Colour-dipole cascades involving initial-state partons

[MCnet meeting in Lund]

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- **Extension of the Colour Dipole Model (CDM): final–initial and initial–initial dipole radiation pattern.**
- **Survey of first dipole-shower results.**

.. based on arXiv:0712.3913.

[a] SHERPA authors: T. Gleisberg, S. Höche, F. Krauss, M. Schönherr, F. Siegert, S. Schumann, J. W.

http://www.sherpa-mc.de/

Parton showers ... recent developments.

- New physics challenges (LHC), rewrites of PYTHIA/HERWIG codes **plus**
- enormous progress in the techniques of combining (N)LO calculations with parton showers led to an **intensive overhaul of existing formulations**.
- Efforts aim at ...
  - *achieving better analytic control.*
  - *gaining better understanding of systematic uncertainties.*
  - *providing (easier/more consistent) merging/matching with LO/NLO calculations.*
  - *going beyond common approximations (LL, large N_{C}, include small-x)?*
- New $1 \to 2$ **splittings** showers, for PYTHIA and HERWIG, and new shower formulation based on Catani–Seymour dipole factorization.
- Still other ways to identify/pick leading logs of multiple QCD emissions? **Yes. $2 \to 3$ splittings.** ➡ VINCIA. And, of course, the successful Lund CDM as implemented in **ARIADNE**.

The Colour Dipole Model (CDM)

Alternative to conventional Altarelli–Parisis parton showers // same principles.

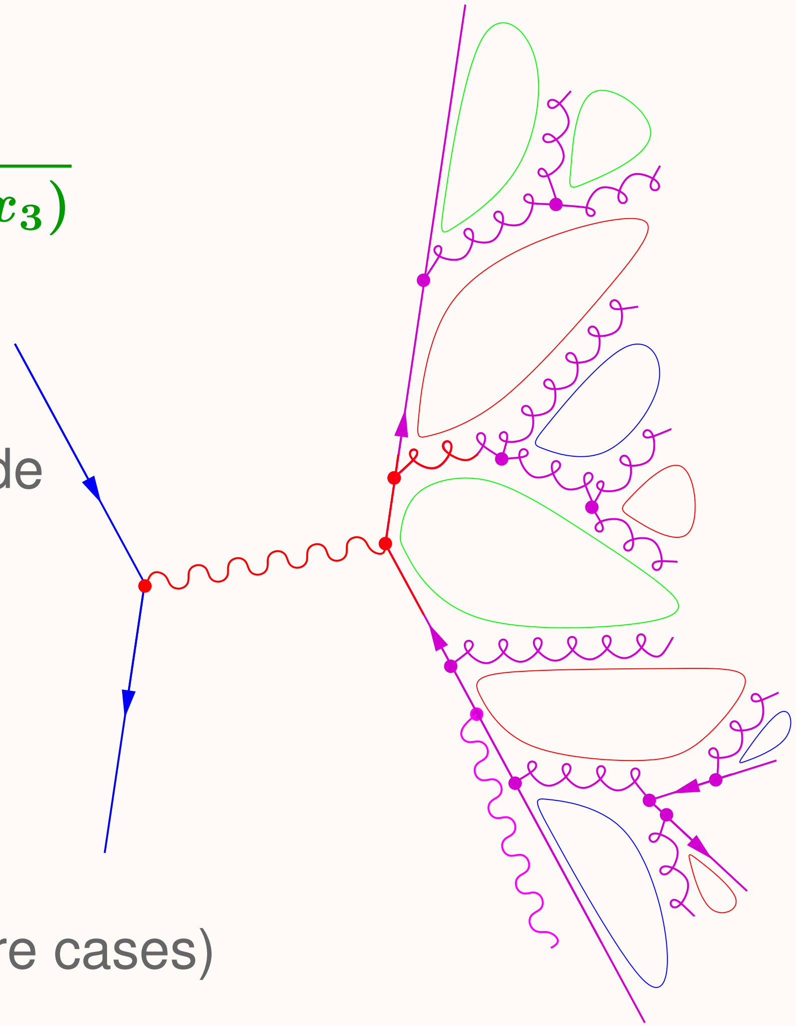
- soft gluons intrinsically correct
- colour coherent emission

→ **Exponentiation of soft gluon limit**

- QCD antenna pattern

$$d\sigma = \frac{8\,\alpha_s}{3\,\pi}\frac{d\omega_g}{\omega_g}\,dy_g = \frac{4\,\alpha_s}{3\,\pi}\frac{dx_1 dx_3}{(1-x_1)(1-x_3)}$$

corrigible for hard bremsstrahlung (spin!)
recall PS: ME corr. + conar conditions



- semiclassical probabilistic picture for dipole cascade

  $q\bar{q}$ emits g, in turn $q'g\bar{q}'$ may emit softer g'
  $q'\bar{q}'$ contribution neglected ($1/N_C^2$ supp.)

- onshell kinematics; no momentum reshuffling
- emitters almost independent of rest of tree

- $2 \longrightarrow 3$ splittings somewhat more complicated (more cases)
- gluon splitting not naturally, easily included

CDM for timelike evolution

Pioneering works: **Azimov, Dokshitzer, Khoze, Troyan / Gustafson, Pettersson, Andersson, Lönnblad**

- Splitting functions (g emit): x_i inv E-fracs; AP limit**!**

$$\frac{d\sigma_{2\to3}}{dx_1 dx_3} = \frac{2\,\alpha_s}{3\,\pi}\left[1+\frac{1}{8}\Theta(g_{1,3})\right]\frac{x_1^{2+\Theta(g_1)}+x_3^{2+\Theta(g_3)}}{(1-x_1)(1-x_3)}$$

- Evolution variables

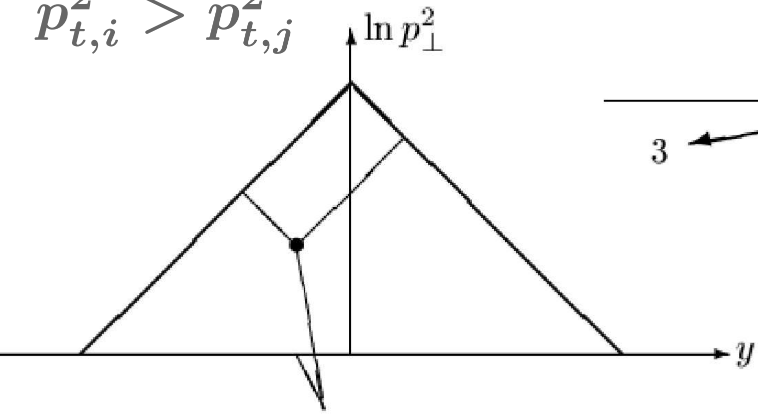
$$p_t^2 = M^2(1-x_1)(1-x_3)\,, \quad y = \frac{1}{2}\ln\frac{1-x_1}{1-x_3} \quad \Rightarrow \quad \boxed{d\sigma_{2\to3} \propto \alpha_s \frac{dp_t^2}{p_t^2}dy}$$

- Sudakov exponentiation

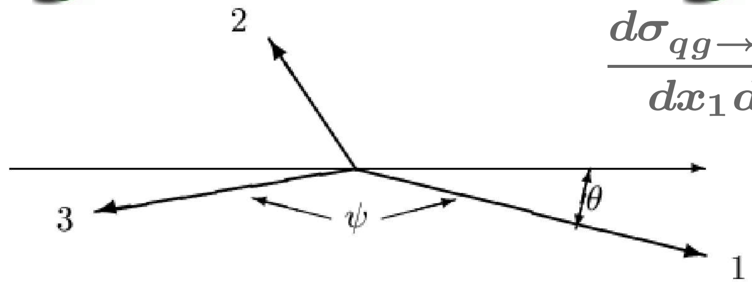
$$\frac{dP}{dp_t^2 dy} = \frac{d\sigma_{2\to3}}{dp_t^2 dy}\exp\left(-\int_{p_t^2}^{p_{t,\max}^2} dk_t^2 \int_{y_{\min}(k_t^2)}^{y_{\max}(k_t^2)} dy'\,\frac{d\sigma_{2\to3}}{dk_t^2 dy'}\right)$$

- Ordering

$p_{t,i}^2 > p_{t,j}^2$



- Recoils

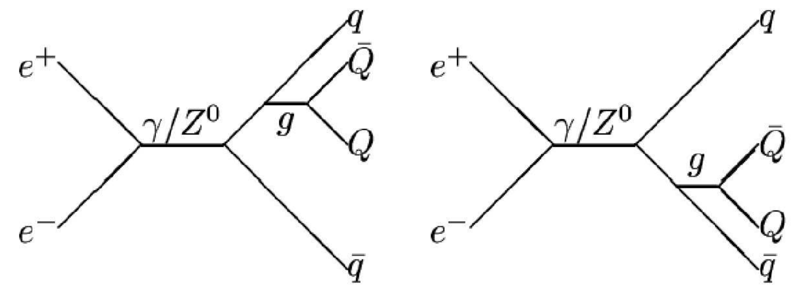


$q\bar{q}$ Kleiss

qg, gg minimize $p_\perp$'s

- Gluon splitting (competition)

$$\frac{d\sigma_{qg\to qQ\bar{Q}}}{dx_1 dx_3} = \frac{N_F\,\alpha_s}{8\,\pi}\,\frac{(1-x_2)^2+(1-x_3)^2}{1-x_1}$$

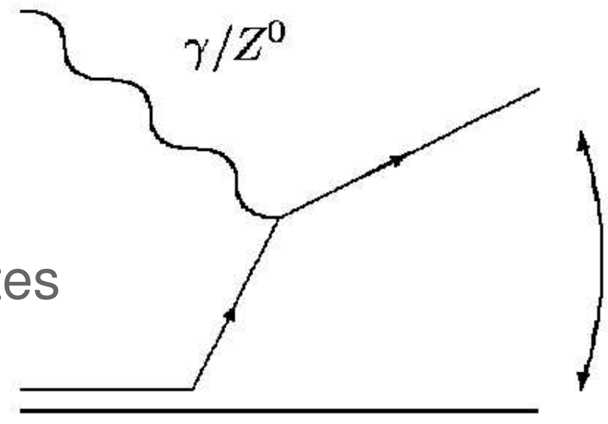


Lund CDM for DIS & hadron–hadron collisions

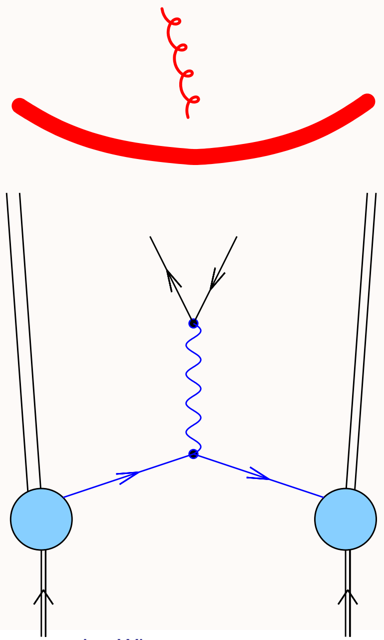
Bo Andersson et al. Z. Phys. C 43 (1989) 625.

QCD cascade is not divided in IS and FS.

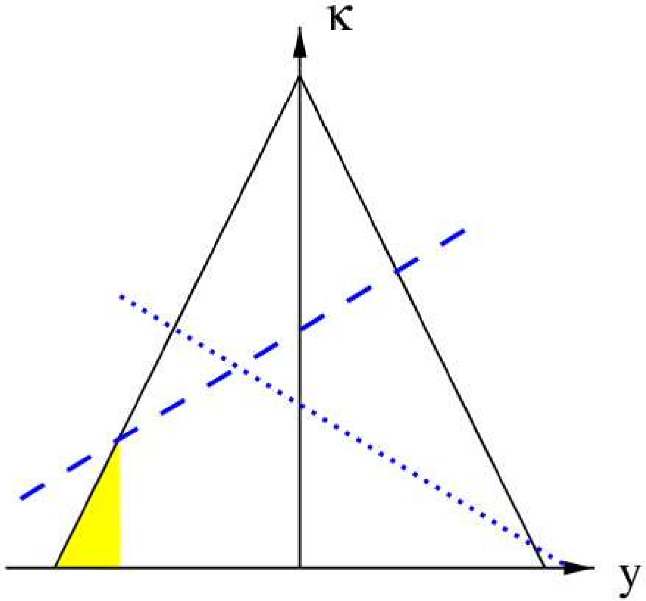
- Struck quark pointlike. Hadron remnant extended.
- Suppression of the emission of small wavelengths from extended antennae.
- Only a fraction of remnant's light-cone momentum participates in emission of $p_\perp$ (extra tunable parameter).



Leif Lönnblad: Small-x effects in $W+$ jets at the Tevatron (CERN-TH/95-212)



- Boson not intrinsically coupled.
- Boson's transverse momentum through recoil transfer according to a phase-space measure.
- 1st emission also ME corrected.



Gluon emission from colour dipoles

- **Differential cross section for a $\tilde{k}\tilde{\ell} \to kg\ell$ dipole splitting:**

$$d\mathcal{P}_{\tilde{k}\tilde{\ell}\to kg\ell} \equiv \frac{d\sigma_{0\to kg\ell}}{d\sigma_{0\to\tilde{k}\tilde{\ell}}} = \frac{\alpha_s(\mu_{\rm R})}{2\pi}\, D_{\tilde{k}\tilde{\ell}\to kg\ell}(p_\perp, y)\,\frac{dp_\perp^2}{p_\perp^2}dy$$

- **Studying the pure final-state case:** $\tilde{k} = k = f, \quad \tilde{\ell} = \ell = \bar{f}', \quad f = q, g$

$$d\Gamma_{0\to fg\bar{f}'} \simeq d\Gamma_{0\to f\bar{f}'}\,\frac{C\alpha_s}{2\pi}\,\hat{D}_{f\bar{f}'\to fg\bar{f}'}(p_\perp, y, \varphi)\;dp_\perp^2\,dy\,\frac{d\varphi}{2\pi}$$

using dipole phase-space and matrix-element factorization:

$$d\Phi_{0\to fg\bar{f}'}(p_0;\, p_f, p_g, p_{\bar{f}'}) = d\Phi_{0\to f\bar{f}'}(\tilde{p}_0 = p_0;\, \tilde{p}_f, \tilde{p}_{\bar{f}'})\,\frac{ds_{fg}\,ds_{g\bar{f}'}}{16\pi^2\,M^2}\,\frac{d\varphi}{2\pi}$$

$$|\mathcal{M}_{0\to fg\bar{f}'}|^2 \simeq 8\pi\alpha_s\,C\,\hat{D}_{f\bar{f}'\to fg\bar{f}'}\,|\mathcal{M}_{0\to f\bar{f}'}|^2$$

$\Rightarrow$ $D_{f\bar{f}'\to fg\bar{f}'}(p_\perp, y) = \xi\,Cp_\perp^2\,\hat{D}_{f\bar{f}'\to fg\bar{f}'}(p_\perp, y)$

- **Instead of redefining ISR in terms of FSR,**

$$\tilde{k}\,\tilde{\ell} \to \begin{cases} \tilde{k}\,g_{\rm f}\,\tilde{\ell} & : \quad \text{gluon emission}\,, \\ q\,g_{\rm i}\,\tilde{\ell} & : \quad \text{quark emission, provided that } \tilde{k} = \bar{q}_{\rm i}\,, \\ \tilde{k}\,g_{\rm i}\,\bar{q} & : \quad \text{antiquark emission, provided that } \tilde{\ell} = q_{\rm i}\,. \end{cases}$$

Gluon emission from colour dipoles

Generalizing the kinematic framework:

- *momentum balances,* $\varsigma_0 = \pm 1$ $(+$ *for II dipoles*$)$, $\tilde{\varsigma}_{\tilde{m}}, \varsigma_m = \pm 1$ $(+$ *outgoing*, $-$ *incoming*$)$,

$$-\varsigma_0\,\tilde{p}_0 \;=\; \tilde{\varsigma}_{\tilde{k}}\,\tilde{p}_{\tilde{k}} + \tilde{\varsigma}_{\tilde{\ell}}\,\tilde{p}_{\tilde{\ell}}\,, \qquad -\varsigma_0\,p_0 \;=\; \varsigma_k\,p_k + \varsigma_g\,p_g + \varsigma_\ell\,p_\ell$$

- *dipole invariant masses,*

$$\tilde{p}_0^2 \;=\; p_0^2 \;=\; M^2 \;=\; s_{kg} + s_{g\ell} + s_{k\ell} \;=\; s_{kg\ell} \;=\; -Q^2$$

- *invariant energy fractions and parton-system invariant masses,*

$$x_m \;=\; \frac{2\,p_m p_0}{p_0^2}\,, \qquad s_{mn} \;=\; (\varsigma_m\,p_m + \varsigma_n\,p_n)^2\,, \quad s_{mnr} \;=\; (\varsigma_m\,p_m + \varsigma_n\,p_n + \varsigma_r\,p_r)^2$$

Lorentz invariant evolution variables:

$$p_\perp^2 \;=\; \left|\frac{s_{kg}\,s_{g\ell}}{s_{kg\ell}}\right|\,, \qquad y \;=\; \frac{1}{2}\,\ln\left|\frac{s_{g\ell}}{s_{kg}}\right|\,; \qquad |s_{kg}| \;=\; |M|\,p_\perp e^{-y}\,, \quad |s_{g\ell}| \;=\; |M|\,p_\perp e^{+y}$$

Gluon emission from colour dipoles

- **Similarly apply to II dipoles:**

$$d\sigma_{\bar{\imath}' i(gi)\to 0g(0q)} \simeq d\sigma_{\bar{\imath}' i(\bar{q}i)\to 0} \left(\frac{dy_{\rm cm}}{d\tilde{y}_{\rm cm}}\right) \frac{f_{\bar{\imath}'(g)}(x_\pm,\mu_{\rm F})\, f_i(x_\mp,\mu_{\rm F})}{f_{\bar{\imath}'(\bar{q})}(\tilde{x}_\pm,\tilde{\mu}_{\rm F})\, f_i(\tilde{x}_\mp,\tilde{\mu}_{\rm F})} \frac{M^4}{s^2_{\bar{\imath}' i(g_{\rm i} i)}(p_\perp,y)}$$

$$\times \frac{\xi\, C\alpha_s}{2\pi}\, \hat{D}_{\bar{\imath}' i(\bar{q}_{\rm i} i)\to\bar{\imath}' gi(qg_{\rm i} i)}(p_\perp,y)\; dp_\perp^2\, dy$$

- $y_{\rm cm} = \ln(x_+/x_-)/2, \qquad \tilde{y}_{\rm cm} = \ln(\tilde{x}_+/\tilde{x}_-)/2$

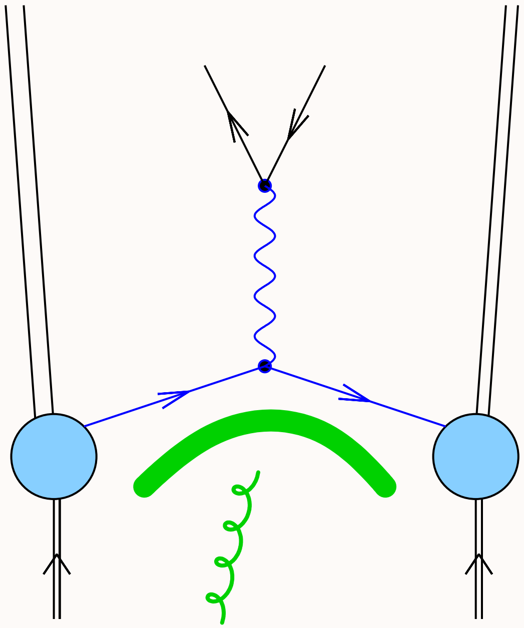
- **And to FI dipoles as well:**

$$d\sigma_{0i(0g)\to fg(f\bar{q})} \simeq d\sigma_{0i(0q)\to f} \frac{f_{i(g)}(x_\pm,\mu_{\rm F})}{f_{i(q)}(\tilde{x}_\pm,\tilde{\mu}_{\rm F})} \frac{Q^4}{\left[s_{fg(f\bar{q})}(p_\perp,y)+Q^2\right]^2}$$

$$\times \frac{\xi\, C\alpha_s}{2\pi}\, \hat{D}_{fi(fq_{\rm i})\to fgi(fg_{\rm i}\bar{q})}(p_\perp,y)\; dp_\perp^2\, dy$$

Colour dipole shower for hadronic collissions

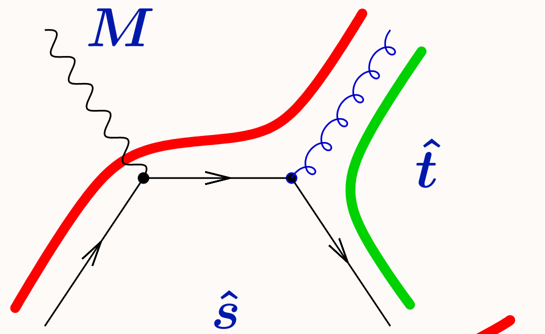
- Formulate IS emission completely perturbatively through colour dipoles (partly) spanned by incoming parton lines.
- Radiation that is associated to **initial**, **initial-final** and **final** colour lines.
- Keep beam remnants outside evolution as long as hadronization has not set in.



Construction principles of perturbative CDM:

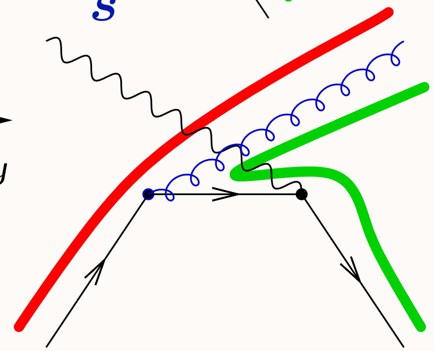
- new dipole types: $\bar{q}_{\rm i}q_{\rm i}$, $g_{\rm i}q_{\rm i}$, $g_{\rm i}g_{\rm i}$ and $q_{\rm f}q_{\rm i}$, $q_{\rm f}g_{\rm i}$, $g_{\rm f}g_{\rm i}$.
- radiation pattern in terms of $2 \to 3$ splittings.
- generalization of the kinematics setup to the new cases
  - *dipole phase-space factorization and invariant evolution variables*.
- *dipole ME factorization* → re-calculate or use crossing symmetry of FF dipole MEs or use antenna functions.
- probabilistic interpretation of Sudakov form factor based on dipole splitting cross sections.
- large $N_{\rm C}$ limit, onshell kinematics, for all ISR apply backward evolution.

Initial-state dipole evolution at a glance: $\bar{\imath}' i \longrightarrow \bar{\imath}' g i$

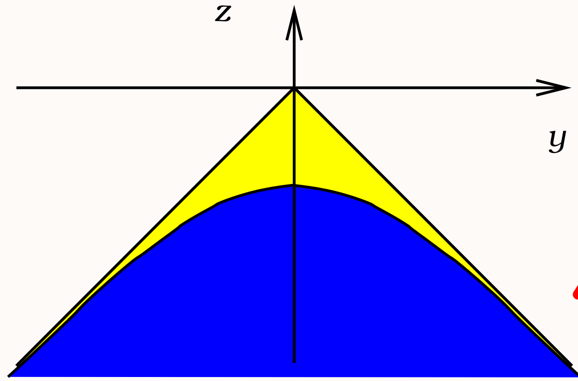


- Invariant transverse momentum and rapidity

$$p_\perp^2 = \left|\frac{s_{\bar{\imath}'g}\,s_{gi}}{s_{\bar{\imath}'gi}}\right| = \frac{\hat{t}\,\hat{u}}{M^2}\,, \qquad y = \frac{1}{2}\ln\left|\frac{s_{gi}}{s_{\bar{\imath}'g}}\right| = \frac{1}{2}\ln\frac{\hat{u}}{\hat{t}}$$



- Phase space, $a = \hat{s}_{\rm max}/M^2 \le S/M^2$



$$|y| \le \operatorname{arcosh}\frac{(a-1)M}{2p_\perp} \le \ln\frac{(a-1)M}{p_\perp} = \ln\frac{1}{z}$$

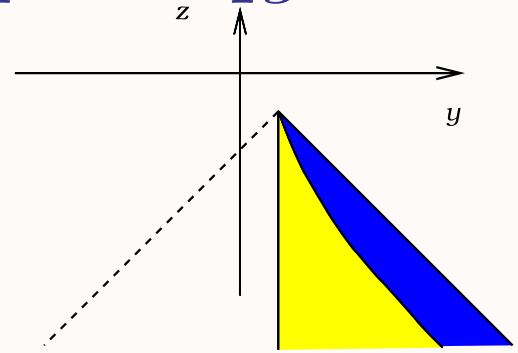
- Dipole splitting function for **gluon emission** off II dipoles, $x_{\bar{\imath}',i} = 1 + \frac{p_\perp}{M}\,e^{\pm y}$

$$D_{\bar{\imath}'i\to\bar{\imath}'gi}(p_\perp,y) = \frac{f_{\bar{\imath}'}(x_\pm,\mu_{\rm F})\,f_i(x_\mp,\mu_{\rm F})}{f_{\bar{\imath}'}(\tilde{x}_\pm,\tilde{\mu}_{\rm F})\,f_i(\tilde{x}_\mp,\tilde{\mu}_{\rm F})}\,\xi_{\{{F \atop A}\}}C_{\{{F \atop A}\}}\,\frac{x_{\bar{\imath}'}^{n_{\bar{\imath}'}}(p_\perp,y)+x_i^{n_i}(p_\perp,y)}{[x_{\bar{\imath}'}(p_\perp,y)+x_i(p_\perp,y)-1]^2}$$

$$\le \mathcal{N}_{\rm PDF}\,\xi_{\{{F \atop A}\}}C_{\{{F \atop A}\}}\left\{\begin{matrix}2\\ a+1\end{matrix}\right\} \equiv D^{\rm approx}_{\bar{\imath}'i\to\bar{\imath}'gi}(p_\perp,y)$$

$$n_{q,g} = 2,3; \qquad \left\{\begin{matrix}\ldots & \text{for quark dipoles}\\ \ldots & \text{else}\end{matrix}\right\}$$

Initial-state dipole evolution at a glance: $\bar{q}_{\rm i} i \longrightarrow q g_{\rm i} i$

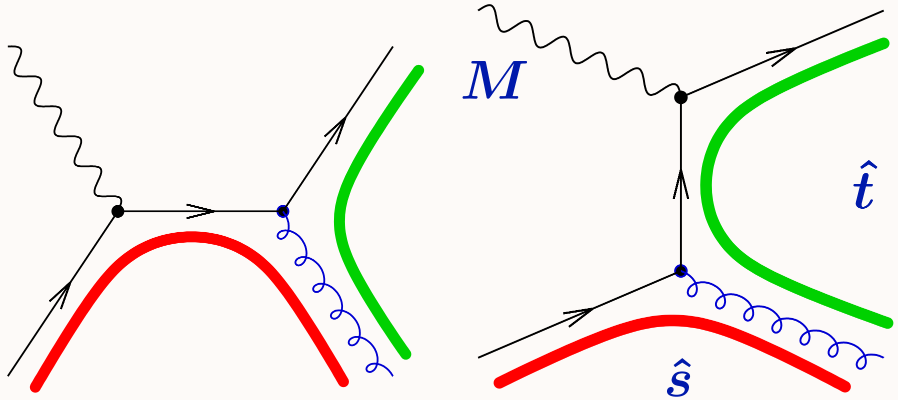


- Invariant transverse momentum and rapidity

$$p_\perp^2 = \left| \frac{s_{qg_{\rm i}}\, s_{g_{\rm i} i}}{s_{qg_{\rm i} i}} \right| = -\frac{\hat{t}\,\hat{s}}{M^2}\,, \qquad y = \frac{1}{2} \ln \left| \frac{s_{g_{\rm i} i}}{s_{qg_{\rm i}}} \right| = \frac{1}{2} \ln \frac{\hat{s}}{-\hat{t}}$$

- Phase space, $a = \hat{s}_{\max}/M^2 \le S/M^2$

$$\operatorname{arsinh} \frac{M}{2\,p_\perp} \le y \le \ln \frac{a\,M}{p_\perp} = \ln \frac{1}{z}$$



- Dipole splitting function for **quark emission** off II dipoles, $x_{q,i} = \mp 1 + \frac{p_\perp}{M}\, e^{\pm y}$

$$D_{\bar{q}_{\rm i} i \to q g_{\rm i} i}(p_\perp, y) = \frac{f_g(x_\pm, \mu_{\rm F})\, f_i(x_\mp, \mu_{\rm F})}{f_{\bar{q}}(\tilde{x}_\pm, \tilde{\mu}_{\rm F})\, f_i(\tilde{x}_\mp, \tilde{\mu}_{\rm F})}\, T_R\, \frac{x_q^2(p_\perp, y) + x_i^{n_i}(p_\perp, y)}{[1 + x_q(p_\perp, y)]^2}$$

$$\le \mathcal{N}_{\rm PDF}\, T_R \left\{ \begin{matrix} 2 \\ a+1 \end{matrix} \right\} \equiv D^{\rm approx}_{\bar{q}_{\rm i} i \to q g_{\rm i} i}(p_\perp, y)$$

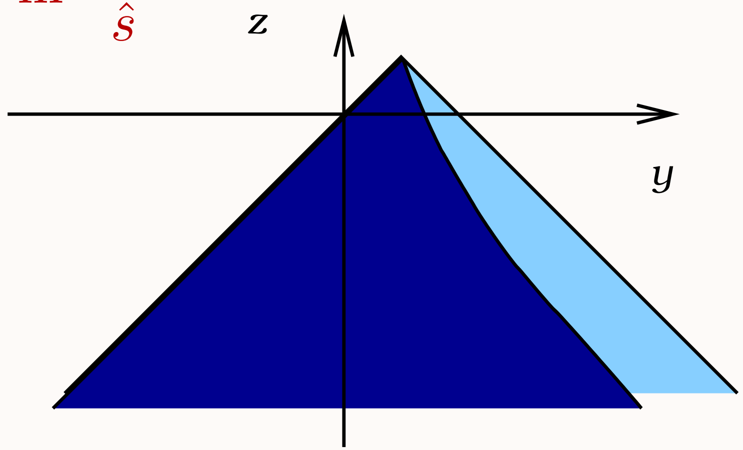
$n_{q,g} = 2, 3;$

$\left\{ \begin{matrix} \ldots & \text{for quark dipoles} \\ \ldots & \text{else} \end{matrix} \right\}$

Final–initial dipole evolution at a glance: $fi \to fgi$

- Invariant transverse momentum and rapidity

$$p_\perp^2 = \left|\frac{s_{fg}\, s_{gi}}{s_{fgi}}\right| = \frac{\hat{s}\,\hat{t}}{-Q^2}\,, \qquad y = \frac{1}{2}\ln\left|\frac{s_{gi}}{s_{fg}}\right| = \frac{1}{2}\ln\frac{-\hat{t}}{\hat{s}}$$



- Phase space, $\quad a = \hat{s}_{\max}/Q^2 \le x_B^{-1} - 1$

$$\ln z = -\ln\frac{a\,Q}{p_\perp} \;\le\; y \;\le\; \operatorname{arsinh}\frac{Q}{2\,p_\perp}$$

- Dipole splitting function for **gluon emission** off FI dipoles, $\quad x_{f,i} = \pm 1 - \frac{p_\perp}{Q}\,e^{\pm y}$

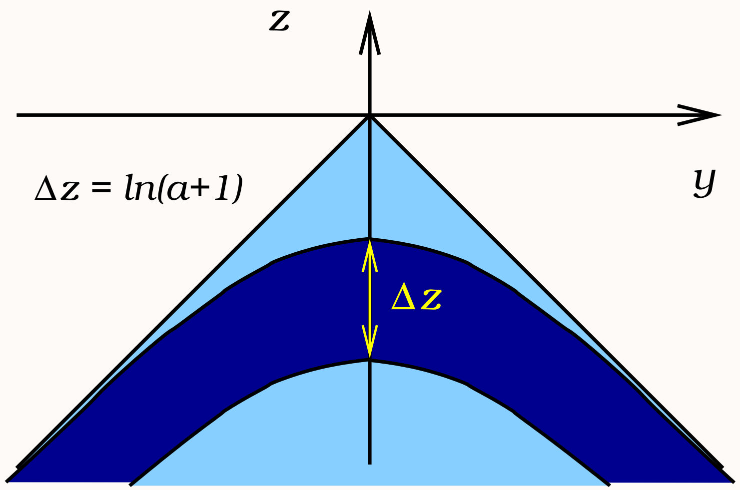
$$D_{fi\to fgi}(p_\perp, y) = \frac{f_i(-x_i x_B, \mu_{\rm F})}{f_i(x_B, \tilde{\mu}_{\rm F})}\,\xi_{\left\{ {F \atop A} \right\}} C_{\left\{ {F \atop A} \right\}}\,\frac{|x_f(p_\perp, y)|^{n_f} + |x_i(p_\perp, y)|^{n_i}}{x_i^2(p_\perp, y)}$$

$$\le \mathcal{N}_{\rm PDF}\,\xi_{\left\{ {F \atop A} \right\}} C_{\left\{ {F \atop A} \right\}} \left\{ \begin{matrix} 2 \\ 2(a+1) \end{matrix} \right\} \equiv D^{\rm approx}_{fi\to fgi}(p_\perp, y)$$

$$n_{q,g} = 2, 3; \qquad \left\{ \begin{matrix} \ldots & \text{for quark dipoles} \\ \ldots & \text{else} \end{matrix} \right\}$$

Final–intial dipole evolution at a glance: $f\,q_{\rm i} \longrightarrow f\,g_{\rm i}\bar{q}$

- Invariant transverse momentum and rapidity



$$p_\perp^2 = \left|\frac{s_{f g_{\rm i}}\, s_{g_{\rm i}\bar{q}}}{s_{f g_{\rm i}\bar{q}}}\right| = \frac{\hat{u}\,\hat{t}}{Q^2}\,, \qquad y = \frac{1}{2}\ln\left|\frac{s_{g_{\rm i}\bar{q}}}{s_{f g_{\rm i}}}\right| = \frac{1}{2}\ln\frac{\hat{t}}{\hat{u}}$$

- Phase space, $\quad a = \hat{s}_{\rm max}/Q^2 \le x_B^{-1} - 1$

$$\text{arcosh}\,\frac{Q}{2\,p_\perp} \le |y| \le \text{arcosh}\,\frac{(a+1)\,Q}{2\,p_\perp} \le \ln\frac{(a+1)\,Q}{p_\perp} = \ln\frac{1}{z}$$

- Dipole splitting function for **antiquark emission** off FI dipoles,

$$x_{f,\bar{q}} = 1 - \frac{p_\perp}{Q}\,e^{\pm y}\,, \qquad x_{g_{\rm i}} = -\frac{2\,p_\perp}{Q}\,\cosh y$$

$n_{q,g} = 2, 3;\ \left\{\begin{array}{ll} \ldots & \text{for quark dipoles} \\ \ldots & \text{else} \end{array}\right\}$

$$D_{f q_{\rm i}\to f g_{\rm i}\bar{q}}(p_\perp, y) = \frac{f_{g_{\rm i}}(-x_{g_{\rm i}}x_B, \mu_{\rm F})}{f_{q_{\rm i}}(x_B, \tilde{\mu}_{\rm F})}\, T_R\, \frac{|x_f(p_\perp, y)|^{n_f} + x_{\bar{q}}^2(p_\perp, y)}{x_{g_{\rm i}}^2(p_\perp, y)}$$

$$\le \mathcal{N}_{\rm PDF}\, T_R \left\{\begin{array}{c} 1 \\ \max\{2,\, a+1\} \end{array}\right\} \equiv D^{\rm approx}_{f q_{\rm i}\to f g_{\rm i}\bar{q}}(p_\perp, y)$$

Sudakov exponentiation, kinematics and showering

- Rule of thumb: no-branching probability exponentiates

$$\Delta(p^2_{\perp,\mathrm{stt}},p^2_\perp) \;=\; \exp\left\{-\int_{p^2_\perp}^{p^2_{\perp,\mathrm{stt}}}\frac{dk^2_\perp}{k^2_\perp}\,\mathcal{I}(k^2_\perp)\right\},$$

$$\mathcal{I}(k^2_\perp) \;=\; \frac{\alpha_s[\mu_\mathrm{R}(k_\perp)]}{2\pi}\sum_{\{\tilde{k}\tilde{\ell}\to kg\ell\}}\int_{y_-(k_\perp,\,a)}^{y_+(k_\perp,\,a)} dy\; D_{\tilde{k}\tilde{\ell}\to kg\ell}(k_\perp,y)$$

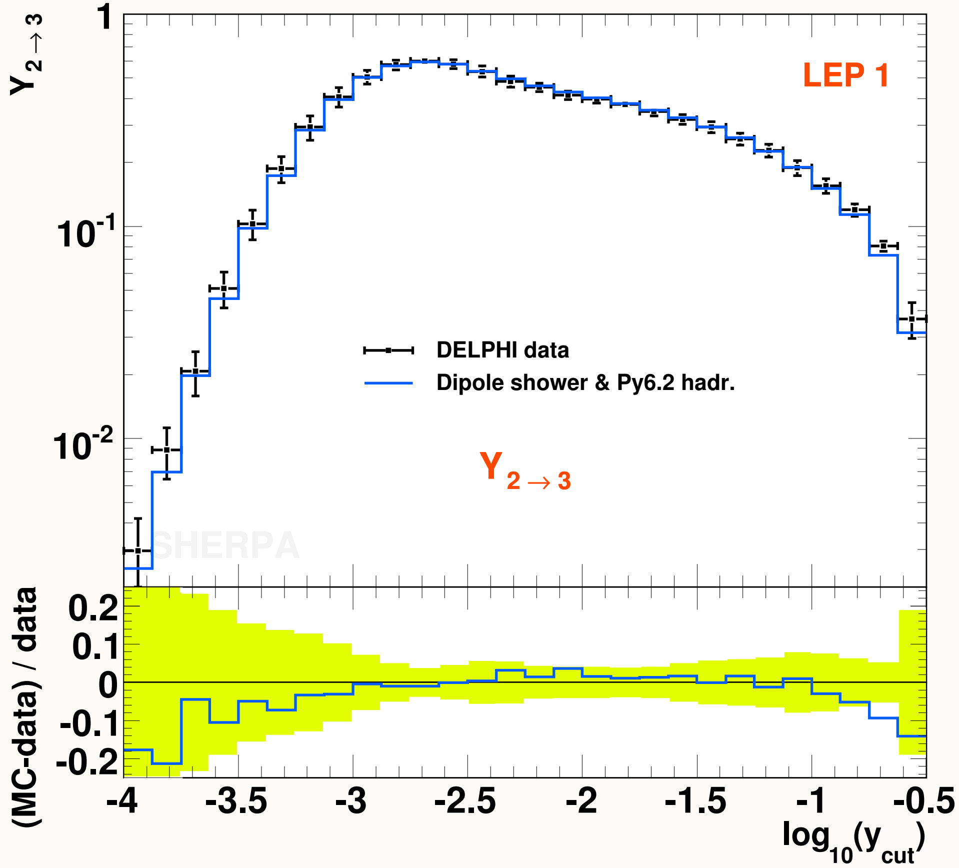
- Differential probability that branching occurs at $p^2_\perp$

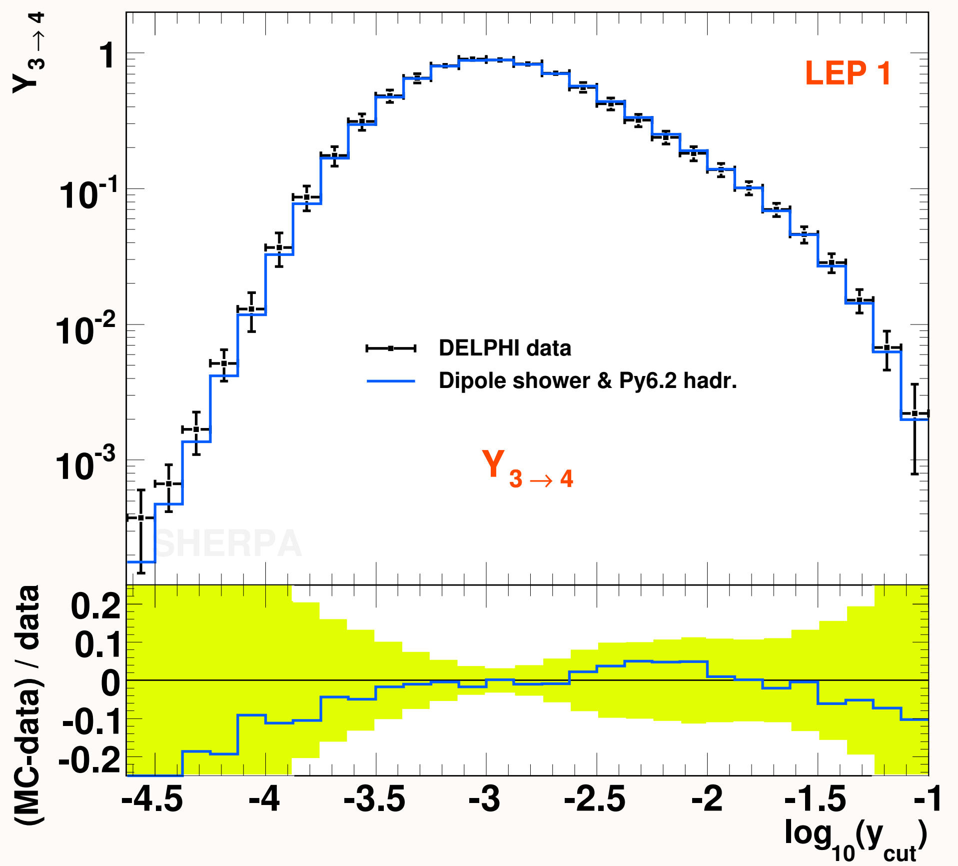
$$\frac{dP}{dp^2_\perp} \;=\; \frac{d\Delta(p^2_{\perp,\mathrm{stt}},p^2_\perp)}{dp^2_\perp} \;=\; \frac{\mathcal{I}(p^2_\perp)}{p^2_\perp}\Delta(p^2_{\perp,\mathrm{stt}},p^2_\perp)$$

- Monte Carlo method (Veto Algorithm) yields values for evolution variables.
- Set up kinematics: use light-cone variables and recoil strategies.
- Shower algorithm fully defined by fixing:
  - *renormalization and factorization scale choices.*
  - *the initializing scale in dependence on the hard process.*
  - *the maximal phase space of a single emission globally.*
  - *the iteration procedure to generate the cascade and the cut-off(s).*

Results for pure final-state cascading

➔ **Testbed: hadron production in electron–positron annihilations @ LEP1**

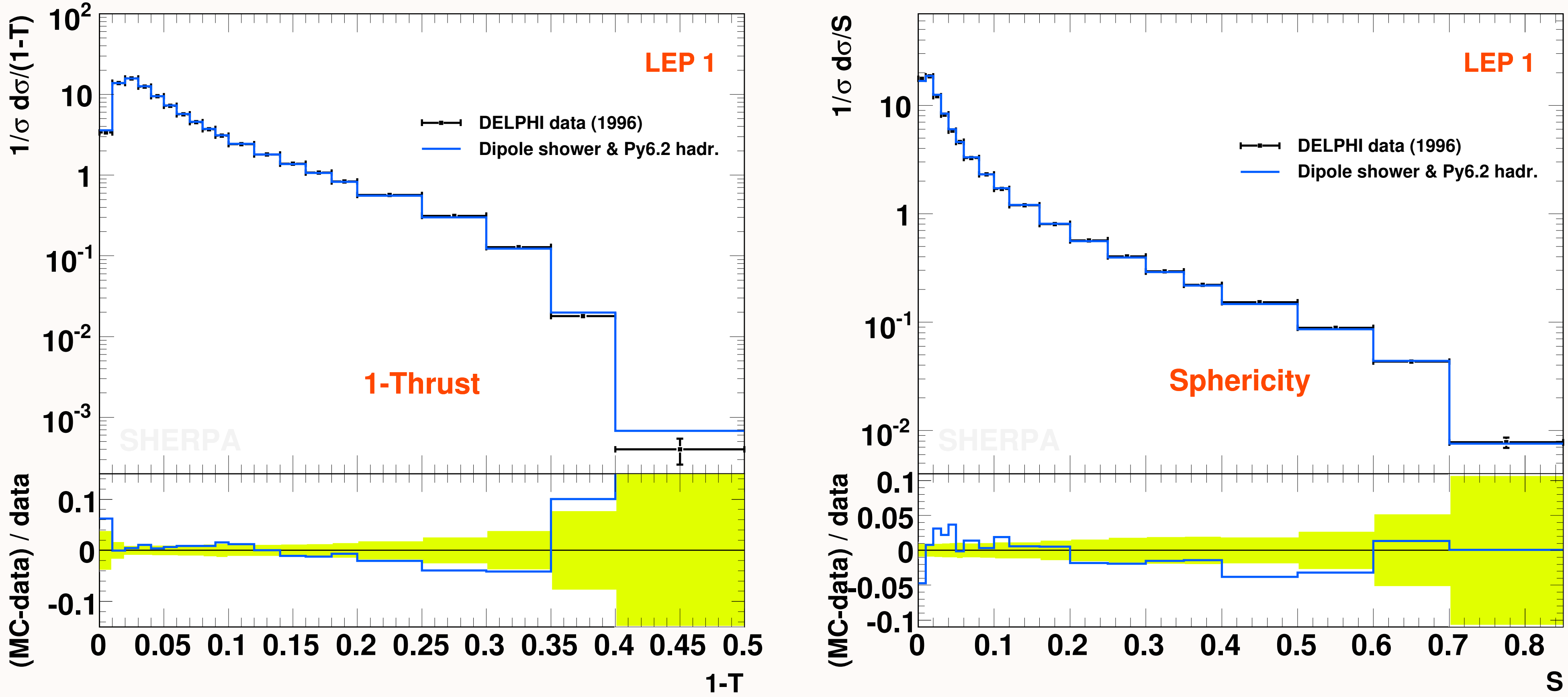




- Durham differential jet rates as a function of the jet-resolution parameter y_{cut}.
- Data: H. Hoeth, diploma thesis, Bergische Universität Wuppertal.

Results for pure final-state cascading

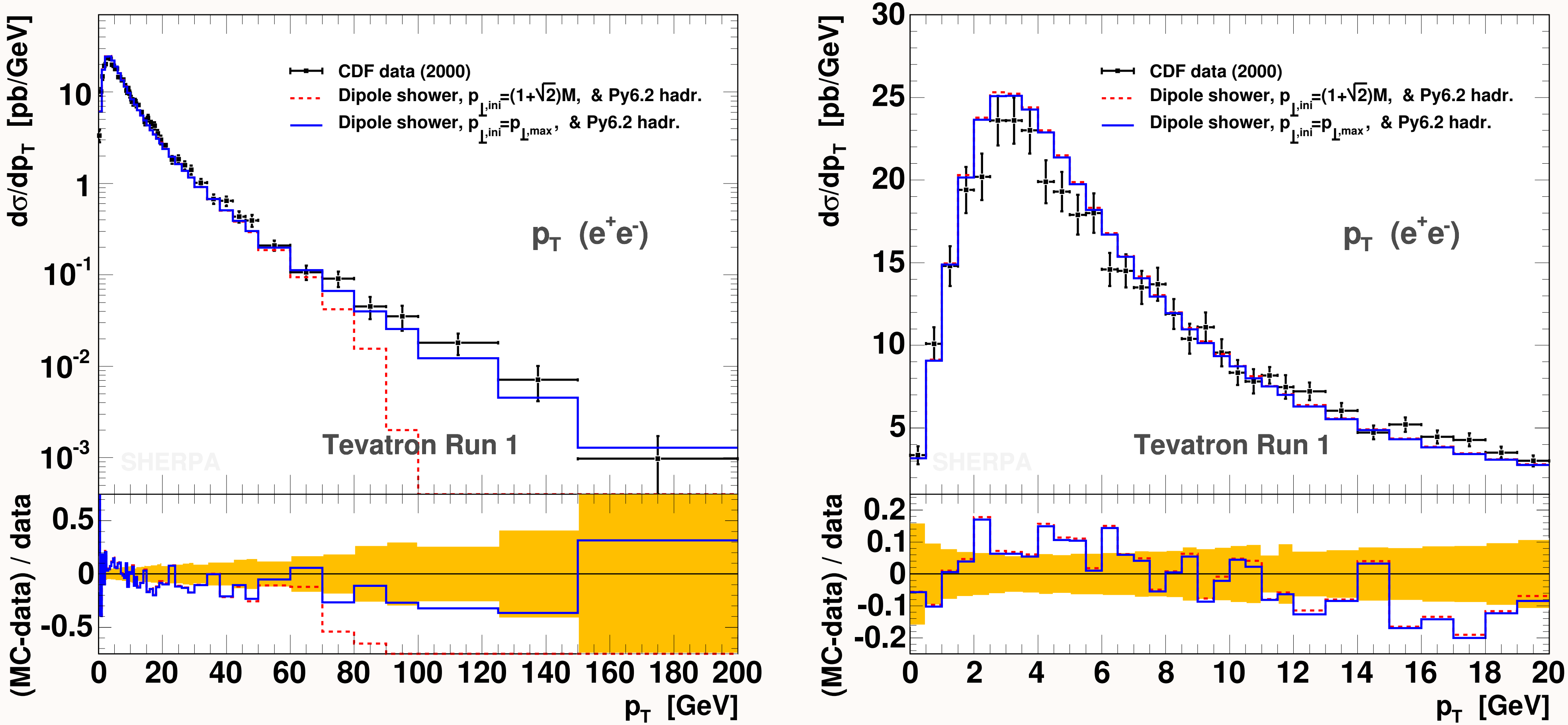
➔ **Testbed: hadron production in electron–positron annihilations @ LEP1**



- Examples of event-shape observables: 1-thrust (left panel) and sphericity.
- Data: P. Abreu et. al. Z. Phys. **C73** (1996) 11.

Results for hadronic collisions

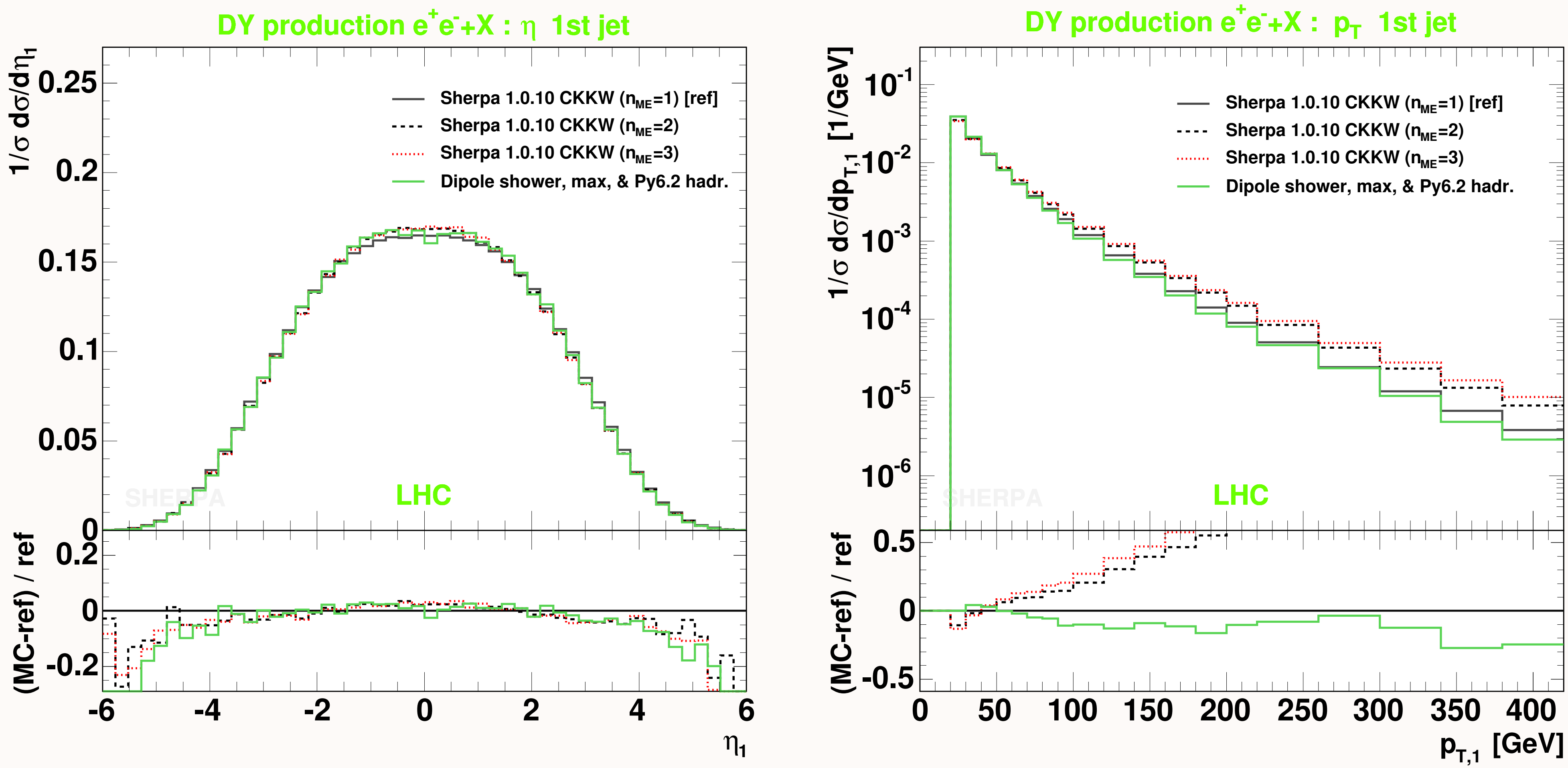
Testbed: inclusive production of Drell–Yan lepton pairs @ Tevatron Run I



- Boson transverse-momentum distribution and its peak region in $e^+e^- + X$.
- Data: A. A. Affolder et. al. Phys. Rev. Lett. **84** (2000) 845.

Results for hadronic collisions

Testbed: Drell–Yan pair production @ LHC, compared to SHERPA predictions

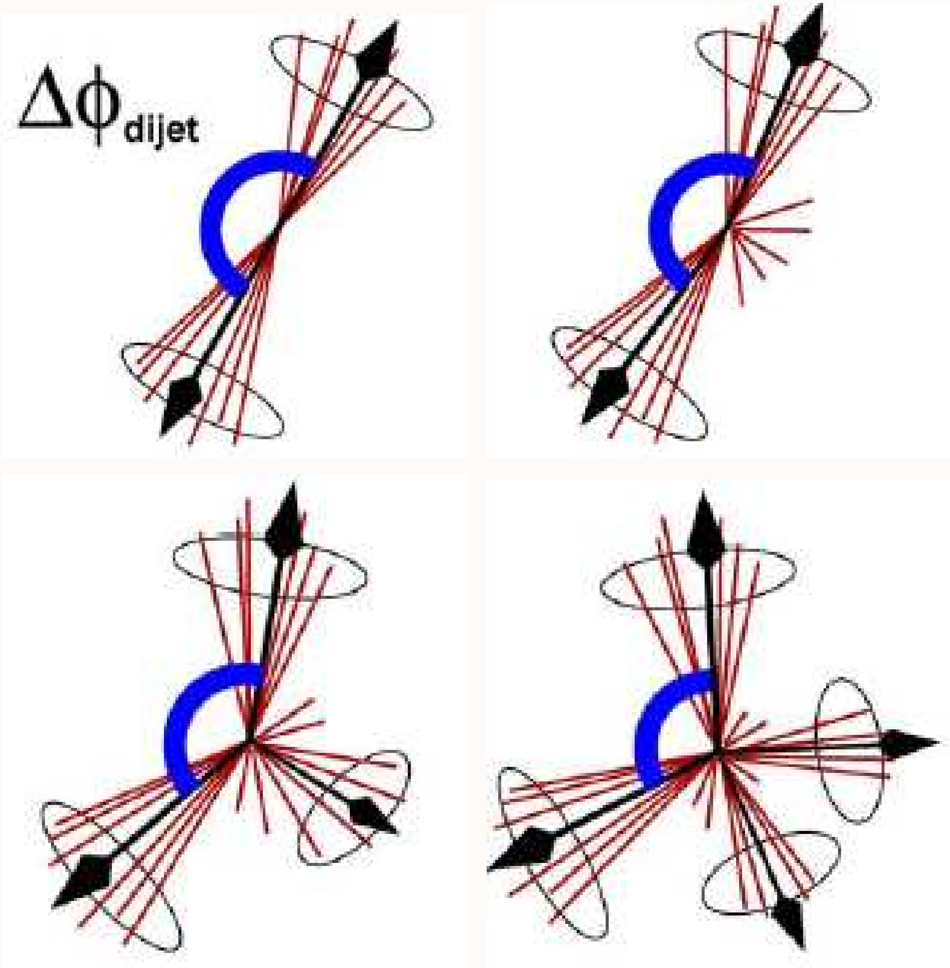


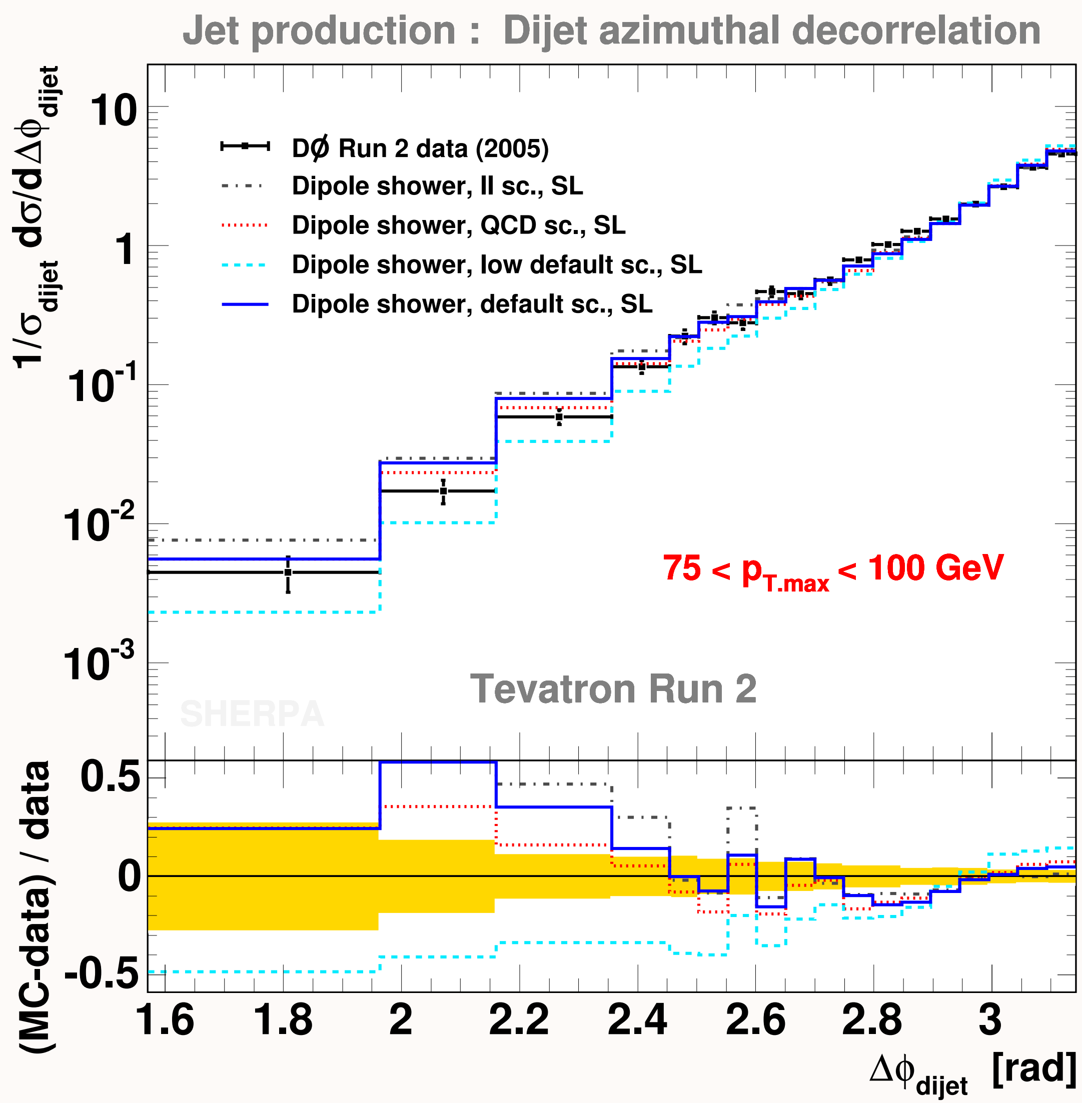
- Pseudo-rapidity (left) and transverse-momentum (right) distribution of the first jet.
- The 1st emission in the dipole shower is ME corrected per construction.

Correlations ... inclusive jet production @ Tevatron

V.M. Abazov et al., Phys. Rev. Lett. **94** (2005) 221801

- Dijet azimuthal decorrelation measured by DØ at Run II.
- Idea: test QCD radiation pattern.





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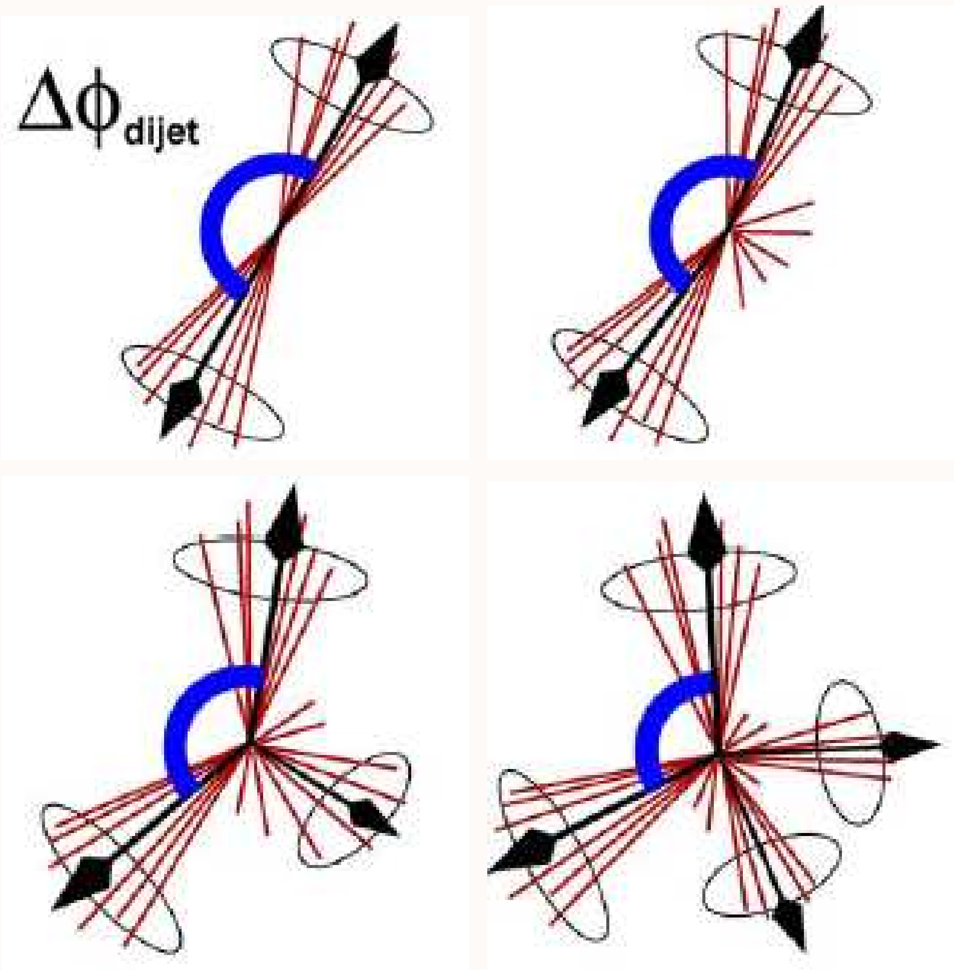

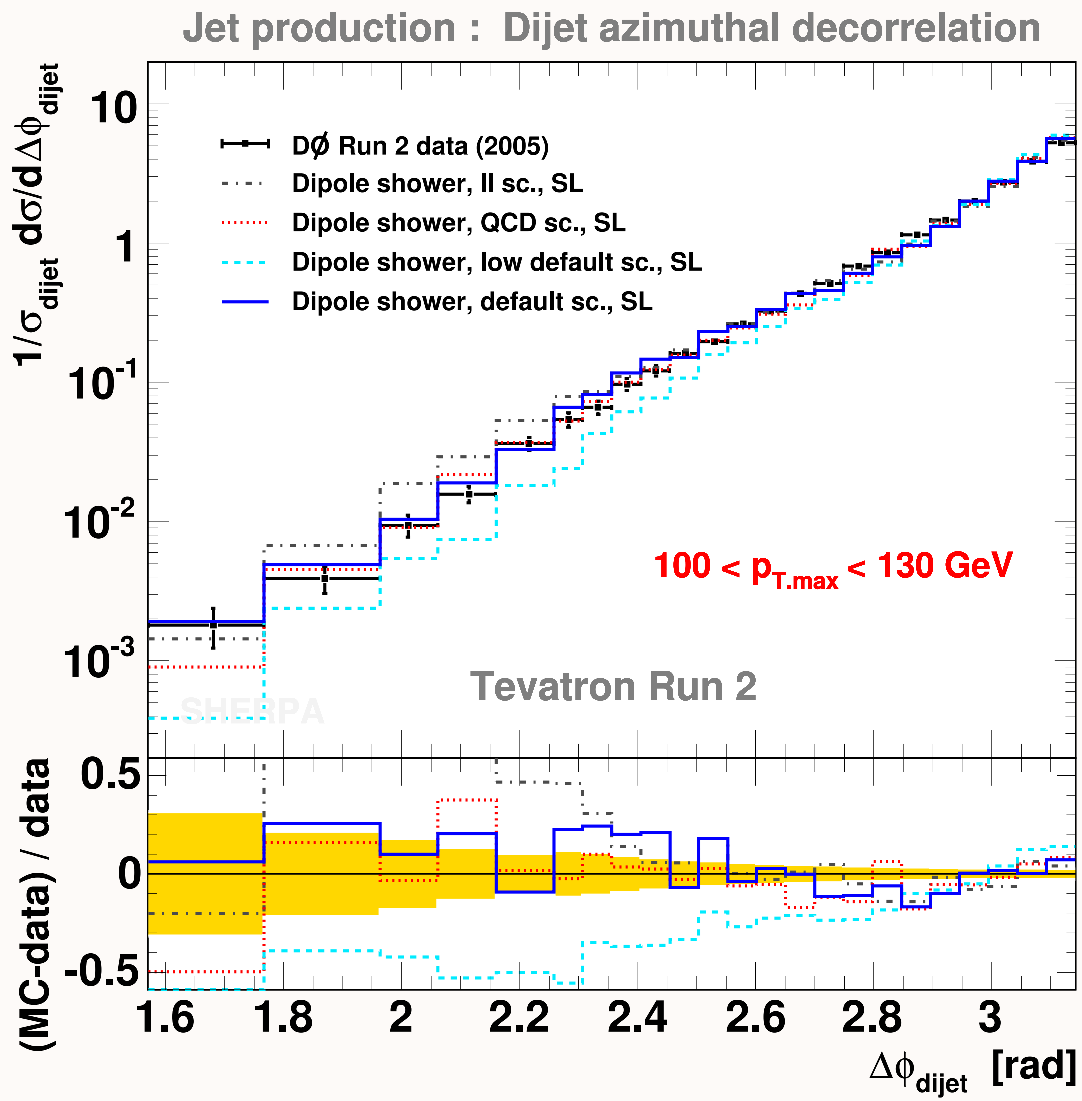

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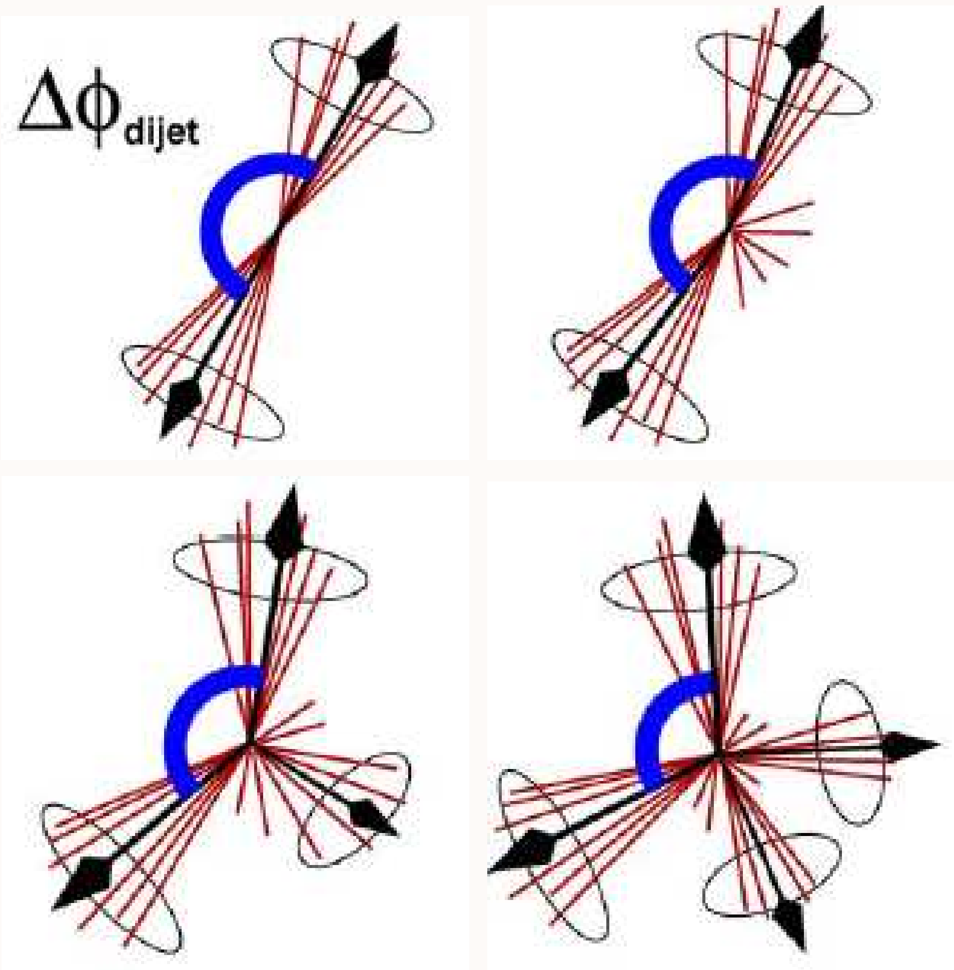

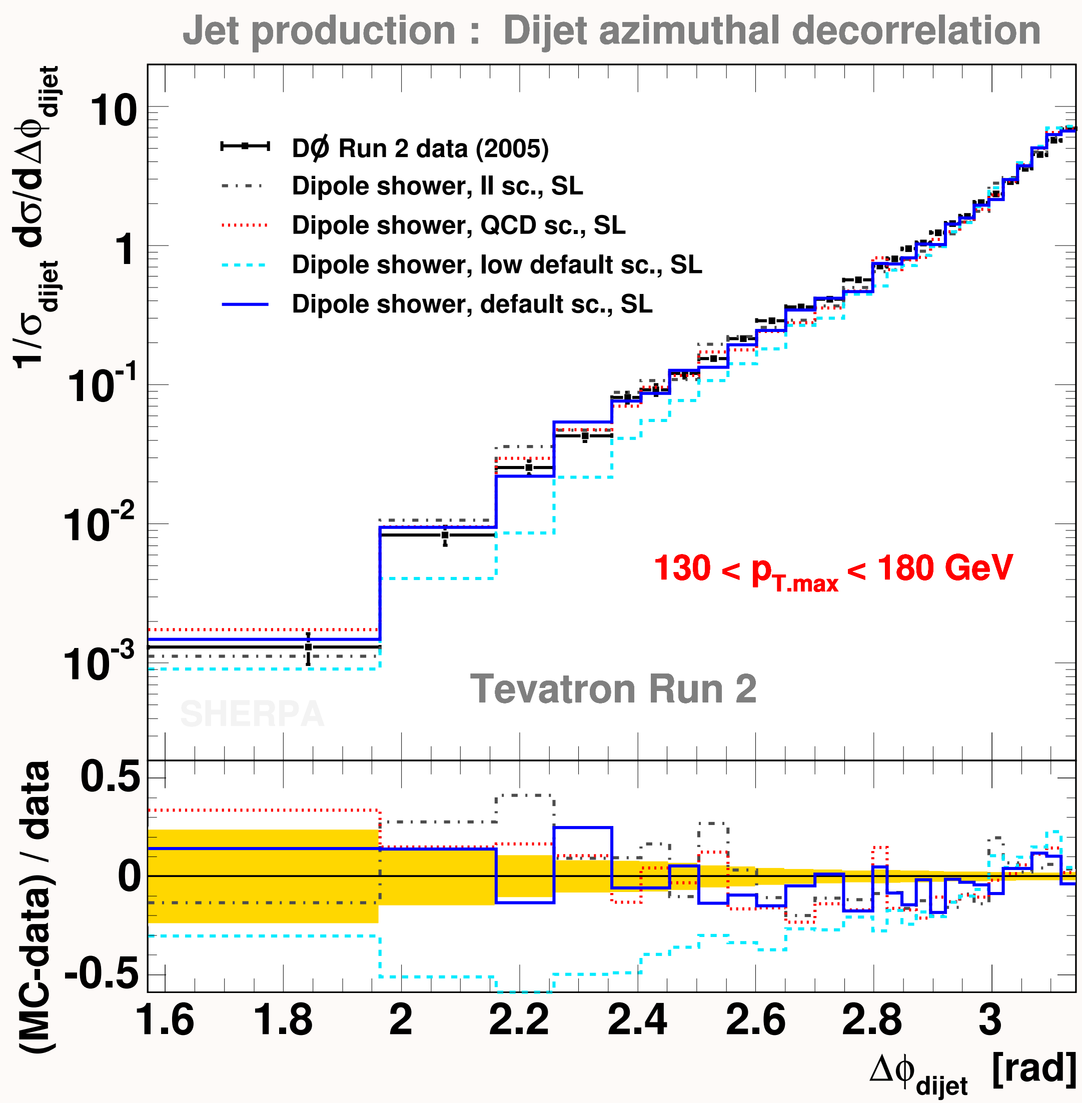

Correlations ... inclusive jet production @ Tevatron

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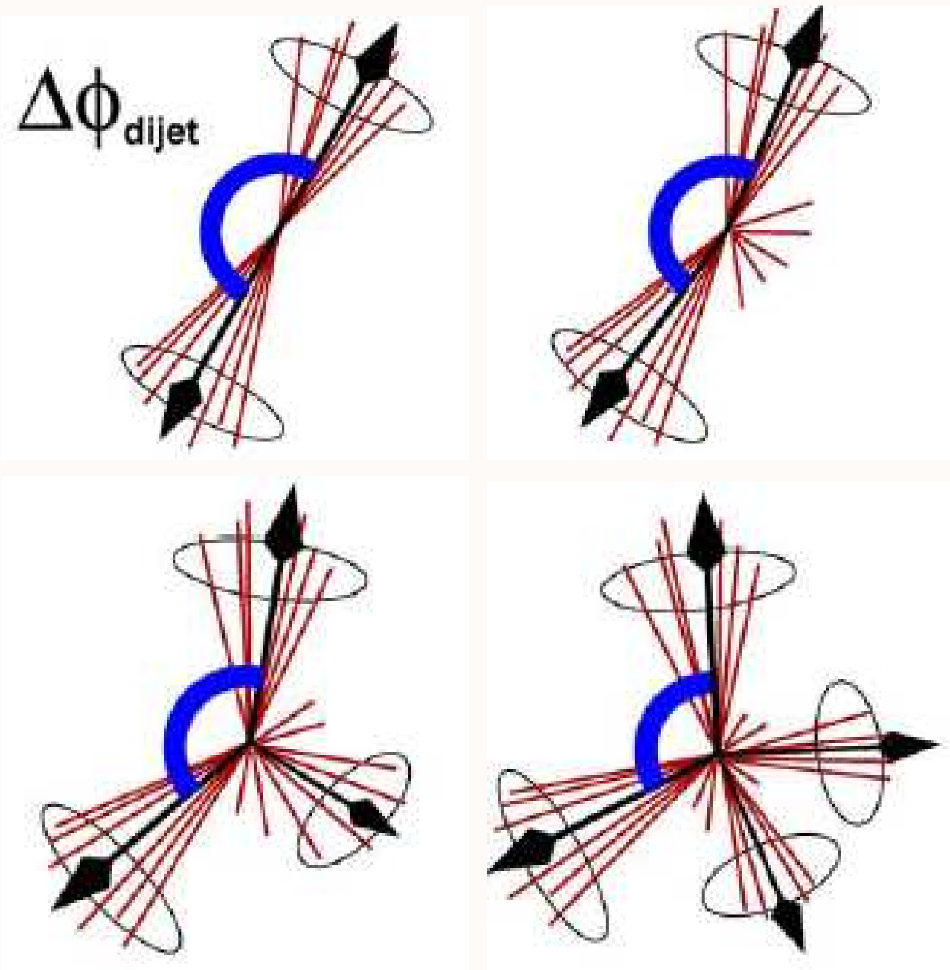
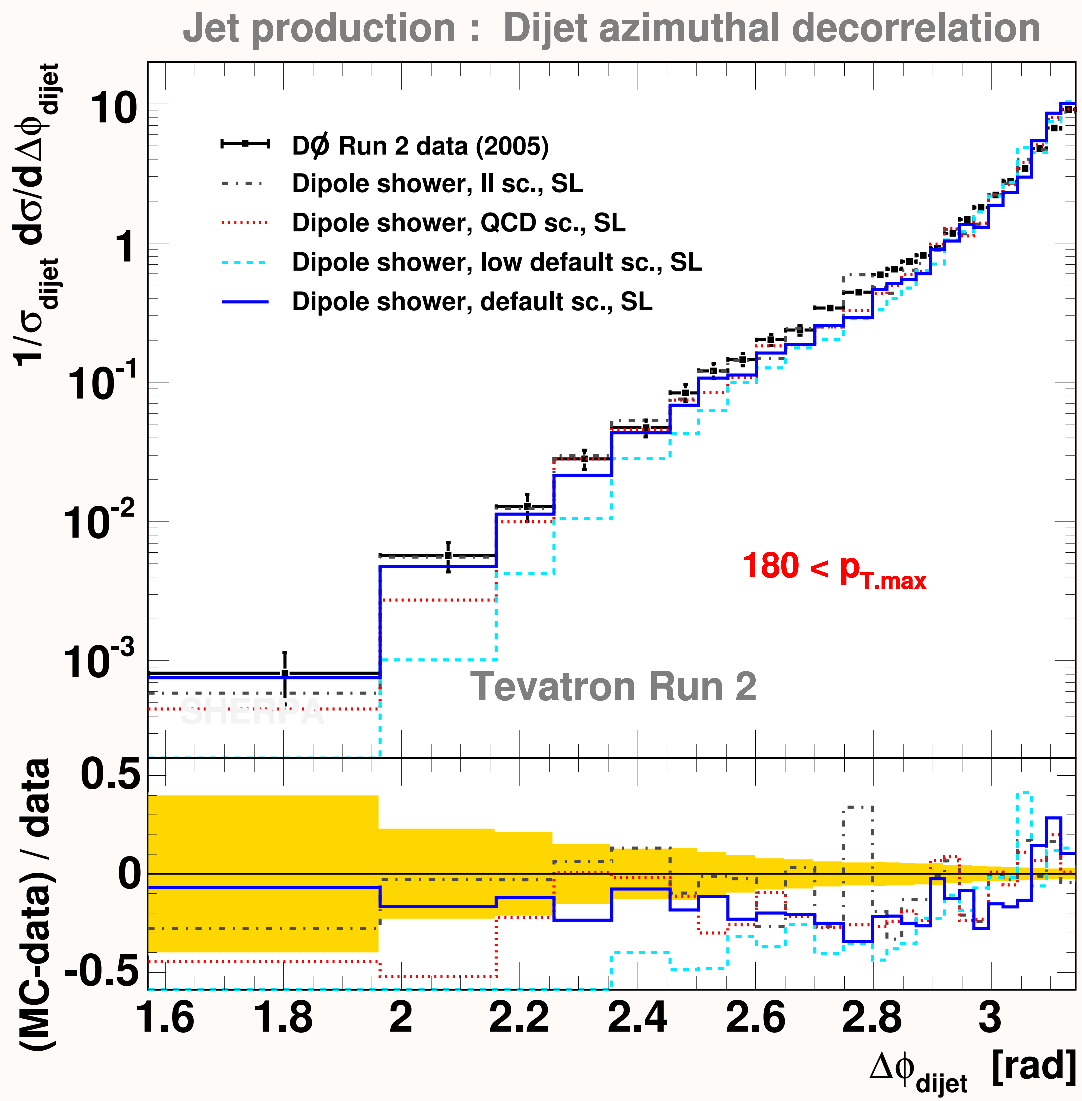
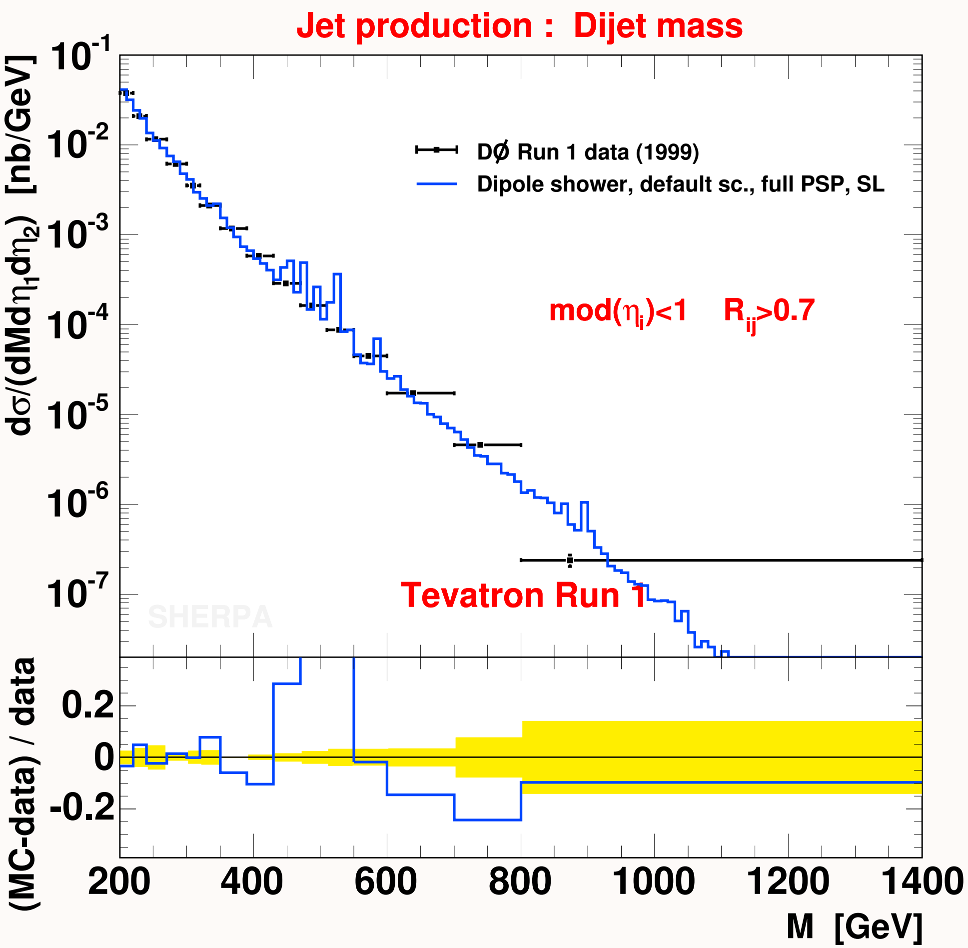
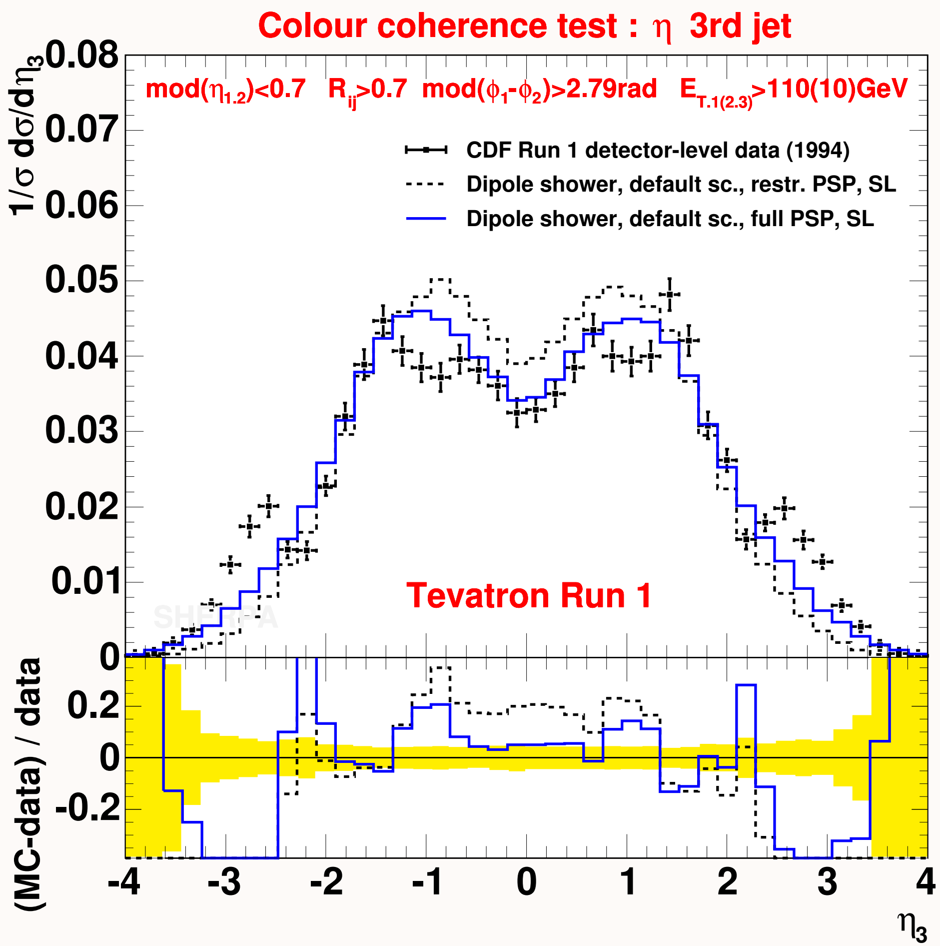




Results for hadronic collisions

➜ Testbed: inclusive jet production @ Tevatron Run I

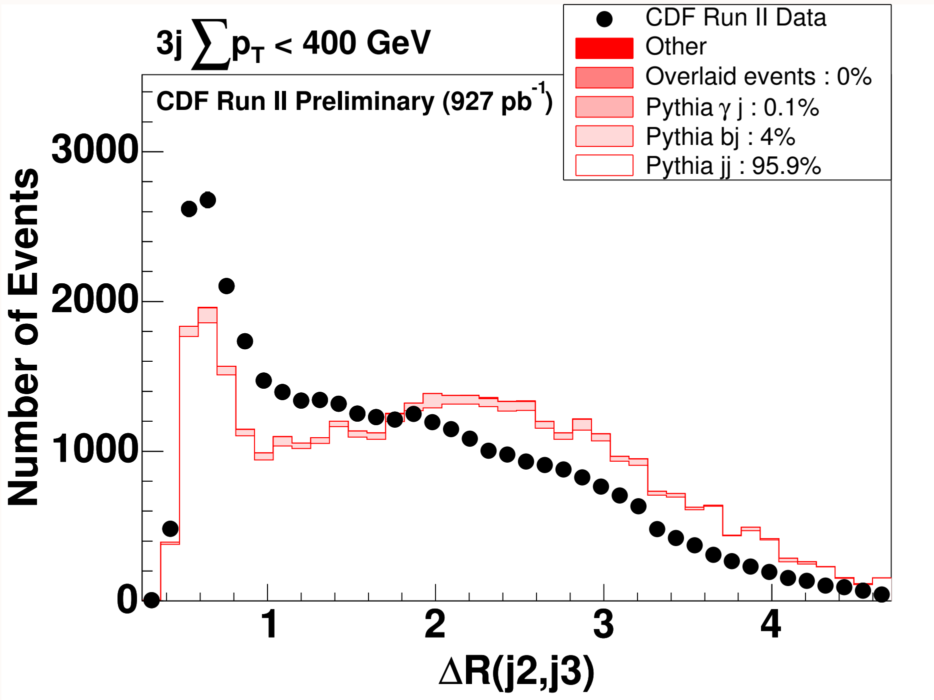


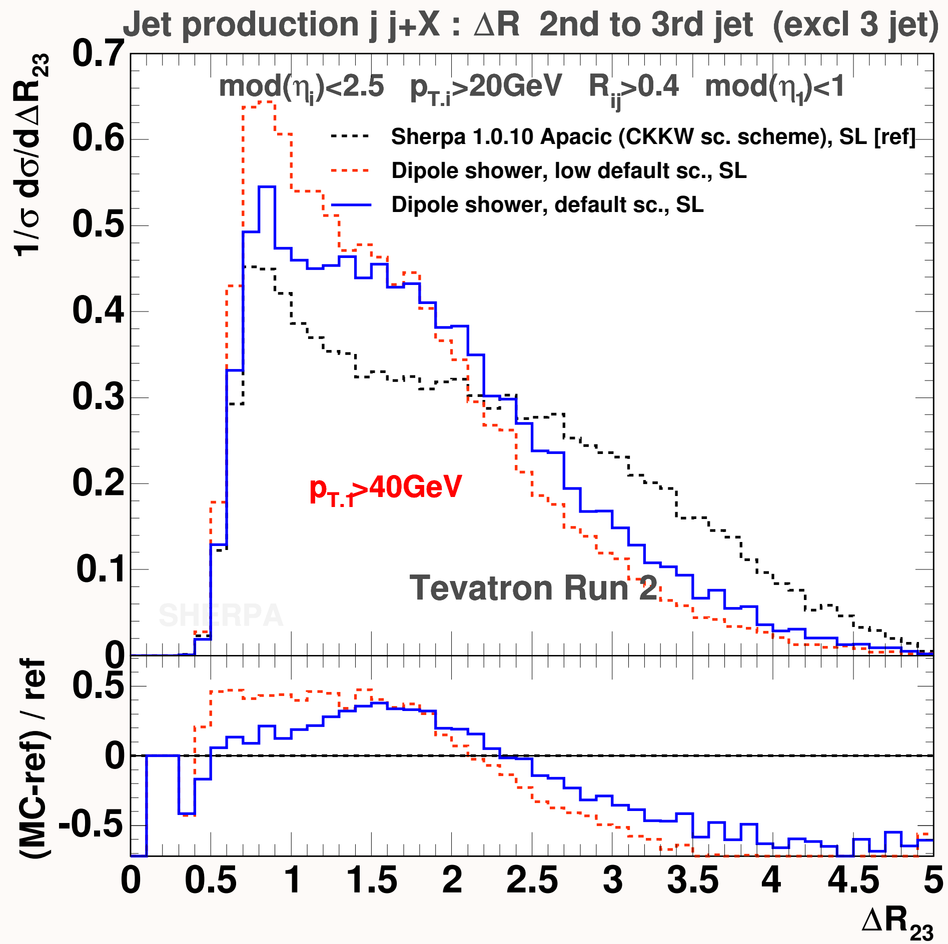


- DØ data: B. Abbott et. al. Phys. Rev. Lett. **82** (1999) 2457.
- CDF data: F. Abe et. al. Phys. Rev. **D50** (1994) 5562.

Results for hadronic collisions

Testbed: inclusive jet production @ Tevatron Run II





- Discrepancy between MC and CDF data: arXiv:0710.2372.
- Was interested what the new dipole shower would predict.