

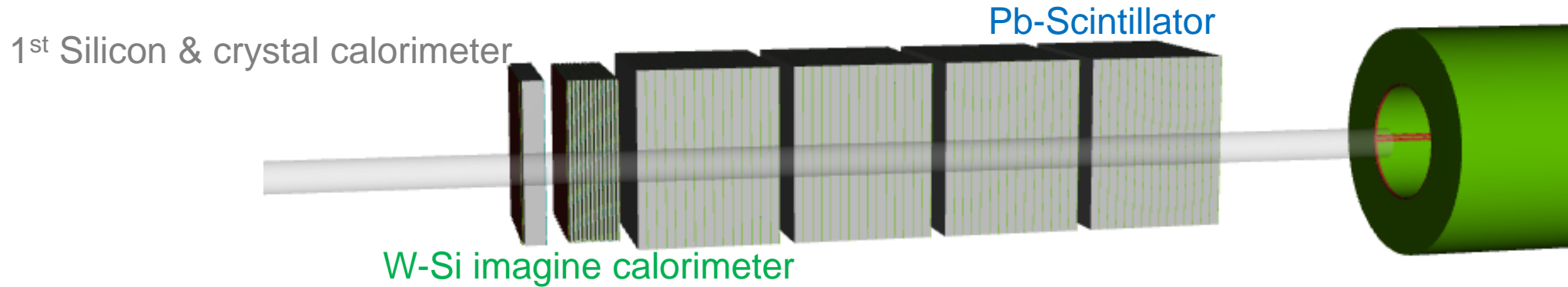


# Updates on ZDC Simulation

September 7, 2023  
ZDC Working Group Meeting

Po-Ju Lin  
National Central University

# New ZDC Geometry

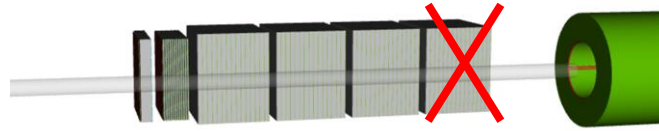


- Use particle gun to generate neutrons of different energy
  - Position at the front of ZDC, at angle along the ZDC center
  - Five different energy settings: (10, 20, 50, 100, 150) GeV
  - 1000 events for each setting
- Do calibration with linear fitter

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

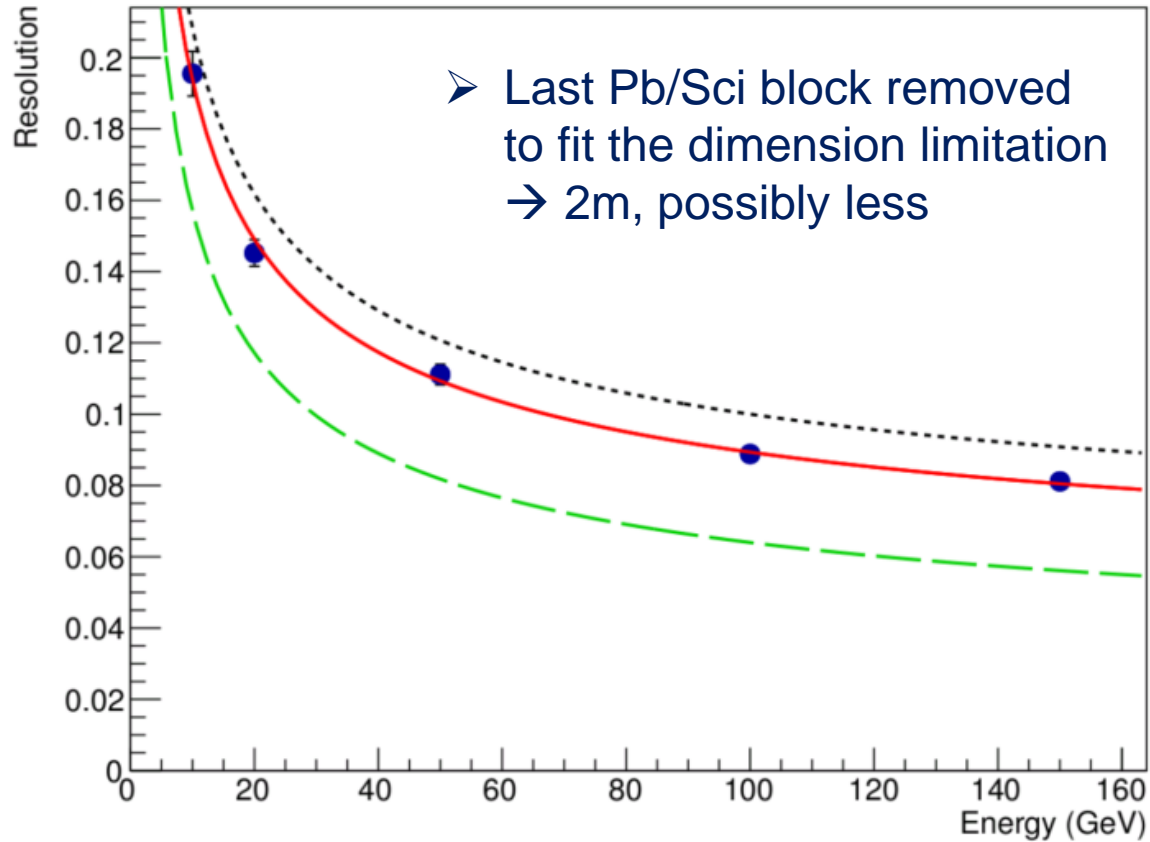
- ◆ Energy-dependent calibration not applied

# New ZDC Geometry



Remove the last Pb/Sci block

Energy Resolution



➤ Removing the last block deteriorates energy resolution

➤ modify the ratio of the thickness of Pb:Scintillator to 4:1 improved the resolution

$$\sigma_E/E = a/\sqrt{E} + b$$

— This study

— Required

— Shima

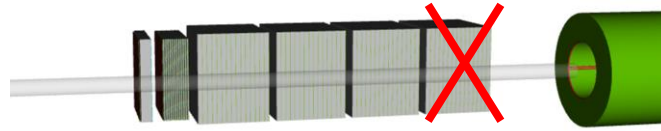
➤ This study:  $\frac{48\%}{\sqrt{E}} + 4.1\%$

➤ Required:  $\frac{50\%}{\sqrt{E}} + 5\%$

➤ Shima:  $\frac{43\%}{\sqrt{E}} + 2.1\%$

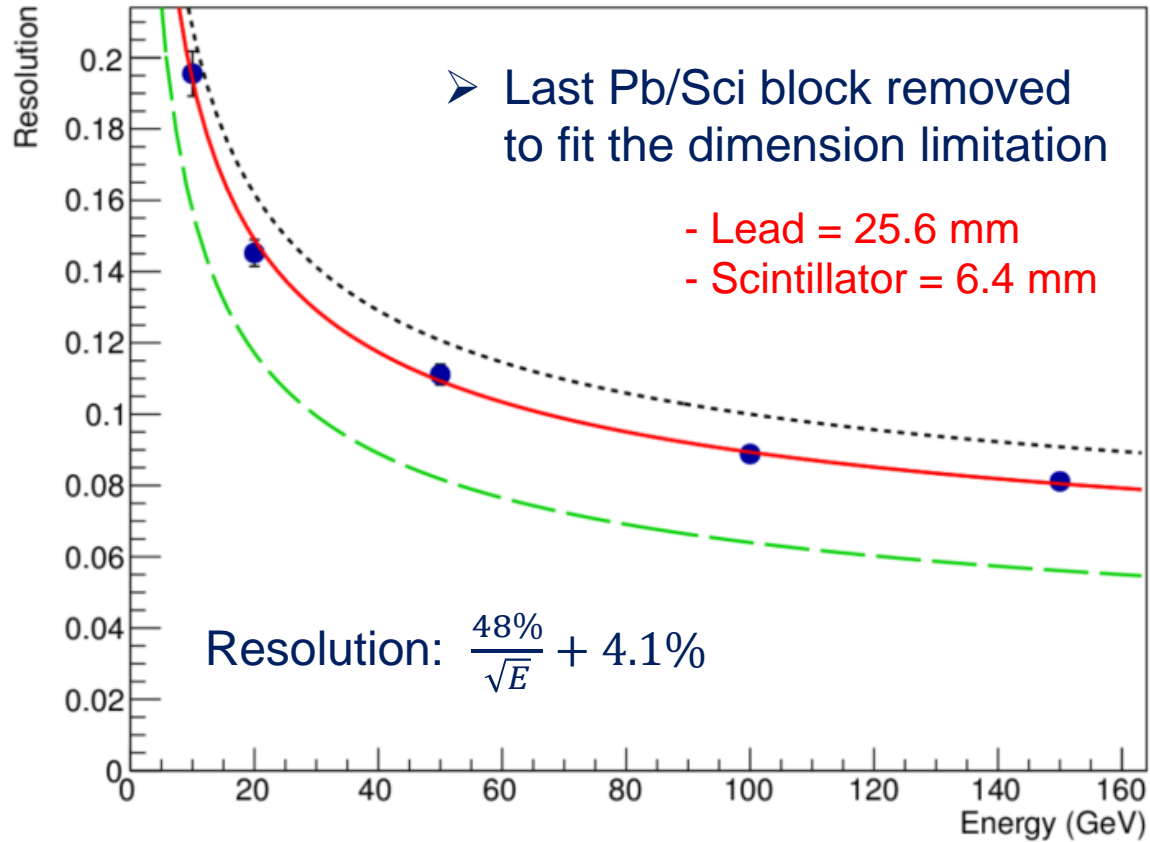
➤ Suggested to follow the ZEUS convention, with 10mm of lead and 2.5mm scintillator to increase sampling rate.

# New ZDC Geometry

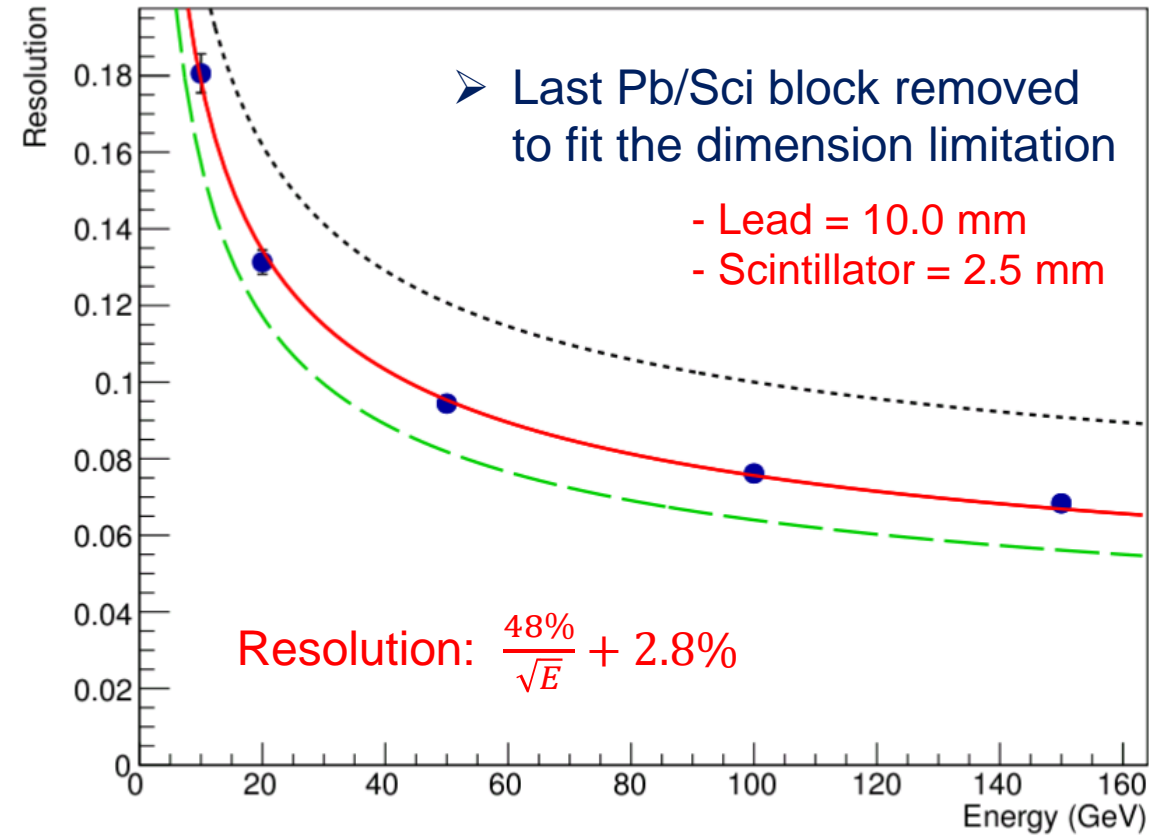


Remove the last Pb/Sci block

Energy Resolution

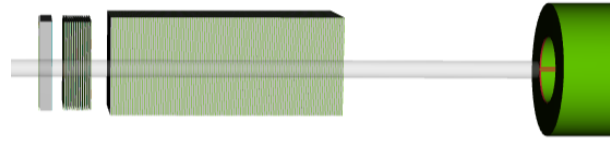


Energy Resolution

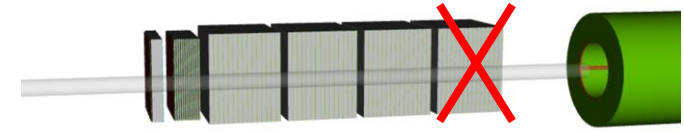
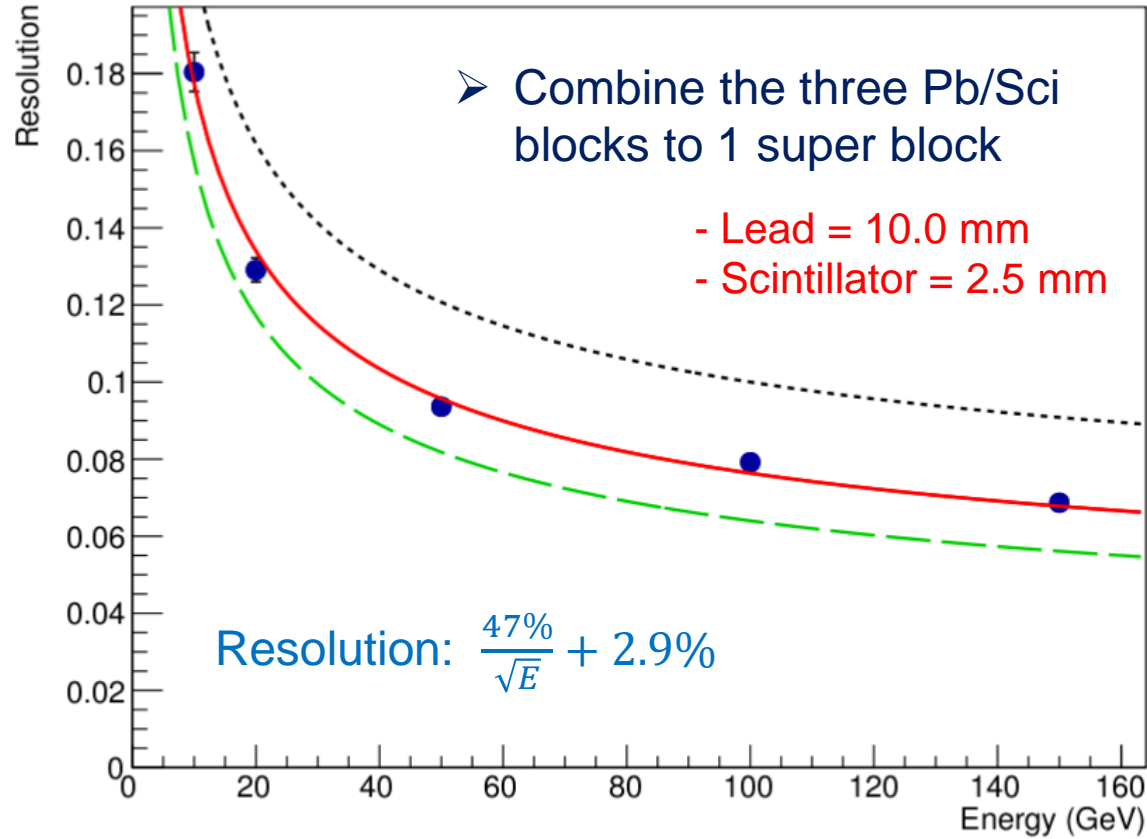


- Use the ZEUS convention further improves the resolution → # of readout channels increased by a factor of 38/15, more than double

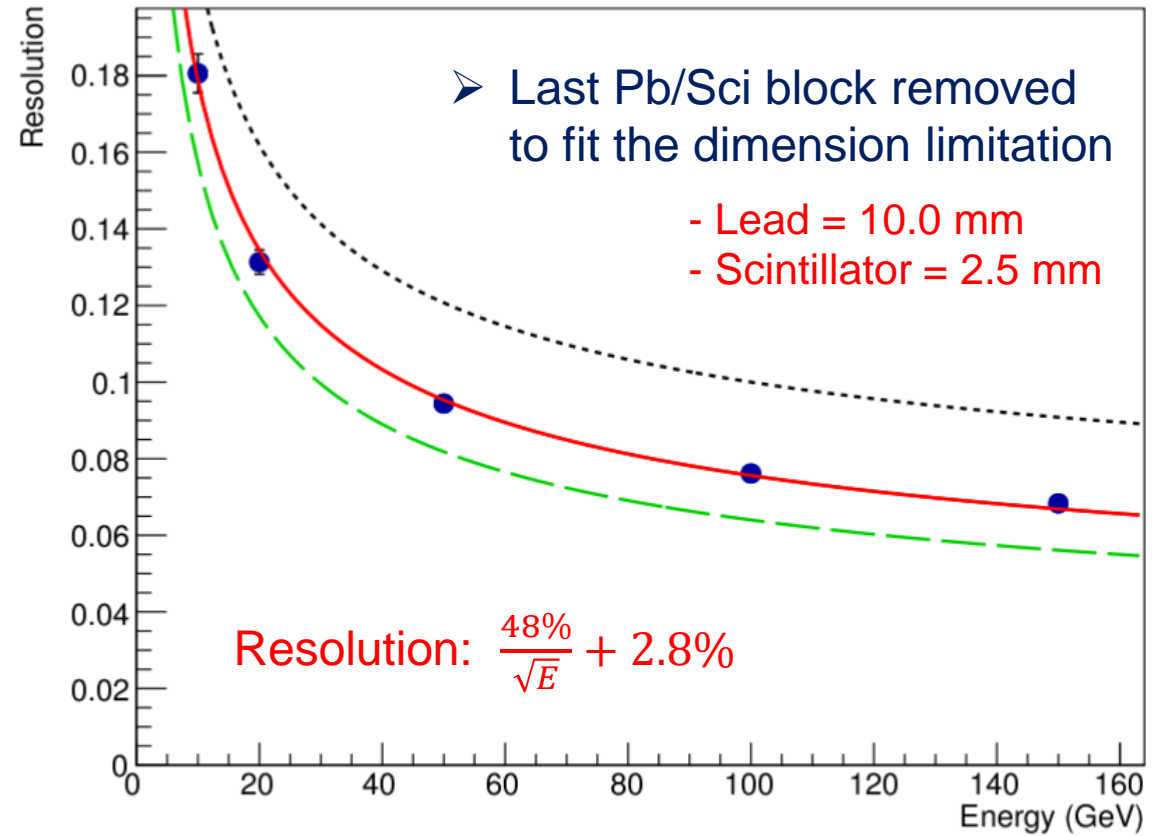
# New ZDC Geometry



Energy Resolution

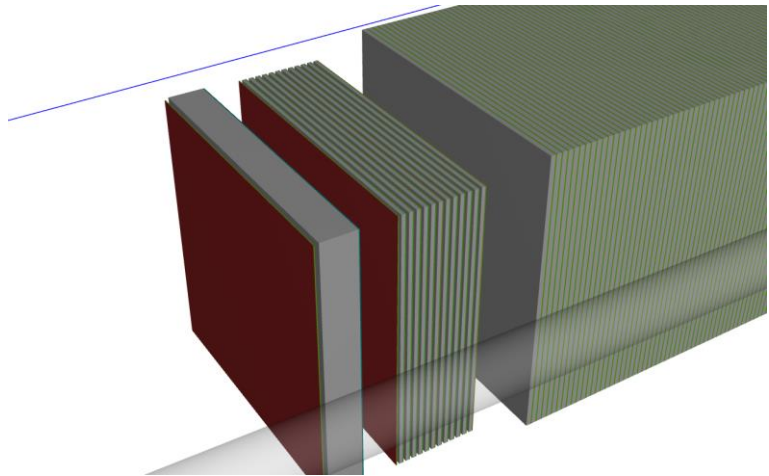


Energy Resolution



- Combining the three blocks into a single super block to further reduce the z-dimension (10cm gap removed) doesn't affect the resolution much.

# Summary

- The energy resolution can reach an acceptable level with a design of thinner Pb/Scintillator slab (ZEUS → 10mm: 2.5mm)
    - Increase in cost acceptable?
  - Combining the three Pb/Scintillator blocks to remove the two gaps between them (5cm) each can bring us more space in Z (total length about 186 cm).
    - Doesn't change the resolution much.
    - Gap between W/Si and Pb/Scintillator around 10cm, can be further reduced if required?
- 
- The current slab design of HCAL can be used as the baseline for the review(?)

# BACKUP