Update on Run 2 Jets Plans for CDF

Jay R. Dittmann

Fermilab

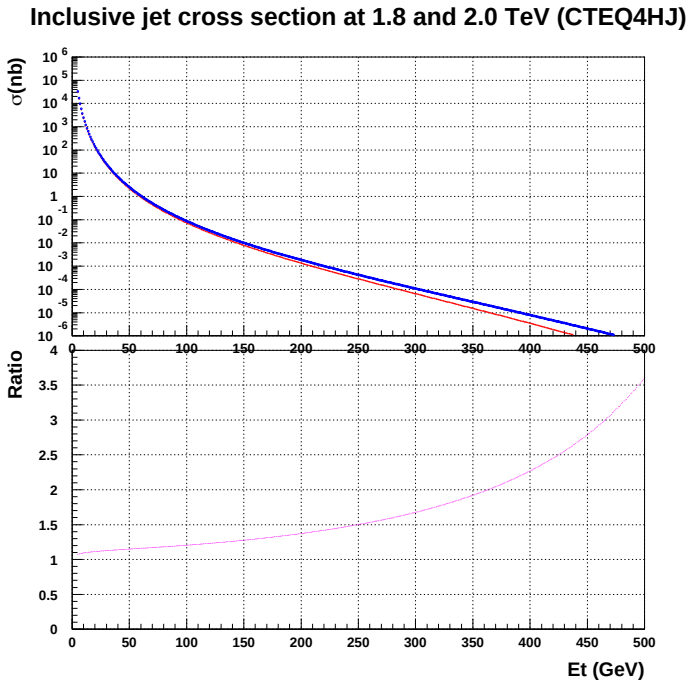
CDF/D0/Theory Jet Workshop

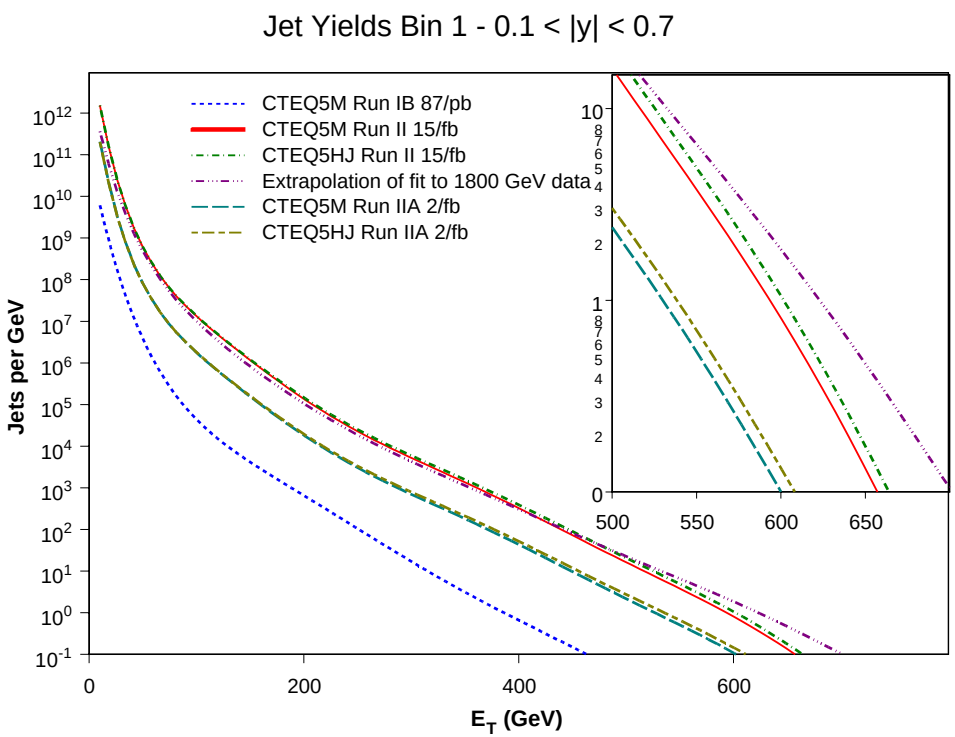
December 16, 2002

- Run 2 Jet Physics
- Jet / Dijet Spectra
- Jet Corrections – Status
- Future Directions

Jet Production in Run 2

The increase in the center-of-mass energy from 1.8 to 1.96 TeV has a large effect on the high E_T jet rate.





For the full Run IIa sample the number of jets above 400 GeV will increase from 11 to ~500.

~18 events by June

~75 events by end of year

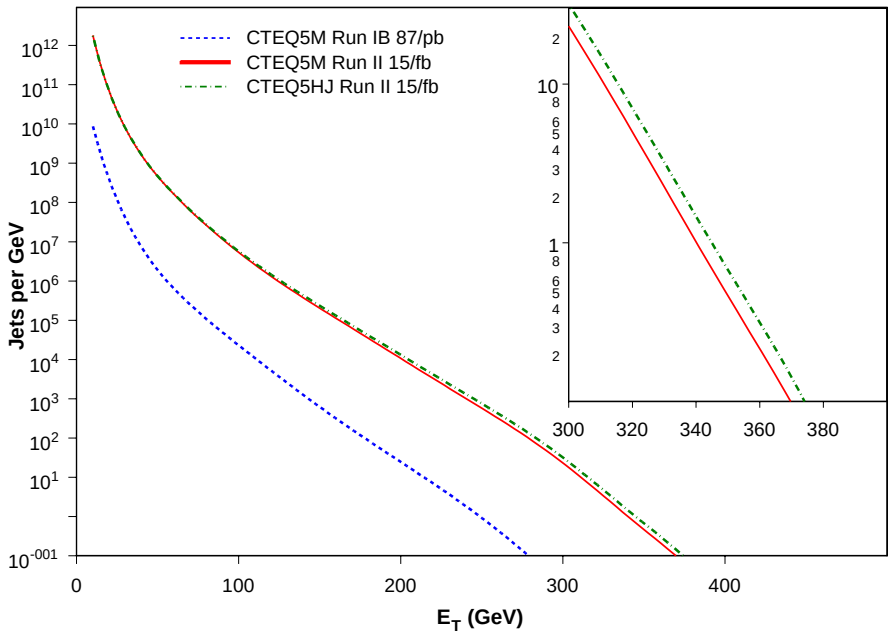
Jets will be reconstructed with the K_T clustering algorithm as well as with improved cone algorithms.

Jet Production in Run 2

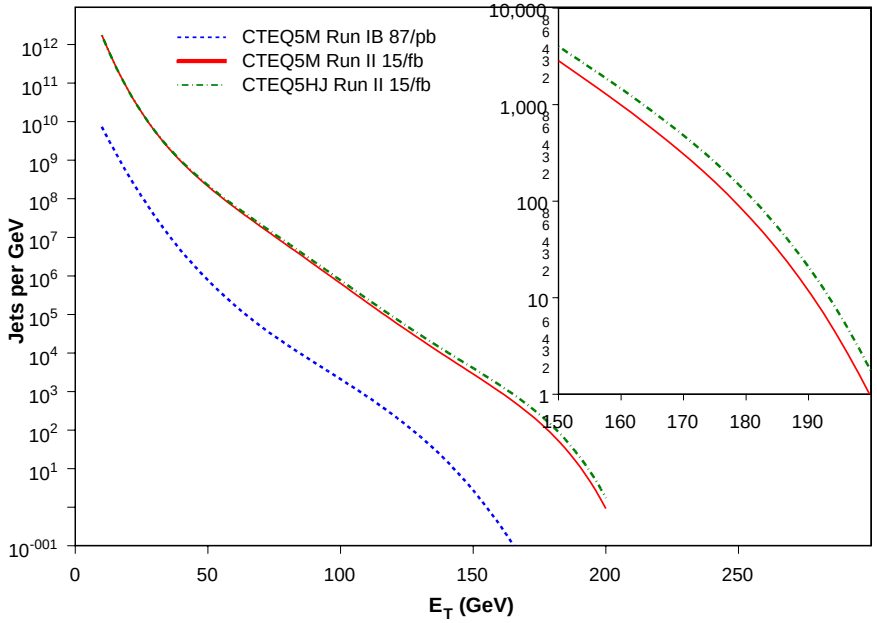
Jet measurements will extend to forward regions!

Measurements in the forward region are crucial. A PDF explanation covers both regions; presumably new physics is central

Jet Yields Bin 3 - 1.4 < |y| < 2.1



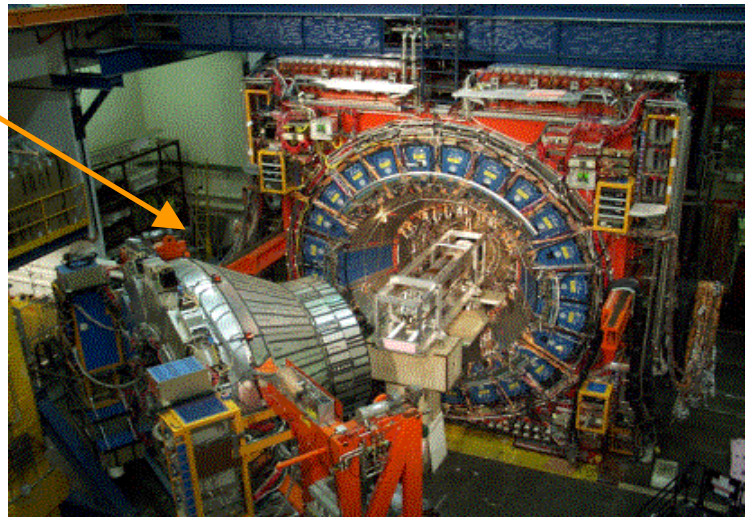
Jet Yields Bin 4 - 2.1 < |y| < 3.0

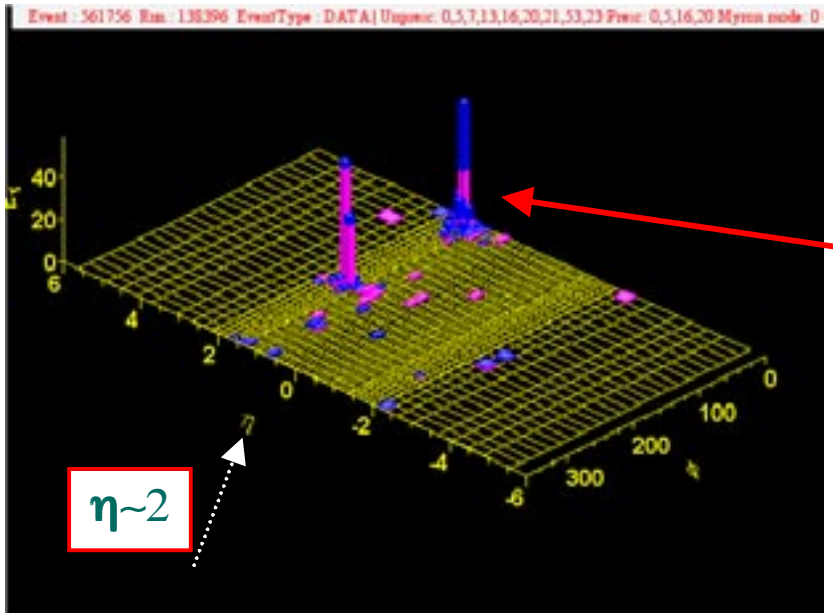


New CDF Plug Calorimeters

Scintillator tile + lead/steel design: Fast! Plus better sampling fraction than Run 1 gas detector

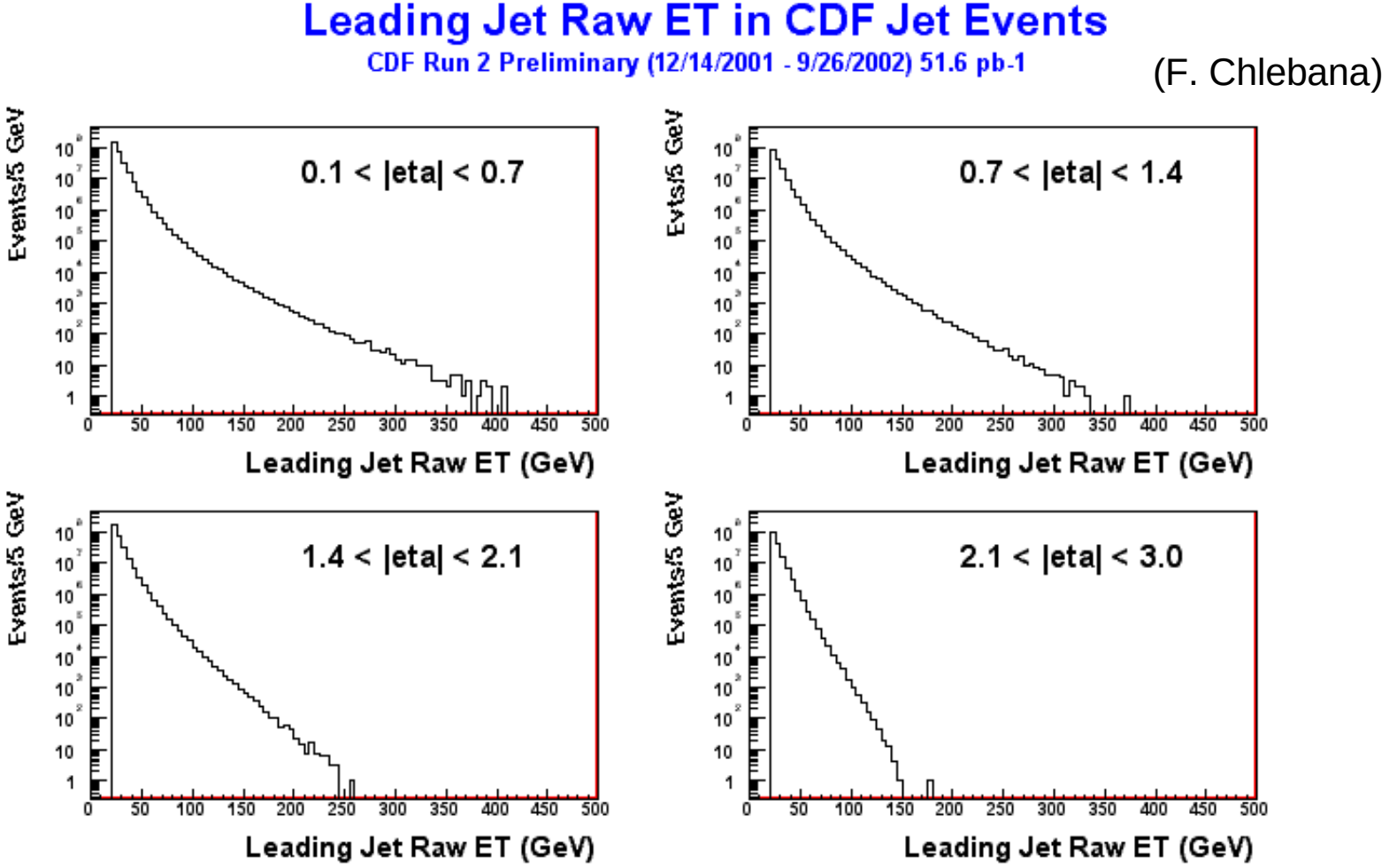
Same technology over full solid angle to $|\eta| = 3.6$





The new plug calorimeter will allow much more precise forward-jet measurements in Run 2

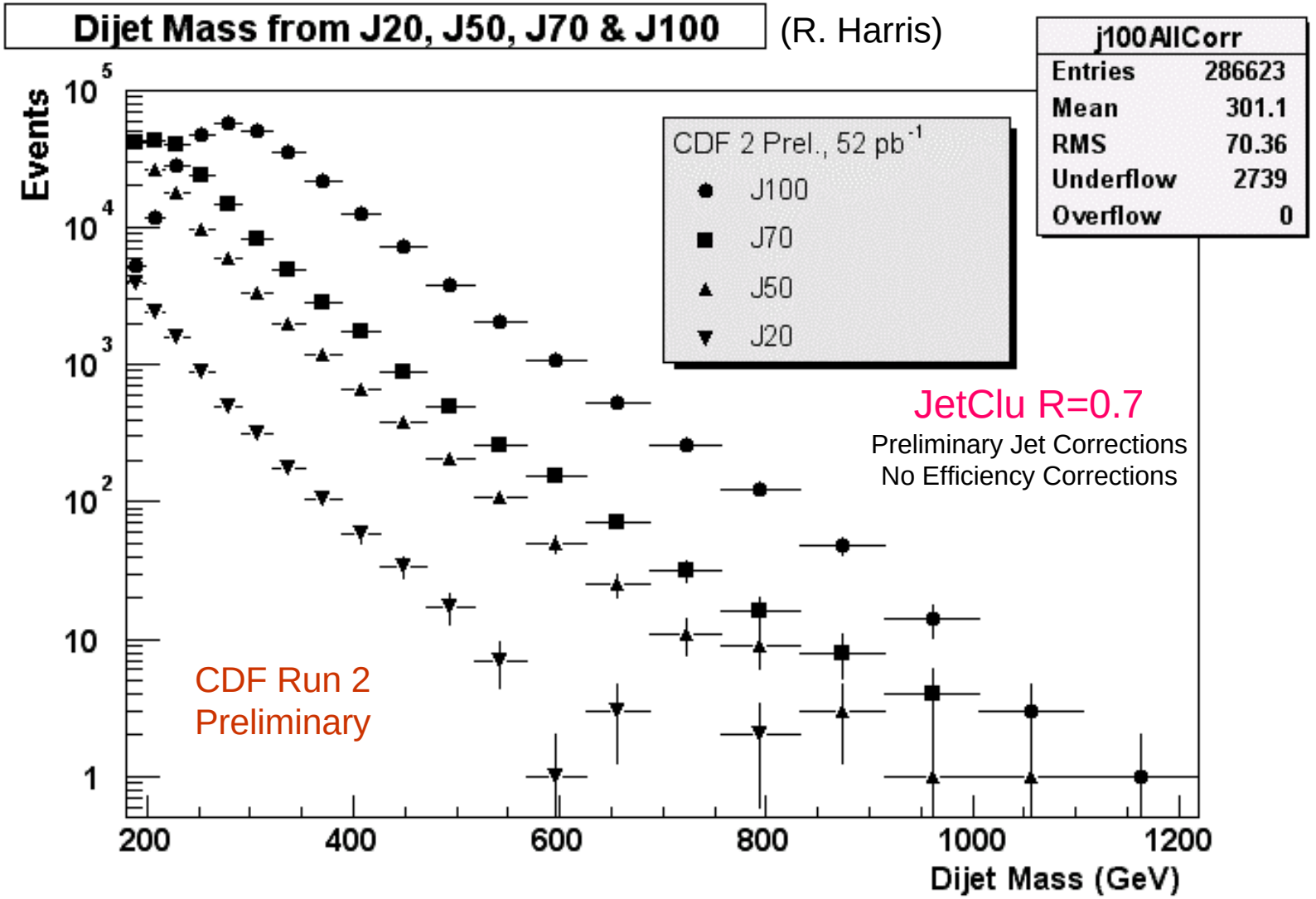
Leading Jet E_T Spectra



(F. Chlebana)

Cone algorithm (JetClu) with R=0.7. We plan to explore new Run 2 algorithms.

Dijet Mass Spectrum



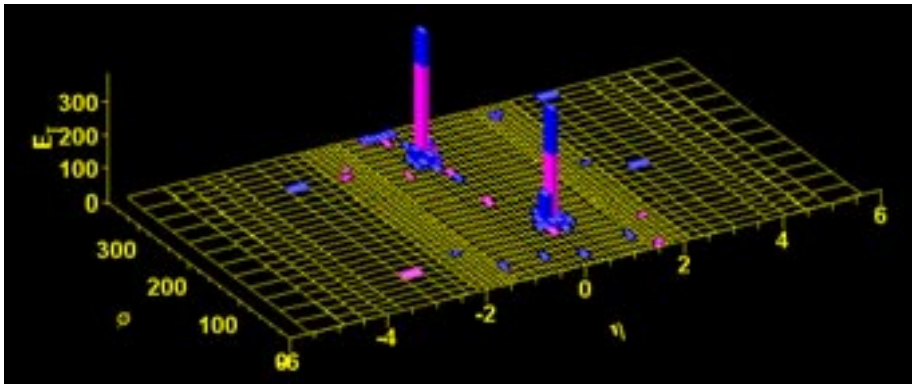
High Mass Dijet Event

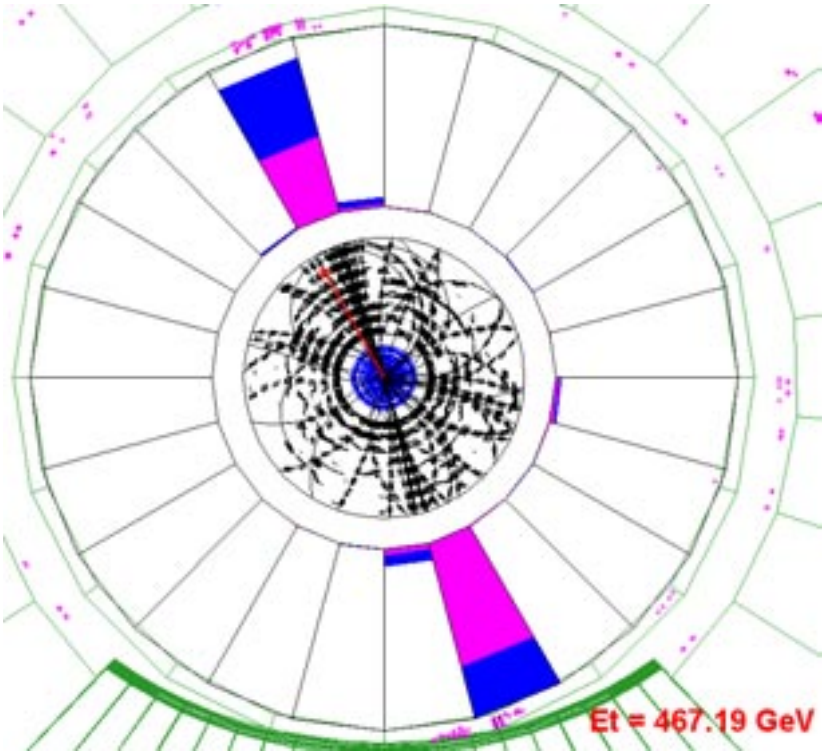
Run 151128 Event 295868 (9/8/02)

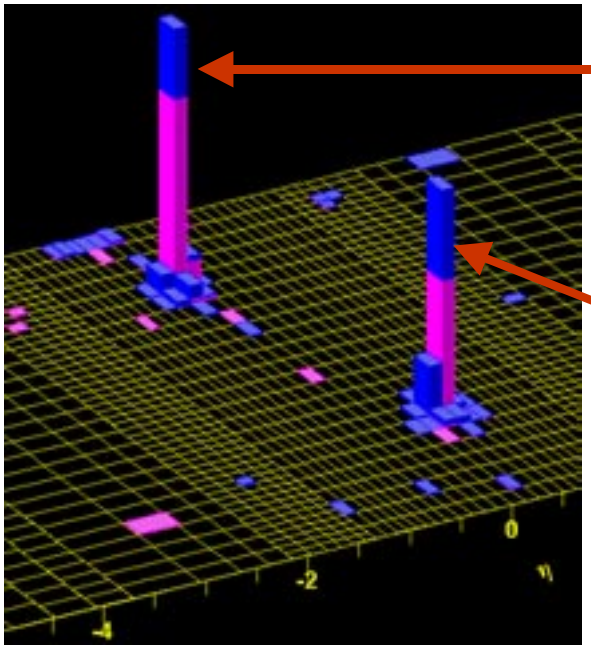
Dijet Mass = 1197 GeV (corr)

cos θ* = 0.36

z vertex = 54 cm







J2 E_T = 471 GeV (raw)
= 556 GeV (corr)
J2 η = –0.32 (detector)
= –0.55 (correct z)

J1 E_T = 480 GeV (raw)
= 561 GeV (corr)
J1 η = 0.42 (detector)
= 0.20 (correct z)

Corrected E_T and mass are preliminary

Jet Corrections

CDF Jet Corrections Group (L. Galtieri, A. Bhatti)

Goal: Provide jet corrections along the lines of Run 1 (JetClu first)

- Jet Corrections – Step 1
  - Check the calorimeter E-scale (use electrons, muons, gamma-jet balancing)
  - Test jet corrections with Run 1 constants 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)*

- Measure the underlying event
- Tune jet fragmentation (charged tracks in jets) in Monte Carlo to reproduce tracks in jets
- Determine absolute corrections using Monte Carlo events

A Dijet Mass Resolution Group is working simultaneously to develop improvements based on tracking, shower profile in addition to calorimeter tower energies

Jet Corrections

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.

Jet Corrections

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.

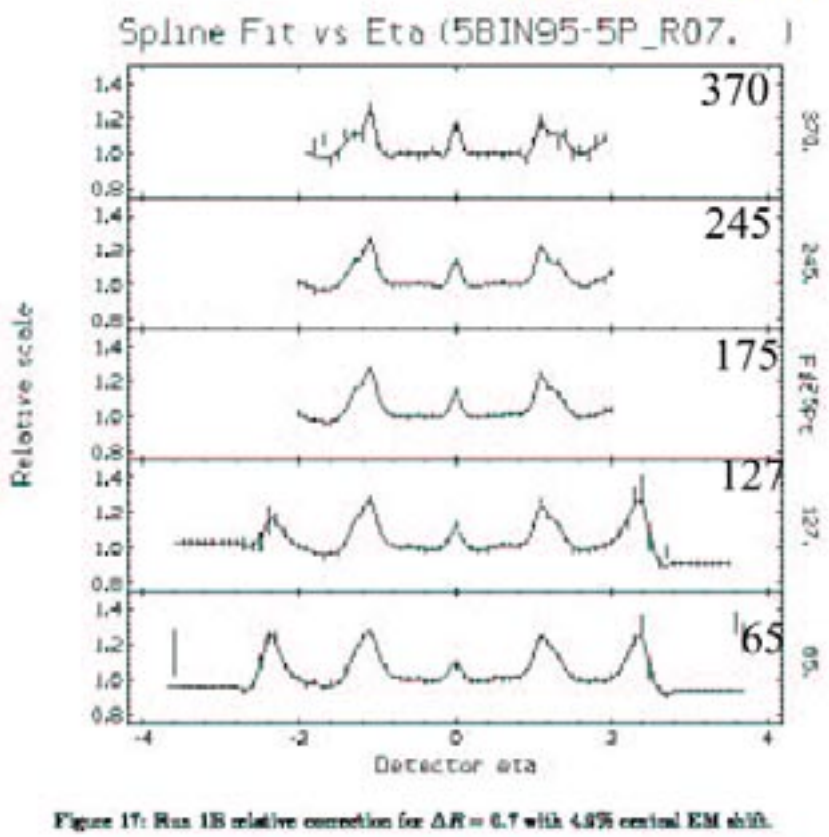
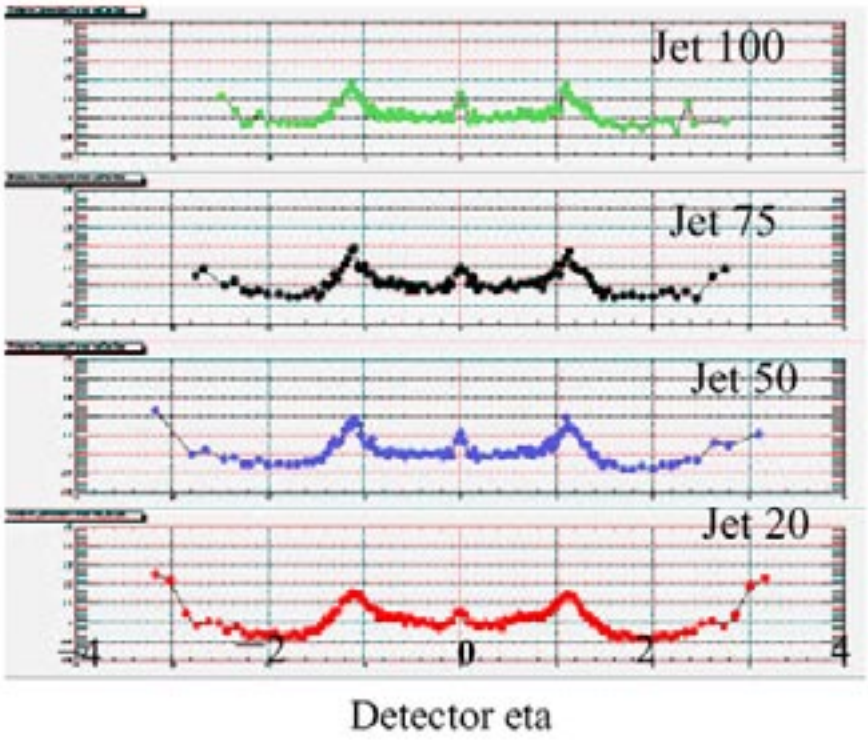


Figure 17: Run 1B relative correction for $\Delta R = 0.7$ with 4.8% central EM shift.

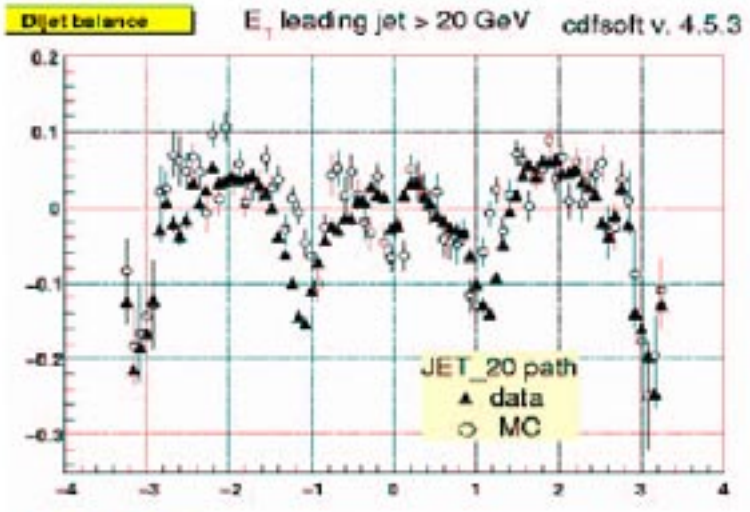
Run II relative correction (Gene Flanagan)



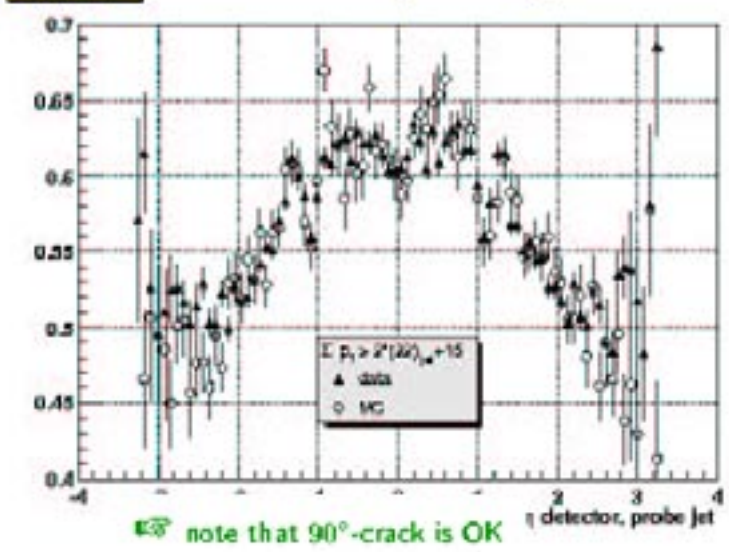
Jet Corrections

Comparison of data and HERWIG Monte Carlo for jet balance.

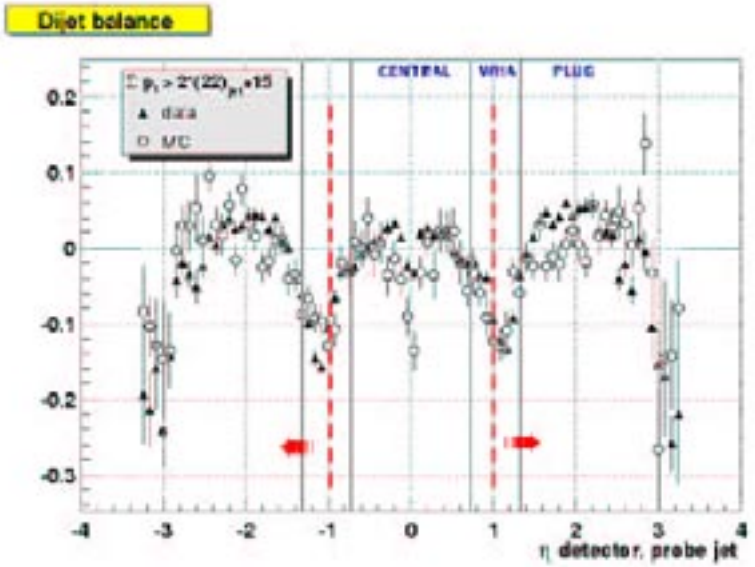
- Plug energy in data lower than MC
- Using factor 0.92 in MC for eta>1.0 gives a better agreement on the 90D crack (needs scale factors by detector)
- Electromagnetic fraction looks OK



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



note that 90°-crack is OK



Current Status and Future Directions

Run 1 JetClu is still alive and well.

- Efforts to understand the calorimeter energy scale (using e.g. gamma-jet balancing) require JetClu
- Old habits die hard. To obtain Run 2 jet corrections, it's easier to start with Run 1 methods and techniques (which rely heavily on JetClu)

- In these early stages of Run 2, connecting back to Run 1 is crucial.

However, we have made significant progress relaying the importance of new Run 2 algorithms:

- Midpoint (awaiting direction on the initial search cone size)
- K_T

Studies of these new Run 2 algorithms continue, but our experimental experience with them is still limited.

First results with the new algorithms by next summer??