Status of the SISCone Note (Part I)

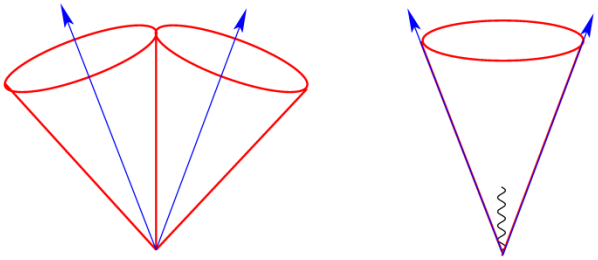
JetMET

Jan 17 2008

Frank Chlebana

Why Use SISCone

Cone-based algorithms that use starting seeds are collinear and infrared unsafe → ***ambiguities arise comparing observation to theory***



Seedless algorithms have taken a prohibitively long time to execute

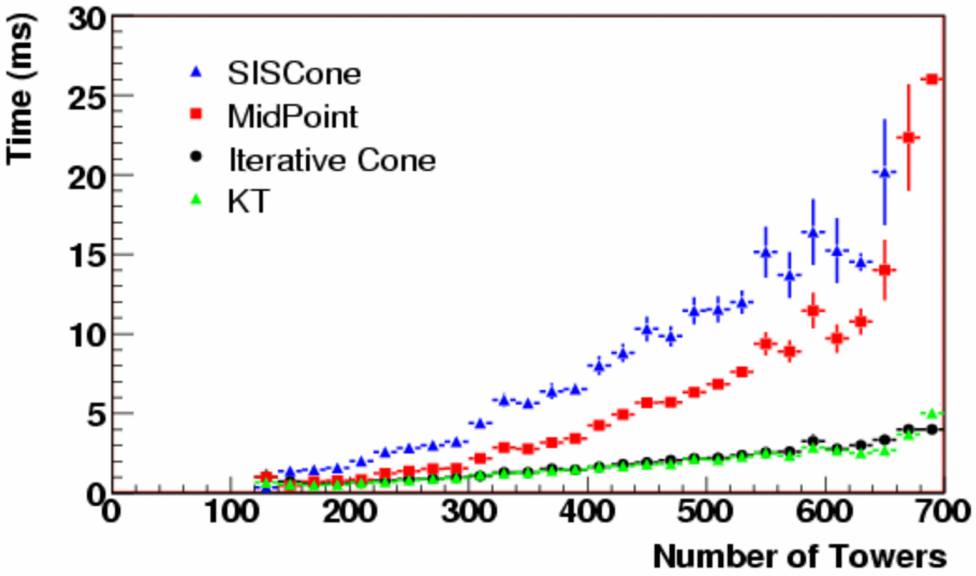
SISCone is a Seedless Infrared Safe Cone algorithm

Significantly reduced execution times, comparable to Midpoint

A version that is 10% faster is available (v1.2.0)

We are using v1.1.1

FASTJET 2.3.0 is available



Why Use SISCone

There has been an evolution of jet algorithms based on the interaction between theorists and experimentalists

At the Tevatron we started from an agreed upon jet clustering algorithm → ***divergence of the algorithms at CDF and DØ***

SISCone is an external package which has been interfaced to CMSSW → ***avoid any divergence***

SISCone is theoretically preferred and does not have the problems associated with earlier cone-based algorithms

Problems with cone-based algorithms show up when trying to compare what is observed back to the theory description

Why Use SISCone

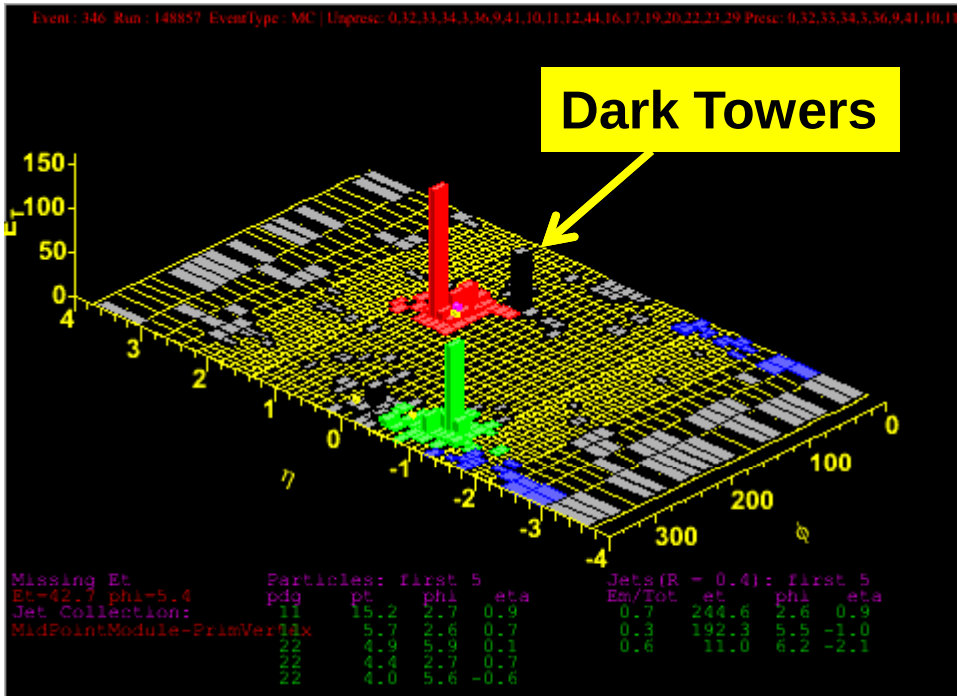
Problem shows up in many different analyses…

From "A practical Seedless Infrared-Safe Cone jet algorithm"
G.P.Salam and G.Soyez

Observable	1st miss cones at	Last meaningful order
Inclusive jet cross section	NNLO	NLO
$W/Z/H + 1$ jet cross section	NNLO	NLO
3 jet cross section	NLO	LO
$W/Z/H + 2$ jet cross section	NLO	LO
jet masses in 3 jets, $W/Z/H + 2$ jets	LO	none

Table 2: Summary of the order (α_s^4 or $\alpha_s^3\alpha_{EW}$) at which stable cones are missed in various processes with a midpoint algorithm, and the corresponding last order that can be meaningfully calculated. Infrared unsafety first becomes visible one order beyond that at which one misses stable cones.

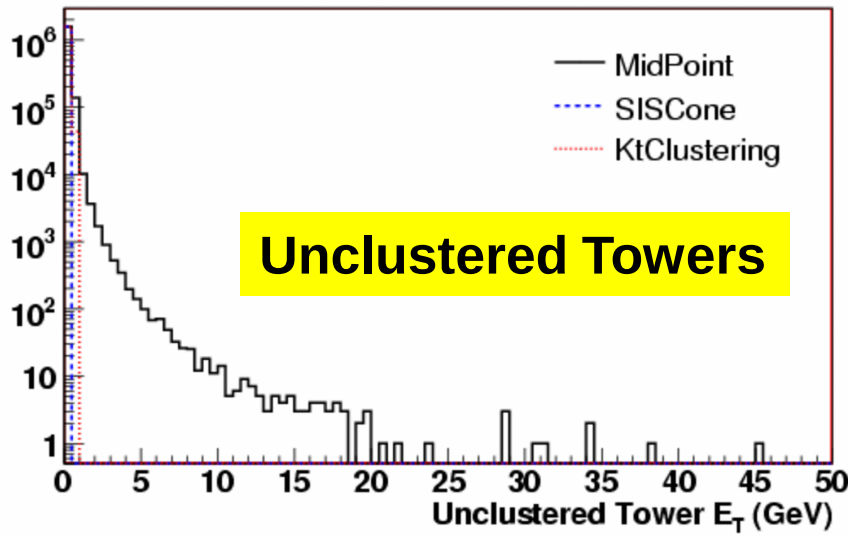
Why Use SISCone



Midpoint can leave unclustered towers (Dark Towers)

We see the same problem at CMS

Midpoint has unclustered towers as high as 45 GeV



SISCone Note Status

Document to support using SISCone as the *preferred* cone-based jet clustering algorithm at CMS

Note documents studies that were done comparing SISCone with Midpoint mostly using CMSSW 1.5.2 samples

Represents the work of many people who are listed as authors

Note was circulated among the authors

Now ready for a larger audience

Available on CMS information server

CMS AN 2007/000

The Compact Muon Solenoid Experiment

Analysis Note

The content of this note is intended for CMS internal use and distribution only

January 7, 2008

Performance of the SISCone Jet Clustering Algorithm

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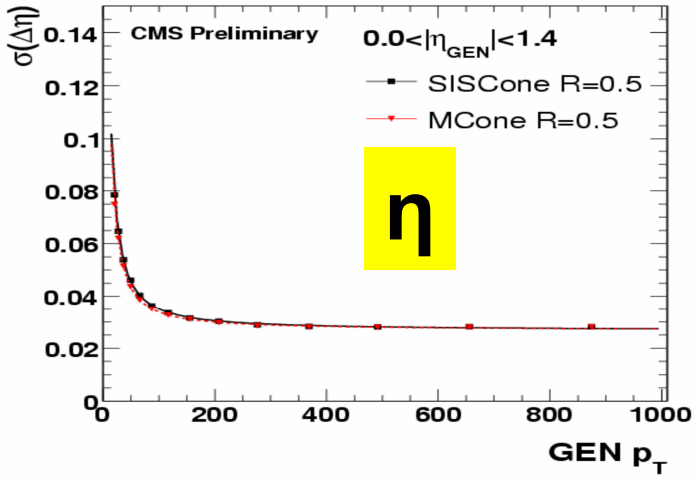
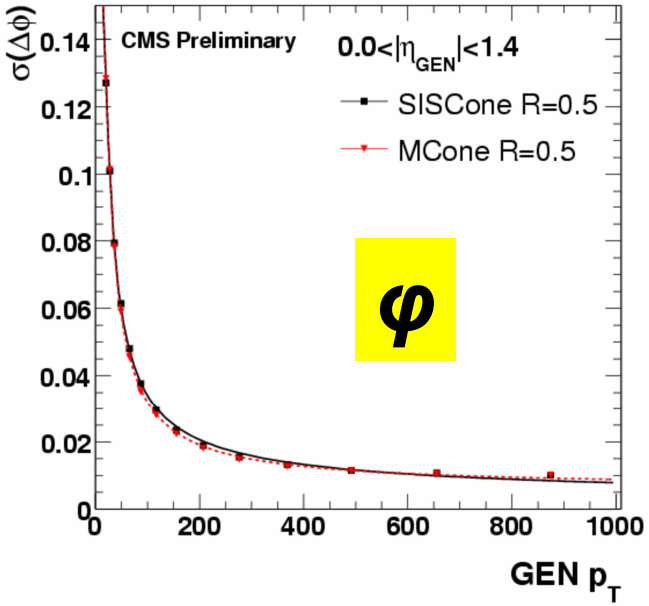
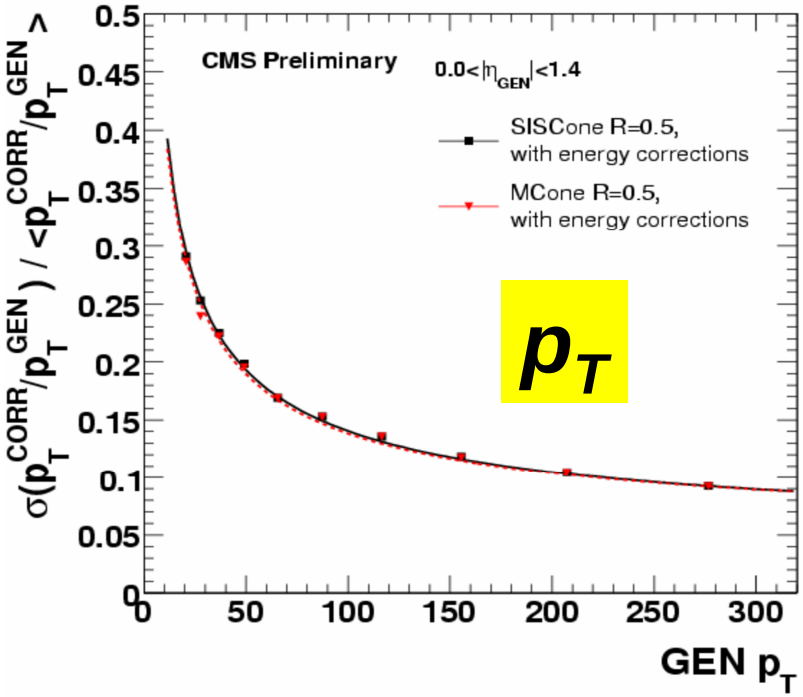
Abstract

We compare the performance of the Seedless Infrared Safe Cone (SISCone) jet clustering algorithm with the Midpoint algorithm for jet reconstructon in CMS calorimeters. It is shown that reconstructed quantities are similar for the two algorithms and they have similar performance for multijet processes such as top production. Unlike the Midpoint algorithm, SISCone is infrared safe and does not leave

P_T ,η,φ Resolution



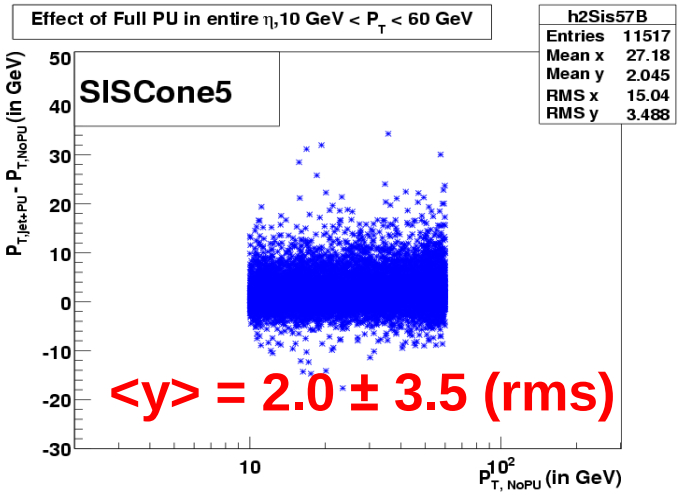


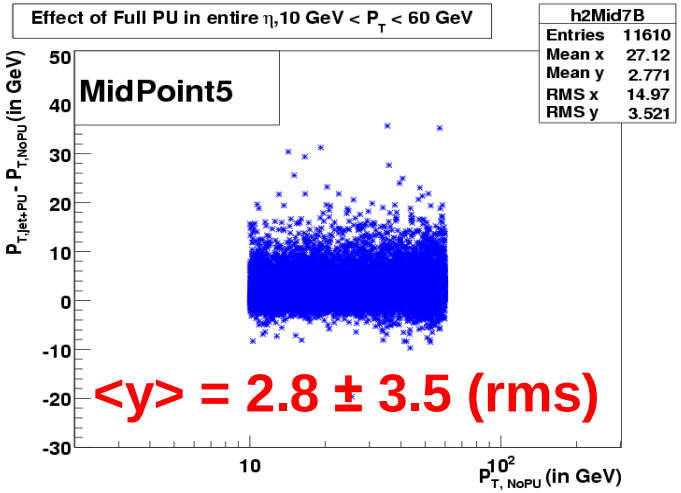


Resolutions for Midpoint and SISCone are comparable *(Endcap and Forward resolutions are included in the Note)*

Looked at P_T, η, φ for different cone sizes (R = 0.5 and 0.7)

Pile Up Studies





Looked at *in-time* and *full* pileup

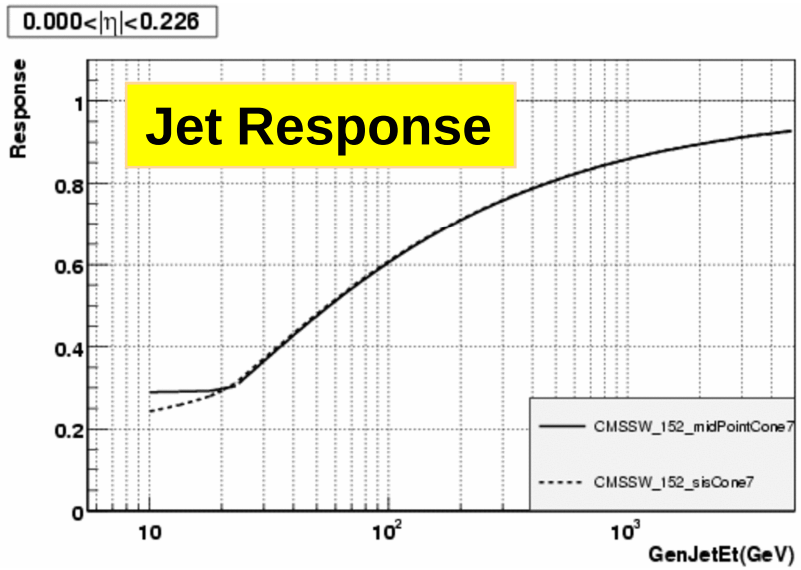
Plots compare the effect of full pileup for jets in the range 10 – 60 GeV

Corresponding to an average of 5 interactions/crossing
(expect ~20 at highest luminosity…)

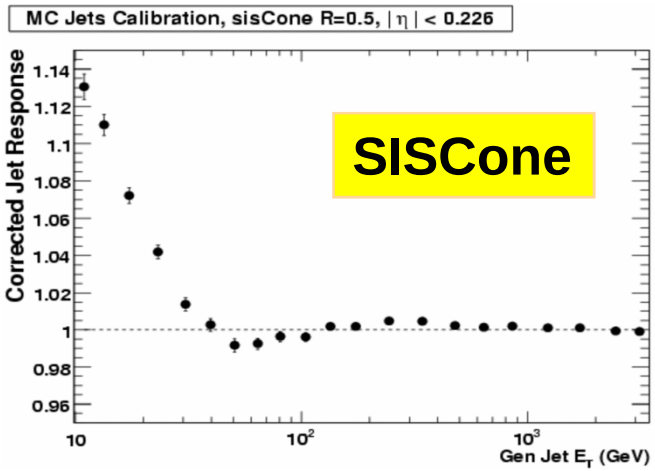
For full pileup we added simulated hits for the adjacent crossing (-5, +3)

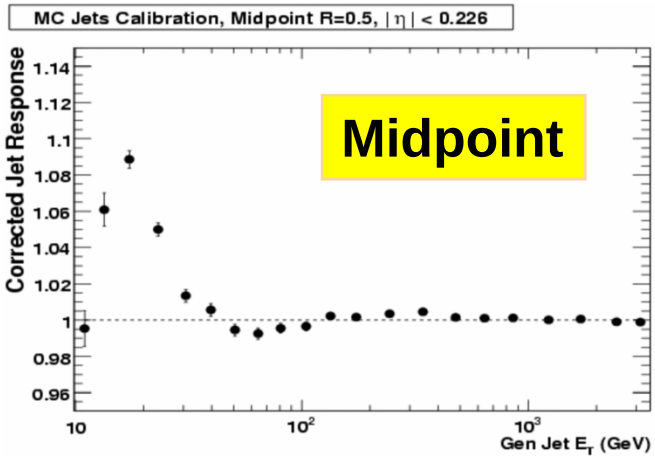
SISCone appears to be less sensitive over entire η range

Jet Corrections



Closure Plots



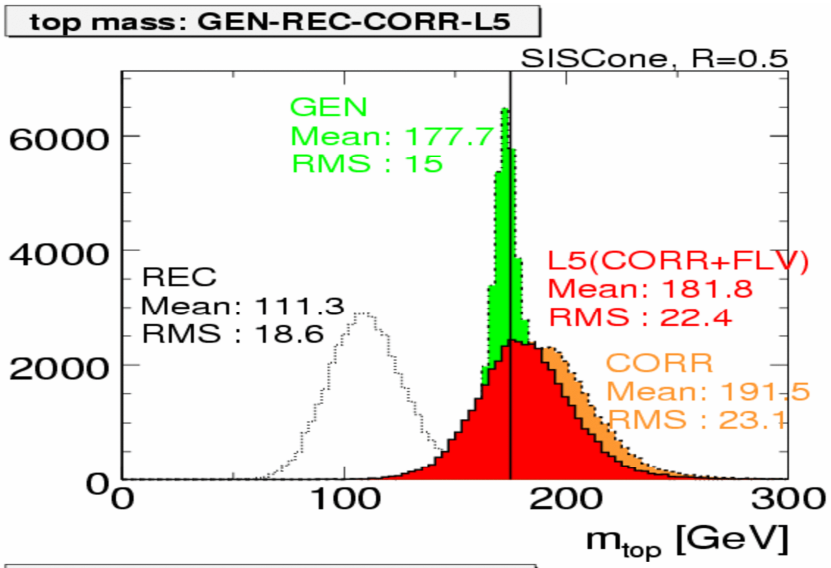


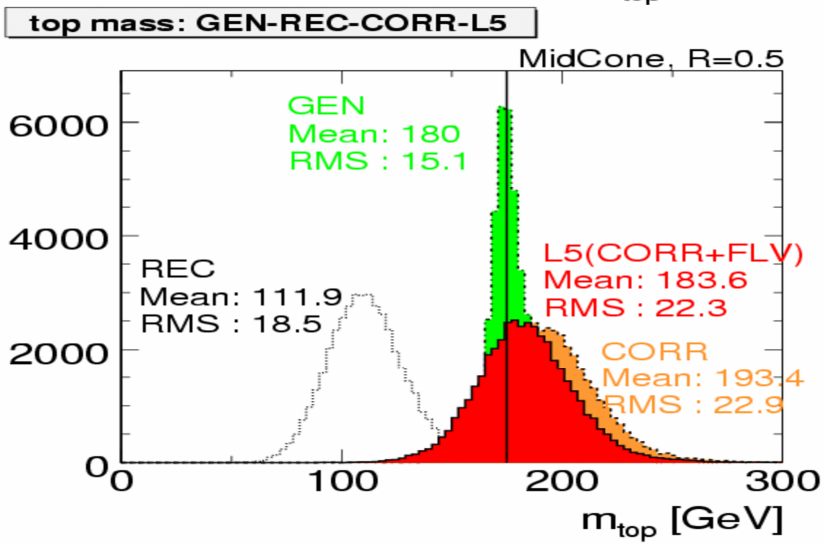
MCJet **corrections are available**

For Jets > 30 GeV we get the same precision for SISCone and Midpoint

Factorized corrections **(L2L3) are also available**

Multi-Jet Studies





Compared SISCone to Midpoint in a more complex multijet process

Looked at *tt* events

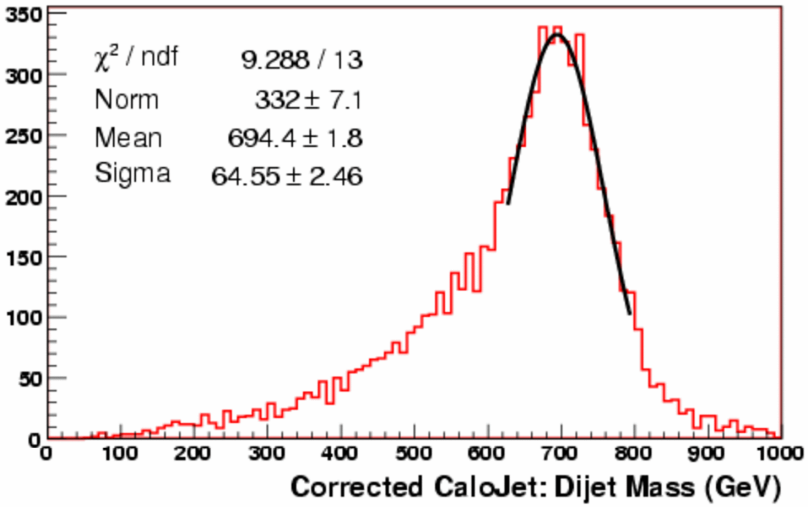
See comparable performance when resolving 6 jets in the fully hadronic decay mode

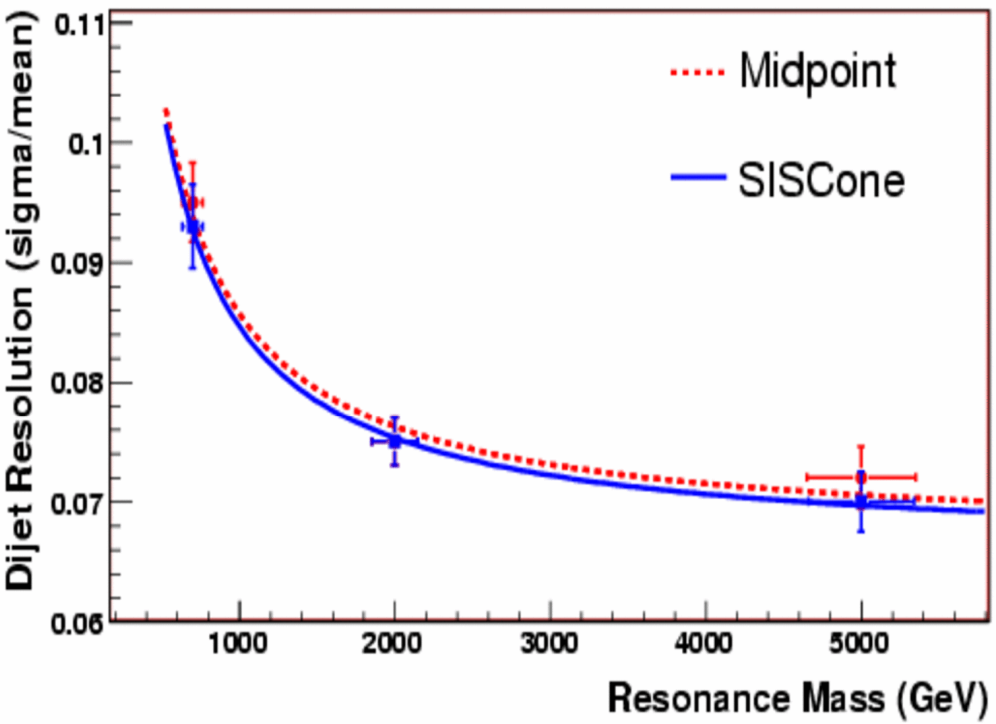
See comparable mass resolution when reconstructing *W* and top from two and three jets

M_{jj} Resolution

Looked at *Z'* sample with different mass

Used newer *factorized* corrections





Resolutions for SISCone are comparable with Midpoint

See Part II of talk

Summary

Note is available which demonstrates that SISCone performs as well or better than Midpoint

Looked at resolutions, pileup, matching efficiencies, performance in multijet events…

Will try to distribute it to a larger audience during "Physics Days"

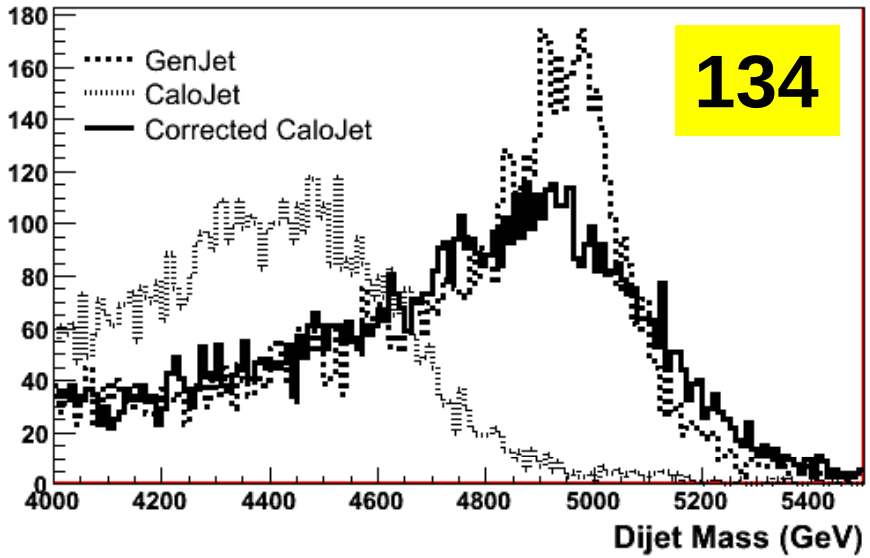
Really need to get CMS to adopt SISCone as *the* default cone-based jet clustering algorithm → *needs to be driven by the JetMET group*

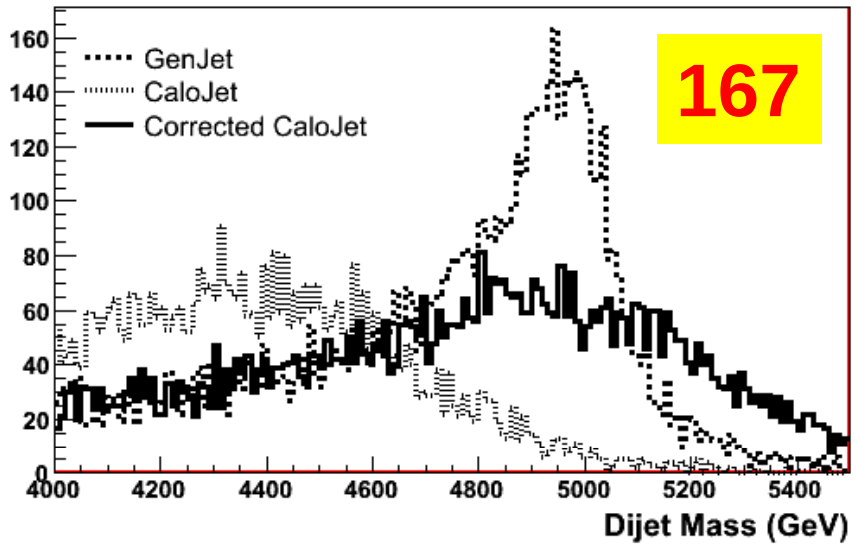
Have physics groups start using SISCone → *if not done soon it will be very difficult to have people change*

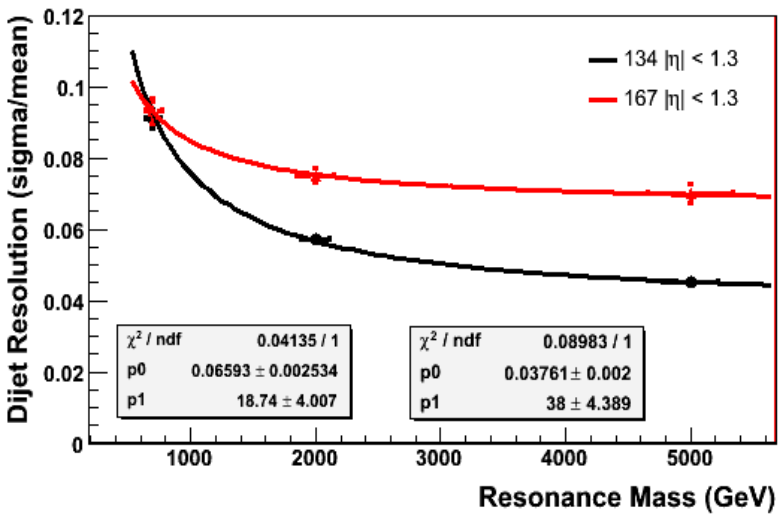
CDF is still using Run I Jet algorithm for some analyses….

M_{jj} Resolutions (Part II)

M_{jj} Resolutions



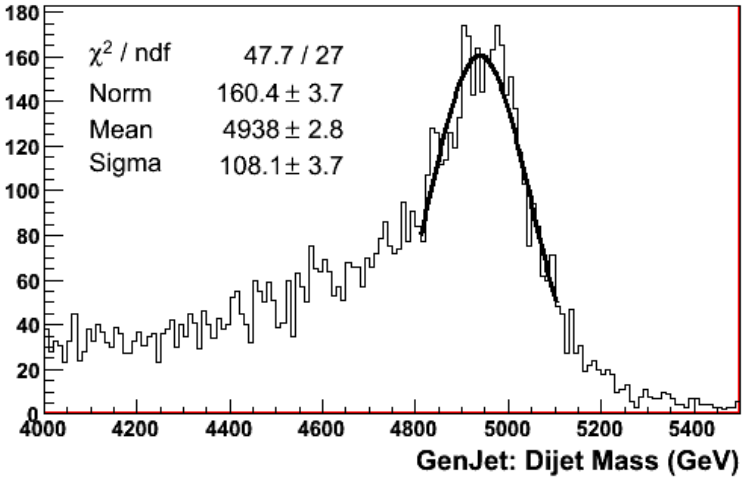


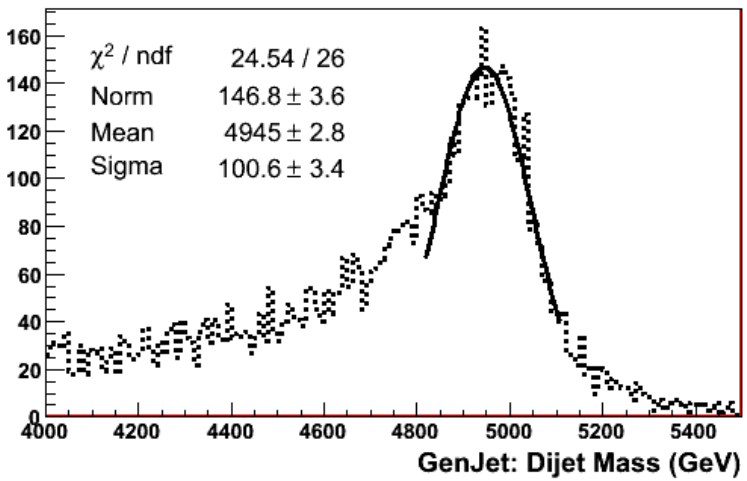


We were looking at the M_{jj} resolutions for the dijet analyses note, CMSSW 134

Notice that the M_{jj} resolution for CMSSW 167 is much worse

M_{jj} Resolutions





GenJet resolutions look the same for the two samples

CaloJet resolutions look much worse for the CSA07 (167) sample

The CSA07 samples were reconstructed with a "100 pb-1 miscalibration"

- ***Verify if this is the source of the effect***
- ***Is this the expected size of effect ?***
- ***Trying to see if the Validation tools would catch this…***