Track Finding

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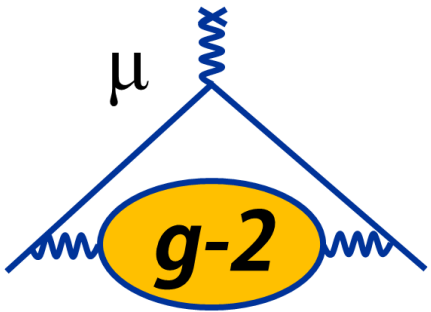
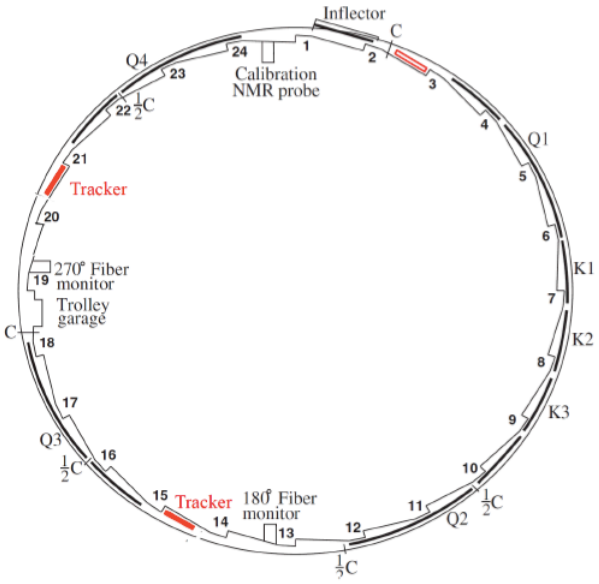
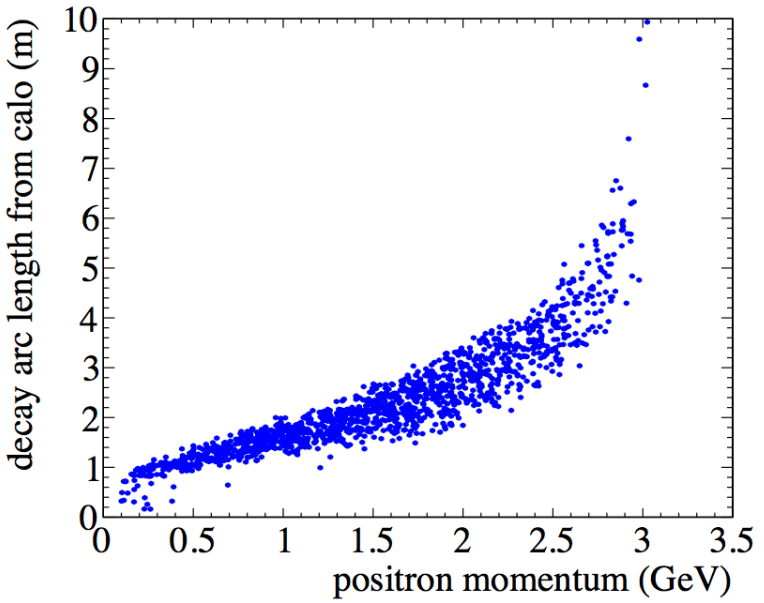


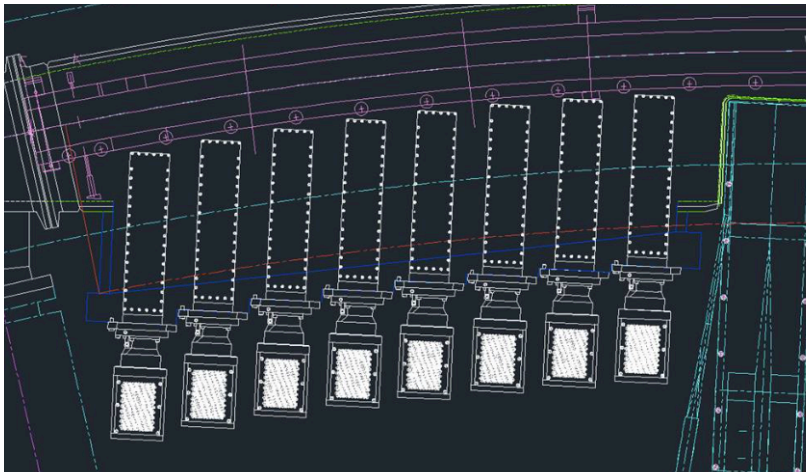
g-2 tracking

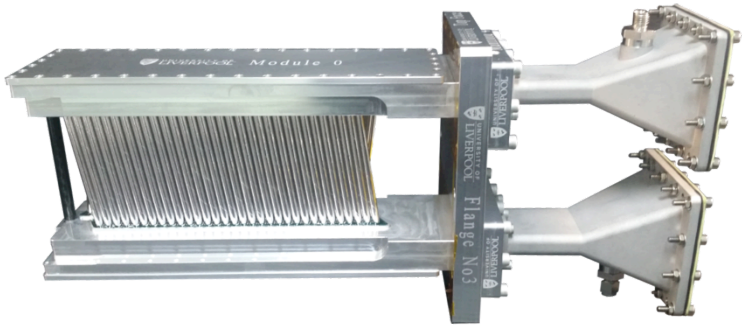




- Trackers are placed at 3 location around the ring, directly in front of the calorimeters
- They measure the momentum of the positron that decayed from the muon
- Give us beam information around entire ring

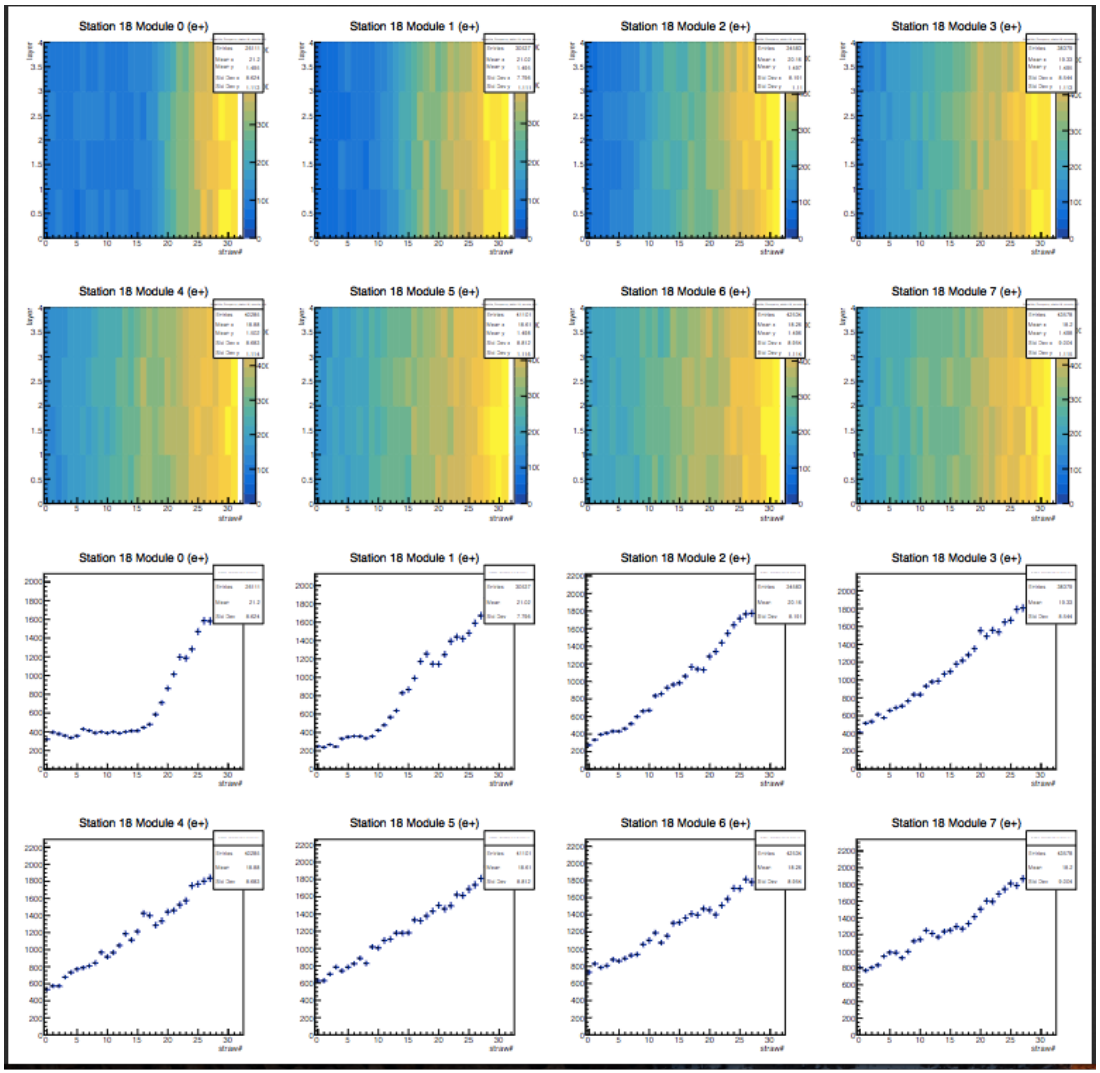
g-2 tracking





- Each tracker contains 8 modules
- Each module consists of 128 straws, in 4 layers, the first 2 angled at +7.5° (U view), the final layers angled at -7.5° (V view)
- Designed optimised for radial position measurements, but vertical coordiante also measured

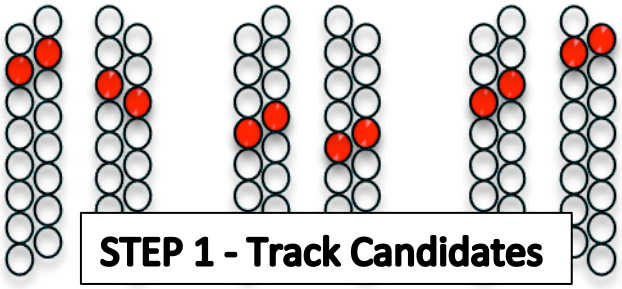
Straw hits

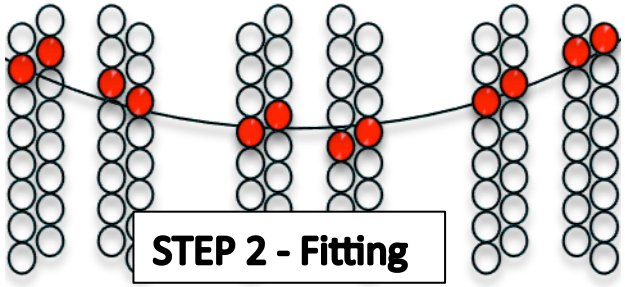


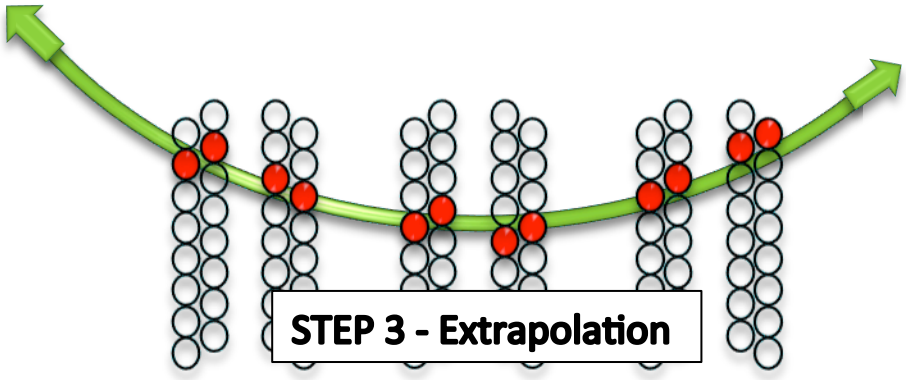
- Shown here is the distribution of positrons as seen by the straws
- More hits at higher radius
- Most important modules are nearest the calorimeters (of course)

Reconstruction

- Tracking can be split up into 3 steps
  - Track candidates - Grouping together of straw digits
  - Fitting - Calculating best fit track given positions and uncertainties
  - Extrapolating - Given best fit track swim tracks to different places (calos, decay vertex) through B field

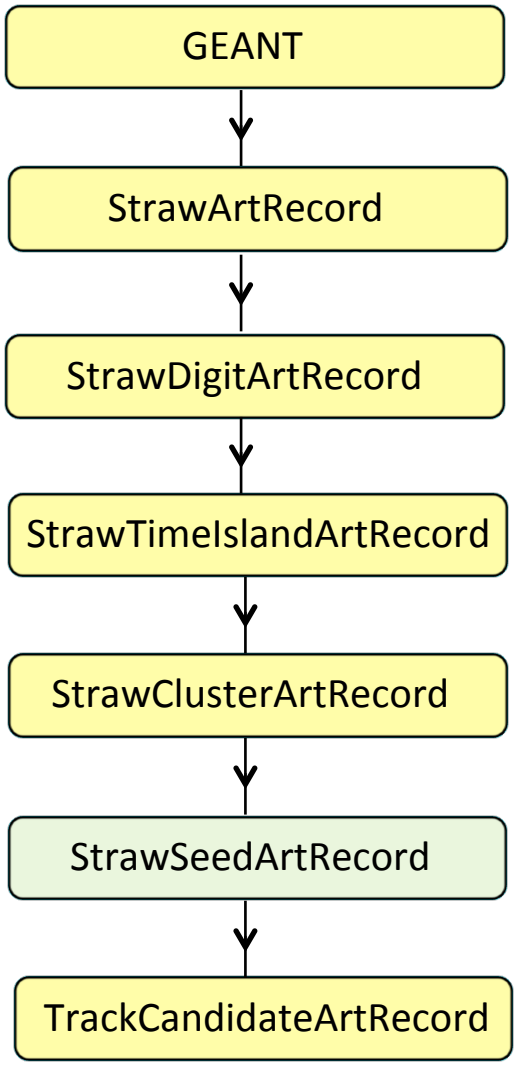






- This talk concentrates on -
  Track candidates

Track finding flow



artG4 generates hits from muon decays. Full detector geometry in place.

Makes art record for all tracks passing through straws. True time, pdgID, trackID etc. saved from geant hit.

Place where data matches simulation. Combine StrawArtRecords into single digits, impose single straw dead time, apply efficiencies, calculate drift times.

Temporal grouping of straw digits. All hits within a given time window (~100ns) are grouped.

Spatial grouping of straw digits. Group hits in same view with different layers if adjacent.

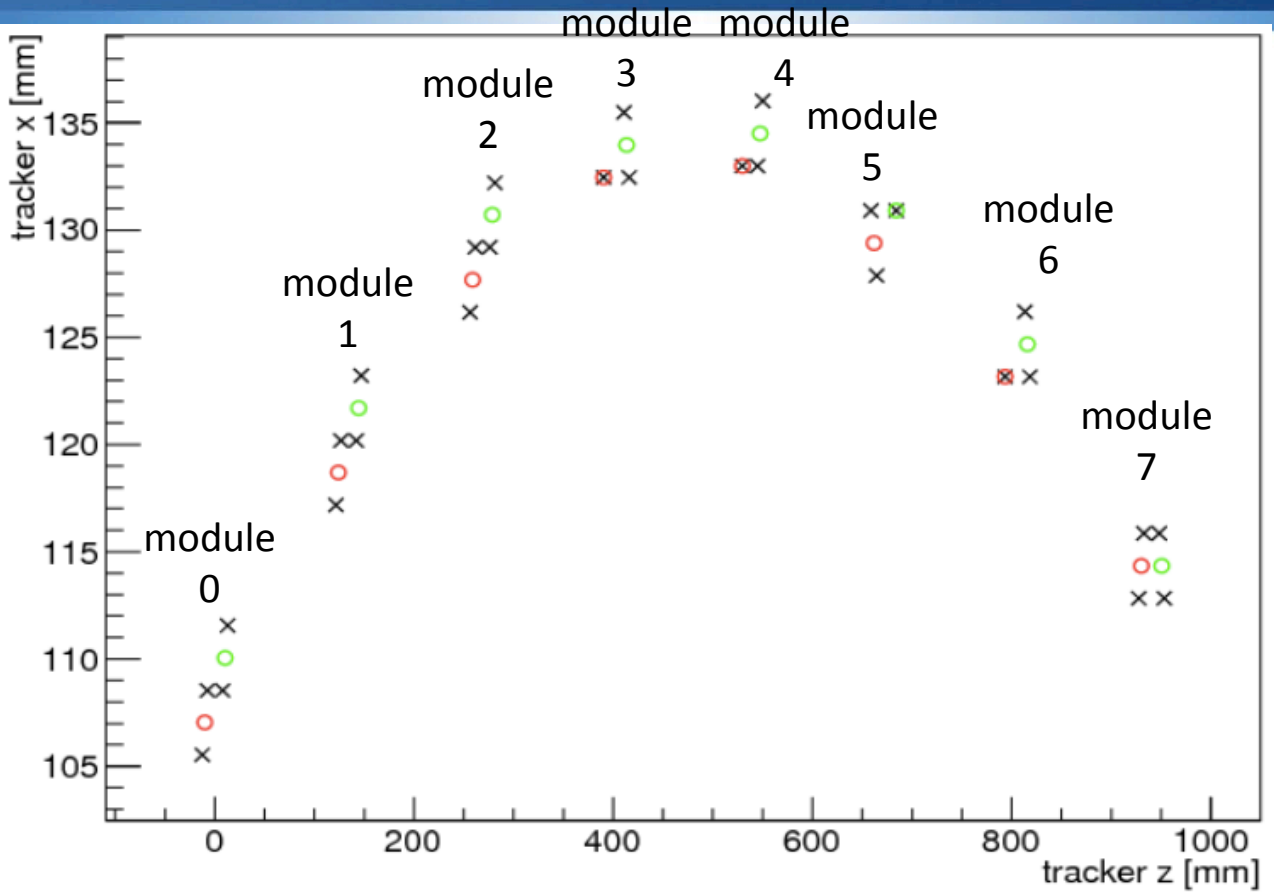
Optional grouping of U and V views into seeds.

Group of clusters/seeds that form a track candidate for fitting.

Example of finding

- What follows is an example of reconstructed track that has passed through the entire chain
- Focusing on track finding so use the straw positions to try and obtain the correct track First look only at the positron from the muon decay…

Positron track



- Top down view of primary track
- X is ~radial
- Y vertcial
- Z along beam

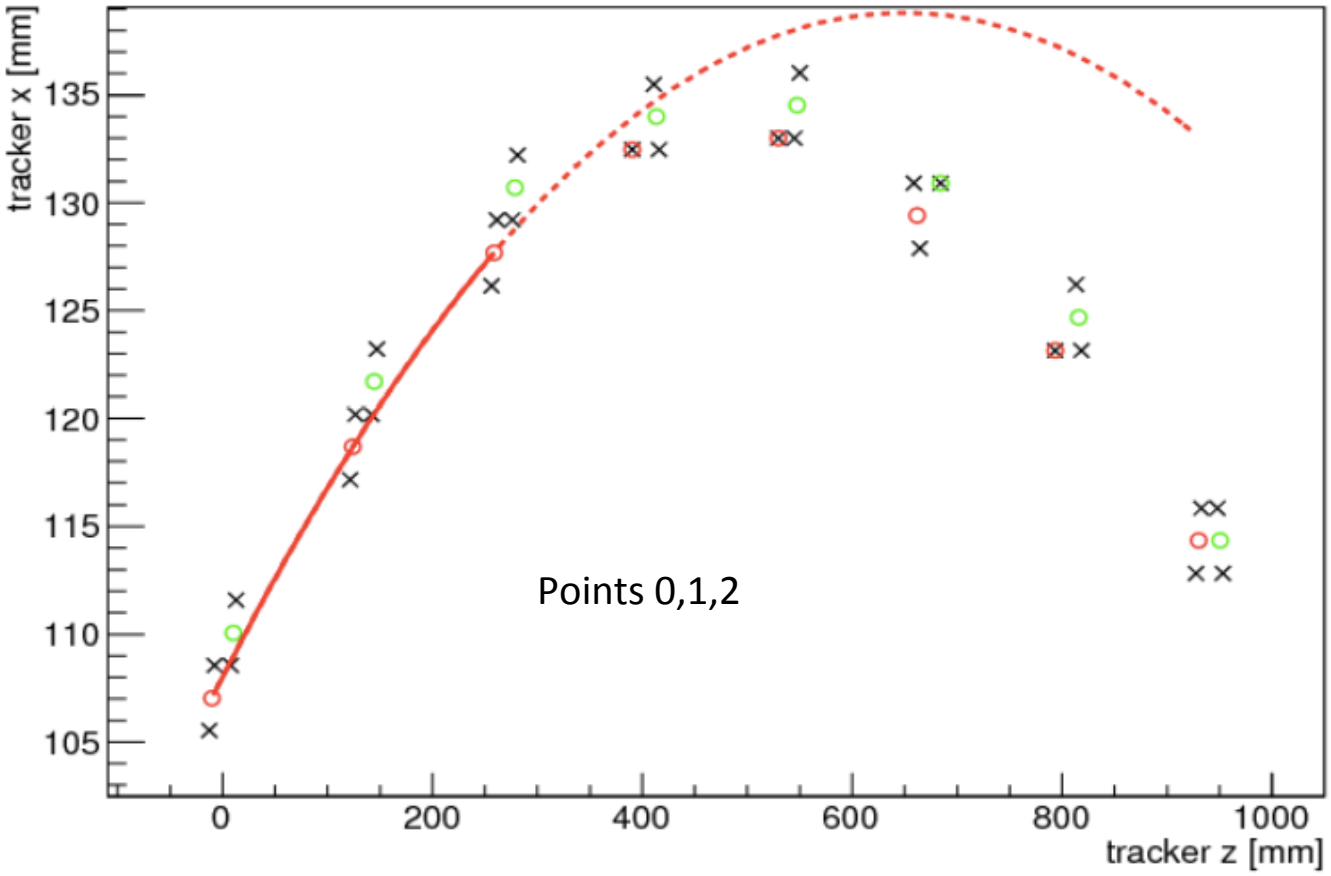
× - wire pos at y=0

O - avg U pos

O - avg V pos

- Starting point of alg. is average position of doublet - red/green circles
- Treating U and V separately
- Ignoring vertical (y) component

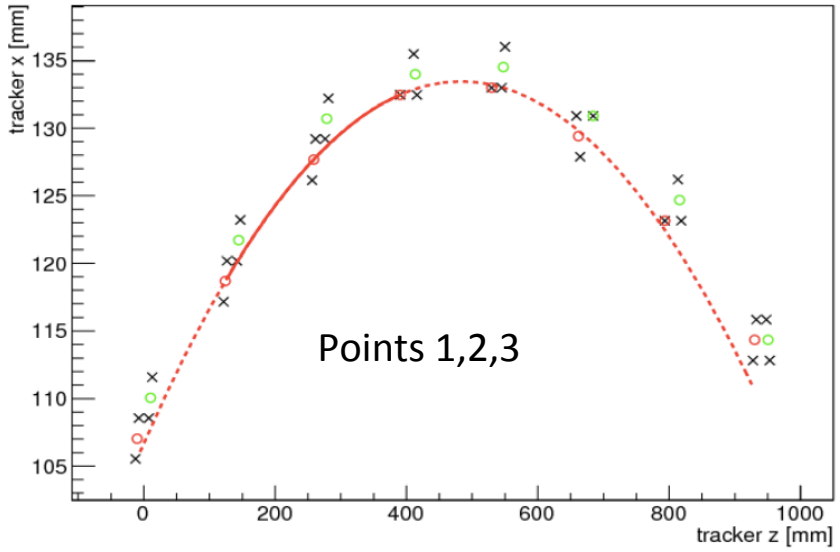
U points - 0,1,2

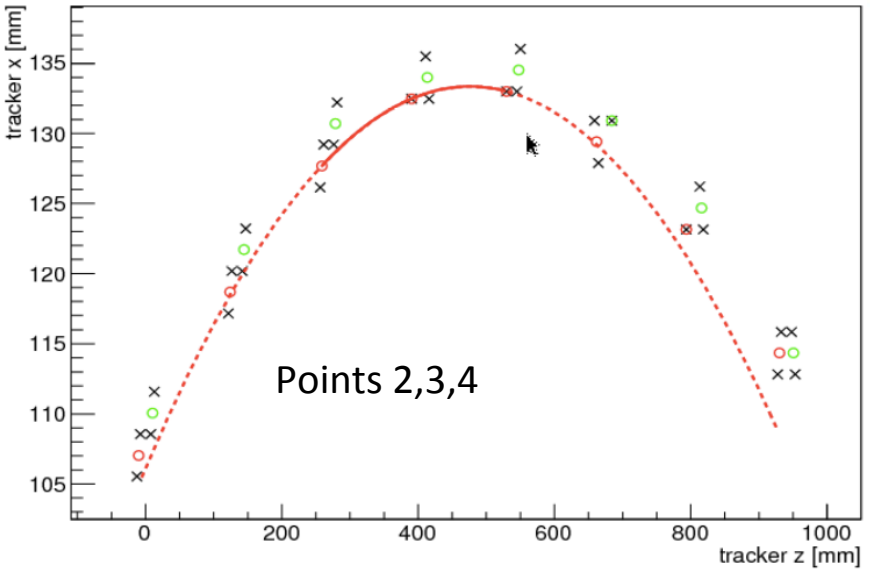


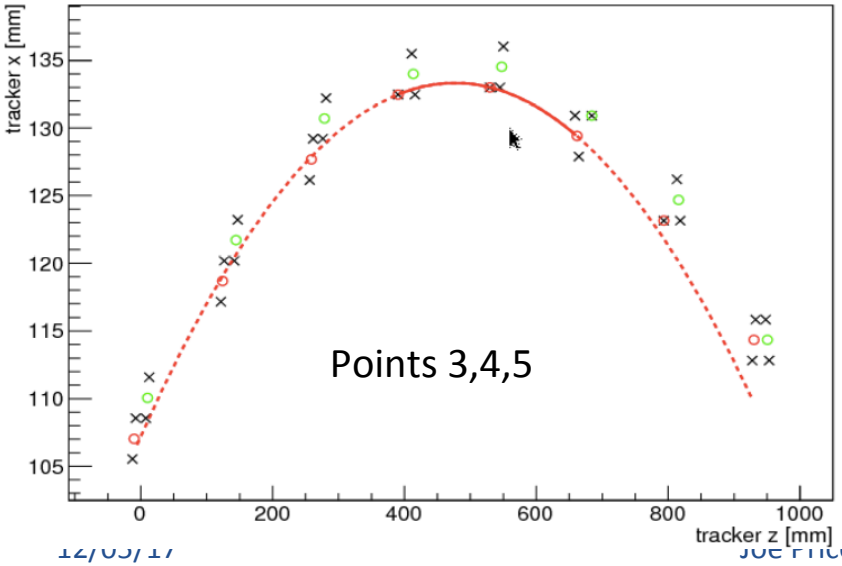
- Solid line is circle bisecting first 3 U points
- Dashed line is projection
- Not good for whole length of track
- Picks out next point well

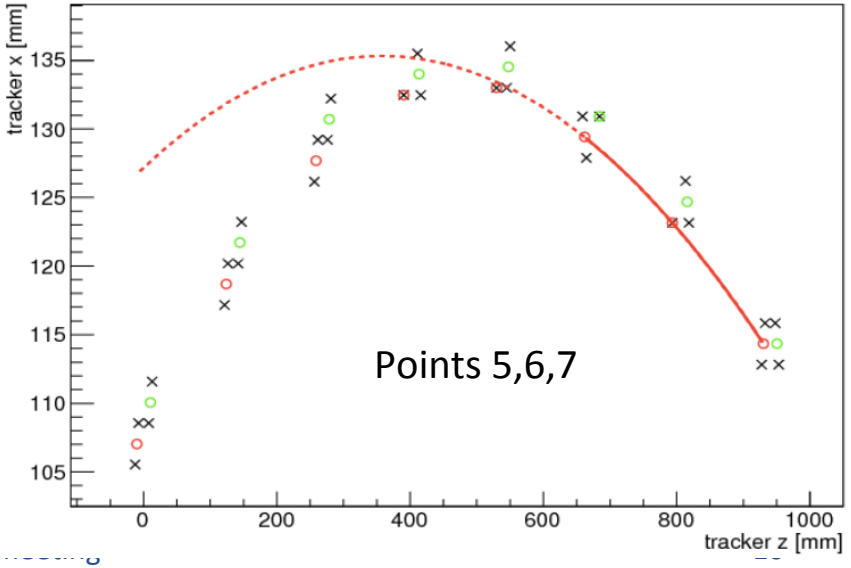
- Calculate circle that fits exactly to average point of 3 layers
- Algorithm performs this for all consecutive layers…

All U points


tracker x [mm]
tracker z [mm]
Points 1,2,3

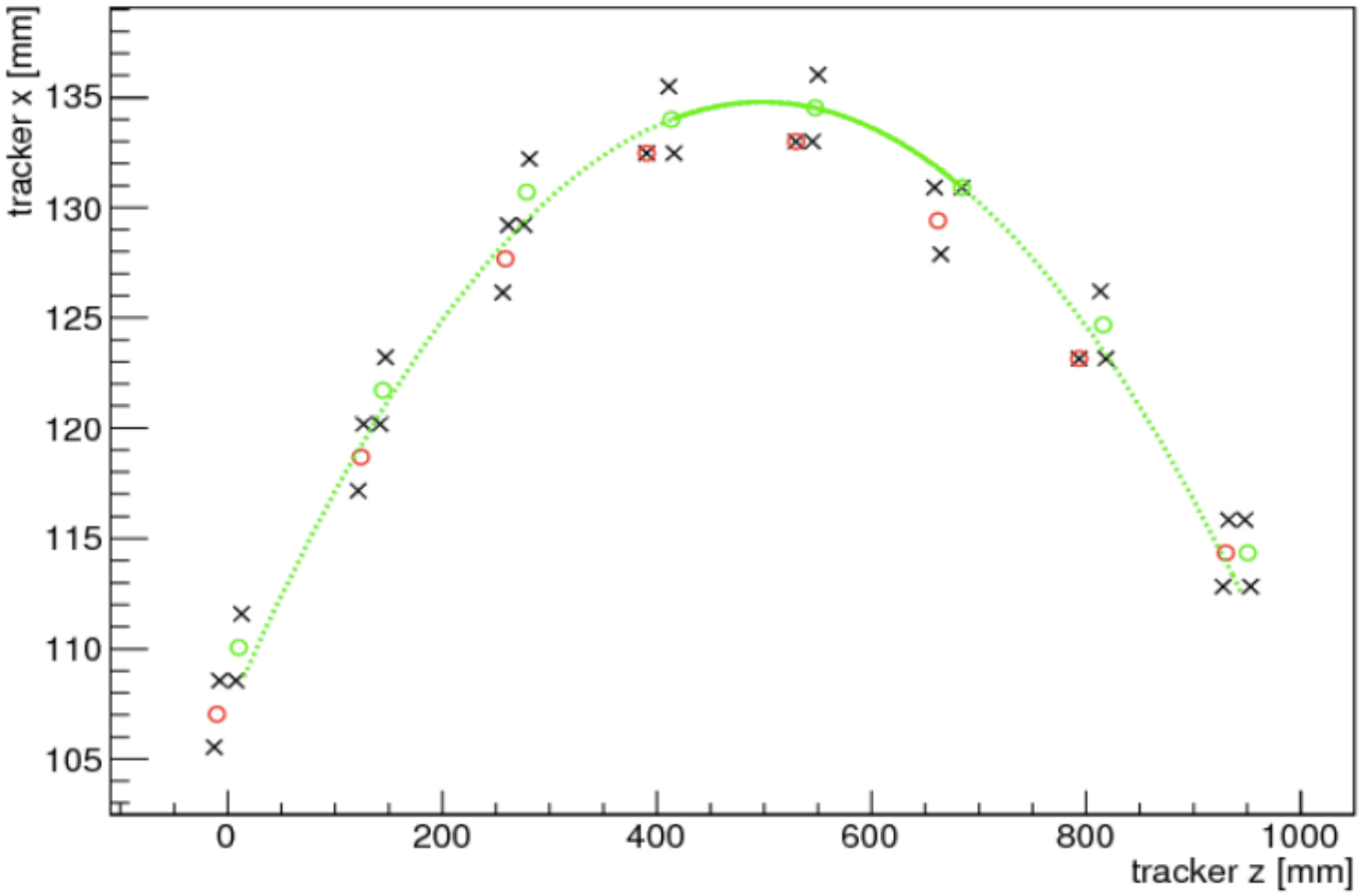

tracker x [mm]
tracker z [mm]
Points 2,3,4


tracker x [mm]
tracker z [mm]
Points 3,4,5


tracker x [mm]
tracker z [mm]
Points 5,6,7

V points

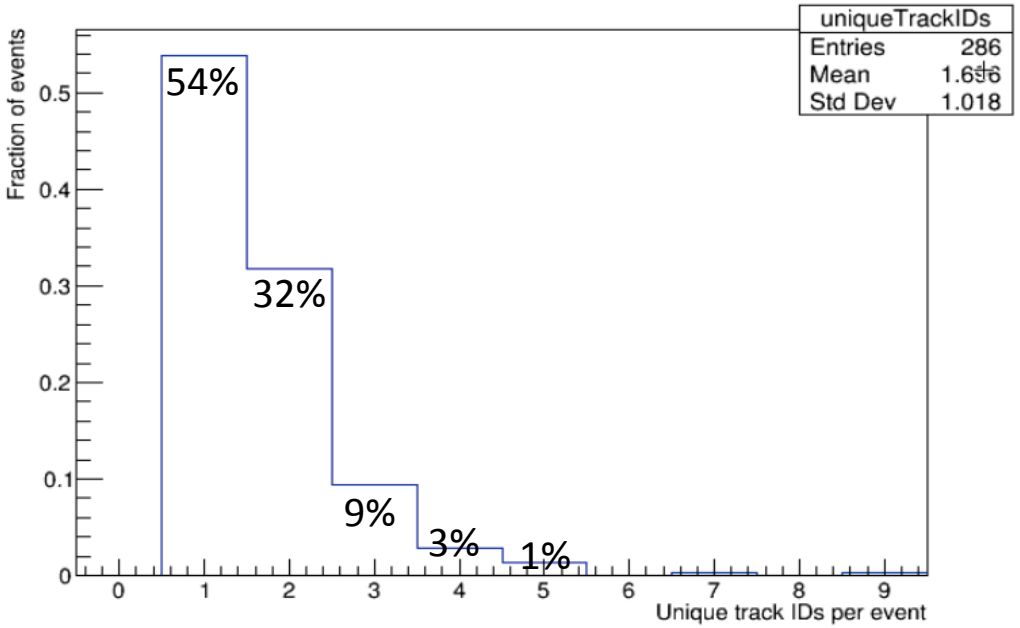
- Perform same algorithm for V layer



- Solid line is circle bisecting next 3 V points
- Dashed line is projection
- Similar plots for all combinations

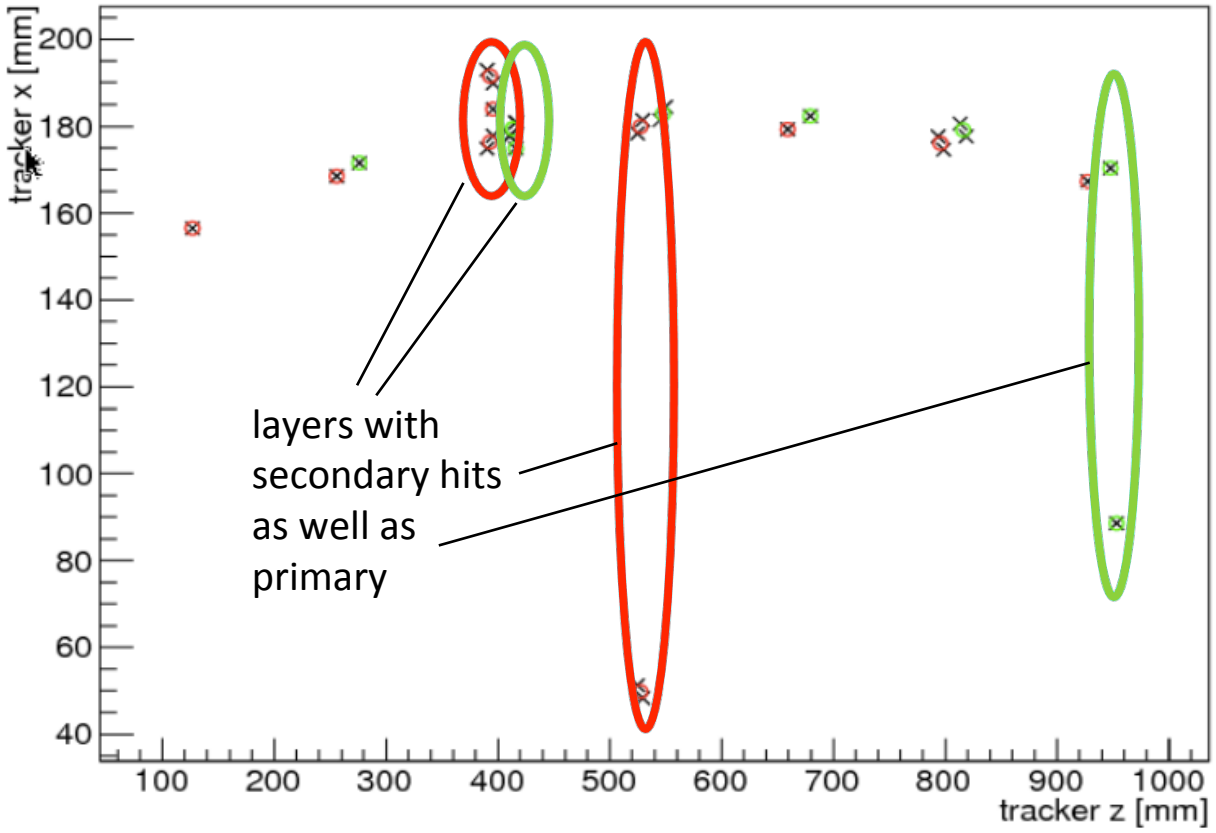
Secondaries

- Identify that a simple circle fitting algorithm predicts approximate position of hit in next module
- Use this simple algorithm to try and remove secondaries…



- >45% of events have secondary tracks
- The majority of these are photons and electrons

Accounting for secondaries



- Top down view of primary track
- X is ~radial
- Y vertical
- Z along beam

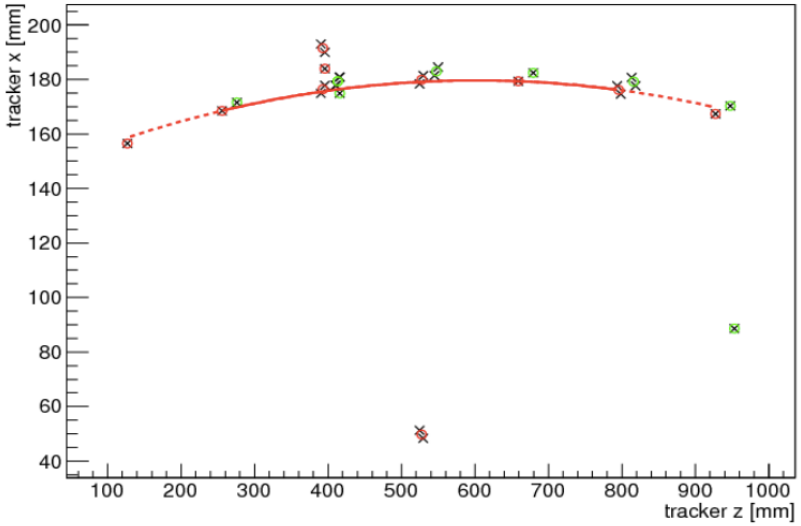
× - wire pos at y=0

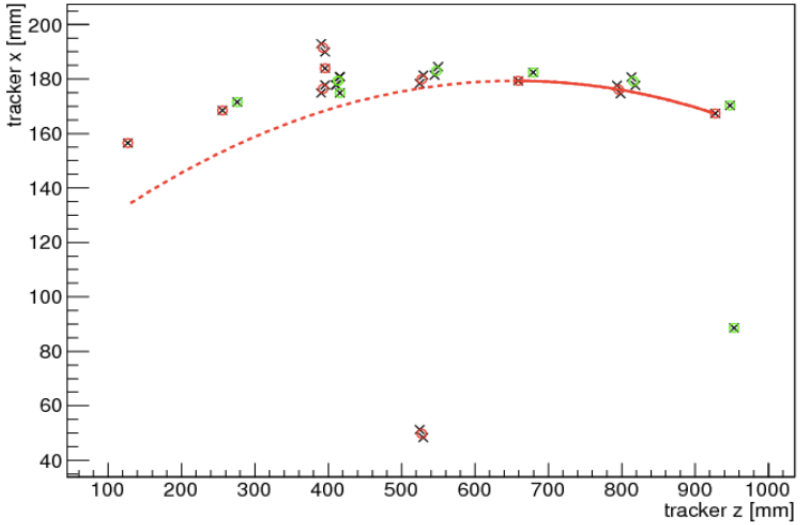
- avg U pos

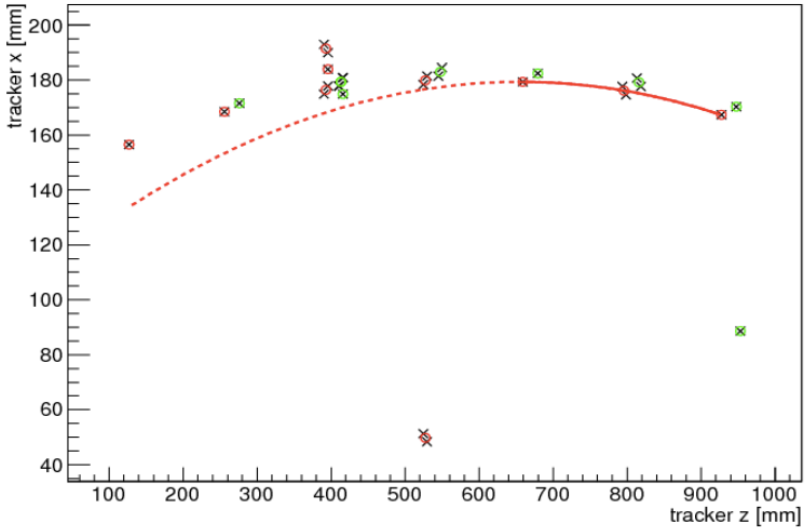
- avg V pos

- Now apply same algorithm when secondaries are present
- Pick out view with multiple hits - ignore them in segment formation

Segments in the U layers

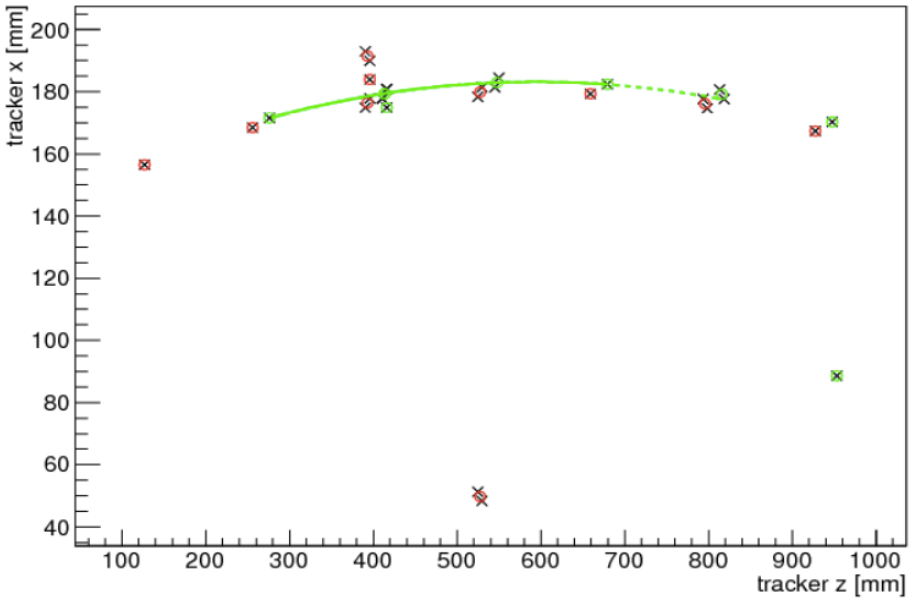


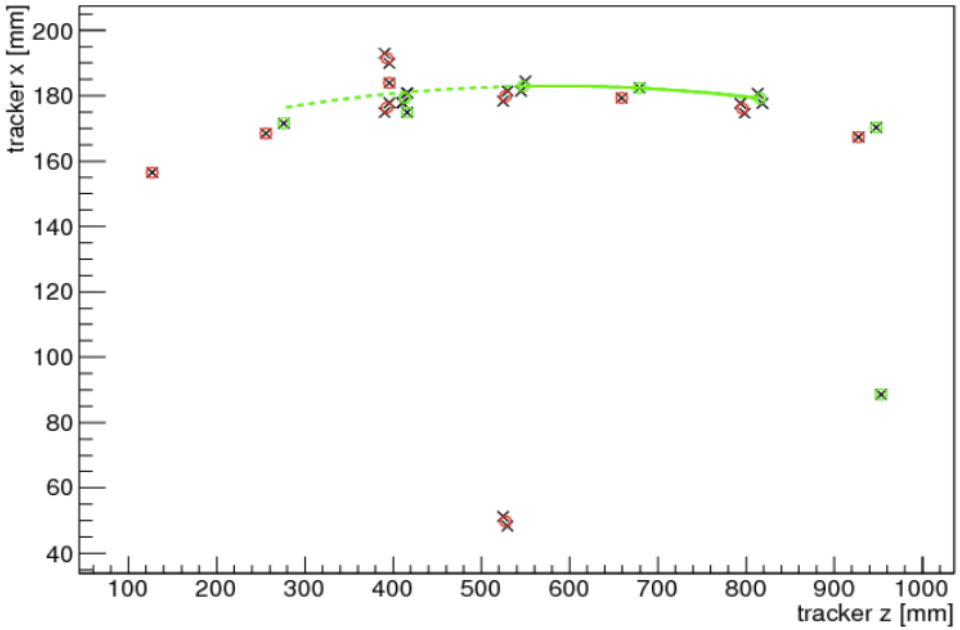




- U view gives 3 circle segments made from modules with uique hits

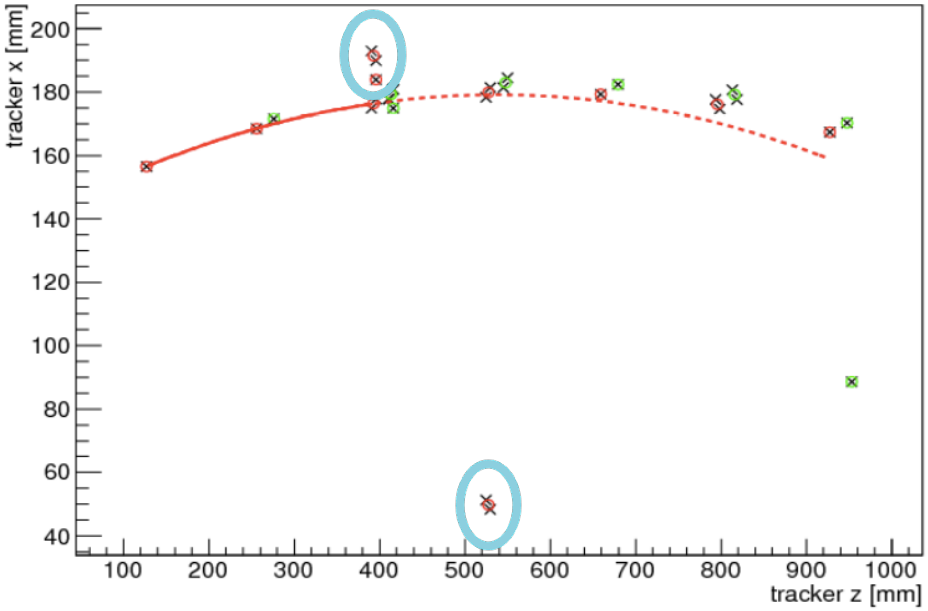
Segments in the V layers

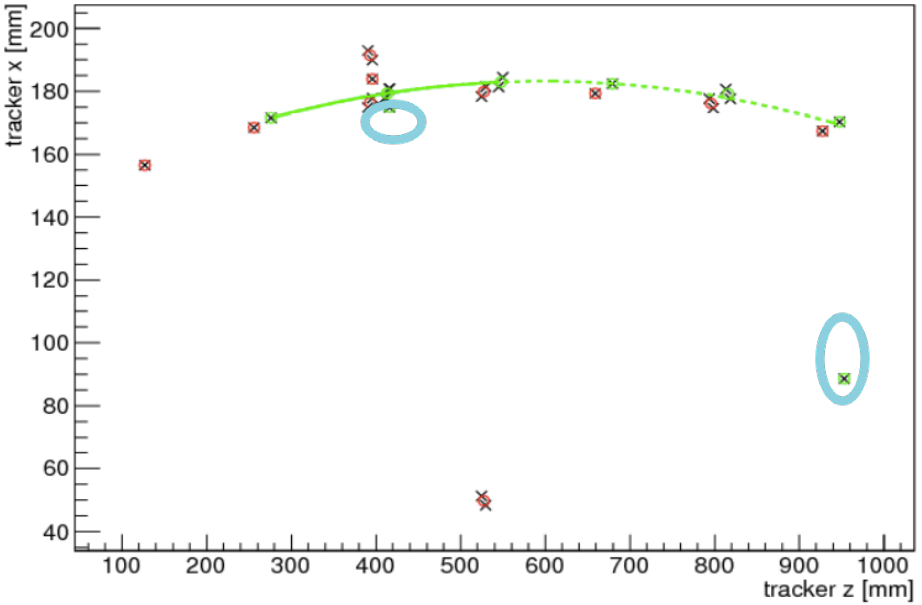




- V layer only has 2 circle segments made from modules with unique hits

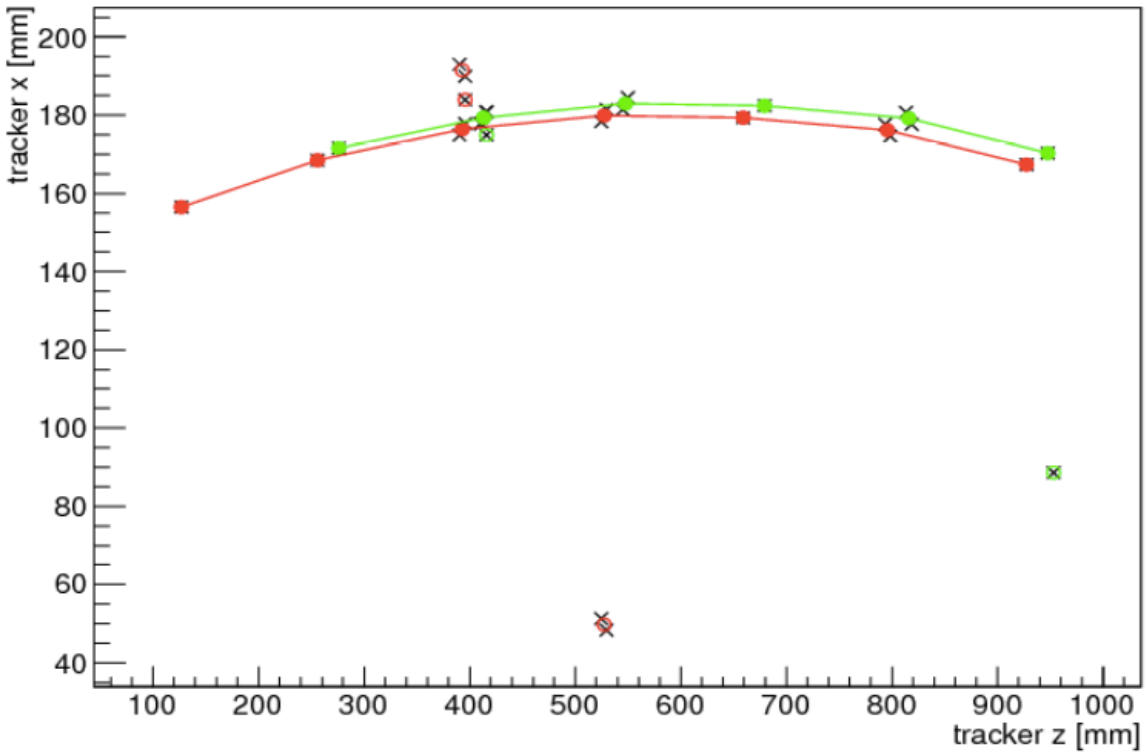
U points





- Have highlighted IGNORED straw hits at each view

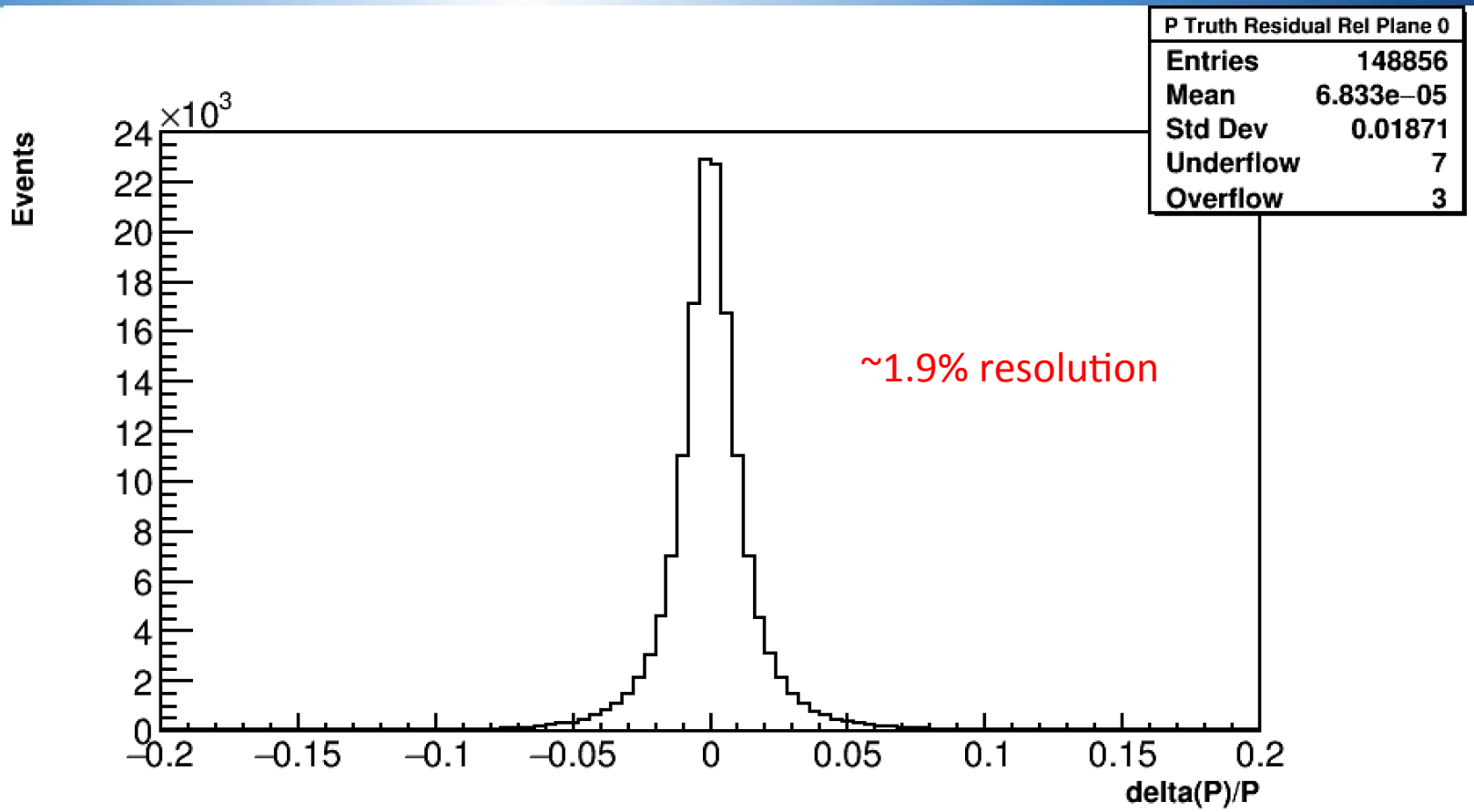
Final results



- Final tracks selected at end of algorithm
- U and V tracks shown separately

- Algorithm has succesfully removed secondaries from track candidate
- Can now pass the final track candidate to the fitting algorithm

Fitting



- Fitting is performed using GEANE
- Final momentum resolution is ~ 2%

Conclusions

- Trackers are used for momentum measurement of positron decays
- Demonstrated simple algorithm to remove secondaries to purify the sample
- GEANE used to fit the track candidates
- Momentum resolution ~2%
- Next step is the extrapolation…

- backups