A first look to SPS TB data

Giacomo Polesello
INFN, Sezione di Pavia
On behalf of the Pavia group

(Many thanks to Gabriella, Romualdo, Edoardo and Iacopo
For discussions and suggestions)

Introduction

Starting exercise on SPS 2012 data:

Work on auxiliary detctors

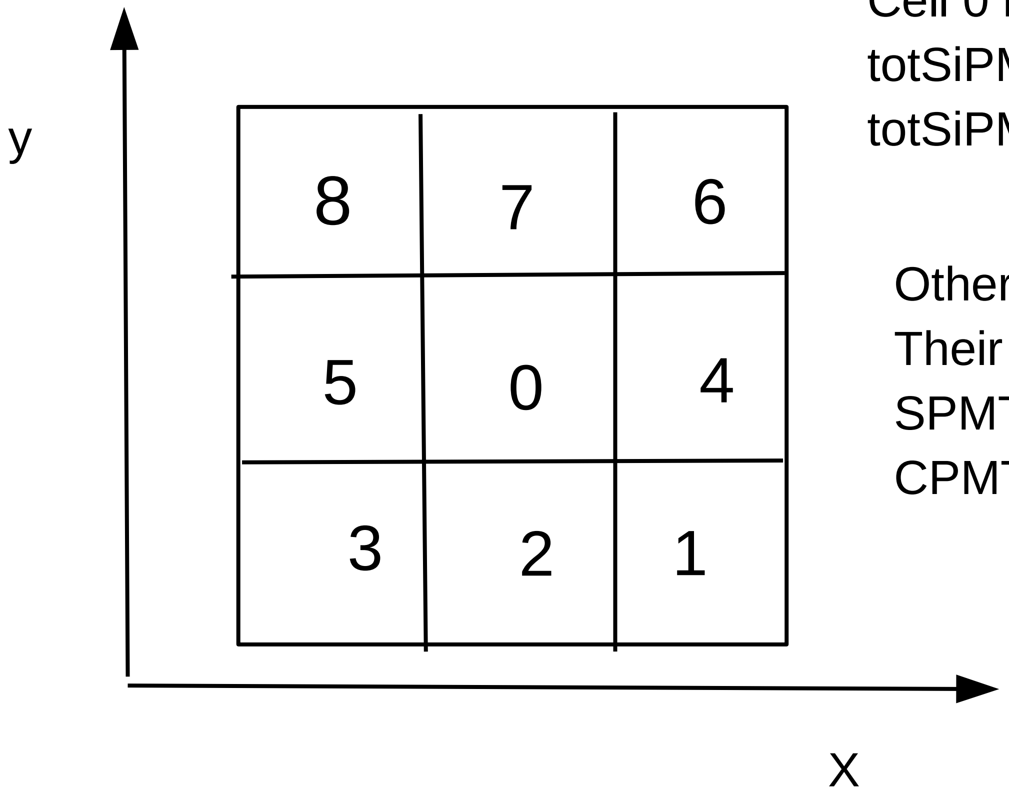
- DWC
  - calibrate and insert in analysis ntuple
  - Align at analysis level (to be ported to reco level)
  - Assess usability
- Preshower
  - Pedestal, calibration counts-mips
  - Define selections 3 mip, 5 mip
- Cerenkov
  - Pedestal, define selection cuts

Calo Performance

- Start from summed values of SiPMs and PMTs
- Intercalibrate and extract performance with tight cuts
- Extract performance in these conditions
- Try to understand limitations of exercise
- Improve through equalisation of single SiPMs and PMTs (ongong)

Reference frame for analysis

View of calo from front

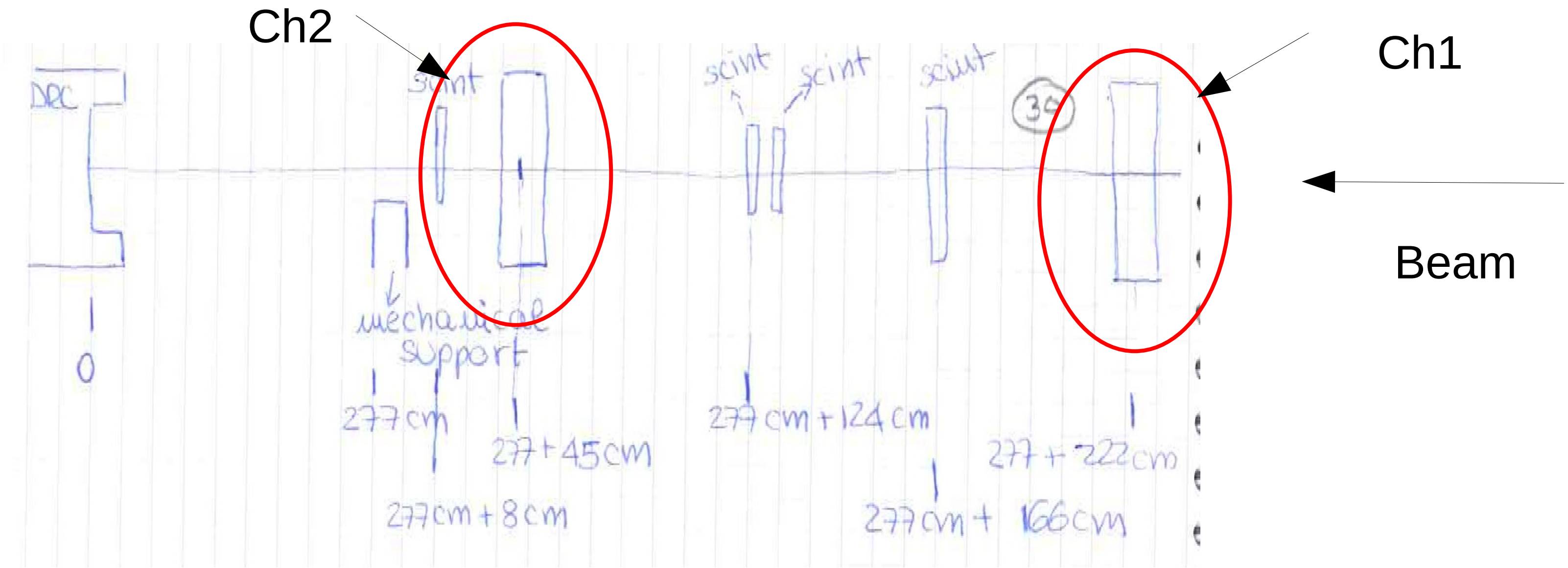


Cell 0 read with SiPM
totSiPMSene: scintillator energy
totSiPMCene: cerenkov energy

Other cells read with SPMT
Their sum:
SPMTenergy: scintillator energy
CPMTenergy: cerenkov energy

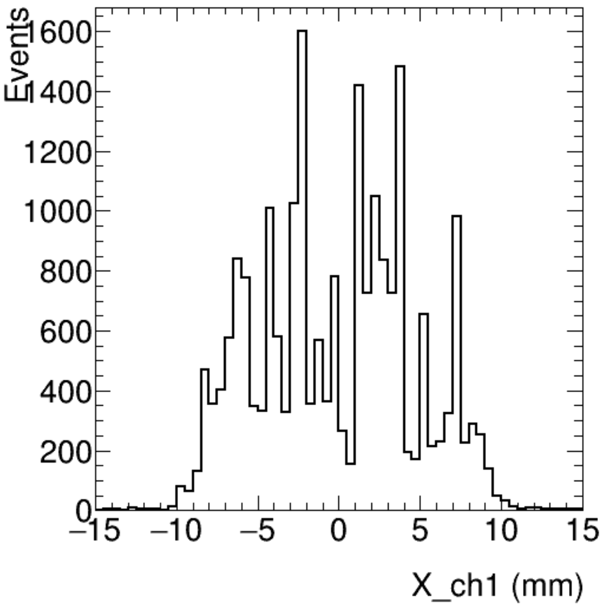
Define (0,0) as the approximate center of the beam
as defined by the beam profile in the DWCs

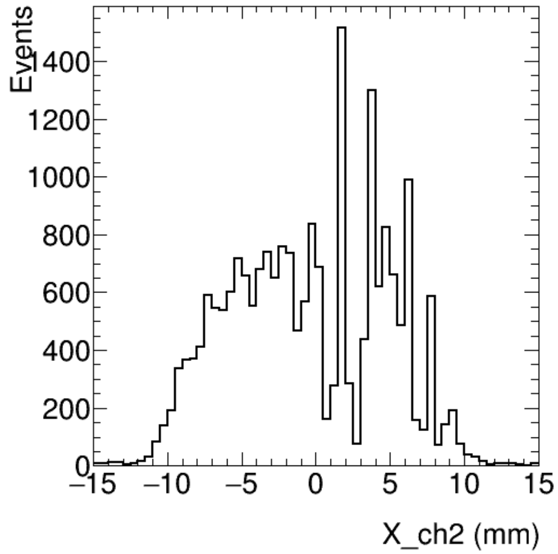
Drift wire chambers (DWCs)

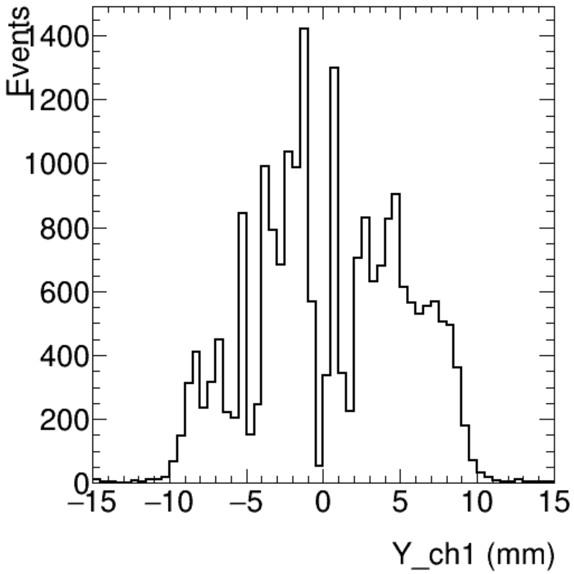


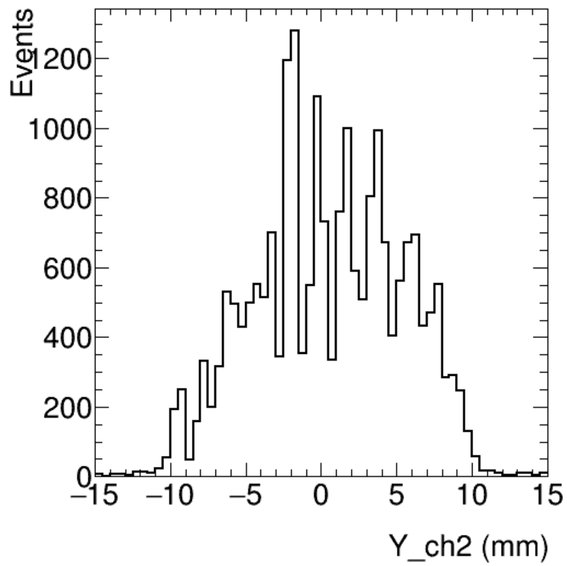
- Calibrate using coefficients provided on the twiki
- Align them such that beam between +10 and 10 mm for reference run 669 (40 GeV)
- Alignment coefficients (mm):
  - XCH1+2.7
  - YCH1-2.7
  - XCH2+4.5
  - YCH2+12
- (Original plan): extrapolate to calorimeter face

Aligned DWC distributions





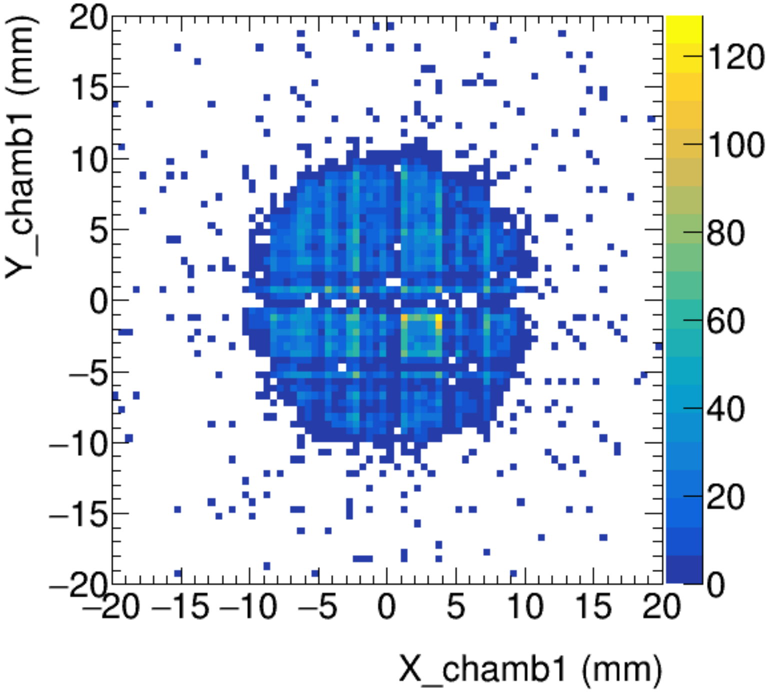


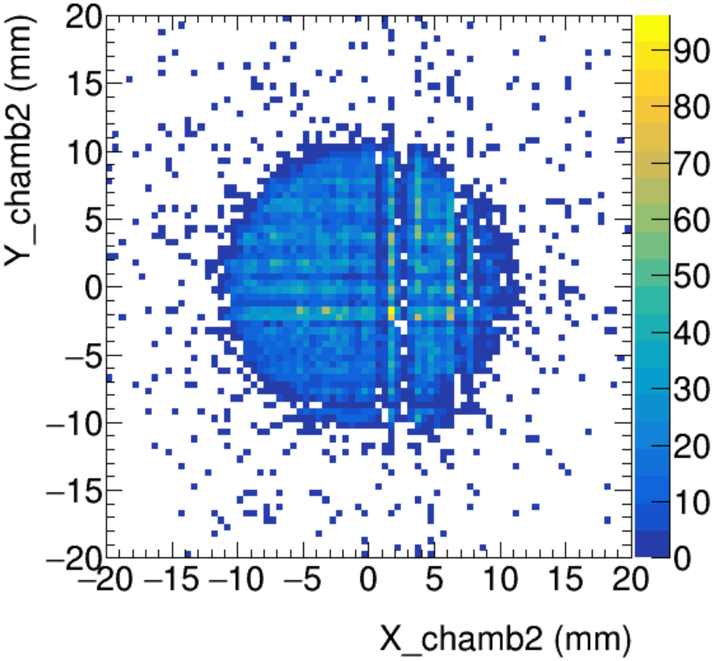


Organ pipe structure with spacing of 2 mm
Possibly a hardware problem with the chambers.

- Resolution order 2mm
- Extrapolation to calorimeter face gets large error due to lever arm between two chambers
- Use position in chamber 2 to define approximate regions for beam

Beam spot in two chambers

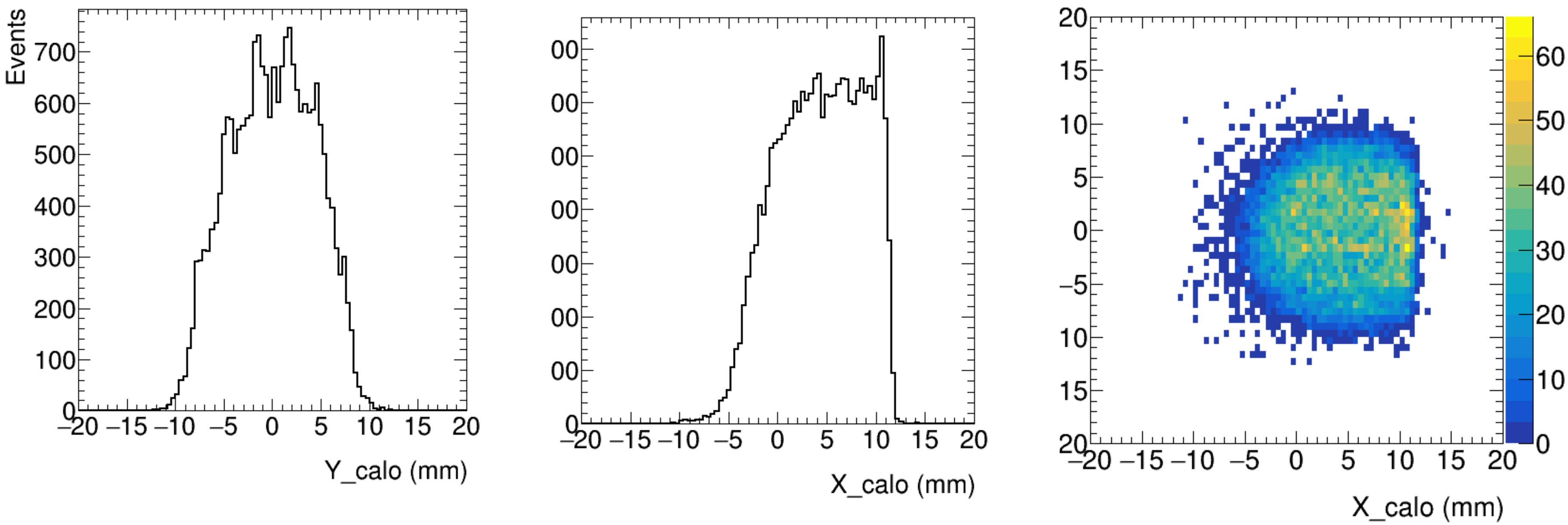




Beam spot determined by veto scitillator wel reconstructed by chambers

→ Can cut at 10mm on radius of aligned cambers to clean the beam

Beam alignment of calo response



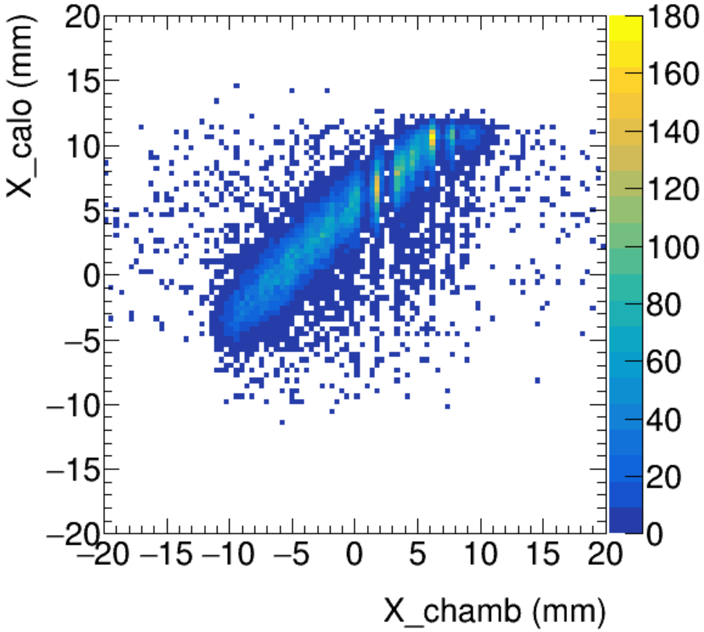
Barycenter of SiPM response for each event: position of shower maximum (biased by edge effects)

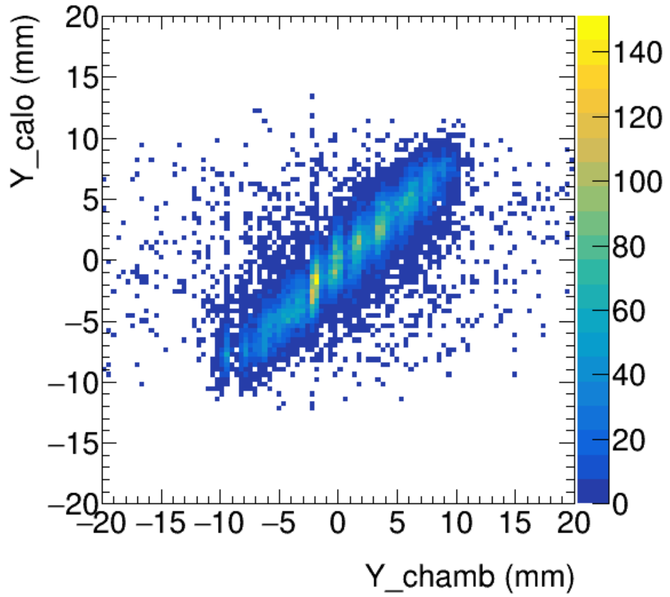
Nice beam spot

Y coordinate OK, X coordinate displaced by ~5mm:

Calorimeter rotated by 1 degree → X position of impact point different different from X position of shower maximum

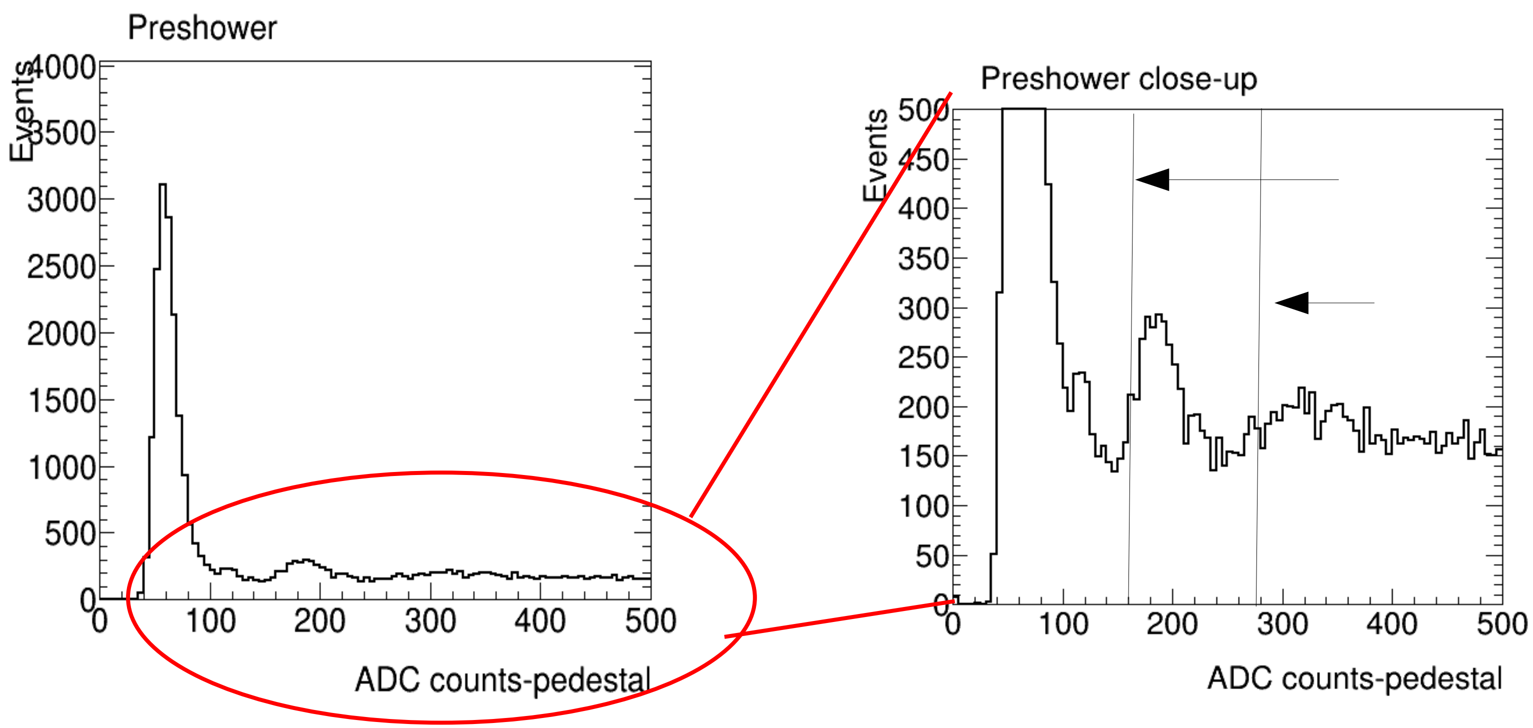
Correlation chamber 2-calo barycenter





Good correlation but very broad (+-2mm): can use chambers
For defining areas of impact, but not for fiber-by-fiber response studies

Preshower detector



Run 669: select events with Cerenkov detectors firing, and calibrated energy in Calorimeter>35 GeV

Pedestal: 210 counts

After pedestal subtraction:

Peak 1 MIP: 60 counts

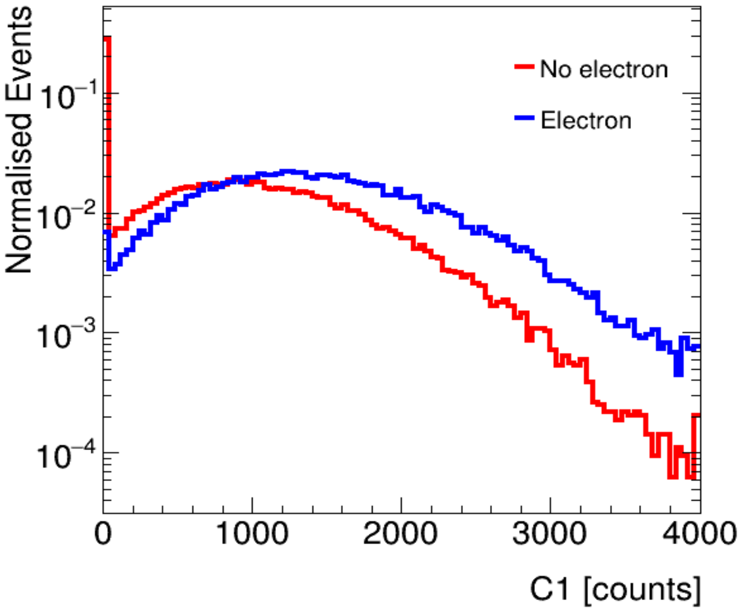
Peak 3 MIP: 180 counts → 3 MIP selection: require>160 counts

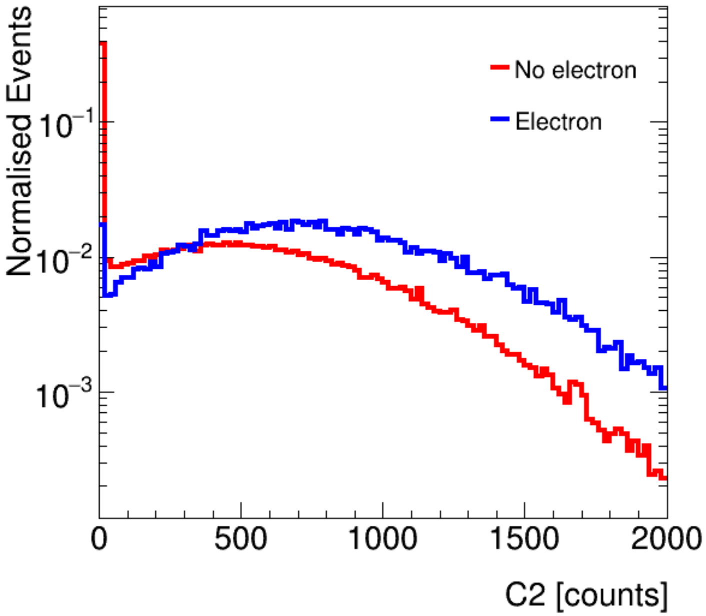
Peak 5 MIP: 300 counts → 5 MIP selection: require>280 counts

Cerenkov detectors

Pedestal C1:78.5 counts → Require >10 counts above pedestal
Pedestal C2:15.8 counts → Require > 10 counts above pedestal

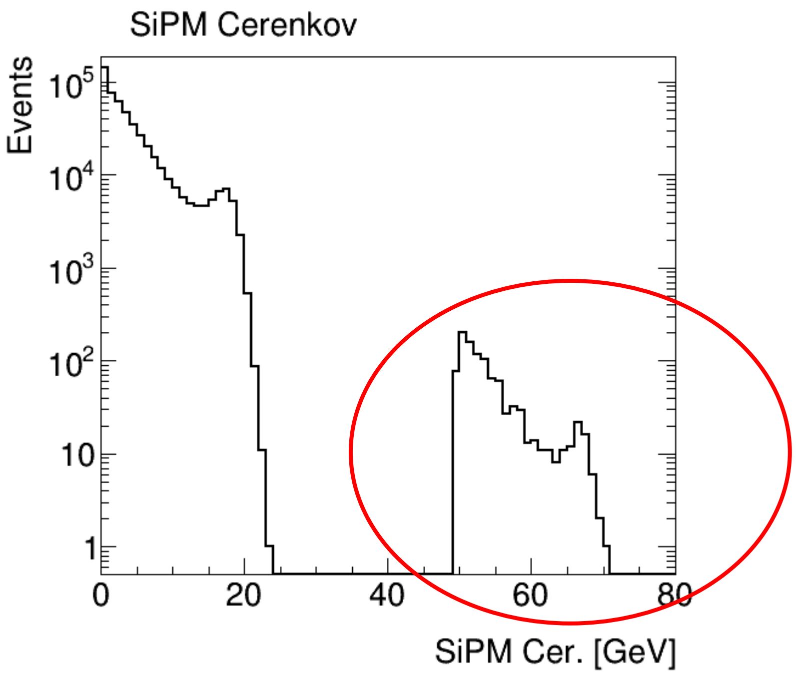
Electron: Preshower>370 and calibrated energy in calo>35 GeV
No electron: Preshower<320 and calibrated energy in calo<10 GeV

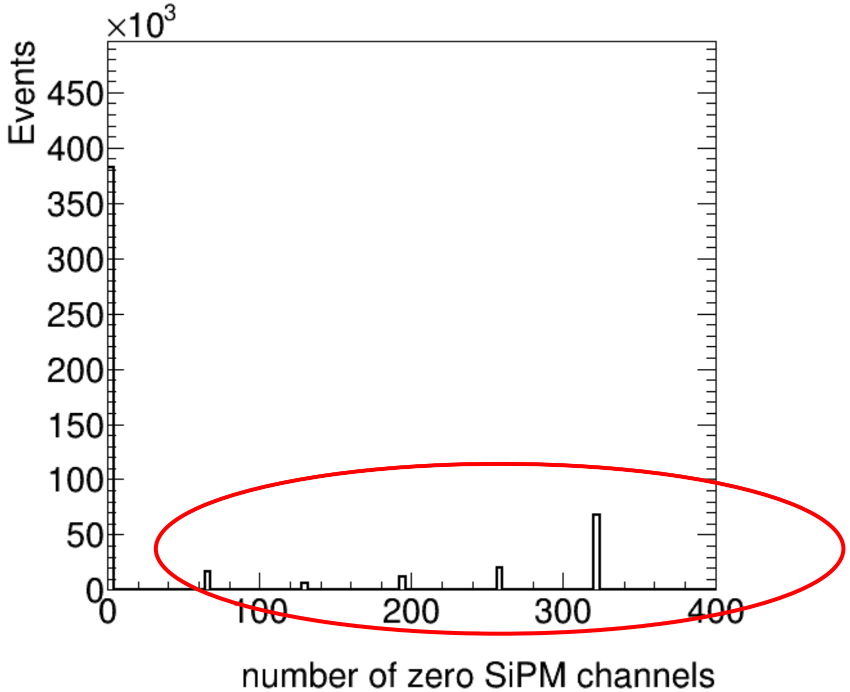




More work probably needed to optimise usage

Calorimeter issues



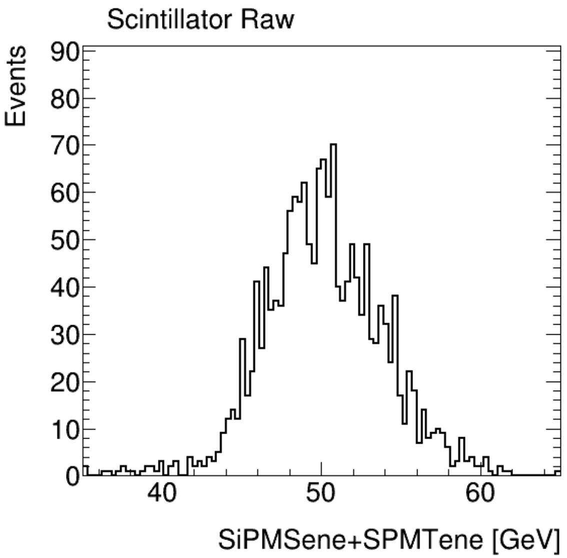


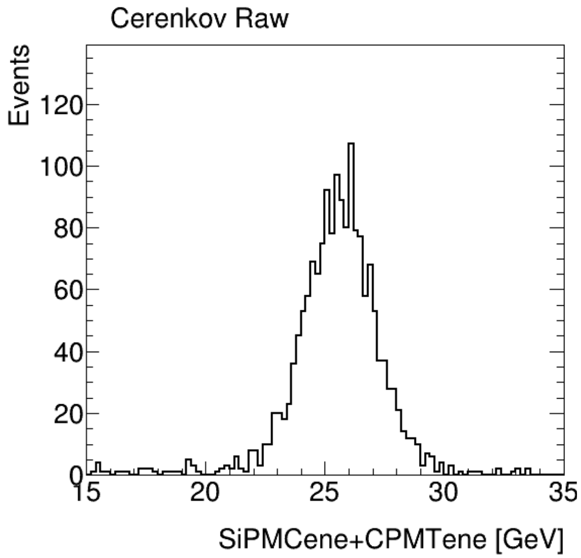
Distribution of sum of signal of Cerenkov SiPM channels
Small bunch of events with unphysical energies
For Ebeam<90 GeV require totSiPMCene<48

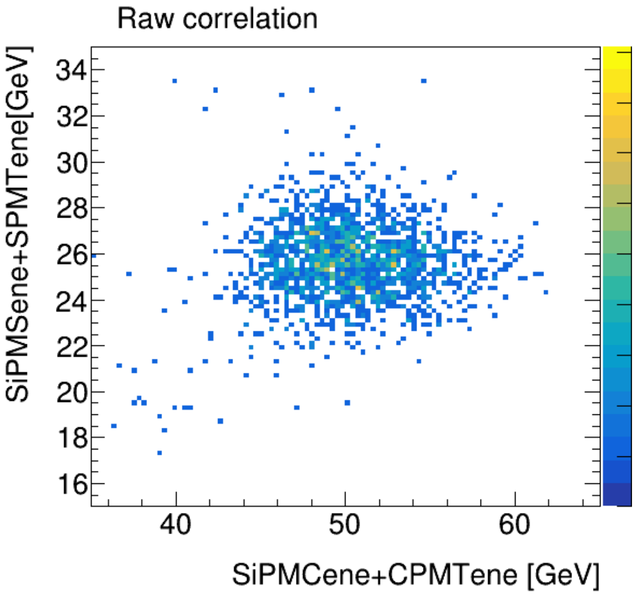
Significant number of events with one or more SiPM cards not read out.
Reject them. Relevant variable made available in ntuple

Raw calorimeter distributions

Select electrons with 5MIP preshower+Cerenkov
Tight beam spot: |X_ch2|<2mm, |Y_ch2|<3 mm to minimize impact point effects







Scintillator not gaussian, tried to vary relative weight of SIPM and PMT and it does not change shape

Cerenkov reasonably gaussian

Given geometry of detector, with alternate rows of cerenkov ans scintillator SiPM, summing scintillator and serenkov may be needed to achieve gaussian response, as suggested by Romualdo

Final Intercalibration of components

5 measurements of energy SiPMs, SiPMc, PMTs, PMTc, PS find linear combination yielding best resolution and linearity

Use Run 669 (40 GeV, 500kevents)

Apply 5mips + Cerenkov elId and tight selections on beam spot

(|X_ch2|<2 mm, |Y_ch2|<3 mm)

Procedure:

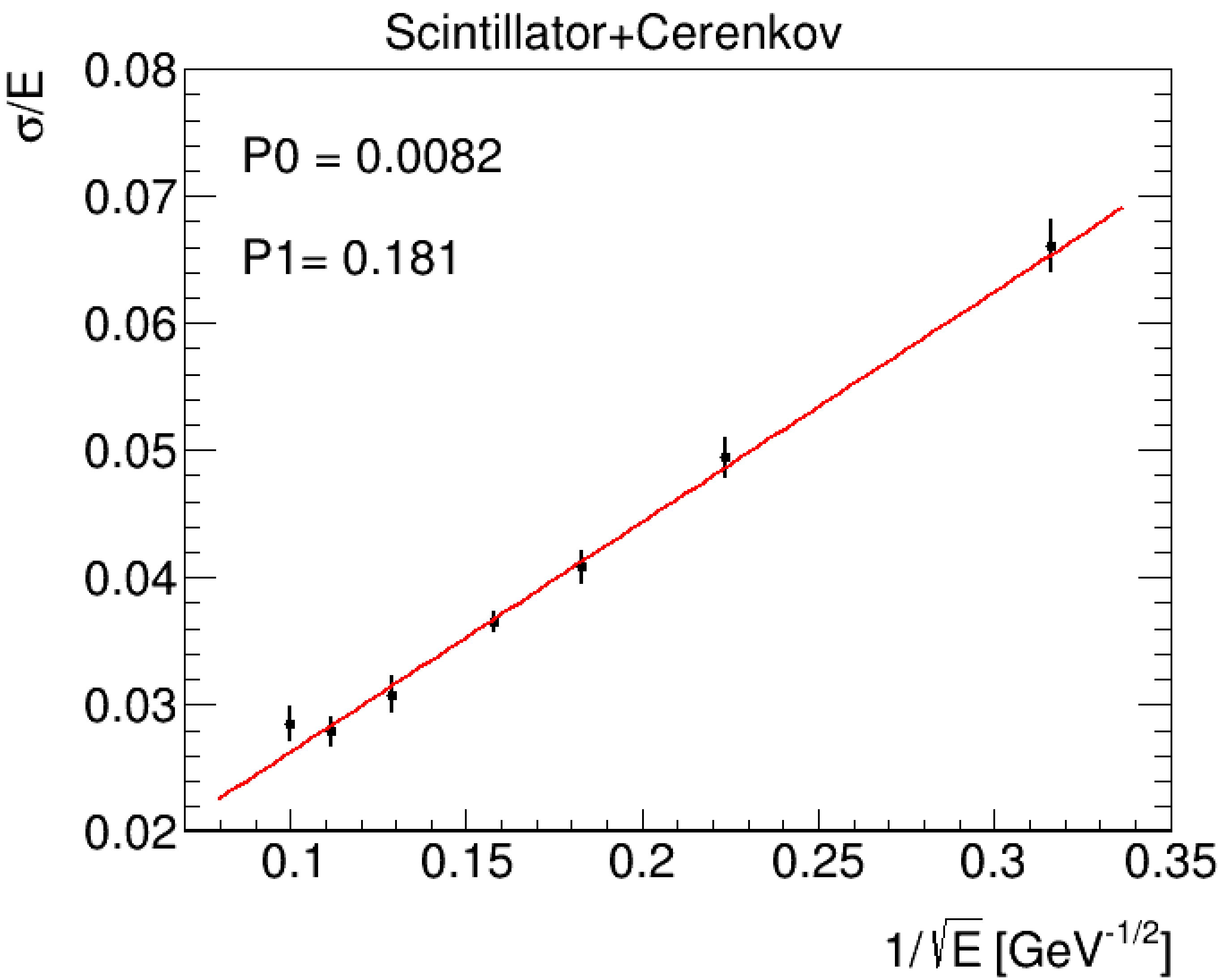
- Based on preliminary intercalibration select events within 1.5 sigmas of 40 GeV (assuming sigma=1.7 GeV). For those events:
- Calculate Cc coefficients for cerenkov such that

  Cc1*SiPMc+Cc2*PMTc+Cc3*PS=40 GeV, and RMS over all events minimum
- Calculate Cs total coefficients such that:

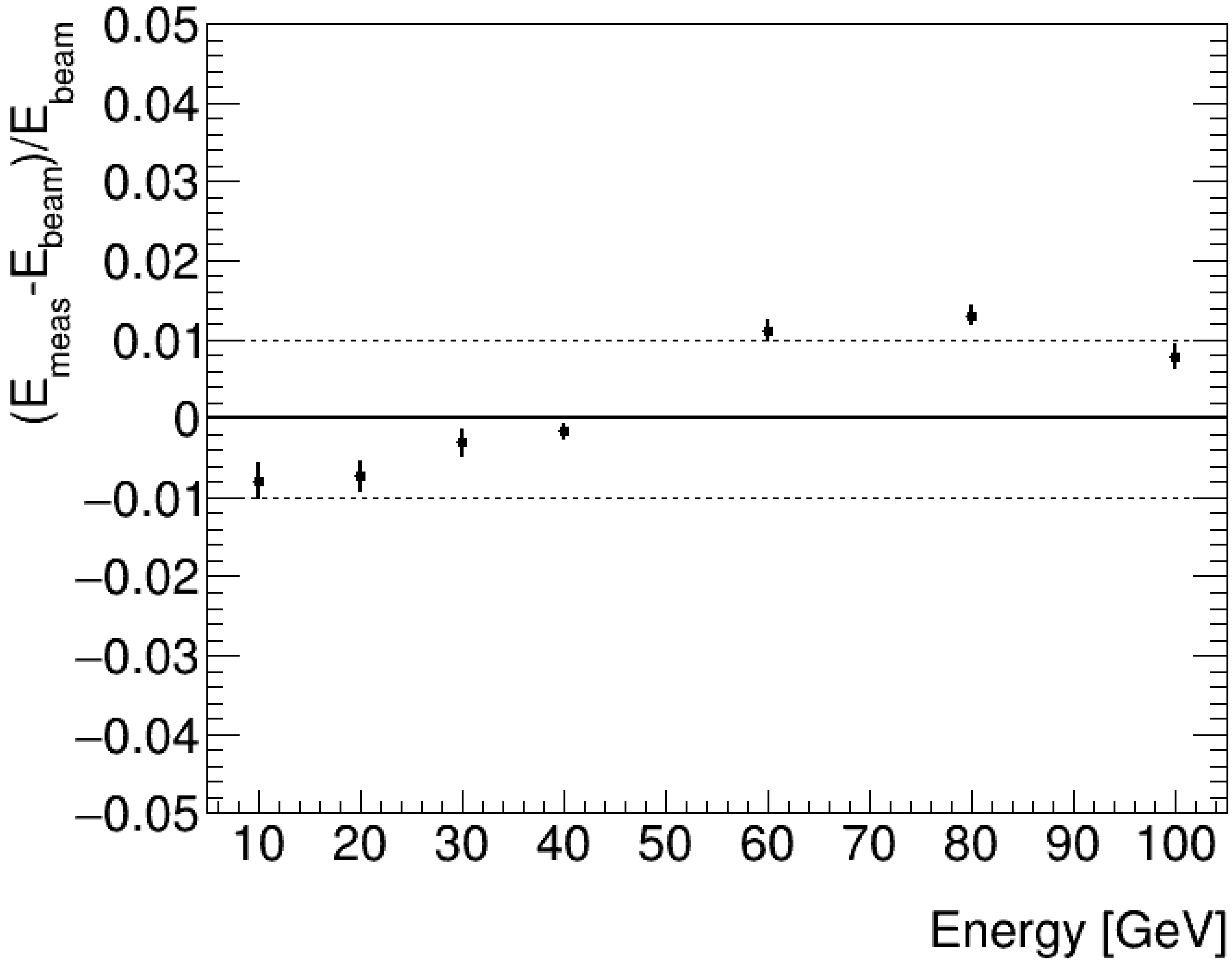
  Cs1*SiPMs+Cs2*PMTs+Cs3*(Cc1*SiPMc+Cc2*PMTc)+Cc3*PS=40 GeV and RMS over all events minimum

For same selections on beam spot and electron id for each beam energy calcolate measured energy for coefficient above, and take mean and sigma of gaussian fitted betwee -1.5 and 3 sigmas (sigma=0.2/sqrt(E)+0.01)

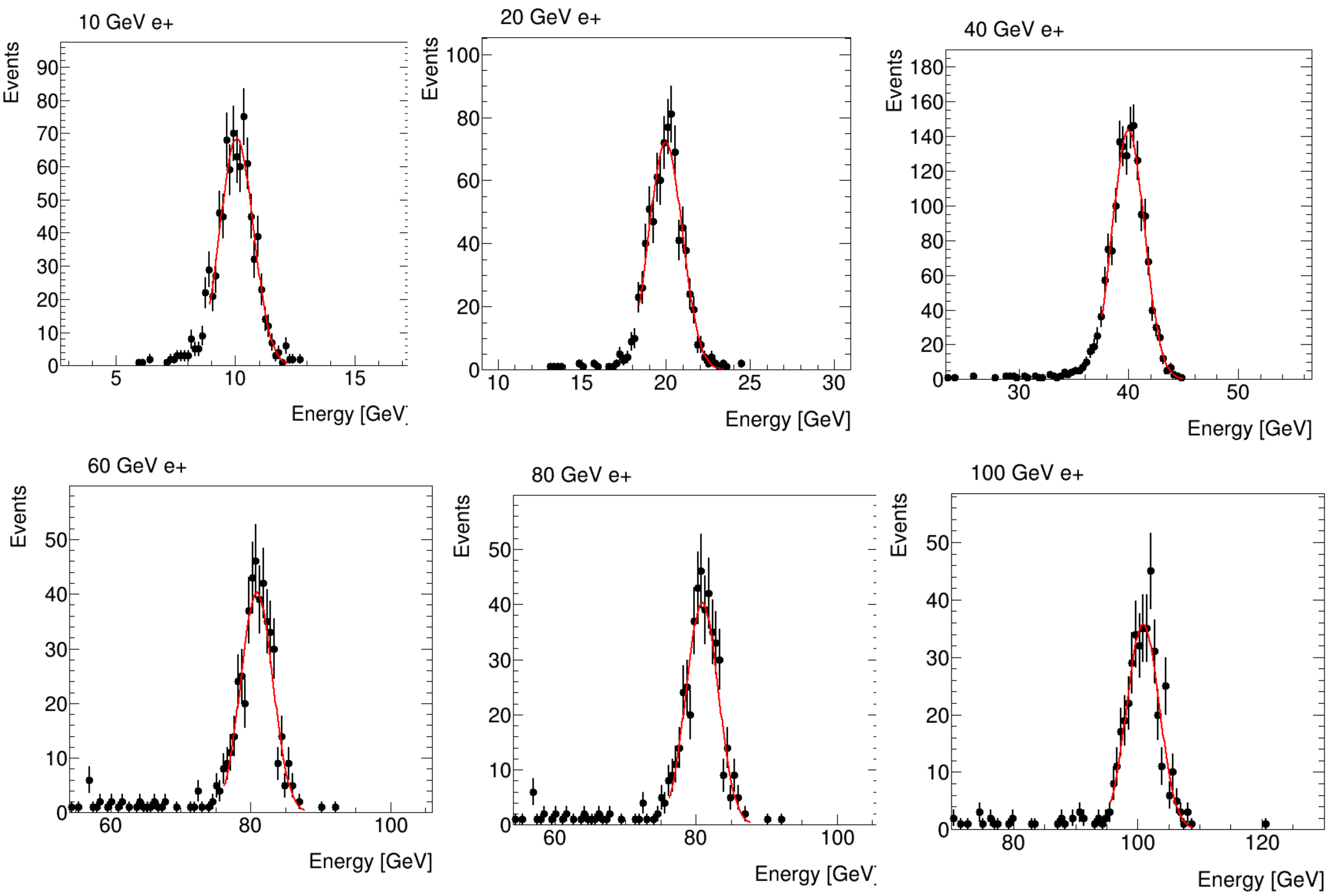
Results: Resolution



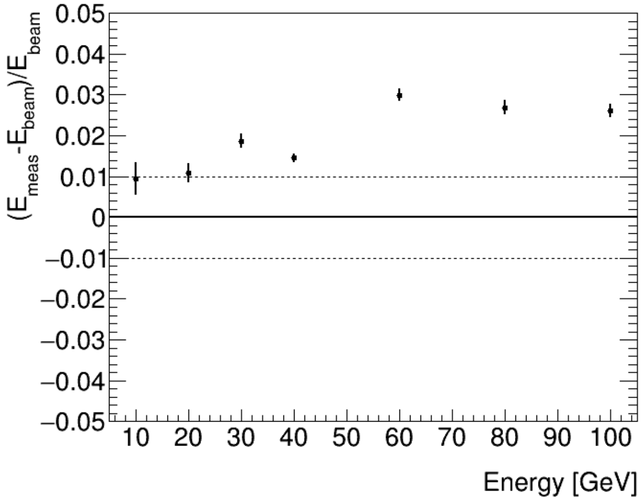
Results: Linearity

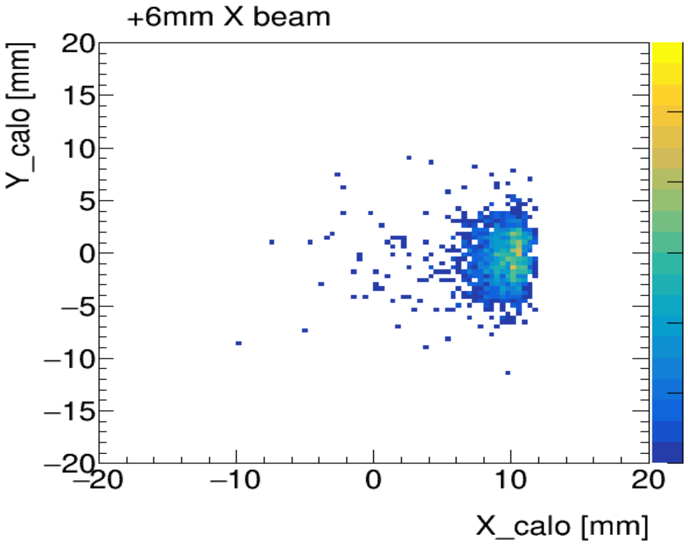


Results: energy distributions

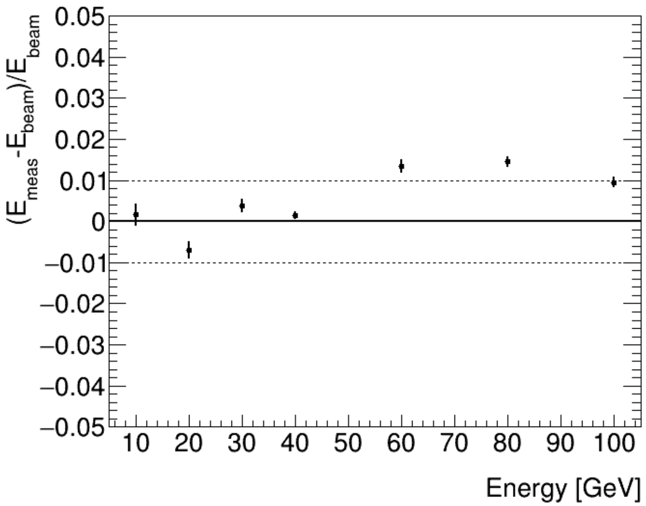


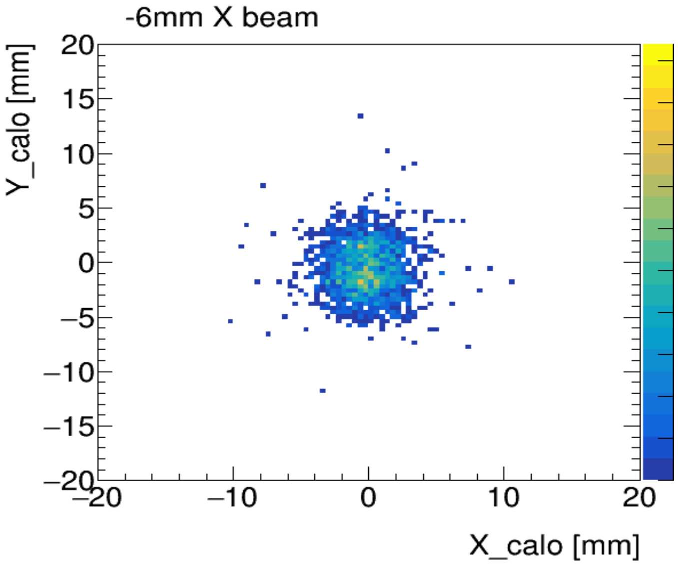
Caibration dependence on beam x position





Moving by 6 mm towards border
Calibration off by 2%
Possibly issue of intercalibration with PMT: minuit overweight PMTs





Moving by 6mm towards center
Calibration OK

SiPM equalisation study

Use muon runs to equalize fiber response

…. in progress

Conclusions

Preliminary exercise on SPS TB data performed

Drift Wire Chambers calibrated and in ntuples: because of probable hardware problems cannot be used for detailed impact point studies

Auxiliary detectors studied, and basic electron ID developed → more study on cerenkov detectors needed

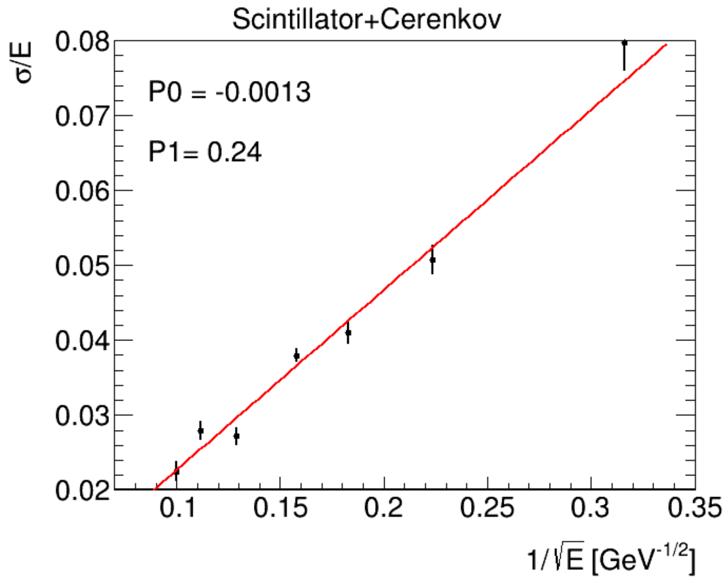
Based on summed SiPM and PMT energies, intercalibration procedure developed yielding reasonable resolution on tight beam spot

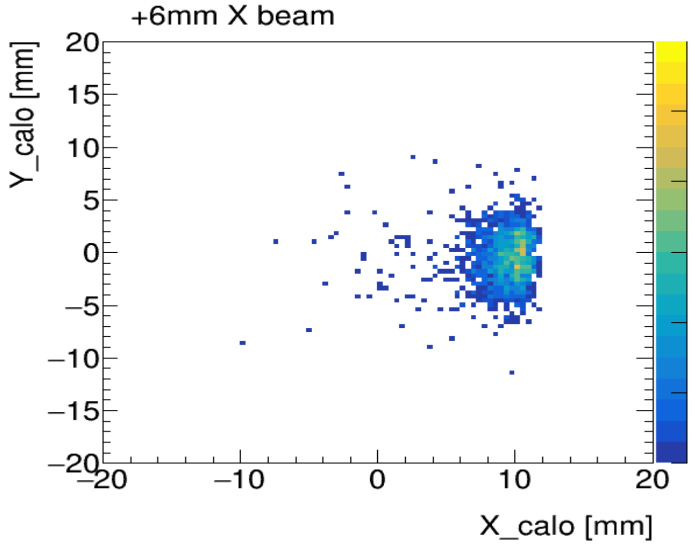
Work ongoing to understand the components of the resolution, its dependence on impact point and on equalisation of response of fibers read out by SiPMs

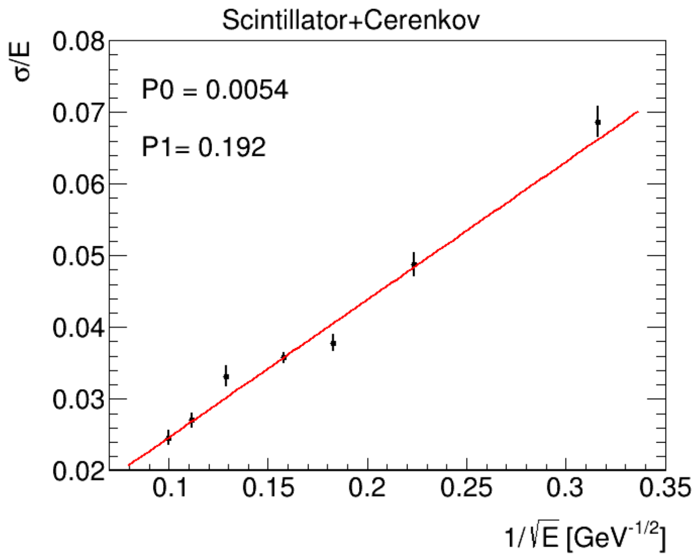
Comparison with simulation needed to understand how far we are from ideal situation with same geometry

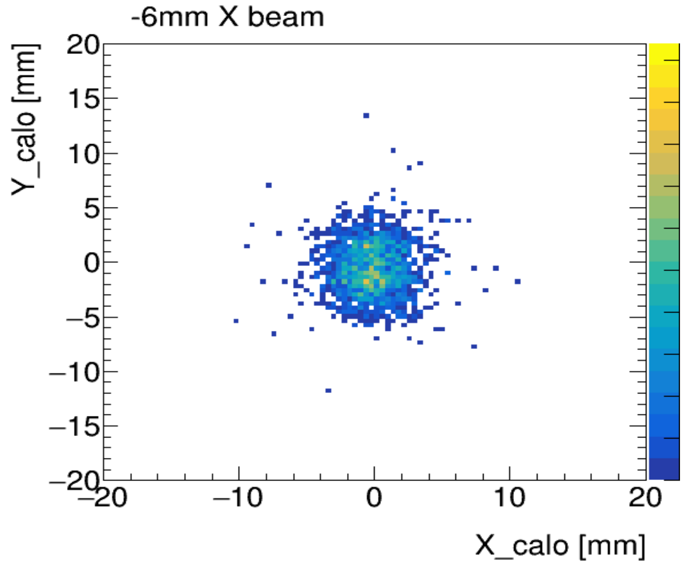
Backup

Resolution dependence on beam x position

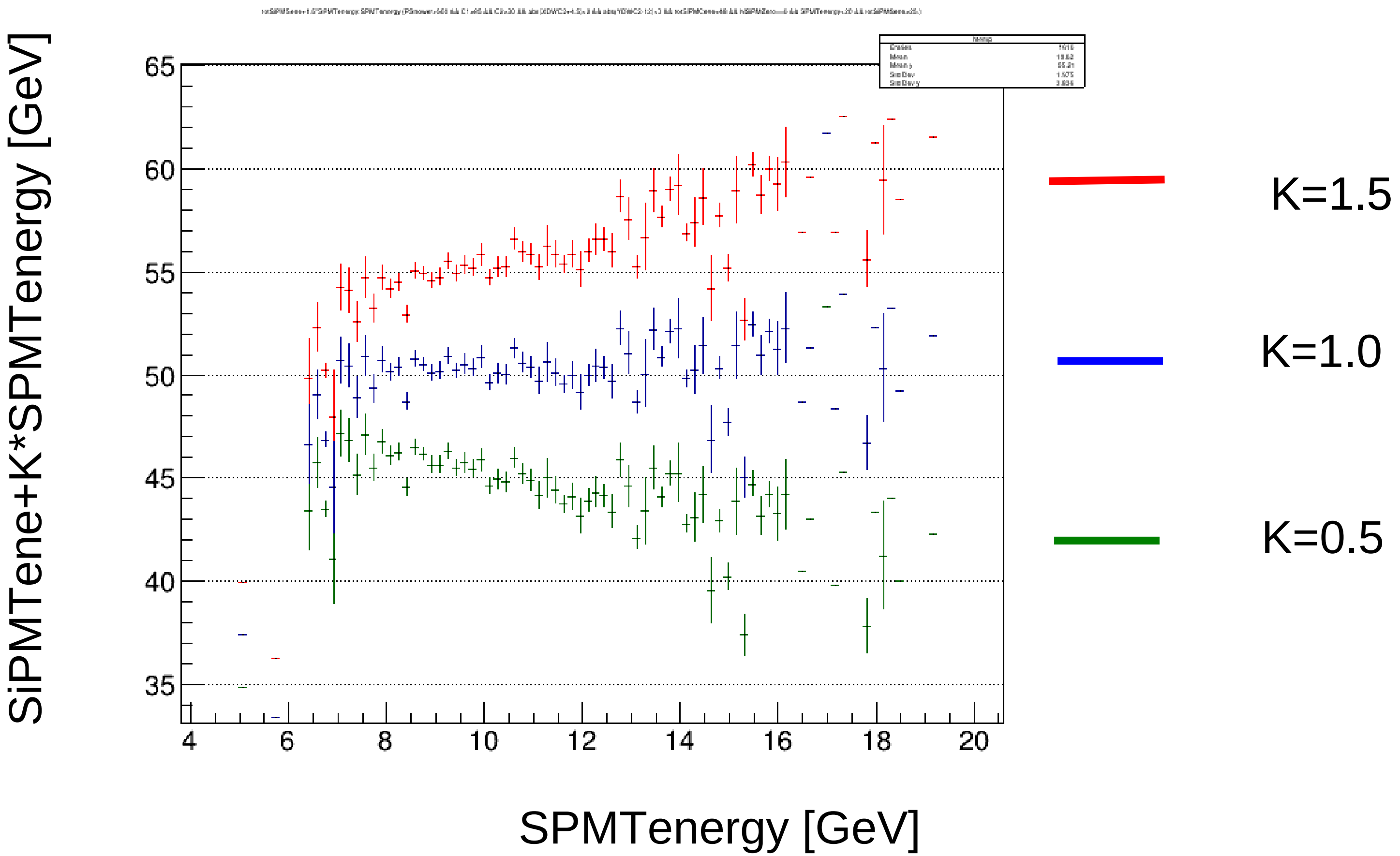




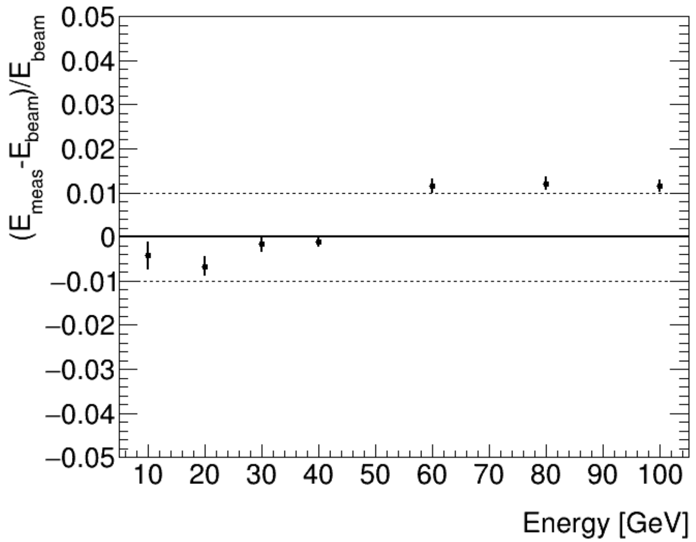


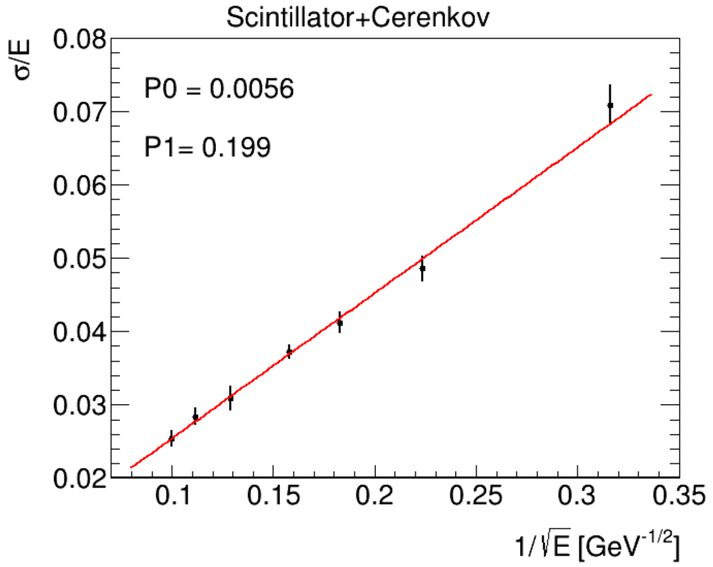


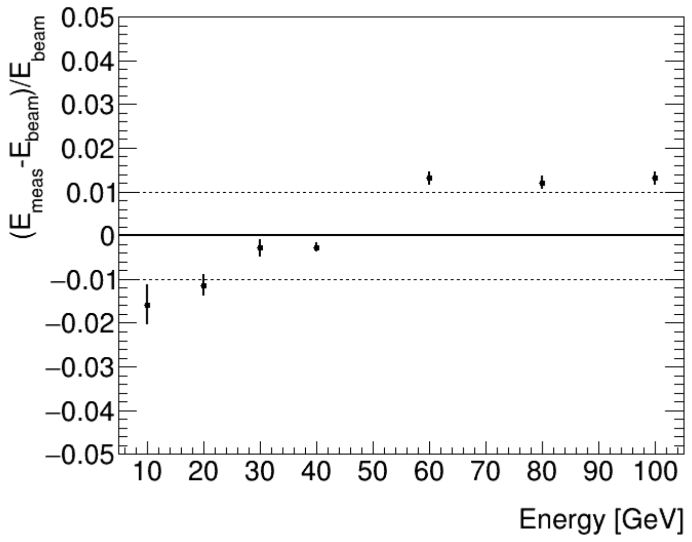
Scintillator intercalibration

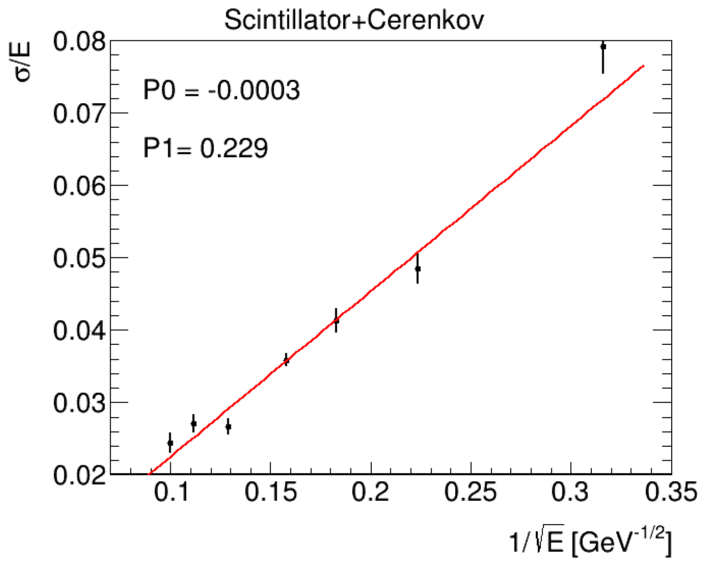


Fixed SiPMS to SPMT ratio to 0.95









Default weights

Cs1*SiPMs+Cs2*PMTs+Cs3*(Cc1*SiPMc+Cc2*PMTc)+Cc3

Cs1=0.276

C2s=0.363

Cs3=0.62

Cc1=1.764

Cc2=1.05

Cc3=0.0017