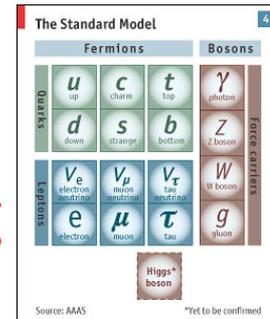


# DØ Physics - Status and Plans

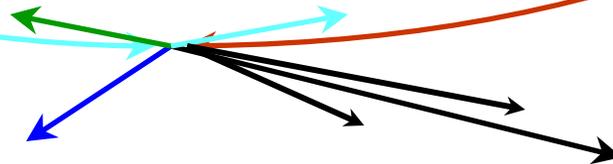
Boaz Klima  
Fermilab



Collaboration Meeting



Feb. 15, 2002





# Outline

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- Past
  - Organizational changes
  - Getting off the ground ("ready for Moriond")
  - Object ID certification
- Present
  - Assessment of the October plan
  - What might be ready for Moriond
- What's next
  - Near future (summer confs)
  - Longer future
  - Even longer future



# Bottom Line

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- Tremendous progress made over the last several months
- Major accomplishments; seeds for future
- We are beginning to see signals of the physics we're interested in
- The next several months are going to be very exciting
- After that it might get too exciting...

...but, still lots to do

# Thanks, disclaimer, WWW

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- Thanks to all convenors for their work and help in assembling this talk
- All mistakes are mine!
- More info, being updated on a regular basis, can be found linked from each group/board web page(s) - all linked from the Physics main web page at

<http://www-d0.fnal.gov/Run2Physics/home.html>

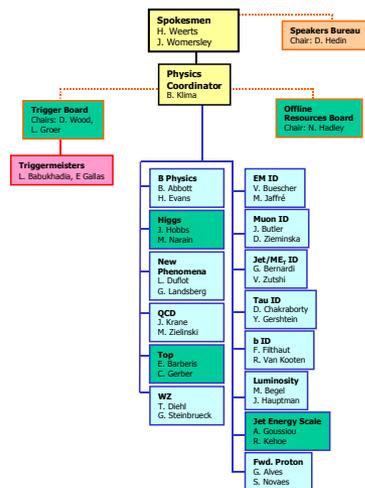
- This talk is linked from that page, or go directly to

[http://www-d0.fnal.gov/Run2Physics/d0\\_private/talks/Collaboration\\_Meeting\\_021502.pdf](http://www-d0.fnal.gov/Run2Physics/d0_private/talks/Collaboration_Meeting_021502.pdf)

# Organizational Changes (July '01)



- Added Trigger Board (TB)
- Added Offline Resources Board (ORB)
- Added Jet Energy Scale (JES) group
- Split HiT into Higgs and Top Physics groups
- Appointed many new convenors/chairs



All the new boards/groups have been functioning very well and already contributed significantly to the operation of the experiment and the analysis of its data

The new (and old) convenors and chairs performed very well both individually and collectively

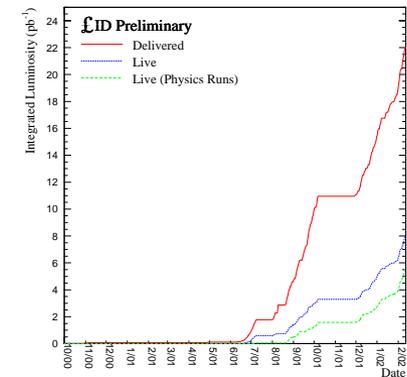


# Getting off the ground



Sometimes called "getting ready for Moriond"

- Still lots to do before we get to Physics
  - Improve accelerator performance
  - Complete detector + electronics + DAQ + trigger
  - Understand what they do - Commissioning/Integration
  - Debug, calibrate, align, develop algorithms (RECO, TTF, DB, ...)
  - Everything else that nobody wants to talk about
- Even more to do to become competitive
  - Really improve accelerator performance
  - Efficient/smart data taking
  - Online (&offline) quality control
  - Smooth and timely offline processing
  - Efficient/easy data access (SAM, DØRACE)



We already made a lot of progress - much more is needed  
We have to do all of this in parallel !



# Object ID Certification



First time done in DØ's long history

- Introduced a new formal process
  - Approval by ID group
  - Certification by godparent
  - Given a version number
- Certified/standardized ID definitions are being (to be) used (from now on) by all Physics groups
- What's available? object definition(s), trigger efficiency, fake rate, performance plots, energy scale, resolution, MC vs Data, macros,...
- First step in a long journey (only version 1 is out now)
- Object IDs will be improved steadily as we get better understanding of our data, more detectors and tools in place, smarter/more sophisticated ideas,...
- Help in pursuing better IDs at all levels is needed



Major step forward! Kudos to all participants + convenors + godparents



# October '01 Plan

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- Presented to the collaboration and distributed around at the beginning of October 2001
- Goals
  - Present first results at Moriond, showing that the detector is working and we are on track for physics results in 2002 (first physics results at the summer confs, based on  $\sim 200\text{pb}^{-1}$ )
  - "Hidden agenda" - long learning curve, full integration (not only hardware!), feedback, morale, PR,...
- Means/How
  - Monitor operations with the aim of identifying and addressing problems, and increasing our efficiency
  - Make/monitor progress on reconstruction and analysis tools
  - Establish Certification of Object IDs
  - Need stable data-taking period (core trigger list unchanged)

**Time scale is VERY short!**



# Detailed Plan (1)



- **October 15**
  - $W/Z \rightarrow e$  signal ✓
  - reporting and oversight established ✓
  - establish a plan for analysis infrastructure (e.g. event<sup>?</sup> display, luminosity tools) and for farm operations ✓ during shutdown
- **November 1**
  - $W/Z \rightarrow \mu$  signal ✗ made tremendous progress understanding data, identifying problems and needs, and getting ready once trigger in place
  - luminosity available by run and trigger ✓
- **November 15**
  - $J/\psi \rightarrow \mu\mu$  signal for calibration ✓
  - Operations:
    - ◆ 20 Hz to tape ✗
    - ◆ Examines, **online monitoring** of data quality ✗
    - ◆ production offline capable of keeping up with data taking & plans to cope with increases ✓ ?
    - ◆ use new tape handling system ✓
  - Last date for major changes to Dec 1 software release ✓



# Detailed Plan (2)

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- **December 1**
  - start stable global running; freeze global trigger list (L1 and L3) ✓
  - Establish EM scale ✓
  - b tagging with muons ✓
  - P10.x software release (= final reco code for Moriond) ✓
- **January 10**
  - certified e, mu physics objects ✓
  - certified tracks ✓
  - certified jet physics objects and certified JES ✓
- **February 1**
  - b tagging with sec vtx or IP ✓
  - complete data taking for Moriond ✓
- **February 8**
  - complete data processing for Moriond ✓
  - (re-processing with p10.14 by today?)
- **March 1**
  - Plots/results ready for approval



# Did it work?

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- Yes! We have accomplished a lot.  We learned a lot.  
**Tremendous progress!**
- But...
- Lessons for the future (motherhood?)
  - Need better understanding of the problems, what's realistic etc (e.g. expecting W/Z  $\rightarrow$   $\mu$  signal on Nov. 1)
  - Need to get everybody on board
  - Need to better coordinate communication and feedback mechanism between hardware/software/analysis
  - Management at all levels needs monitoring of progress, identifying problems along the way and solving them quickly
  - We all need to pay attention to details
- Are we better off today than 4 months ago
  - **Definitely YES**
  - We are further ahead on every frontier
  - We know how to correct most (all?) of our mistakes

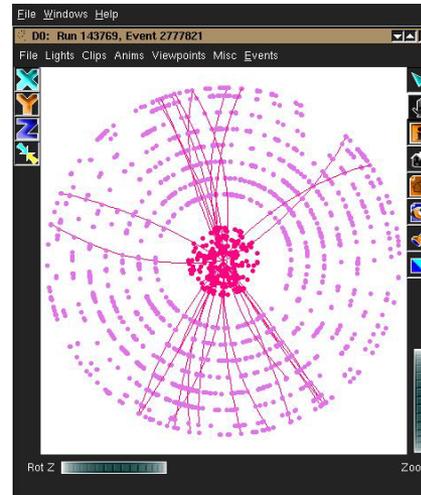


# Where's the beef?



Or, where are we today wrt Physics?

- We can show that
  - Almost all detectors are operational
  - Most of those produce data as (or close to what's) expected
  - In most cases we understand what needs to be studied/done/investigated to get us to the promised land
- We see almost all obvious objects (see "Latest Run 2 Results")
  - $W/Z \rightarrow e + \nu/e$
  - $Z \rightarrow \mu\mu$
  - $J/\Psi \rightarrow \mu\mu$  (F & C)
  - $K_S \rightarrow \pi\pi$
  - Jets
  - $\cancel{E}_T$
  - $W/Z + \text{jets}$
  - $b$  ( $\mu$ -tag)
  - $b$  (SMT/IP tag) (?)
  - $J/\Psi \rightarrow ee$  (?)





# Moriond

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What will we (**may**) be able to show at Moriond?

Disclaimer  
Caveats

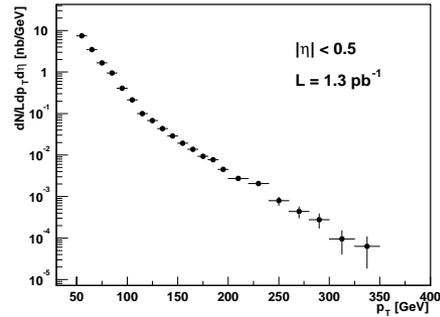
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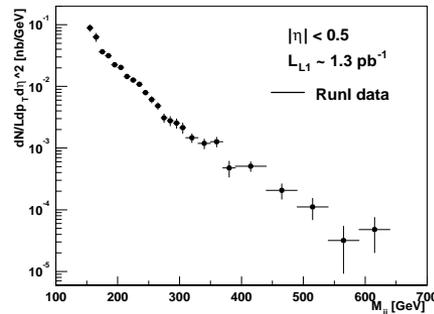
# QCD Physics



## 2-jet event display

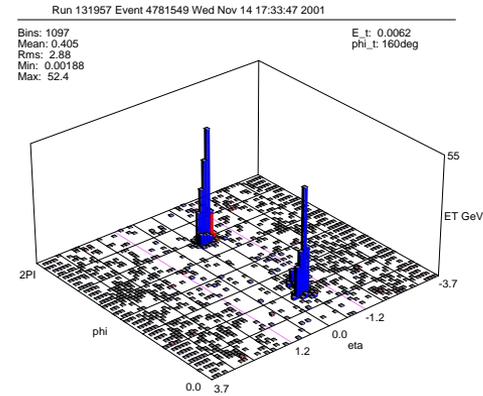


## Jet $E_T$ x-section



## Dijet invariant mass

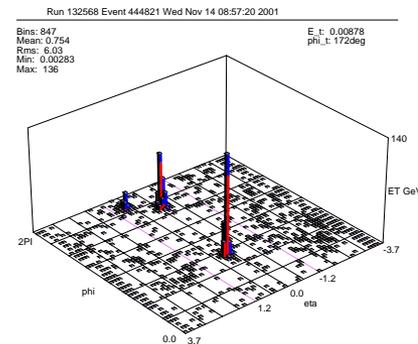
- o Energy Scale Corrections v1.1 applied
- o No Trigger or Reco (in)efficiencies applied



## 2-jet event

- $E_{T,jet1} \sim 230 \text{ GeV}$
- $E_{T,jet2} \sim 190 \text{ GeV}$

## 3-jet event display



## 3-jet event

- $E_{T,jet1} \sim 310 \text{ GeV}$
- $E_{T,jet2} \sim 240 \text{ GeV}$
- $E_{T,jet3} \sim 110 \text{ GeV}$
- $E_T \sim 8 \text{ GeV}$

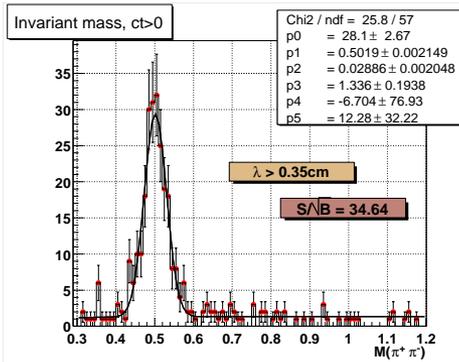


# b Physics



## Particles

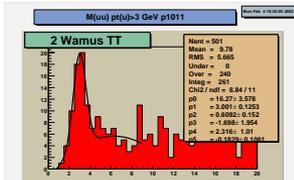
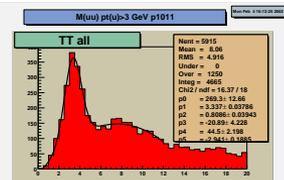
## b tagging



$$K_S \rightarrow \pi\pi$$

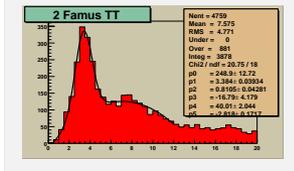
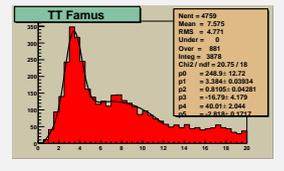


All



CC

FF



FF

$$J/\Psi \rightarrow \mu\mu$$

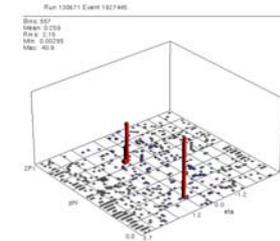
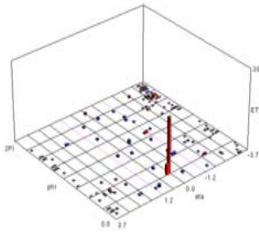


# WZ/Higgs/Top Physics

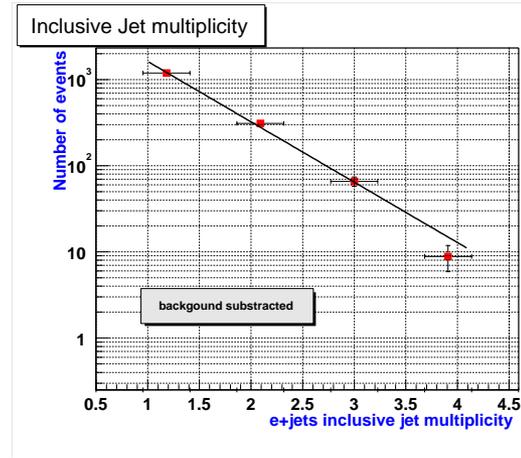
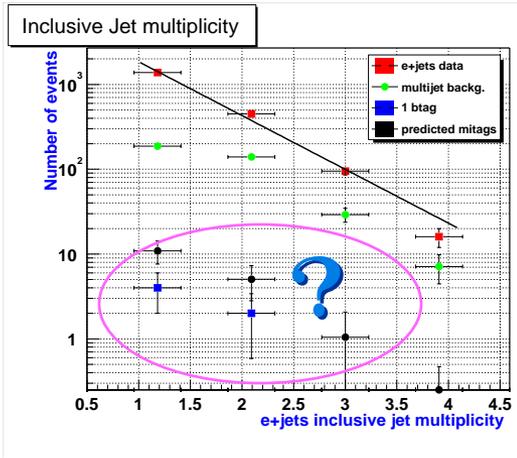


$$W \longrightarrow ev$$

$$Z \longrightarrow ee$$



$W(\rightarrow ev) + \text{jets}$



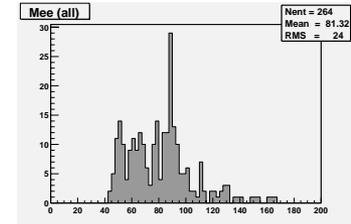
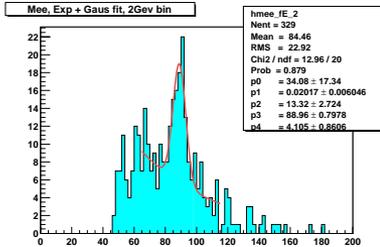


# WZ/Higgs/Top Physics

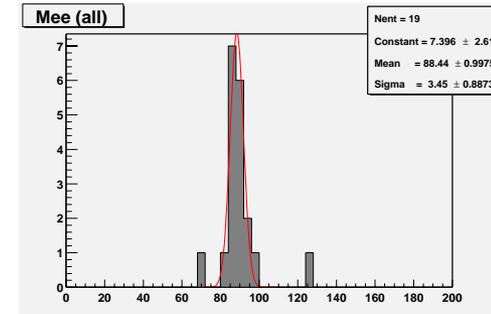
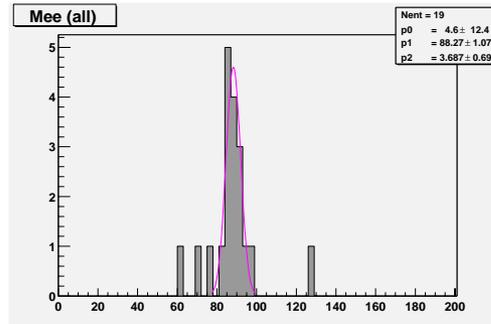
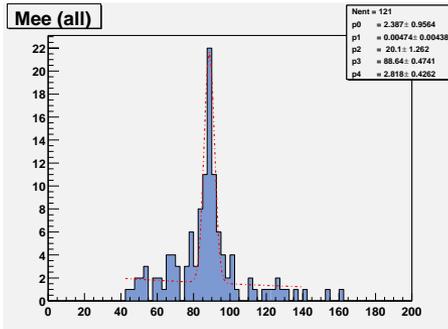


$$Z \longrightarrow ee$$

Using certified/standard  
Object ID cuts



Nice, but...



Tighter cuts

with Global tracks

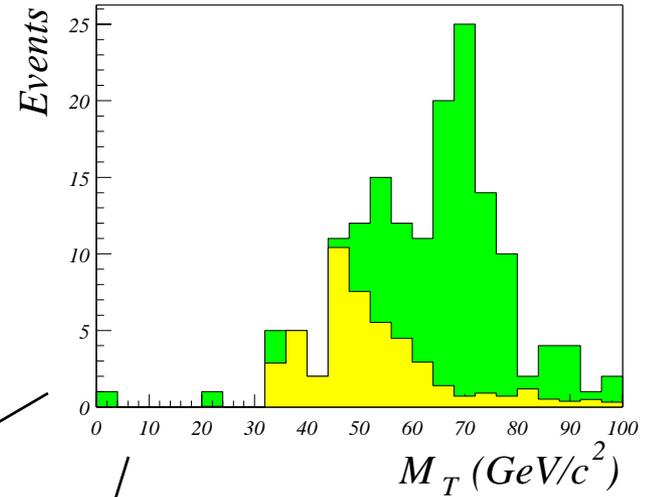
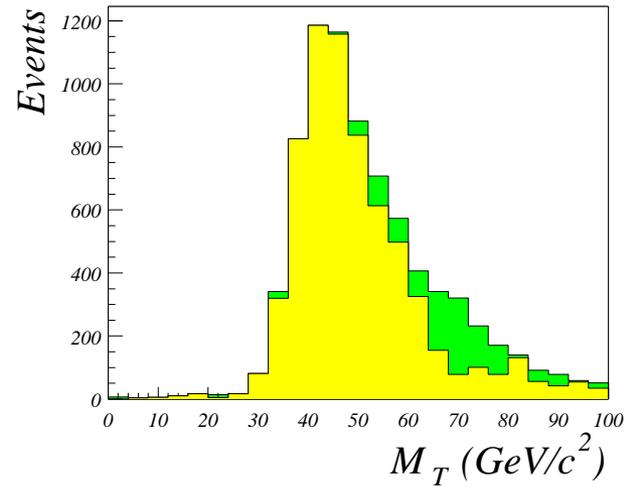
with SMT tracks



# WZ/Higgs/Top Physics



$$W \longrightarrow ev$$

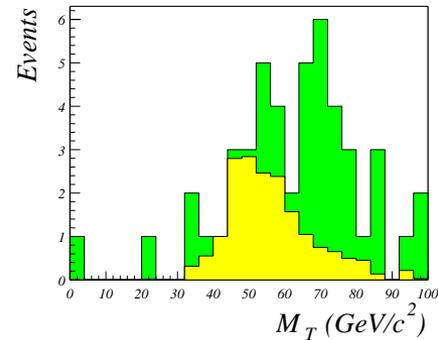
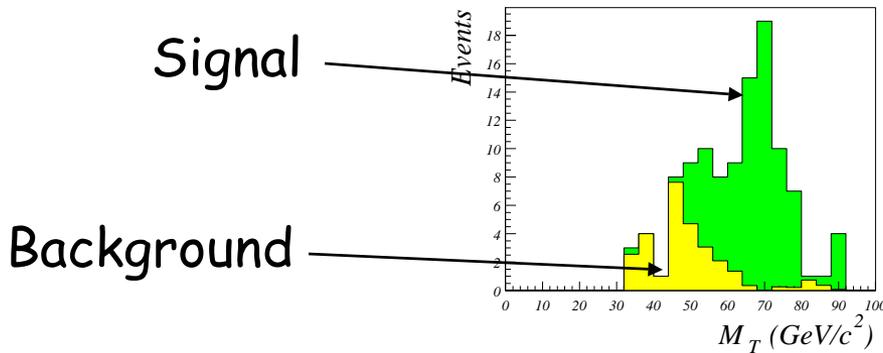


Using certified ID cuts

no jets

w/ jets

Using SMT tracks





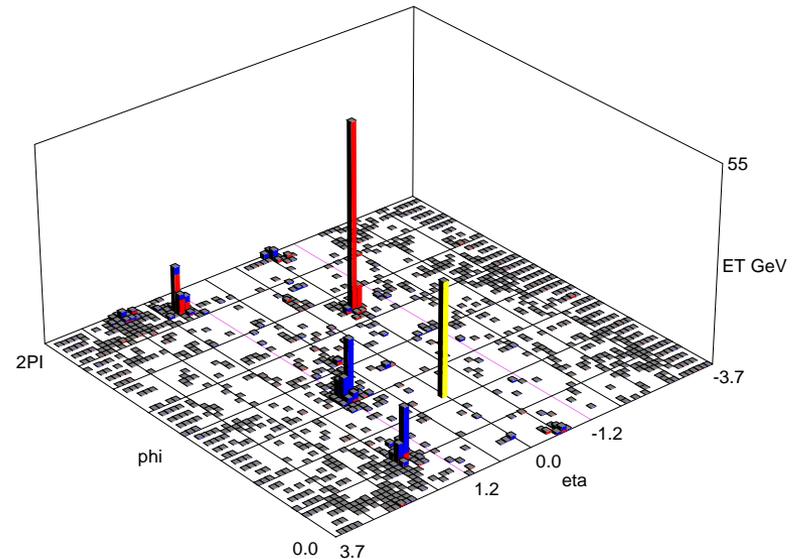
# WZ/Higgs/Top Physics



## Higgs candidate event

## Top candidate event

Run 140558 Event 300881 Wed Feb 13 14:57:02 2002



- $p_T^e \sim 70.0 \text{ GeV}$ ;  $E_T^{\cancel{e}} \sim 25.3 \text{ GeV}$
- $M_T(e, \nu) \sim 63.5 \text{ GeV}$
  
- $E_T^{\text{jet1}} \sim 74.4 \text{ GeV}$ ;  $E_T^{\text{jet2}} \sim 57.5 \text{ GeV}$
  
- $E_T^{\text{jet3}} > 49.3 \text{ GeV}$ ;  $E_T^{\text{jet4}} > 23.0 \text{ GeV}$

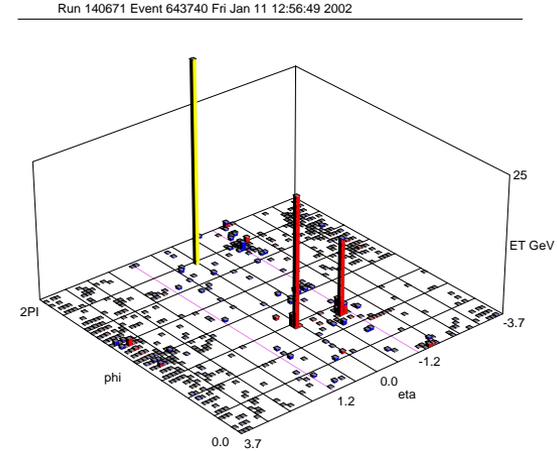
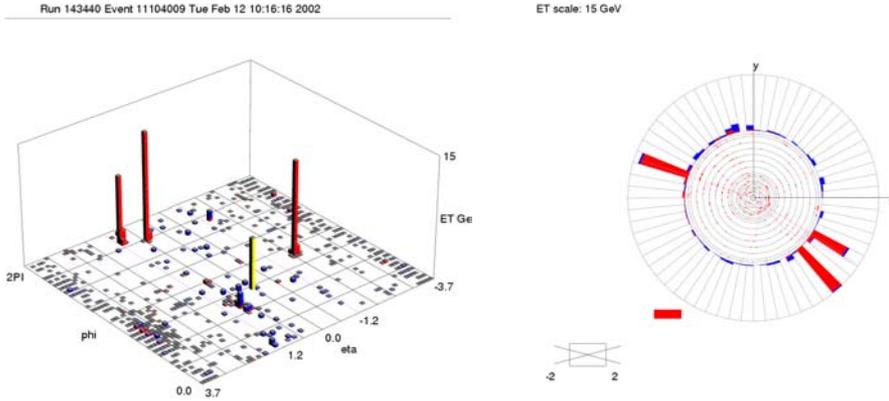


# New Phenomena Physics



## Triple-lepton ( $eee$ ) candidate

## $W+\gamma$ candidate event



$e1$	$e2$	$e3$
$p_T = 15.9$	$p_T = 12.5$	$p_T = 11.9$
$\eta = 0.43$	$\eta = -1.97$	$\eta = 1.06$
$\varphi = 5.42$	$\varphi = 2.8$	$\varphi = 5.72$
EMfrac = 1	EMfrac = 1.01	EMfrac = 1
HMx8 = 9.74	HMx8 = 11.4	HMx8 = 4.46
iso = 0.0052	iso = -0.027	iso = 0.052
id = 10	id = -11	id = 10
$m_{e1e2} = 51.1$	$m_{e1e3} = 9.74$	$m_{e2e3} = 57.8$

- Potential Distributions
  - Searches - ED, LQ, ...
  - Performance -  $\gamma\gamma E_T, \dots$

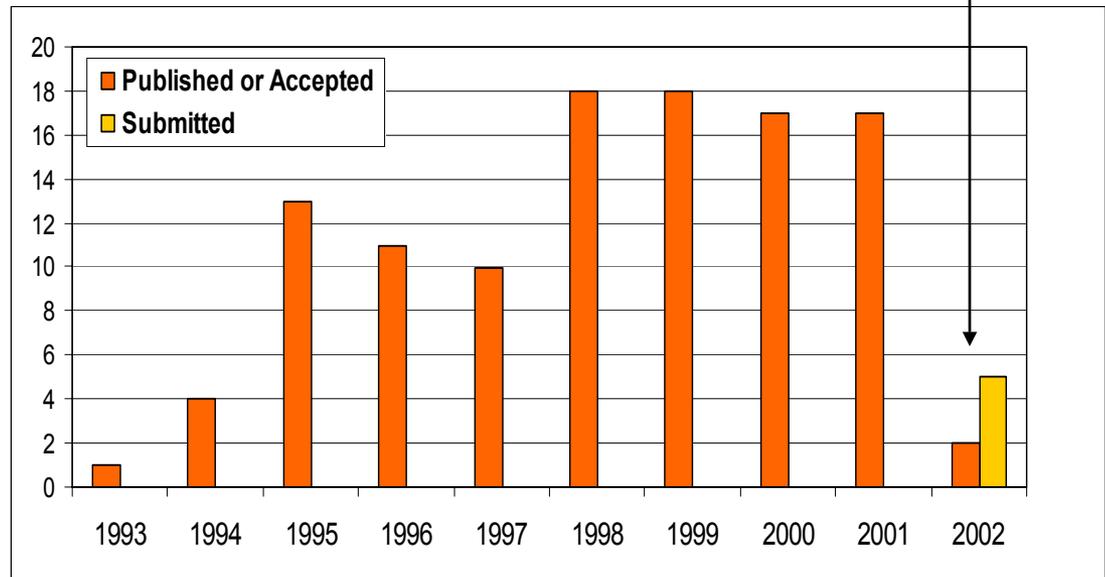


# Run 1 analysis is going, and going...



## (Still) Jianming's Report

- DØ has published (or submitted) 116 papers so far
  - 2  $k_T$  papers published this week (PRD & PLB)
- 2 drafts are in Collaboration review
- 2 drafts are in Style review (→ Collaboration)
- 5 analyses are in Physics/EB review
- 8 analyses in progress
- Done in 2002?





# What happened during the collaboration meetings?

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- I attended (too) many ID/Physics meetings
  - Negative
    - Rooms too small for most meetings (maybe this is positive?)
    - Rooms not air-conditioned, too hot/steamy
- Next time: Physics → WH1W, IDs → WH1W, 9<sup>th</sup> Circle
- Positive
    - Enormous progress
    - A lot in the pipeline, many starts
    - Identify needs, problems, tasks, volunteers(?)
    - Excitement & "discoveries" (W - Markus, W+jets - Ia)
    - Fun, fun, fun (many laughs!)

Great! Continue as is



# Where do we go from here?

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- Still lots to do... (am I annoying or what?!)
- Short term
  - We have to be serious about getting first Physics results out by the summer conferences
  - We need a plan and a commitment
  - We have to execute better
- Longer term
  - Figure out where we can gain big time
  - Pay careful attention to "small" effects
  - Do the more challenging stuff ( $\tau$ ,  $b \rightarrow e$ , NN,...)
  - ...discover Higgs, SUSY, ED, BH,...



# The next several months



## "Getting ready for ICHEP 2002"

- **May 1**
  - certified object IDs ( $e$ ,  $\mu$ , jet,  $E_T$ , JES,  $b$ ,  $\tau$ ,...)
- **June 1**
  - complete data taking for ICHEP
- **June 8**
  - complete data processing for ICHEP
- **June 15**
  - complete Express Stream re-processing
- **July 1**
  - Plots/results approved by Physics groups
- **July 8**
  - Rehearsal of talks
- **July 12**
  - **EB approval** of analysis and talks
- **July 24, 2002**
  - 1<sup>st</sup> day of ICHEP 2002 (Amsterdam)



# Conclusions

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- Still lots to do
- Tremendous progress made over the last several months
- Major accomplishments; seeds for future
- We are beginning to see signals of the physics we're interested in
- The next several months are going to be very exciting
- After that it might get too exciting...

Let's get ready to produce first significant Physics results in summer 2002!