RunII Inclusive Jet Cross Section at the Collider Detector at Fermilab

Giuseppe Latino
(University of New Mexico - CDF Collaboration)

APS/DPF-2003
Philadelphia April 5, 2003.

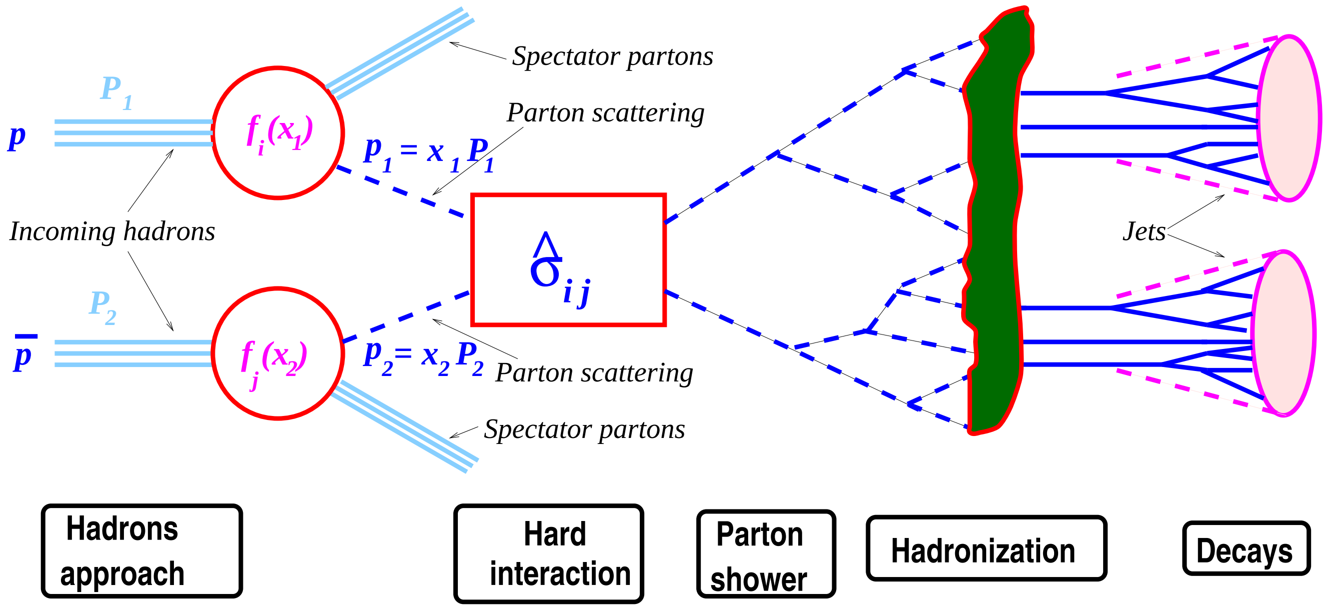
Highlights:

- Motivation.
- Analysis.
- Results.
- Summary & Plans.

Inclusive Jet Cross Section @ Tevatron

Motivation:

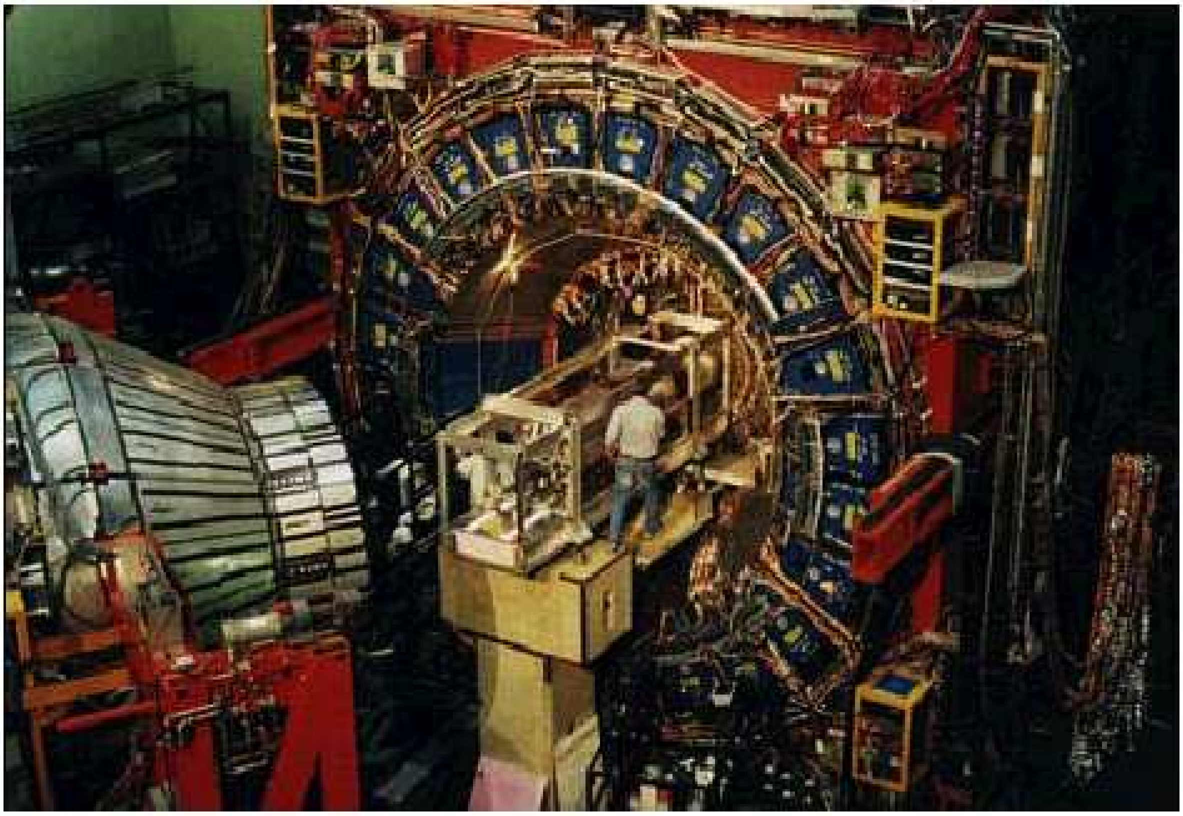
- Tevatron: $p\bar{p}$ collider
  $\Rightarrow$ jet production dominant process.
- Fundamental test of pQCD predictions.
- Constrain PDFs.
- Probe highest momentum transfer
  $\Rightarrow$ search for new physics.



Tevatron & CDF RunII Upgrades

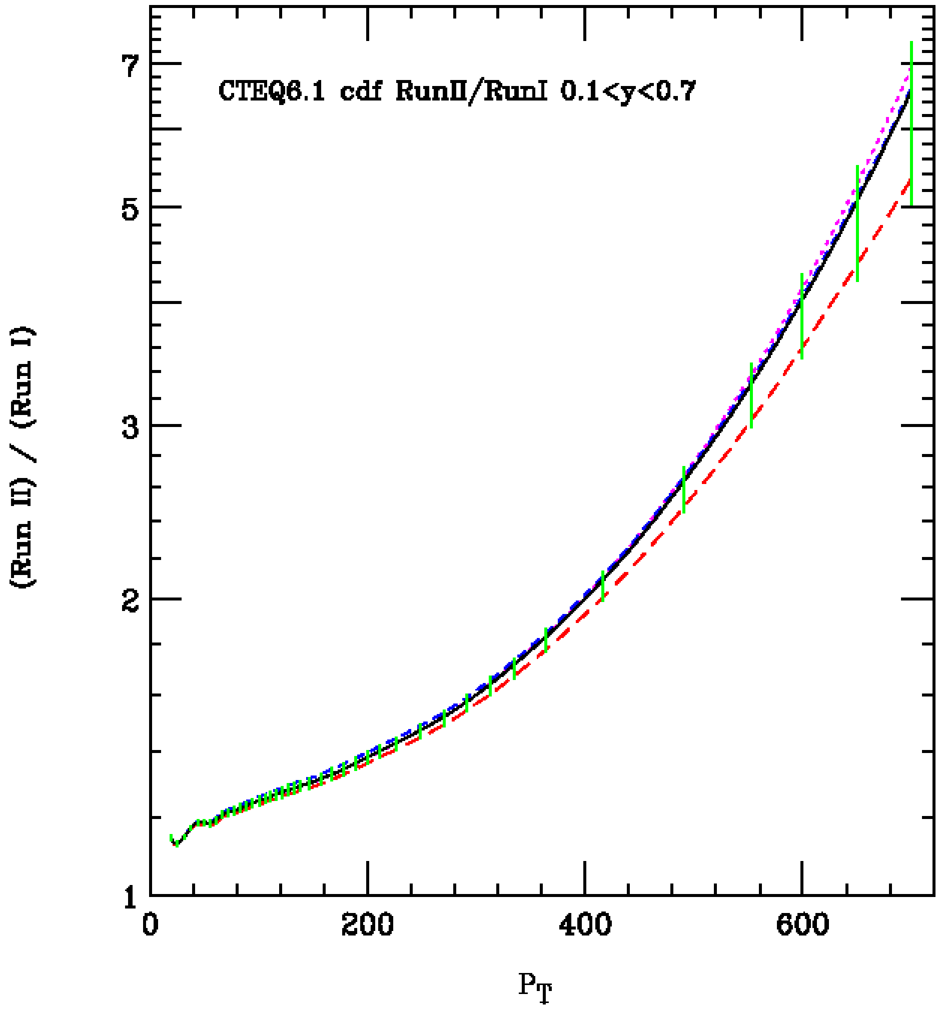
Improvements:

- $\sqrt{s}$: 1.8 TeV $\rightarrow$ 1.96 TeV
  $\Rightarrow$ increased kinematic range for jet prod.
- Larger L_{int} & upgraded trigger
  $\Rightarrow$ increased statistics.
- New plug calorimeter $(1.1 < |\eta_{D}| < 3.6)$
  $\Rightarrow$ measurement extended to high η.



Run II vrs. RunI Jet Production Theory Prediction

$\sqrt{s}$: 1.8 TeV → 1.96 TeV



⇒ Higher σ_{jet} especially at high E_T ($\sim \times 4$ at $E_T = 600$ GeV !).

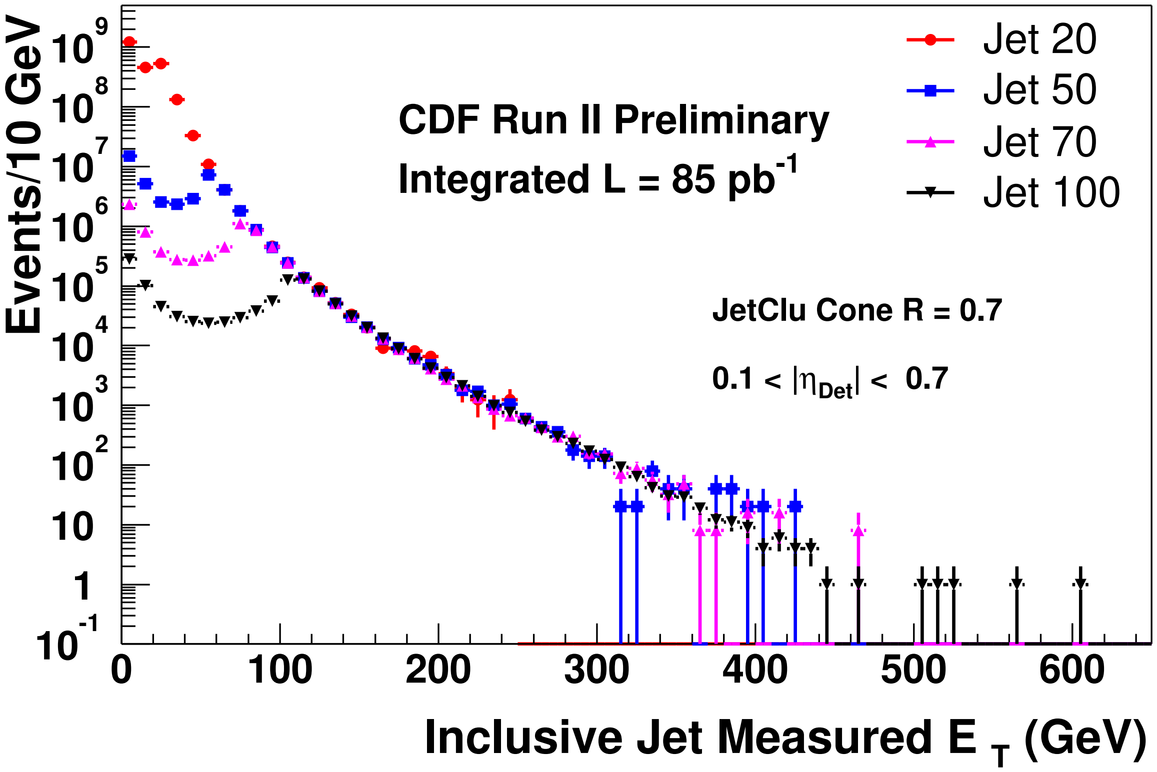
⇒ With $L_{int}^{RunII} \sim L_{int}^{RunI}$ already more jets and $\sim$ 200 GeV increase in E_T range.

RunII Inclusive Jet Cross Section

Preliminary measurement to be compared to RunI results → same techniques used:

- Cone algorithm (JetClu) with $R = 0.7$
- Central jets ($0.1 < |\eta_D| < 0.7$)
- Jet energy corrections.

Raw Inclusive Jet E_T Distribution (Trigger PS Corr.):

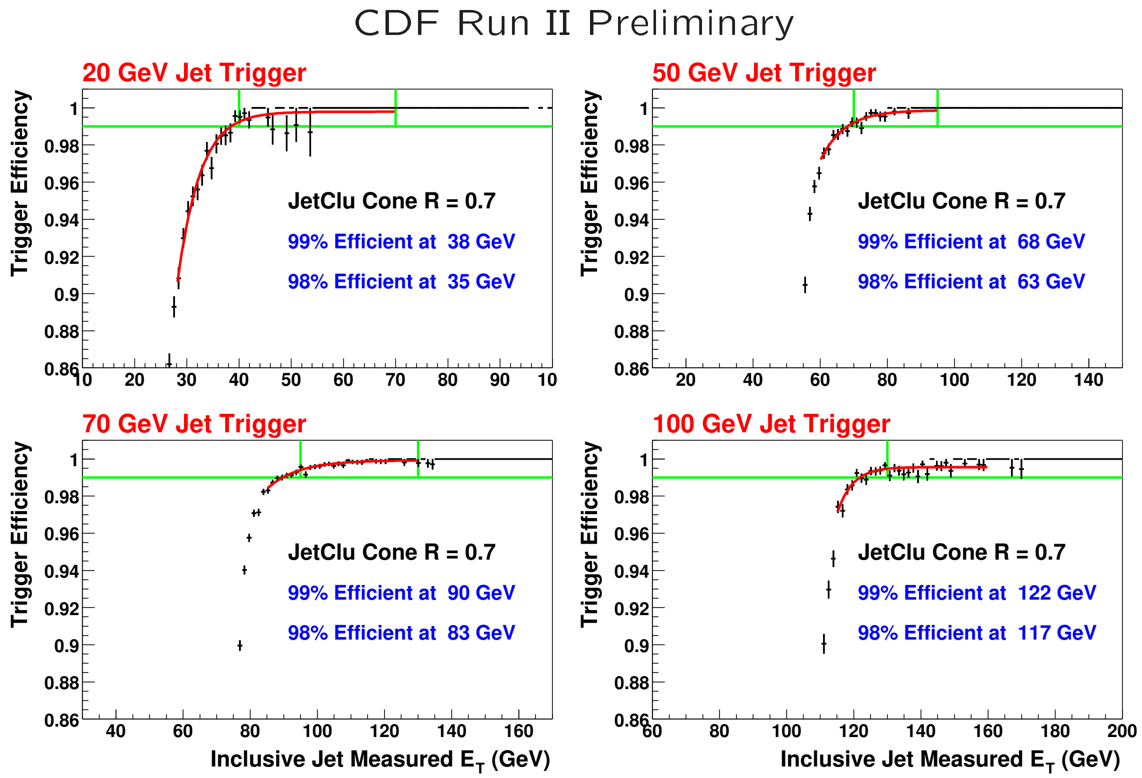


⇒ ∼ 8 orders of magnitude !

⇒ Highest E_T jets ever produced (RunI: ∼ 400 GeV) !

Sample Selection

- Select "good" events:
  - At least one jet with $E_T > E_T^{cut}$.
  - Additional cuts against cosmics.
- Require fully efficient trigger ($> 99\%$):
  - E_T^{cut} from trigger efficiency curves.
  - Different ranges of the E_T spectrum from different trigger samples.

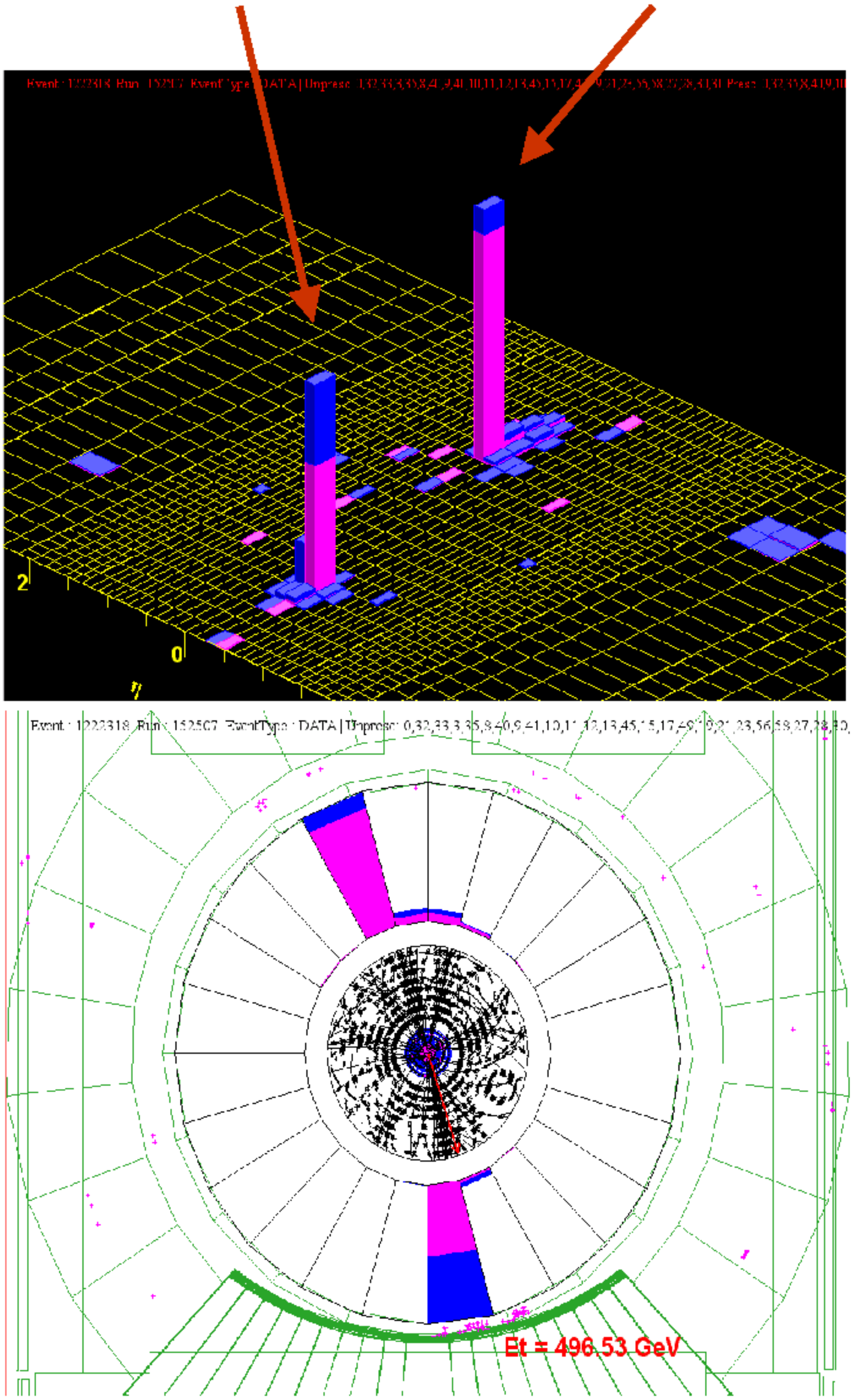


Highest E_T Jets

Run 152507 Event 1222318

Jet 2: E_T = 569 GeV (Unc.) η_D = -0.19

Jet 1: E_T = 608 GeV (Unc.) η_D = 0.43

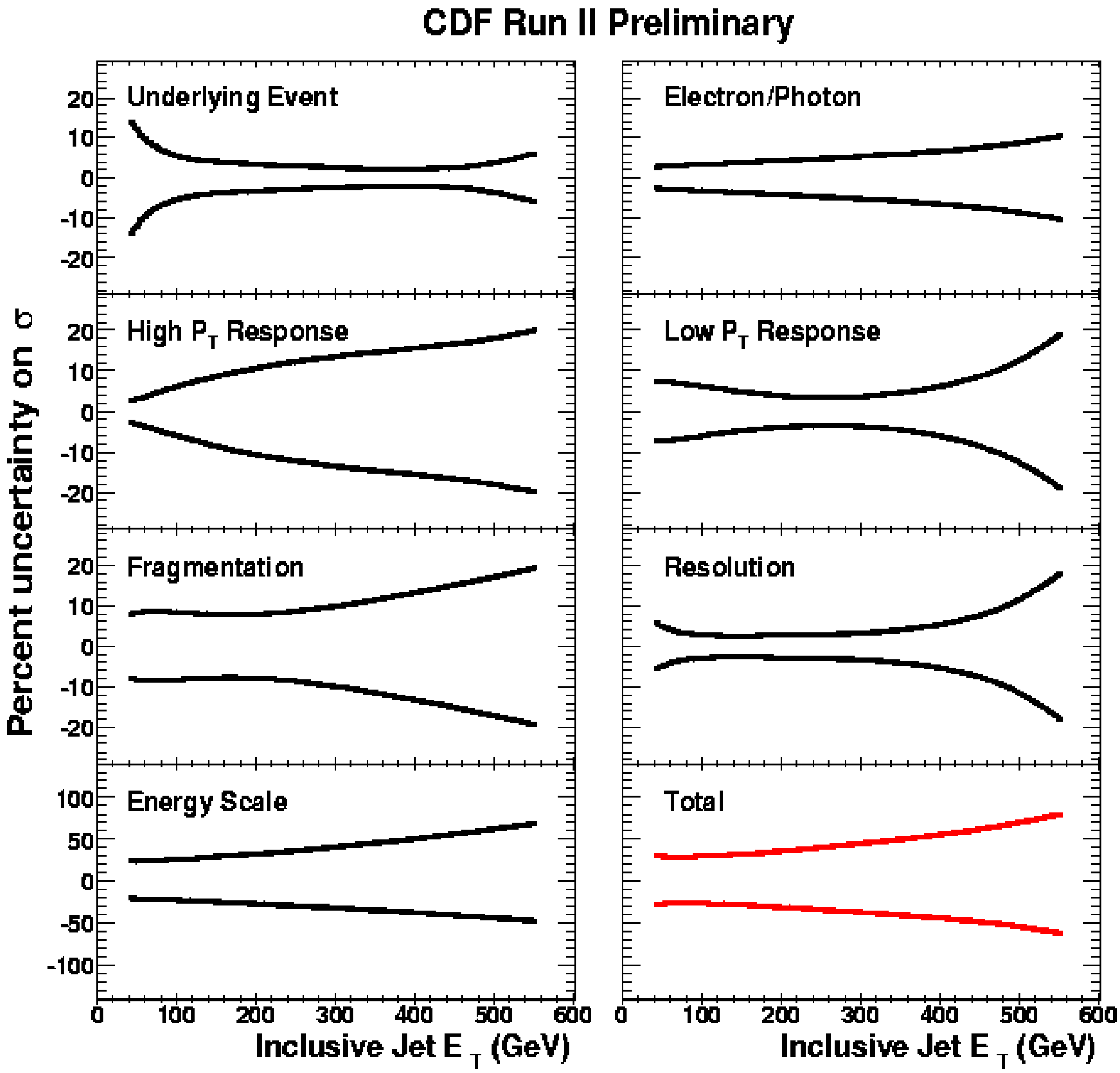


Cross Section: $\frac{d^2\sigma}{dE_T \cdot d\eta} = \frac{N^{jet}}{\Delta E_T \cdot \Delta\eta_D \cdot L_{int}}$

Unsmearing procedure:

$\Rightarrow$ Absolute jet E_T correction, jet resolution unsmearing.

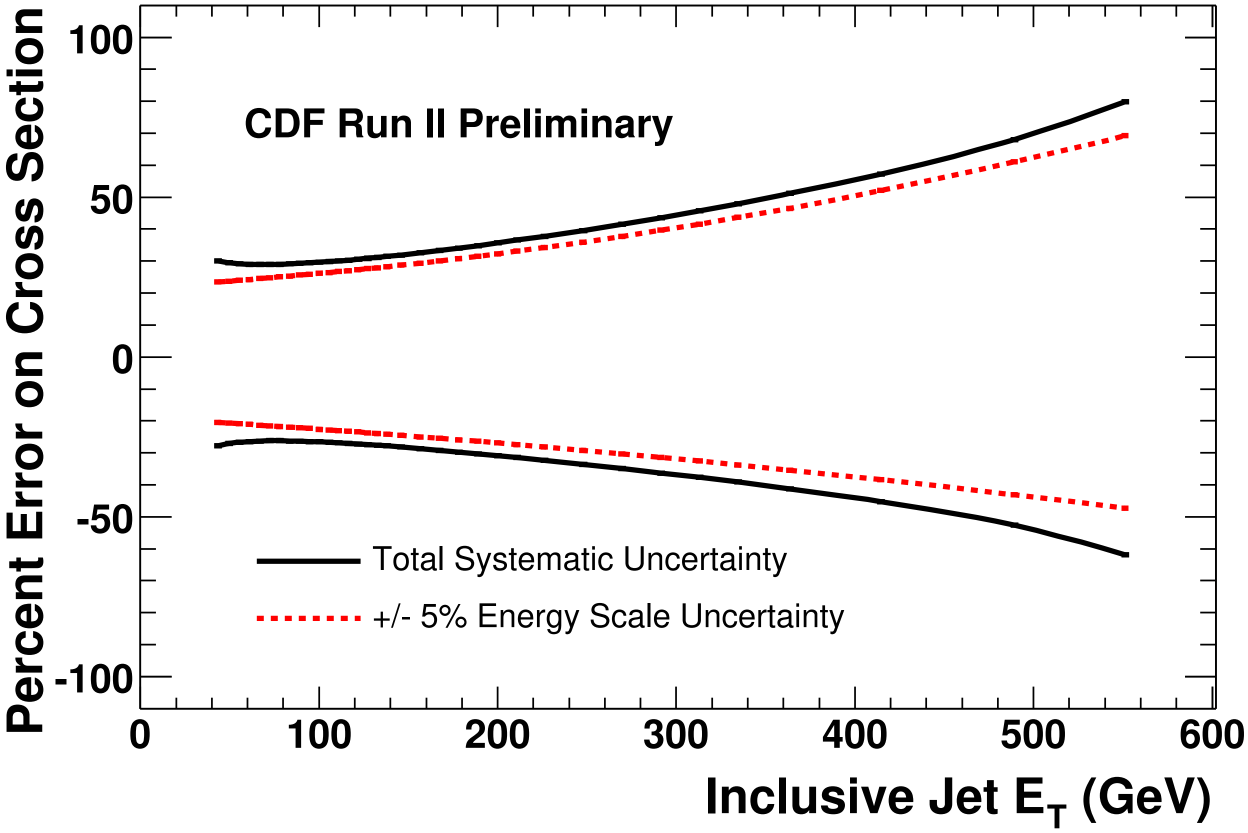
Systematic Uncertainties:



Additional 6% from L_{int} not shown.

$\Rightarrow$ Energy scale dominant uncertainty.

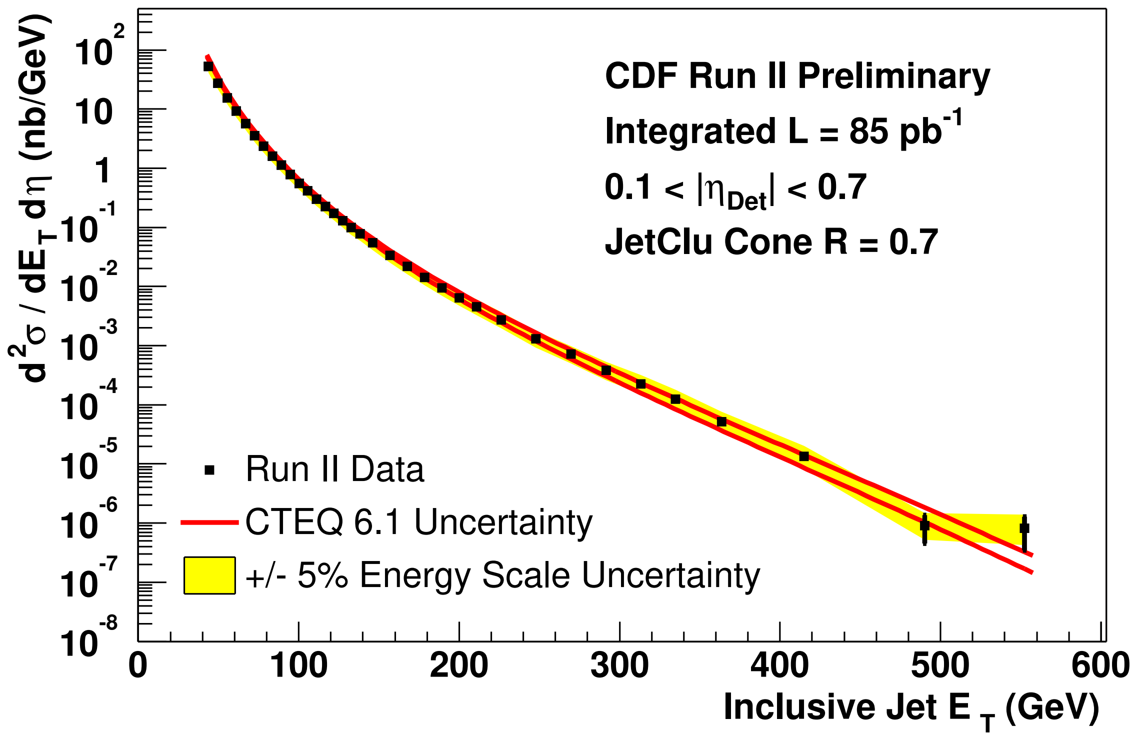
More on Systematic Uncertainties

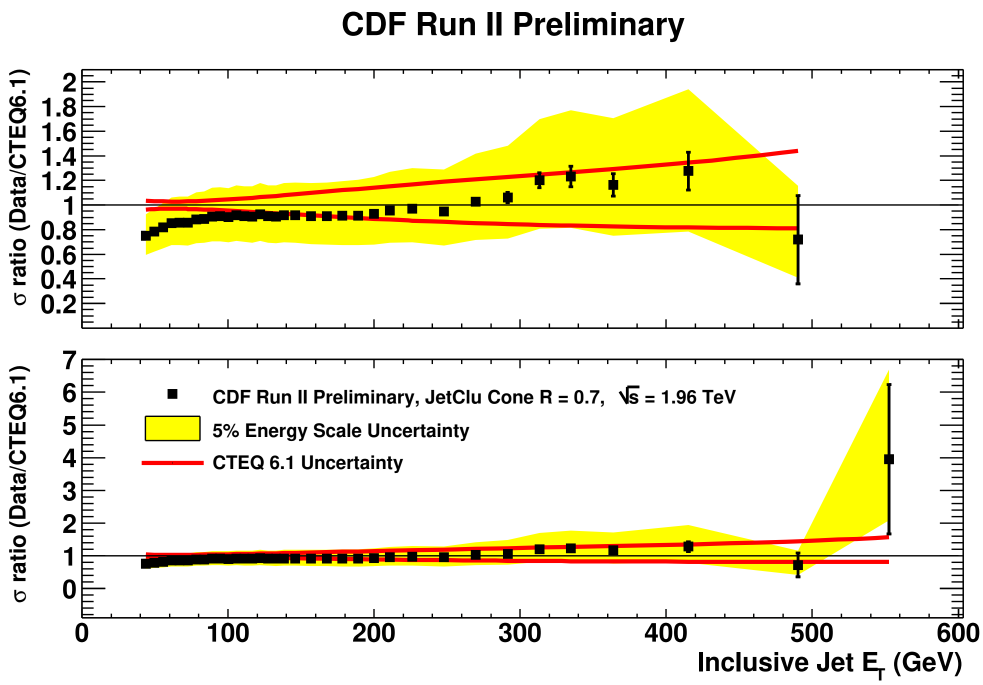


- Total systematic error obtained by adding all sources in quadrature.
- Energy scale uncertainty <u>dominant</u> source.

Results: Comparison to QCD Predictions

NLO pQCD ($\mu = E_T^J/2$) & CTEQ6.1 PDFs.



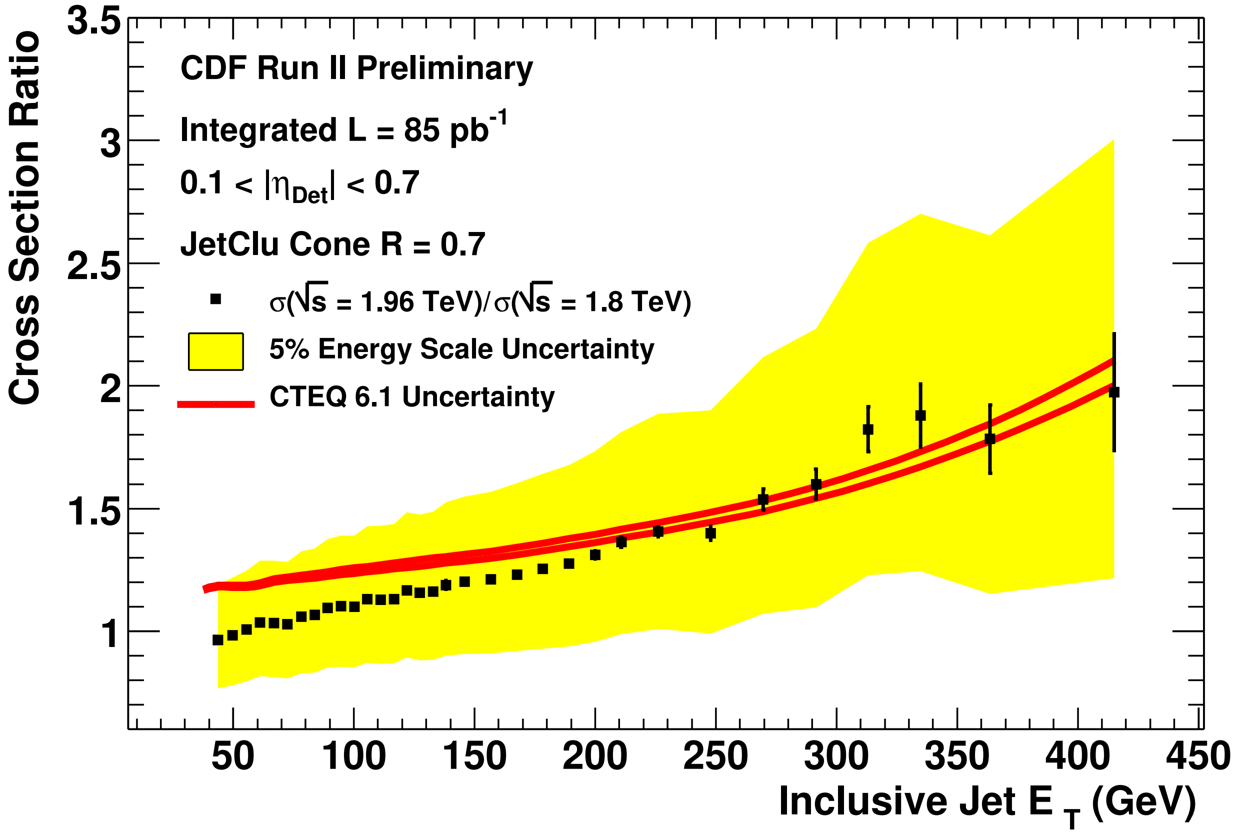


Largest theoretical uncertainty from PDFs (high x gluon).

⇒ Reasonable data-theory agreement within uncertainties.

Results: Comparison to RunI Data

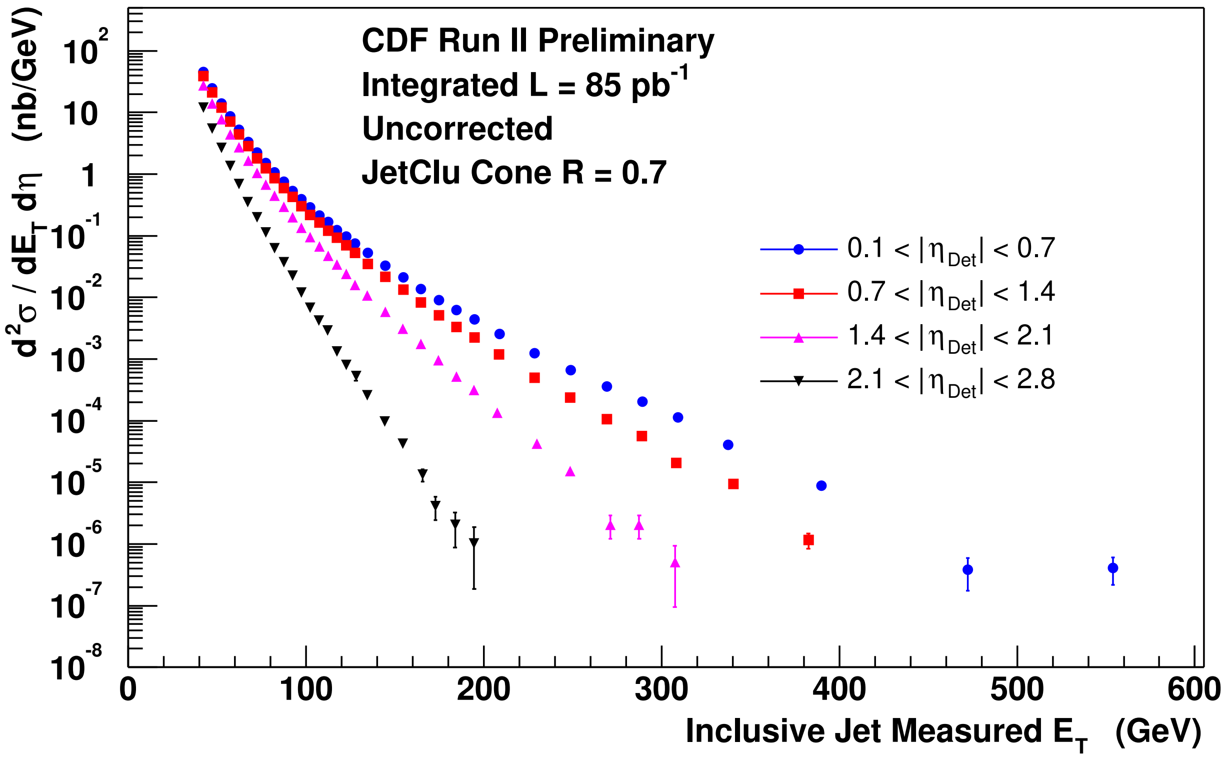
$\sigma(RunII)/\sigma(RunI)$



- Higher σ in RunII due to $\sqrt{s}$: 1.8 TeV $\rightarrow$ 1.96 TeV.
- Systematic errors mostly cancel in the ratio, but RunII jet energy scale uncertainty is at the moment dominant.
- Reasonable data-theory agreement (NLO pQCD & CTEQ6.1 PDFs) within uncertainty bands (especially for E_T above 200 GeV).
- Behavior below 200 GeV to be better understood.

Future Plans: Extending the Analysis to High η

Inclusive jet σ (not unfolded) in different η ranges:



- Forward measurements allow to constrain the gluon PDF at high x (a region where it is not well probed).
- Powerful study in order to distinguish between conventional and non-conventional explanations for any potential cross section excess in the central region.
- More work needed in order to better understand the new plug calorimeter jet response.

Summary & Plans

- A preliminary measurement of the inclusive jet cross section has been performed in CDF RunII.
- Same techniques adopted as the ones used in RunI.
- Reasonable agreement between data and NLO theory (CTEQ6.1) within uncertainties.
- Measurement error dominated by systematics in jet energy scale; theoretical error dominated by high x gluon PDF uncertainty.
- Future plans for upcoming analyses:
  - reduce systematics on E scale
  - use standard RunII jet algorithms (MidPoint, K_T)
  - extend analysis to forward regions (up to $|\eta_D| = 3$).