Pileup Effects on Jet Response

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Pileup

the term 'pileup' refers to a couple of things:

- in each bunch crossing there are $\langle n_{mb} \rangle \sim 23$ inelastic minimum-bias collisions
- in the LAr, the digitized shaping pulse lasts $600ns$, or 24 bunch crossings

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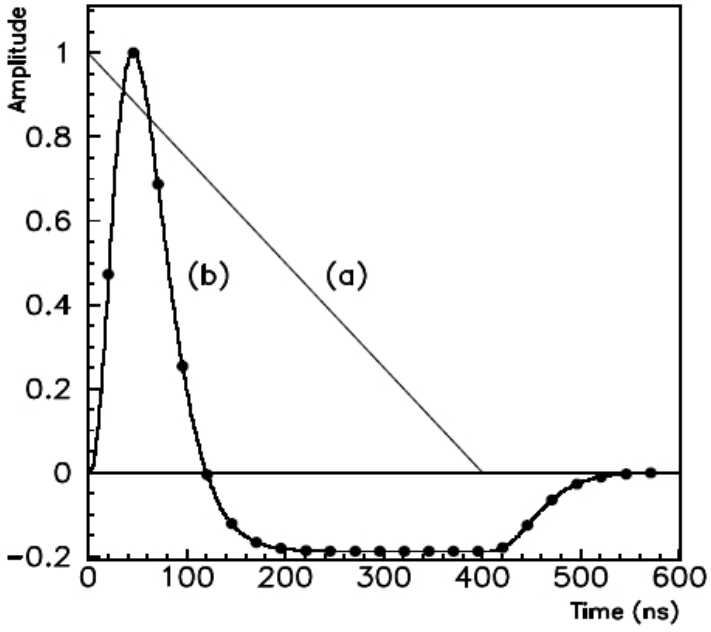


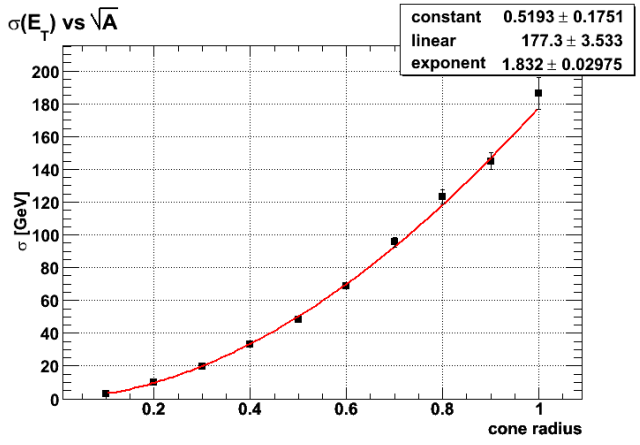
on the nature of pileup...

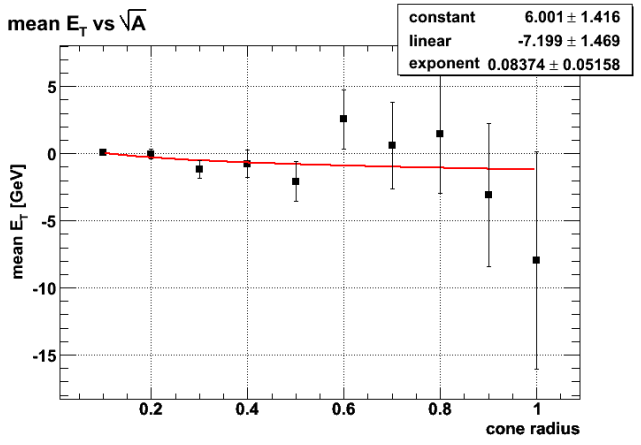
- from NIM A338 (1994) **467-497** expect that $\sigma(E_{meas}) \propto \sigma(E_{dep}) \int g^2(t)\, dt$
- Chollet showed in CAL-NO-75 (1995) that there are statistical correlations in pileup E_T distributions
- $\langle E_T \rangle = 0$ with luminosity-dependent fluctuations

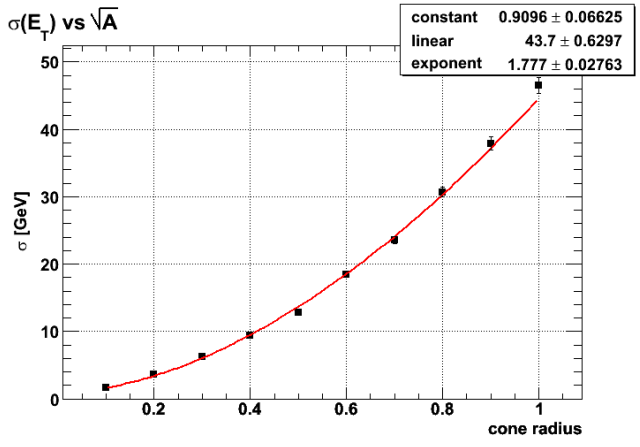
Pileup Correlations

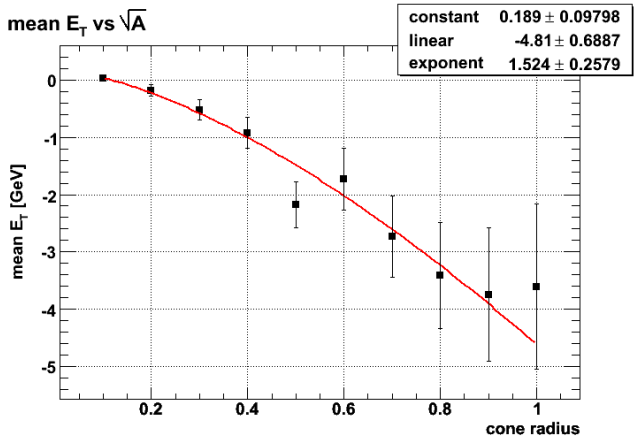
The effect is easiest to demonstrate by considering uncorrelated energy in N cells

$$\begin{aligned}\sigma_T^2(E_T) &= \sum_{i=1}^{N} \sigma_i^2(E_T) \\ &= N\sigma^2(E_T) \longrightarrow \sigma_T = c_1\sqrt{A}\cdot\sigma(E_T)\end{aligned}$$









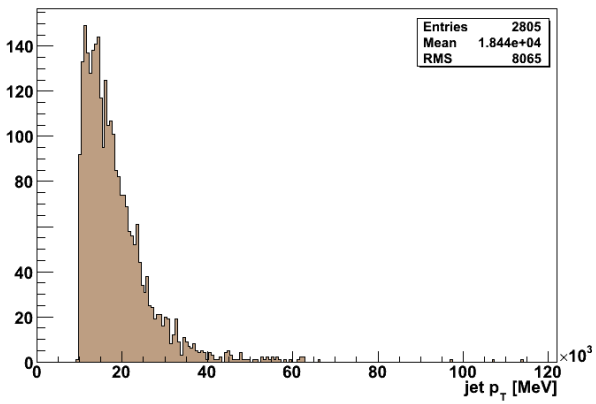
top row (endcap): $(\eta, \phi) = (2.5, 1.5)$, **bottom row (barrel)**: $(\eta, \phi) = (0.5, 1.5)$

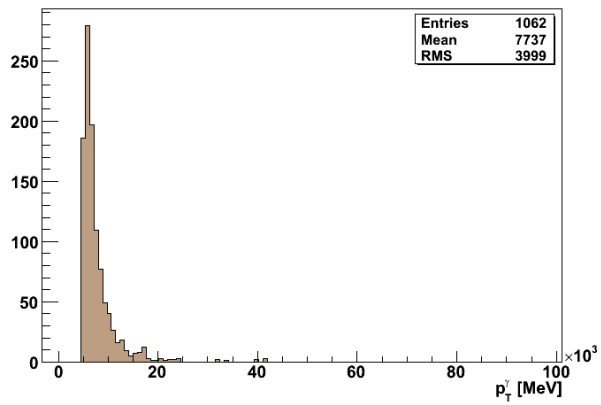
Minimum Bias

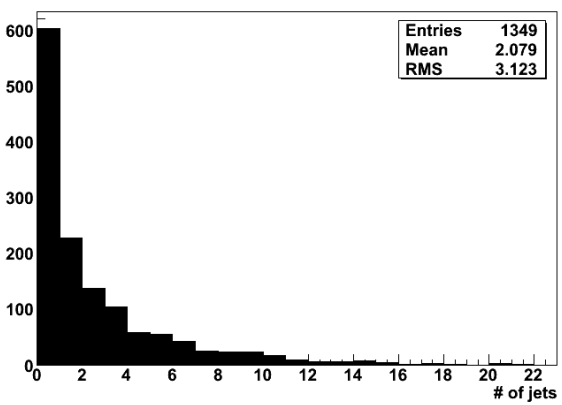
probablity to reconstruct pileup jet

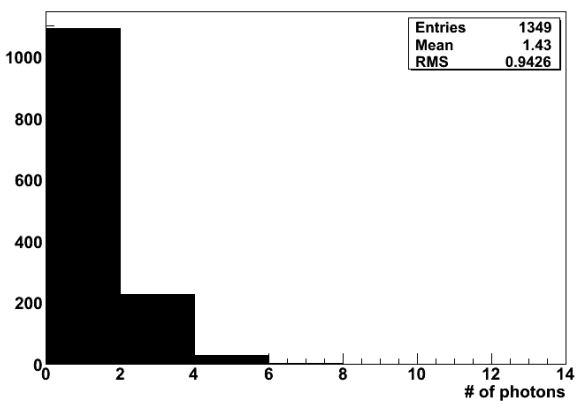
- Rome (003014) M1 minbias sample
- ratio of events that have $N_{jets} \geq 1$ and $p_T^{leading} \geq$ threshold

p_T cut	11.5 mb/xing (%)	18 mb/xing (%)
20.0 GeV	33.5	42.6
30.0 GeV	15.1	21.9
40.0 GeV	8.8	12.8





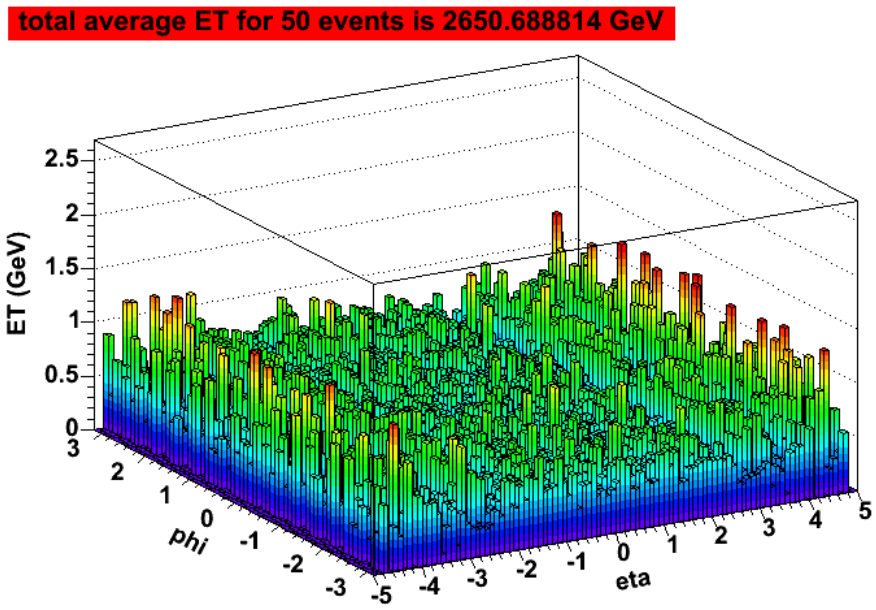


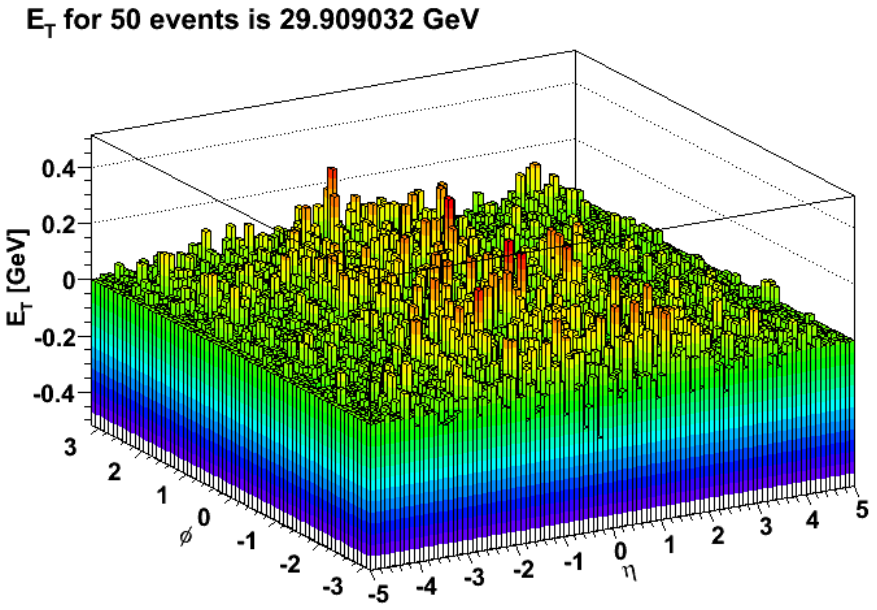


events reconstructed with 11.5 mb/crossing

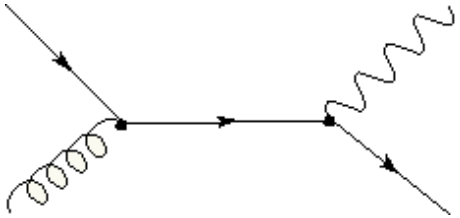
Warning!

$9.4.0 \leq R \leq 10.4.0$ pileup digitization is broken. Don't use it. I tried to. Bad move.





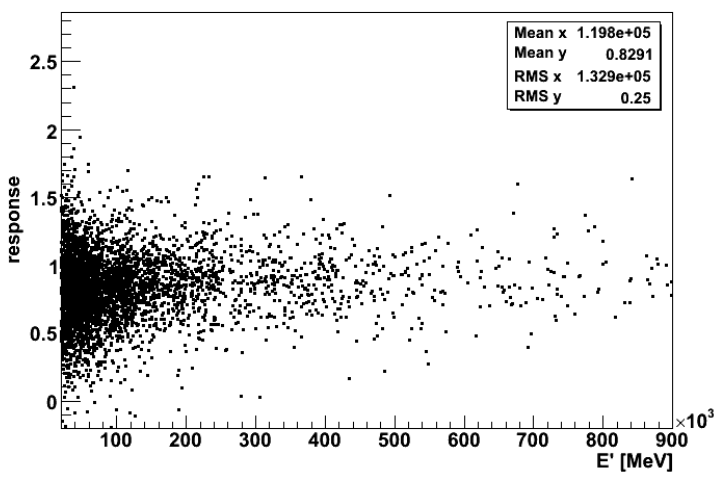
Jet Response

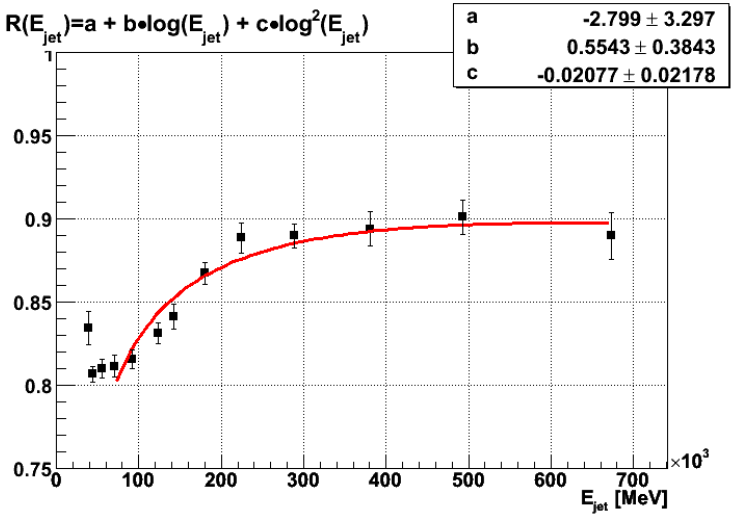


- exploit balance between p_T^{γ} and p_T^{jet}
- assume EM-scale well calibrated with $Z \rightarrow ee$
- use $\not{E}_T$ as a measure of p_T imbalance

Missing E_T Projection

- select the leading good γ (isolation $E_T < 0.15$, isEM % 0x007ff = 0)
- match to leading jet in $\Delta\phi$ window
- calculate jet response $R_{jet} = 1 + MPF = 1 + \frac{\hat{n}_\gamma \cdot \vec{\not{E}}_T}{E_T^{\gamma}}$





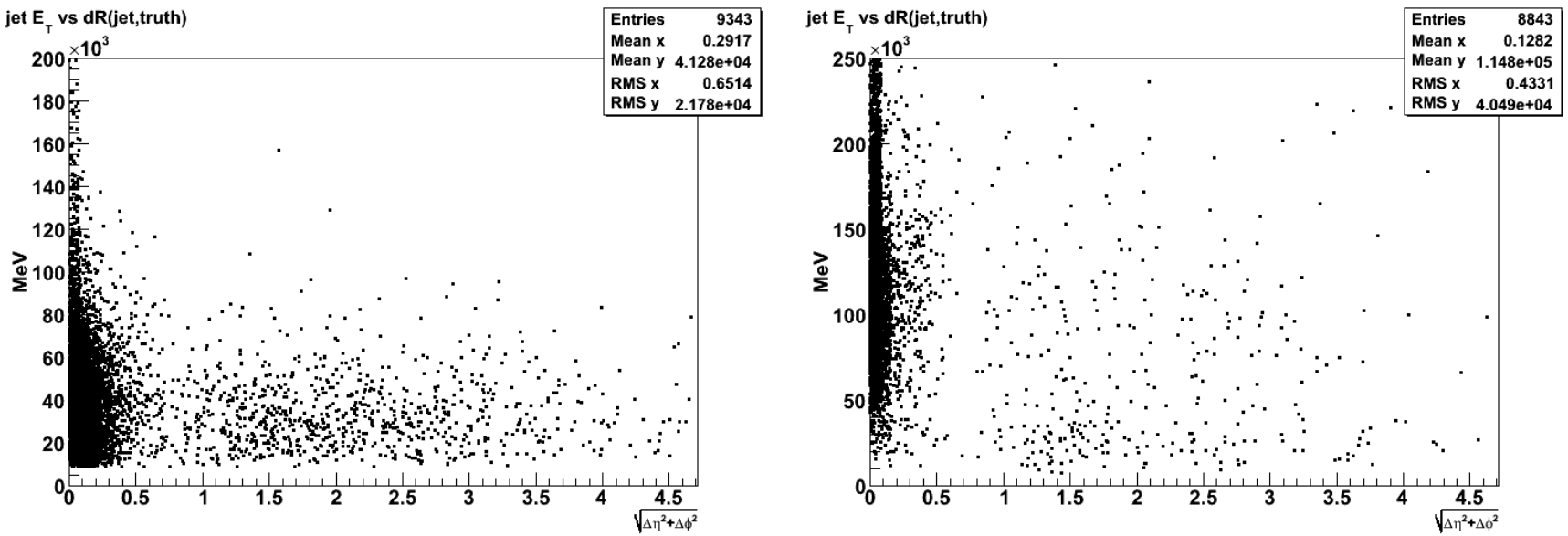
more on this method in *In-Situ Calibration with Initial Running Conditions* on Friday

Jet Response

in calculating the jet response...

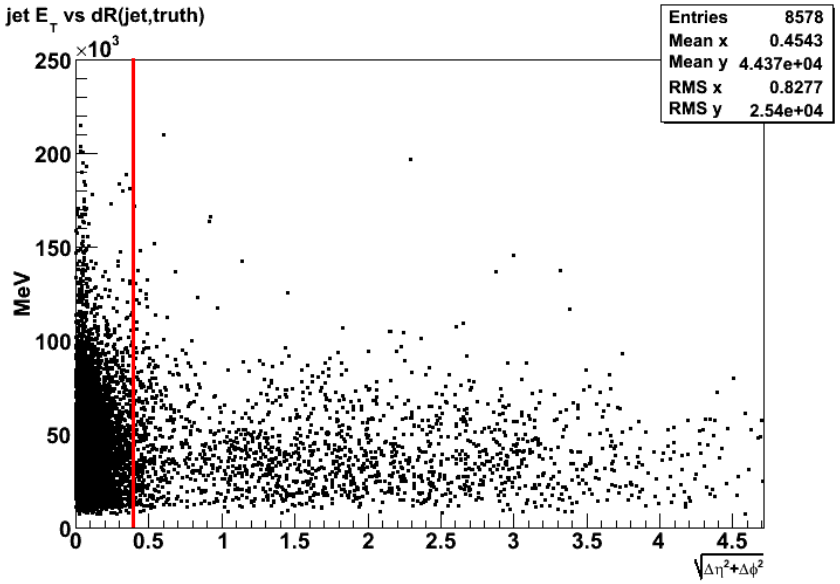
- you may match the wrong jet (you chose a pileup jet, instead of the hardscatter jet)
- you have pileup energy in your photon and jet
- your $|\overrightarrow{\not{E}}_T|$ is not well measured

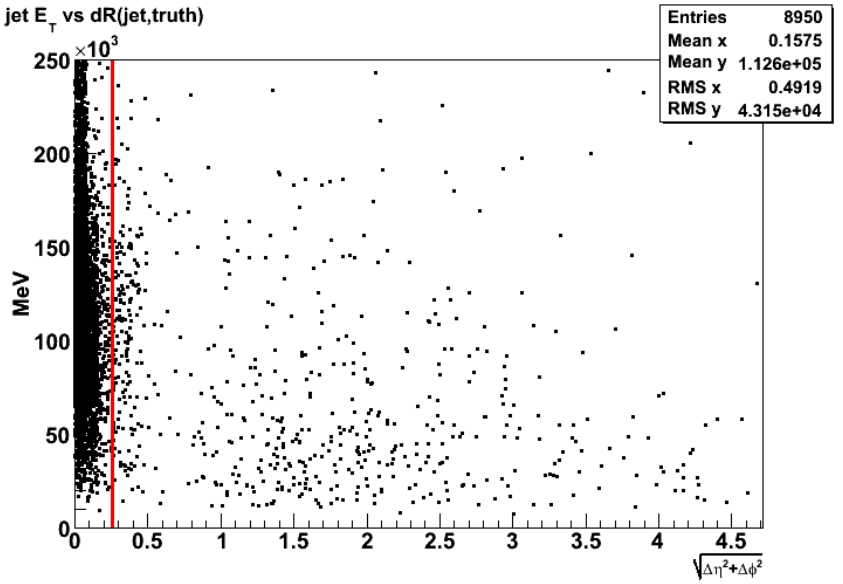
Used a truth vertex filter to identify particles originating from the hardscatter, and looked at the number of times a pileup or underlying-event jet is chosen.



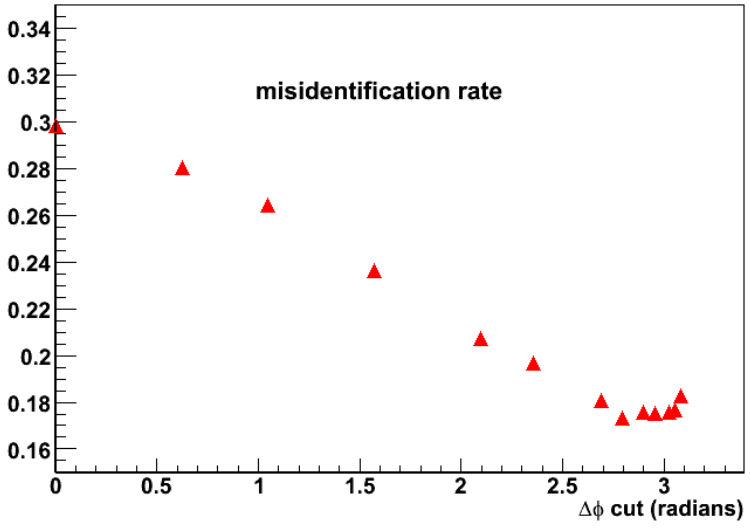
generation $p_T > 25.0$ **GeV (left)** 85.0 **GeV (right), low-luminosity**

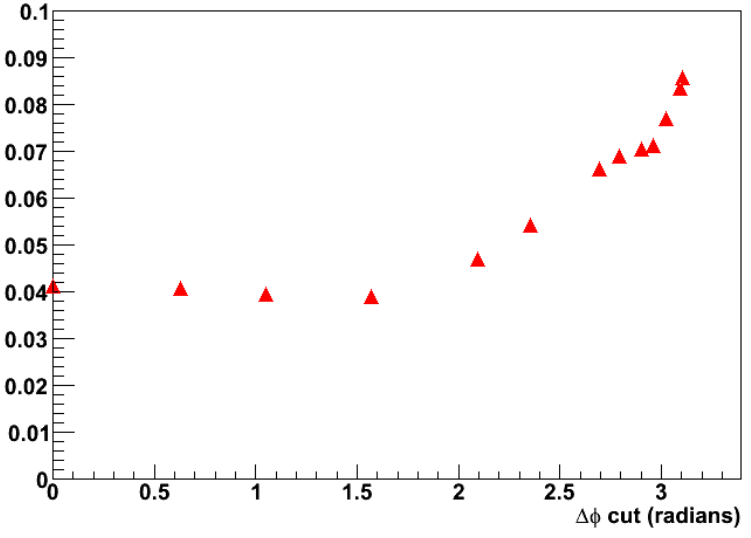
Pileup Fakes



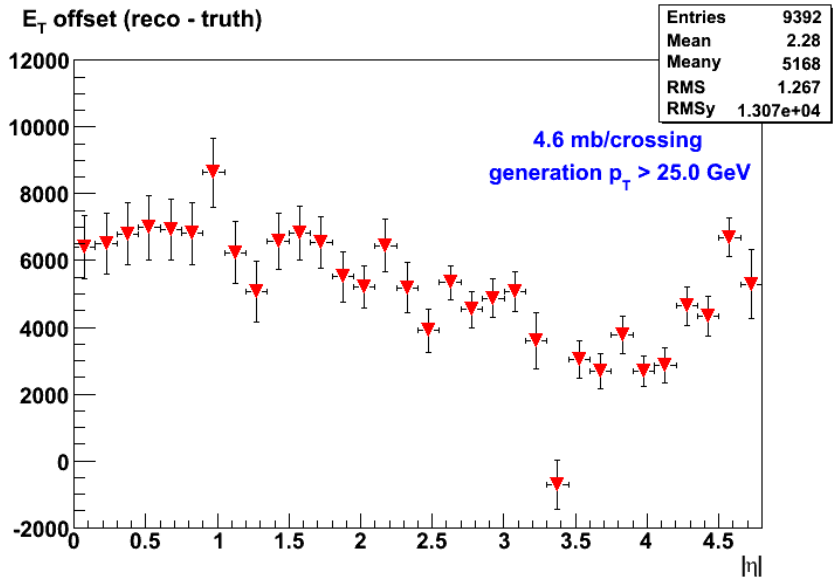


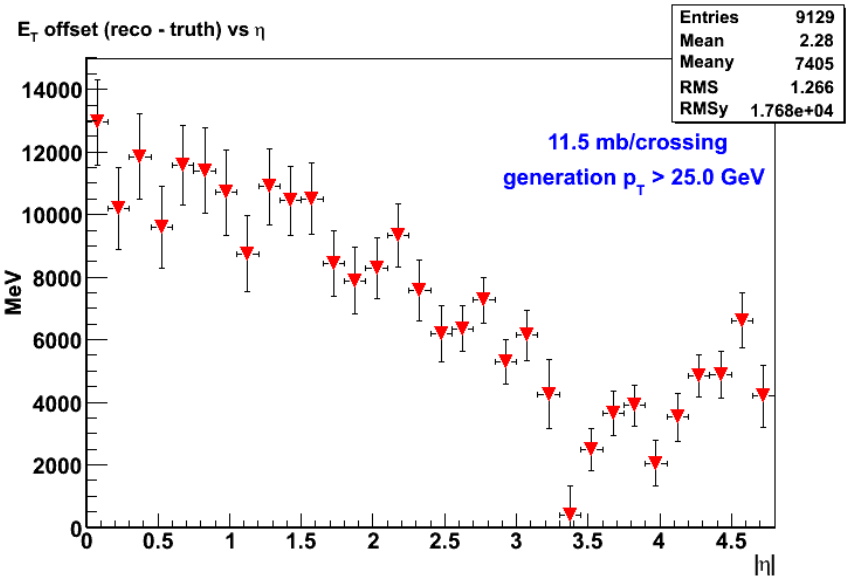
generation $p_T > 25.0$ GeV (left) 85.0 GeV (right), 11.5 mb/xing





E_T Offset in Jets from Pileup

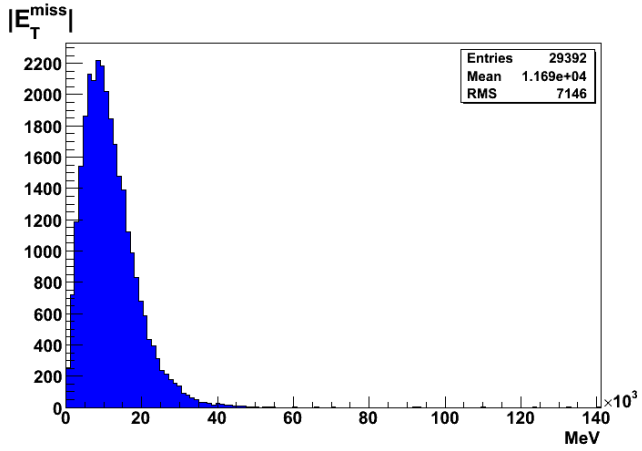


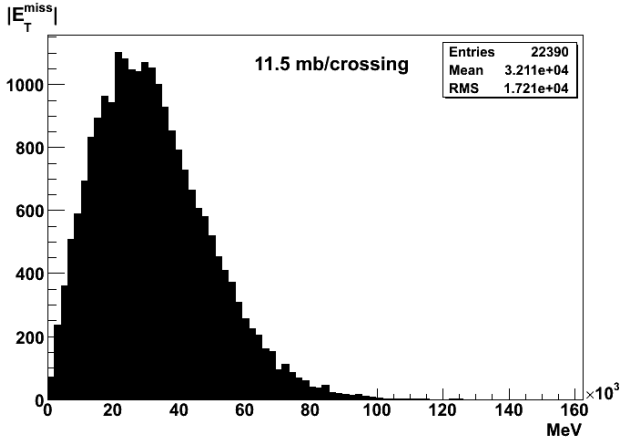


interesting notes

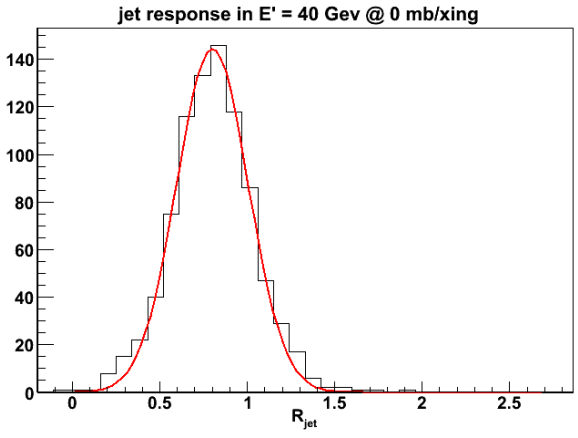
- there seems to be two regimes - the luminosity dependance is higher in the barrel
  - could this be due to the tile pulse shape (no negative tail!)
- positive shift contradicts earlier plots w/ $\langle E_T \rangle \leq 0$

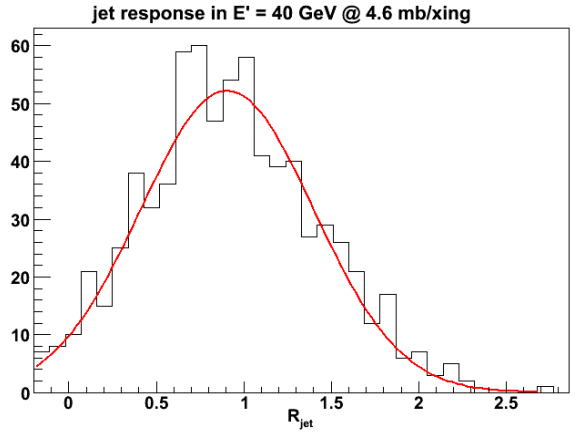
Missing E_T Measurement





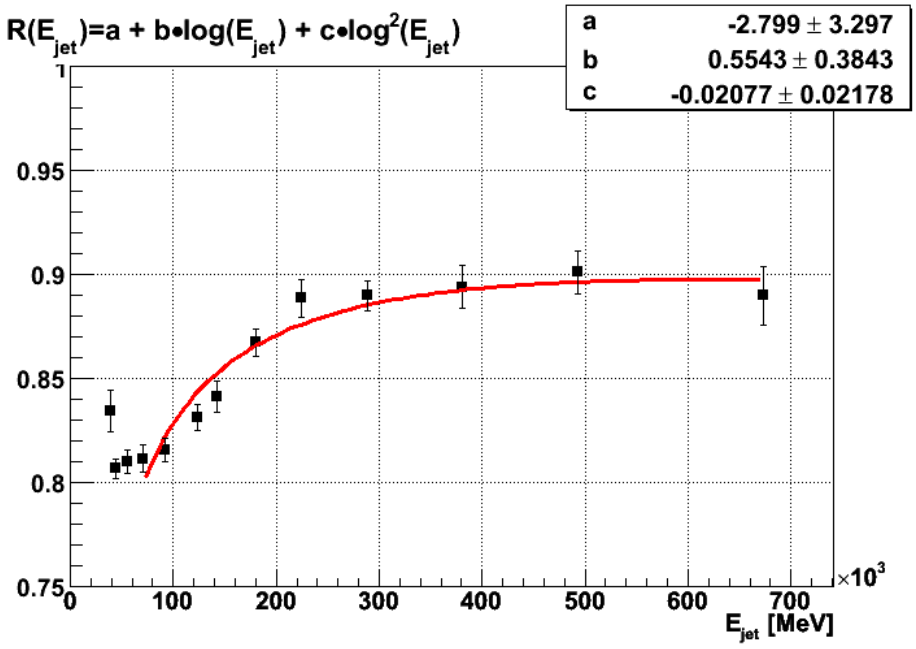
- $\overrightarrow{\not{E}}_T$ strongly affects measurement of R_{jet}
  - left (no pileup) $R_{jet} = 0.80$, right (lo-lumi) $R_{jet} = 0.91$

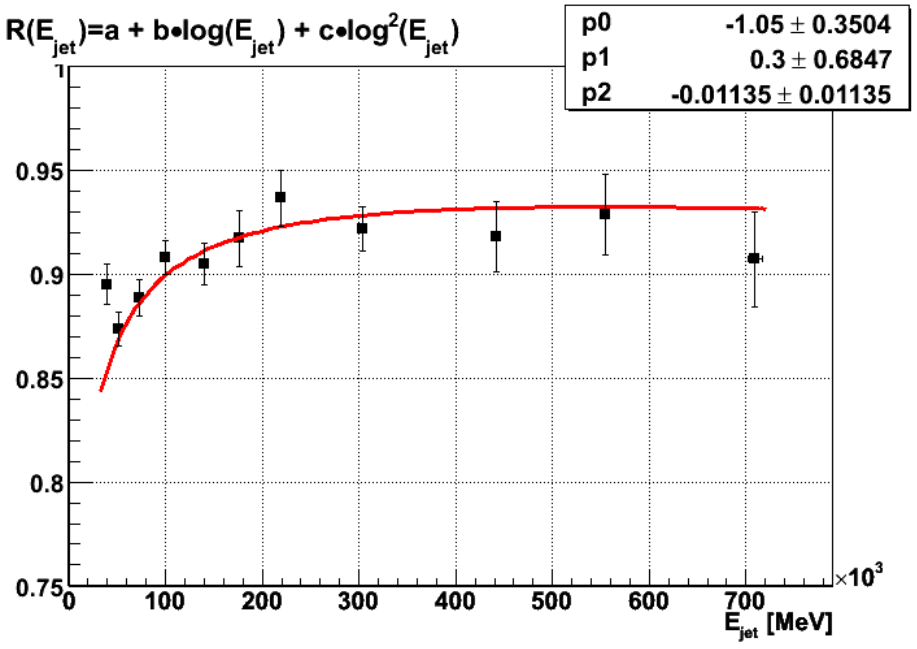




- how much does H1-weighting affect σ for $\overrightarrow{\not{E}}_T$?
- should we expect a luminosity-dependant noise cut prior to applying H1 weights?

Jet Response





left: response with no pileup, right: response with 4.6 mb/xing

Current Status & Workplan

many things to report on...

- first looked at MPF w/o pileup; see how FSR/ISR affect pT balance, validity of $\Delta\phi$ cut, low-E_T bias
- generated large datasamples @ low (4.6 mb/crossing), medium (11.5 mb/crossing), and high (23 mb/crossing) luminosities
  - studied/studying luminosity dependance of in-situ calibration: pileup offset, $\not\!\!E_T$ measurement, jet muliplicity (and matching)
- sidetracked into looking @ H1 calibration w/ pileup because of bug in 10.0.1

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in the future...

- luminosity dependence of response (up to ultra-high luminosity)
- jet reconstruction @ different luminosities (efficiency, optimum cone size, etc)
- statistics, statistics, statistics ... generate more data
- look at 2-jet events and determine the mis-ID rate for γ