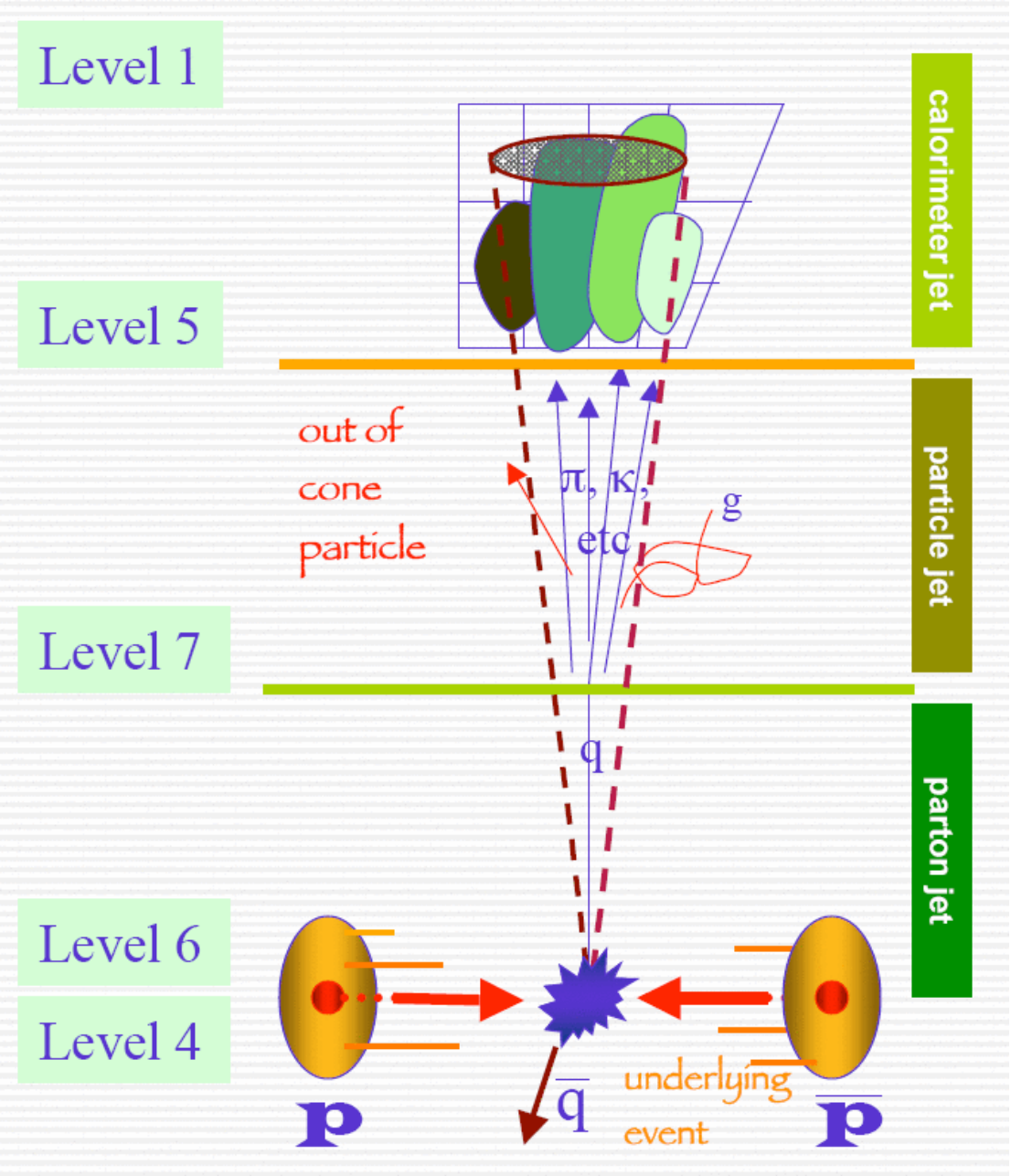
Jet Corrections and systematics from NIM

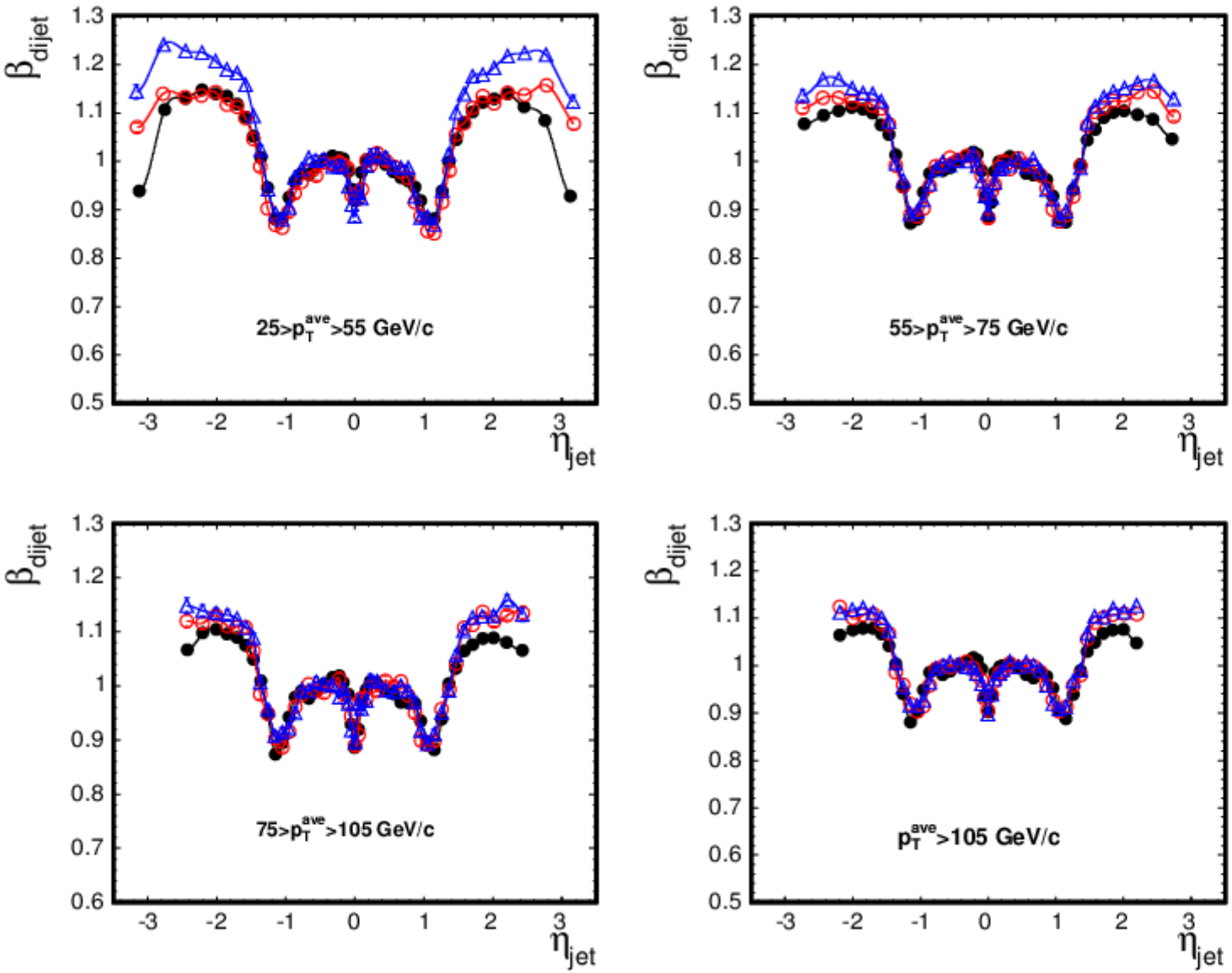
Jet correction studies:

- Relative correction
- Jet response
- Absolute correction
- Underlying event
- Out of cone corrections

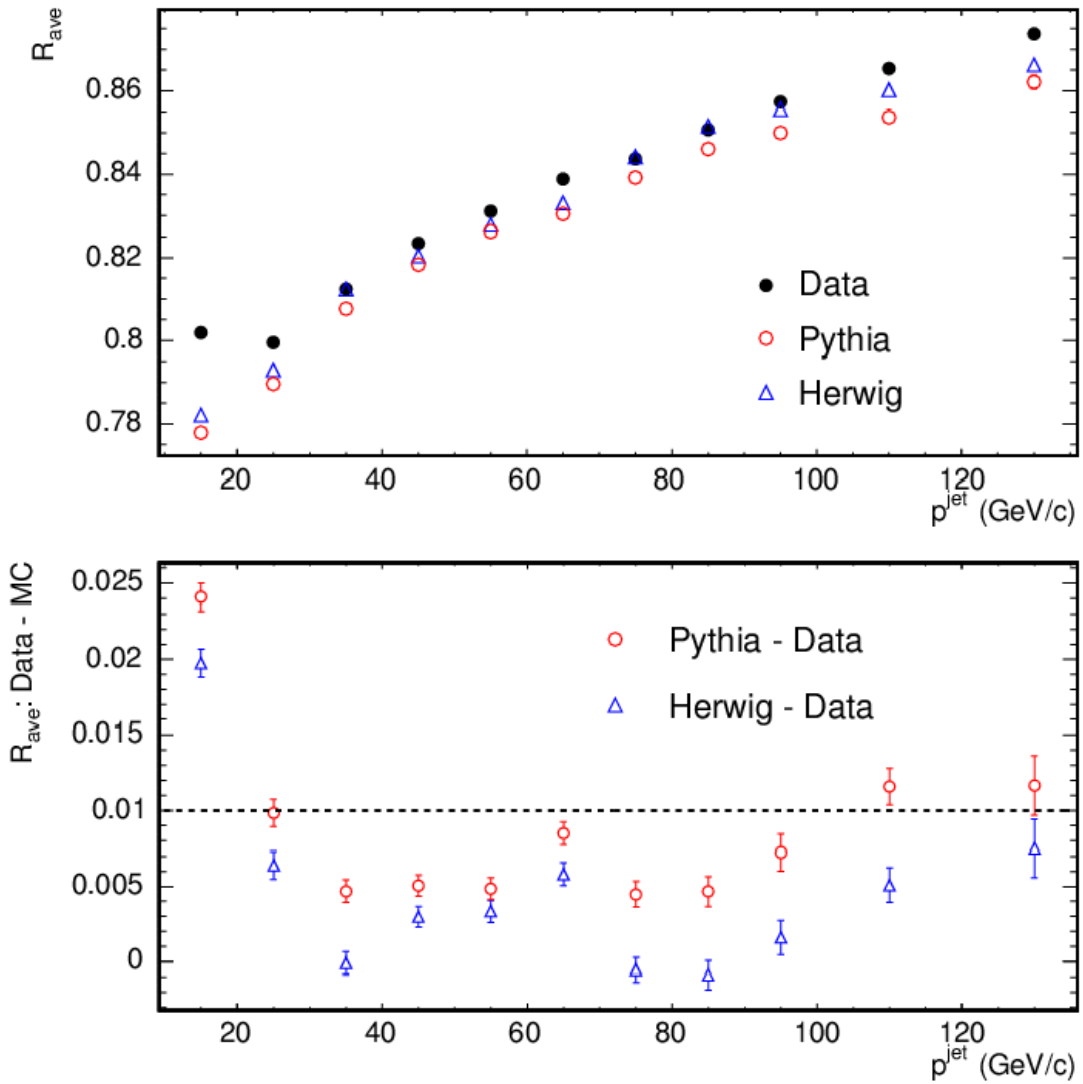
Jets


Level 1
Level 5
Level 7
Level 6
Level 4
calorimeter jet
particle jet
parton jet
out of
cone
particle
π, κ,
etc
g
q
p
q̄
underlying
event
p̄

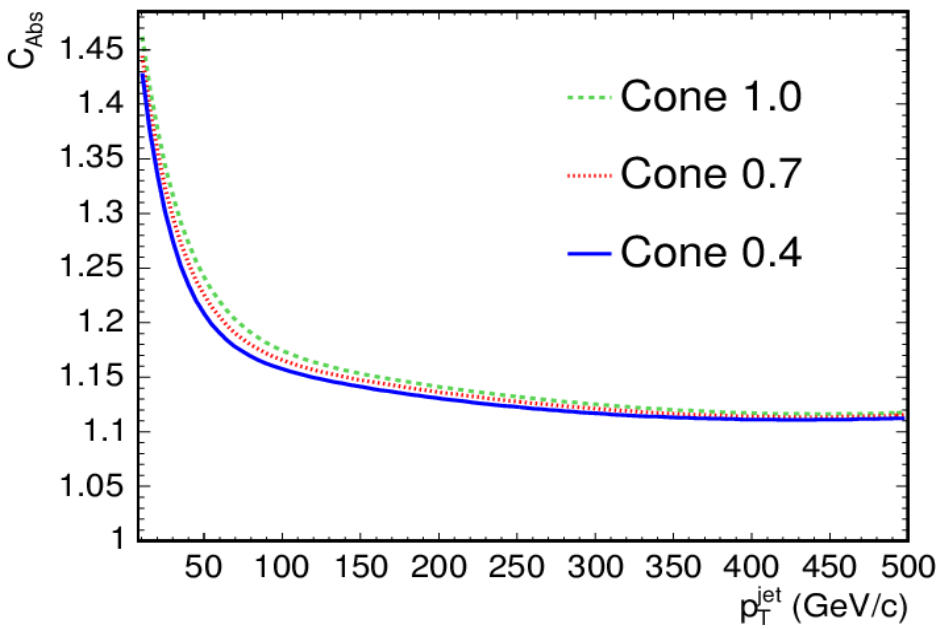
relative

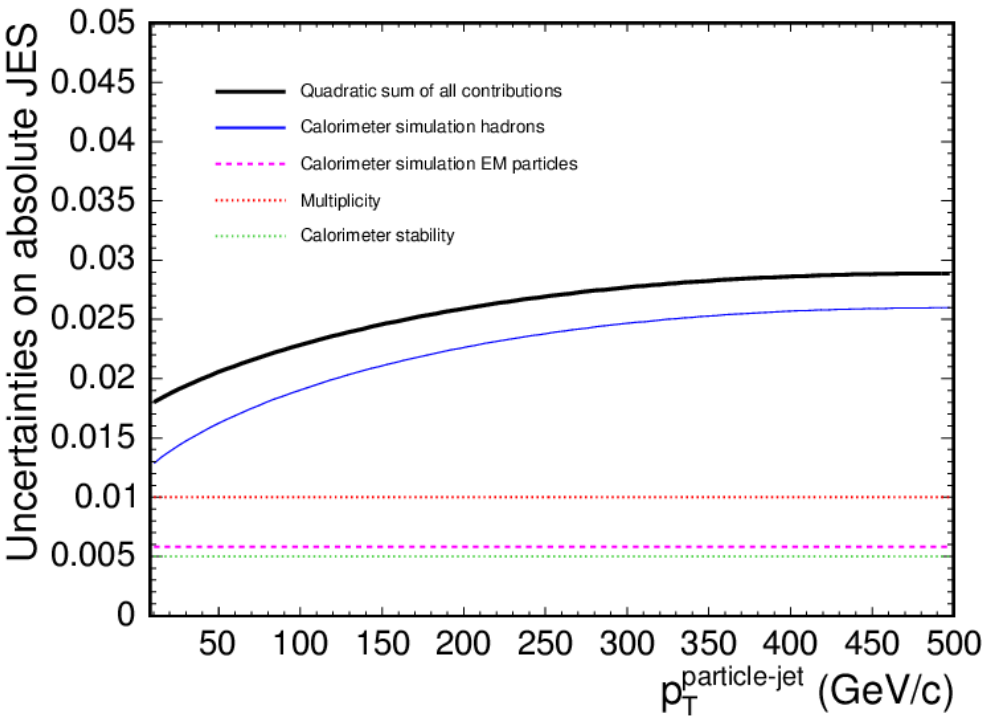

β_{dijet}
η_{jet}
$25>p_T^{ave}>55$ GeV/c
$55>p_T^{ave}>75$ GeV/c
$75>p_T^{ave}>105$ GeV/c
$p_T^{ave}>105$ GeV/c

Jet response

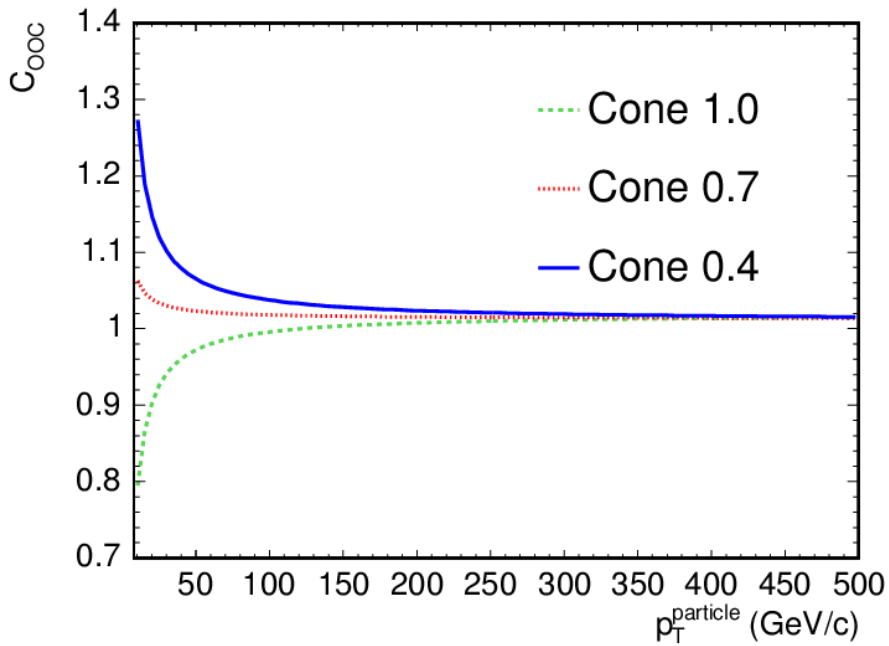


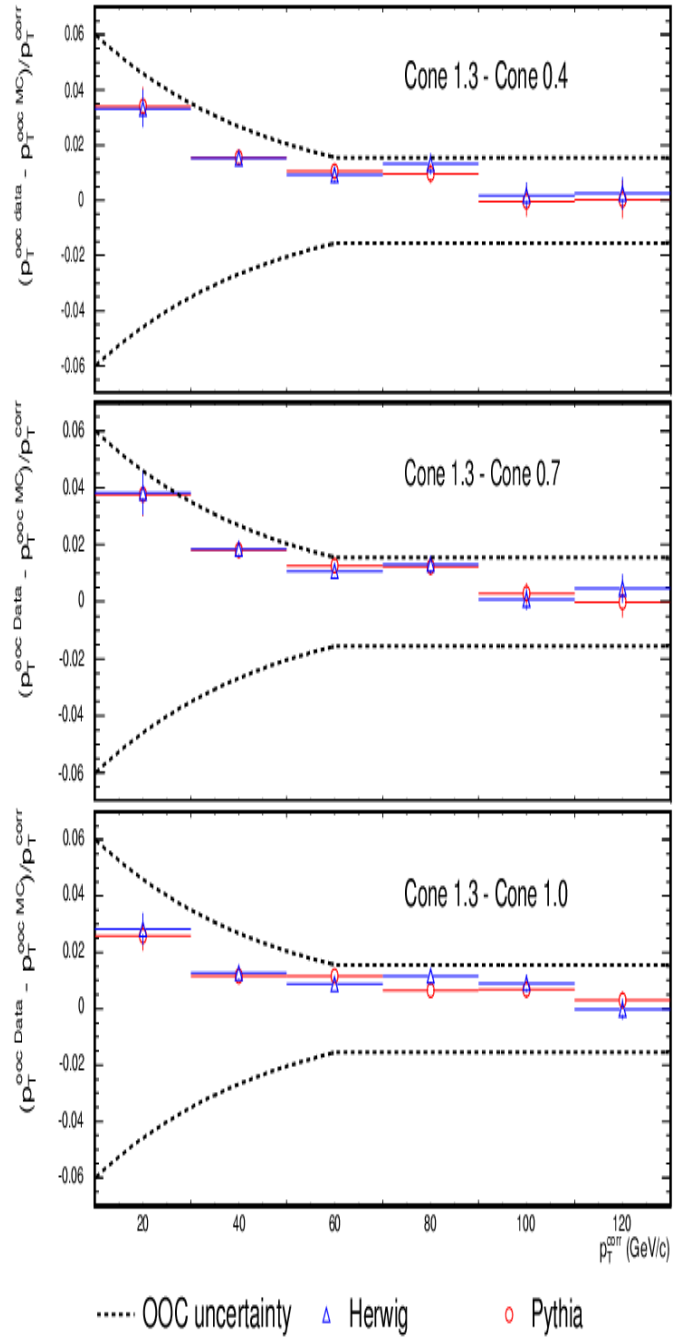
absolute


C_{Abs}
1.45
1.4
1.35
1.3
1.25
1.2
1.15
1.1
1.05
1
50 100 150 200 250 300 350 400 450 500
p_T^{jet} (GeV/c)
Cone 1.0
Cone 0.7
Cone 0.4


Uncertainties on absolute JES
0.05
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
50 100 150 200 250 300 350 400 450 500
$p_T^{particle\text{-}jet}$ (GeV/c)
Quadratic sum of all contributions
Calorimeter simulation hadrons
Calorimeter simulation EM particles
Multiplicity
Calorimeter stability

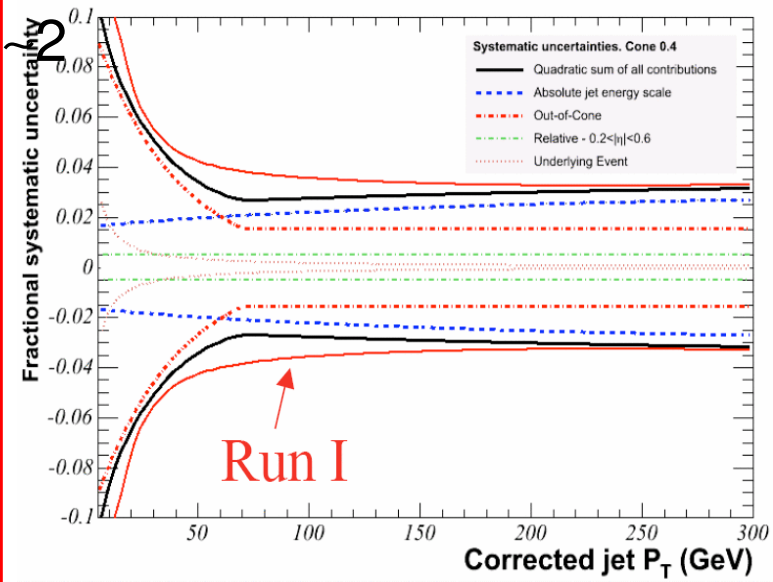
out-of-cone


C_{OOC}
Cone 1.0
Cone 0.7
Cone 0.4
$p_T^{particle}$ (GeV/c)

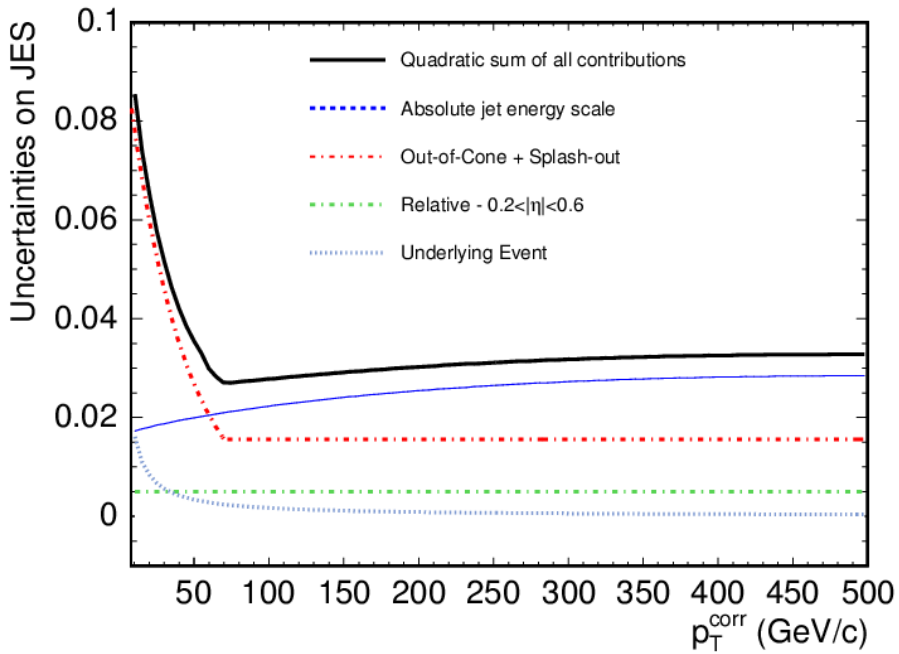

Cone 1.3 - Cone 0.4
Cone 1.3 - Cone 0.7
Cone 1.3 - Cone 1.0
$(p_T^{ooc\ data} - p_T^{ooc\ MC})/p_T^{corr}$
p_T^{corr} (GeV/c)
OOC uncertainty
Herwig
Pythia

Total systematics

Reduced ΔM_{top} syst.. by fac. ~2



Paper submit. to NIM (10/'05)



γ-jet balance: η(rel. corr. only) NIM

Relative corrections calculated from di-jet samples: separately for data and MC (using PYTHIA)

Systematics calculated by varying the selection cuts

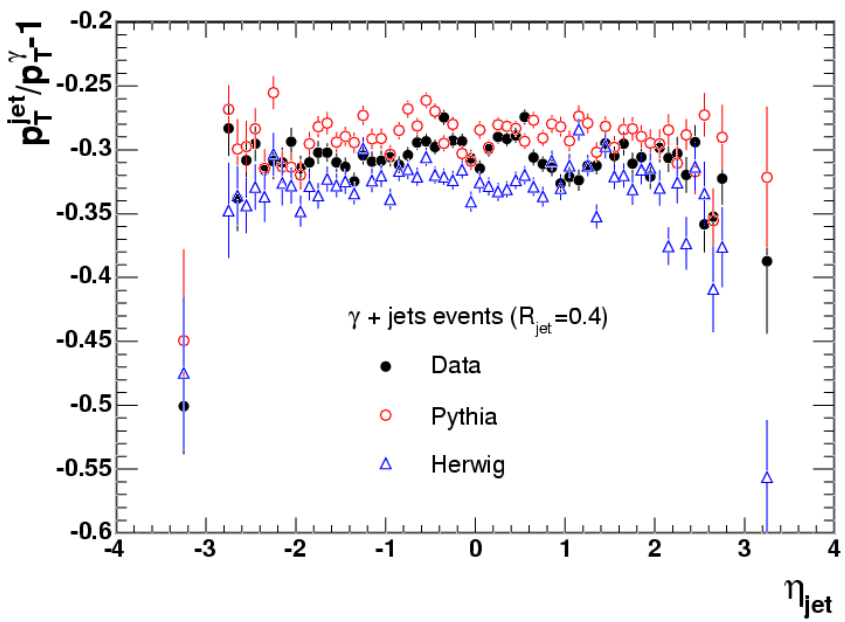


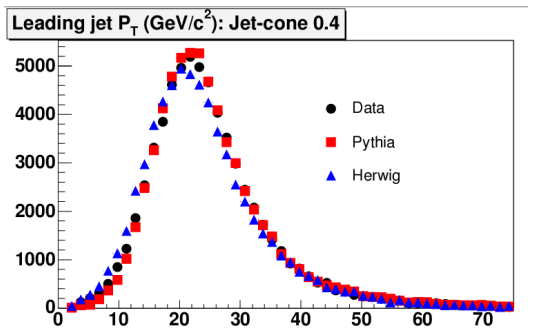
Figure 34: p_T balance, $\frac{p_T^{jet}}{p_T^{\gamma}} - 1$, in data (full circles), Pythia (open circles) and Herwig (open triangles) as function of η_{jet} for $R_{jet} = 0.4$

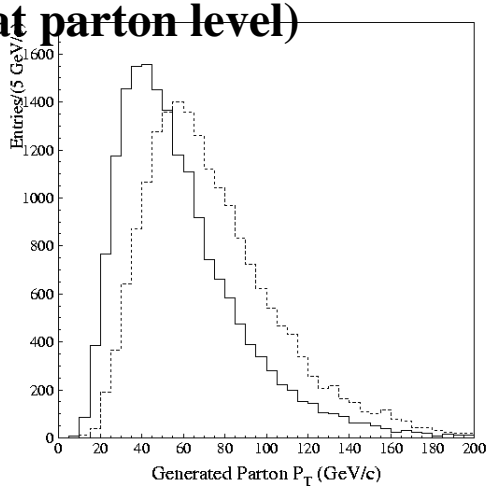
Plot shows test of corrections on γ-jet data and in MC samples.

Jets in γ-jet events (uncorrected)

Top jets:light and b quarks at parton level)

Mousumi Datta





Jets in γ-jets are softer than top jets

HERWIG has 2% less P_T in cone of R=0.4

PYTHIA has 2% more P_T in cone of R=0.4

Jet response (NIM absolute corrections)

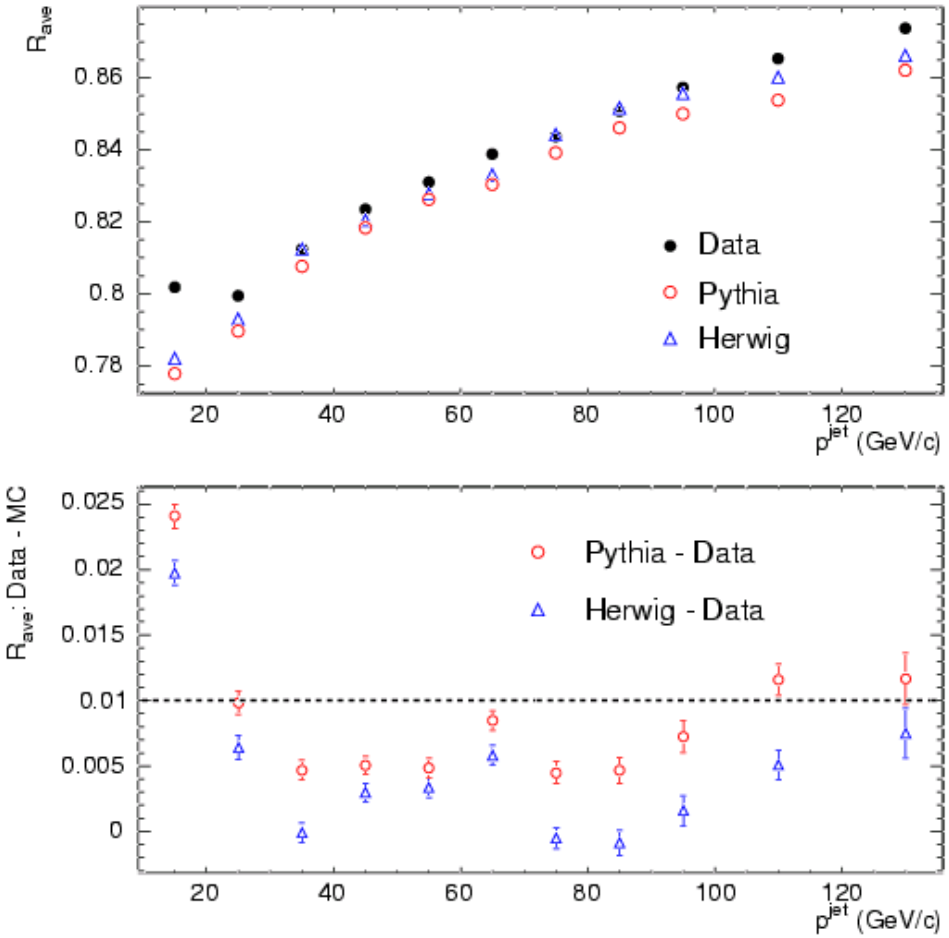


Figure 24: *Top: Jet response R_{ave} for data (closed circles), Pythia (open circles) and Herwig (open triangles) for $R_{jet} = 0.4$ jets as function of p_T^{jet}. Bottom: Difference between data and Pythia (open circles) and data and Herwig (open triangles).*

HERWIG is better then PYTHIA on jet response

PYTHIA used to calculate the absolute corrections.

Systematics from many sources. The largest one from uncertainty of calorimeter response to charged particles.

GLASH used for calorimeter simulation.

See CDF-7450, Bhatti et al.

γ-jet balance (partial corr.) NIM

Check of relative and absolute corrections on γ-jet events

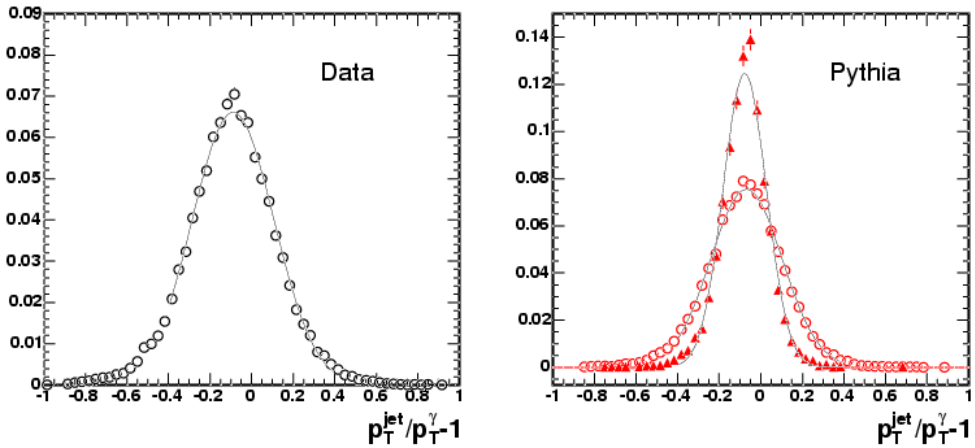


Figure 35: γ-jet balance in data, Pythia and Herwig for R_{jet}=0.4. Overlaid is the cor sponding γ-jet balance on generator level (triangles). The distributions are normalized

HERWIG-data ~ - 2.0%

PYTHIA -data ~ + 1.8%

No way to choose

Table 4: Mean value of $p_T^{jet}/p_T^{gamma}-1$ after η-dependent and absolute energy correction for data, Pythia, and Herwig for R_{jet}=0.4, 0.7 and 1.0. For Pythia and Herwig, the values are given also for particle jets.

Sample	R_{jet}=0.4	R_{jet}=0.7	R_{jet}=1.0
Calorimeter jets			
Data	-0.088 ± 0.001	-0.016 ± 0.001	0.022 ± 0.001
Pythia	-0.070 ± 0.001	-0.015 ± 0.001	-0.002 ± 0.001
Herwig	-0.108 ± 0.001	-0.043 ± 0.001	-0.024 ± 0.001
Particle jets			
Pythia	-0.078 ± 0.001	-0.037 ± 0.001	-0.009 ± 0.001
Herwig	-0.113 ± 0.002	-0.061 ± 0.002	-0.019 ± 0.002

For γ-jet balance studies see CDF-7452, Canelli et al.

Underlying event (NIM)

Rick Field's studies show PYTHIA tune A fits data better

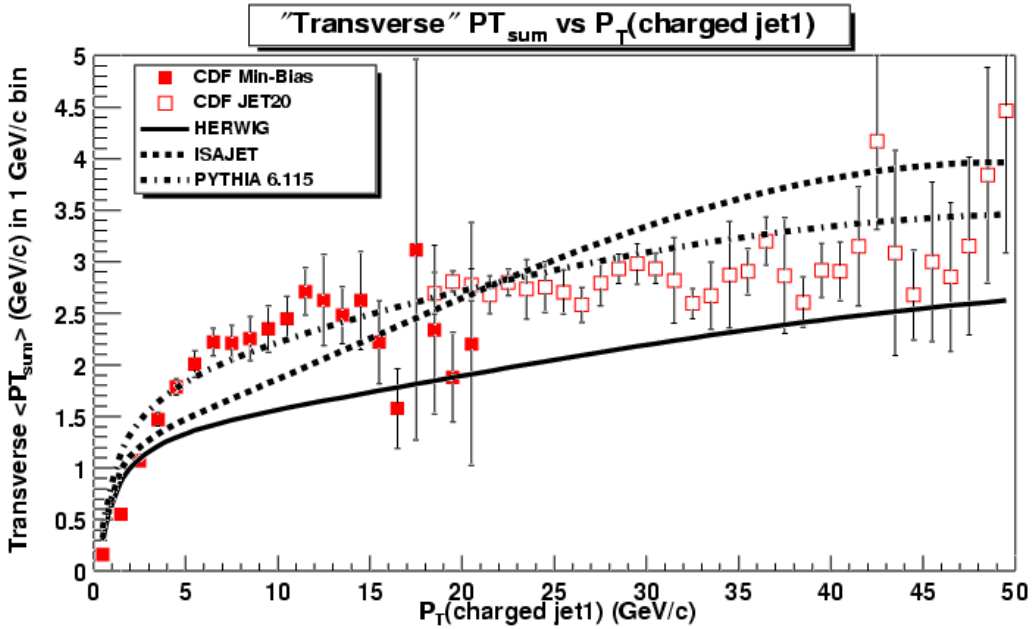


Figure 33: *The average transverse momentum of charged particles in the transverse region versus jet p_T [33]. The data are shown as points and are compared to the predictions from Pythia (dashed-dotted line), Herwig (solid line) and Isajet (dashed line).*

For P_T> 10 GeV/c HERWIG is lower than the data by ~ .5 GeV/c. This is the Sum(PT) in the transverse region (A=4/3*π), for a radius of 0.4 we expect 0.5*3/4*.16=0.06 GeV discrepancy. This is ~0.1 GeV (20%) for the UE=0.4 GeV evaluated from calorimeter measurements (see next

Out of cone (NIM)

γ-jet balance results (P_T jets ≤ 100 GeV). Left plot shows P_T in annulus 0.4-1.3: includes both UE and Out-of-Cone P_T

HERWIG (blue) is closer to the data than PYTHIA

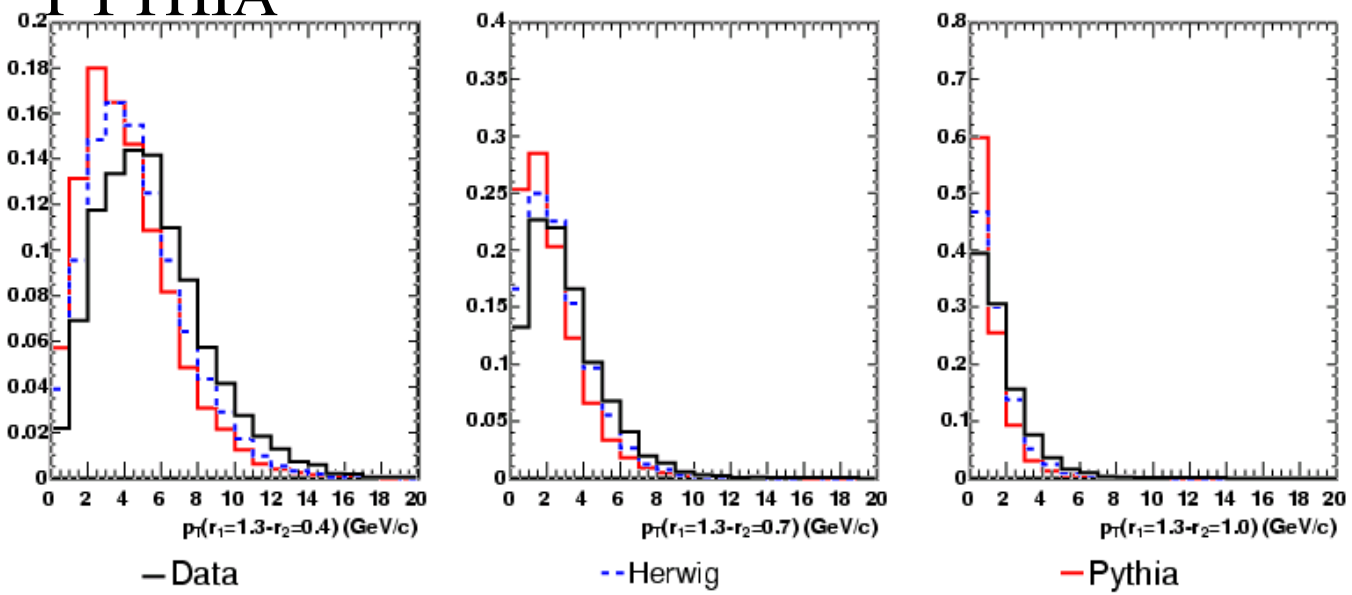


Figure 31: *Normalized distributions of the momentum in different annuli outside the jet cone for data, Pythia and Herwig γ+jets events.*

OOCC and UE (0.4 GeV for R=0.4) determined from PYTHIA dijet samples.

Systematics include difference between PYTHIA and HERWIG.

γ-jet balance: all corrections NIM

All corrections applied (UE and OOCC determined from PYTHIA)

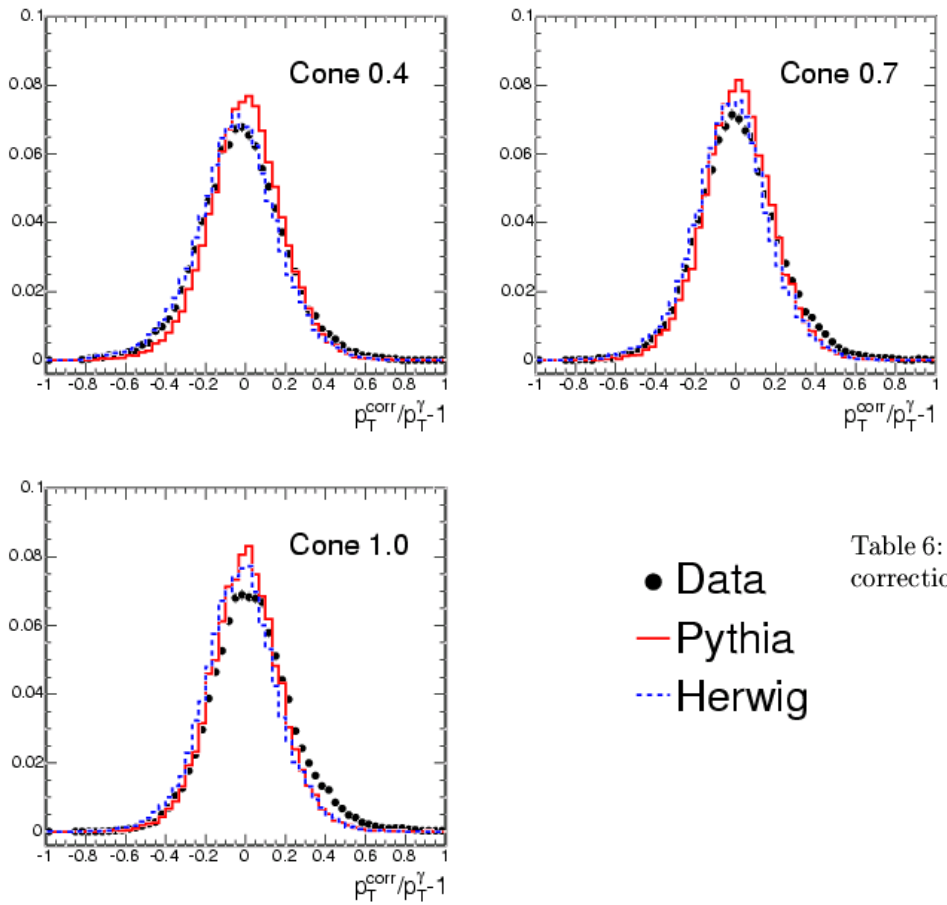


Figure 36: *γ-jet balance in data, Pythia and Herwig using R_{jet}=0.4, 0.7 and 1.0 after η-dependent, absolute and OOC+UE corrections.*

HERWIG-data ~ - 2.0%

PYTHIA-data ~ + 1.8%

No way to choose

Table 6: Mean value of $p_T^{jet}/p_T^{\gamma}-1$ after all corrections, including the out-of-cone energy correction for data, Pythia, and Herwig for jet cones of R_{jet} = 0.4, 0.7 and 1.0.

Sample	R_{jet}=0.4	R_{jet}=0.7	R_{jet}=1.0
Data	-0.019 ± 0.001	0.010 ± 0.001	0.024 ± 0.001
Pythia	-0.001 ± 0.001	0.011 ± 0.001	0.000 ± 0.001
Herwig	-0.040 ± 0.001	-0.018 ± 0.001	-0.023 ± 0.001

Summary

- Mario's plots show that PYTHIA is better than HERWIG between R= 0.3 and 0.7

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- Jet response show that HERWIG is slightly better than PYTHIA

- Out of cone plots show that HERWIG is better than PYTHIA between R= 0.4 and 1.3.

- γ-jet balance data show that HERWIG is below the data by ~2%

Both PYTHIA and HERWIG disagree with the data at the 2% leveln.
(note, however, that jets in γ-jet are softer that top jets)

PYTHIA does not have spin correlations in the Matrix Element.

Are the ME analyses sensitive to spin correlations?

Jet Resolution

From a talk by Florencia