Energy scale from isolated tracks and di-jets

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- *Isolated hadron tracks (region covered by tracker)*

- *Di-jet events (region without tracker)*

Requirements to HCAL calibration

- *simple algorithms, allowing to produce calibration with minimum of data*
- *stable to the variation of event selection criteria*
- *stability in time*

such calibration can't be universal (e.g. it can't take into account energy dependence of HCAL response)

more elaborate calibrations (like jet energy calibration, MET calibration etc) should be applied on top of the basic calibration

Isolated tracks

Isolation on the calorimeter surface is required

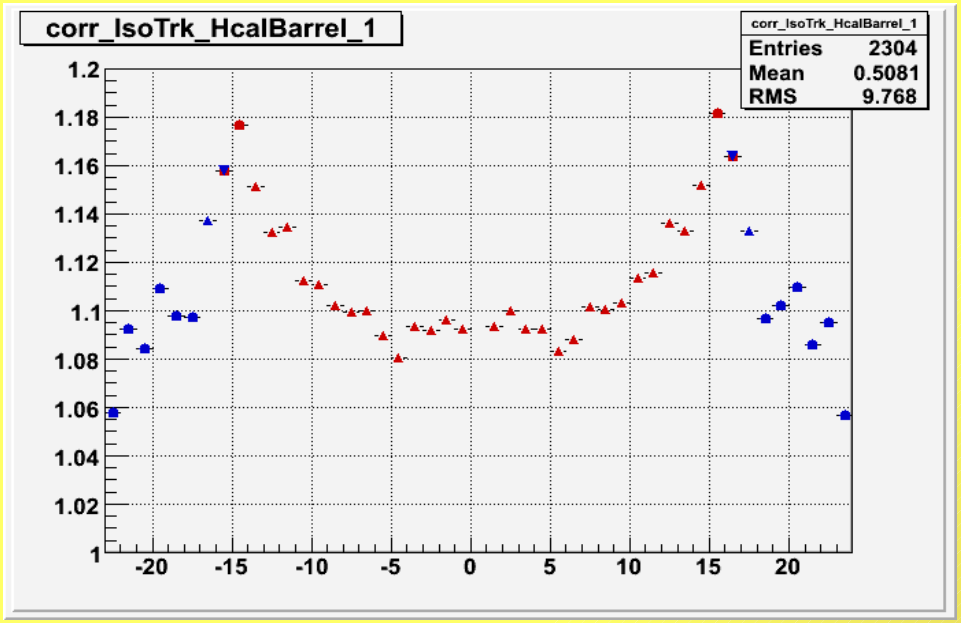
Selection criteria:

- *no other tracks (with p>2 GeV) within 40 cm*
- $|\eta|<2.1$ *tracks (HCAL towers:* $|i_\eta<24|$*, current HLT is for* $|\eta|<2.0$*)*
- *energy in ECAL is less than 1 GeV*
- *E_within_70cm – E_cone_0.1 < 8 GeV*
- *HCAL energy is reconstructed in 3x3 tower array*

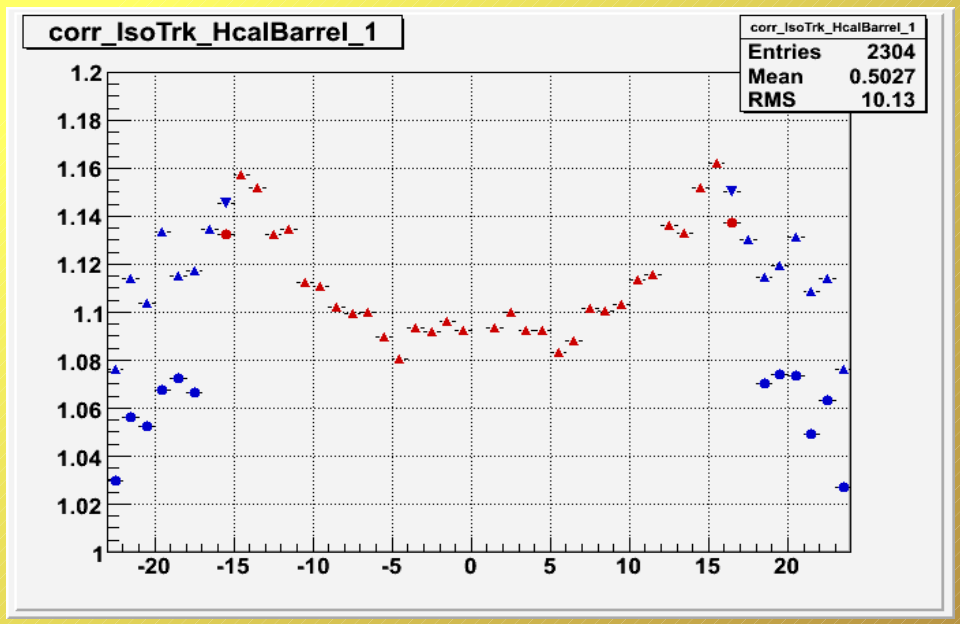
For the calibration exercise 50 GeV π-mesons were used
10.5 mln. events were initially generated, 2.8 mln. left for calibration after all selection criteria were applied

Isolated tracks

correction factors with all depths summed



correction factors with depths separate in HE

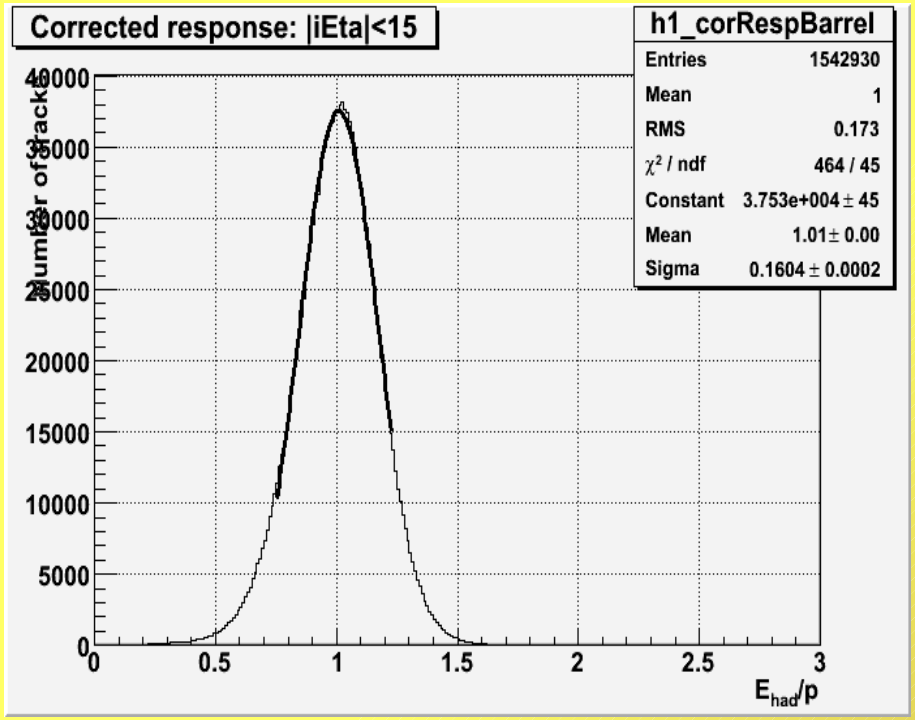


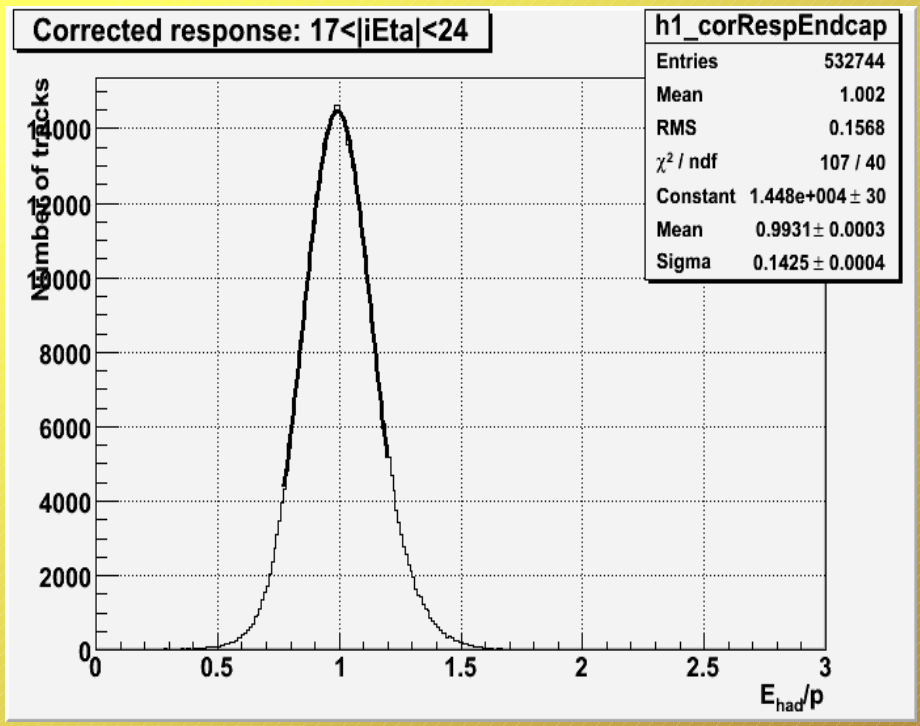
The eta dependence of the correction factors reflects the material effects.

triangles show calibration for depth 1

circles show calibration for depth 2

Isolated tracks

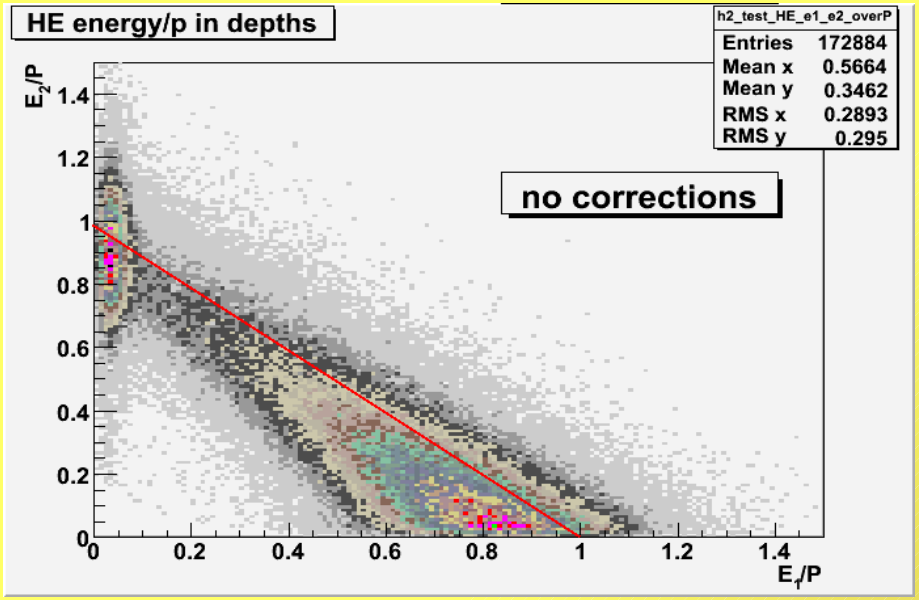


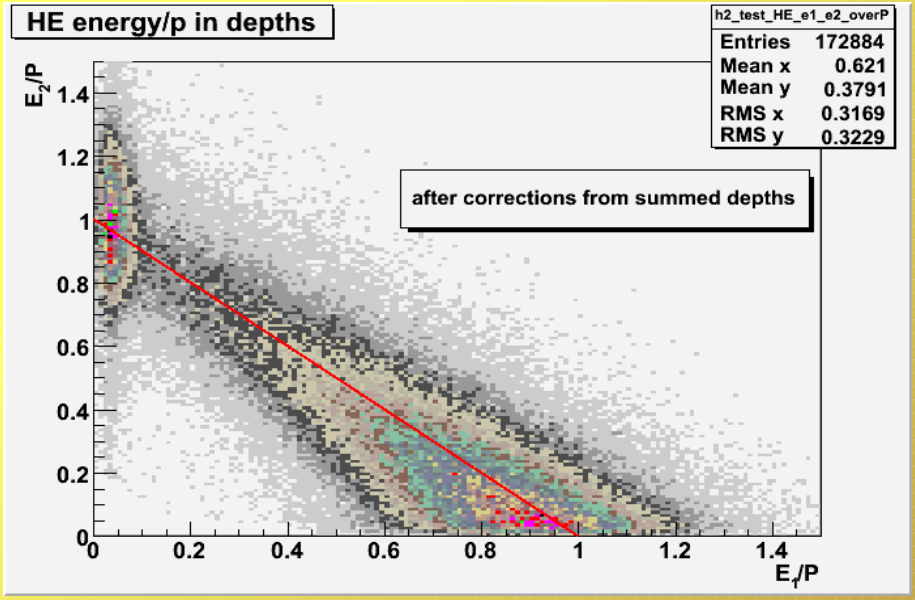


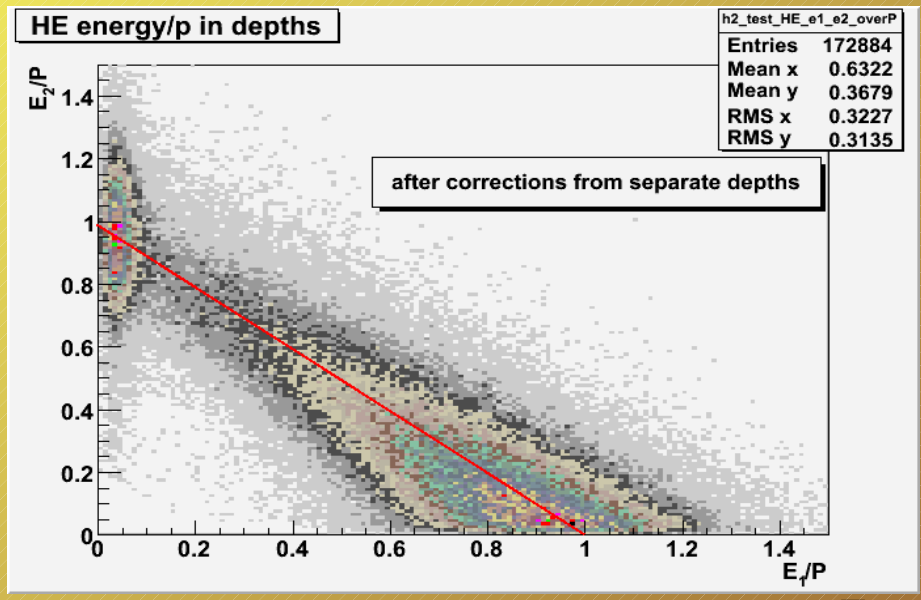
Shape of HCAL response to 50 GeV pions after applying the corrections in HB and HE (E_{EM}<1 GeV)

Isolated Tracks

distribution of relative contributions in different depths (normalized to track momentum)







Using separate depths seems to produce more symmetrical distribution:
need further studies.

In the following the results from summed depths are used.

Di-Jet Calibration

Selection criteria:

- $|\eta_{J1}| < 0.9$, $Et_{J1} > 30$ GeV, $|\eta_{J2}| > 1.5$
- $|\varphi_{J1} - \varphi_{J2}| > 150^0$
- $Et_{J3} < 5$ GeV
- $EE/(EE + HE + HF) < 0.1$

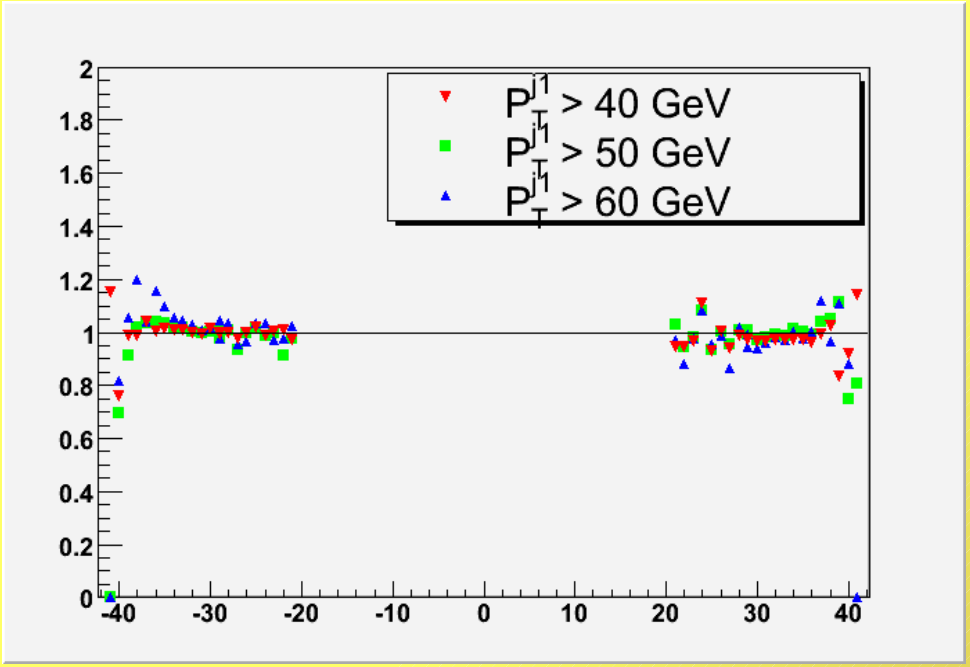
From $Et_{J1} \sim Et_{J2} \Rightarrow E_{J2}$ ***is estimated***

the calibration from isotracks and dijets are adjusted in the intermediate region (i_eta = 21, 22, 23)

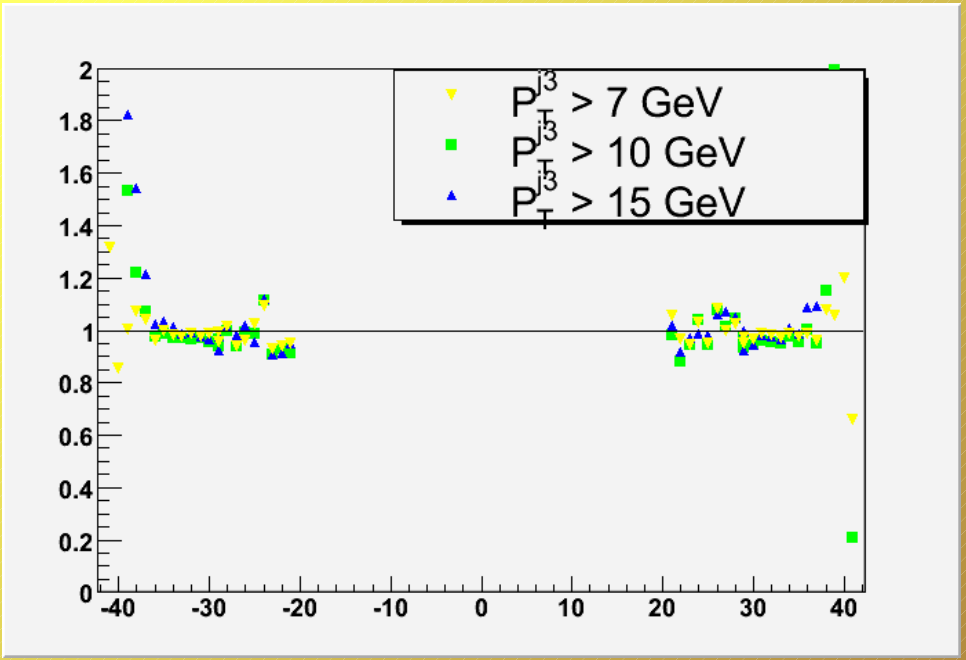
For the calibration exercise 4 mln dijet events were used, CSA08, CMSSW_2_0_7

Di-Jet Calibration

Ratios of calibrations derived using various selection relative to the default selection (described on the previous slide)



ratios of corrections for different Pt cuts on the central jet

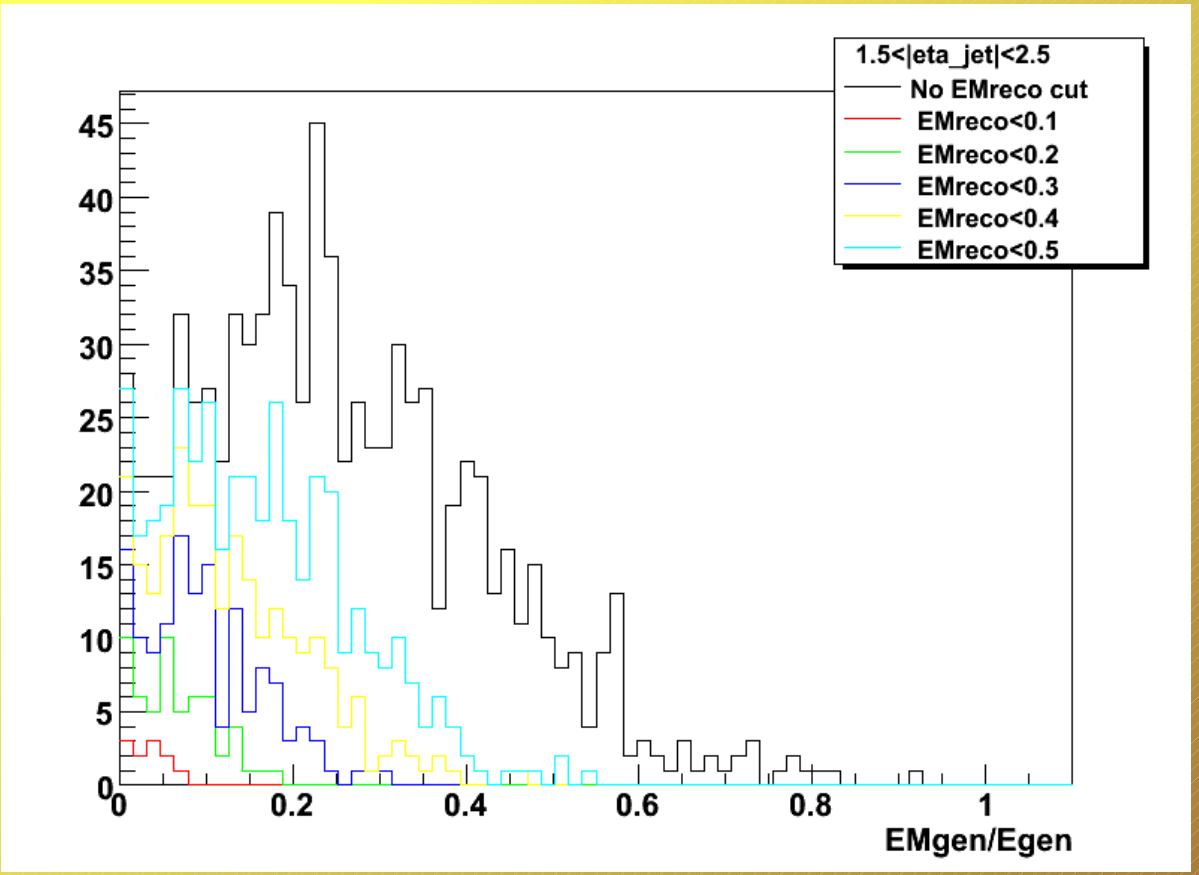


Ratios of corrections for different Pt cuts on the third (veto) jet

Di-Jet Calibration

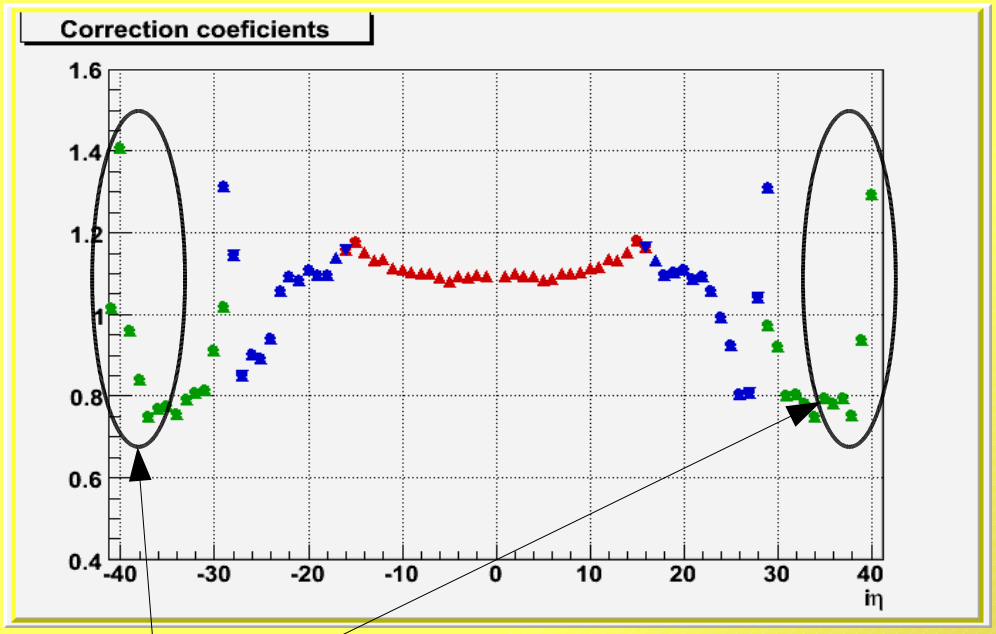
fractional contribution to jet energy from EM particles (generator level) for several cuts on the reconstructed EM / (EM+HE+HF).

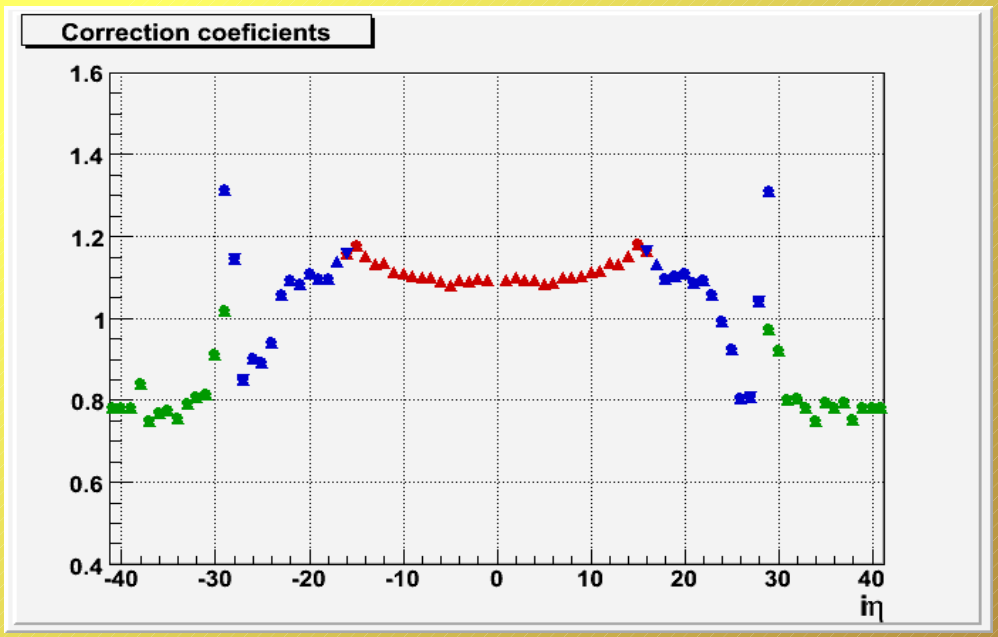
We apply the EM fraction cut to select jets consisting mostly of HAD particles.



Di-Jet Calibration

calibration coefficients in the whole eta range of HCAL from the isotracks and di-jets combined





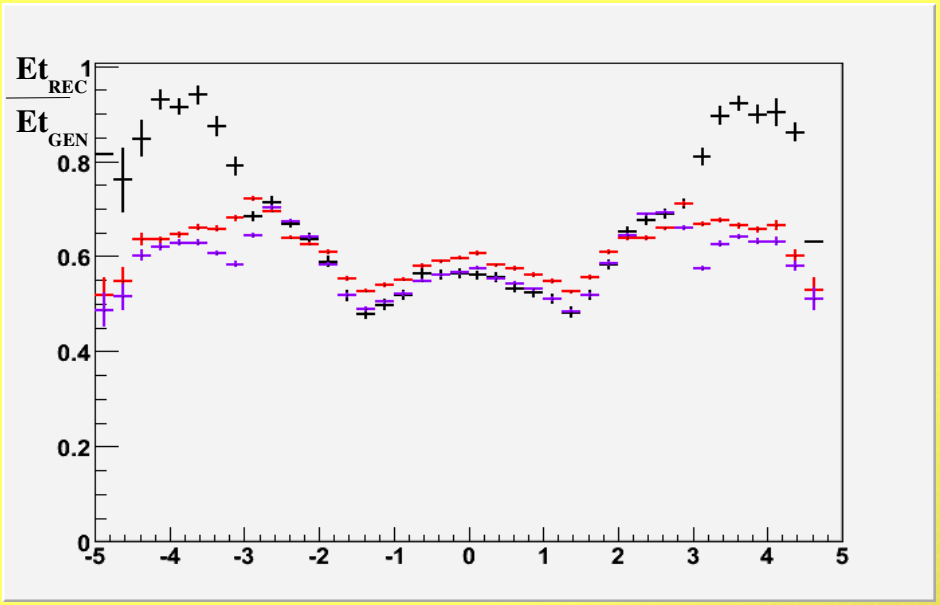
these points come from the leakages of jets outside the HF

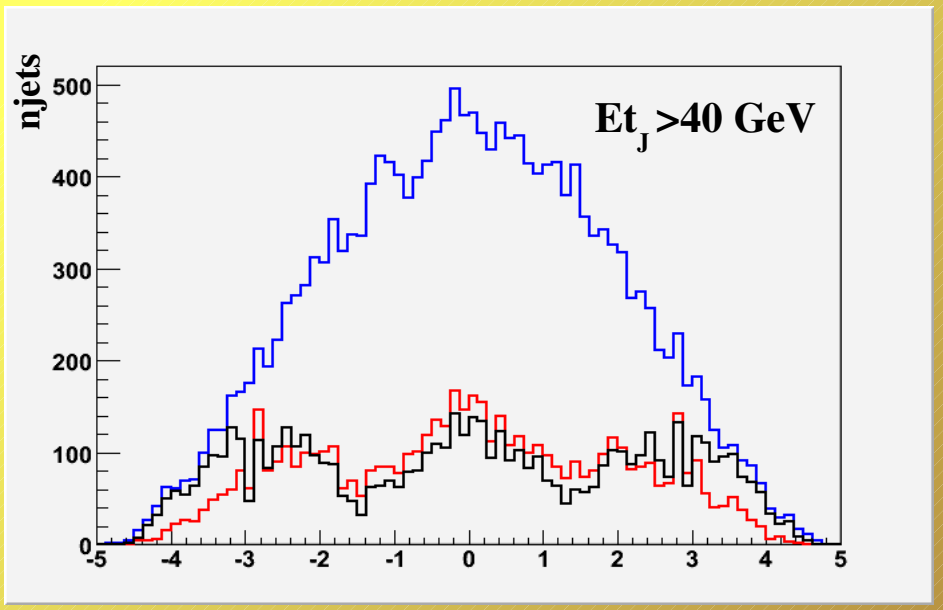
The treatment of leakage effects presents a challenge and has to be worked on.

For the validation we set the correction coefficients in the last 3 iEta rings to the average of their neighbors

Di-Jet Calibration

CMSSW_2_1_10 RelValQCD_Pt_50_80 (factor 0.7 in HF)





black – uncorrected (without factor 0.7)
red – corrected (without factor 0.7), corrections are derived with CSA08 samples
blue – uncorrected (with factor 0.7)

black – uncorrected jets (witout factor 0.7)
red – corrected jets (without factor 0.7), corrections are derived with CSA08 samples
blue – generated jet

Summary

- *Isolated tracks and di-jets are used to calibrate the whole HCAL*
- *These methods provide simplicity and are stable to variation of the selection criteria*
- *The response in transitional regions (HB/HE and HE/HF) is smooth for the used energy range*
- *These methods allow production of calibration constants with early data (collected in about one week)*