Flanagan/Chlebana
Feb 28 2003

Inclusive Jet Cross Section Blessing

Changes since last time:

4.17% $\rightarrow$ 4.2% energy scale correction

4.17% $\rightarrow$ 5% energy scale uncertainty

Dropped the first two E_T bins to avoid trigger efficiency correction

Theory using JetClu, previously used MidPoint and scaled result by 1.07 to account for differences between p_T and E_T

Looked closer at effect of the energy scale error

Good Run Criteria

Started by looking at the good run bits in the database

```
SHIFTCREW_STATUS  = 1
RUNCONTROL_STATUS = 1
OFFLINE_STATUS    = 1
RUNNUMBER  >= 138815
CLC_STATUS  = 1
L1T_STATUS  = 1
L2T_STATUS  = 1
L3T_STATUS  = 1
CAL_STATUS  = 1
CAL_OFFLINE = 1
(COT_STATUS = 1 OR COT_OFFLINE = 1)
```

Removed runs where there was a disagreement between the number of events in the ntuple and the number recorded in the database.

Run	Database	ntuple	Run	Database	ntuple
144624	4182	0	155129	22666	22110
144627	2238	1365	155764	1173	586
145415	1229	1287	156362	2773	2267
150145	716	4638	156365	1395	0
150803	30016	28638	156369	11538	0
151435	8140	6987	156370	728	0
151683	11523	12833	156371	1383	0
151900	8020	7162	156455	3594	0
152944	3073	1317	156372	1111	0
152967	47877	46016	156401	2643	0
153411	2083	1023	156452	1422	0
153416	23629	22754	156454	1788	0
153446	5802	4702	156457	3374	0
154050	30955	29997	156458	5178	0
154208	18590	18038	156460	14854	0
			156464	1988	52

Removed about 5 pb^{-1} due to mismatches between the number of events in the ntuple and with the expected number recorded in the database.

Some runs failed because of a missing TL3D bank.

Used data in the gjet08 dataset (better understood calorimeter).

DataSet	Offline LiveLumi (nb^{-1})
gtst1c	3429
gtst1d	1820
gjet08	107231
gjet08 (used)	85348

Used 85.3 pb^{-1} of data out of 112 pb^{-1} of data (76% of the data written to tape).

With better Data Quality Monitoring tools we would be able to utilize more of the data.

Prescale Determination

The prescale on the Level 2 15 GeV Cluster (CL15) trigger changed part way into the run.

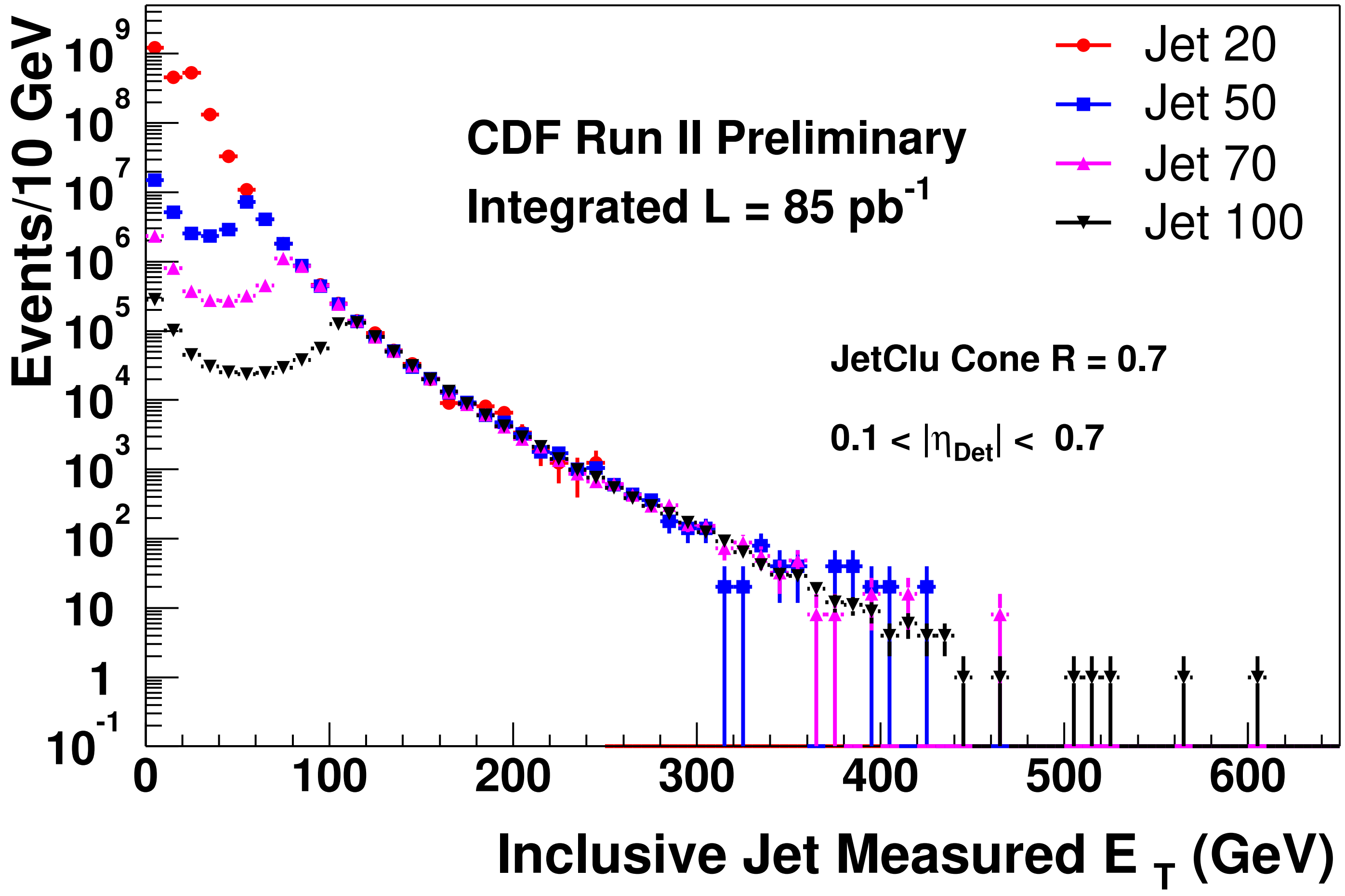
L1 Trigger	L2 Trigger	L3 Trigger
ST5 (20)	CL15 (12, 25)	J20
	CL40 (1)	J50
ST10 (1)	CL60 (8)	J70
	CL90 (1)	J100

Need to determine the effective prescale from the data

For an independent trigger counted the number of events that "Fired" the trigger compared to the number that was "Accepted" after prescaling.

Trigger	Fired	Accepted	Effective Prescale
ST5	1.50833e+06	75558	19.9626
C15	1.5264e+06	98088	15.5616
C60	1.32131e+06	164907	8.01244

Comparison of the inclusive jet Raw E_T distribution for the different triggers after accounting for prescaling.



Vertex Cut Correction

After passing all cuts but the Vz cut find:

Trig	Failed Vz	Passed	(F+P)/P
J20	13676	271365	1.0504
J50	41875	734942	1.05698
J70	23540	378183	1.06224
J100	30837	469435	1.06569

$\rightarrow$ Scaling the data by 1.05 before unsmearing.

Results agree with:

W.K. Sakumoto and A. Hocker, *"Event $|Zvtx| < 60cm$ Cut Efficiency for Run II"*, CDF/ANAL/ELECTROWEAK/CDFR/6331.

Event Selection

$0.1 < |\eta_{Det}| < 0.7$

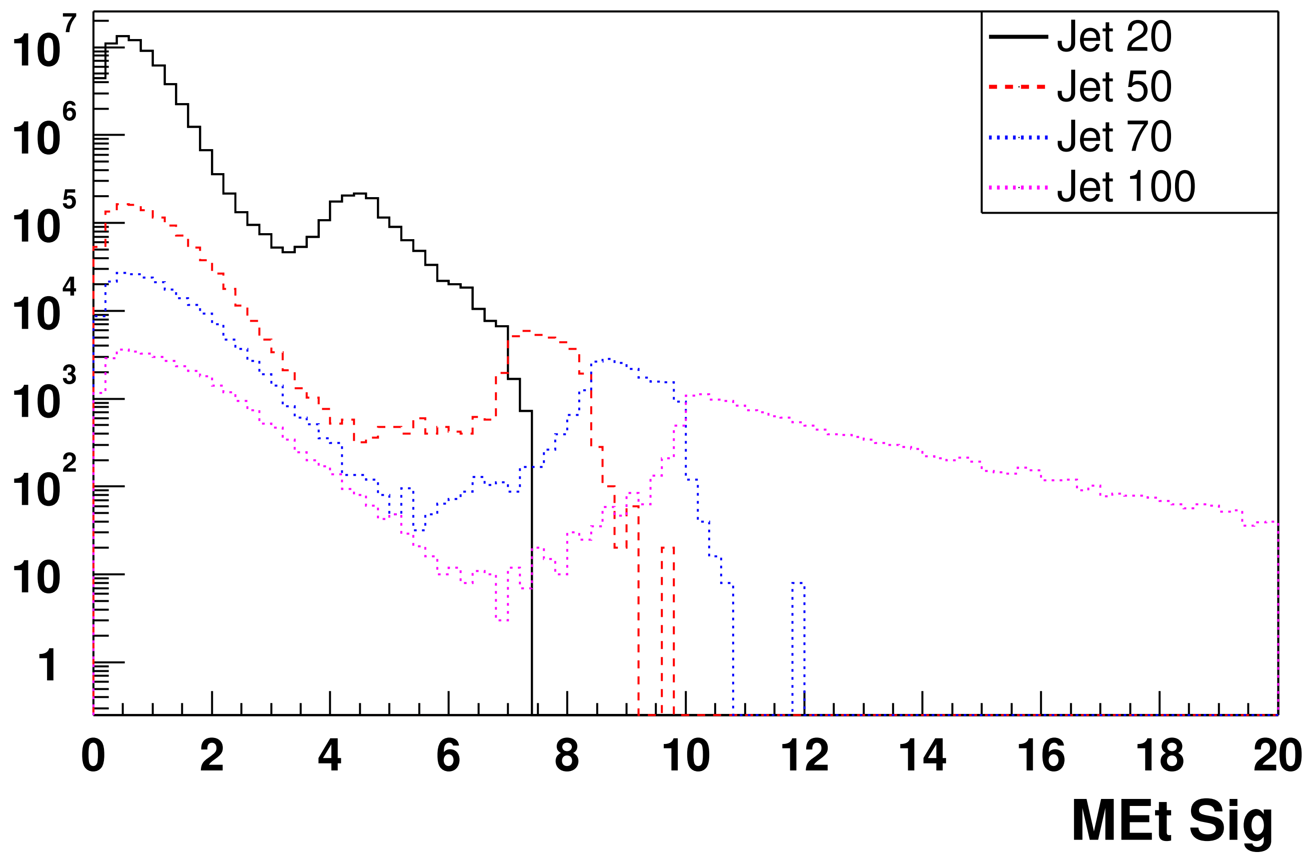
$|z| \leq 60$ cm

MEtSig $\leq$ X

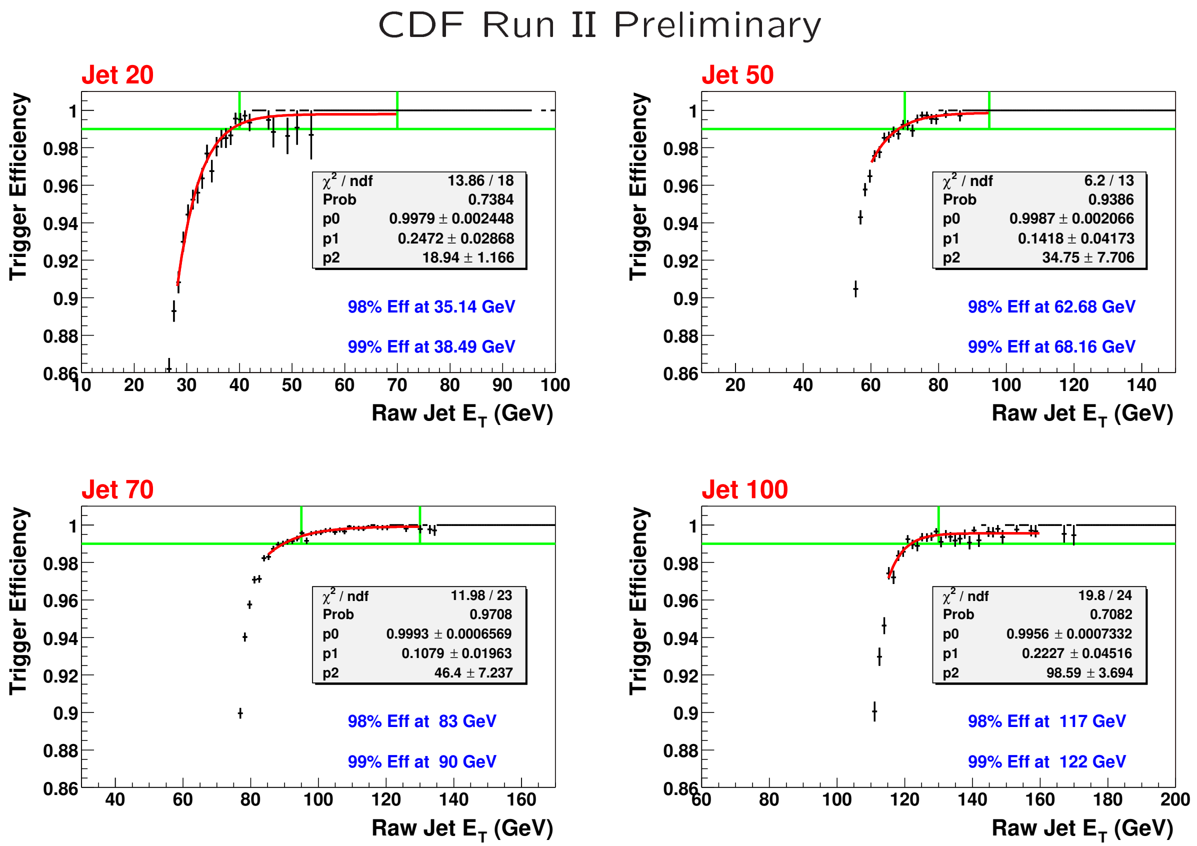
$E_{tot} \leq 2000$ GeV

Hadron timing (Not used... need to understand)

Cut	Events Remaining			
	J20	J50	J70	J100
Full Sample	5607610	1477696	678921	856961
$0.1 < \|\eta^{Det}\| < 0.7$	495149	680304	349944	444465
$\|z\| \leq 60$ cm	473676	638966	328096	417181
MEtSig $\leq$ X	471761	631694	319203	383402
$E_{tot} \leq 2000$ GeV	471761	631694	319203	383399
Hadron timing	469434	624365	313366	372146



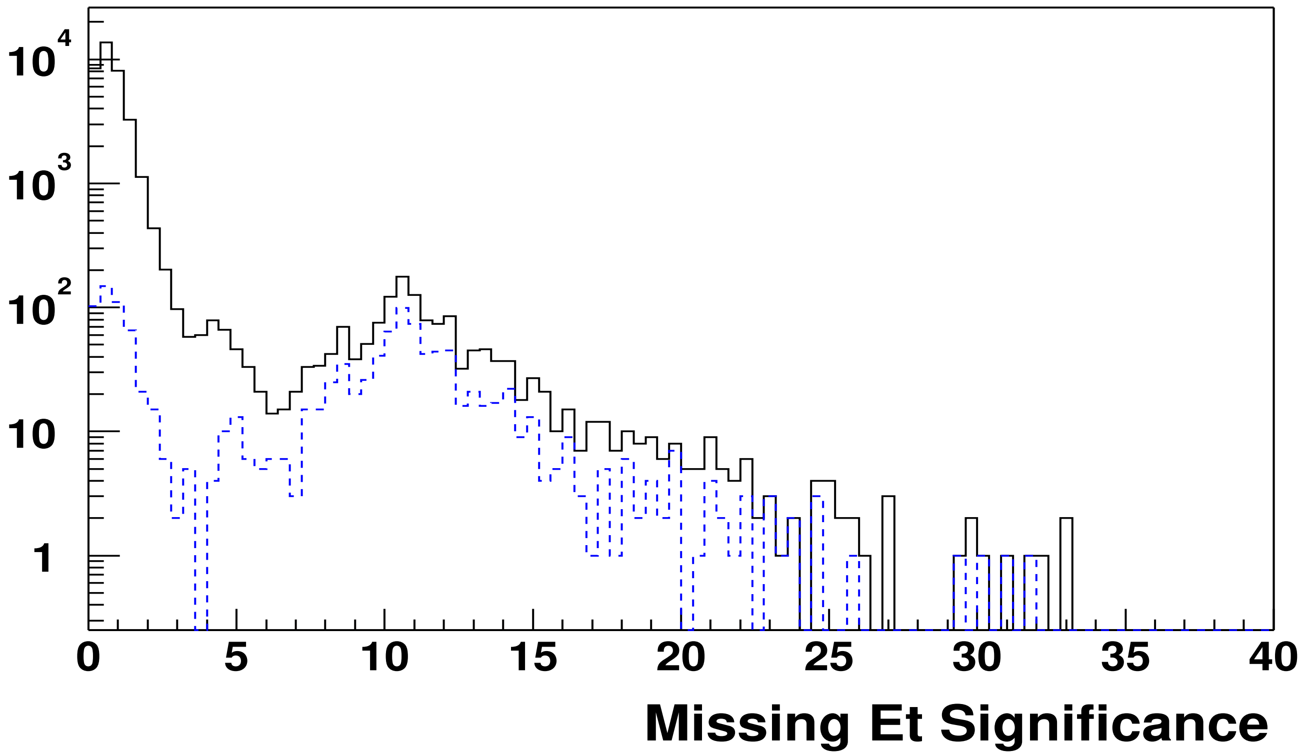

```
if ((jetFlag == 20)  && (metSig > 3.5)) evtOK = 0;
if ((jetFlag == 50)  && (metSig > 5))   evtOK = 0;
if ((jetFlag == 70)  && (metSig > 6))   evtOK = 0;
if ((jetFlag == 100) && (metSig > 7))   evtOK = 0;
```



Staying far away from trigger threshold effects...

Trigger	ET Range	Trigger	ET Range
J20	40 - 70	J70	95 - 130
J50	70 - 95	J100	130 - 620

Events tagged with out of time energy shown as the dashed histogram.



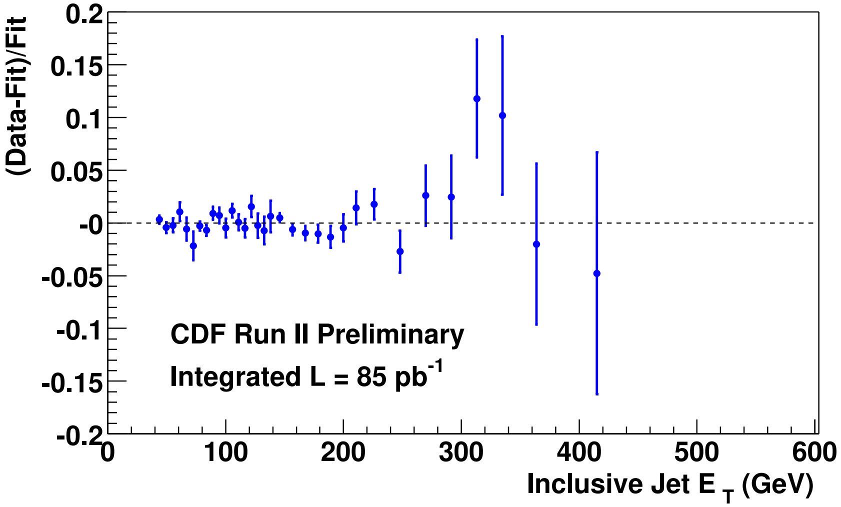
J20	J50	J70	J100
0.995	0.988	0.982	0.971

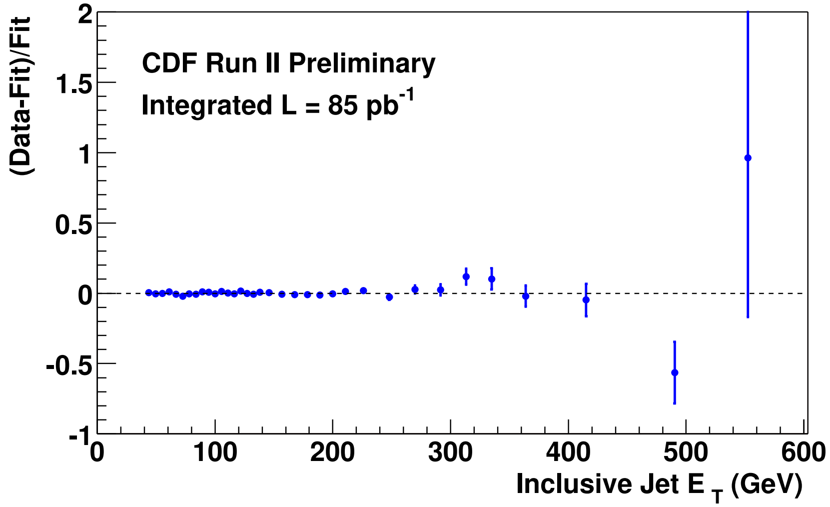
Fraction rejected increases with increasing E_T *Under study...*

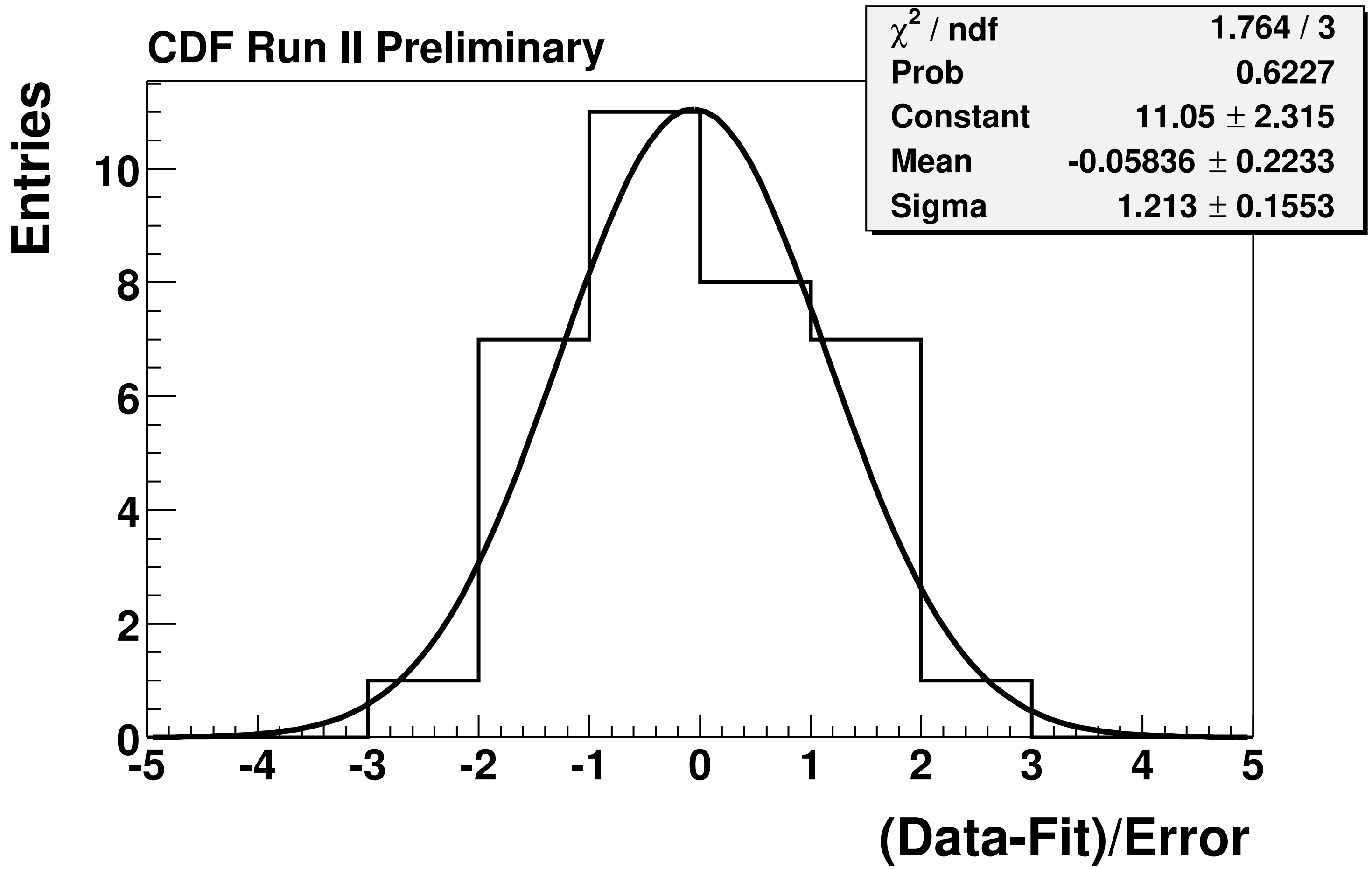
Corrected the energy scale to the Run I level (4.2%) (as determined by the Jet Correction Group via photon-jet balancing).

Used the same unsmearing procedure as in Run I.

Results of the fit to the data after unsmearing



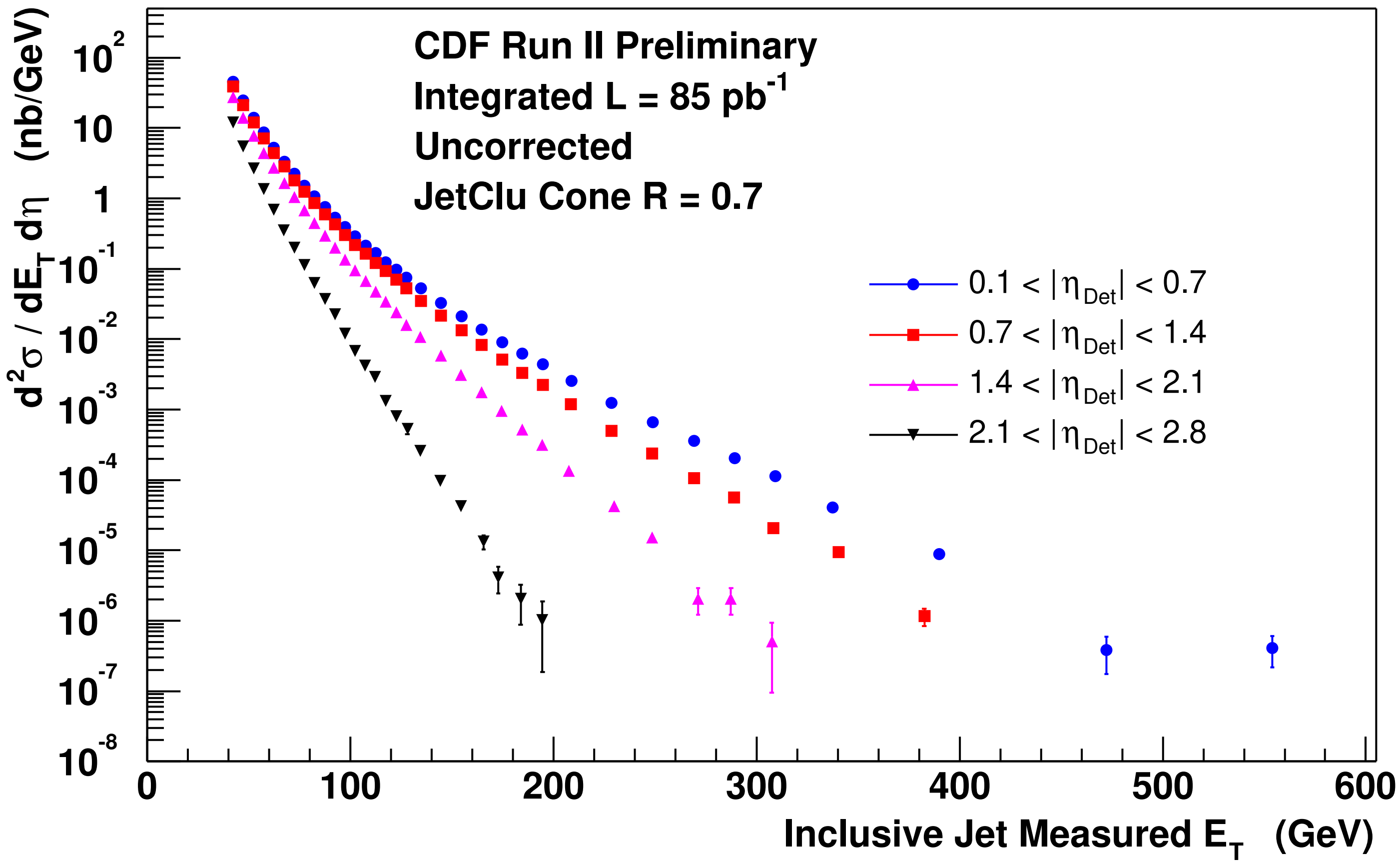




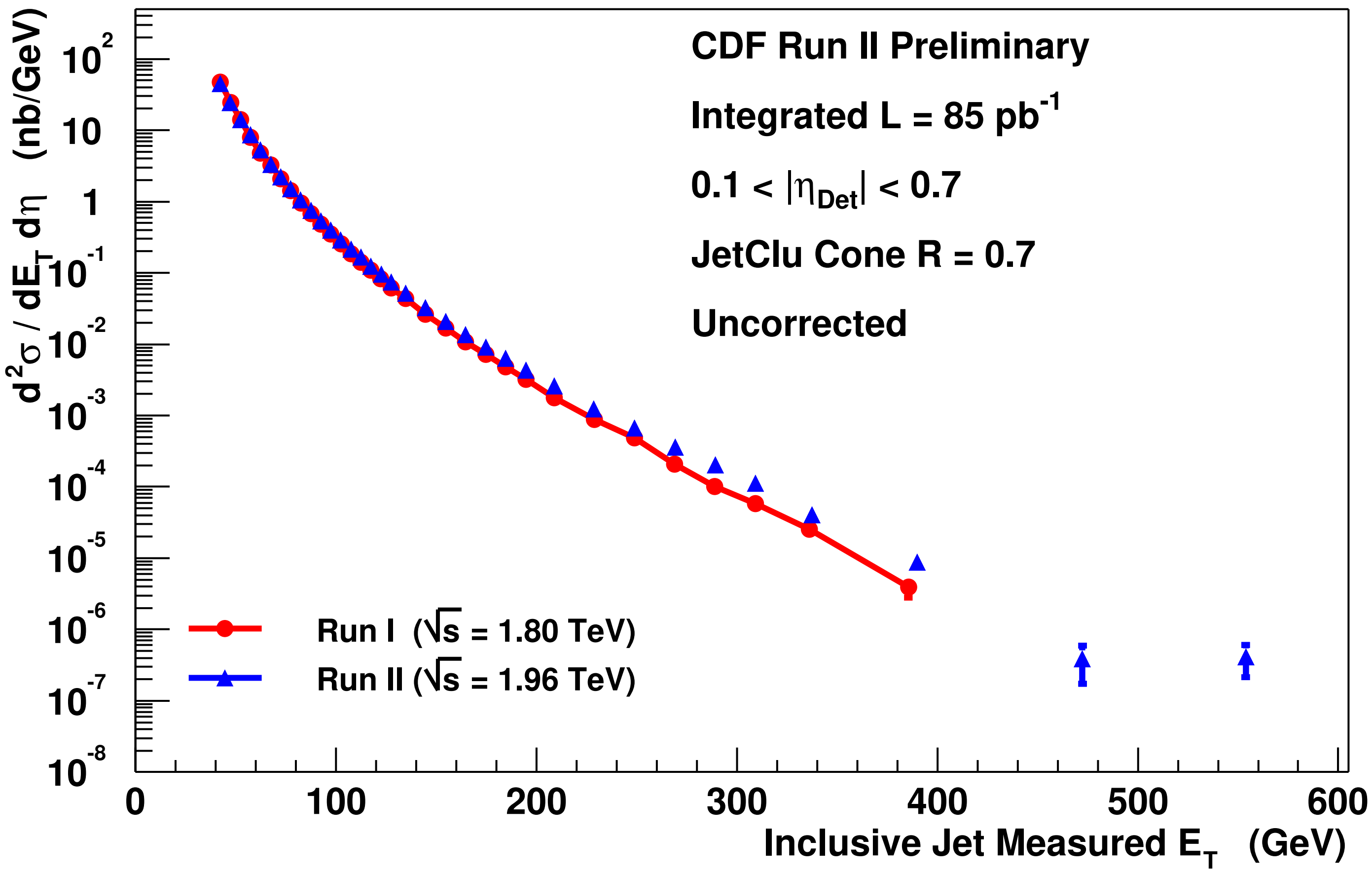
CDF Run II Preliminary
χ^2 / ndf 1.764 / 3
Prob 0.6227
Constant 11.05 ± 2.315
Mean -0.05836 ± 0.2233
Sigma 1.213 ± 0.1553
Entries
0
2
4
6
8
10
-5
-4
-3
-2
-1
0
1
2
3
4
5
(Data-Fit)/Error

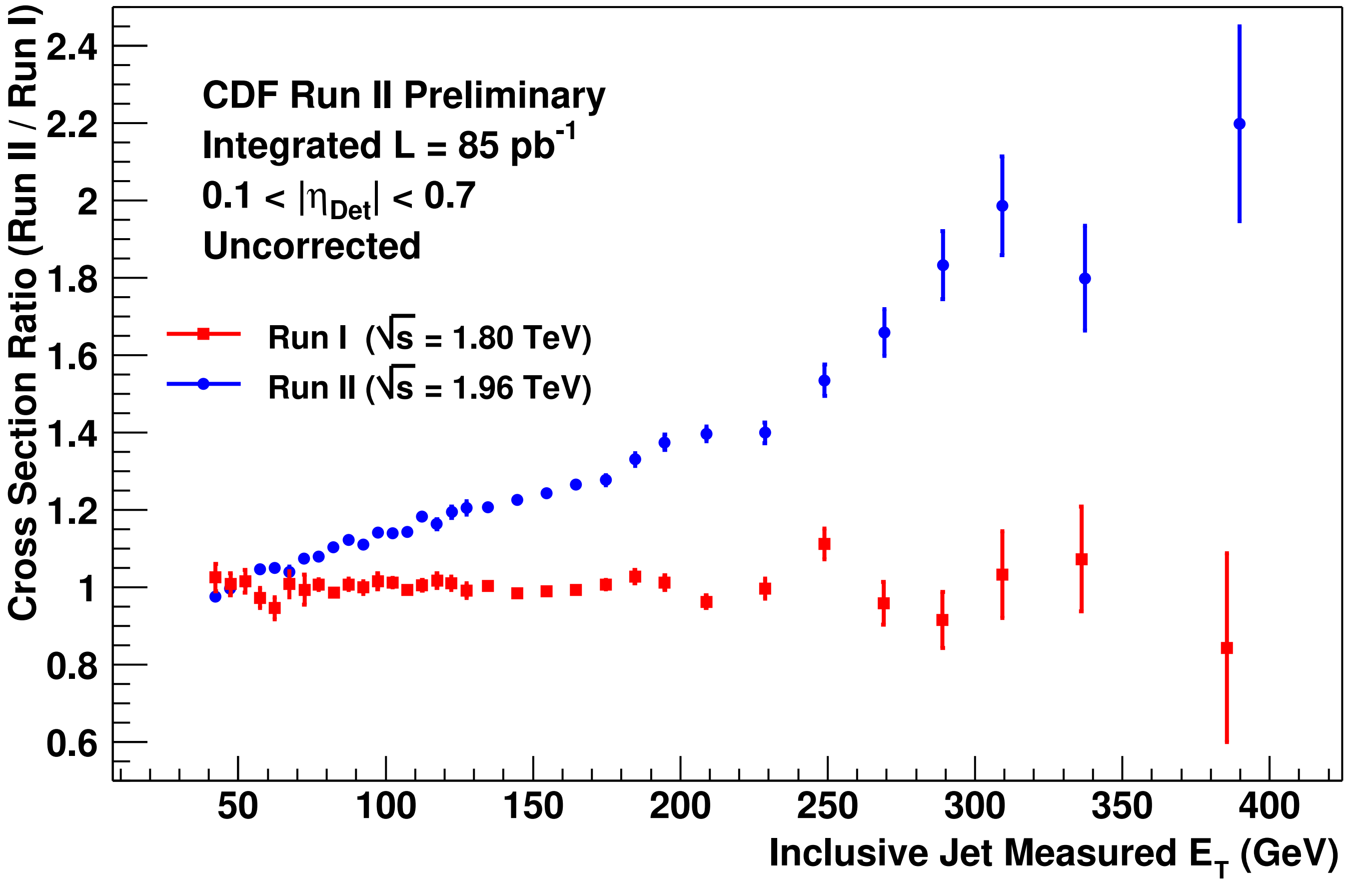
Currently focusing on the “well understood” central region

Eventually will extend the measurement to the forward region



Have added two additional high E_T bins extending the Run I results from $412 \to 551$ GeV.





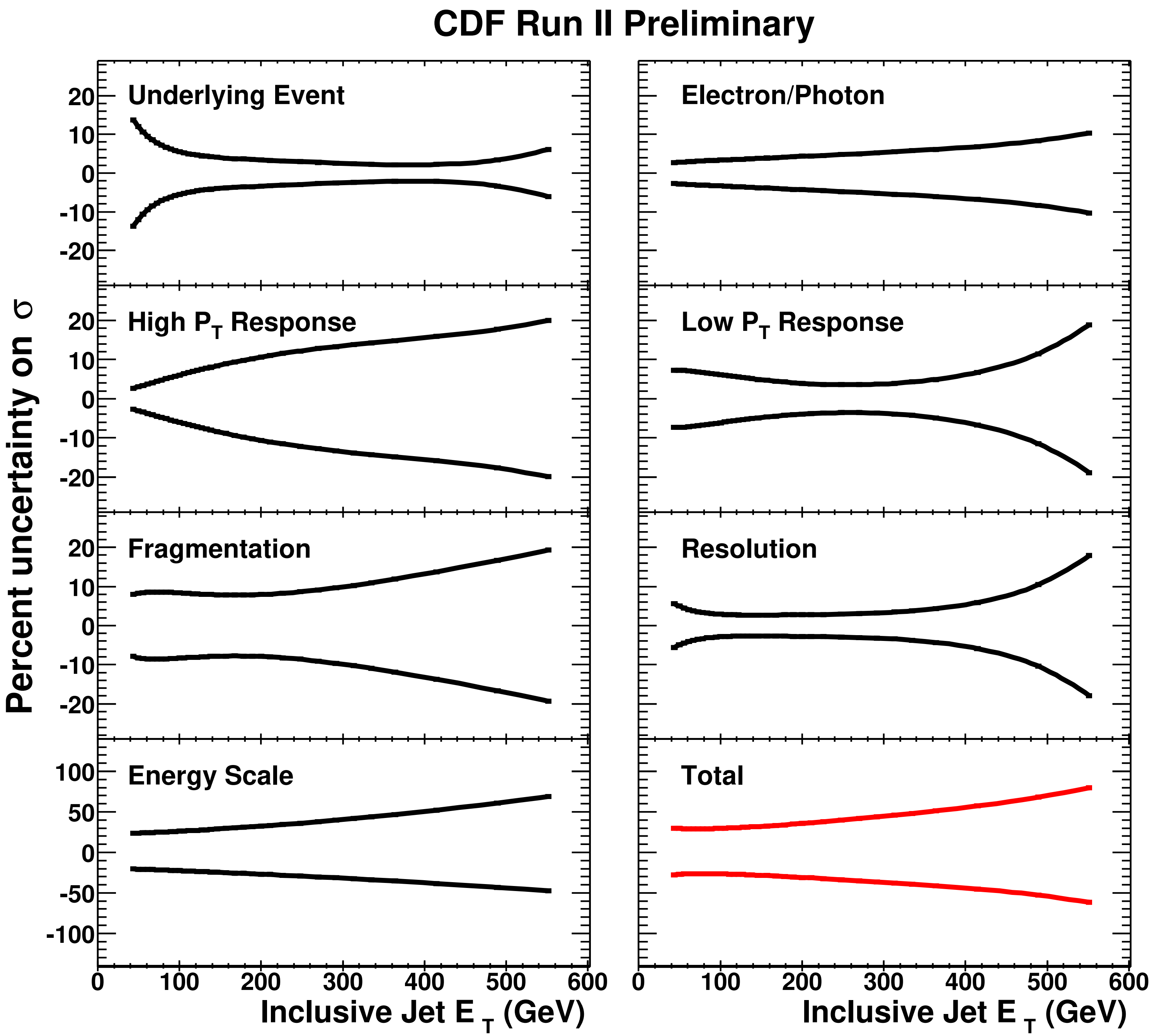
CDF Run II Preliminary
Integrated L = 85 pb^{-1}
$0.1 < |\eta_{Det}| < 0.7$
Uncorrected
Run I ($\sqrt{s}$ = 1.80 TeV)
Run II ($\sqrt{s}$ = 1.96 TeV)
Cross Section Ratio (Run II / Run I)
Inclusive Jet Measured E_T (GeV)
0.6
0.8
1
1.2
1.4
1.6
1.8
2
2.2
2.4
50
100
150
200
250
300
350
400

Systematic Errors

Consider the same sources of systematic error as in Run I.

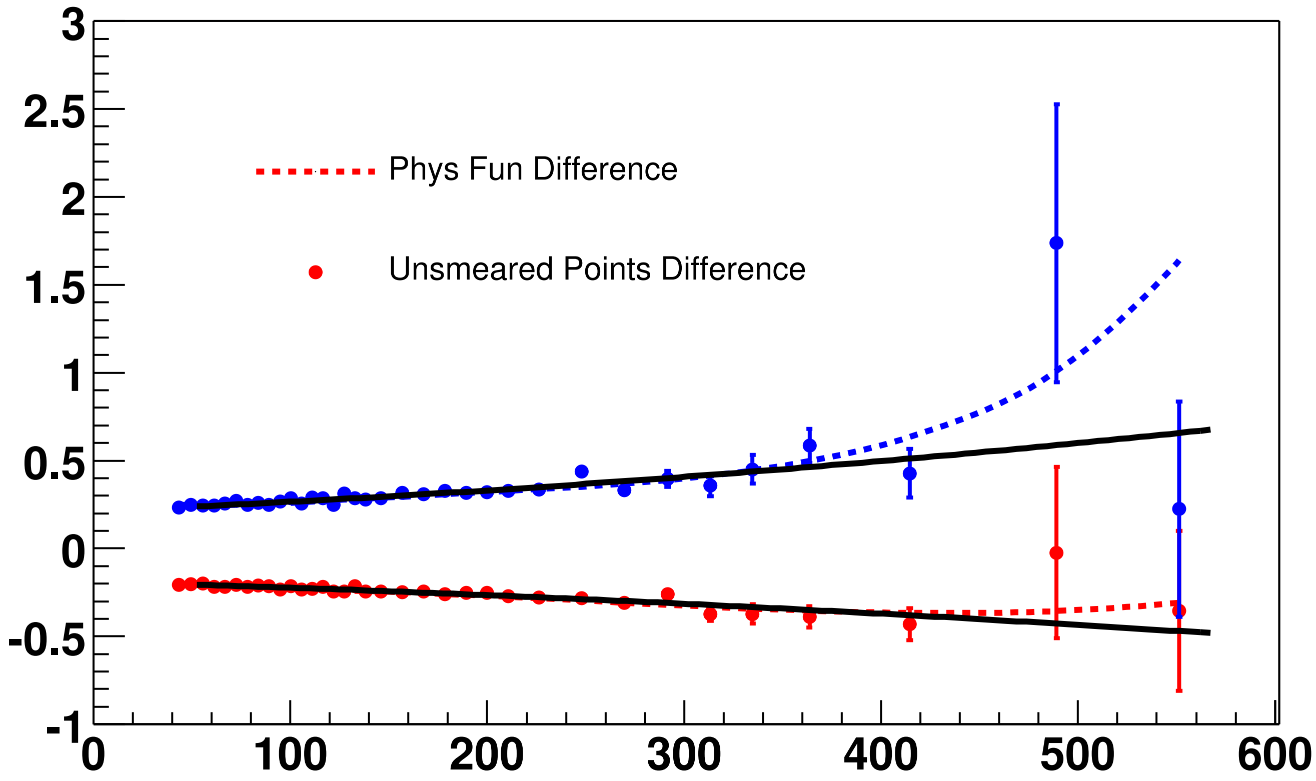
Details can be found in FERMILAB-Pub-01/008-E

- “hi pt”: High p_T hadronic response +3.2% -2.2%.
- “lo pt”: Low p_T hadronic response ±5%.
- “E scale”: Energy scale stability ±5%.
- “frag”: Fragmentation.
- “uEvt”: Underlying event ±30%.
- “el/ph”: Electron/photon response ±2%.
- “Res”: Calorimeter resolution ±10%.



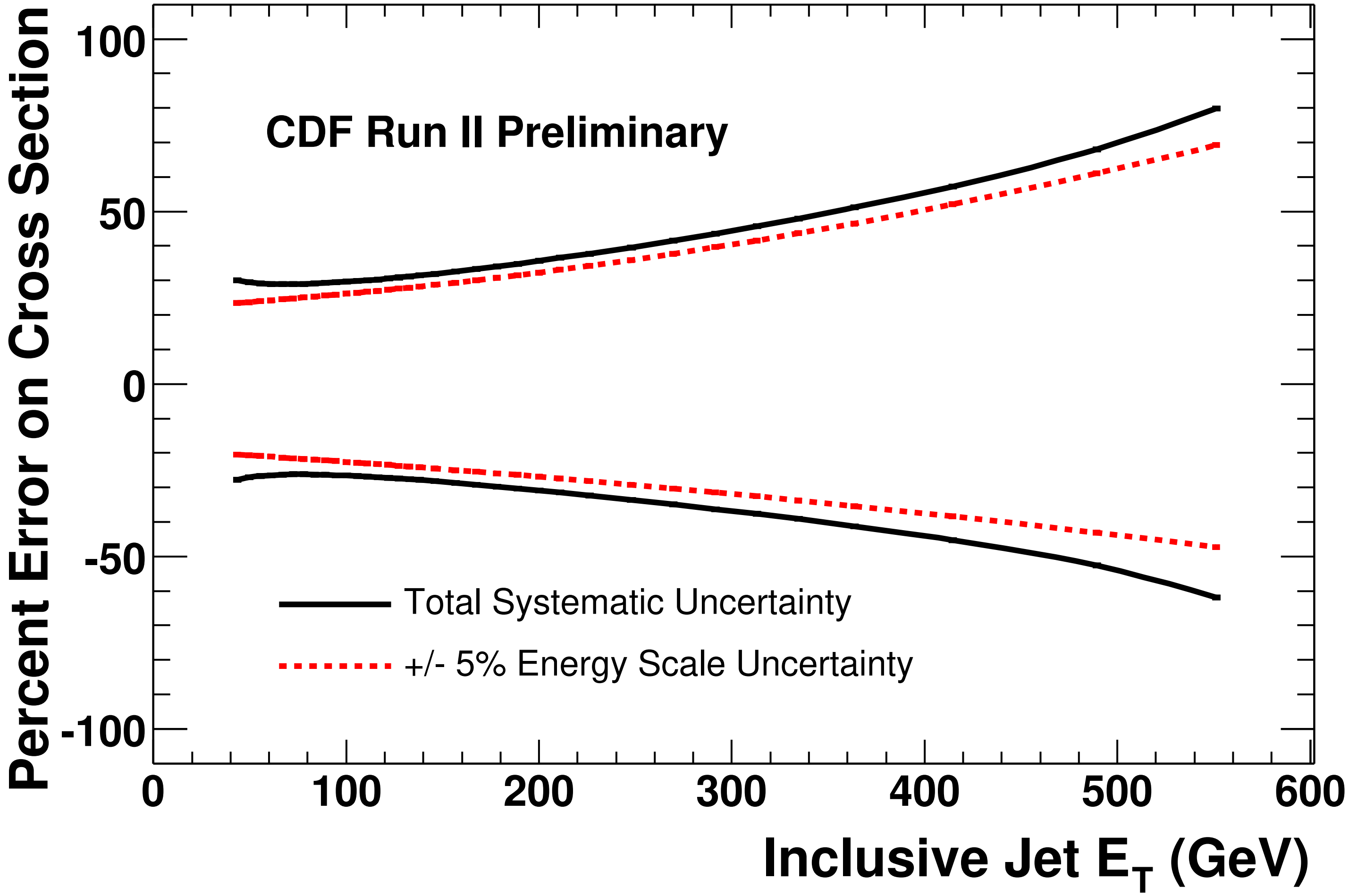
CDF Run II Preliminary
Underlying Event
Electron/Photon
High P_T Response
Low P_T Response
Fragmentation
Resolution
Energy Scale
Total
Percent uncertainty on σ
Inclusive Jet E_T (GeV)
Inclusive Jet E_T (GeV)

Compared the difference in the physics function with a fit to the difference in the unsmeared points.



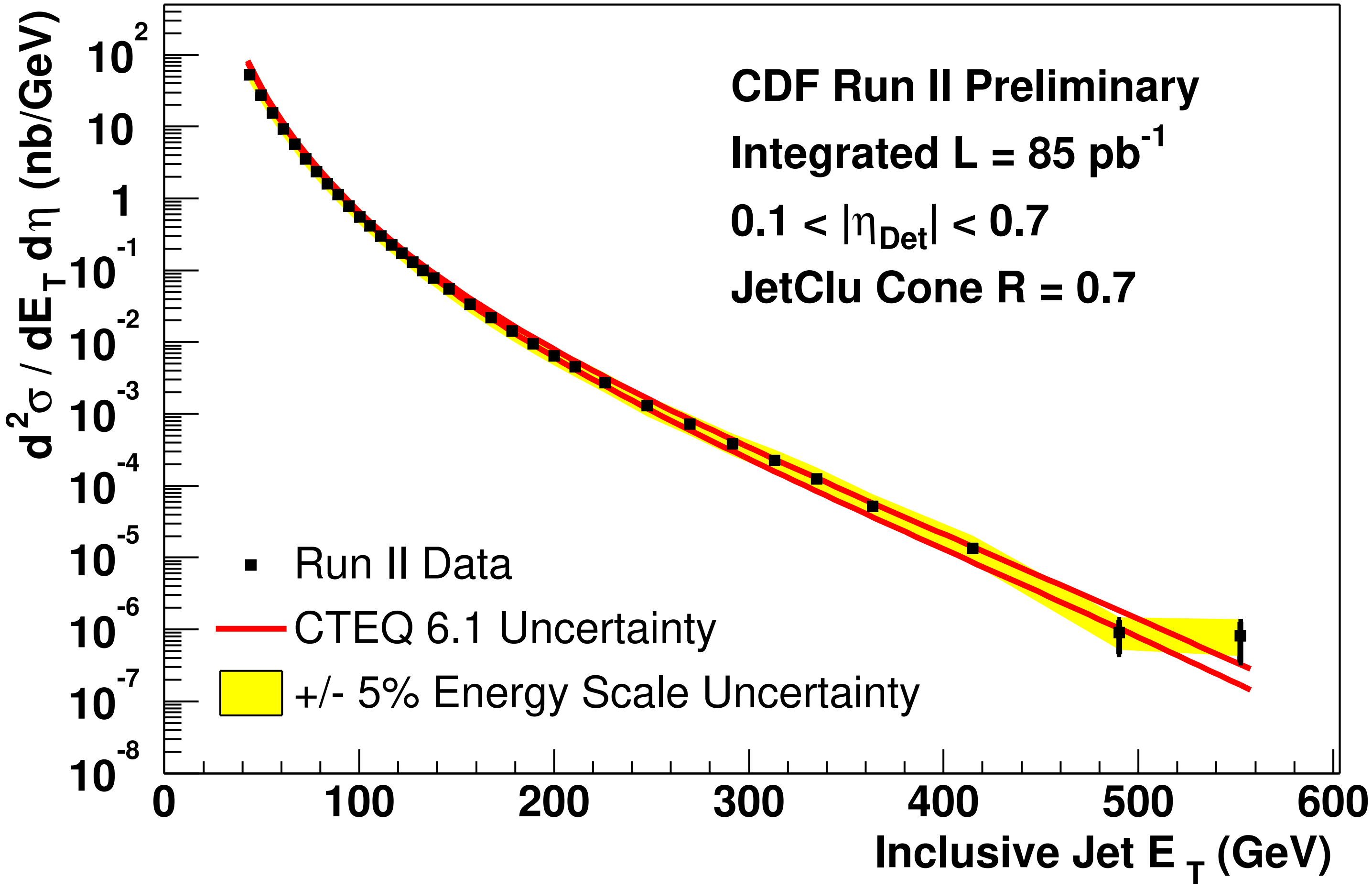
Used a fit to the shifted data points to estimate the effect of a 5% energy scale error.

The percent error resulting from a $\pm$ 5% change in the energy scale shown as the inner band. The outer band shows the total systematic error added in quadrature.



→ Still need to add the uncertainty due to the luminosity...

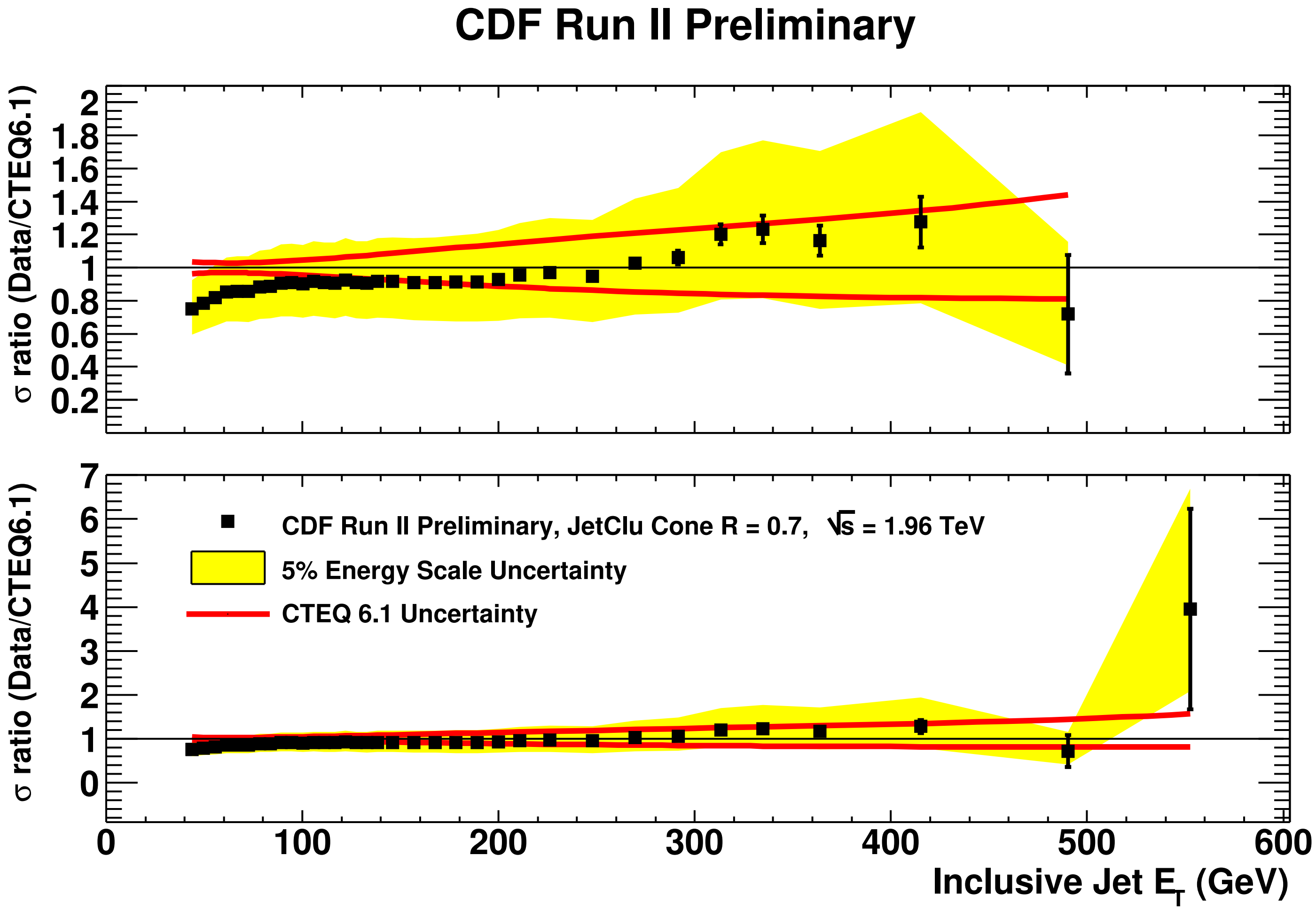
Green band shows the change in cross section resulting from the $\pm$ 5% uncertainty in the energy scale

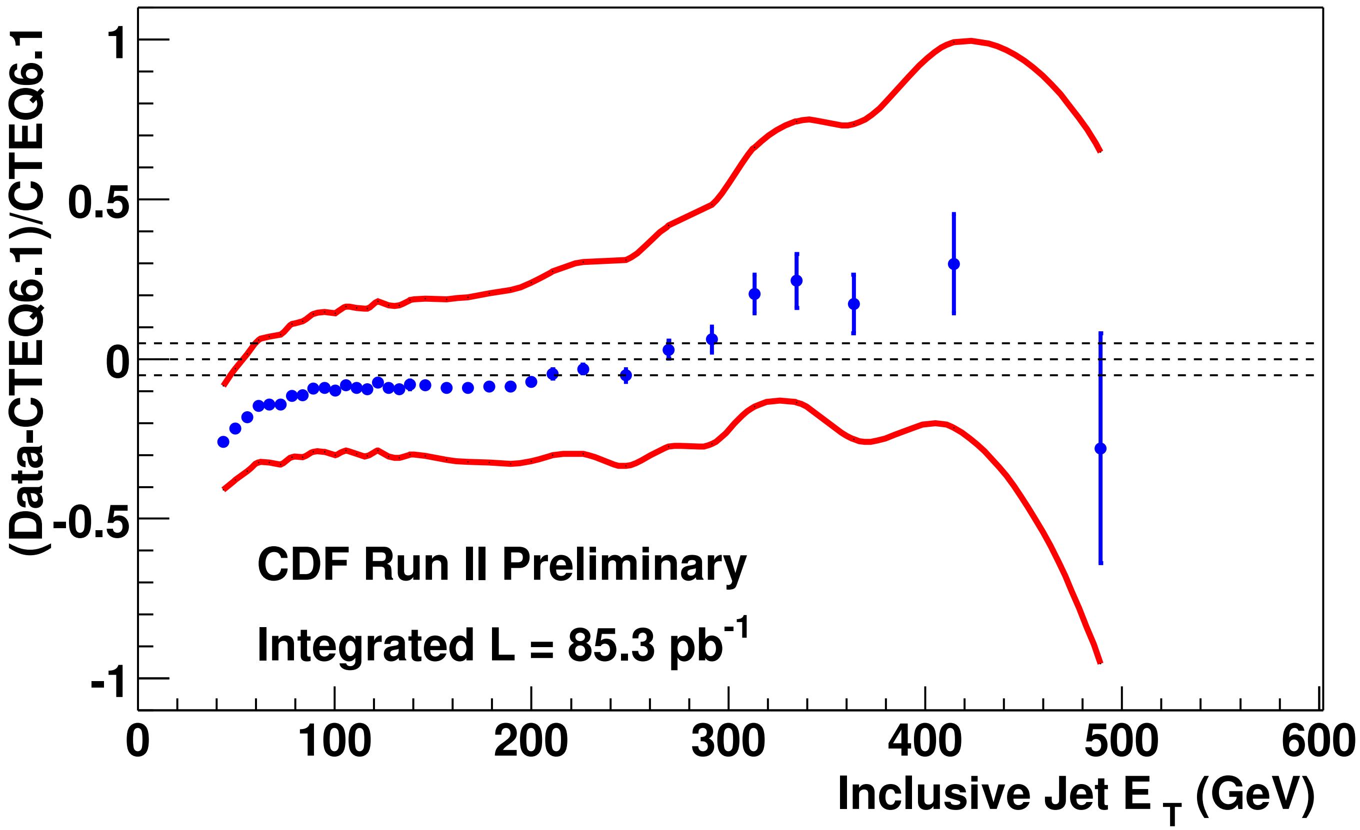


Red line shows the prediction of CTEQ 6.1

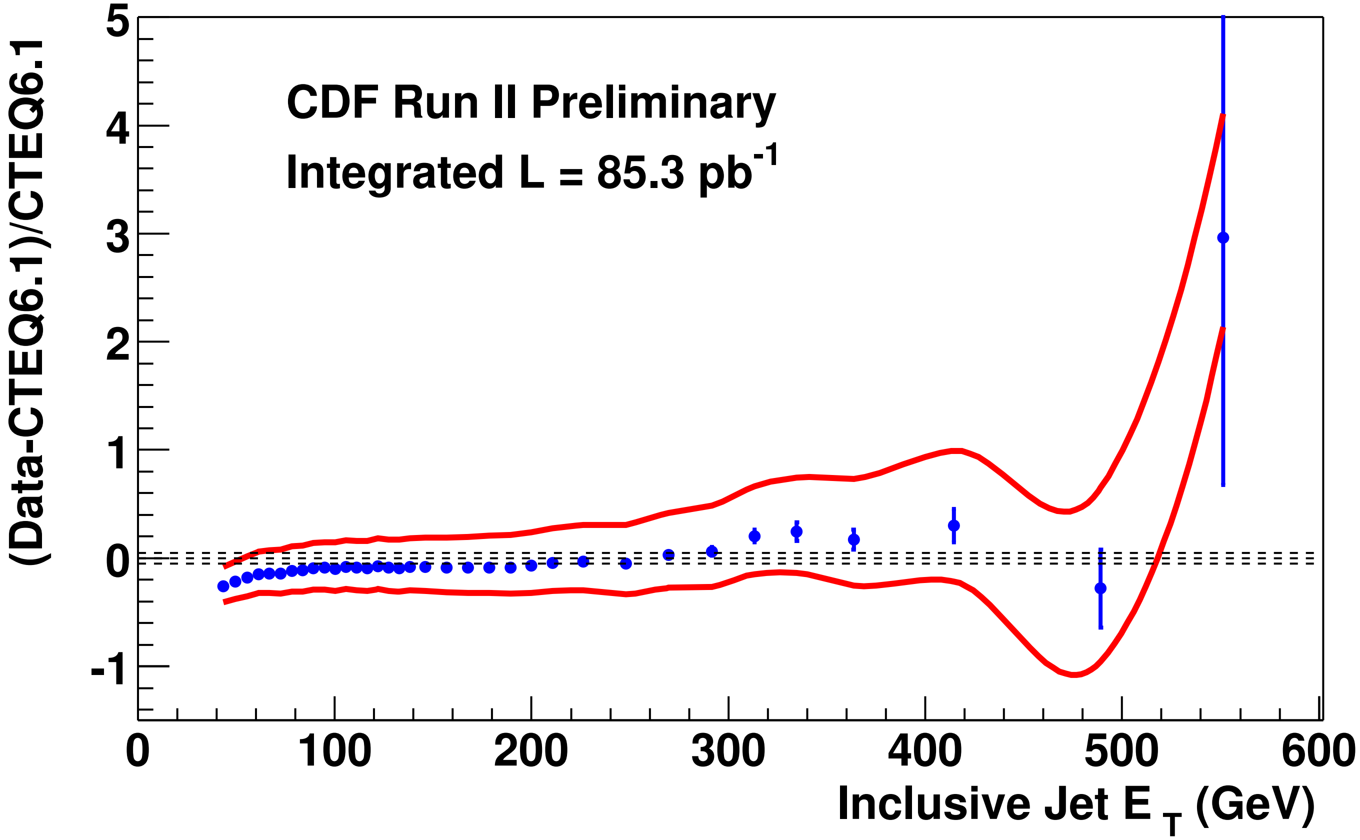
Red line shows the error band due to the $\pm 5\%$ uncertainty in the energy scale.

Green band shows the uncertainty in the PDF

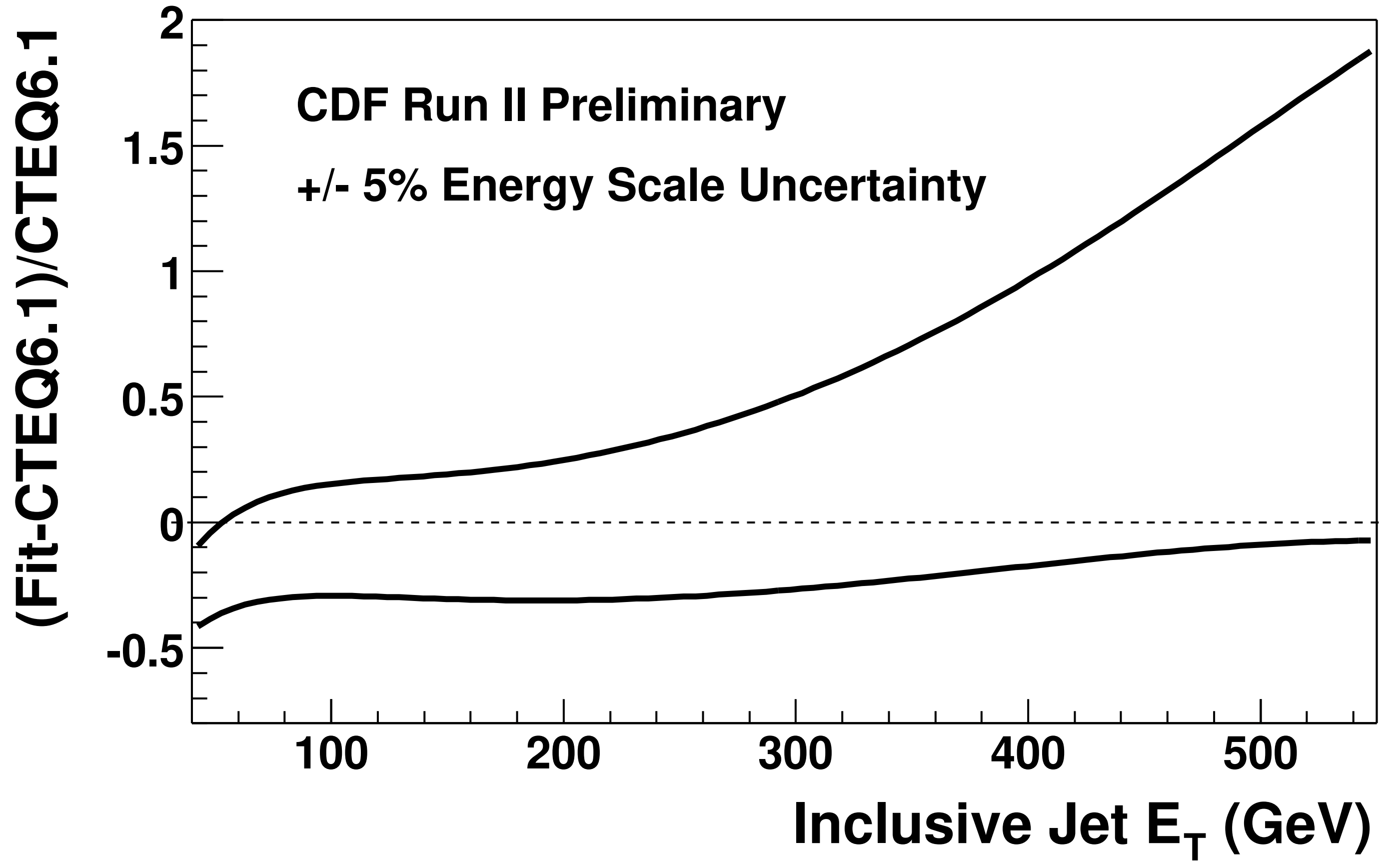


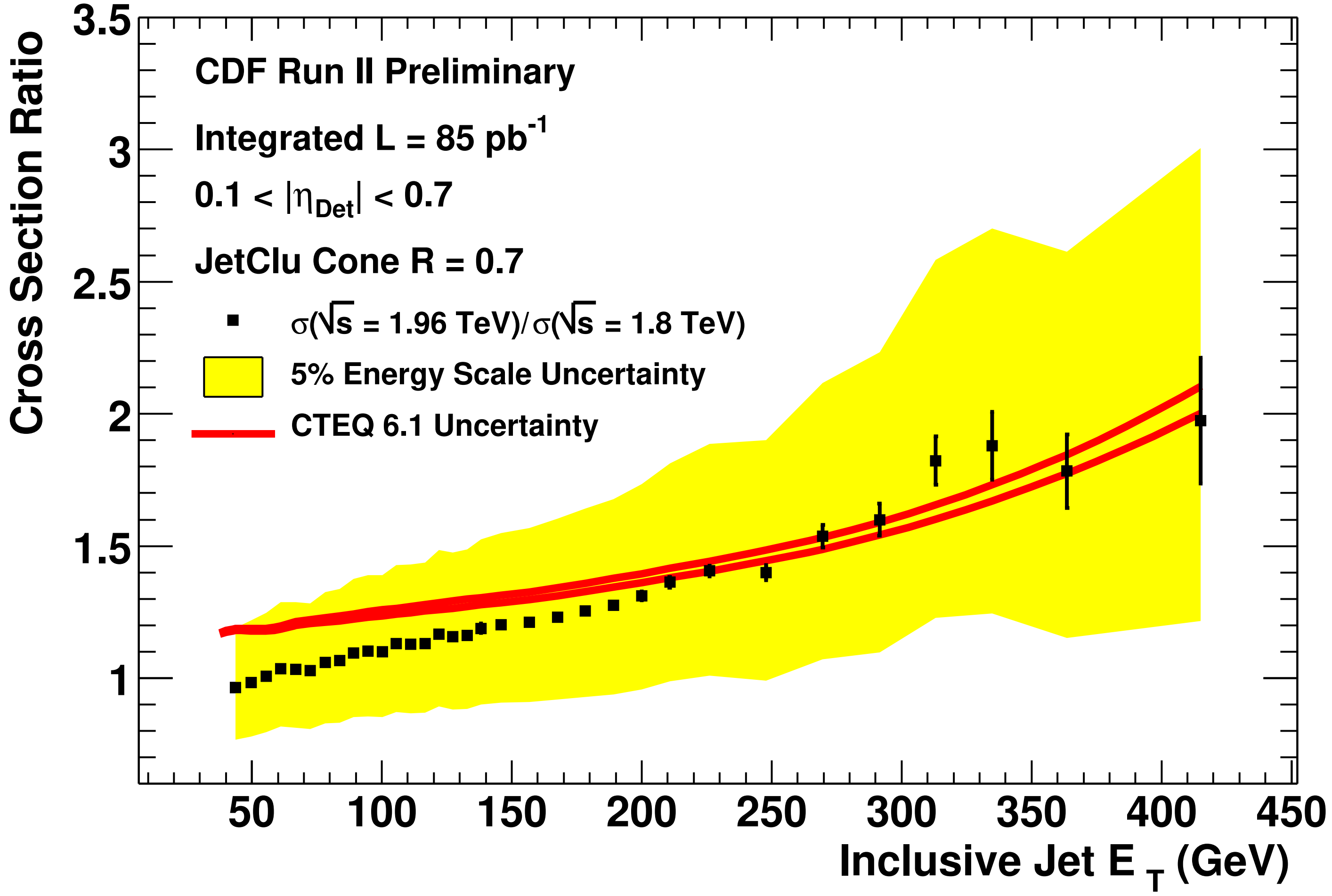


(Data-CTEQ6.1)/CTEQ6.1
1
0.5
0
-0.5
-1
0
100
200
300
400
500
600
Inclusive Jet E T (GeV)
CDF Run II Preliminary
Integrated L = 85.3 pb-1


CDF Run II Preliminary
Integrated L = 85.3 pb-1
(Data-CTEQ6.1)/CTEQ6.1
Inclusive Jet E T (GeV)
5
4
3
2
1
0
-1
0
100
200
300
400
500
600

Energy scale error band (5%), around the fit to the data, compared to the prediction of CTEQ 6.1





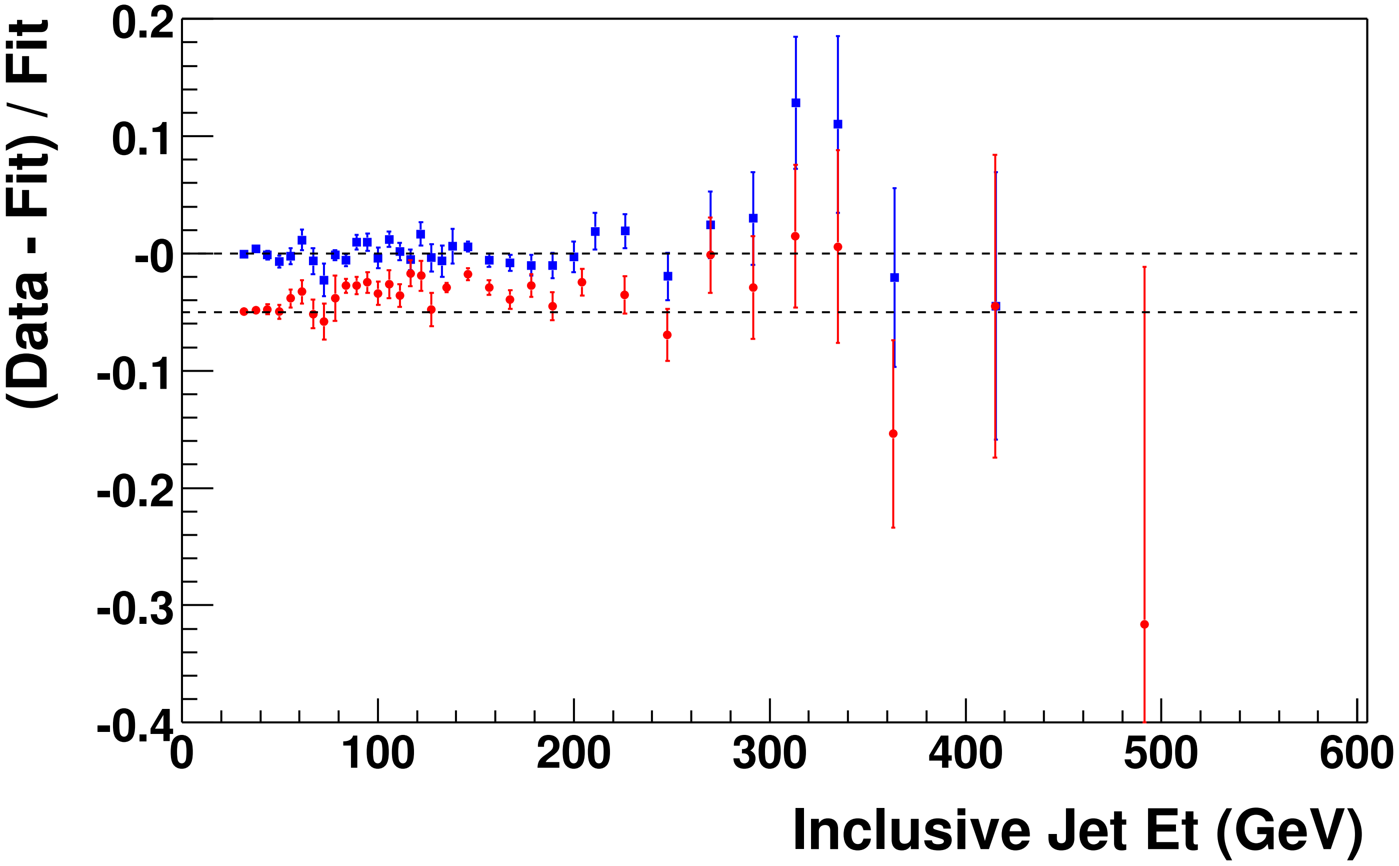
CDF Run II Preliminary
Integrated L = 85 pb-1
0.1 < |ηDet| < 0.7
JetClu Cone R = 0.7
σ(√s = 1.96 TeV)/σ(√s = 1.8 TeV)
5% Energy Scale Uncertainty
CTEQ 6.1 Uncertainty
Cross Section Ratio
Inclusive Jet E T (GeV)
1
1.5
2
2.5
3
3.5
50
100
150
200
250
300
350
400
450

Two independent analysis starting from different ntuples

1) ntuples generated from the Standard Ntuple

2) ntuples generated via the DataAccess Package (85 pb^{-1})

Started with the gjet08 dataset (processed with 4.8.4) then reran the Calorimetry modules using 4.9.1.



Results between the two analyses agree to within 5%

$\rightarrow$ luminosity

$\rightarrow$ joining the samples from the different triggers

Conclusions...

The energy scale uncertainly of 5% is the largest source of error and can be expected to be reduced as our understanding of the calorimeter improves In Run I the error was 1%

Run I data ends at 412.9 GeV, Run II data extends our E_T reach to 550 GeV.

Results are consistent with QCD Predictions of CTEQ 6.1 but will keep watching the high E_T region...

This model of having two independent analysis
$\rightarrow$ provides important cross checks
$\rightarrow$ helps keep the momentum going

Last night saw six runs with hot towers

Run	Events
153327	19
153345	4
153389	66
153739	3
154030	2
155821	3

Low Et	High Et	Events
95	100	23729
100	105	17342
105	110	12893
110	115	9951
115	120	7466

Remove bad runs 85.348 -> 82.485 pb-1

Scale by 1.9% 82.485 * 1.019 = 84.052

```
-- run/evt = 153327/4798773 Et  = 108.451 eta = -0.0631816 phi = 3.27817
-- run/evt = 153327/4798774 Et  = 108.451 eta = -0.0631816 phi = 3.27817
-- run/evt = 153327/4798775 Et  = 108.451 eta = -0.0631816 phi = 3.27817
-- run/evt = 153327/4798777 Et  = 108.451 eta = -0.0631816 phi = 3.27817
-- run/evt = 153327/4798779 Et  = 108.451 eta = -0.0631816 phi = 3.27817
-- run/evt = 153327/4798780 Et  = 108.451 eta = -0.0631816 phi = 3.27817
-- run/evt = 153327/4798781 Et  = 108.451 eta = -0.0631816 phi = 3.27817
-- run/evt = 153327/4798783 Et  = 108.451 eta = -0.0631816 phi = 3.27817
-- run/evt = 153327/4798784 Et  = 108.451 eta = -0.0631816 phi = 3.27817

-- run/evt = 153327/5247179 Et  = 108.744 eta = 0.449588 phi = 5.27838
-- run/evt = 153327/5247180 Et  = 108.744 eta = 0.449588 phi = 5.27838
-- run/evt = 153327/5247181 Et  = 108.744 eta = 0.449588 phi = 5.27838
-- run/evt = 153327/5247183 Et  = 108.744 eta = 0.449588 phi = 5.27838
-- run/evt = 153327/5247184 Et  = 108.744 eta = 0.449588 phi = 5.27838
-- run/evt = 153327/5247185 Et  = 108.744 eta = 0.449588 phi = 5.27838
-- run/evt = 153327/5247186 Et  = 108.744 eta = 0.449588 phi = 5.27838
-- run/evt = 153327/5247187 Et  = 108.744 eta = 0.449588 phi = 5.27838
-- run/evt = 153327/5247188 Et  = 108.744 eta = 0.449588 phi = 5.27838
-- run/evt = 153327/5247189 Et  = 108.744 eta = 0.449588 phi = 5.27838

-- run/evt = 153345/1397932 Et  = 139.092 eta = -0.456059 phi = 4.03202
-- run/evt = 153345/1397933 Et  = 139.092 eta = -0.456059 phi = 4.03202
-- run/evt = 153345/1397934 Et  = 139.092 eta = -0.456059 phi = 4.03202
-- run/evt = 153345/1397935 Et  = 139.092 eta = -0.456059 phi = 4.03202

-- run/evt = 153389/4358904 Et  = 103.767 eta = 1.31246 phi = 2.43486
-- run/evt = 153389/4358905 Et  = 103.767 eta = 1.31246 phi = 2.43486
```

```
-- run/evt = 153389/4358906 Et  = 103.767 eta = 1.31246 phi = 2.43486
-- run/evt = 153389/4358908 Et  = 103.767 eta = 1.31246 phi = 2.43486
-- run/evt = 153389/4358910 Et  = 103.767 eta = 1.31246 phi = 2.43486
-- run/evt = 153389/4358911 Et  = 103.767 eta = 1.31246 phi = 2.43486
-- run/evt = 153389/4358912 Et  = 103.767 eta = 1.31246 phi = 2.43486
-- run/evt = 153389/4358913 Et  = 103.767 eta = 1.31246 phi = 2.43486
-- run/evt = 153389/4358915 Et  = 103.767 eta = 1.31246 phi = 2.43486

-- run/evt = 153389/4513244 Et  = 134.968 eta = -0.185481 phi = 2.52466
-- run/evt = 153389/4513245 Et  = 134.968 eta = -0.185481 phi = 2.52466
-- run/evt = 153389/4513246 Et  = 134.968 eta = -0.185481 phi = 2.52466
-- run/evt = 153389/4513248 Et  = 134.968 eta = -0.185481 phi = 2.52466
-- run/evt = 153389/4513249 Et  = 134.968 eta = -0.185481 phi = 2.52466
-- run/evt = 153389/4513250 Et  = 134.968 eta = -0.185481 phi = 2.52466
-- run/evt = 153389/4513251 Et  = 134.968 eta = -0.185481 phi = 2.52466
-- run/evt = 153389/4513253 Et  = 134.968 eta = -0.185481 phi = 2.52466
-- run/evt = 153389/4513254 Et  = 134.968 eta = -0.185481 phi = 2.52466
-- run/evt = 153389/4513255 Et  = 134.968 eta = -0.185481 phi = 2.52466

-- run/evt = 153389/4629212 Et  = 183.876 eta = 0.193629 phi = 4.65694
-- run/evt = 153389/4629213 Et  = 183.876 eta = 0.193629 phi = 4.65694
-- run/evt = 153389/4629214 Et  = 183.876 eta = 0.193629 phi = 4.65694
-- run/evt = 153389/4629215 Et  = 183.876 eta = 0.193629 phi = 4.65694
-- run/evt = 153389/4629216 Et  = 183.876 eta = 0.193629 phi = 4.65694
-- run/evt = 153389/4629217 Et  = 183.876 eta = 0.193629 phi = 4.65694
-- run/evt = 153389/4629219 Et  = 183.876 eta = 0.193629 phi = 4.65694
-- run/evt = 153389/4629220 Et  = 183.876 eta = 0.193629 phi = 4.65694
-- run/evt = 153389/4629221 Et  = 183.876 eta = 0.193629 phi = 4.65694
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-- run/evt = 153389/4867502 Et  = 109.485 eta = -0.07457 phi = 2.21928
-- run/evt = 153389/4867503 Et  = 109.485 eta = -0.07457 phi = 2.21928
-- run/evt = 153389/4867504 Et  = 109.485 eta = -0.07457 phi = 2.21928
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-- run/evt = 153389/4867506 Et  = 109.485 eta = -0.07457 phi = 2.21928
-- run/evt = 153389/4867507 Et  = 109.485 eta = -0.07457 phi = 2.21928
-- run/evt = 153389/4867510 Et  = 109.485 eta = -0.07457 phi = 2.21928
-- run/evt = 153389/4867512 Et  = 109.485 eta = -0.07457 phi = 2.21928
-- run/evt = 153389/4867513 Et  = 109.485 eta = -0.07457 phi = 2.21928

-- run/evt = 153389/6055317 Et  = 153.244 eta = 0.358195 phi = 4.04184
-- run/evt = 153389/6055318 Et  = 153.244 eta = 0.358195 phi = 4.04184
-- run/evt = 153389/6055319 Et  = 153.244 eta = 0.358195 phi = 4.04184
-- run/evt = 153389/6055321 Et  = 153.244 eta = 0.358195 phi = 4.04184
-- run/evt = 153389/6055322 Et  = 153.244 eta = 0.358195 phi = 4.04184
-- run/evt = 153389/6055323 Et  = 153.244 eta = 0.358195 phi = 4.04184
-- run/evt = 153389/6055324 Et  = 153.244 eta = 0.358195 phi = 4.04184
-- run/evt = 153389/6055326 Et  = 153.244 eta = 0.358195 phi = 4.04184
-- run/evt = 153389/6055327 Et  = 153.244 eta = 0.358195 phi = 4.04184

-- run/evt = 153389/6062101 Et  = 108.931 eta = -0.337645 phi = 2.8025
-- run/evt = 153389/6062102 Et  = 108.931 eta = -0.337645 phi = 2.8025
-- run/evt = 153389/6062103 Et  = 108.931 eta = -0.337645 phi = 2.8025
-- run/evt = 153389/6062105 Et  = 108.931 eta = -0.337645 phi = 2.8025
-- run/evt = 153389/6062106 Et  = 108.931 eta = -0.337645 phi = 2.8025
-- run/evt = 153389/6062107 Et  = 108.931 eta = -0.337645 phi = 2.8025
-- run/evt = 153389/6062108 Et  = 108.931 eta = -0.337645 phi = 2.8025
```

```
-- run/evt = 153389/6062110 Et  = 108.931 eta = -0.337645 phi = 2.8025
-- run/evt = 153389/6062111 Et  = 108.931 eta = -0.337645 phi = 2.8025
-- run/evt = 153389/6062112 Et  = 108.931 eta = -0.337645 phi = 2.8025

-- run/evt = 153389/6155148 Et  = 107.525 eta = 0.33245 phi = 4.74349
-- run/evt = 153389/6155149 Et  = 107.525 eta = 0.33245 phi = 4.74349
-- run/evt = 153389/6155150 Et  = 107.525 eta = 0.33245 phi = 4.74349
-- run/evt = 153389/6155151 Et  = 107.525 eta = 0.33245 phi = 4.74349
-- run/evt = 153389/6155152 Et  = 107.525 eta = 0.33245 phi = 4.74349
-- run/evt = 153389/6155153 Et  = 107.525 eta = 0.33245 phi = 4.74349
-- run/evt = 153389/6155154 Et  = 107.525 eta = 0.33245 phi = 4.74349
-- run/evt = 153389/6155155 Et  = 107.525 eta = 0.33245 phi = 4.74349
-- run/evt = 153389/6155158 Et  = 107.525 eta = 0.33245 phi = 4.74349
-- run/evt = 153389/6155159 Et  = 107.525 eta = 0.33245 phi = 4.74349

-- run/evt = 153739/393129 Et  = 127.874 eta = 0.203804 phi = 6.04835
-- run/evt = 153739/393130 Et  = 127.874 eta = 0.203804 phi = 6.04835
-- run/evt = 153739/393131 Et  = 127.874 eta = 0.203804 phi = 6.04835

-- run/evt = 154030/2224598 Et  = 150.546 eta = -0.442937 phi = 0.553981
-- run/evt = 154030/2224601 Et  = 150.546 eta = -0.442937 phi = 0.553981

-- run/evt = 155821/3075912 Et  = 130.131 eta = 1.57105 phi = 4.7955
-- run/evt = 155821/3075914 Et  = 130.131 eta = 1.57105 phi = 4.7955
-- run/evt = 155821/3075915 Et  = 130.131 eta = 1.57105 phi = 4.7955
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