Jet energy scale: Part III

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  - *For contributing to this section, I hope I reflected your work as accurate as possible*
- *Also all the "behind the curtain" people that makes everything possible:*
  - *The MC, simulation, reconstruction programmers*
  - *Borut and the production group*
  - *Iacopo and the validation group*
  - *Jet/Etmiss SW developers: PA, PO, etc*
- *And Koji Terashi and Michiru Kaneda for producing the DPDs*

Overview

- Topological and flavor corrections
  - Corrections for close-by jets
  - Flavor corrections
- Tests of the energy scale
  - Efficiency using track jet: *Stephani's talk*
  - In situ energy resolution
  - Jet shapes
  - Basic questions on systematics
  - Test of the jet energy scale in the W mass
  - Strategy for the test of the jet energy scale

Response studies for non-isolated jets

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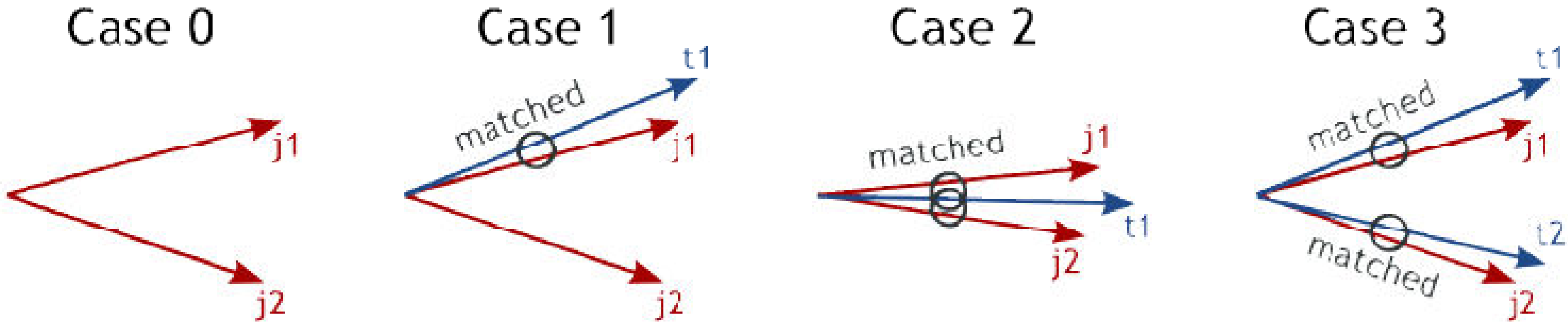
Preliminaries



	not isolated	case 0	case 1	case 2	case 3
Antikt4 topo	16.89 %	0.11 %	40.59 %	2.74 %	55.92 %
Antikt4 tower	19.06 %	0.27 %	47.97 %	0.55 %	50.55 %
Cone4 topo	13.22 %	1.95 %	40.23 %	1.70 %	54.60 %
Cone4 tower	10.95 %	1.61 %	35.59 %	1.20 %	60.22 %

topoclusters as inputs masks the impact of the jet reco. algorithm

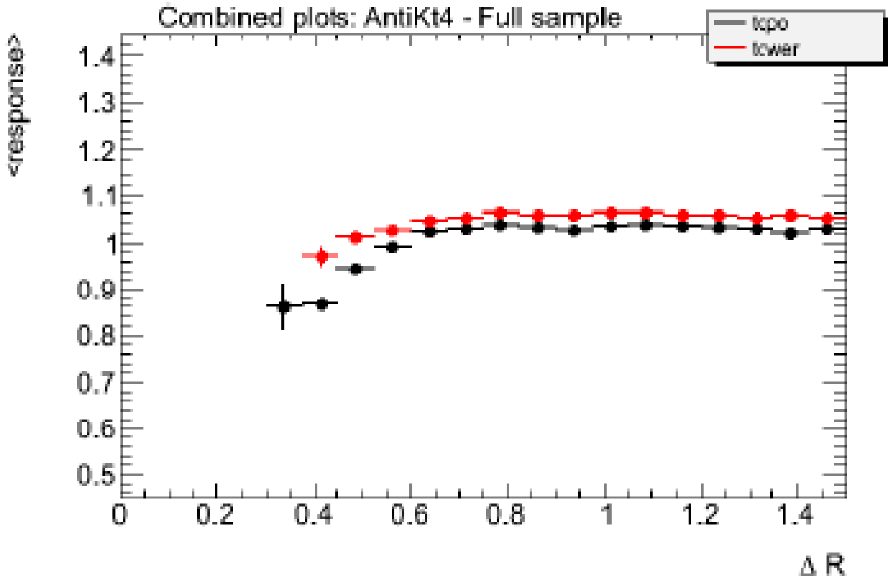
notice the large amount of Case 1 for AntiKt4 tower wrt Cone4 tower

`mc08.105011.J2 pythia_jetjet.recon.DPD_NOSKIM.e344_s479_635.AANT`

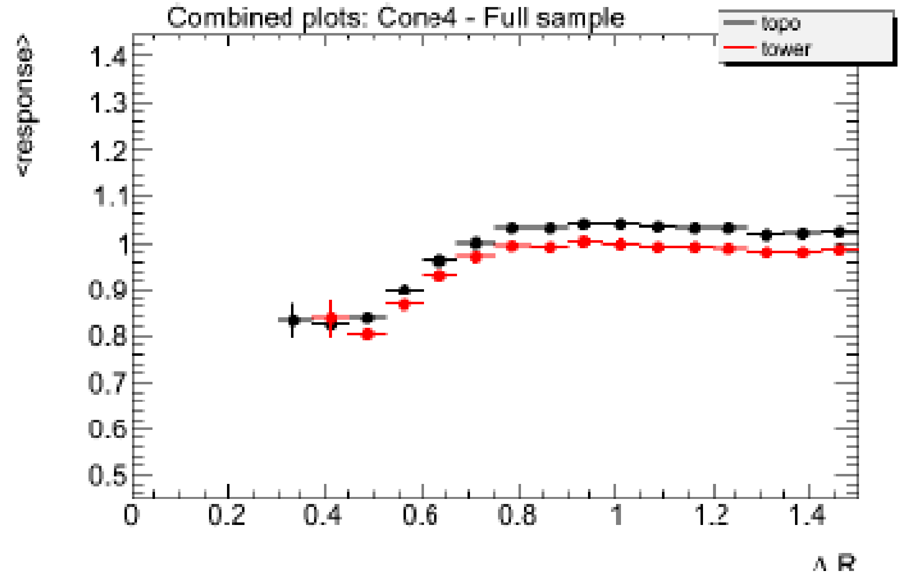
Response (all cases)

Response needed for non-isolated jets!!

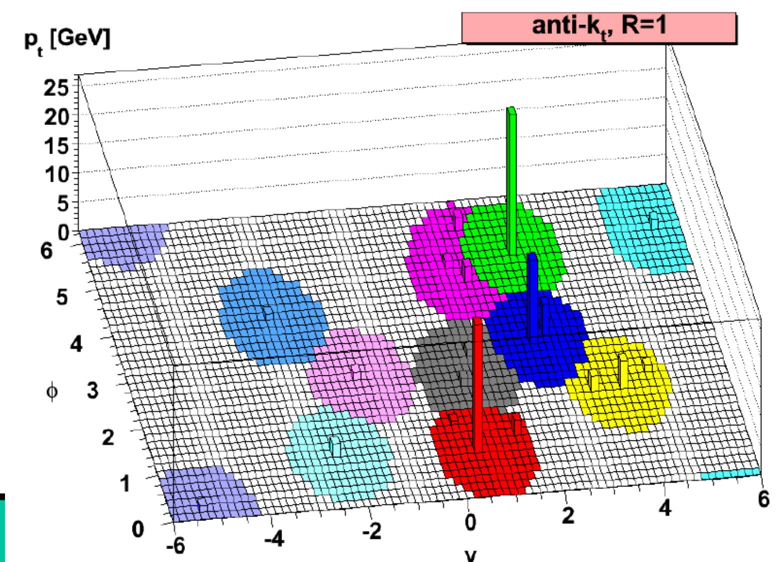
AntiKT4



Cone4

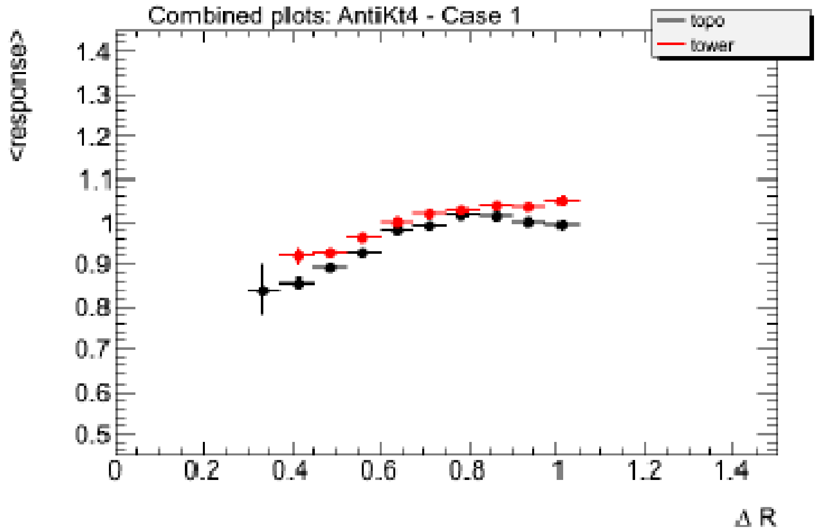


Notice also that having more number of case 1 events AntiKt shows less sensibility to close by jets: clusters the hardest jet in a cone shape "stealing" energy from the softest jet: conefication effect

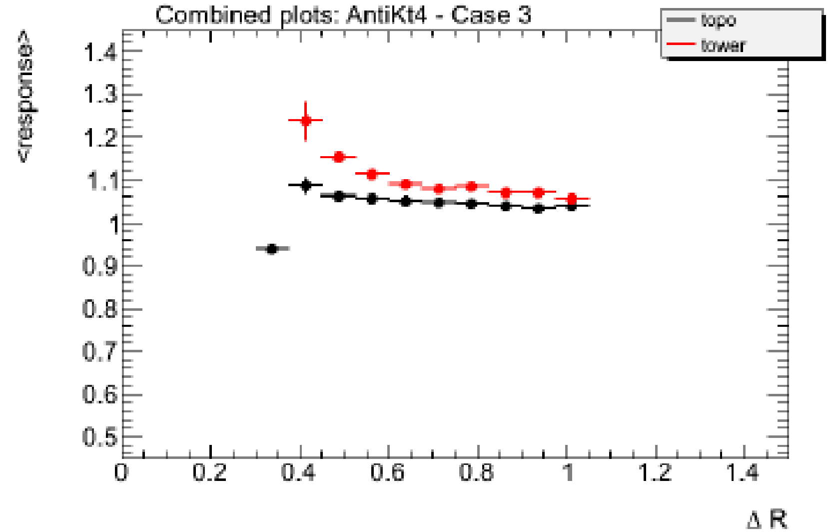


Response correction is case dependent

Case 1: AntiKT4

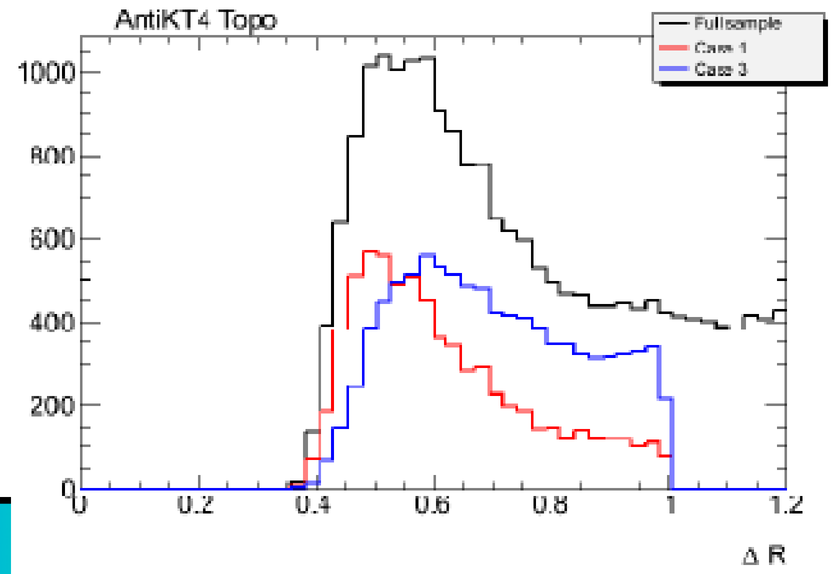


Case 3: AntiKT4



how to distinguish cases in real data?

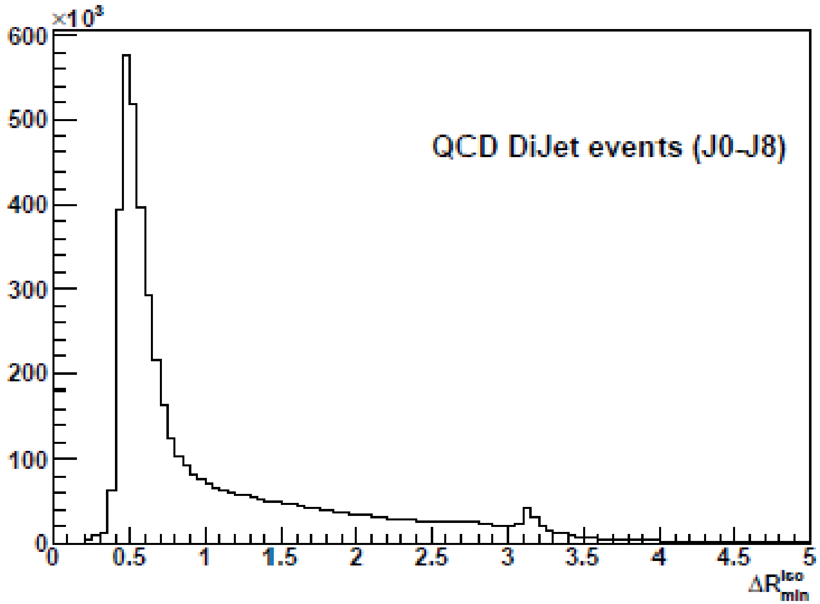
- Transverse momentum p_T of j1
- Number of constituents
- ΔR →
- Momentum ratio $p_T^{ratio} = \frac{p_T^{j1}}{p_T^{j2}}$

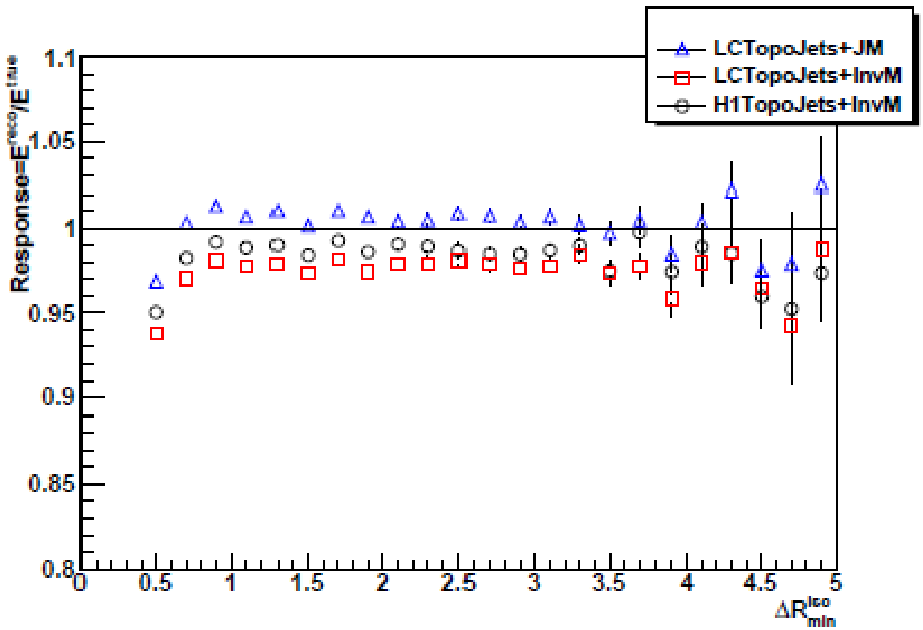


Isolation: $\Delta R^{iso}_{min} > 1.0$ w.r.t. reco & truth jets

Andreas Jantcsh

- What do we mean with isolation?
- W.r.t. all jets? (so far $E_T > 7\ GeV$)
- Better w.r.t. all clusters?
- Most of the jets will be non-isolated & pile-up makes it worse

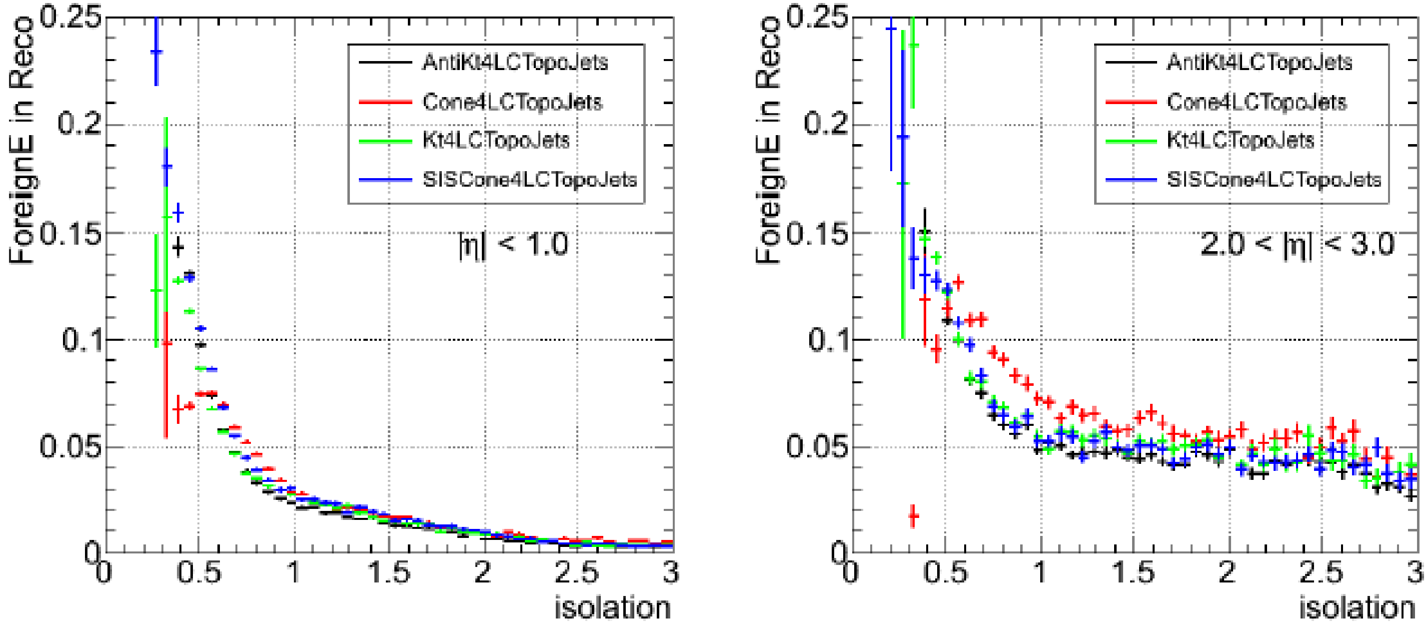




Foe energy in reconstructed jet as a function of isolation

Gennady Pospelov

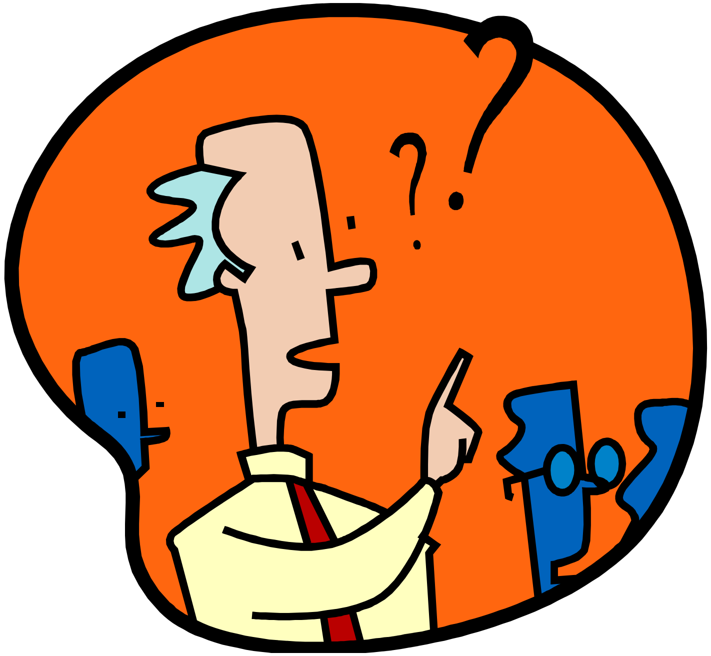
- Ratio of Reco jet energy caused by particles not belonging to the Truth matched jet to the jet total energy, as a function of isolation parameter for different jet algorithms
  - matching criteria $\Delta R<0.3$, Et(truth)>20GeV, Et(reco)>12GeV



- Jets have large foreign energy contribution even at large isolation (long tail)
  - primary particles across the detector not belonging to any Truth jet (7GeV cut?)

- Usage of isolation criteria
  - As a quality cut to discard “bad” jets (?)
  - Not to use isolation as quality cut, but make correction aware of isolation (?)

Discussion

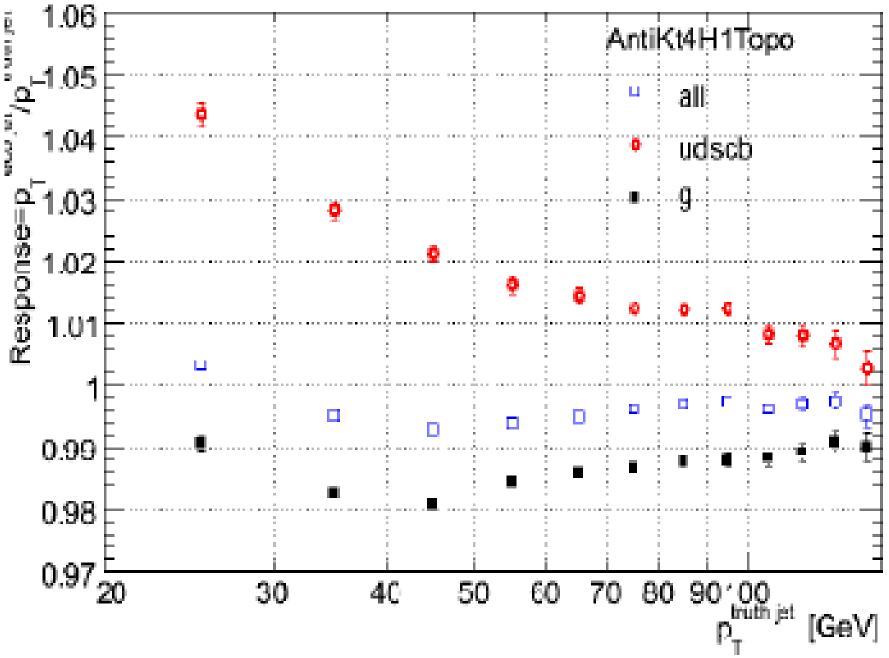


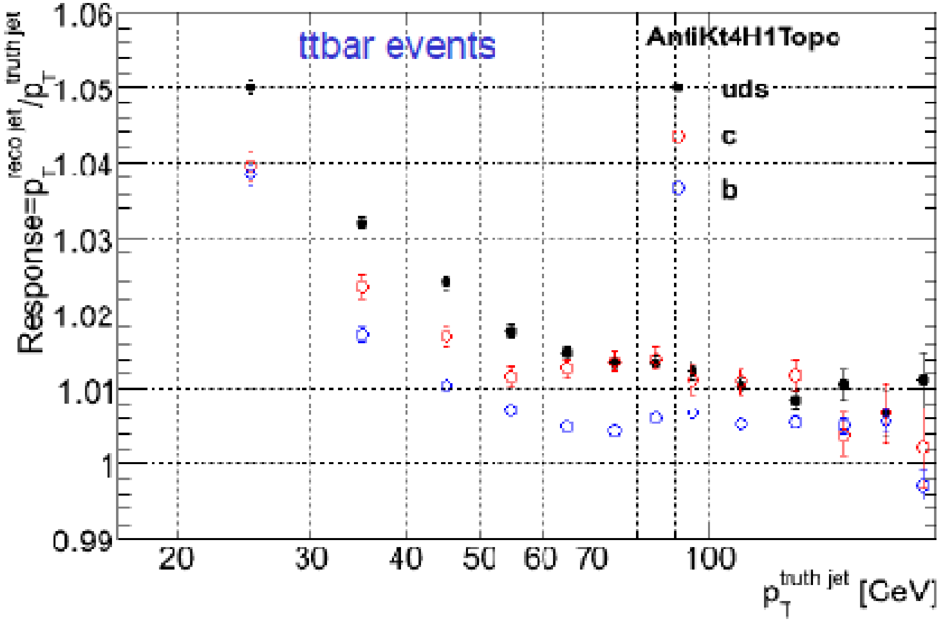
Flavor dependence on the JES (part I)

Hongbo Liao, Jérôme Schwindling
CEA Saclay

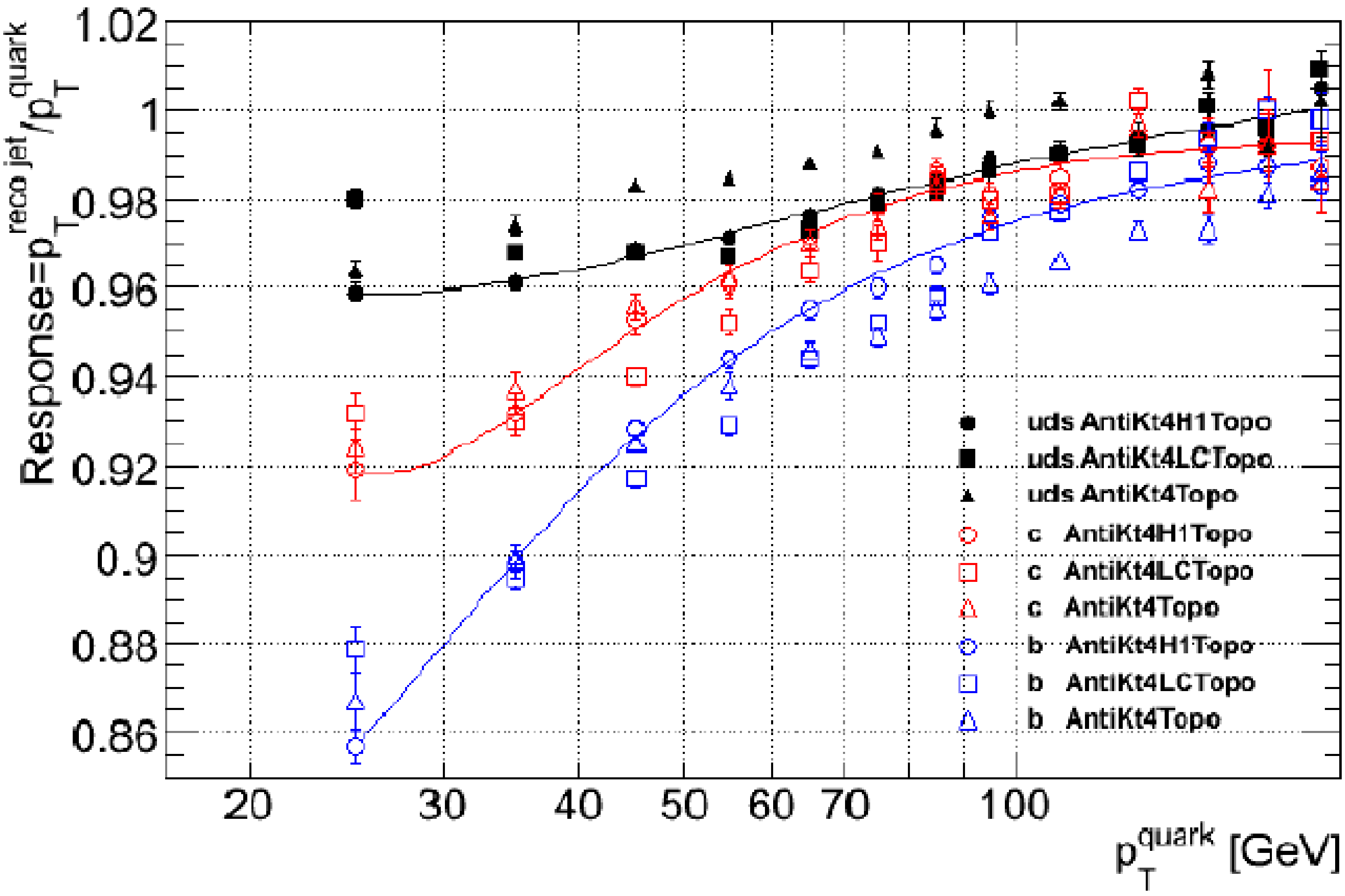
QCD vs. ttbar

– user09.KojiTerashi.mc08.105200.T1_McAtNlo_Jimmy.recon.DPD_NOSKIM.e357_s462_r635_DPDMaker000164_p1
– Take the 4 quarks in tt → lνb qqb decays, find the closest jet and truth jet (ΔR < 0.3), require ΔR(jet, closest jet) > 1.0





Flavor dependence for different jet calibration techniques



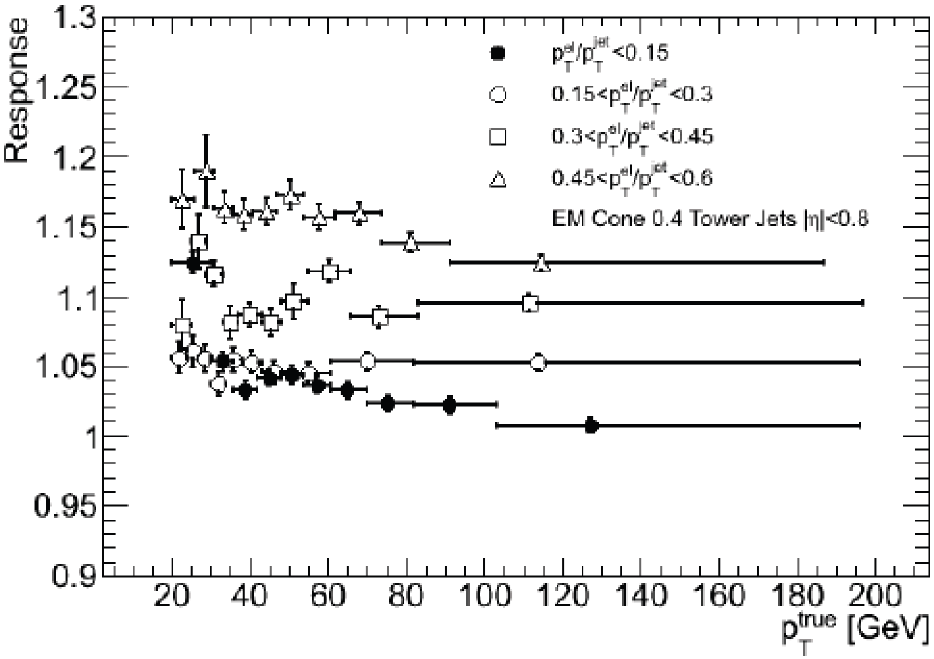
Flavor dependence on the JES (part II)

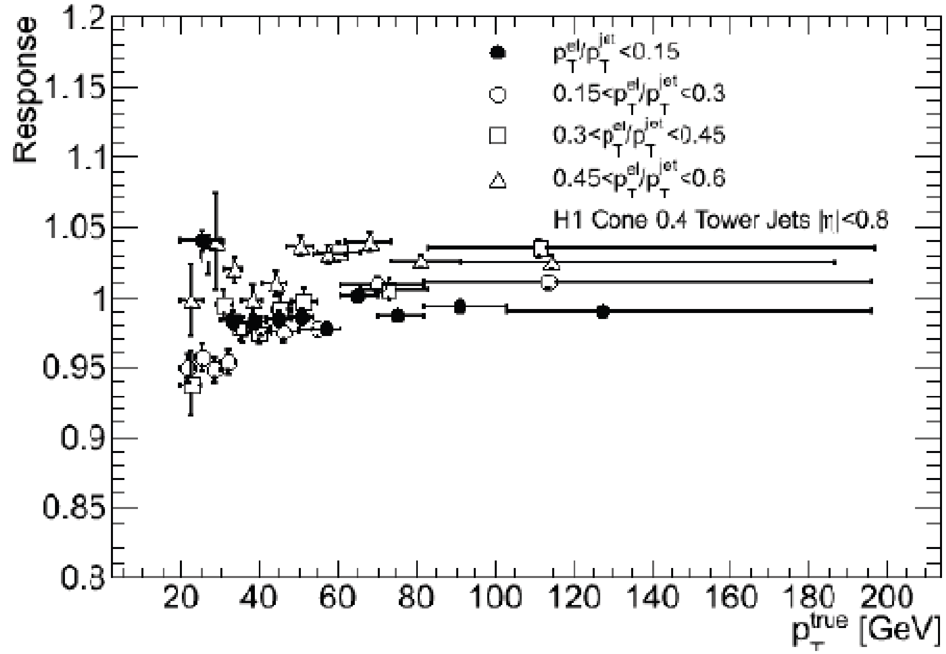
Hadronic flavor corrections for semileptonic b-jets

David López Mateos (with S. Moed, A. Schwartzman, E. Hughes and M. Franklin),
June 23, 2009

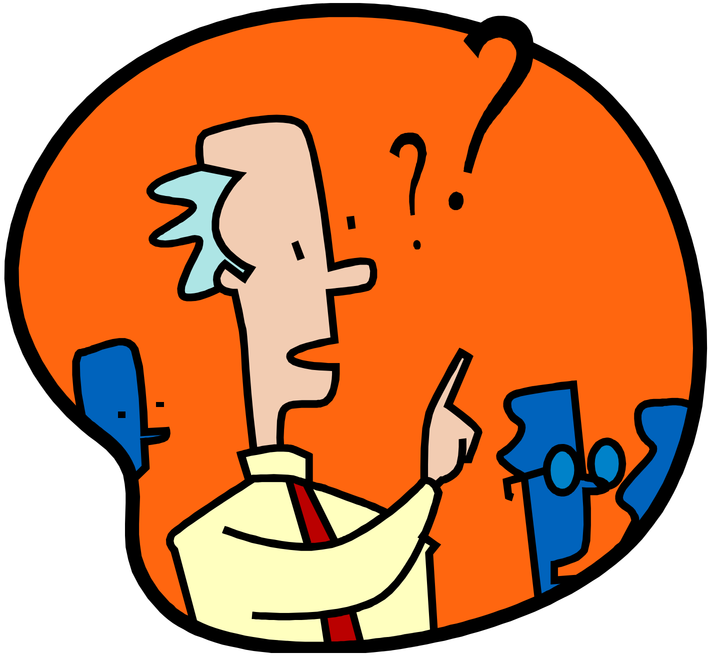
We have a correction for semileptonic bjets going to muons to account for the neutrino, now we want to do the same for electrons

Here we selected true semileptonic ttbar bjets going to an electron with the electron reconstructed





Discussion



- Questions:
  - To which level do we believe the fraction of gluons (and other flavours) given by Pythia in γ/Z^0 + jet ?

Tests of the energy scale

Stephani’s talk

In situ energy resolution

Gastón L. Romeo
Universidad de Buenos Aires

Ariel Schwartzman (SLAC)
Ricardo Piegaia (UBA)

Introduction

- We present two different data-driven techniques, which allow the jet energy resolution to be estimated from calorimeter observables
  1. Dijet Balance Method (DØ collaboration)
  2. Bisector Method (CDF collaboration)

Dijet balance method

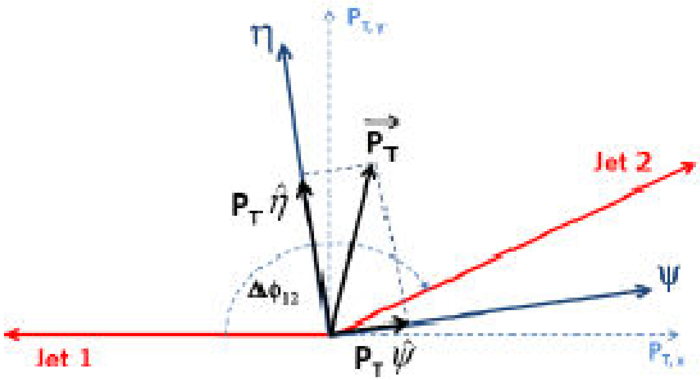
$$A \equiv \frac{p_{T,1} - p_{T,2}}{p_{T,1} + p_{T,2}}$$

$$\langle p_{T,1} \rangle = \langle p_{T,2} \rangle \equiv p_T$$

$$\sigma_{p_{T,1}} = \sigma_{p_{T,2}} = \sigma_{p_T},$$

$$\frac{\sigma_{p_T}}{p_T} = \sqrt{2}\,\sigma_A$$

Bisector method



$$\sigma_\psi^2 \equiv Var(P_{T,\psi})$$ JER – gluon rad.

$$\sigma_\eta^2 \equiv Var(P_{T,\eta})$$ JAR – gluon rad.

$$\frac{\sigma(P_T)}{P_T} = \frac{\sqrt{\sigma_\psi^{2\ calo} - \sigma_\eta^{2\ calo}}}{\sqrt{2}\,\langle P_T \rangle}$$

Dealing with radiation in dijet balance method

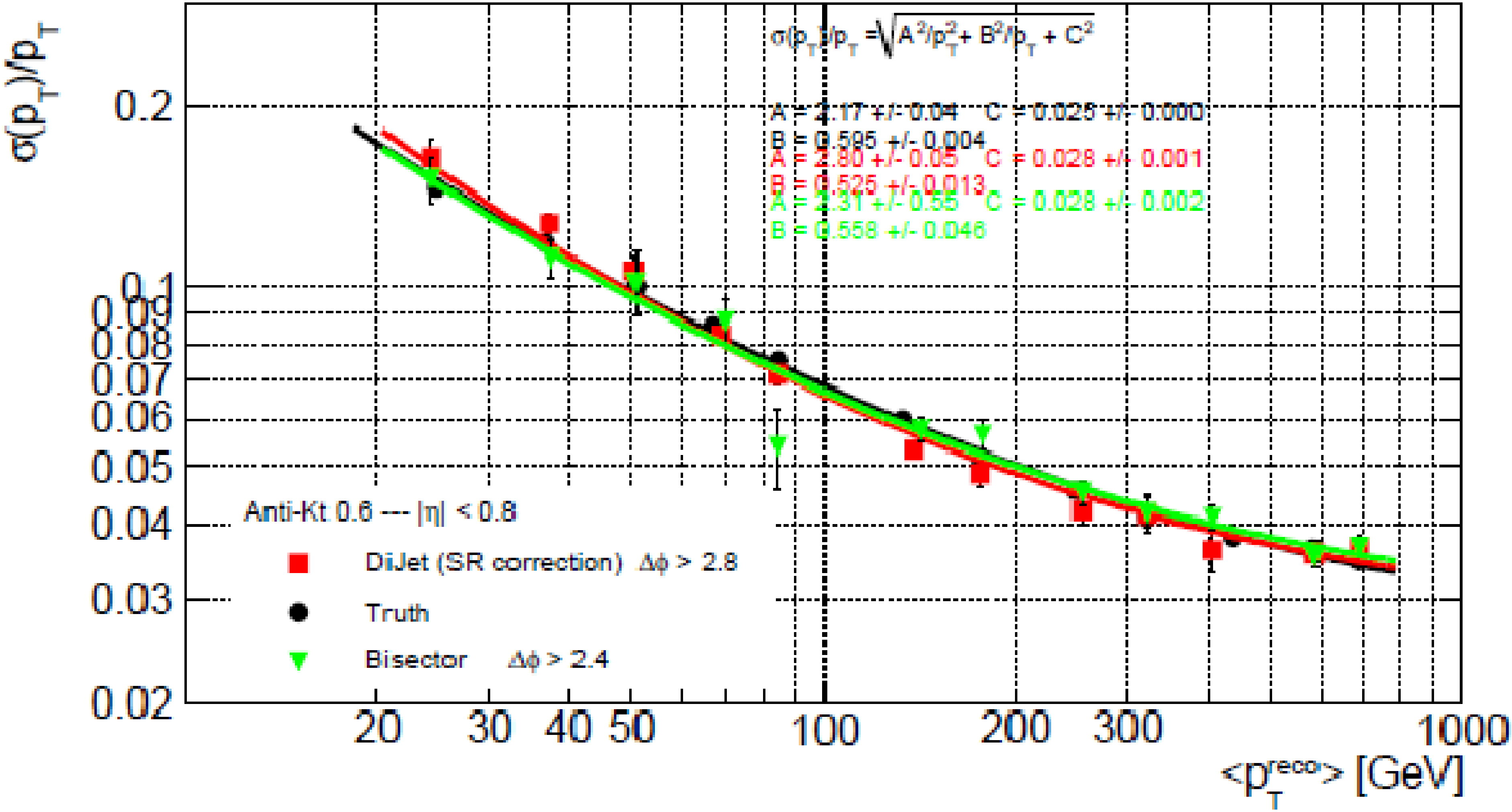
- Two back to back leading jets, satisfying at least $\Delta\phi > 2.8$ btw them.
- Both jet in $|\eta| < 0.8$
- Other jets are required to have $p_T < 10$ GeV
- Events including b-jets and jets with muons are vetoed.

$A \equiv \frac{p_{T,1} - p_{T,2}}{p_{T,1} + p_{T,2}}$ is measured for a series of $p_{T,3}$ threshold values. For each p_T bin, the set of resolutions obtained from the different $p_{T,3}$ threshols are fitted and extrapolated to $p_{T,3} \rightarrow 0$.

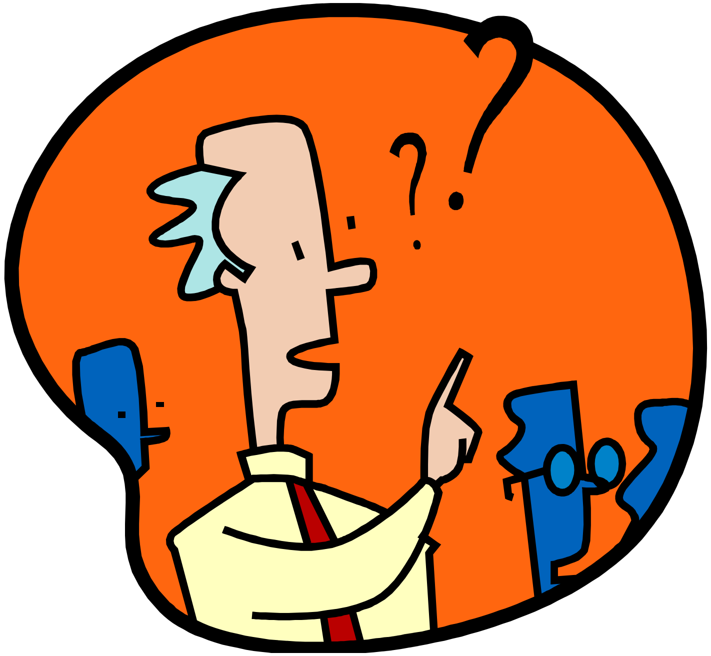
The bisector method is not so sensitive to the radiation, however a $\Delta\phi > 2.4$ is needed, and it is very sensitive of this cut

Results

The results of the two methods are compatible between them and wrt MC method



Discussion

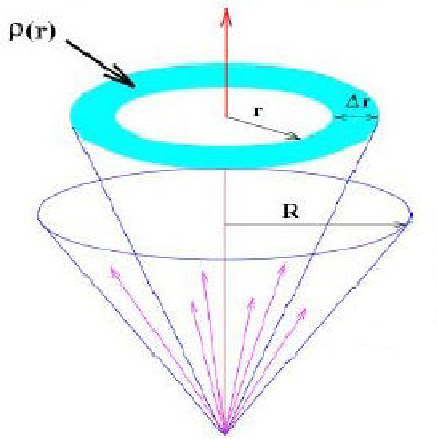


Jet shapes

M. D'Onofrio, S. Grinstein, M. Martínez, F. Vives

IFAE (Barcelona)

Jet shapes at hadron level



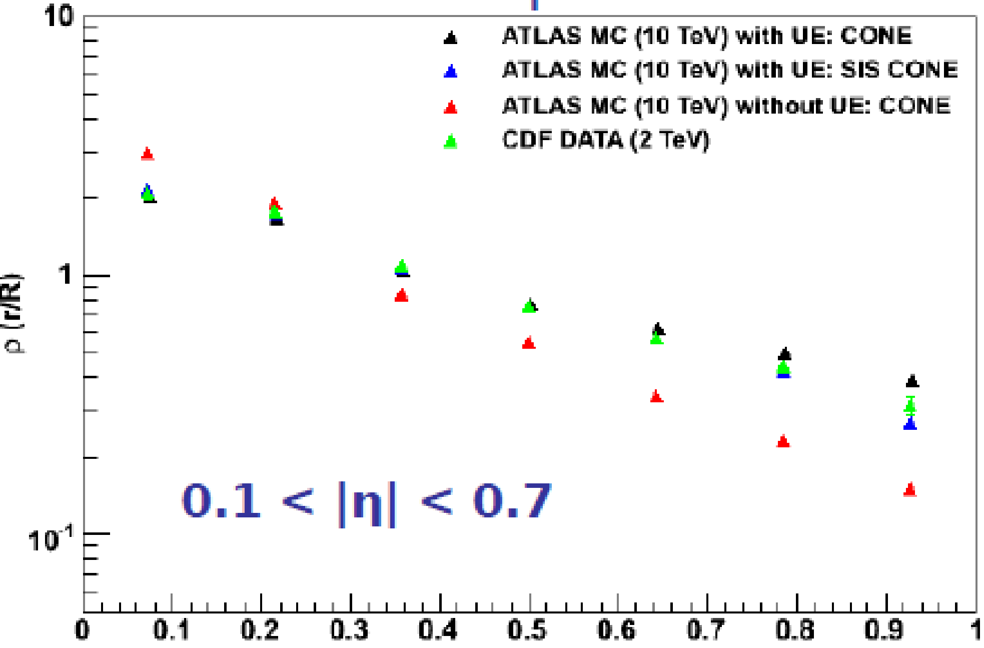
$$\rho(r) = \frac{1}{\delta r}\frac{1}{Njets}\sum_{jets}\frac{PT(r-\delta r/2, r+\delta r/2)}{PT(0,R)}$$

Differential Jet Shape

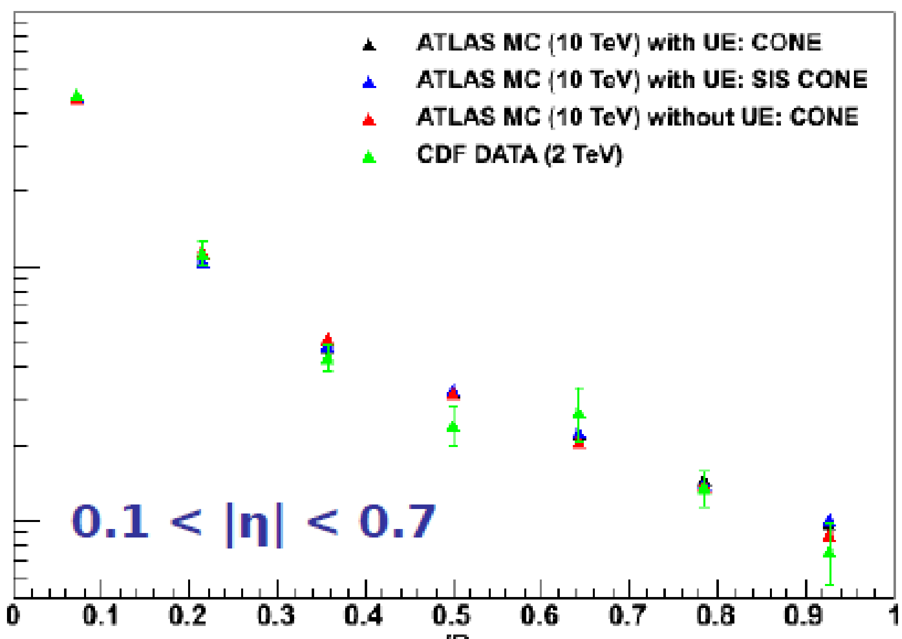
$$r = \sqrt{\Delta\eta^2 + \Delta\varphi^2} \qquad 0 \le r \le R = 0.7$$

At hadron level : sensitive to UE

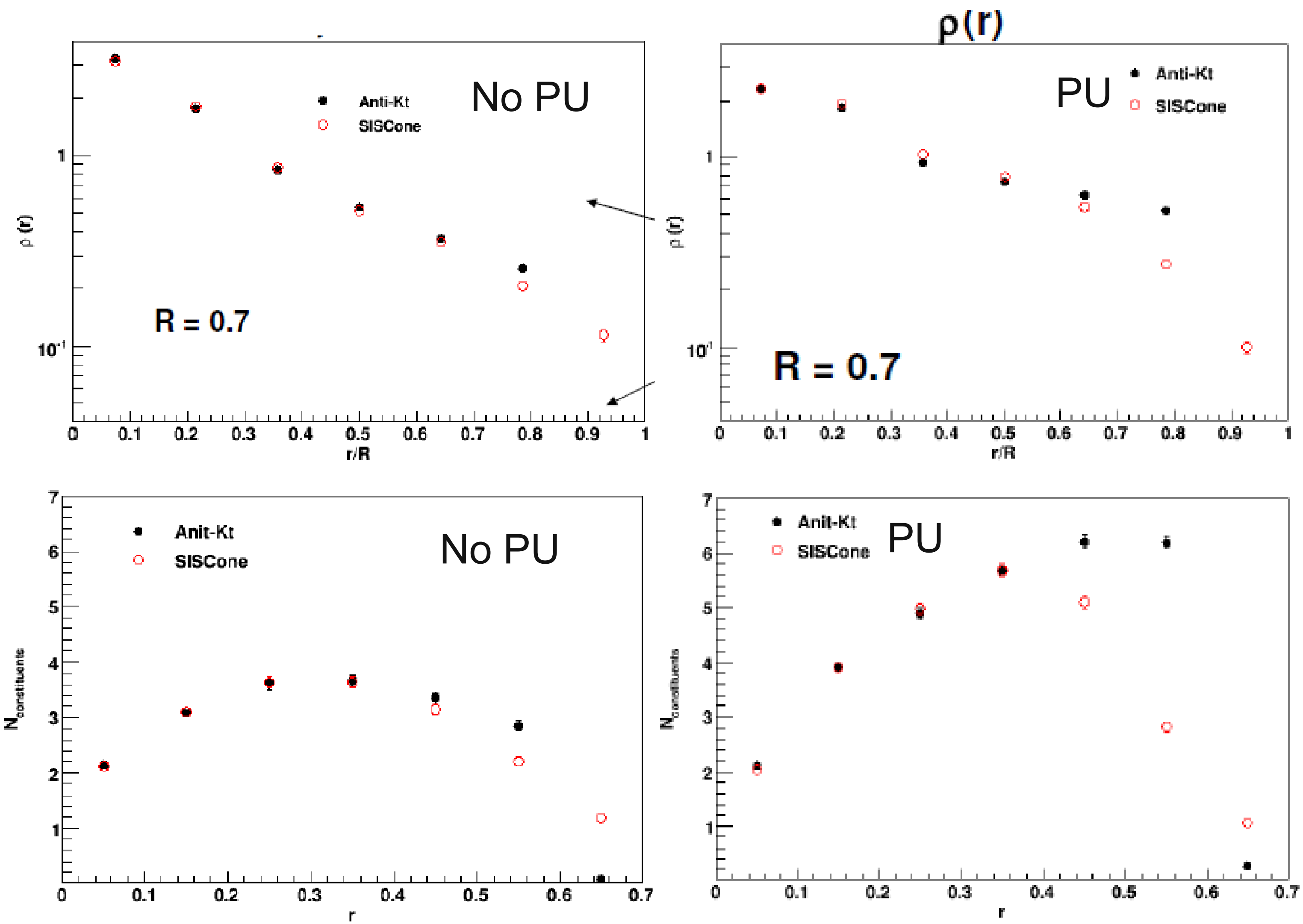
37 GeV < P_T < 45 GeV



304 GeV < P_T < 340 GeV



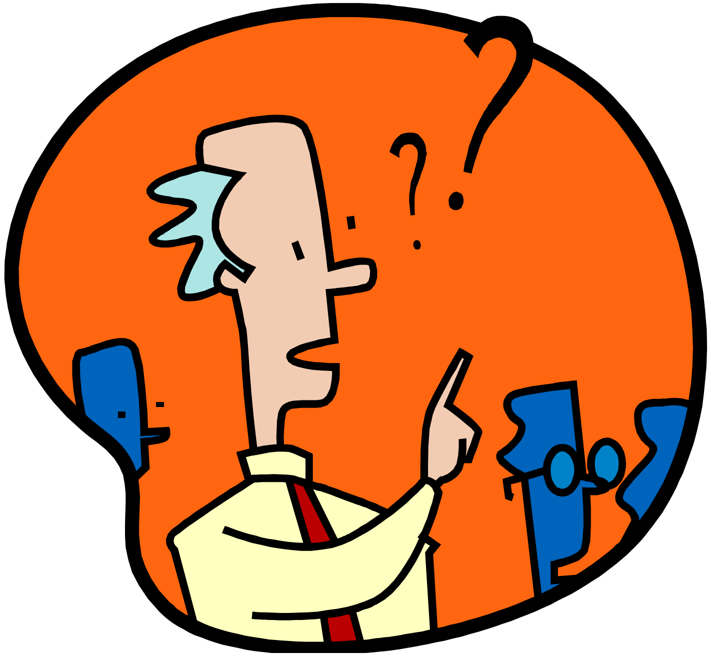
Jet shapes at detector level



Anti-Kt jets narrower than SIScone and both sensitive to pile up

Anti-Kt jets are more conical and their shape is more stable against pile up

Discussion



Test of the jet energy scale (part I)

Basic questions on systematics

Andreas Jantsch

Max-Planck-Institut für Physik
München

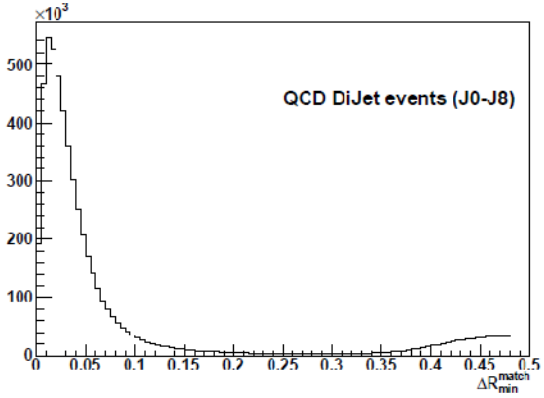
Factors to take into account

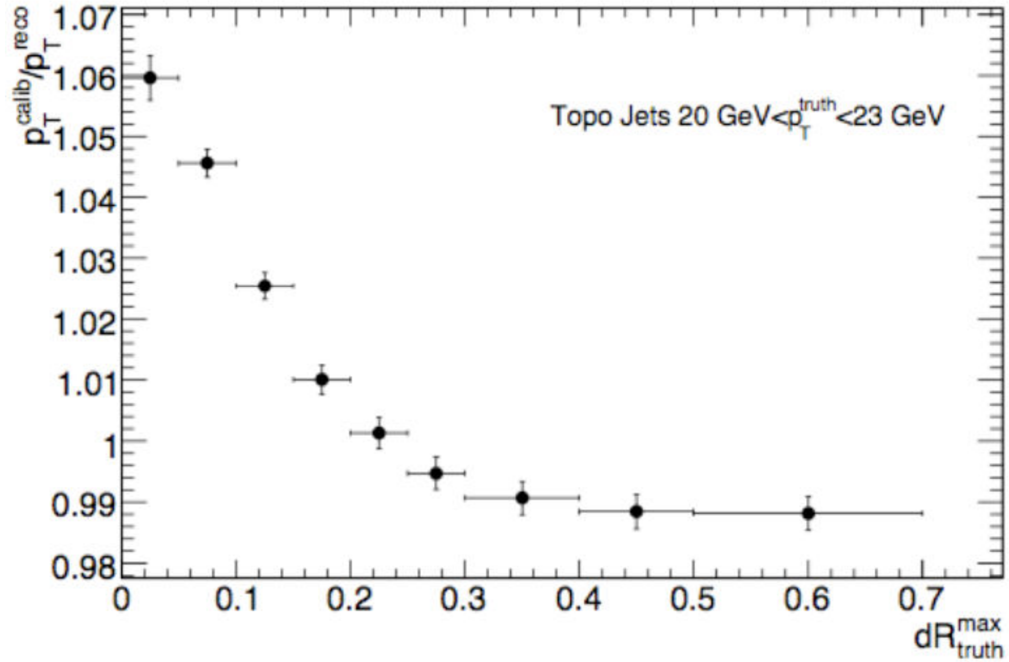
Isolation: $\Delta R^{iso}_{min} > 1.0$ w.r.t. reco & truth jets

Already discuss

Matching: $\Delta R^{match}_{min} < 0.3$ & $p_T^{true} > 20\ GeV$

response very
sensitive to this cut





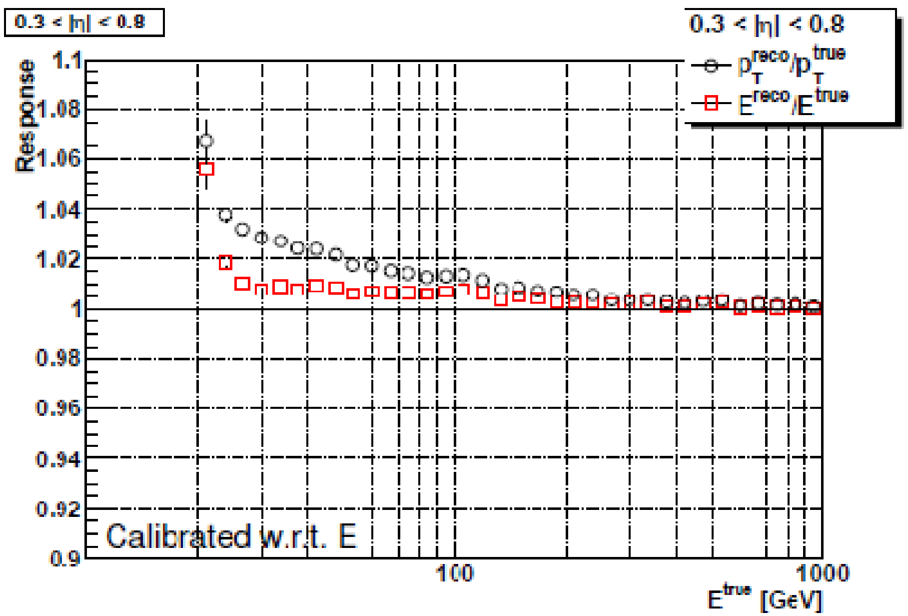
A new tool is being developed that can be very useful for this issue

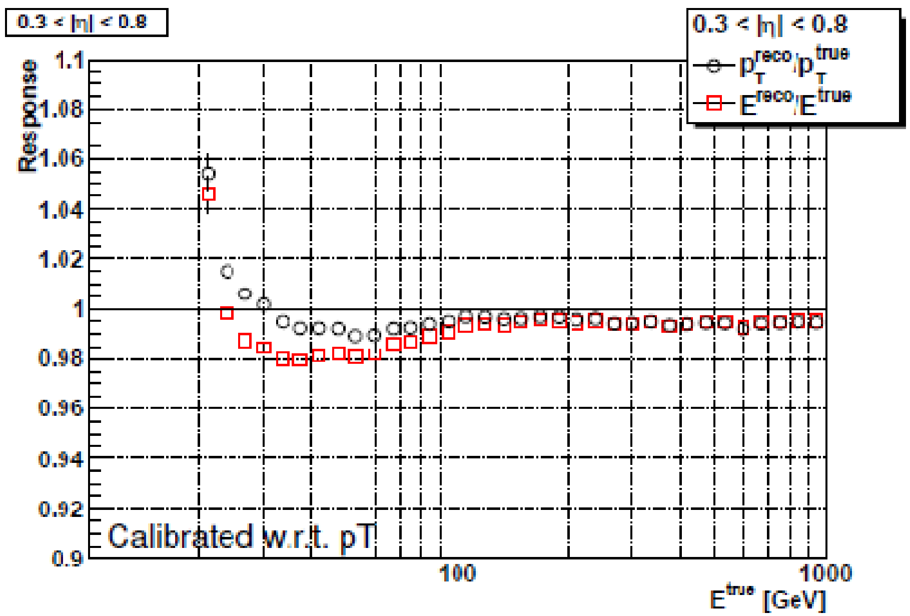
See the material from Guennadi Pospelov in this session

Factors to take into account

E vs. p_T

- Does calibration of p_T or E matter?





Test of the jet energy scale (part II)

Test of the Jet Reconstruction and Calibration analyzing the invariant mass of the W decay products

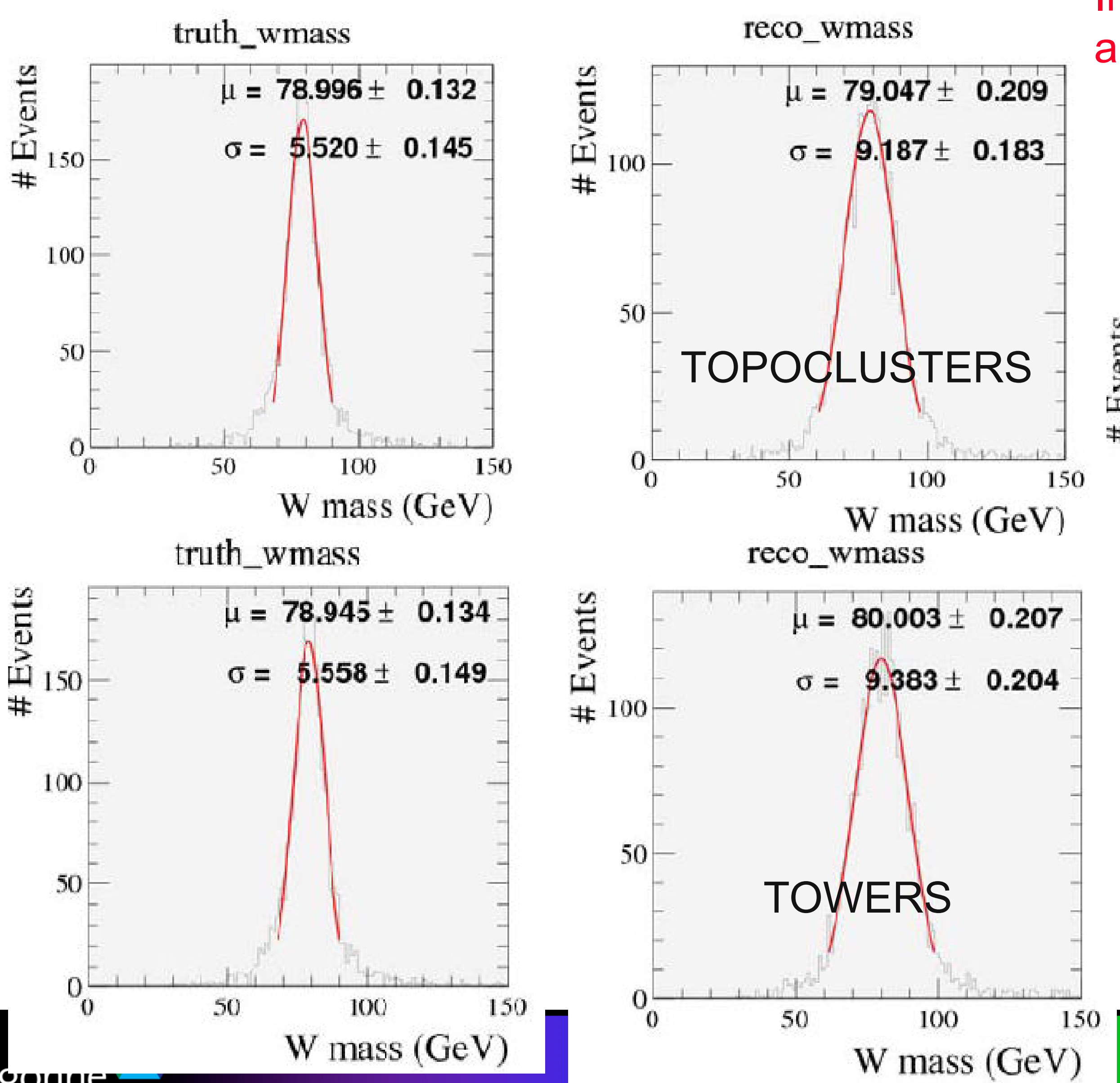
"Work in Progress"

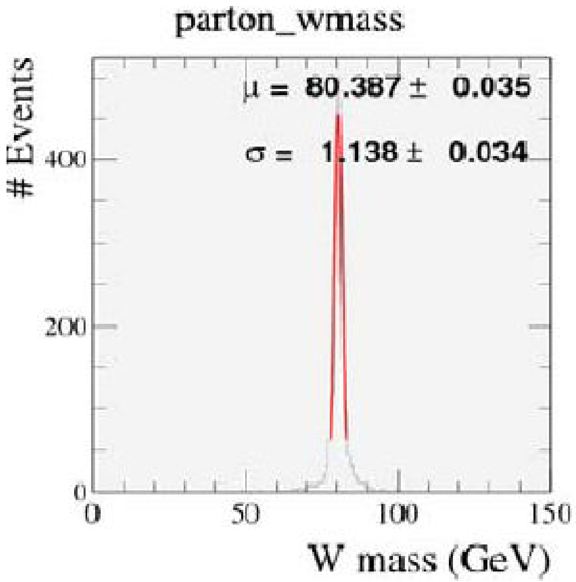
Belen Salvachua & Jimmy Proudfoot

Similar studies carried out by Nabil Ghodbane with similar results

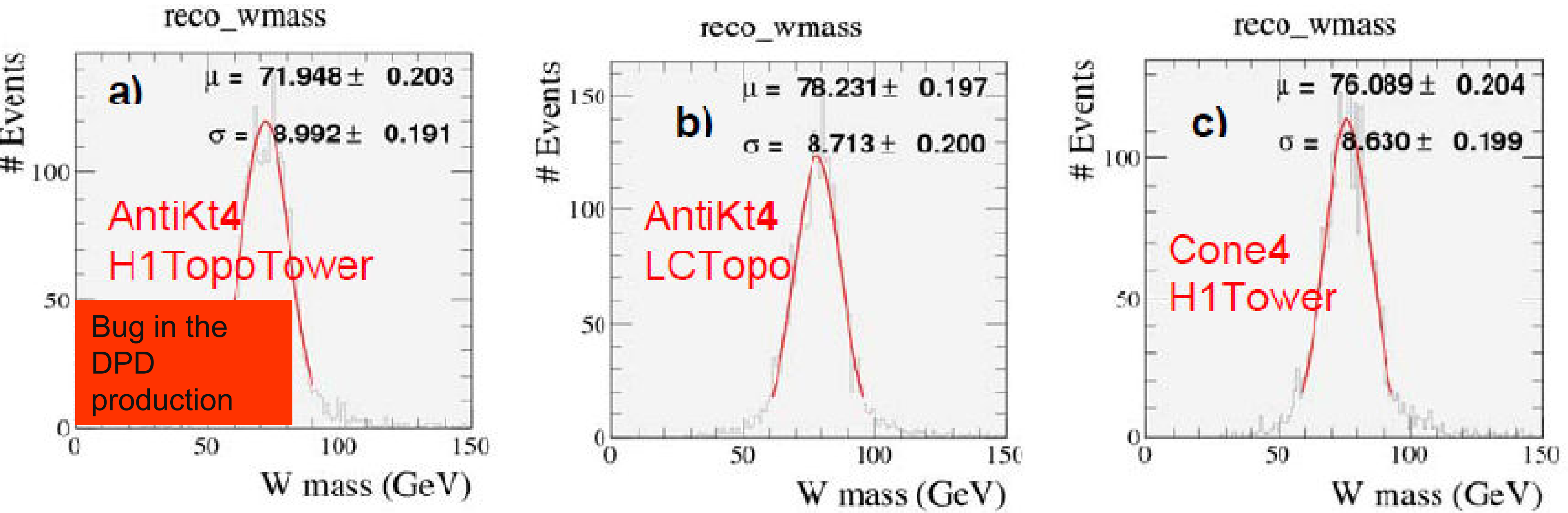
W mass dependence with the input to the jet algorithm

In both cases jet algo. is AntiKt





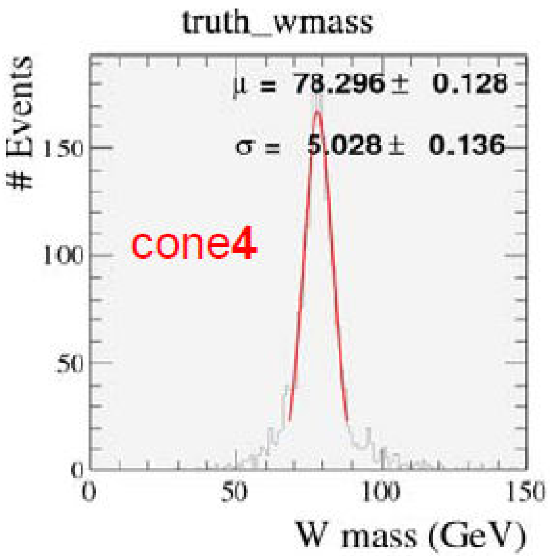
W mass dependence with the jet calibration

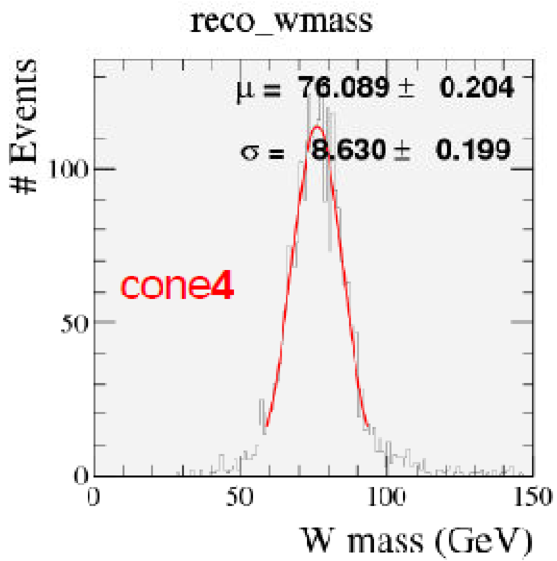


Numerical inversion applied on top of all the jet calibration algorithm

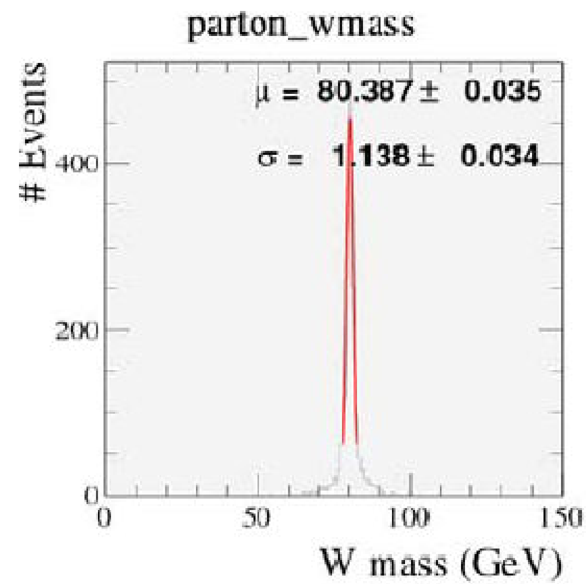
When Numerical inversion applied at the Em scale the distribution is 6% wider

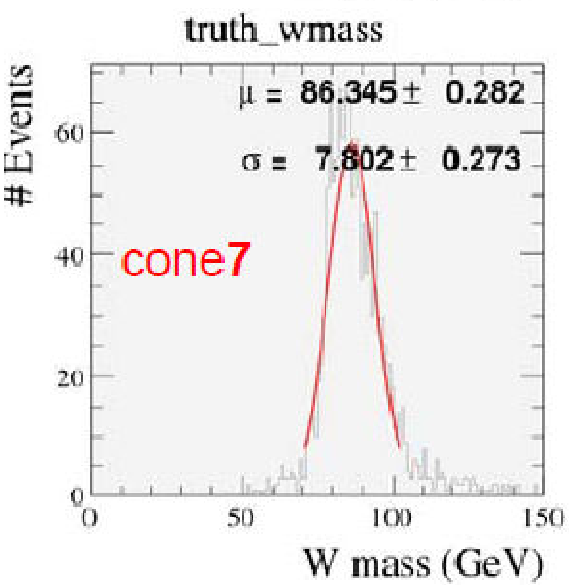
W mass dependence with the jet algorithm: jet size

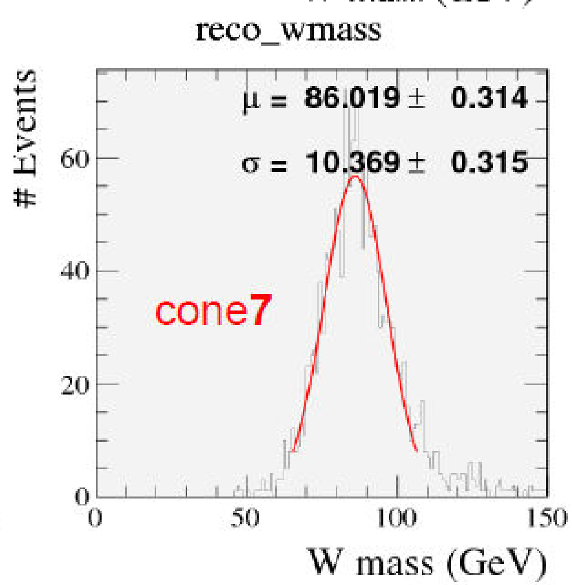




Narrow jets tend to underestimate the W mass…







…wider jets to overestimate it

Test of the jet energy scale (part III)

Strategy for the test of the jet energy scale

Chiara Roda & Vincent Francois Giangiobbe

Work done in collaboration with the jet energy scale task force

Preliminary

- The present strategy for the JES consists in a series of factorizable steps, each correcting a different detector effect.
- The correction factors of each step are calculated once the previous corrections have been applied, thus the corrections are, in general, not interchangeable
- Each correction is validated using the same sample and the same cuts from which the correction constants were calibrated
- Is is needed a test that validates the full correction chain
- Two kind of test are proposed:
  - Based in MC truth
  - Tests based on quantities completely derivable from data

MC based calibrations : The (cell density weighting or local calibration) + JES correction

- They both rely in two important factors
  - A properly calibrated calorimeter at the EM scale
  - An reliable Geant4 simulation
- We can asses the validation of both methods using data-driven techniques
  - QCD Dijet sample
  - γ + jet sample
- If JES does not work among the whole pseudorapidity we can use dijet balance on top of it: partially data driven calibration chain
  - Then only γ + jet sample can be used for validation

Back-up solution: the completely data-driven approach

- In the EM-scale-calibrated calorimeter differs in more than 10% from the MC then a fully data-driven calibration could be considered while the understanding of data allows a better implementation of the simulation
- One possible data-driven approach:
  - dijet balance to restores uniformity
  - γ + jet balance to restore the scale
  - Caveat: the scale is restored at parton level

Discussion