Update on CR Systematics

There is a lot of activity from the PYTHIA team to tune the new generator (V6.4) with existing data. (see Perugia, Oct. 2008). Used LEP data :event shapes, fragmentation functions and flavor spectra.

The flavor and hadronization parameters are tuned for the new P_T ordered shower. New UE and MPI model parameters not tuned. (Done for old Q^2 ordered parton shower).

Some comparison to Tevatron data was shown $p_T(Z)$ and single jet distributions. The tuning is going on. The parameters are not stable, it is a moving target!

Nathan (thank you!) has generated ttbar events with the Perugia tunes, called “pro”. We look at these today.

Procedures

Use the l+jets sample: events with 1 lepton + 4 jets (Et>20 GeV)

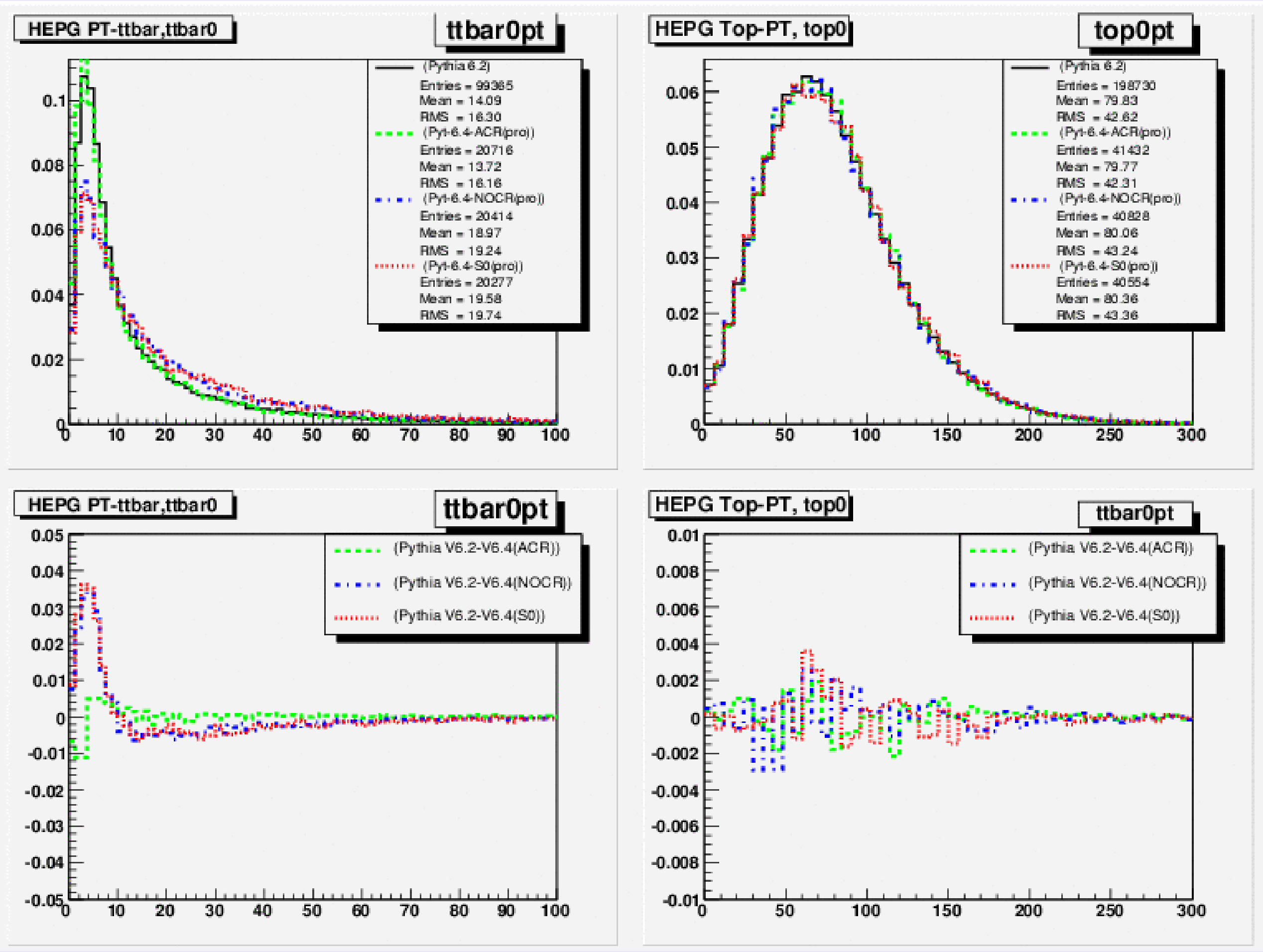
A. Given a MC sample, for each event we match the partons from top decays to the observed jets (Ntight = 4)
We then know which jet is light quark jet and which ones are b-jets.
We correct the jets at L5 (no out of cone correction)
To check the changes between the 2 MC's we do the following:

- Compare Pt5/Pt(parton) and dE in cone of R=0.4
- We calculate M(W) and M(top) using the matched jets

B. We apply to each sample the top mass measurement analysis to obtain a mass and an uncertainty.

- For methods A and B, we compare results obtained for
  V6.2(tune A) old MC (used for CDF measurements)
  V6.4 (tune ACR) only CR added to old shower
  V6.4 (tune NOCR, S0) new shower, wo/w CR

P_T(ttbar) and P_T(top) at parton level



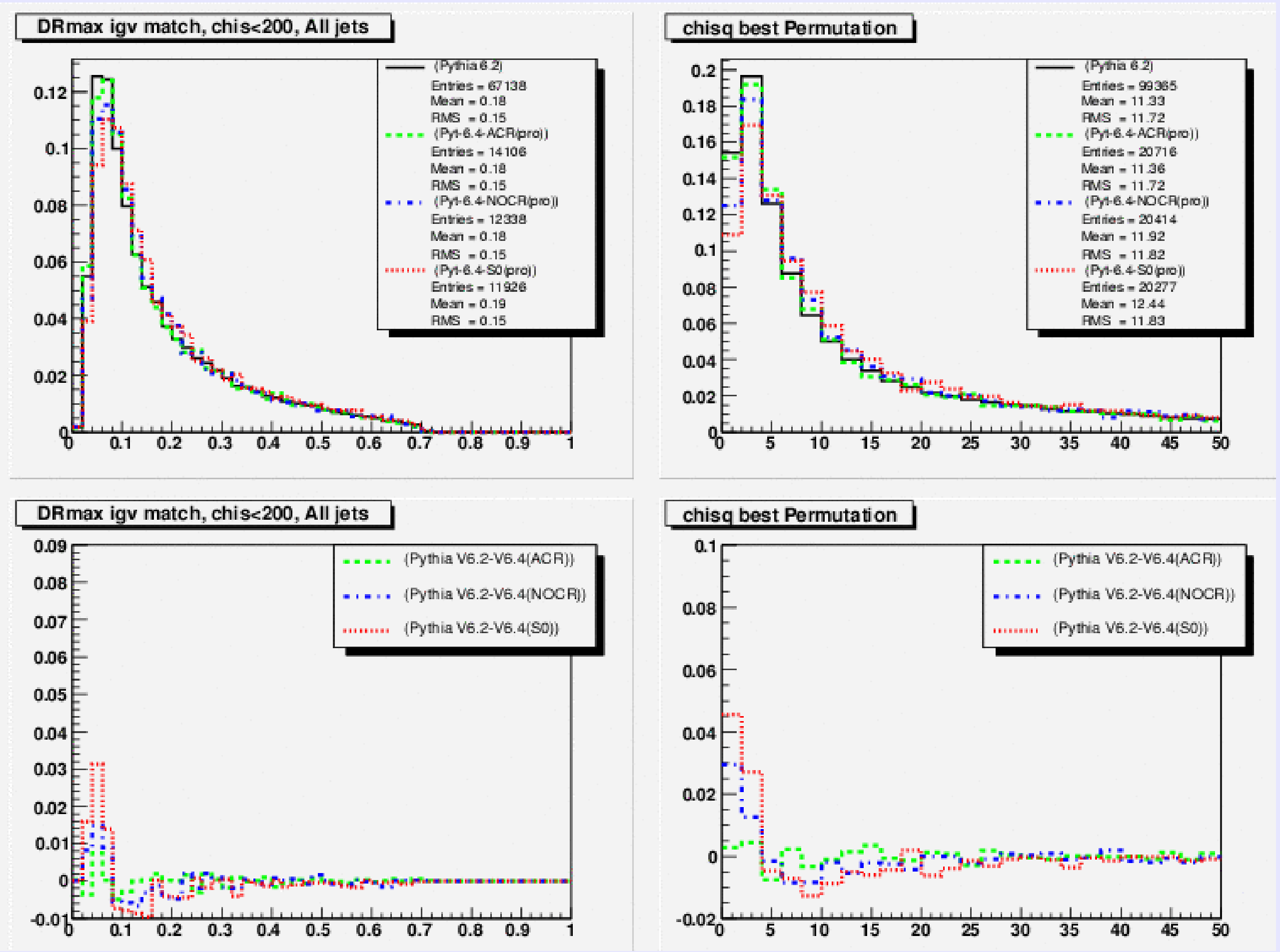
M=175 GeV
V6.2 (tune A)
V6.4 ACR
V6.4 NOCR
V6.4 S0

P_T (ttbar) for the new shower tunes is wider as advertised, ACR is still close to the old distribution. Not clear if the parameters we use are correct

P_T(top) is not affected much by the new modeling.

Comparison of matching

The whole event is matched using ΔR for each parton-jet pair. An overall χ^2 is calculated, best $\chi^2 < 200$ are accepted as matched



M=175 GeV

V6.2 (tune A)	68%
V6.4 ACR	68%
V6.4 NOCR	60%
V6.4 S0	59%

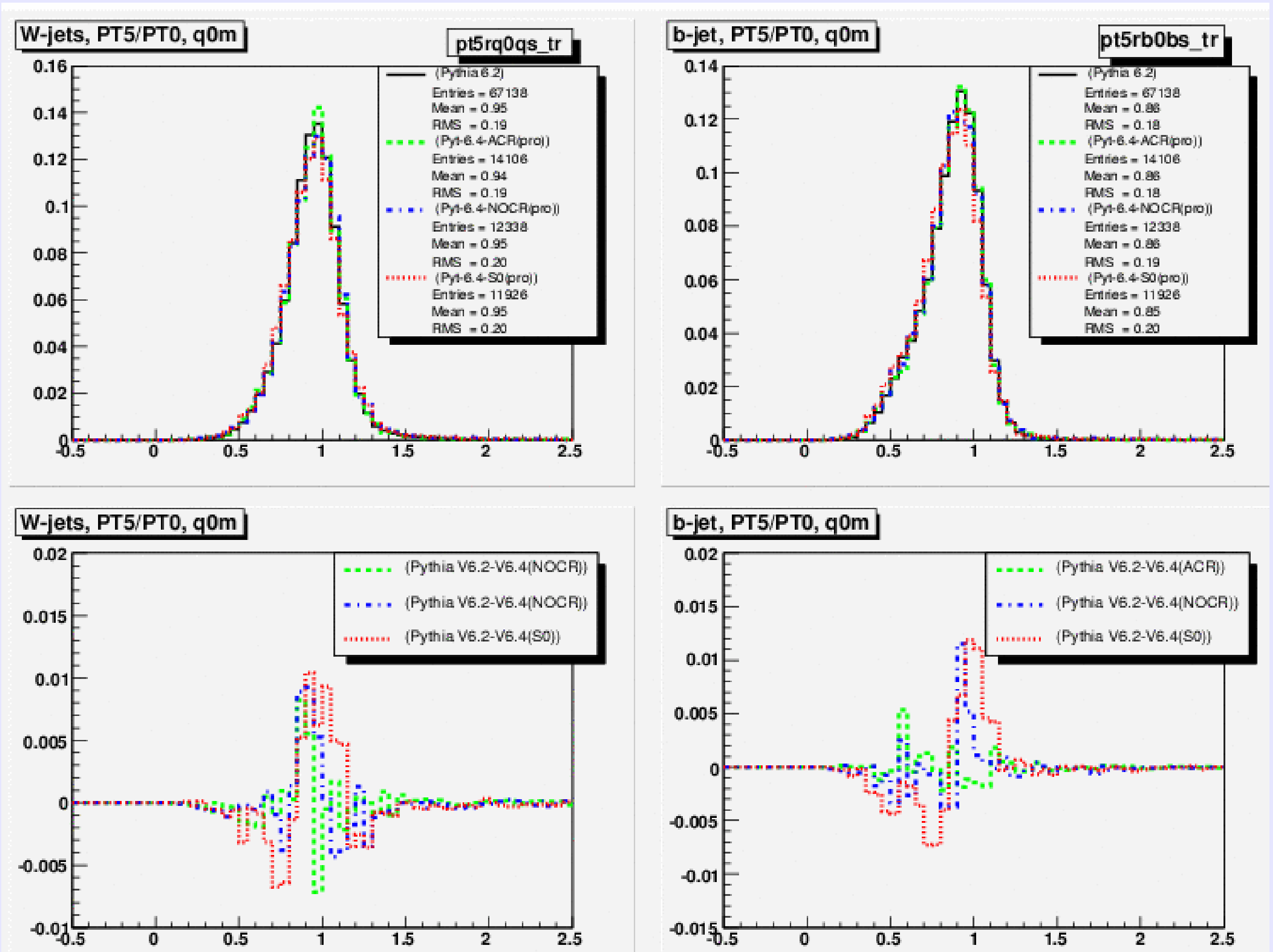
Samples with the newer tunes (NOCR and S0) have:

wider χ^2 distributions

wider ΔR "

Jets in NOSR and S0 tunes are more displaced from the partons.

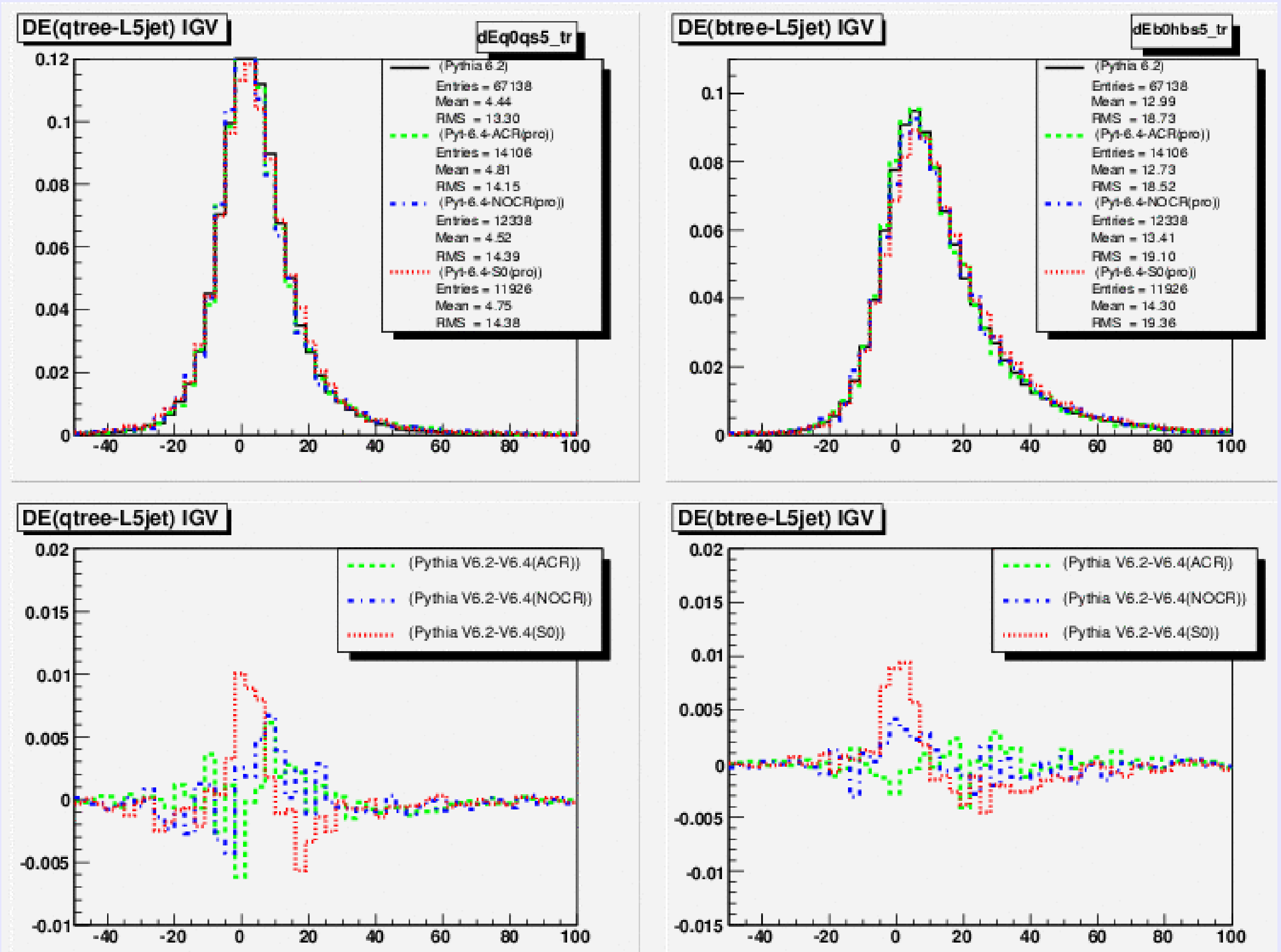
P_T(jet)/P_T(parton) for jets in top events



M=175 GeV
V6.2 (tune A)
V6.4 ACR
V6.4 NOCR
V6.4 S0

Distributions for V6.4 tune S0 look a bit wider (PT(jet)/PT(parton) smaller) and shifted for the b-jets

δE= E(parton)-E(jet) in cone ΔR=0.4



M=175 GeV
V6.2 (tune A)
V6.4 ACR
V6.4 NOCR
V6.4 S0

Plots show difference between the top curves:
δE(V6.12)
-δE(new tunes)

For the S0 tune, there is less energy in the cone of ΔR = 0.4

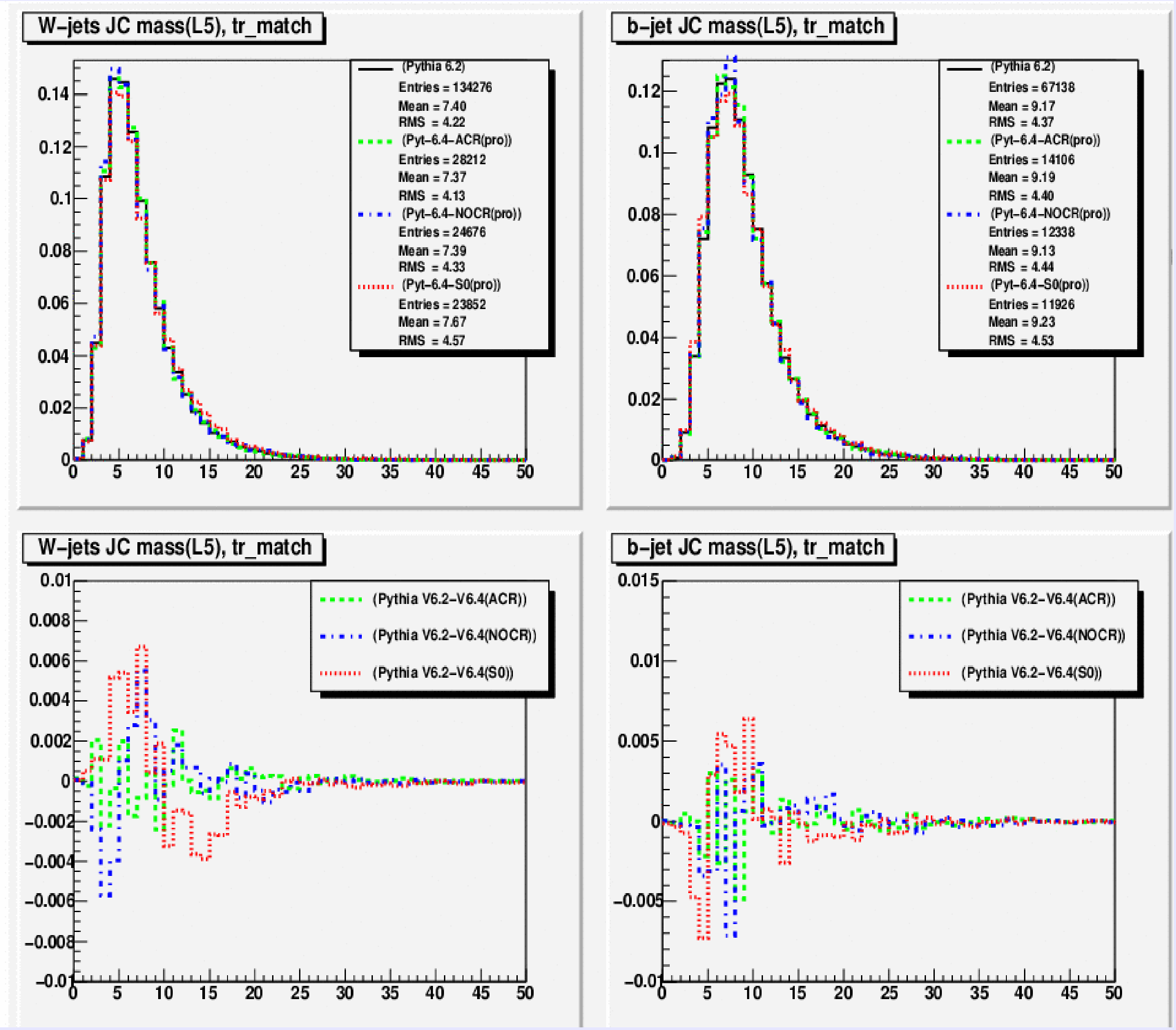
What did we learn about jets?

	MC samples at M = 175 GeV/c^2					
Sample	Jets from W			b Jets		
	PT	dE(part-jet)	Δ(dE)	PT	dE(part-jet)	Δ(dE)
	GeV/c	GeV	GeV	GeV/c	GeV	GeV
V6.2 (nominal) (ttkt75)	56.0	4.44±0.05	–	71.6	13.0±0.07	–
V6.4 tune A (otop45)	56.5	4.69±0.11	0.25±0.13	71.6	13.13±0.16	+0.17±0.17
V6.4 ACR (otop46)	56.0	4.81±0.12	0.37±0.13	71.4	12.7±0.16	-0.26±0.17
V6.4 NOCR (otop47)	56.3	4.52±0.13	0.08±0.14	72.2	13.4±0.16	0.58±0.18
V6.4 S0 (otop44)	56.2	4.65±0.13	0.31±0.14	72.1	14.3±0.18	1.31±0.19

- The jets are wider in S0, i.e. less energy in a cone of 0.4 radius. We get on the average b-jets with a shift of -1.3 GeV.
- The ACR case has smaller effects than S0
- The NOCR shows less visible effects than S0 (-0.58 GeV b-jet shift)

Tunes with the new parton shower give jets with less energy in cone of ΔR =0.4

Comparing Jet mass



M=175 GeV
V6.2 (tune A)
V6.4 ACR
V6.4 NOCR
V6.4 S0

Jet masses are different as well

Summary of jet findings

Shifts in P_T, E and jet mass in a cone of ΔR=0.4

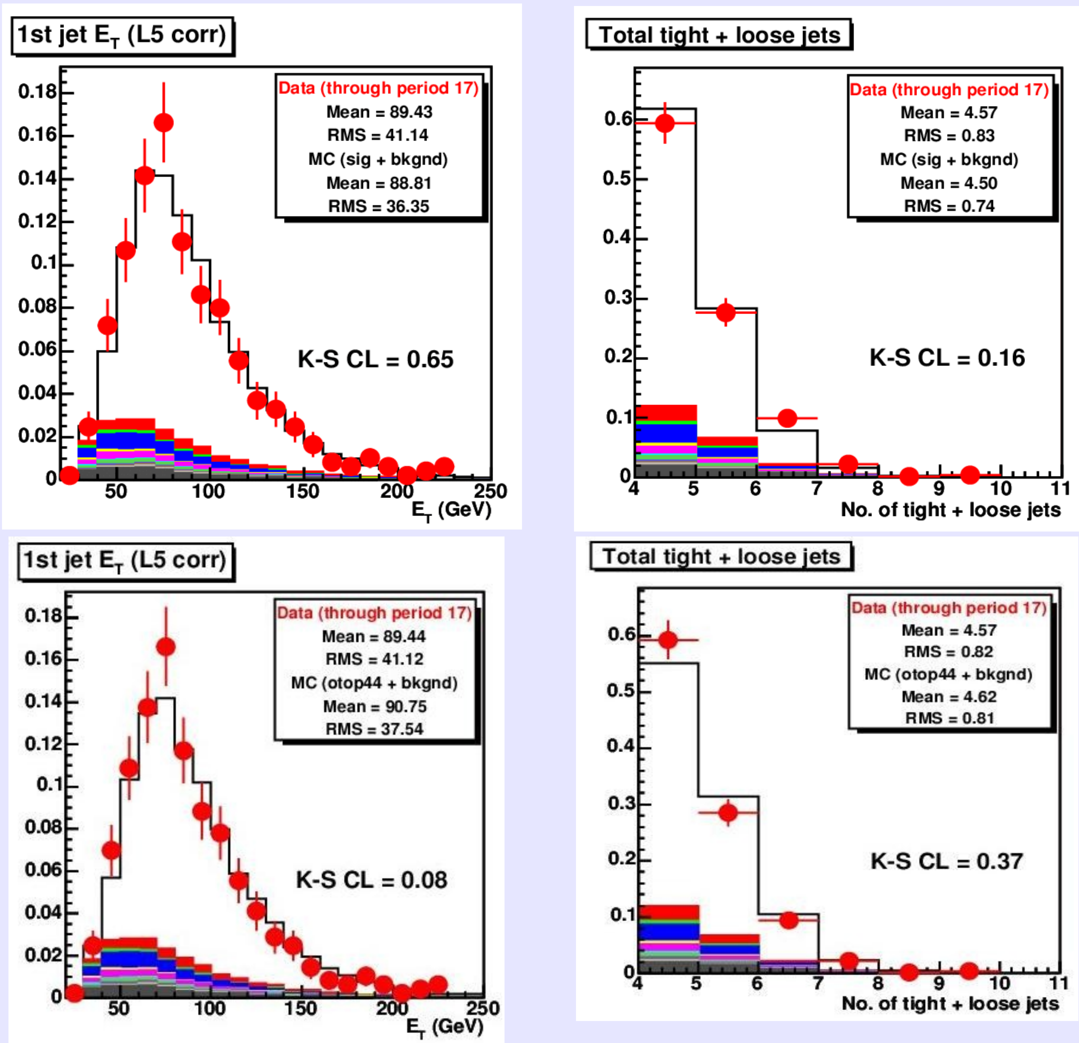
(values in red are shifted by >2σ)

	What	W-jets	b-jets
Nominal-S0-pro	$\Delta(P_T)$ (GeV)	$+0.16 \pm 0.30$	-0.72 ± 0.33
Nominal-S0-pro	$\Delta(E)$ (GeV)	-0.31 ± 0.14	-1.33 ± 0.19
Nominal-S0-pro	$\Delta(M)$ (GeV)	$+0.27 \pm 0.03$	$+0.20 \pm 0.04$

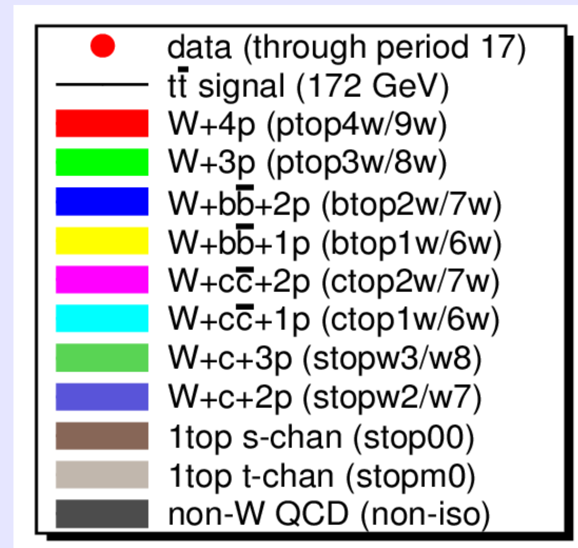
- For tune S0 we observe large shifts in the energy and mass of jets.
- The b-jets seem to be more affected than the light quark jets

Data-MC comparison V6.2 and 6.4

CDF Data (494 events in 2.7 fb-1), not enough to distinguish!



PYTHIA V6.2

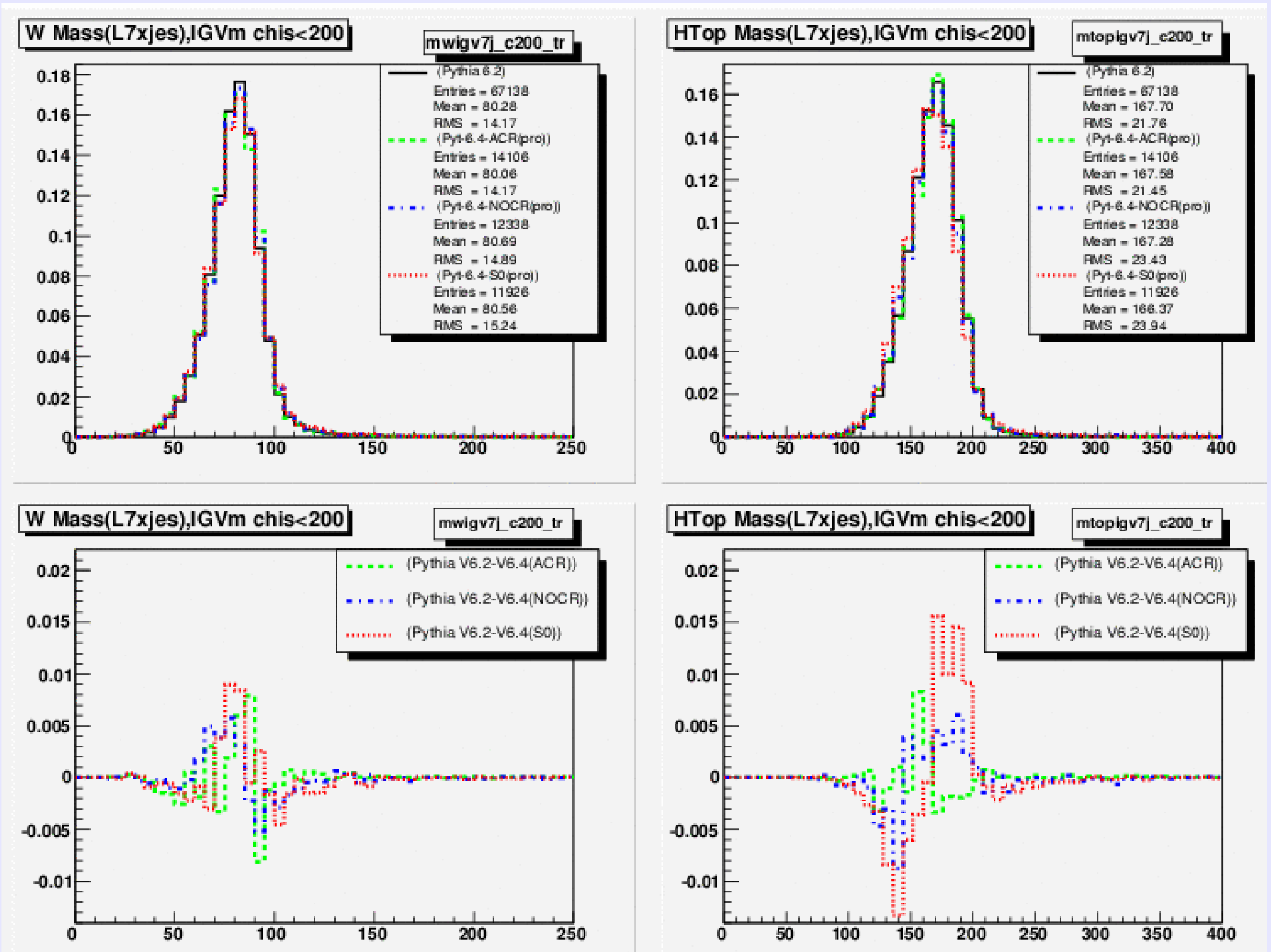


PYTHIA V6.4 (S0)

Highest E_T jet: there is a 2 GeV difference between the two MC samples

Reconstructed W and top masses

Using event matching we find:



M=175 GeV
V6.2 (tune A)
V6.4 ACR
V6.4 NOCR
V6.4 S0

M_W is somewhat shifted . M_{top} shifted for both the NOCR and the S0 samples

Summary of studies on M_{top}

Comparison of V6.2 (nominal) to V6.4 (the "pro" files)
Using both methods, i.e., reconstructing top mass with our ME method.

	MC event matching		MTM3 Pseudo-Exp		
Sample	Δm_W (GeV/c^2)	Δm_t (GeV/c^2)	m_t (GeV/c^2)	Δm_t (GeV/c^2)	Δ_{JES} (σ)
	MC samples at M = 175 GeV/c^2				
V6.2 (nominal) (ttkt75)	–	–	175.03±0.22	-	0.01±0.05
V6.4 tune A (otop45)	-0.13±0.13	-0.12±0.20	175.21±0.22	+0.18±0.31	0.03±0.05
V6.4 ACR (otop46)	-0.22±0.14	-0.12±0.21	174.70±0.22	-0.33±0.31	0.07±0.05
V6.4 NOCR (otop47)	+0.41±0.14	-0.42±0.22	173.75±0.23	-1.28±0.32	0.21±0.05
V6.4 S0 (otop44)	+0.28±0.15	-1.33±0.23	173.30±0.33	-1.73±0.30	0.11±0.05

- ACR (old shower+CR) shows little effect from CR = -0.33 ± 0.31 GeV
- NOCR: Event matching finds large ΔM_W, ME fit compensated for this with a large value of Δ_{JES}, resulting in ΔM_{top} = -1.3 GeV
- S0 : ΔM_{top} = -1.7 GeV, expected because of -1.3 GeV b-jet shift. comparing NOCR and S0, we find CR (sys)= -0.45 ± 0.46 GeV

Summary

- We find the following CR values :
  -0.33 $\pm$ 0.31 GeV from ACR
  -0.45 $\pm$ 0.46 GeV from S0-NOCR, consistent with zero, <0.46 GeV

- The S0 tune gives ΔM_{top} = -1.7 GeV
  this is directly related to different jet shapes, i.e., different p-shower

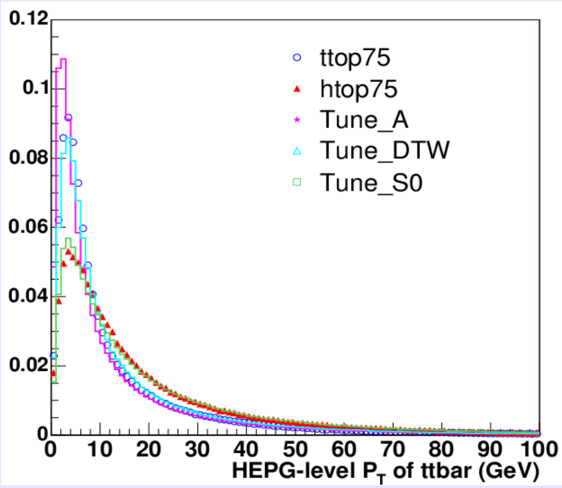
- Tune S0 includes systematics that we are already taking into account ,i.e.
  - generator: $\Delta(m_t)$ = 0.51 $\pm$ 0.37 GeV
  - ISR/FSR: $\Delta(m_t)$ = 0.29 $\pm$ 0.26 GeV
  - OOC : $\Delta(m_t)$ = 0.52
  - b-jets : $\Delta(m_t)$ = 0.38

  that is, most MC related systematics (0.87 GeV)

- More comparison of the S0 tune with Tevatron data need to be done before we use it. We also need to disentangle the various sys contributions

Backup slides

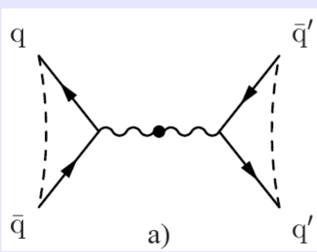
Monte Carlo Issues: P_T(ttbar)



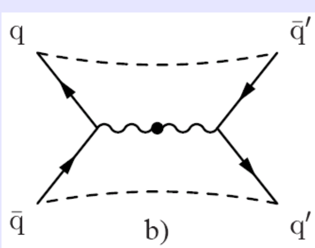
Discussions with the PYTHIA authors were motivated by the disagreement of the p_T(ttbar) distribution between PYTHIA and HERWIG

Solution: PYTHIA V6.4, tune S0, gives a correct p_T(ttbar) distribution. However, V6.4 includes color reconnection (CR) effects, not present in V6.2.

CR effects at LEP, W mass



CR effects on the MW measurement at LEP contribute to systematics

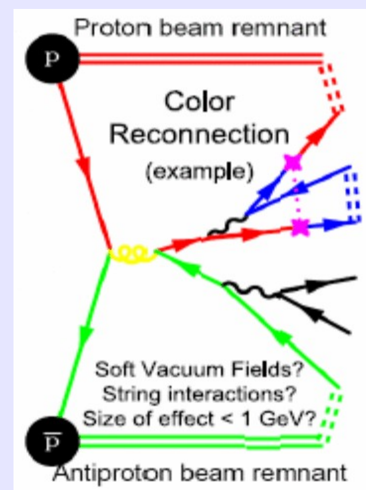


CR(sys) = 8 MeV

out of 22 MeV (total sys)

(LEPEWWG hep-ex/061203)

CR at the Tevatron

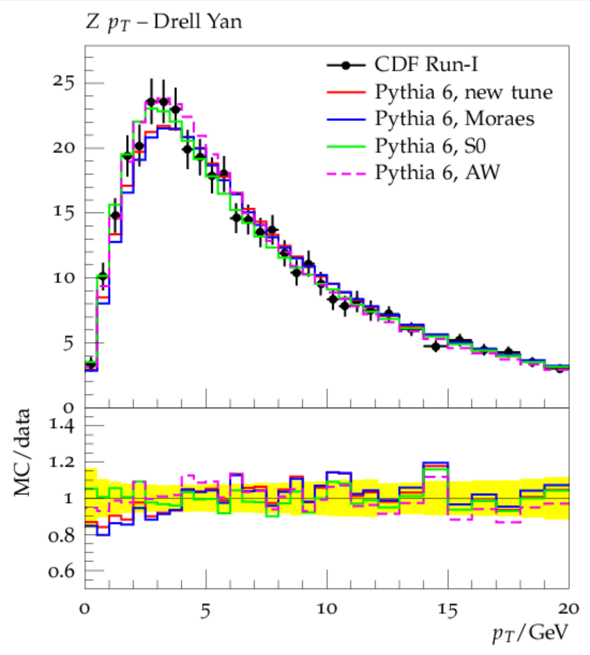


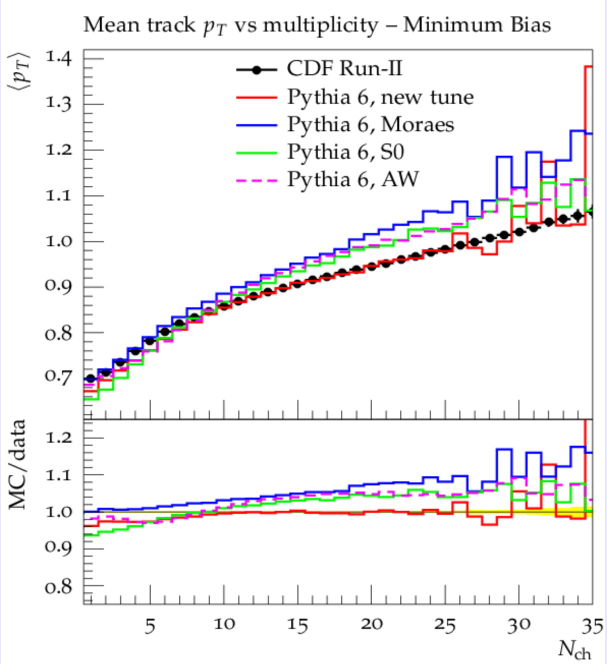
Systematics on top mass can be as large as 1 GeV

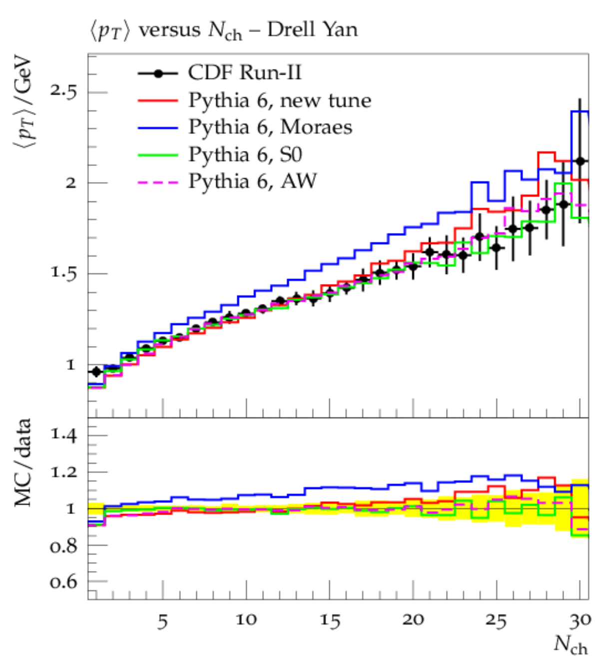
Some Tevatron plots with new tunes

From Hendrix Hoeth talk (Perugia 2008). New tunes (called professor from tools used) use LEP data: event shapes, fragmentation functions and flavor spectra. The flavor and hadronization parameters are tuned for the new P_T ordered shower. New UE and MPI model not tuned. (Done for old Q^2 ordered parton shower).

Some comparison with Tevatron data has been shown at Perugia Tune S0 (used by CDF), Tune Moraies (used by ATLAS).

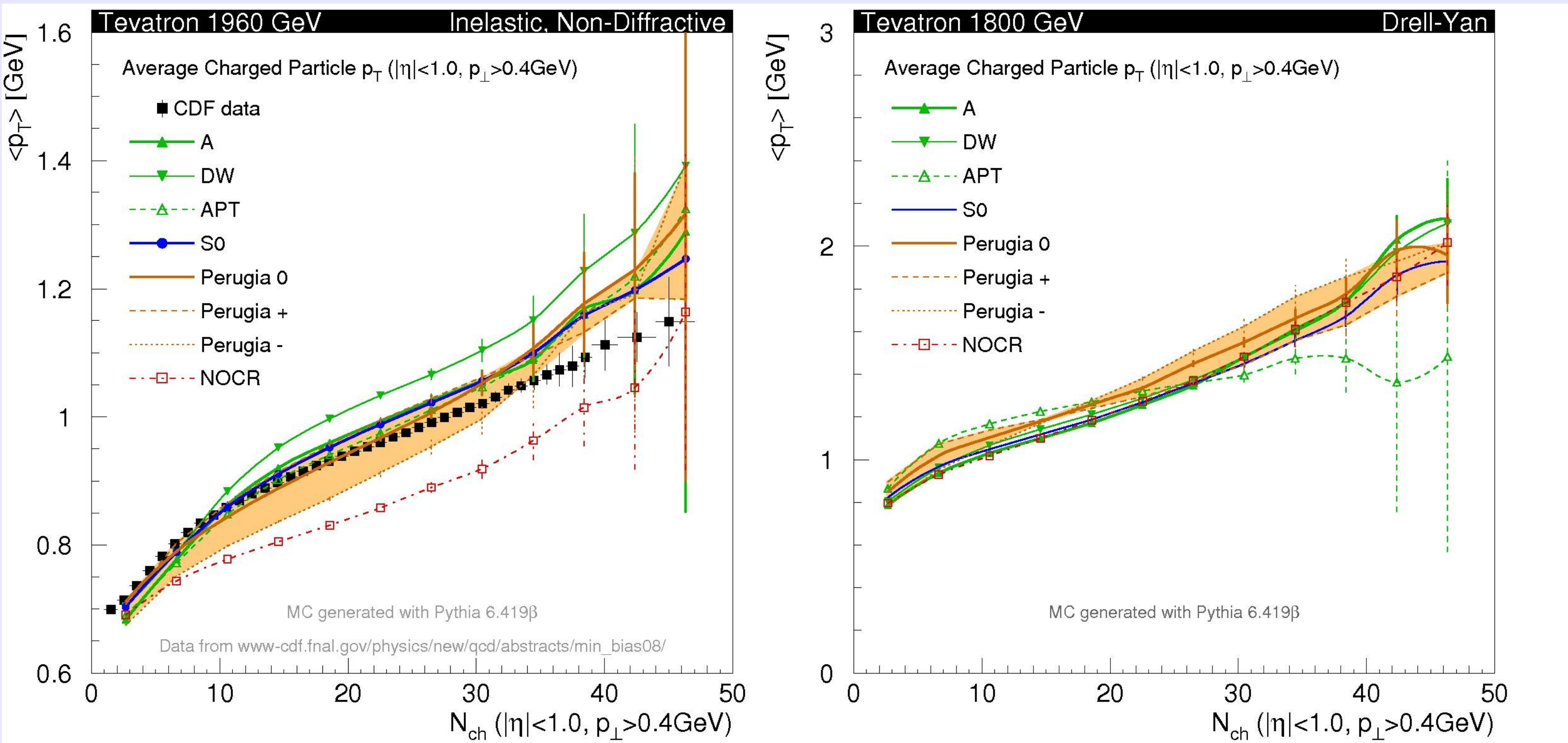






Perugia Tunes

- Perugia tunes of new model, using Tevatron 630/1800/1960 GeV data
  - Average track pT as a function of multiplicity: sensitive probe of CR?
  - Used to fix CR strength parameter in tunes



Data from CDF, N. Moggi et al., 2008

From Peter Skands talk at Perugia

Mass systematics

Residual JES is mostly due to OOC systematics

Without the calibration systematics, the MC Dependent sys are 0.87 GeV

Systematic source	Δm_t (GeV/c^2)
Calibration	0.14
MC generator	0.51
ISR and FSR	0.29
Residual JES	0.52
b-JES	0.38
Lepton P_T	0.18
Permutation weights	0.01
Pileup	0.09
PDFs	0.17
Background: fraction	0.36
Backg: composition	0.18
Backg: average shape	0.03
Backg: Q^2	0.08
Backgrounf:MC statistics	0.05
Total (MC Dependent)	1.01 (0.88)