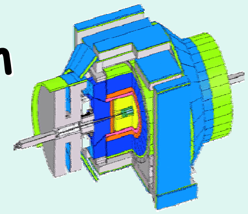
Inclusive Jet Production using the k_T algorithm



Olga Norniella
IFAE-Barcelona

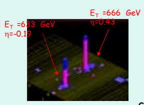
Results on inclusive jet production using the k_T algorithm in proton-antiproton collisions at $\sqrt{s}$ = 1.96 TeV are presented, based on 1 fb^{-1} of CDF Run II data. The measurements are carried out for jets with $p_T^{jet} > 54$ GeV/c in five different jet rapidity regions up to $|y^{jet}| = 2.1$. The measured cross sections are corrected to the hadron level and compared to next-to-leading order perturbative QCD predictions (NLO pQCD)

Physics motivation

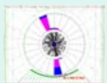
• The measurement of the inclusive jet cross section probes distances down to 10^{-19} m and constitutes a stringent test of pQCD over more than eight orders of magnitude

Event with the highest dijet mass

Dijet Mass ≅ 1.4 TeV/c^2

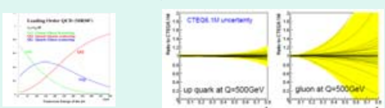


Calorimeter "Lego" Plot



CDF central tracking chamber and Calorimeter (r-ϕ view)

• At high p_T^{jet} the measured cross section is sensitive to new physics but suffers from the limited knowledge of the gluon distribution in the proton

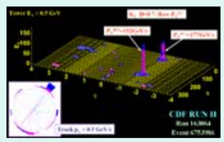


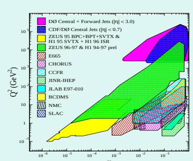
Gluon-Gluon and Gluon-Quark contributions are important at high energy. However, the Gluon parton distribution function (PDF) at high-x is not well known

Jet measurements in the forward region

• Forward jet measurements allow to constrain the gluon PDF at high-x in a p_T^{jet} range where new physics search for compositeness is not compromised

This jet configuration allows to test high-x partons





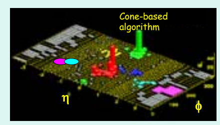
Tevatron jet production probes the region at high Q^2 , high-x

Jet algorithms

• A precise jet search algorithm is necessary to compare the measurements with the theory

✓ Run I cone-based algorithm presented sensitivity to soft and collinear radiation

✓ Cone-based algorithms need a experimental prescription to merge/split overlapped jets



Overlapping situation, red cluster, between jets defined with a cone-based algorithm.

✓ Theory suggests to separate the jets according to their relative momentum -> **k_T algorithm**

CDF Run II measurements with 1fb^{-1}

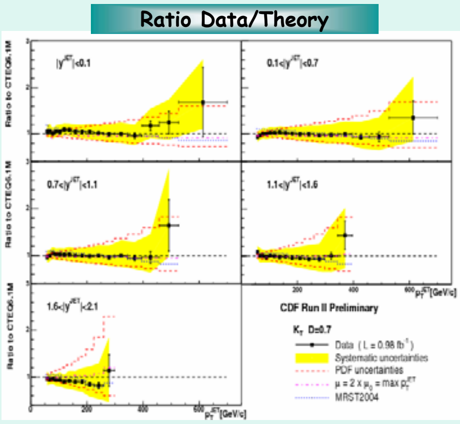
• The k_T algorithm separates jets according to their relative p_T

$$d_{ij} = \min(P^2_{T,i}, P^2_{T,j})\frac{\Delta R^2}{D^2} \qquad d_i = (P_{T,i})^2$$

✓ D parameter approximately controls the size of the jet

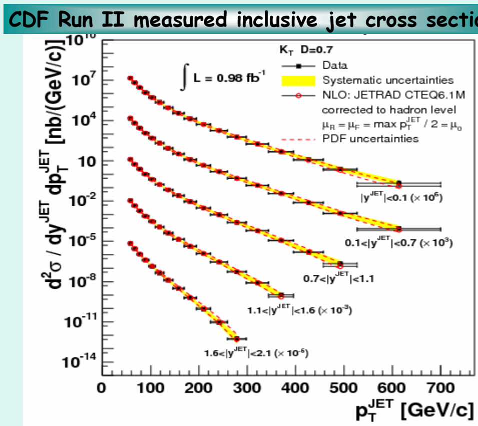
✓ The terms d_i cluster particles along $p\bar{p}$ beam remnants

Ratio Data/Theory



Ratio Data/theory as a function of p_T^{jet} in different y^{jet} regions. The yellow bands show the systematic uncertainties on the data. The red dashed lines indicate the PDF uncertainties on the theoretical predictions

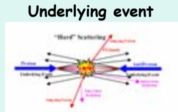
CDF Run II measured inclusive jet cross section



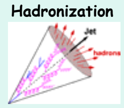
Measured inclusive jet production cross section at the hadron level using k_T algorithm in five rapidity regions up to $|y^{jet}| = 2.1$. The measurements are compared to pQCD NLO predictions.

• The final measurements are compared to NLO predictions. The theoretical predictions are corrected for underlying event and fragmentation contributions

Underlying event



Hadronization

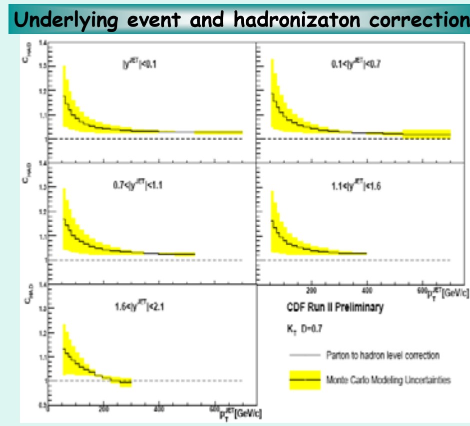


• The final measurements are corrected to the hadron level

• The systematic uncertainties on data are dominated by ± 2-3 % uncertainty on the jet energy scale

• The gluon distribution is the biggest contribution on the PDF uncertainties

Underlying event and hadronizaton corrections



Magnitude of the parton-to-hadron correction, C_{HAD} , used to correct the NLO pQCD predictions. The shaded band indicates the quoted Monte Carlo modeling uncertainty

Good agreement with theory

Forward region measurements will allow to reduce the PDFs uncertainties