high-transverse-momentum charged-hadron production at the Tevatron

CDF Run II, $\sqrt{s} = 1.96$ TeV

- Observables:
  - incl. charged particle $p_T$
  - trans. energy sum $\sum E_T$
  - $C_{<p_T>}$ vs $N_{ch}$
- What is new?
- Tracking system:
  - inner silicon
  - outer drift chamber (COT)
  - trans. mom resolution: $\sigma(p_T)/p_T \simeq 0.1\% p_T/\text{GeV}$
- Minimum bias trigg. - BBC
- Systematic uncertainties.
- Cuts:
  - $p_T \geq 0.4$ GeV, $\eta \leq 1$
- Comparison with CDF data from 1988.
  - power-law modeling:

$$f = A \left( \frac{p_0}{p_T + p_0} \right)^n$$

$$A \left( \frac{p_0}{p_T + p_0} \right)^n + B \left( \frac{1}{p_T} \right)^s$$
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FIG. 5: Left upper plot: the track $p_T$ differential cross section is shown. The error bars describe the uncertainty on the data points. This uncertainty includes the statistical uncertainty on the data and the statistical uncertainty on the total correction. A fit to the functional form in Eq. 8 in the region of $0.4 < p_T < 10 \text{ GeV/c}$ is also shown for the data used in the 1988 analysis [9] at the center of mass energy of 1800 GeV (dashed line). A fit with a more complicated function (Eq. 9) is shown as a continuous line. The fit to the 1800 GeV data is scaled by a factor 2 to account for the different normalization. In the plot at the bottom the systematic and the total uncertainties are shown. The total uncertainty is the quadratic sum of the uncertainty reported on the data points and the systematic uncertainty. The right-hand-side plots show the same distributions but with a logarithmic horizontal scale.
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[CDF Run II, $\sqrt{s} = 1.96$ TeV]

[0904.1098], 29 Apr 2009
Albinio, Kniehl, Kramer

[1003.1854] 9 Mar 2010
Arleo, d’Enterria, Yoos

[1003.2963] 15 Mar 2010
M.Cacciari, G.Salam, Strassler

[1003.3433], 17 Mar 2010
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NLO QCD, using PDF and FF (fragm. functions)
• FF: AKK08, DSS, HKNS
• ren. and fact. scale:
  $\mu = k_{pT}, \mu_f = k_{f_{pT}}$, $k, k_f = 0.5, 1, 2$
• PDF: CTEQ6.6M, MSTW2008, HERAPDF0,1
• Final state hadron's mass effects.
  gluon FF - less constrained then quark
  “have no left-over adjustable parameters”
• Factorization breaking in high-transverse-momentum charged-hadron production at the Tevatron?
• CMS ($p_T < 4$) GeV?
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[CDF incl. jet production vs CDF incl. charge particle]$
\downarrow$
jet = single hadron

CDF charged particle spectra within jets for a dijet mass of

$200 - 260 \text{ GeV}$
\downarrow
$\rho_{t,\text{jet}} \sim 100 \text{ GeV}$
\downarrow
0.1% jets contain hadron carrying of jet $90\%$ mom.

- BSM physics?
Large $x$-section, ionising (electric or magnetic charge or large dipole mom.), not affect the di-jet fragm.
M.Cacciari, G.Salam, Strassler

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Figure 3: Figure 20 of ref. [12], by the CDF Collaboration, showing the inclusive distribution of momentum fraction \( x \) of charged particles in cones around each of the two jets axes in dijet events at the Tevatron (Run I).
CDF incl. jet production vs CDF incl. charge particle
\[
\downarrow
\]
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Questions:

- What kind of problems we might encounter measuring high-pt charged particle in CDF?
- Can we check how these high-pt charged particle events look like?
- [1005.1078] May 2010, contribution of weak interaction? (I am checking it.)
Published CDF data on the $p_T$ distribution of charged particles in Min-Bias collisions (ND) at 1.96 TeV compared with PYTHIA Tune A

**No excess at large $p_T$!**

50 GeV/c!

**CDF consistent with CMS and UA1!**

$\Delta x_T = 2T \cdot \sqrt{s}$

This is ok
everyone makes mistakes - important is to understand what is going on!
This is ok everyone makes mistakes - even MC authors ;). Important to check your analysis using more then one MC generator. And answer questions like: Is the effect I’m seeing due to different models, or approximations, or is it a bug?