Update on Color Reconnection Studies

What have we learned about CR over the last year or so?

The new version of PYTHIA V6.4 has a new parton shower in addition to color reconnection effects.

Present systematic uncertainty on the top mass is 0. 3 GeV from color reconnection effects.

However, using the new PYTHIA tune Perugia0, we find a mass shift of 1.6 GeV.

The question then is: is the new parton shower more in agreement with the data then the old one? If so, we would have to take the whole 1.6 GeV as a systematic uncertainty.

We will review the situation with the large statistics MC samples at 172.5 GeV and using tagged b-jets in the data. Brief update today.

Comparison of PYTHIA V6.2-V6.4

Comparison at the event level

Given a MC sample of lepton +jets top events, we can match the simulated jets with the initial partons. The algorithm uses only the DR between the parton and the jets, calculates an overall chisq for the event and applies some chisq cut. (Used by the MTM3 analysis).

From event matching we get the following results:

Matching events:

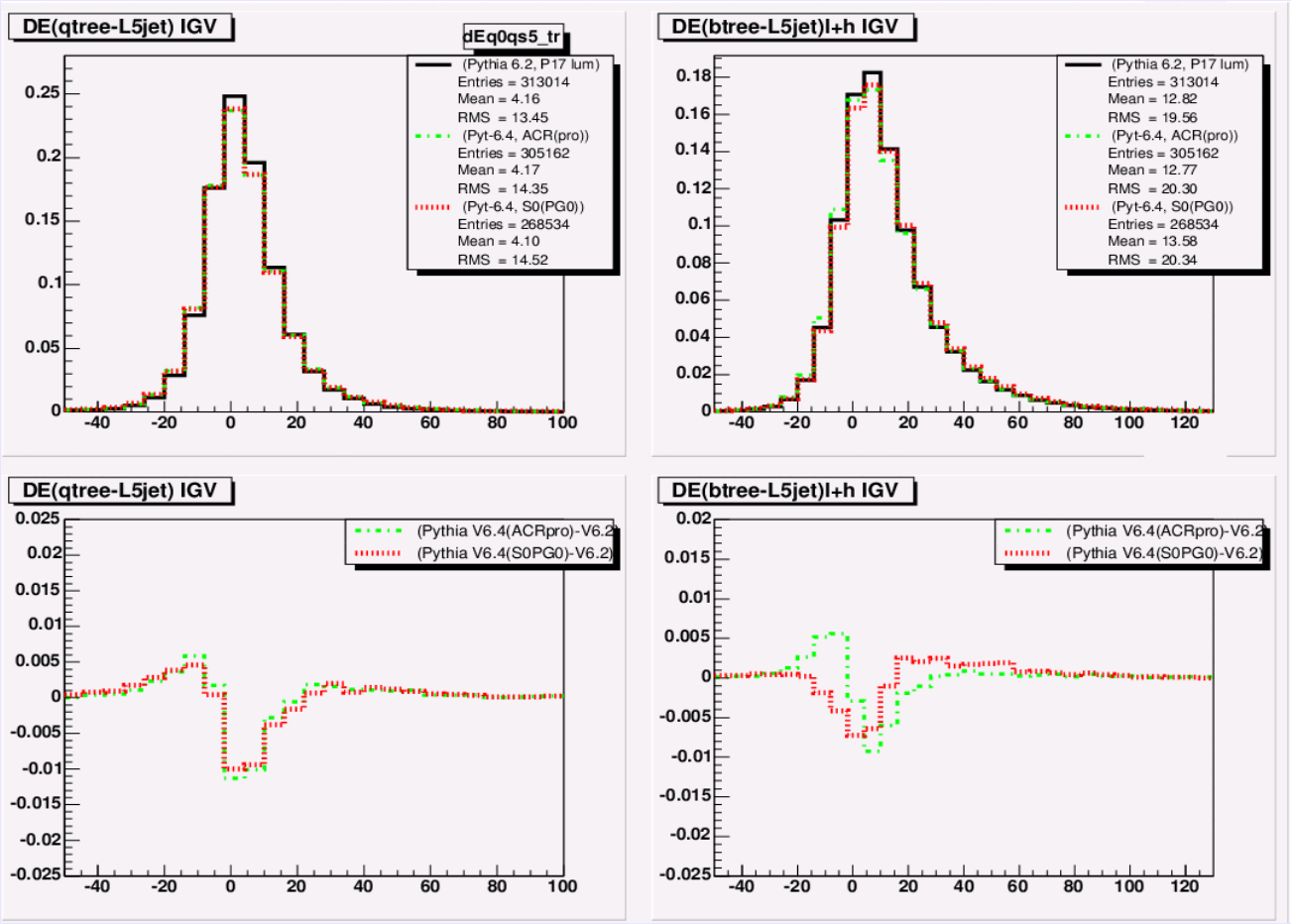
V6.2 (tune A)	68%
V6.4 ACR	68%
V6.4 NCR-Pg0	59%
V6.4 S0-Pg0	59%

The event topology for tunes with new parton shower is different than the V6.2 one. More ISR or FSR?

Comparison: E in cone of 0.4

Using the matching we can compare the difference of the energy in a cone of 0.4 that we obtain for the different MC.

D E = D (E(parton)-E(cone))



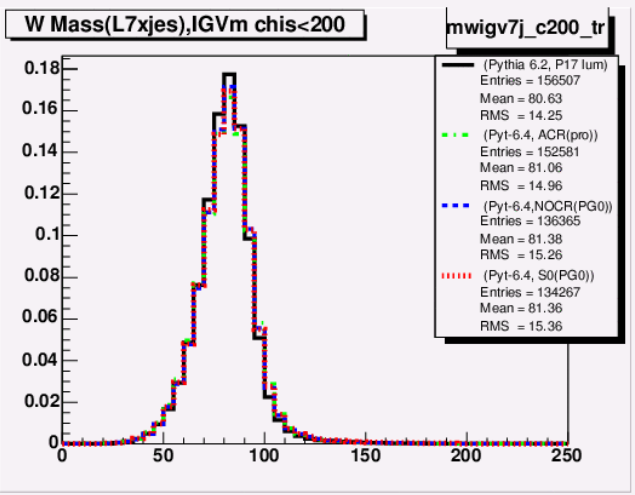
S0Pg0 -Nominal
175 GeV(less stat)
Δ (ΔE) (cone) GeV
W-jets -0.40+-0.12
b-jets -1.20+-0.16

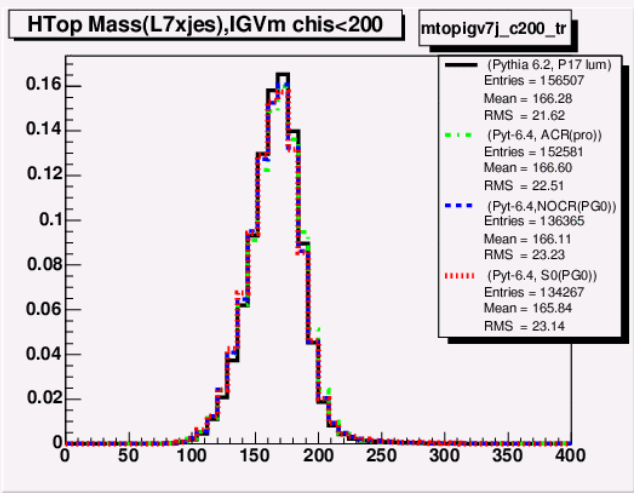
S0Pg0 -Nominal
172.5 GeV(6M ev.)
Δ (ΔE) (cone) GeV
W-jets +0.06 ± 0.04
b-jets -0.76 ± 0.05

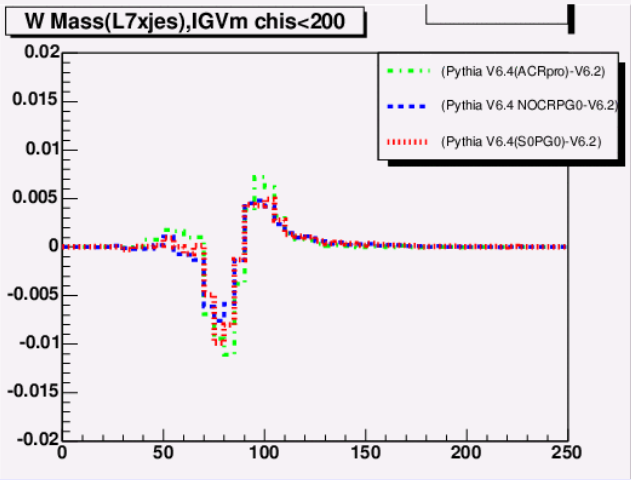
The S0-Perugia0 tune has less energy in cone of 0.4 for the b-jets

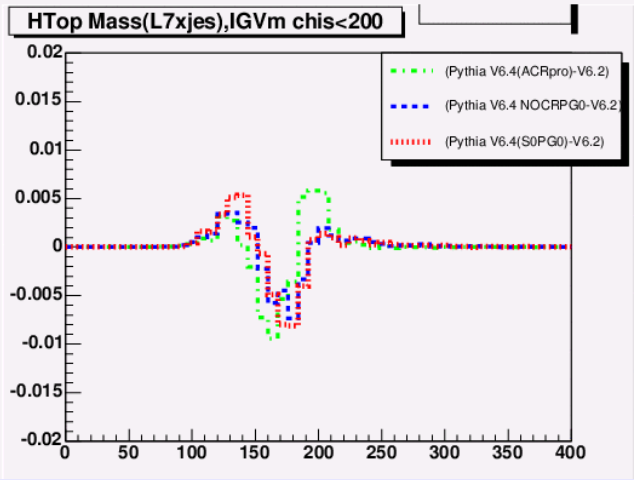
S0-Perugia0 W and Top mass shifts

Reconstructed MW and M(top) using the matched jets









S0Pg0 -Nominal
175 GeV(less stat)

$\Delta Mw = +0.38 \pm 0.12$

$\Delta Mtop = -1.18 \pm 0.18$

S0Pg0 -Nominal
172.5 GeV(6M ev.)

$\Delta Mw = +0.27 \pm 0.05$

$\Delta Mtop = -0.42 \pm 0.08$

The S0- Perugia0 obtains a top mass shift of 0.42 GeV with 6M events

Top mass measured by MTM3

Using the machinary of the MTM3 analysis (ME integration) we obtain a significant shift (1.6 GeV) for the PG0 sample.

The value of the previous page refers to events perfectly matching (58% for the PG0 sample), while the MTM3 is using all events as well as the background.

Sample	Measured m_t (GeV/c^2)	Measured Δ_{JES} (σ)	Δm_t (GeV/c^2)
Nominal 6.2 (`ttop25`)	172.90 ± 0.17	0.03 ± 0.04	—
6.4 Tune Apro (`ctopsd`)	172.77 ± 0.18	0.05 ± 0.04	-0.13 ± 0.25
6.4 Tune ACRpro (`ctopse`)	172.45 ± 0.18	0.17 ± 0.04	-0.45 ± 0.25
6.4 Tune S0 Pg0 (`ctopsb`)	171.35 ± 0.24	0.21 ± 0.05	-1.55 ± 0.29
6.4 Tune NOCR Pg0 (`ctopsc`)	171.20 ± 0.24	0.37 ± 0.05	-1.70 ± 0.29

It is not surprising that the 0.42 is now 1.6 GeV.

Systematics from color reconnection is taken to be (ACR(pro)-A(pro))=0.32 +-0.25 GeV

Update on PYTHIA V6.2-vs-V6.4

Is the 1.6 GeV mass shift in V6.4, Pg0 real? Is the parton shower used in V6.4 the correct model to use?

We have seen that the b-jets in PG0 have less energy in a cone of 0.4 and that the topology of the events is somewhat different (58% matching). Need to investigate:

1. Are the jets shapes different?

2. Is there more gluon radiation in the events?

3. Can we use the data to discriminate between these two version of the parton shower?

Data up to P23 (N(tagged) >=1) we have:

739 events (880 jets) in the N(tight) = 4 sample (21 % back.)
1367 events (1450 jets) in the N(tight) = 3 sample (36% back)

Comparison of jet variables MC- Data

Continuing studies on color reconnection systematics require the understanding of jets from PYTHIA V6.4

We have looked at b-jet variables and compare them to jets in top data.

Top events in the l+jet channel have four jets. Since b-jets and light quark jets have different shapes, we can compare data and MC only for b-tagged jets.

Variables:

- PT of b-jets
- Number of charged particles
- Eta moments
- Phi moments

We have many histograms. I only show a few of them. Work in progress.

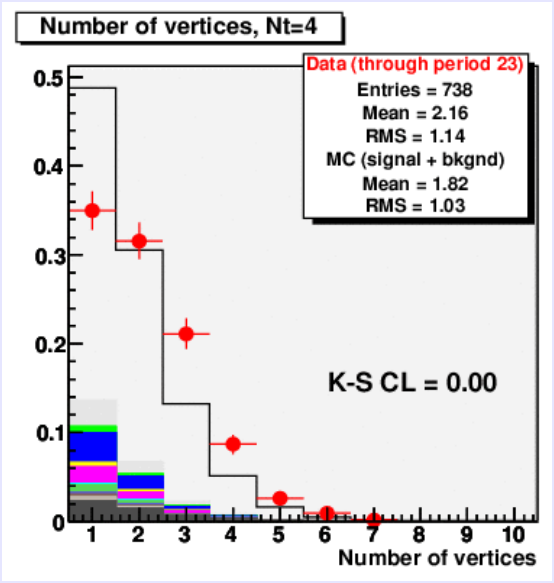
Adding jets from the N(tight)=3 sample

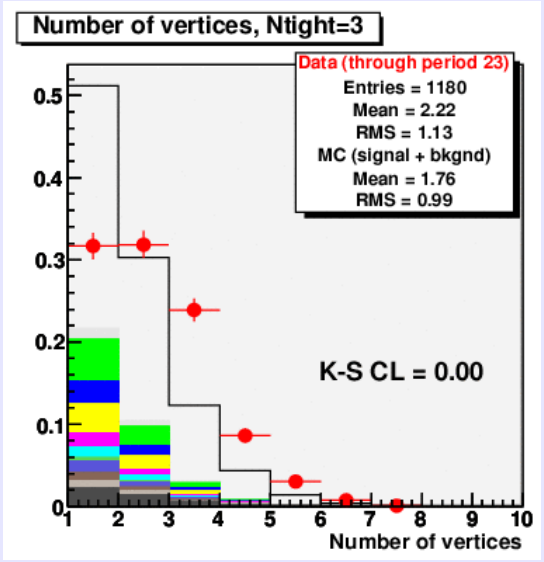
For the N(tight)=3 events, we use the cuts used by Tom's analysis

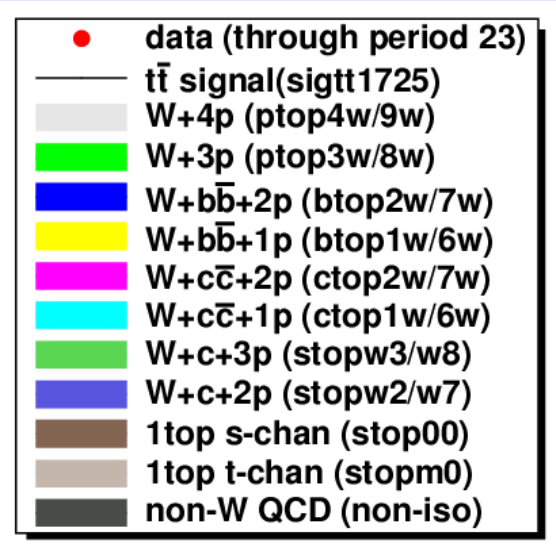
MET> 25 GeV and HT > 250 GeV

Comparing the Nt=4 and Nt=3 samples for possible discrepancies

Luminosity profile



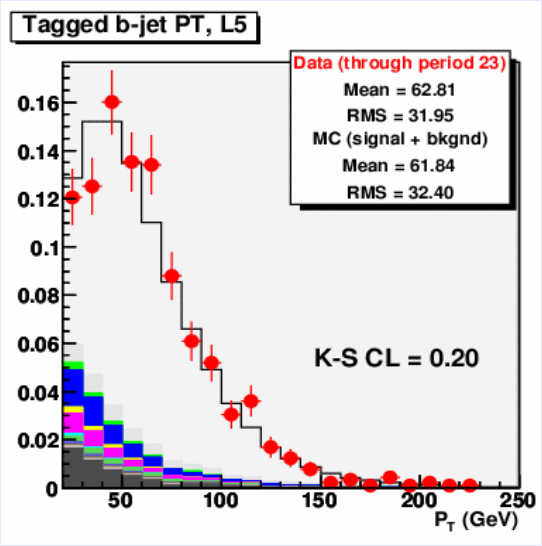


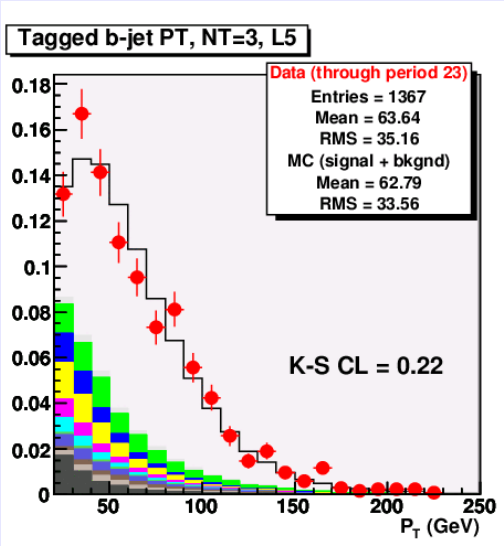


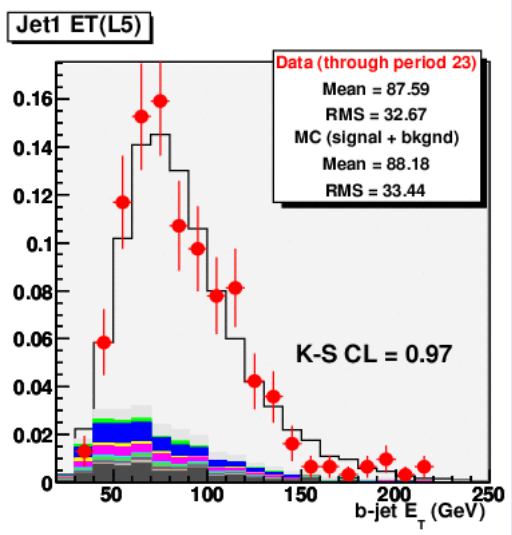
Luminosity profile is correct up to P17, need reweighting. For both cases the background for P12-P17 has not been used.

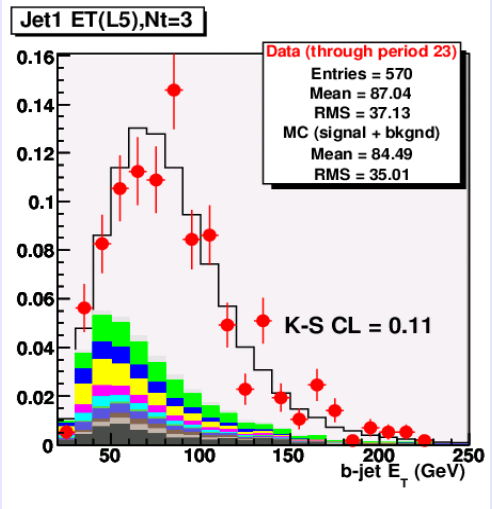
B jet PT for PYTHIA V6.2

Tagged jet pt for data and MC. Good values for KS test.









Within statistics the Pt values obtained from the data agree with the MC.

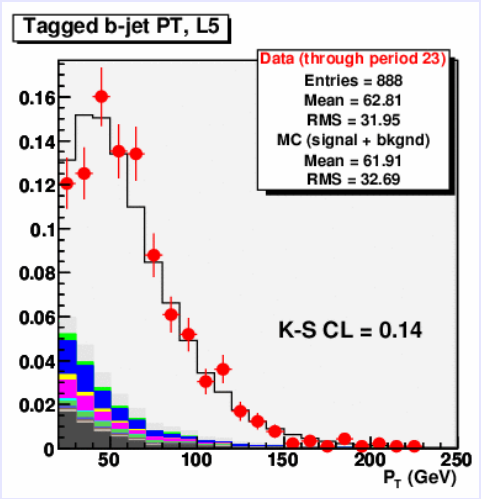
PT(btags) = 62.81+-1.1 Nt=4
PT(btags) = 63.64+-0.9 Nt=3

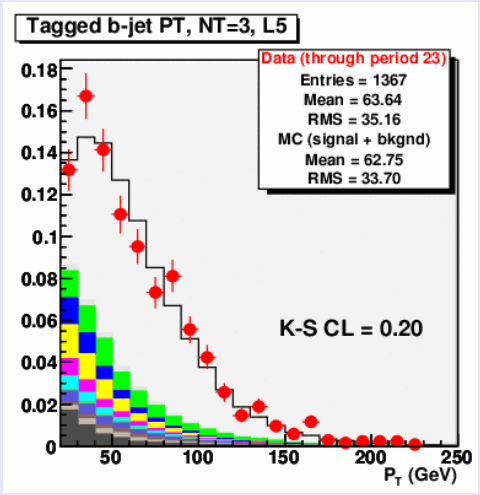
The MC expectation are:
61.64 -vs- 62.79 for all b-tags
88.18 -vs- 84.49 for Jet1

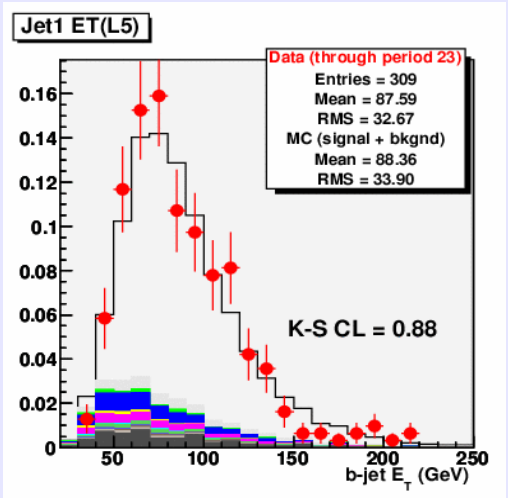
Conclusion: it is difficult to see a difference of 0.8 GeV in different samples . Statistic not enough, background not precise enough.

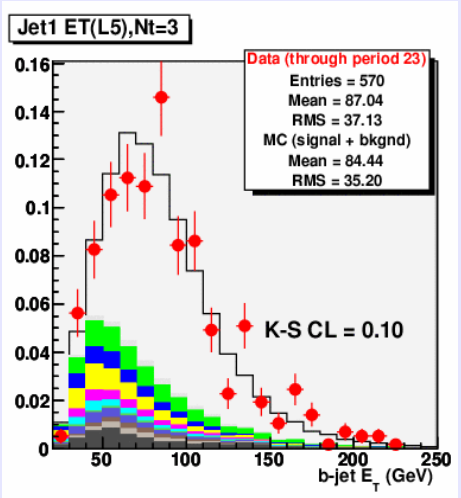
Bjet PT:PG0 plots

B jet pt: comparing the signal MC we find a 0.8 GeV shift for Pg0. What do we find in the data?









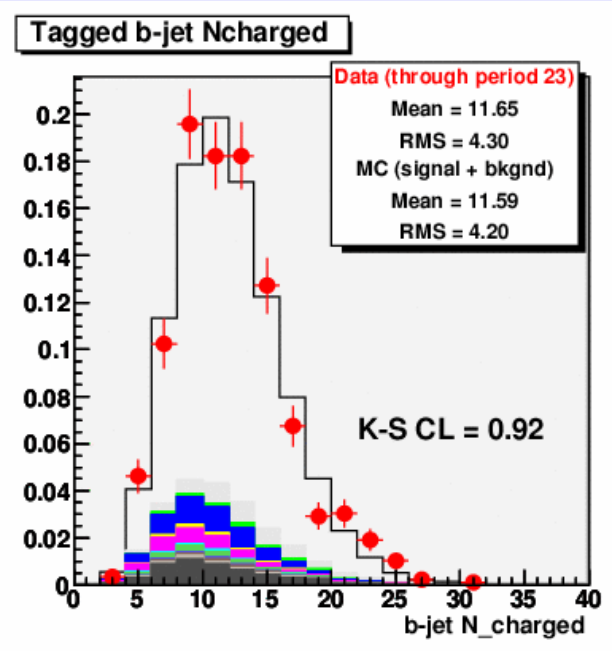
The jet PT agrees with the data for PG0 as well.

KS for the 4 plots

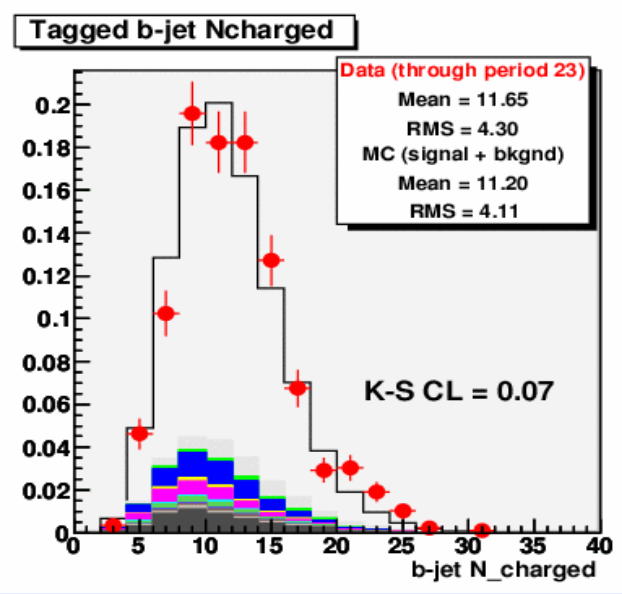
0.20 0.22 0.97 0.11 V6.2
0.14 0.20 0.88 0.10 V6.4

Not enough info to allow choice between the two MC.

Plots: Ncharged

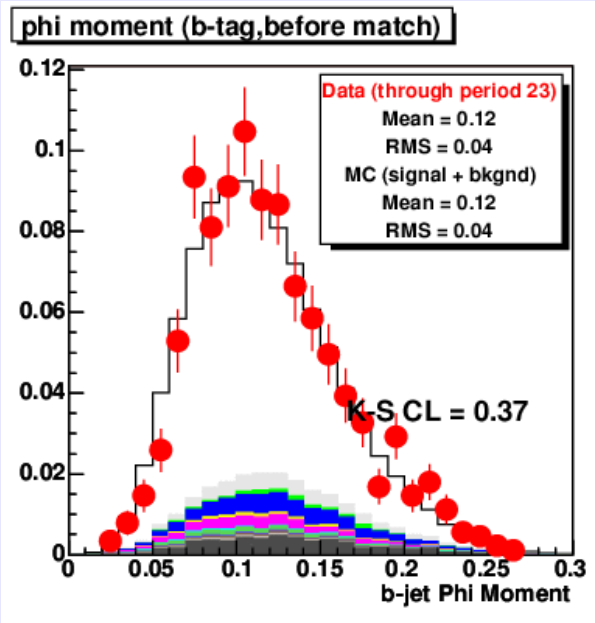


HERWIG



PYTHIA V6.2

Plots: Phi Moments



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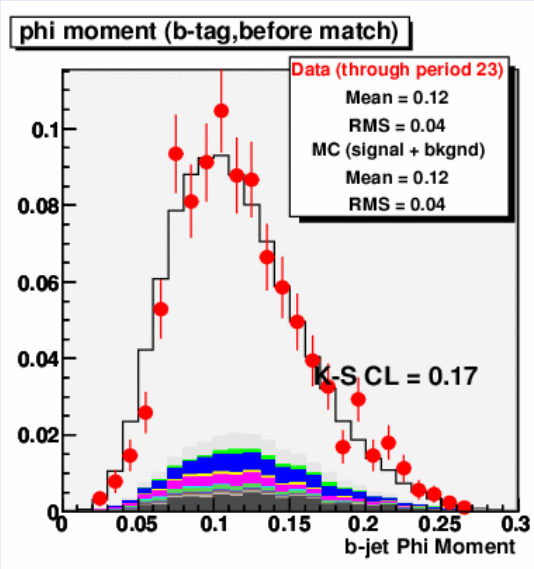


PYTHIA V6.2

Summary

We have about 6M events in 7 samples that we can use to study the new PYTHIA tunes.

There are a number of variables that may be more sensitive to the parton shower than the Pt of the tagged jet, that I just showed.

We need to use a luminosity weighted background.
We need to apply a luminosity weight to go from P17 to P23 (25?) as well as add the NT=4 and the NT=3 samples.

No point in showing more plots until these three things are done.

Top Mass Measurement and CR

Backup slides

Jet Shapes:moments

The eta and phi moments are sensitive to the width of the parton shower. We use calorimeter (both electromagnetic and hadronic components) information to evaluate the moments

We sum over all towers:

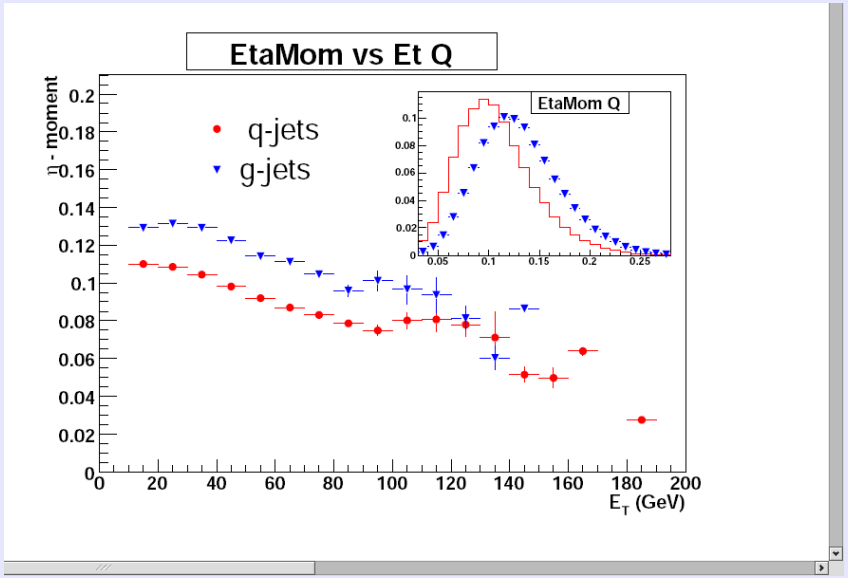
$$M_\eta \equiv \sqrt{\sum_{towers} \frac{E_T^{tower}}{E_T^{jet}} \eta_{tower}^2 - \eta_{jet}^2}$$

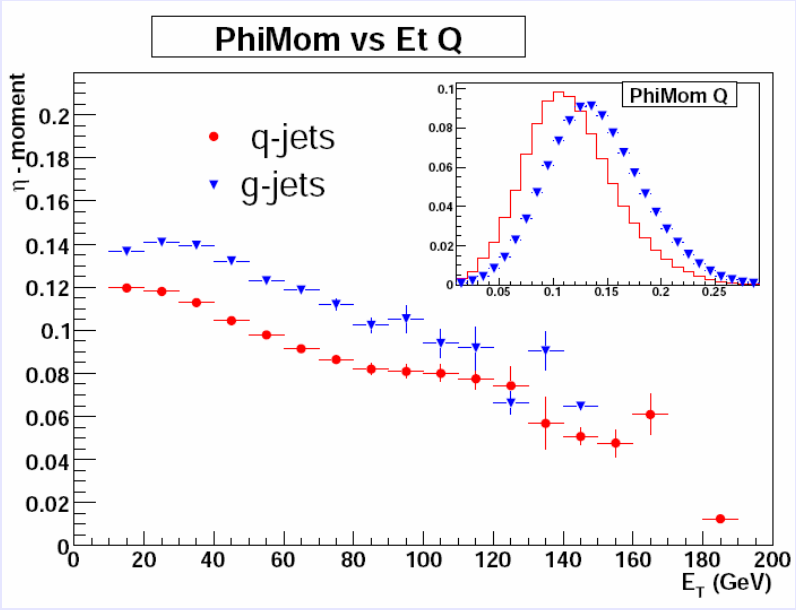
And similar expression for the phi moments,

Used in CDF to distinguish quark jets from gluon jets in ttbar production in the 6 jets topology

Moments for quark and gluon jets

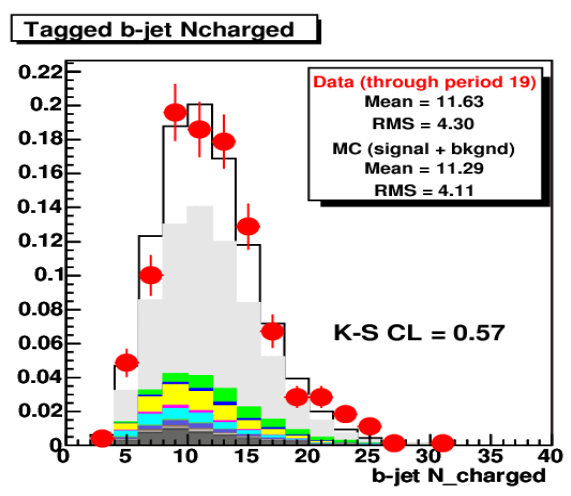
From Brigliadori, Castro, Margaroli's work we have the Expected moments for light quarks and gluons.

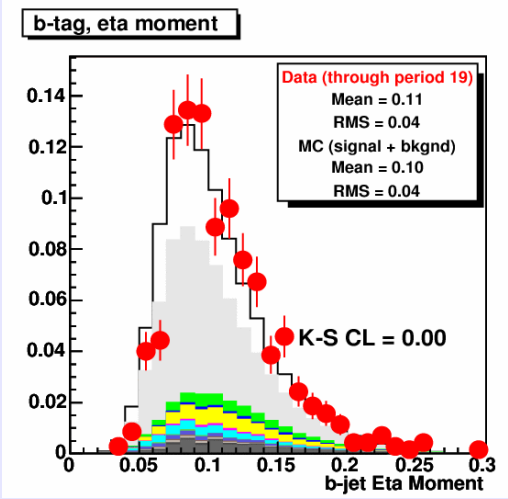


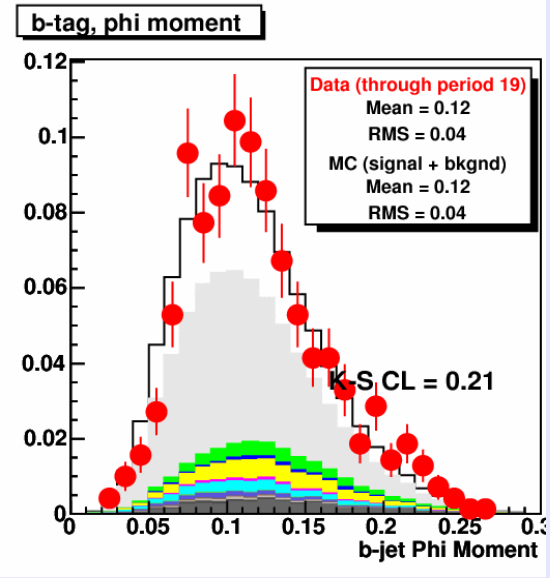


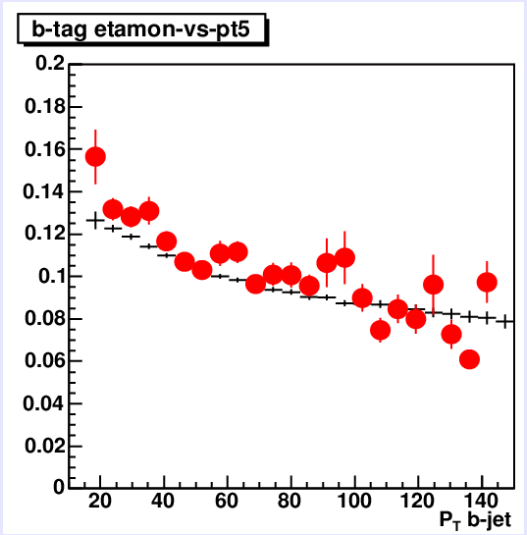
Jet Shapes Variables in b-jets (to P19)

V6.2 tune AV comparison of N(charged) in cone and φ and η Moments to P19









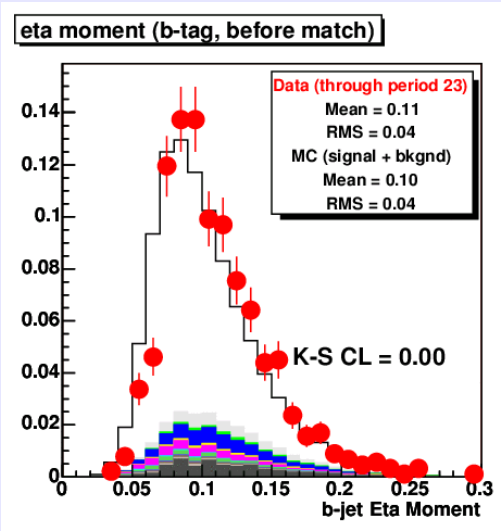
PYTHIA 6.2 agrees quite well with data for the N(charged) variable.

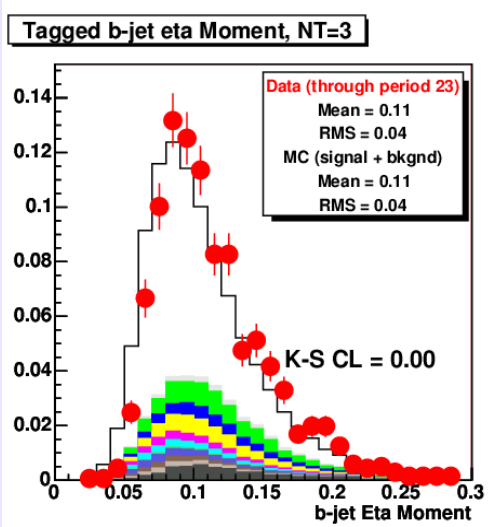
For the moments distributions, we have not normalized to 50 GeV, as the PT distributions for data and MC agree quite well and we are using only one mass point (175 GeV).

The φ moments agree well with the data.
The η moments do not agree at all as already observed by Andrea and Hyunsu. The Moment dependence on P_T(jet) is in clear disagreement with the data

Problems with η Moments

Bins below M(eta)=0.07 are low. Any detector effects ?





Look at PT jet, Ncharged, eta jet.

Add the Ntight =3 for statistics