Effect of track-jet corrections on EM and H1 calibrated jets

Gastón L. Romeo
Universidad de Buenos Aires

Ariel Schwartzman
SLAC

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Outline

Track-Based Corrections using EM and H1 calibrated jets

Motivation and Refresher

- Use tracks to extract jet-by-jet information about its topology and fragmentation and correct the response of jet applying track-based corrections
- Given jets calibrated at EM scale, we apply the Numerical Inversion such that (on average) jets have a uniform response in transverse momentum (More info: see D. Lopez's talk at Task Force meeting)
- Investigate to what extend track-jet corrections can be applied to improve the resolution using both Num. Inversion + f_{trk} correction and H1 calibration + f_{trk} correction

Today

- Two different f_{trk} correction derived for both H1 and Num. Inv. calibrated jets, up to $|\eta| < 1.2$ (two different regions) and their performances
- Fraction of jet p_T carried by tracks pointing to the jet defined as $f_{trk} \equiv \frac{\sum p_T^{tracks}}{p_T^{calo}}$

Data Samples and Event Selection

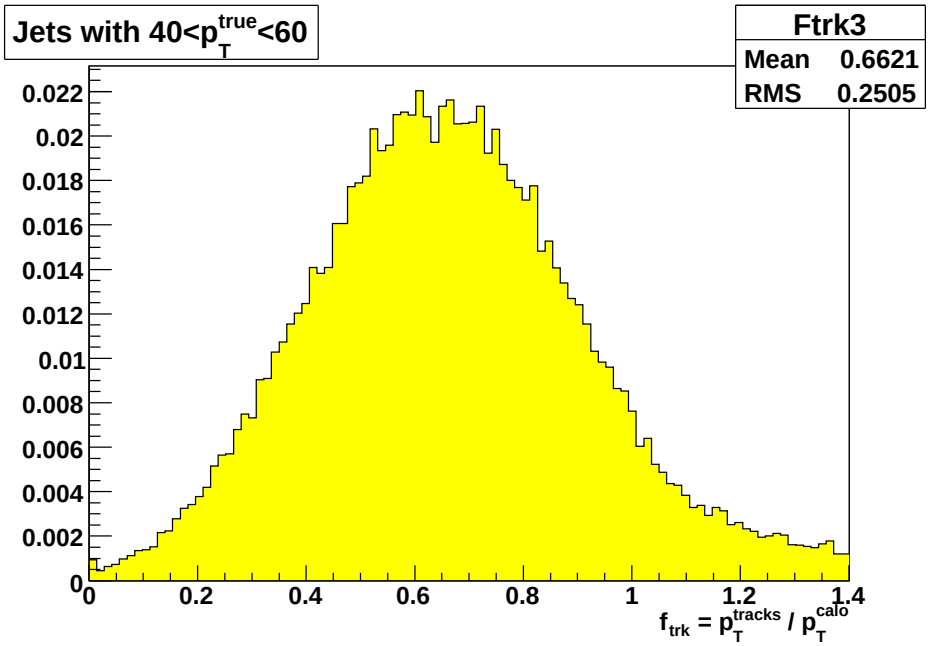
Methodology

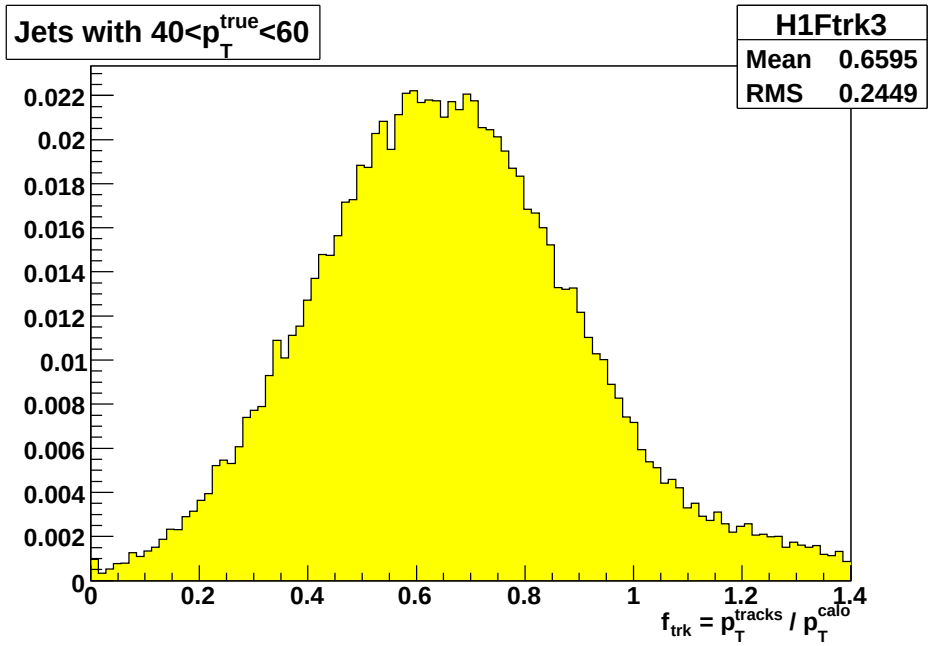
- Dataset: mc08.pythia_jetjet.recon.ESD.e344_s475_r586
- Only jet with $|\eta| < 1.2$ (η^{RAW} and η^{H1})
- Cone 0.4 Topo-jets and Tower-jets
- Look at jets with P_T^{true} between 30 - 350 GeV
- All EM calibrated jets were corrected using Numerical Inversion
- Use reconstructed jets with no reconstructed jet within a radius of 1.0 (isolated jets)

Track quality cuts

- Tracks within a cone of radius 0.4 in η-ϕ around a jet's axis were included in the calculation of f_{trk}
- $p_T^{track} > 1GeV$ and $\chi^2/dof < 3$

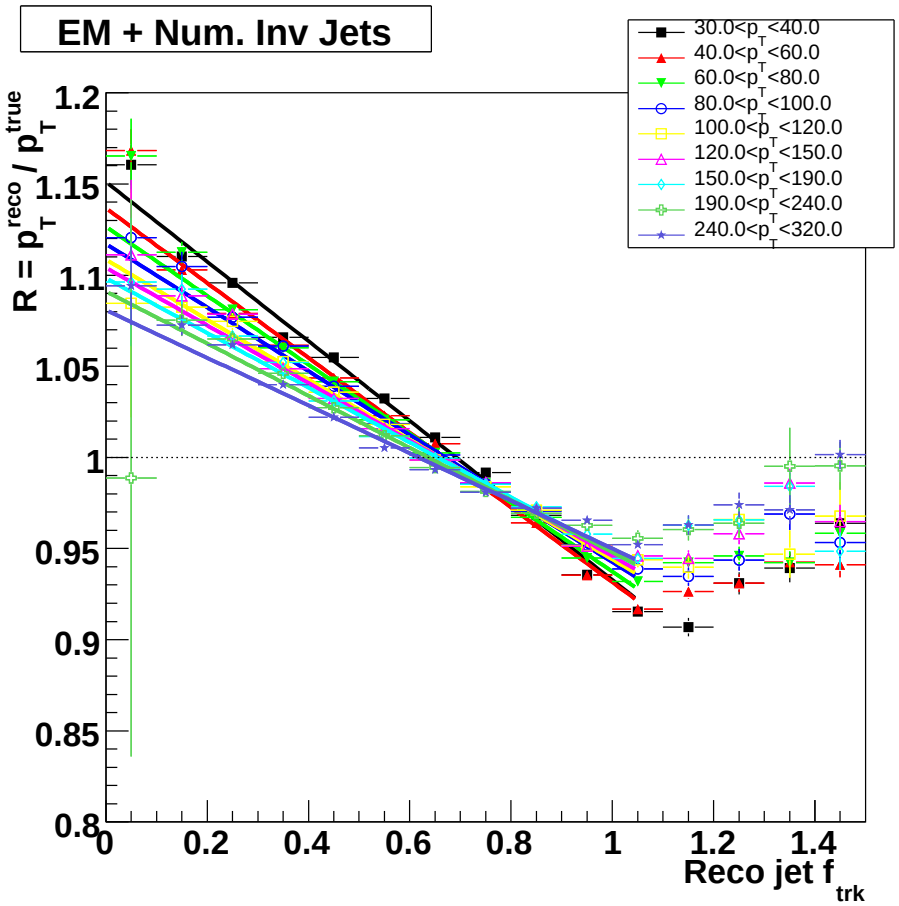
Track Information: f_{trk} Distribution ($|\eta_{jet}| < 0.7$ - Topo-Jets)

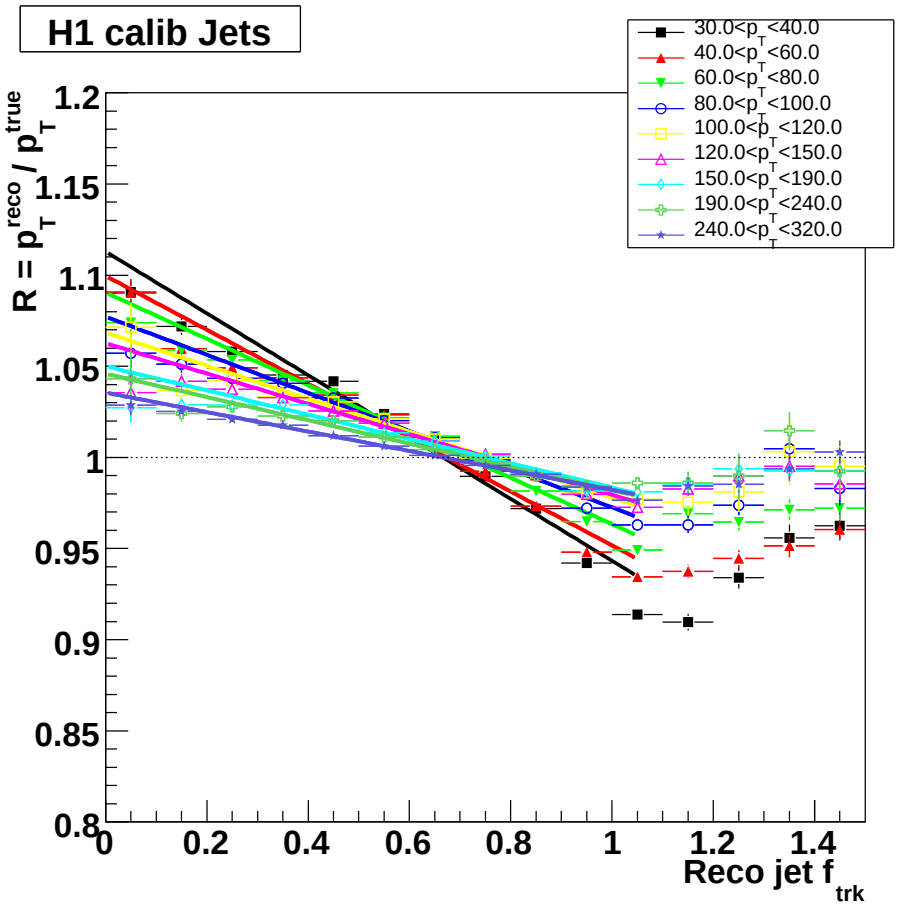




- QCD dijet samples have roughly f_{trk} gaussian distributions centered around 0.6 as expected naively
- Tails near $f_{trk} \approx 1$ coming from low p_T jets associated to tracks with incorrectly measured momenta

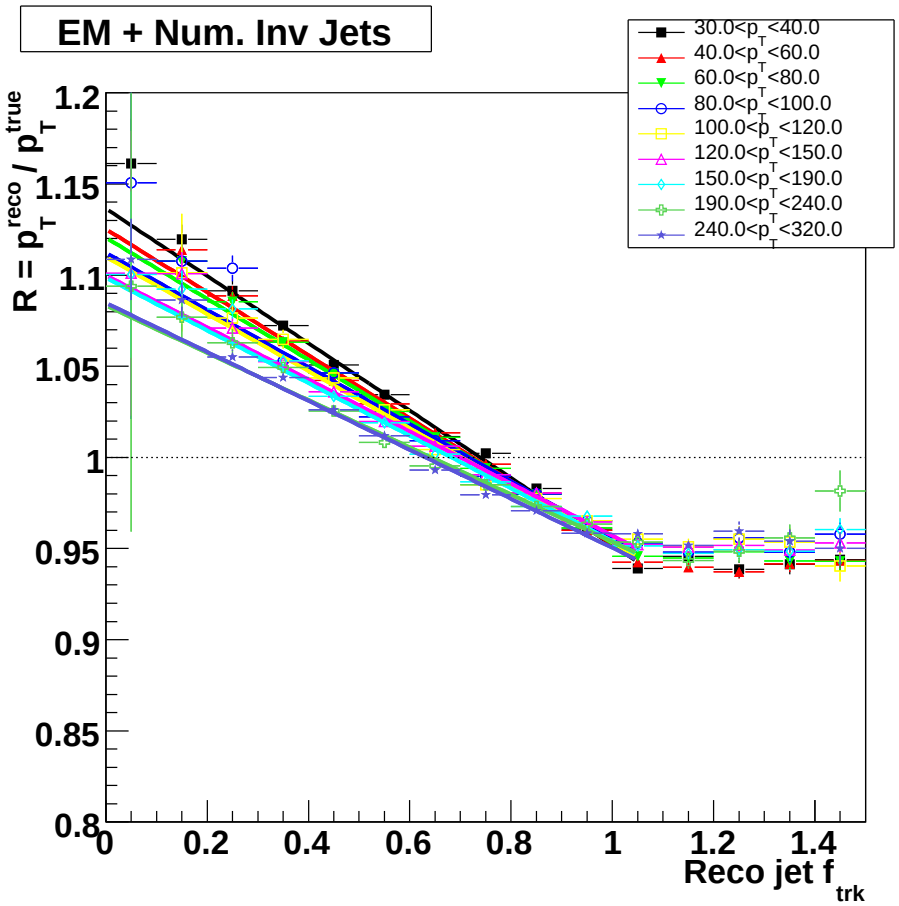
Response vs f_{trk} for different p_T bins ($|\eta_{jet}| < 0.7$ - Topo-Jets)

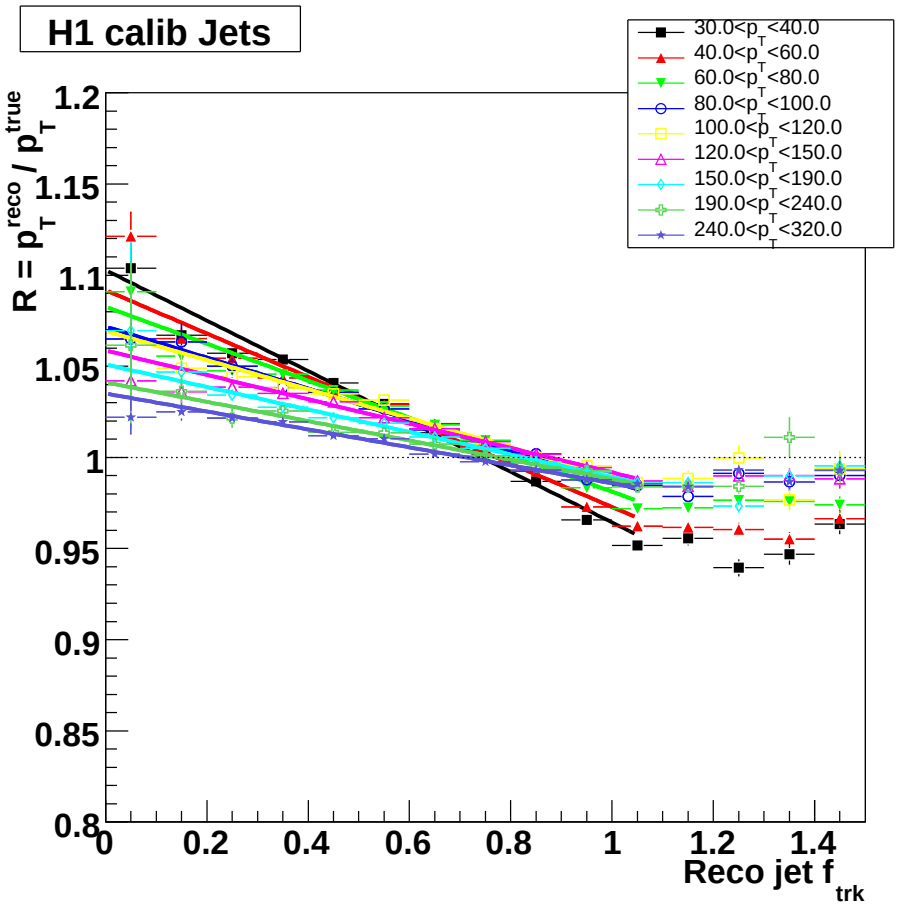




- Fits were done using $f_{trk} \leq 1.05$
- For completeness all f_{trk} bins are shown, up to 1.4 (badly reconstructed jets)

Response vs f_{trk} for different p_T bins ($0.7 < |\eta_{jet}| < 1.2$ - Topo-Jets)





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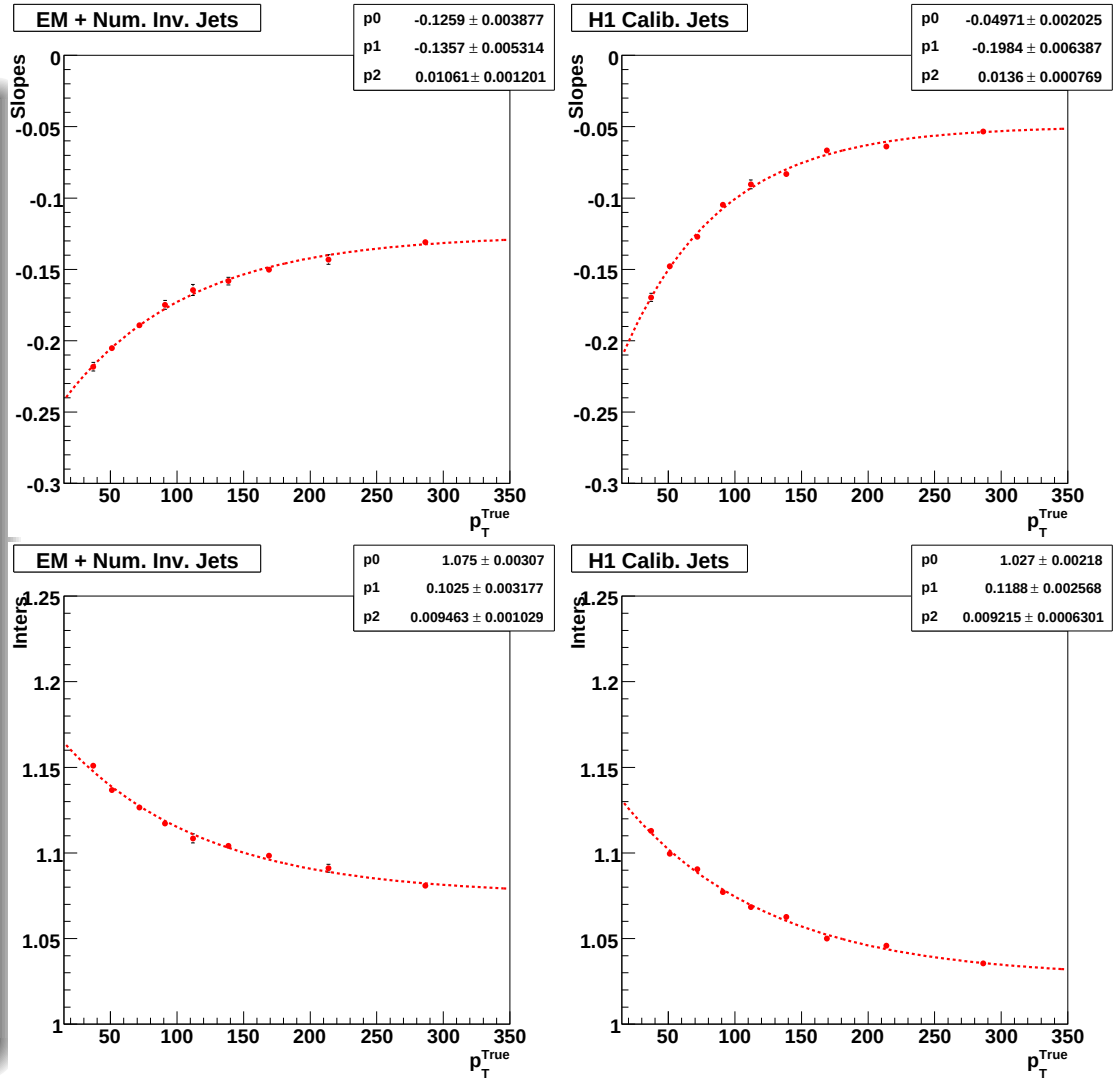
R(p_T,f_{trk}) ($|\eta_{jet}| < 0.7$ - Topo-Jets)

$R(f_{trk}, p_T) = a(p_T) * f_{trk} + b(p_T)$

- $b(p_T) = p0 + p1 * exp(p2 * p_T)$
- $a(p_T) = p3 + p4 * exp(p5 * p_T)$

To derive the correction, isolated cut over reco jets (ΔR > 1.0) was used to avoid jet-jet contamination which may skew f_{trk}
At low p_T the effect of f_{trk} seems to be bigger over EM jets than H1.
However, the higher the p_T bin the smaller the effect over H1 jets, as for the EM jets it nearly remains the same for $p_T > 100$ GeV

- Dataset has the new H1 calibration constants



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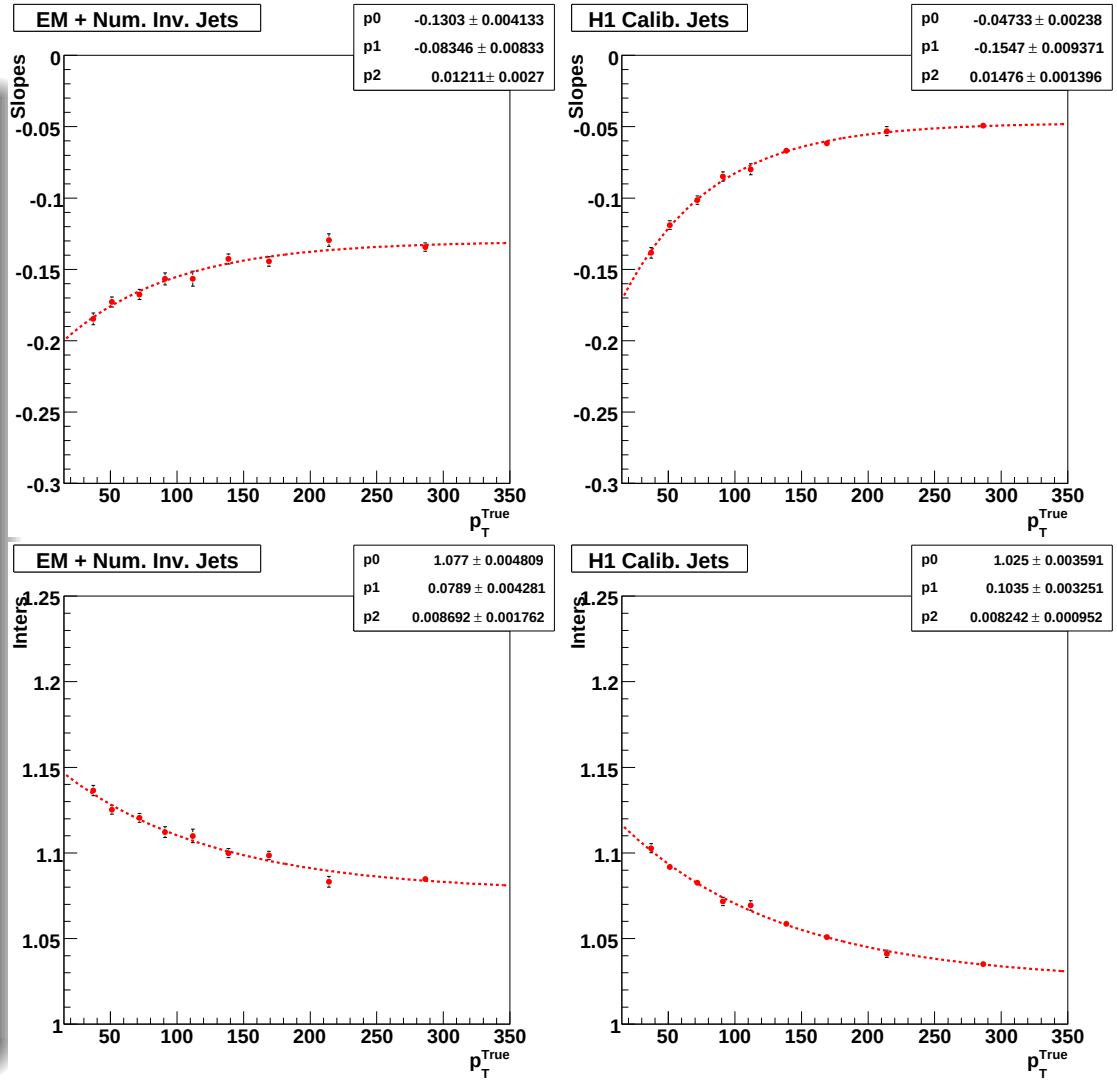
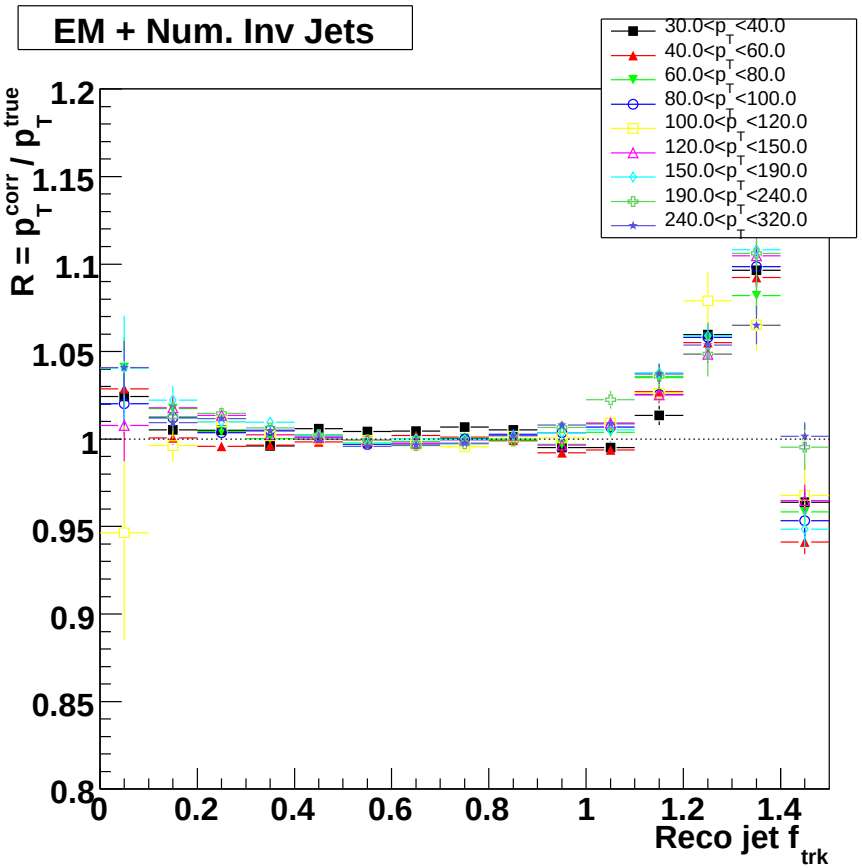
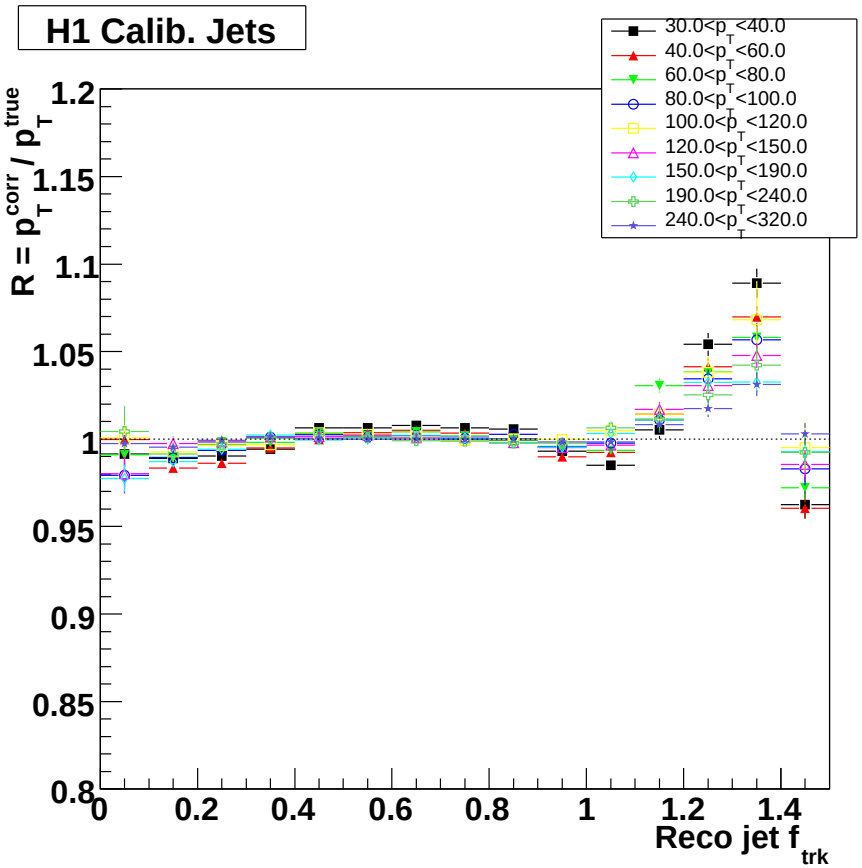


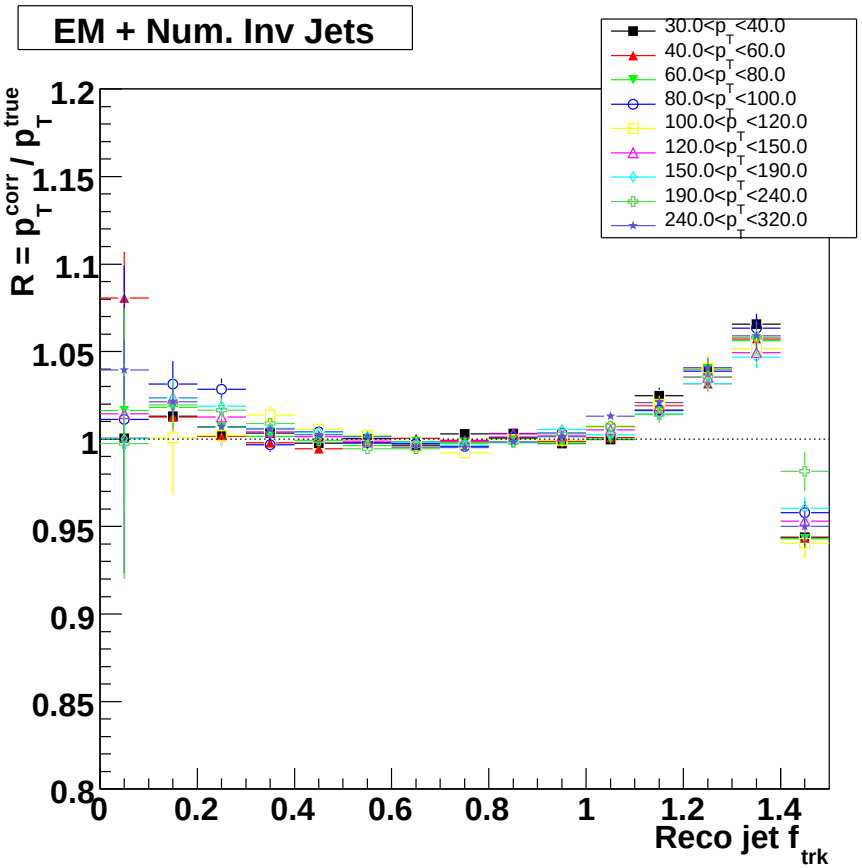
Responses after f_{trk} correction ($|\eta_{jet}| < 0.7$ - Topo-Jets)

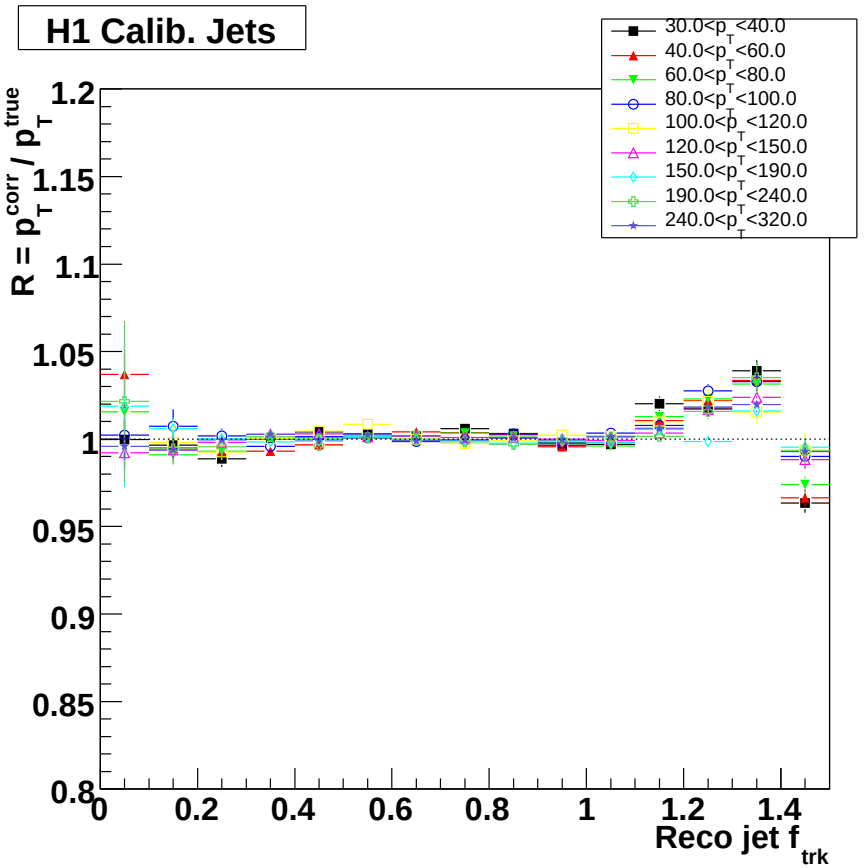




- After applying the correction over 1.0 isolated jets, the response was found to be flat and centered at 1 within $1 - 2\%$
- Although above $f_{trk} = 1$ the fits do not completely correct the jet momentum response, there are very few jets lie in this region.

Responses after f_{trk} correction ($0.7 < |\eta_{jet}| < 1.2$ - Topo-Jets)





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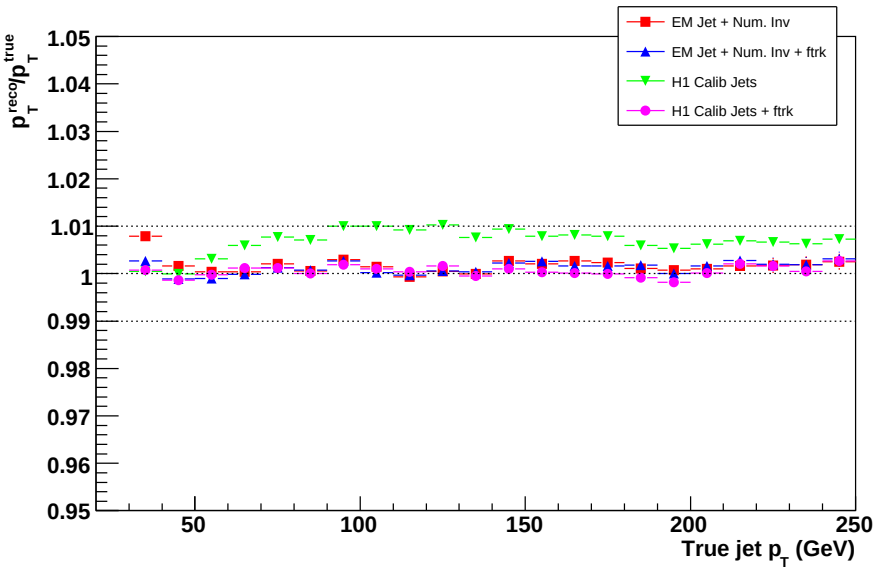
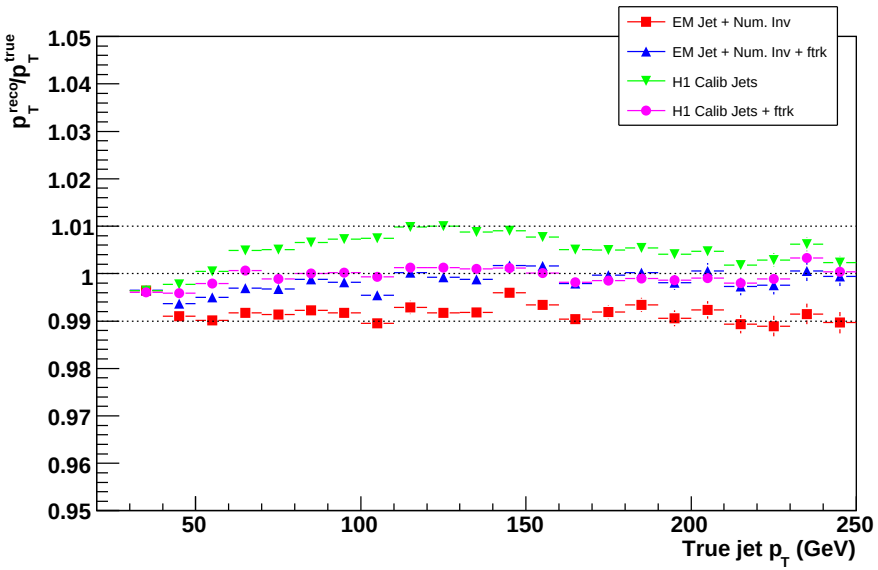
Closure Test (Topo-Jets)

Response After f_{trk} Correction

- Closure tests have been done applying the correction over 1.0 isolated jets
- Response (calculated as p_T^{reco}/p_T^{true}) keeps centered at 1 within 1%

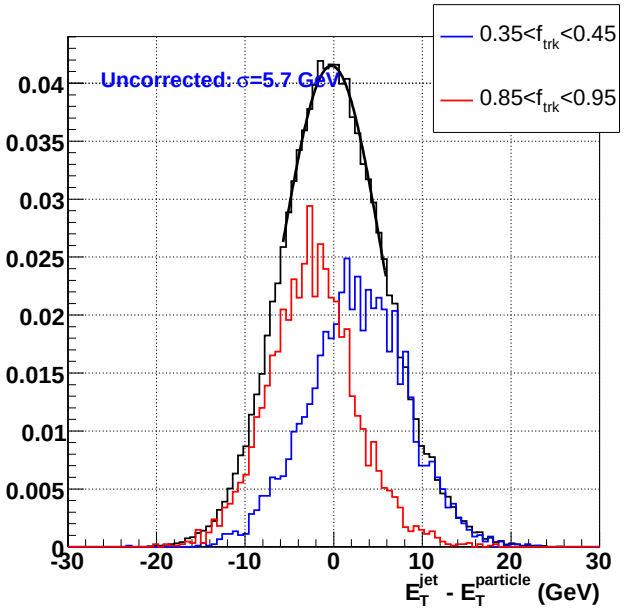


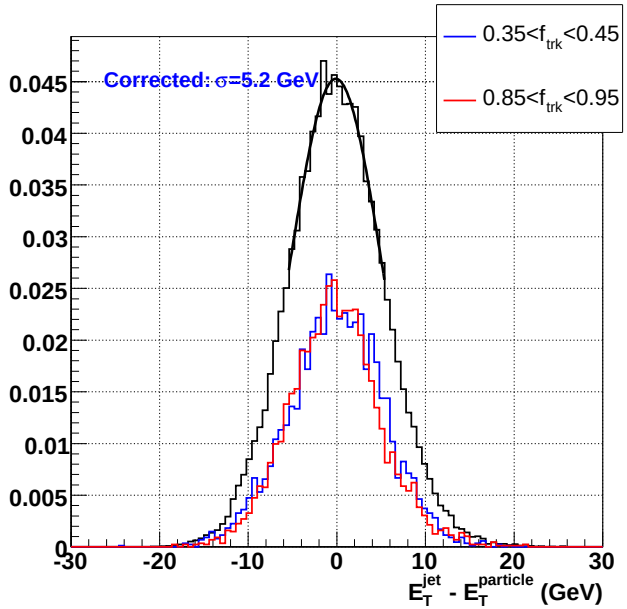


Closure Test (Topo-Jets)

Improvement in Resolution After f_{trk} Correction

- The jet resolution before the $R(p_T, f_{trk})$ correction can be thought of as re-centering several offset gaussians with different f_{trk}, therefore by re-centering the underlying distributions an improvement in the resolution is expected
- Gaussian fit within Mean $\pm$ RMS
- When looking at the distributions, the improvement after applying f_{trk} correction is around 10 % for the lowest p_T bin (Num. Inv. Calibrated Jets)

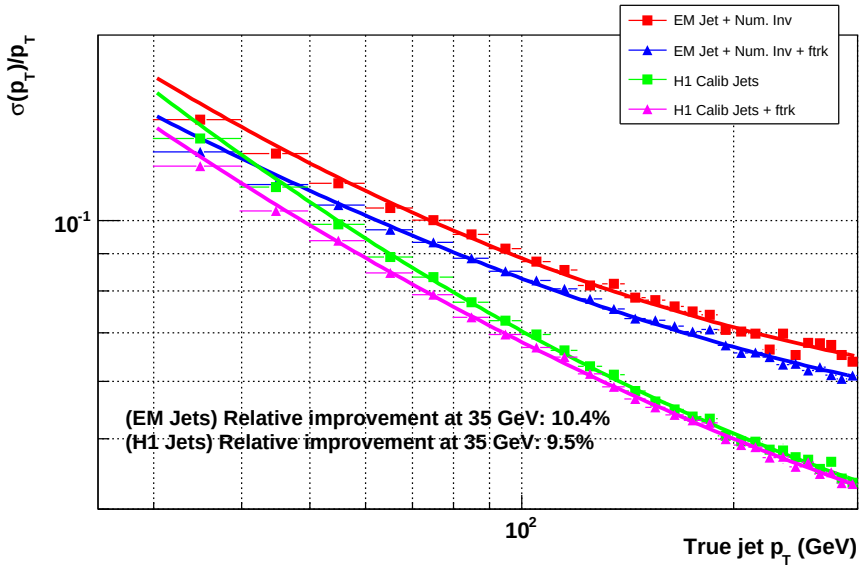


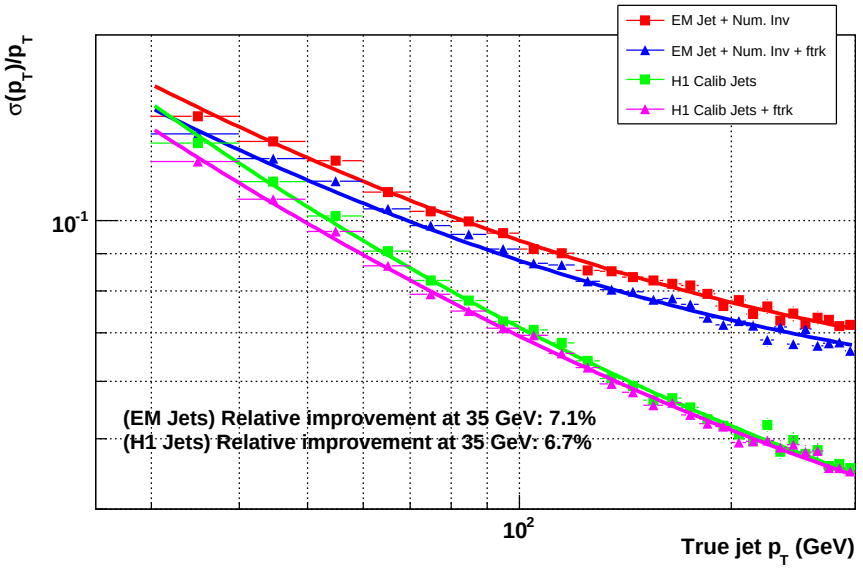


Closure Test (Topo-Jets)

Improvement in Resolution After f_{trk} Correction

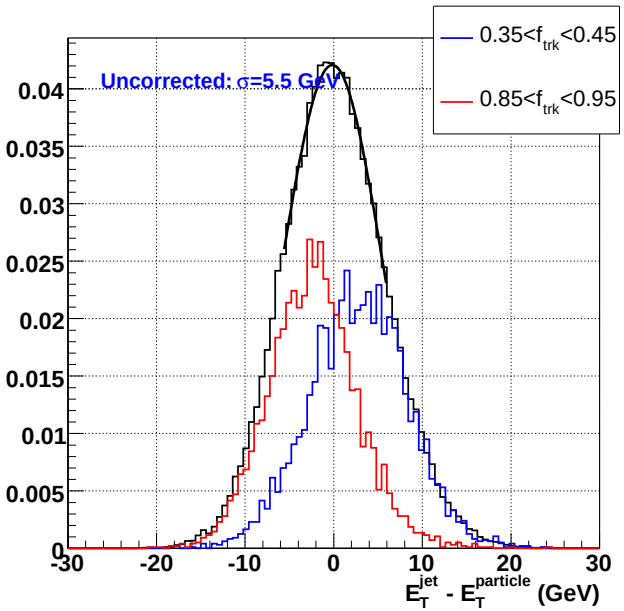
- All jets with f_{trk} up to 1.4 were corrected (when requiring $f_{trk} < 1$, the correction performs the same within errors (1 %))
- After applying f_{trk} correction an improvement of $\approx$ 10.5 - 9.5 % at low p_T has been observed for EM + NI and H1 calibrated jets (8.5 % and 0.5 % at 250 GeV) respectively

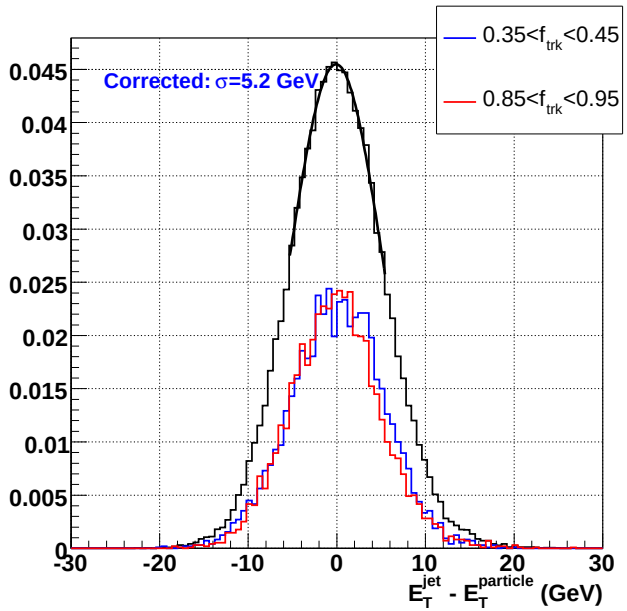




f_{trk} correction applied over Tower-jets

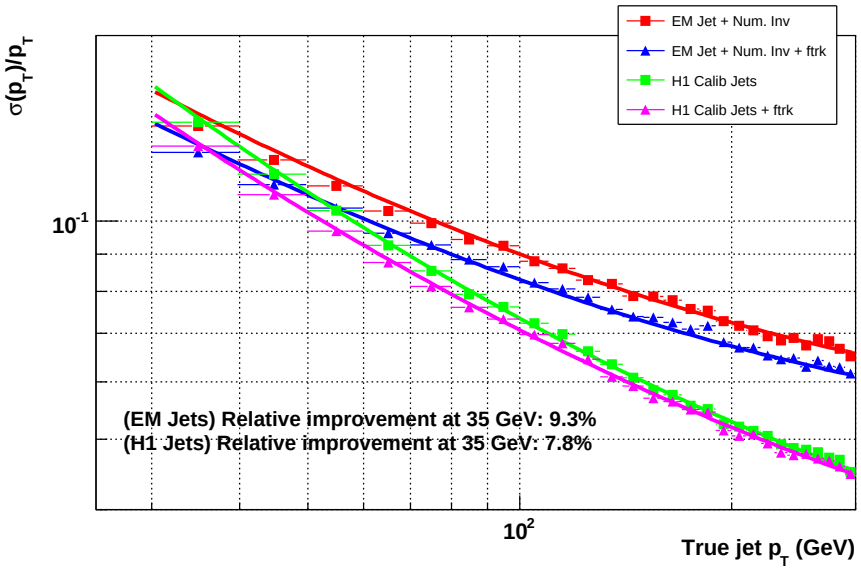
- f_{trk} correction has been derived using jets made of topological clusters
- When considering Tower-jets, only the seeds to the jet algorithm differ, so one might expect that the track properties of the two would be similar
- In order to test this notion, identical corrections were applied to Tower-jets

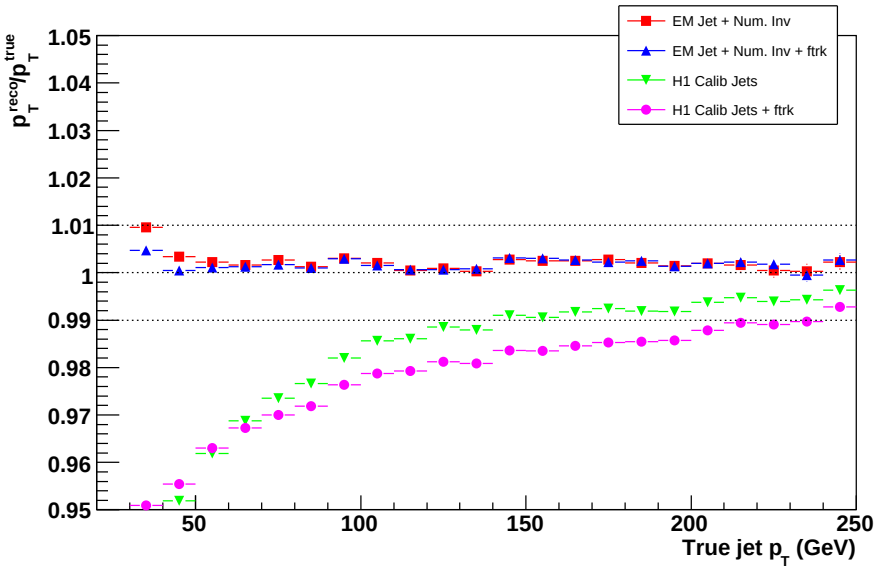




f_{trk} correction applied over Tower-jets

- Response keeps centered at 1 within 1% for EM + NI, but H1 seems to have bigger fluctuations at low p_T of $\approx$ 4%
- After applying f_{trk} correction an improvement of $\approx$ 9 - 8 % at low p_T has been observed for EM + NI and H1 calibrated jets (7 % and 1.5 % at 250 GeV) respectively





Outlook and Next Steps

Summary

- f_{trk} correction has been derived for both H1 and EM + Num. Inv calibrated jets (so far up to $|\eta| < 1.2$)
- The correction keeps the response centered at 1 within 1 %
- Topo-jets: An improvement of $\approx$ 10.5 - 9.5 % at low p_T has been observed for EM + NI and H1 calibrated jets (8.5 % and 0.5 % at 250 GeV) respectively after applying f_{trk} correction
- Tower-jets: An improvement of $\approx$ 9 - 8 % at low p_T for EM + NI and H1 calibrated jets (7 % and 1.5 % at 250 GeV) respectively

Conclusions

- EM scale: f_{trk} correction improves the resolution along the whole range of p_T
- H1: f_{trk} only gives an improvement at low p_T. At high p_T H1 correctly distinguishes EM from HAD deposition
- Ultimate performance is achieved by combining H1 + f_{trk}

Outlook and Next Steps

To do

- Derive the correction using a 2-D fit and to extend $|\eta|$ region up to 2
- Factorized sequential correction: Several other track variables show large response variation after f_{trk} correction (track multiplicity, spread of the tracks within the jet, fraction of track p_T carried by the leading jet)
- Fully data-driven f_{trk} correction just derived using different strategies, still working on closure test and checking their performances (perhaps next meeting)