



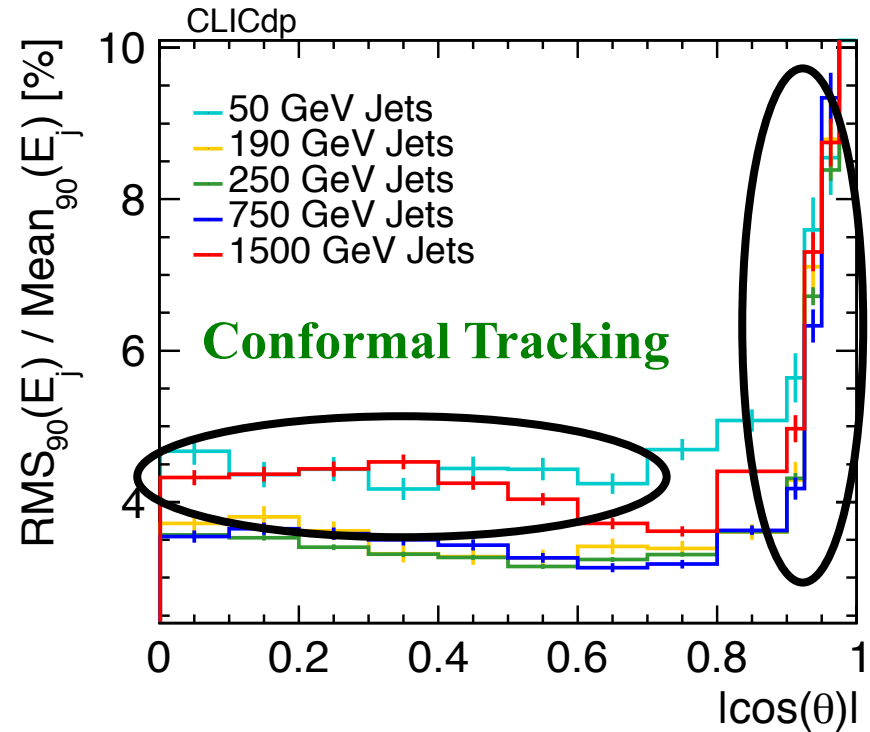
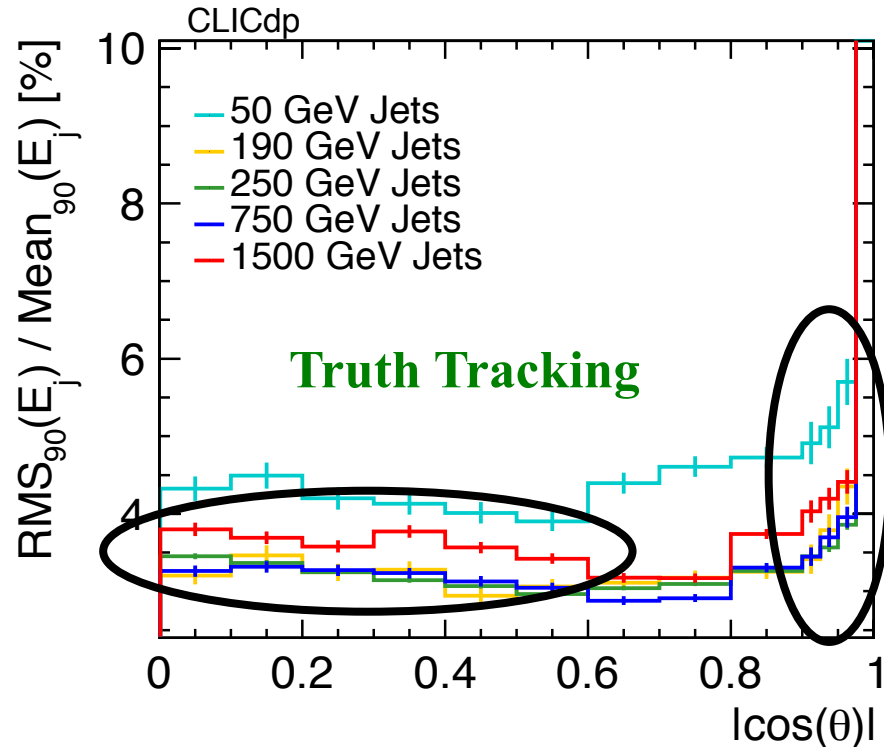
Performance Note

Matthias Weber (CERN)

Jet Energy Resolution



Jet Energy Resolution summary plot: using TruthTracking vs ConformalTracking



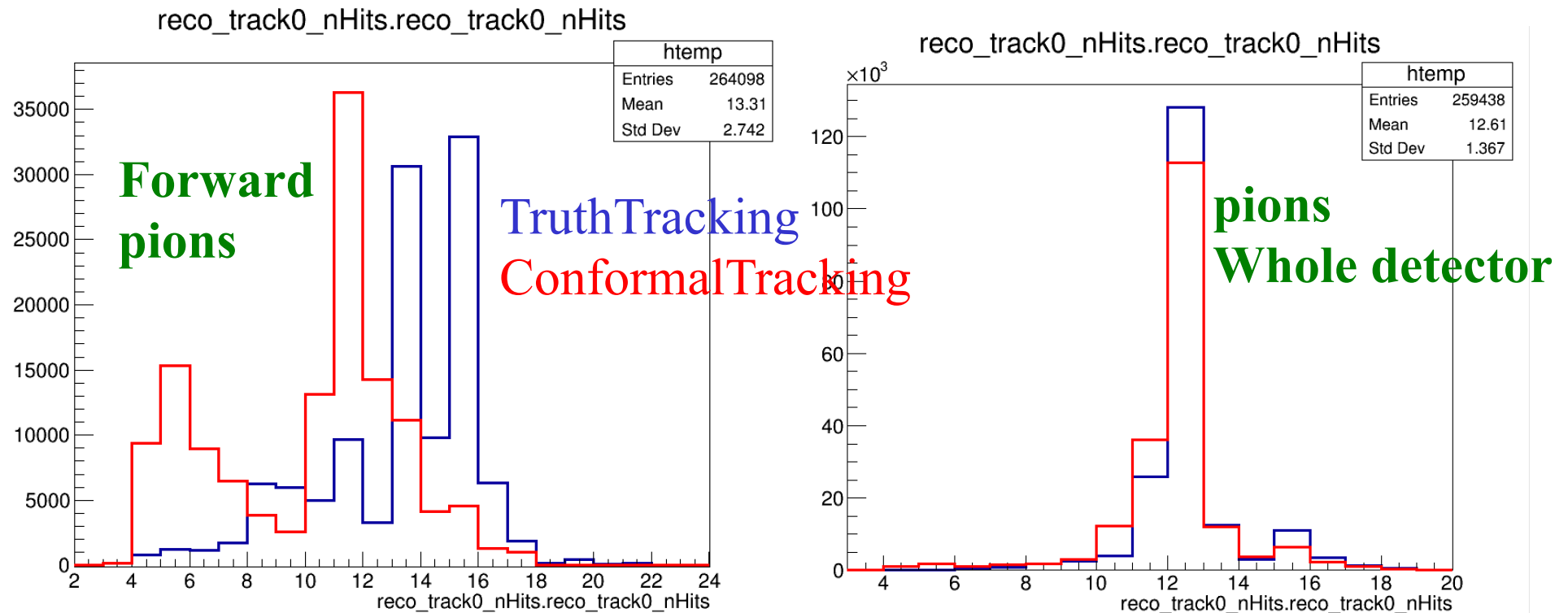
Sizable difference for forward jets → related to larger non gaussian tails in distribution if using conformal tracking

For 1500 GeV jets difference between Truth and Conformal Tracking around 20-25 % (for other energies 3.5-5 %)

Tracking 10 GeV pions: Forward vs All Range



Look at tracks of reconstructed charged pions (preselection, pions 0-20 and 160-180 degrees), compare to tracks from charged pions in whole detector

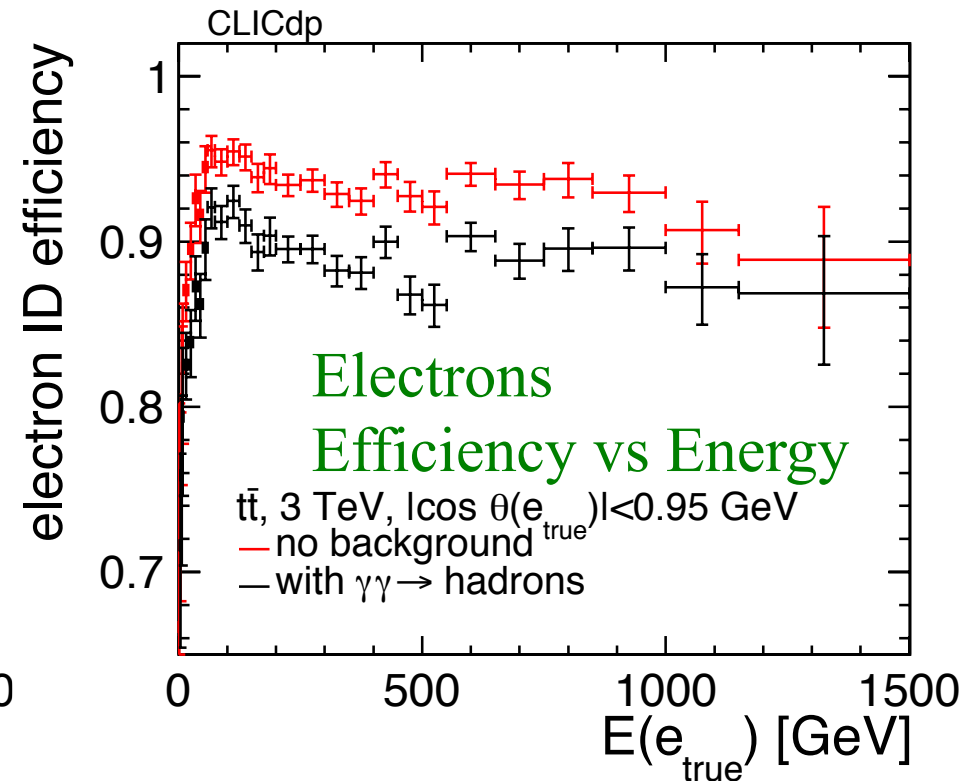
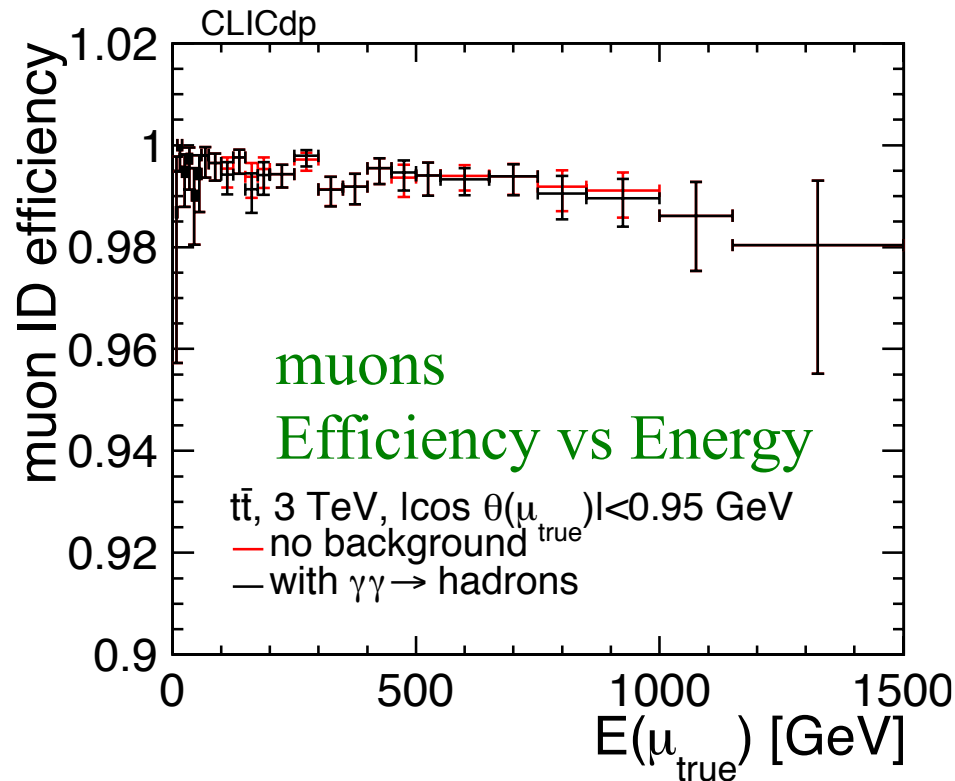


➔ For whole detector distribution of hits per track pretty similar,
For forward pions significantly less hits per reconstructed track

Muons & Electrons in $t\bar{t}$ with/without background



$t\bar{t}$ at 3 TeV: with and without $\gamma\gamma \rightarrow$ hadrons, muons and electrons from W's

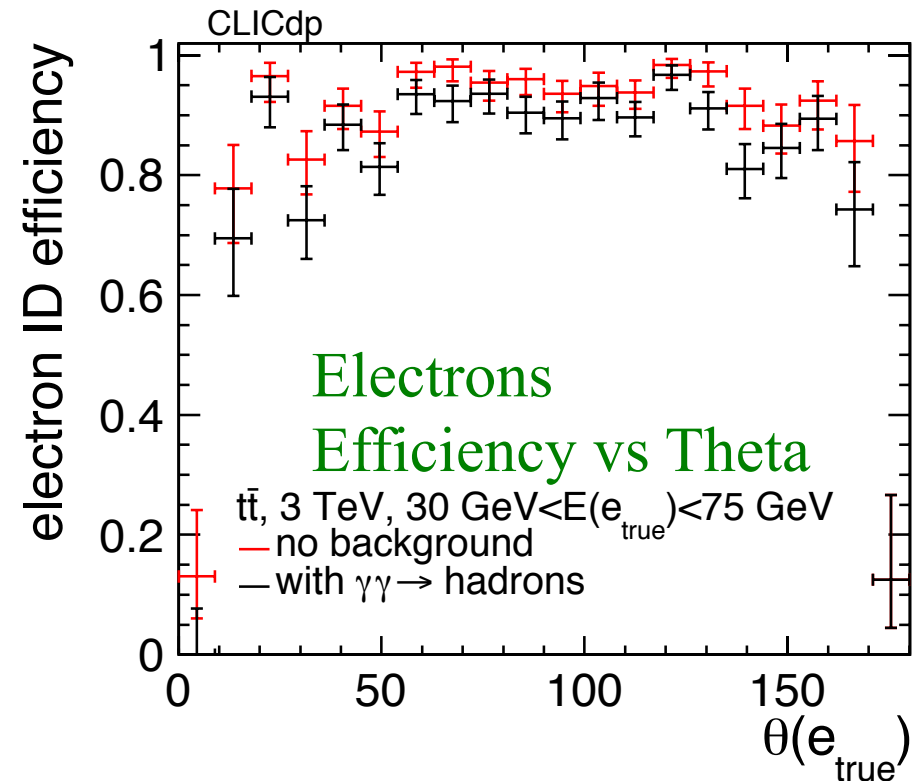
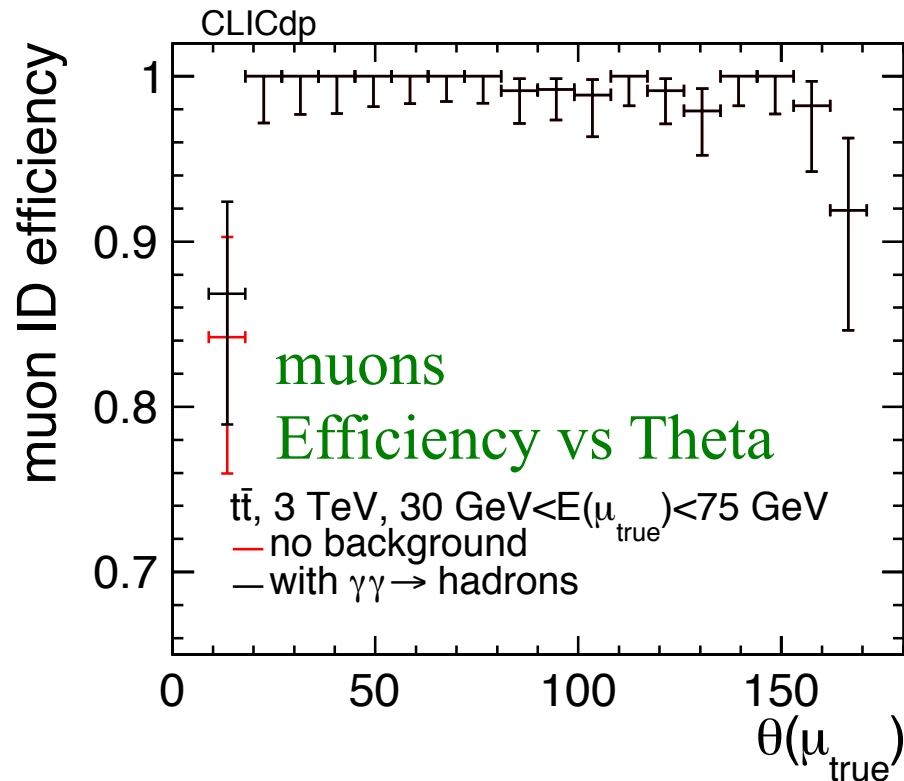


- Require angular matching between true and reconstructed lepton within 1°
- \rightarrow no impact of background on muon efficiency, 2-3 % effect on electrons
- \rightarrow for muons relative p_T matching of 5 % has no impact on efficiency

Muons & Electrons in $t\bar{t}$ with/without background



$t\bar{t}$ at 3 TeV: with and without $\gamma\gamma \rightarrow$ hadrons, muons and electrons from W's

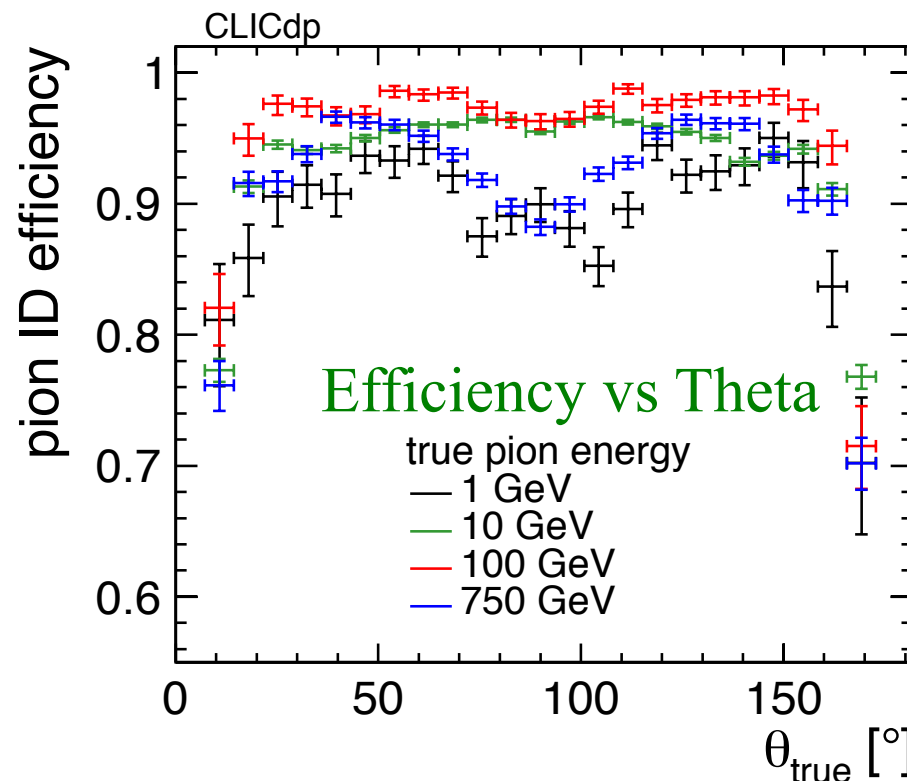
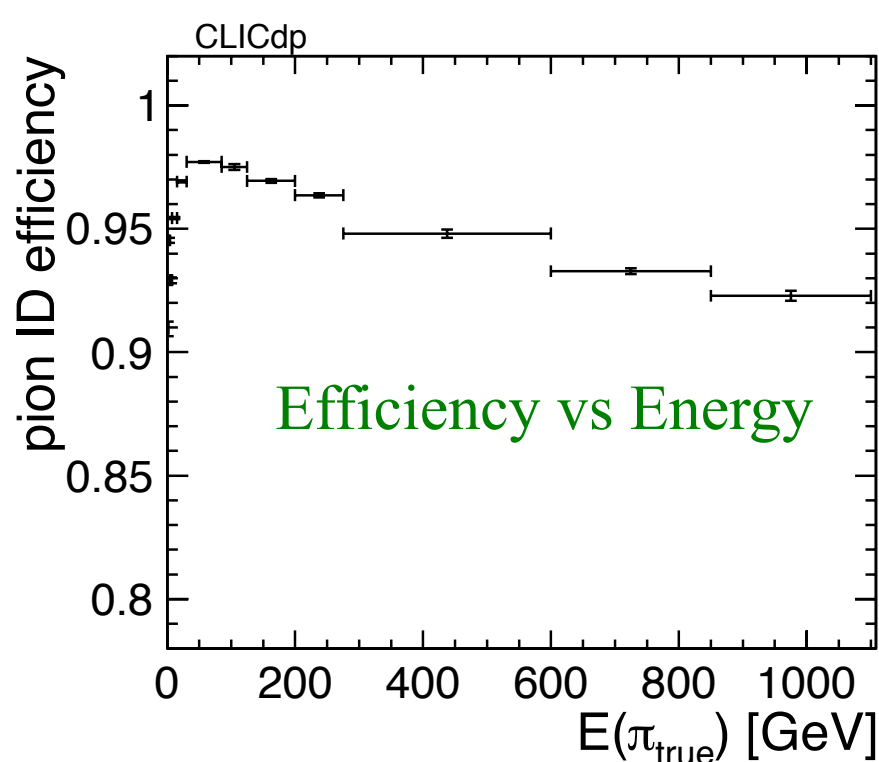


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Pion Efficiencies: Single Particle Events



Pion single particle gun events

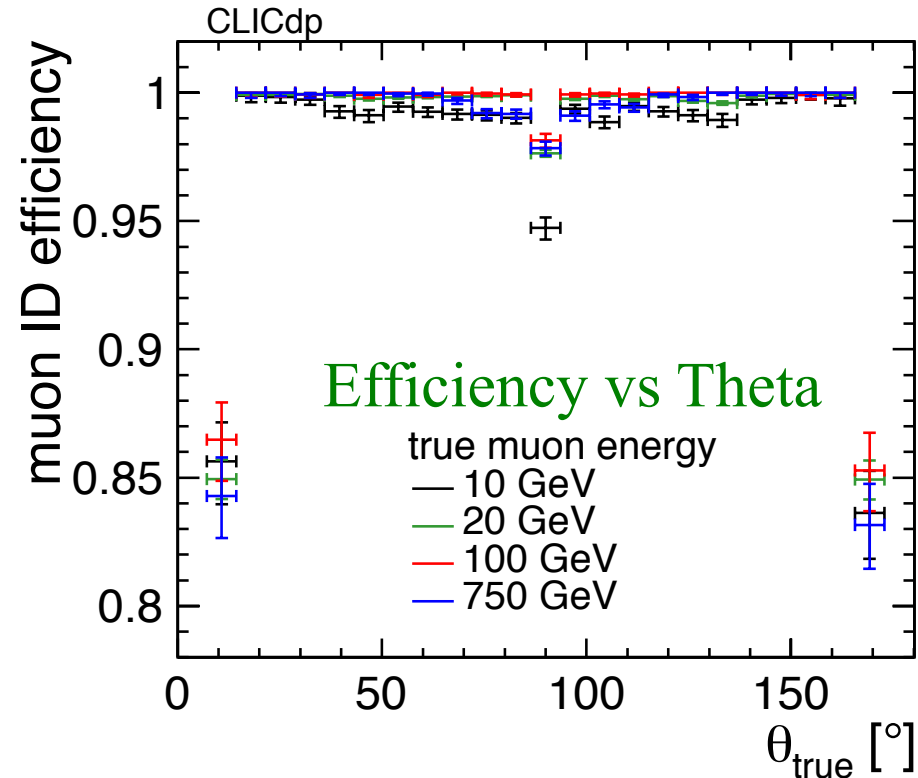
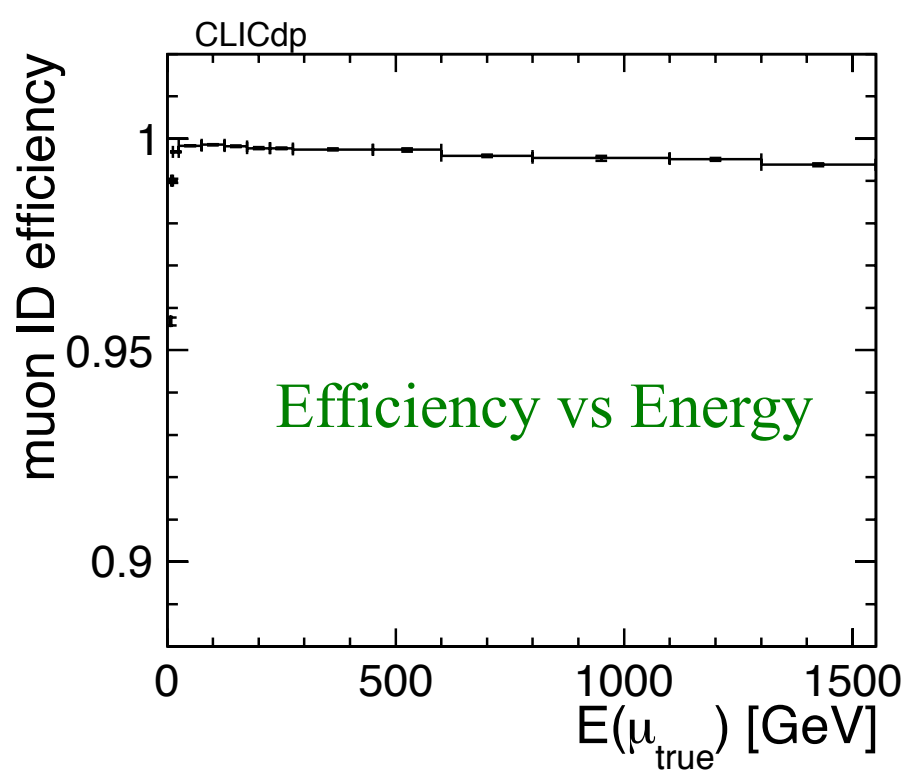


- Require angular matching between true and reconstructed pion within 1°
- Beyond 92 % for all energies, for high energies issues in central part of detector
- for pions relative p_T matching of 5 % has no impact on efficiency

Muon Efficiencies: Single Particle Events



Muon single particle gun events

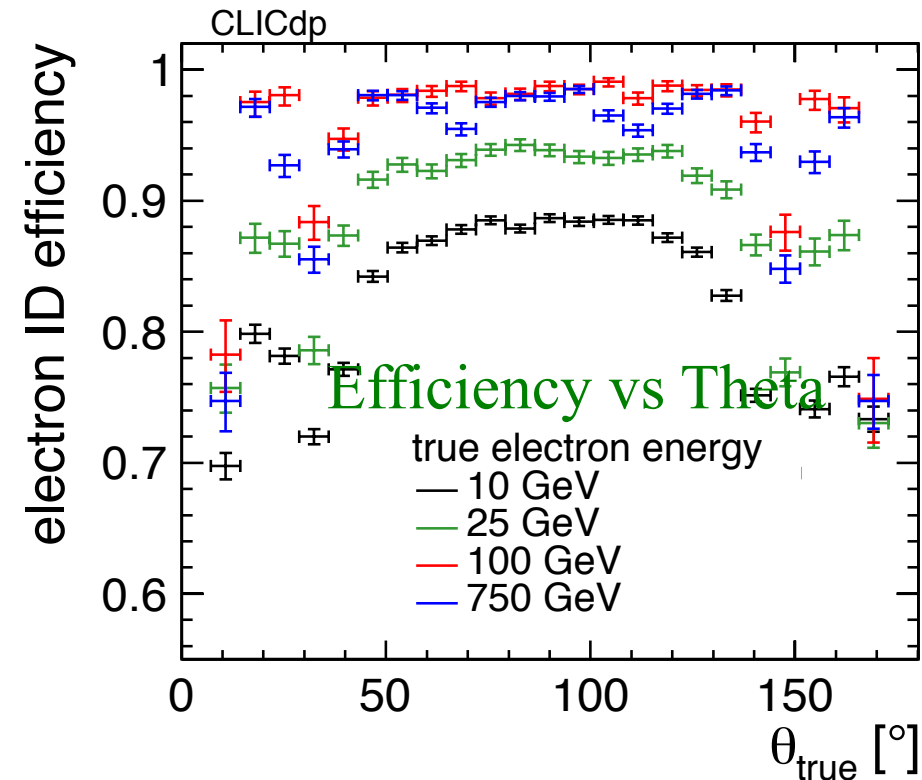
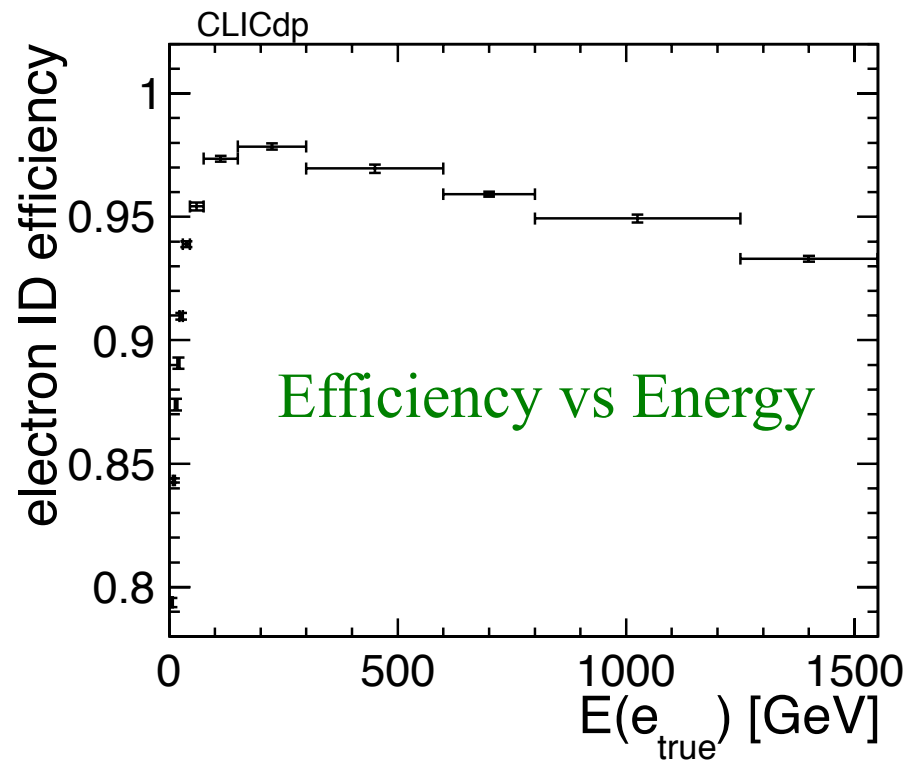


- Require angular matching between true and reconstructed pion within 1°
- Beyond 98 % for all energies, for high energies drop at high energies in central detector
 - for muons relative p_T matching of 5 % has no impact on efficiency

Electron Efficiencies: Single Particle Events



Electron single particle gun events



Require angular matching between true and reconstructed pion within 1°

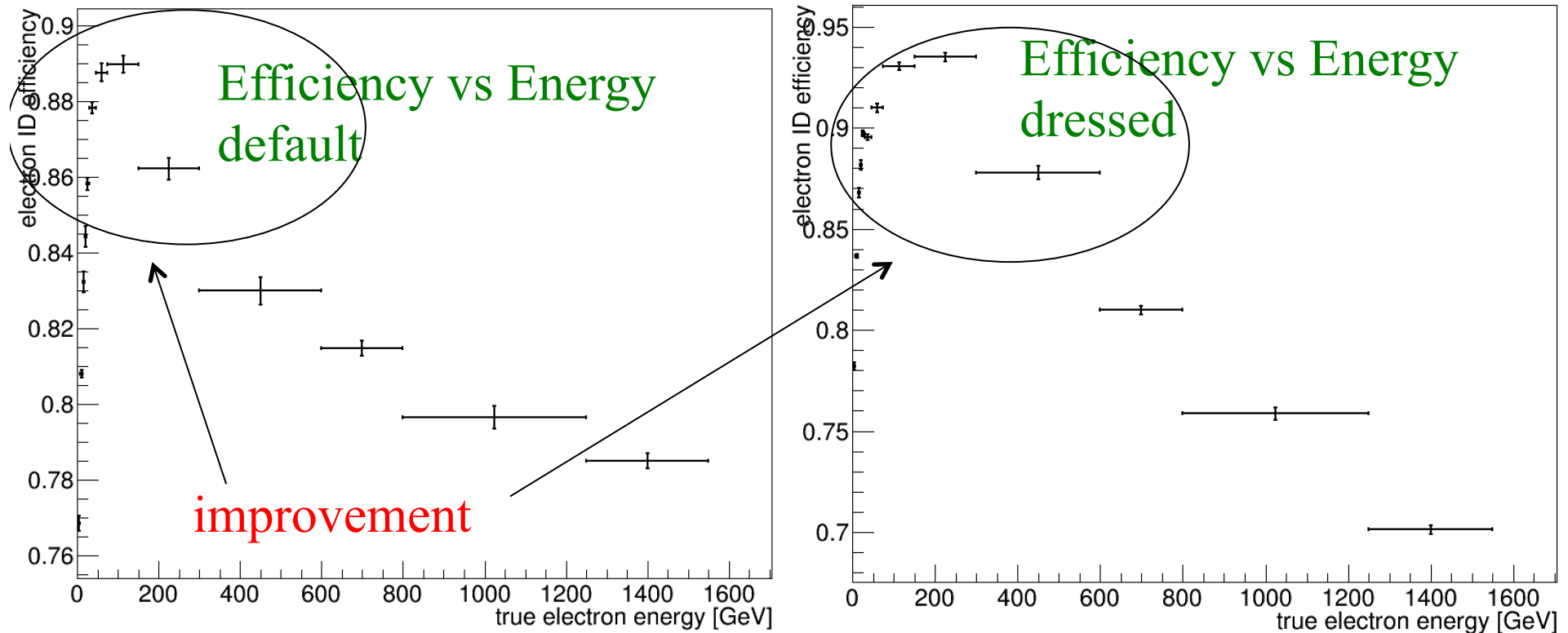
→ Beyond 80 % for all energies, above 90 % beyond 25 GeV

→ Due to bremsstrahlung if energy matching is required, drop by 10-15 %

Electron Efficiencies: Dressed vs no Dressed



Electron single particle gun events: re



Require angular matching and p_T matching (5 %) between true and reconstructed pion within 1°

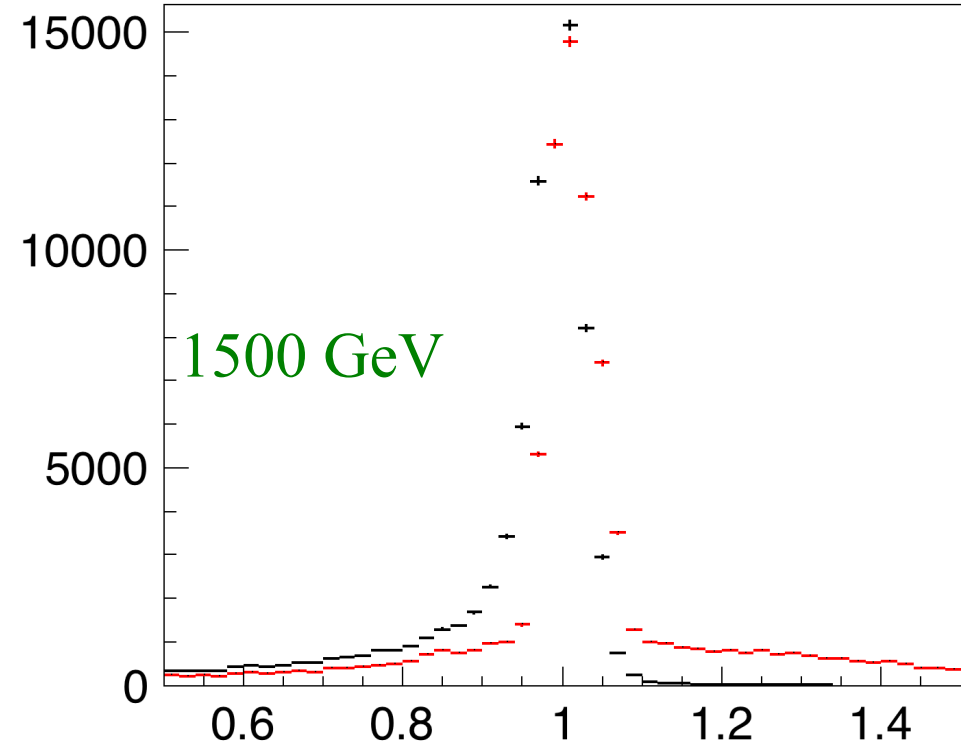
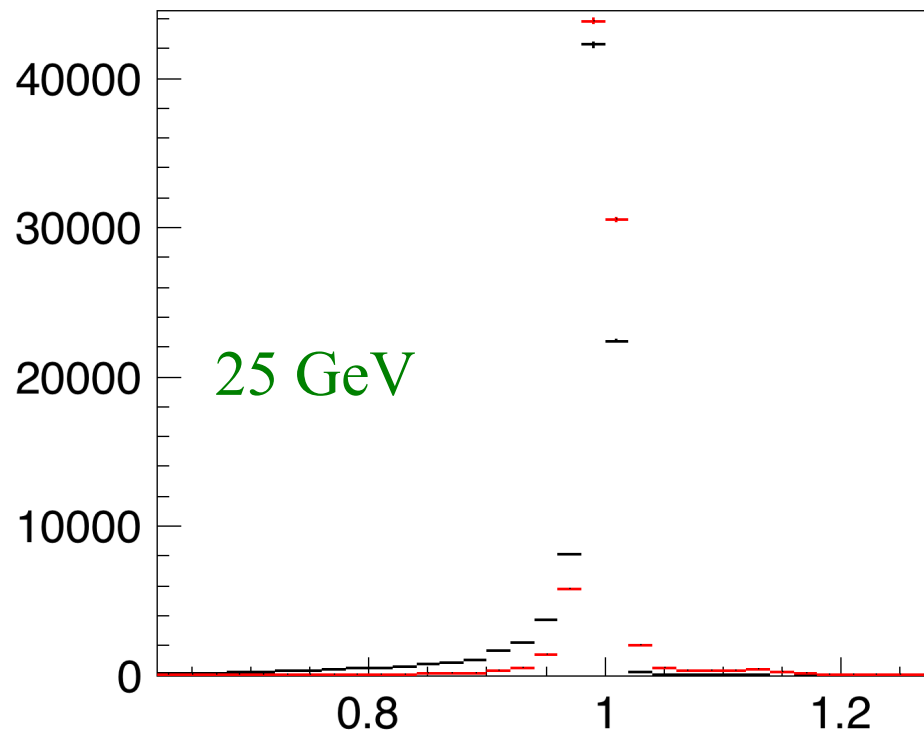
→ Due to bremsstrahlung if energy matching is required, drop by 10-15 %

→ Require energy matching for this check

Electron Efficiencies: Dressed vs no Dressed



Electron single particle gun events: dress with all photons within 2 degree



After dressing: gaussian core, distribution centered around 1

→ At 25 GeV tail disappears, everything fine

→ At 1500 GeV introduce larger tails, particularly to high end

Treatment of converted photons is tricky

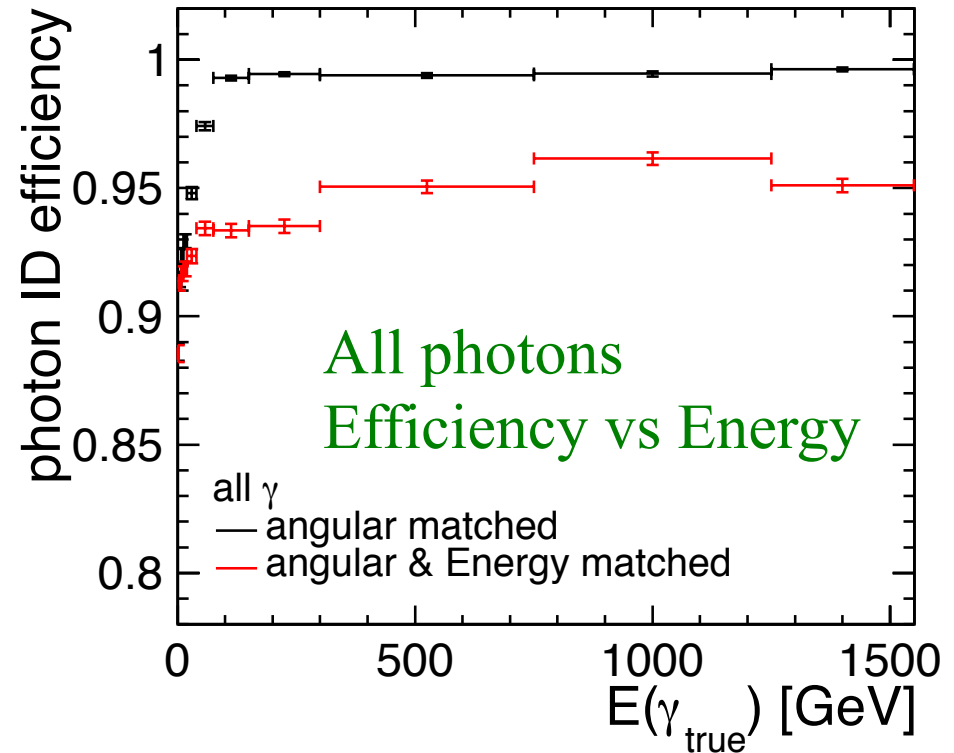
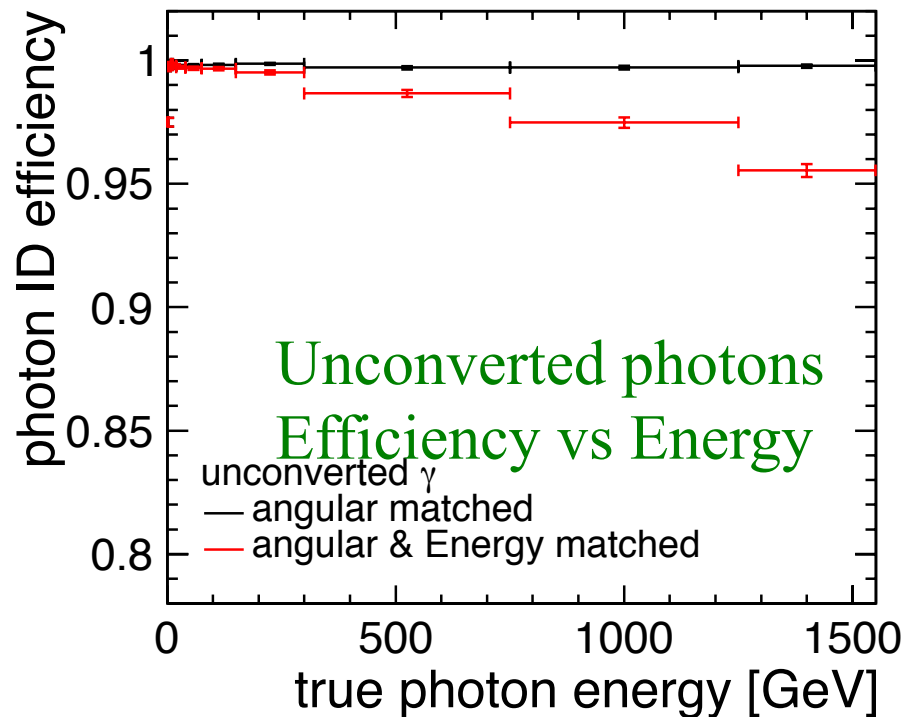
Consider unconverted photons first:

- Check against leading photon candidate: angular matching with true photon within 1 degree
- Energy matching within $5 \cdot \sigma(E)$, use energy resolution functions derived in barrel/endcap and transition region from photons within 5 and 200 GeV
 - for high energetic photons leakage into HCAL leads to tail events
 - non linear response, correct for mean prior to the energy matching requirement, at 1.5 TeV, $\sigma(E)$ according to fit below 1 %, but mean of response at 1.035 %

Unconverted vs all Photons



Photon single particle gun events



Require angular matching between true and reconstructed pion within 1°

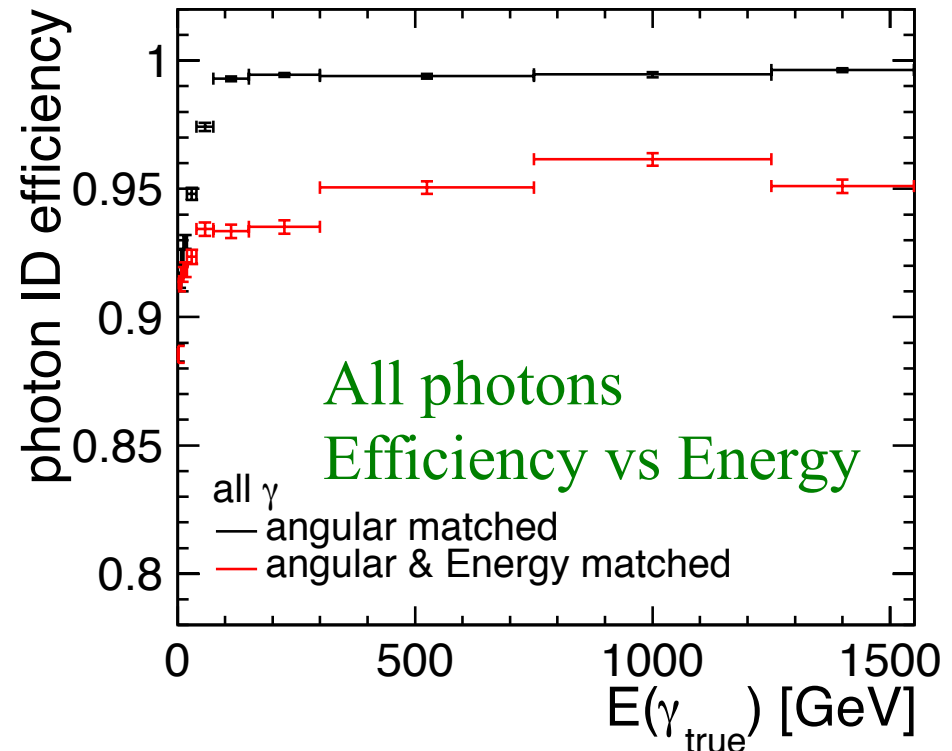
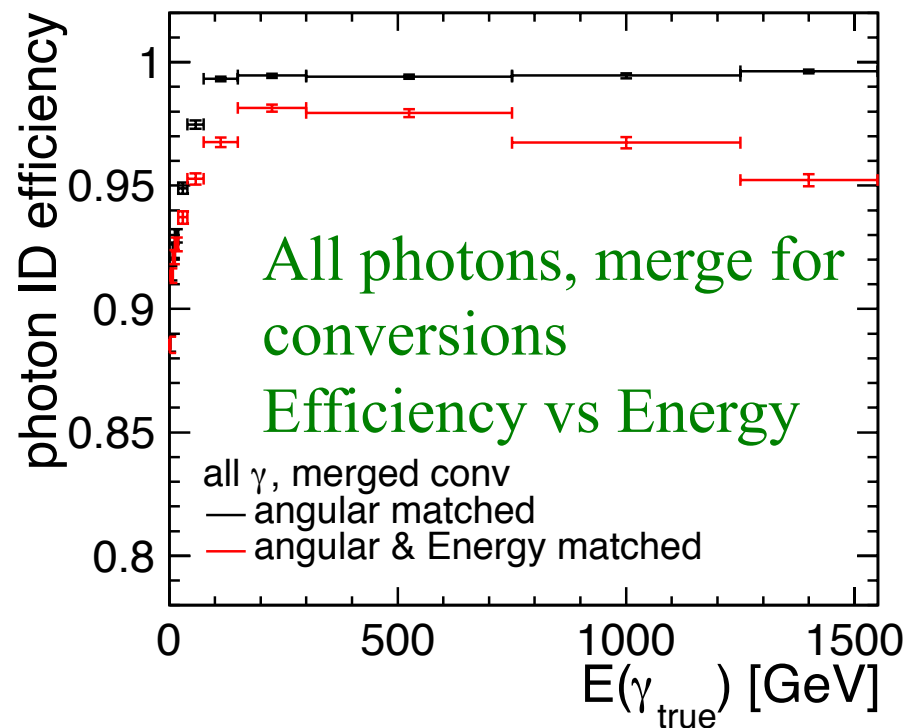
→ For unconverted photons $>99\%$ angular, in energy $>95\%$

→ Add converted photons (13-15% of whole sample), above 100 GeV we reach 93% for energy matching

Unconverted vs all Photons: merging for conversions

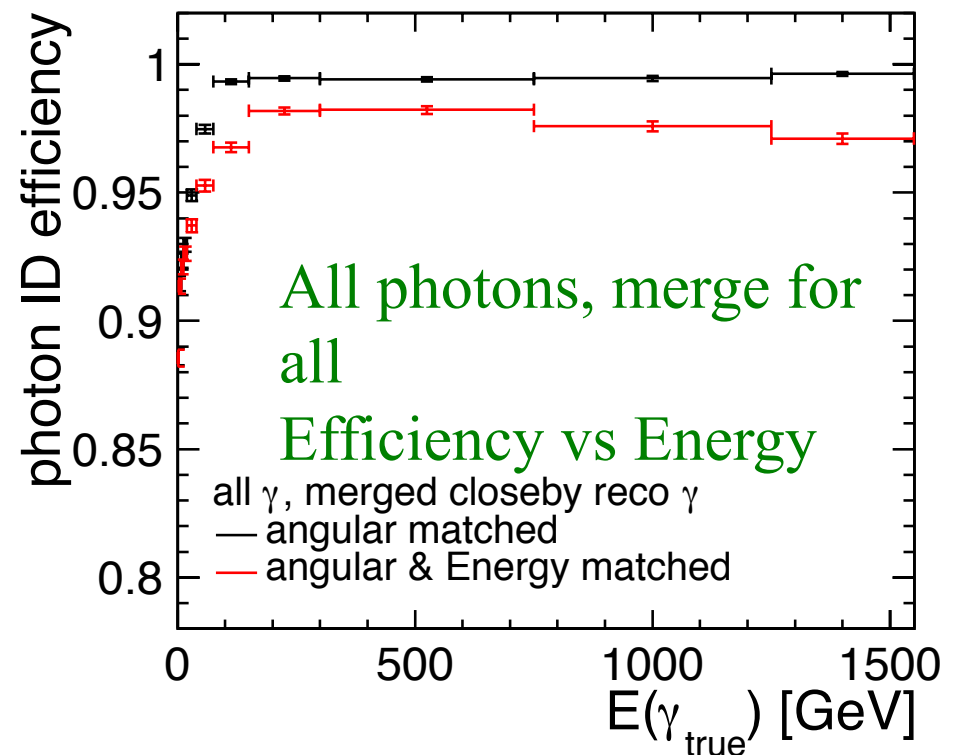
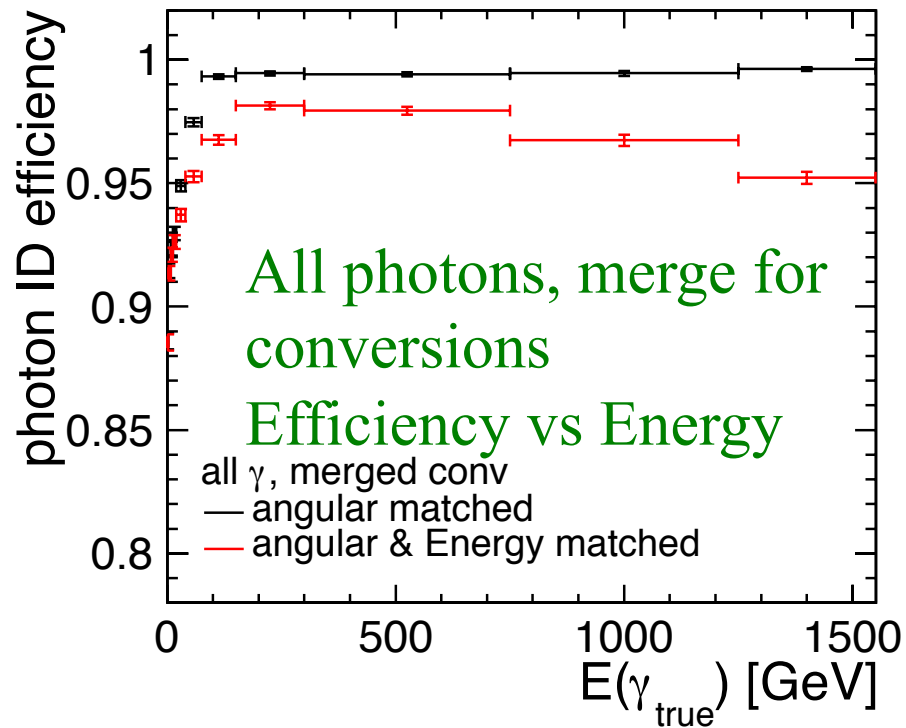


Photon single particle gun events



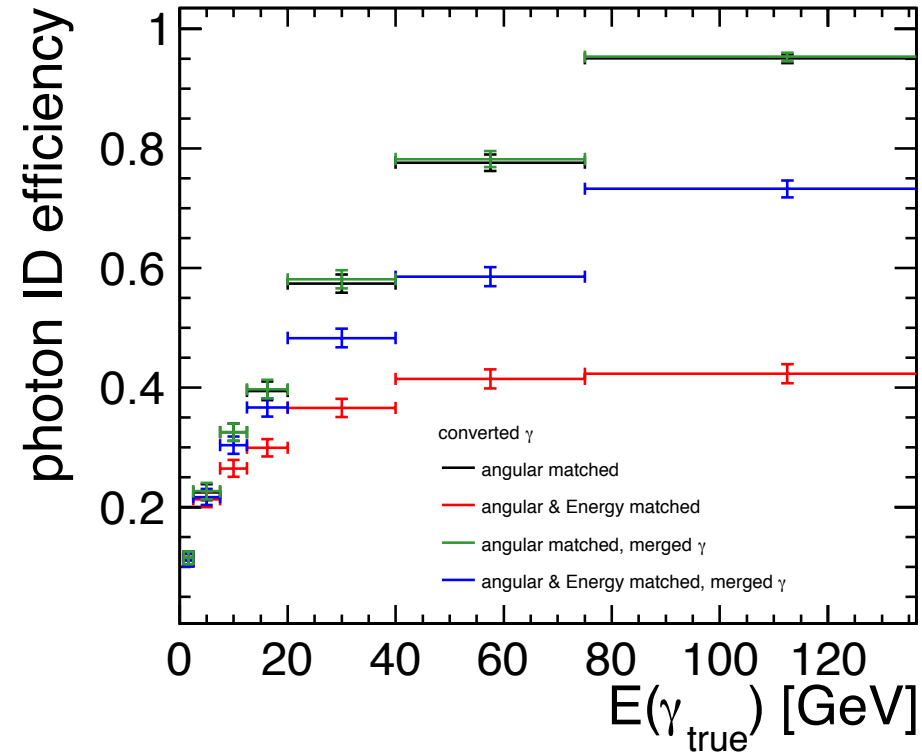
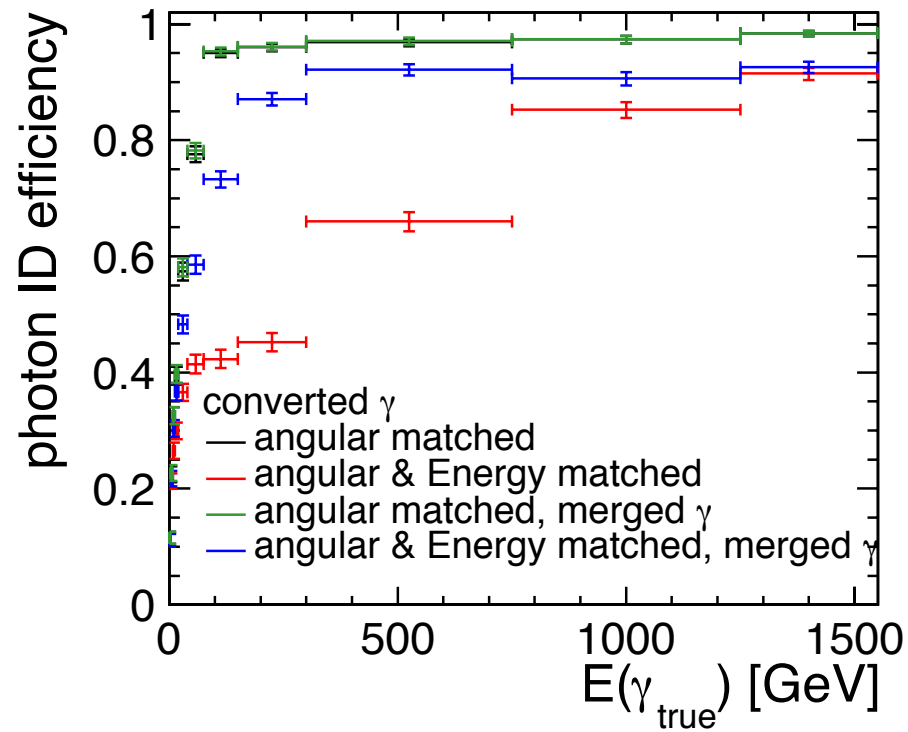
NOW for converted photons (selected using true information) → consider leading two reconstructed photons in energy: if less than 2 degree apart, then merge: new merged “photon” as reco photon (else leading one remains candidate)
→ Significant improvement at lower photon energies, beyond 95 % already at 30 GeV

Unconverted vs all Photons: merging for all photons



NOW for all events (no use of truth info) → consider leading two reconstructed photons in energy in all events: if less than 2 degree apart, then merge and compared new merged “photon” as reconstructed candidate
→ At large energies improvement by 2-3 %, still accidental splitting (not huge effect, but still noticeable)

Photon Conversion: check

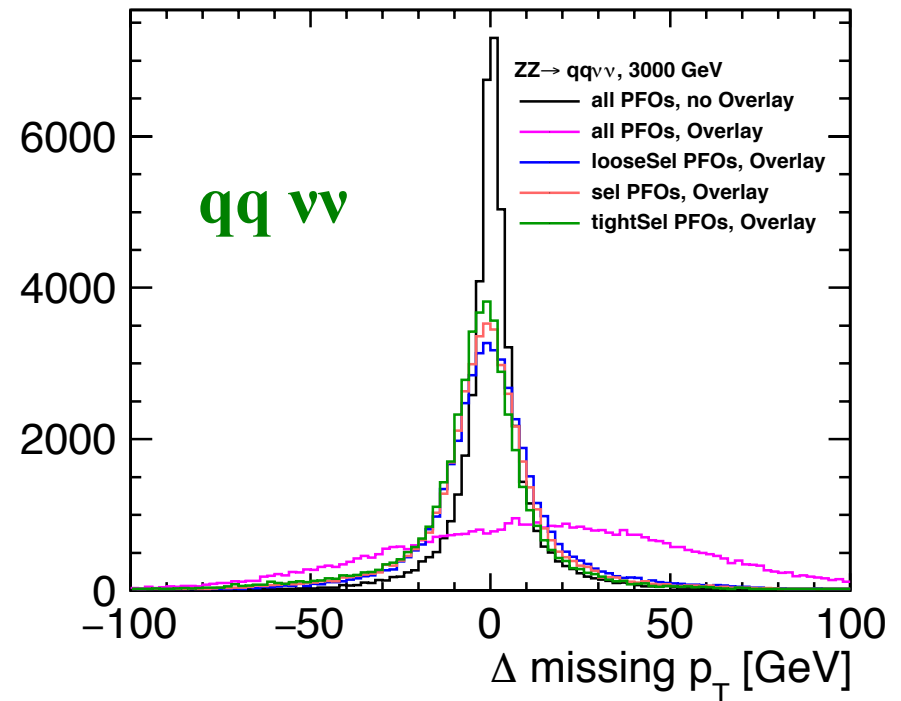
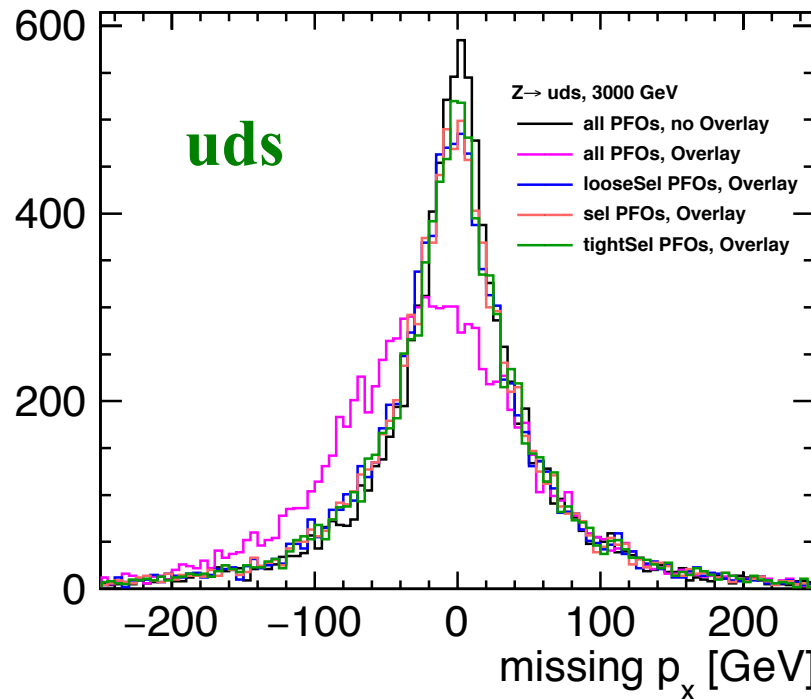


Check now what happens for converted photons actually

Missing transverse energy: beam background



MET resolutions: no genuine ($Z \rightarrow uds$) vs events with missing energy ($ZZ \rightarrow qq \nu\nu$)



For events without genuine missing energy, resolution worse if using all PFOs, performance almost recovered using selected PFOs

For events with genuine missing energy more significant impact of beam background, maybe check difference in values of true missing p_T , check effects in angular distribution as well