Run 1 Jet Energy Scale

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UVa

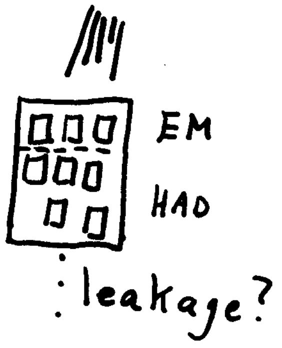
Q1: What's a jet?

- Never forget to ask this question at start of any jets analysis

After defining an Algorithm, the scale may be chosen

A: Equivalance of particle Energy to detector Energy (Run 1 - cones)

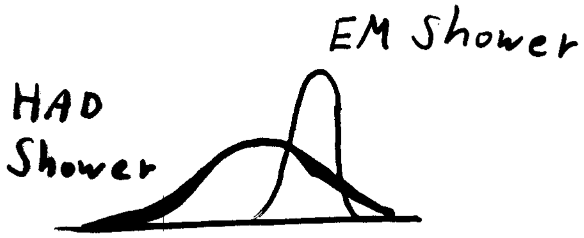
B: Equivalance of particle Momentum to detector Momentum (Run 1 - k_T)



The jet at particle level

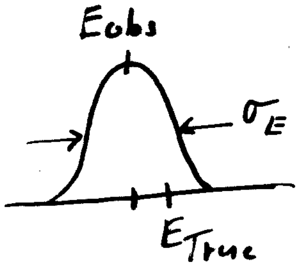
In the Detector

Single Particle Response



Jets are ~ $\langle 1/3 \rangle$ EM-like, increasing w/ ln(E)

Jet Response in hermetic detector

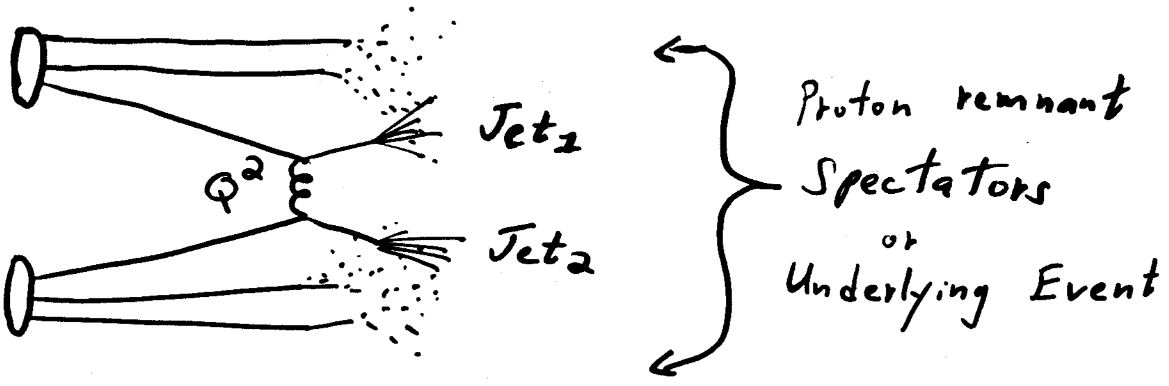


~ Normal distribution

Central Limit Theorem at work!

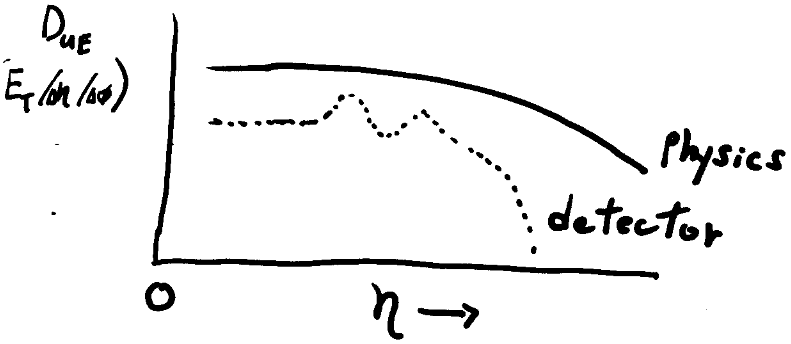
Nominally jet scale moves $E_{obs} \rightarrow E_{True}$

Ideally it should also reduce $\sigma_{E_{obs}}$!



ock to Q1: What's (in) a jet?

Run 1 choice ULE is not part of jet,
subtract on average based on jet algorithm & η.

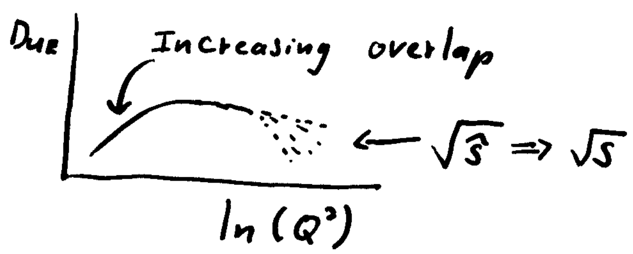


Density of ULE
(Min Bias Model)

$\langle E_T \rangle / \Delta\eta / \Delta\phi$

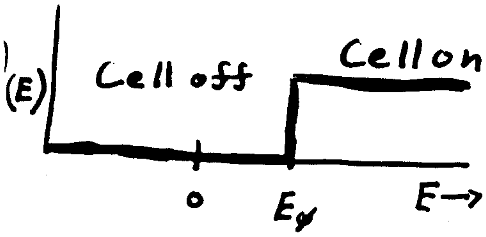
Alternate choices:

- Include ULE in jet energy
- Define ULE (Q^2)



Subtraction of ULE (+ noise + event pileup)

Complicated by zero suppression effects



Cell readout is
Zero suppressed

$$\sum_{\text{Cells}} E_{jet}\,\Theta(E_{jet}, E_\phi) + E_{noise}\,\Theta(E_{noise}, E_\phi) + E_{ULE}\,\Theta(E_{ULE}, E_\phi)$$

$$\neq \sum_{\text{Cells}} E_{Total}\,\Theta(E_{Total}, E_\phi)$$

E_{jet} is not a simple offset component subtraction

$$E_{jet} = E_{Total} - \langle E^{ULE} \rangle - \langle E^{noise} \rangle - \underline{O_c(E, \eta, L)}$$

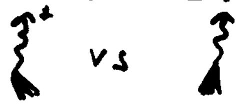
The offset correction depends on <u>occupancy</u>.

Run 1 (cone): develop emperical occupancy correct from data to get back E_{jet}

Run 1 (k_T): Overlay noise + ULE + generated jets apply ZSP in Software + directly measure effect on jets ☆

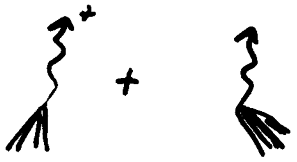
After finding amount of clustered energy belonging to the jet, apply <u>Response</u> Corrections

1) Normalize overall response between Central + end calorimeters



2) Derive η-dependent relative response Correction. Important for IC region!

3) Apply absolute hadronic response correction. This correction depends only on the jet algorithm and the jet energy.



* γ's may be central or forward

Comments on Response Corrections

γ Selection - no need for 'Golden' photons
nt EM cluster cuts need to be tight enough
o reject background (DY, W, Z, jets w/o dominant π^0)

logy Sensetivity : $\Delta\phi(jet, \gamma) \gtrsim 2.8$ rads

1. Sensetivity

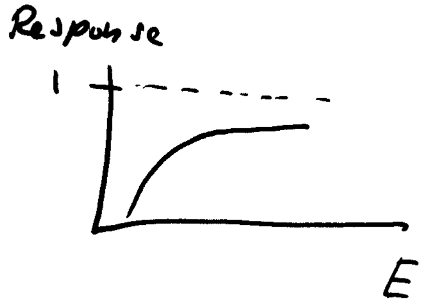
Response depends on $\not{E}_T$

In Run 1 we found Response dependence on
inosity due to misvertexed events.
tion : Use low-lum events + MI cut

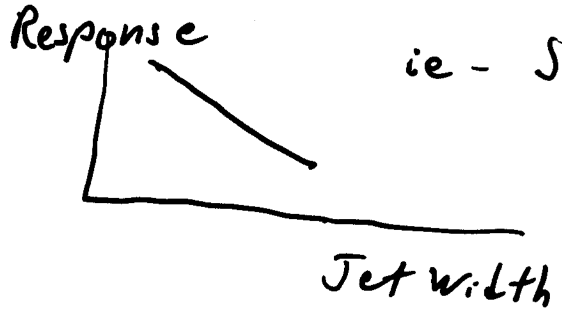
In Run 2 vertexing is much improved - still
l to analyze <effect> of large number of
up events on $\not{E}_T$ reconstruction

Response Enhancements

In Run I all jets received the same absolute Response correction, depending only on Energy.



In Run II we will try added parameters.



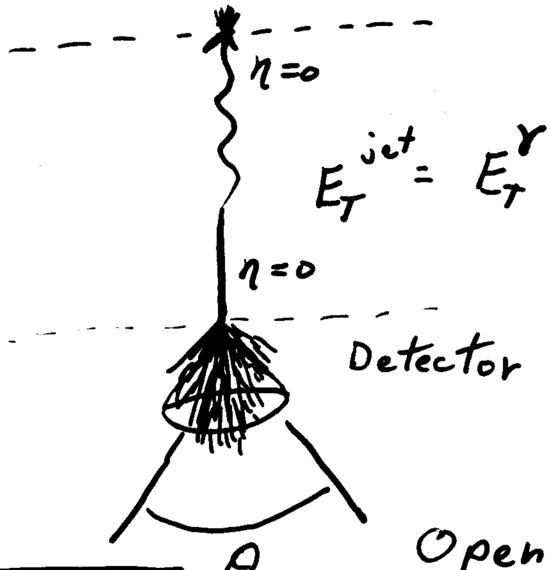
ie - Strong dependence on jet width

Enhanced Response parameterization could improve overall Energy resolution.

Unfortunately width is highly Lum-dependent
Need smarter choice

- ΔR (hottest towers)
- Jet longitudinal profile
- Fit to Transverse dist. of jet core
- etc

MPF Showering Bias



Opening angle of jet due to particle shower development

$: E^{jet} \cos \theta/2$

'loss' from showering

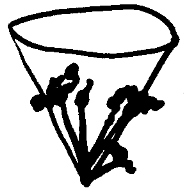
$\not{E}_T \rightarrow E_\gamma (1 - \cos \theta/2)$

For 10 cm Transverse shower radius

$\Delta \not{E}_T \sim \frac{1}{4} - \frac{1}{2} \%$

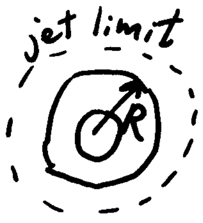
This partly compensates for OOC showering effects

Out of Cone Showering



→ correct for energy showered outside (inside) jet cone due to detector shower development

) Data - based



Find 'base line' energy in region around jet, subtract, Find energy in 'jet limit' but outside jet cone.

MC - based

Trace particles in jet cone into detector, calculate expected fraction of energy inside cone.

* This method contains sufficient information to determine mpf bias + avoid overcorrection.

Status for Today

~Large MC samples ($t\bar{t}$, QCD, γ-jet) in rootuples

- Various amounts of pileup (Lum)
- Numerous jet algorithm parameter sets

Cone : M/S Frac
Cone size
Tower Threshold

k_T : D-cut
Tower Threshold

Pointer to ntuples available on Jets / Missing E_T page

To Do List

Request to:

- Finish γ+jet generation / Sim (needs added filtering) — Steve M.
- Study lum sensetivity of various jet algs — ________ (QCD)
- ULE Czar - generate jet samples w/o ULE
  - Software ZSP studies, to derive correction — ________
  - New Q^2-dependent modules
- Showering / Mpt bias Studies — ________
- η dependent normalizations — ________
  - new η_d word available!
- γ+jet studies — [redacted] Mainz
  - lum effects
  - new parameterized MC, include showering bias effects for study
- New parameters - Scan jet words for Tuning Response correction (IMPORTANT!) — Vipin
- ϕ - response normalization (HAD cells) — ________ (CALOR)
- P/E - applications for low -> moderate E_T jet corrections — Steve M.
- B scale — ________ (HIT)