AHCAL Optimization in CEPCV4

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OutLine

- Introdution

- AHCAL Optimization

  – Simulation Setup

  – Cell size
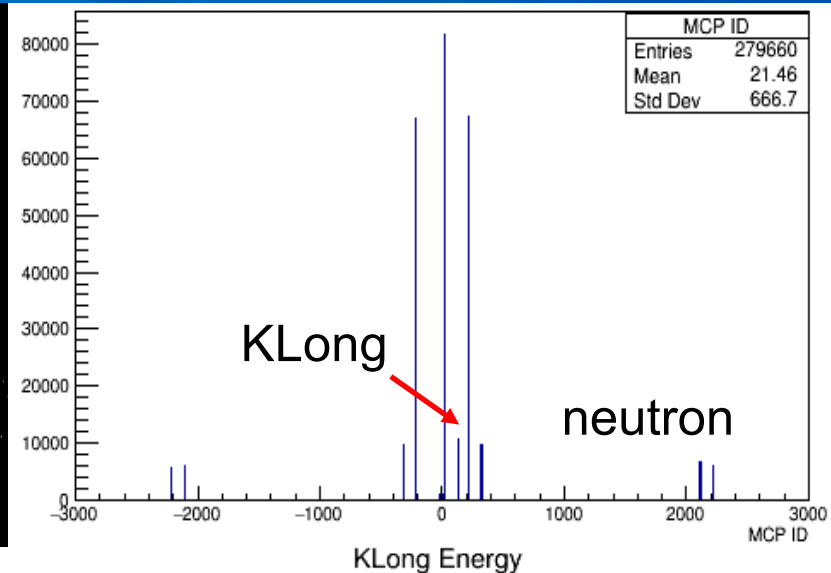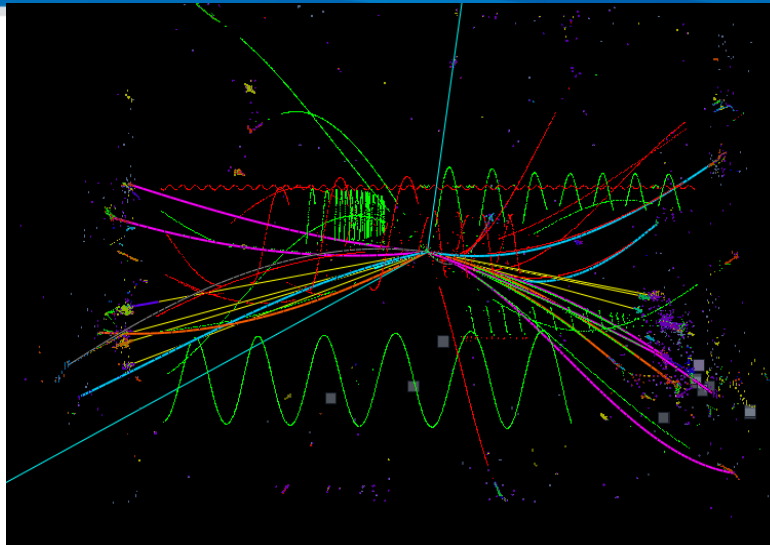
  – Number of readout layers

- Conclusion

Motivation

- 1/3 of Higgs events have 2jets : hadronic decays of bosons
- The requirement from benchmark physics processes on boson mass resolution(BMR) : 4%
- Calorimeter cell size and number of readout layers should be optimized in terms of BMR.

$$\text{Accuracy} = \frac{\sqrt{S+B}}{S}$$
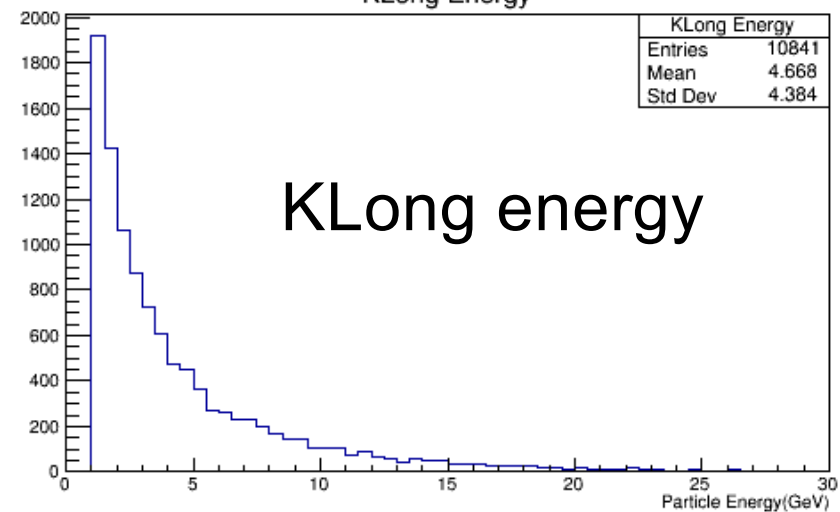
3

KLong

neutron
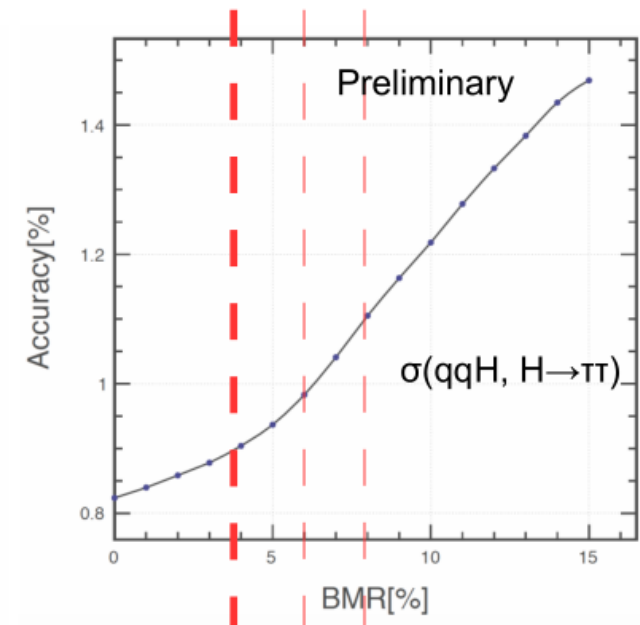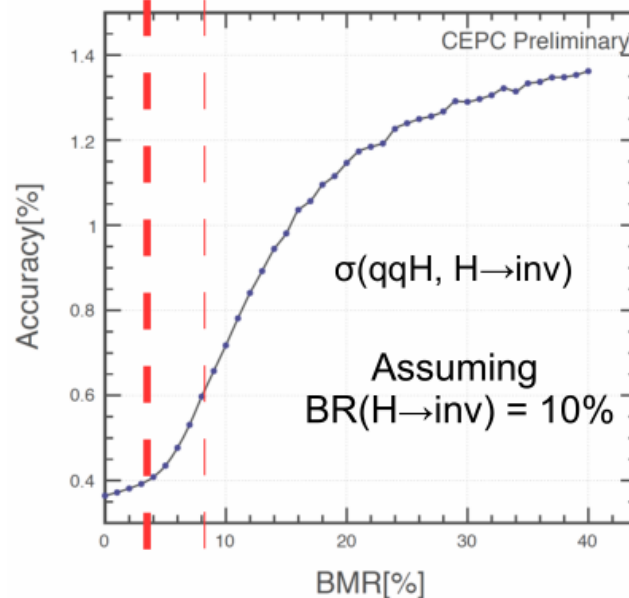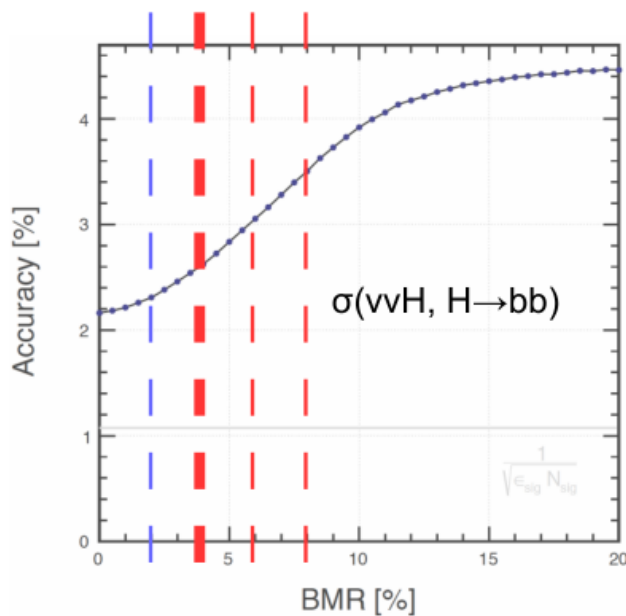
KLong energy

- # CEPC V4 geometry
  - Tracker
  - Si-W ECAL
  - Sci-Fe HCAL
- # vvH-gg event
  - KLong is largest in number in neutral Hadrons
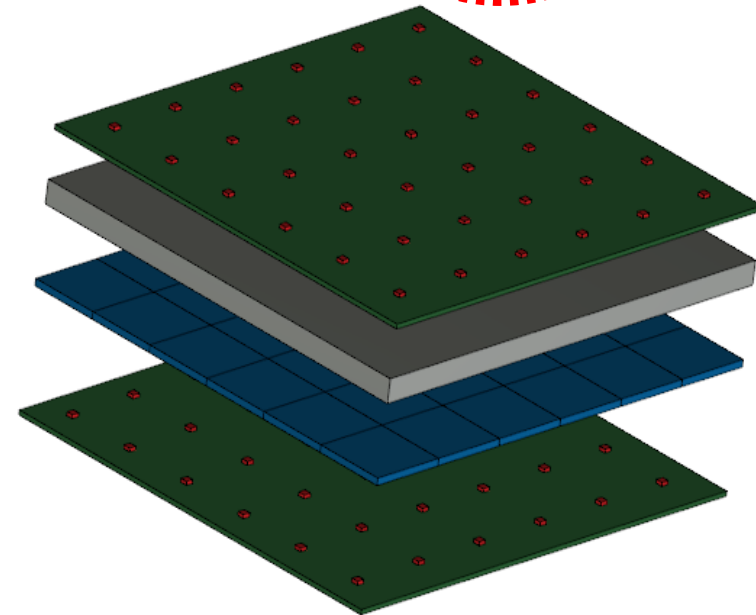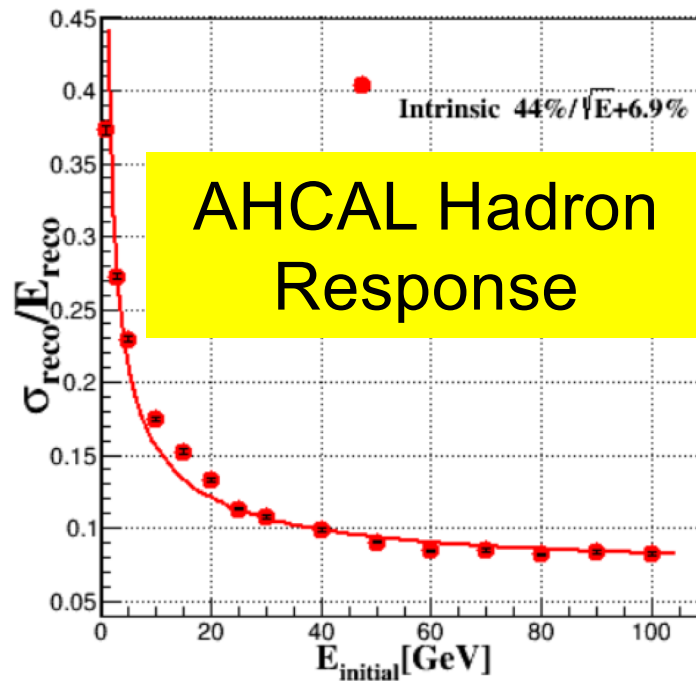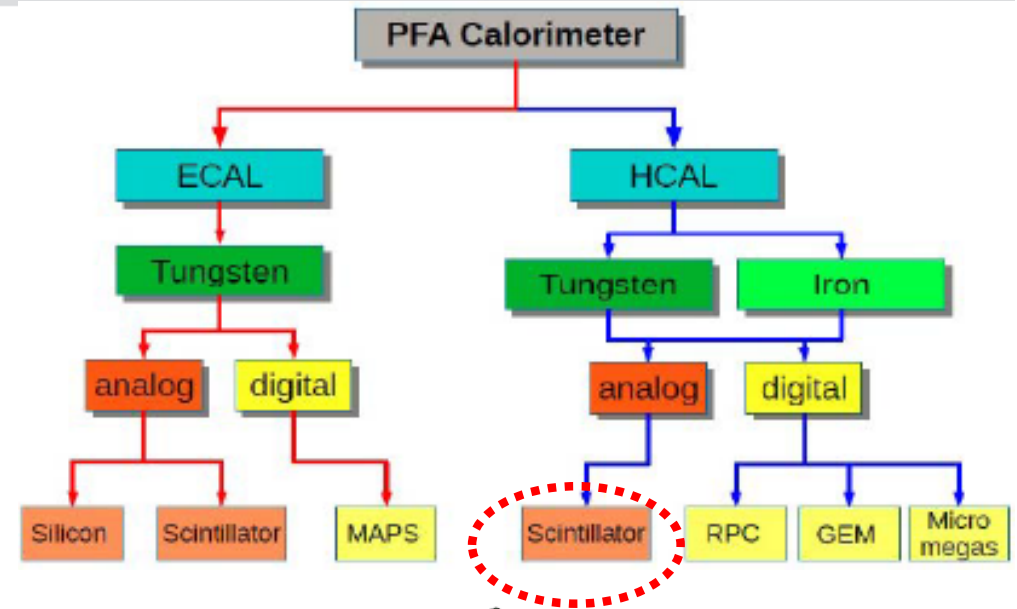 - KLong energy usually below 30 GeV

4

Calorimetry Geometry

- ## SiW ECAL

- ## AHCAL

  - 40 layers
  - Absorber:20mm Fe
  - Scintillator:$30 \times 30 \times 3mm^3$
  - PCB:2mm

AHCAL Hadron Response

Intrinsic $44\%/\sqrt{E}+6.9\%$

σ_{reco}/E_{reco}

$E_{initial}$[GeV]

Reconstruction

Hit

Bush

Cluster

- Reconstruction
  - Arbor processor : connect hits into a bush
  - Bushconnect processor : connect bushes into a cluster
  - LICH processor : judge a cluster's particle ID, gives its four-momentum
  - In vvH-gg event Higgs four-momentum is sum of four-momentum of all reconstructed particles
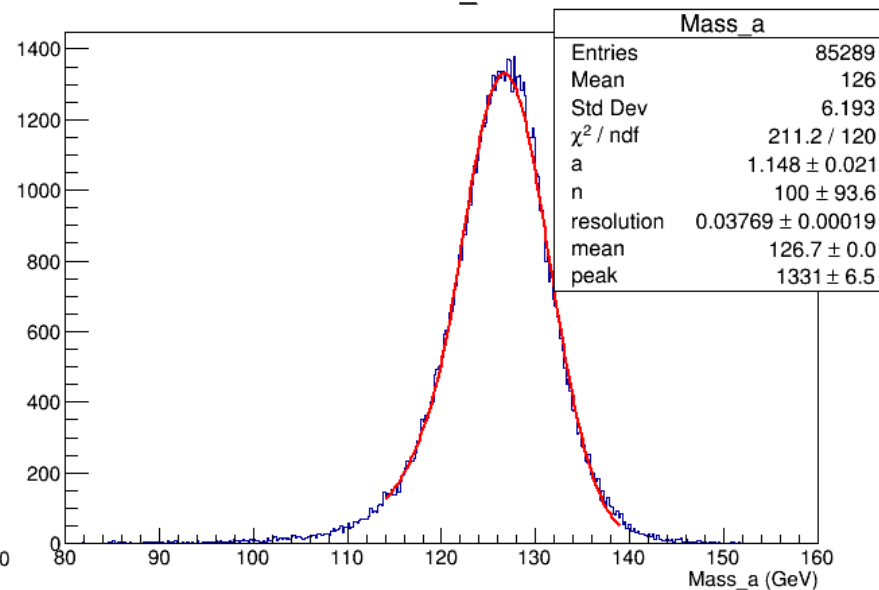
6

Figure of Merit

- ## Boson mass resolution(BMR)
  - Higgs Boson is reconstructed at different AHCAL Cell Size from 10mm to 70mm
  - Higgs BMR is fitted by crystal ball function
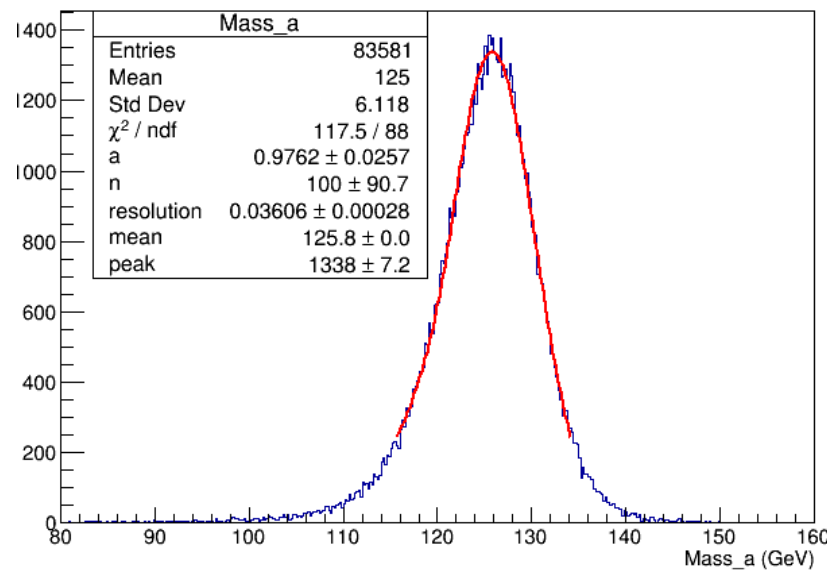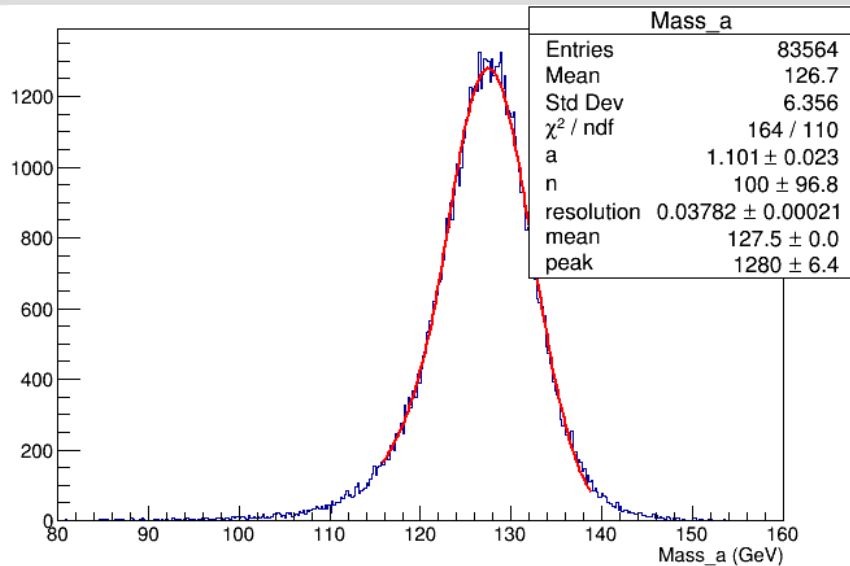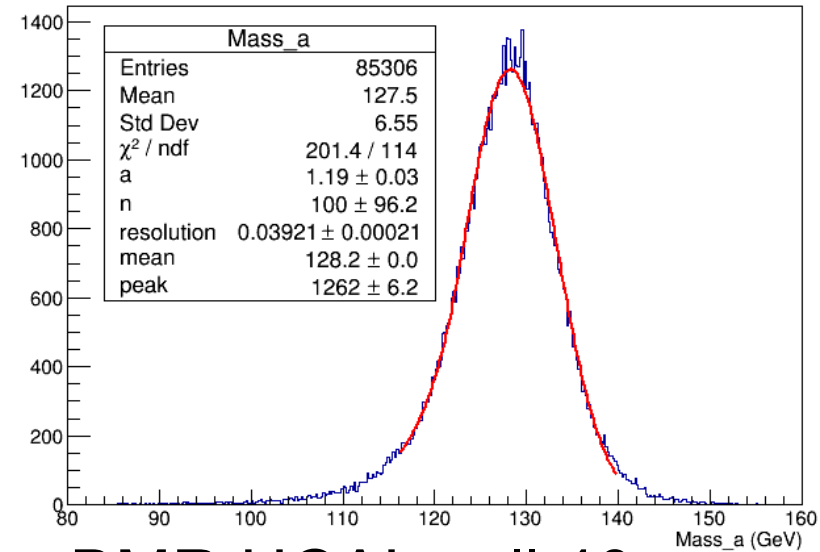

BMR HCAL cell 10mm

BMR HCAL cell 20mm
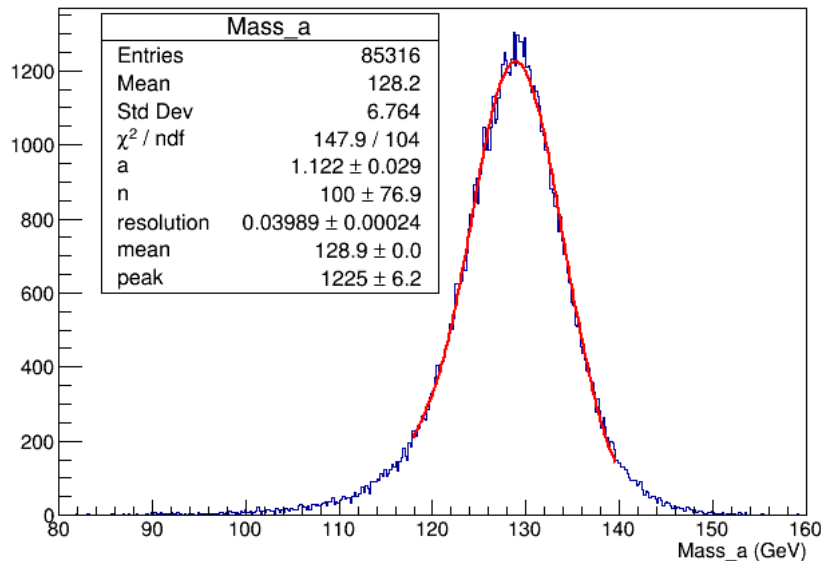
Cell-size optimization

BMR HCAL cell 30mm

BMR HCAL cell 40mm

BMR HCAL cell 50mm

BMR HCAL cell 60mm

8

Cell-size optimization

- 30 mm is a appropriate choice, but maybe 40 mm is also acceptable
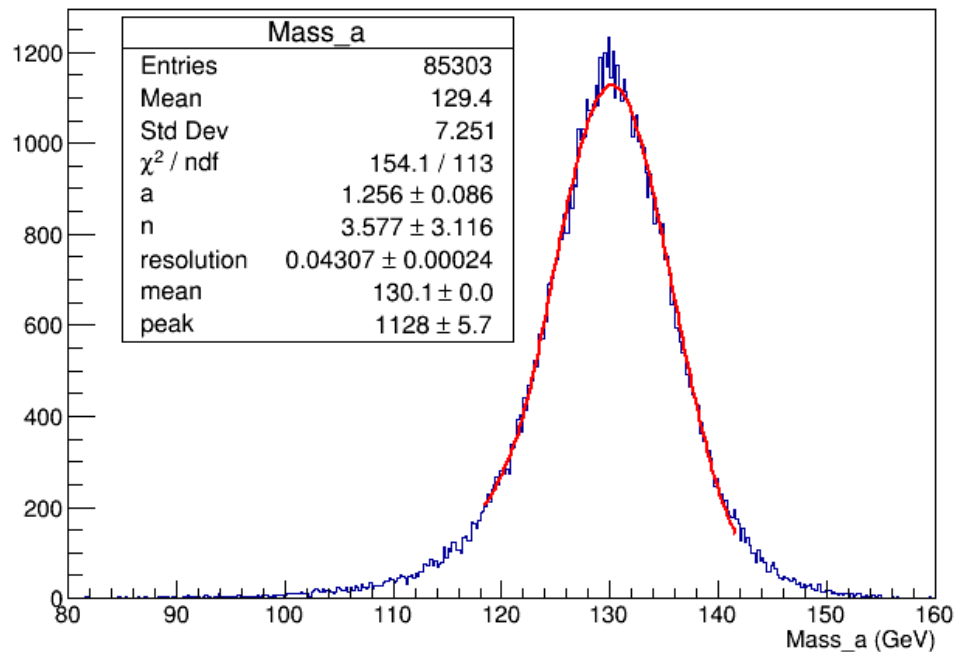
BMR HCAL cell 70mm
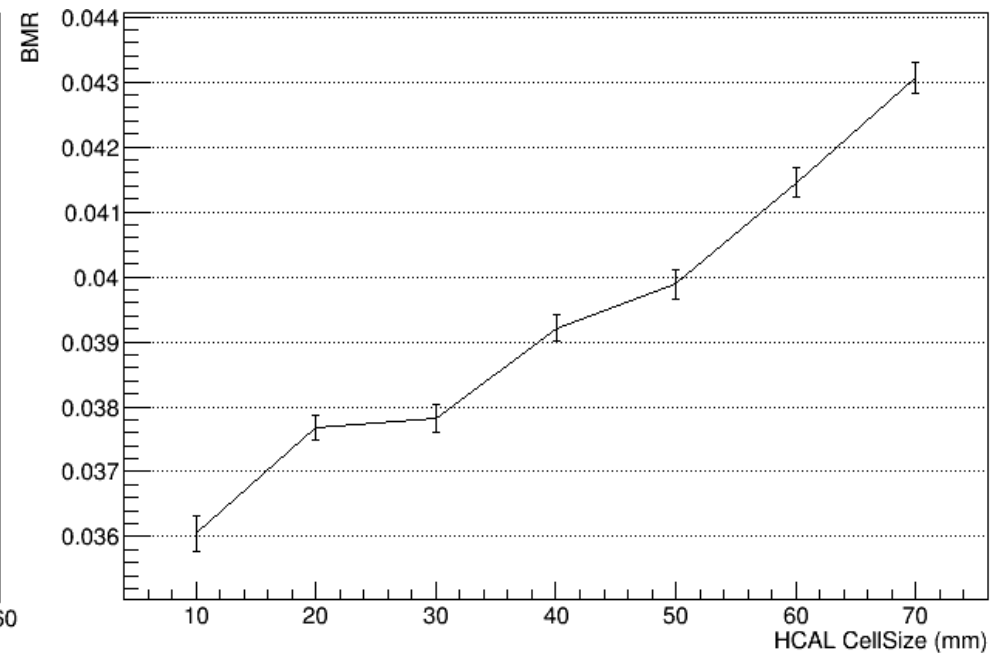
BMR - HCAL Cell Size

Number of Readout layers optimization

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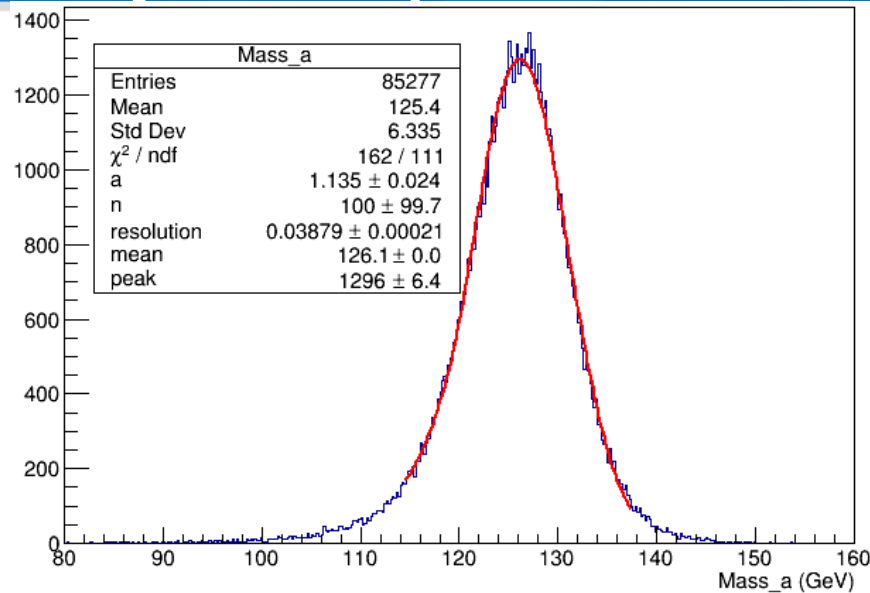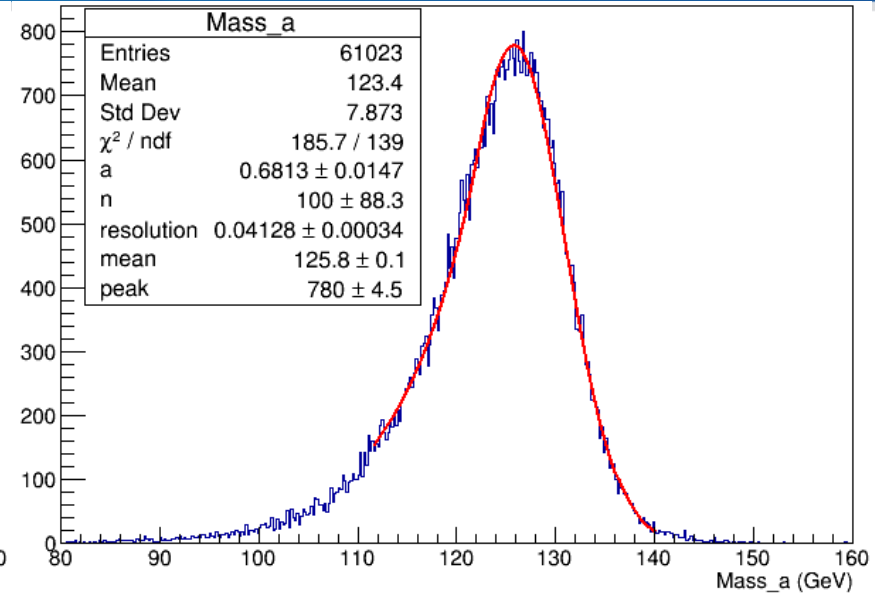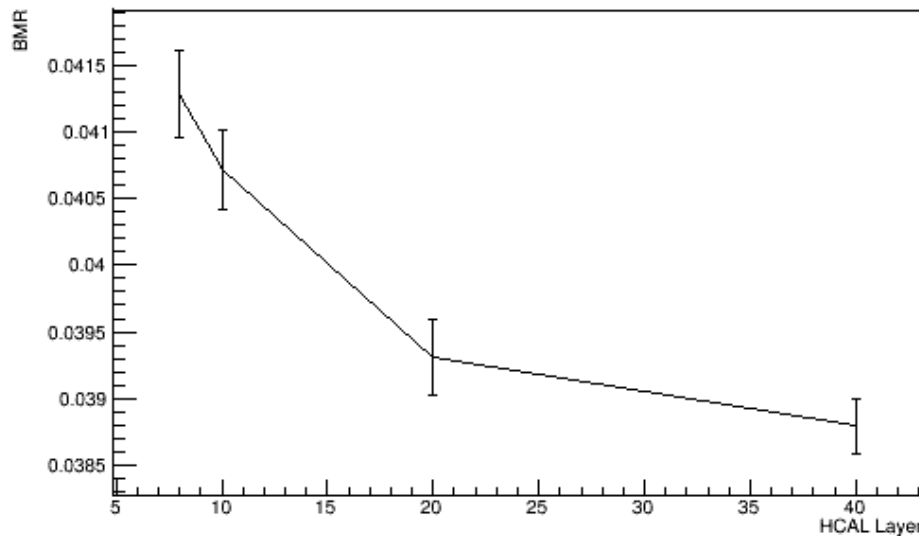

BMR HCAL Layer 40

BMR HCAL Layer 8

- Readout layer combination
  - This idea is to combine adjacent sampling layers in readout.
  - There are always 40 sampling layers.
  - AHCAL Cell Size is fixed to 30mm
  - Scaned from 40 to 8 layers

10

Conclusion

- ## AHCAL Cell Size
  - Cell size is scanned from 10mm to 70mm, 30 mm is an appropriate choice for AHCAL

- ## Number of AHCAL Readout Layers
  - Readout Layer number ranges from 40 to 8 at 30mm CellSize
  - Having only 20 readout layers by combining consecutive two sampling layers in readout seems OK from initial full PFA performance assessment.