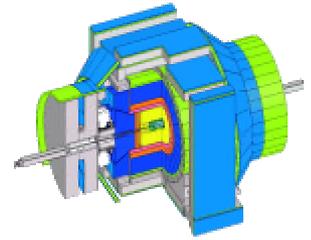


QCD Working Group Overview



Mario Martinez
(FNAL)



CDF Collaboration Meeting, January 2003

QCD Working Group Meetings

- Conveners: Jay Dittmann & Mario Martinez
- Place/Time: Theater On-Weeks Friday @ 8:30
- Main QCD WWW Page (thanks to Rick Field)
www-cdf.fnal.gov/internal/physics/qcd/qcd.html
- Jet Sub-Group (G. Latino, R. Snihur)
created to push the inclusive analysis for the winter conferences

QCD Run I Physics Results

- Charged Particle Multiplicities in Gluons and Quarks
(A. Korytov, A. Pronko)
- Three-Jet Cross Section compared to NLO
(S. Seidel, I. Goralev, A. Brandl)
- $W/Z \rightarrow \text{jet jet}$
(O. Lobban)
- Lambda polarization in high- E_T jet events
(T. Devlin)
- K^0/Λ^0 production in MB events
(N. Moggi, F. Rimondi)
- Statistical Studies of E_T Distributions in MB events
(N. Moggi, F. Rimondi)

QCD Run I I Ongoing Analyses

- Inclusive Jet Cross Section
- Jet Shapes/Energy Flows
- Dijet Mass Distribution
- $W+2\text{jets}$ Cross Section vs NLO
- Diphoton Cross Section
- Study of Jet Algorithms
- Underlying Event Studies
- Diffractive Analyses
- Prompt Photon Cross Sections
- Inclusive B-jet Cross Section
- Cosmics/Beam Halo Rejection

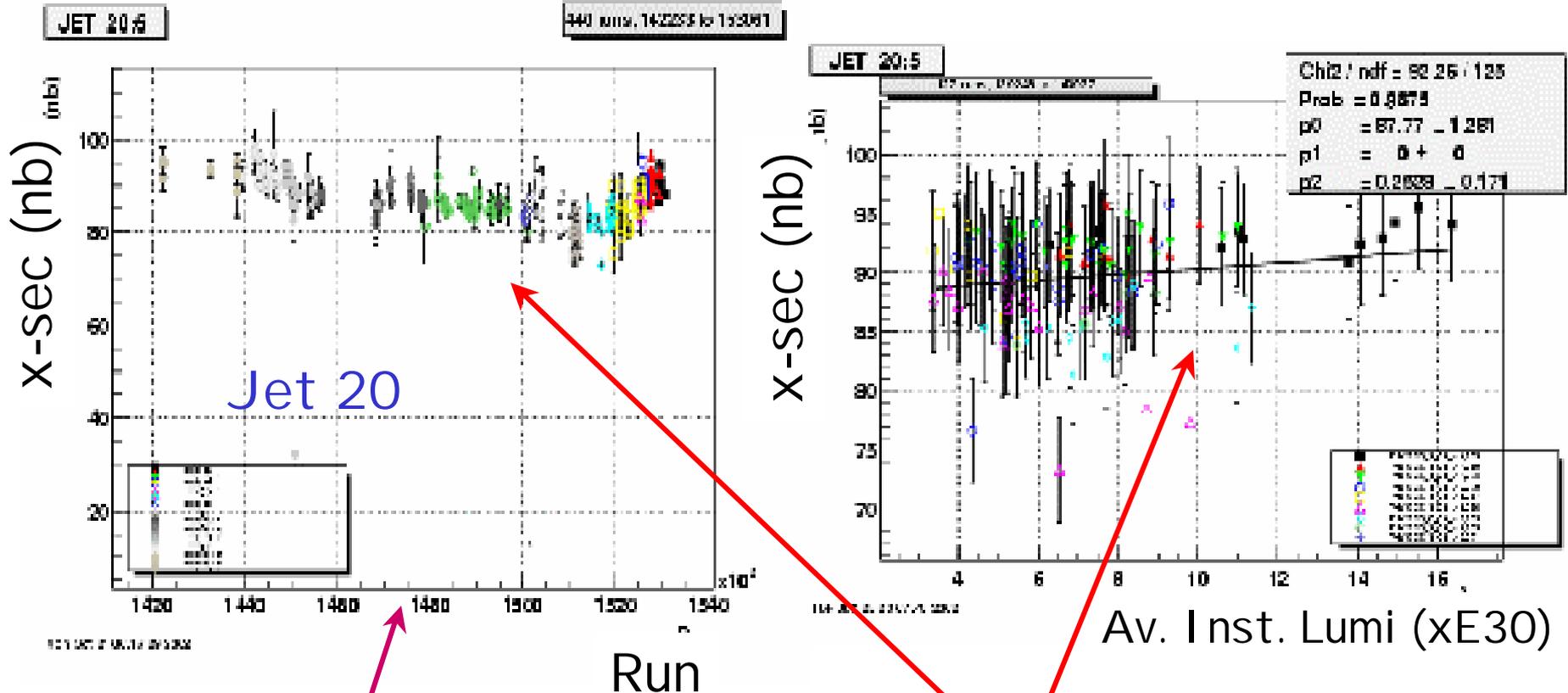
QCD L3 Triggers

- JET_100_v-4
 - JET_20_v-7
 - JET_20_CENTRAL_v-1
 - JET_20_NO_L2_v-7
 - JET_50_v-4
 - JET_70_v-4
 - JET_70_NO_L2_v-6
 - JET_CAL_SINGLETOWER_10_v-2
 - JET_CAL_SINGLETOWER_5_v-2
 - JET_CAL_TRACK3_ISO_v-6
 - JET_CAL_TRACK7_ISO_v-6
 - TWO_JET_15_M120_v-3
 - TWO_JET_40_M175_v-2
 - TWO_JET_60_M230_v-2
 - TWO_JET_90_M300_v-2
 -
 - DIFFRACTIVE TRIGGERS
- EXPRESS_1_v-11
 - JET_2_v-4
 - JET_2_v-4
 - JET_2_v-4
 - JET_2_v-4
 - JET_2_v-4
 - JET_2_v-4
 - JET_ST_1_v-2
 - JET_ST_1_v-2
 - JET_CALIB_2_v-1
 - JET_CALIB_2_v-1
 - DIJET_MASS_1_v-2
 - DIJET_MASS_1_v-2
 - DIJET_MASS_1_v-2
 - DIJET_MASS_1_v-2
 -
 - DIFFRACTIVE_1_v-5

Very stable trigger configuration is preserved...

QCD Run II Trigger Status

R. Snihur



Trigger cross sections are monitored run-by-run

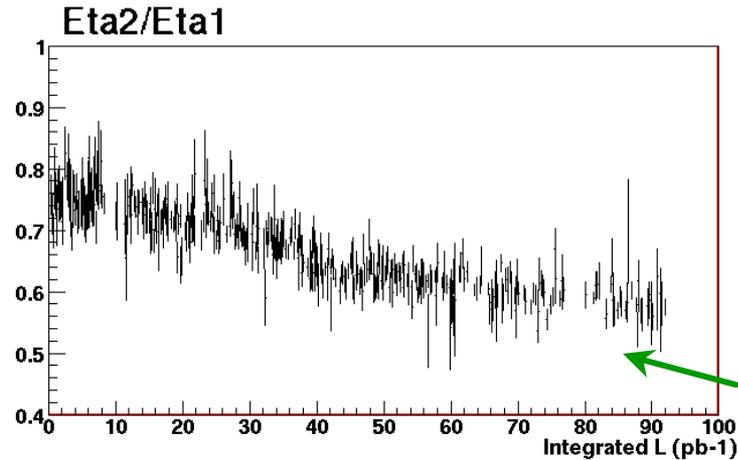
Sensitive to changes in calorimeter response and presence of hot channels

Evolution of CAL Response

F. Chlebana

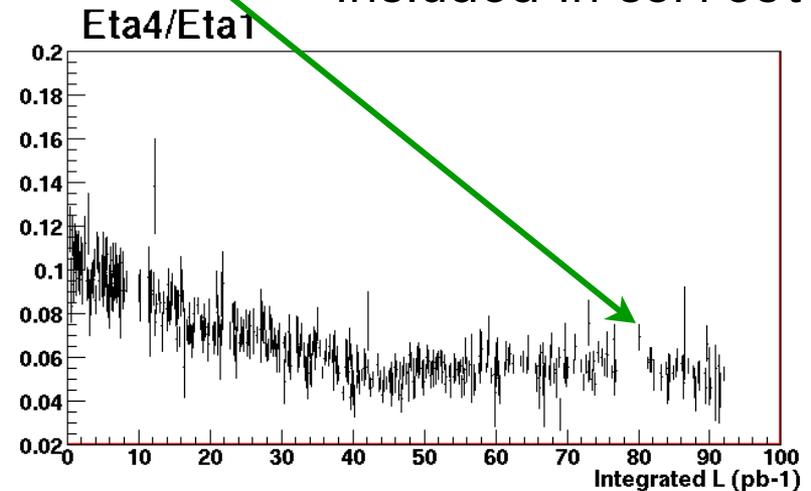
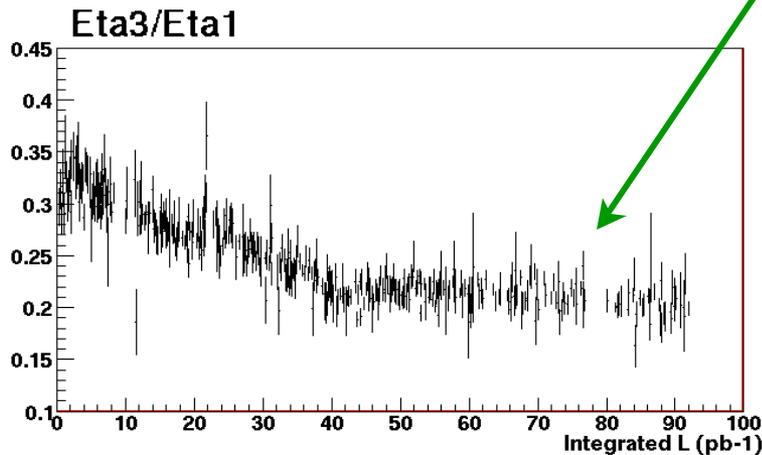
Relative rates of jets in forward/central

- Eta1: $|\eta| < 1$
- Eta2: $1 < |\eta| < 2$
- Eta3: $2 < |\eta| < 2.5$
- Eta4: $2.5 < |\eta| < 3.0$



Stable now (?)

Response vs time now included in corrections

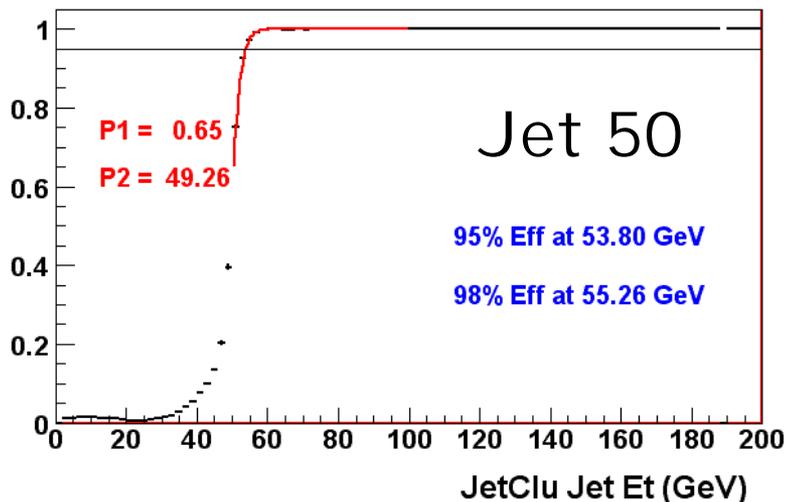
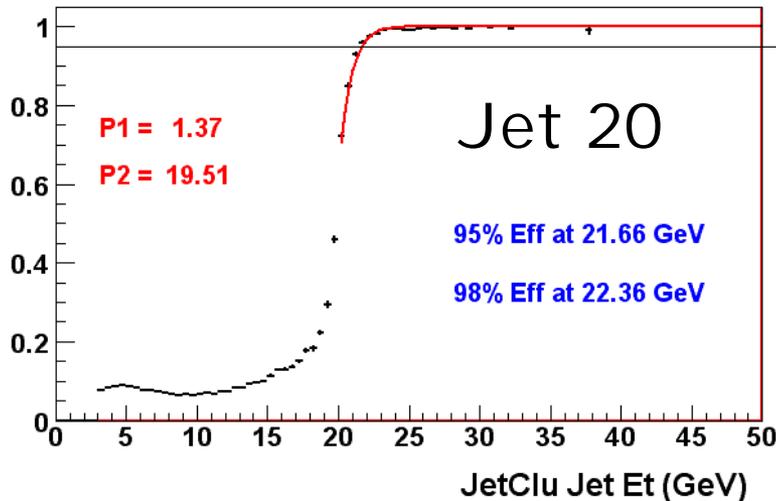


Jet Trigger Efficiencies

F. Chlebana, G. Flanagan

Trigger efficiency curves studied for the different jet triggers (20, 50, 70, 100)

Inclusive analysis selects regions with ~100% trigger efficiency for each threshold



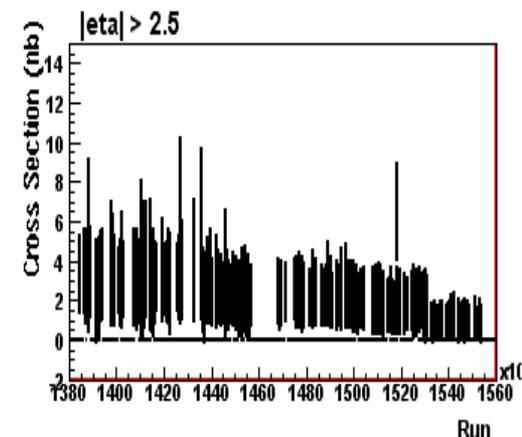
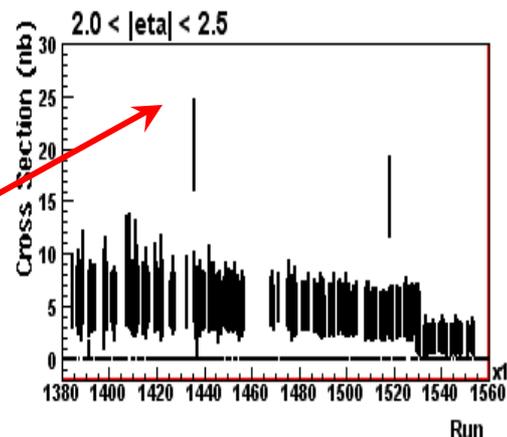
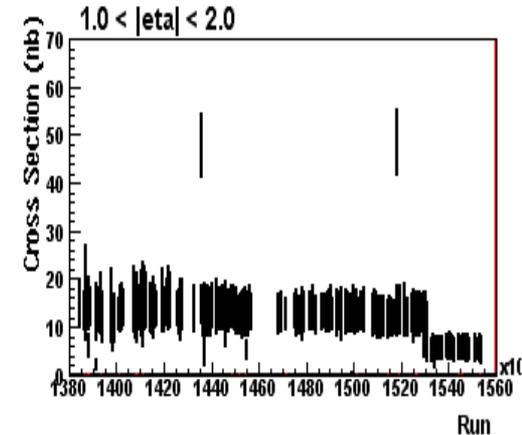
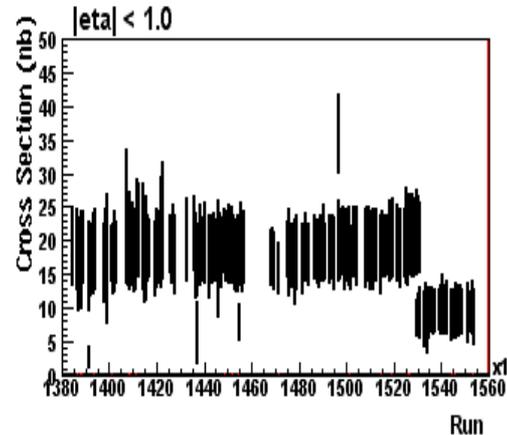
Jet Trigger	Eff=98% (GeV)
Jet 20	23.4
Jet 50	55.3
Jet 70	76.8
Jet 100	112.3

Good Run List/Quality Control

K. Kordas, R. Snihur

- Good Run list:
 - SHIFTCREW_STATUS
 - RC_STATUS
 - OFFLINE_STATUS
 - RUN > 138815
 - CLC, TRIGGER, CAL, COT
 - CAL_OFFLINE

- This eliminates runs with anomalous jet rates



Good Runs : $\sim 80 \text{ pb}^{-1}$

QCD Run I I Secondary Datasets

Thanks to G. Latino

4.8.4 Secondary Datasets are being produced

- JET_20_CENTRAL
- JET_20
- JET_50 On disk
- JET_70
- JET_100
- PLUG_DIJETS On disk
- TWO_JET_15_M120 On disk
- TWO_JET_40_M175 On disk
- TWO_JET_60_M230 On disk
- TWO_JET_90_M300 On disk
- JET_CAL_SINGLETOWER_5_1HZ
- JET_CAL_SINGLETOWER_10_1HZ
- ZEROBIAS
- MINBIAS_1HZ

Jet Data almost finished

Due to DHL problems: stripping data is very time-consuming task

Samples have been copied to disk

QCD Run I I New MC Samples

- **PYTHIA QCD 4.9.1**

- $P_T > 18$ GeV (3M evts)
- $P_T > 0$ GeV (0.5M evts)
- $P_T > 5$ GeV (0.5M evts)
- $P_T > 10$ GeV (0.5M evts)
- $P_T > 40$ GeV (0.5M evts)
- $P_T > 60$ GeV (0.5M evts)
- $P_T > 90$ GeV (0.5M evts)

- **HERWIG QCD 4.9.1**

- $P_T > 18$ GeV (0.5M evts)
- $P_T > 0$ GeV (0.5M evts)
- $P_T > 5$ GeV (0.5M evts)
- $P_T > 10$ GeV (0.5M evts)
- $P_T > 20$ GeV (0.5M evts)
- $P_T > 40$ GeV (0.5M evts)
- $P_T > 50$ GeV (0.5M evts)
- $P_T > 60$ GeV (0.5M evts)
- $P_T > 90$ GeV (0.5M evts)

run

done

Jet Energy Corrections

See A. Bhatti's talk

- Lots of work done during last year to understand calorimeter corrections (special thanks to Lina !)
- First version of Jet Corrections released (based on Run I Philosophy)
 - Relative Corrections (Run II)
 - Plug Gain Variations (Run II)
 - Underlying Event, Multiple Interactions (Run II)
 - Absolute Corrections (Run I + 4.4% not understood)
 - Out-of-Cone Corrections (Run I)
- We will need new corrections after Winter Conf.
- Needs to be reviewed depending on the analysis

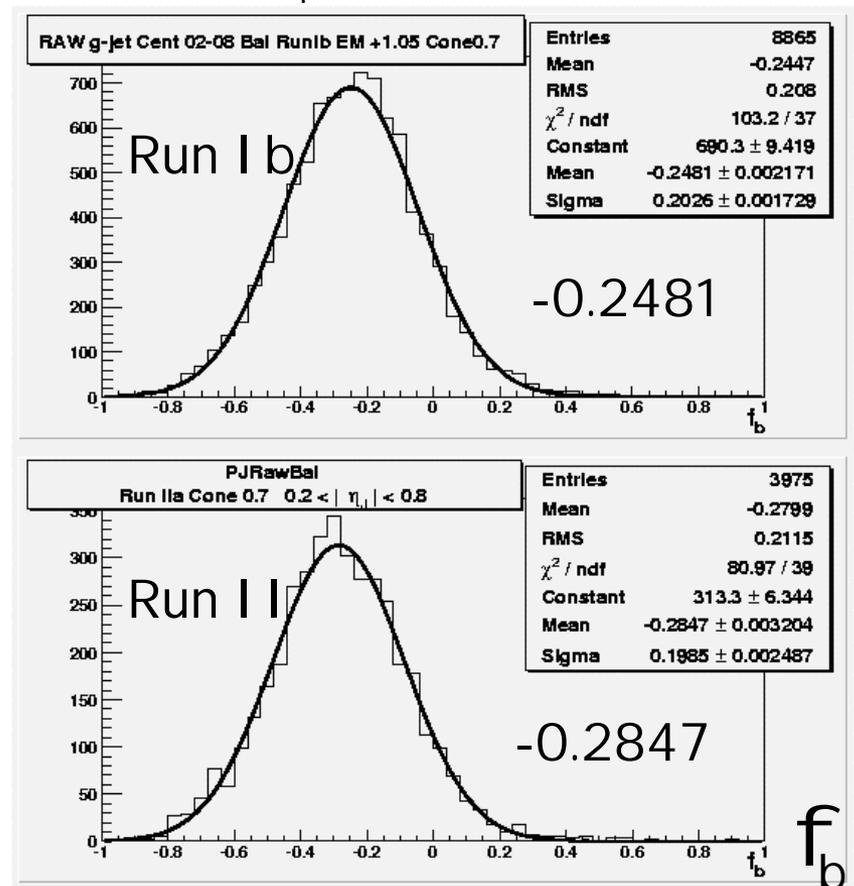
Run I I vs Run I b Energy Scale

G. Latino

- Comparison Run I – Run II γ -Jet balance suggests an additional ~4-5% needed in Run 2 E-scale ??
- For winter conferences "close your eyes...use it.."
- This is a critical point that must be understood in great detail ... affects all physics (not only QCD)
- Dedicated additional manpower is perhaps needed.....

$$f_b = \frac{(P_T^J - P_T^g)}{P_T^g}$$

Cone 0.7



Abstracts submitted to APS

- **A. Pronko:** Measurement of Charged Particle Multiplicities in Gluon and Quark Jets at CDF
- **I. Gorelov:** Three-Jet Production Cross Section Measurement at CDF
- **K. Terashi:** Diffractive Measurements at CDF
- **G. Latino:** Inclusive Jet Cross Section at CDF

Results for Winter Conferences

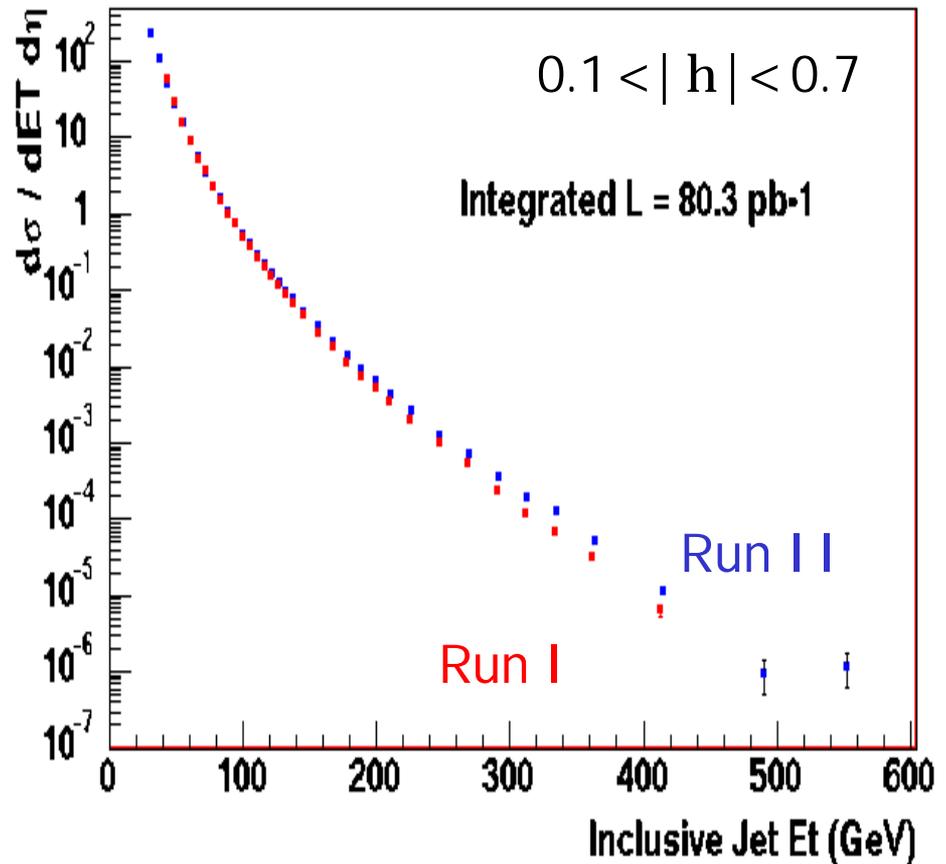
talks

- Inclusive Jet Cross Section
- Dijet Mass Distribution
- Diffractive Structure Functions
- Diphoton Mass
- Jet Shapes/E-Flows

Inclusive Jet Cross Section

F. Chlebana, G. Flanagan

- Two independent analysis already in good shape
- Including all the data available and latest corrections (incl. 4.4%)
- Uses unsmearing procedure taken from Run I analysis
- Some studies still needed at low transverse energy



See talk by G. Flanagan

Pre-blessing scheduled for Feb. 14th

Dijet Mass Distribution

F. Chlebana, R. Harris

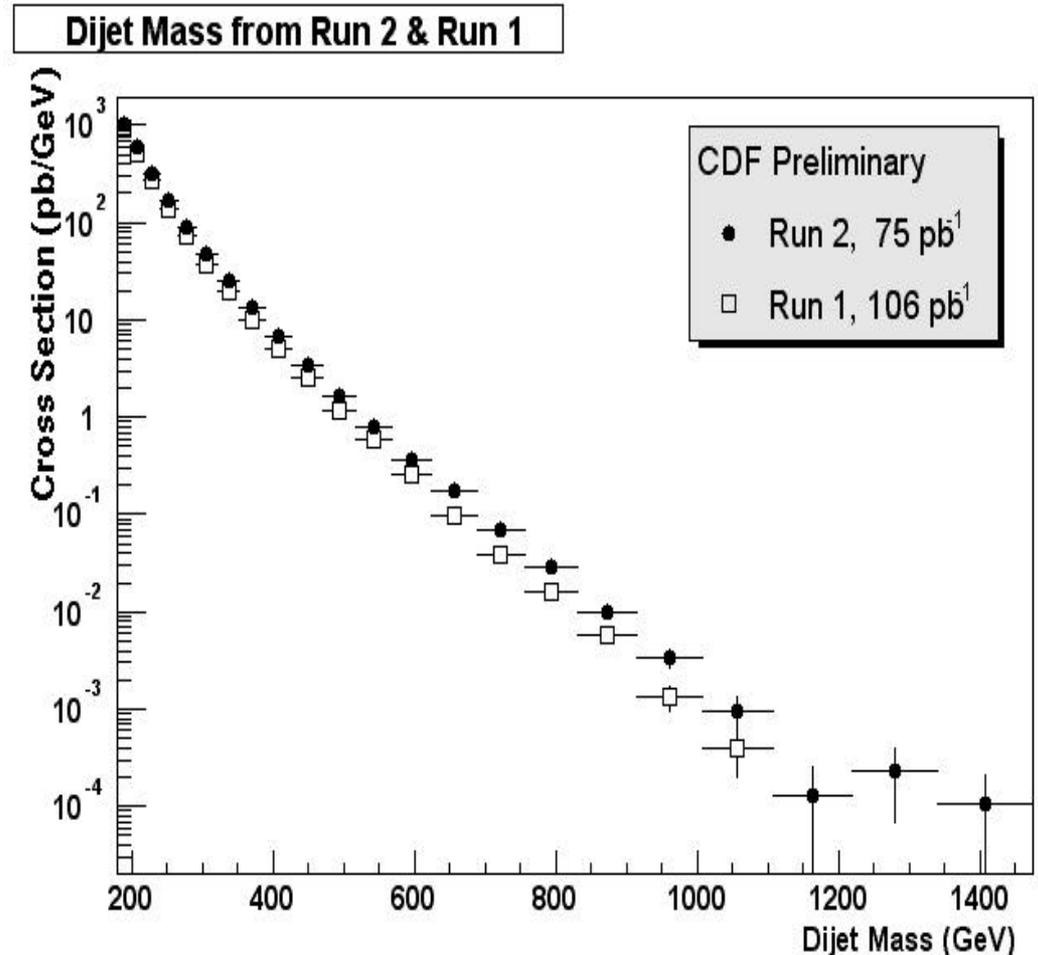
Includes all recent jet data and the latest jet corrections

Consistent with Incl. Analysis

Analysis searches for narrow resonance over a QCD-inspired falling shape in the measured dijet mass distribution

95% CL limits are derived

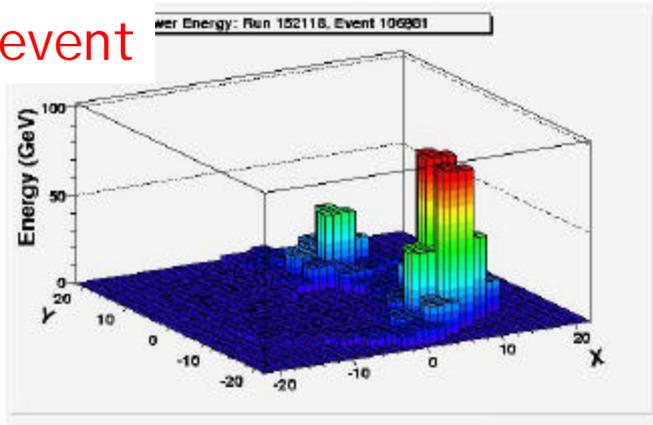
See talk by R. Harris



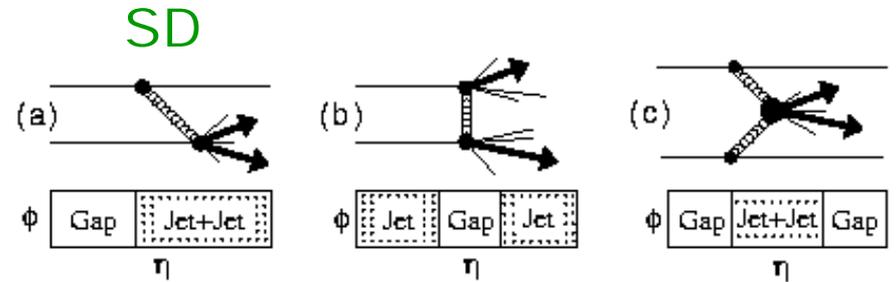
Pre-blessed on January 17th

Diffractive PDF's

MP event



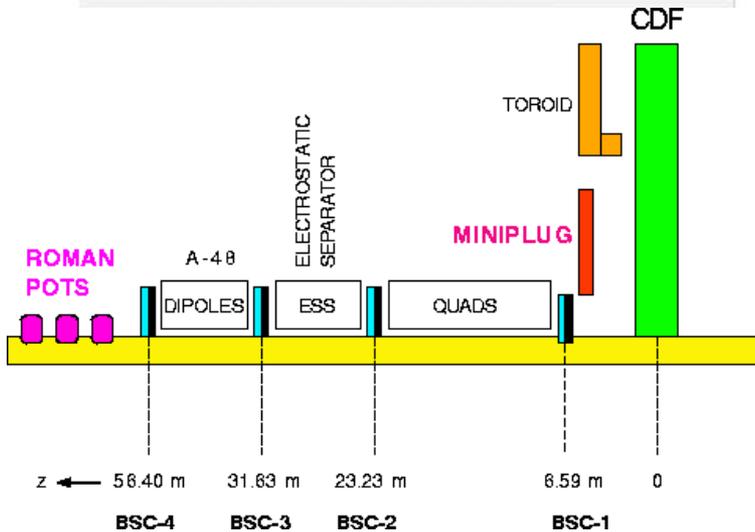
M. Gallinaro et al.



New triggers based on MP gaps and RPs

Full diff. physics program ahead!

- Hard Single Diffraction
- Double Diffraction
- Double Pomeron Exchange
- Forward Jets (jet-gap-jet)
- ...



See talk by M. Gallinaro

Pre-blessing scheduled for Feb. 21st

Diphoton Mass Run I I Analysis

Y. Liu et al.

67 pb-1 Good Runs

Diphoton12iso trigger

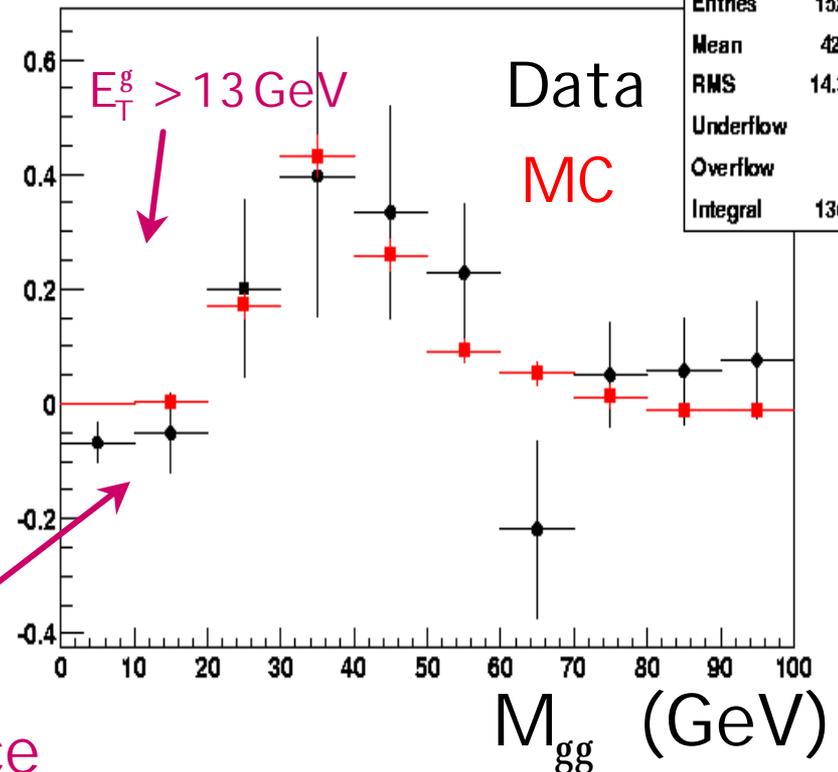
$$E_T^{gg} > 13 \text{ GeV}$$

$$|h^{gg}| < 0.9$$

Good agreement with MC

Will be corrected for acceptance

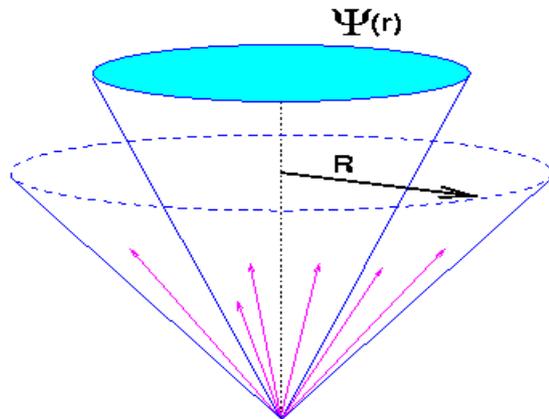
$1/N dN/dM_{gg}$



Pre-blessing scheduled for Feb. 7th

Jet Shapes in Dijet Events

M. M

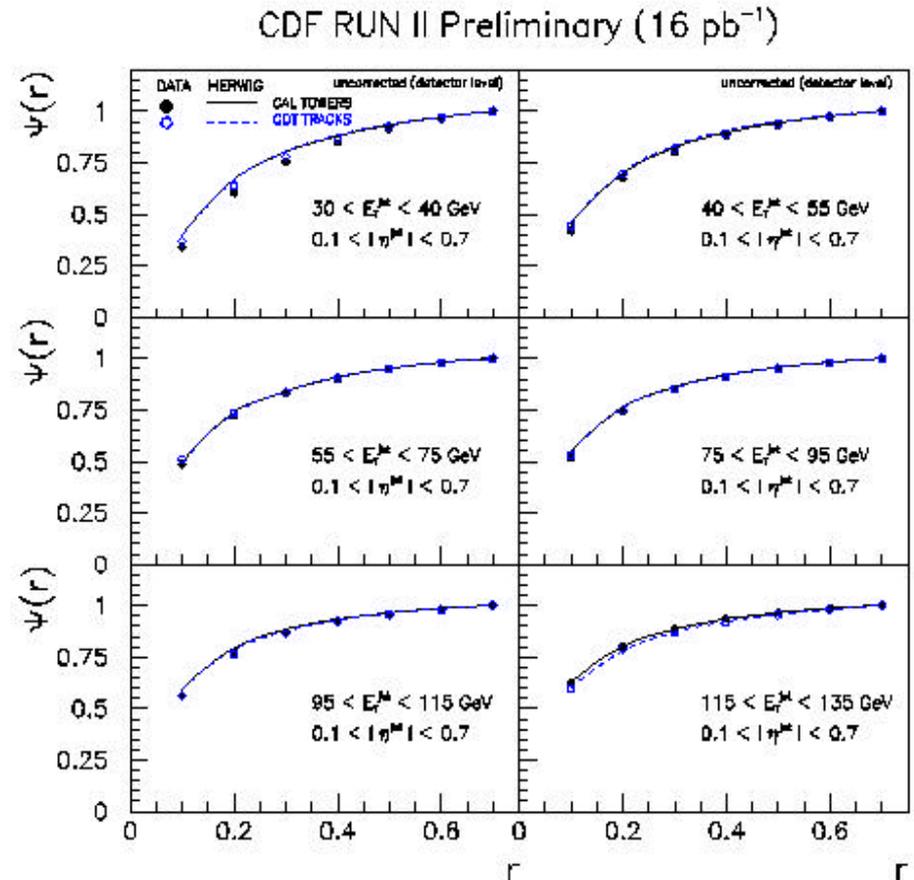


$$\Psi(r) = \frac{1}{N_{\text{jets}}} \sum_{\text{jets}} \frac{E_T(0, r)}{E_T^{\text{jet}}(0, R)}$$

$$\Psi(r = R) = 1$$

Results being updated using latest versions of MC and DATA

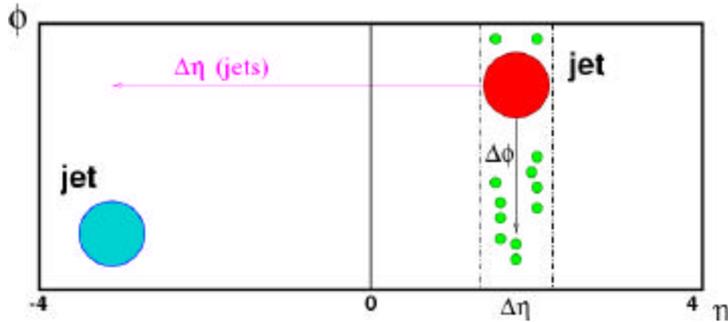
Comparison to Midpoint Jets



Pre-blessing scheduled for Feb. 14th

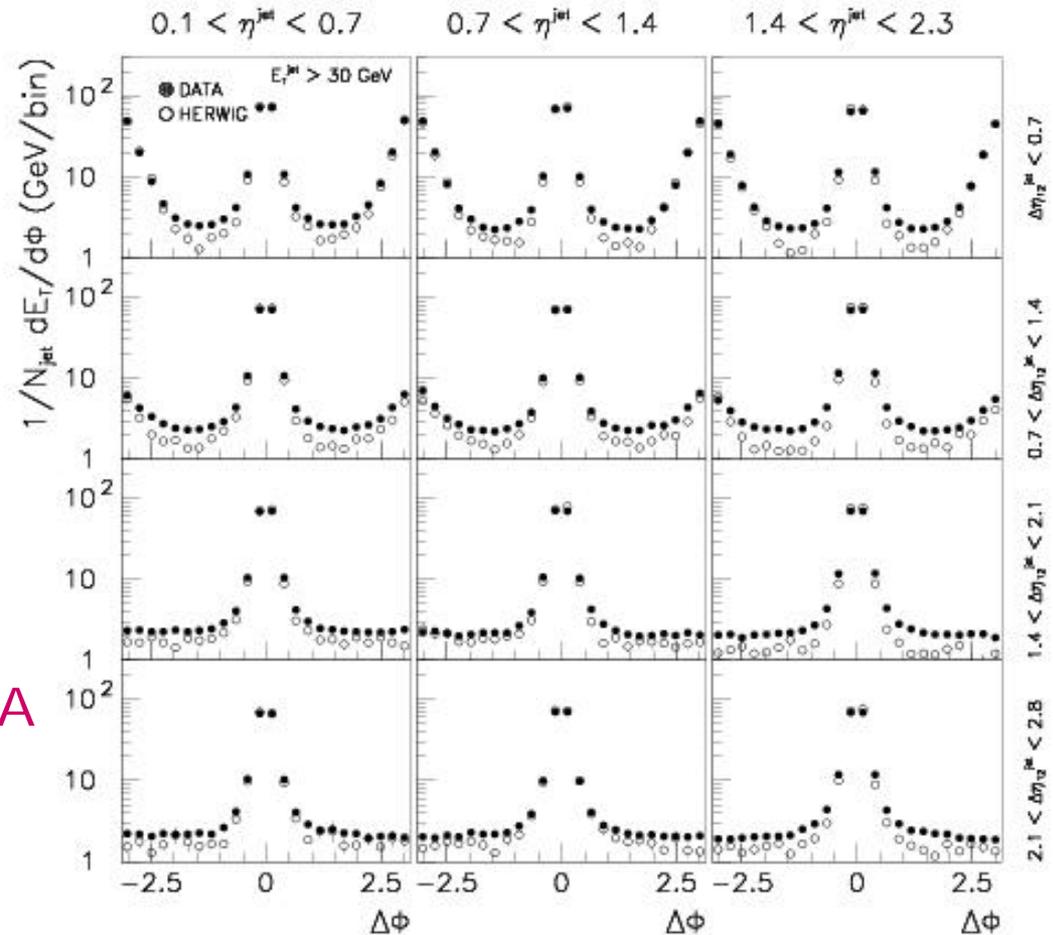
Study of Energy Flows

M. M



Energy Flows around jets sensitive to Underlying Event and soft gluon radiation

Results being updated using latest versions of MC and DATA including all new corrections



Pre-blessing scheduled for Feb. 14th

Beyond Winter Conferences

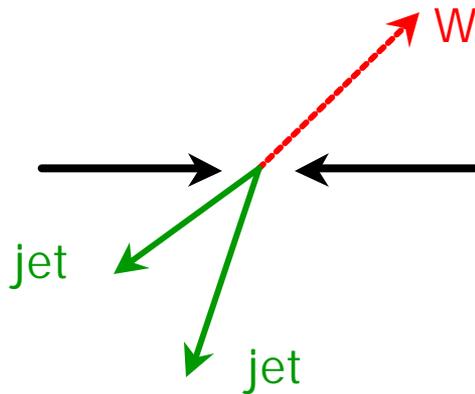
- Push all results toward publication...
.....
- Understand Calorimeter Energy Scale
- New Jet Energy Corrections
- Use of Midpoint Jet algorithm
- Study of K_T algorithm performance
- Inclusive b-jet Production
- W/Z + 2jet Production vs NLO
- Inclusive B-jet Production Cross Section
- Improved Jet Energy Resolution
(CAL+Tracks algorithms)

Jet Algorithms

- Results are currently based on JETCLU
- JETCLU allows meaningful comparisons with Run I results, to understand jet data and jet corrections and produce fast results for Winter conferences
- However, CDF cannot continue using JETCLU as default algorithm for future results
- CDF will have to switch to a Midpoint Algorithm common for all Tevatron Experiments as discussed during the last Jet Algorithms Workshop at Fermilab

W+2jets Production at CDF

Background for Higgs Physics:

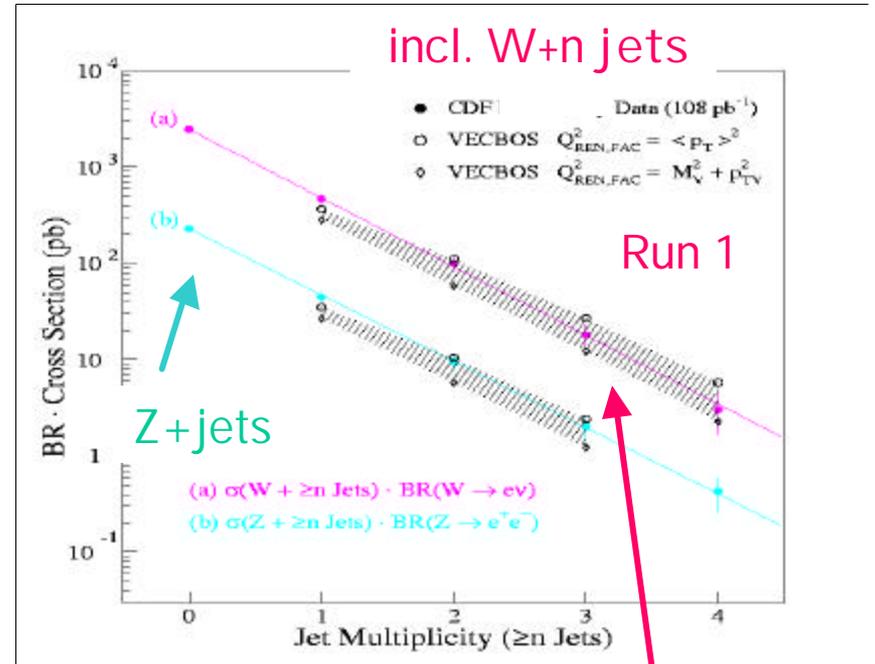


NLO for W+2jets now available...

CDF data will allow precise comparisons to NLO calculations



Will prefer an infrared and collinear safe jet algorithm



Reasonable agreement with VECBOS (LO..... large scale dependence)

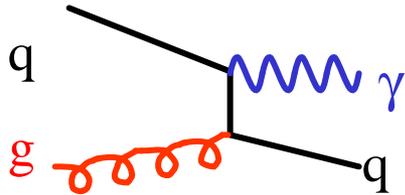
New generation of W+jets programs:

..ALPGEN,COMPHEP,GR@PPA,MADGRAPH,MCFM

...crucial measurement for Run 2

Dijet Mass Resolution WG

S. Kuhlmann et al.



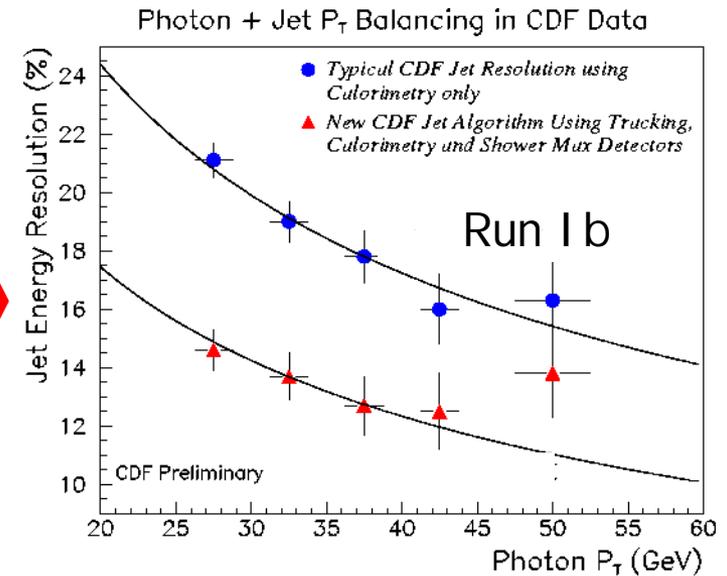
The combination calorimeter+tracks improves the jet energy resolution

$$\frac{83\%}{\sqrt{E}} \rightarrow \frac{64\%}{\sqrt{E}} \quad (\text{Run I b})$$



Run II: 18% improvement
in region $E_T = 25-55$ GeV

Tests on MC already started



Final algorithm needs EndPlug
Calorimeters and ISL
standalone tracking....long term

Manpower vanishing.....

?

...is not this essential for Higgs ☹️

Summary and Conclusions

- Huge effort has been made to push Run II results for Winter Conferences
- Beyond Winter Conferences we should consider new jet algorithms, new jet corrections.....lots of work!
- Good understanding of the CAL E-scale crucial
- Fundamental measurements waiting for new students !
- A Good QCD Physics Program at Tevatron will be essential for future discoveries.....