# Updates on ZDC Simulation

July 13, 2023
ZDC Working Group Meeting

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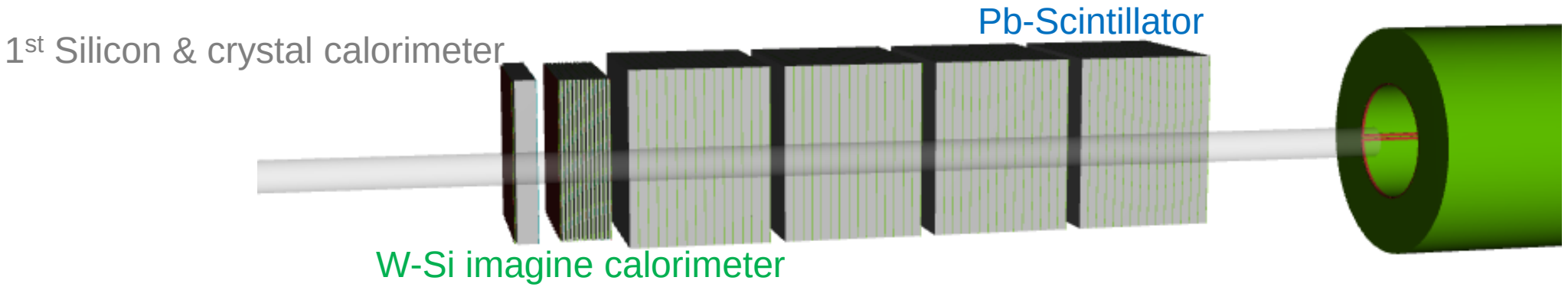
Academia Sinica

# New ZDC Geometry

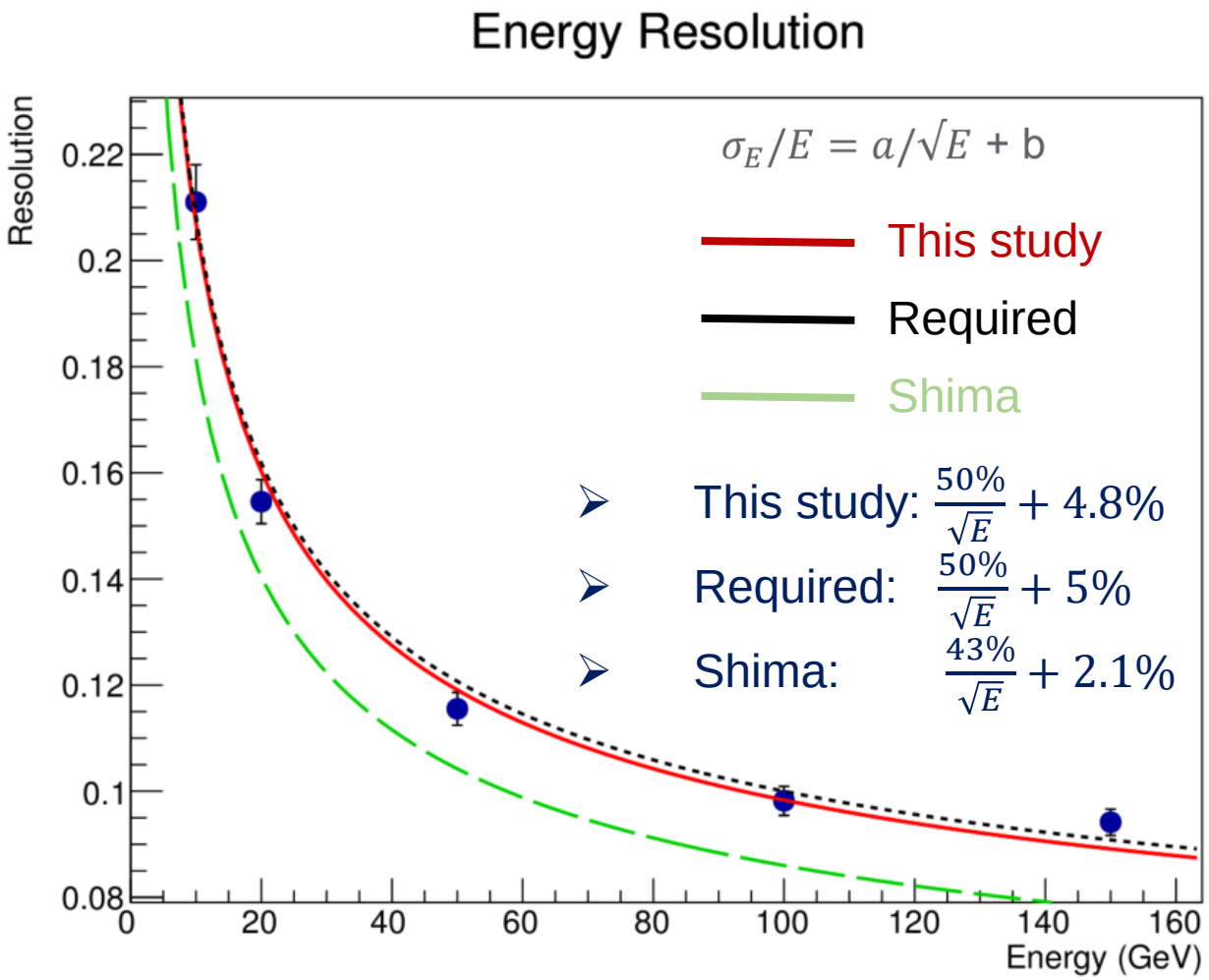



- Use particle gun to generate neutrons of different energy
  - Position at the front of ZDC, at angle along the ZDC center
  - Five different energy settings: (10, 20, 50, 100, 150) GeV
  - 1000 events for each setting
- Do calibration with linear fitter

$$E_{rec.} = c_1 E_{SiPix} + c_2 E_{Crystal} + c_3 E_{WSi} + c_4 E_{PbScint} + \mathrm{b}$$

  - Energy-dependent calibration not applied

# New ZDC Geometry




- A test suggested → modify the ratio of the thickness of Pb:Scinitllator to 4:1

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PERFORMANCE OF A COMPENSATING
LEAD-SCINTILLATOR HADRONIC CALORIMETER

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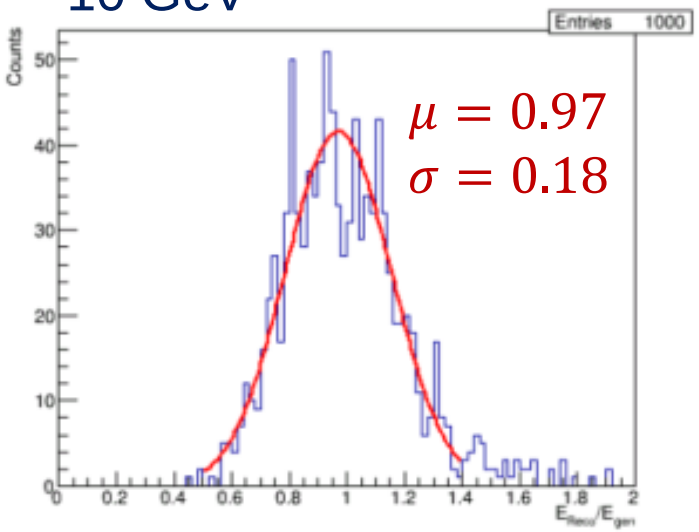
*Abstract*

We have built a sandwich calorimeter consisting of 10 mm thick lead plates and 2.5 mm thick scintillator sheets. The thickness ratio between lead and scintillator was optimized to achieve a good energy resolution for hadrons. We have exposed this calorimeter to electrons, hadrons and muons in the energy range between 3 and 75 GeV, obtaining an average energy resolution of $23\%/\sqrt{E}$ for electrons and $44\%/\sqrt{E}$ for hadrons. For energies above 10 GeV and after leakage corrections, the ratio of electron response to hadron response is 1.05.

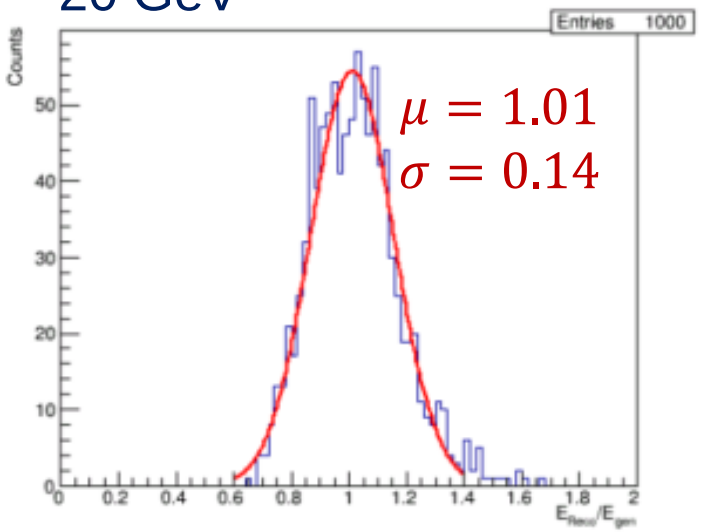
# New ZDC Geometry

➢ Gaussian fits of $E_{reco}$ / $E_{Gen}$

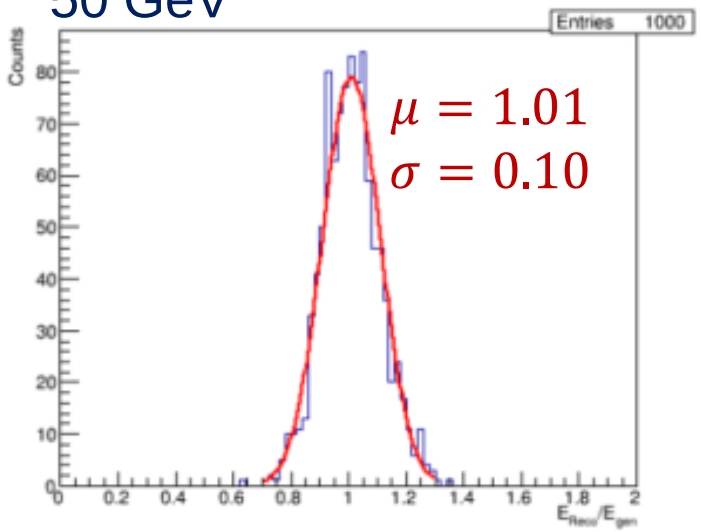
10 GeV



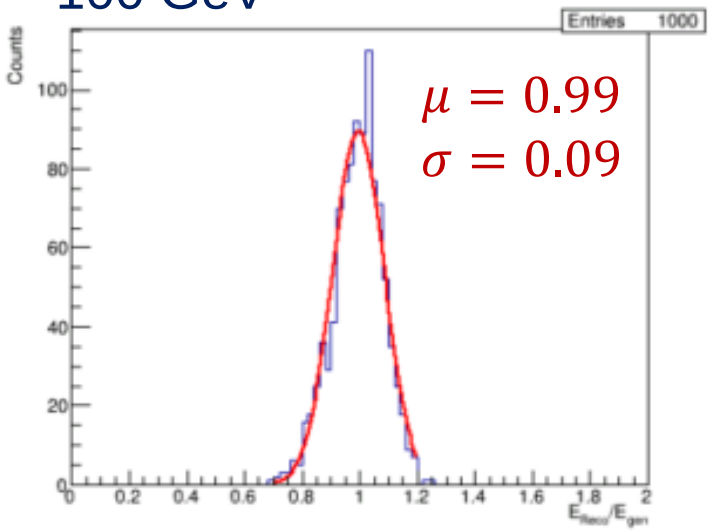

20 GeV



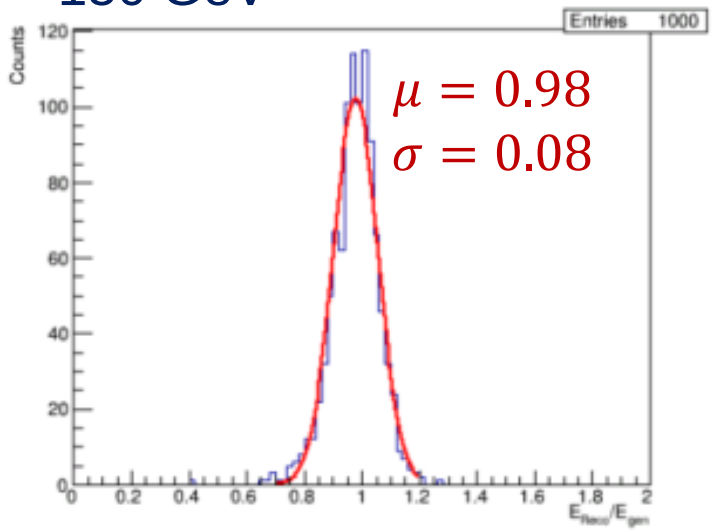

50 GeV




100 GeV




150 GeV

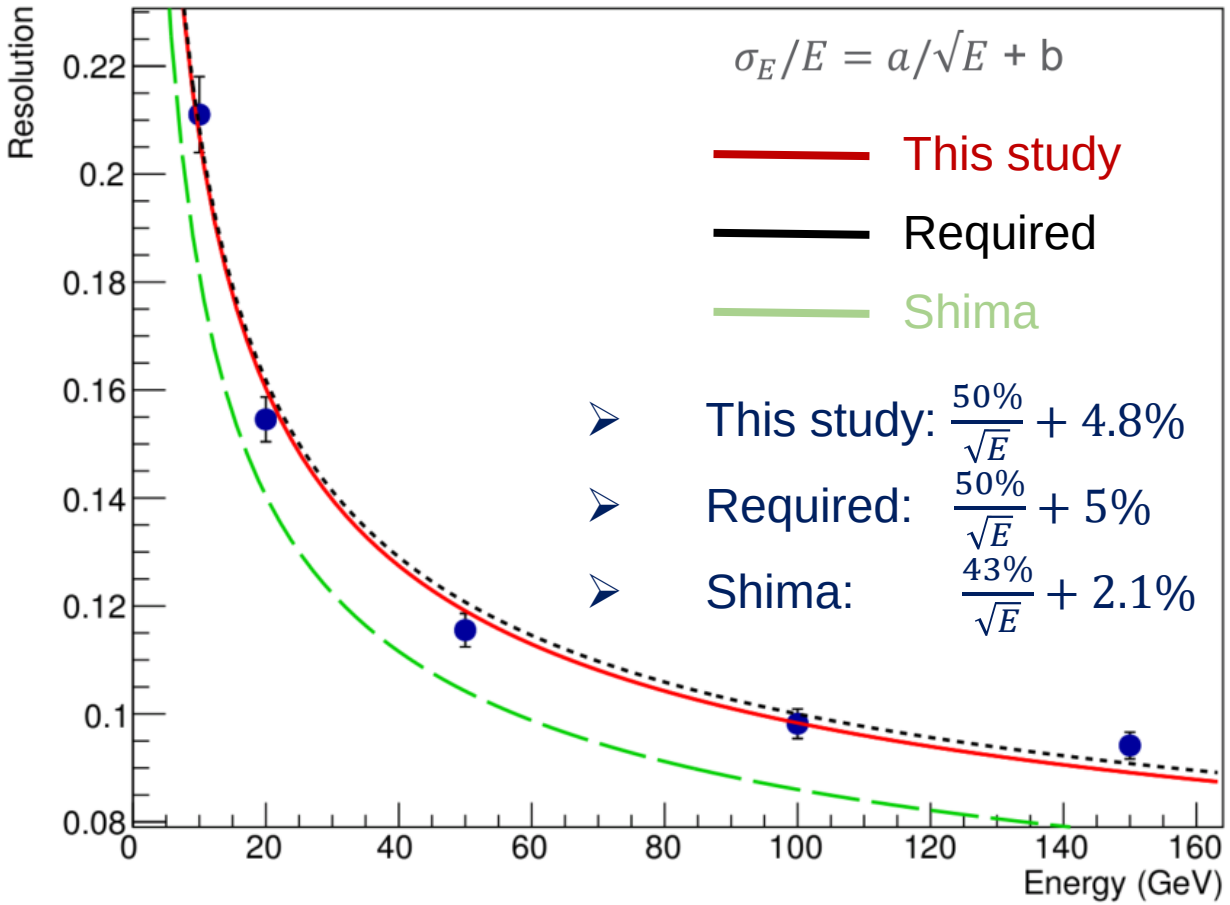



- Before:
  - Lead = 30 mm
  - Scintillator = 2 mm
- Now:
  - Lead = 25.6 mm
  - Scintillator = 6.4 mm

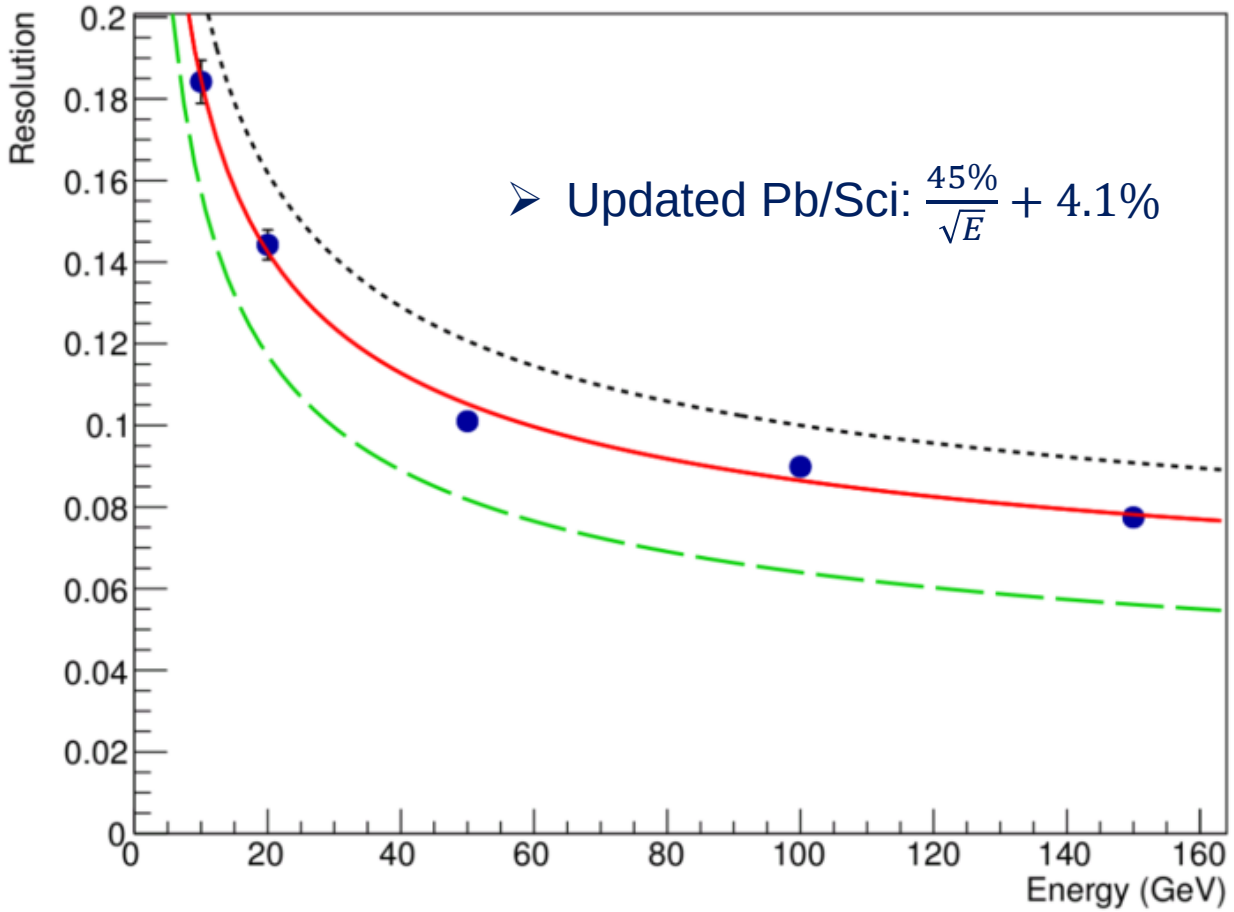
Each module contains 15 layers of Pb/Scintillators (480mm), unchanged.

# New ZDC Geometry

Before

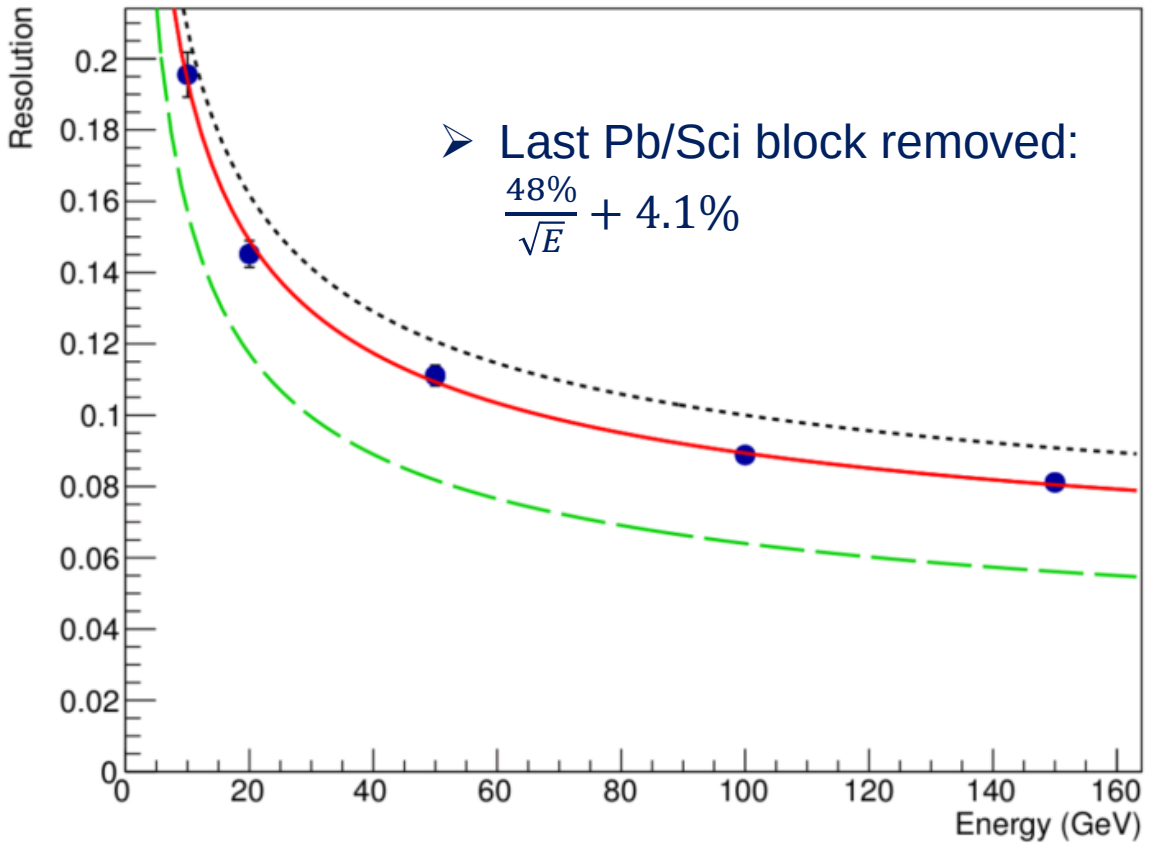



Now



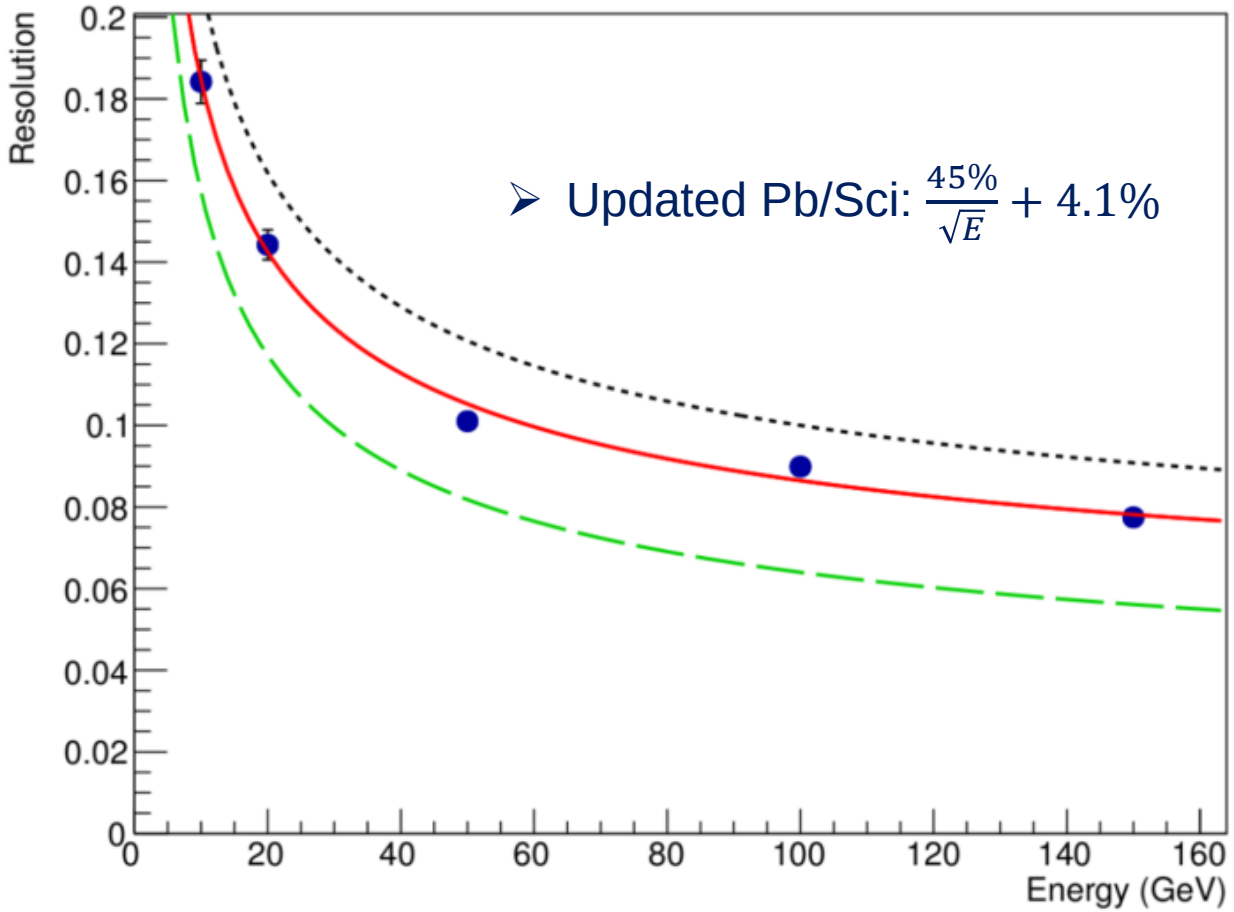
# New ZDC Geometry

Remove the last Pb/Sci block




- Last Pb/Sci block removed: $\frac{48\%}{\sqrt{E}} + 4.1\%$

Now




- Updated Pb/Sci: $\frac{45\%}{\sqrt{E}} + 4.1\%$

- Removing the last block deteriorates energy resolution

# Next Steps

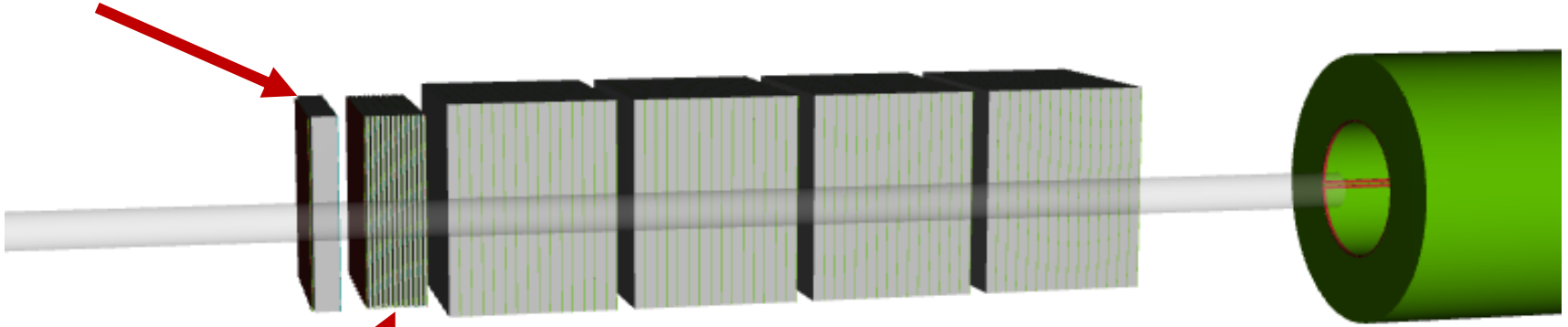
- Shower development and the place for the imaging part of HCAL
  → Procedure?
- Implementation of reconstruction → Reference: EMCAL at B0 by Michael Pitt
- Position resolution

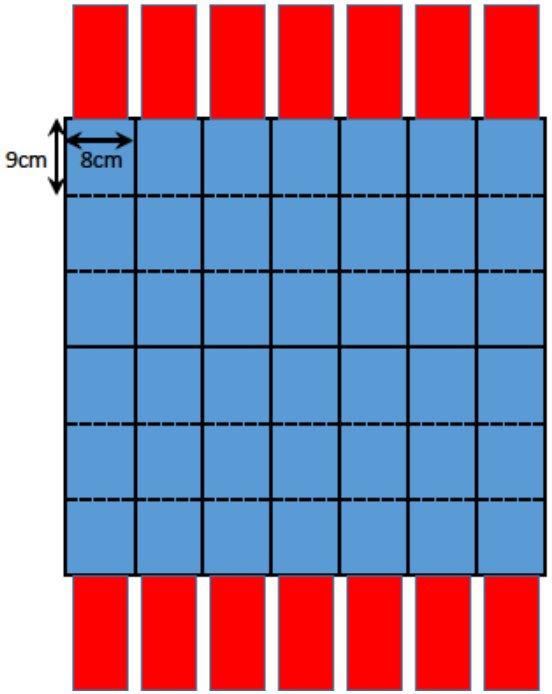
- Reference by Migeul et al. - https://arxiv.org/abs/2208.05472
- New group expressing interest in ZDC simulation work:
  Group of Kentaro Kawade from Shinshu University

# BACKUP

# New ZDC Geometry

- 1st Silicon & crystal calorimeter:
  - Smaller lateral dimension (x, y) = (56, 54) cm.
- Silicon Pixel lateral size (x, y) = (4, 3) mm



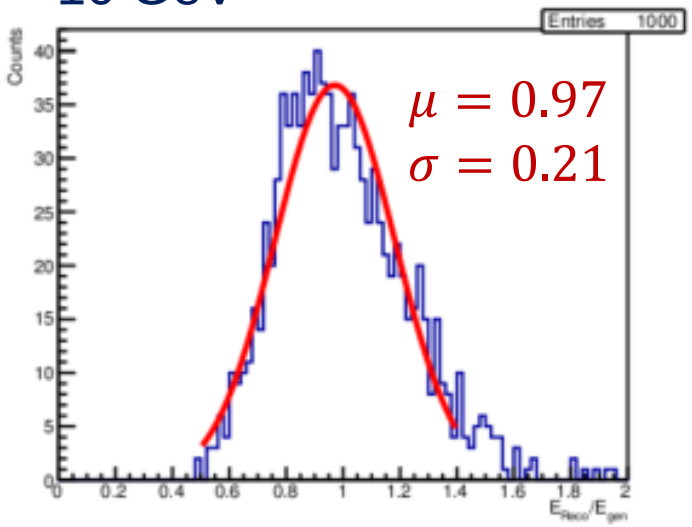



- W-Si imagine calorimeter
  - Smaller lateral dimension (x, y) = (56, 54) cm.
  - Smaller number of layers $1X_0 \times 22 \rightarrow 2X_0 \times 12$ layers

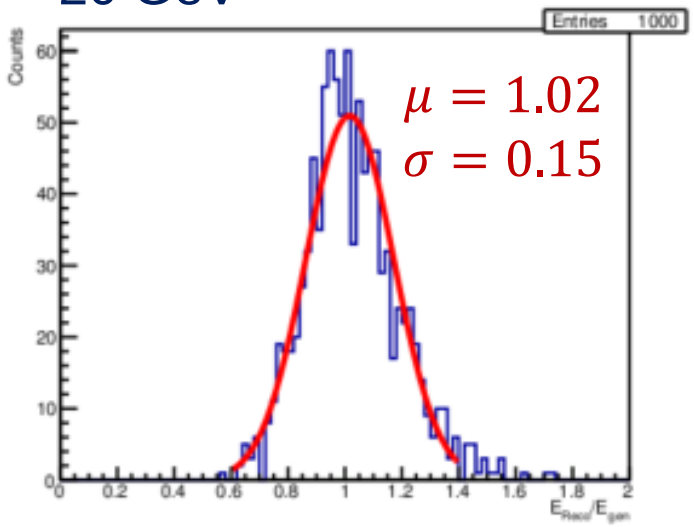
- Pb-Scintillator + fused silica
  - Towers of 10cm x 10cm x 48cm, each module is 60cm x 60cm x 48cm
  - 4 modules
  - Not yet have the implementation of fused silica – only scintillator now
- Pb-Si modules removed

# New ZDC Geometry

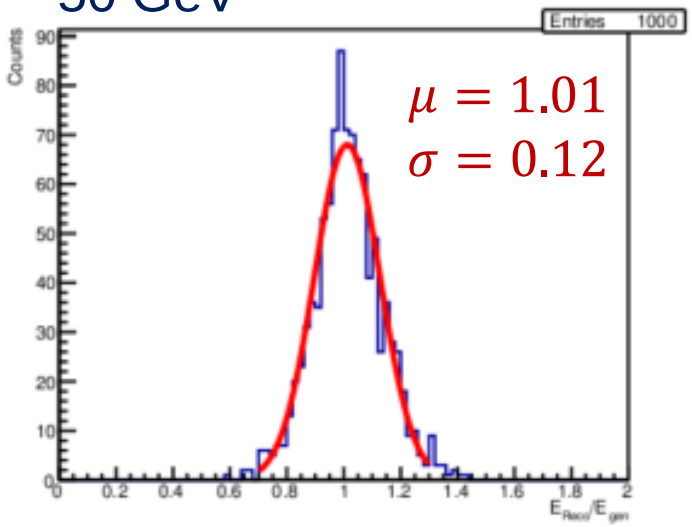
10 GeV



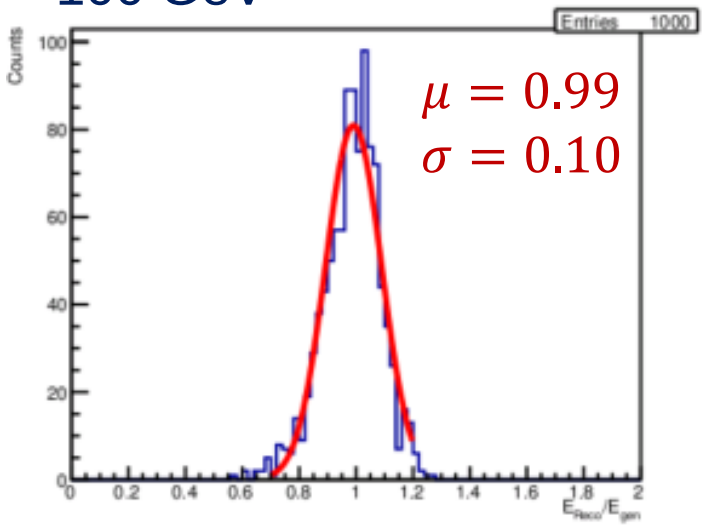

20 GeV



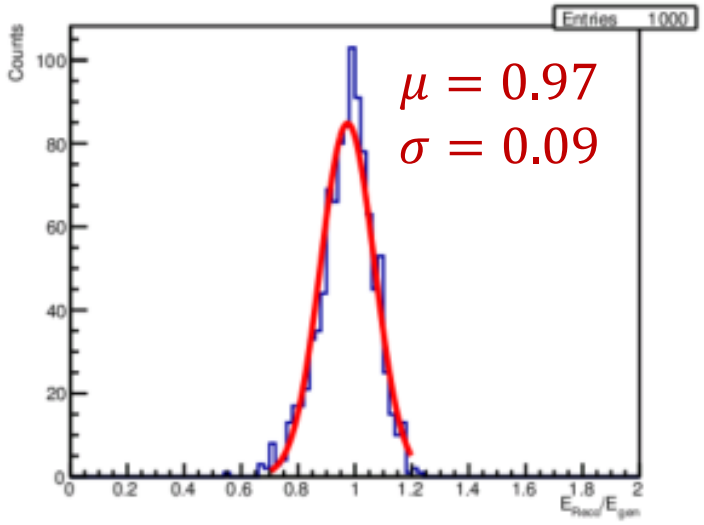

50 GeV




100 GeV




150 GeV




- Gaussian fits of $E_{reco}$ / $E_{Gen}$