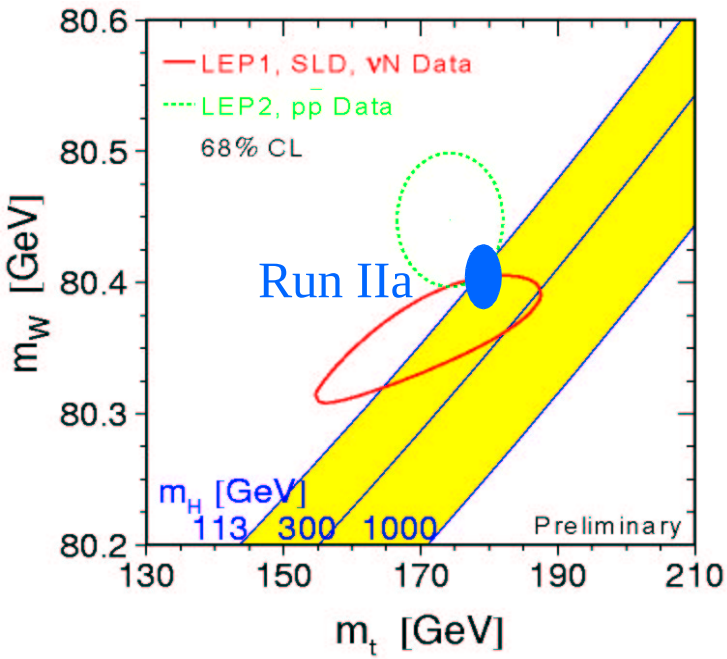
CHA 4% fix: physics motivation

How important is to have a well calibrated calorimeter?

Much physics depends on good calorimeter measurements and low systematics. One example: top mass measurement. This is a VERY IMPORTANT measurement to do.

Electroweek precision measurements

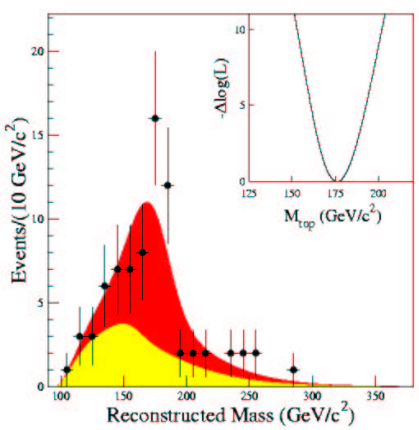


Run II "projected" ΔM=±2 GeV

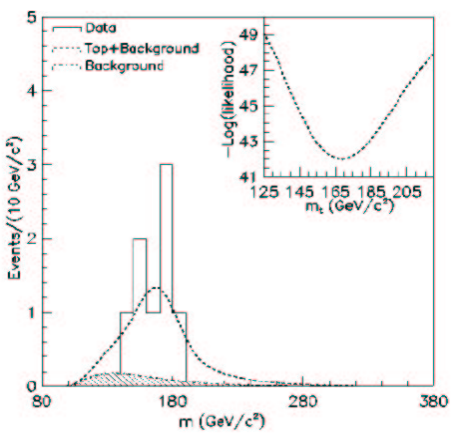
M(top) = 176.0 ± 4.0 (stat) ± 5.1 (syst) GeV

M(top) = 174.3 ± 5.1 GeV CDF+D0 comb.

CDF Top Mass measurement in Run I



l+jets



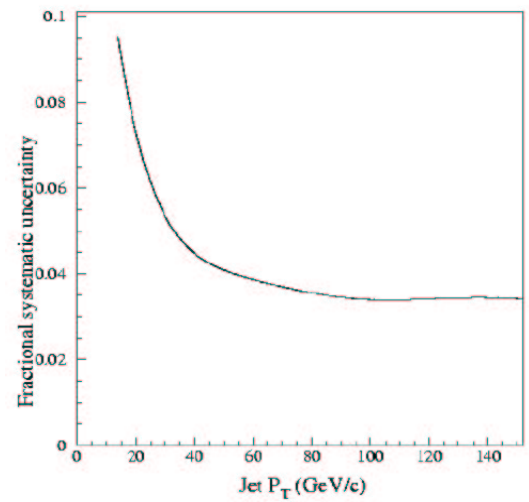
Dilepton

How can we improve the top mass?

Plan is to reduce the systematic error from 5.1 to 2.0 GeV

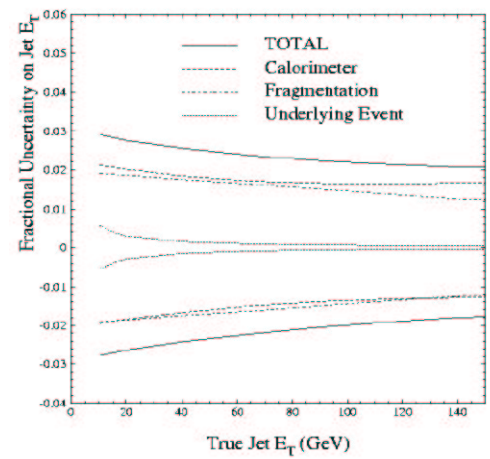
- We used three channels, major systematic error is from jets (>3.8 GeV)

Channel	dilepton	l+jets	all−had
Nev(sig/back)	6.7/1.3	40/36	45/142
Jet energy scale	3.8	4.4	5.0
ISR, FSR	2.7	2.6	1.8
Monte Carlo (gen,sim)	1.1	0.5	1.0
Background shape	0.3	1.3	1.7



Major systematics from jets (cone=0.4):

Calorimeter stability	1%
Absolute corr. (+UE) :	2.5%
Relative correction	0.2%, 4% in cracks
UEM (UE from mul. int.)	100 MeV/vertex
OOCC (exp to 55, >55)	6−1.4%



Calorimeters systematics on top mass

- Calorimeter Stability : 1%

  1% $\longrightarrow$ $\Delta M_t = 0.66\%\ M_t = 1.2$ GeV

- Absolute corrections : 2% $\Delta M_t = 2.4$ GeV

  This sets the E−SCALE, includes:

  calorimeter non linearity uncertainties

  cracks in central calorimeter, etc.

- We need to keep the stability to at least 1%
- We need to reduce the uncertainties due to non−linearity and possibly cracks (more data)
- Will use additional data to reduce the systematics on the E−scale

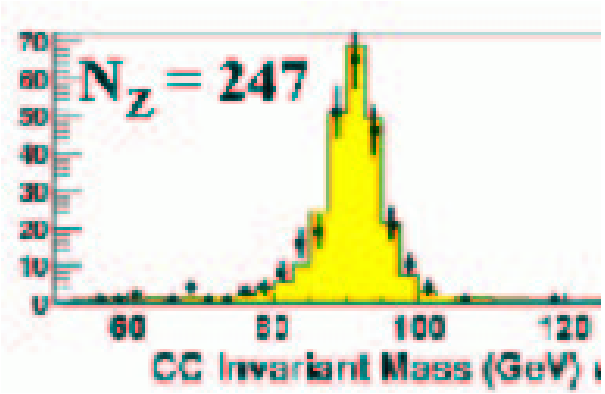
  Z $\longrightarrow$ b−bar

  gam−jet balance

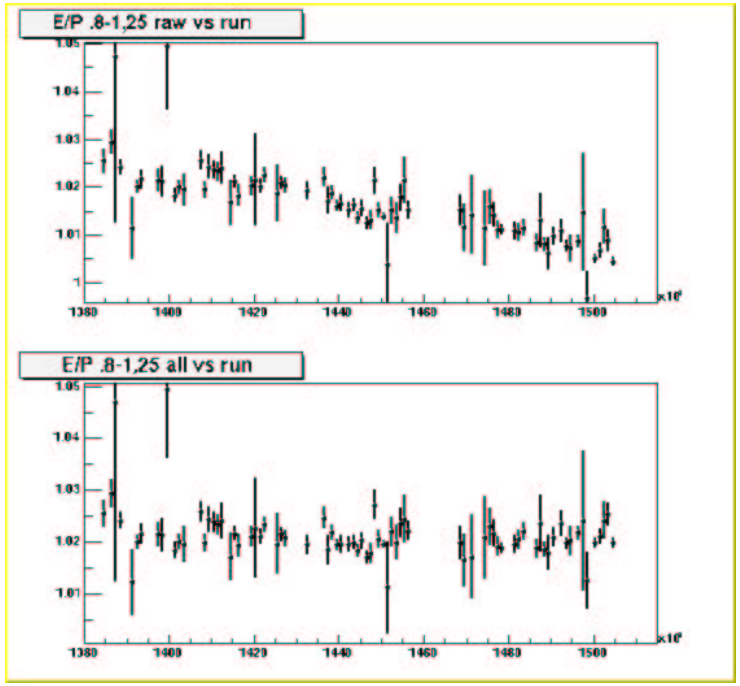
  Z−jet balance

Calorimeter stability to 1% issue

- CEM scale
  known with <2% uncertainty.
  Use M(Z) to check scale. Need factor=1.02



- CEM stability:
  using high P_T electrons
  E/P − vs−Run Number (ETF group).
  2% drift February−August



- Question:

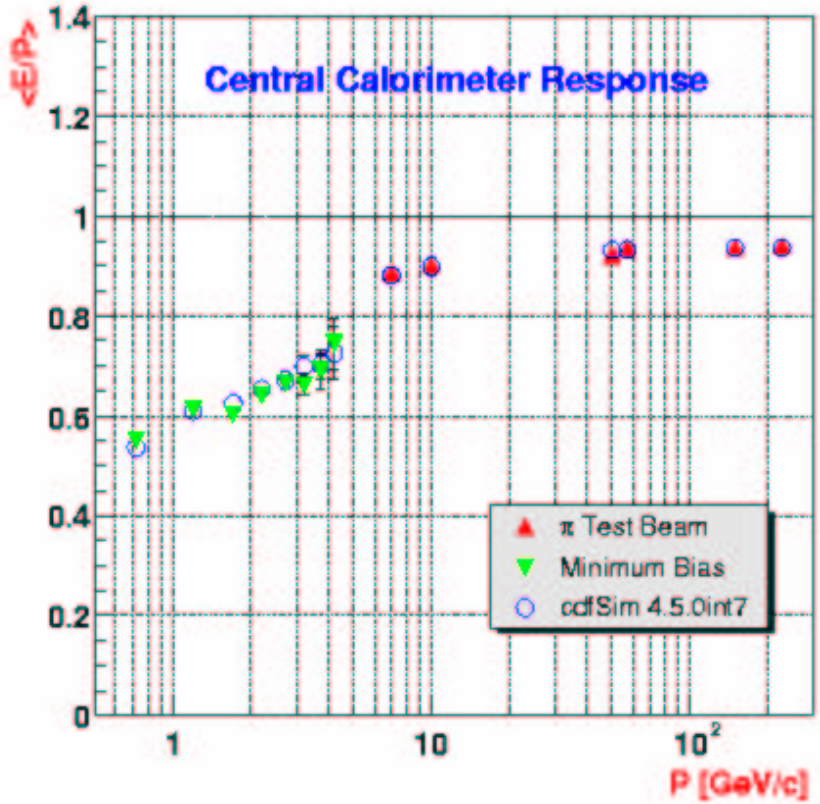
  was the 2% scale from the Z mass implemented in hardware?

Simulation tuning: low P_T pions

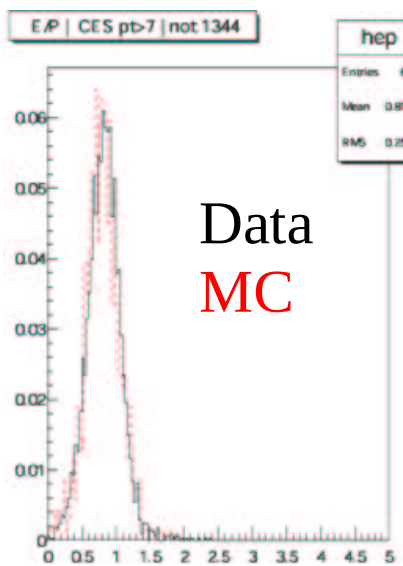
Soon Yung Jun

- Calorimeter E−scale set by 57 GeV test beam data taken in 1991.
- GFLASH tuned to test beam data above 8 GeV (see CDF−5886). Plug+Central and minbias data (CDF−5874) for PT<5 GeV

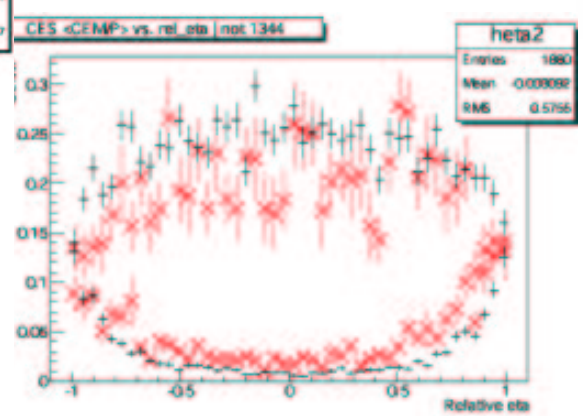
  New track trigger data: 4 and 10 GeV Baumgart+Shochet, CDF−6093



- Most data agree with the tuned MC



Lateral shower shape



- V4.5.2 has the tuning to minbias data
- New tuning being done to fit lateral shower shape and take into account CHA E−scale change

Central Calorimeter E−scale

CHA scale from Muons

Use MIP peak. Compare with run I.

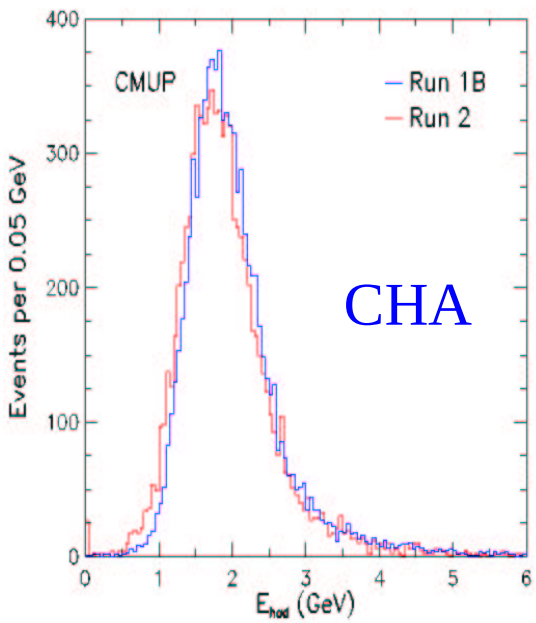
High P_T muons sample (Hyunsoo Kim)

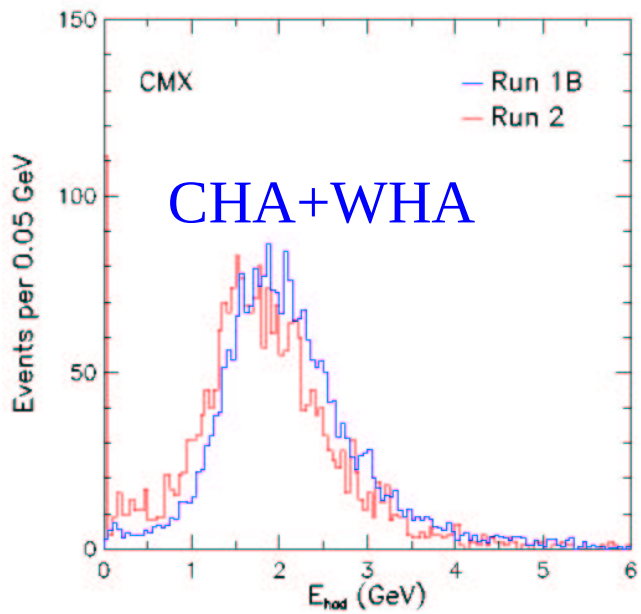
J/ψ muons (Robyn Madrak)

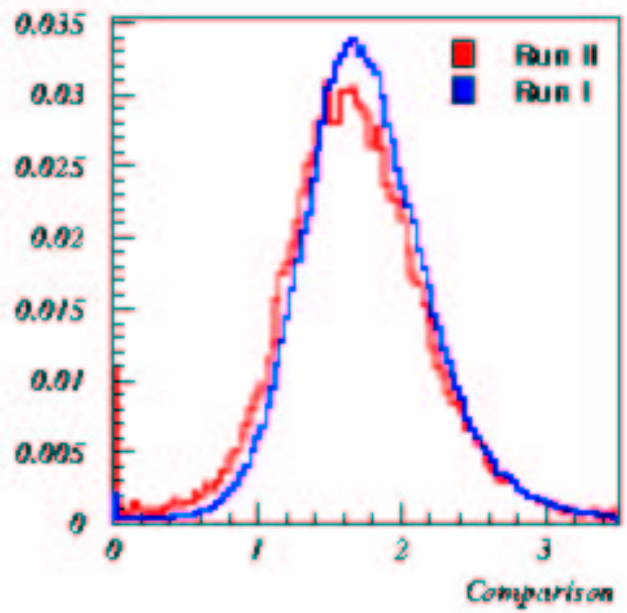
CMUP
M_{II}/M_I=0.958

CMX
M_{II}/M_I=0.901

$(M)_{II}/(M)_I$= 0.960 ±0.005



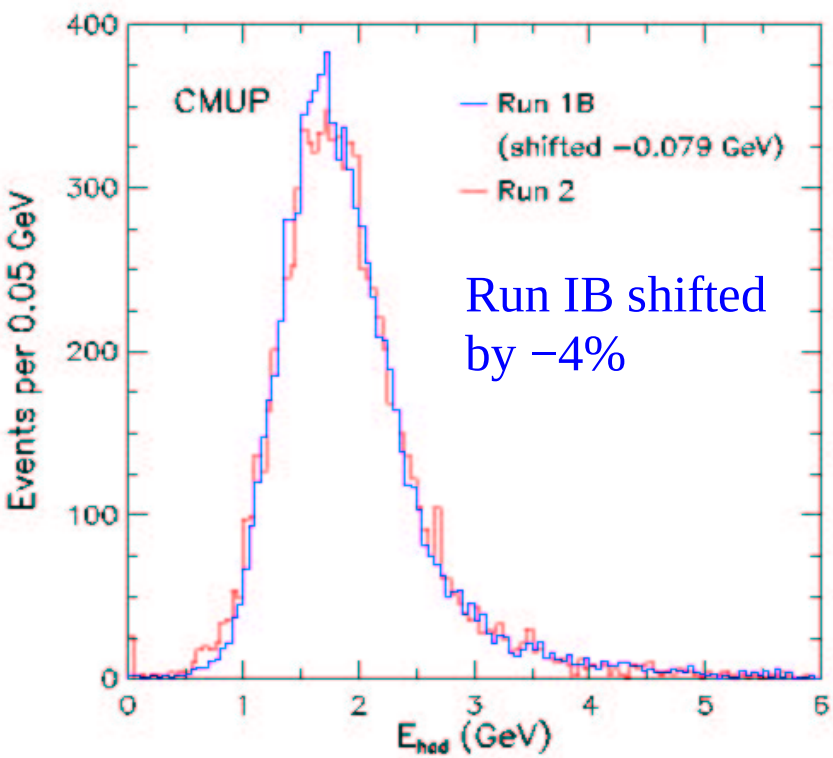


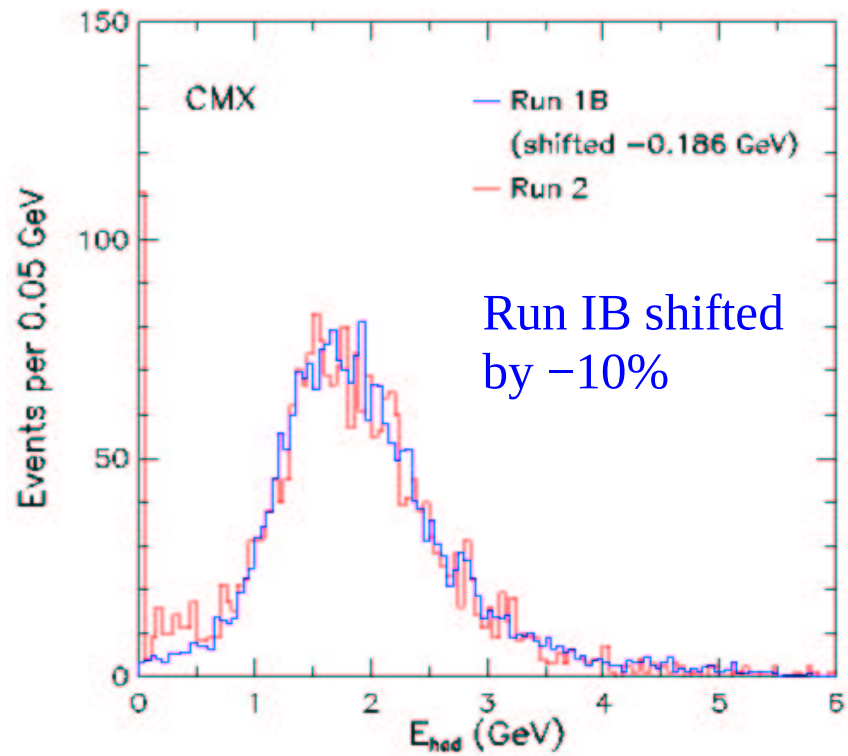


More on high P_T muons

Hyunsoo Kim doing more work on muons from W/Z

- Looked at new possible fits to the data
- Compared the CHA and CMX data after shifting the E−scale by the values found above.



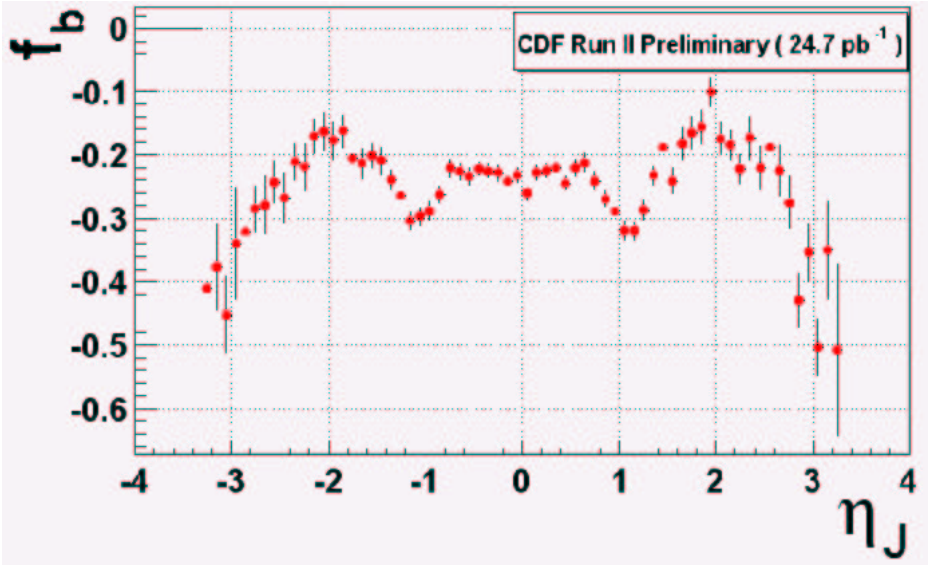


Gam−Jet balance

Use γ−jet balance to find jet scale compared with run I.

$$f_b = (P_T^{Jet} - P_T^{\gamma})/P_T^{\gamma}$$

- All corrections applied to the γ



Giuseppe Latino

Find: $f_b = -0.2436 +- 0.0024$ Run II

$f_b = -0.1980 +- 0.0017$ Run I

$\Delta f_b = (4.5 \pm 0.3)\%$

This 4.5% is not yet understood. 4% CHA energy shift is not sufficient to explain it, as HAD energy contribution = 0.37 in central calorimeter. PHA can contribute to the loss.
Investigating low P_T signal loss

Summary

- Particle response:
  - CEM electrons E−scale OK within ~2%
    We need to keep this within 1%.
  - CHA muon MIP peak is shifted by −4%. Needs fixing.
  - WHA scale to be determined from muons
  - PEM+PHA need lots of work because of gain changes with time

- Absolute corrections from gam−jet balance

  - Central E−scale lower by 4.5% from run I
    Some of this due to CHA and WHA E−scale shifts
    More Myron mode data being studied to assess low Pt losses

- Central−Plug relative Corrections :
  Plug gain chnages: needs correction as a function of time and eta.

- Calorimeter simulation tuning needs second pass, because of CHA shift