Longitudinally segmented dual readout calorimetry

Working Report

Georgios Mavromanolakis °•, Adam Para °, Niki Saoulidou °

FERMILAB °
University of Cambridge •

Outline

- **General**
- **Case Studies**
- **Summary**

Dual readout and energy correction

- **· correct Eion for single pions**

  : define CorrectionFactor = 1 - calibr * Eion/Echer
  with calibr = Echer/Eion for electrons at given energy

  : get correction function Fion() by fitting Eion vs CorrectionFactor
  of single pions at given energy

  : corrected energy = Eion/Fion(), applied to pions of various energies

Dual readout and energy correction

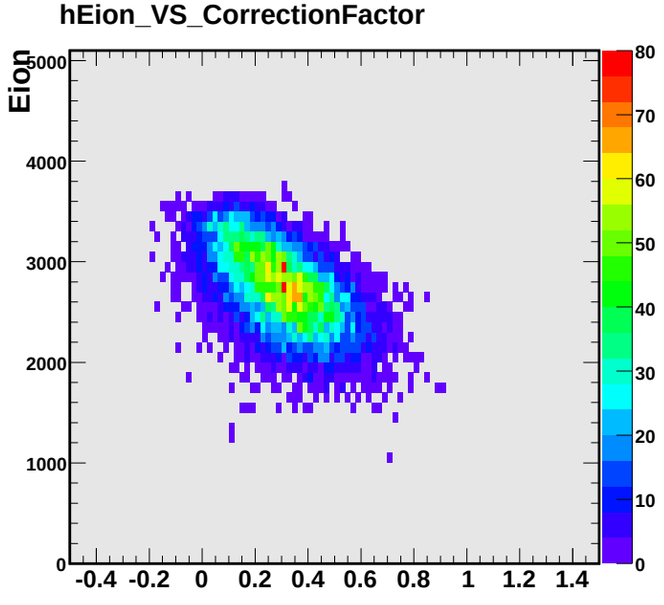
- **correct Echer for single pions**

  : define CorrectionFactor = 1 - calibr * Eion/Echer
  with calibr = Echer/Eion for electrons at given energy

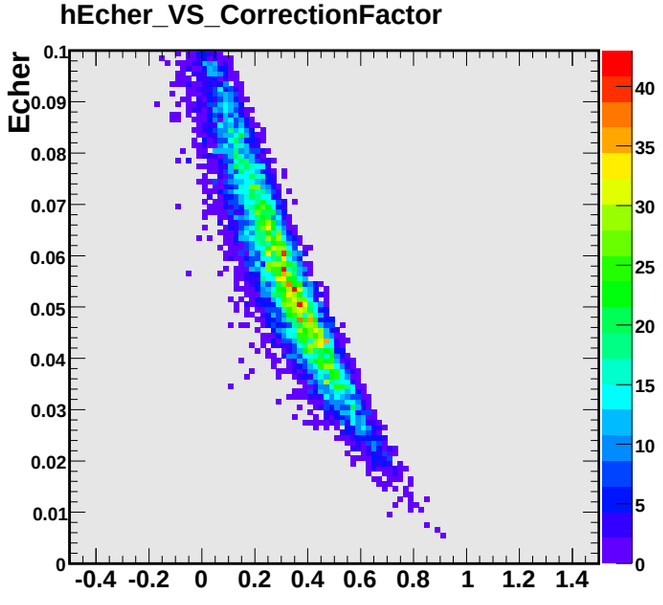
  : get correction function Fcher() by fitting Echer vs CorrectionFactor
  of single pions at given energy

  : corrected energy = Echer/Fcher(), applied to pions of various energies

Eion, Echer correlation



Eion vs CorrectionFactor



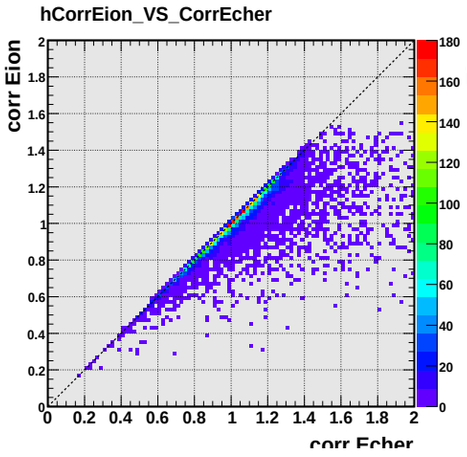
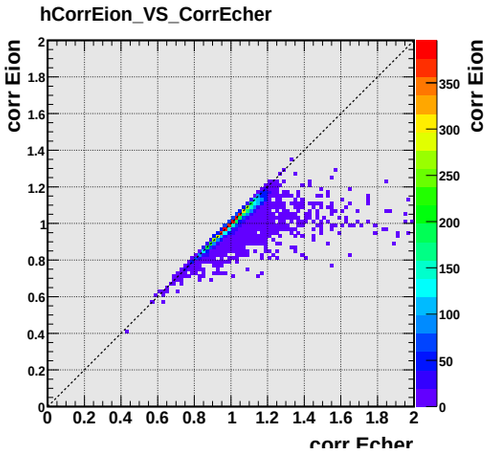
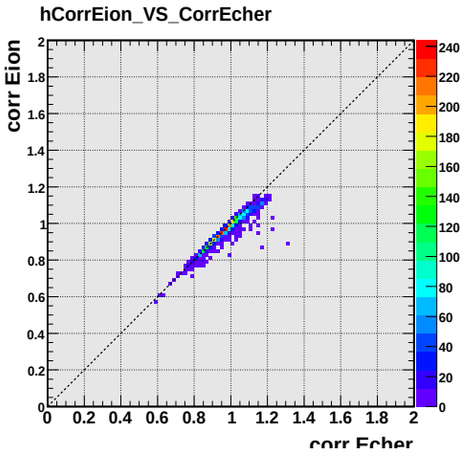
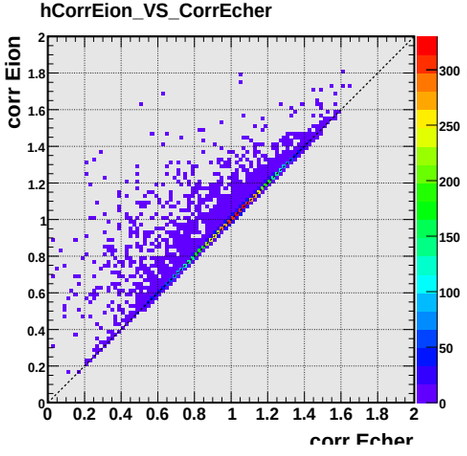
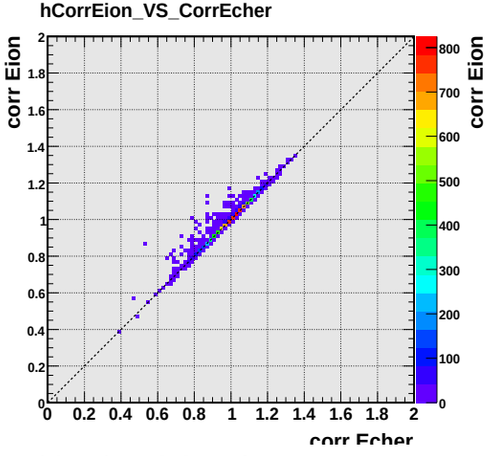
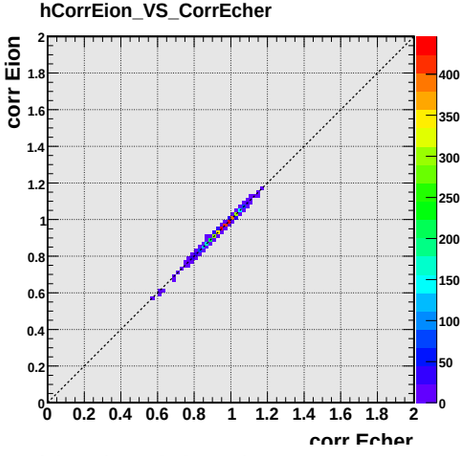
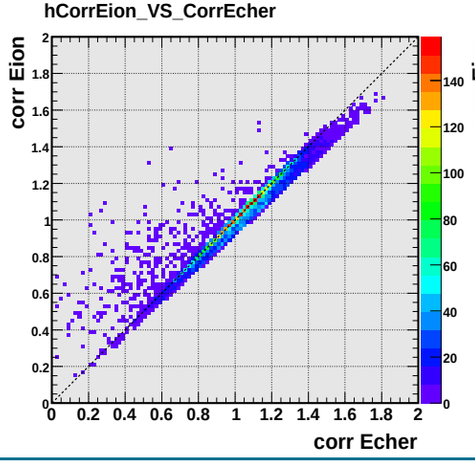
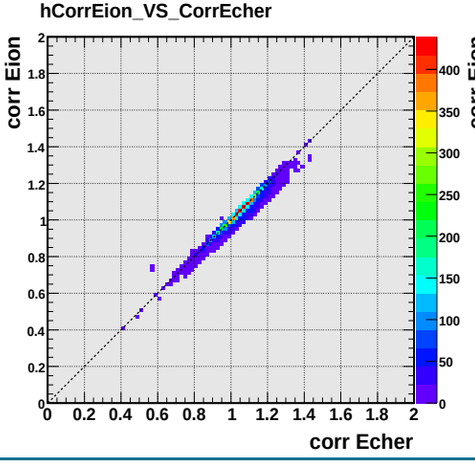
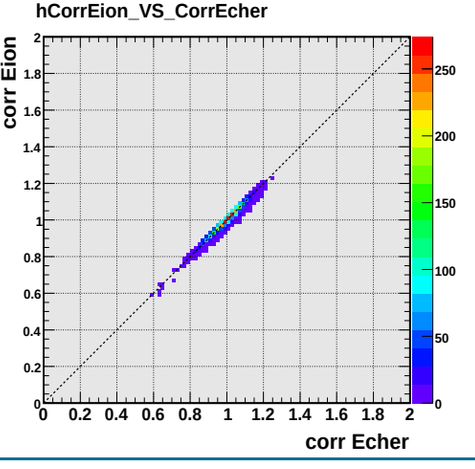
Echer vs CorrectionFactor

Case Studies

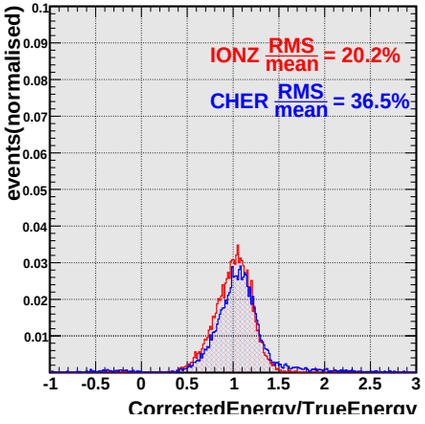
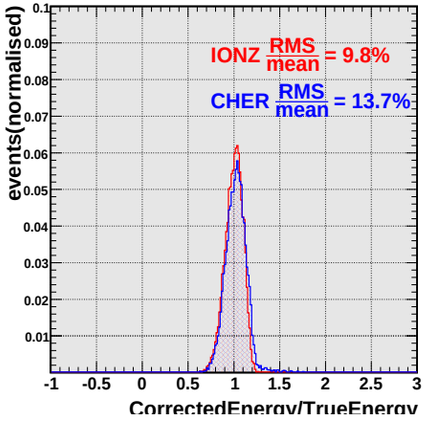
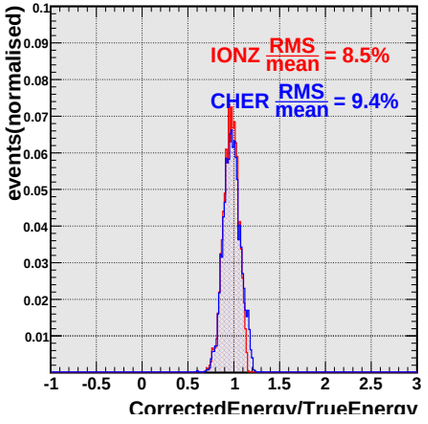
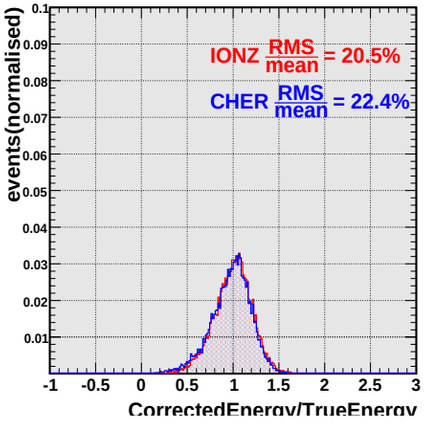
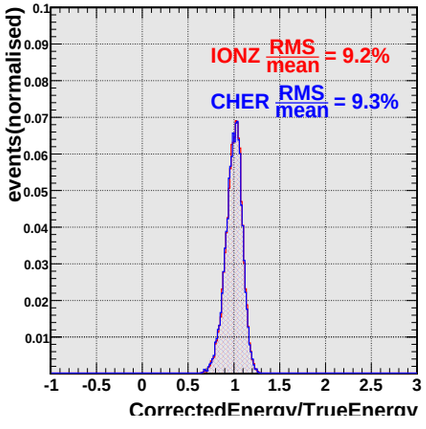
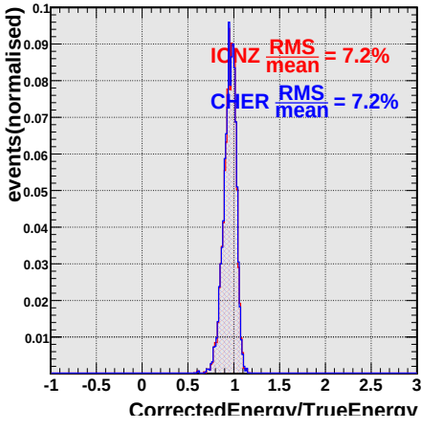
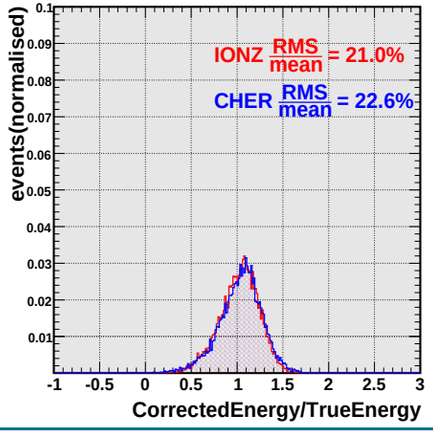
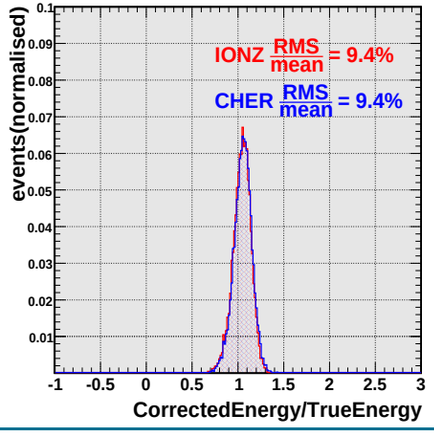
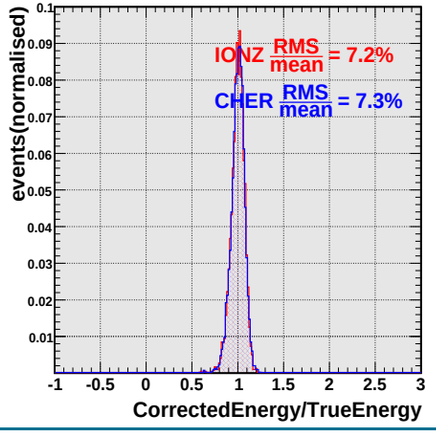
- .
  - : calorimeter volume composed of lead glass only,
    segmented longitudinally in 10000 layers, 1 mm thick each
  - : study cases of different sampling unit(=absorber+ionisation+cherenkov part)
    with xx,yy,zz layers per part

- **. data files**
  - : e^- 5 GeV, `e-_E5.0_N10000_Tac0._Tch1.0_Tab0.0_MactLeadGlass_MabsLeadGlass.root`
  - : π^- 10 GeV, `pi-_E10.0_N10000_Tac0._Tch1.0_Tab0.0_MactLeadGlass_MabsLeadGlass.root`
  - : π^- 1 GeV, `pi-_E1.0_N10000_Tac0._Tch1.0_Tab0.0_MactLeadGlass_MabsLeadGlass.root`
  - : π^- 5 GeV, `pi-_E5.0_N10000_Tac0._Tch1.0_Tab0.0_MactLeadGlass_MabsLeadGlass.root`

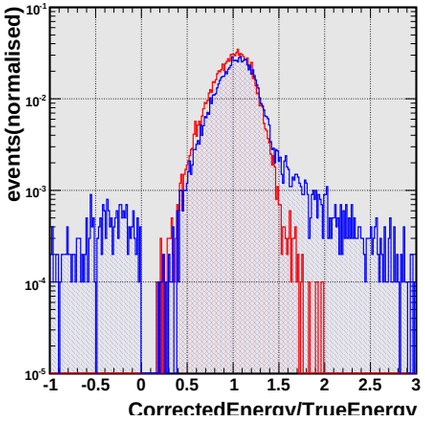
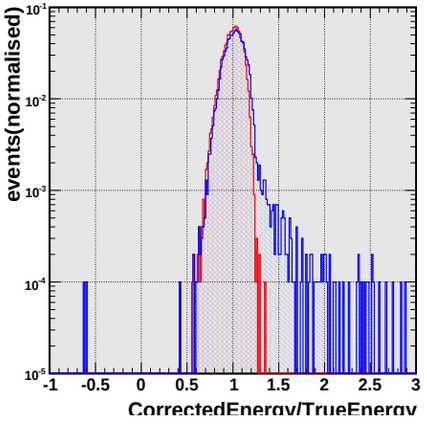
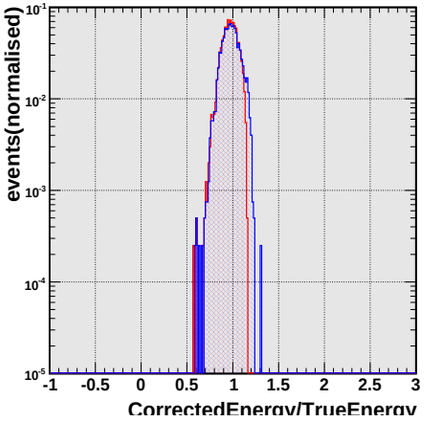
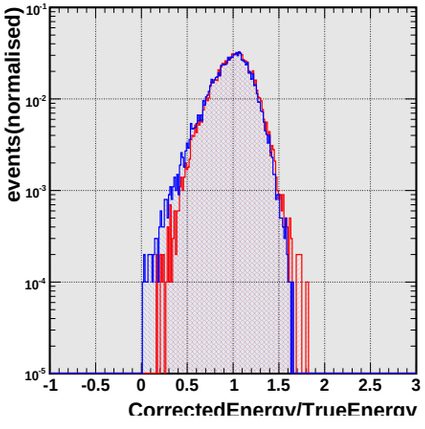
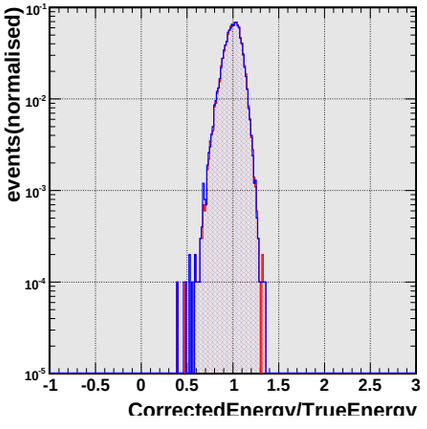
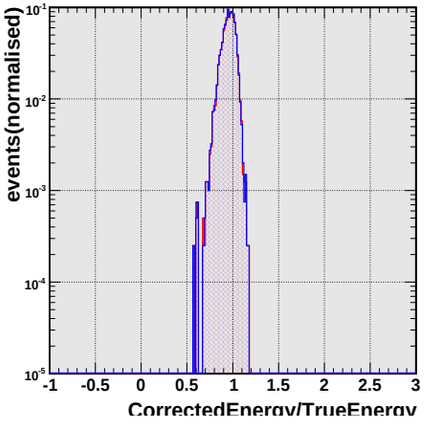
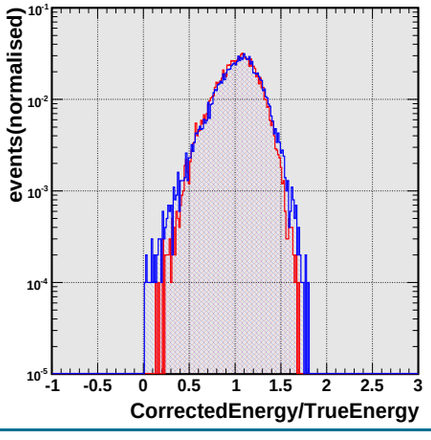
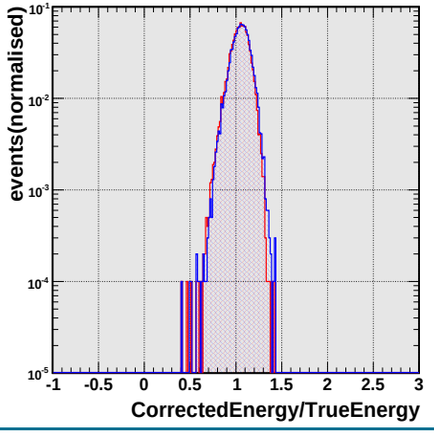
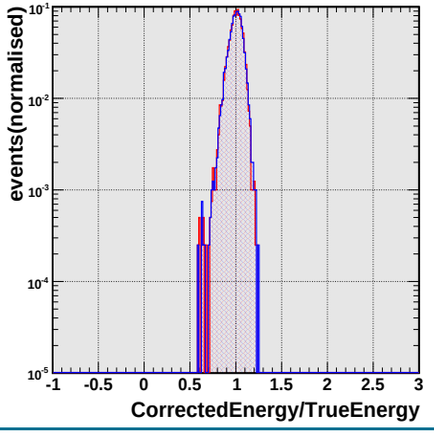
sampling abs:ioncher 0:1 mm

	π^- 1 GeV	π^- 5 GeV	π^- 10 GeV
corrected by 1 GeV			
corrected by 5 GeV			
corrected by 10 GeV			

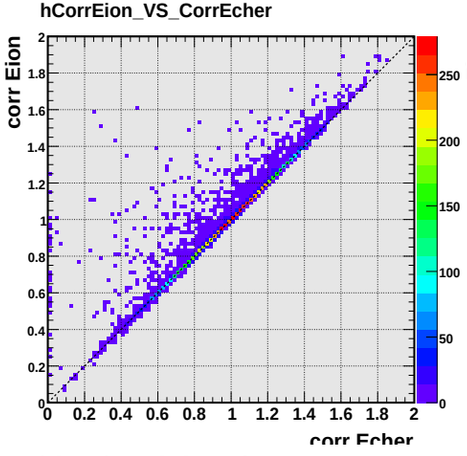
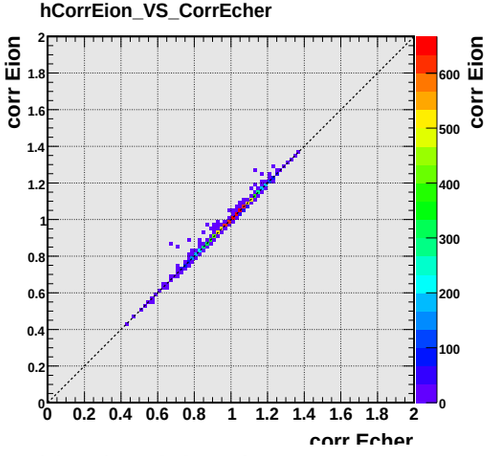
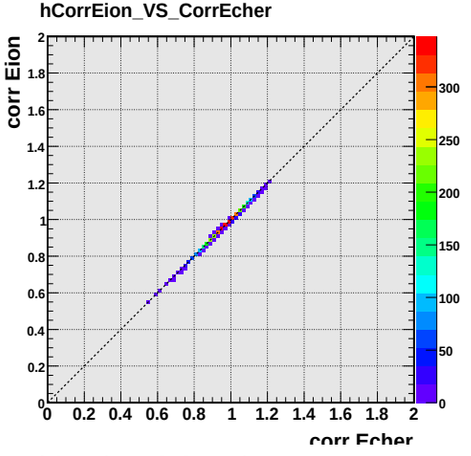
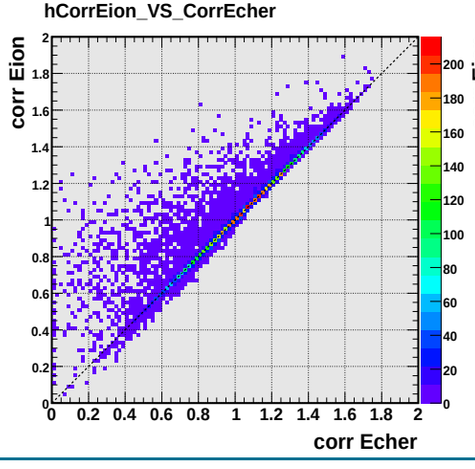
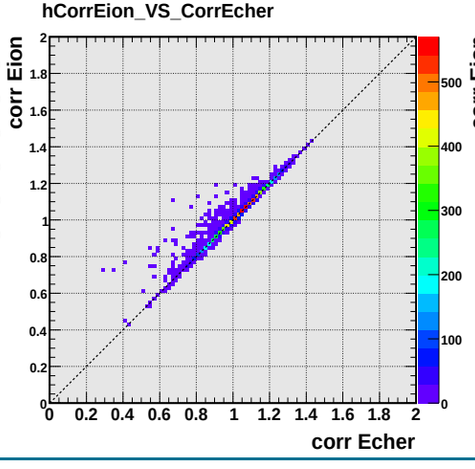
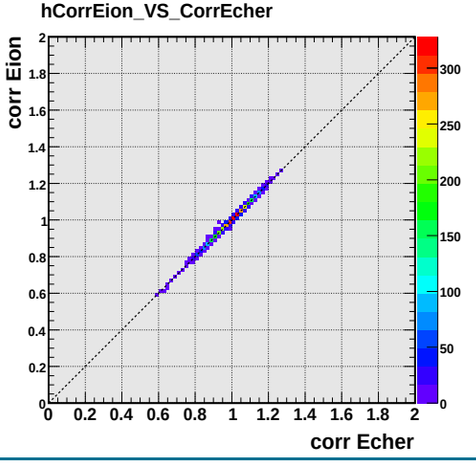
sampling abs:ioncher 0:1 mm

	π^- 1 GeV	π^- 5 GeV	π^- 10 GeV
corrected by 1 GeV			
corrected by 5 GeV			
corrected by 10 GeV			

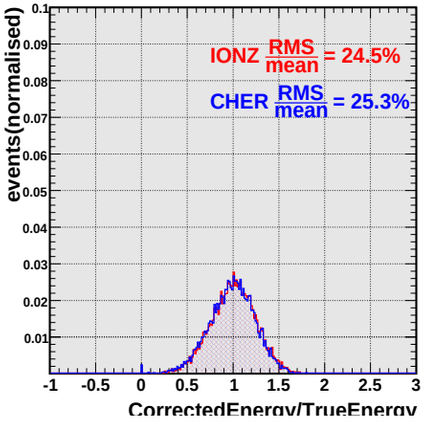
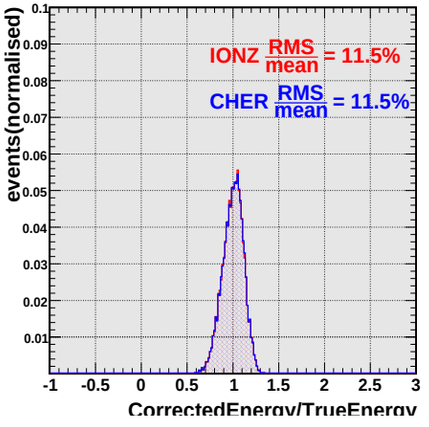
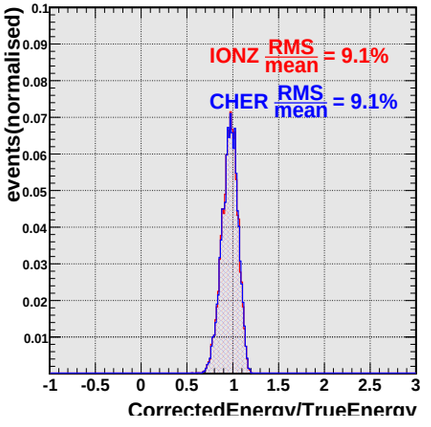
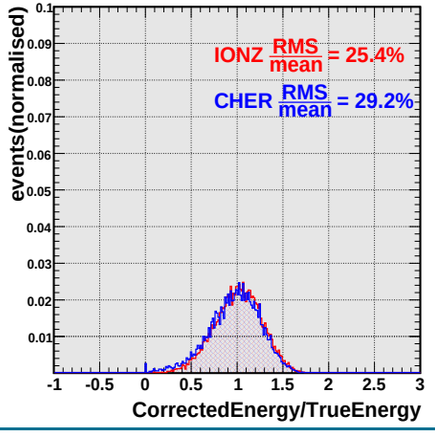
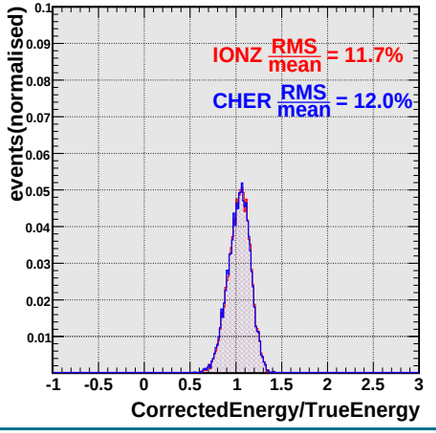
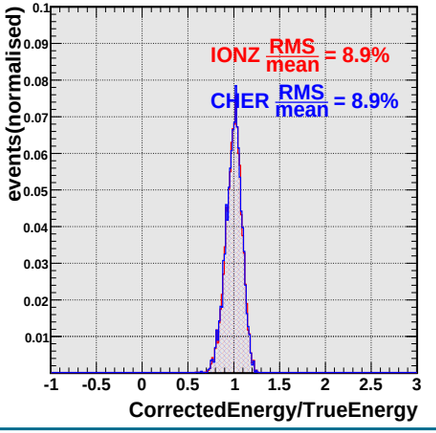
sampling abs:ioncher 0:1 mm

	π^- 1 GeV	π^- 5 GeV	π^- 10 GeV
corrected by 1 GeV			
corrected by 5 GeV			
corrected by 10 GeV			

sampling abs:ion:cher 5:18:2 mm

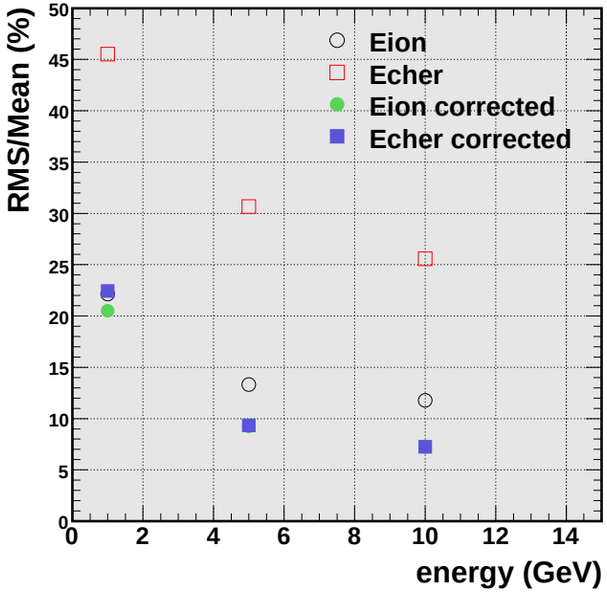
	π^- 1 GeV	π^- 5 GeV	π^- 10 GeV
corrected by 1 GeV			
corrected by 5 GeV			
corrected by 10 GeV			

sampling abs:ion:cher 5:18:2 mm

	π^- 1 GeV	π^- 5 GeV	π^- 10 GeV
corrected by 1 GeV			
corrected by 5 GeV			
corrected by 10 GeV			

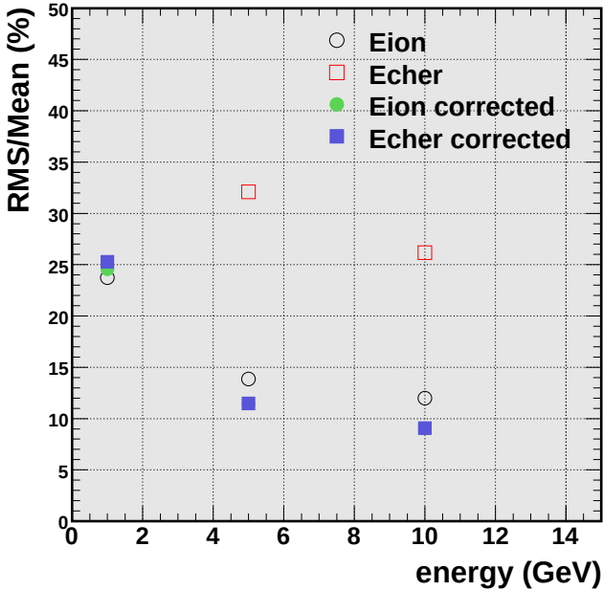
Energy resolution for single pions

corrected by π^- 5 GeV



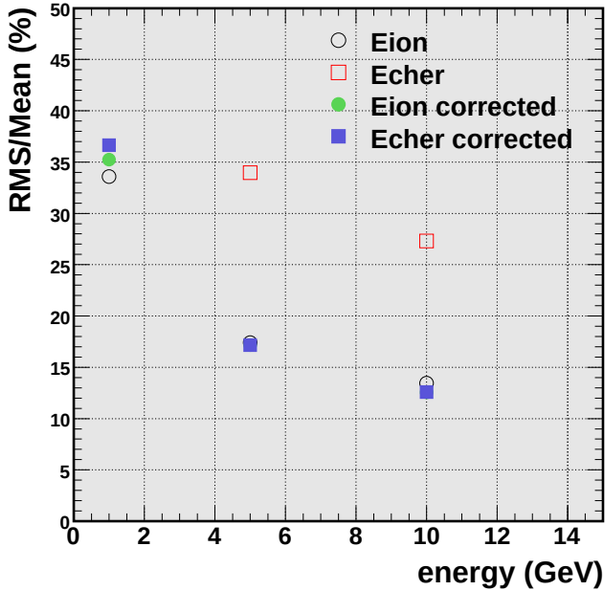
case abs:ioncher 0:1

corrected by π^- 5 GeV



case abs:ion:cher 5:18:2

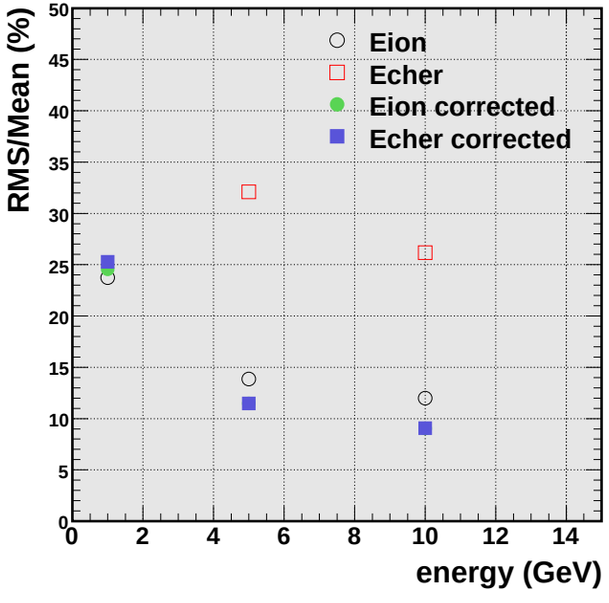
corrected by π^- 5 GeV



case abs:ion:cher 30:18:2

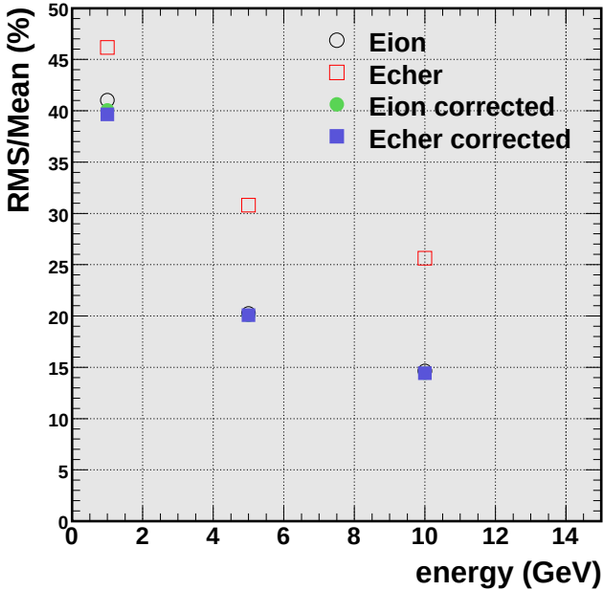
Energy resolution for single pions

corrected by π^- 5 GeV



case abs:ion:cher 5:18:2

corrected by π^- 5 GeV



case abs:ion:cher 5:2:18

Summary

- **energy correction**

  : "correcting Echer" is equivalent to "correcting Eion"
  i.e. same improvement on energy resolution

  : corrected Echer vs corrected Eion shows strong linearity,
  line has 45° slope and passes from (0,0)

- **dual readout and longitudinal segmentation**

  : balance of passive material and ionization and cherenkov
  active media is crucial

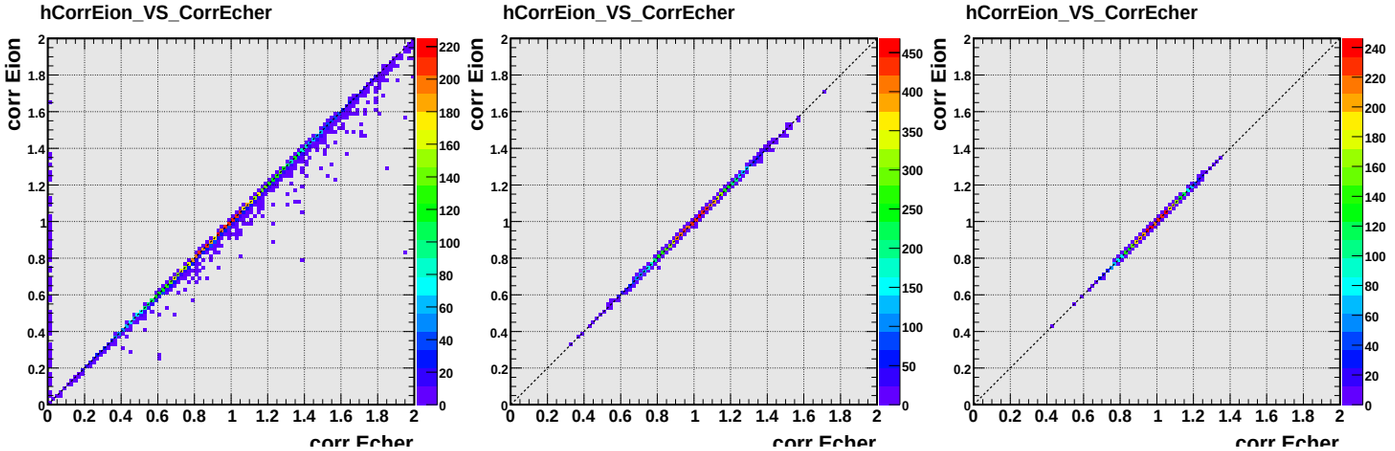
BACKUP SLIDES

sampling abs:ion:cher 30:18:2 mm

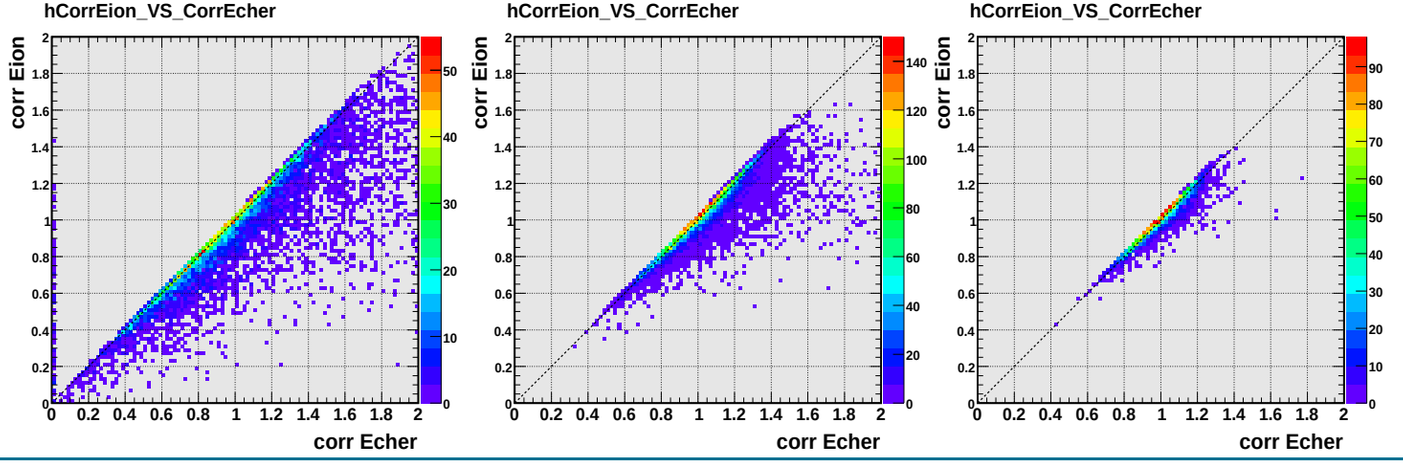
π^- 1 GeV π^- 5 GeV π^- 10 GeV

corrected by 1 GeV

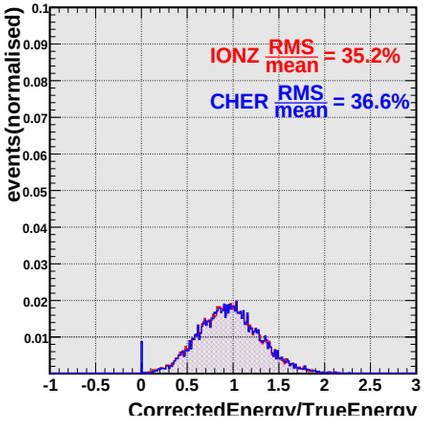
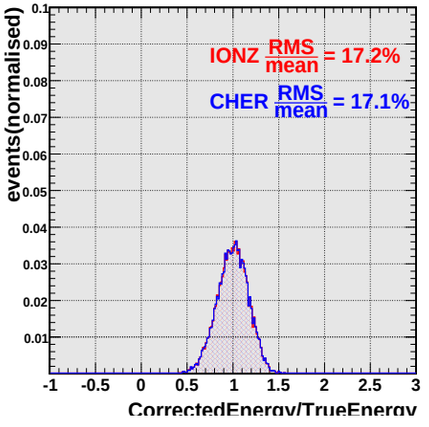
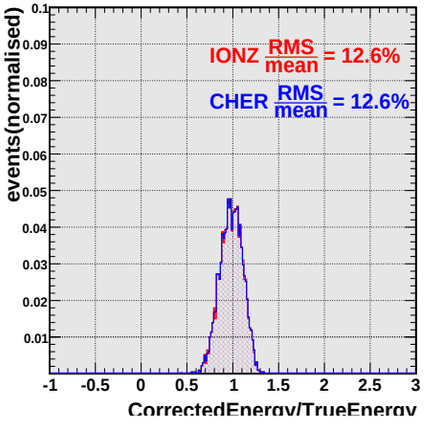
corrected by 5 GeV



corrected by 10 GeV



sampling abs:ion:cher 30:18:2 mm

	π^- 1 GeV	π^- 5 GeV	π^- 10 GeV
corrected by 1 GeV			
corrected by 5 GeV			
corrected by 10 GeV