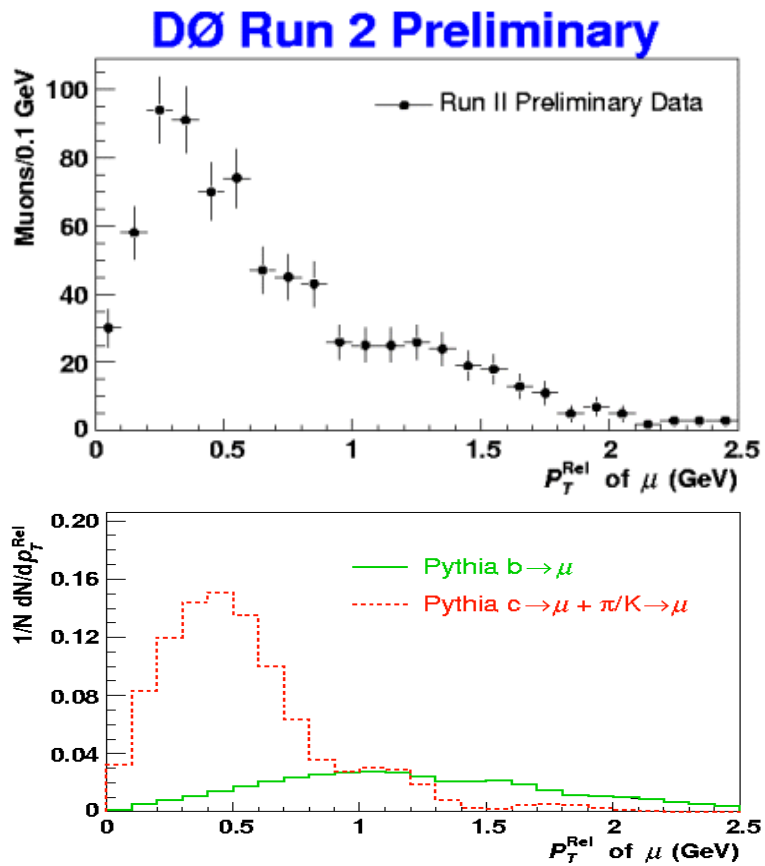
B-Physics (cont'd)

- Normalized μ+jet differential cross-section (data sample <0.2 pb^{-1}).
- Trigger and reconstruction efficiencies and jet energy scale corrections included.



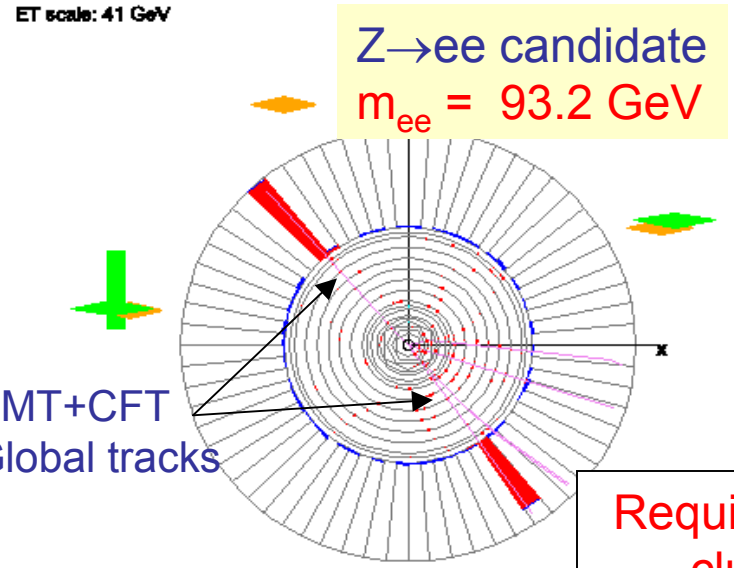
➢ Consistent in shape with DØ Run I results in same kinematic region.

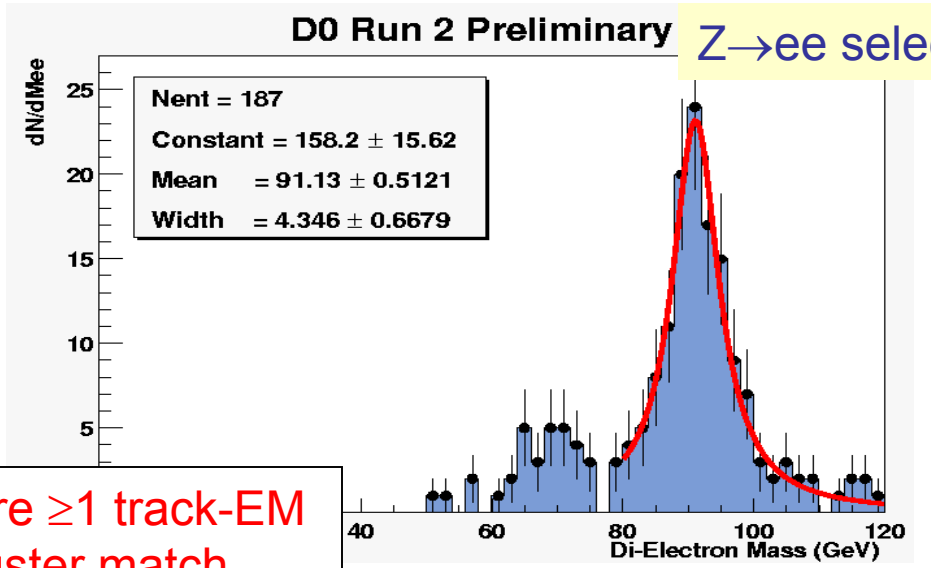
- Transverse momentum of the μ with respect to the jet axis is a good discriminant between direct b→μ and backgrounds.



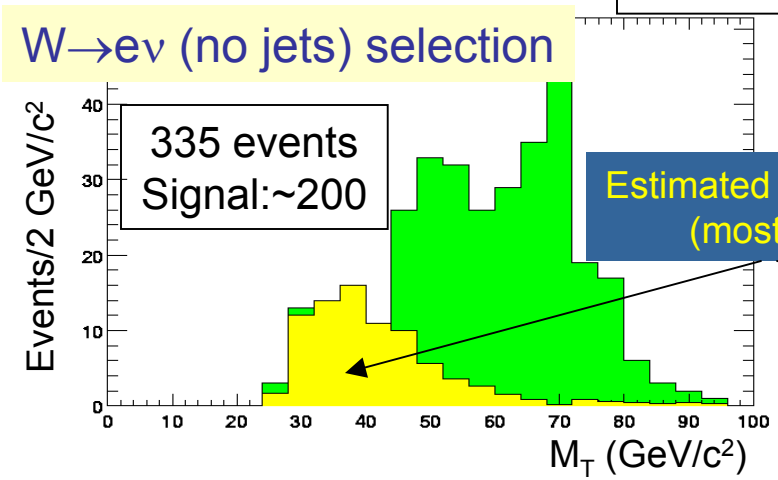
➢ Evidence for the b-content in the μ+jet sample.

Electroweak Physics (W/Z, Top, Higgs)

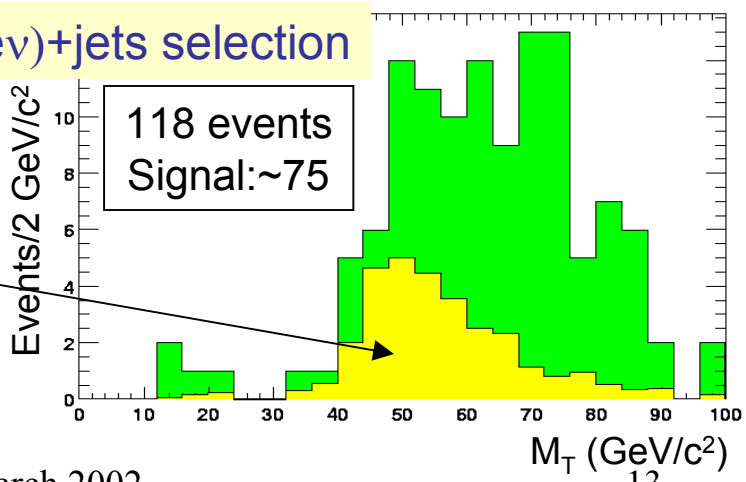




Require ≥1 track-EM cluster match



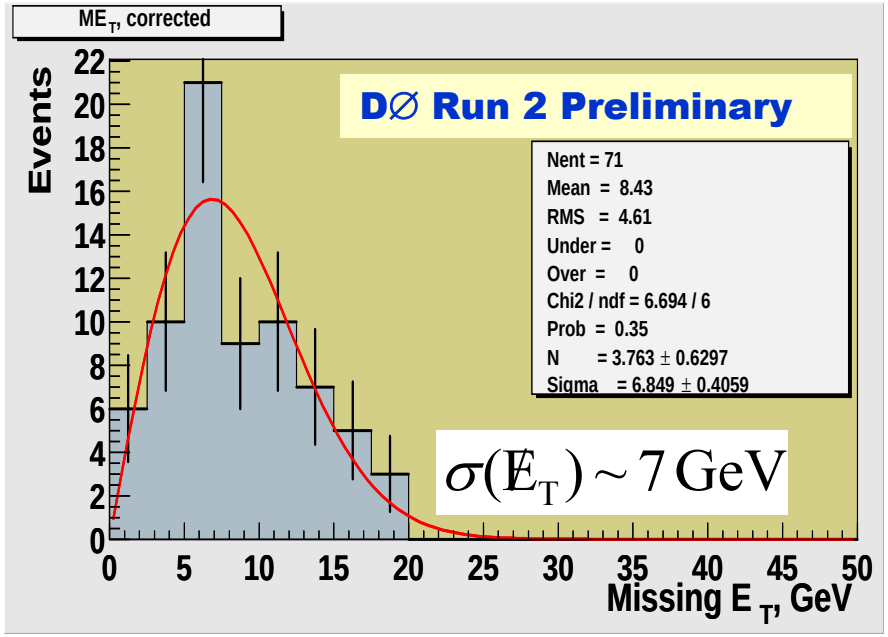
Estimated background (mostly γ, π^0)



New Phenomena Physics

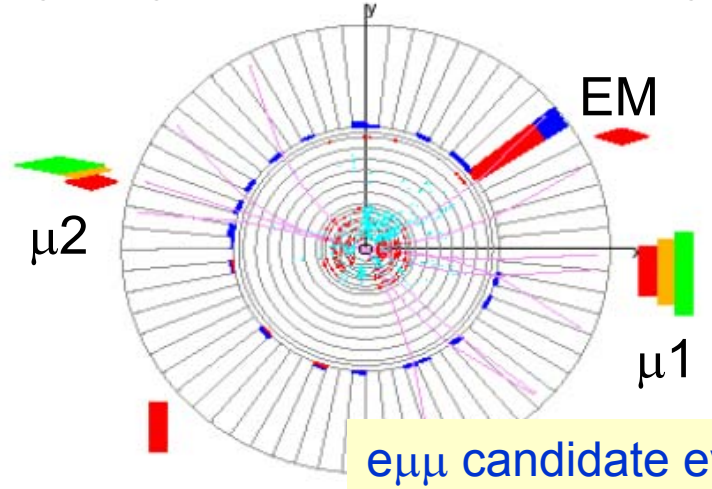
Di-EM+Missing E_T channel

- Important signature for new physics searches (SUSY, extra dimensions, etc).
- Determine ME_T resolution from inclusive di-electron sample w/ at least one track match.



Search for Trileptons

- Trilepton events are one of the cleanest signatures of SUSY (e.g. chargino+neutralino production through W*)



eμμ candidate event

EM	μ1	μ2
E_T = 19.2 GeV η = 0.40 φ = 0.63 no track match	p_T = 28.2 GeV η = -0.10 φ = 6.20 charge = -1	p_T = 9.82 GeV η = -1.48 φ = 2.88 charge = 1
	$m_{\mu\mu}$ = 41.5 GeV	
Missing E_T =31.8 GeV		

Outlook

- The Tevatron Run 2 started in March 2001. It is offering one of the most exciting physics programs for the next decade.
- Enormous progress made over the course of the last year in terms of detector commissioning. Entering physics results phase.
- Integrated luminosity delivered so far ~20 pb^{-1}.
  Expect ~300 pb^{-1} by the end of 2002.
- Preliminary performance results are encouraging and indicate that the upgraded DØ detector will be able to fully exploit the available physics opportunities.
- First physics results already emerging: J/Ψ, W, Z, jet distributions, searches, etc.

  It will get even better:
  - optimization of detector, trigger and DAQ performances,
  - calibration,alignment,
  - improved selection and reconstruction procedures,
  - ...
  - and lots of integrated luminosity!

Expect a lot more for the Summer Conferences!!!