Energy conservation & resolution plots

Simran
Lokesh Kumar
Panjab University, Chandigarh, INDIA

Details:

- Details for calorimeters:
  - EMCal: Material: Lead tungstate (PWO) crystals for $\eta < -2$; For the other areas several options exist (Scintillating glass, Lead glass, etc.) depending on the geometrical constraints.
  - Hcal: Material: [Steel absorber (inner hcal) , Aluminium absorber (outer hcal)]+ plastic scintillators
- Details for the slides:
  - Particles: e-, pi-, K-
  - Generated energy (ge) range: 0-30 GeV
  - Generated transverse momentum (gpT) range: 0-30 GeV (e-, pi-) and 0-40 GeV (K-)
  - Generated momentum (gp=sqrt(gpx*gpx+gpy*gpy+gpz*gpz)) range: 0-30GeV
  - Generated pseudorapidity (geta) range: -4 to 4
  - Generated phi (gphi) range: -pi to pi
  - Reconstructed energy cut on cluster energy (ce): 200 MeV
  - **Generated pseudorapidity (geta) cuts:**
    - **CEMC: -1.5 to 1.2**
    - **EEMC: -3.5 to -1.7**
    - **FEMC: 1.3 to 3.3**
    - **FHCAL: 1.2 to 3.5**
    - **HCALIN: -1.1 to 1.1**
    - **HCALOUT: -1.1 to 1.1**
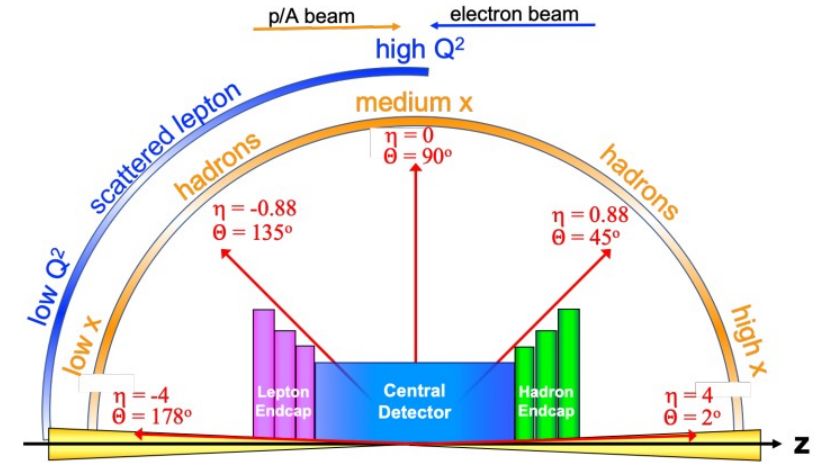
A schematc showing how hadrons and the scattered lepton for different x-Q^2 are distributed over the detector rapidity coverage. Reference: EIC Yellow Report

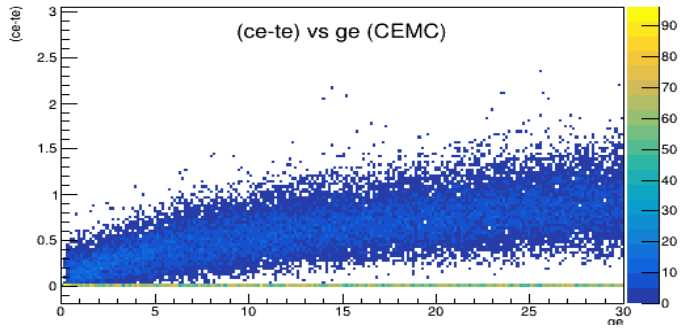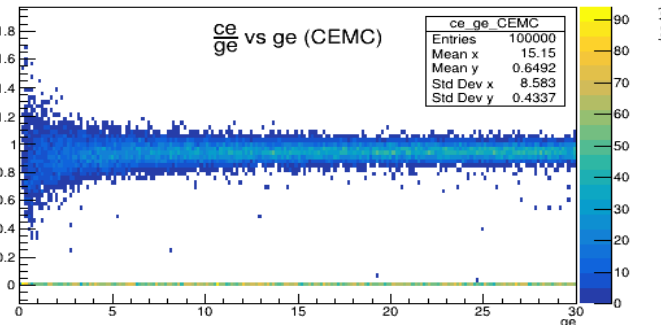(Reference: Electron-Ion Collider Detector Requirements and R&D Handbook Version 1.1)
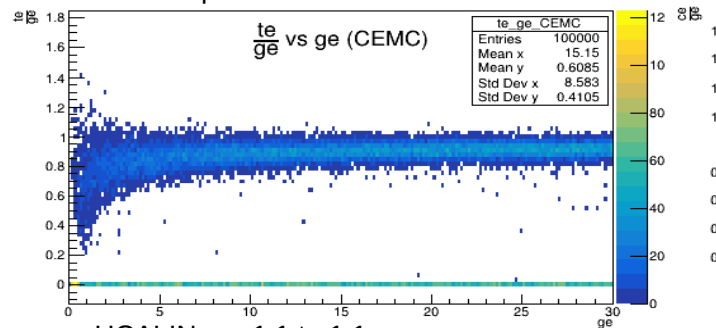
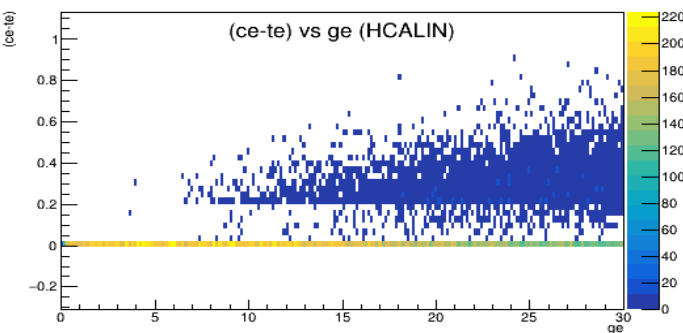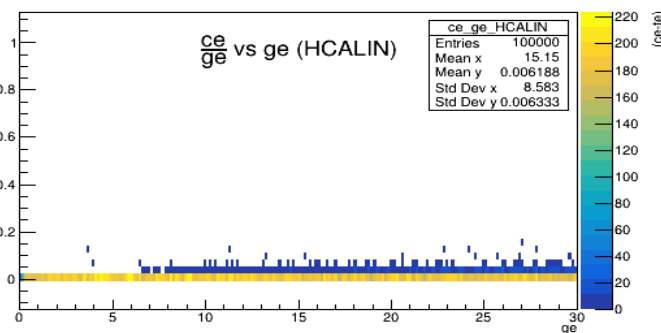# Energy conservation plots

te : tower energy
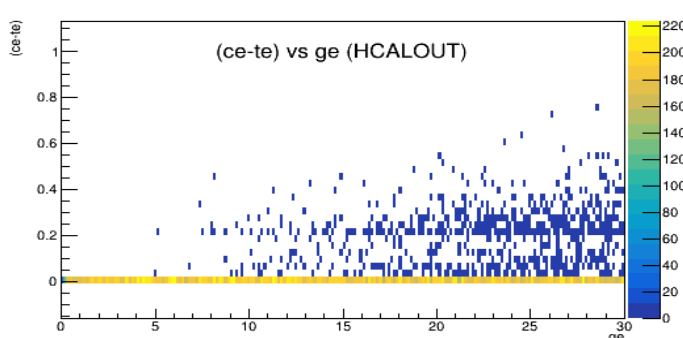
ce: cluster energy

ge: generated energy
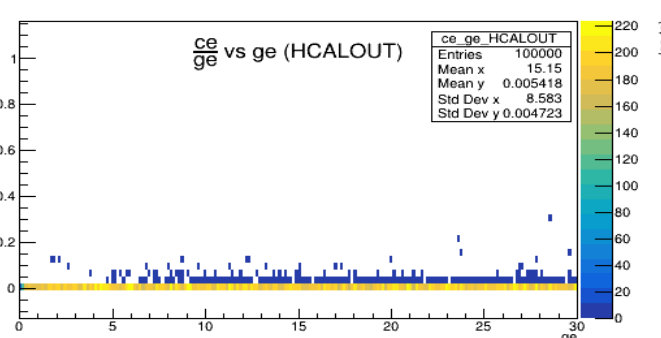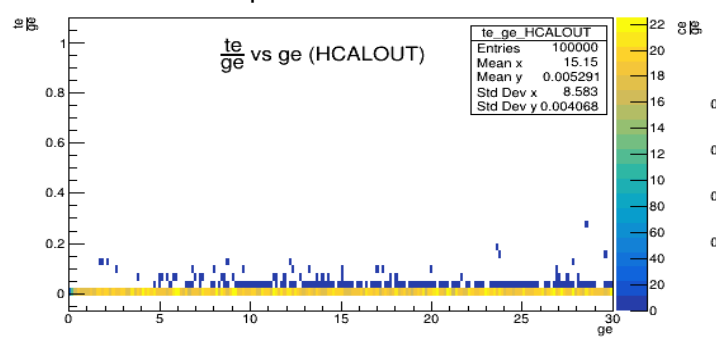
Electron

Electron

HCALIN+HCALOUT
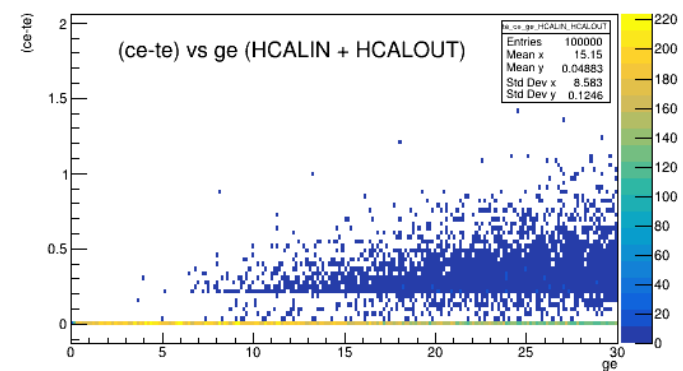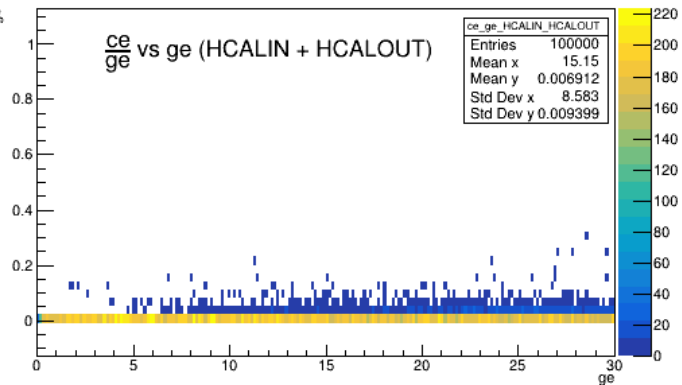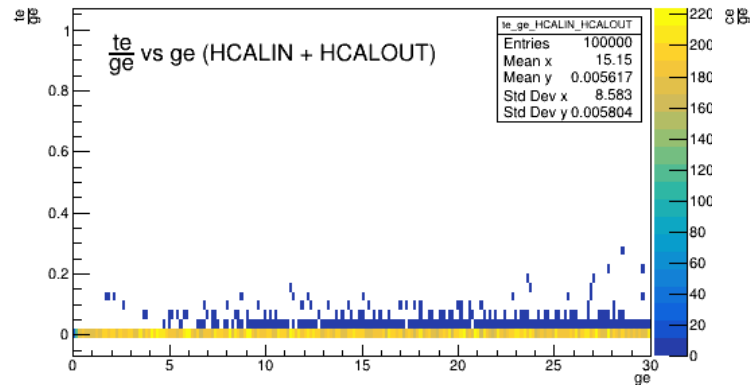
HCALIN+HCALOUT   (Add method)
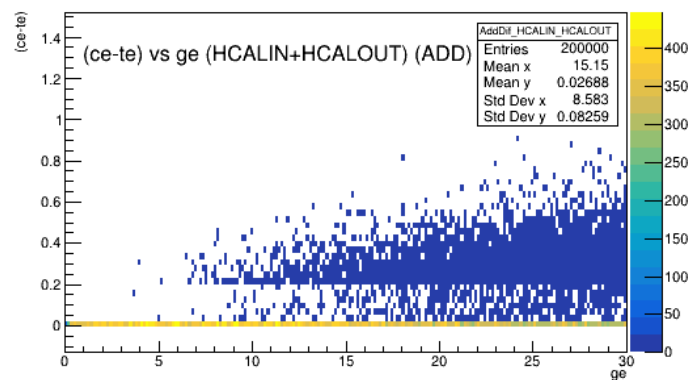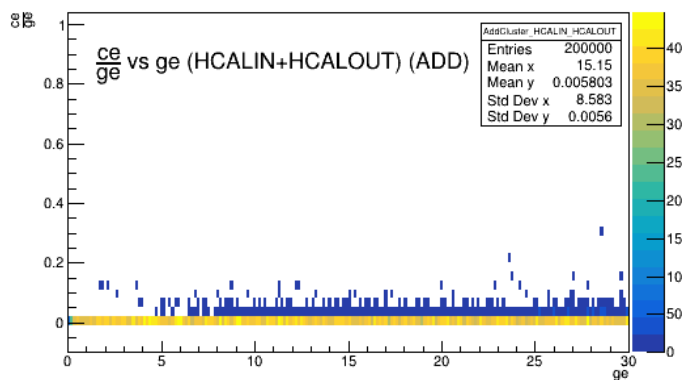
Electron

CEMC+HCALIN+HCALOUT

CEMC+HCALIN+HCALOUT (Add method)

Electron

FEMC: η: 1.3 to 3.3

FHCAL: η: 1.2 to 3.5

Electron

FEMC+FHCAL
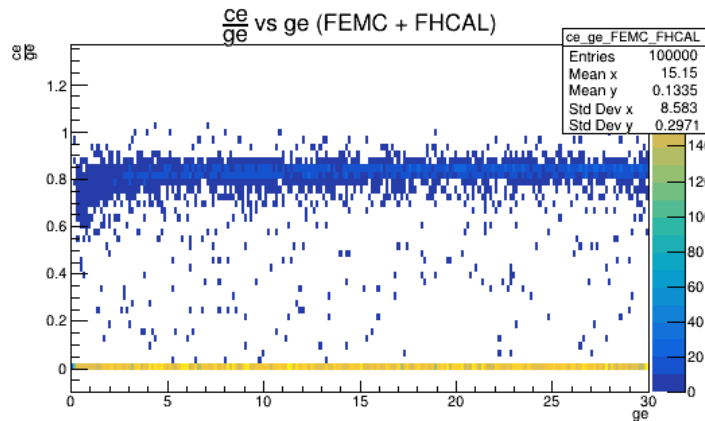
FEMC+FHCAL (Add method)
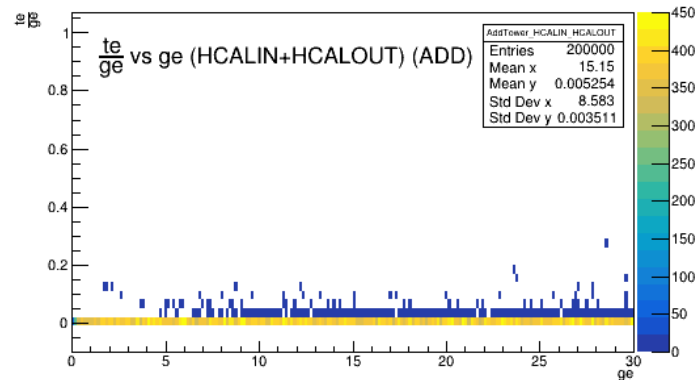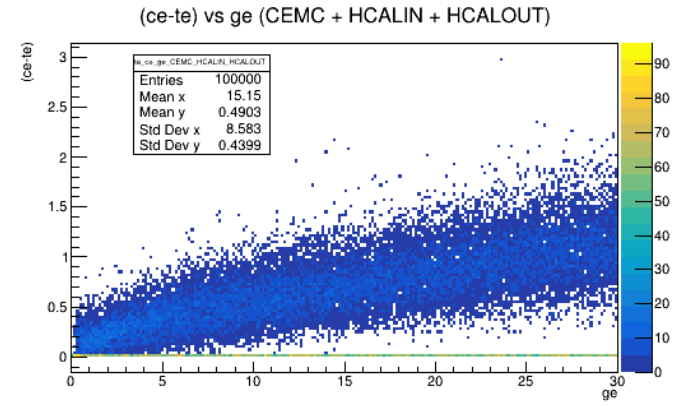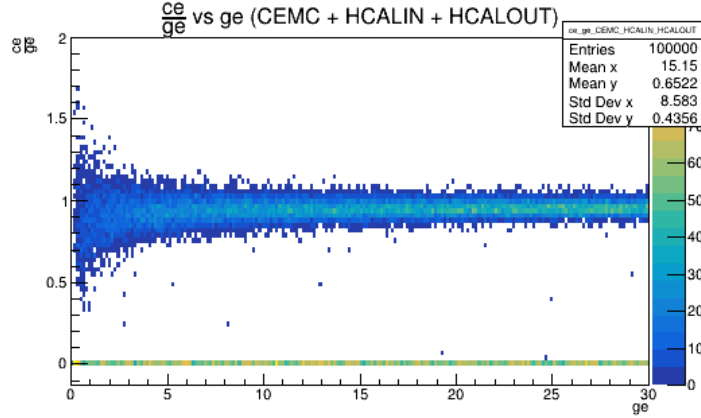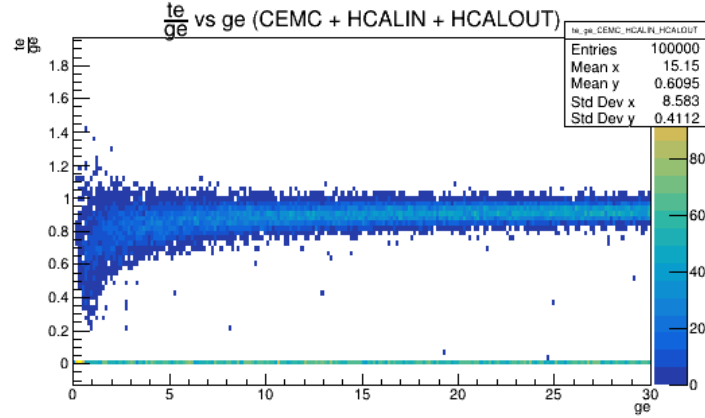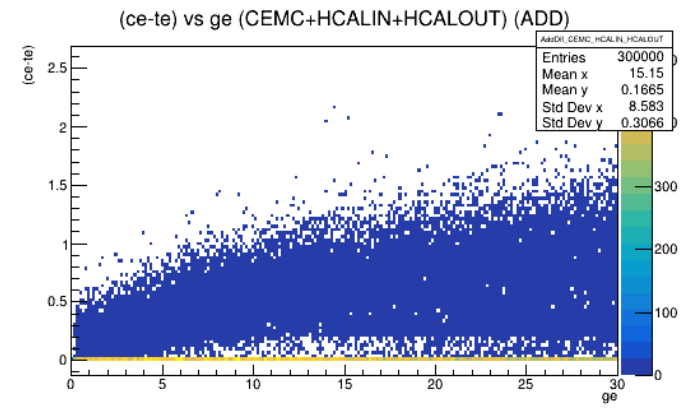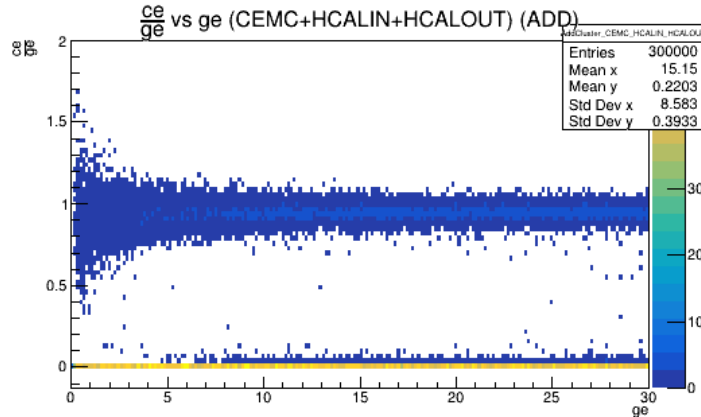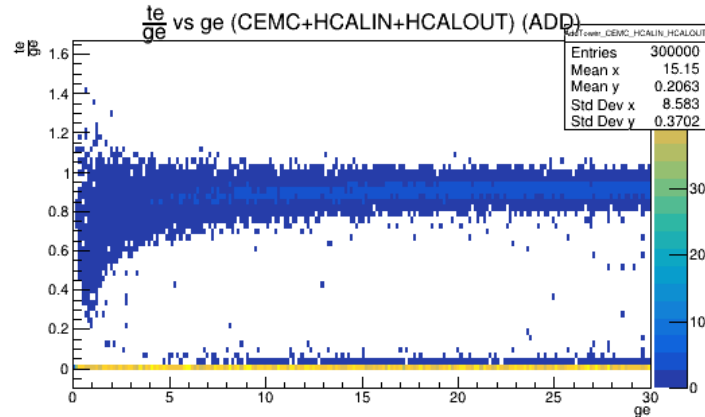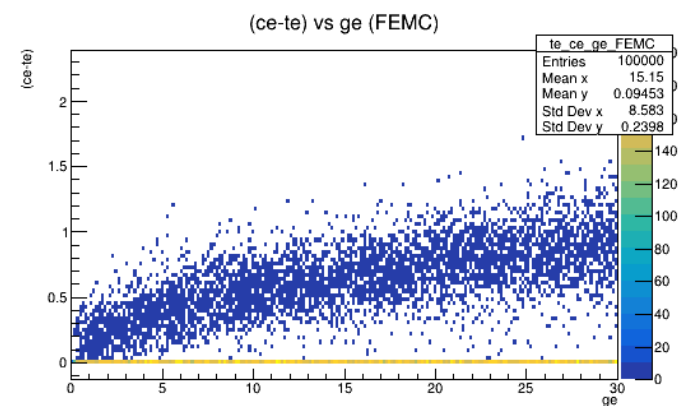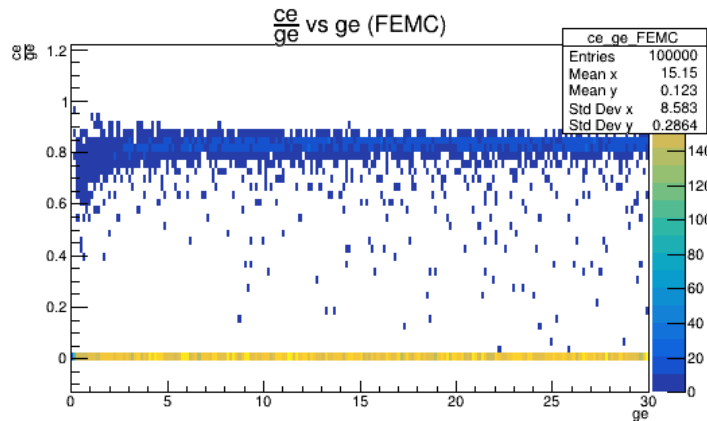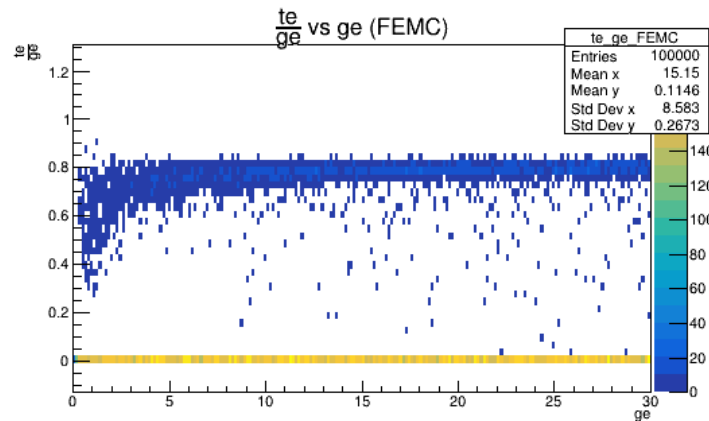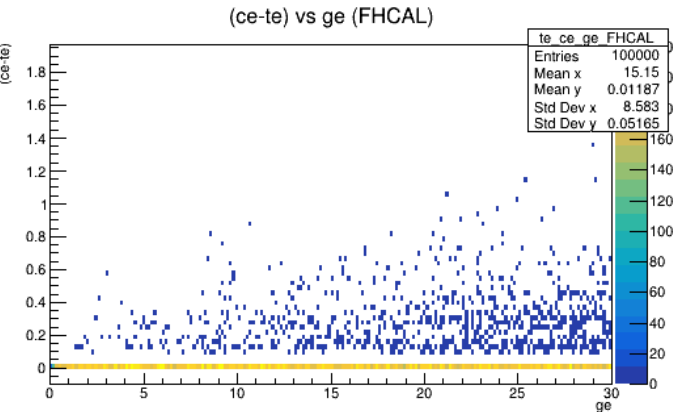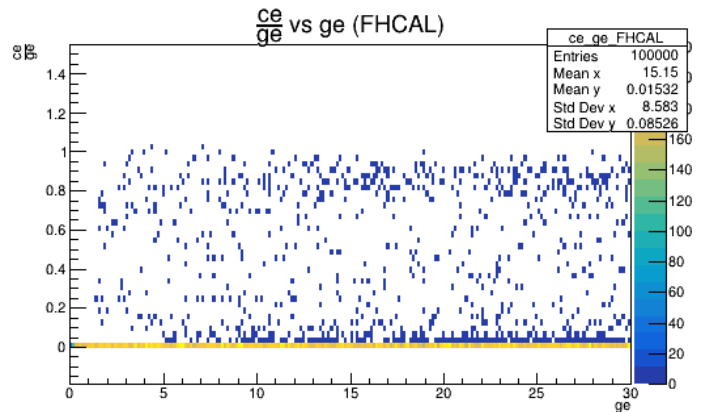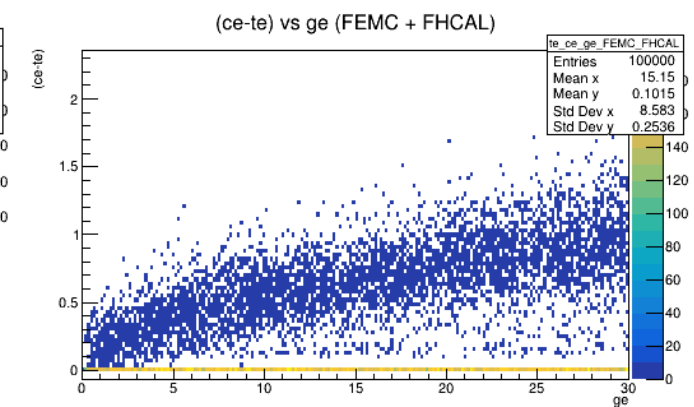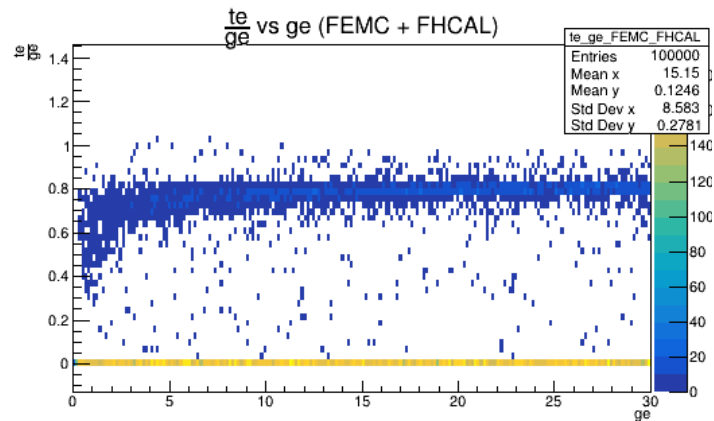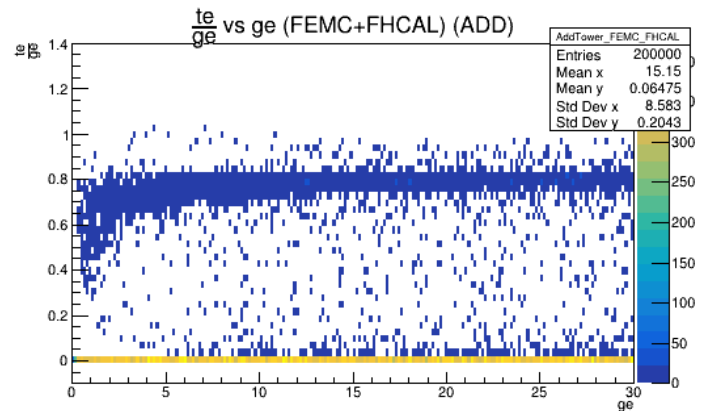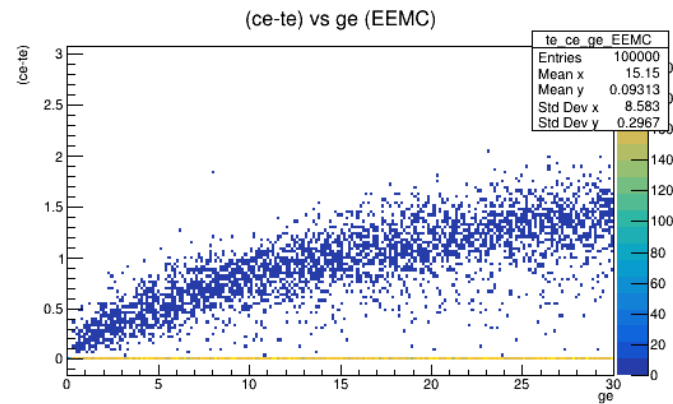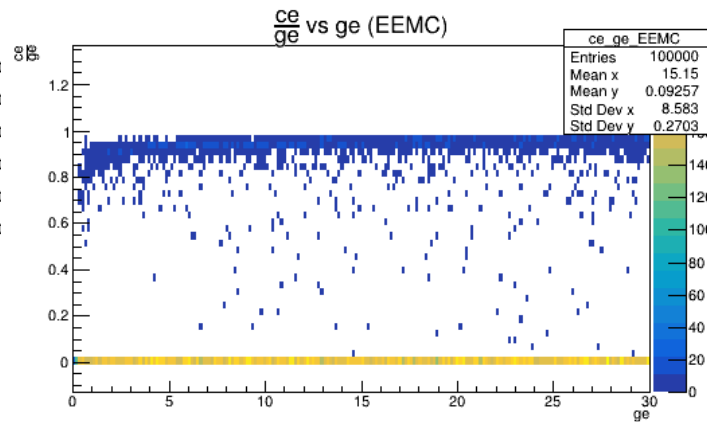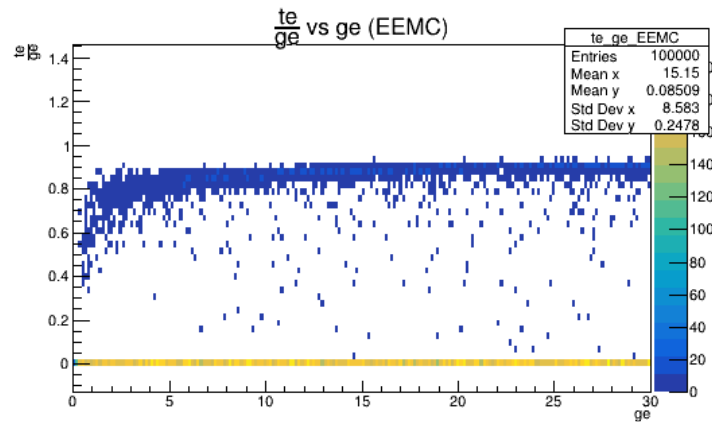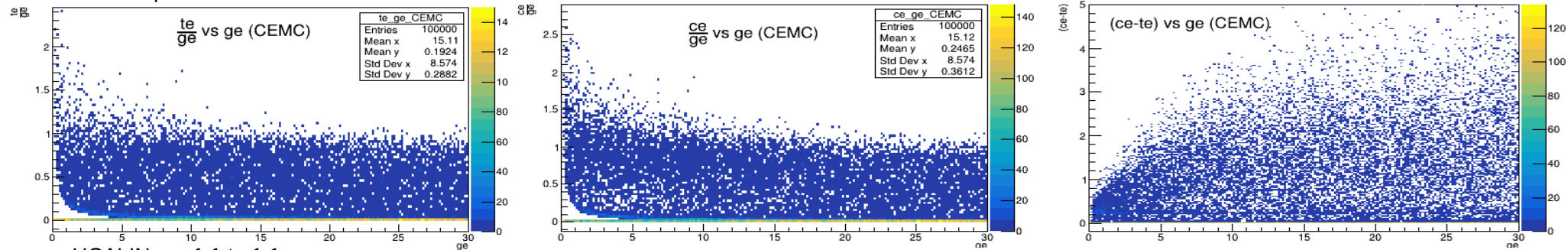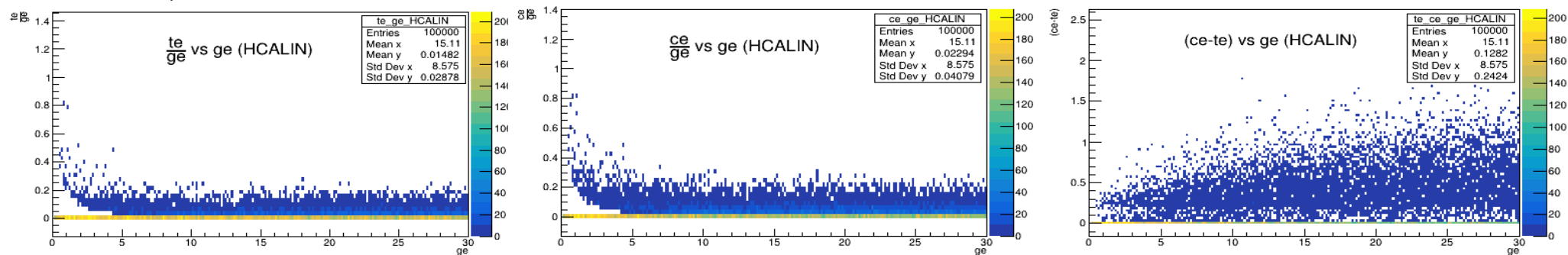
Electron

EEMC: η: -3.5 to -1.7

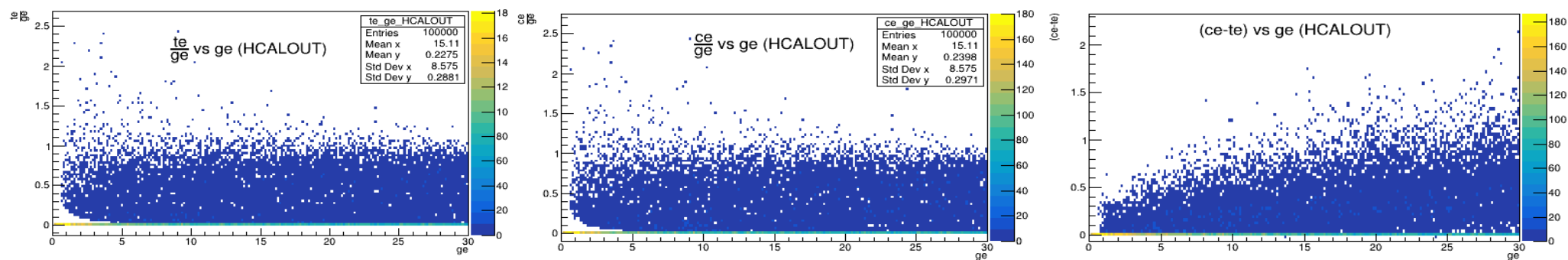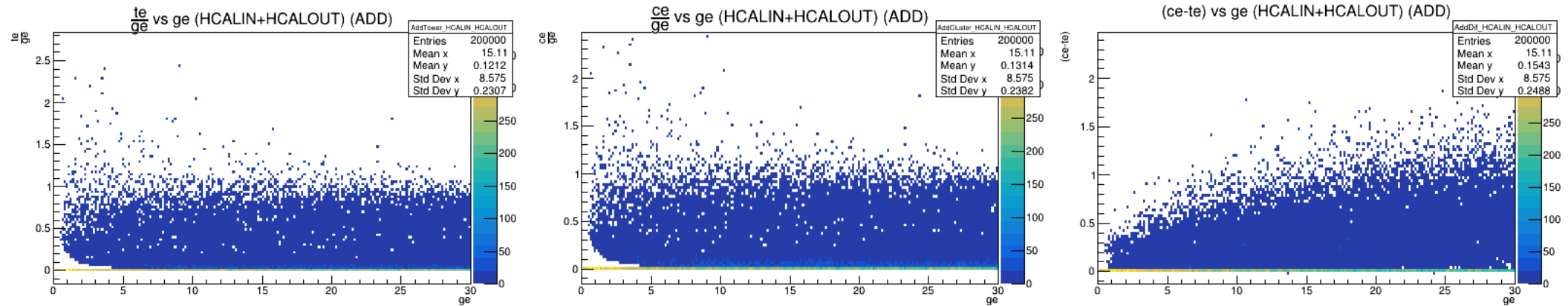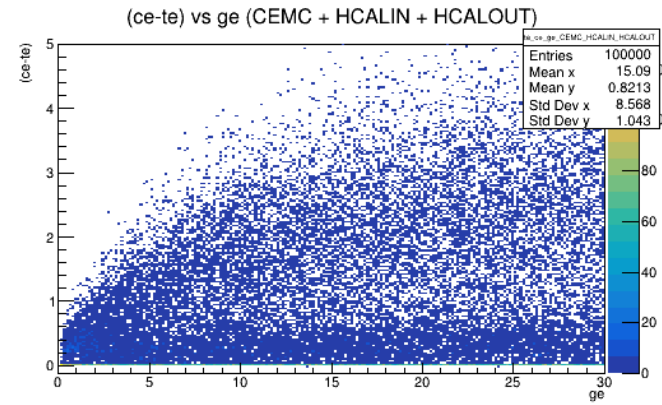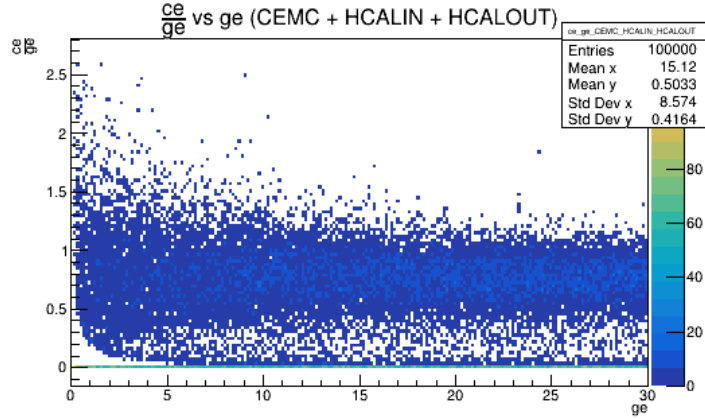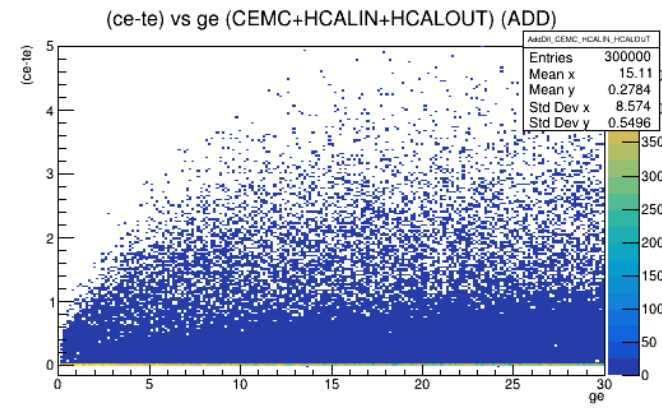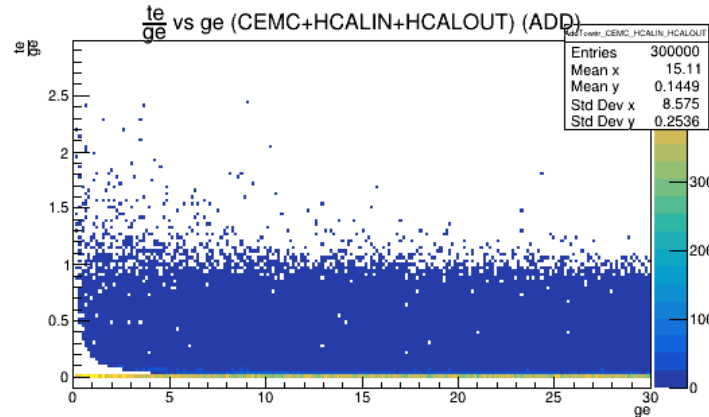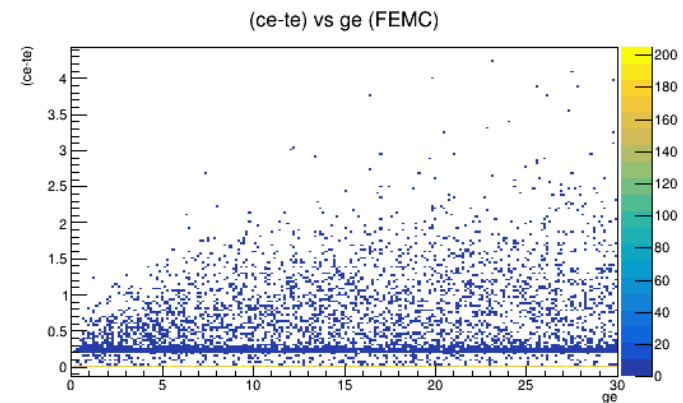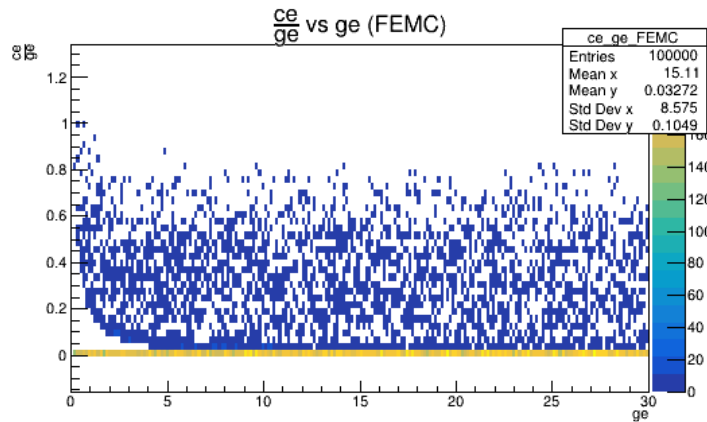# Pion

CEMC: η: -1.5 to 1.2

$\frac{te}{ge}$ vs ge (CEMC)

te_ge_CEMC	
Entries	100000
Mean x	15.11
Mean y	0.1924
Std Dev x	8.574
Std Dev y	0.2882

$\frac{ce}{ge}$ vs ge (CEMC)

ce_ge_CEMC	
Entries	100000
Mean x	15.12
Mean y	0.2465
Std Dev x	8.574
Std Dev y	0.3612

(ce-te) vs ge (CEMC)

HCALIN: η: -1.1 to 1.1

$\frac{te}{ge}$ vs ge (HCALIN)

te_ge_HCALIN	
Entries	100000
Mean x	15.11
Mean y	0.01482
Std Dev x	8.575
Std Dev y	0.02878

$\frac{ce}{ge}$ vs ge (HCALIN)

ce_ge_HCALIN	
Entries	100000
Mean x	15.11
Mean y	0.02294
Std Dev x	8.575
Std Dev y	0.04079

(ce-te) vs ge (HCALIN)

te_ce_ge_HCALIN	
Entries	100000
Mean x	15.11
Mean y	0.1282
Std Dev x	8.575
Std Dev y	0.2424

HCALOUT: η: -1.1 to 1.1

$\frac{te}{ge}$ vs ge (HCALOUT)

te_ge_HCALOUT	
Entries	100000
Mean x	15.11
Mean y	0.2275
Std Dev x	8.575
Std Dev y	0.2881

$\frac{ce}{ge}$ vs ge (HCALOUT)

ce_ge_HCALOUT	
Entries	100000
Mean x	15.11
Mean y	0.2398
Std Dev x	8.575
Std Dev y	0.2971

(ce-te) vs ge (HCALOUT)

Pion

HCALIN+HCALOUT
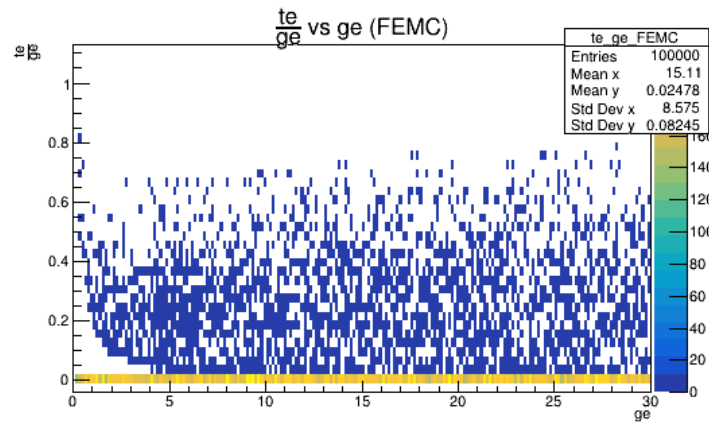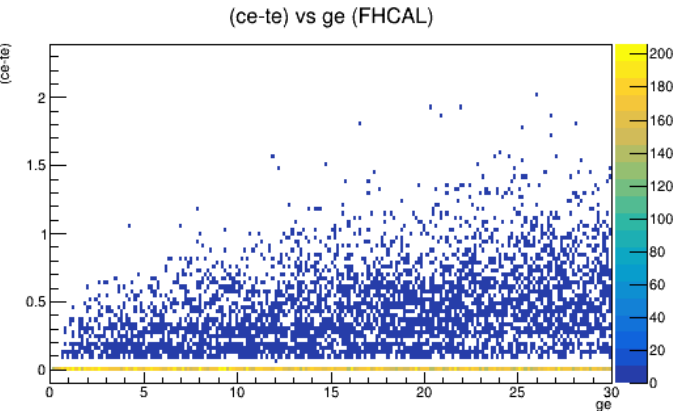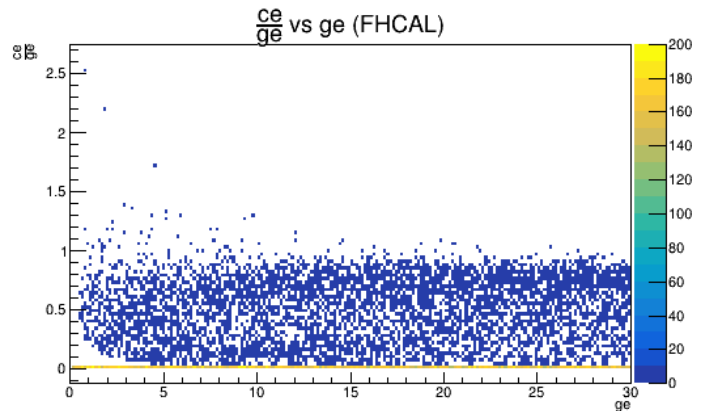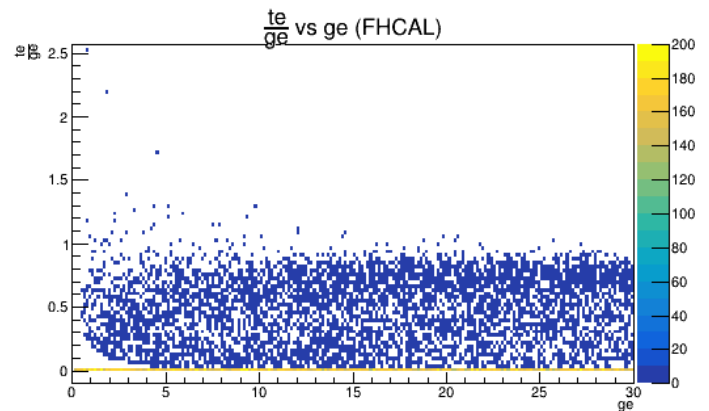

HCALIN+HCALOUT   (Add method)

Pion

CEMC+HCALIN+HCALOUT
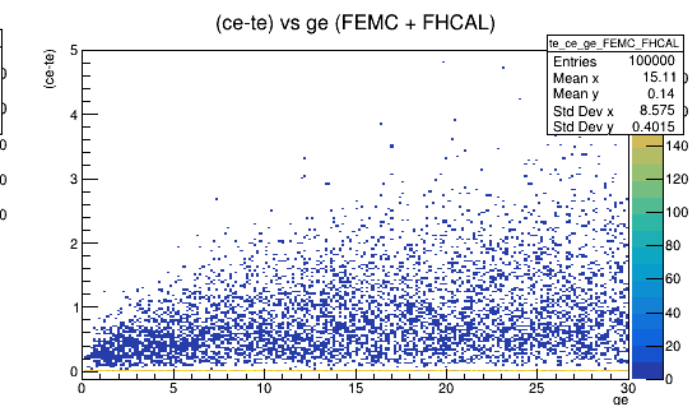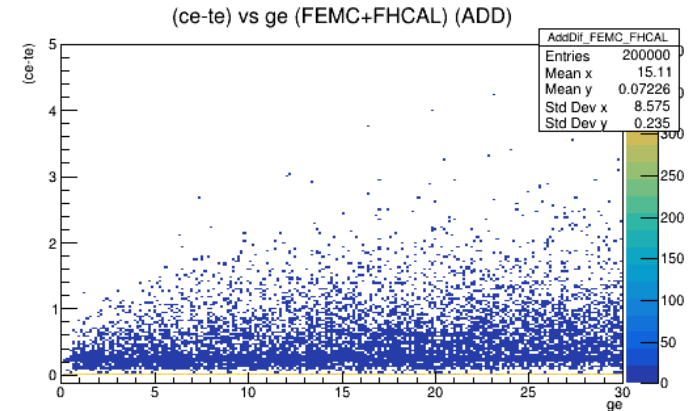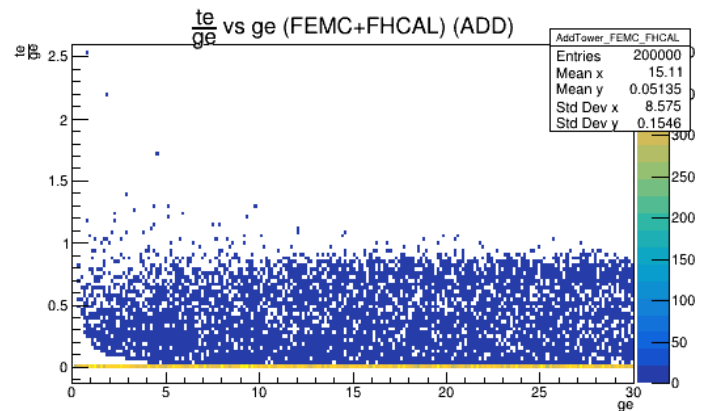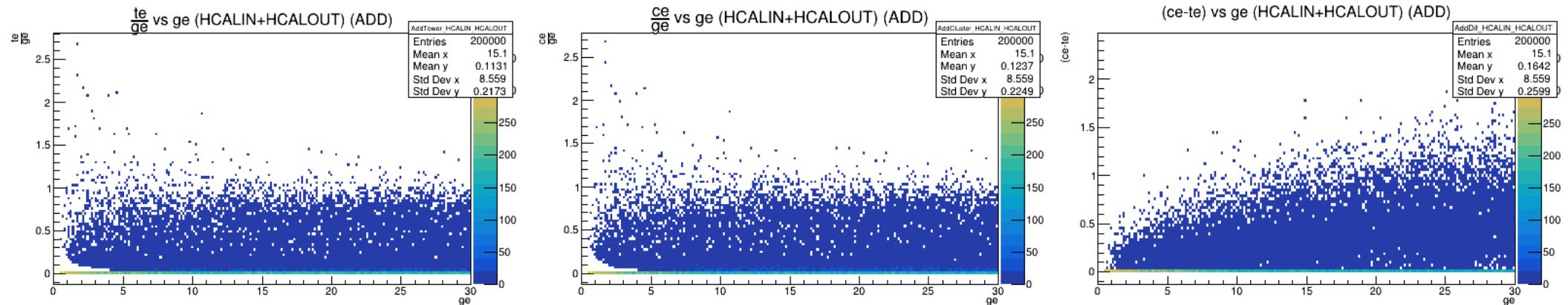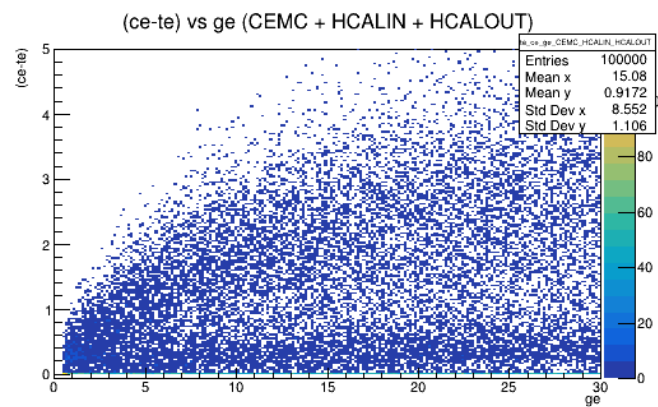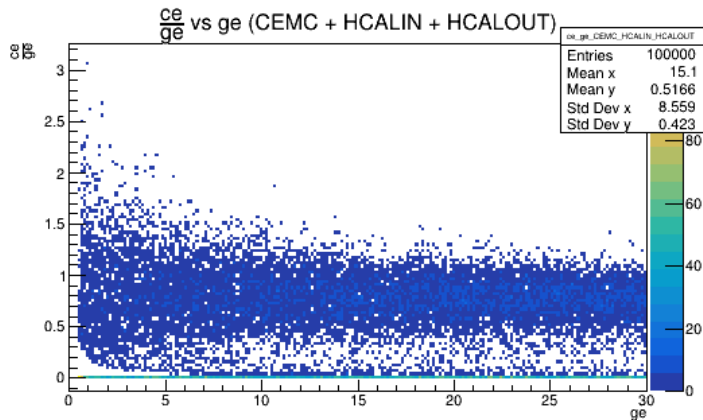

CEMC+HCALIN+HCALOUT (Add method)

Pion

FEMC: η: 1.3 to 3.3

$\frac{te}{ge}$ vs ge (FEMC)

te_ge_FEMC	
Entries	100000
Mean x	15.11
Mean y	0.02478
Std Dev x	8.575
Std Dev y	0.08245

$\frac{ce}{ge}$ vs ge (FEMC)

ce_ge_FEMC	
Entries	100000
Mean x	15.11
Mean y	0.03272
Std Dev x	8.575
Std Dev y	0.1049

(ce-te) vs ge (FEMC)

FHCAL: η: 1.2 to 3.5

$\frac{te}{ge}$ vs ge (FHCAL)

$\frac{ce}{ge}$ vs ge (FHCAL)

(ce-te) vs ge (FHCAL)
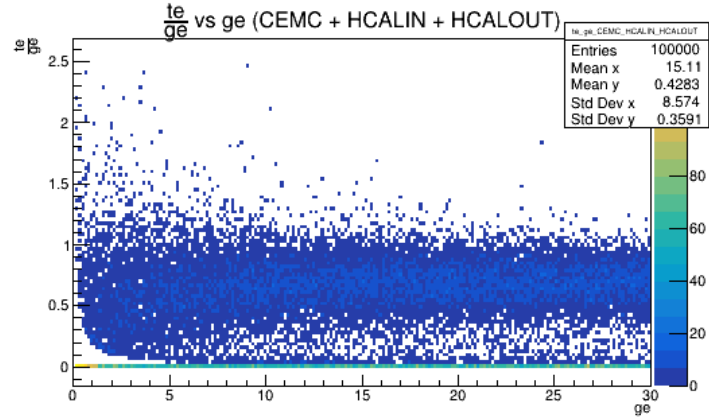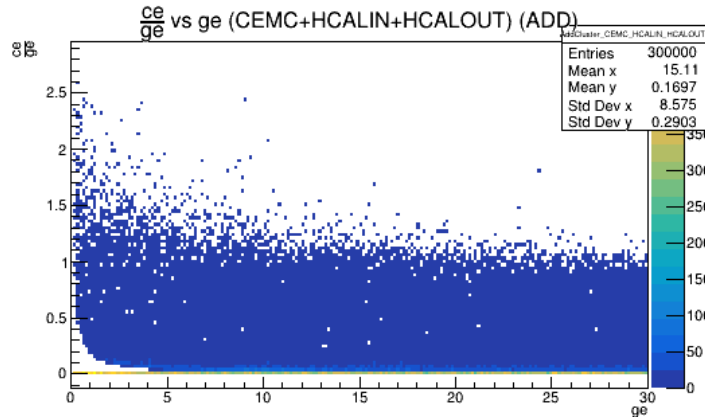
Pion

FEMC+FHCAL

FEMC+FHCAL (Add method)

Pion

EEMC: η: -3.5 to -1.7

Kaon

CEMC: η: -1.5 to 1.2

$\frac{te}{ge}$ vs ge (CEMC)

te_ge_CEMC	
Entries	100000
Mean x	15.1
Mean y	0.2149
Std Dev x	8.559
Std Dev y	0.2966

$\frac{ce}{ge}$ vs ge (CEMC)

ce_ge_CEMC	
Entries	100000
Mean x	15.1
Mean y	0.275
Std Dev x	8.559
Std Dev y	0.3735

(ce-te) vs ge (CEMC)

HCALIN: η: -1.1 to 1.1

$\frac{te}{ge}$ vs ge (HCALIN)

te_ge_HCALIN	
Entries	100000
Mean x	15.1
Mean y	0.01505
Std Dev x	8.559
Std Dev y	0.02731

$\frac{ce}{ge}$ vs ge (HCALIN)

ce_ge_HCALIN	
Entries	100000
Mean x	15.1
Mean y	0.0239
Std Dev x	8.559
Std Dev y	0.03983

(ce-te) vs ge (HCALIN)

te_ce_ge_HCALIN	
Entries	100000
Mean x	15.1
Mean y	0.1426
Std Dev x	8.559
Std Dev y	0.2577

HCALOUT: η: -1.1 to 1.1

$\frac{te}{ge}$ vs ge (HCALOUT)

te_ge_HCALOUT	
Entries	100000
Mean x	15.1
Mean y	0.2111
Std Dev x	8.559
Std Dev y	0.2729

$\frac{ce}{ge}$ vs ge (HCALOUT)

ce_ge_HCALOUT	
Entries	100000
Mean x	15.1
Mean y	0.2235
Std Dev x	8.559
Std Dev y	0.2822

(ce-te) vs ge (HCALOUT)

Kaon

HCALIN+HCALOUT

HCALIN+HCALOUT   (Add method)

Kaon

CEMC+HCALIN+HCALOUT
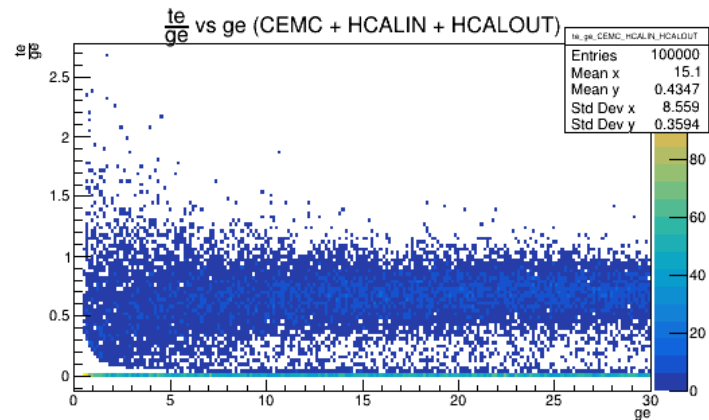
CEMC+HCALIN+HCALOUT (Add method)

Kaon

FEMC: η: 1.3 to 3.3
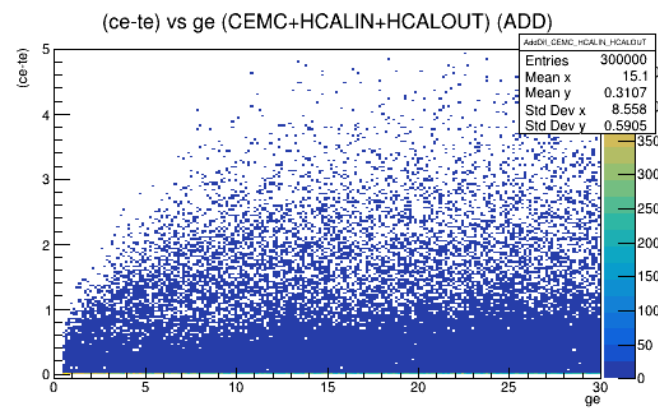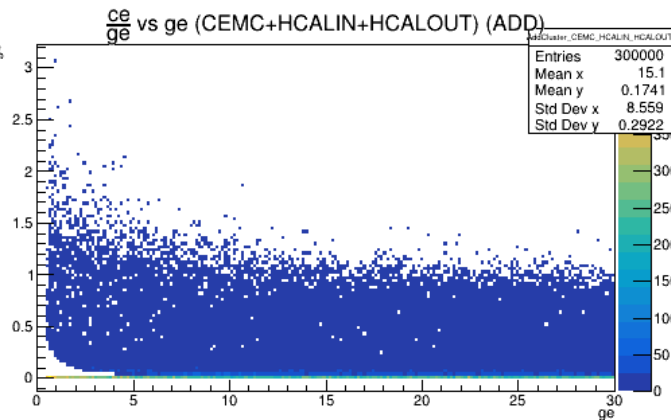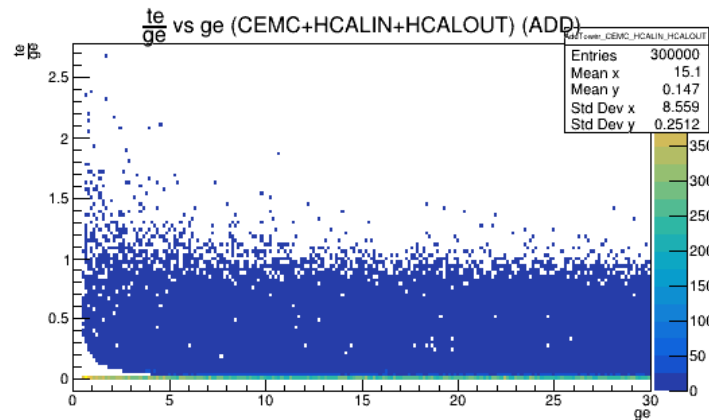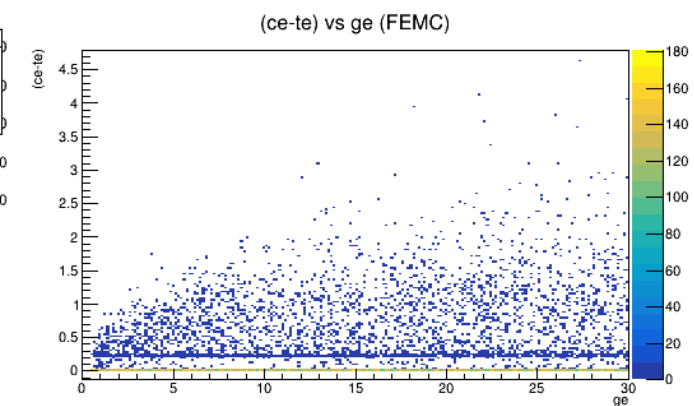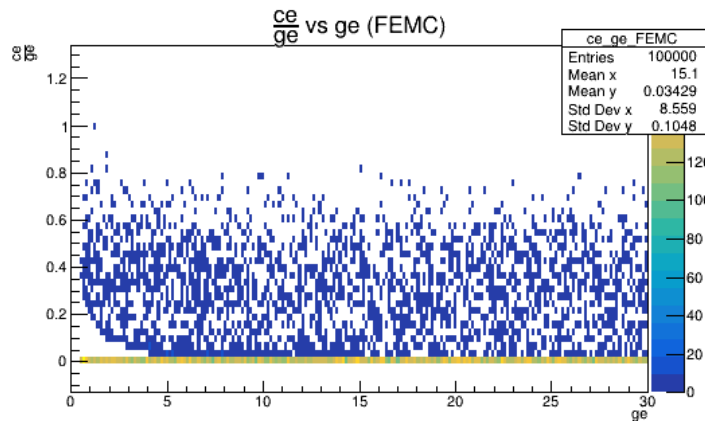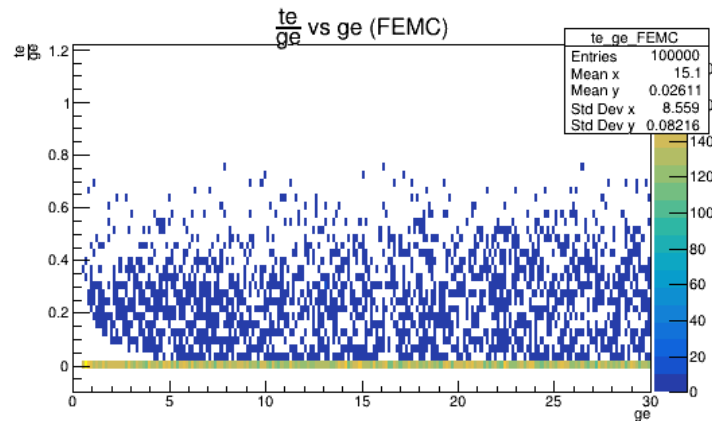
FHCAL: η: 1.2 to 3.5
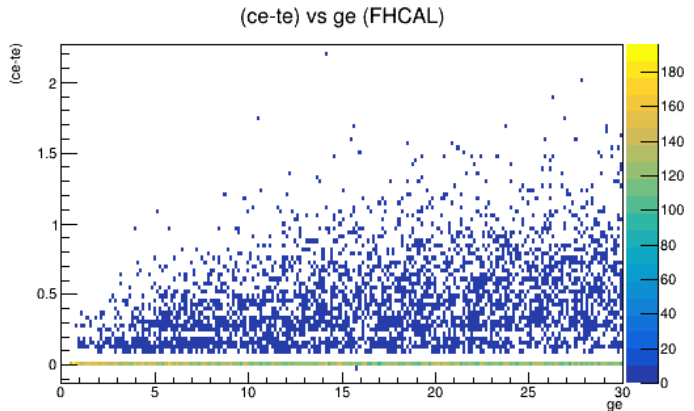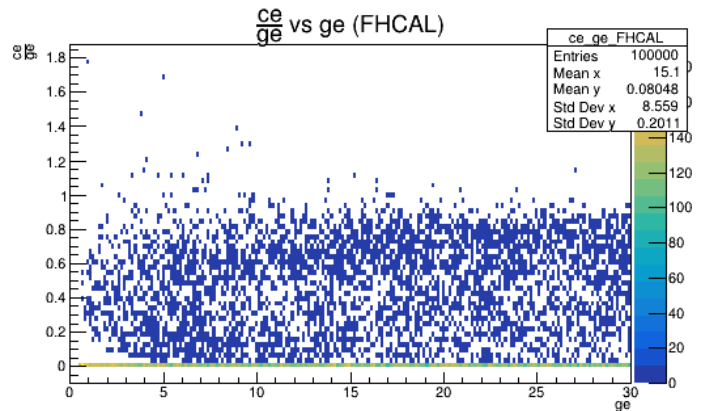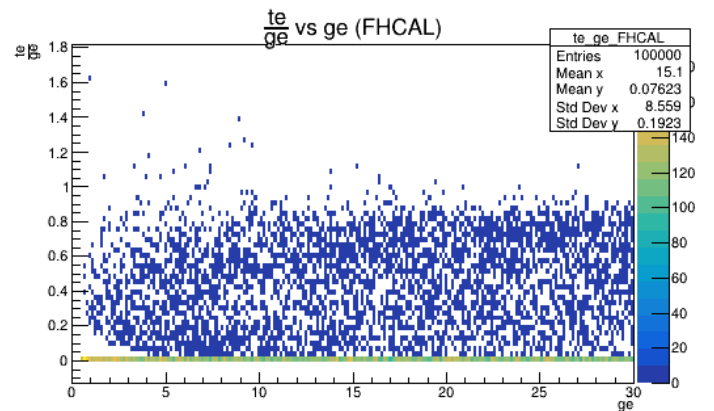
Kaon

FEMC+FHCAL
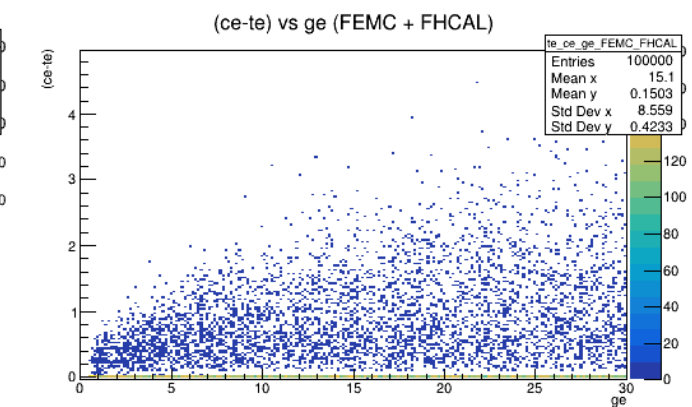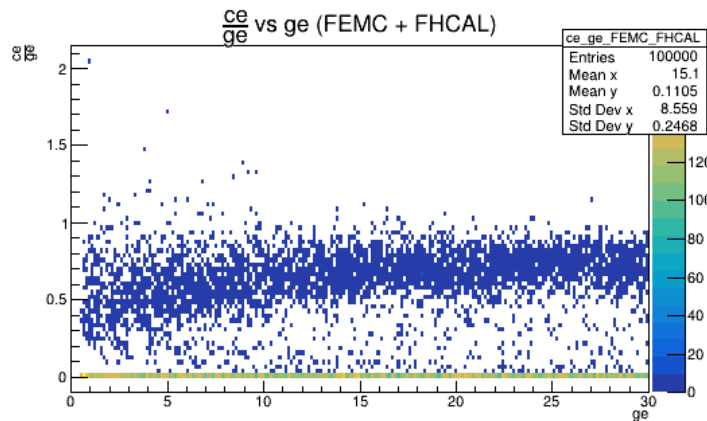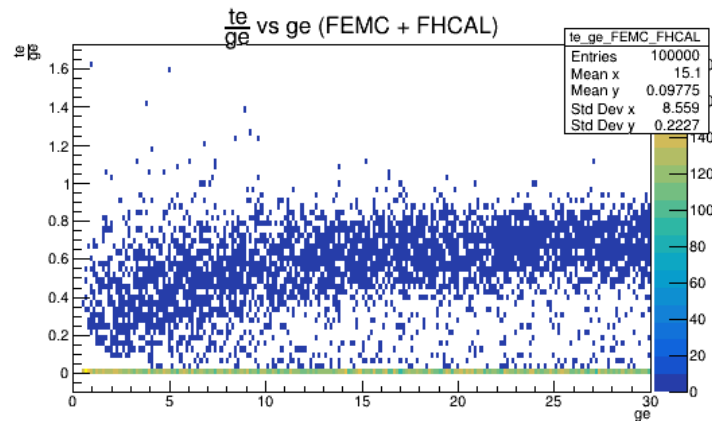
FEMC+FHCAL (Add method)
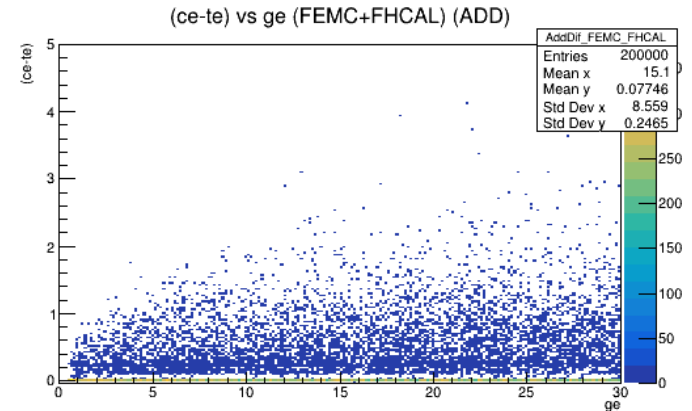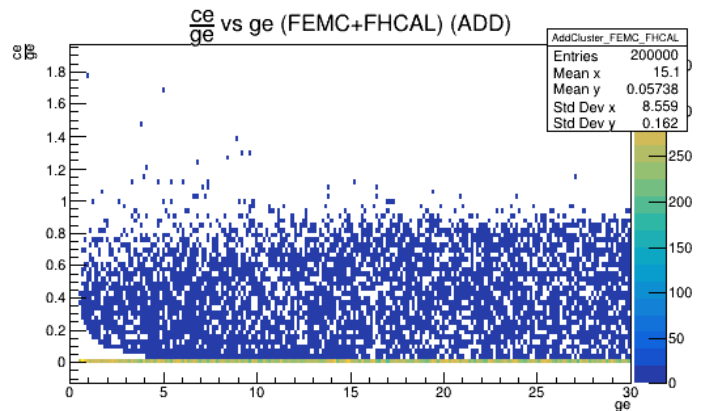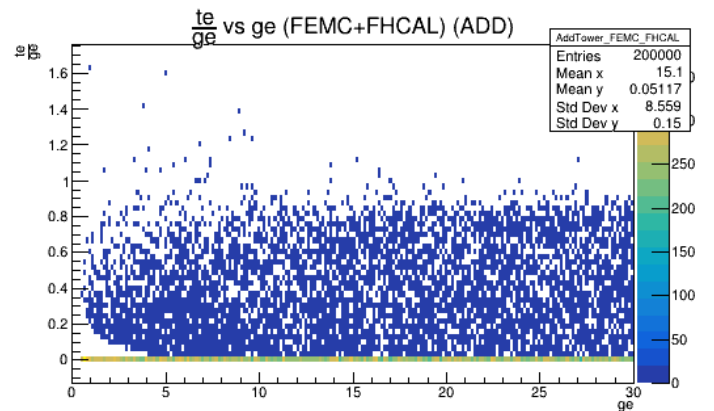
Kaon

EEMC: η: -3.5 to -1.7
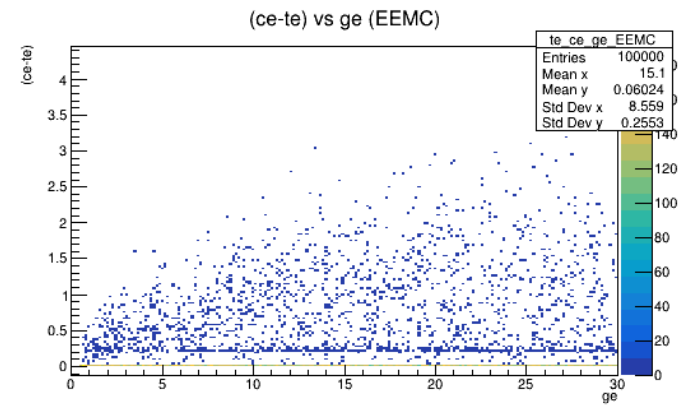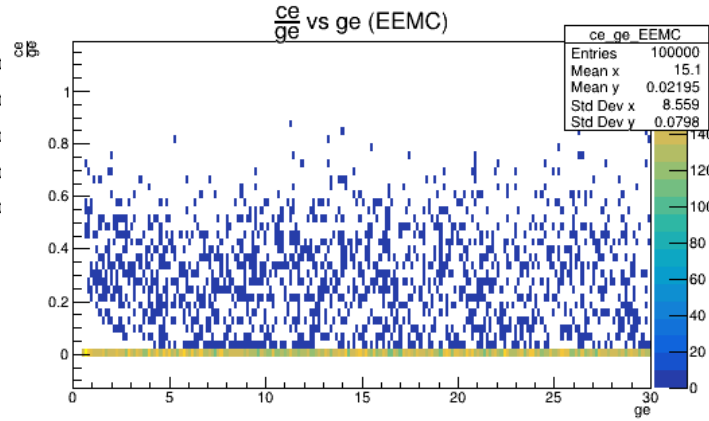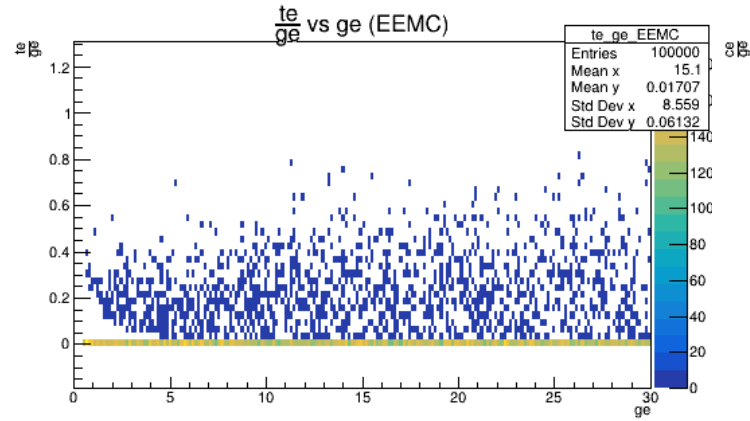
Energy Resolution plots

Electron

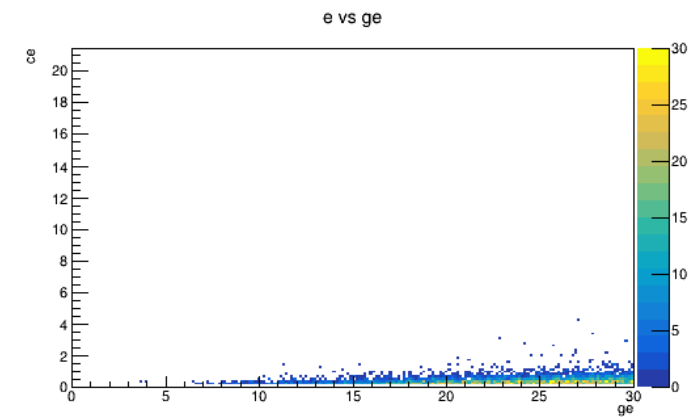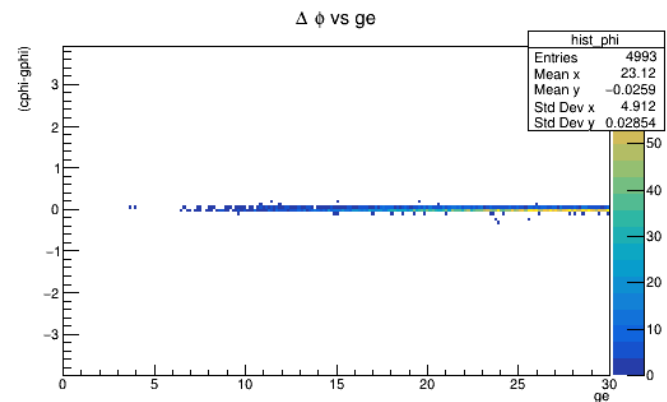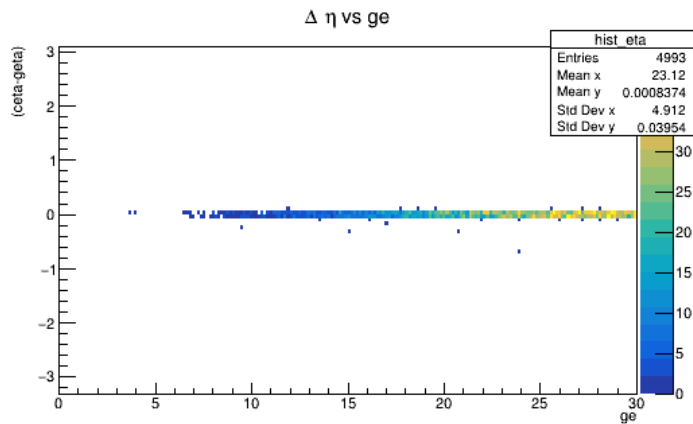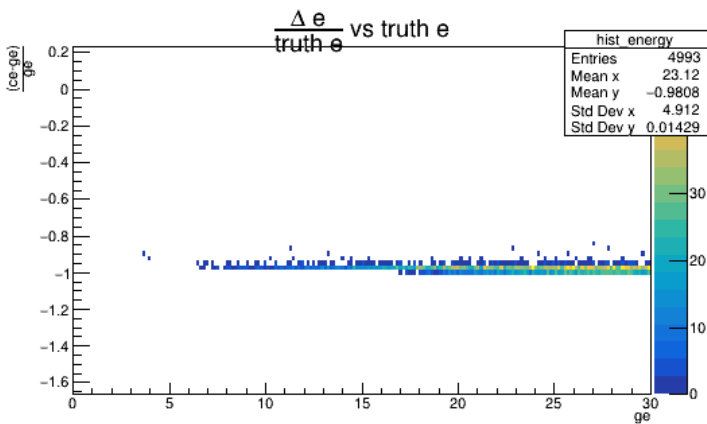CEMC: η: -1.5 to 1.2
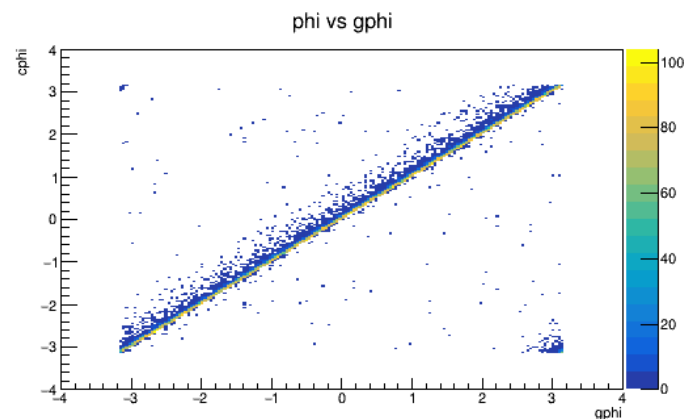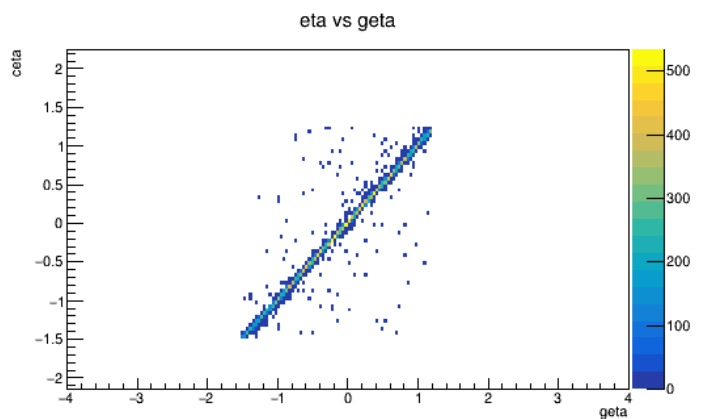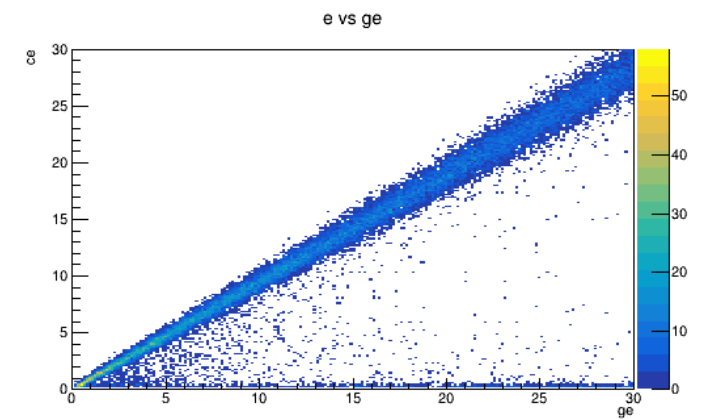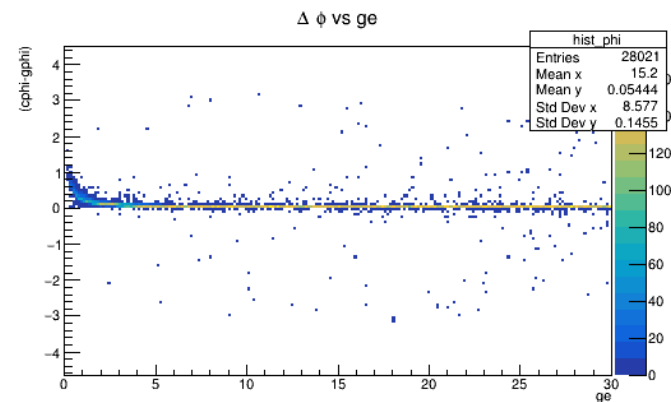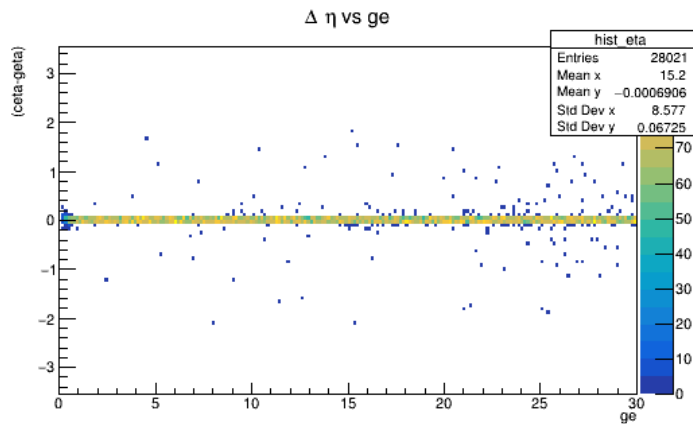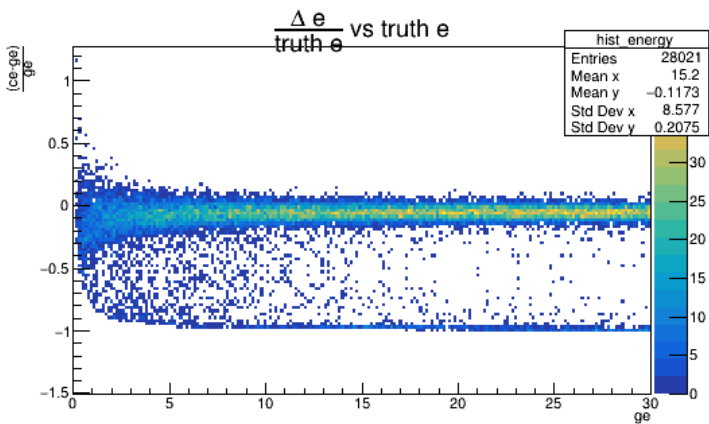
Electron

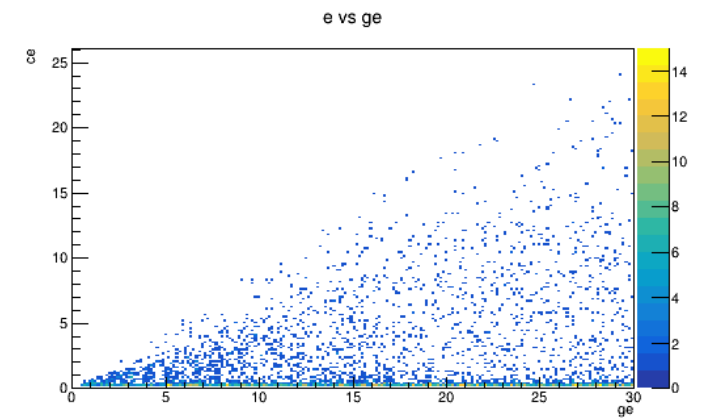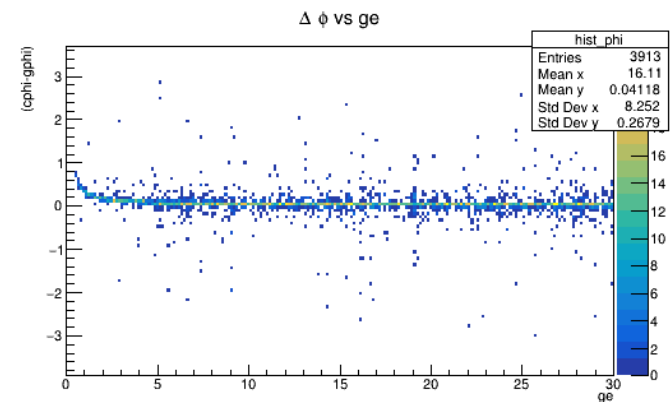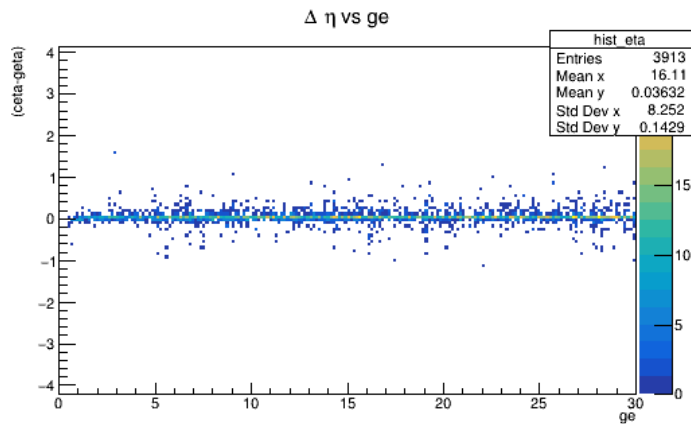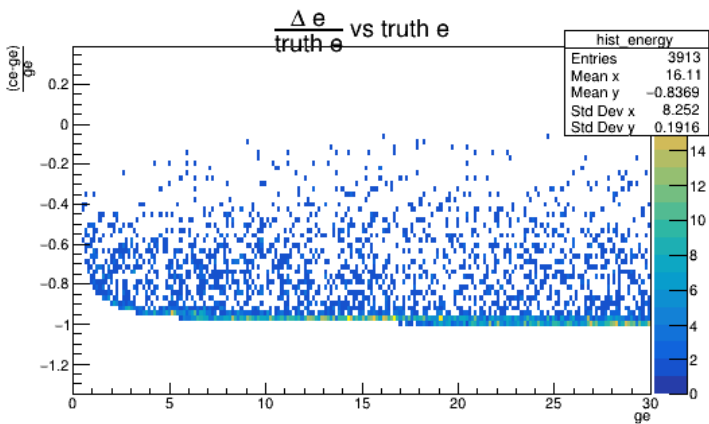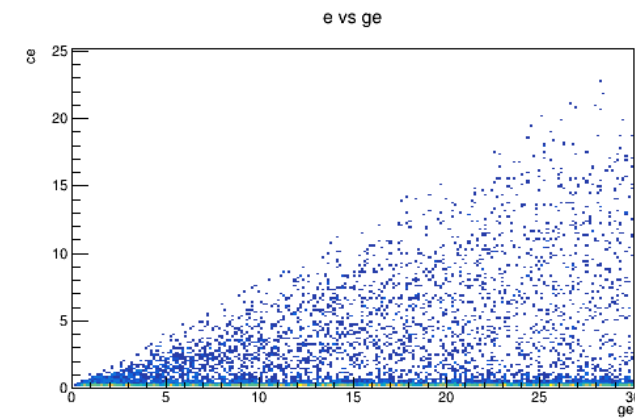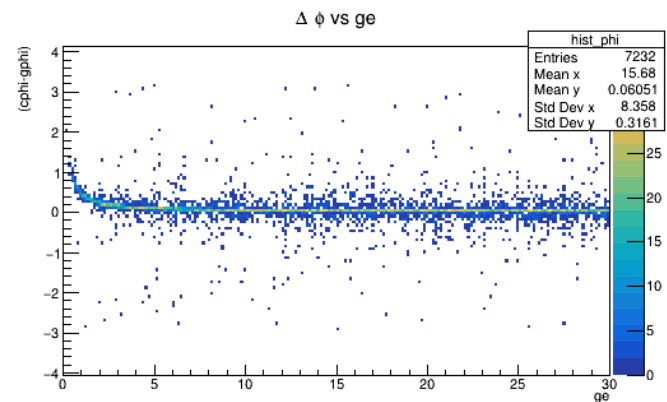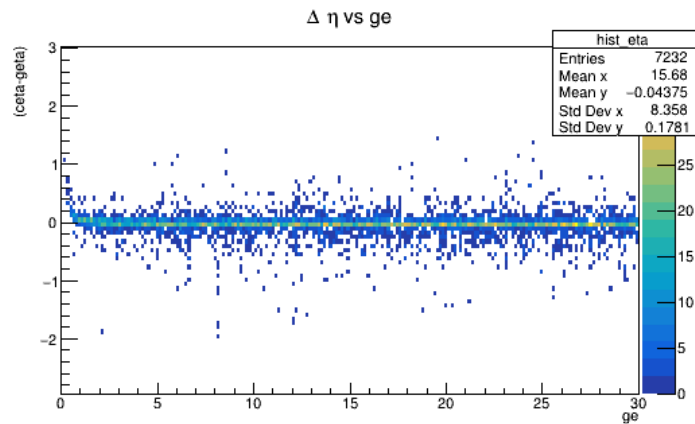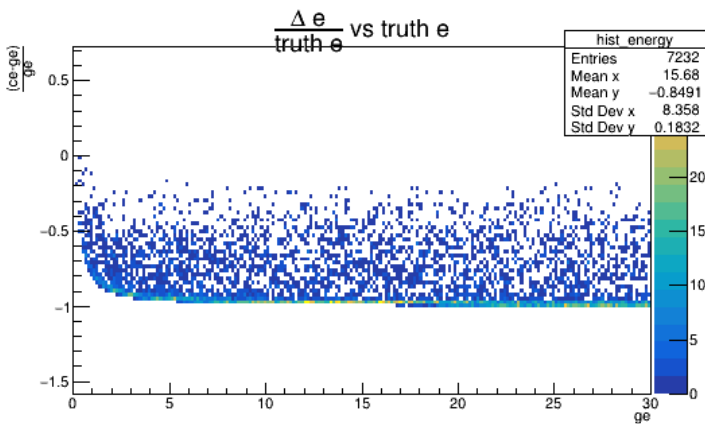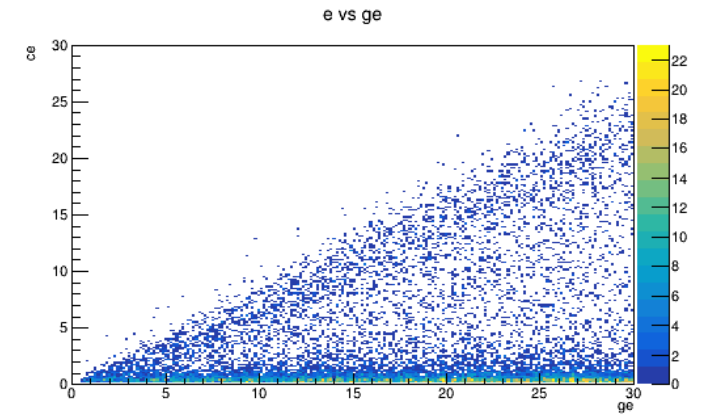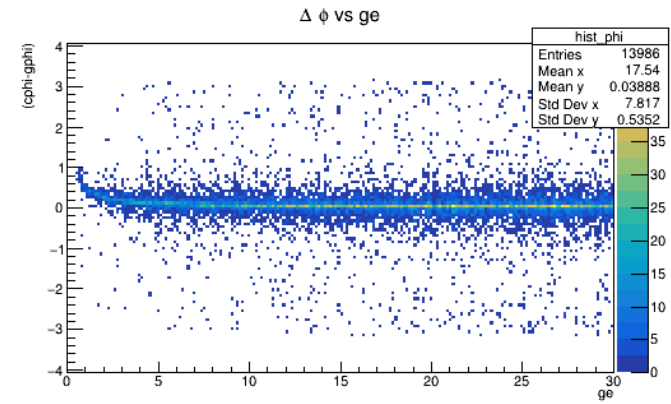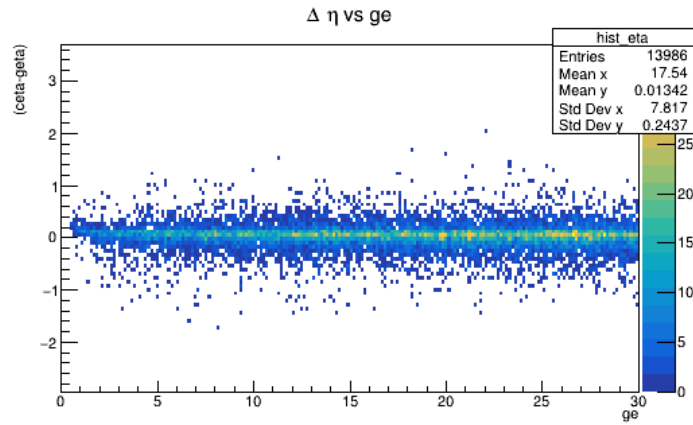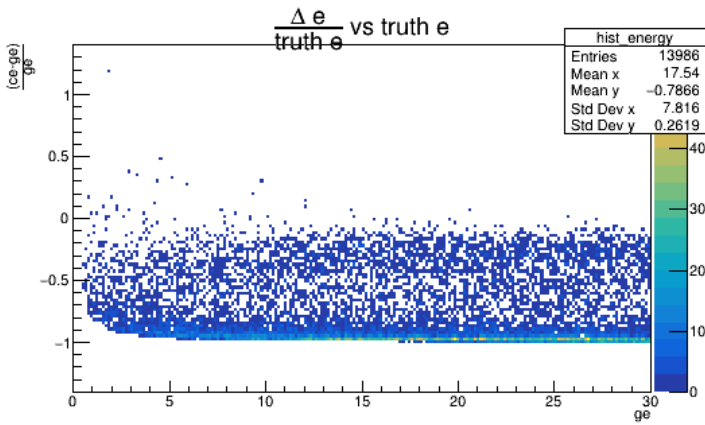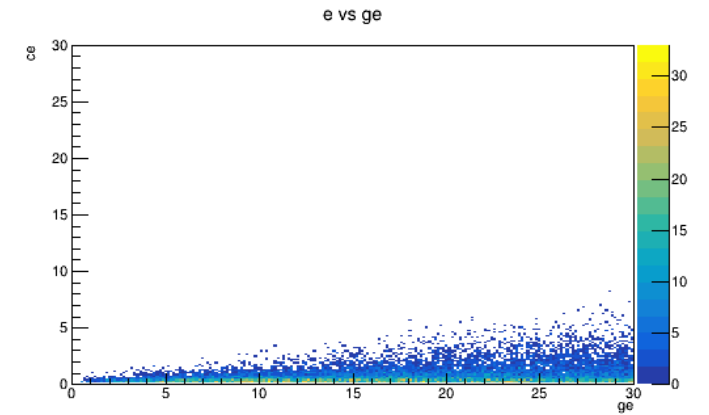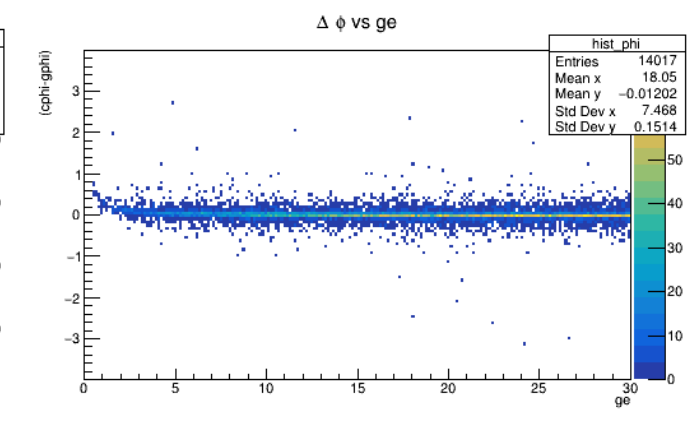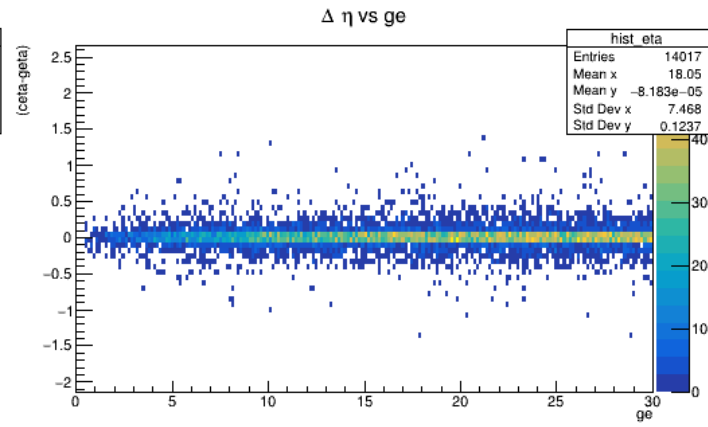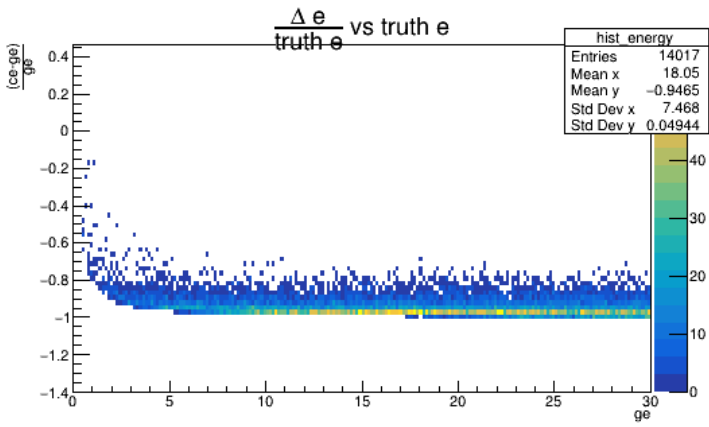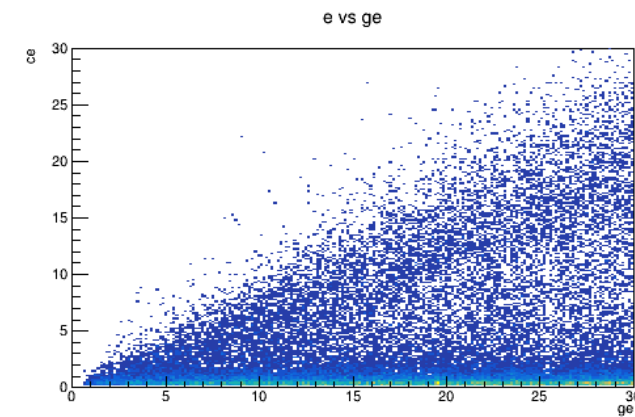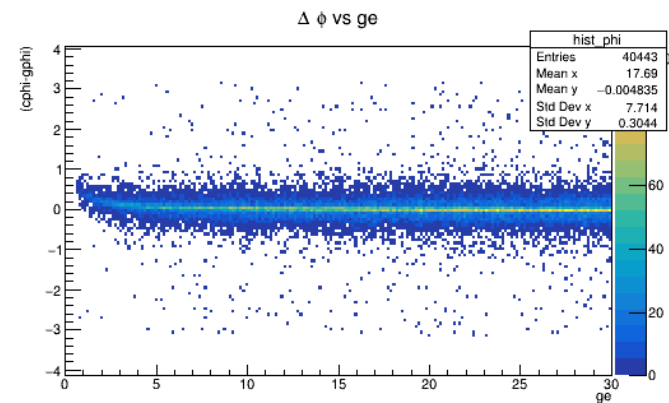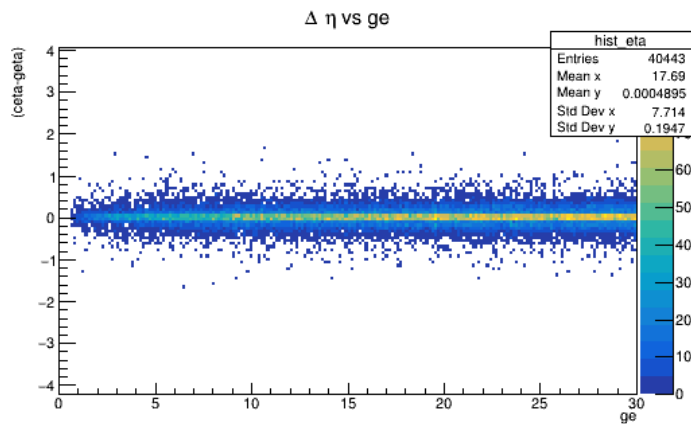EEMC: η: -3.5 to -1.7
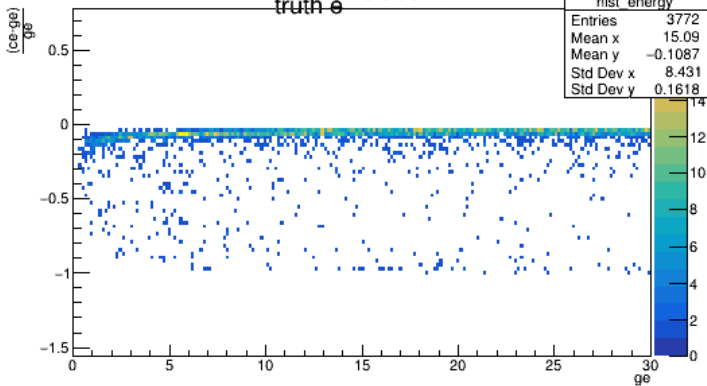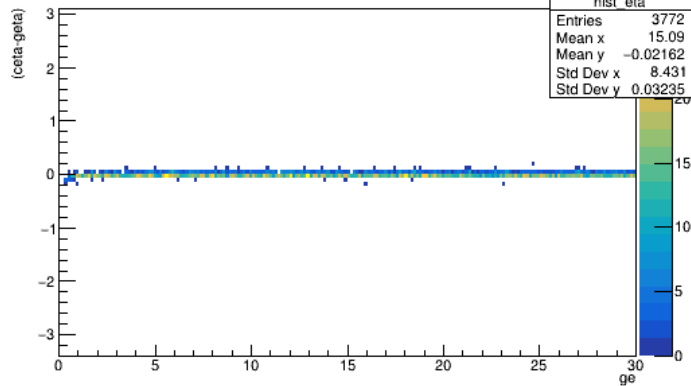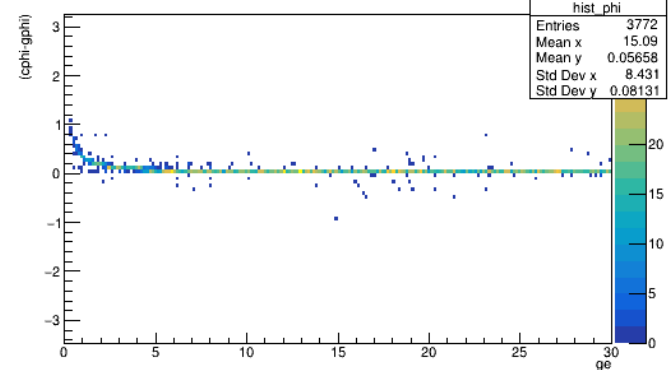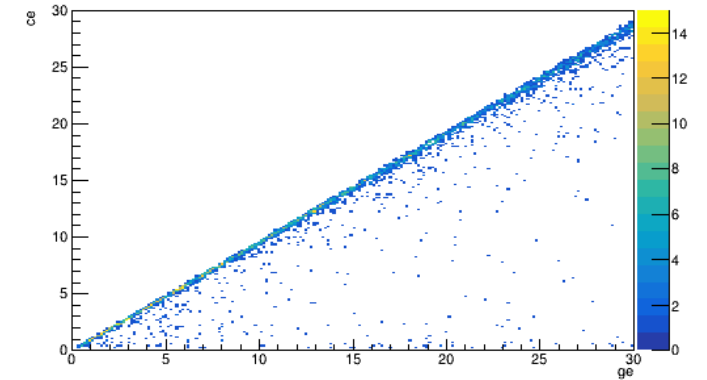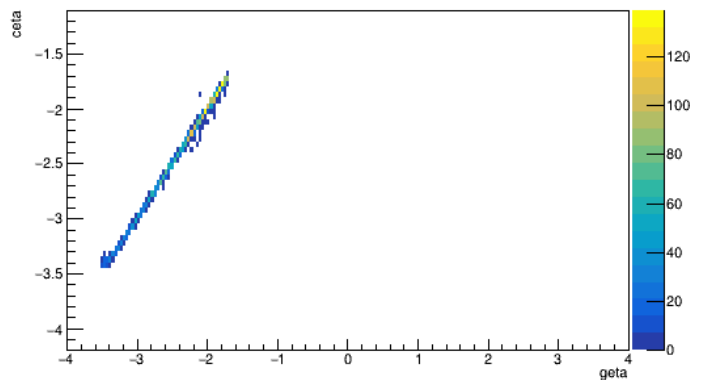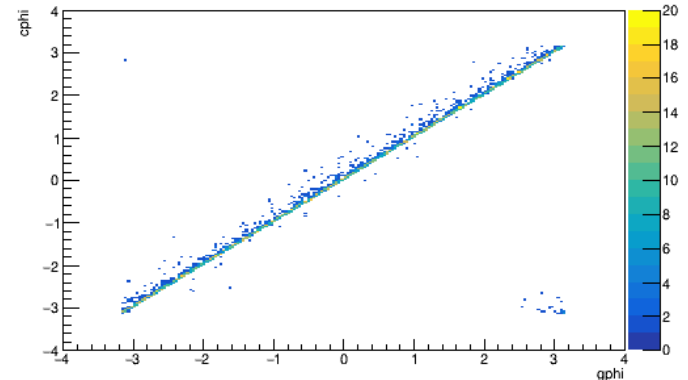
Electron

FEMC: η: 1.3 to 3.3
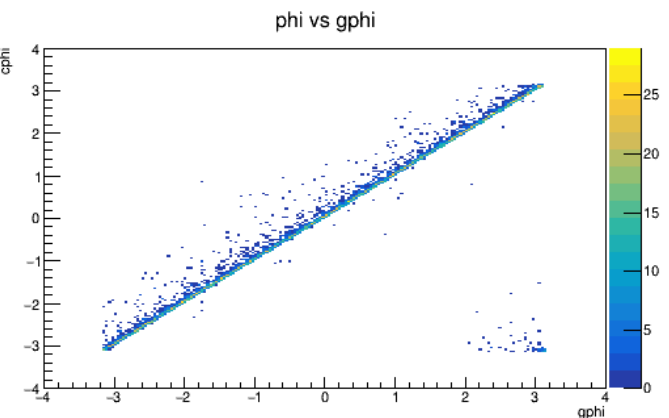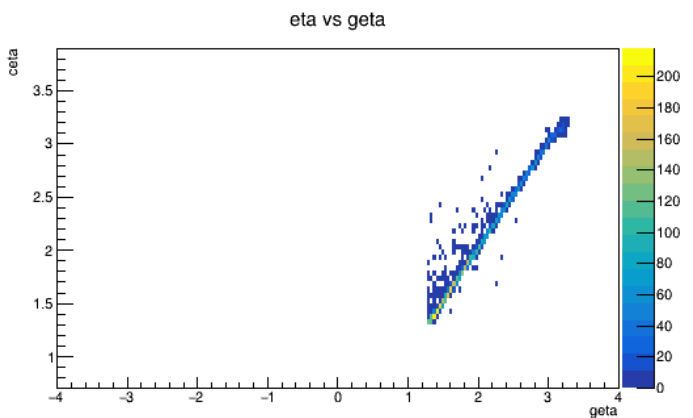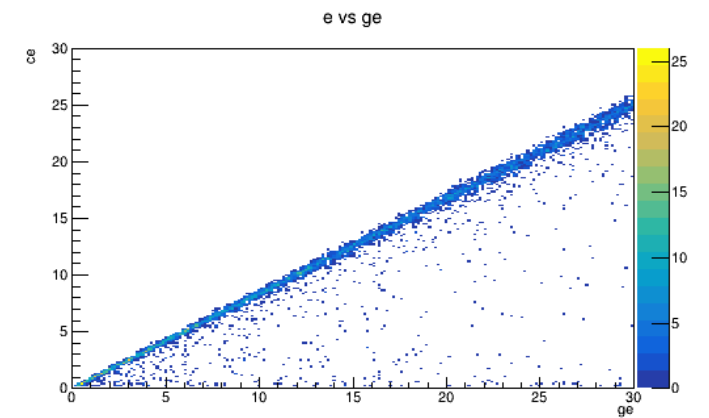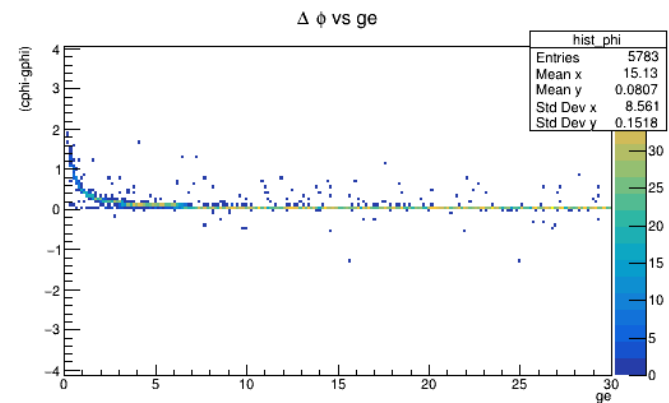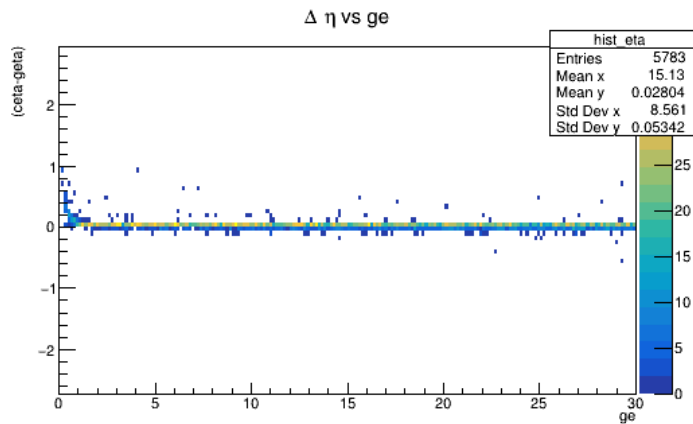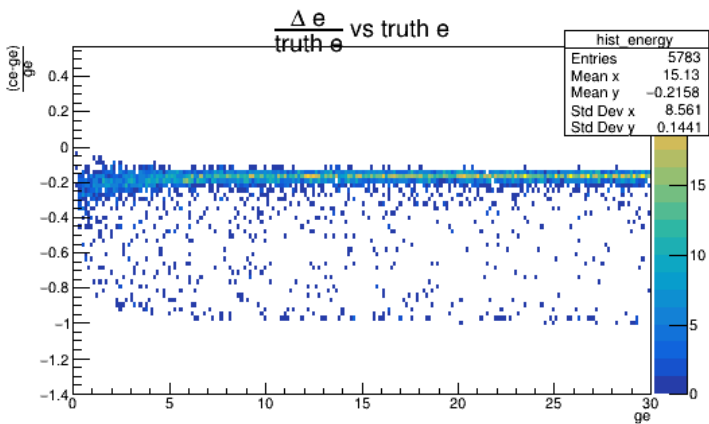
Electron

FHCAL: η: 1.2 to 3.5
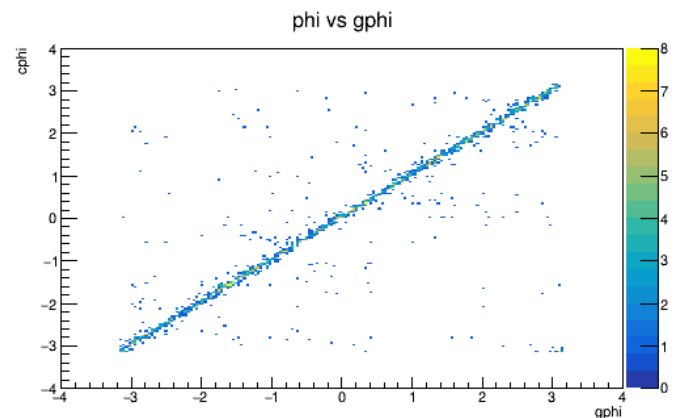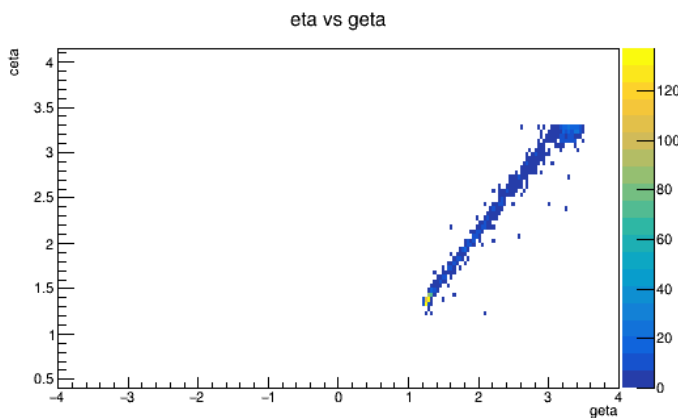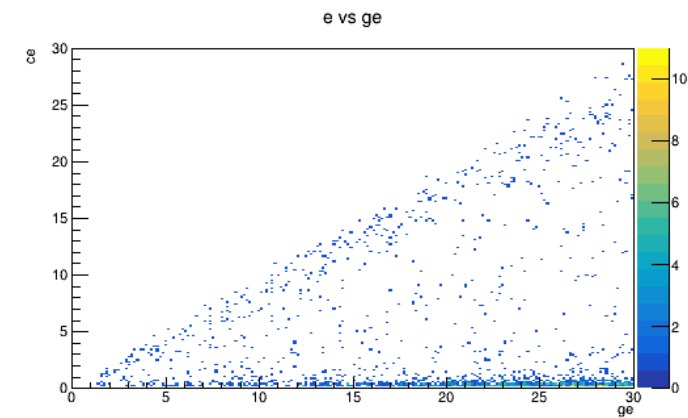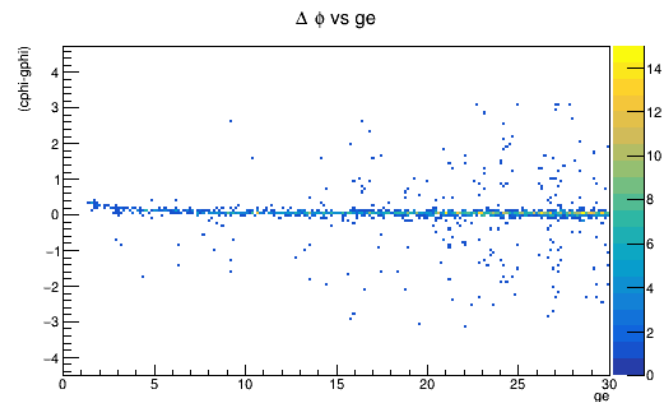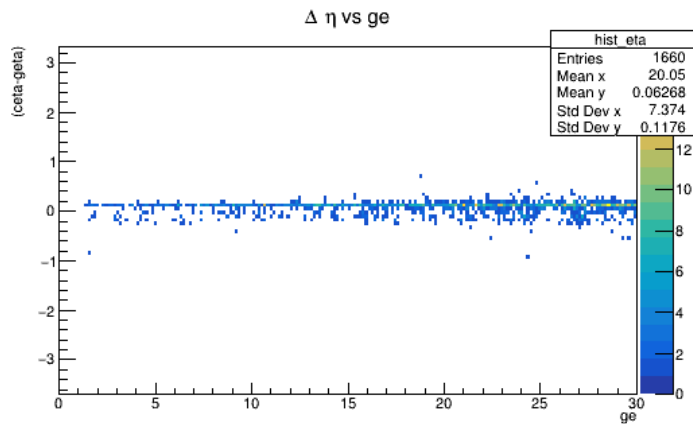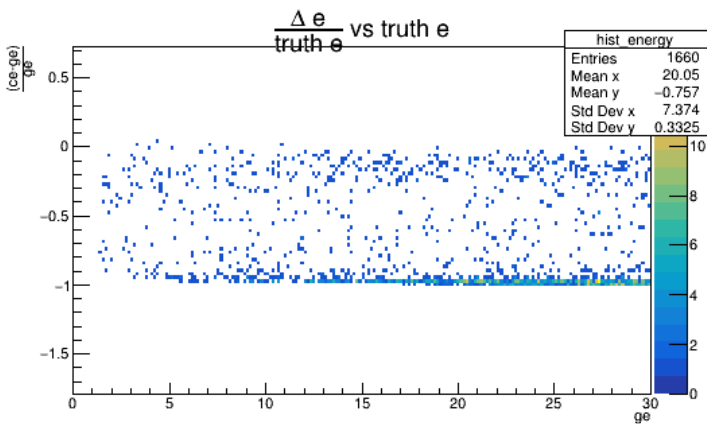
Electron
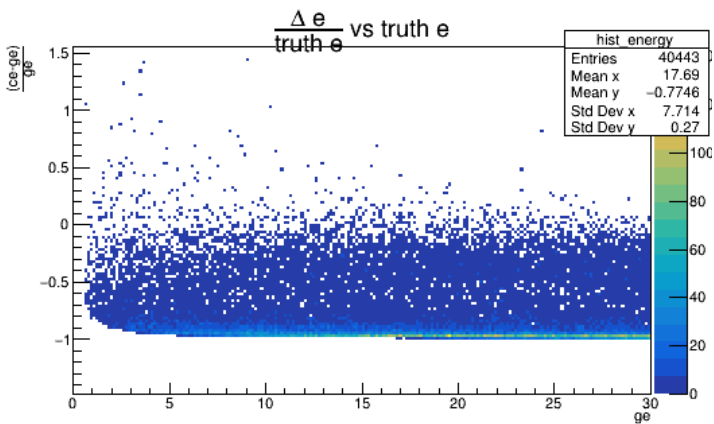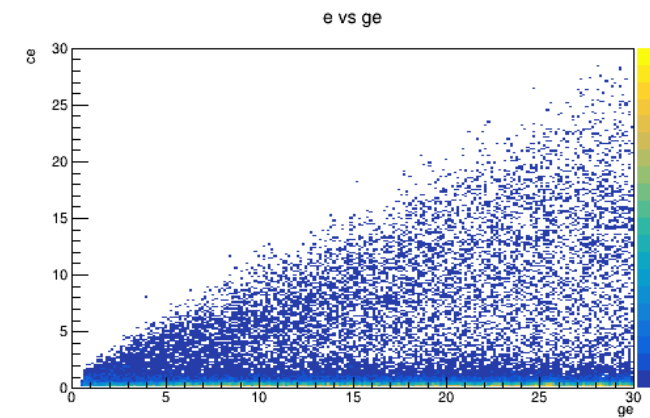
HCALIN: η: -1.1 to 1.1
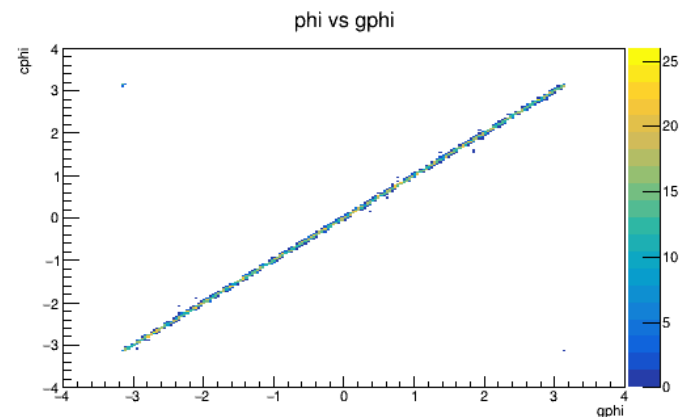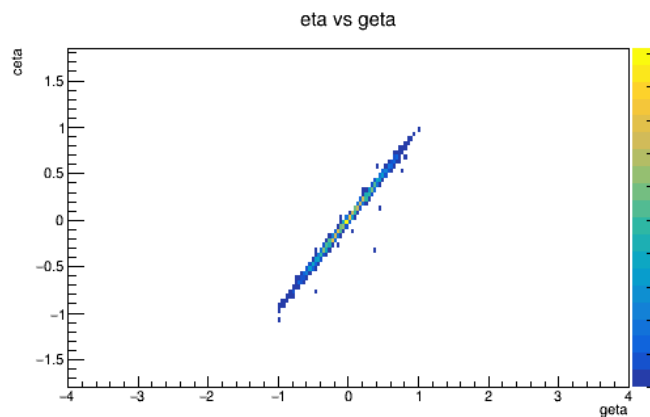
Electron
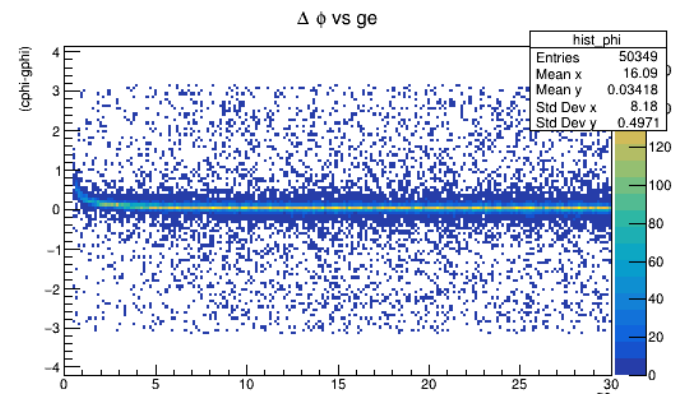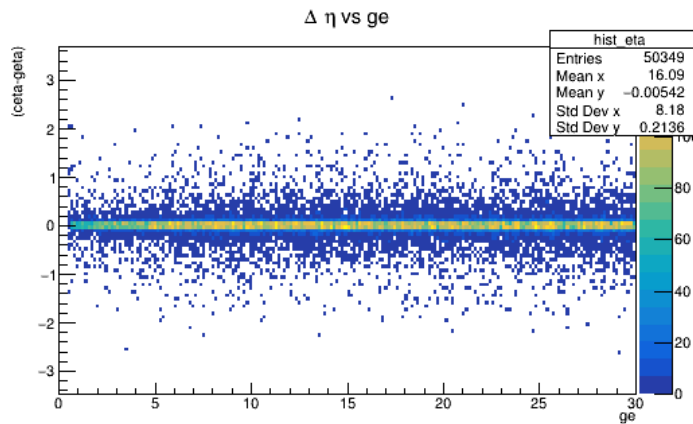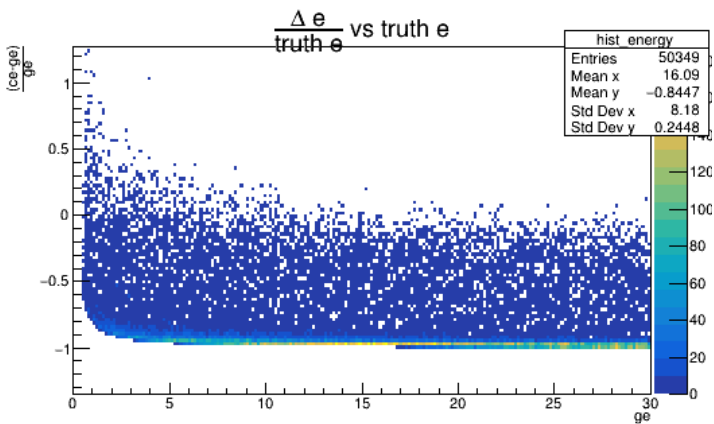
HCALOUT: η: -1.1 to 1.1
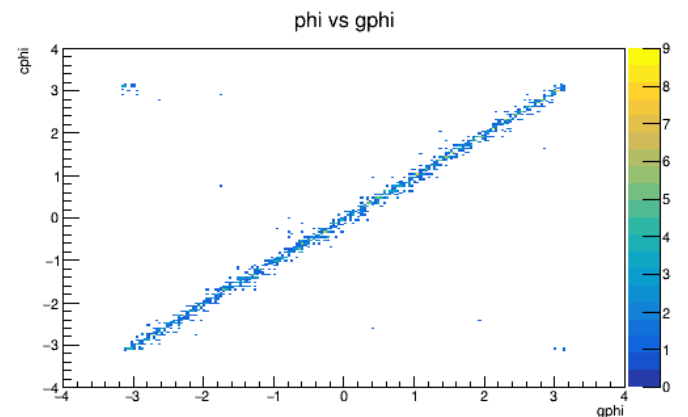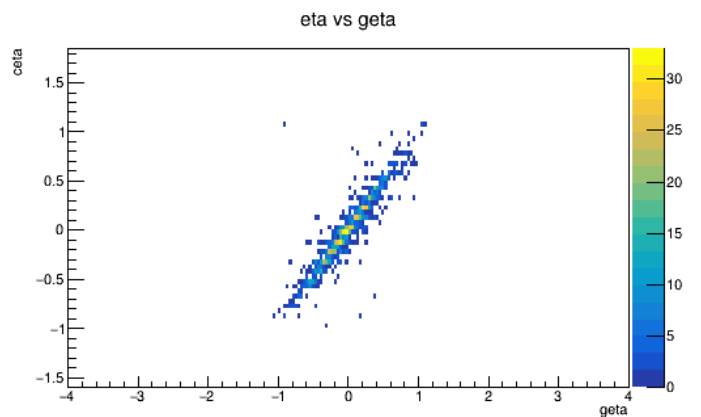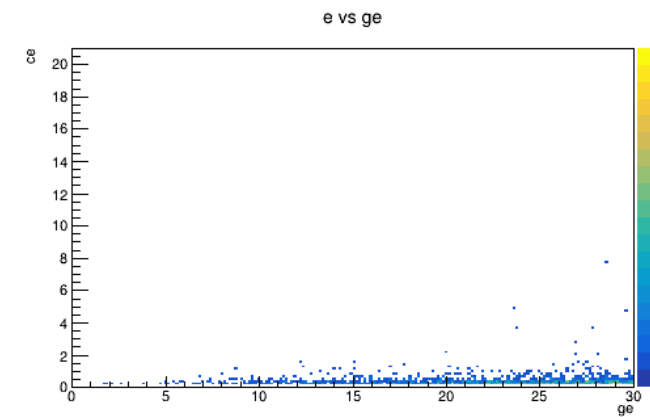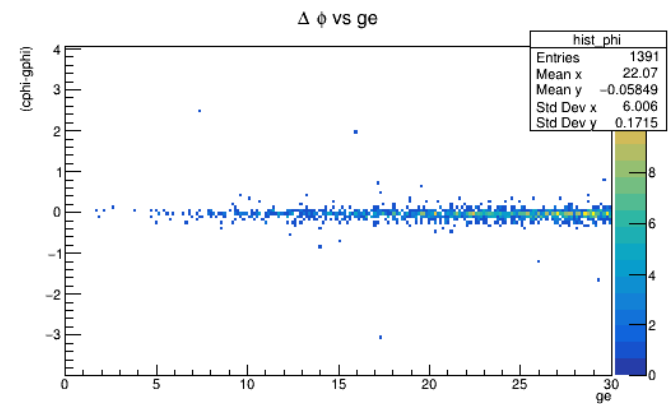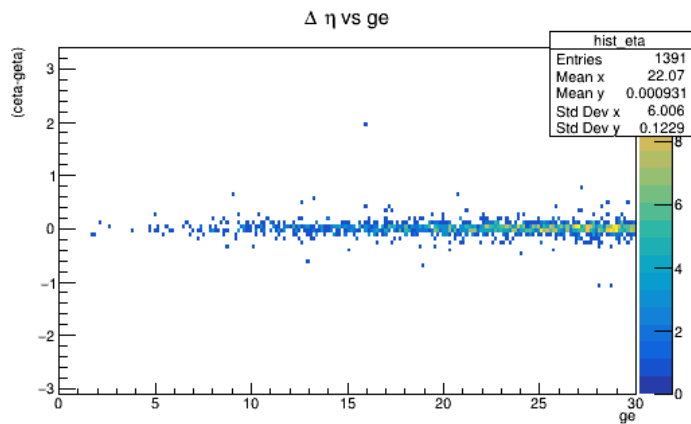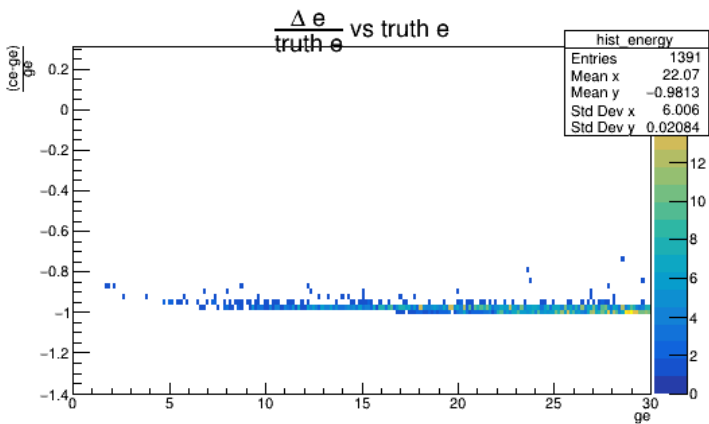
Electron – Energy resolution

Since the lepton concerns only with emcals so energy resolution is calculated only for the three electromagnetic calorimeters.
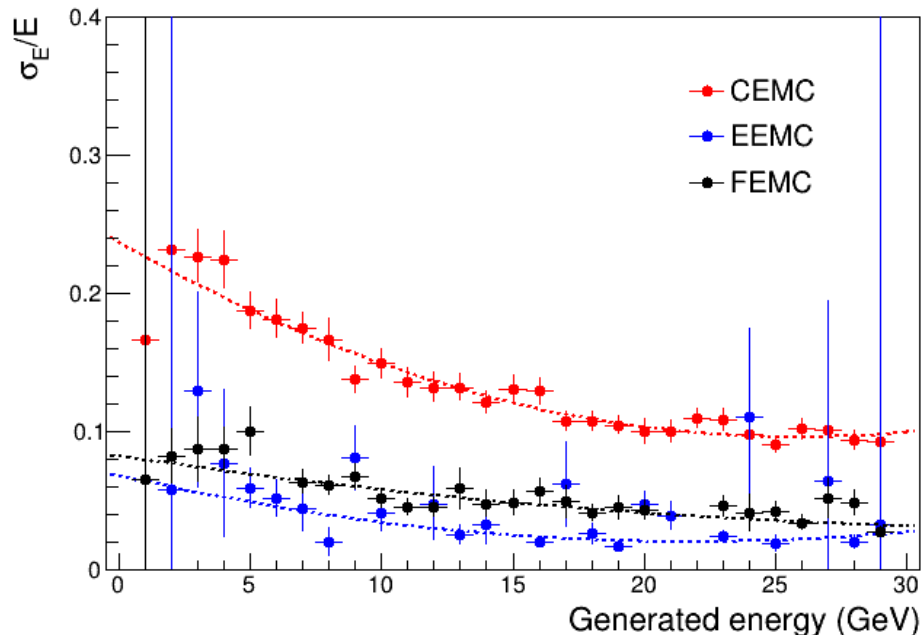
Key points:

1. EEMC had less statistics due to various cuts which has affected the resolution.

2. Out of the three, CEMC has worst resolution while FEMC and EEMC seem to have similar resolution.

Pion

CEMC: η: -1.5 to 1.2

Pion

EEMC: η: -3.5 to -1.7

Pion

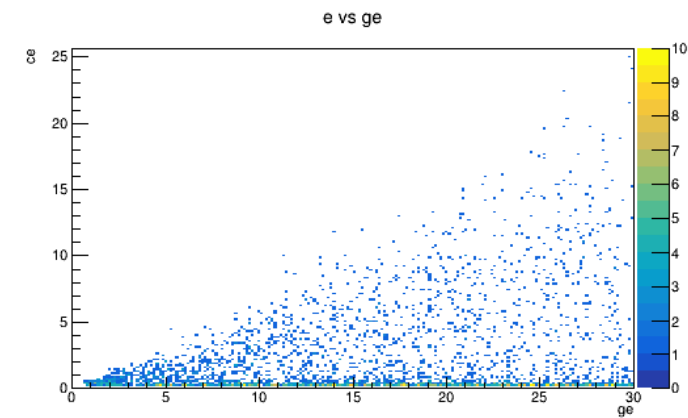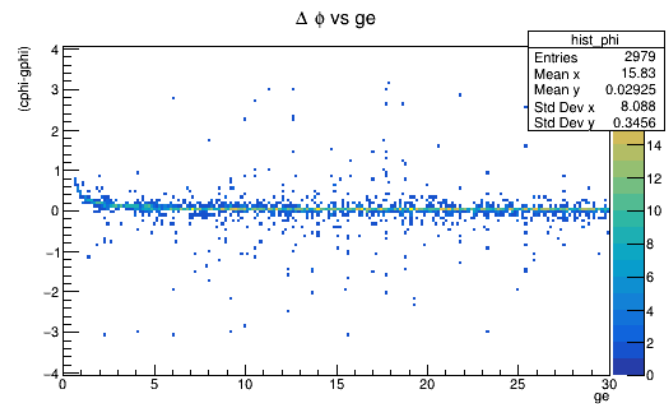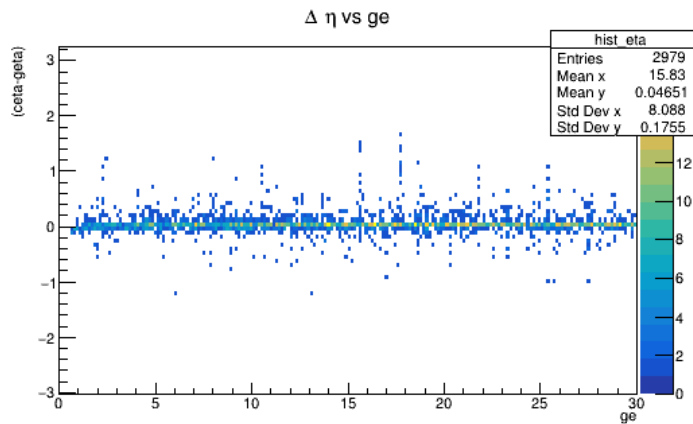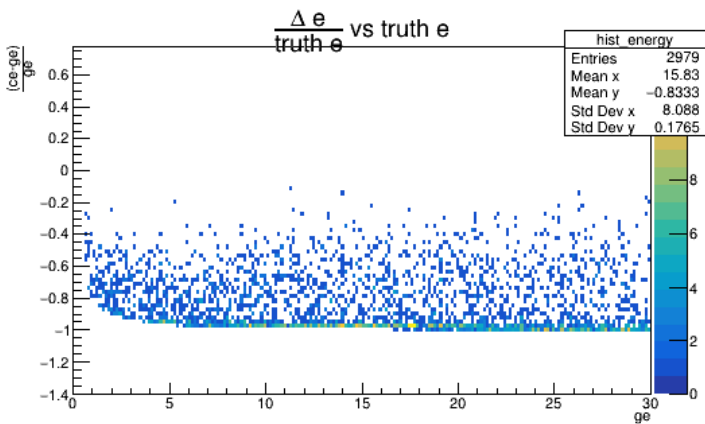FEMC: η: 1.3 to 3.3
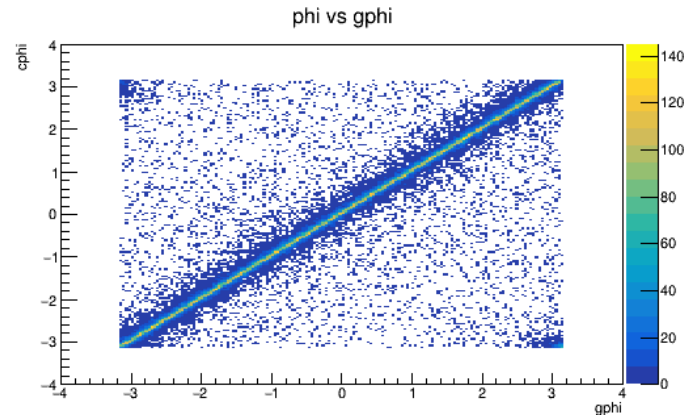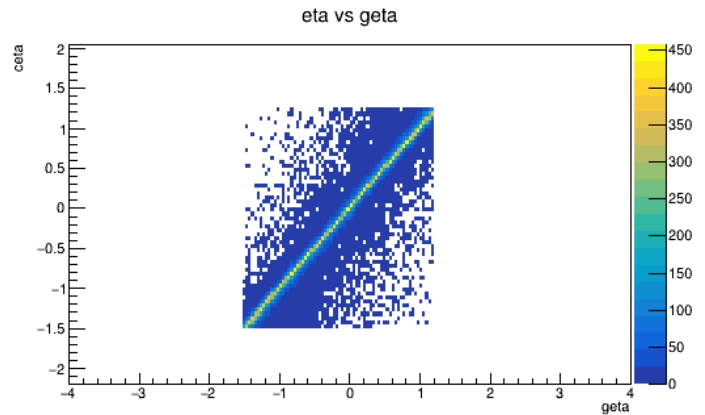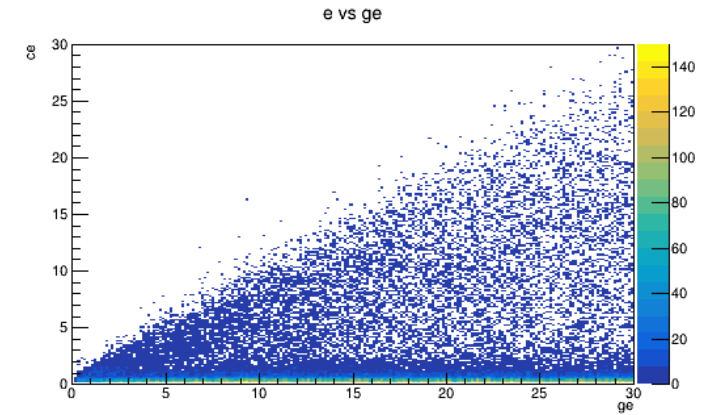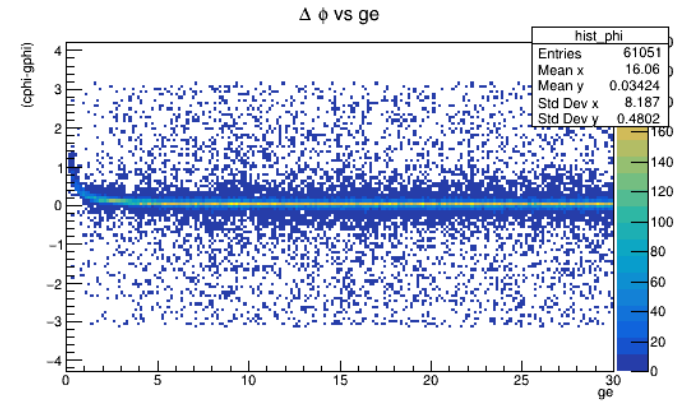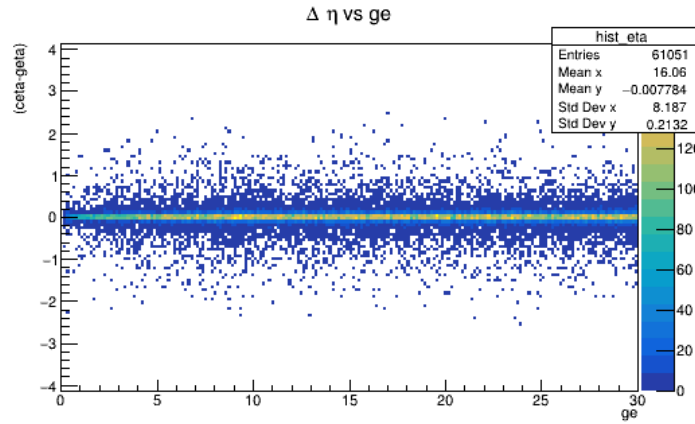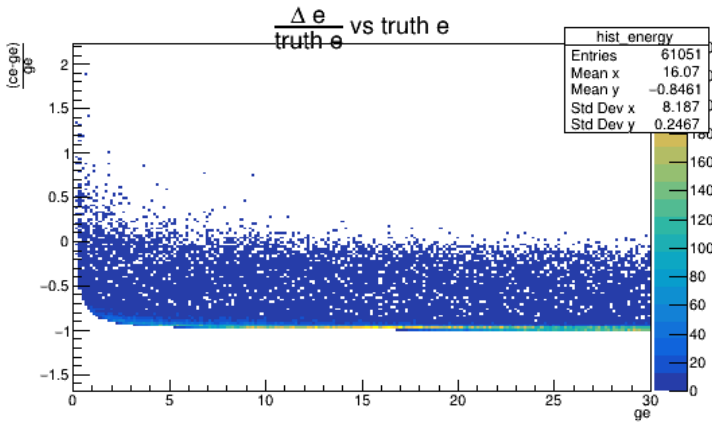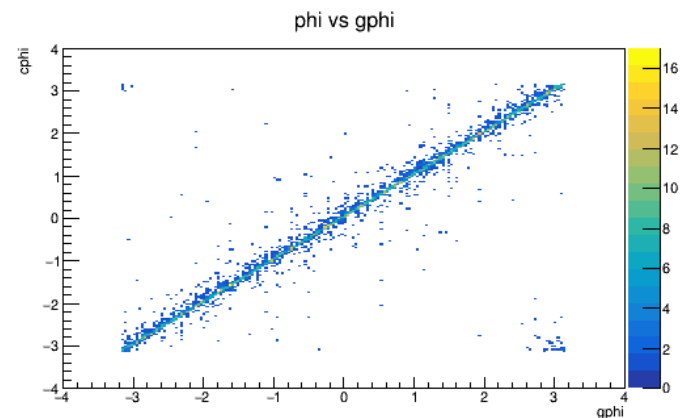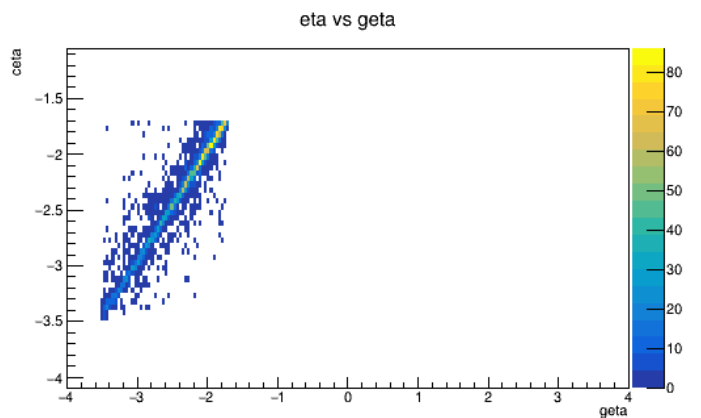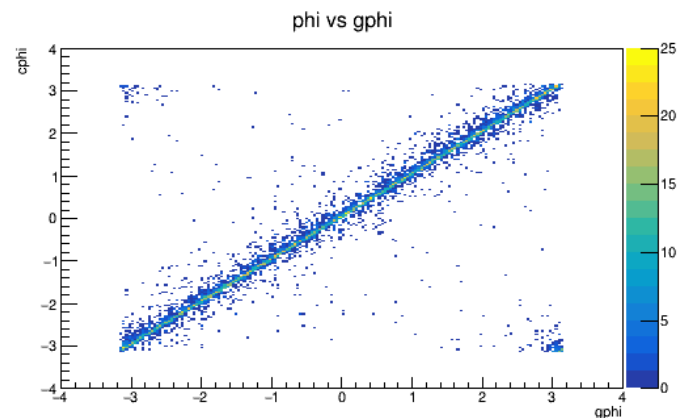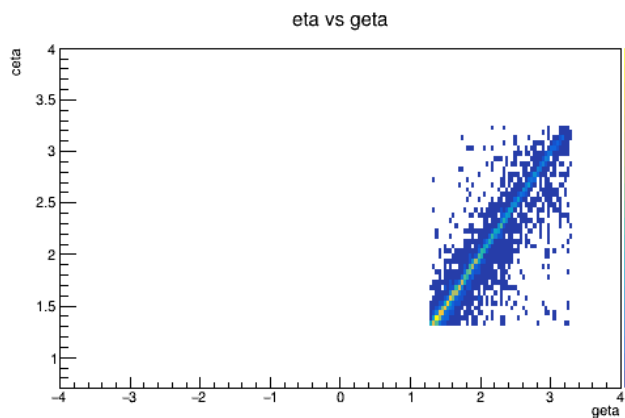
Pion

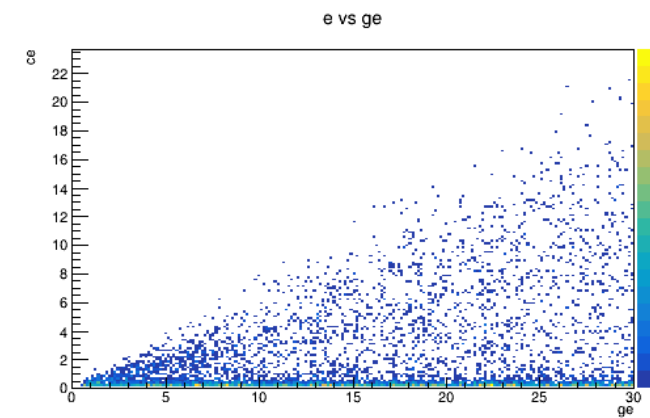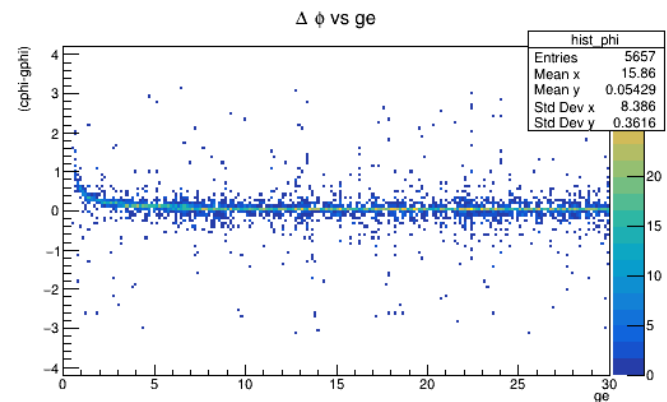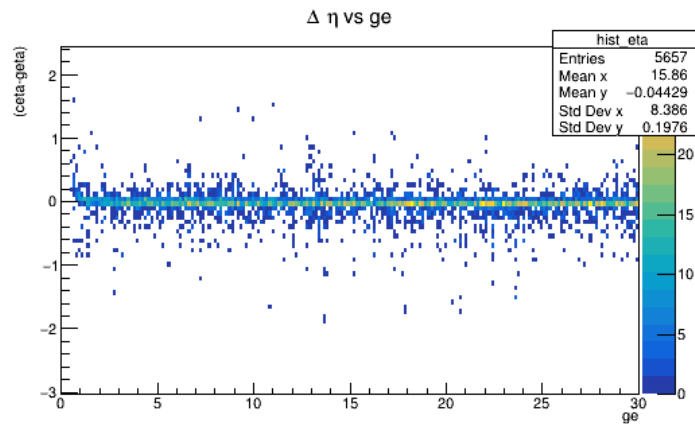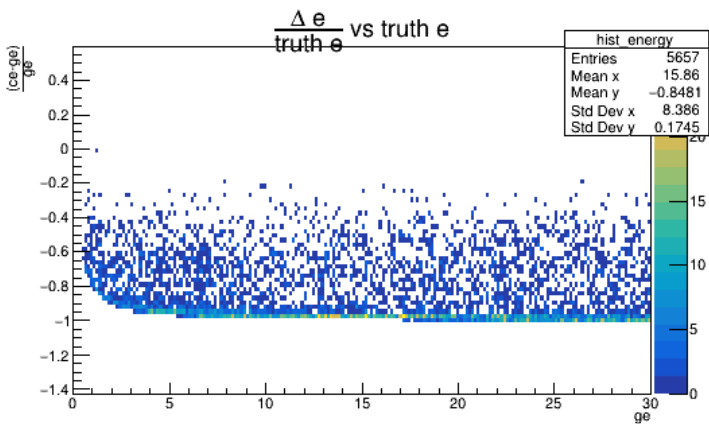FHCAL: η: 1.2 to 3.5
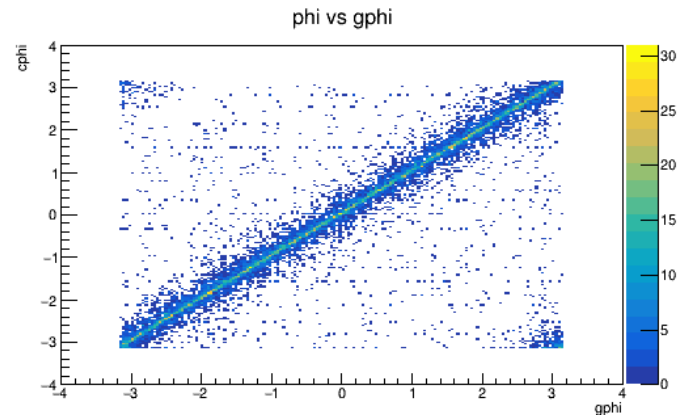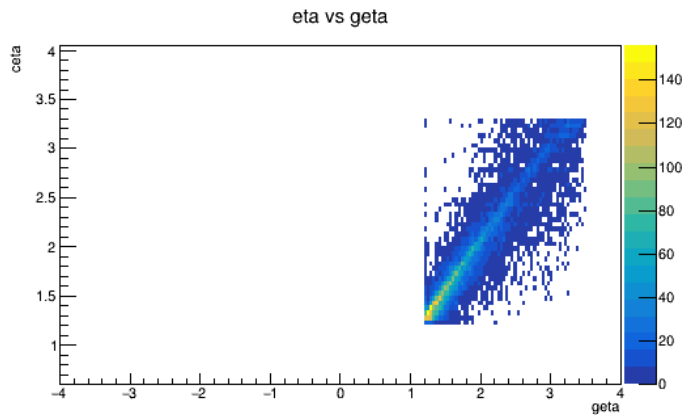
Pion

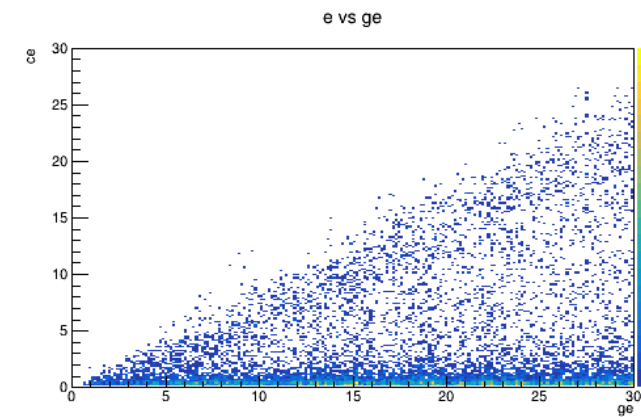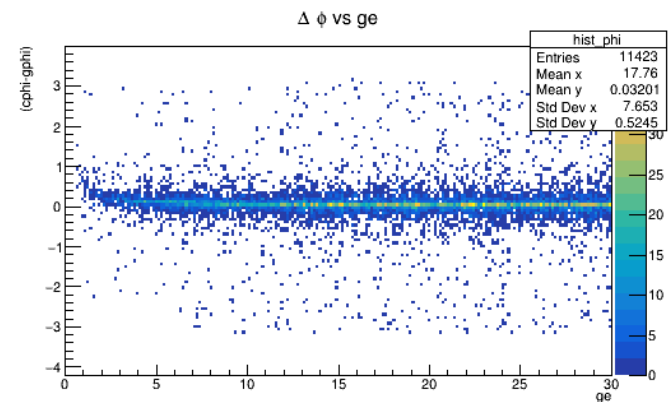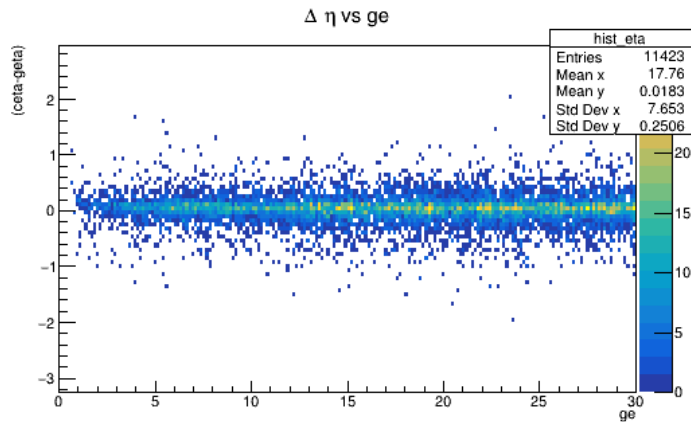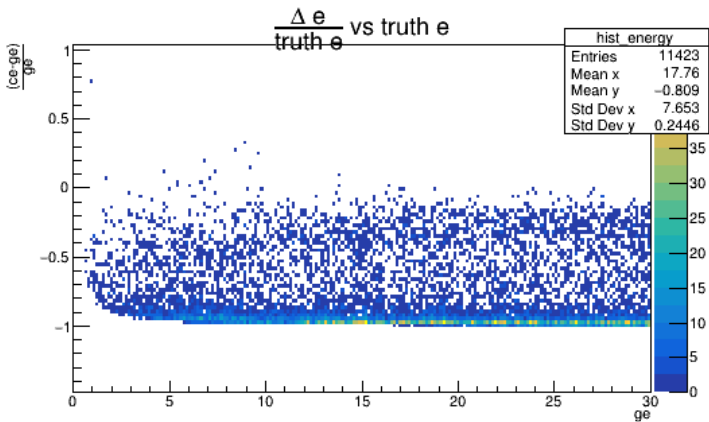HCALIN: η: -1.1 to 1.1
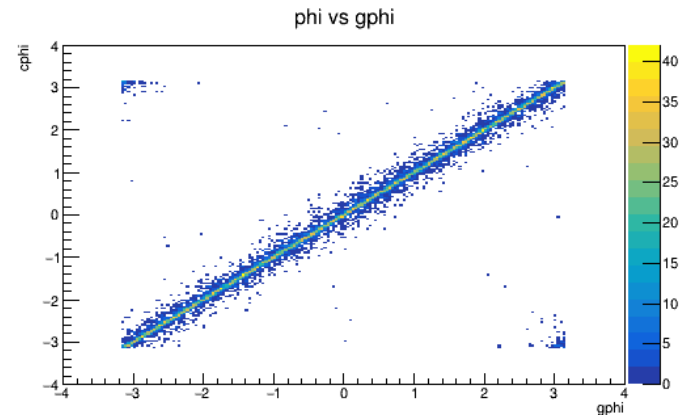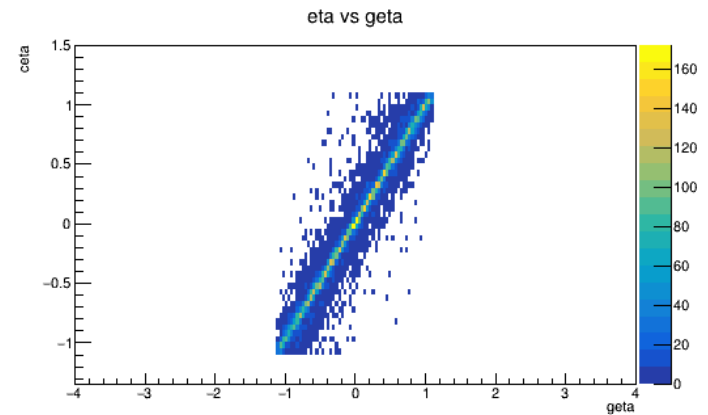
Pion

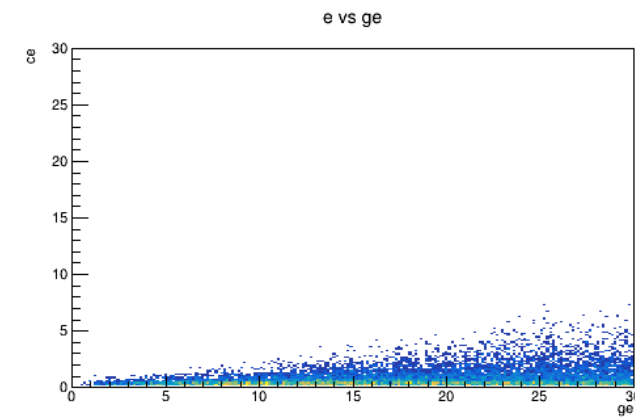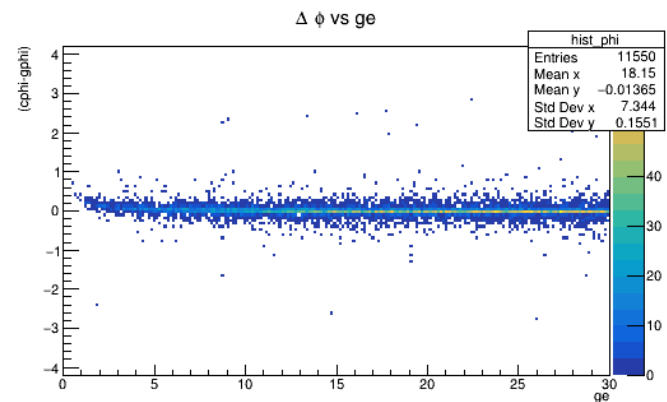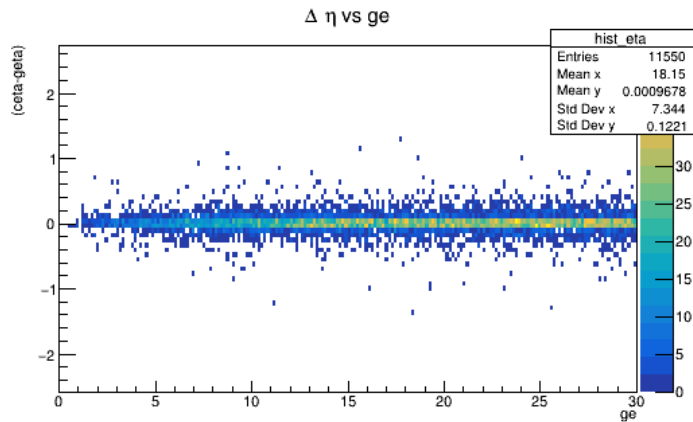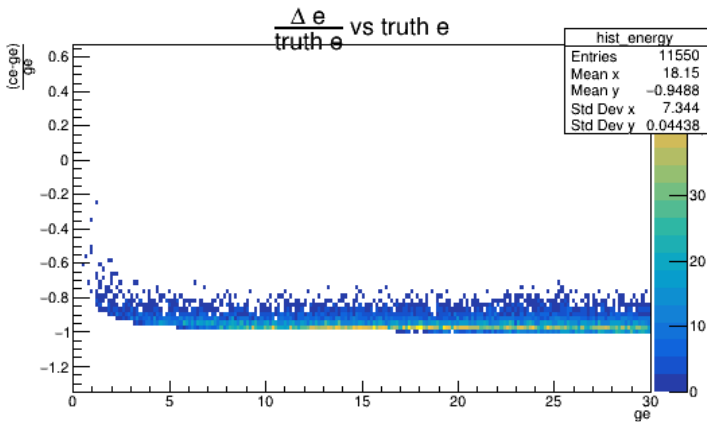HCALOUT: η: -1.1 to 1.1

Kaon

CEMC: η: -1.5 to 1.2

Kaon

EEMC: η: -3.5 to -1.7

Kaon

FEMC: η: 1.3 to 3.3
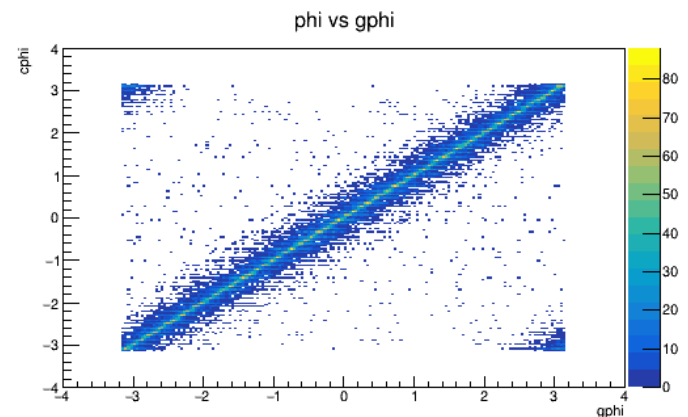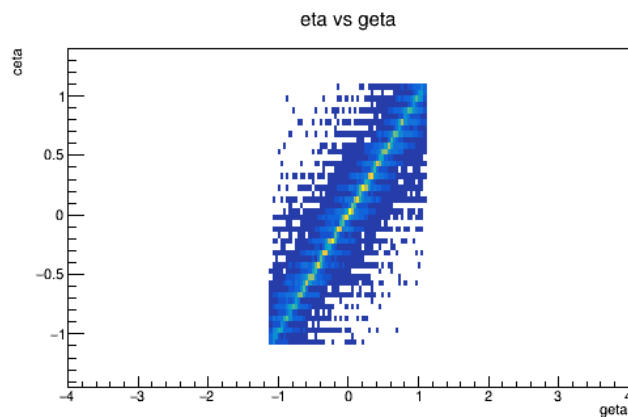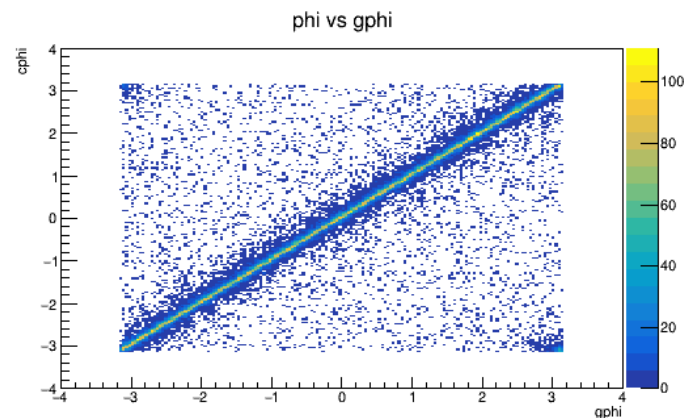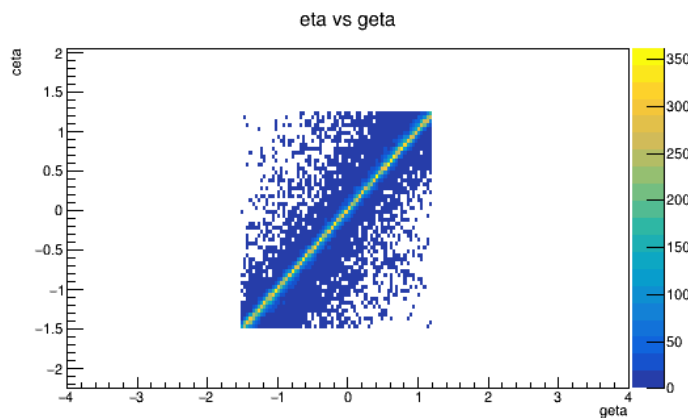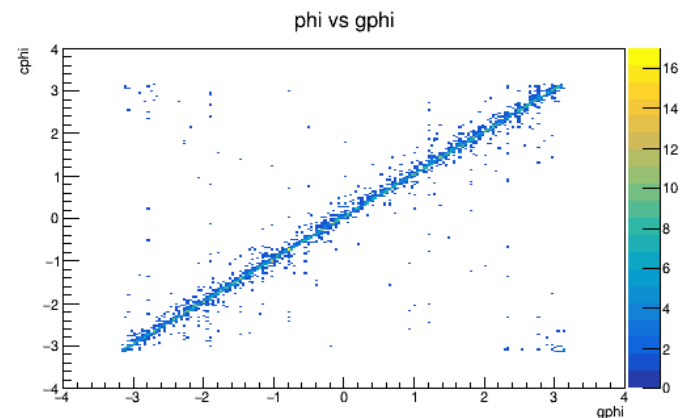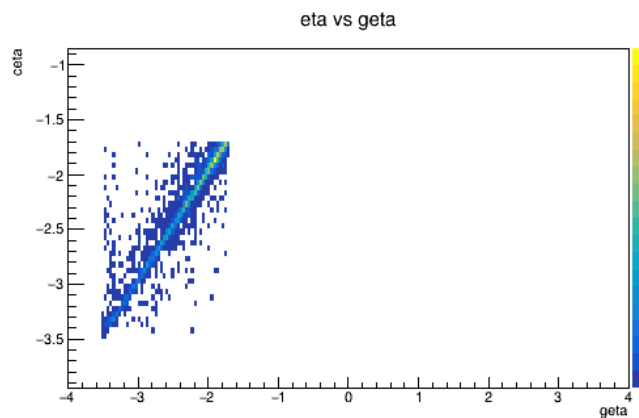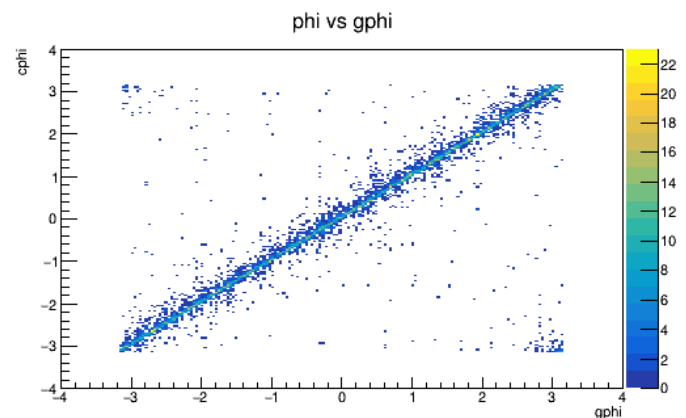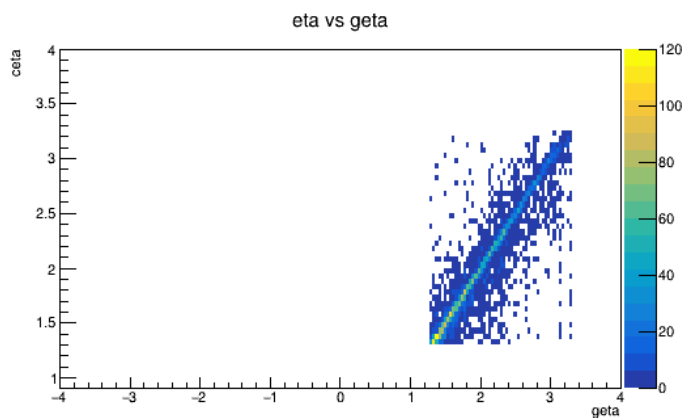
Kaon

FHCAL: η: 1.2 to 3.5
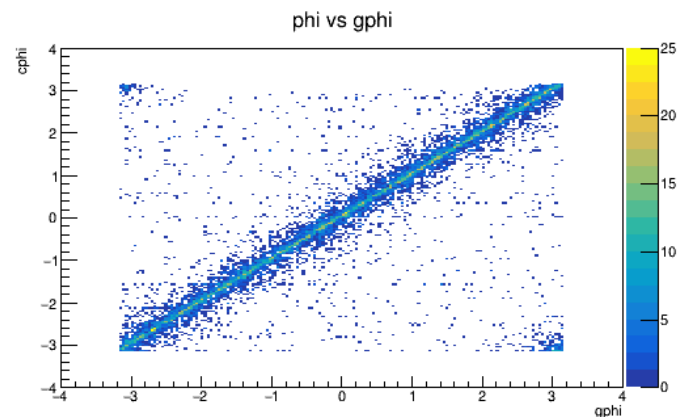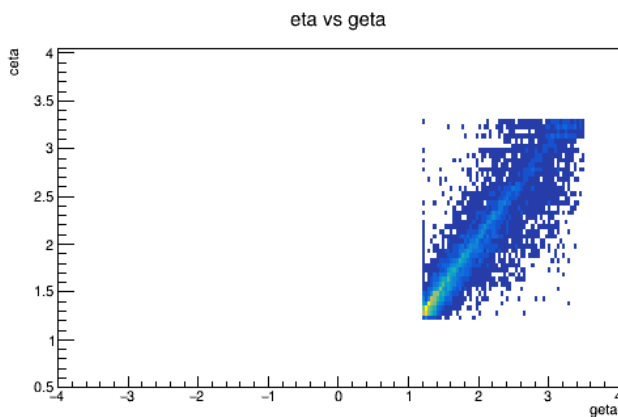
Kaon

HCALIN: η: -1.1 to 1.1
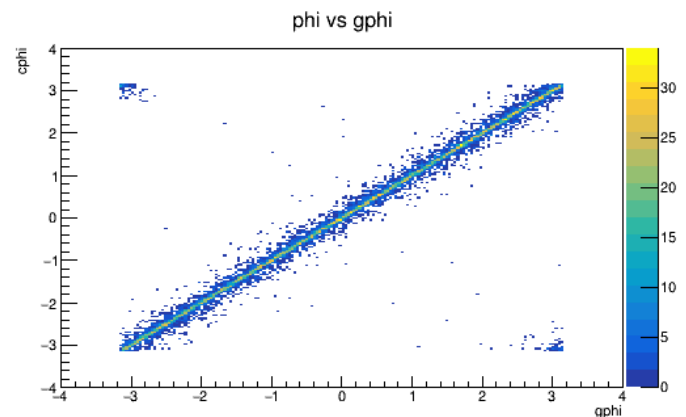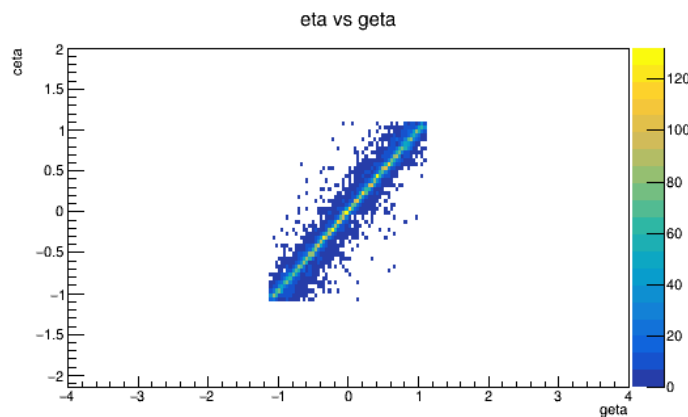
Kaon

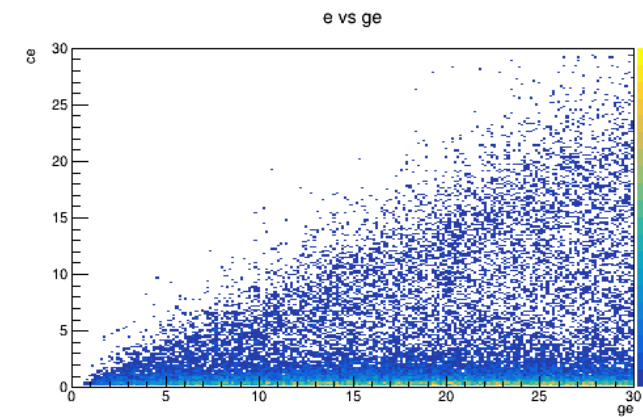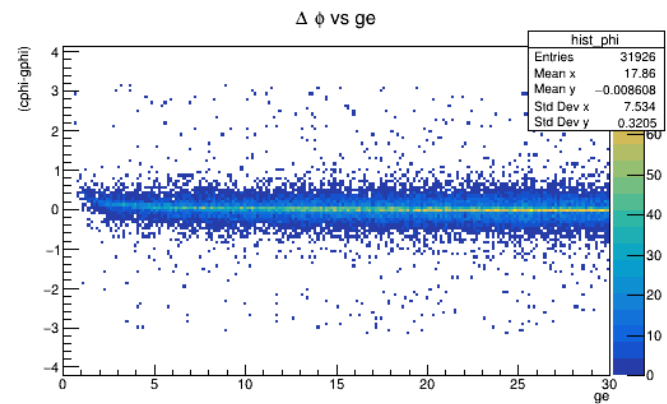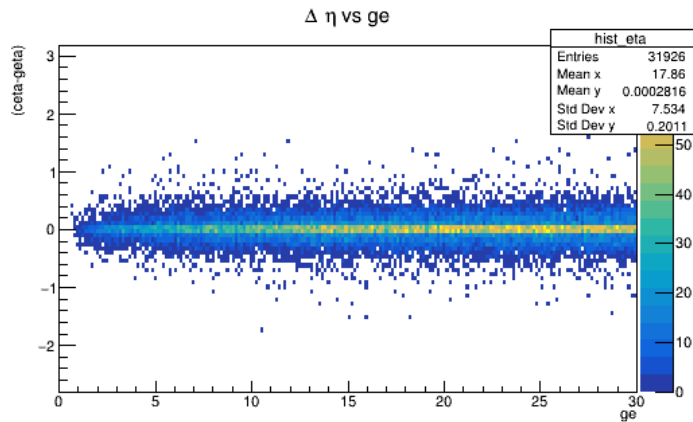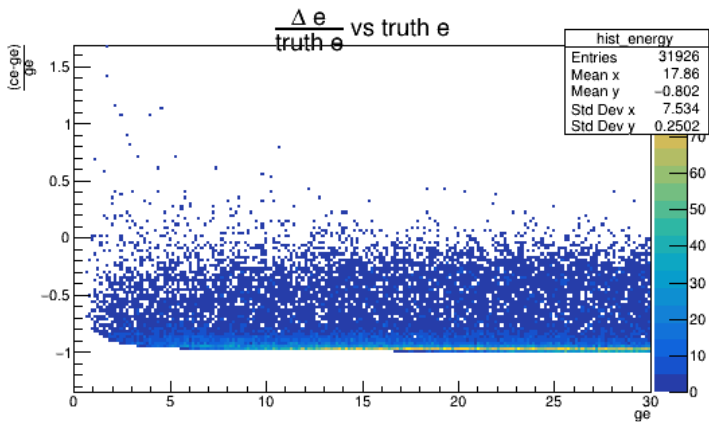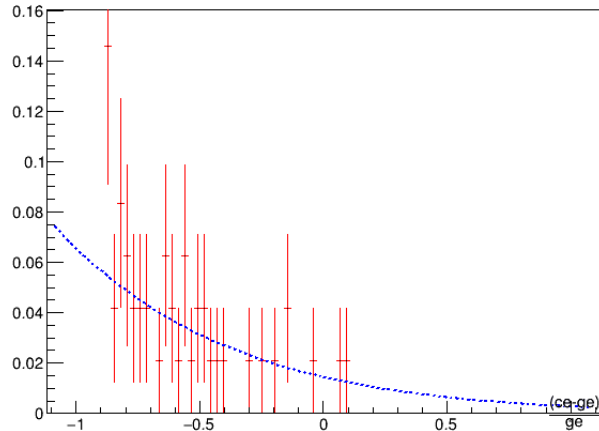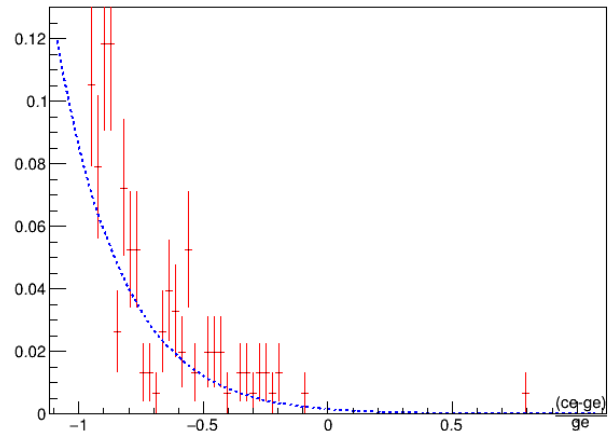HCALOUT: η: -1.1 to 1.1
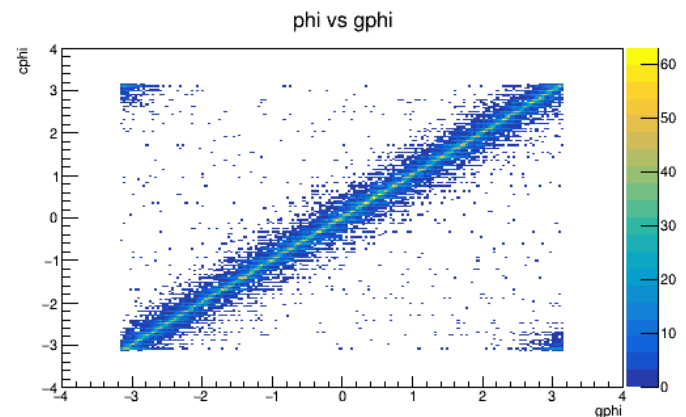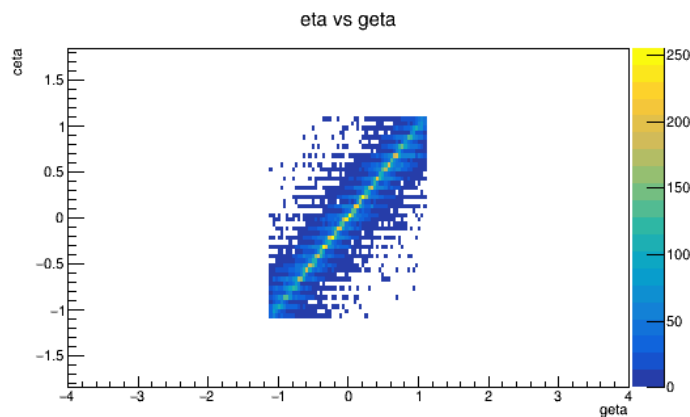
Pion, Kaon – Energy resolution

- No centering around 0 in the delta E/E vs ge plots which means that there isn't much precision in energy measurement of hadrons in the hadronic calorimeters. Hence, the energy resolution is bad in case of hcals.
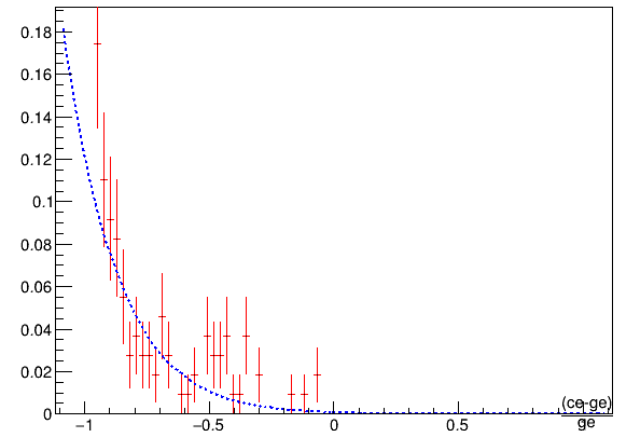

Gaussian fits for Pion in HCALOUT