



# PandoraPFA Questions

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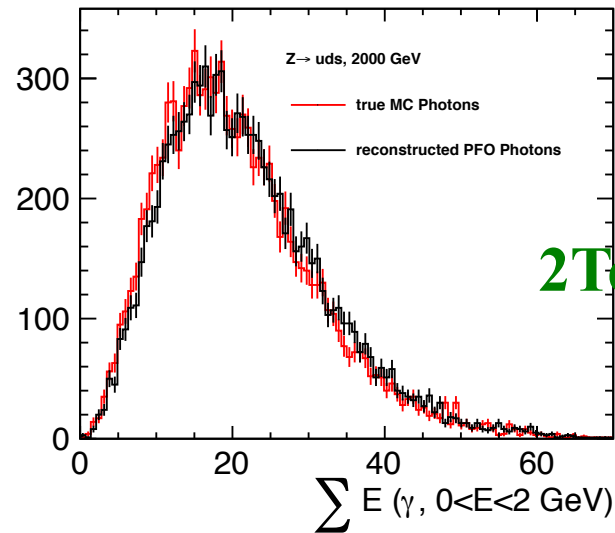


# **Photon Identification inside of jets: At high energies we loose photons into neutrons**

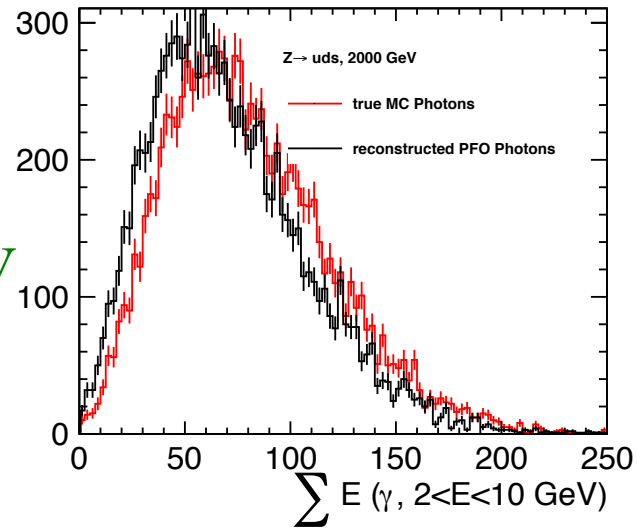
# Remaining issues at high energies: contribution from photons



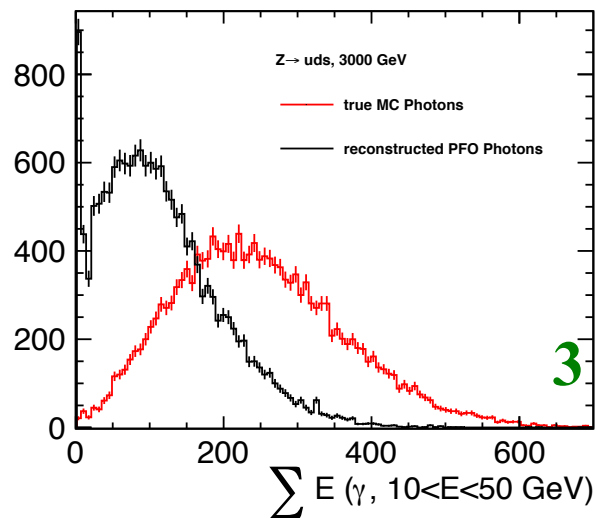
Check what might cause the higher jet energy resolution values for high energetic jets: photon energy distributions



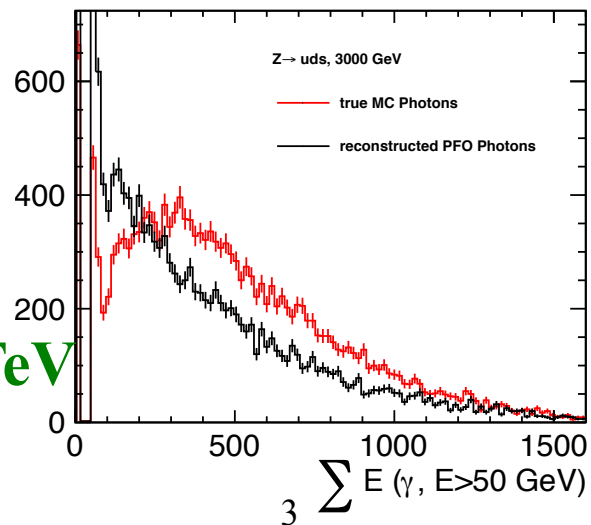
2 TeV



For low energetic photons contribution well reconstructed, contribution from photons between 10 and 50 GeV vastly underestimated



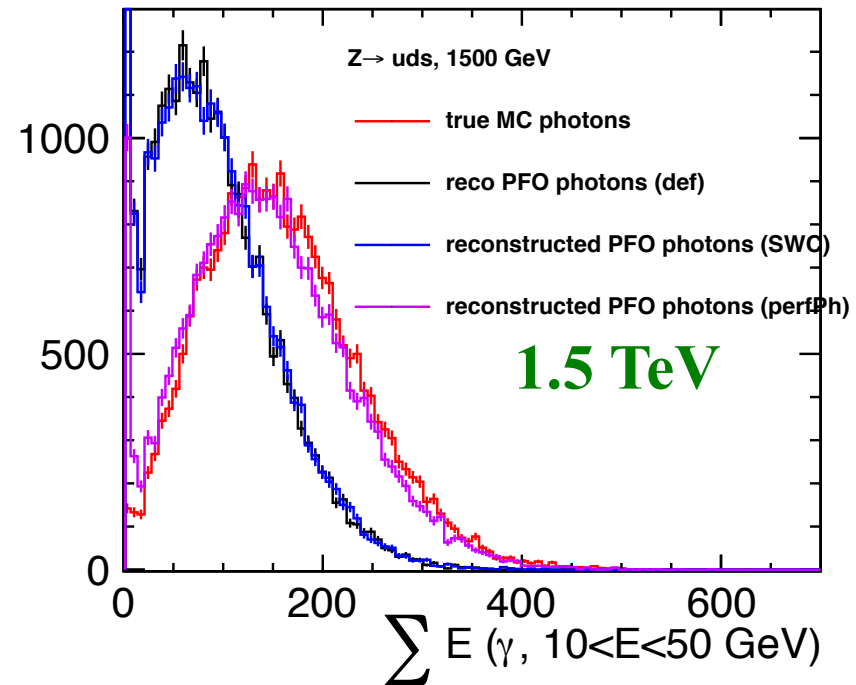
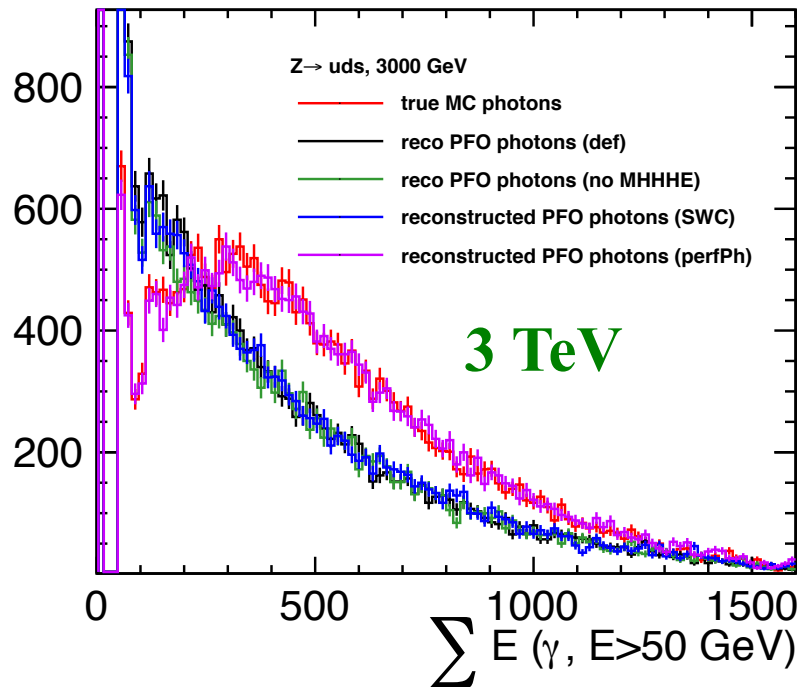
3 TeV



# PhotonEnergy component in jets



PandoraPerfectPhoton (cheats photo pattern recognition) gives far better result of energy sum of high energetic photons



Only (cheated) perfect photon pattern recognition achieves to correctly identify the contribution of high energetic photons to the event energy

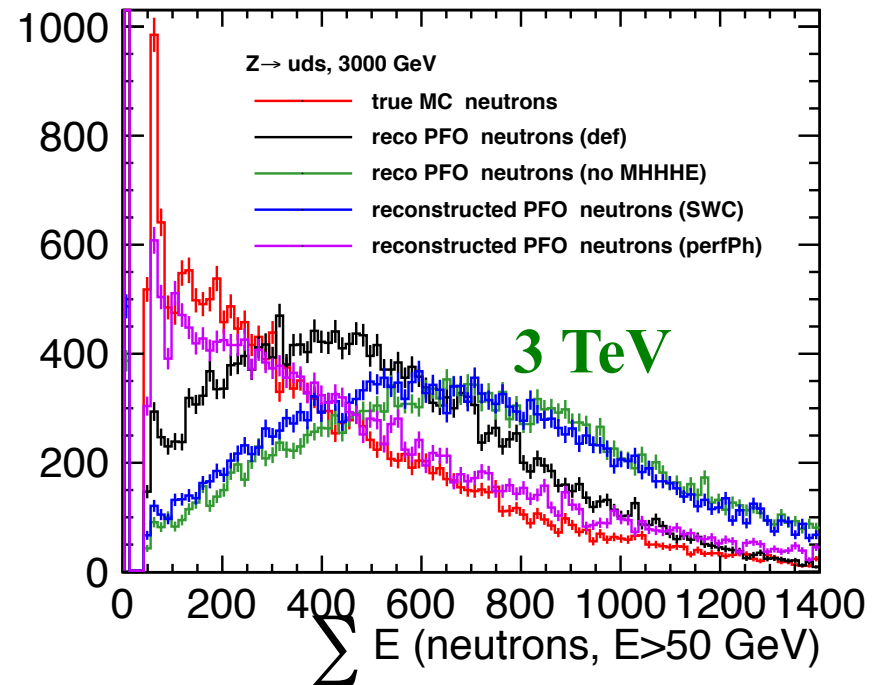
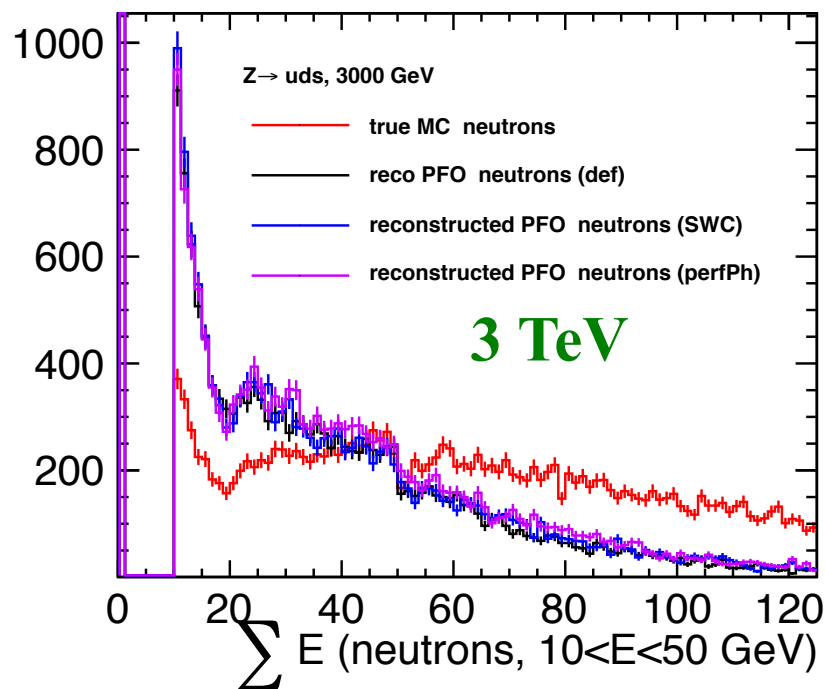
All other settings (CLIC default settings, default setting removing MHHHE cut, software compensation) shifted to lower values, but agreeing with each other

# PhotonEnergy component in jets

## where do we lose the energy, where does it go to



Check all energy contributions comparing the perfect photon cheated identification with other reconstruction settings



All pion distributions unchanged, same for energy contribution from low and medium energetic neutrons  $\rightarrow$  contribution from high energetic neutrons overestimated by all “real” reconstruction settings, energy from default CLIC settings lower than high MHHHE and SWC settings (this is the energy we loose in the default settings)

# Photon Identification tuning in PandoraPFA

## What we tried

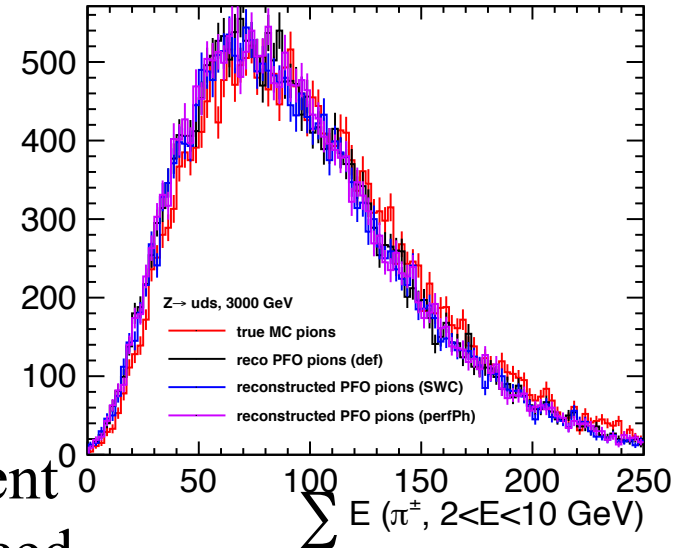
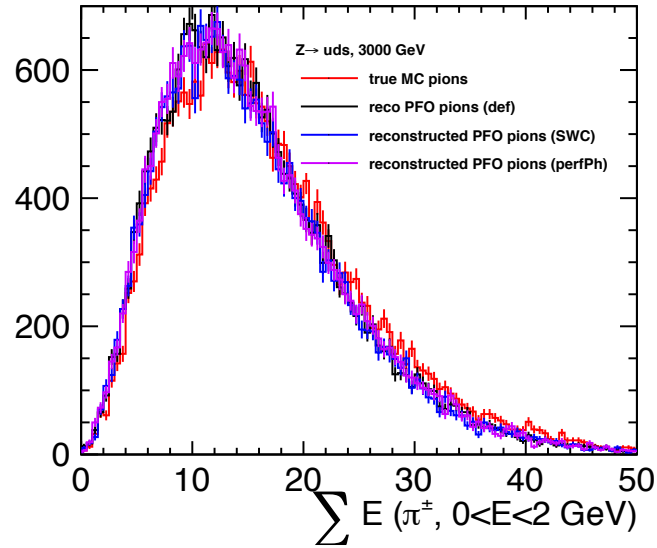


For each model the photon identification is retuned

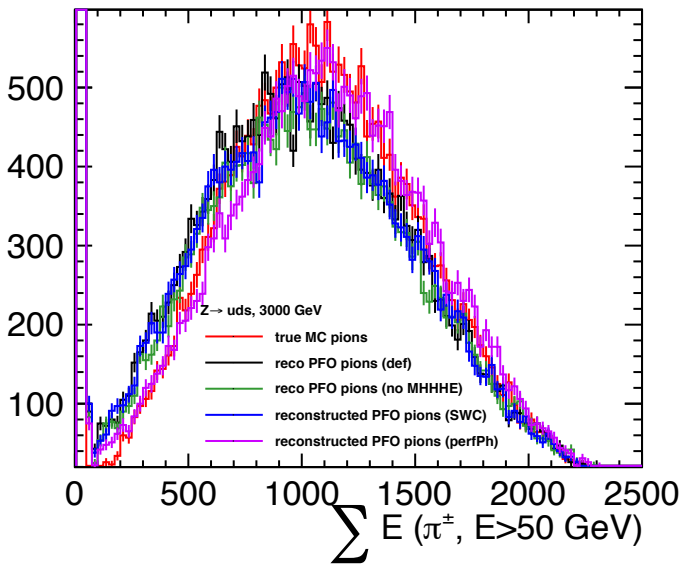
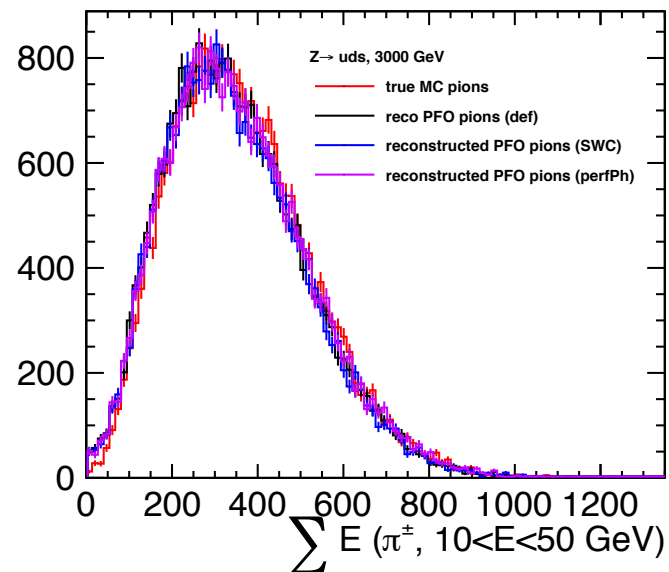
- Use PandoraSettingsPhotonTraining configuration file, result is a likelihood file for photons
- Binned in terms of energy (0, 0.2, 0.5, 1, 1.5, 2.0, 5, 10, 20 GeV)
- After photon likelihood file has been determined rerun calibration
- tested increase in photon identification bins to 11 to account more for possible differences at high photon energies (0, 0.2, 0.5, 1, 1.5, 2.0, 5, 10, 20, 35, 50 GeV)
  
- Unfortunately no sizeable improvement observed
- What could we do as next step: how are the signal and background like distributions defined
- Could we check if input distribution in likelihood might lose discrimination power for higher photon energies, or where things might get a bit different
- Produce maybe map in energy and theta, to check where problem appears

precisely

# Pion Energy component in jets



Charged component correctly reproduced





**Software Compensation Questions:  
Input is the arXiv draft in  
<https://arxiv.org/abs/1705.10363>**



# Software Compensation training samples



Paper states training sample of single K0L and neutrons from 10-95 GeV

- What is the ratio of K0L to neutrons (spectrum is slightly different in Z→uds files) is it 1:1 and mixed
- Are the training samples discrete (e.g. one sample at 10 GeV, another at 20 GeV etc), or is it a sample flat in cosTheta and flat in energy
- What is the physics behind the energy dependence of equations 4-6, is it empirical or based on a certain theory model (i.e. can we use them for even higher energetic neutral hadrons)
- I assume equation (3) holds for all energy densities  $\omega(\rho) = p_1 \exp(p_2\rho) + p_3$

Implementation:

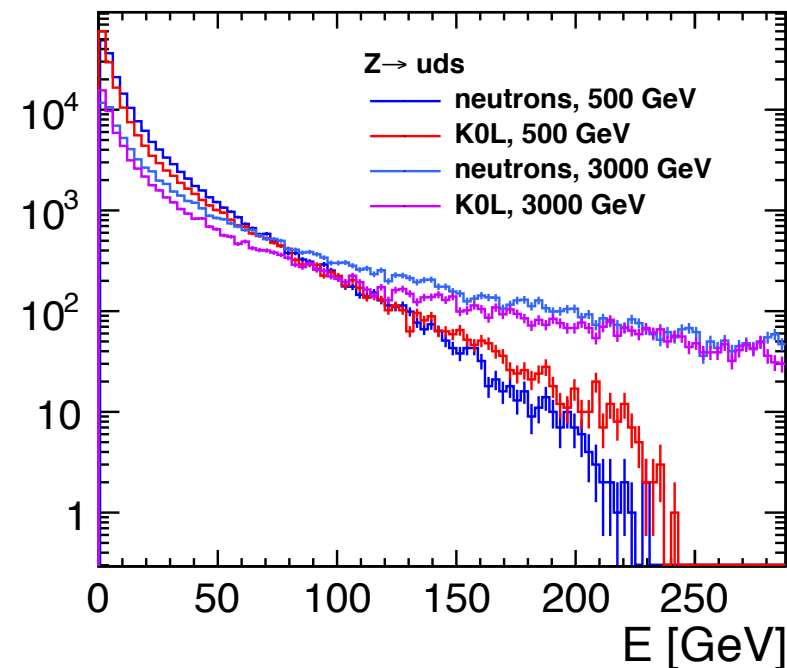
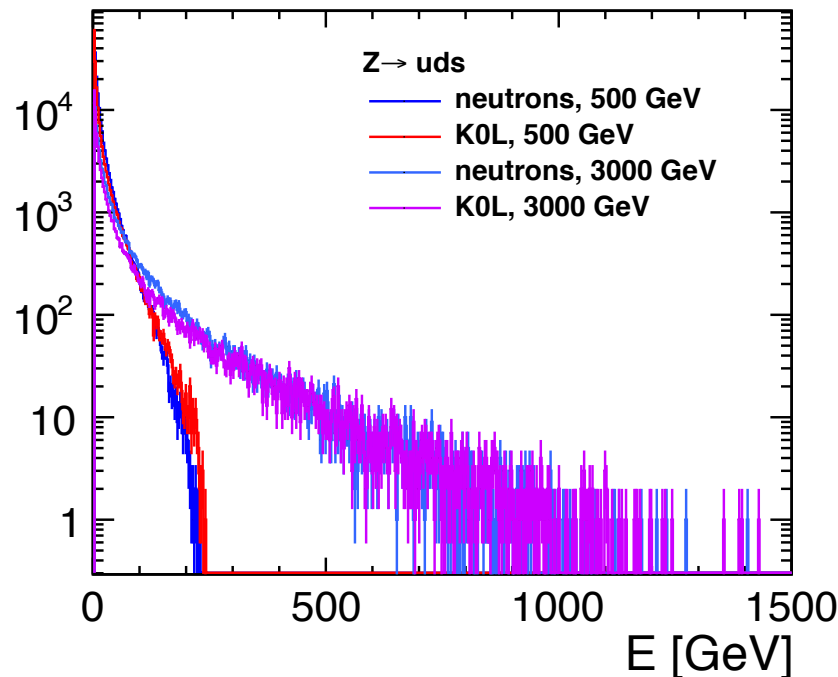
- The default weights are hard coded, can we try to make the number of density bins variable, everything else seems to be possible to read in via xml settings in the function of `LCSoftwareCompensation::ReadSettings(const TiXmlElement xmlHandle)`

# Hadron spectrum for CLIC (Zuds 500 vs Zuds 3000 GeV)



For 500 GeV dataset neutral hadron energies beyond 90 GeV are 1.9 %, for 3000 dataset 13.7 % → if we want same coverage of neutral hadron energy spectrum need to calculate weights for samples up to 400 GeV (1.7 % beyond that point for 3000 GeV sample)

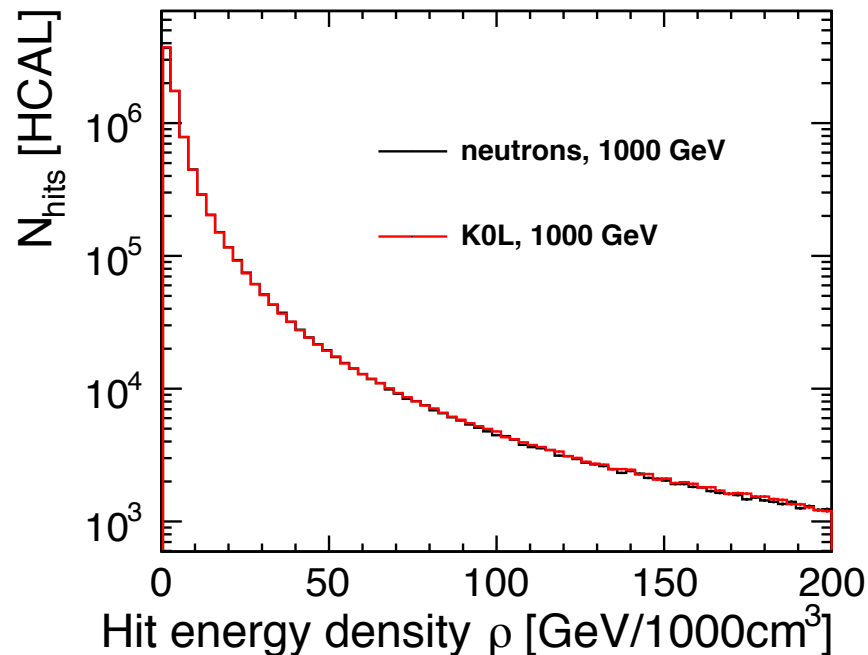
→ For high end tail definitely need CLIC specific weights



# Hit energy density for 1000 GeV neutral hadrons



Software compensation weights are determined by minimisation of a  $\chi^2$  like function using all energy points and densities up to 30 GeV/1000 cm<sup>3</sup>



Quite a few hits with high energy density beyond 100 GeV/dm<sup>3</sup> (cutoff until when weights are applied) → so we need to extend the software reweighting  
→ In case we do use the current weights most cell energies are reweighted with a constant factor smaller than 1 (energy dependence)

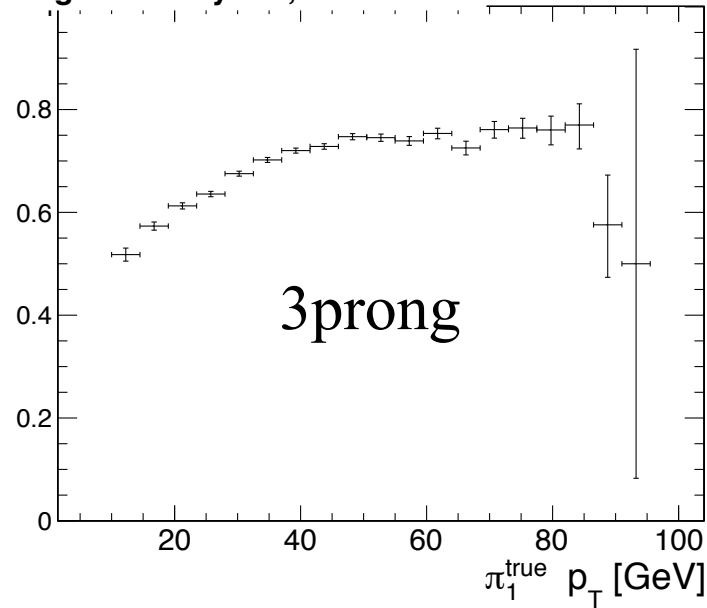


## **Back to tau's**

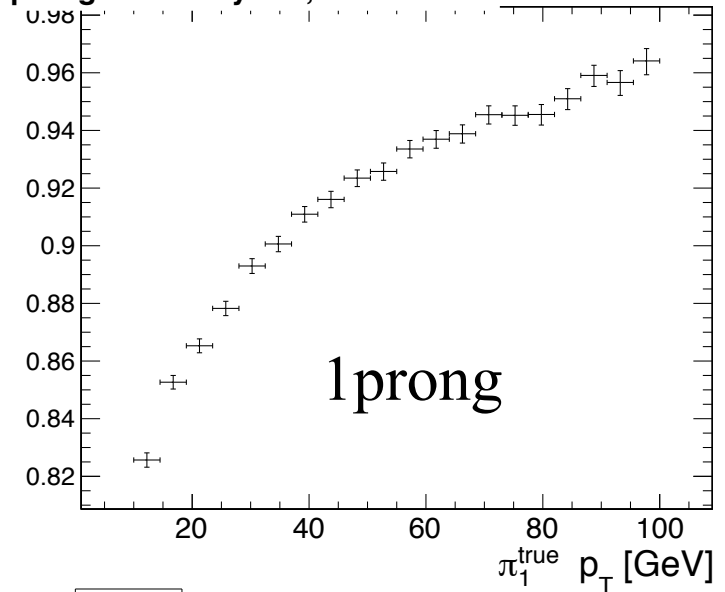
# Tau efficiency vs leading pion $p_T$ leading in energy 200 GeV samples



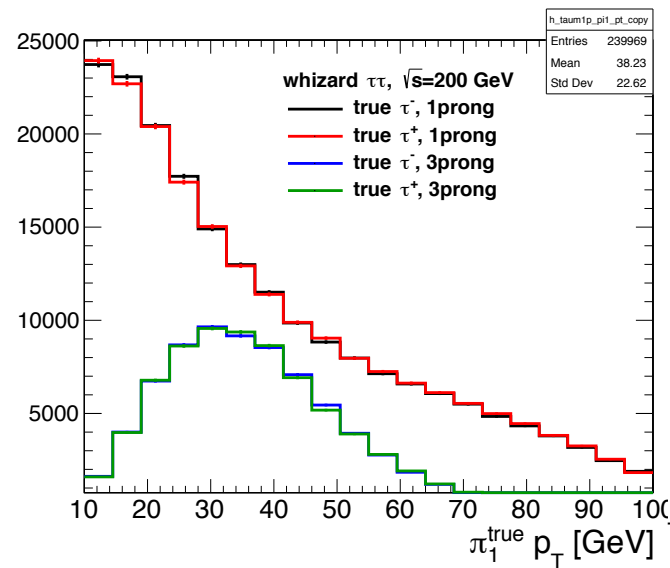
$\tau^-$  3prong Efficiency  $\tau^-\tau^+$ , E=200 GeV



$\tau^-$  1prong Efficiency  $\tau^-\tau^+$ , E=200 GeV



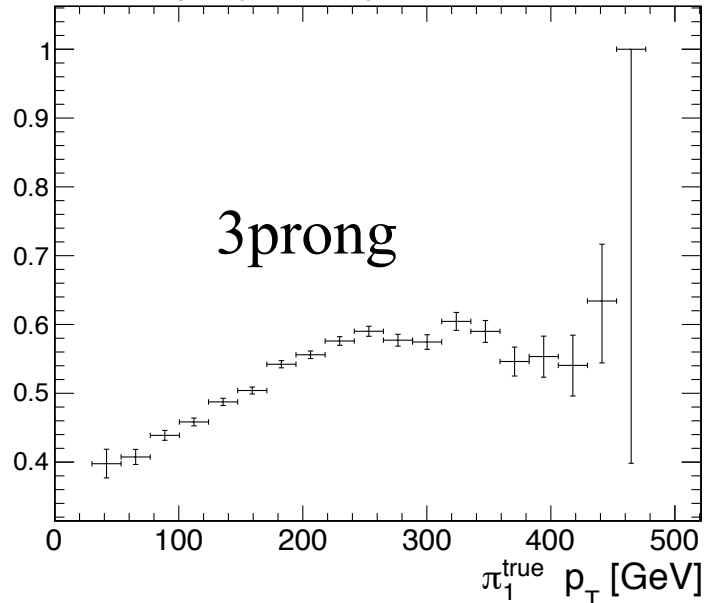
True leading  
Pion  $p_T$



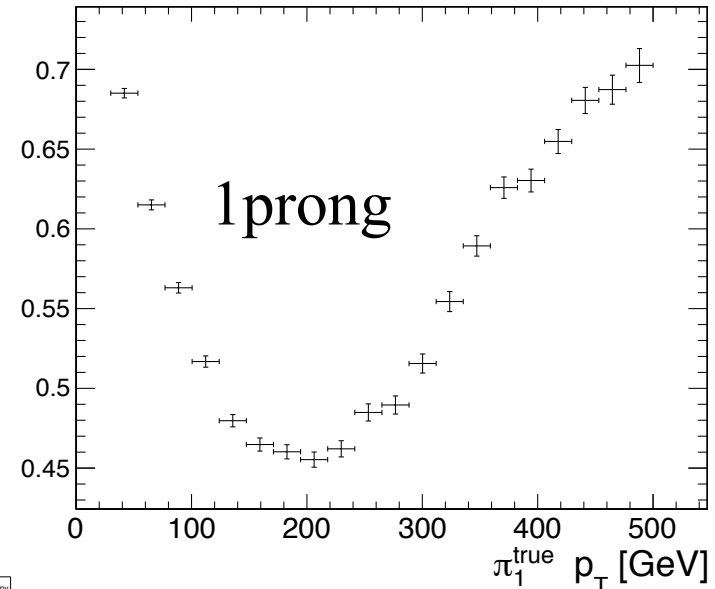
# Tau efficiency vs leading pion $p_T$ leading in energy 1000 GeV samples



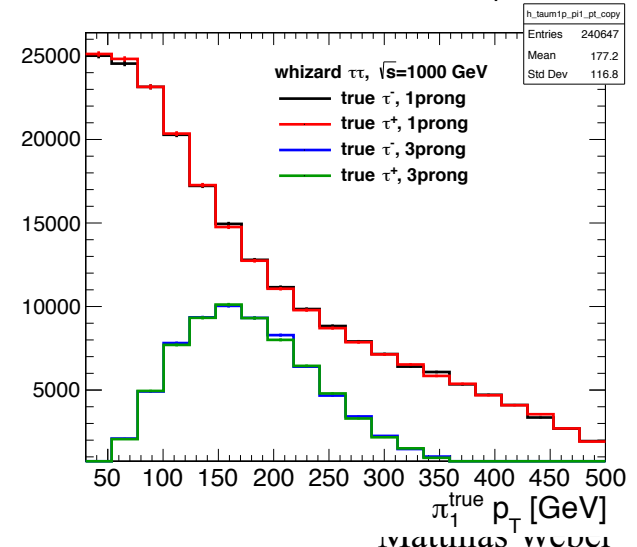
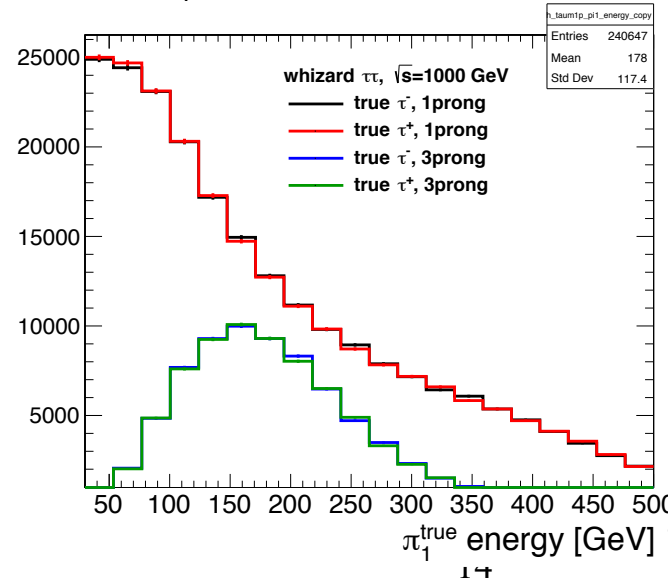
$\tau^-$  3prong Efficiency  $\tau^-\tau^+$ , E=1000 GeV



$\tau^-$  1prong Efficiency  $\tau^-\tau^+$ , E=1000 GeV



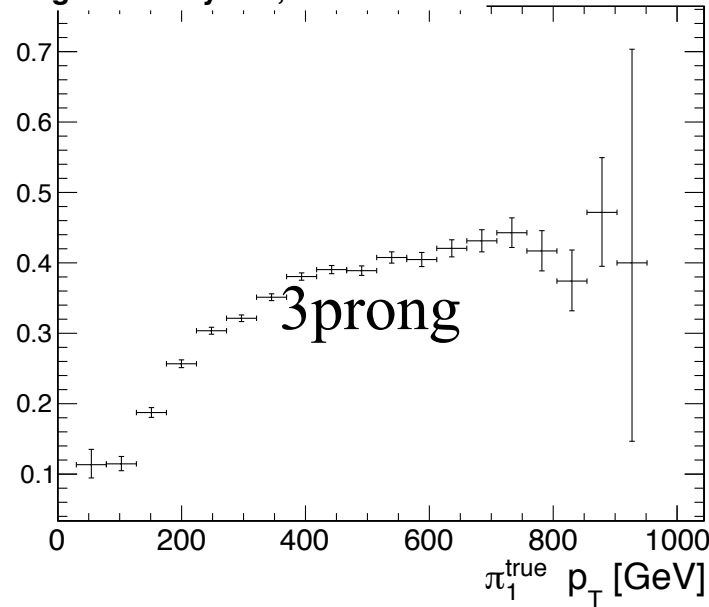
True leading  
Pion  $p_T$



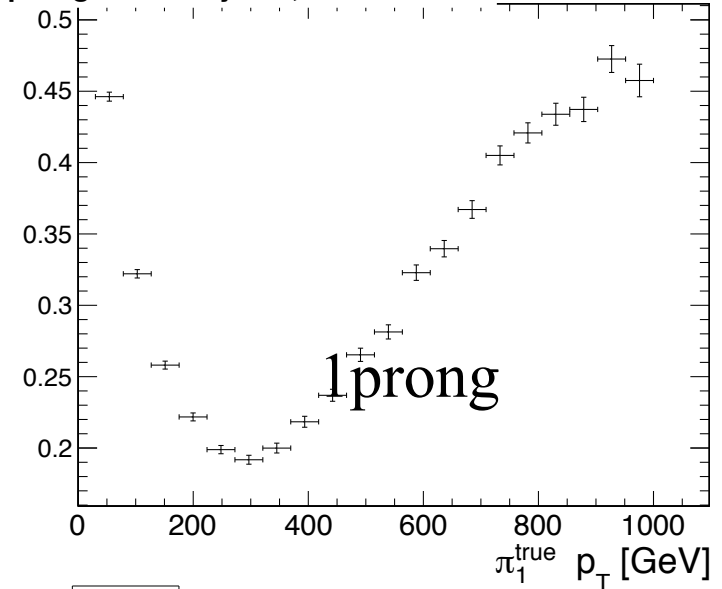
# Tau efficiency vs leading pion $p_T$ leading in energy 200 GeV samples



$\tau^-$  3prong Efficiency  $\tau^-\tau^+$ , E=2000 GeV



$\tau^-$  1prong Efficiency  $\tau^-\tau^+$ , E=2000 GeV



True leading  
Pion  $p_T$

