



# Updates on ZDC Simulation

June 08, 2023

Po-Ju Lin

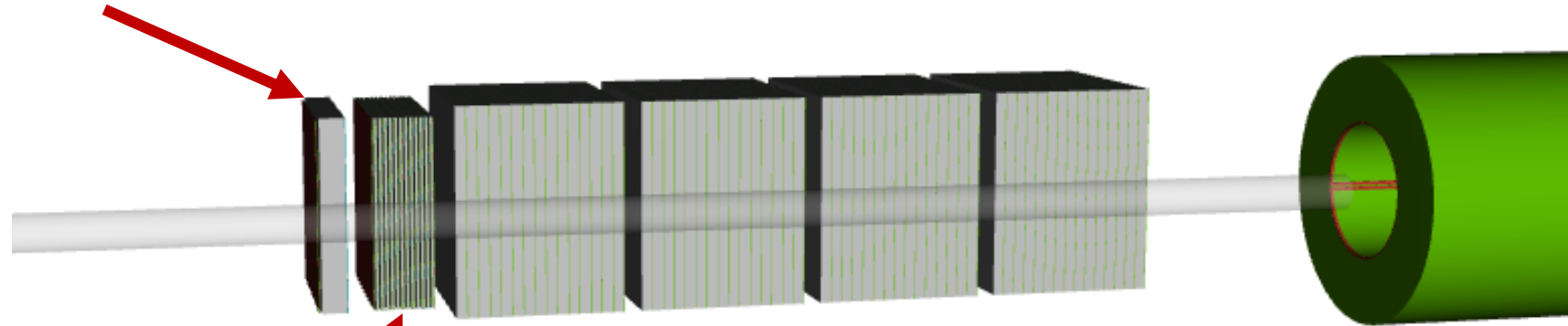
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# New ZDC Geometry

➤ 1<sup>st</sup> Silicon & crystal calorimeter:

- Smaller lateral dimension (x, y) = (56, 54) cm.

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



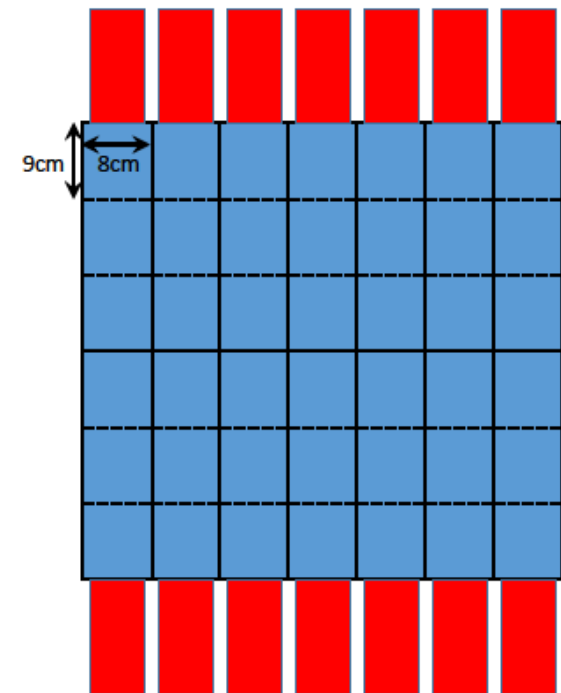
➤ W-Si imagine calorimeter

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

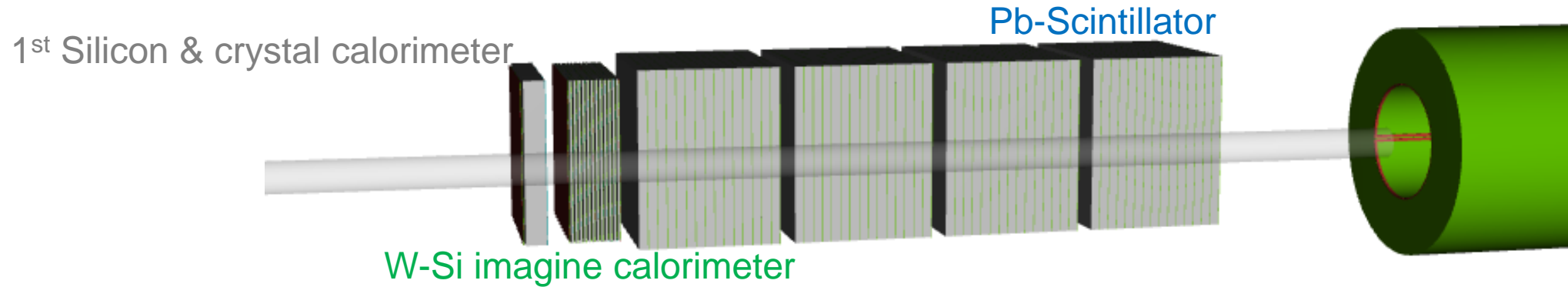
➤ Pb-Scintillator + fused silica

- 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

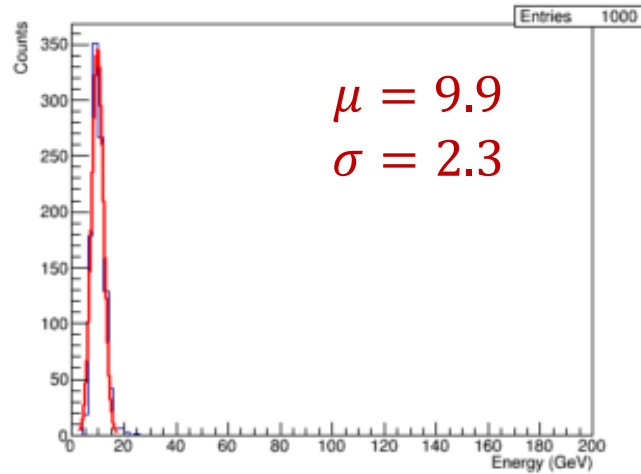


- Use particle gun to generate neutrons of different energy
  - Position at the front of ZDC, at angle along the ZDC center
  - Five different energy settings: (10, 20, 50, 100, 150) GeV
  - 1000 events for each setting
- Do calibration with linear fitter

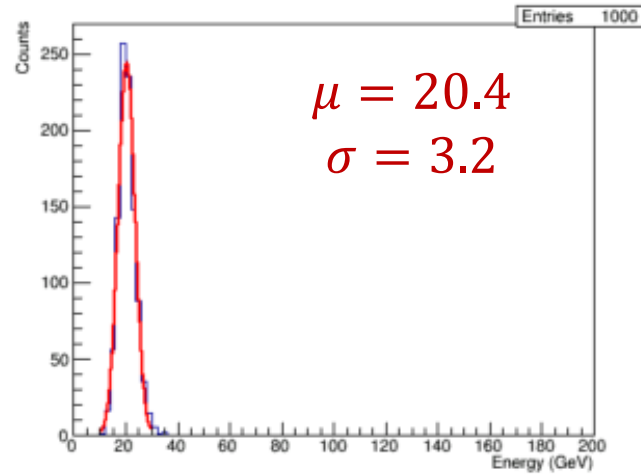
$$E_{rec.} = c_1 E_{SiPix} + c_2 E_{Crystal} + c_3 E_{WSi} + c_4 E_{PbScint} + b$$

# New ZDC Geometry

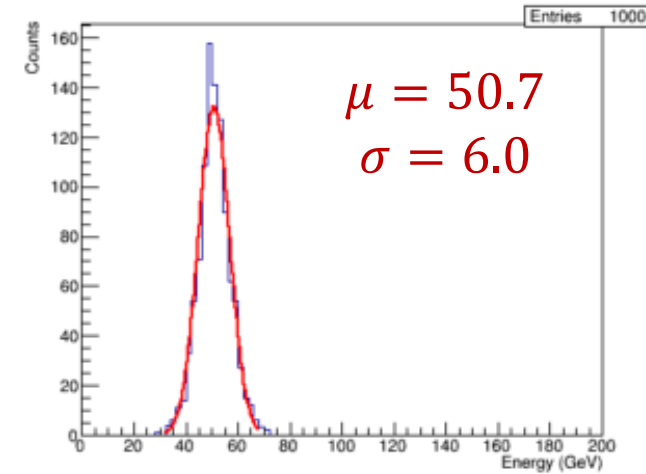
10 GeV



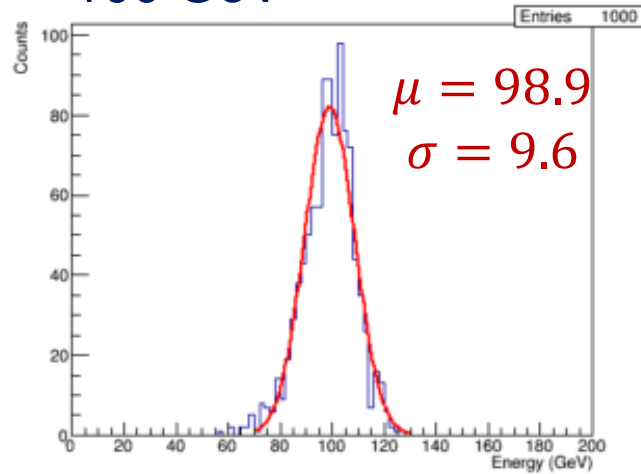
20 GeV



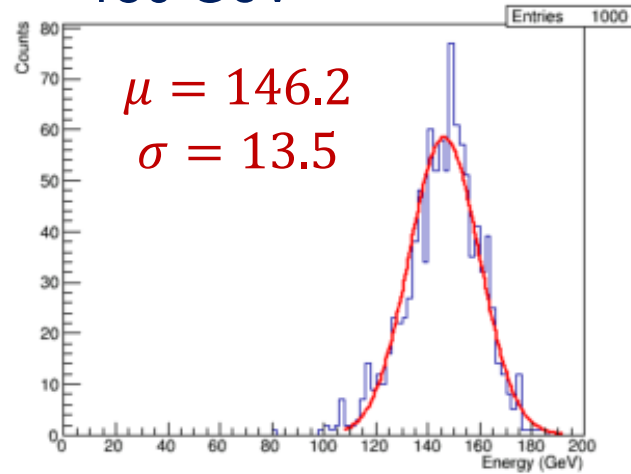
50 GeV



100 GeV



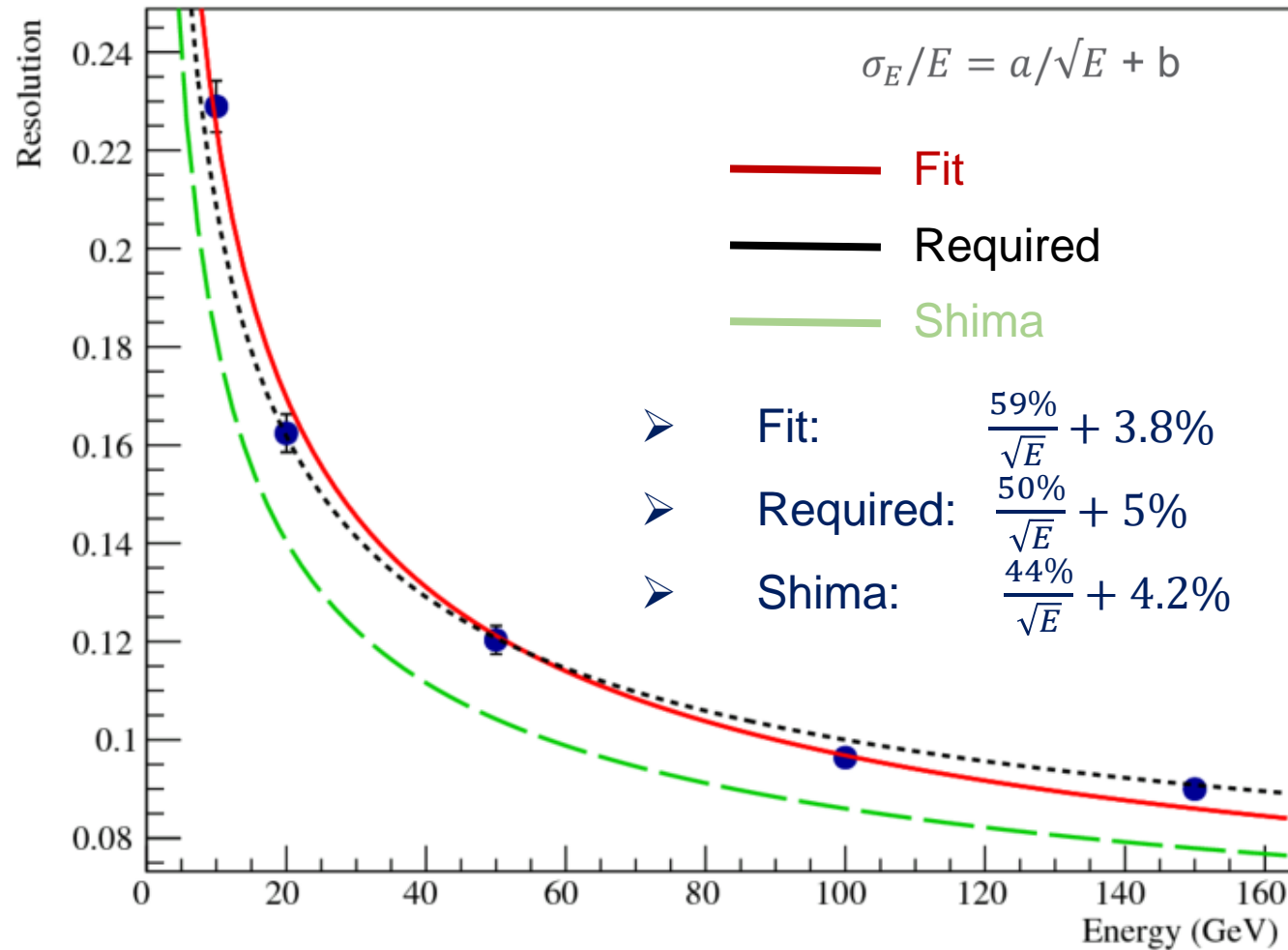
150 GeV



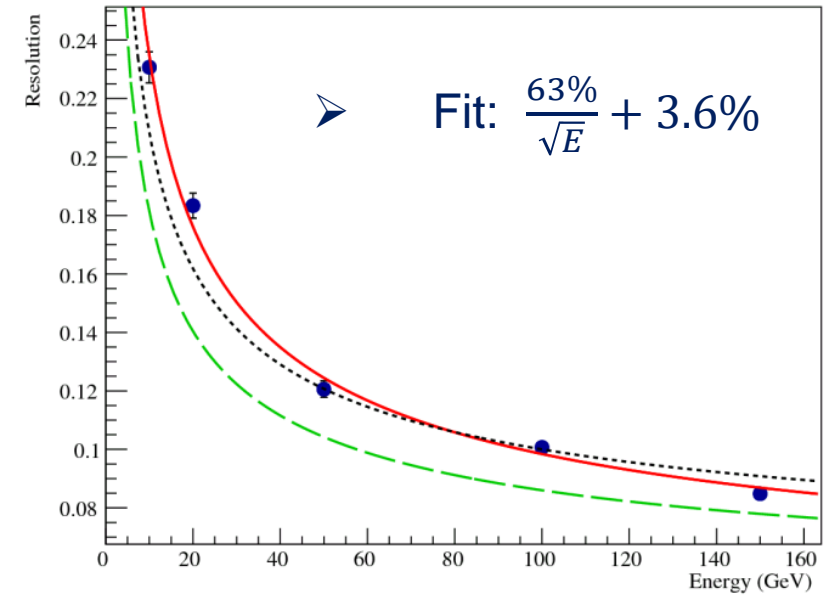
➤ Gaussian fits with calibrated energy

# New ZDC Geometry

With new geometry Energy Resolution



Energy resolution with current design by Shima



➤ Comparable results observed.

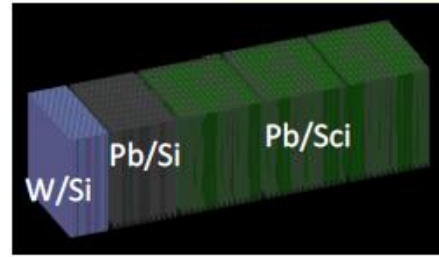
# 1<sup>st</sup> Version of ZDC Geometry

## Parameters from fit

- ◆ The energy response in each detector looks quite linear.
- ◆ Extract parameters from fits:

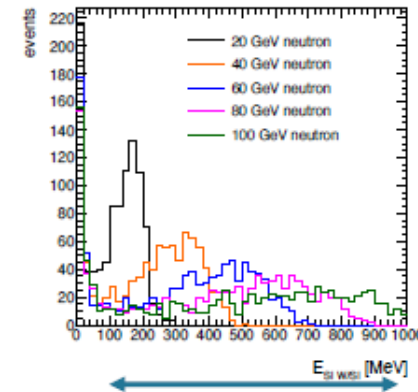
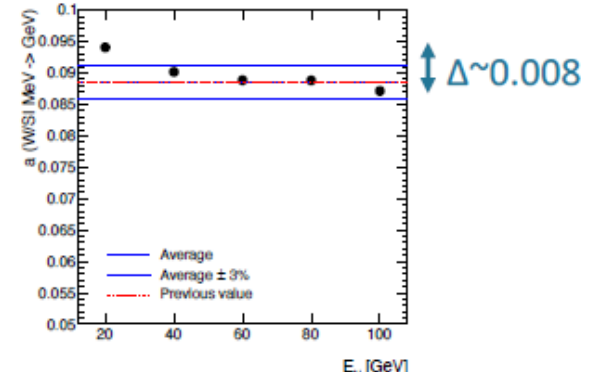
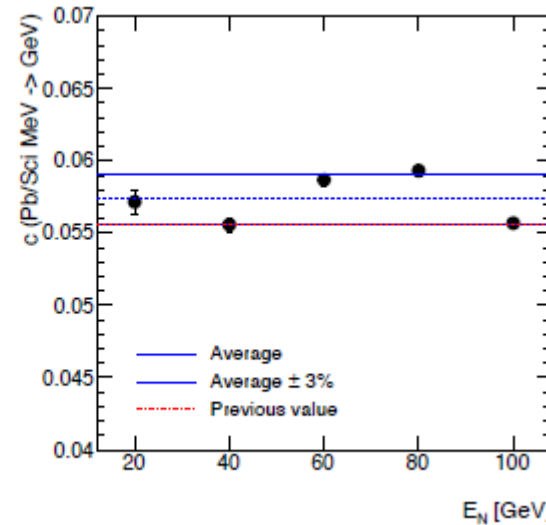
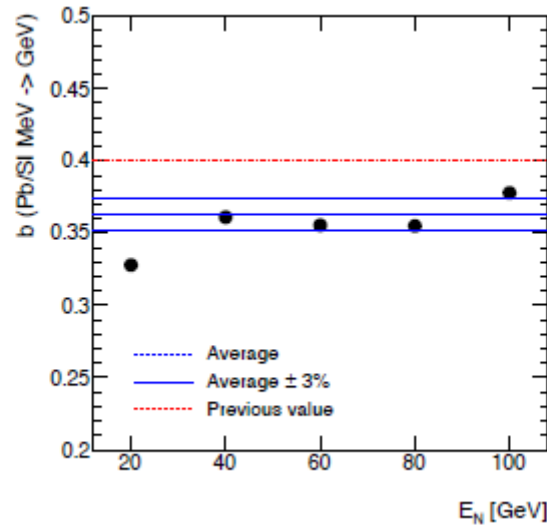
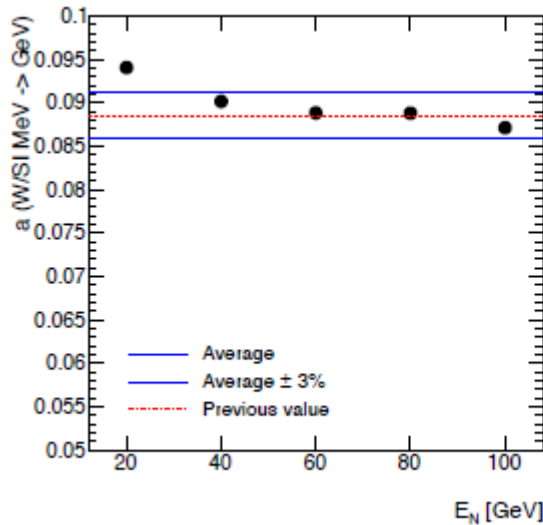
$$a \cdot E_{SI} (W/SI) + b \cdot E_{SI} (Pb/SI) + c \cdot E_{Sci} = E_N \quad (E_N = \text{Neutron energy})$$

Fit is done for each energy sample ( $E_N = 20, 40, 60, 80, 100$  GeV)



- W/SI: Average \* (1-0.008\*( $E_{SI}$ -500)/1000)
- Pb/SI: Average \* (1+0.04\*( $E_{SI}$ -50)/100)

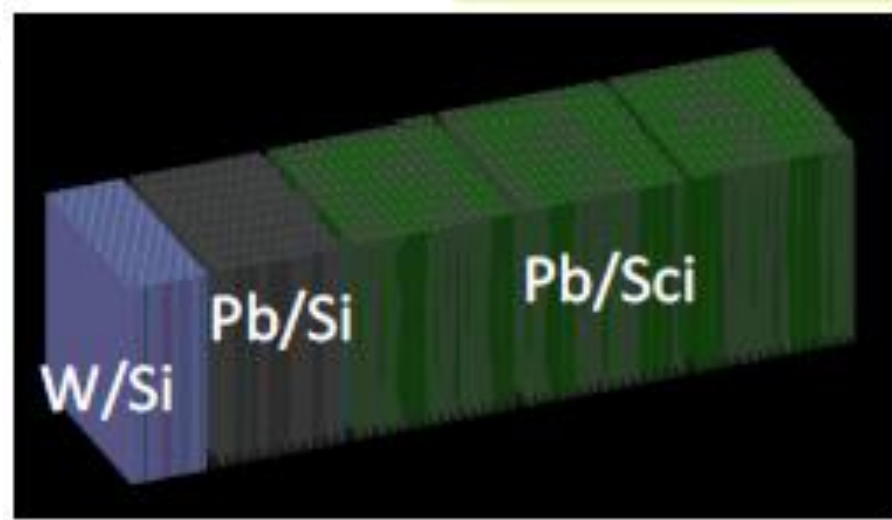
Made-up slopes by eye. Optimisation is needed in future.



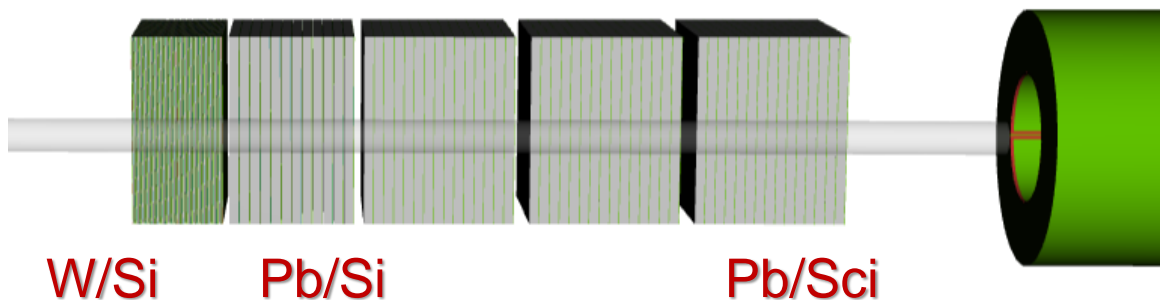
Leaver arm ~ 1000

# 1<sup>st</sup> Version of ZDC Geometry – 3 module test

Shima:



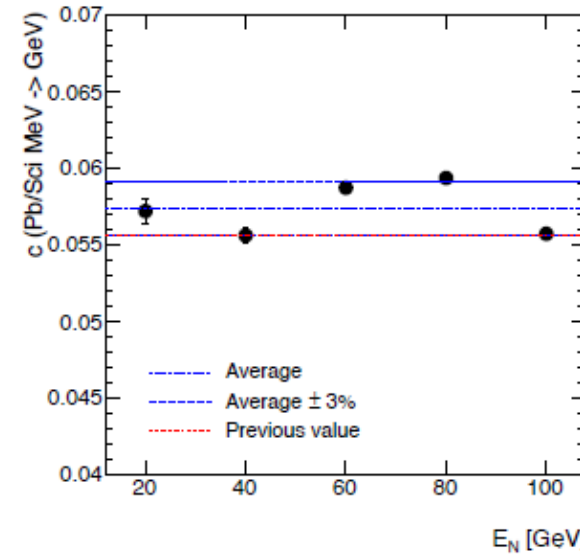
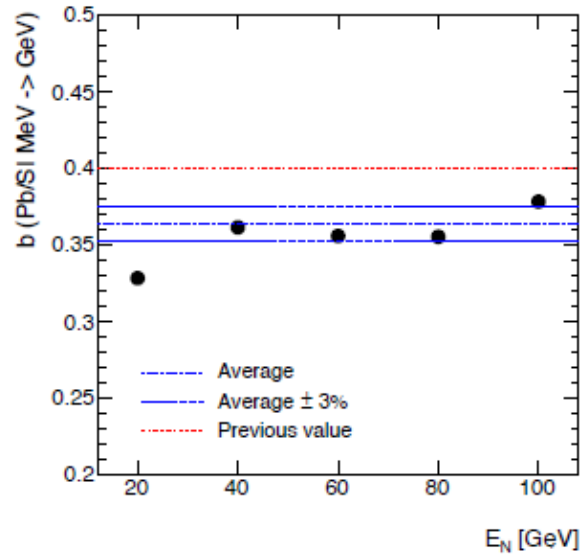
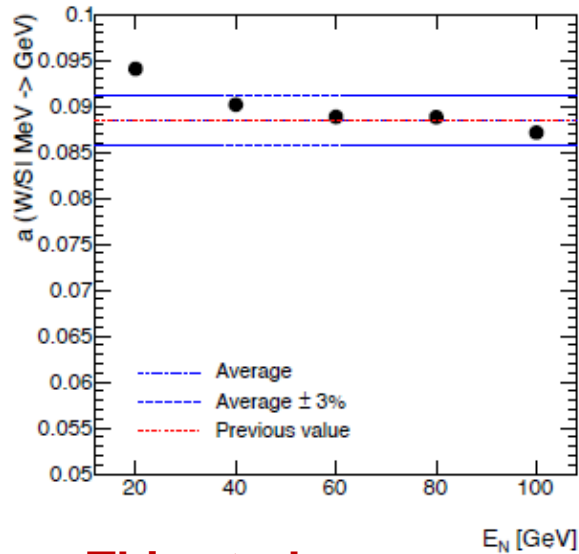
Current:



- Implementation of the 1st-version ZDC Geometry
  - Based on the slides that I have, should be similar enough, if not identical
- Try to reproduce the result of Shima with the first design.
- The error observed before has been resolved.
  - ERROR: MultiSegmentation: Invalid sub-segmentation identifier!
  - Caused by erroneously assigned IDs for the silicon layers after doubling the numbers of them.

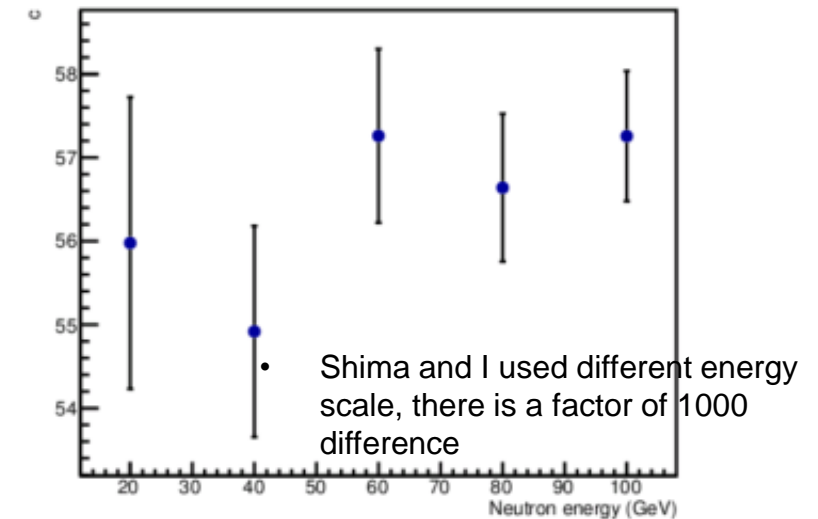
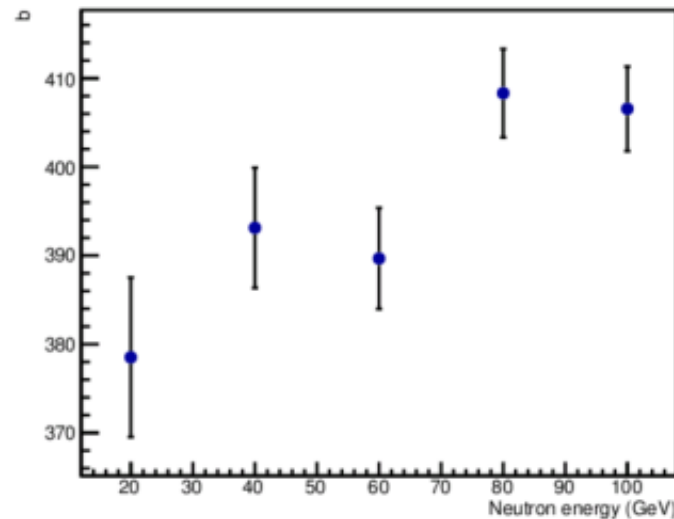
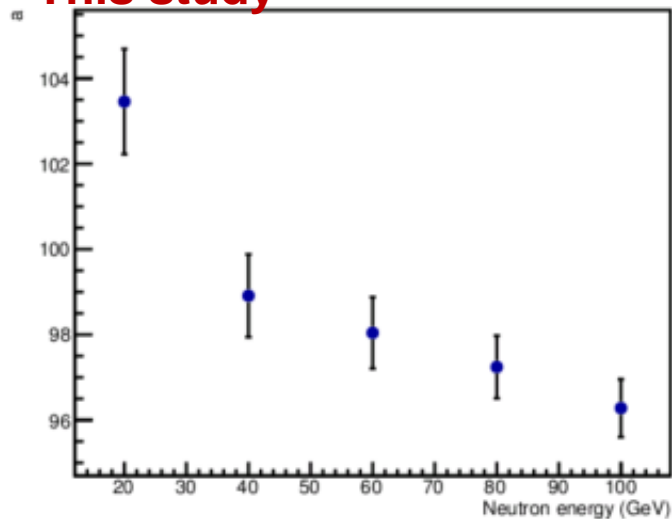
# 1<sup>st</sup> Version of ZDC Geometry – 3 module test

## Result of Shima



- Similar trend of energy dependence is observed
- The parameters I have is larger than what Shima got
- Will try energy dependent calibration like Shima

## This study





# First ZDC design

Plots of energy deposition are in backup slides.

