PandoraPFA and Calorimeters

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Samples and Software used

Produce single particle gun samples of neutrons and K0L's separately, for each point simulate and reconstruct 70000 events
Use the PandoraSettingsSoftwareCompensationTraining script for reconstruction

Cleaning of clusters in the Pandora training script identical to cleaning for default reconstruction
→Then run **PandoraPFACalibrate_SoftwareCompensation** script in PandoraAnalysis/calibration

Energy points at 2,5,10,20,30,40,50,60,75,90,100,150,200,250,400,500,1000 GeV for neutrons and Kaons, for Kaons additional energy point at 1 GeV

Merge Kaons and neutrons in one sample (relative weight 1:1) and use energy points of 2,5,10,30,75,150,200,400,**1000** for software compensation training

Density binning: 0 2 5 7.5 9.5 13 16 20 23.5 28 33 40 50 75 100, overflow 110

Samples and Software:NEW

Largest neutral hadron energy point/limit of application of software compensation

- Relevance for highest center of mass energy
  - → At 3 TeV largest neutral hadron in PandoraPFA clustering step around 1300 GeV, appears typically at least once in 100 events.
  - → With overlay expect this rate might even increase: add additional single hadron testing point at 1500 GeV to check behavior

Density binning: 0 2 5 7.5 9.5 13 16 20 23.5 28 33 40 50 75 100, overflow 110

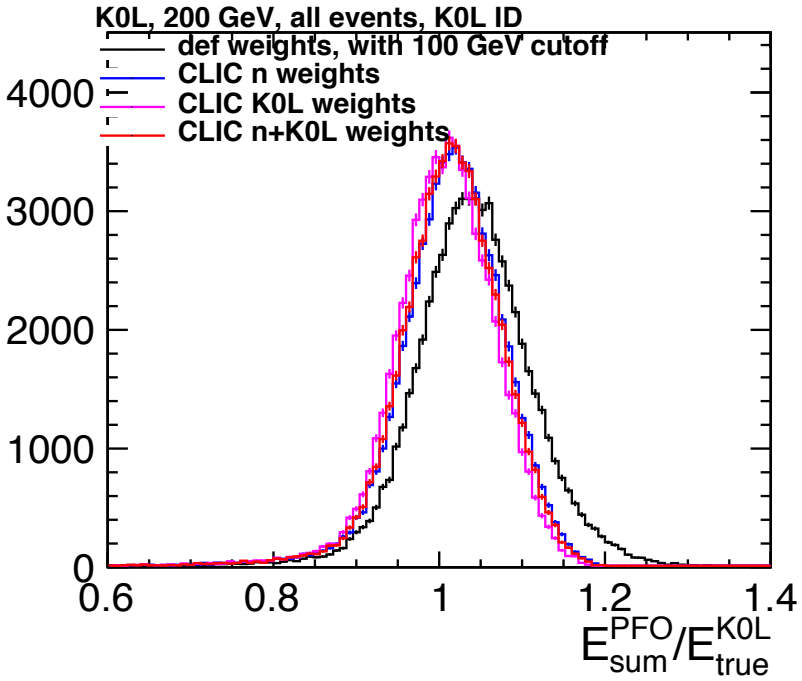
- suggestion: reduce number of bins for high density
  - → tested for combined sample of neutrons and Kaons, doesn't reduce memory load, gives slightly worse performance for high energy point

Disable software compensation in PandoraPFA calibration:

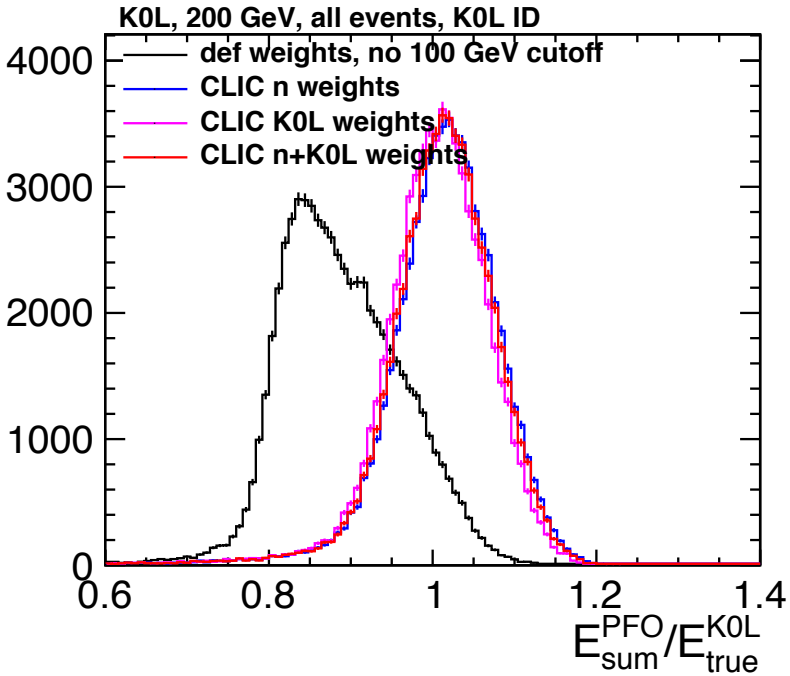
- Scripts in ILCSoft suggested calibration with software compensation enabled, consulted with Cambridge group and decided to remove software compensation in calibration step, SWC training after PandoraPFA calibration is fixed

Single Hadron response closures: Kaons at 200 GeV

At this point per default the ILD derived weights are not applied anymore (application threshold at 100 GeV) → check performance if we increase this threshold to 1800 GeV

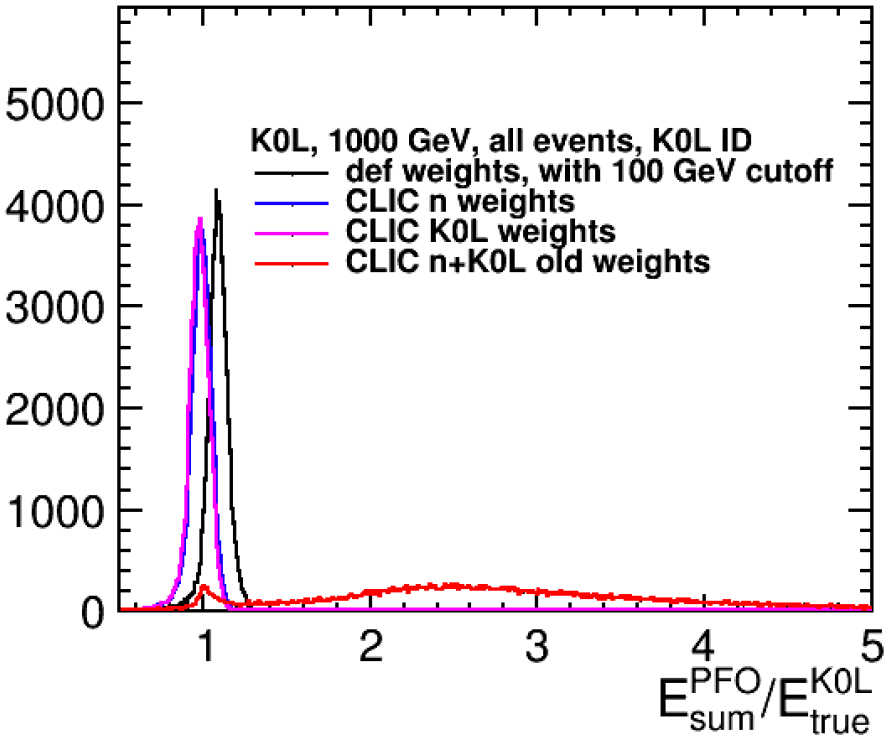


Default (black): no ILD weights applied

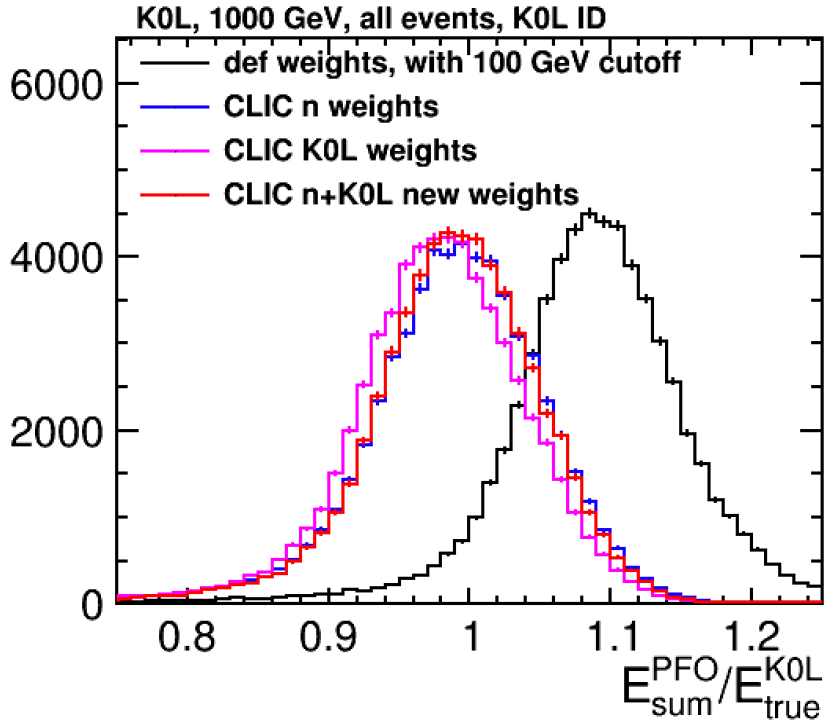


Black: ILD weights applied
Definitely a bad idea
→check behavior of SWC beyond training limit

Issue at high energies for previous n&K0L combined sample SWC weights



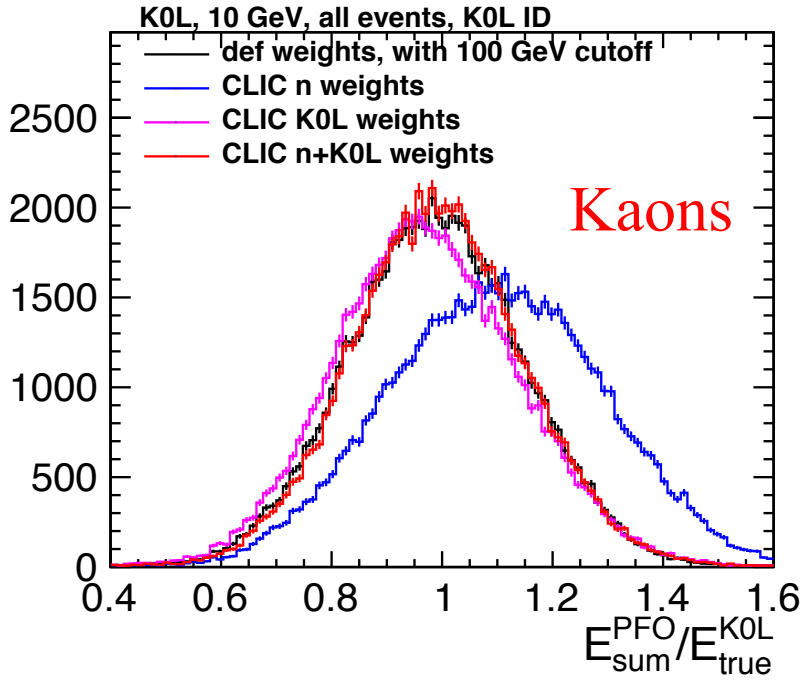
Tuned only up to 400 GeV neutral hadrons, works perfectly fine for 500 GeV hadron dataset, fails catastrophically for 1000 GeV hadrons

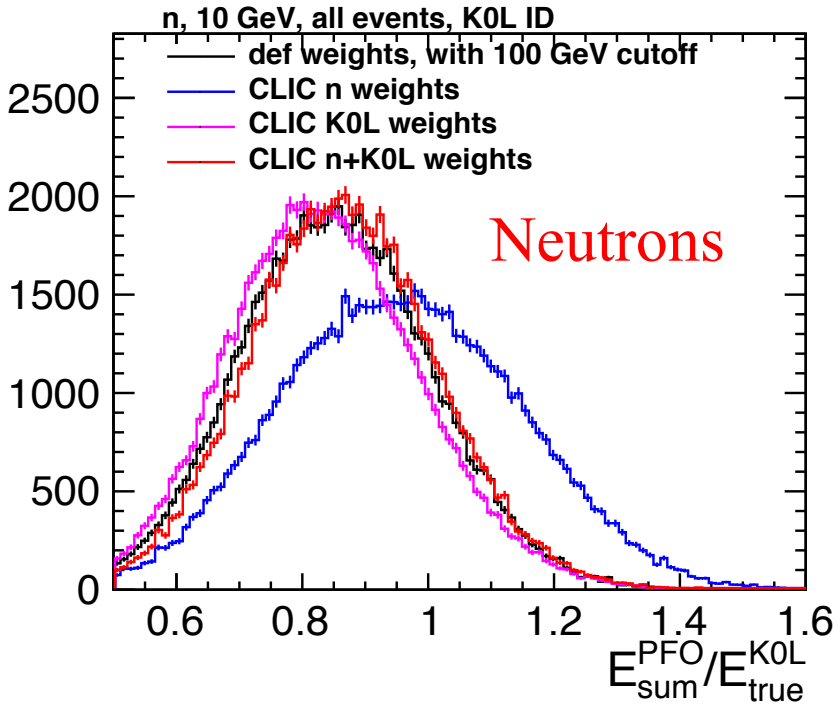


Considerable improvement using 1000 GeV sample for tuning

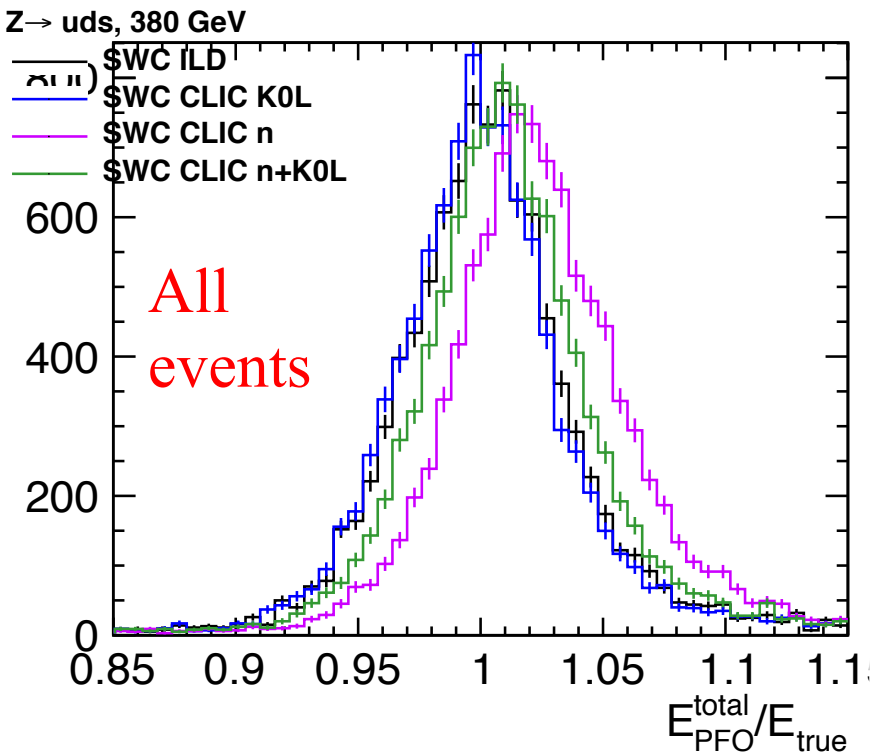
Single Hadron response closures: low energy Kaons and neutrons

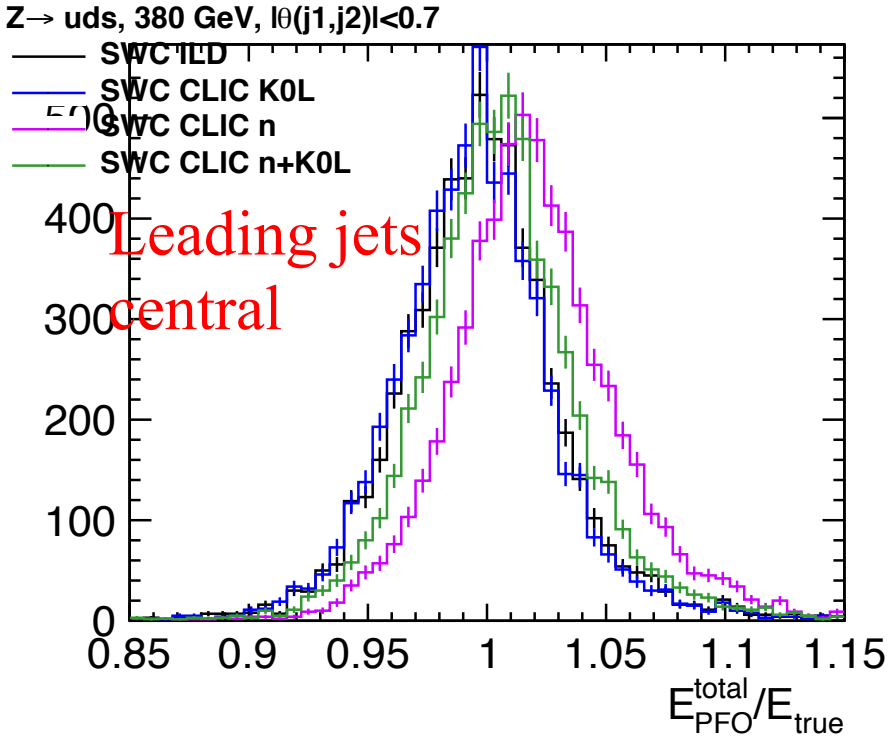
10 GeV Kaons and neutrons:
Kaon response mean around 1 besides for neutron weights
Neutron response mean the opposite: response only close to 1 for software compensation weights from neutrons (response difference between neutrons and Kaons expected)





Jet Energy Resolution
Z to u/d/s sample at 380 GeV

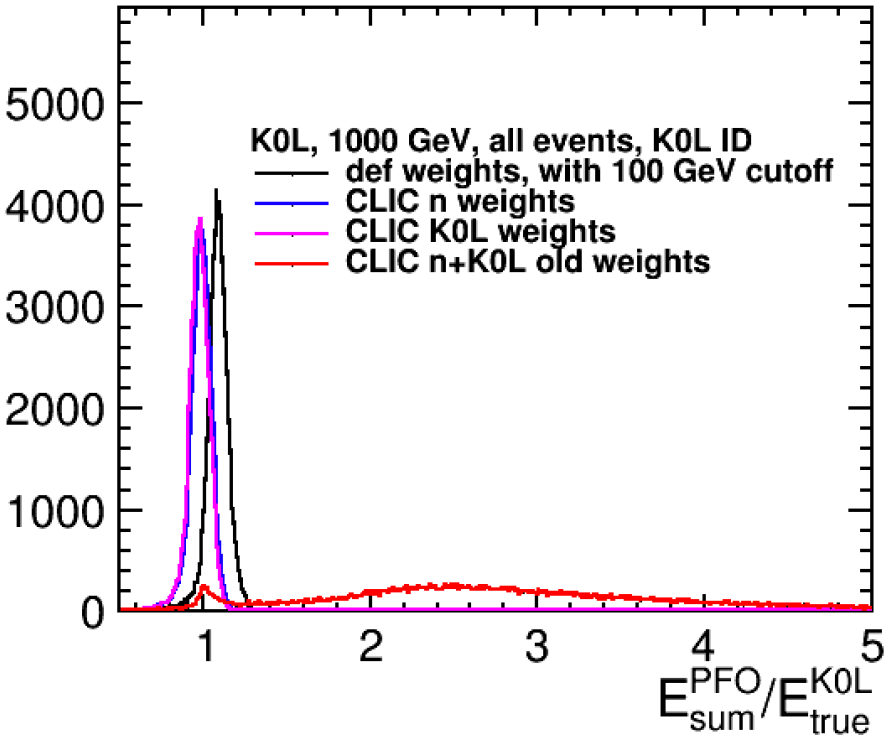




For neutron derived weights response larger than desired

mean/RMS ILD 1.00267/0.0383557
mean/RMS K0L 1.00055/0.0380975
mean/RMS n 1.02361/0.0381131
mean/RMS K0L+n 1.01078/0.0378763

Issue at high energies for n&K0L combined sample SWC weights



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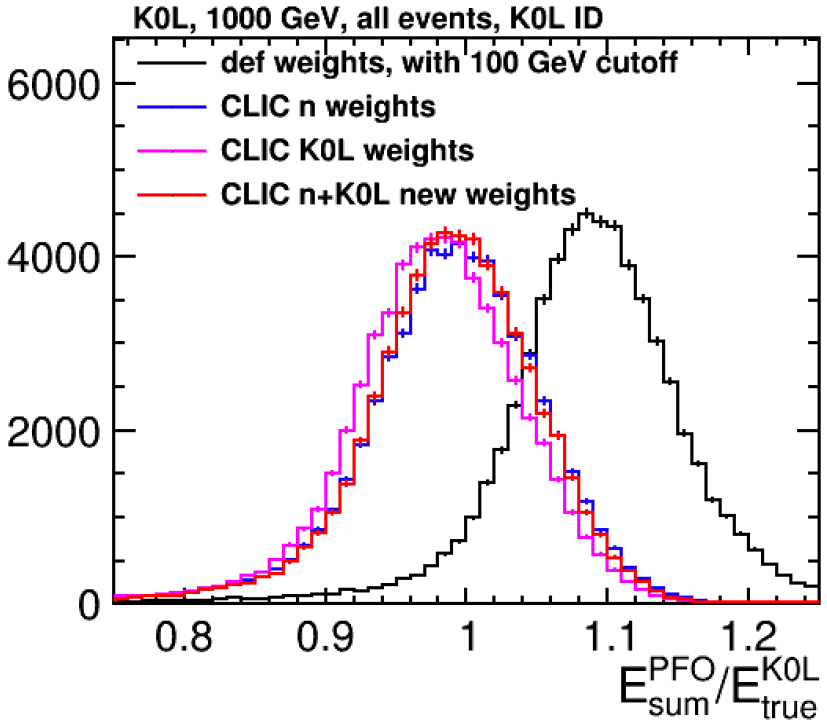
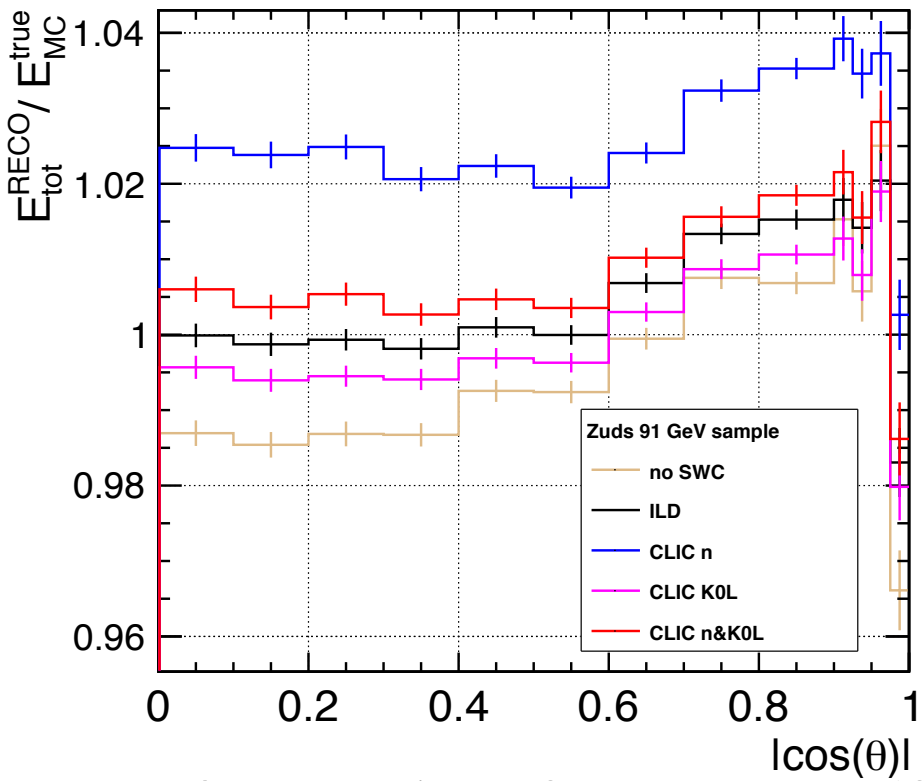
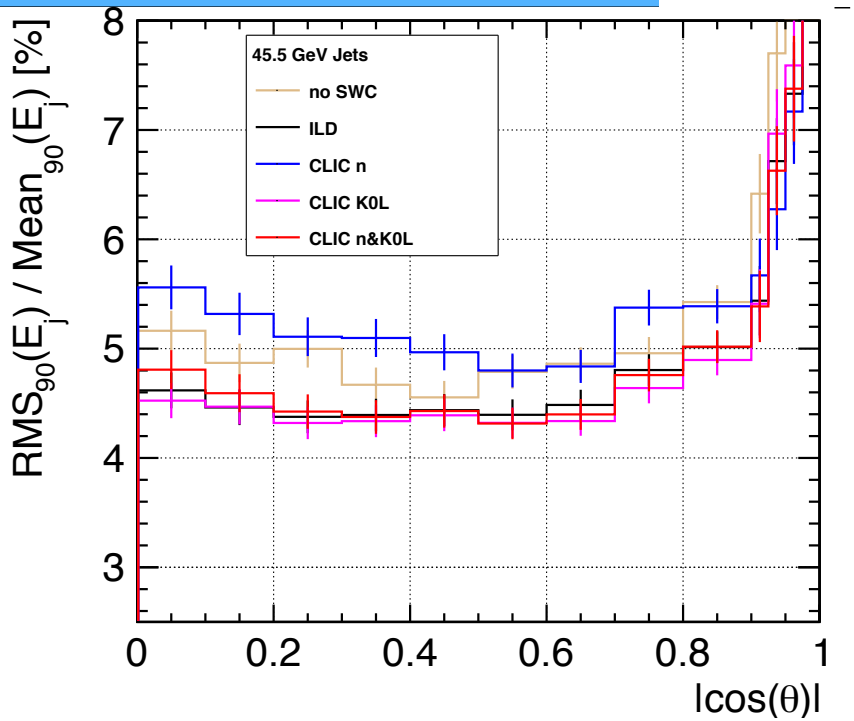


Considerable improvement using 1000 GeV sample for tuning

Jet Energy Resolution
Z to u/d/s sample at 91 GeV

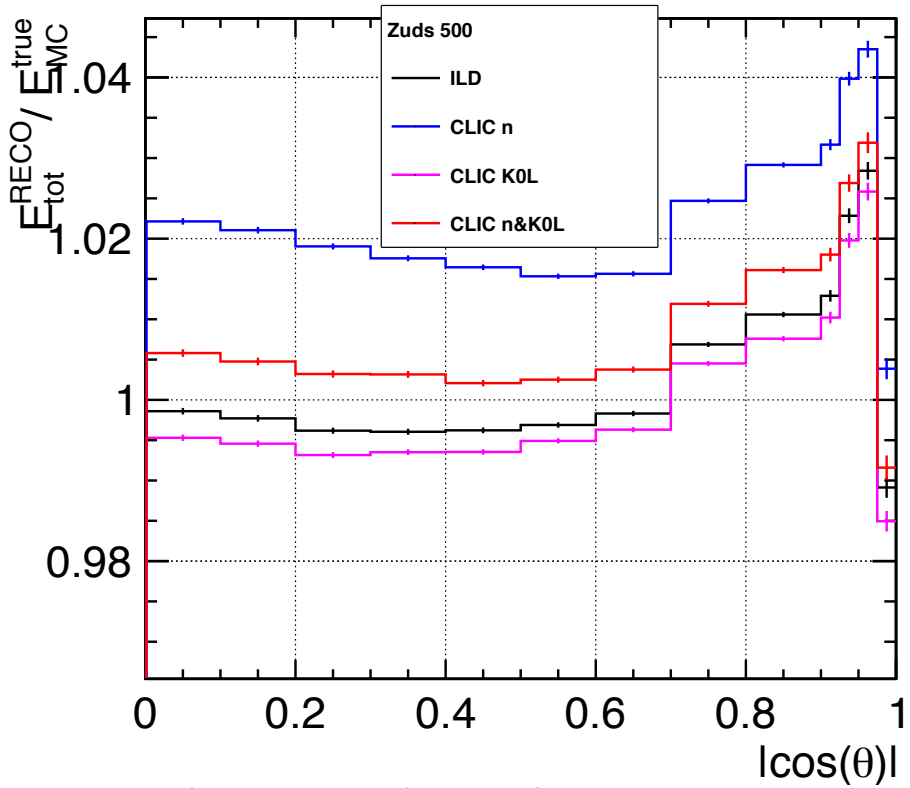


Mean of energy best for K0L case (for new weights), with neutron derived SWC mean slightly too high

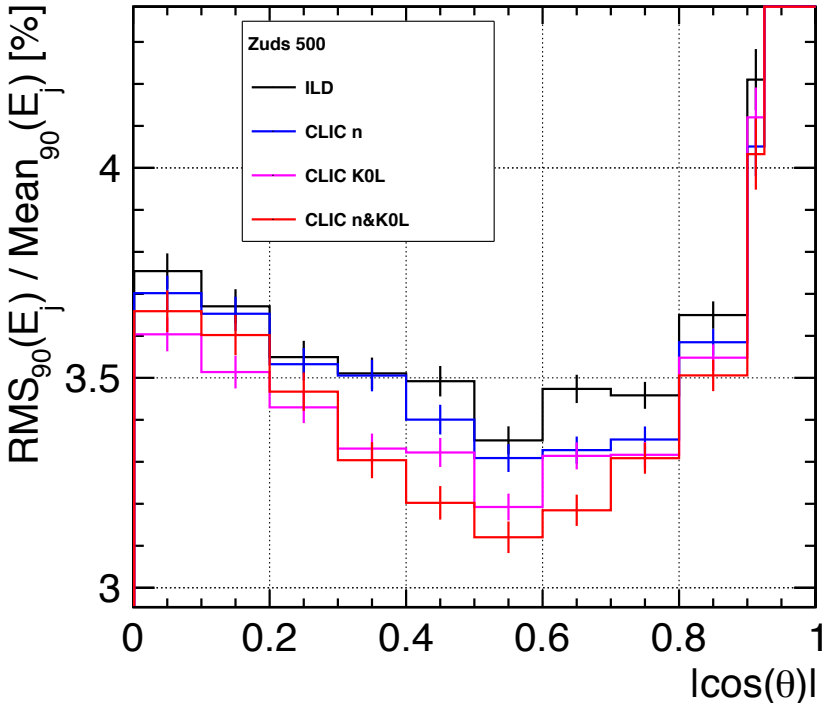


Compatible distribution in jet energy resolution compared to old SWC weights → new weights from n+K0L have been used

Jet Energy Resolution
Z to u/d/s sample at 500 GeV

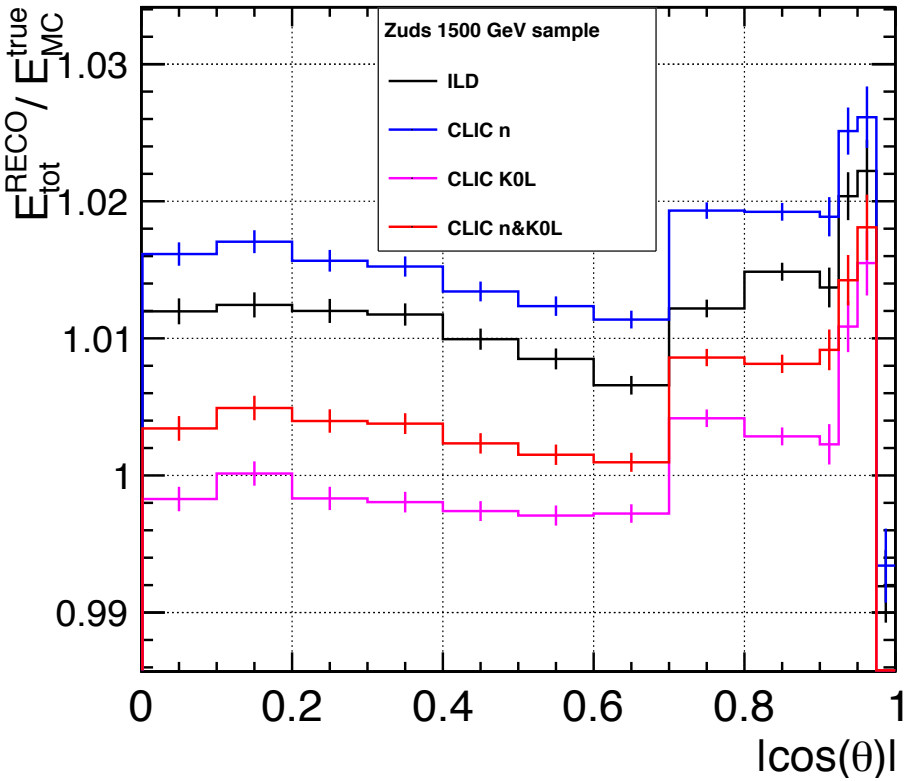


Mean of energy best for K0L case, with neutron derived SWC mean slightly too high

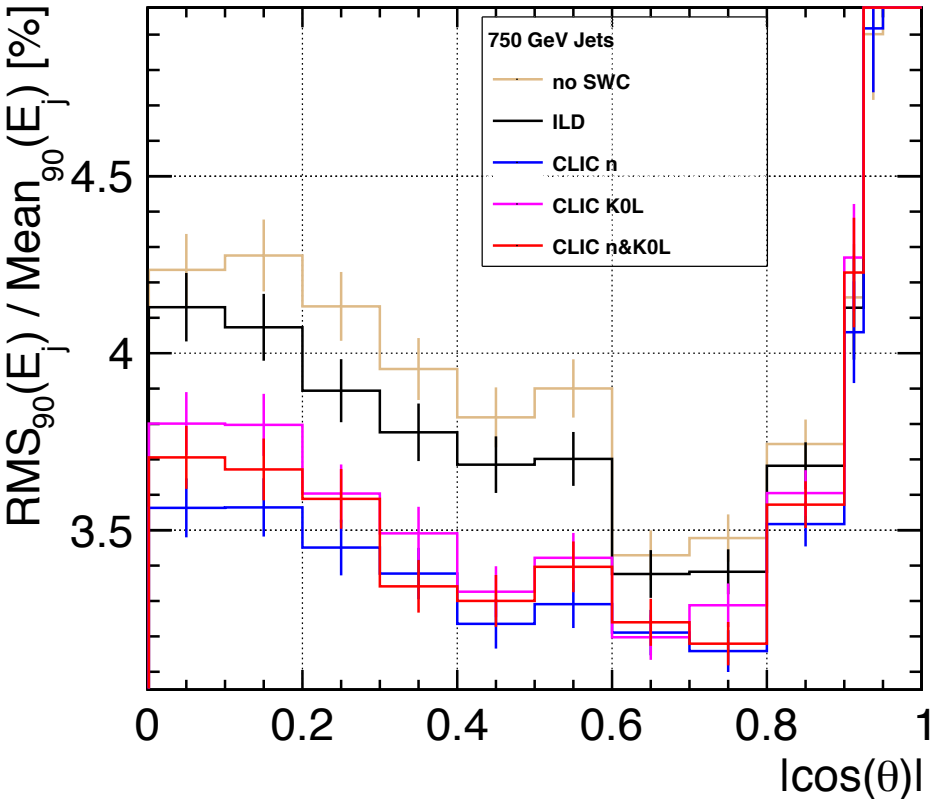


Considerable improvement in jet energy resolution compared to old SWC weights → new weights from n+K0L have been used

Jet Energy Resolution
Z to u/d/s sample at 1500 GeV

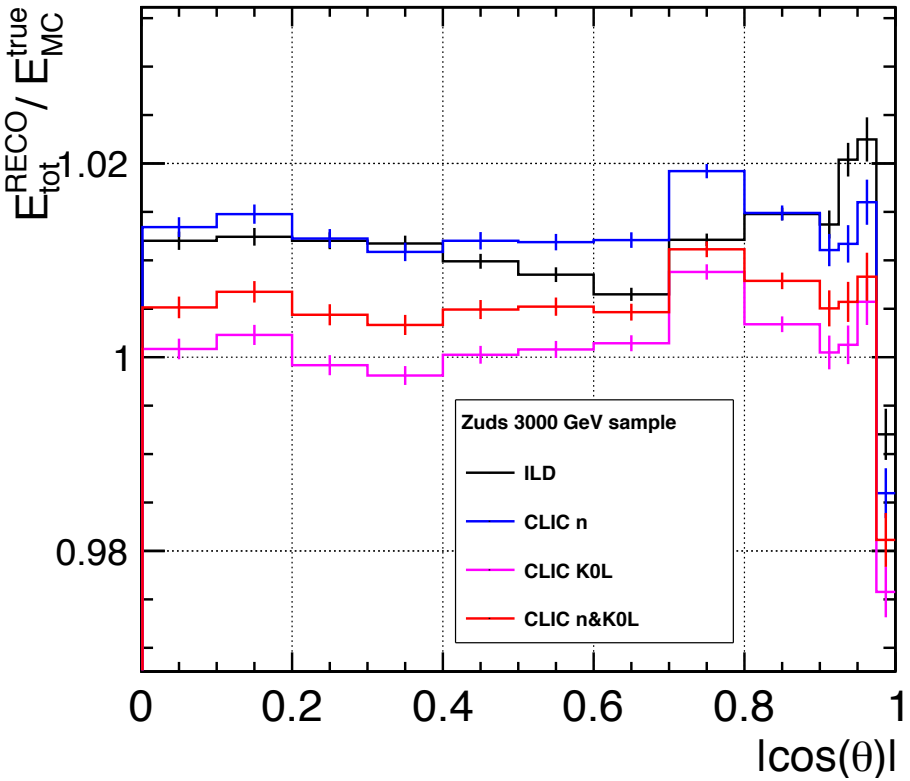


Considerable improvement in jet energy resolution compared to old SWC weights

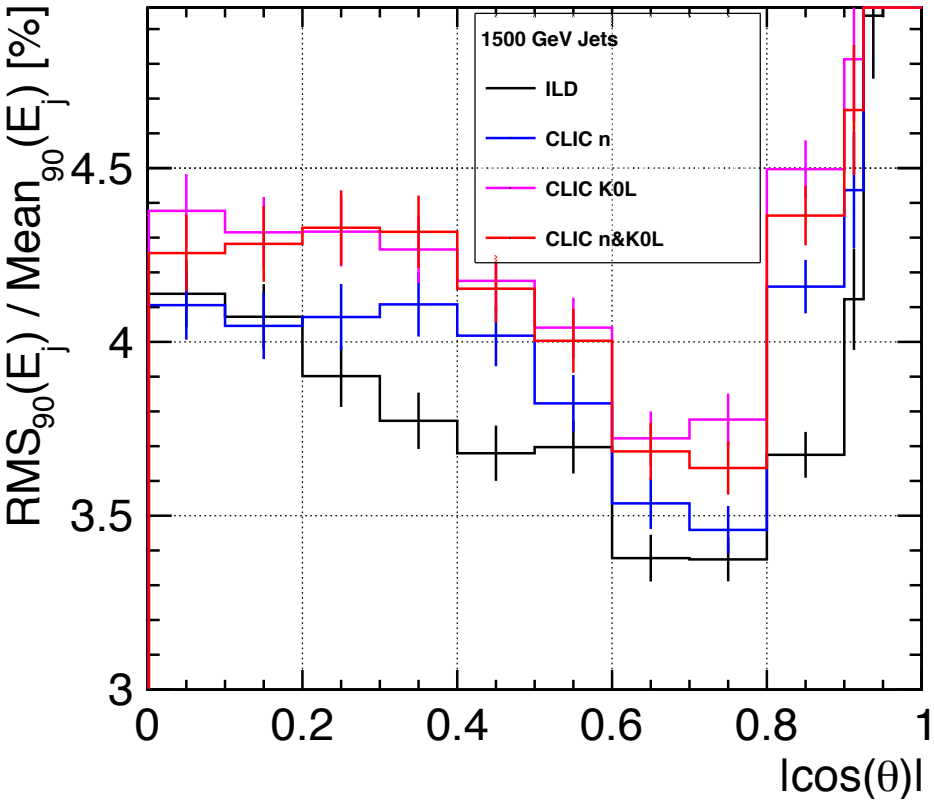


Considerable improvement in jet energy resolution compared to old SWC weights → new weights from n+K0L have been used

Jet Energy Resolution
Z to u/d/s sample at 3000 GeV

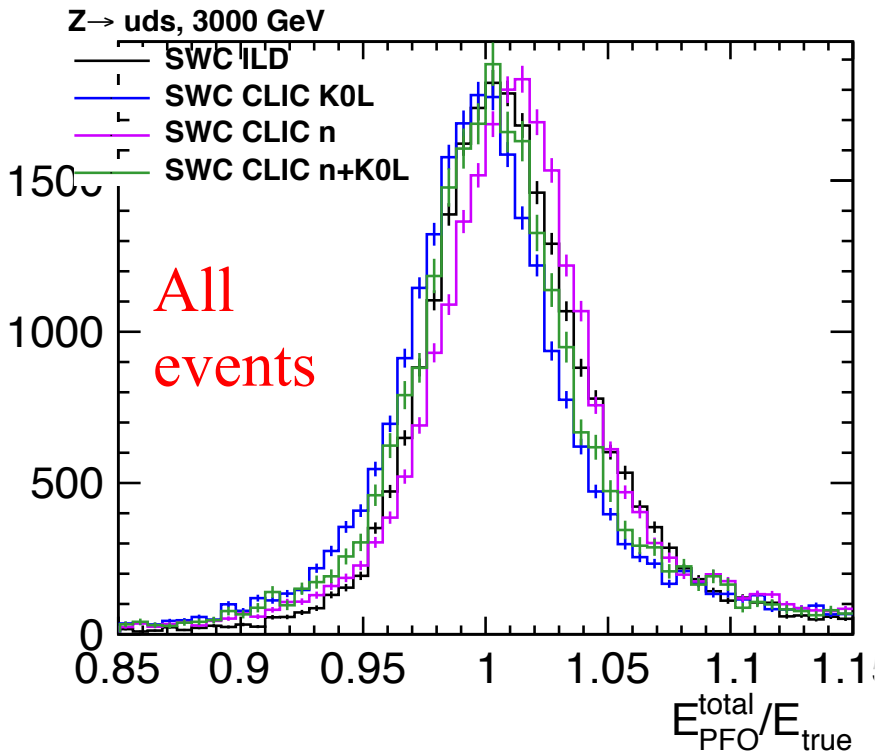


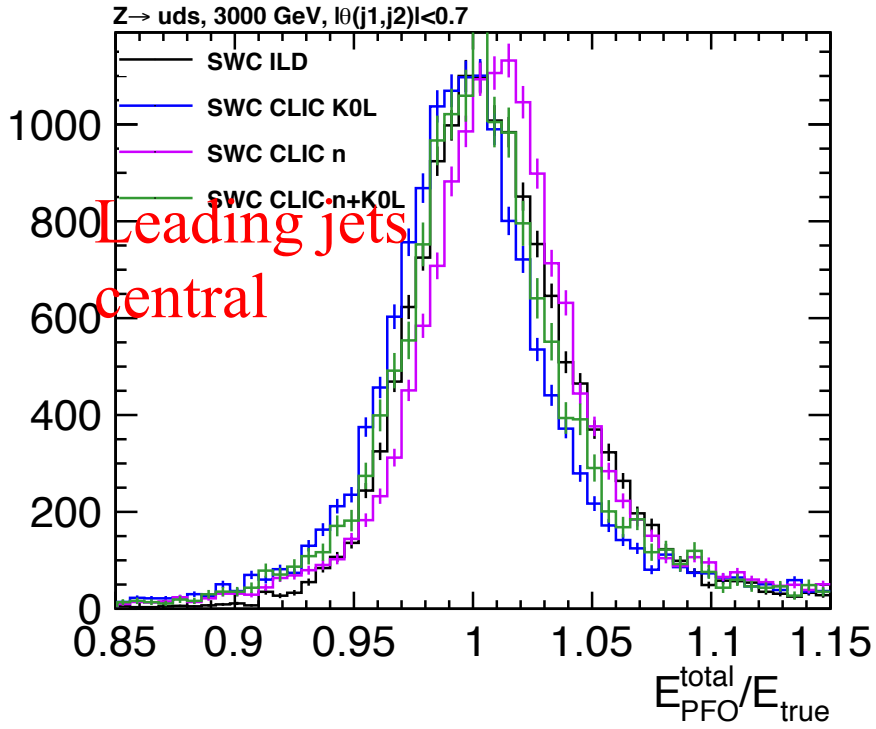
Considerable improvement in jet energy resolution compared to old SWC weights



Considerably worse performance → new weights drom n+K0L have been used

Jet Energy Resolution
Z to u/d/s sample at 3000 GeV



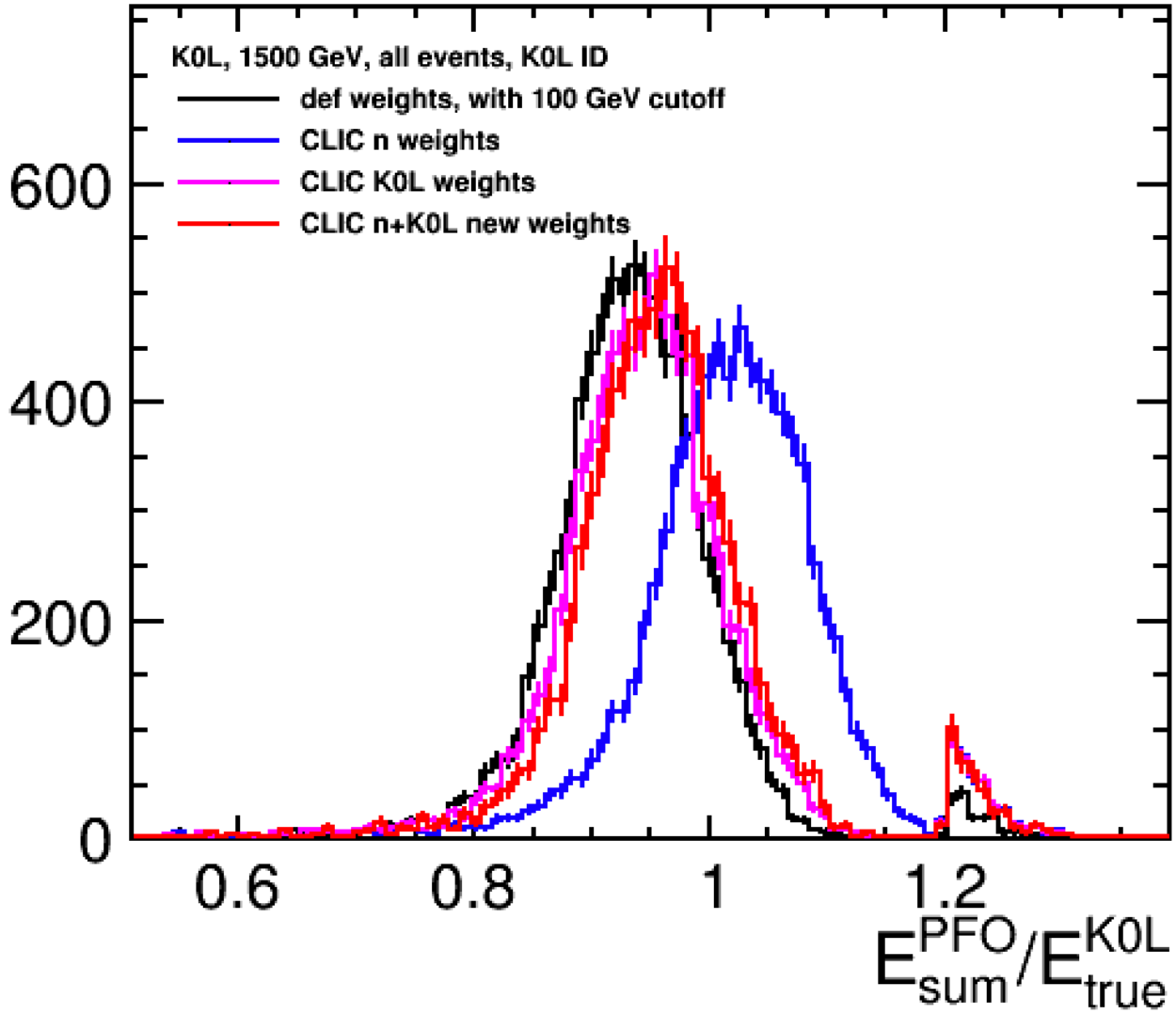


For neutron derived weights response larger than desired, slightly larger asymmetric tail to larger energies for ILD setting

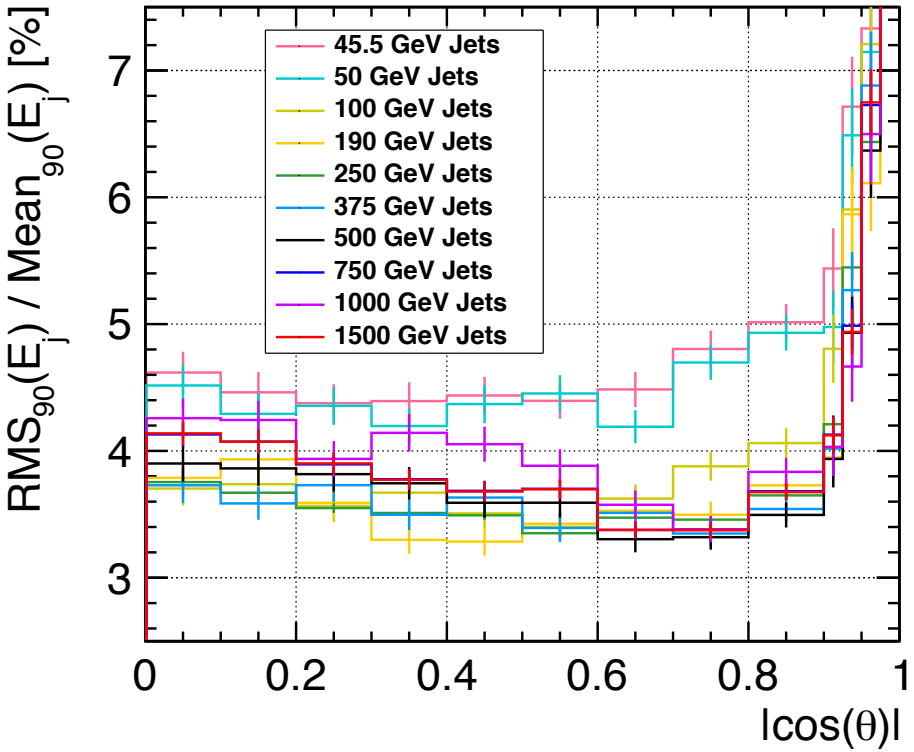
mean/RMS ILD 1.01003/0.0374649
mean/RMS K0L 1.00009/0.0423927
mean/RMS n 1.01214/0.0407749
mean/RMS K0L+n 1.00491/0.0414489

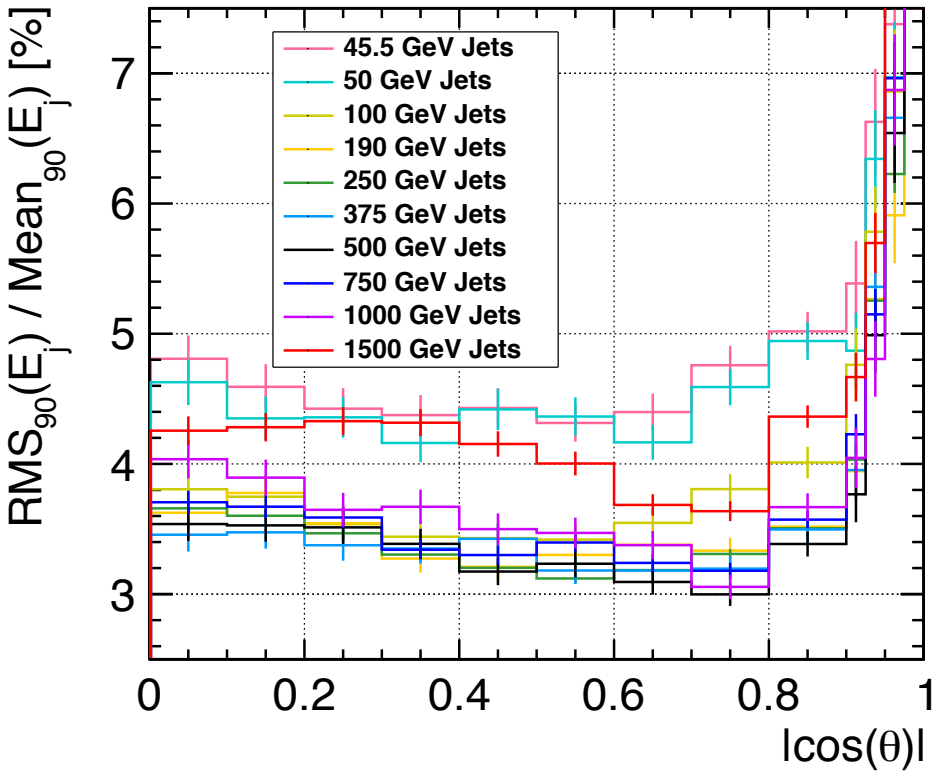
Problem with very high neutral hadrons
K0L at 1500 GeV

No issue observed



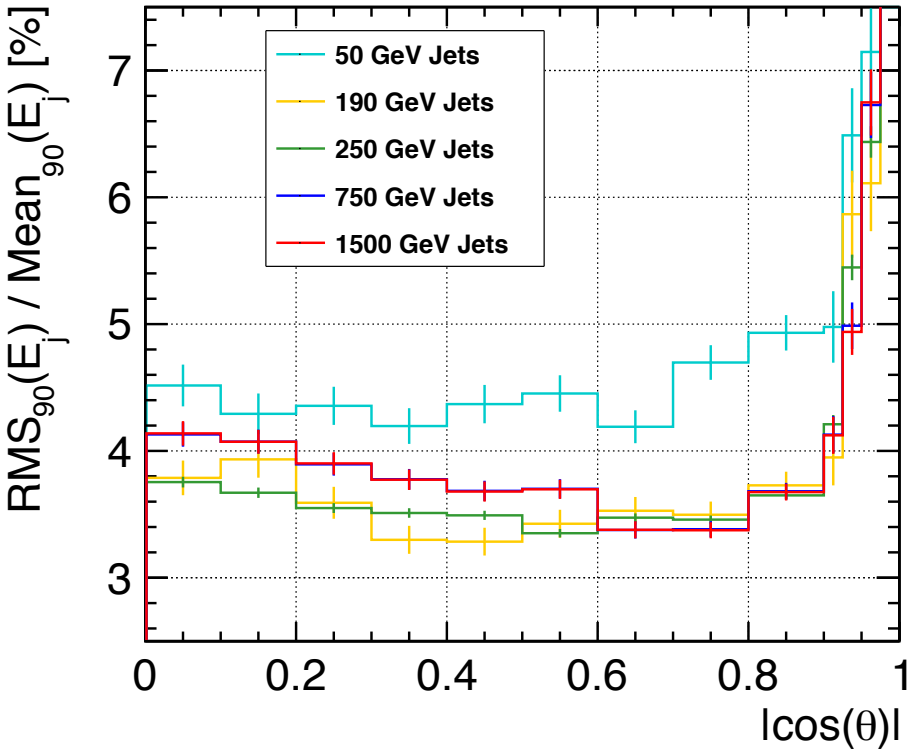
Jet Energy Resolution Summary

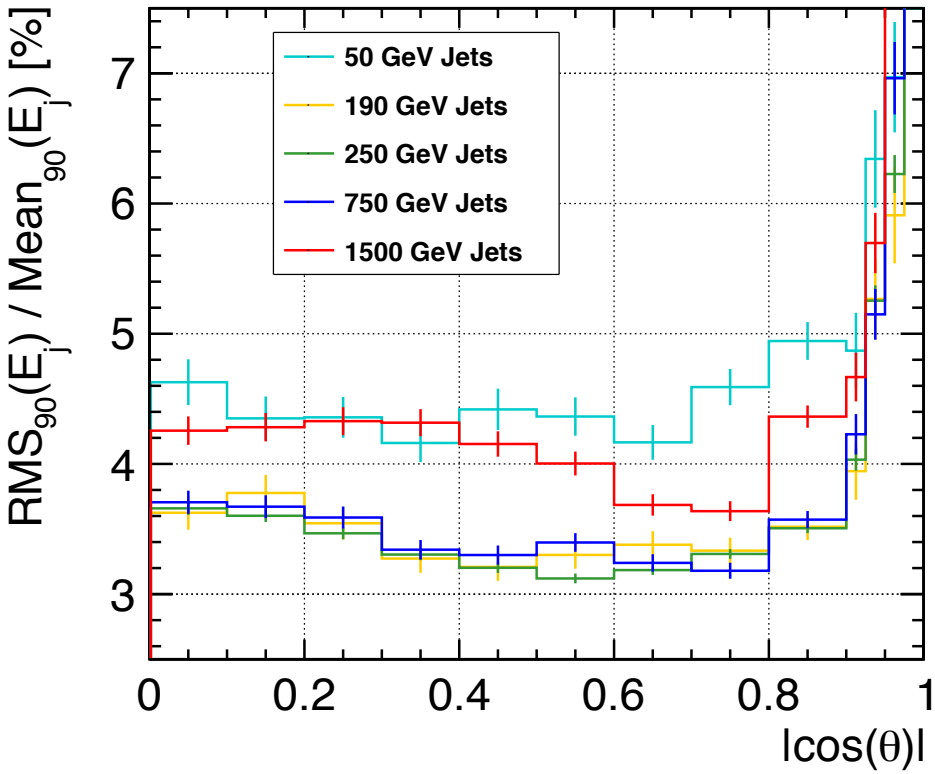




Improvement in jet energy resolution compared to old SWC weights for all energies, besides the very highest

Jet Energy Resolution
Summary Reduced





Improvement in jet energy resolution compared to old SWC weights for all energies, besides the very highest