Jet Corrections in Run II: status report

Lina Galtieri, for the Jet correction group

- Provide Jet Corrections along the lines of Run I (JETCLU first).
- Di−Jet group: improve jet resolution (see J. Dittman's talk)

Jet Corrections Step 1:

- Check the calorimeter E−scale (with calor., electron, muon groups)
  - Use electrons, muons, gam−jet balance
- Test Run I JTC96X corrections and determine their uncertainties
- Determine the relative central−plug response
- Tune simulation to reproduce test−beam data and low P_T pion data

Jet Corrections Step 2 (reduce uncertainties)

- Determine underlying event
- Tune jet fragmentation (charged tracks in jets) in Monte Carlo to reproduce tracks in jets.
- Determine absolute jet corrections using the Monte Carlo.
- Complete the new Run II corrections: JTC02X (?).

Summary of Jet E_T Scale in CDFII

Calorimeter E−scale

CEM : absolute scale checked with $Z \rightarrow e^+e^-$
Results show E−scale OK within 2%.

CHA : scale checked with MIP peak from J/ψ muons, W/Z electrons
Run II scale 4% low with respect to run I

WHA: First observation of MIP peak from muons!

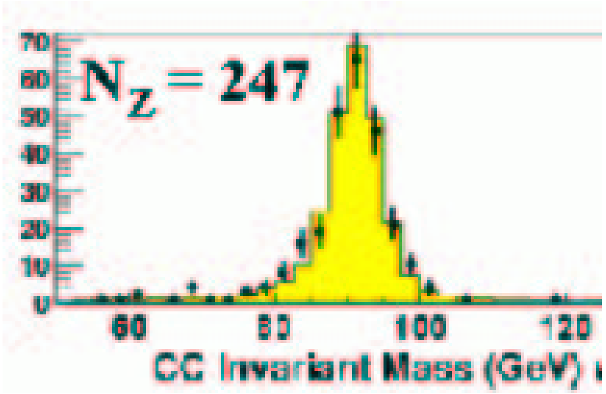
PEM : absolute scale checked with $Z \rightarrow e^+e^-$, one e in the central
Need many corrections: face , tower−tower, PPR.
Scale off up to 10% depending on cluster algorithm used.
Abnormal gain decrease at high eta

PHA: calibration from test beam. Need plug η

Jet E−scale: γ−jet balance, using JTC96X corrections, seems to be ~7% off for central jets.

Central Calorimeter E−scale

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

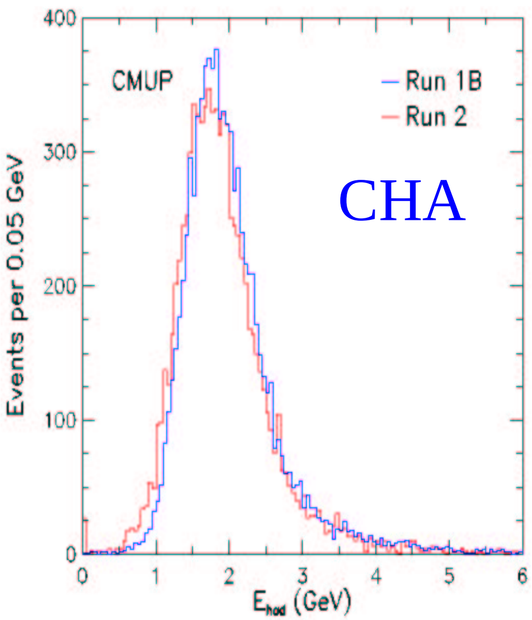


CHA scale from Muons

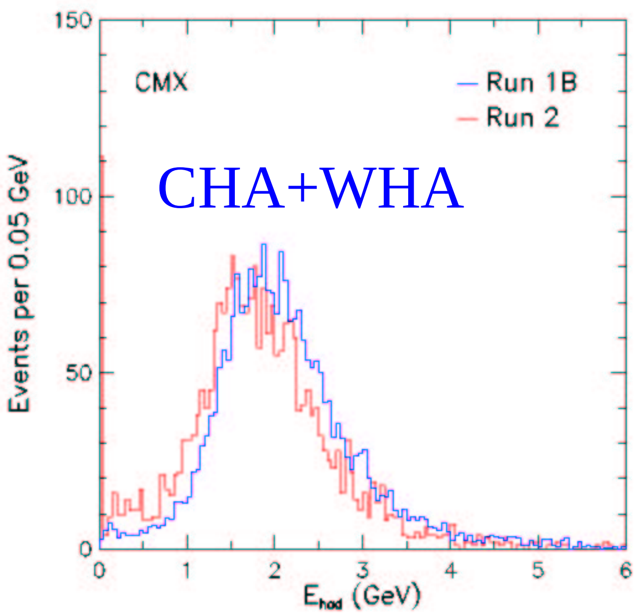
Use MIP peak. Compare with run I.

High P_T muons sample (Hyunsoo Kim)

CMUP
$M_{II}/M_I=0.958$

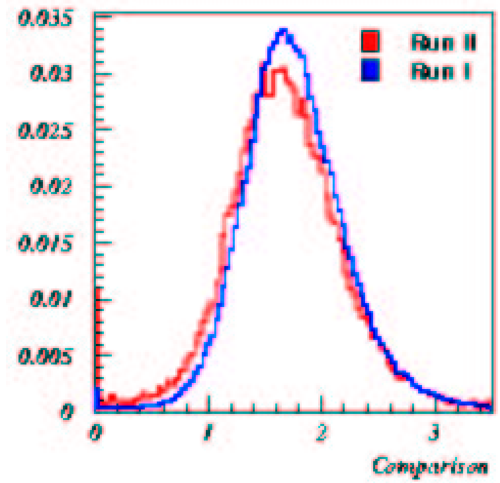


CMX
$M_{II}/M_I=0.901$



J/ψ muons (Robyn Madrak

$(M)_{II}/(M)_I= 0.960 \pm 0.005$



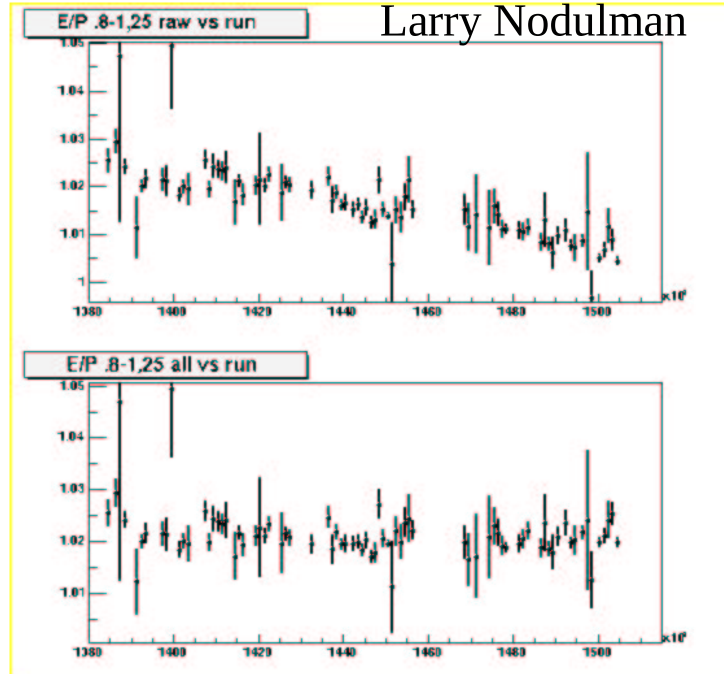
Central Calorimeter Stability

- CEM :using high P_T electrons

E/P − vs−Run Number (ETF group).

2% drift February−August

Larry Nodulman



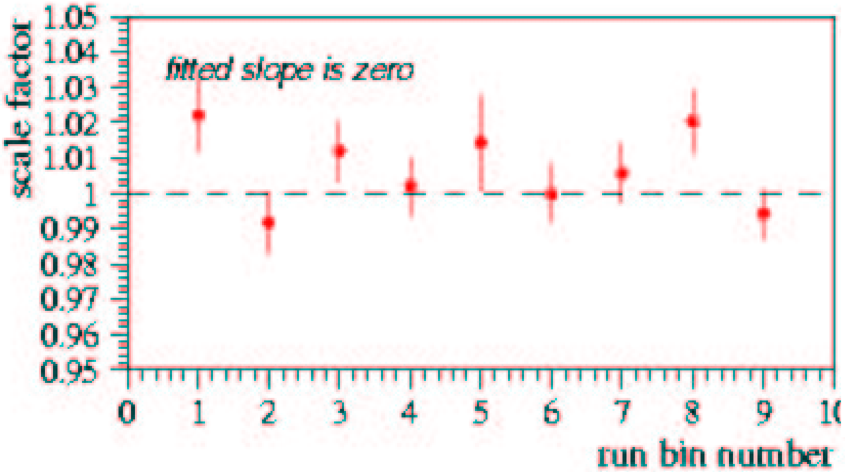
- CHA : using high P_T muons and

J/ψ muons.

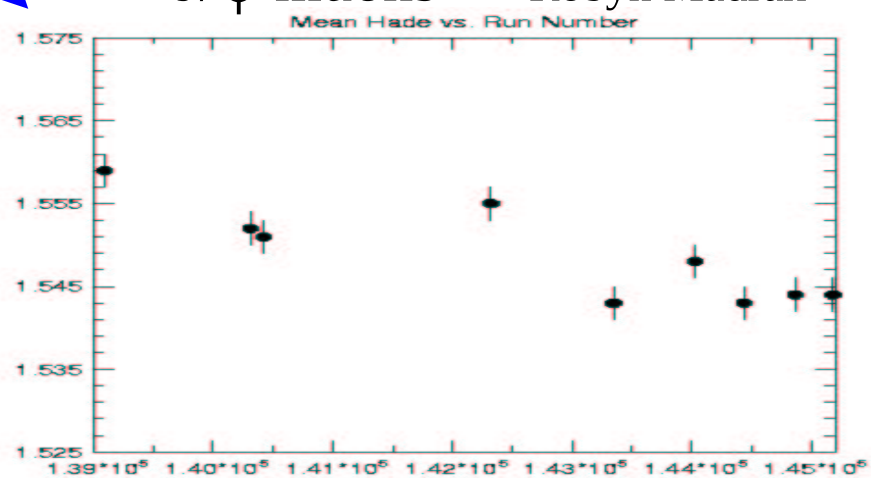
<1% drift February−June

high-p_T muons

Michael Schmitt



J/ψ muons Robyn Madrak



Central calorimeter E−scale (cont.)

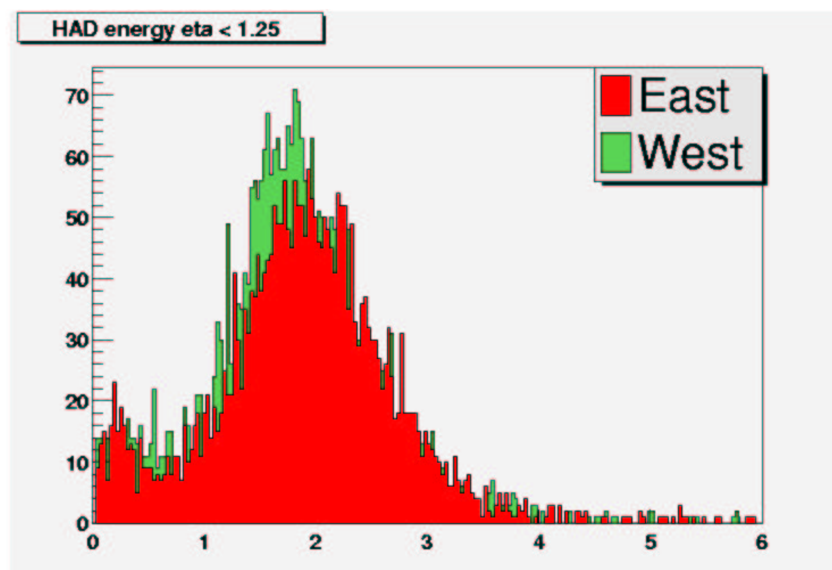
To do:

- Tower −to−tower corrections in CHA (D. Tsybychev, Gaijar)
- Move CHA E−scale by the observed 4%
- Use muon data to understand WHA E−scale
- Use muon data to obtain tower−to−tower corrections in WHA

MORE MUON DATA NEEDED

- First IMU trigger test used to look at muon response in WHA (η=1.0−1.2)
  - Observe East−West plug asymmetry
  - More data needed to understand background and peak position
  - A few PHA muons collected in same trigger

WALL muons, Dan Cyr



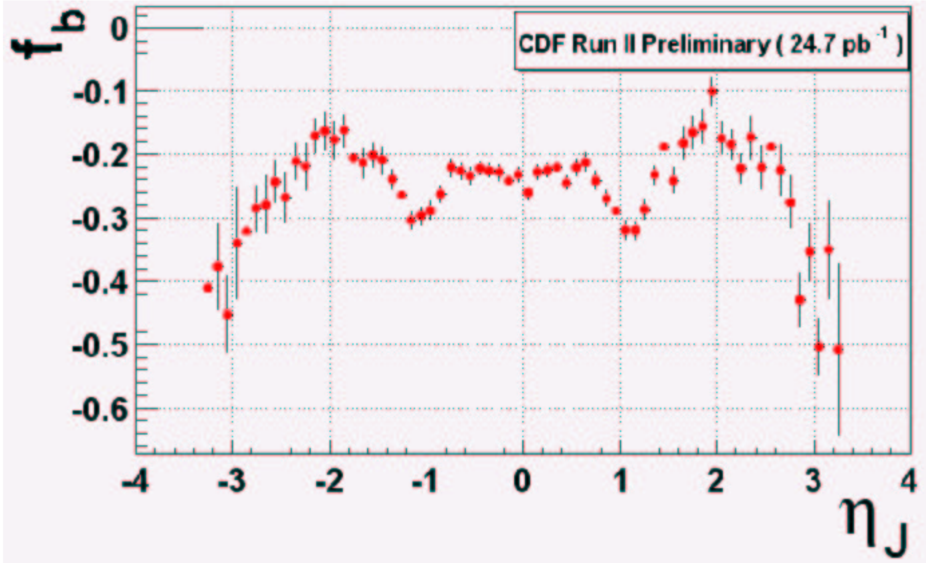
Gam−Jet balance

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

- Face map correction
- Tower−to−tower correction
- Run−by−Run corrections



Giuseppe Latino

Find: $f_b = -0.2436 \pm 0.0024$ Run II

$f_b = -0.1980 \pm 0.0017$ Run I

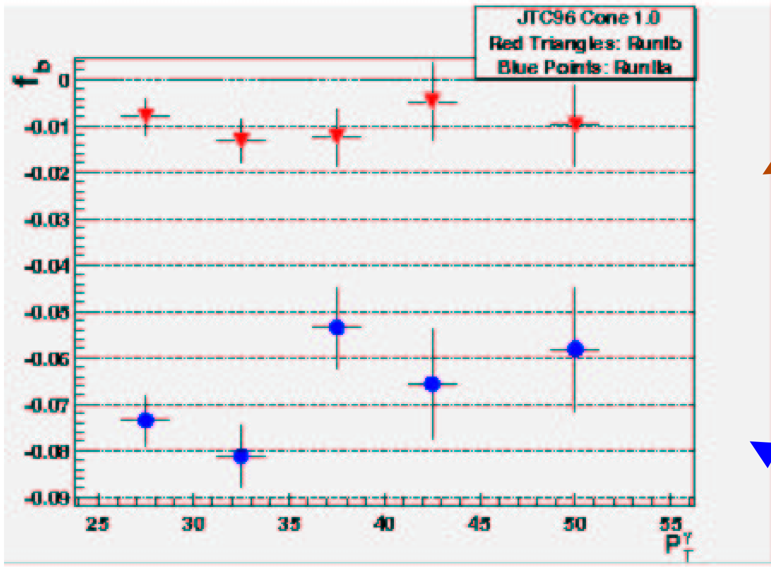
$\Delta f_b = (4.5 \pm 0.3)\%$

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.

Gam−Jet balance: can we use JTC96X?

Try to apply Run I corrections, JTC96X , to central jets in Run II.

VertexStrategy = 1, Cone 1.0.

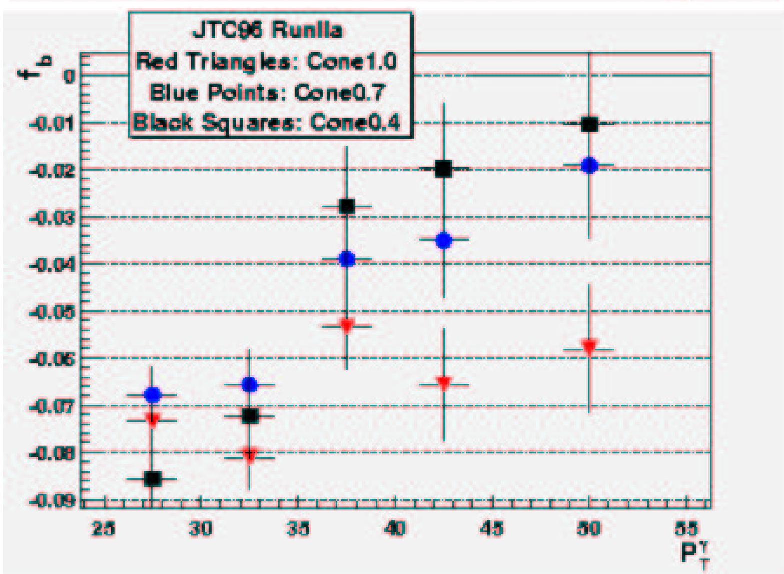


γ−jet balance as a function of $P_T(\gamma)$.

In Run I, after corrections, obtained a balance to within 1−2%

K_T kick effect?

Run II:
after corrections, unbalance of −7%



Run II corrections for different cone sizes. Need to understand step at 35 GeV.

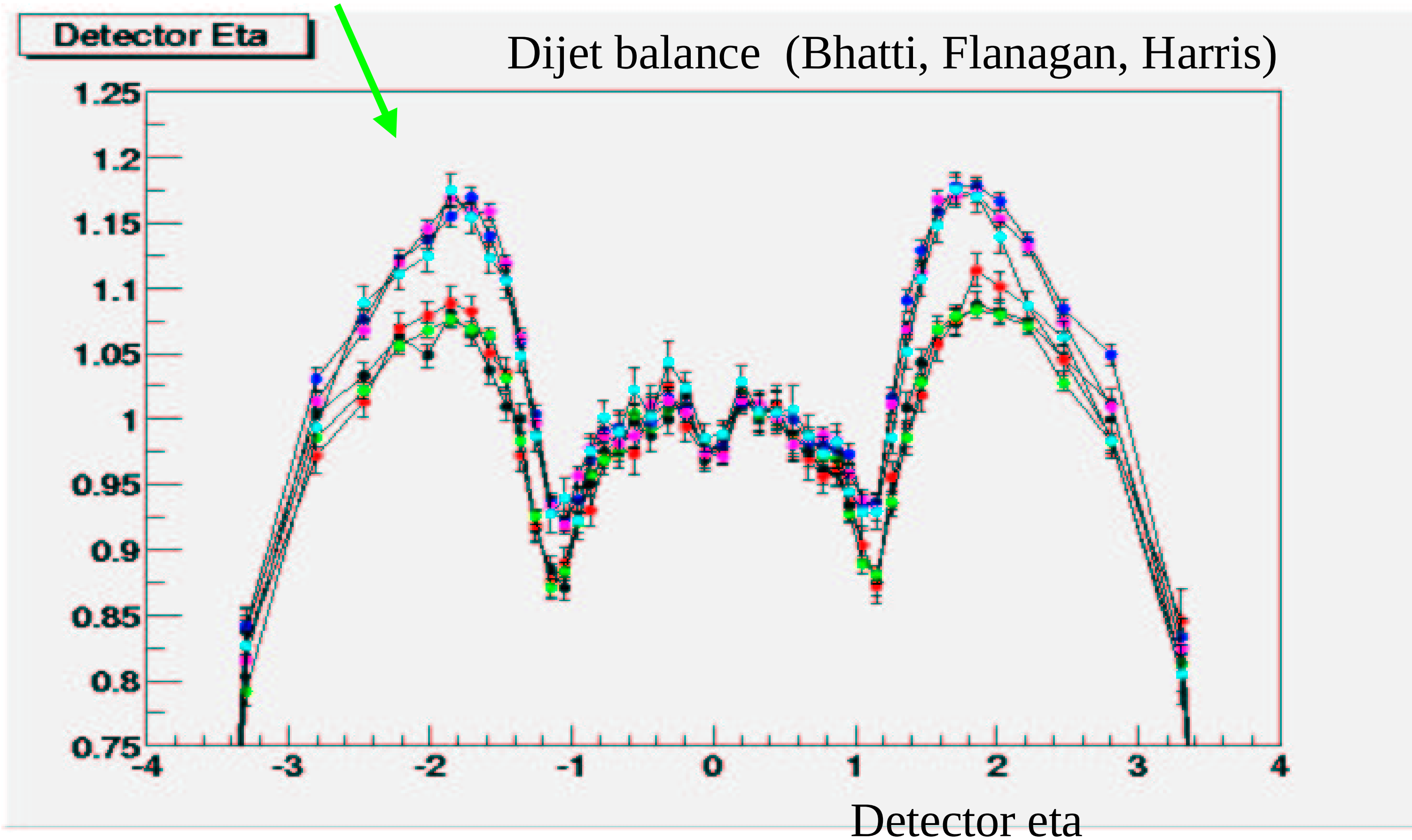
Giuseppe Latino

Plug Calorimeters:PEM energy scale

- Studying the effect of adding the PPR to the PEM energy.

$$\text{Plug EM} = \text{PEM} + \alpha \times \text{PPR}$$

- Need to tune the weight α of the PPR energy. (J. Lee and Willis). Work in progress.
- Effect on plug jets is as high as 10% at low P_T (using α =1)



Adding the PPR to the PEM energy

Is the addition of the PPR term improving the resolution?

This has been checked with gam−jet balance (Giuseppe Latino).
Uses the bisector method to measure jet resolutions:

$$\sigma_D = \sqrt{\sigma_\xi^2 - \sigma_\eta^2}$$

East and West plug looked at separately

CONE 0.7	NO PPR (Rescaled)	PPR
σ_E^D	4.31 ± 0.44	4.04 ± 0.44
σ_W^D	4.44 ± 0.51	3.99 ± 0.45
CONE 1.0		
σ_E^D	4.24 ± 0.45	4.25 ± 0.47
σ_W^D	4.21 ± 0.58	4.13 ± 0.47

Little improvement in resolution. Similar results from jets (Flanagan)
Not clear what weight to use for low Pt electrons.

Jet correction group decided to wait until tuning of weight is done and comparison with Monte Carlo is satisfactory.

Plug−Central relative corrections

Bhatti, Flanagan, Harris, Currat and others

For the plug we evaluate a correction relative to the central calorimeter by doing jet−jet balance . One jet is always in the central calorimeter.

PPR INFORMATION NOT USED

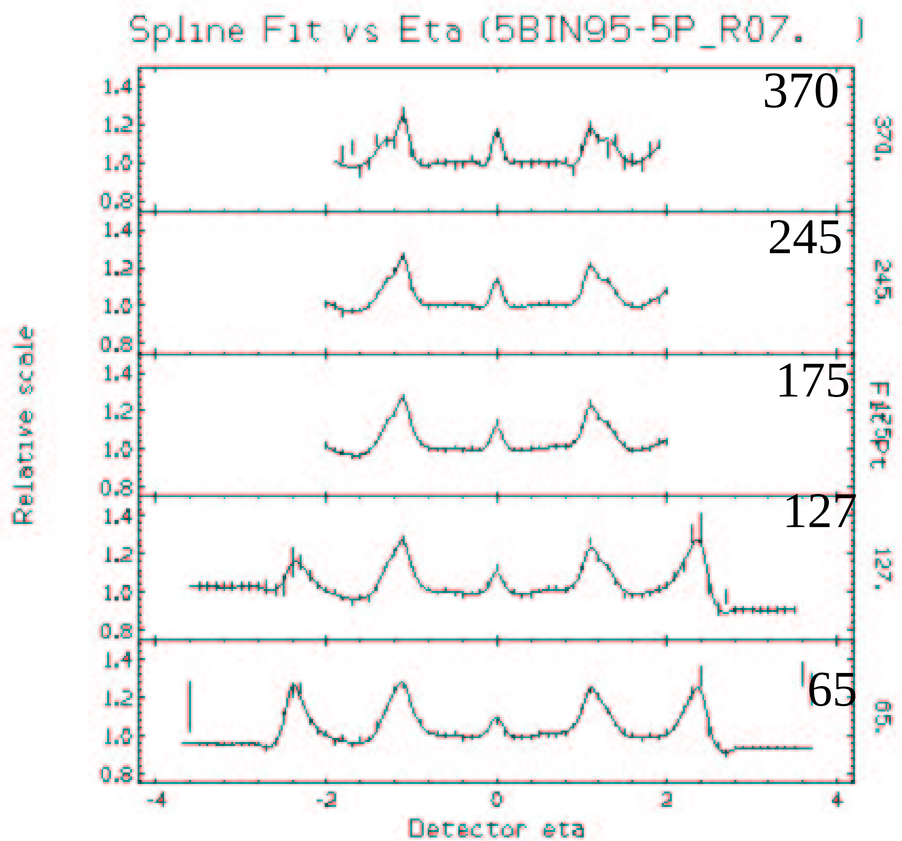
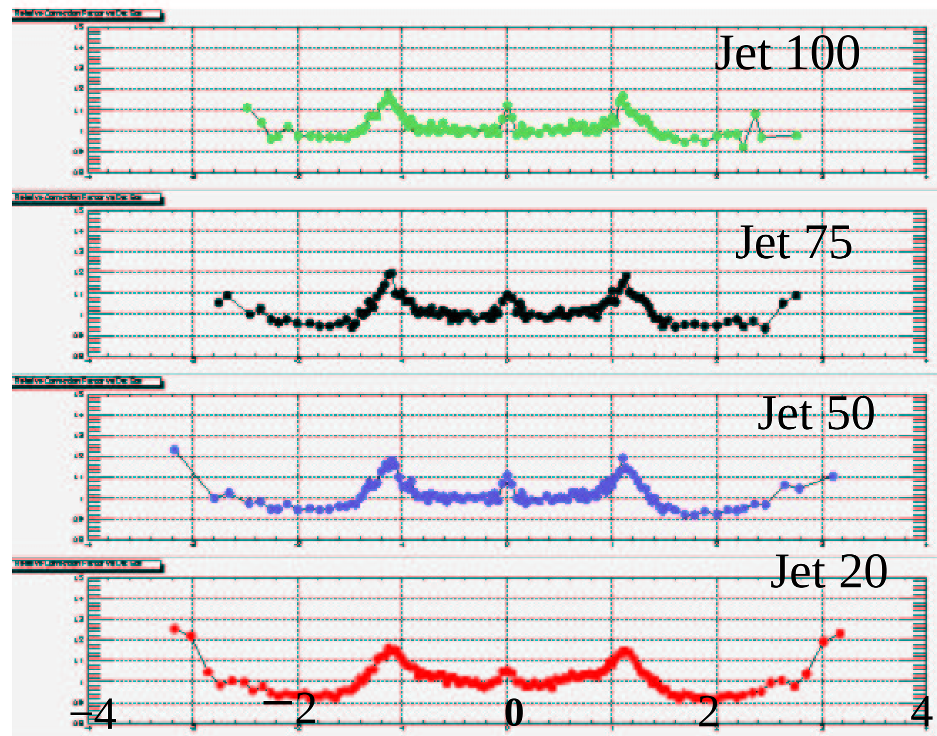


Figure 17: Run 1B relative correction for $\Delta R = 0.7$ with 4.9% central EM shift.

Run II relative correction (Gene Flanagan)

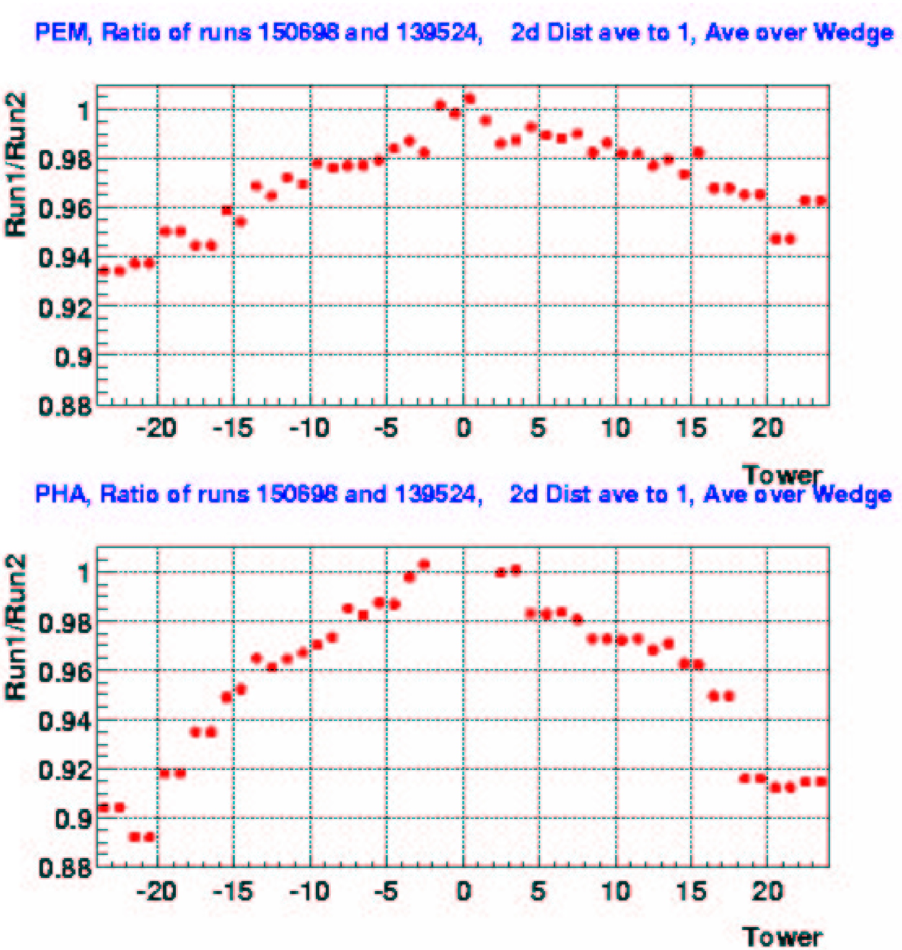


Detector eta

Time dependence of Plug gains

Laser calibration has shown time dependence of the PM tubes response.
Calorimeter group trying to understand this and avoid it in the future.

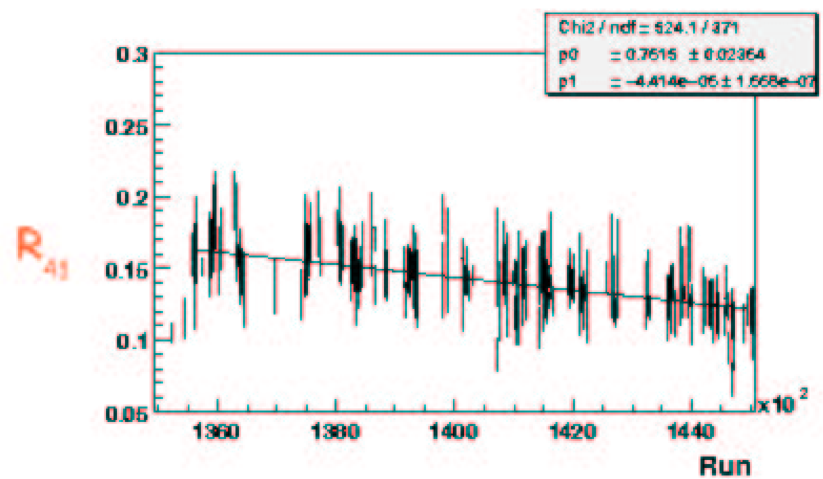
Laser data Feb−August



Howard Budd

Looking at data

- Jet rates Frank Chlebana



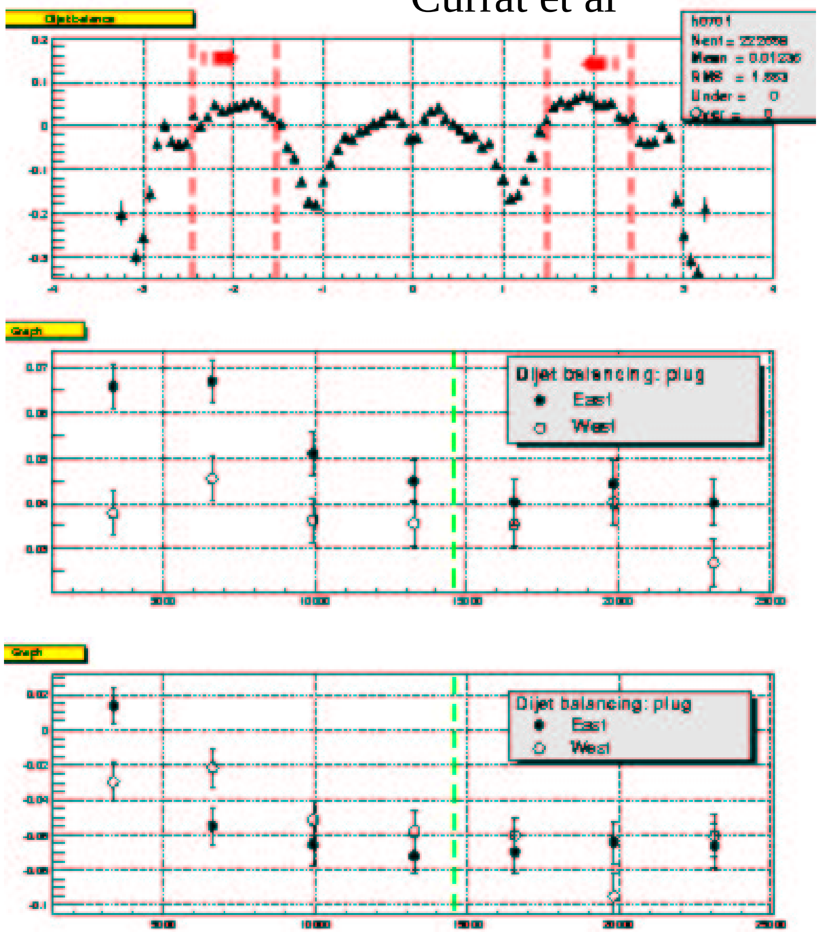
$$R_{41} \equiv \frac{\text{Njets @ Eta 4}}{\text{Njets @ Eta 1}}$$

- Min bias (Beate, Gibson, Thompkins)
- Di−jet data and gam−jet

Effect of Gain Changes in the Plug

Results from di−jet balance. EMF in the plug is (50−60)%

Currat et al



Di−jet balance using all data between Feb and August

η = 1.5−2.4 drop: −1% west
−2% east
stable after shutdown

η > 2.4 drop: −4% west
−7% east
stable after shutdown

Using this and all other information, we need to find a time correction!!!

What do we need to do

- Summary of understanding of data

Systematics	Run I(cone=0.4)	Run II, now
Cal E−scale status	OK	PHA −4%, WHA(??)
Calorimeter stability	1%	OK for central
Relative correction	0.2%, 4% in cracks	Plug gain drifts!!!
UEM (UE from mul. int.)	100 MeV/vertex	n.a
Absolute corr. (+UE) :	2.5%	−7% shift from RunI
OOCC (exp to 55, >55	6−1.4%	n.a.

- To do:

  - Move E−scale of CHA by 4%. Determine WHA E−scale shift
  - Understand 4.5% shift in gam−jet balance
  - Evaluate relative correction to Central Calorimeter

    Evaluate corrections for different PT bins

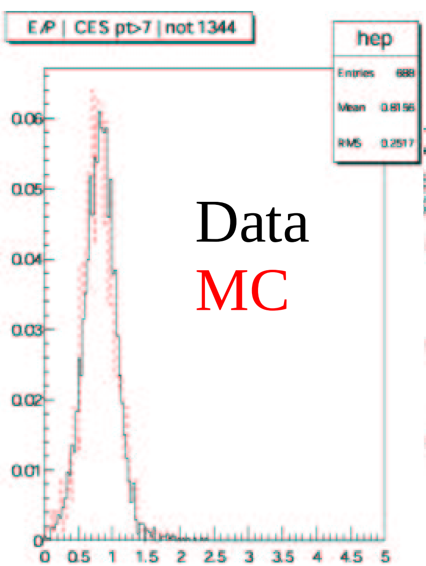
    Find time dependence of plug calorimeters response
  - Revisit corrections with JTC96X (gam−jet balance)
  - Start on part 2 of the jet corrections program

    (see Mario−Martinez−Perez talk in QCD session)

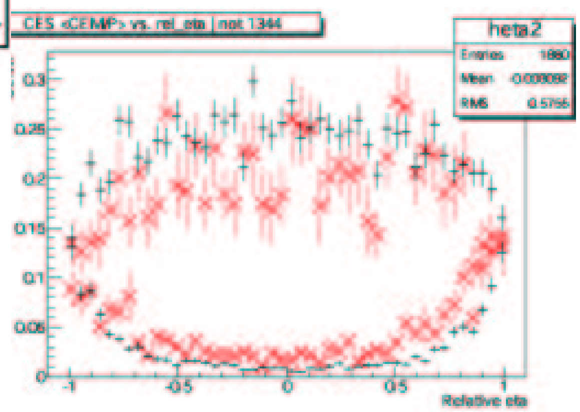
Simulation tuning of calorimeters

- Used test beam data above 8 GeV (see CDF−5886). Plug+Central (Jun+Currat)
- For calorimeter non−linearity, used minbias events PT<5 GeV CDF−5874
  New track trigger data: 4 and 10 GeV
  Baumgart+Shochet, CDF−6093

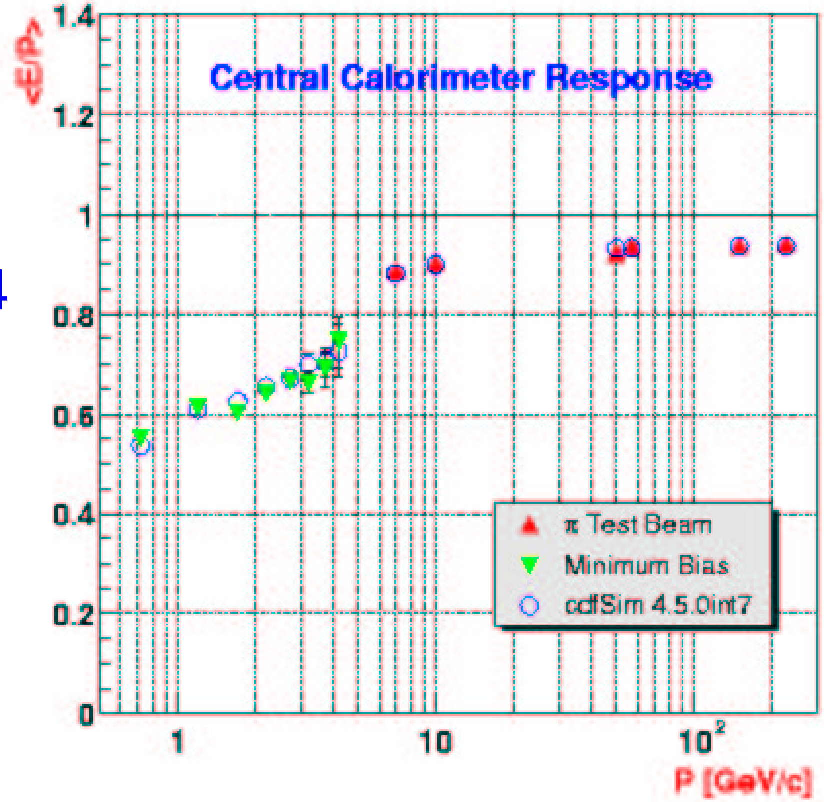
•Most variables agree very well with the present tuned MC



Lateral shower shape



Soon Yung Jun



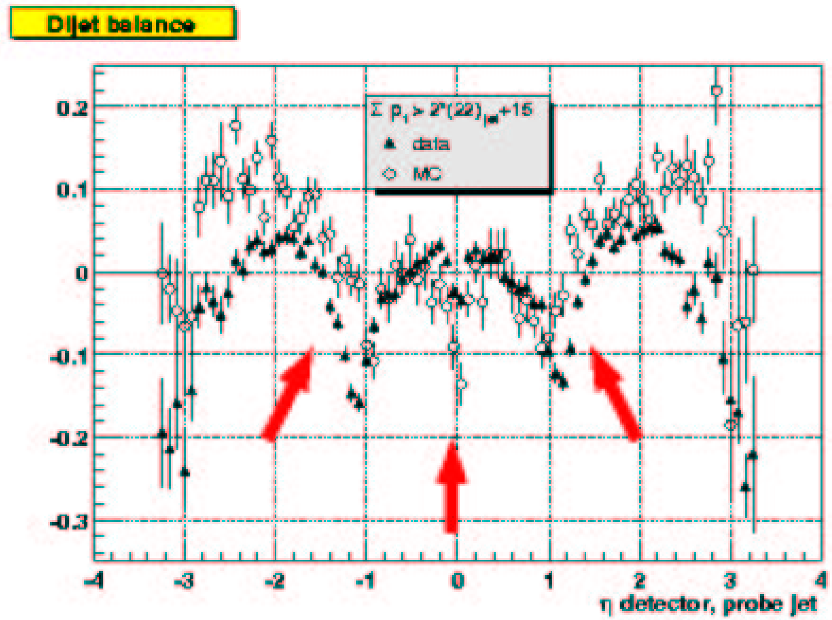
- V4.5.2 has the tuning to minbias data
- New tuning being done to fit lateral shower shape.
- Present tuning is OK except for isolation studies

Simulation of jets in Monte Carlo

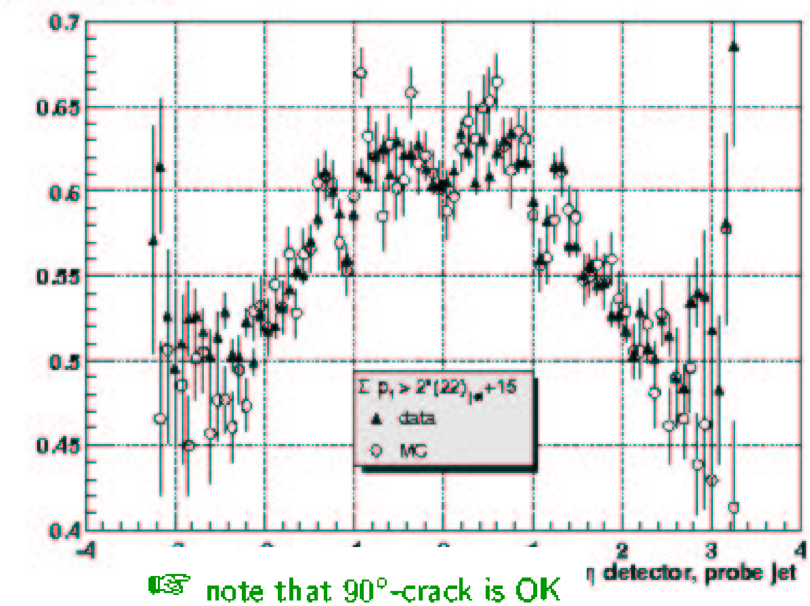
Currat, Lys, Galtieri, Shapiro

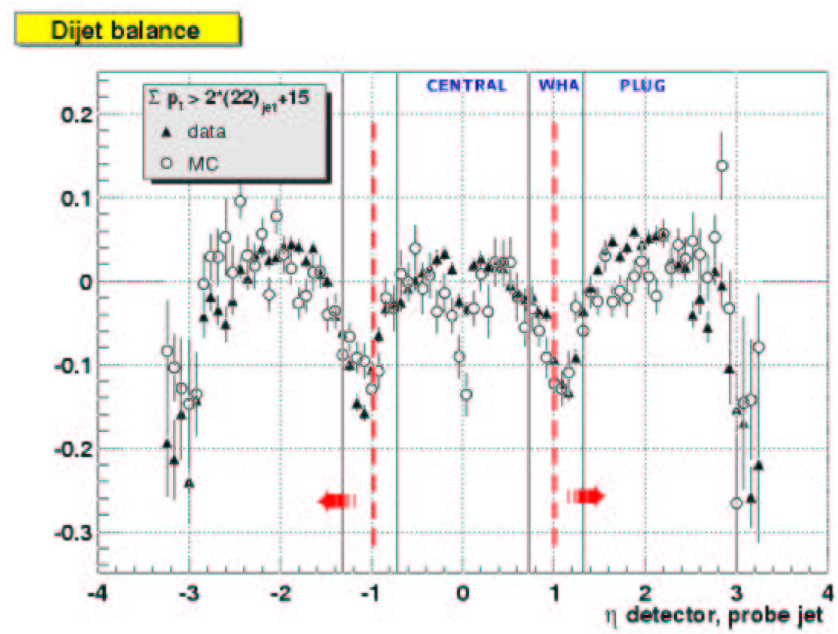
Comparison of data and HERWIG Monte Carlo for jet balance.

- Plug energy in data lower than MC
- Using factor 0.92 in MC for eta>1.0 gives a better agreement on the 90D crack (needs scale factors by detector)
- Electromagnetic fraction looks OK



Jet EM fraction in agreement right "out of the box" ...





Summary

- Particle response:
  - CEM electrons E−scale OK within ~2%
  - CHA muon MIP peak is shifted by about 4%
  - PEM needs more work:E−scale low by 4−10%. PPR studies !!
  - WHA and PHA could benefit from muon triggers

- Gam−Jet balance and Di−jet balance
  - Central E−scale lower by 4.5% from run I
    Run I correction in central (−7% shift, need to understand!!)
  - Central−Plug relative Corrections : no PPR corrections to PEM.
    Need corrections as a function of Jet P_T and time dependence.

- More work on the MC
  Calorimeter simulation tuning needs second pass.
  Tune the cracks and compare E−scales

- Organizing a workshop on jets corrections, soon.

Gam−Jet balance can we use JTC96X?