



Updates on ZDC Simulation

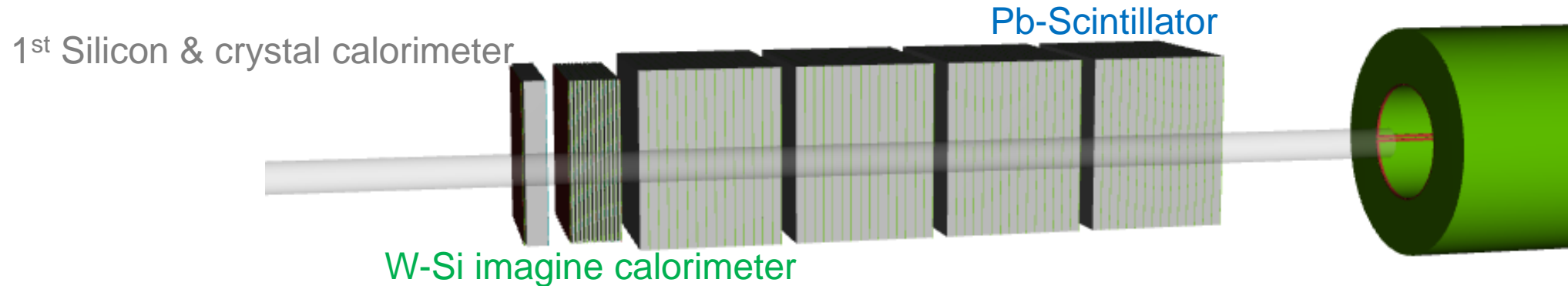
July 13, 2023

ZDC Working Group Meeting

Po-Ju Lin

Academia Sinica

New ZDC Geometry



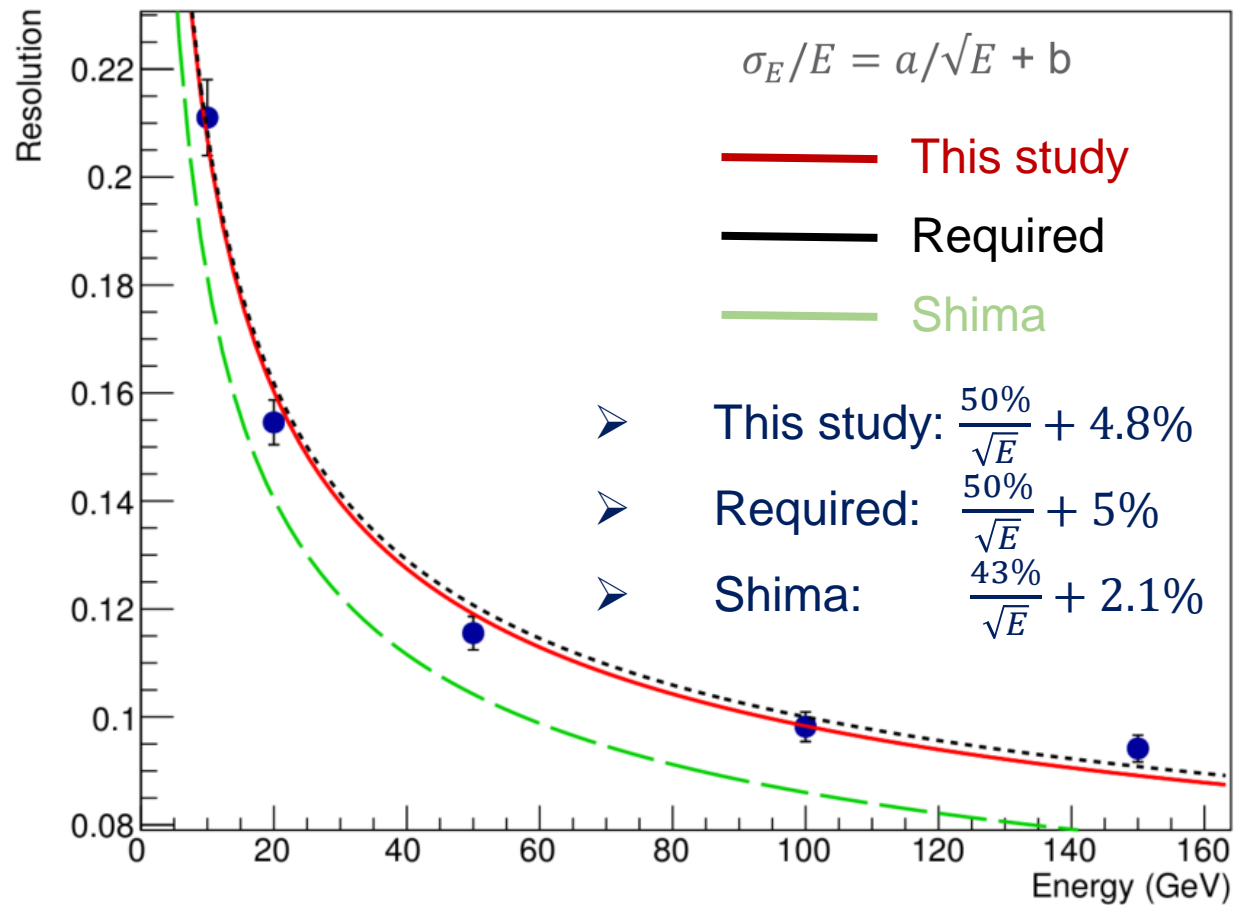
- Use particle gun to generate neutrons of different energy
 - Position at the front of ZDC, at angle along the ZDC center
 - Five different energy settings: (10, 20, 50, 100, 150) GeV
 - 1000 events for each setting
- Do calibration with linear fitter

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

- ◆ Energy-dependent calibration not applied

New ZDC Geometry

Energy Resolution



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

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PERFORMANCE OF A COMPENSATING
LEAD-SCINTILLATOR HADRONIC CALORIMETER

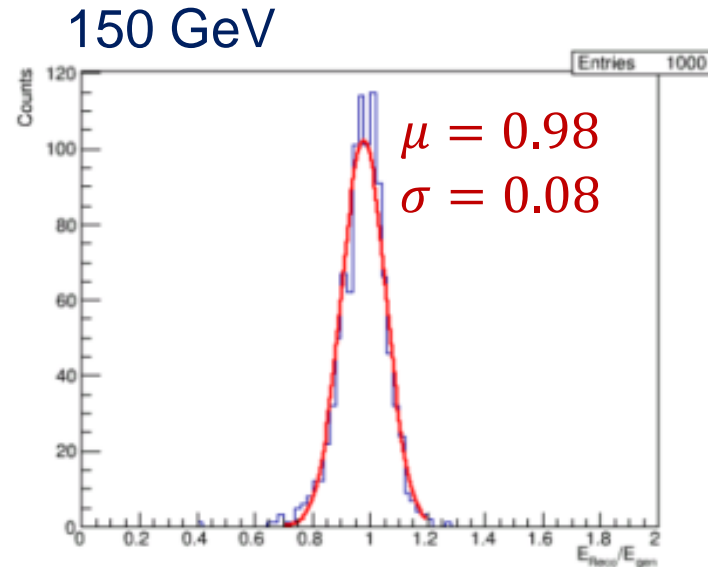
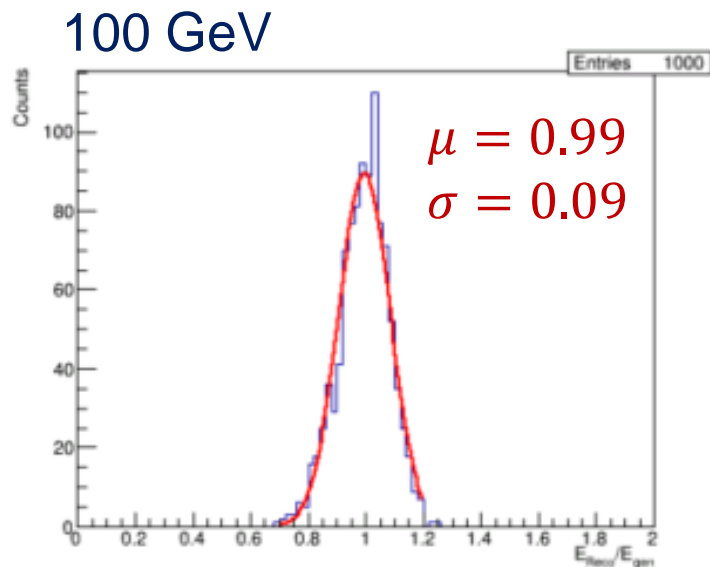
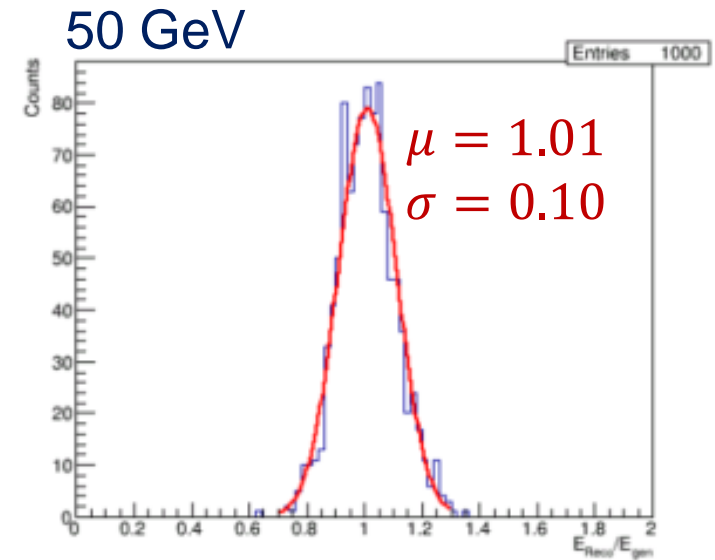
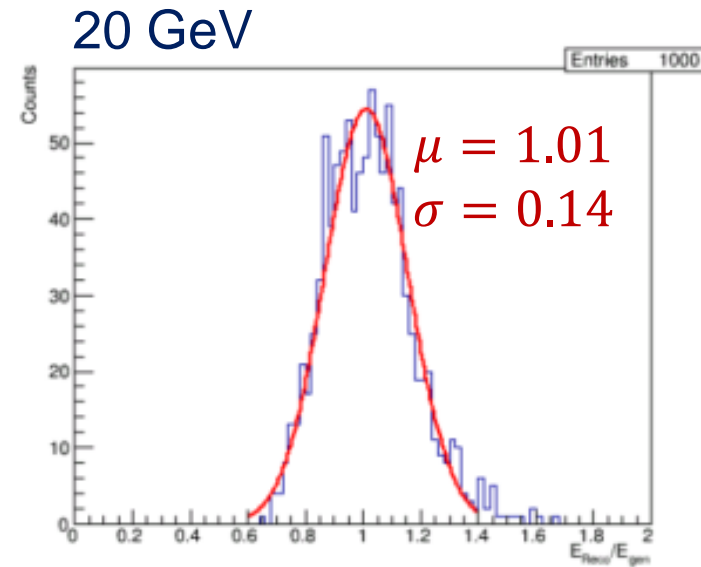
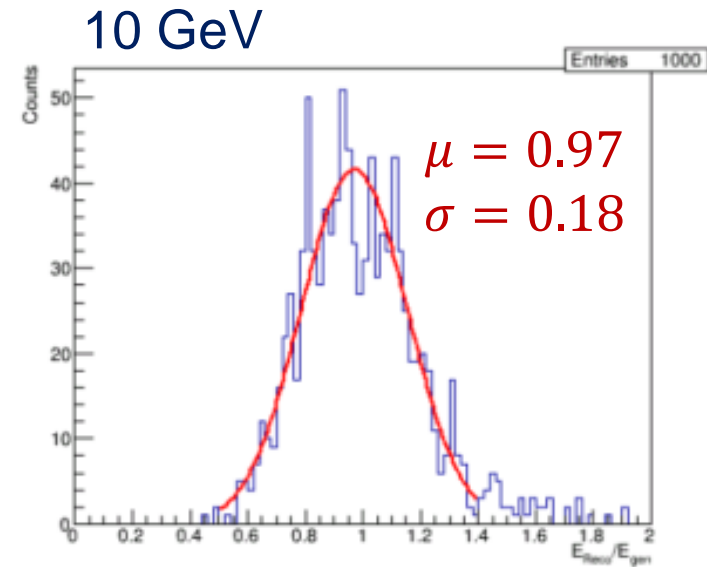
E. Bernardi¹, G. Drews¹, M.A. Garcia², R. Klanner¹, U. Kötz¹, G. Levman³, M. Lomperski⁴,
D. Lüke¹, E. Ros², F. Selonke¹, H. Tiecke⁵, M. Tsirou⁴, W. Vogel⁶

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 $E_{\text{reco}} / E_{\text{Gen}}$

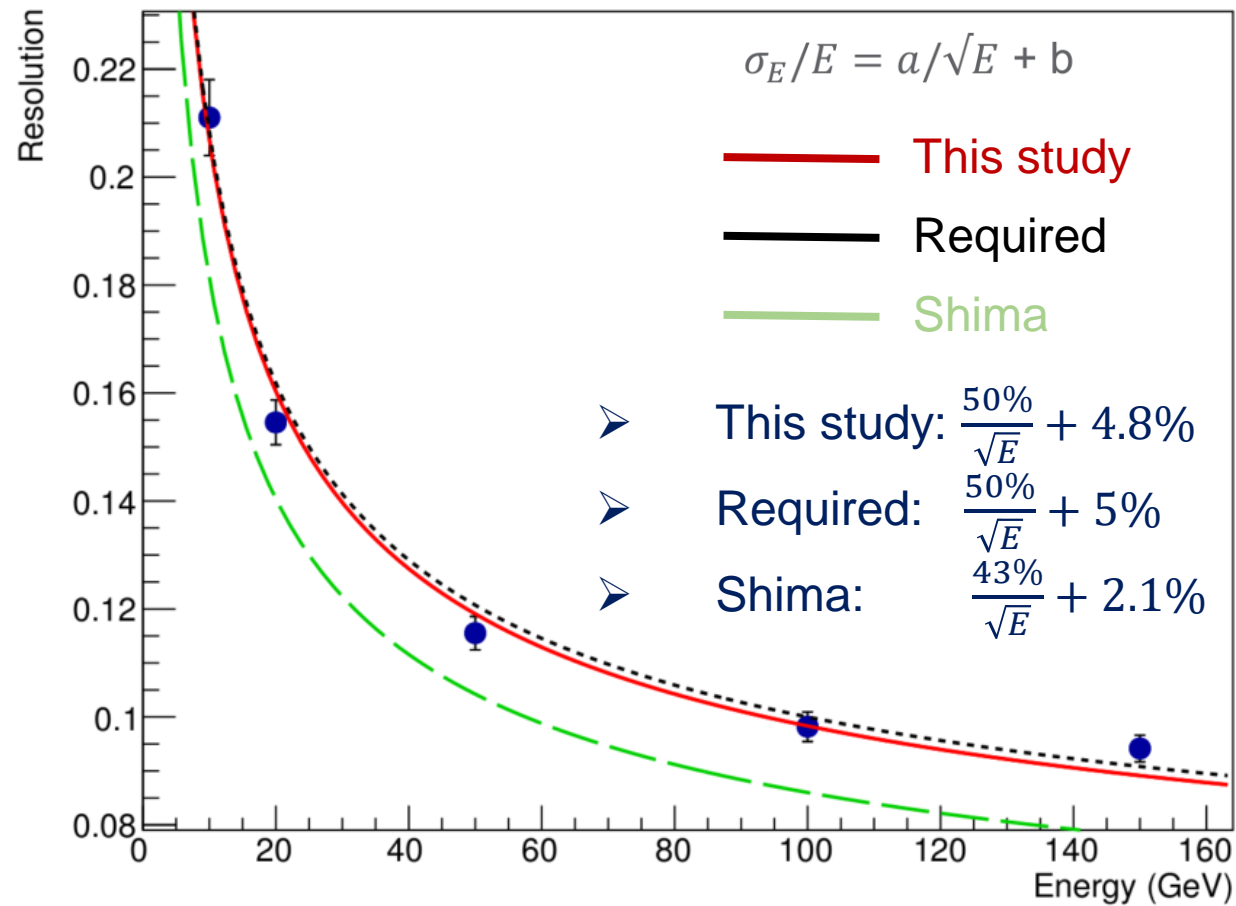


- Before:
 - Lead = 30 mm
 - Scintillator = 2 mm
- Now:
 - Lead = 25.6 mm
 - Scintillator = 6.4 mm

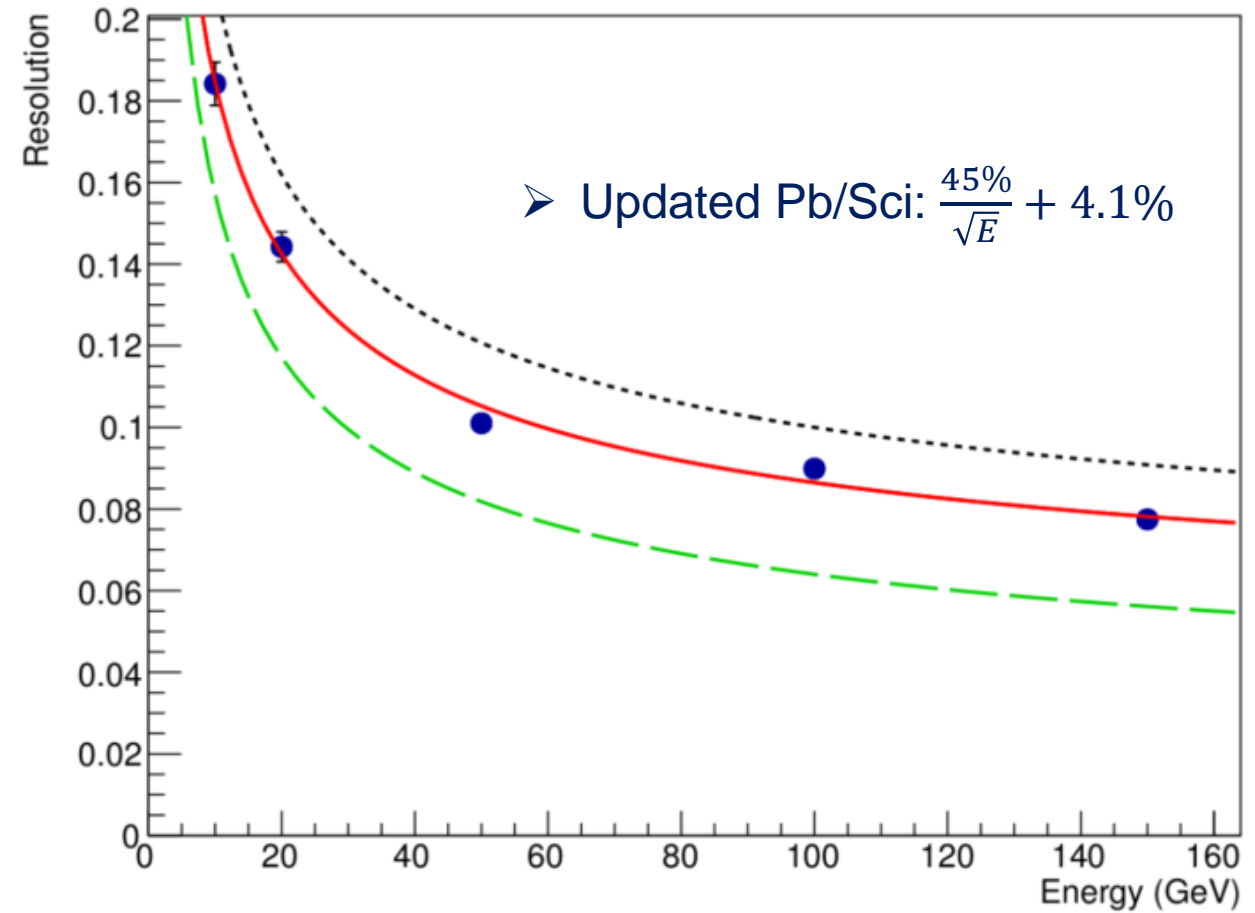
Each module contains 15 layers of Pb/Scintillators (480mm), unchanged.

New ZDC Geometry

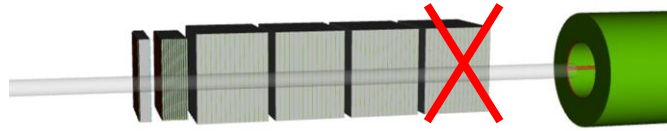
Before



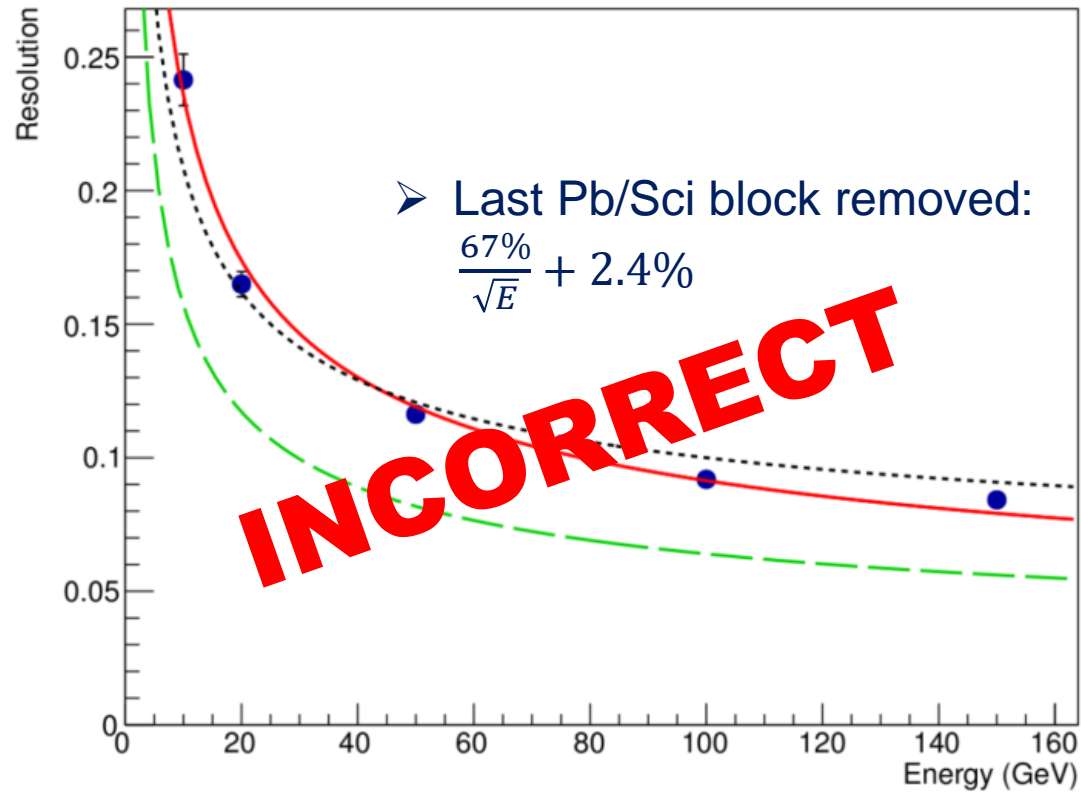
Now



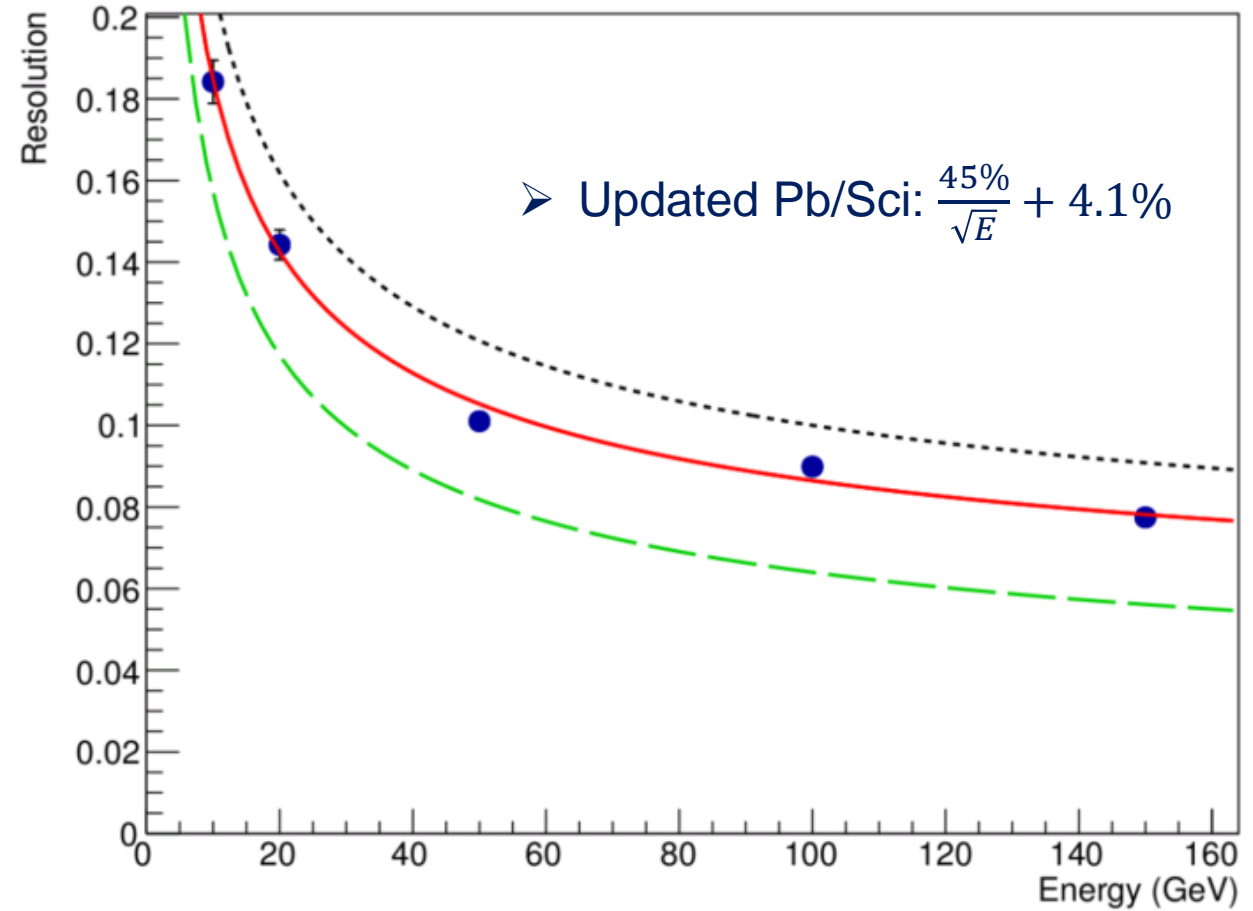
New ZDC Geometry



Remove the last Pb/Sci block



Now



➤ Removing the last block deteriorates energy resolution

Next Steps

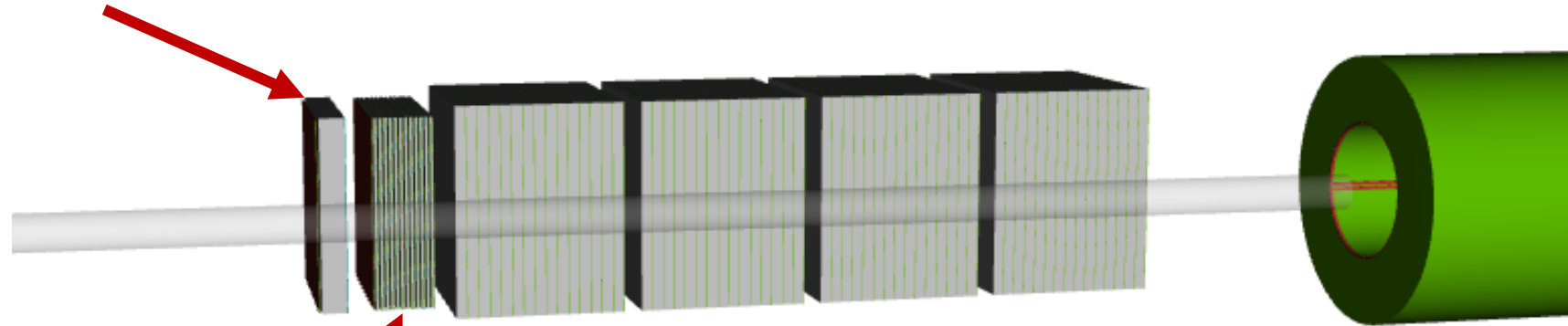
- Shower development and the place for the imaging part of HCAL
 - Procedure?
 - Implementation of reconstruction → Reference: EMCAL at B0 by Michael Pitt
 - Position resolution
-
- Reference by Migeul et al. - <https://arxiv.org/abs/2208.05472>
 - New group expressing interest in ZDC simulation work:
Group of Kentaro Kawade from Shinshu University

BACKUP

New ZDC Geometry

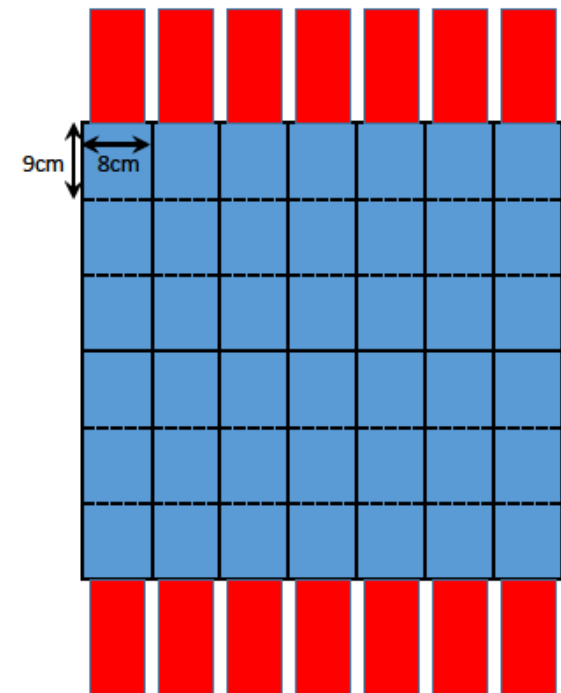
- 1st Silicon & crystal calorimeter:
 - Smaller lateral dimension $(x, y) = (56, 54)$ cm.

- Silicon Pixel lateral size $(x, y) = (4, 3)$ mm



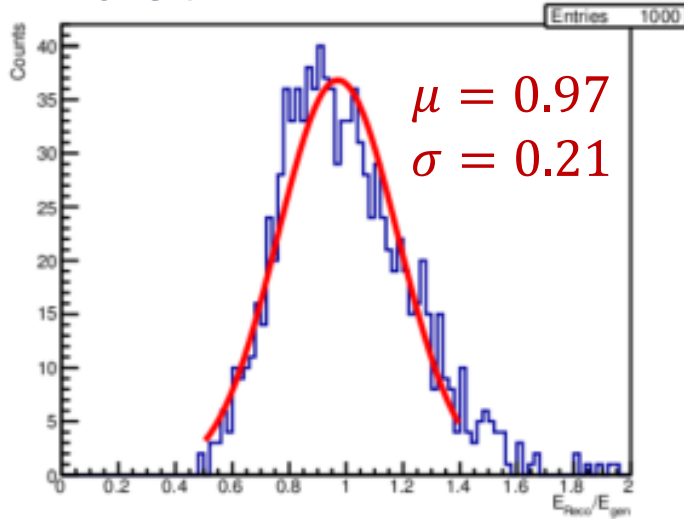
- W-Si imagine calorimeter
 - Smaller lateral dimension $(x, y) = (56, 54)$ cm.
 - Smaller number of layers $1X_0 \times 22 \rightarrow 2X_0 \times 12$ layers

- 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**

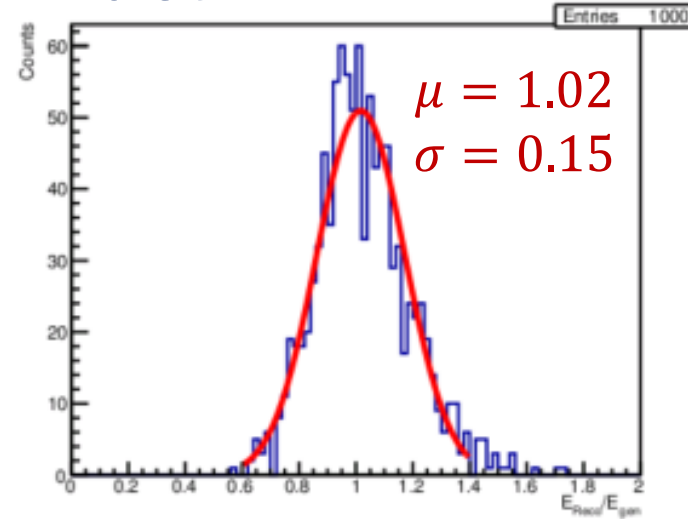


New ZDC Geometry

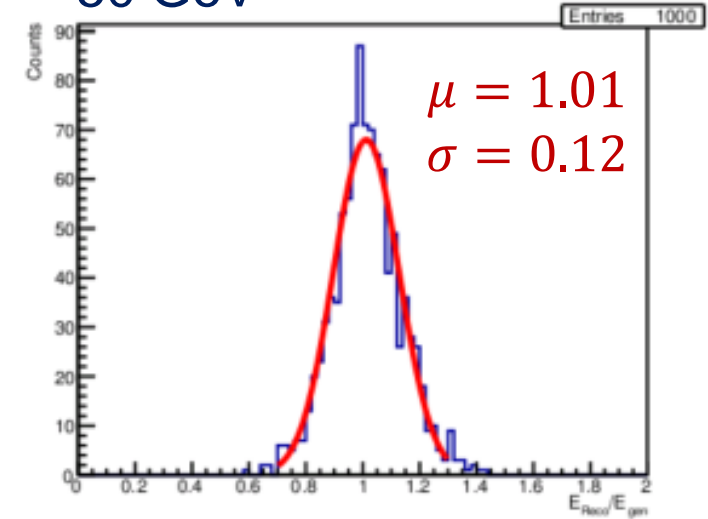
10 GeV



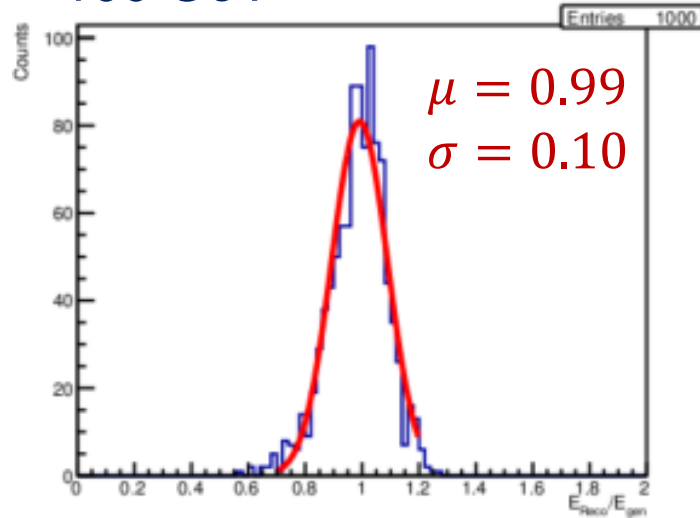
20 GeV



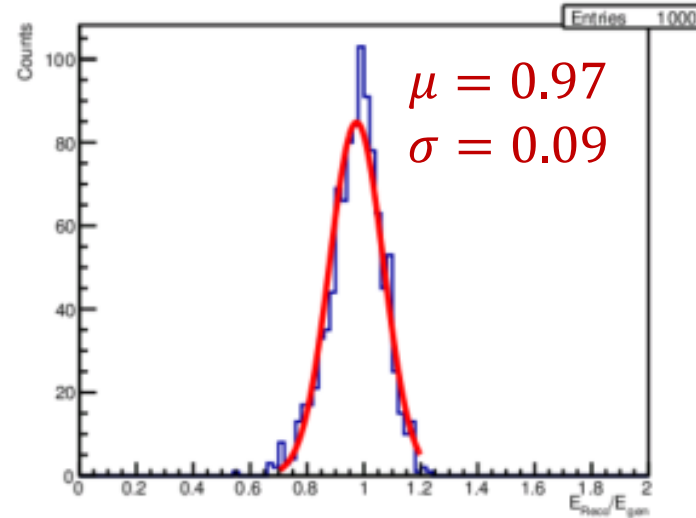
50 GeV



100 GeV



150 GeV



➤ Gaussian fits of $E_{\text{reco}}/E_{\text{Gen}}$