Tracking Update

Xinzhan Bai
University of Virginia

SoLID Collaboration Meeting
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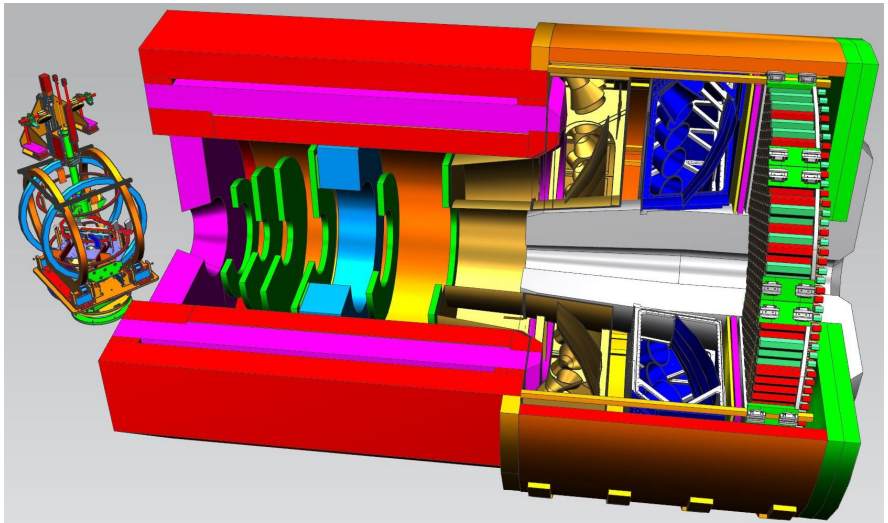
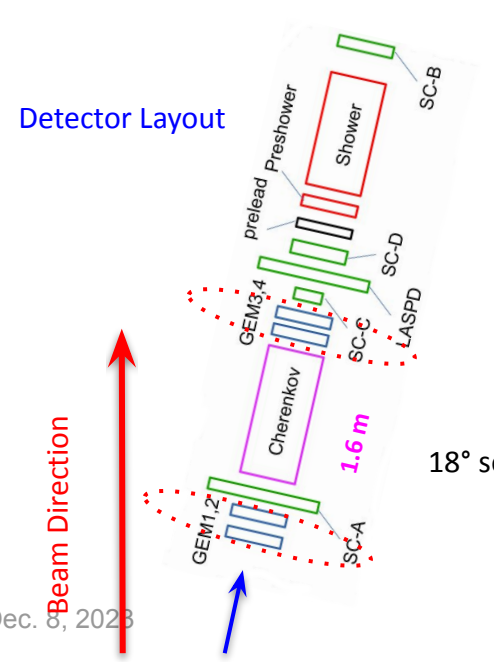
Outline

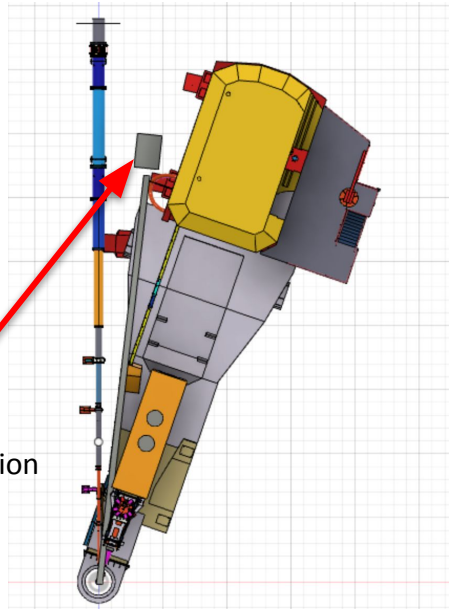
- Beam test tracking update
  - Efficiency correction
  - Tracking update
- Outlook for SoLID simulation tracking
- Summary



Beam Test Setup

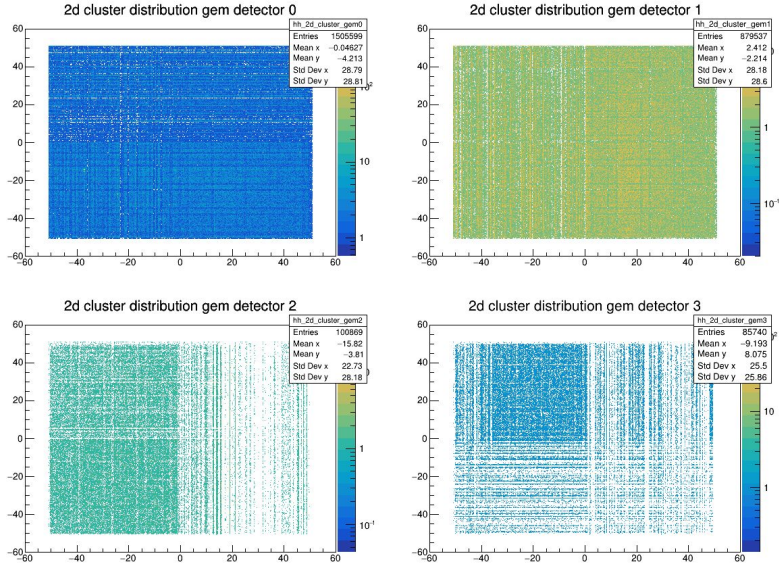
- Front to back GEM1+2, SC-A, Cer, GEM3+4, SC-C, LASPD, Preshower, Shower, SC-B
- Two test conditions: 7 and 18 degree
- GEM 1+2 and GEM 3+4 separation: 1.6 meters



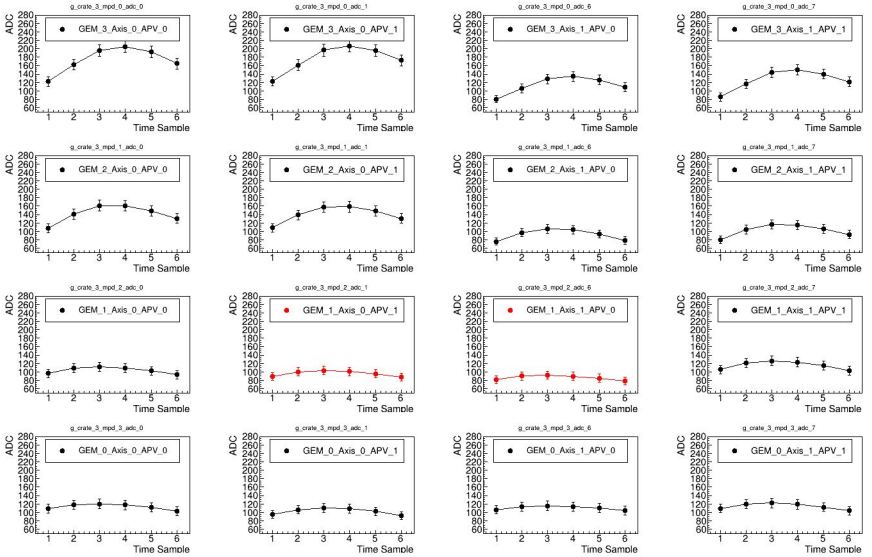


Efficiency Correction

- Low cluster count on a few APVs
- Low gain APVs, broken strips on APV hybrid cards, broken strips on readout board



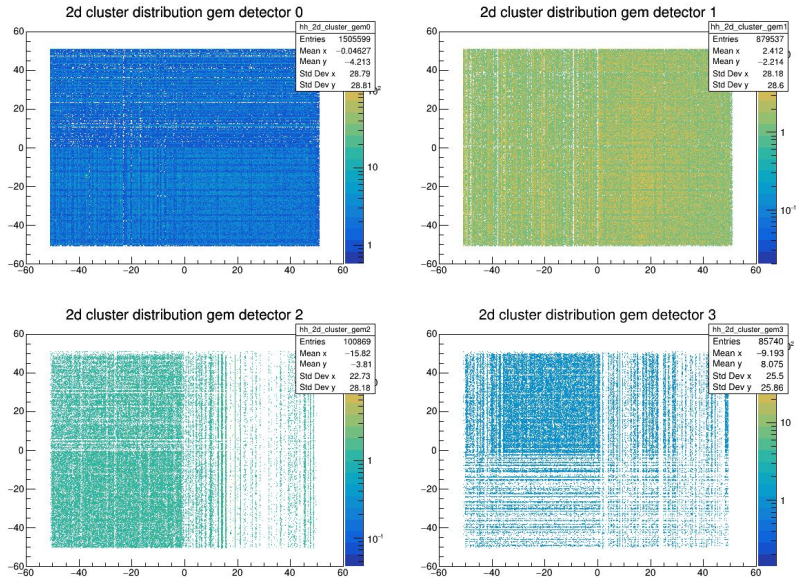
Cluster 2D Map



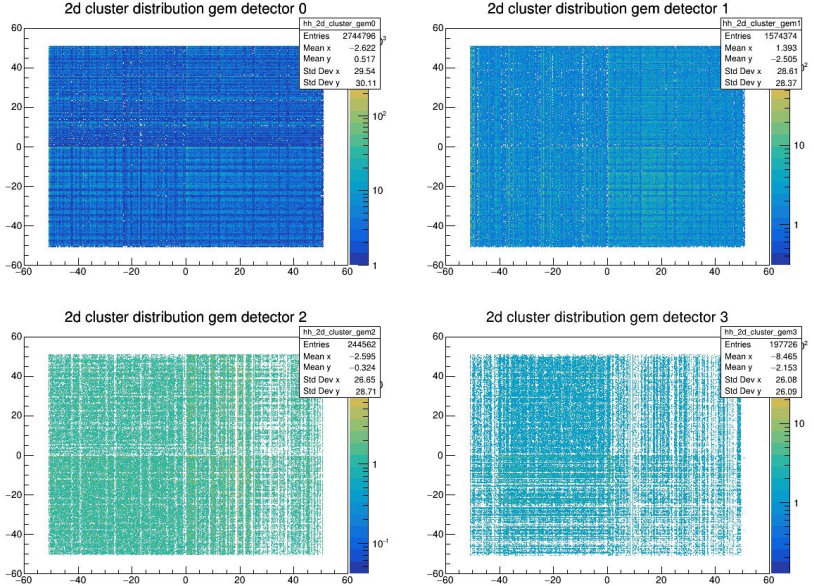
Average APV signal amplitude

Efficiency Correction

- Correction: APV gain equalization, Zero suppression threshold -> recover the hit on the low count area
- All these methods will introduce more noise to the signals, use tracking to reject the noise



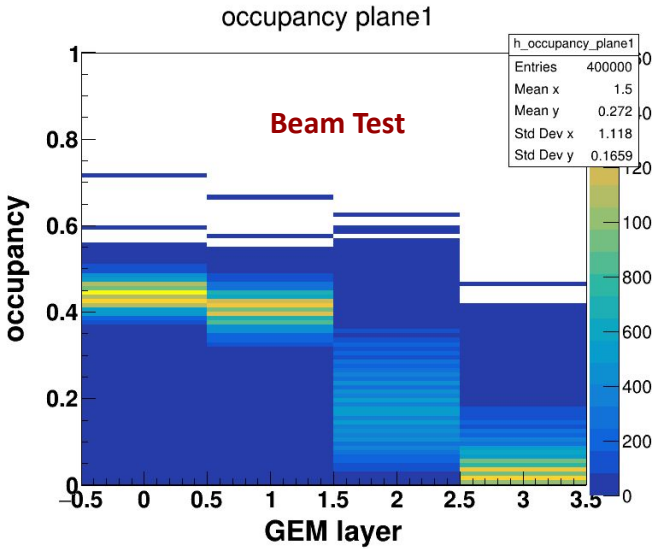
Raw 2D hit map

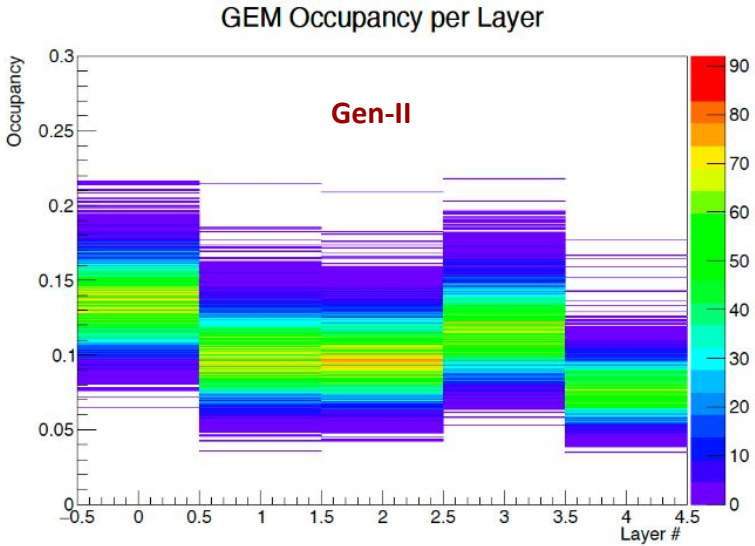


Fine-tuning on zero suppression, gain equalization

Occupancy

- Raw occupancy is higher than GEn experiments
- 40% on the front two layers, 10% on the back two layers
- Lower occupancy on back layers due to smaller solid angle coverage and shielding from detectors in the middle





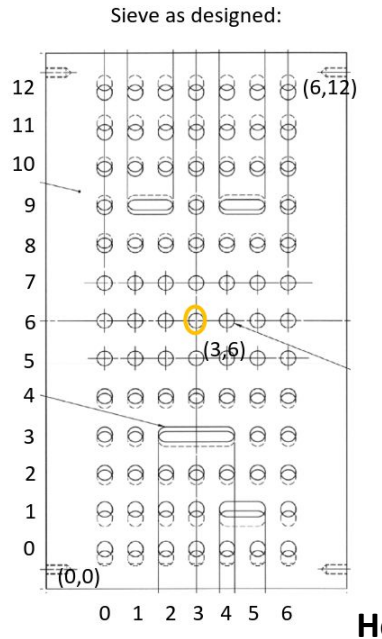
Gen-II run 2551 - 45 uA on polarized 3He target

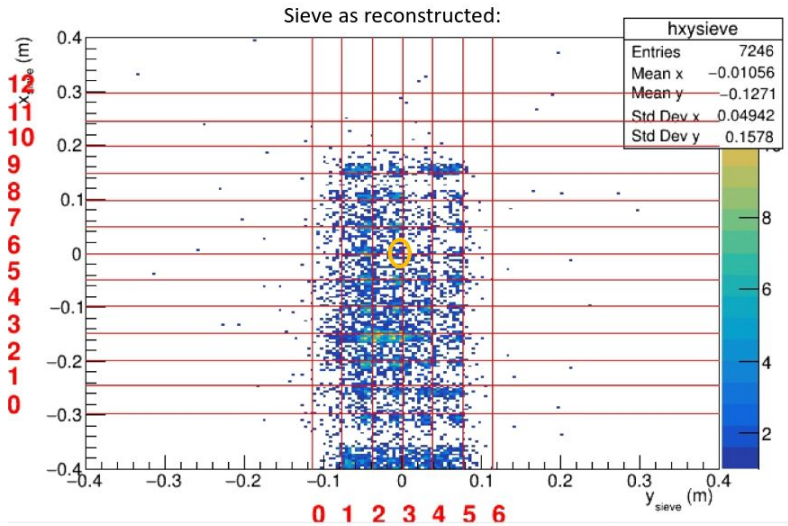
PVDIS GEM occupancies		
Plane	Total strip number (u+v) per sector	Raw Occupancy (%)
1	1156	4.48
2	1374	2.55
3	1374	2.21
4	2287	0.82
5	2350	0.75

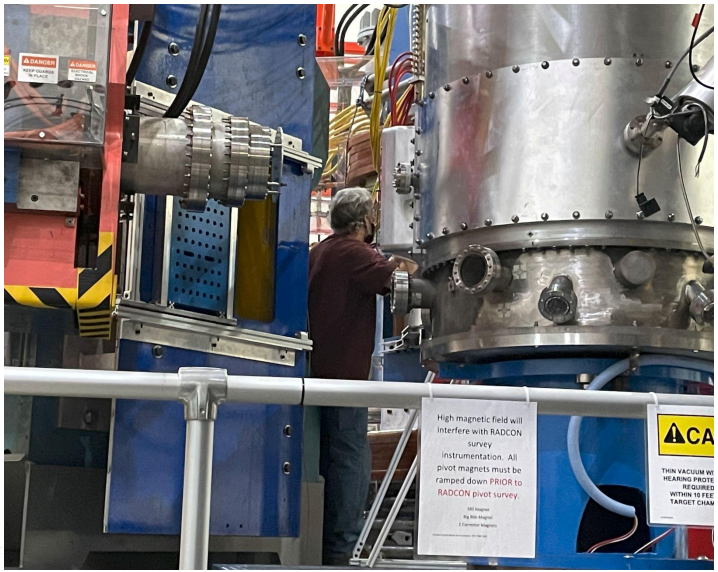
SBS achieved occupancies higher than what is projected for PVDIS and SIDIS

Optics for SBS

- Propagation matrix for particle transport under magnetic field
- Wishlist for beam test, with no magnetic field, **the pattern on different layers can determine the rotation angle and constraint offset**



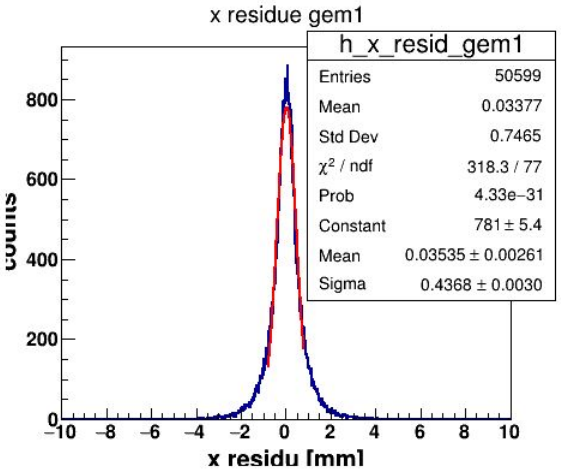


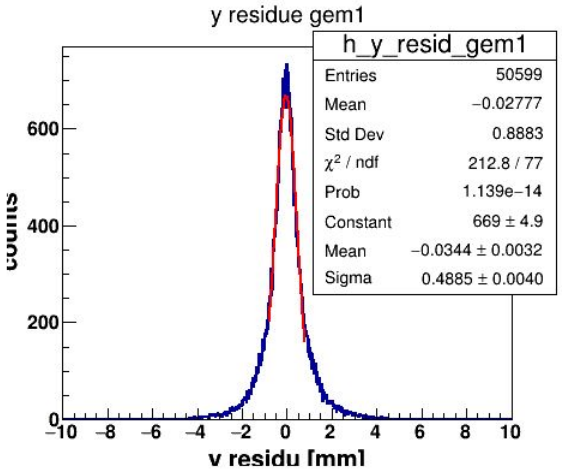


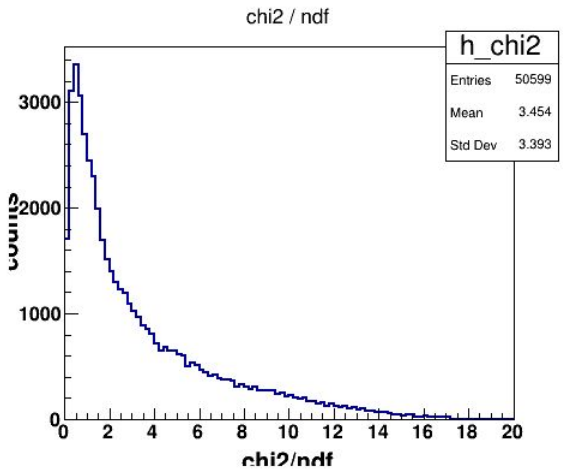
Holly, Andrew Puckett – SBS Optics

Current Alignment Result

- Tested both SBS tracking algorithm and Millipede algorithm
- Residue standard deviation after alignment: 0.5 mm
- High occupancy, No optics, No Survey Data – How reliable is this result?



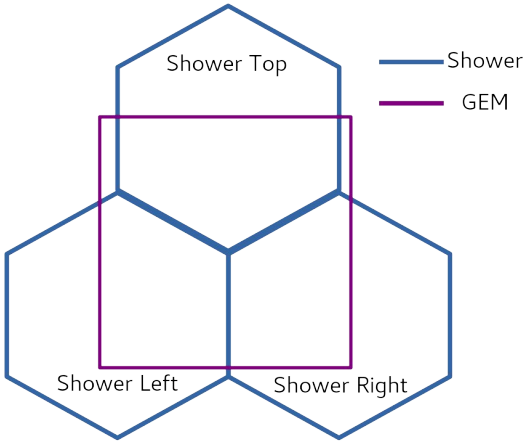


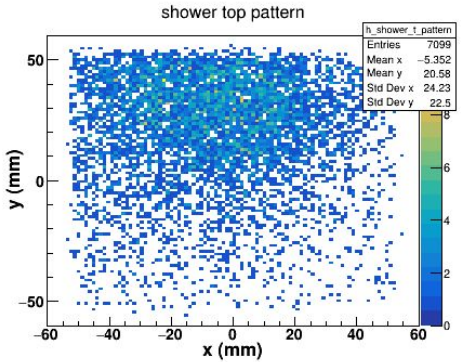


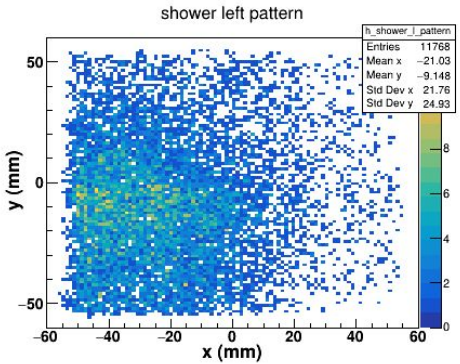
Tracking for Beam Test

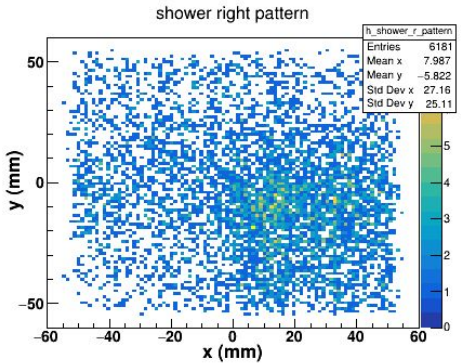
- Track projected hit pattern under different Shower energy Cut
- For low-beam-current runs

GEM and Shower Layout









Clean Pion Cut

- Clean pion events to improve tracking
- No significant improvements observed so far – number of possible tracks per event still large
- Ongoing effort

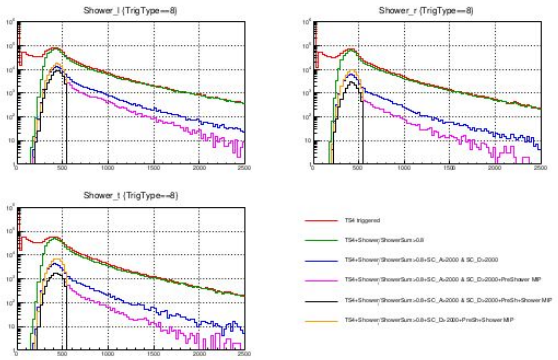


Figure 1: Shower distributions with different pion selection cuts combining the 10 μA runs 4778, 4779, and 4786.

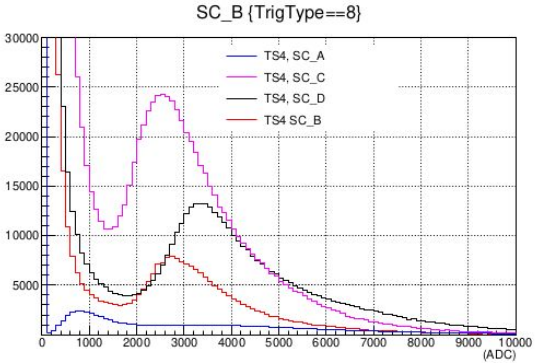


Figure 2: Scintillator distributions with different pion selection cuts combining the 10 μA runs 4778, 4779, and 4786.

cuts	total event number
cut1: rigType==8	2.8e6
cutL2: TrigType==8 & Shower_l/ShowerSum > 0.8	8.7e5
cutR2: TrigType==8 & Shower_r/ShowerSum > 0.8	6.8e5
cutT2: TrigType==8 & Shower_t/ShowerSum > 0.8	5.9e5
cutL3: TrigType==8 & Shower_l/ShowerSum > 0.8 & SC_A > 2000 & SC_D > 2000	1.3e5
cutR3: TrigType==8 & Shower_r/ShowerSum > 0.8 & SC_A > 2000 & SC_D > 2000	5.7e4
cutT3: TrigType==8 & Shower_t/ShowerSum > 0.8 & SC_A > 2000 & SC_D > 2000	4.4e4
cutL4: TrigType==8 & Shower_l/ShowerSum > 0.8 & SC_A > 2000 & SC_D > 2000 & PreSh_l > 200 & PreSh_l < 580	7.7e4
cutR4: TrigType==8 & Shower_r/ShowerSum > 0.8 & SC_A > 2000 & SC_D > 2000 & PreSh_r > 200 & PreSh_r < 580	2.2e4
cutT4: TrigType==8 & Shower_t/ShowerSum > 0.8 & SC_A > 2000 & SC_D > 2000 & PreSh_t > 200 & PreSh_t < 580	1.6e4
cutL5: TrigType==8 & Shower_l/ShowerSum > 0.8 & SC_A > 2000 & SC_D > 2000 & PreSh_l > 200 & PreSh_l < 580 & Shower_l > 200 & Shower_l < 540	5.3e4
cutR5: TrigType==8 & Shower_r/ShowerSum > 0.8 & SC_A > 2000 & SC_D > 2000 & PreSh_r > 200 & PreSh_r < 580 & Shower_r > 200 & Shower_r < 540	1.7e4
cutT5: TrigType==8 & Shower_t/ShowerSum > 0.8 & SC_A > 2000 & SC_D > 2000 & PreSh_t > 200 & PreSh_t < 580 & Shower_t > 200 & Shower_t < 540	1.2e4
cutL6: TrigType==8 & Shower_l/ShowerSum > 0.8 & SC_D > 2000 & PreSh_l > 200 & PreSh_l < 580 & Shower_l > 200 & Shower_l < 540	1.1e5
cutR6: TrigType==8 & Shower_r/ShowerSum > 0.8 & SC_D > 2000 & PreSh_r > 200 & PreSh_r < 580 & Shower_r > 200 & Shower_r < 540	5.9e4
cutT6: TrigType==8 & Shower_t/ShowerSum > 0.8 & SC_D > 2000 & PreSh_t > 200 & PreSh_t < 580 & Shower_t > 200 & Shower_t < 540	4.7e4

Table 1: The pion selection cuts and the corresponding survival event number

Ye Tian, Syracuse

Outlook for SoLID Simulation Tracking

- Data and simulation comparison using beam test, check simulation and digitization
- SoLID tracking with actual layout and dead-area (PVDIS, SIDIS_He3, SIDIS_NH3, JPsi) to check efficiency and resolution
- Optimize GEM plane location and size (mainly SIDIS), using simple GEM plane first
- DDVCS tracking
- Transfer to ACTS software?
- AI/ML
- VMM digitization and data comparison
- Input from SBS tracking

Task list with the contribution from Zhiwen, Weizhi, …

Summary & Outlook

- More validations are still needed for beam test tracking
- Will be working with the current workforce on validation of the beam test, VMM digitization, GEM layout optimization for the SoLID spectrometer…
- SBS tracking experience