QCD group summary

J. Huston, for the QCD conveners

QCD group

- Most of the tools we want to produce/develop in this workshop are QCD-related
  - ME/MC generation
  - NLO
  - jet algorithms
  - pdf's and pdf uncertainties
  - …
  - I don't even know why people are going to the other groups

    -my ed. comment

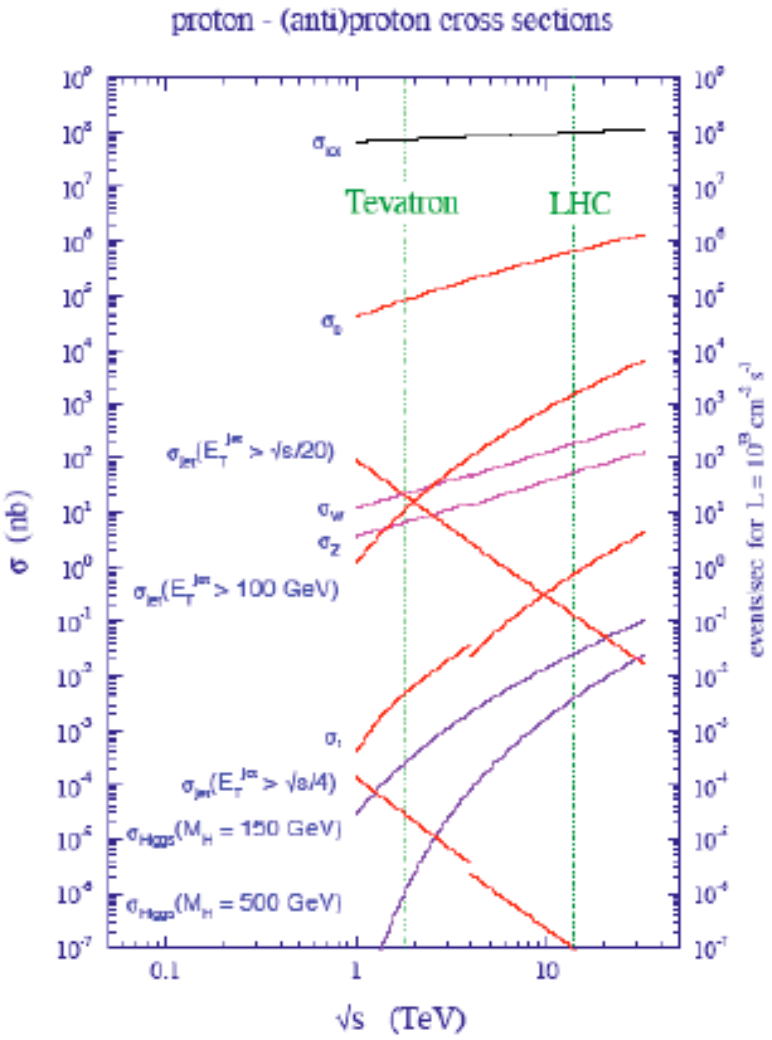
- Note that there have been a series of previous meetings organized by Steve Mrenna and myself dealing with these types of issues for Run 2
  - cepa.fnal.gov/patriot/mc4run2/index.html

Parallel session talks

- **09:00 Jet measurements at the Tevatron: the story so far** (30') **J. Huston** *(Michigan State University)*
- **09:30 Properties of the Run II cone algorithm at D0** (30') **Z. Hubacek** *(Czech Technical University)*
- **10:00 Multiple Interactions, Sherpa results vs. Tevatron data** (30') **S. Hoeche** *(TU Dresden)*
- **10:30 Discussion** (20') **All**
- **11:10 fastNLO: fast calculations of NLO cross sections** (30') **Klaus Rabbertz** *(Univ. Karlsruhe)*
- **11:40 Towards a new type of QCD ISR parton shower MC** (15') **S Jadach** *(Krakow)*
- **14:00 Update on ALPGEN** (30') **Mangano, M.** *(CERN)*
- **14:30 Report on PYTHIA 8 and parton showering in PYTHIA 6.3** (30') **T. Sjostrand** *(CERN/Lund University)*
- **15:00 W + jets at the Tevatron: the story so far** (30') **S. Mrenna** *(Fermilab)*
- **15:30 Simulation jet and W/Z+jets production with SHERPA** (30') **Gleisberg, T.** *(TU Dresden)*
- **16:30 W/Z + jets at D0** (30') **A. Kharchilava** *(Notre Dame U.)*
- **17:00 tt+j at NLO** (30') **Uwer, P.** *(CERN)*
- **17:30 ATLAS sensitivity to W polarization and top spin correlation in ttbar events** (30') **Hubaut, F.** *(CPPM Marseille)*
- **18:00 MC@NLO: recent activity and future plans** (30') **S. Frixione** *(Genoa)*

SM Physics: the obvious

- Before we publish new physics at the LHC, we need to understand SM physics
- A lot of prior knowledge can come from the Tevatron.



QCD physics group goals

- QCD sub-groups
  - pdf's and event classification
    - extraction of pdf's purely at high-momentum transfers
    - establishment of jet contracts between experiments and theorists
    - subtleties and practicalities of jet algorithms
  - hard scattering and hadronization
    - testing of matrix element-parton showering matching
    - underlying event tunes and model development
    - tests of hadronization and tunes/universality of tunes
  - diffraction

- Top and Electroweak
  - top production and decay
  - analysis techniques
  - improved tagging strategies

great deal of overlap
…and that's why much of our parallel session time here (and in other TeV4LHC meetings) was spent in joint meeting

Conveners and info

- QCD conveners
  - M. Albrow, F. Chlebana,A. de Roeck, S. Ellis, W. Giele, J. Huston, W. Kilgore, S. Mrenna, W-K. Tung, M. Wobisch, M. Zielinski
- Group website
  - www.pa.msu.edu/~huston/tev4lhc/wg.htm

Jet Projects

1. inclusion of jet production in MC@NLO

   Steve Ellis,Bill Kilgore, Stefano Frixione, Joey Huston

   work will begin in earnest at Les Houches (if Steve gets his passport in time)

2. Practicing safe exclusive (jet) final states (jet vetos)

   Steve Ellis

3. jet algorithms at the Tevatron and LHC

   -impact of splitting/merging; understanding the effects of splitting/merging at the parton and hadron level

   -impact on boosted systems, e.g. W->jj in high p_T top

   -understanding differences observed in jet reconstruction between CDF and D0 environments

-reconstruct sample of MC events that produce problems in the CDF environment using D0 and LHC algorithms

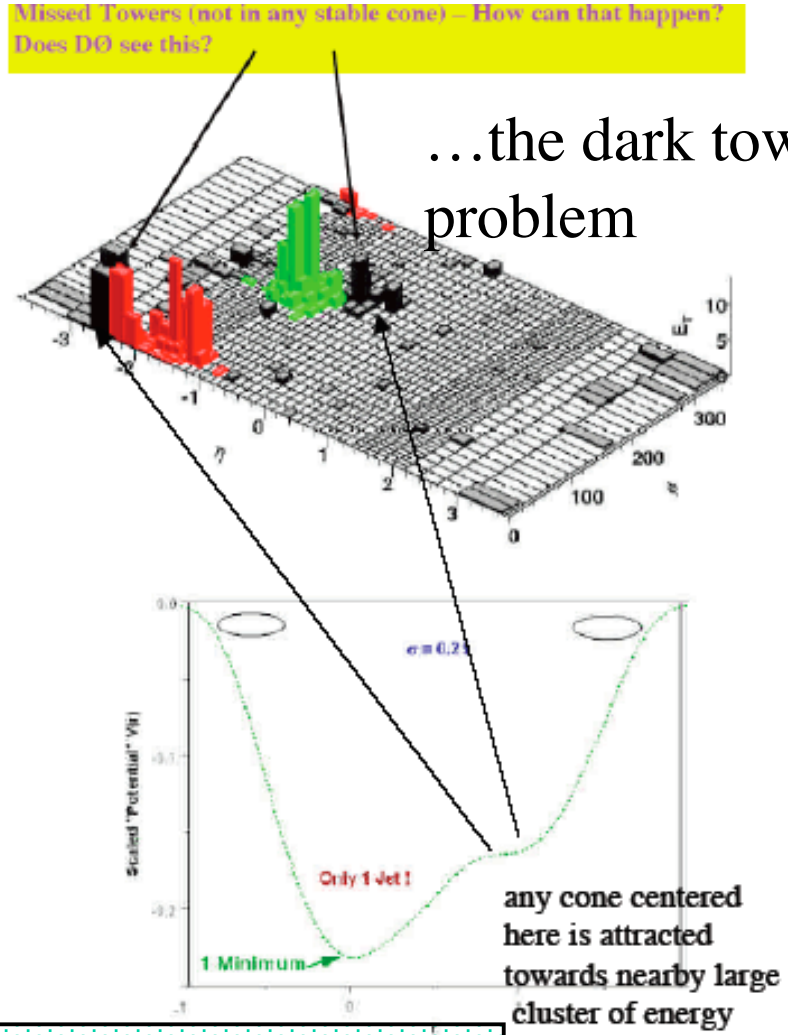
From website

- A stand-alone CDF Fortran/C++ jet clustering routine is available here.
- Some descriptive text from Matthias Tonnesmann is available here.
- The Monte Carlo events that resulted in "dark towers" or "fat jets" in the CDF clustering are available here (along with some descriptive text from Matthias).

Michael Begel, Frank Chlebana, Steve Ellis, Joey Huston, Alison Lister, Matthias Tonnesmann,Markus Wobisch, Marek Zielinski

Jet clustering

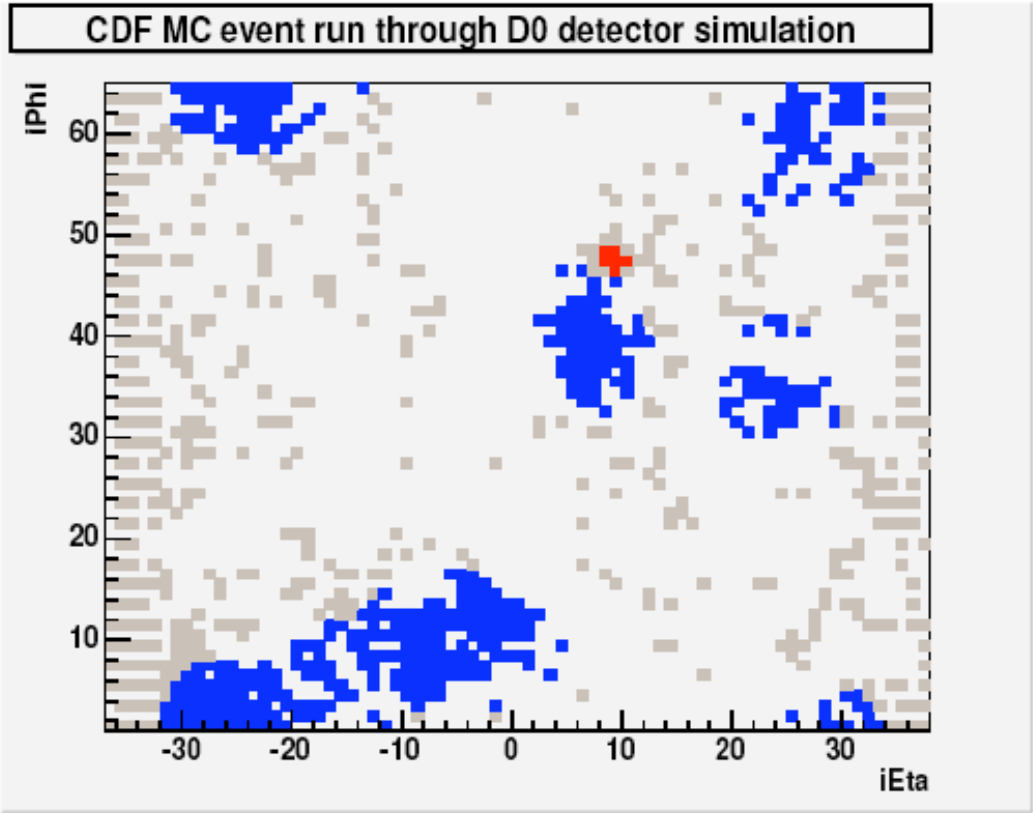
- Run II analyses in CDF and D0 use both cone and k_T jet algorithm
- CDF has used both JetClu (Run I) and midpoint (Run II) algorithms; D0 solely midpoint
  - subtle issues (and solutions) regarding use of midpoint algorithm
  - See hep-ph/0111434, S. Ellis, J. Huston, M. Tonnesmann, *On Building Better Cone Jet Algorithms*



Solution: smaller initial search cones ($R_{cone}/2$)

D0 jet study: Zdenek Hubacek

- To address CDF observation of unclustered E_T

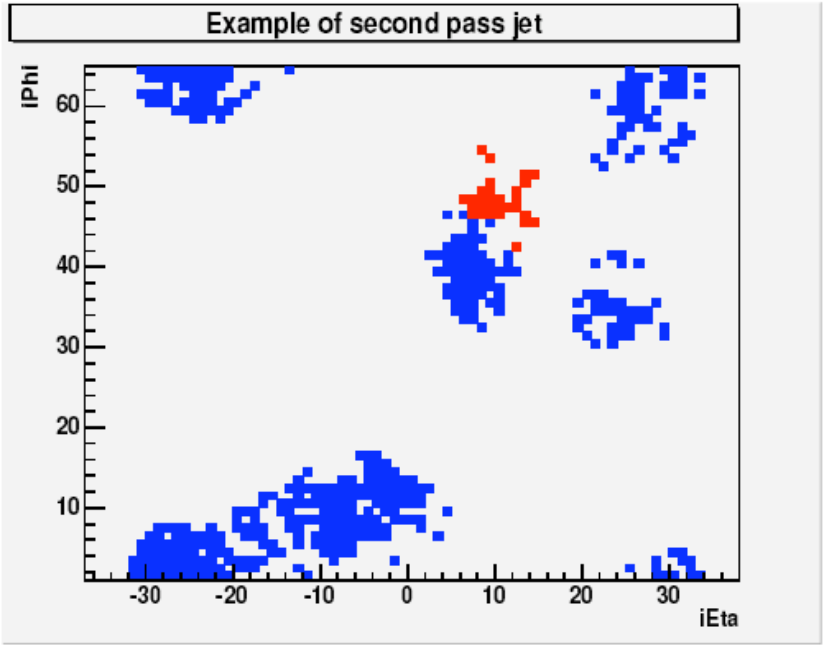


- RunII cone $R = 0.7$
- **Jet** towers
- **Unclustered** towers $pT < 2GeV$
- **Unclustered** towers $pT > 2GeV$

We see it too!

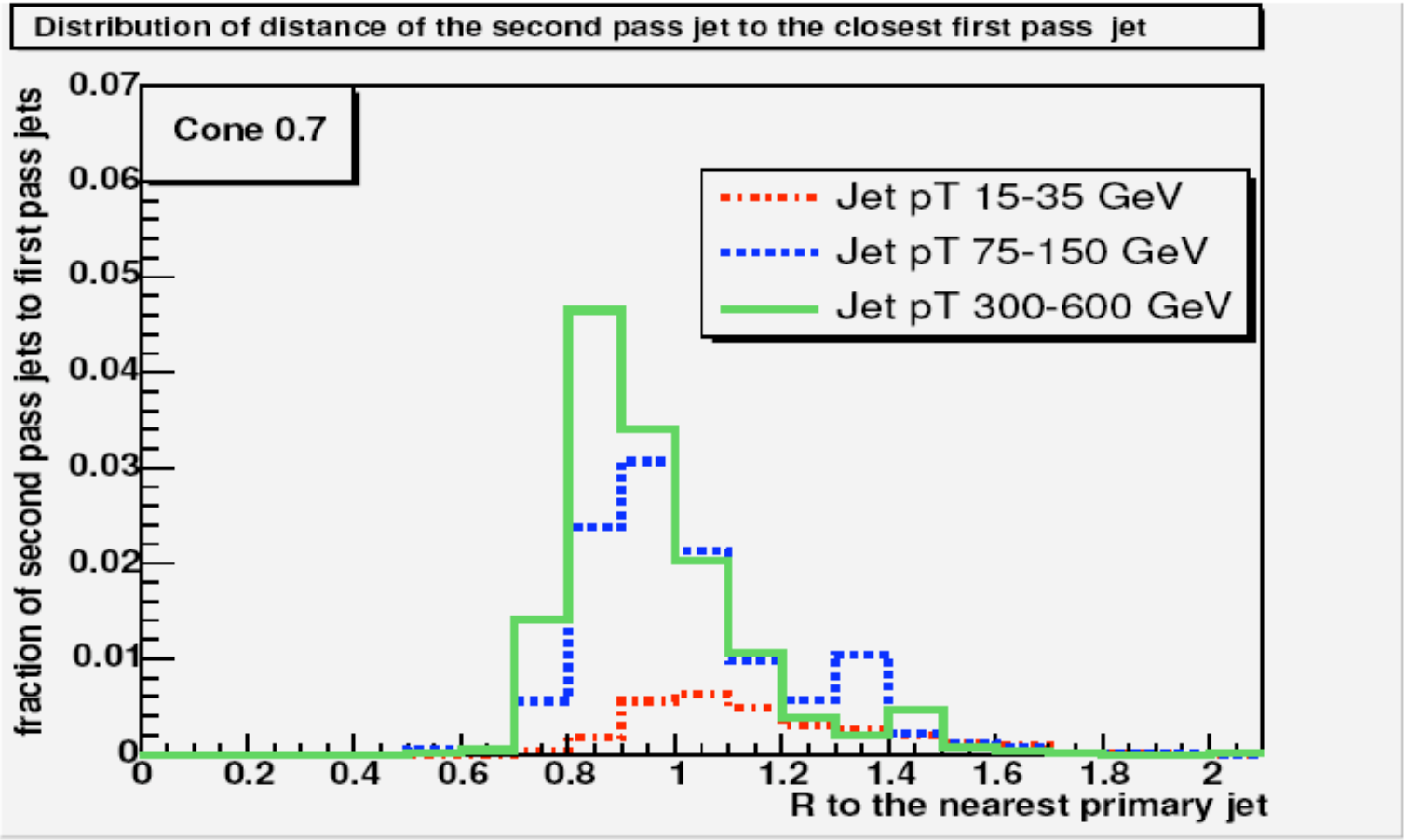
Second pass jets

- After first iteration of jet-finding algorithm, remove found-jet towers and re-run jet clustering algorithm



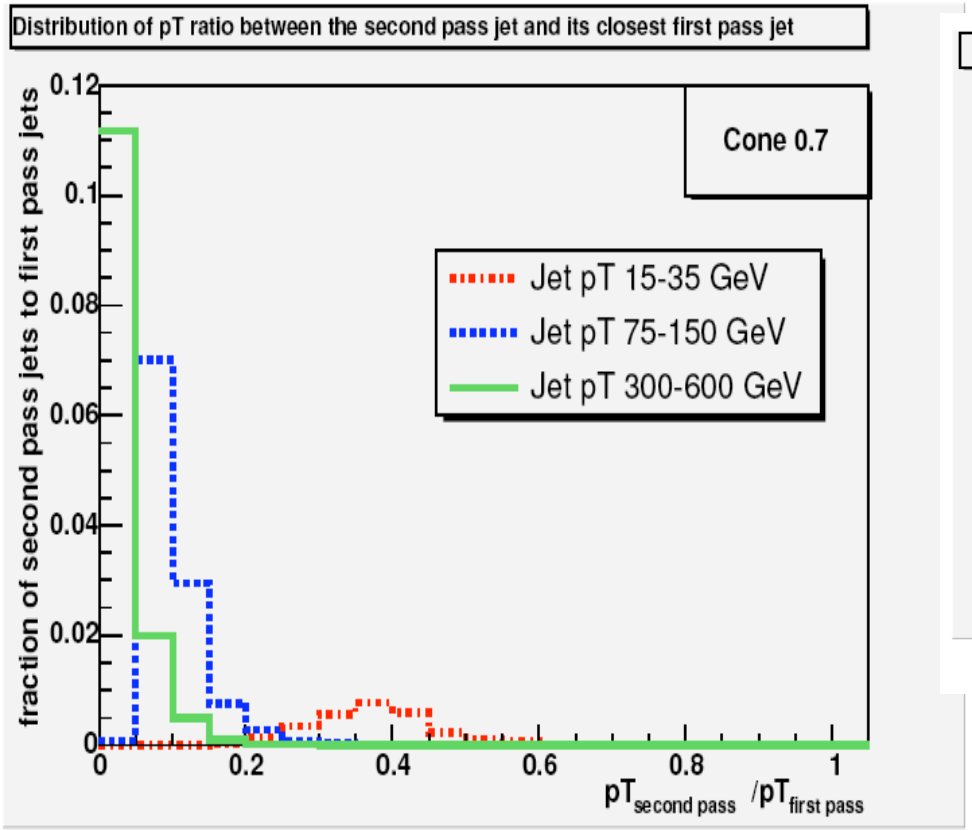
The unclustered energy made a second pass jet!

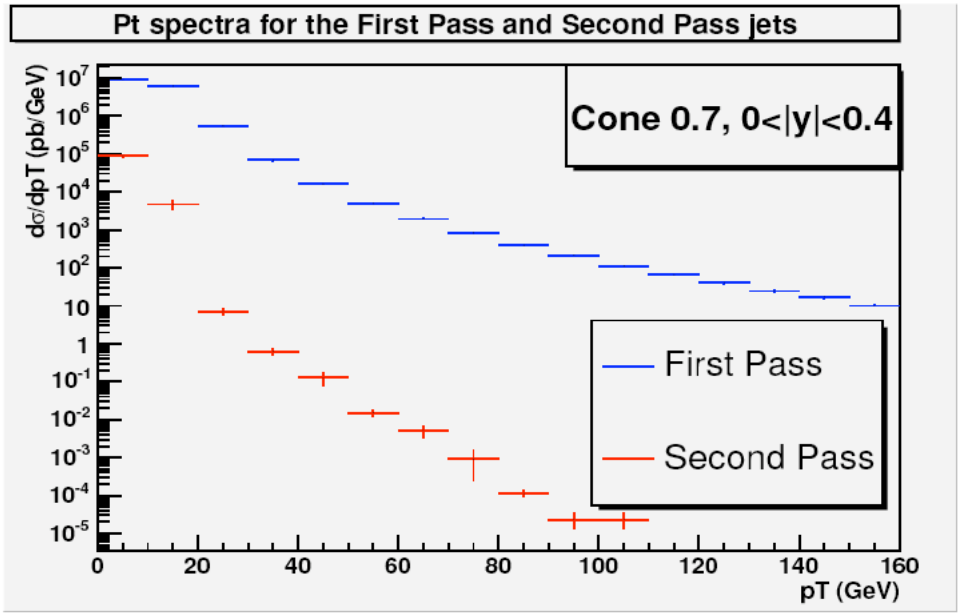
ΔR for second pass jet



High pT jets are more likely to have a second pass jet nearby
(low pT cut for second pass jets: $pT > 6$GeV)

p_T ratio



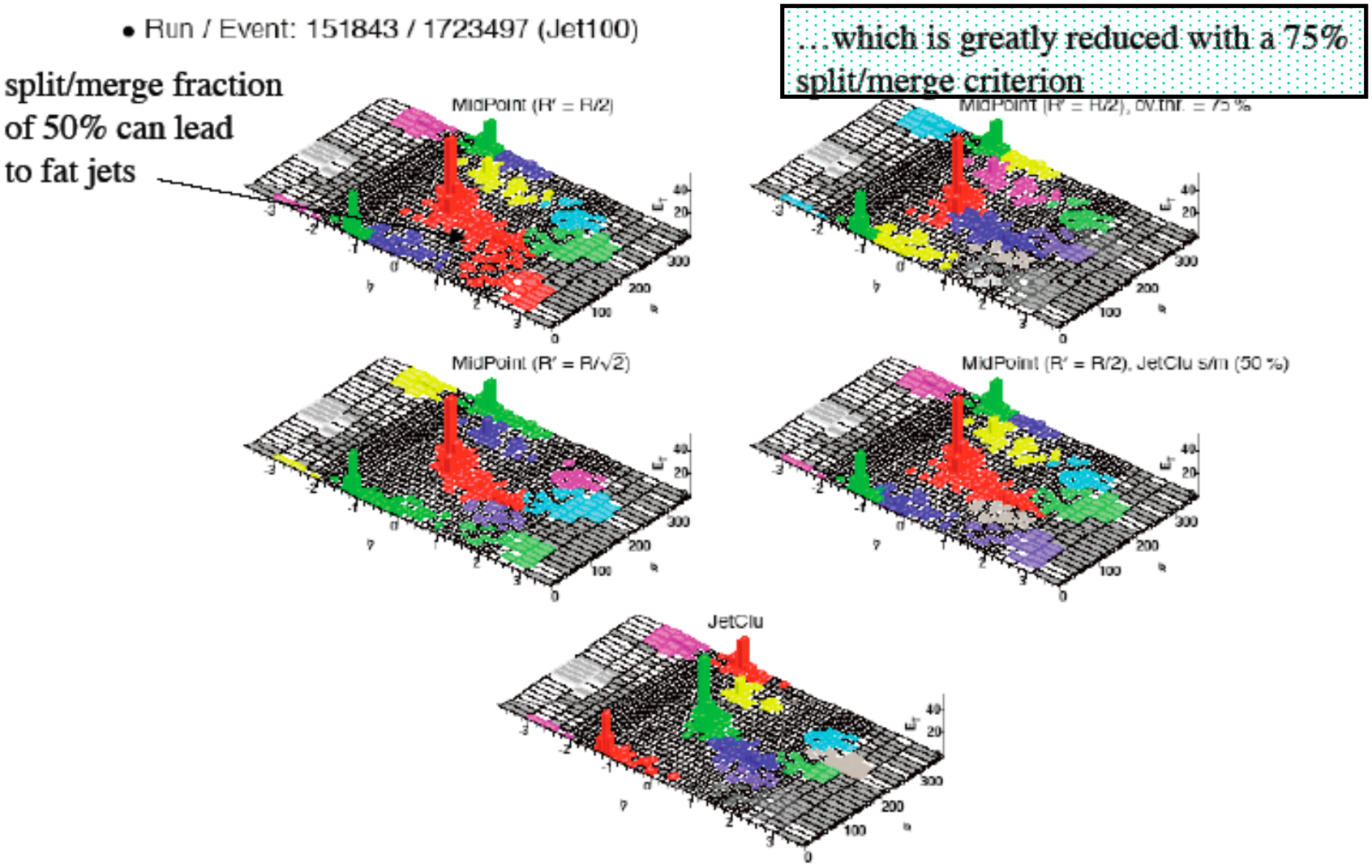


Contribution to the cross-section is negligible

…but if unclustered energy is added to first pass jets (as is done for the modified CDF midpoint algorithm), contribution is not negligible

NLO theory is agnostic on this point

Fat jets

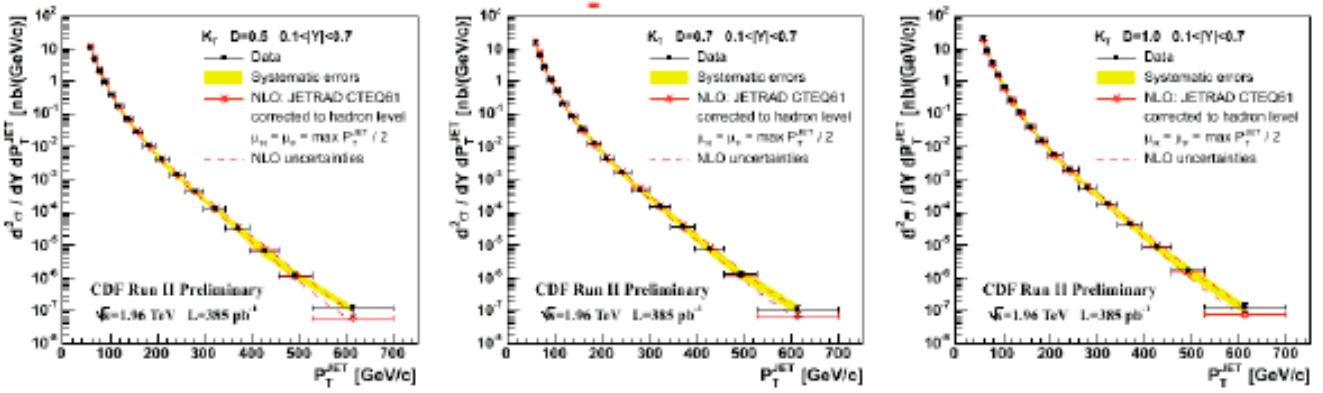


…may be more of a problem in a high luminosity environment

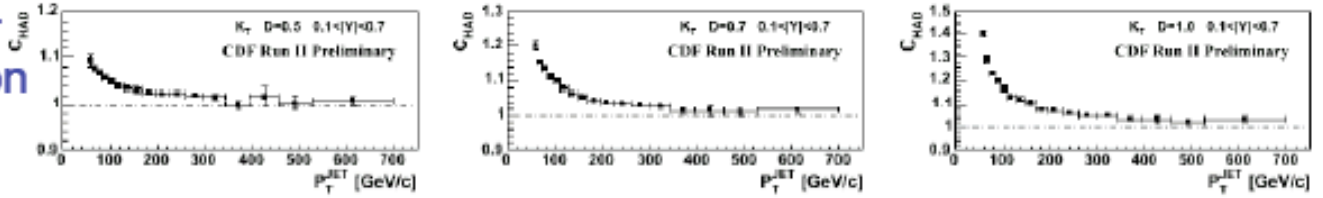
k_T jets in CDF in Run 2

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

k_T algorithm seems to work well at a hadron collider



underlying + hadronization correction



Jet Projects

3. UE subtraction

-definition of UE + uncertainty for comparisons of data to NLO

UE subtraction uncertainty

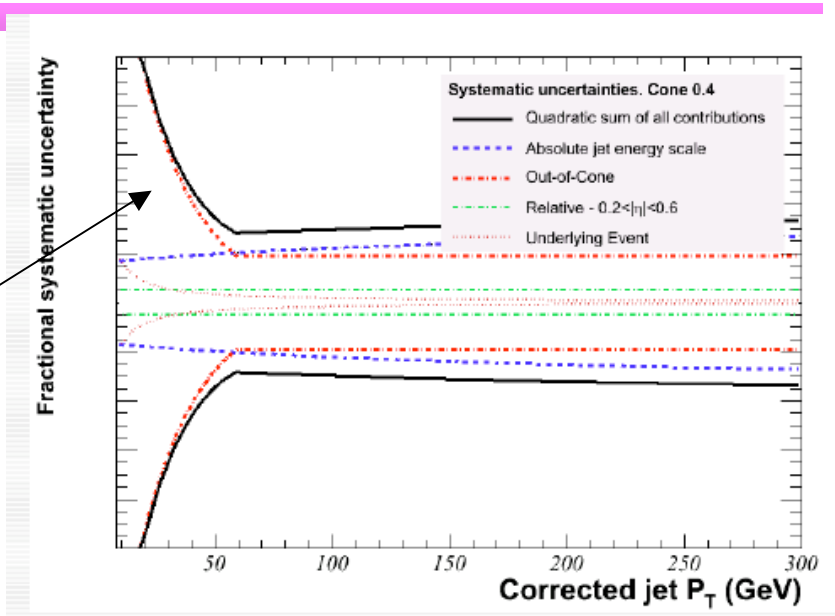
dominant at low E_T

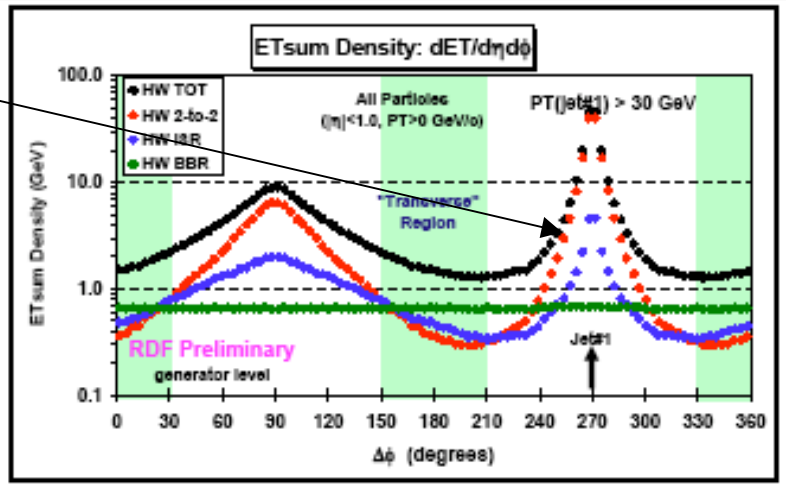
-impact of ISR on jets and jet predictions

->is there an ISR contribution not accounted for by NLO?

-operation in high multiple interaction environment

Rick Field, Joey Huston, Peter Skands





R. Field, TeV4LHC WG meeting in December

PDF projects

1. benchmarks for NLO/NNLO fits (W/Z at Tevatron and LHC)

   Dimitri BourilkovJoey Huston, Pavel Nadolsky

2. validity of NLO DGLAP formalism (see Thurs talk)

   Joey Huston, Pavel Nadolsky

3. pdf uncertainties

   -universal delta_chisquare

   -pdf weighting; impact of uncertainty of Sudakov FF's

   -mis-match between PS pdf evolution and DGLAP?

   -embedding LHAPDF into programs

   Stefan Gieseke, Joey Huston, Pavel Nadolsky, Dimitri Bourilkov. Peter Skands

4. inclusion of Tevatron data in global fits

   -W+c

   -γ +b/c

   -Z+b

   Frank Chlebana, Mario Campanelli, Joey Huston, Pavel Nadolsky

6. heavy flavor pdf's and their uncertainties

   Pavel Nadolsky

Using pdf uncertainties

- PDF uncertainties are important both for precision measurements (W/Z cross sections) as well as for studies of potential new physics (a la jet cross sections at high E_T)
- Most Monte Carlo/matrix element programs have "central" pdf's built in, or can easily interface to PDFLIB
- Determining the pdf uncertainty for a particular cross section/distribution might require the use of many pdf's
- **->LHAPDF**
  - a replacement for PDFLIB as the source for up-to-date pdf's
  - originated by Walter Giele; now maintained by Mike Whalley of Durham

- Using the interface is as easy as using PDFLIB (and much easier to update)
- call InitiPDFset(*name*)
  - called once at the beginning of the code; *name* is the file name of external PDF file that defines PDF set
- call InitPDF(*mem*)
  - *mem* specifies individual member of pdf set
- call evolvePDF(*x*,*Q*,*f*)
  - returns pdf momentum densities for flavor *f* at momentum fraction *x* and scale *Q*

Version 3 of LHAPDF

LHAPDF Version 3

released Sept 2004

http://durpdg.dur.ac.uk/lhapdf/ -> http://durpdg.dur.ac.uk/lhapdf3/
http://durpdg.dur.ac.uk/lhapdf2/
http://durpdg.dur.ac.uk/lhapdf1/

older versions are "frozen" and kept available

(1) More PDFs available:

New : ZEUS – LHpdf file using QCDNUM (thanks to Mandy Cooper-Sarkar)
H1 – LHgrid file (thanks to Christian Pascaud)
MRST2003c (nlo and nnlo) – LHpdf and LHgrid files

Legacy: CTEQ4, CTEQ5, GRV98 – all using the original interpolation codes – ie LHgrid files

From talk of Mike Whalley at HERALHC meeting at CERN in October

PDFLIB interface courtesy of Dimitri Bourilkov

Using pdf uncertainties, continued…

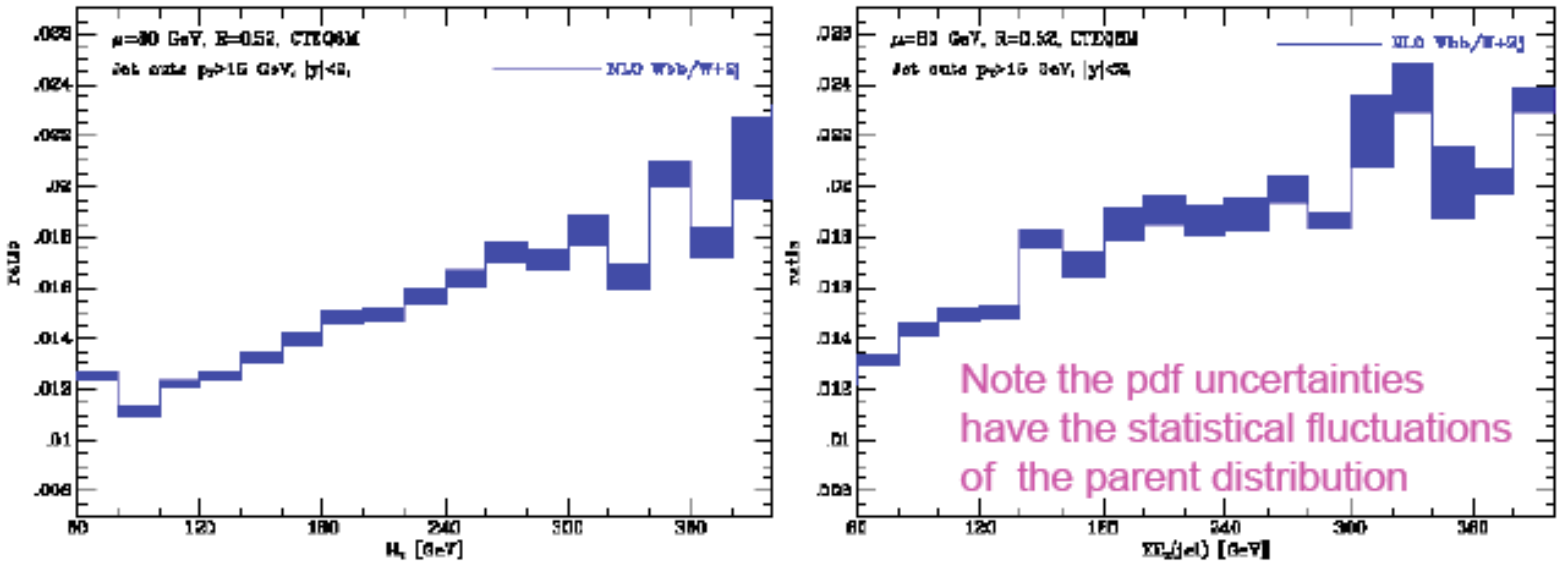
NLO programs can be slow, especially if you have to run 41 pdf's
But if new version of LHAPDF is used, can run full cross section with central pdf and store pdf*pdf luminosity for each event and then re-weight

- Total cross-section uncertainty: Using MCFM, ~~see CDF6849~~

  J. Campbell and J. Huston:hep-ph/0405276->PRD

  $W b\bar{b} \rightarrow 2.5\%\,, \qquad W + 2j \rightarrow 1.5\%.$

- Uncertainty in the $(W b\bar{b}/W + 2$ jet) ratio:



In Version 3 of LHAPDF, all pdf's can be stored in memory at the same time

PDF uncertainty for any cross section can be calculated by weights

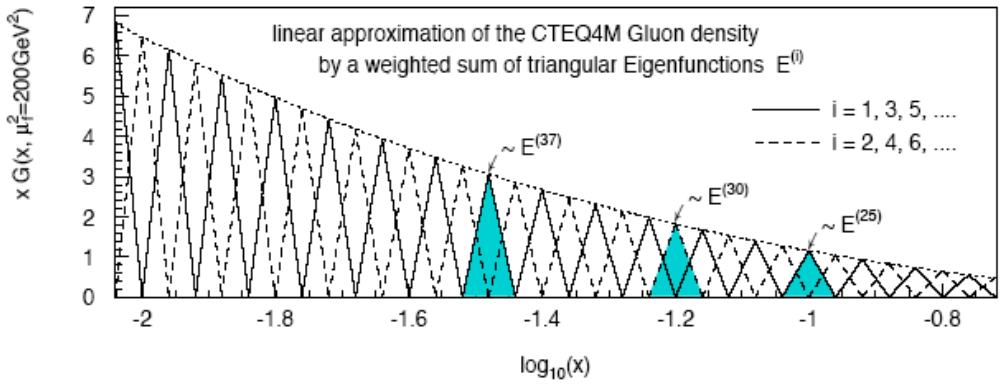
fastNLO

TeV4LHC

Thomas Kluge,
DESY

Klaus Rabbertz,
University Karlsruhe

Markus Wobisch
Fermilab



- introduce a set of discrete x-values labeled $x^{(i)}$ $(i = 0, 1, 2, \cdots, n)$
- with $x^{(n)} < x^{(n-1)} < x^{(n-2)} < \cdots < x^{(0)} = 1$
- around each $x^{(i)}$, define an eigenfunction $E^{(i)}(x)$
- with $E^{(i)}(x^{(i)}) = 1$, $E^{(i)}(x^{(j)}) = 0$ for $i \neq j$ and $\sum_i E^{(i)}(x) = 1$ for all x

- express a single PDF $f(x)$ by a linear combination of eigenfunctions $E^{(i)}(x)$ with coefficients given by the PDF values $f(x^{(i)})$ at the discrete points $x^{(i)}$

$$f(x) = \sum_i f(x^{(i)})\, E^{(i)}(x)$$

$$\sigma_{\mathrm{hh}} = \sum_n \alpha_s^n(\mu_r) \sum_{k=1}^{7} \sum_{i,j} H_k(x_1^{(i)}, x_2^{(j)}) \left(c_{k,n}(\mu_r, \mu_f) \otimes E^{(i,j)}(x_1, x_2) \right)$$

important: integral is independent of PDFs!
the numbers $H_k(x^{(i)}, x^{(j)})$ contain all information on the PDFs

$\Rightarrow$ **exactly what we wanted!!**

fastNLO

TeV4LHC

Status:

- concept for fastNLO is fully developed
- implementation of code for hadron-hadron jet cross section finished
- currently: studying precision / x-binning / "tweaking"

Outlook:
(start with inclusive jet production)

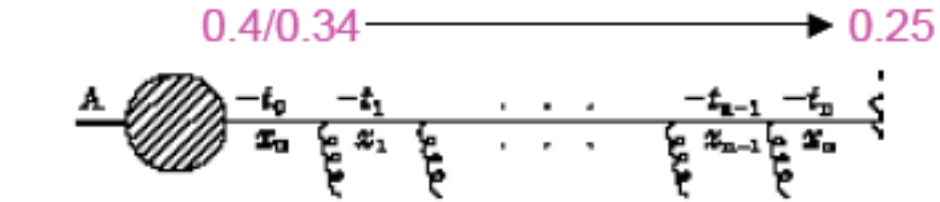
- first: provide tables and user code for published Run I results from CDF and DØ at 630 GeV and 1800 GeV — in analysis specific bins
  (⟶ data can easily be included in all PDF fits)
- next: provide tables and user code for Run II and LHC energies – flexible in p_T, y
  - need to know: reasonable (p_T, y) binning for LHC (?)
  - for different jet algorithms – which jet algorithm(s) will be used at the LHC (?)
- later: extend to dijet production / Drell-Yan@NNLO / ··· ???

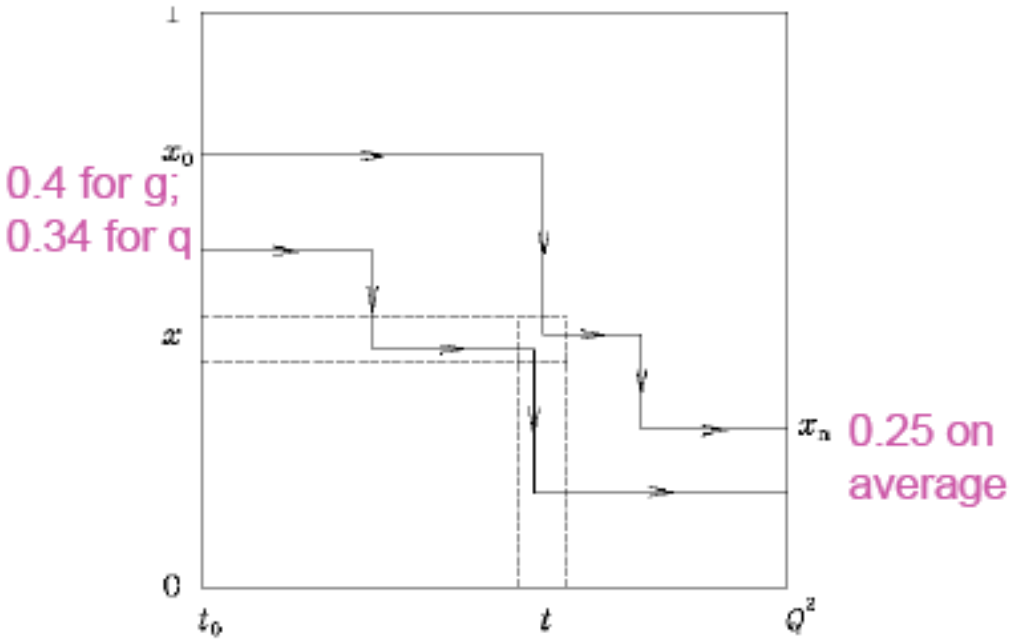
⇒ first results by summer

PDF weight technique with parton showers

- An error may be introduced when using this technique with parton shower Monte Carlos
- The backward evolution in the initial state depends not only on the value of the pdf at a specific x and Q^2 value but also the slope of the pdf in going to higher x and lower Q^2
- In ISR, parton evolves backwards towards higher x and lower Q^2
- Backwards evolution Sudakov factors are weighted by the ratio of pdf's
- So the larger a pdf is at higher x and lower Q^2, the larger is the probability of a gluon emission having occurred

This technique has correct Sudakov only for CTEQ6, not for error pdf's.





At the Tevatron, for top production, quarks start at about x=0.34 at Q_o and end at x=0.25 at $Q^2=10^4$ GeV^2;
gluons start higher at x=0.4

Uncertainties on Sudakov form factors

Uncertainties of Sudakov form factors

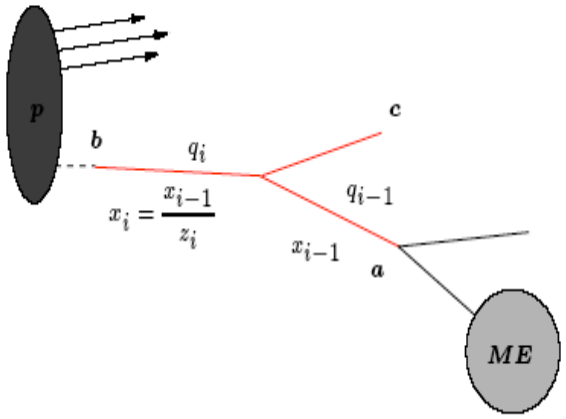
Stefan Gieseke
Institut für Theoretische Physik
Universität Karlsruhe, 76128 Karlsruhe, Germany
gieseke@particle.uni-karlsruhe.de

ABSTRACT: We study the uncertainties of Sudakov form factors as the basis for parton shower evolution in Monte Carlo event generators. We discuss the particular cases of systematic uncertainties of parton distribution functions and scale uncertainties.

KEYWORDS: Quantum Chromodynamics, Monte Carlo Event Generator, Parton Shower, Parton Distribution Functions.

Stefan said he couldn't be here just because his wife was having a baby.

Consider only single branching $b \to ac$:



Sudakov decomposition $q_i = \alpha_i p + \beta_i n + q_{\perp i}$. Basis $(p, n)\|$ proton direction. reconstructed from

$$\alpha_i = \frac{\alpha_{i-1}}{z}, \qquad \boldsymbol{q}_{\perp i} = \frac{\boldsymbol{q}_{\perp i-1} - \boldsymbol{p}_{\perp i}}{z_i}.$$

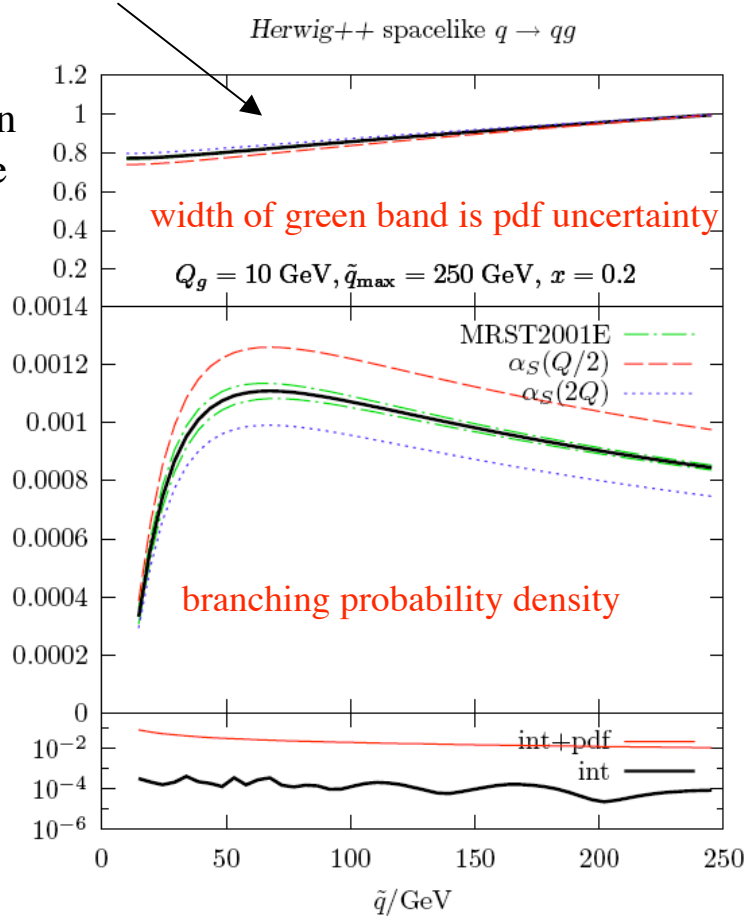
$$\boldsymbol{p}_{\perp i}^2 = (1 - z_i)^2 \tilde{q}_i^2 - z_i Q_g^2 .$$

Q_g closely related to parton shower cutoff.

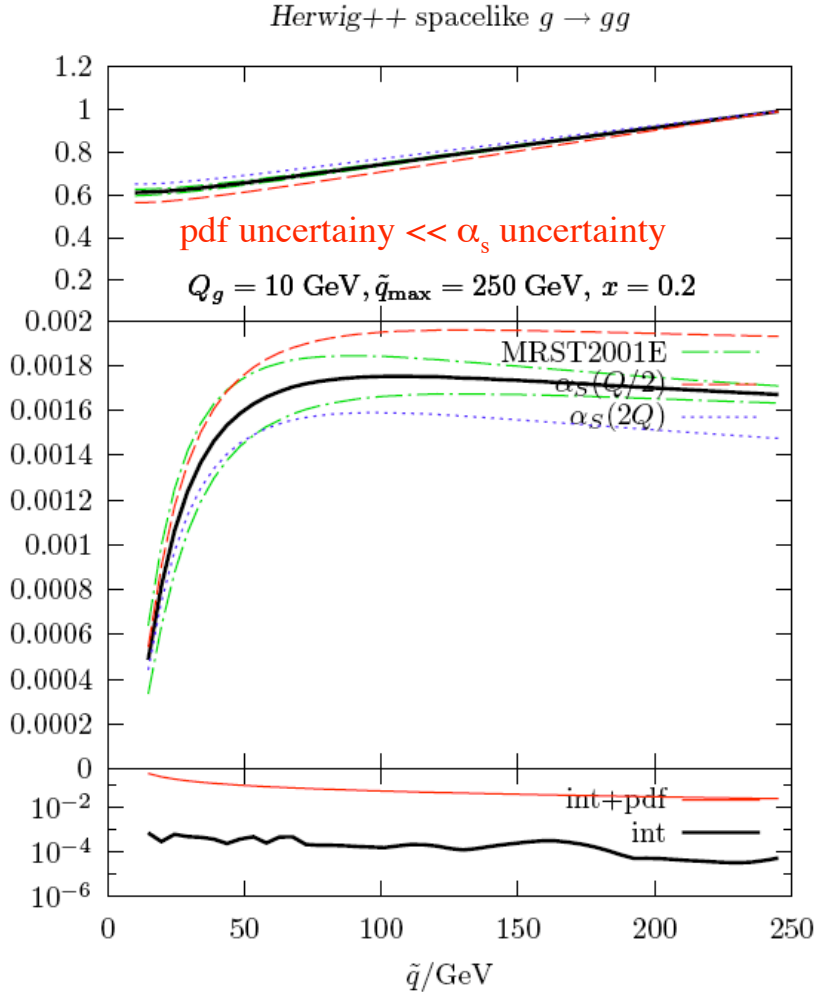
Uncertainties on Sudakov form factors

Probability that a quark at x=0.2 will not emit a gluon of greater than 10 GeV when evolving backwards from 250 GeV

so there's an 80% chance for a quark of x=0.2 to evolve backwards from 250 GeV to 10 GeV **without** emitting a gluon of more than 10 GeV



Gluons like to radiate more than quarks; probability is only 60% for a gluon of x=0.2

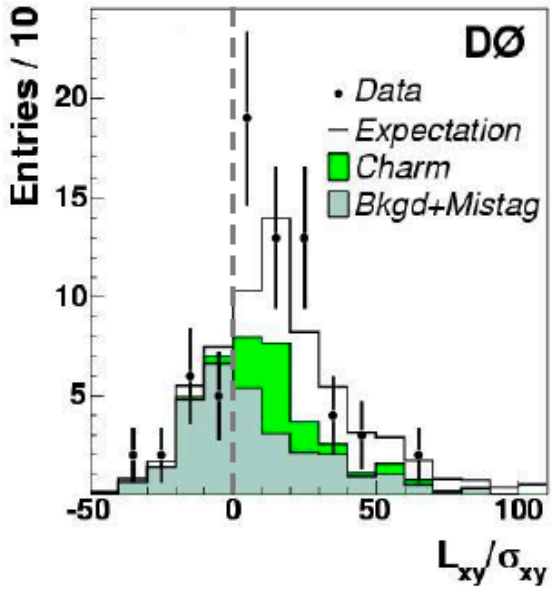


PDF uncertainty band (MRST2001E) is very small; pdf weighting technique works.

Z+b: Avto Kharchilava

σ(Z+b)/σ(Z+j) ratio

- Decay length significance of sec. vertices in transverse plane for b-tagged jets



Heavy flavor component in b-tagged candidate events is clearly seen !

- Measure cross section ratio Z+b/Z+j

$0.021 \pm 0.004\ (\text{stat})\ ^{+0.002}_{-0.003}\ (\text{syst})$

- Prediction: 0.018±0.004

J.Campbell, R.K.Ellis, F.Maltoni, S.Willenbrock, Phys. Rev. D69 (2004) 074021

- Systematics studies

Source (dominant)	Uncertainty (%)
Jet energy scale	+5.8 -6.9
Bkgd. estimation	+5.7 -5.2
Jet tagging	+4.6 -5.1
Z+(QQ) vs Z+QQ	+1.7 -5.4
σ(Z+c)/σ(Z+b)	+2.8 -2.8
Total	**+10.4 -11.8**

PRL 94, 161801 (2005)

ME/MC projects

1. W + jets comparisons at the Tevatron->predictions for the LHC

   -NLO->MCFM

   -CKKW

   -Mrenna-Richardson

   -Sherpa

   -backgrounds to WW->H, the "Zeppenfeld plots"

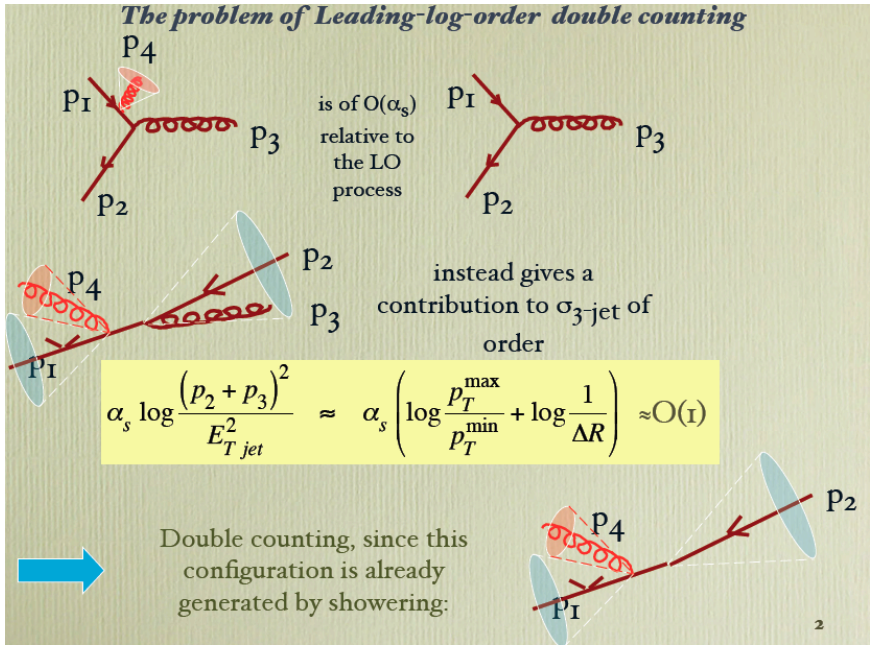
   Michael Begel,John Campbell, Ben Cooper, Joey Huston, Rachid Mazini, Steve Mrenna, Dave Waters, Dieter Zeppenfeld, Marek Zielinski

2. parton shower/resummation

   -predictions for tt, Higgs

   -impact of new parton shower algorithms

   Joey Huston, Steve Mrenna, Peter Skands, Torbjorn Sjostrand

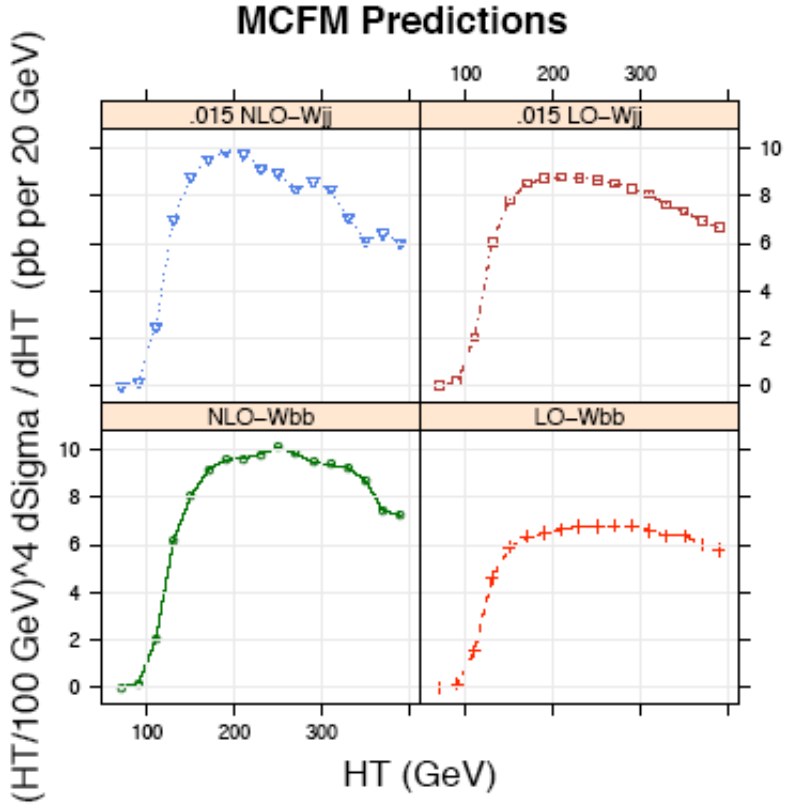


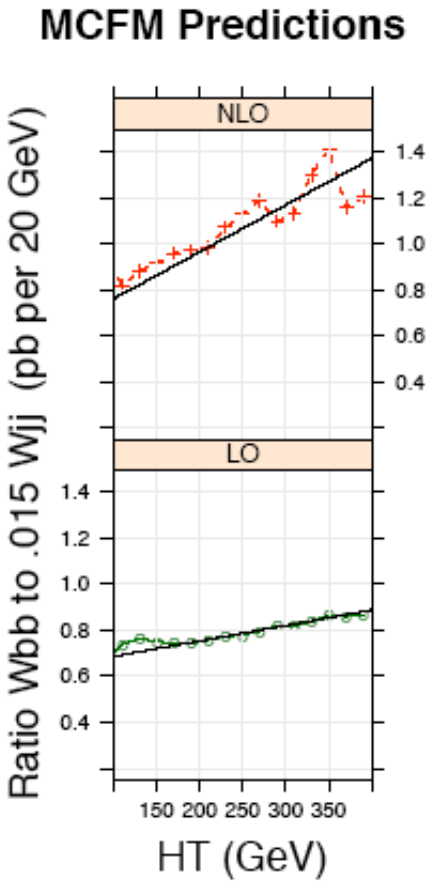
- need to control size of unwelcome logs when interfacing ME and PS
- mlm and CKKW approaches for controlling logs both in use at Tevatron
- A number of talks on both approaches in yesterday's sessions

Steve Mrenna: comparison of MCFM to CKKW

Wbb and Wjj at the Tevatron

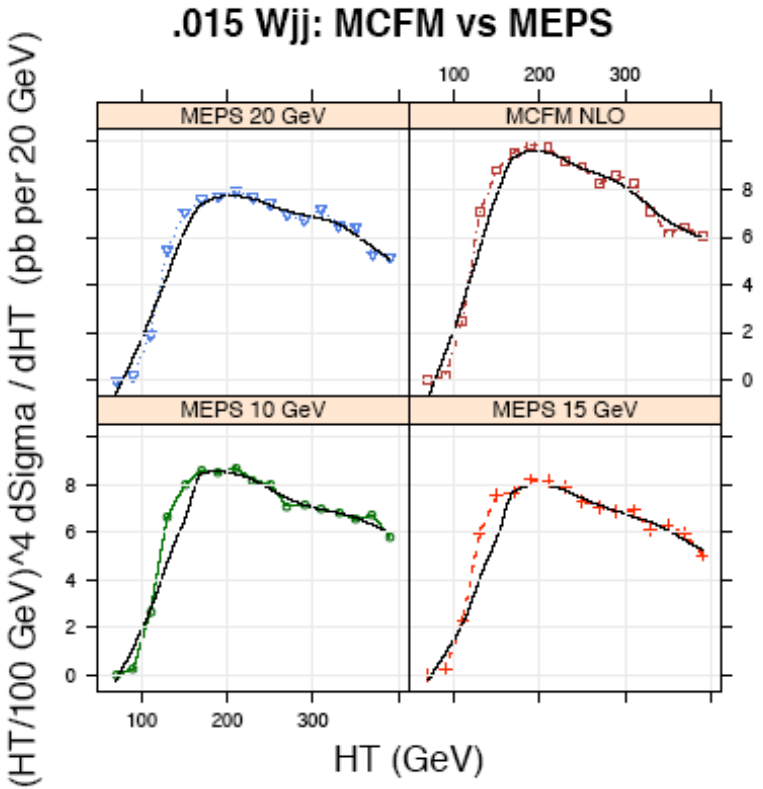
MCFM Campbell and Ellis (see also Campbell & Huston)





Significant change in normalization and shapes LO $\Rightarrow$ NLO

Can understand HO shape changes using CKKW



J. Campbell,
J. Huston,
S. Mrenna
…in progress

Wjj Matched Datasets have less variation with cutoff

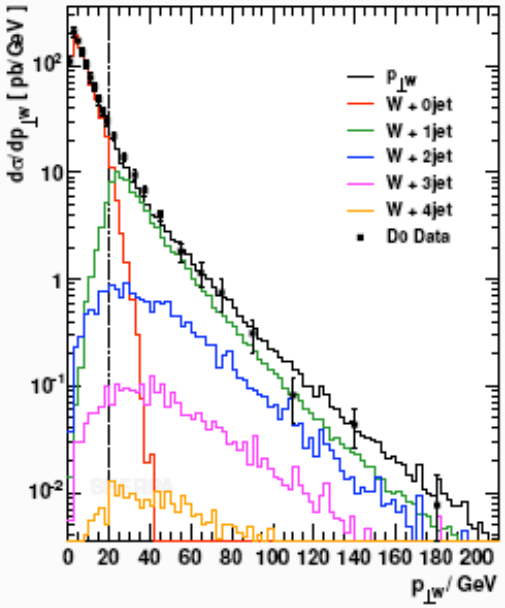
Matched normalization here is smaller (no skipped Sudakov)

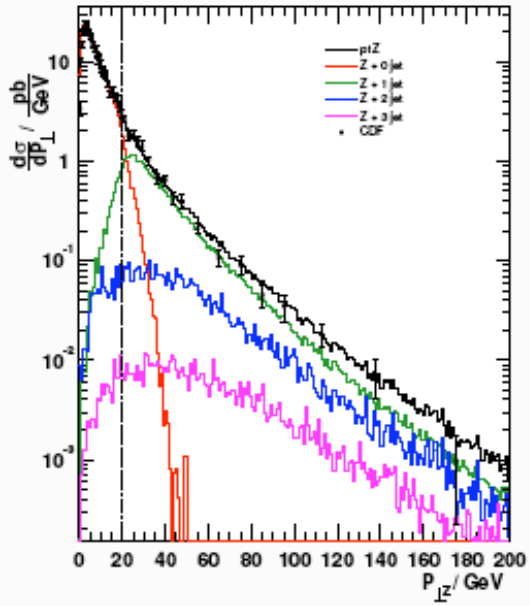
Stiffer shape (HO topologies)

SHERPA: Tanju Gleisberg

Inclusive W and Z transverse momentum distributions from Tevatron Run II

- MEs with up to four (W) or three (Z) extra jets
- momenta smaller than merging scale are sensitive to the details of the PS
- $Q_{cut} = 20$ GeV





D0: Phys. Lett. B **513**, 292 (2001)

CDF: Phys. Rev. Lett. **84**, 845 (2000)

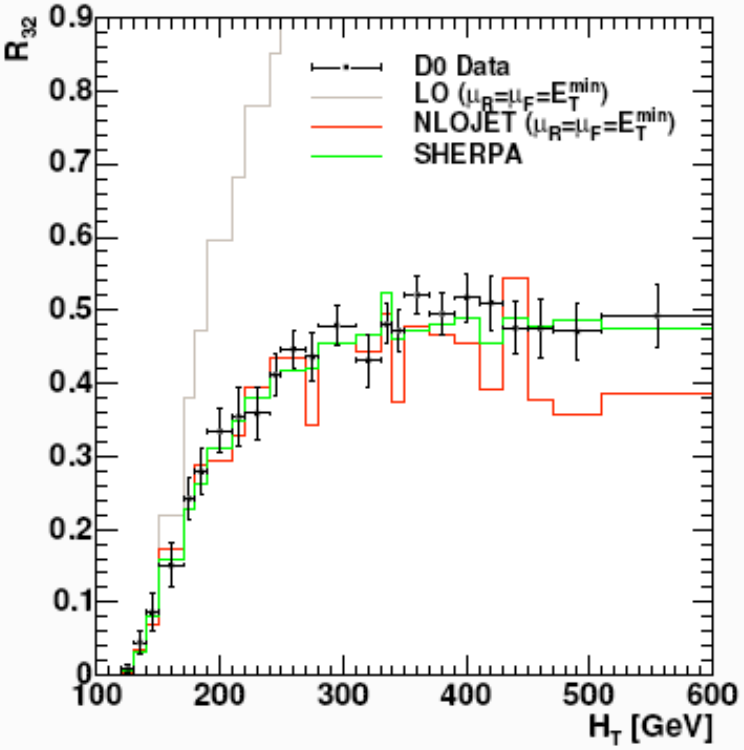
Inclusive jet production in SHERPA

…adding extra jets to 2->2 hard-scatter with CKKW formalism

- Ratio of inclusive 3-jet to inclusive 2-jet cross section

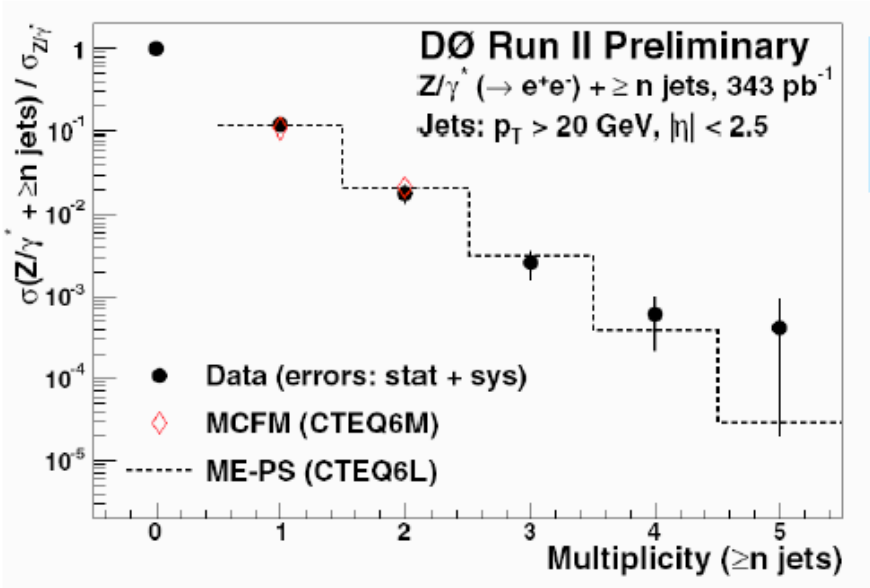
$$R_{32} = \frac{\sigma_3}{\sigma_2} = \frac{\sigma(p\bar{p} \to 2jets + X)}{\sigma(p\bar{p} \to 3jets + X)}$$

- Tevatron, Run I measurement:
  D0: Phys. Rev. Lett. **86**, 1955 (2001)
- $E_{T,jet} > 40$ GeV, $|\eta_{jet}| < 3$
- Jets analysed using a midpoint-cone algorithm (R=0.7)



Z+n jets: Avto Kharchilava

$\sigma(Z/\gamma^* + \geq n \text{ jets}) / \sigma(Z/\gamma^*)$ ratio



Z/γ* inclusive cross section corresponds to $75 < M_{ee} < 105$ GeV

ME-PS: modified CKKW algo. normalized to data at ≥ 1j bin

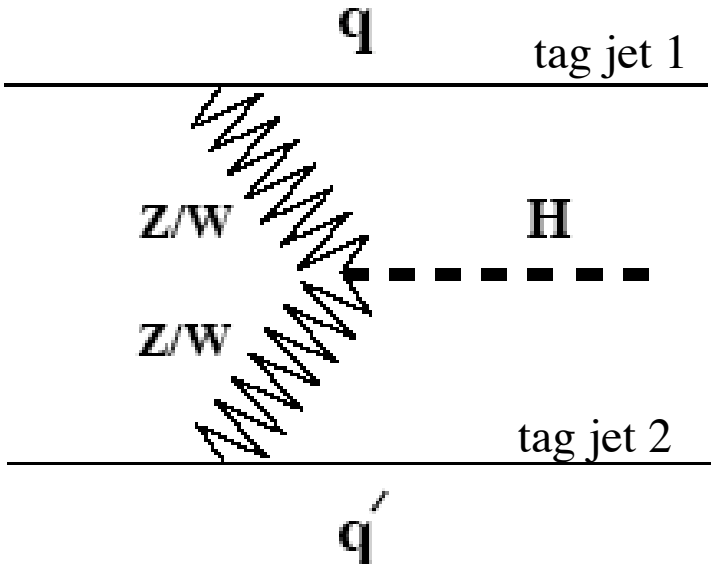
Cross section ratios:

Systematics dominated by uncert. on JES & jet reco*ID eff.

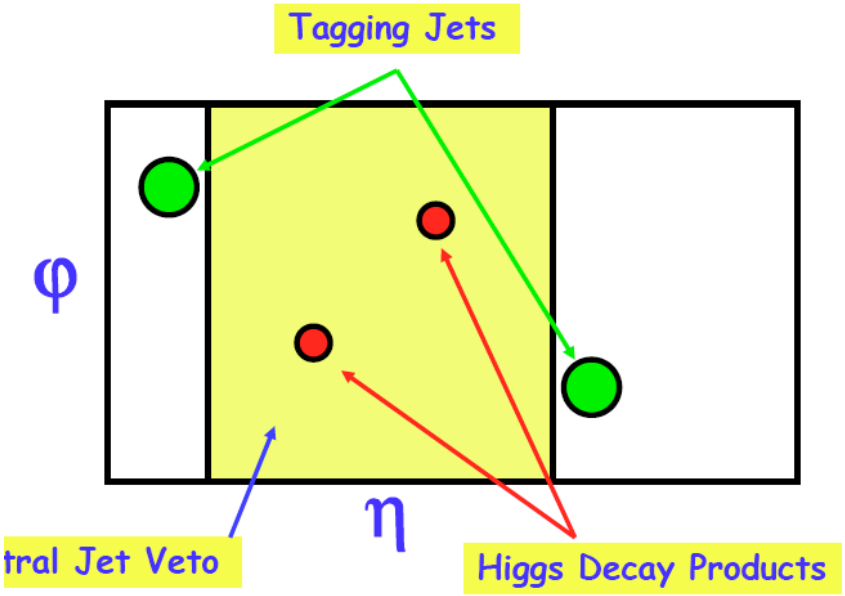
Multiplicity (≥n jets)	$R_n = \frac{\sigma_n}{\sigma_0}$ $[\times 10^{-3}]$	Statistical Uncertainty $[\times 10^{-3}]$	Systematic Uncertainty $[\times 10^{-3}]$
1	119.1	±3.3	+17.2 / -16.2
2	18.1	±1.3	+4.5 / -4.3
3	2.6	±0.52	+0.90 / -0.89
4	0.61	±0.28	+0.29 / -0.27
5	0.42	±0.30	+0.42 / -0.24

WW fusion: the Zeppenfeld plots

- Some of the primary search modes for a Higgs discovery at the LHC proceed through the WW fusion process



- Several different decay modes for Higgs accessible
- Two key features of VBF production:
  - presence of forward-backward tagging jets with large rapidity separation
  - suppression of gluon radiation in central rapidity region between the jets due to color singlet



Backgrounds

- There are sizeable backgrounds to this production process due to W + 2 jets/top production
- See, for example, talk of Dieter Zeppenfeld in first meeting of TeV4LHC; my talk from Dec TeV4LHC WG meeting
- At the Tevatron, Higgs production not accessible through this process, but we can try to understand level of background
  - and in particular effect of a central jet veto
- MC plots here; data comparisions blessed for summer

Background studies

- For W+>= 2 jets at the Tevatron
  - look at $|\eta_1-\eta_2|$ as a function of p_T^{min}
  - compare to MCFM, LO and NLO; ALPGEN/MADGRAPH+ Herwig/Pythia (mlm matching and CKKW)
    - CKKW generated by Steve Mrenna using Madgraph+Pythia
- For W+>=3 jets
  - η_3^* distribution as a function of p_T^{min} and $|\eta_1-\eta_2|$
    - $\eta_3^*=\eta_3-(\eta_1+\eta_2)/2$
  - 3 jet fraction as a function of p_T^{jet3}

Dieter Zeppenfeld; talk at TeV4LHC

Expected (LO) cross sections for 2,3 jets in $W^\pm$ production; B(W → eν, μν) included

$p_{Tj} > 15$ GeV, $|\eta_j| < 3$

	W+2j	W+3j	σ_3/σ_2
$\|\eta_1-\eta_2\|>2$	15 pb	3 pb	19 %
$p_T^{tag}>30$GeV			
$\mu_R = m_W$	3.2 pb	1.4 pb	44 %
$\mu_R = p_{Tj}$	4.2 pb	2.6 pb	62 %
$\|\eta_1-\eta_2\|>3$	0.8 pb	0.37 pb	47 %

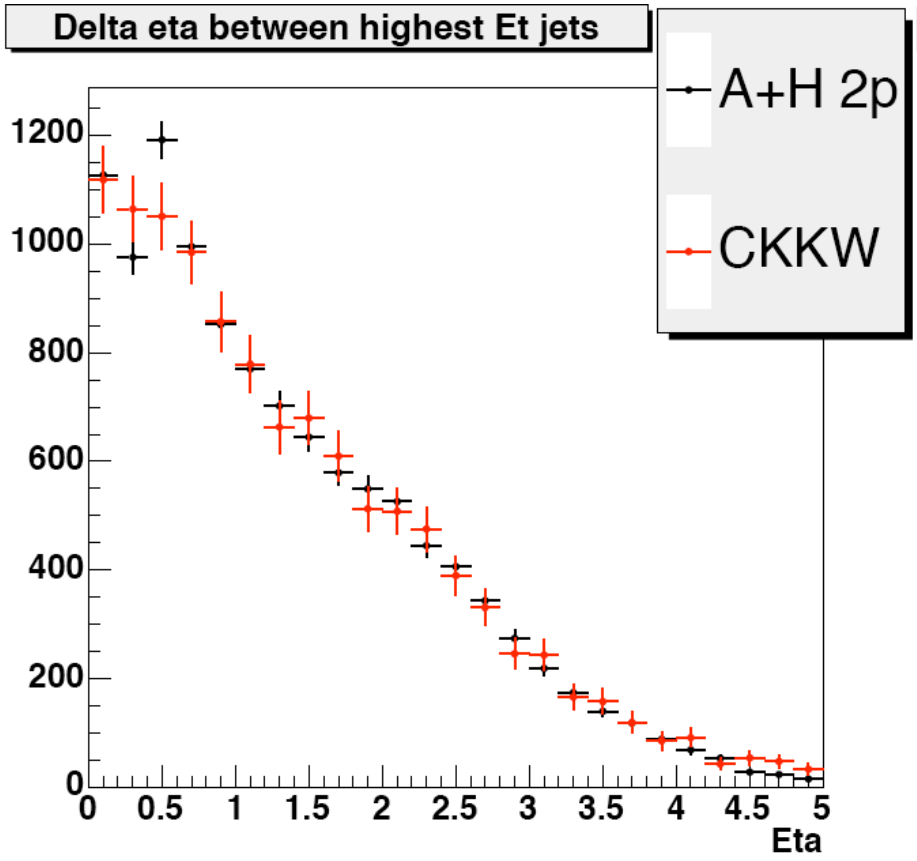
- No NLO calculation for W+3j available → substantial scale dependence
- 3 jet fraction is large → fixed order perturbation theory insufficient

More reliable predictions from parton shower programs?

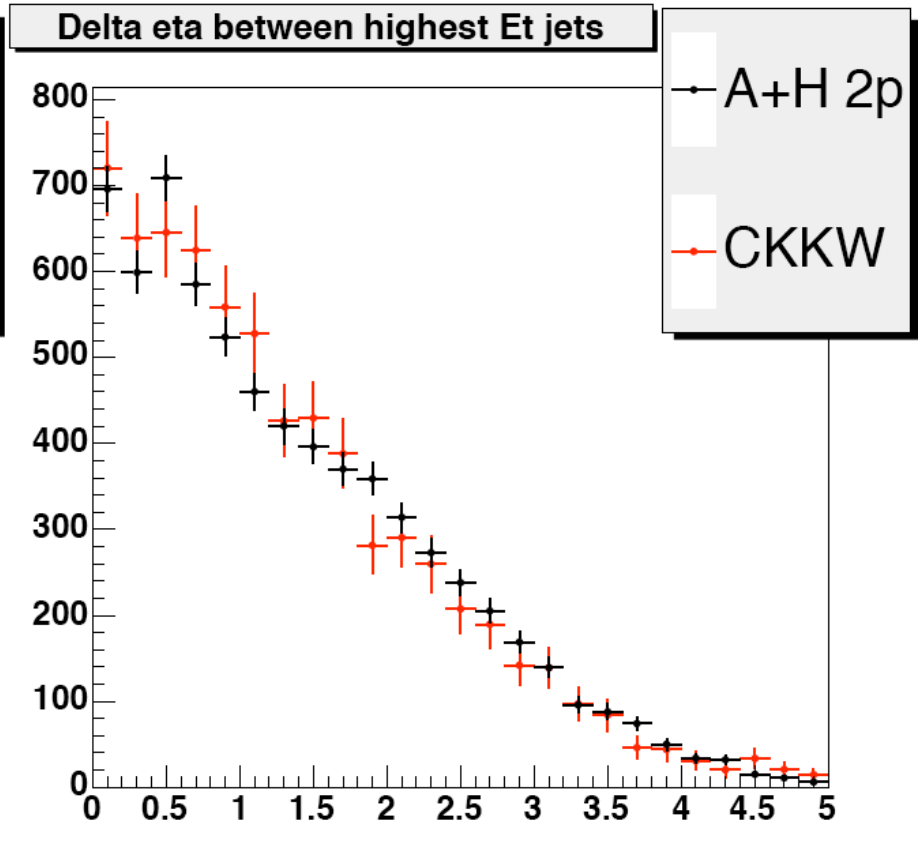
large variation on impact of veto

Δη of tag jet plots: CDF MC

E_T of tag jets > 15 GeV/c



E_T of tag jets > 20 GeV/c

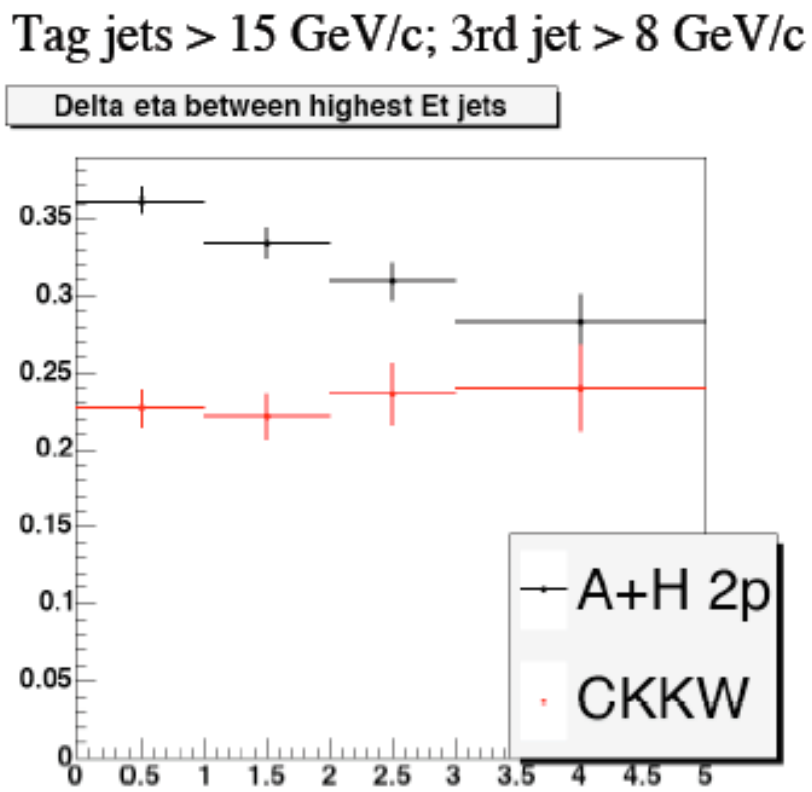


Both A+H and CKKW seem to describe the data reasonably well.

Brief summary of result

- There's a high probability in extra central jets in W+2 jets at the Tevatron
  - good news for WW fusion searches
  - Dieter is happy

  - CKKW describes data best
  - data comparisons will be blessed for summer conferences

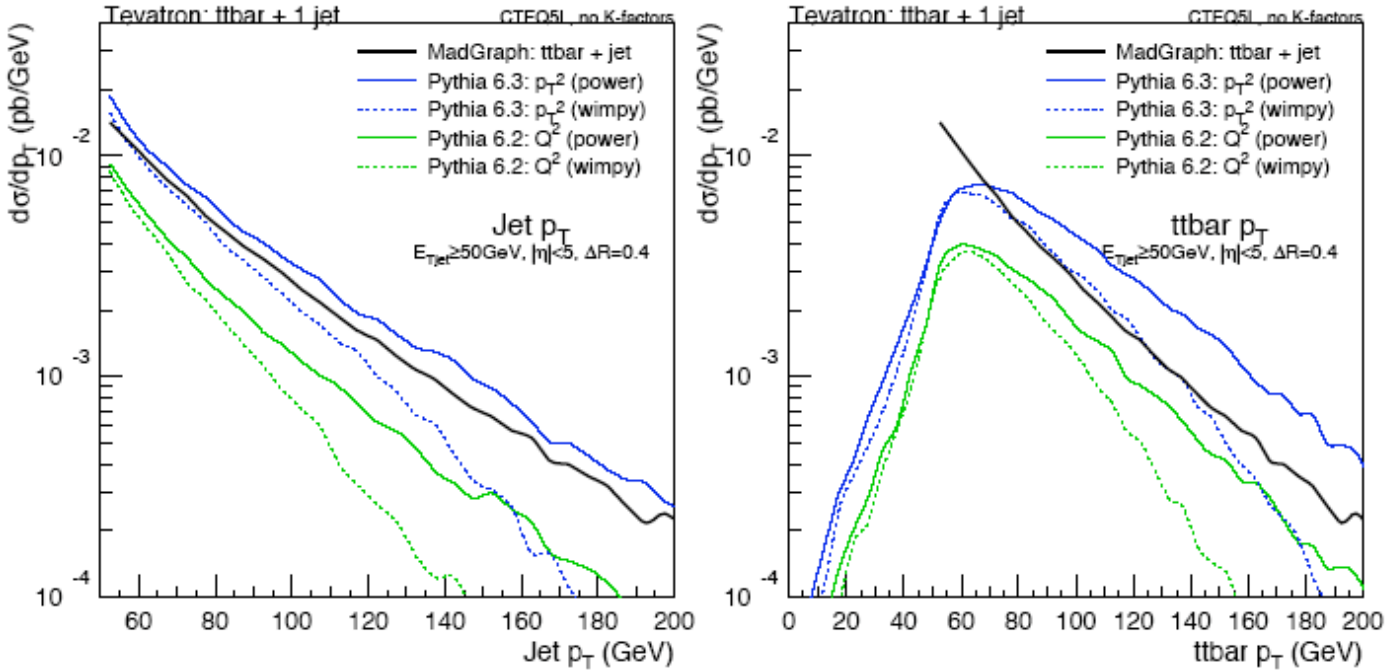


fraction of events with >=2 jets that have **only** 2 jets, i.e. ~75% of events have 1 or more extra jets

Torbjorn Sjostrand: p_T-ordered parton showers

Current test: $t\bar{t}$ production at the Tevatron

Plots and shower studies by P. Skands
MadGraph ME calculations by T. Plehn & D. Rainwater
(publication in preparation)



Parton-level only, no underlying event, no top decays

$E_{\perp \text{jet}} > 50$ GeV, $\Delta R = 0.4$

MCatNLO: Stefano Frixione

Single top production

I don't have physics results to show yet

- With E. Laenen and P. Motylinski
- We played around a bit with the subtraction formalism (Frixione, Kunszt, Signer) upon which MC@NLO is based, to have more flexibility in reducing negative weights (Θ functions have been replaced with smooth functions)
- We will start with s- and t-channels (i.e., no W production), without spin correlations
- NLO code completed on 26/4/05 (perhaps still minor differences wrt ZTOP). We only have to compute a jacobian to go to MC@NLO
- We will use this experience when implementing dijet production

Thanks to Joey Huston for supporting me at HCP2004, where this project was started

MCatNLO: Stefano Frixione

TeV4LHC

Outlook

- Tutorial on MC@NLO at Les Houches (dates not fixed yet, but definitely before 11/5)
- $b\bar{b}$ with hard cuts, then other processes if OK
- Single-t production
- Spin correlations for ZZ, WZ, $t\bar{t}$ (presumably in this order)
- Dijets (start in Les Houches?)
- CKKW $\longrightarrow$ $W + n$ jets ?

http://www.hep.phy.cam.ac.uk/theory/webber/MCatNLO

UE/hadronization topics

1. UE tunes for Tevatron

   ->predictions for LHC

   -understanding color connections and their apparent promiscuity

   -Pythia 6.3

   -Jimmy

   Rick Field, Peter Skands

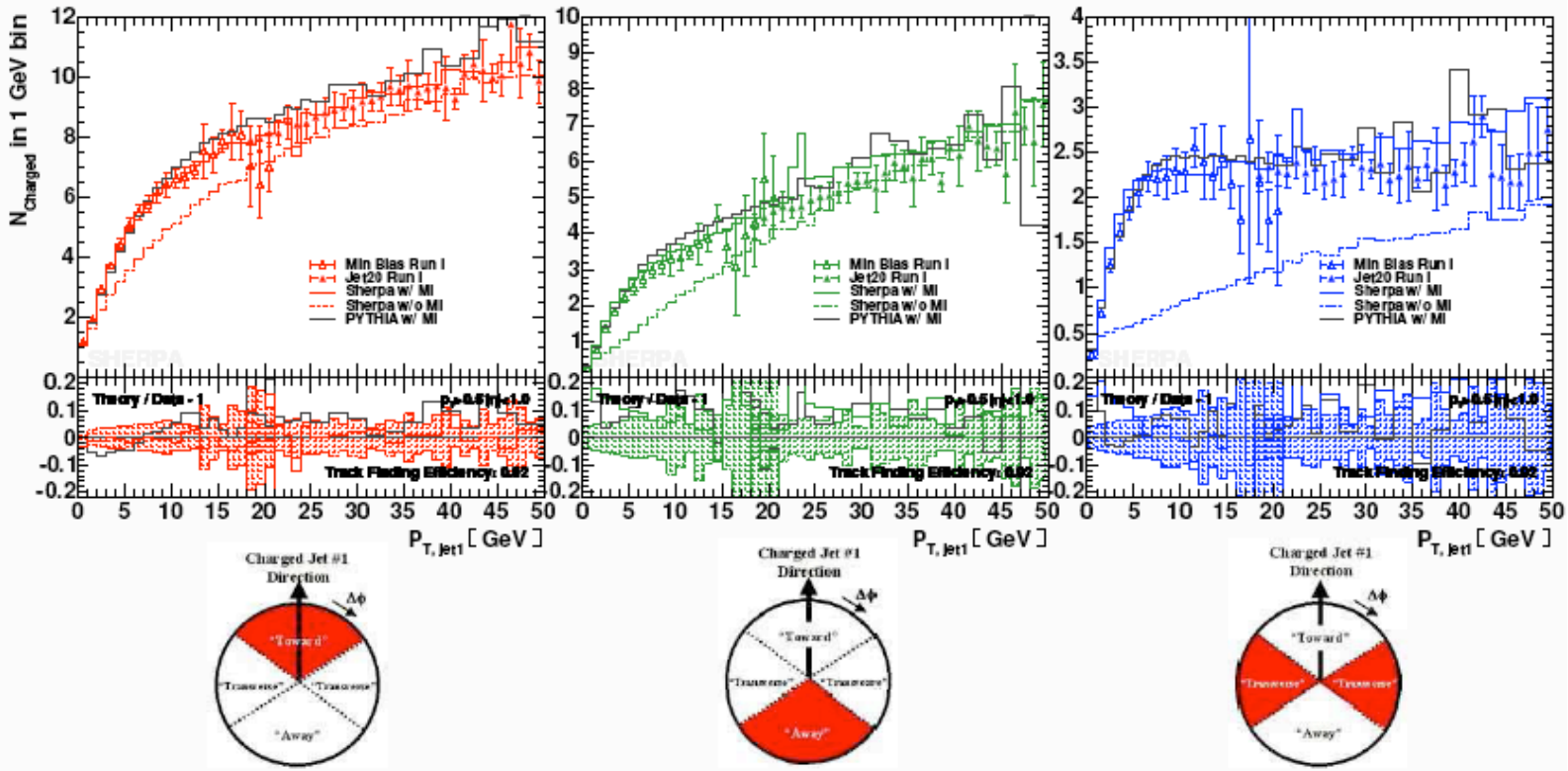
2. hadronization corrections for NLO processes
3. ISR/UE corrections->subtractions for NLO

   Rick Field, Joey Huston

4. understanding high interaction multiplicity environment

- To first order, hadronization corrections are a constant and of order of 1 GeV/c for reasonably high E_T for a cone of 0.7 using Herwig
  - should be checked for other cone sizes, and with other Monte Carlos, i.e. Pythia
  - should be checked for lower values of E_T
  - and we should make a more detailed comparison of parton level jet shape to that from Monte Carlo, data

Stefan Hoeche:SHERPA UE tuning



➡ Charged multiplicity vs. P_T of leading charged particle jet in $\Delta\phi_{\rightarrow \mathrm{jet1}}$ regions [1]

[1] Phys. Rev. D65 (2002) 092002

- MIs included in Sherpa
- MIs combined consistently with CKKW

✓

You're all wondering, How can I enlist?

- Four listserver mailing groups have been set up:

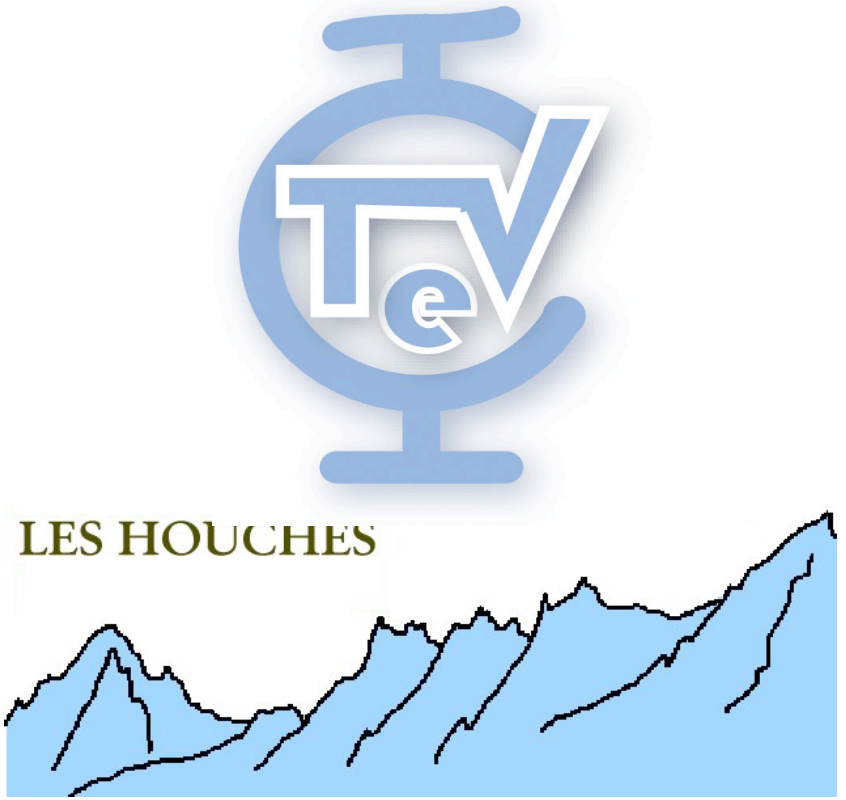
  tev4lhc-qcd
  tev4lhc-higgs
  tev4lhc-topew
  tev4lhc-landscape

- If you would like to subscribe to the working groups, here are the instructions:
  - To subscribe to a mailing list called MYLIST

    1. Send an e-mail message to listserv@fnal.gov
    2. Leave the subject line blank
    3. Type "SUBSCRIBE MYLIST FIRSTNAME LASTNAME" (without the quotation marks) in the body of your message.

Les Houches workshop

- Physics at TeV Colliders
  - *From 800 pb^{-1} at the Tevatron to 30 fb^{-1} at the LHC*
  - May 2-20
    - right after CERN meeting of TeV4LHC
- 2 main working groups
  - SM and Higgs
  - BSM and Higgs modeling



plan is to continue work from TeV4LHC …one example is inclusion of jet production in MC@NLO