Anode-Piercing / Cathode-Crossing Samples for SCE Calibration

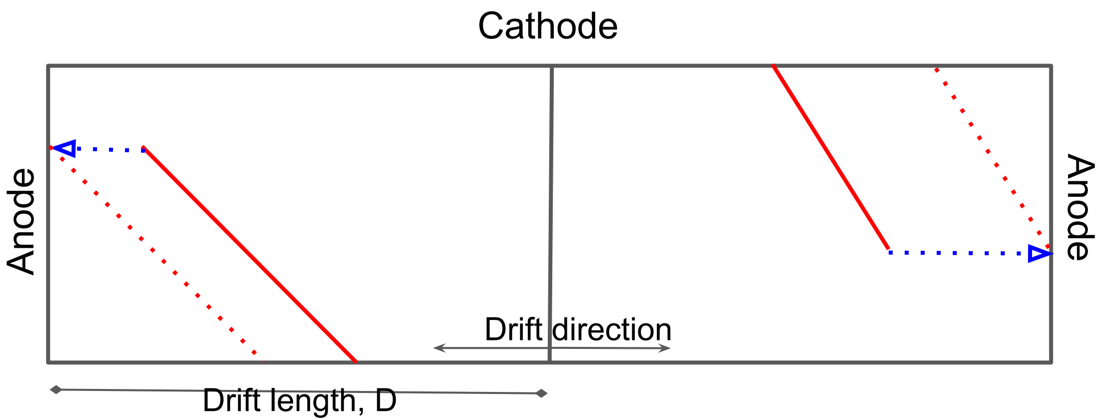
Hannah Rogers - *Wednesday, October 10, 2018*

ProtoDUNE Simulation / Reconstruction Meeting

Anode-Piercing Tracks

$t_0 = (D+x_{reco}) / v_{drift}$

$x_{corrected} = x_{reco} - v_{drift} t_0$

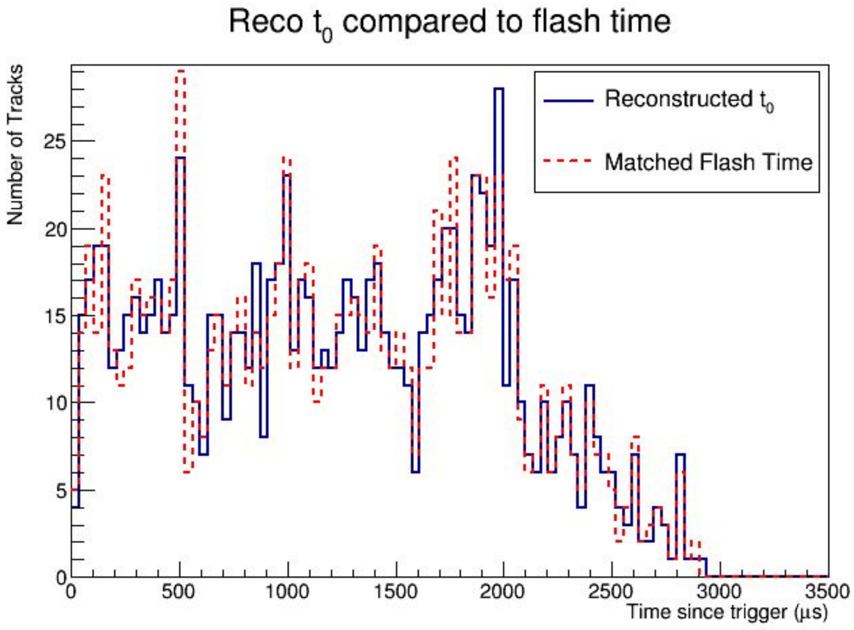


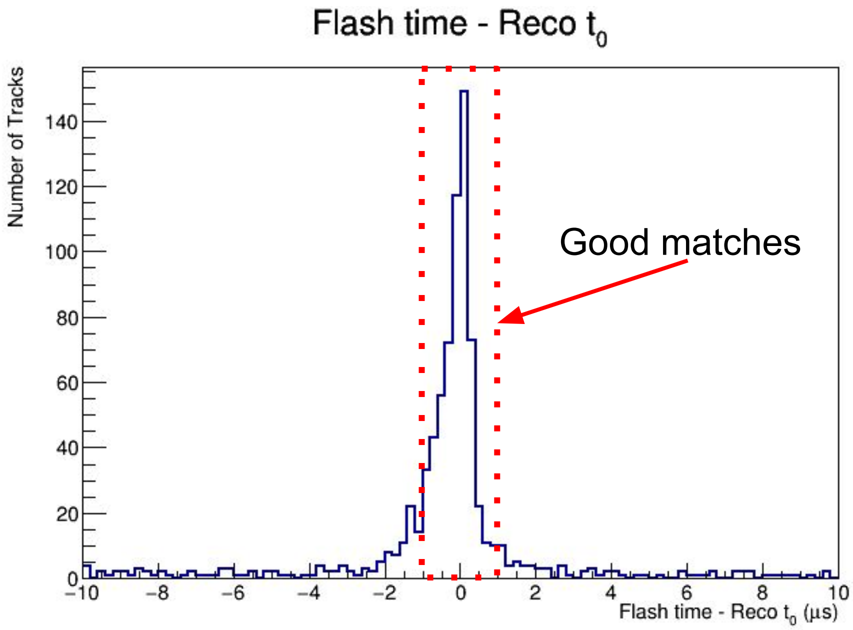
$t_0 = (D-x_{reco}) / v_{drift}$

$x_{corrected} = x_{reco} + v_{drift} t_0$

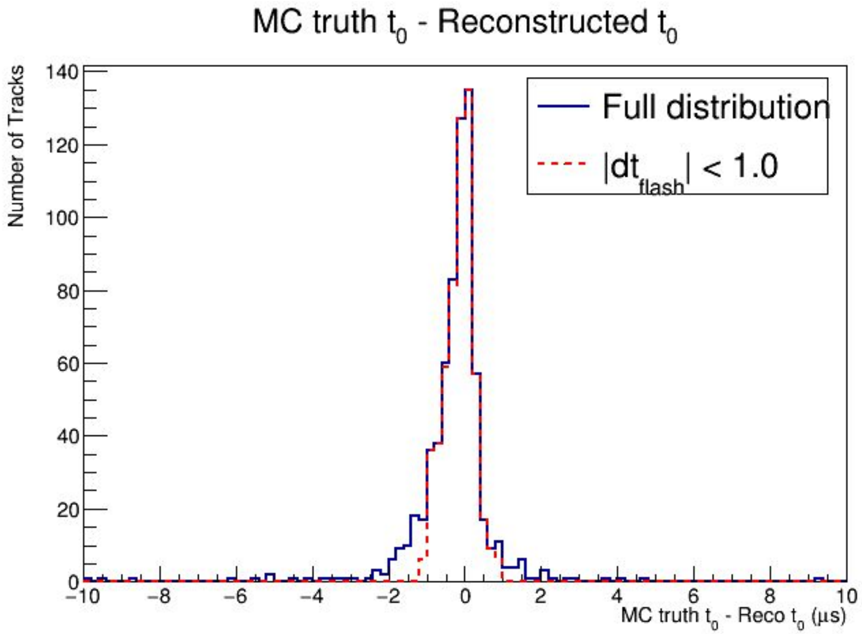
- Anode-piercing tracks assumed to be through going (must pass through only one of top, bottom, front, or back of the detector; other end passes through anode or cathode)
- Cathode-crossing tracks removed by drift direction
- $T_{measured} = T_{anode} + t_0$ and $T_{anode} = 0$ μs
- Calculated t_0 matched to flash time from PMTs
- All times measured with respect to trigger time
- Technique adapted from MicroBooNE public note: MICROBOONE-NOTE-1028-PUB

Non-SCE Simulated Anode-Piercing Sample





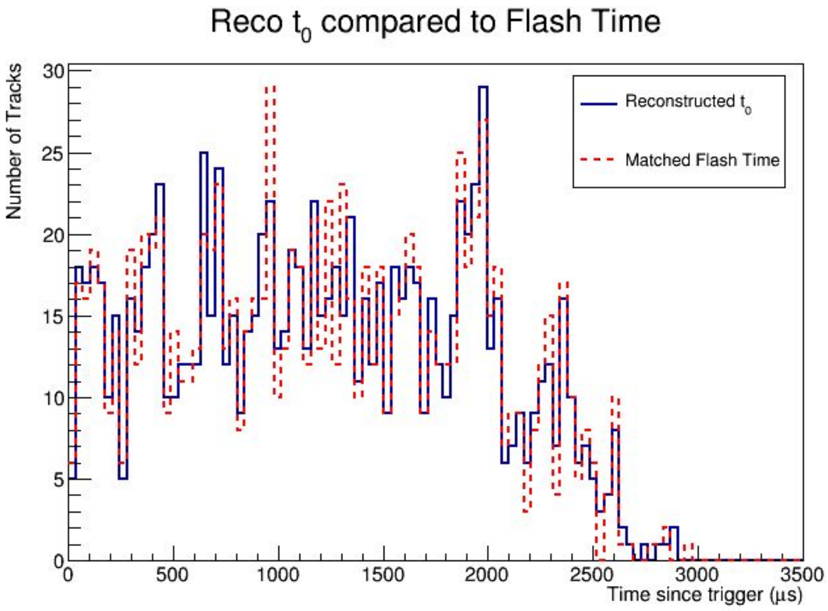
Non-SCE Simulated Anode-Piercing Sample Purity

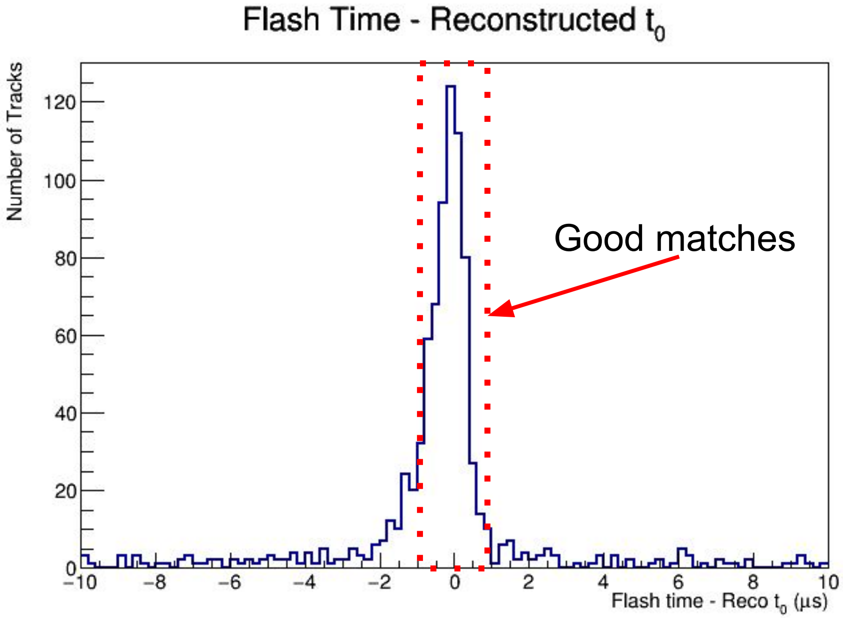


	Full distribution	$\|dt_{flash}\| < 1.0$ μs
Total tracks	15149	15149
Anode tracks	1023	586
“Pure” tracks	679	572
Purity	66.4%	**97.6%**
Selected Track Fraction	6.75%	3.87%

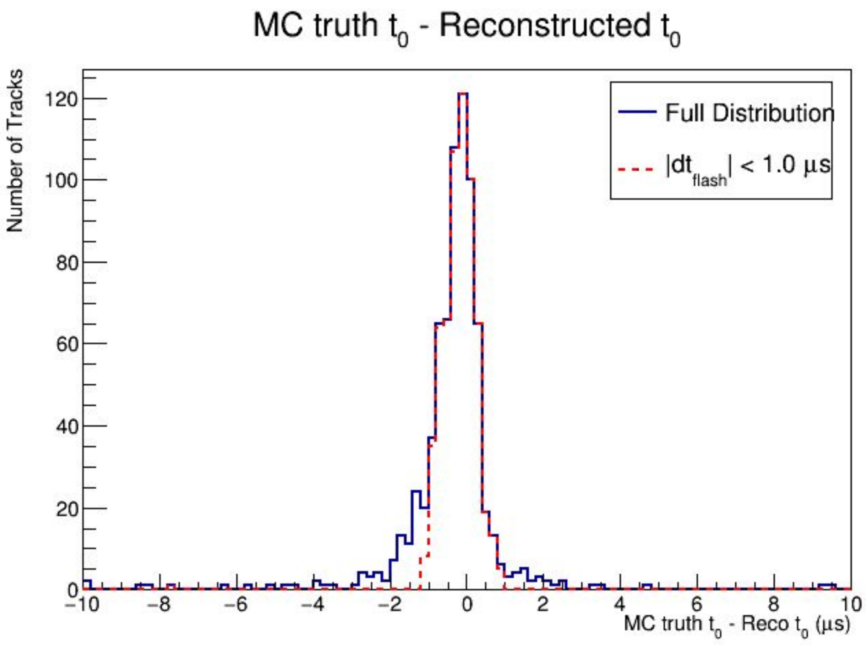
- “Pure” is defined as $|dt_{MC}| < 10.0$ μs
- Calculated for 100 events

SCE Simulated Anode-Piercing Sample





SCE Simulated Anode-Piercing Sample Purity



	Full distribution	$\lvert dt_{flash}\rvert < 1.0$ µs
Total tracks	14523	14523
Anode tracks	1060	620
“Pure” tracks	730	609
Purity	68.9%	**98.2%**
Selected Track Fraction	7.30%	4.27%

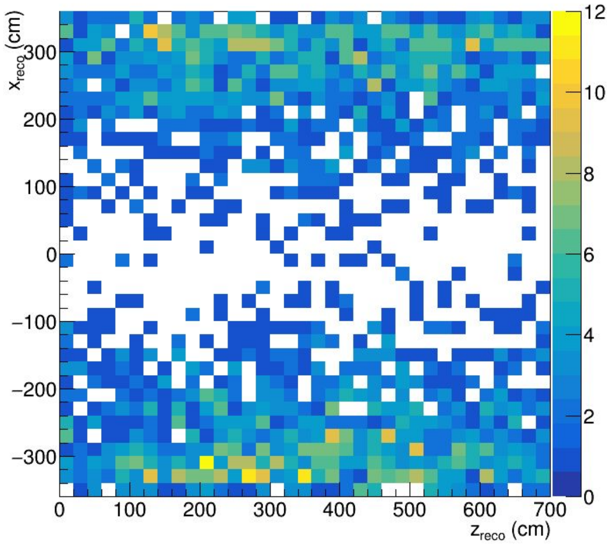
- “Pure” is defined as $\lvert dt_{MC}\rvert < 10.0$ µs
- Calculated for 100 events

Anode-Piercing/Cathode-Crossing Coverage

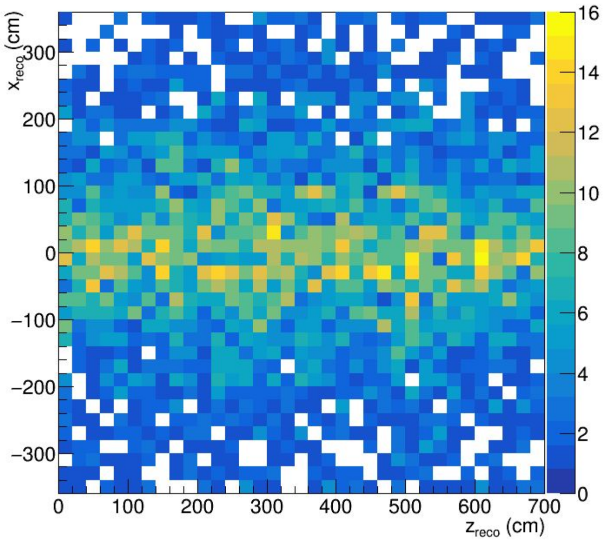
- Cathode-crossing tracks cover the middle of the detector well
  - ~ 9 cathode-crossing tracks per event
- Anode-piercing tracks cover the edges better
  - Roughly 6 good anode-piercing tracks per event

MC Coverage with SCE - Top

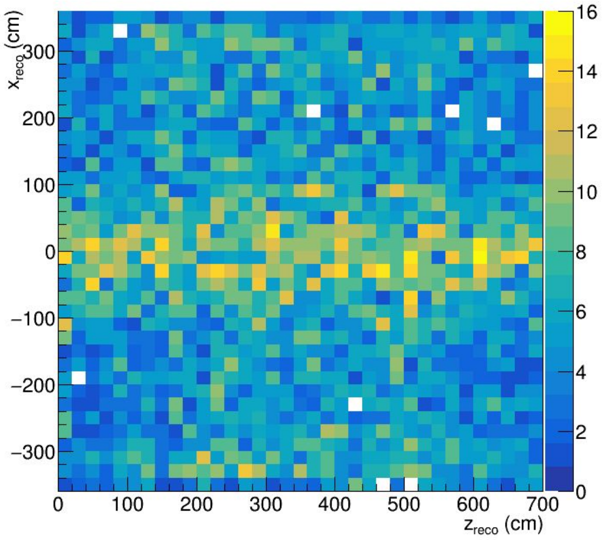
Anode-Piercing Tracks



Cathode-Crossing Tracks

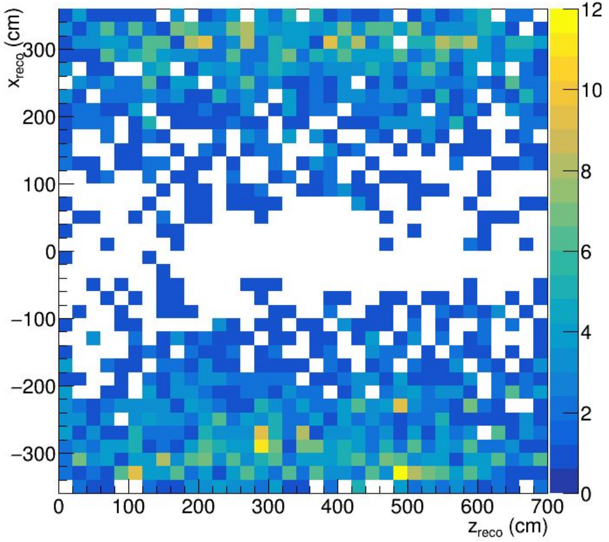


Combined

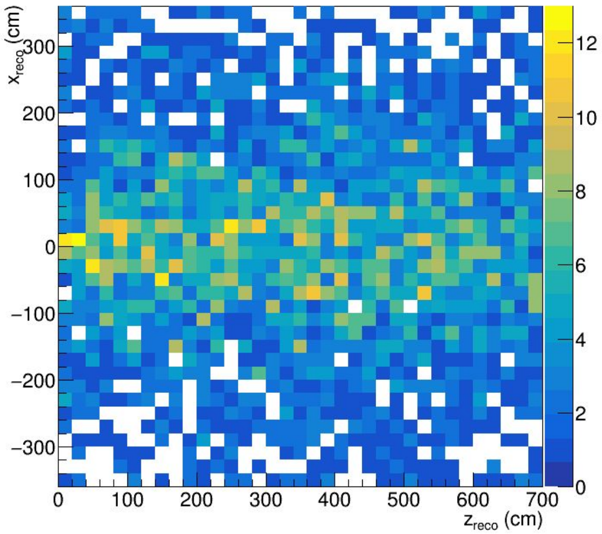


MC Coverage with SCE - Bottom

Anode-Piercing Tracks



Cathode-Crossing Tracks



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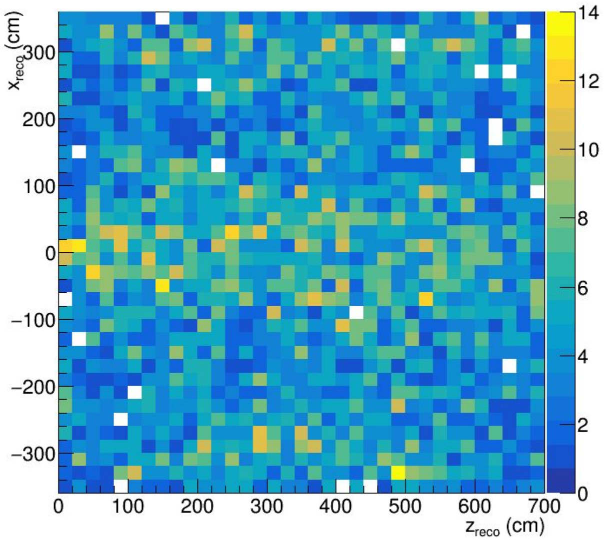
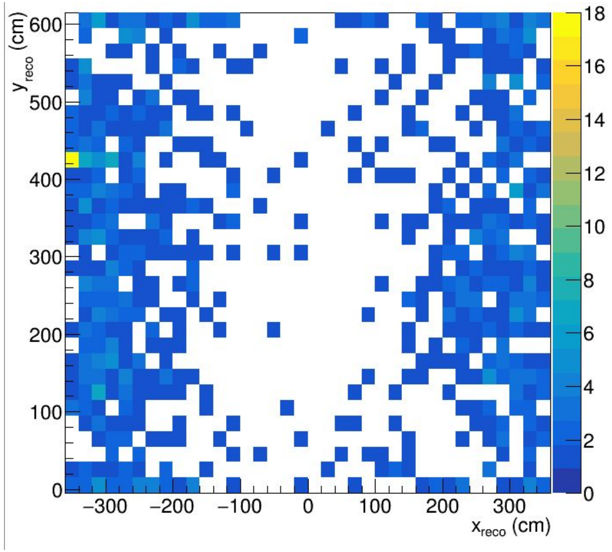
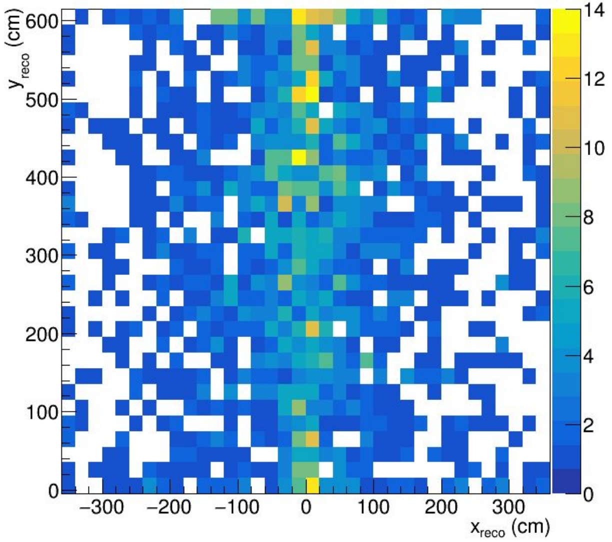


MC Coverage with SCE - Front (low Z)

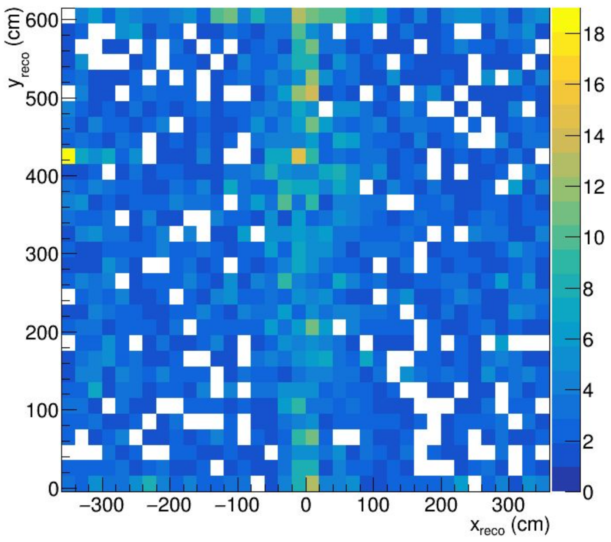
Anode-Piercing Tracks



Cathode-Crossing Tracks

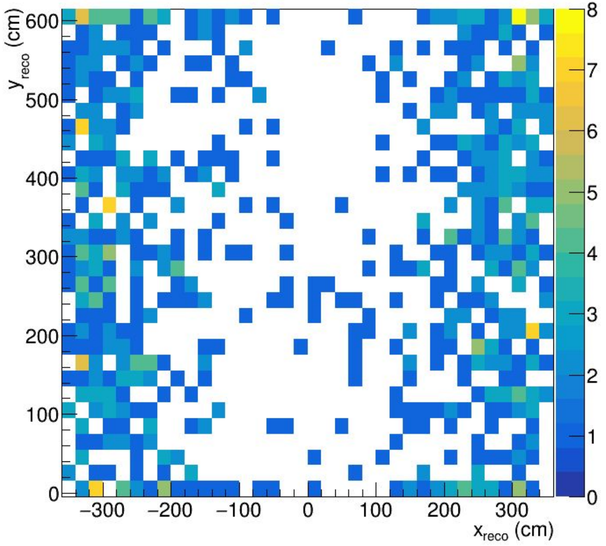


Combined

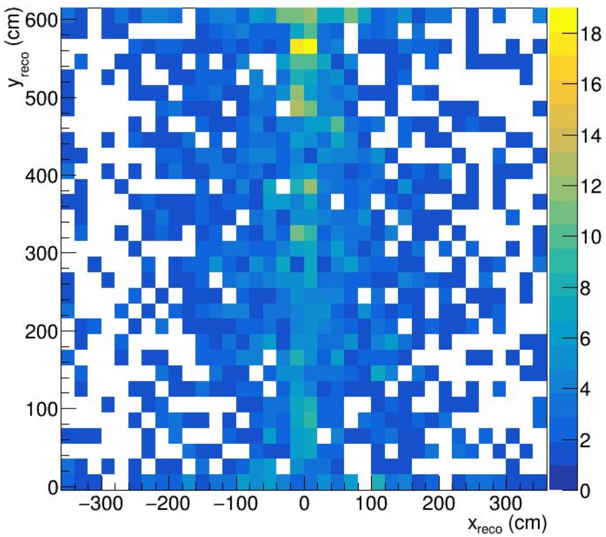


MC Coverage with SCE - Back (high Z)

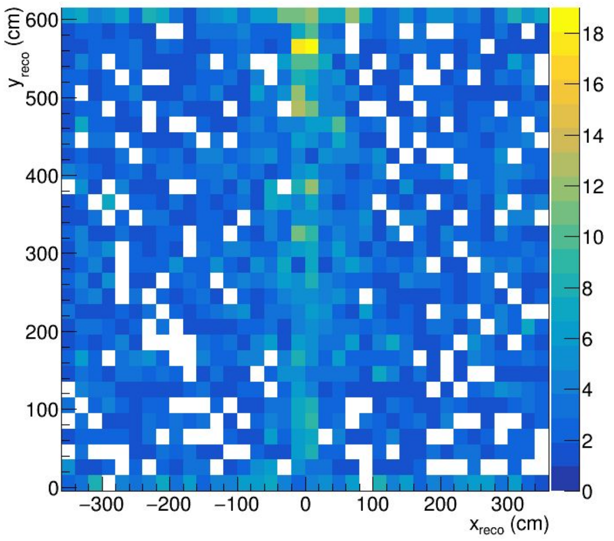
Anode-Piercing Tracks



Cathode-Crossing Tracks

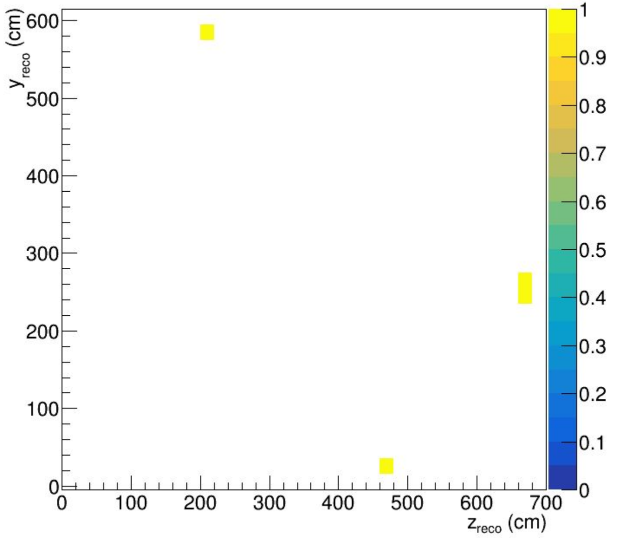


Combined

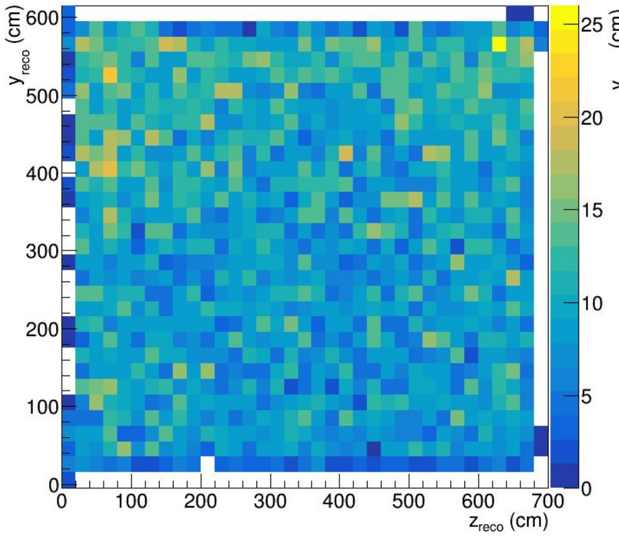


MC Coverage with SCE - Positive Cathode

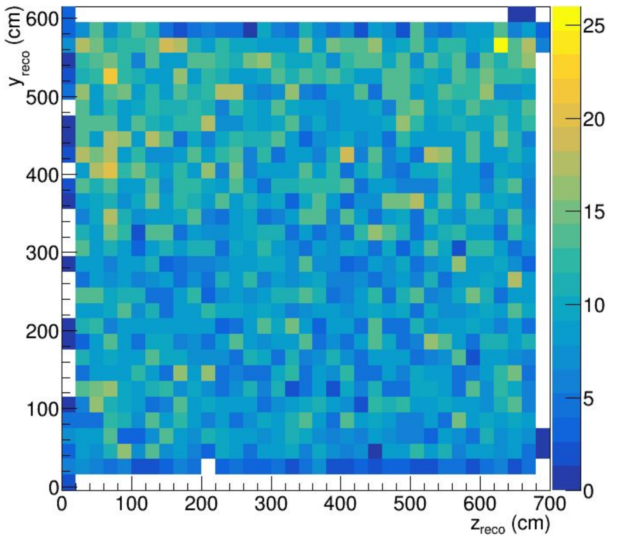
Anode-Piercing Tracks



Cathode-Crossing Tracks



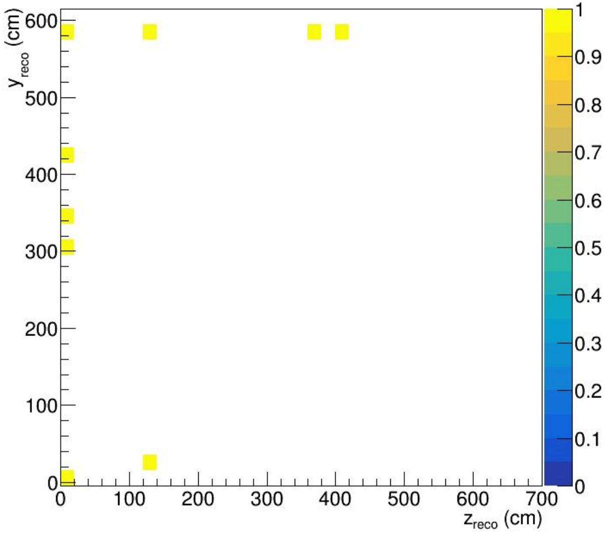
Combined



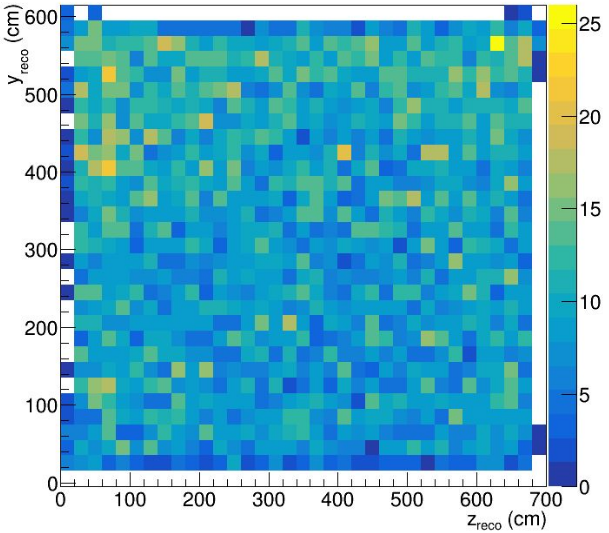
- Negative / Positive cathode coverage maps very similar: Make sense based on cathode-crossing technique

MC Coverage with SCE - Negative Cathode

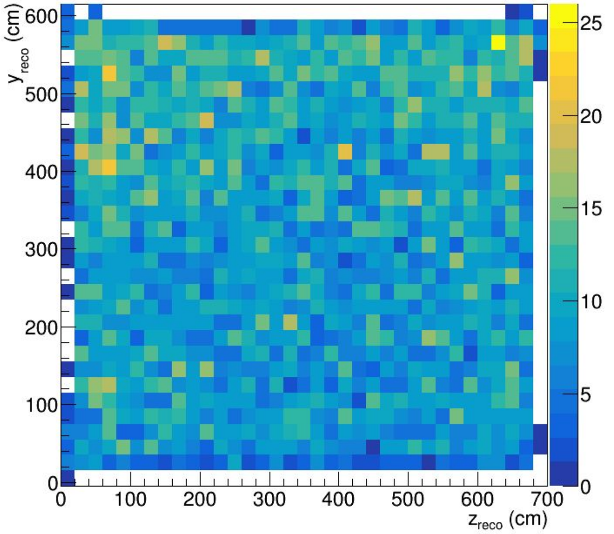
Anode-Piercing Tracks



Cathode-Crossing Tracks



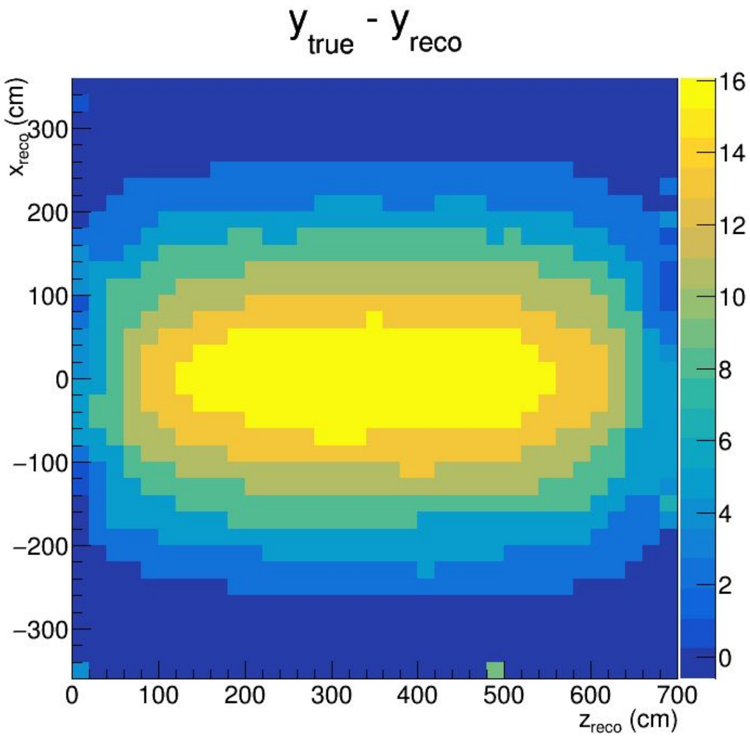
Combined



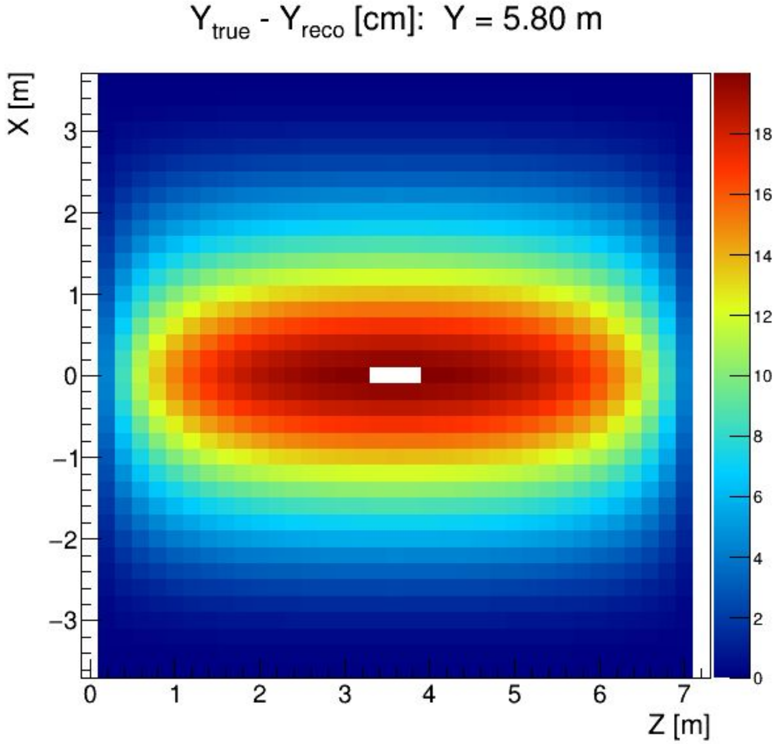
- Negative / Positive cathode coverage maps very similar: Make sense based on cathode-crossing technique

MC SCE Spatial Offsets - Top

From t_0-tagged tracks:

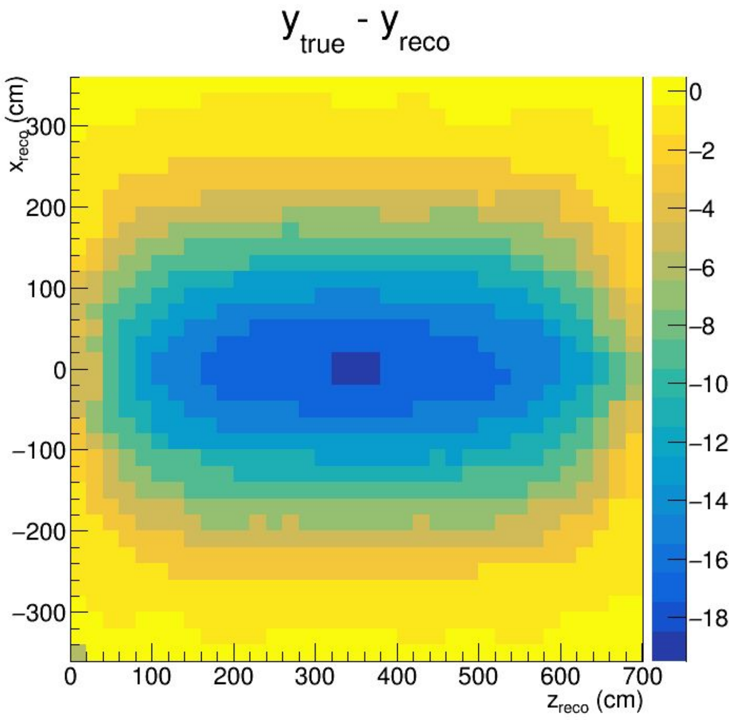


From simulation map:

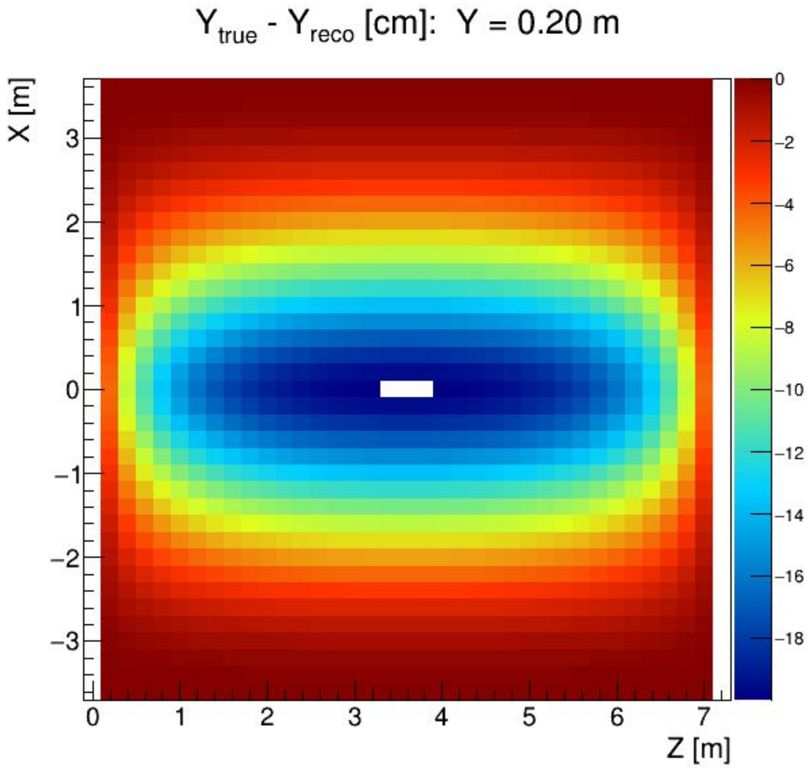


MC SCE Spatial Offsets - Bottom

From t_0-tagged tracks:

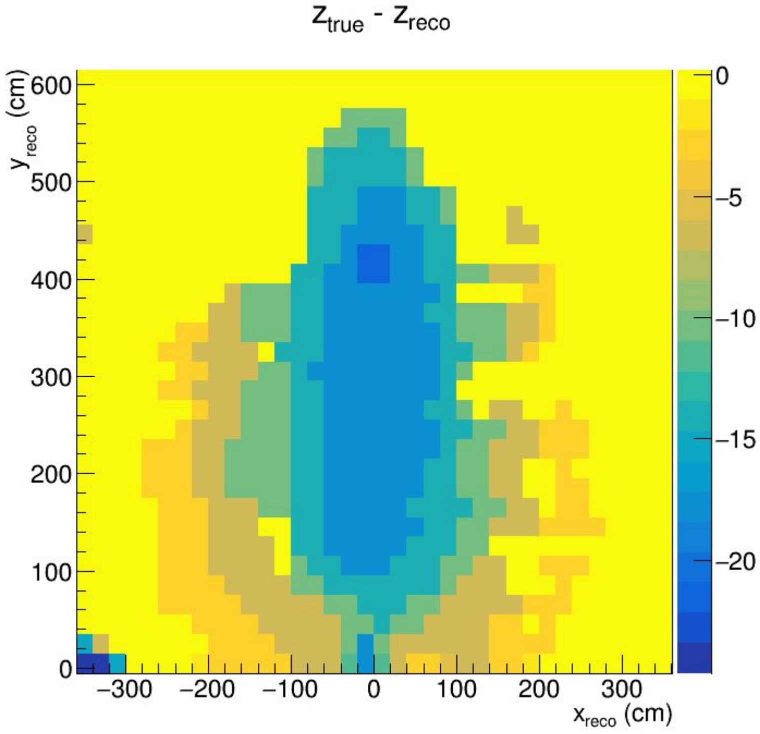


From simulation map:

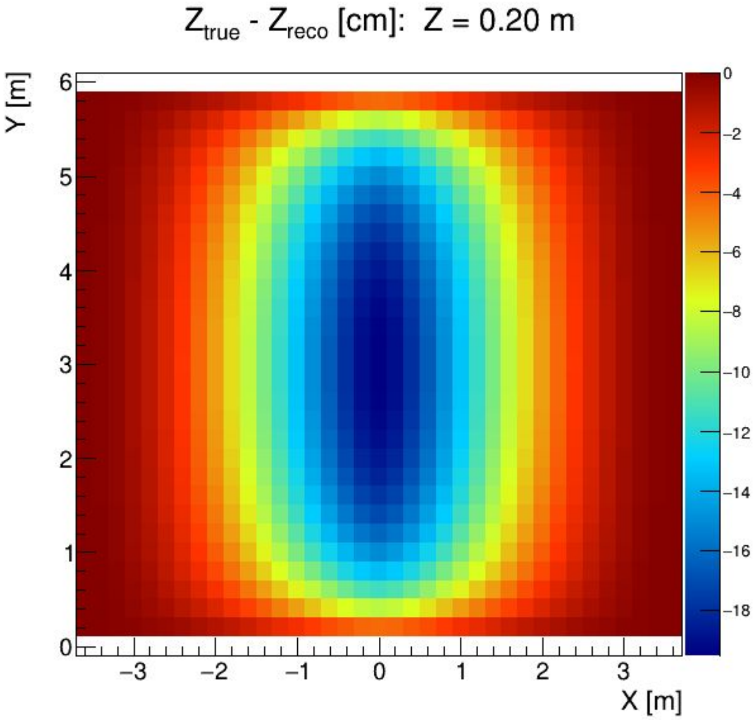


MC SCE Spatial Offsets - Front (low Z)

From t_0-tagged tracks:

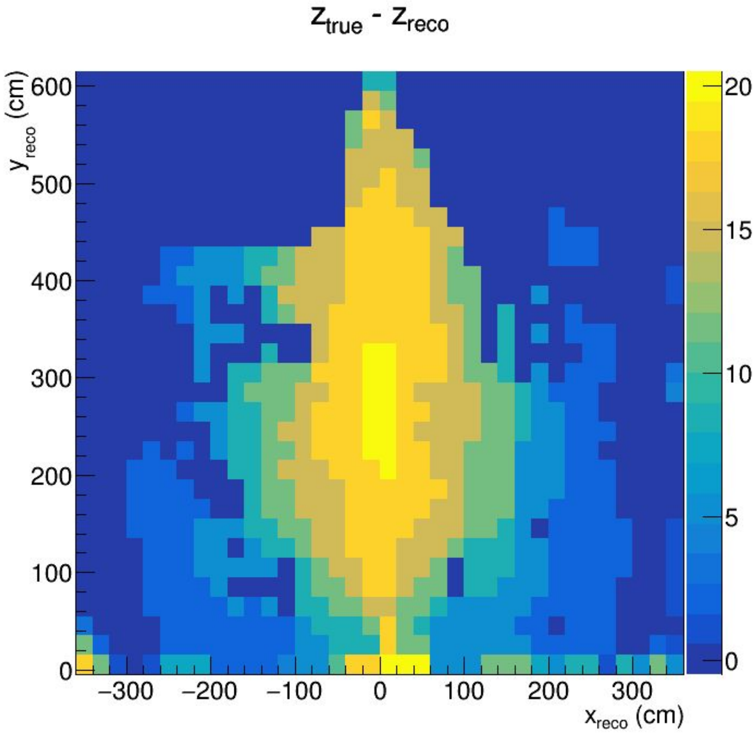


From simulation map:

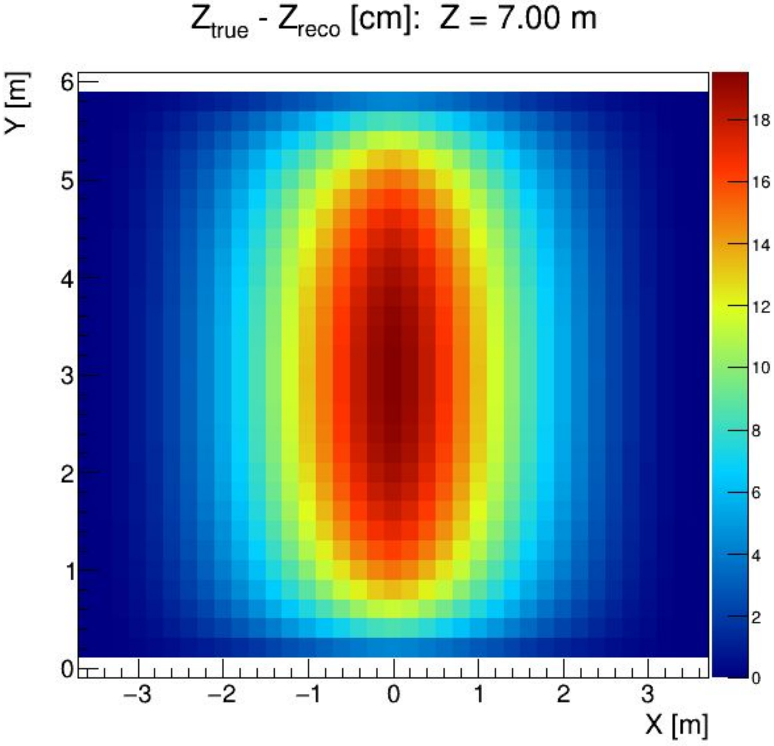


MC SCE Spatial Offsets - Back (high Z)

From t_0-tagged tracks:

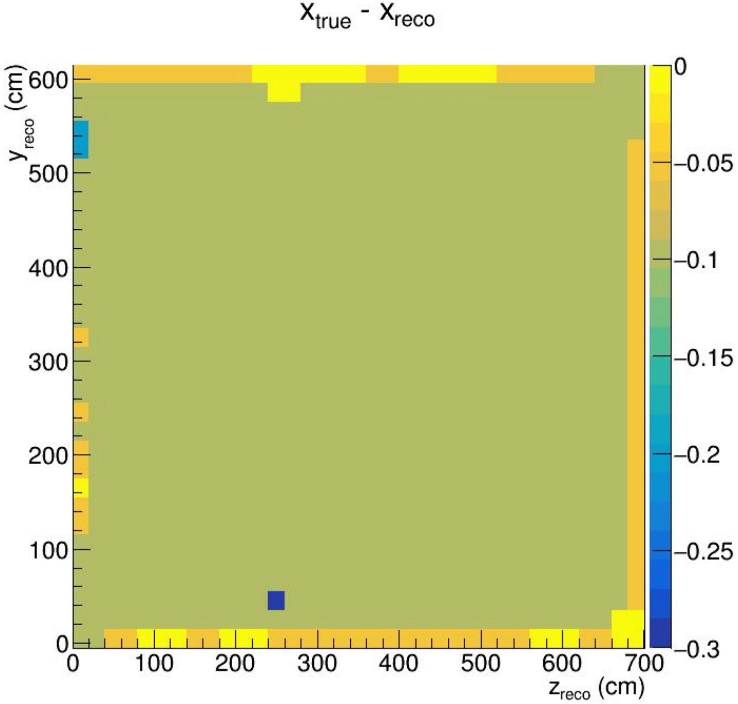


From simulation map:

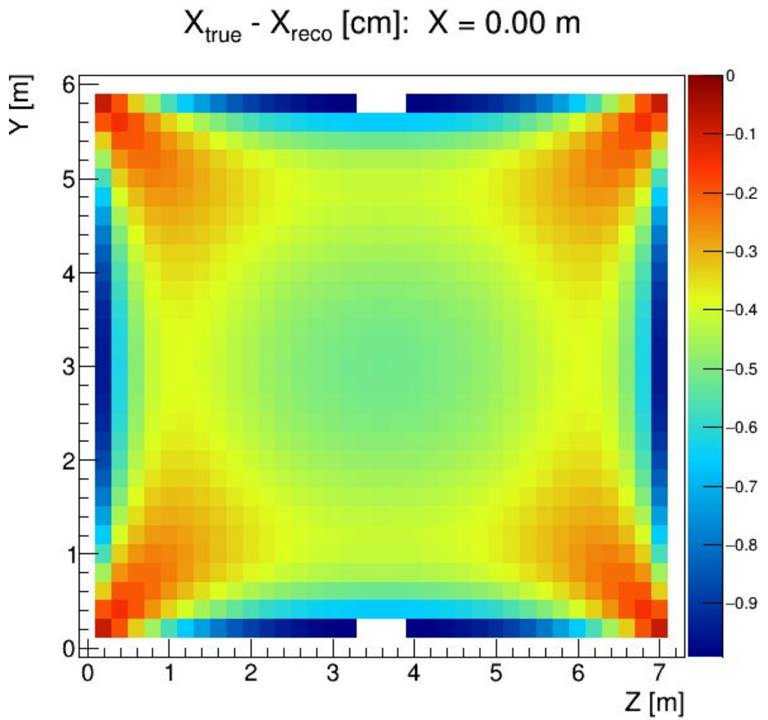


MC SCE Spatial Offsets - Positive Cathode

From t_0-tagged tracks:



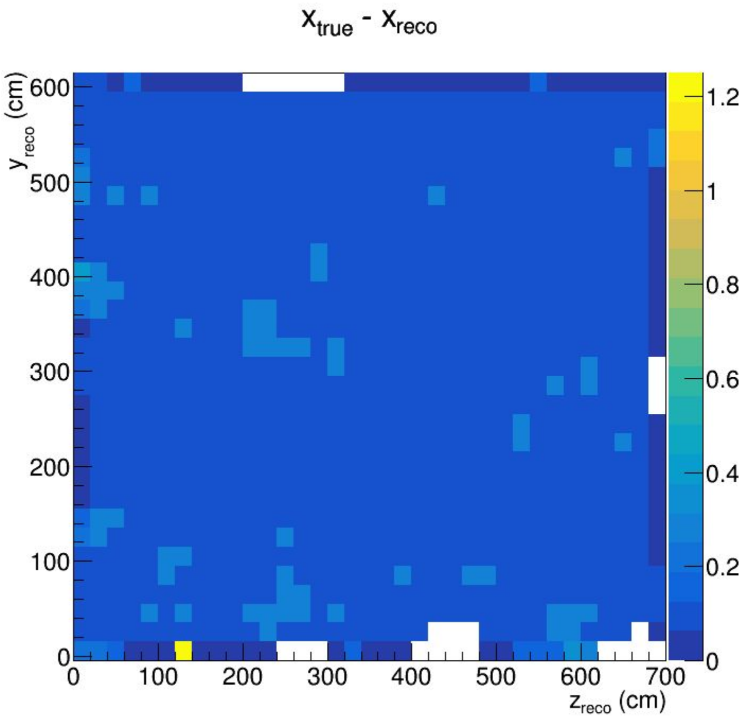
From simulation map:



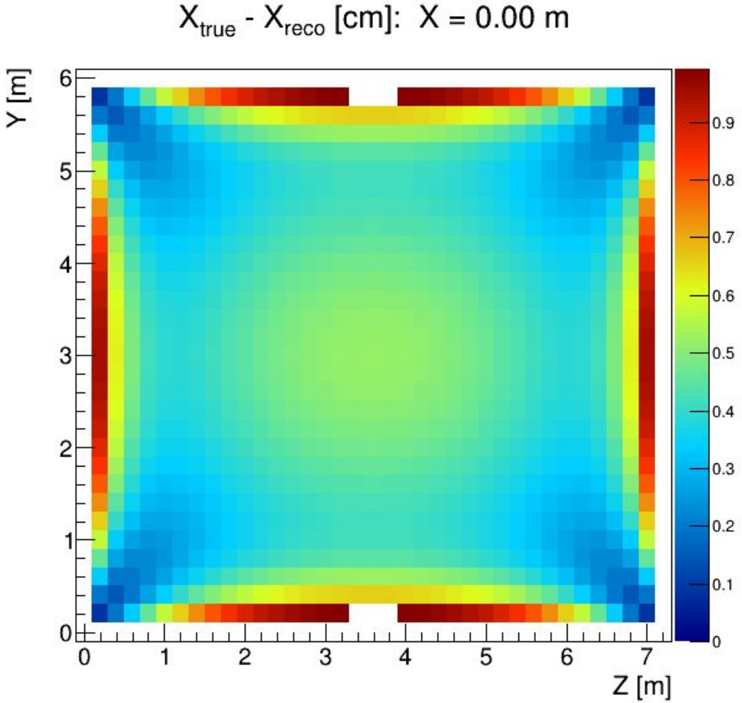
- Does cathode-stitching in pandora force the offset to be zero?
- If matching can make straightest track instead of moving tracks to zero, SCE offsets could be possible.

MC SCE Spatial Offsets - Negative Cathode

From t_0-tagged tracks:



From simulation map:



- Does cathode-stitching in pandora force the offset to be zero?
- If matching can make straightest track instead of moving tracks to zero, SCE offsets could be possible.

Next steps for MC

- Understand spatial offsets at cathode
- Calculate bulk spatial offsets
- Use fluid flow maps in simulation

What’s needed to repeat study with data:

- To get anode-piercing tracks: Need flash data
- To get cathode-crossing tracks: Need purity high-enough to see near cathode
    - Some data does exist (Run 5007), but it has not been run through the reconstruction chain yet
    - When I attempted to run through reco myself, it resulted in a segmentation fault.