Beam Test paper draft v1

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INTT meeting

sPHENIX INTT sPHENIX 國立中央大學 National Central University RIKEN

Overview

- Version 1 with line number is ready
- Link:
  - (Invenio, v1): https://sphenix-invenio.sdcc.bnl.gov/records/gf2fy-0h617
  - (Overleaf, view): https://www.overleaf.com/read/kyfhznpxrhtv#fcfe3d

- Questions and comments are welcome
  - Comment submission deadline: the end of July 1st, 2025

- Additional todo:
  - Author list: a copy from INTT ladder NIM, need to be updated in the future version
  - Acknowledgments: copied from the ELPH report and INTT ladder NIM, need to be updated
  - References: format needs to be updated

Structure

- Title: Performance evaluation of the Intermediate Silicon Tracker for sPHENIX
- Abstract

1. Introduction
   1.1. The sPHENIX experiment
   1.2. The Intermediate Silicon Tracker (INTT)
   1.3. The beam test experiment at ELPH
2. Common analysis components
3. Signal-to-noise ratio
4. Residual distribution
5. Hit detection efficiency
6. Track reconstruction
7. Conclusion

- Acknowledgments
- References

1. Introduction

- The sPHENIX experiment
  - sPHENIX goal, design, acceptance
  - 2015 LRP, TDR, and sPHENIX prediction papers cited

- The Intermediate Silicon Tracker (INTT)
  - Brief barrel geometry (number of ladders, placements, etc)
  - Role of INTT in sPHENIX
  - INTT ladder design (chip, silicon strip geo., etc)
  - FPHX processing
  - Column definition
  - FPHX IEEE, INTT ladder NIM, and BEX-cable papers cited

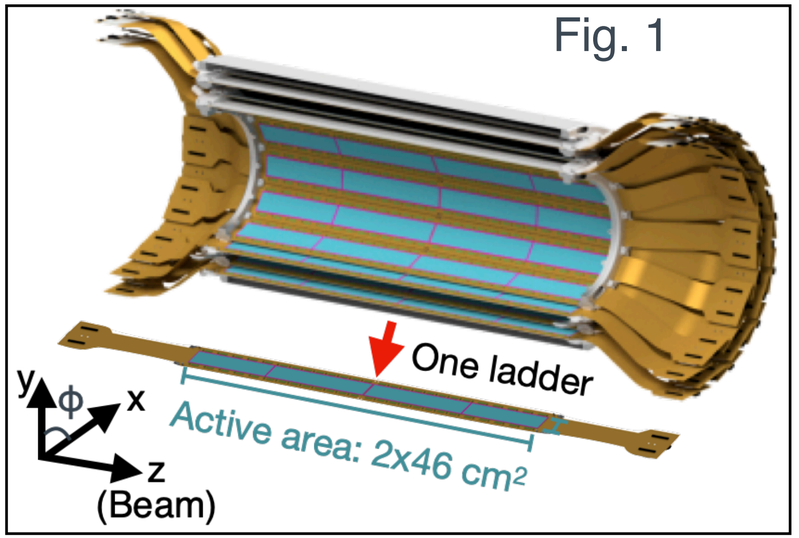


Fig. 1

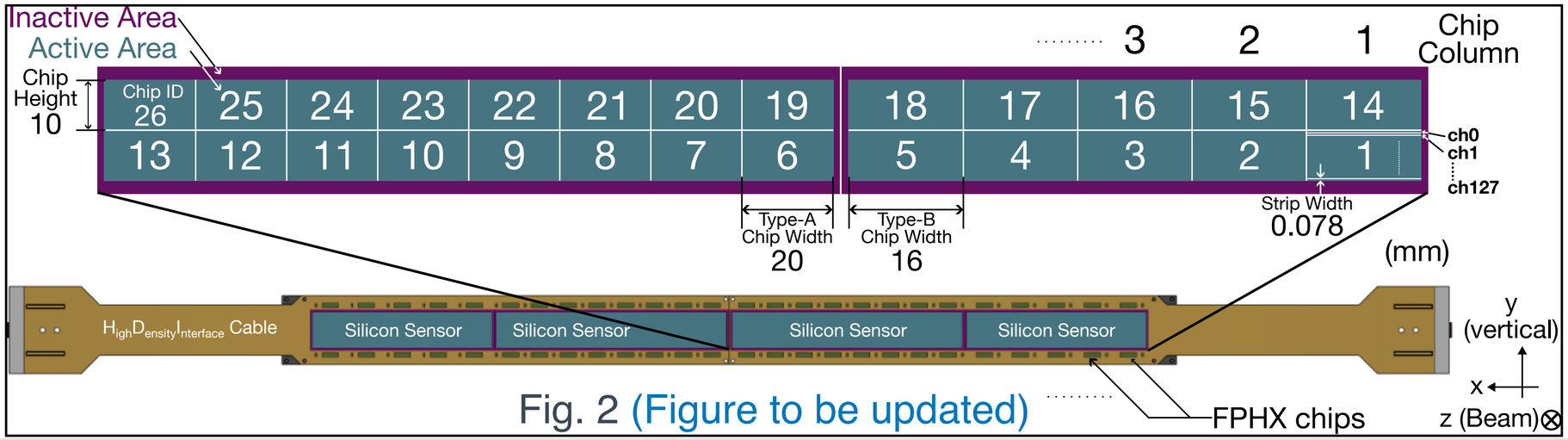


Fig. 2 (Figure to be updated)

1. Introduction

- The beam test experiment at ELPH
  - INTT telescope, scintillators, & location
  - ELPH positron beam
  - Readout chain & DAQ
  - First ladder not operated
  - Threshold, and hot channels
  - Supplied bias voltage (per Akiba san's comment)

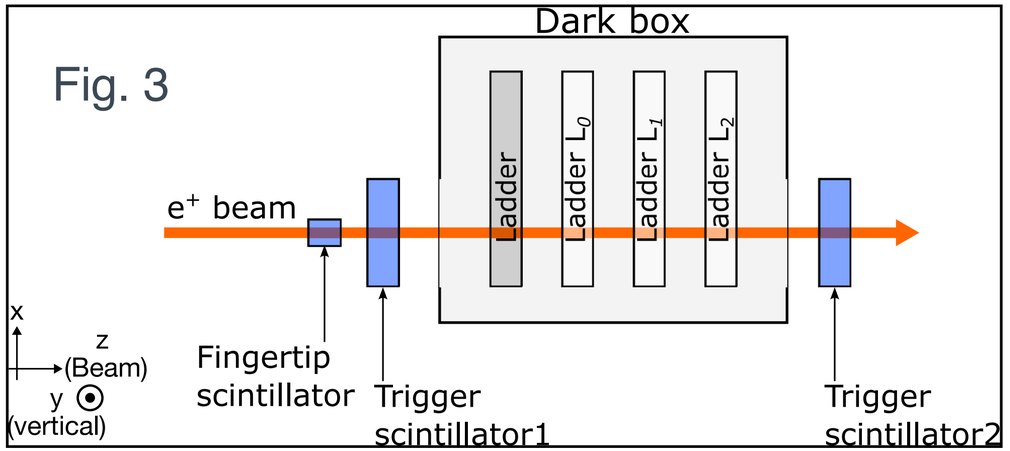


Fig. 3

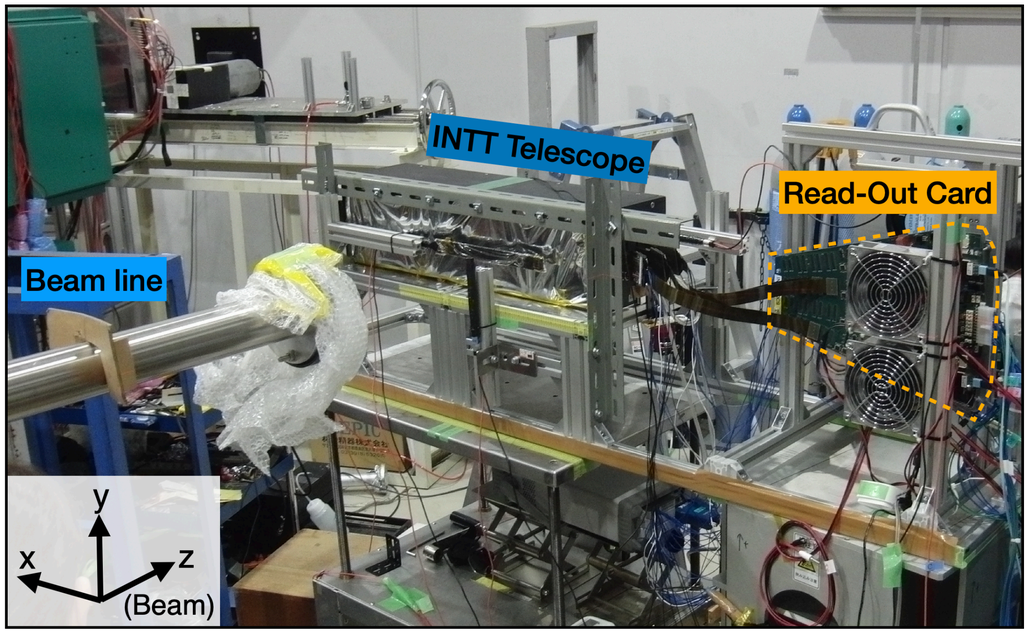


Fig. 4

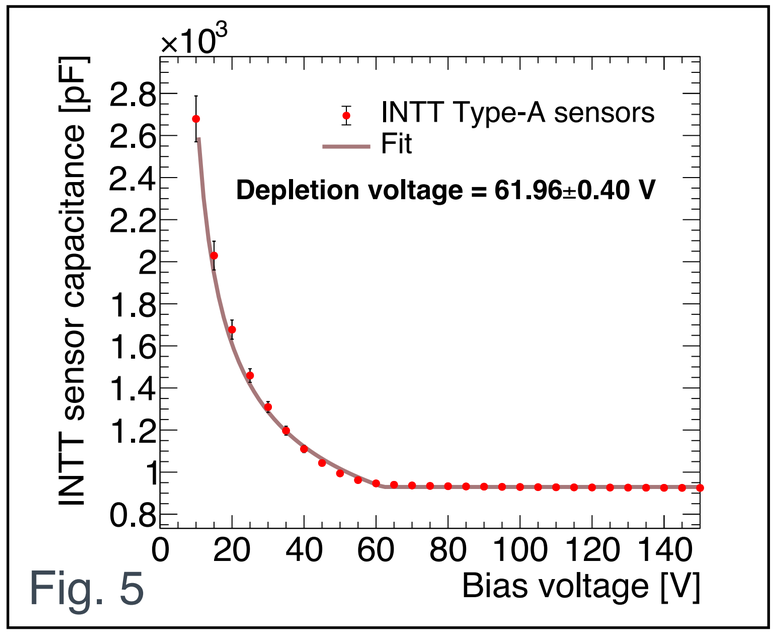


Fig. 5

2. Common analysis components

- Analysis-topic introduction
- Clustering algorithm and simulation setup introduced

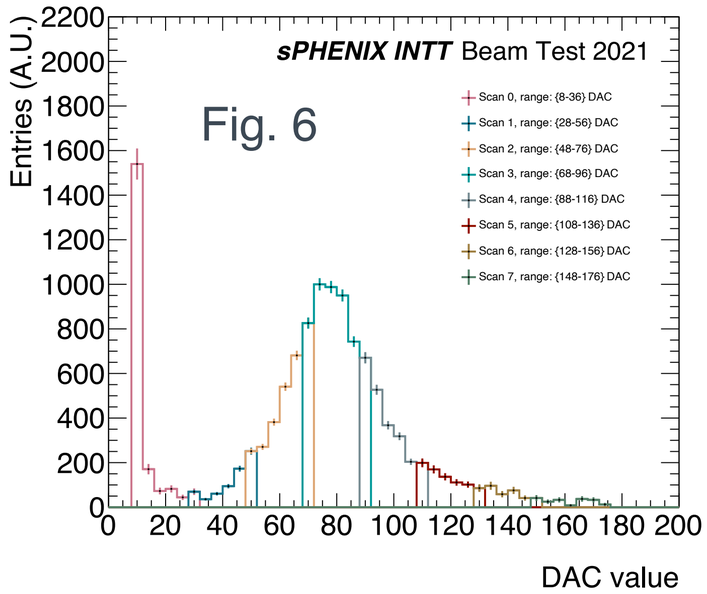
Equation 1

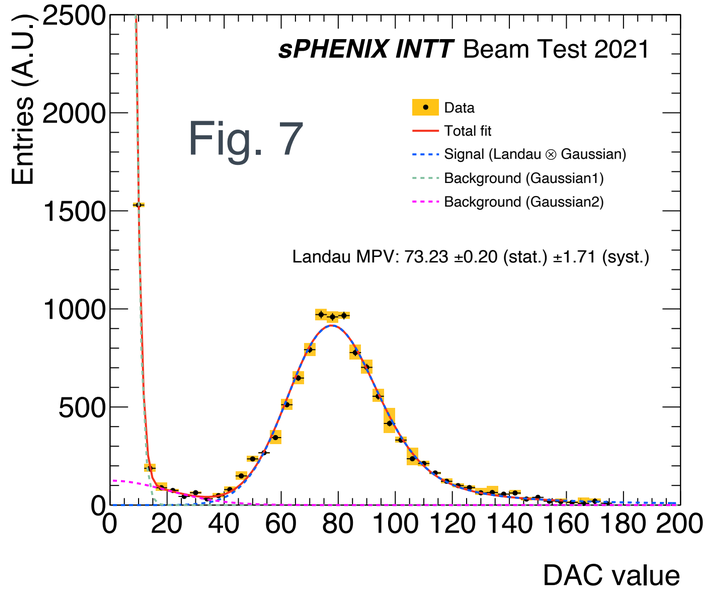
$$CluY = \sum_{i=1}^{n}(E_i \cdot y_i)/\sum_{i=1}^{n} E_i, \text{ and}$$

$$CluY\ Ampl. = \sum_{i=1}^{n} E_i,$$

3. Signal-to-noise ratio

- Definition of S/N
- Reason of DAC Scan
- Procedure of DAC Scan
- Event selection
- Procedure of using histograms to construct the energy deposit distribution
- Combine results with fits
  - Fit is described as well
- MPV value: 73.23 ± 0.20 (stat.) ± 1.71 (syst.)
- Weighted average Gaussian width 4.56 ± 0.16
- Signal-to-noise ratio: > 15.1





4. Residual distribution

- Definition of residual: $r = (ClusY_{L1} + CorrY_{L1}) - Y_{pred}$
- The procedure to obtain the L1 misalignment correction
- Event selections
- Result, discussion & comparison with MC

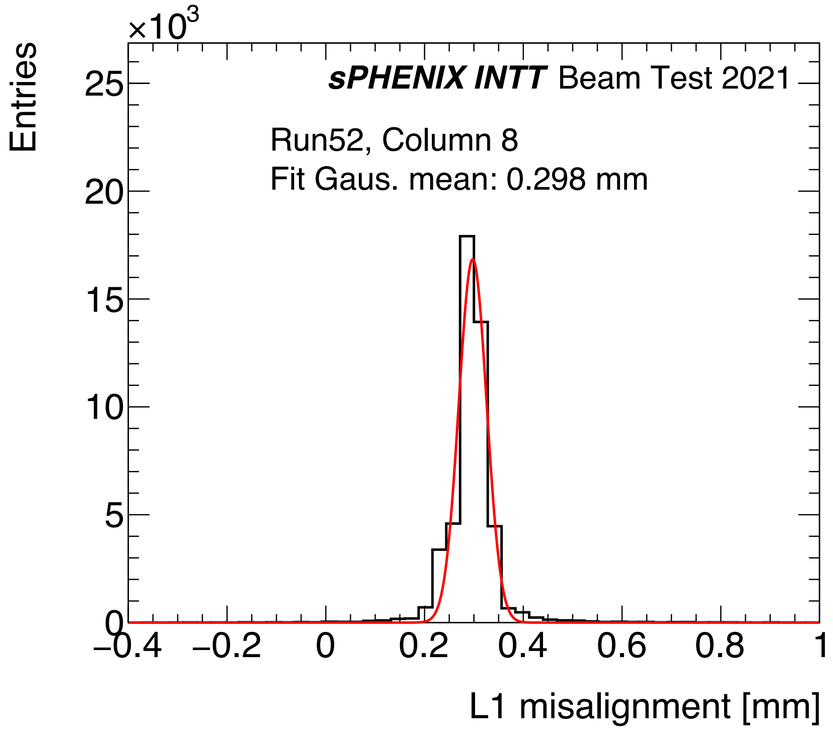


Fig. 8

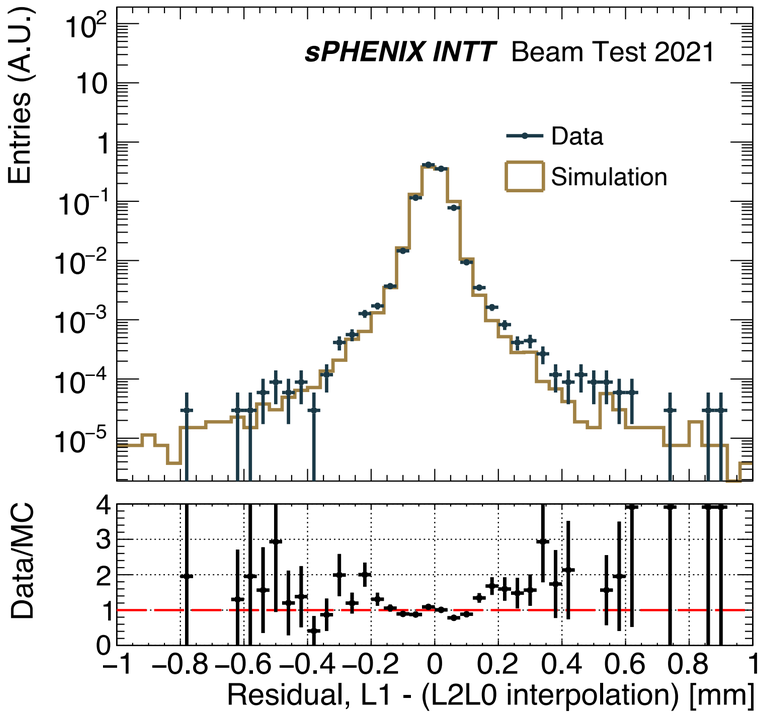


Fig. 9

5. hit detection efficiency

- Introduction to the DUT method
- Event selection & track reconstruction
- Definition of hit detection efficiency : $Effi. = \frac{N_{\text{matched DUT tracks}}}{N_{\text{Good events}}} = \frac{N(L0 \bigcap L1 \bigcap L2)}{N(L0 \bigcap L2)}$
- Systematic uncertainty
- Results & discussion
- The reported effi.: $99.61\ ^{+0.02}_{-0.02}\ (\text{stat.})\ ^{+0.05}_{-0.01}\ (\text{syst.})\ \%$

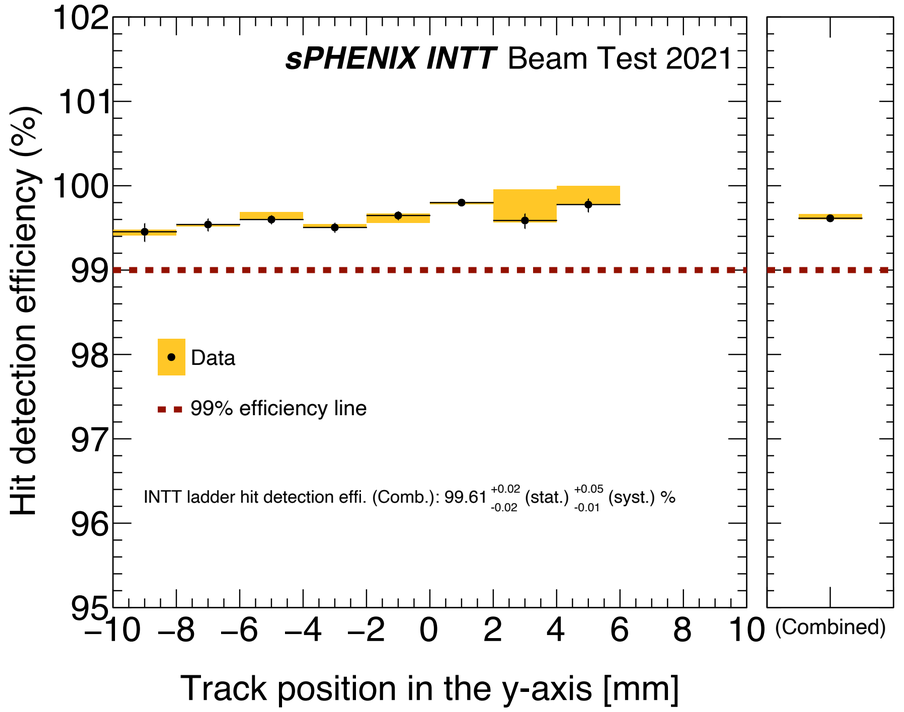


Fig. 10

6. Track reconstruction

- Track finding algorithm
- Result, comparison with MC & discussion

- Update: this is a new result with three hot channels masked in data and simulation
  - Module 1, chip 26, channel 126 (layer 0)
  - Module 5, chip 19, channel 119 (layer 2)
  - Module 5, chip 4, channel 0 (layer 2)
- Result identical to the previous one
- Analysis note is updated accordingly (AN v3)

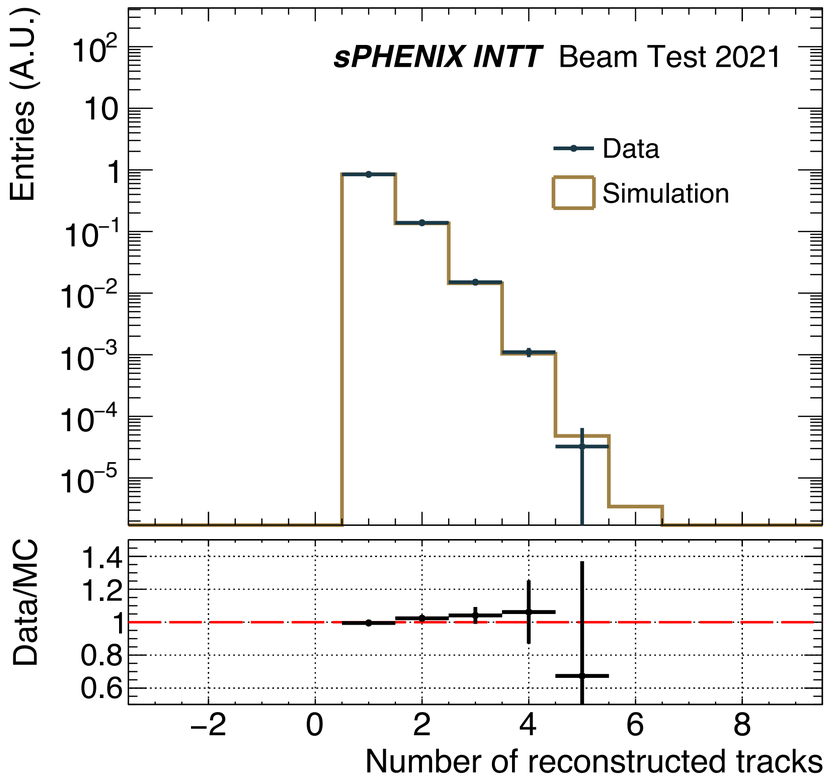


Fig. 11