PandoraPFA:
Software Compensation

Matthias Weber (CERN)

First training of SoftwareCompensation
With model CLIC_o3_v13

Samples used

Produce single particle gun samples of neutrons and K0L's separately, for each point simulate and reconstruct 80000 events
Use for reconstruction of samples the PandoraSettingsSoftwareCompensationTraining script

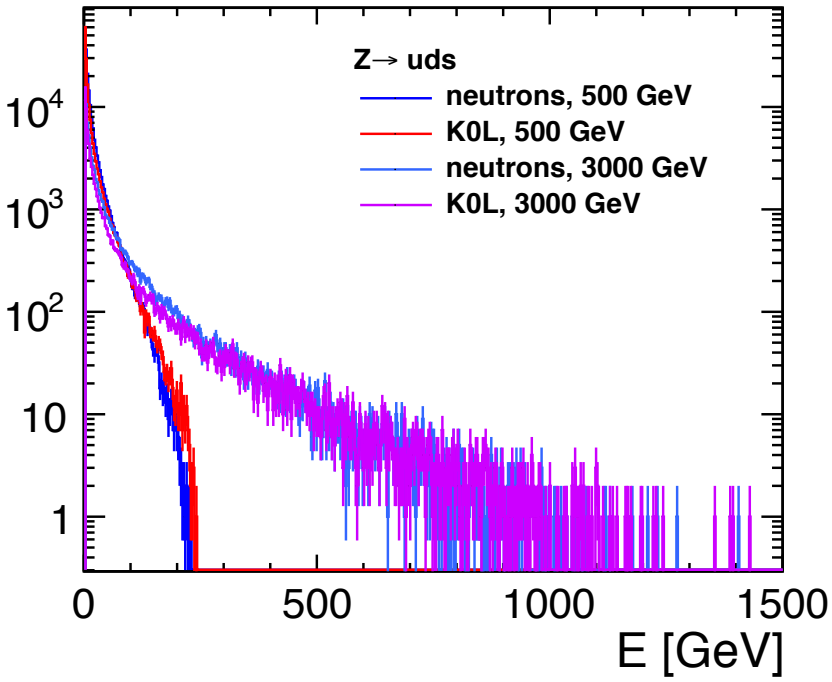
Then run with latest HEAD version of LCContent (i.e. after PR including the variables for Cleaning Clusters into the TrainingTree).
→Then run **PandoraPFACalibrate_SoftwareCompensation** script in PandoraAnalysis/calibration

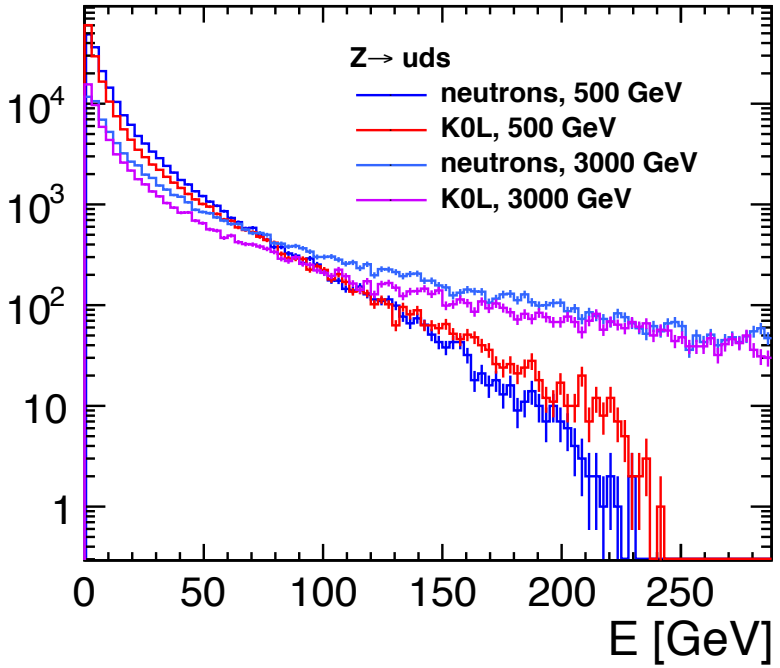
Energy points at 2,5,10,20,30,40,50,60,75,90,100,150,200,250,400,500,1000,1500 GeV

→weights have large fractional uncertainties, calculated using the full covariance matrix

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

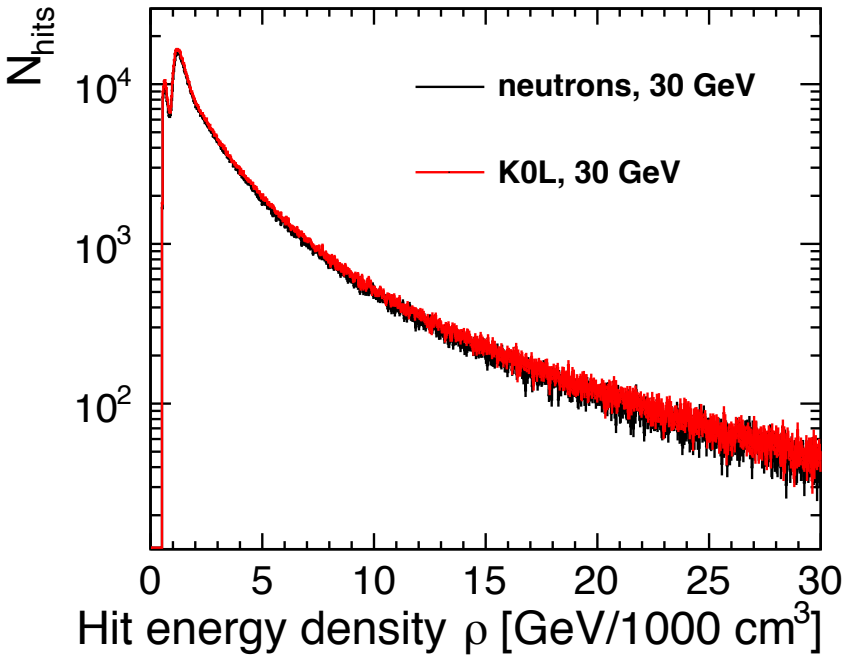
For 500 GeV dataset neutral hadron energies beyond 90 GeV are 1.9 %, for 3000 dataset 13.7 % → if we want same coverage of neutral hadron energy spectrum need to calculate weights for samples up to 400 GeV (1.7 % beyond that point for 3000 GeV sample)

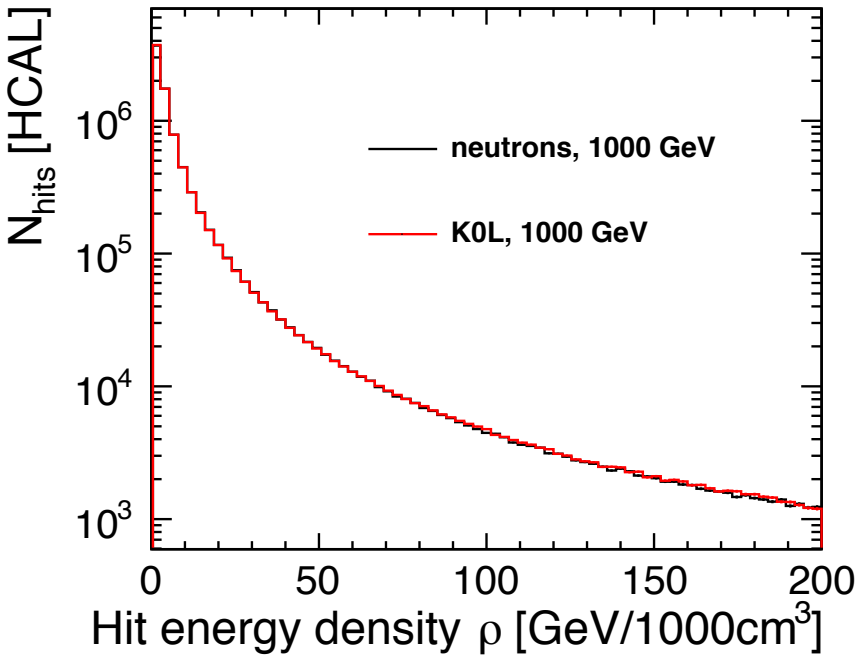




Check on hit energy densities for very high K0L

So far did not yet change the binning of weights, maybe should extend weights to densities of 100/150 GeV/dm^3





The energy of calorimeter clusters are computed as:

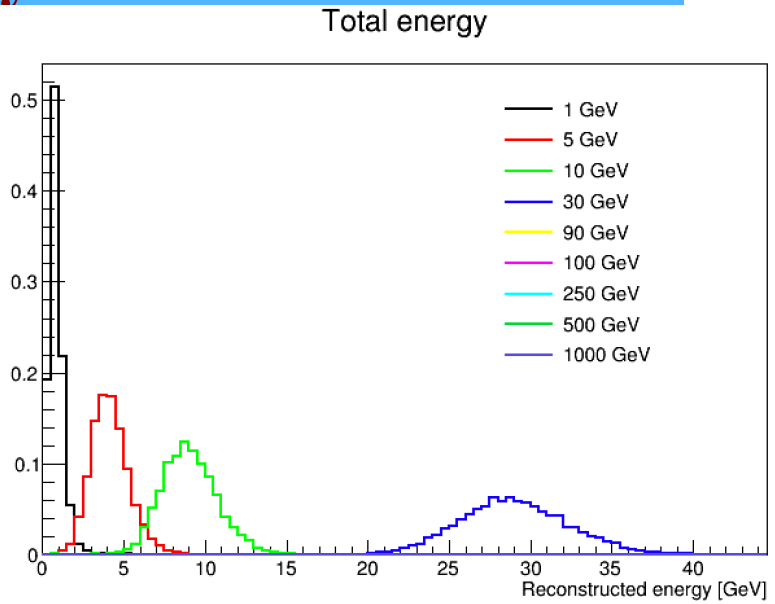
$$E_{SC} = \sum_{hits} E_{ECAL} + \sum_{bin\ i} (E^i_{HCAL} \times \omega(\rho_i))$$

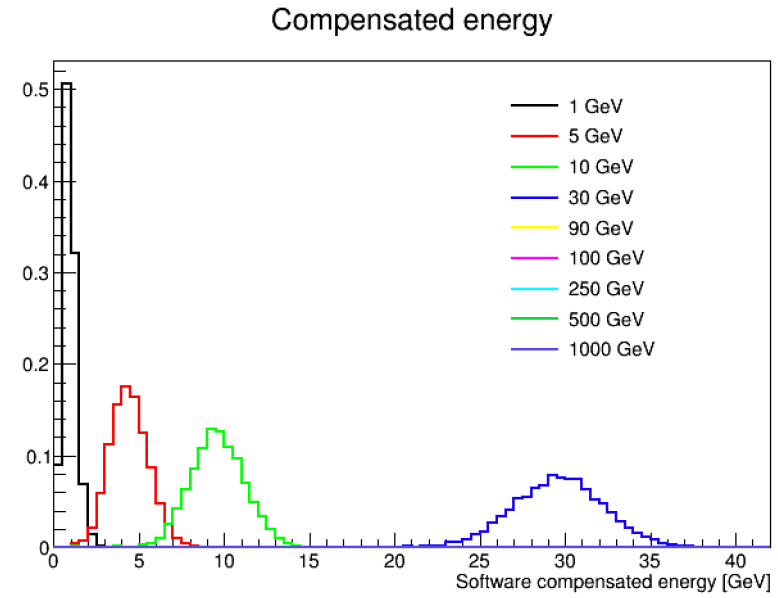
with $E^i_{HCAL} = \sum_{hits \in bin\ i} E_{hit}$,

$$\omega(\rho) = p_1 \exp(p_2 \rho) + p_3$$

Results: K0L: self closure
mean and RMS of energy before and after

BEFORE
mean/RMS/E 0.862322/0.452165 1 GeV
mean/RMS/E 4.18601/1.19816 5 GeV
mean/RMS/E 9.05221/1.76954 10 GeV
mean/RMS/E 28.9913/3.60439 30 GeV
mean/RMS/E 92.5591/8.25645 90 GeV
mean/RMS/E 103.289/8.57889 100 GeV
mean/RMS/E 269.263/20.1762 250 GeV
mean/RMS/E 555.373/34.1561 500 GeV
mean/RMS/E 1122.46/59.079 1000 GeV
AFTER
mean/RMS/truenenergy 0.960838/0.384253 1 GeV
mean/RMS/truenenergy 4.44121/1.13428 5 GeV
mean/RMS/truenenergy 9.60939/1.64482 10 GeV
mean/RMS/truenenergy 29.5613/2.89539 30 GeV
mean/RMS/truenenergy 90.3259/6.03734 90 GeV
mean/RMS/truenenergy 100.669/6.1958 100 GeV
mean/RMS/truenenergy 249.886/14.7526 250 GeV
mean/RMS/truenenergy 505.67/25.5292 500 GeV
mean/RMS/truenenergy 995.967/54.3942 1000 GeV





Default vs CLIC Software compensation

Default: apply software compensation for hadron energies up to 100 GeV, extend the range to all hadrons (i.e. as value give 1800 GeV)
Weight applied as function of hit energy density:
Default binning: 0 2 5 7.5 9.5 13 16 20 23.5 28, last bin set to 30 (overflow bin set to 30 GeV/dm^3 for reweighting)

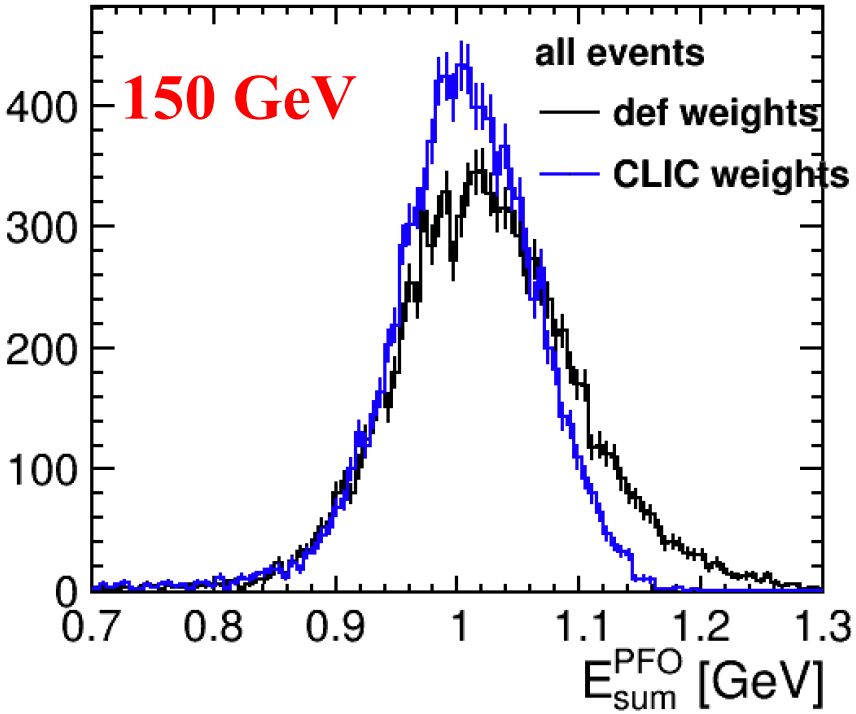
NEW CLIC binning (lower binning identical):
28 33 40 50 75 100, last bin set to 200

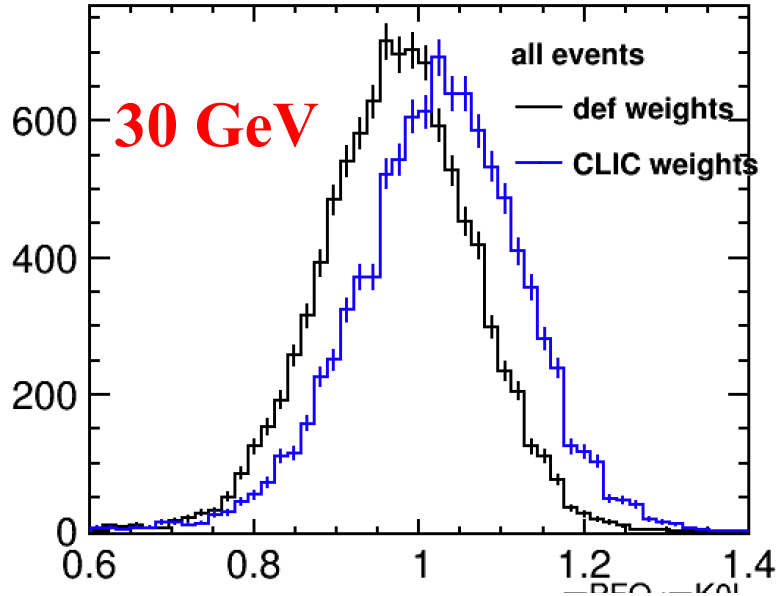
→weights are separately very different, default weight energy dependence leads to an almost constant reweighting at high energies for various hit energy densities

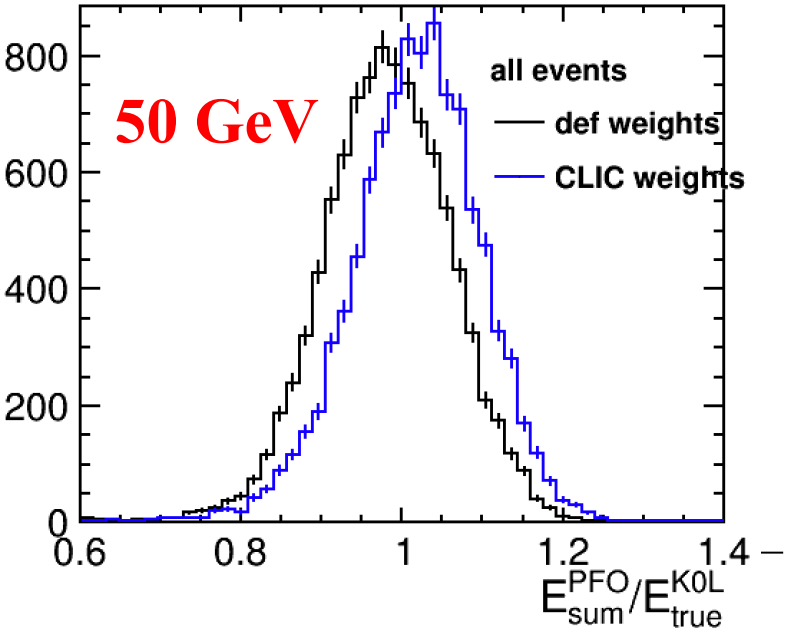
Previously for a 200 GeV neutron reweighting is 0.752 for 3 GeV/dm^3 hit as well as for 30 GeV/dm^3

Now for 200 GeV neutron weight for 3 GeV/dm^3 is 0.989 and for 30 GeV/dm^3 it is 0.788

Apply new weights derived from neutrons on single K0L events







Significant improvement (default weight not applied) → limit 100 GeV

Weights are applied and derived at those energies now

For lower energies similar width, but mean off →recalibrate?