

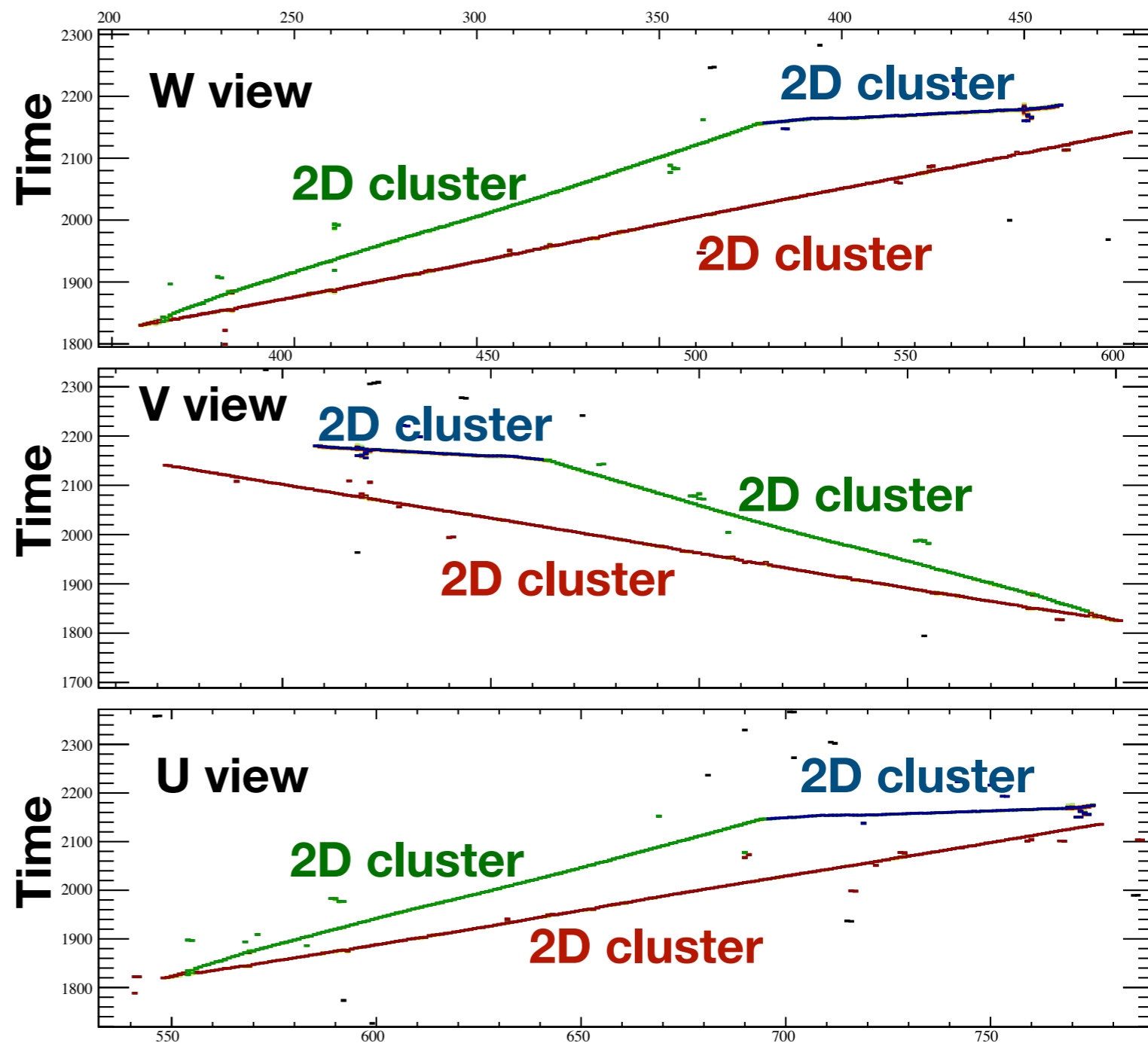


Looking at calorimetry in pandora: 3D matching

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FD sim/reco meeting
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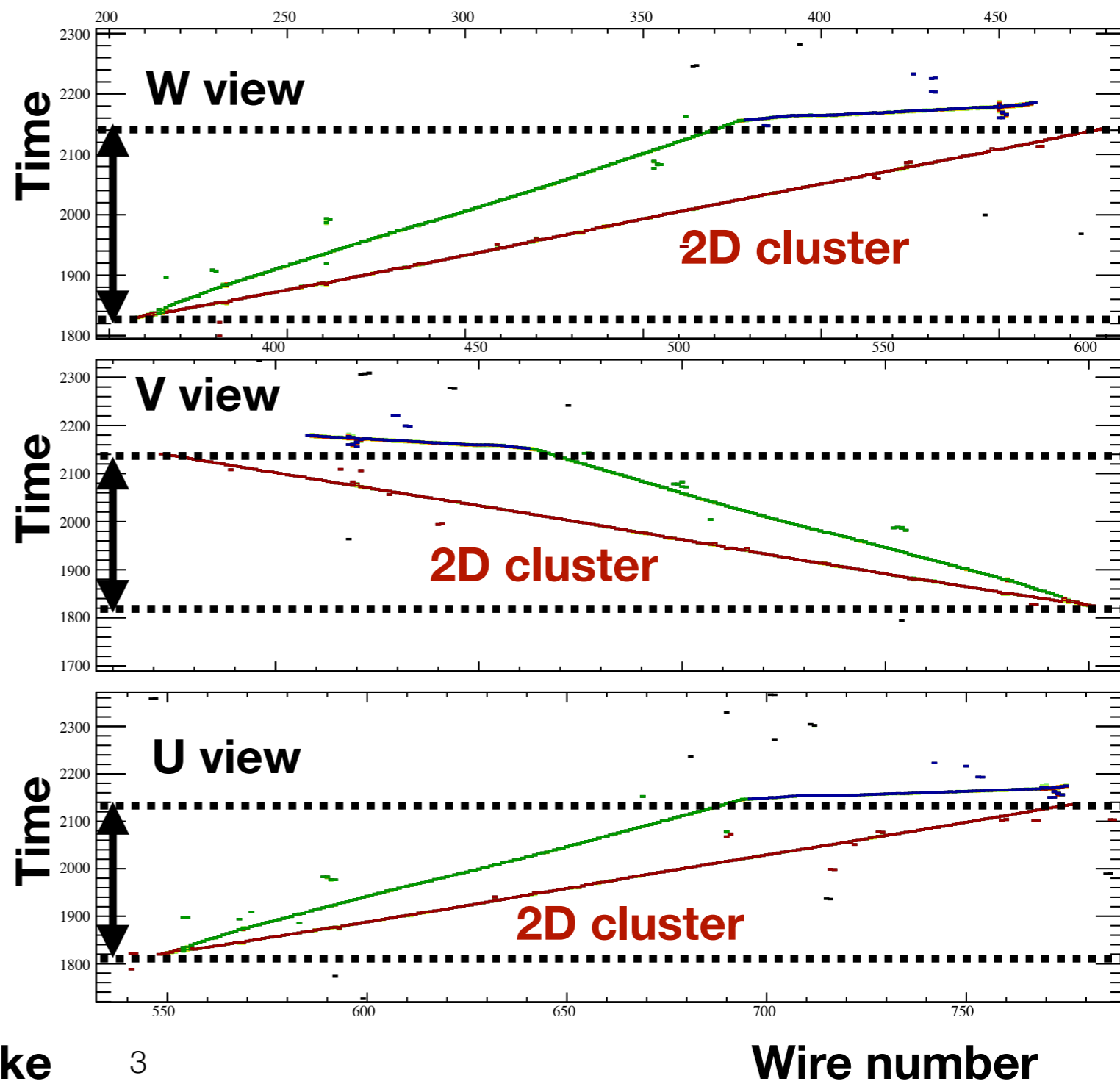
The current time-based 3D matching in pandora

- Aim: turn the 2D clusters observed in each wire plane into 3D clusters
- Achieved by comparing every U:V:W triplet combinatoric and assessing their compatibility
- In this example, there would be
 - 3 U clusters x 3 V clusters x 3 W clusters == 27 comparisons



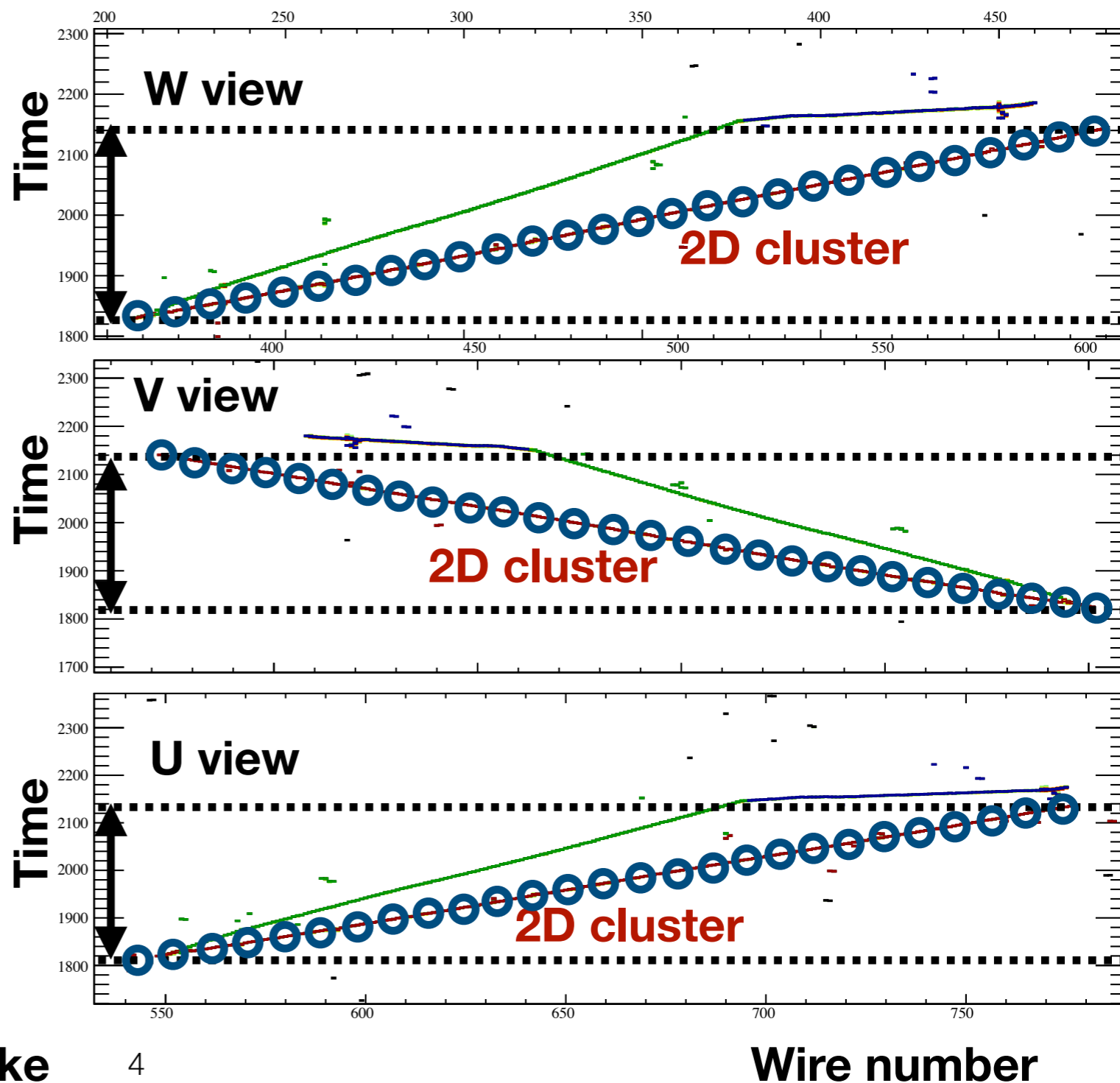
The current time-based 3D matching in pandora

- For each comparison triplet, the common overlap in time for the clusters is found
- In this example, the common time overlap essentially encapsulates the entirety of the three clusters



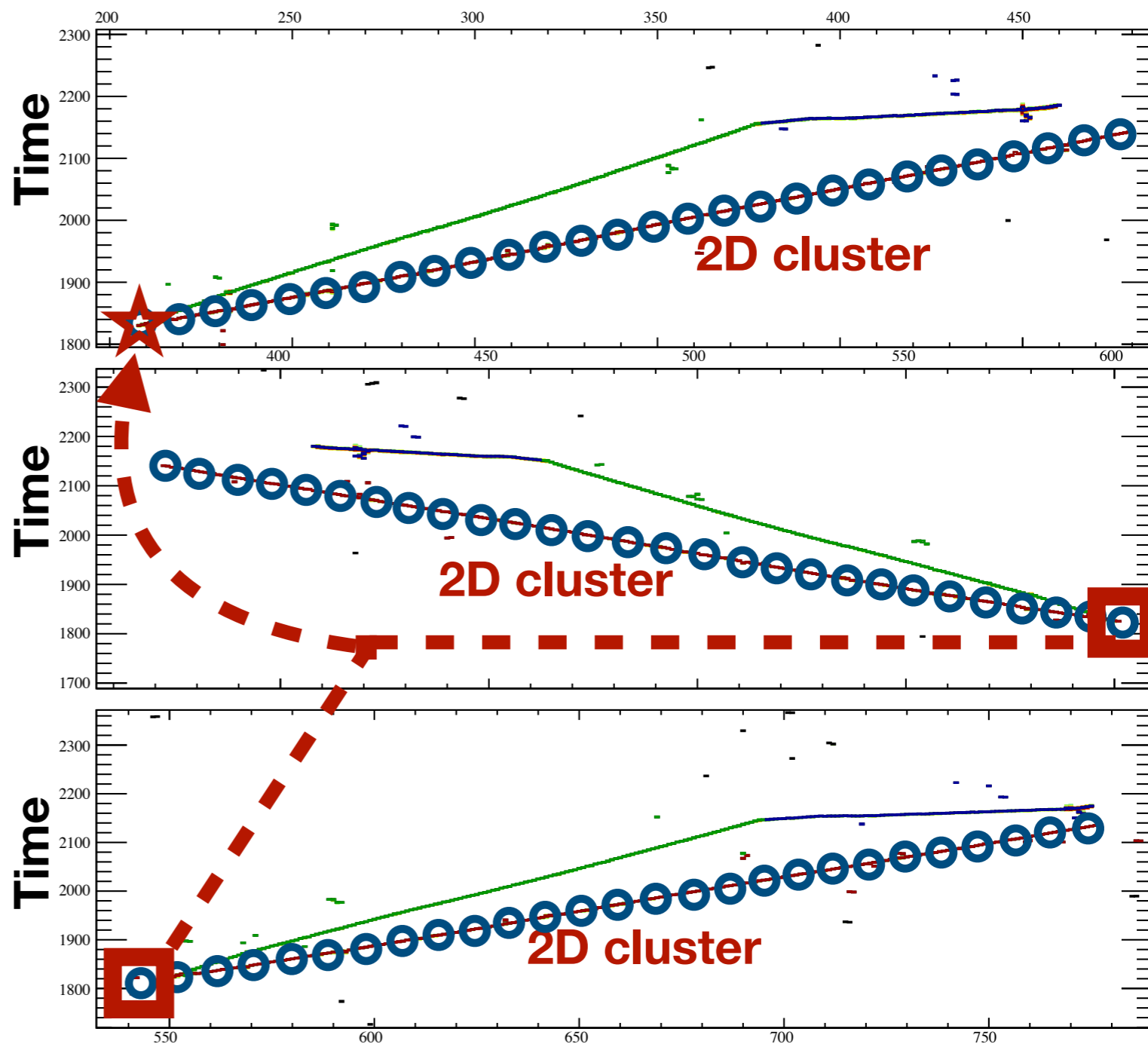
The current time-based 3D matching in pandora

- The clusters are then split into discrete sampling points
- The clusters are sampled at equivalent points in time



The current time-based 3D matching in pandora

- The equivalent points in two views (**red squares**) are used to predict a location in the third view (**red star**)
- A chi2 is calculated between the prediction and the sampling point
 - Each view has its point predicted and the resulting chi2 are summed together
- This is repeated for all sampling points
- Cluster matching counted as sensible if more than 50% of the sampling predictions have a chi2 of less than 3
 - Hereafter referred to as the **matched fraction**
- Sensible cluster matches are assessed by further tools before forming the 3D clusters

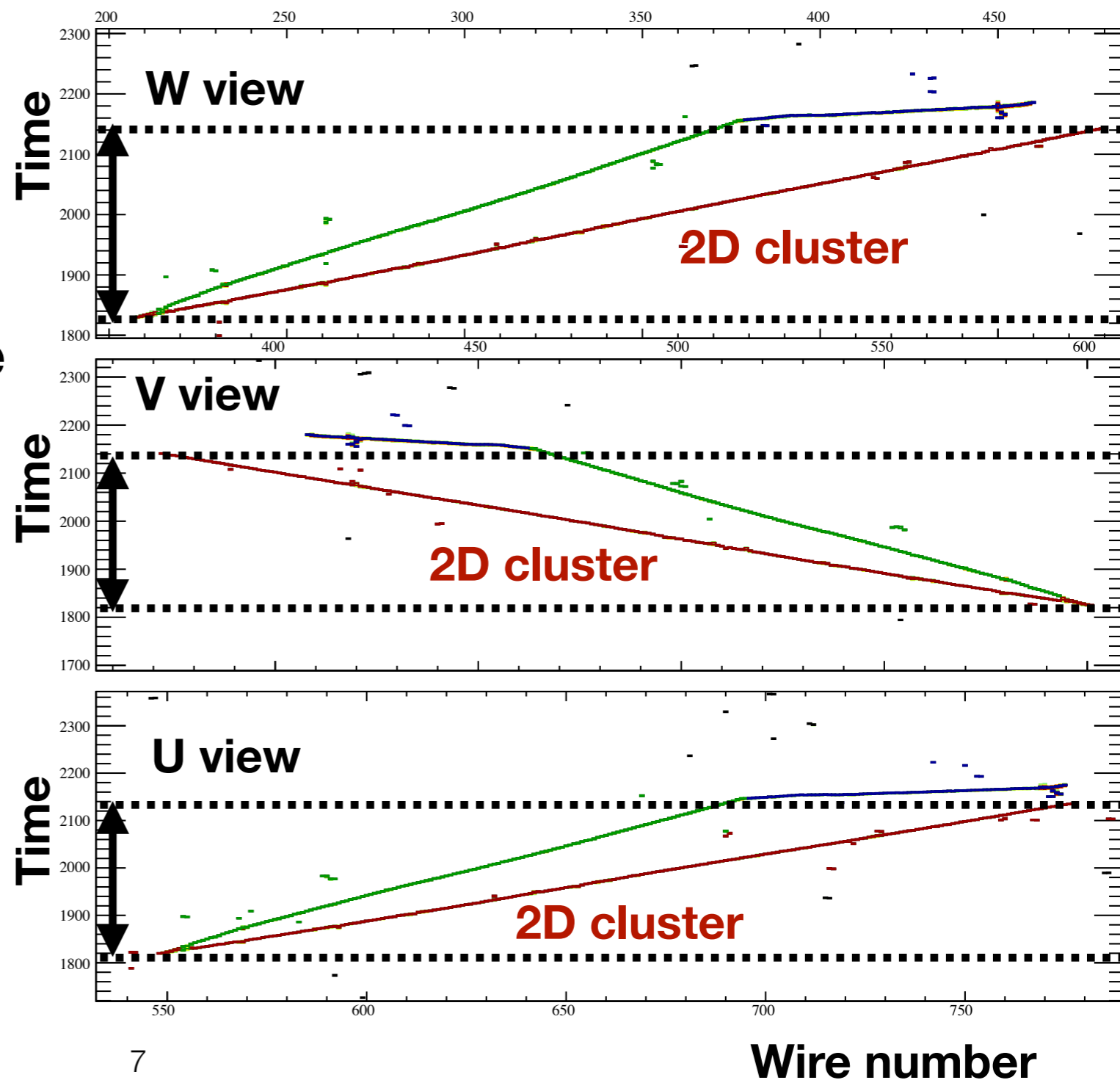


Looking at calorimetry in the 3D matching

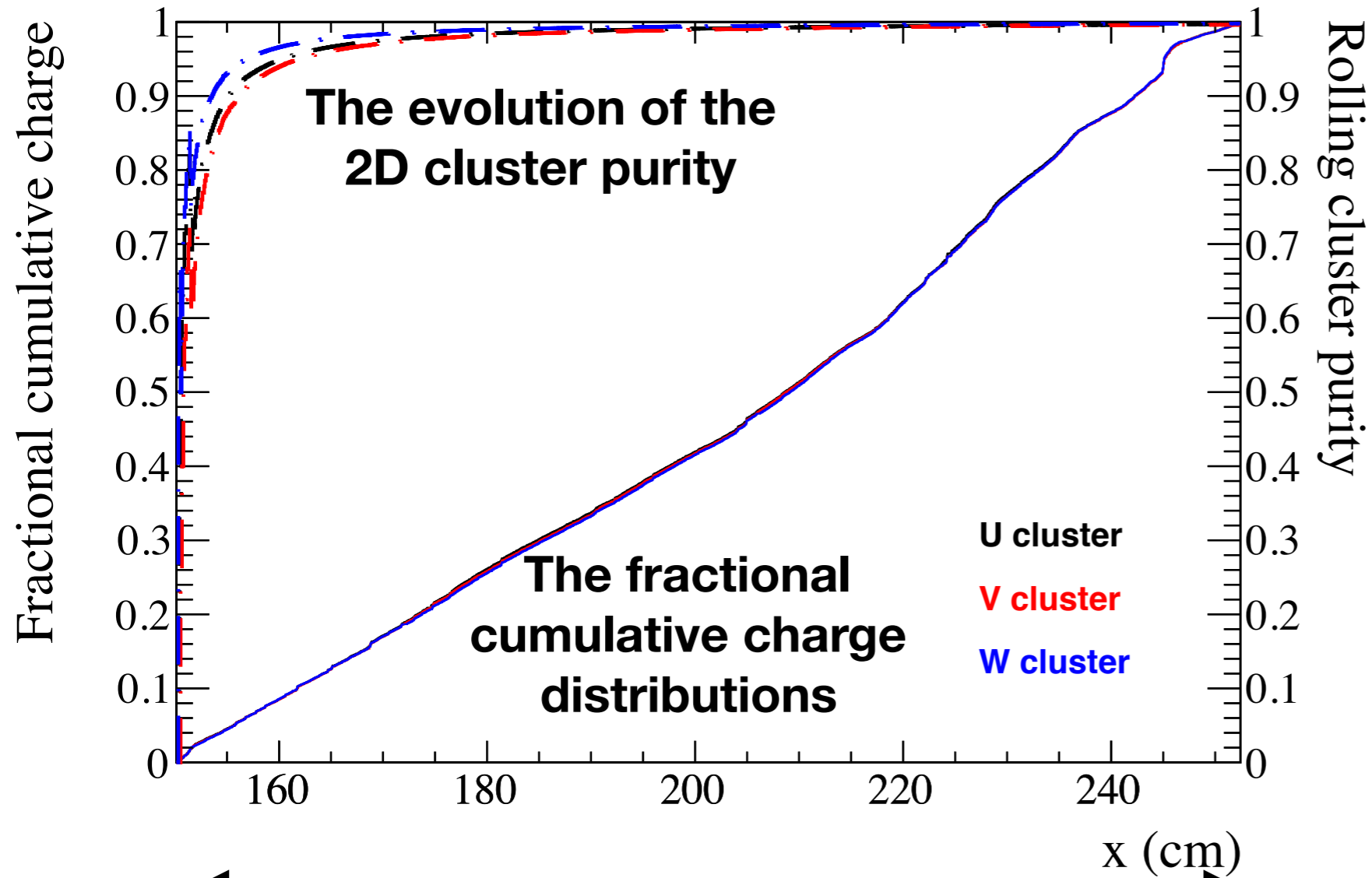
- Calorimetry currently not used much in pandora
- The 3D matching is a prime area to make use of calorimetry
 - All three views sample the same energy depositions -> avoids Landau fluctuations screwing algorithms up
 - Provides a unique measure of the profile of the track which should be consistent between views
 - A unique window to feature identification which may or may not be consistent between views
- The gotchas
 - Wire views have different responses/thresholds/other stuff -> Certain things can be done to mitigate this e.g. making charge measurements fractional
- Tie'ing the above together:
 - I'm currently looking at measuring/comparing the fractional cumulative distributions of charge as a function of the time overlap for all clusters in a matching triplet

Looking at calorimetry in the 3D matching

- Back to the view-to-view cluster comparisons
- For each cluster in a comparison triplet, collect the constituents hits contained in the time-overlap region
- After organising the hits, construct a fractional cumulative distribution of the charge and compare these distributions



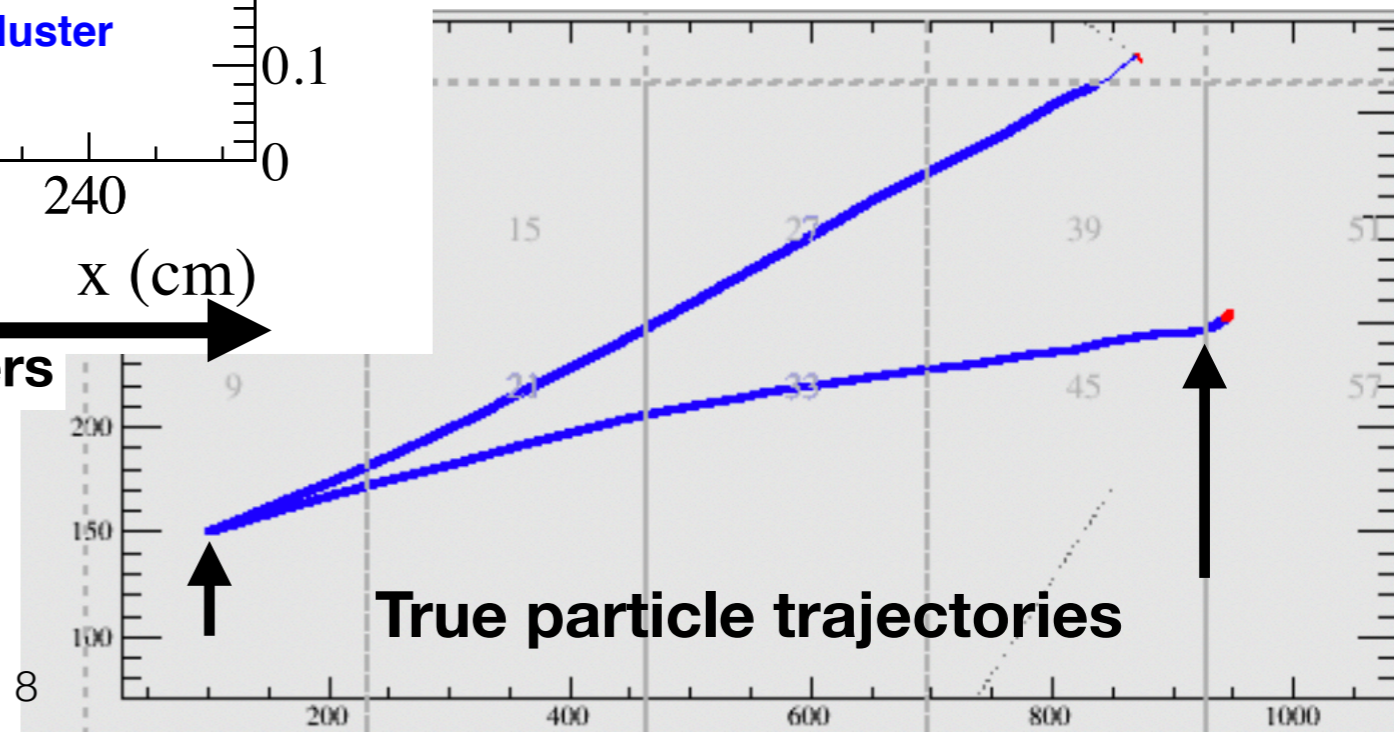
Correct matching triplet



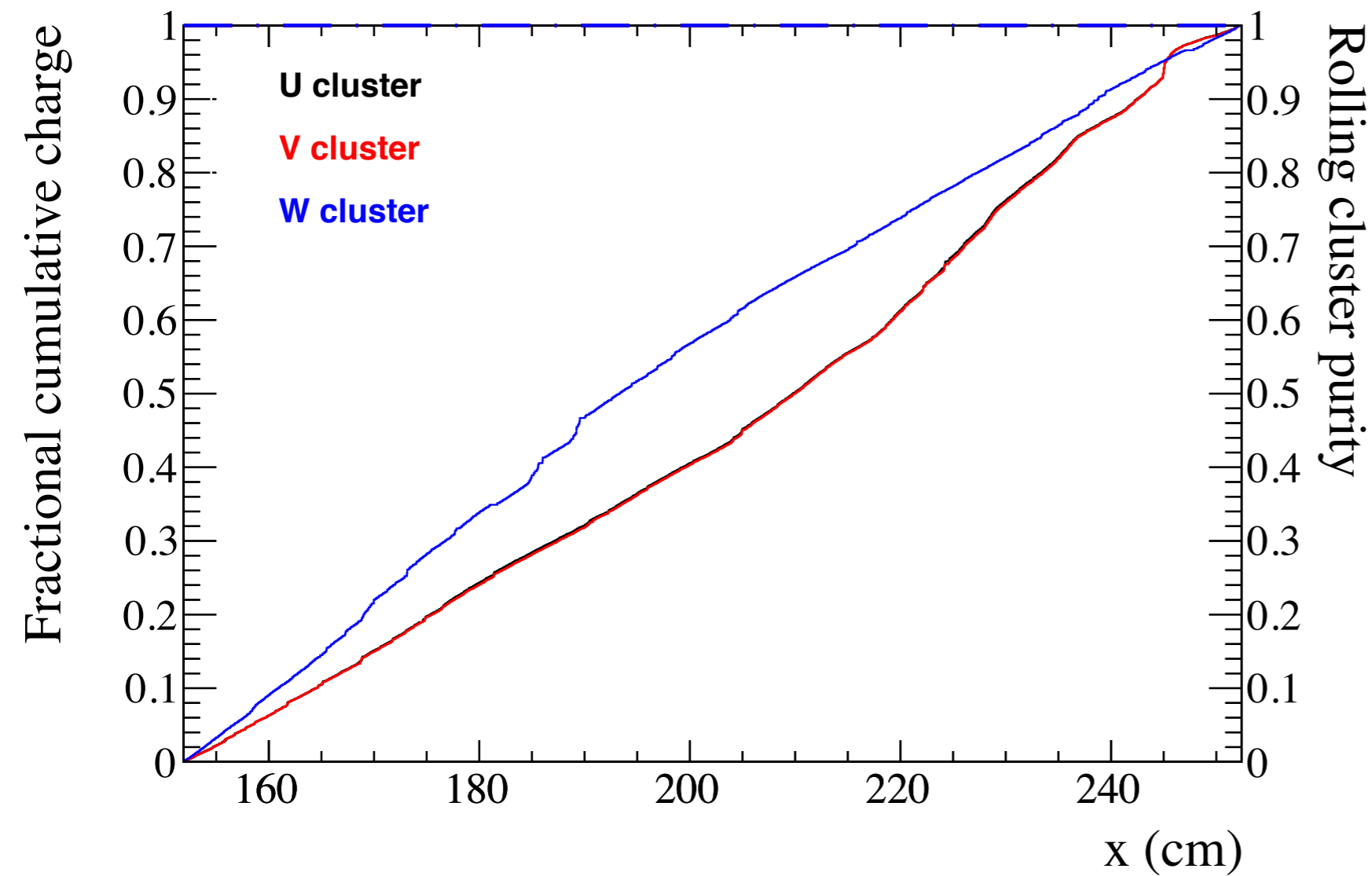
- All three views truth match to the same particle
- All three cumulative charge distributions follow each other nicely
- Matched fraction == 1

← The overlap region for the three clusters →

- Taken from di-muon particle gun

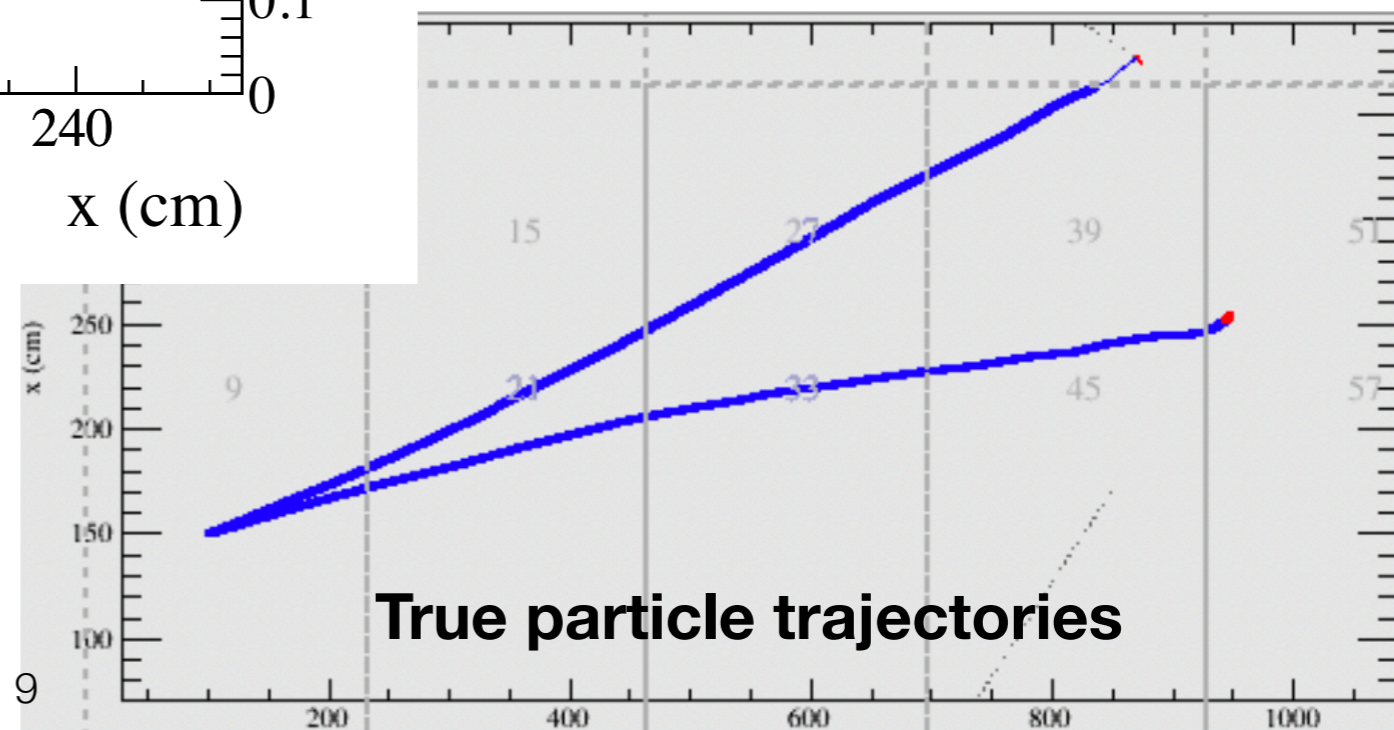


Incorrect matching triplet



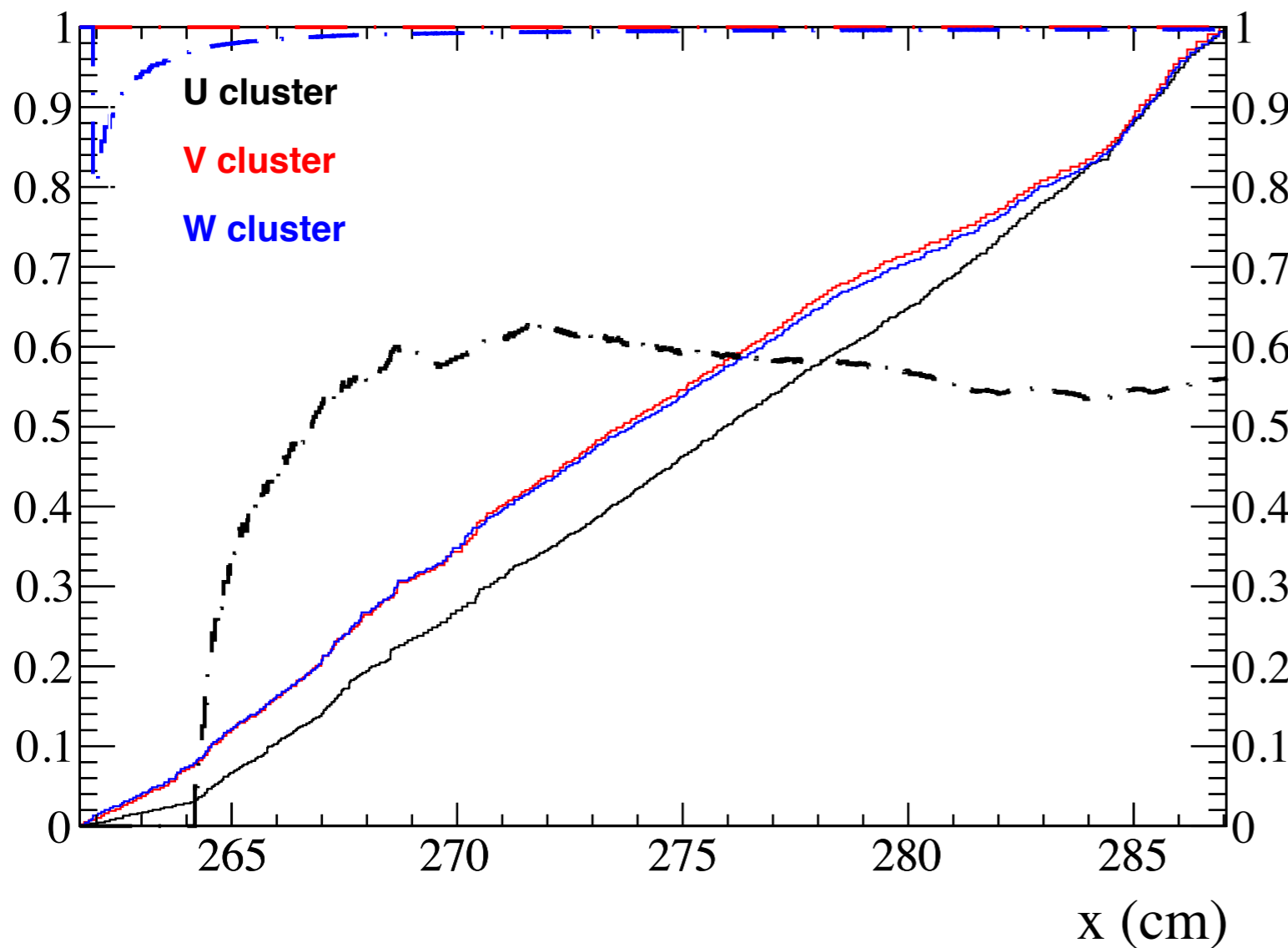
- Same event as previous slide (W cluster swapped out, U/V clusters unchanged)
- U and V clusters truth match to same particle but W cluster does not
- Matched fraction = 0.006

- Taken from di-muon particle gun



Incorrect matching triplet

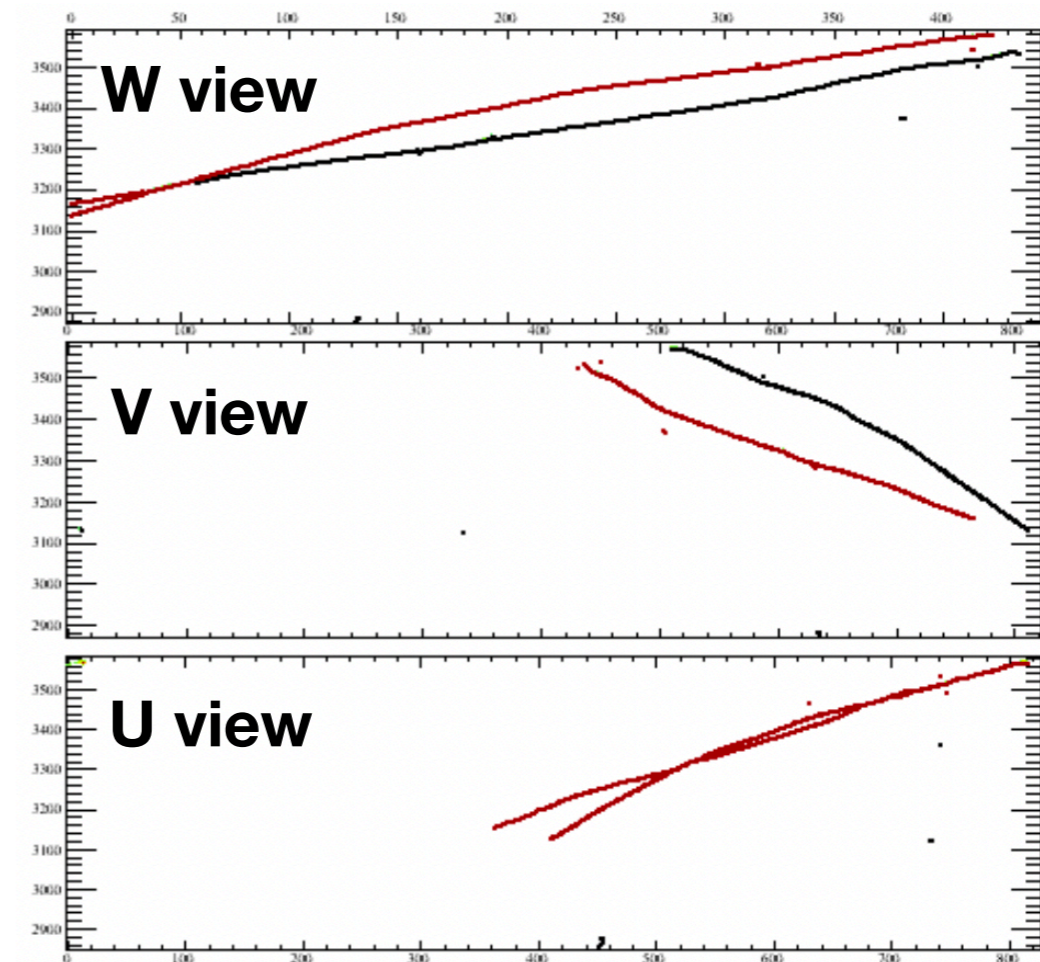
Fractional cumulative charge



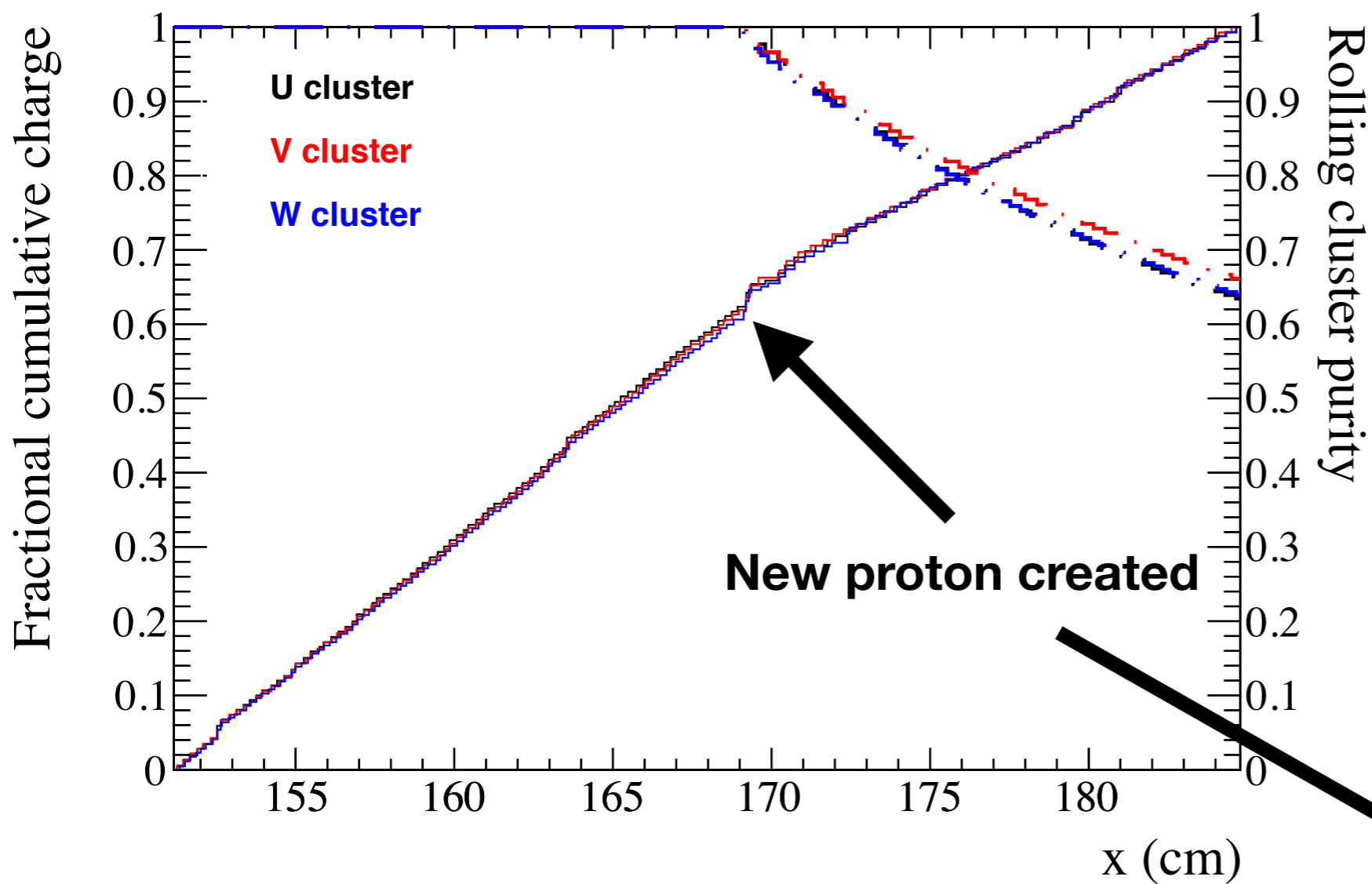
- Taken from di-muon particle gun

Rolling cluster purity

- V-W clusters truth-match, U does not
- Due to tricky cluster in U view
- Matched fraction: 0.81

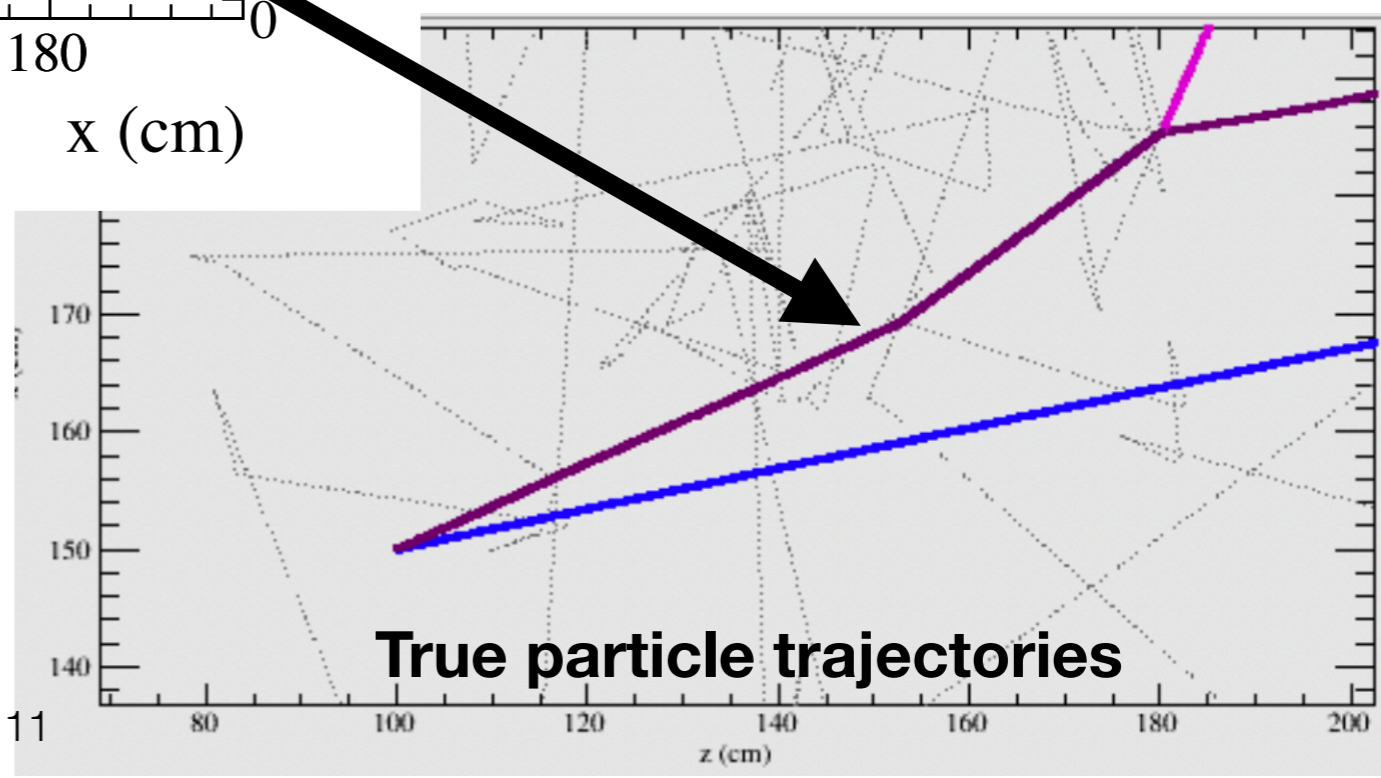


'Correct' matching triplet

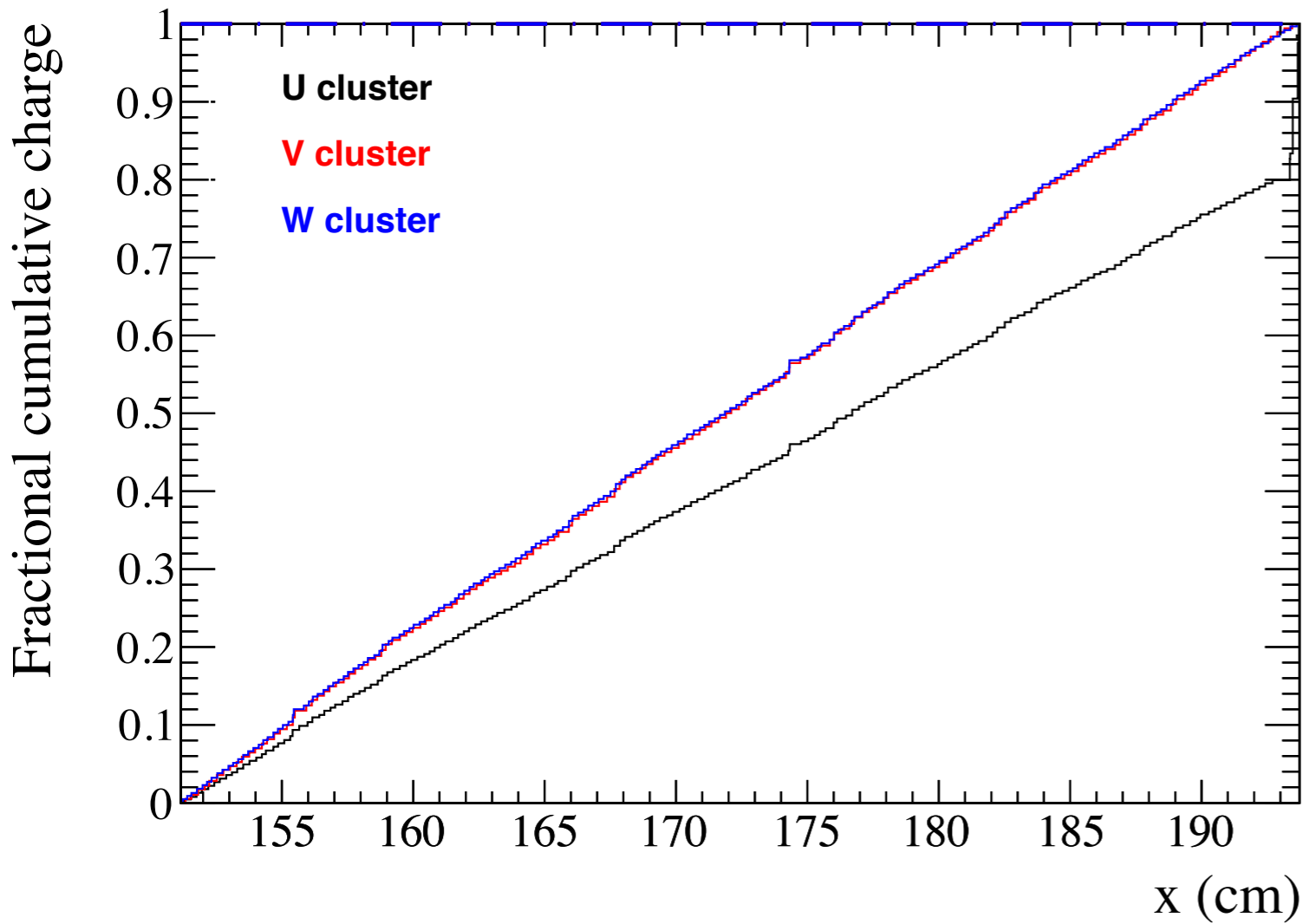


- All three views follow each other
- Cumulative distribution sensitive to the scatter
- matched fraction == 1

- Taken from 1mu + 1p particle gun

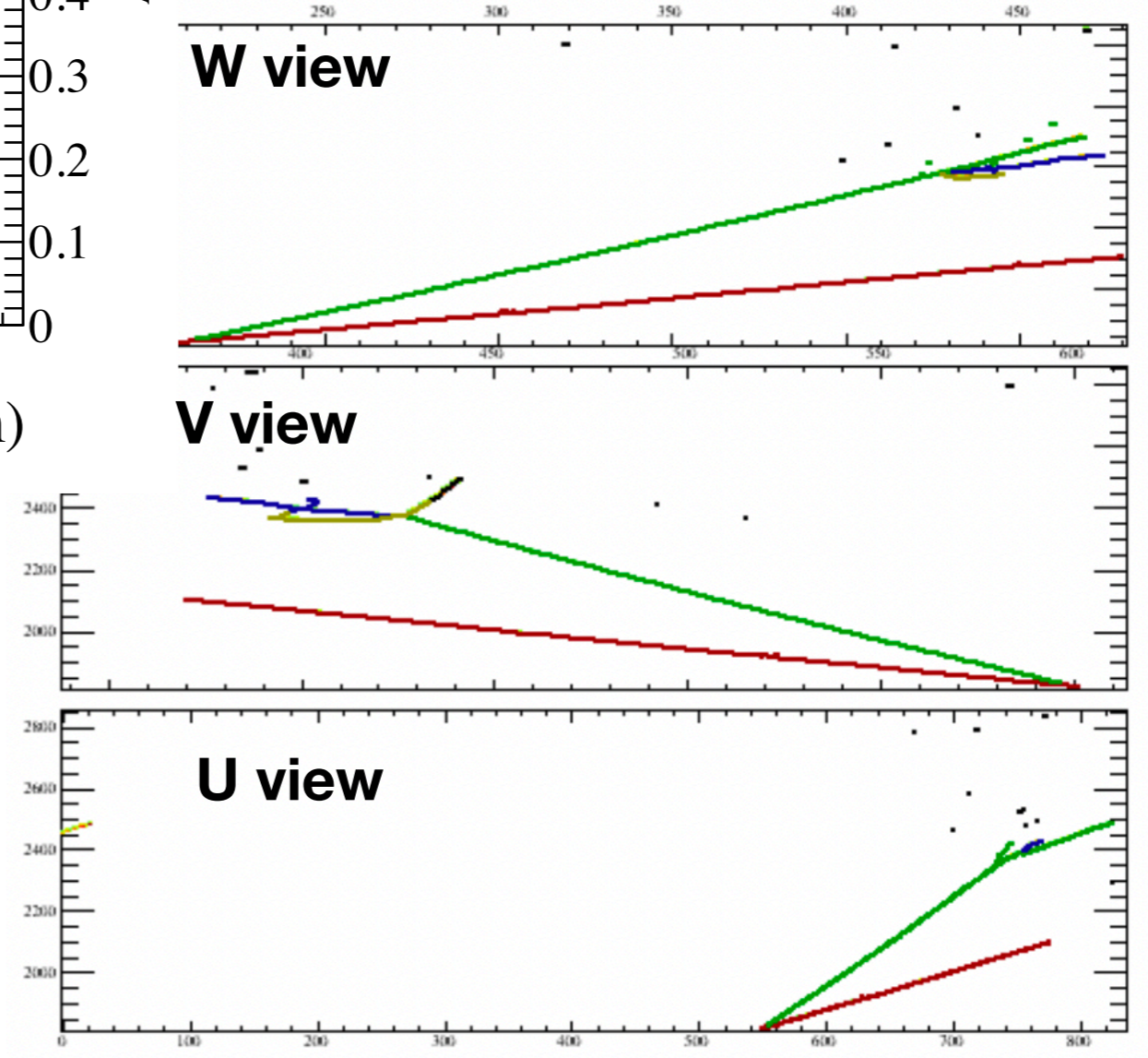


'Correct' matching triplet



- Taken from 1mu + 1p particle gun

- All three views truth match to the proton
- U disparity due to tricky clustering at track end
- Matched fraction == 1

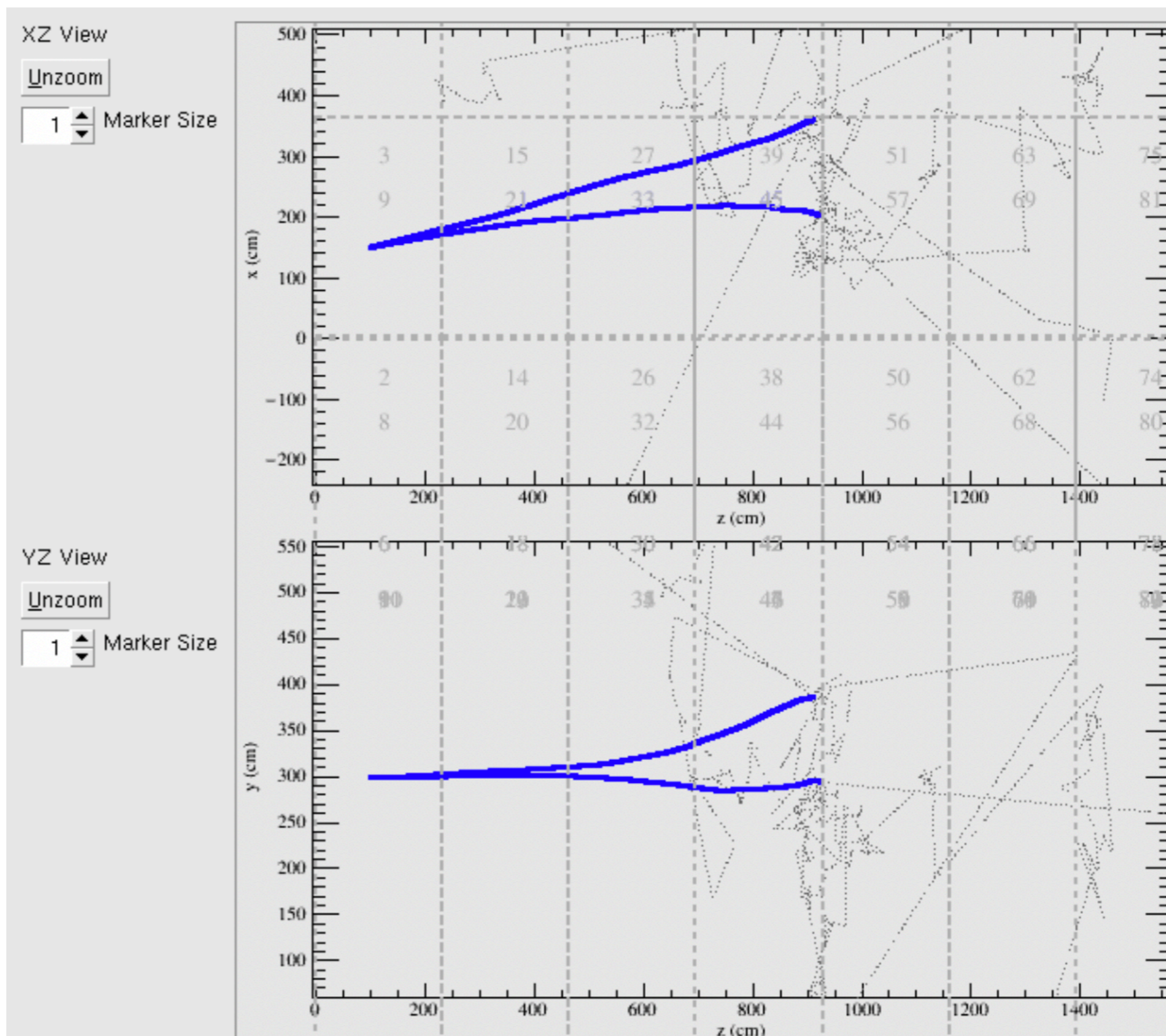


Summary

- First look at calorimetry in the time-based 3D matching in pandora
- Tracking the cluster charge deposition profile as a function of time for the three wire views appears sensitive to many effects
- Early indications are that there is a lot of scope in this area
 - Enhancing the view to view matching
 - Feature identification
 - Single view mis-clustering
 - Cluster splitting
 - Other stuff

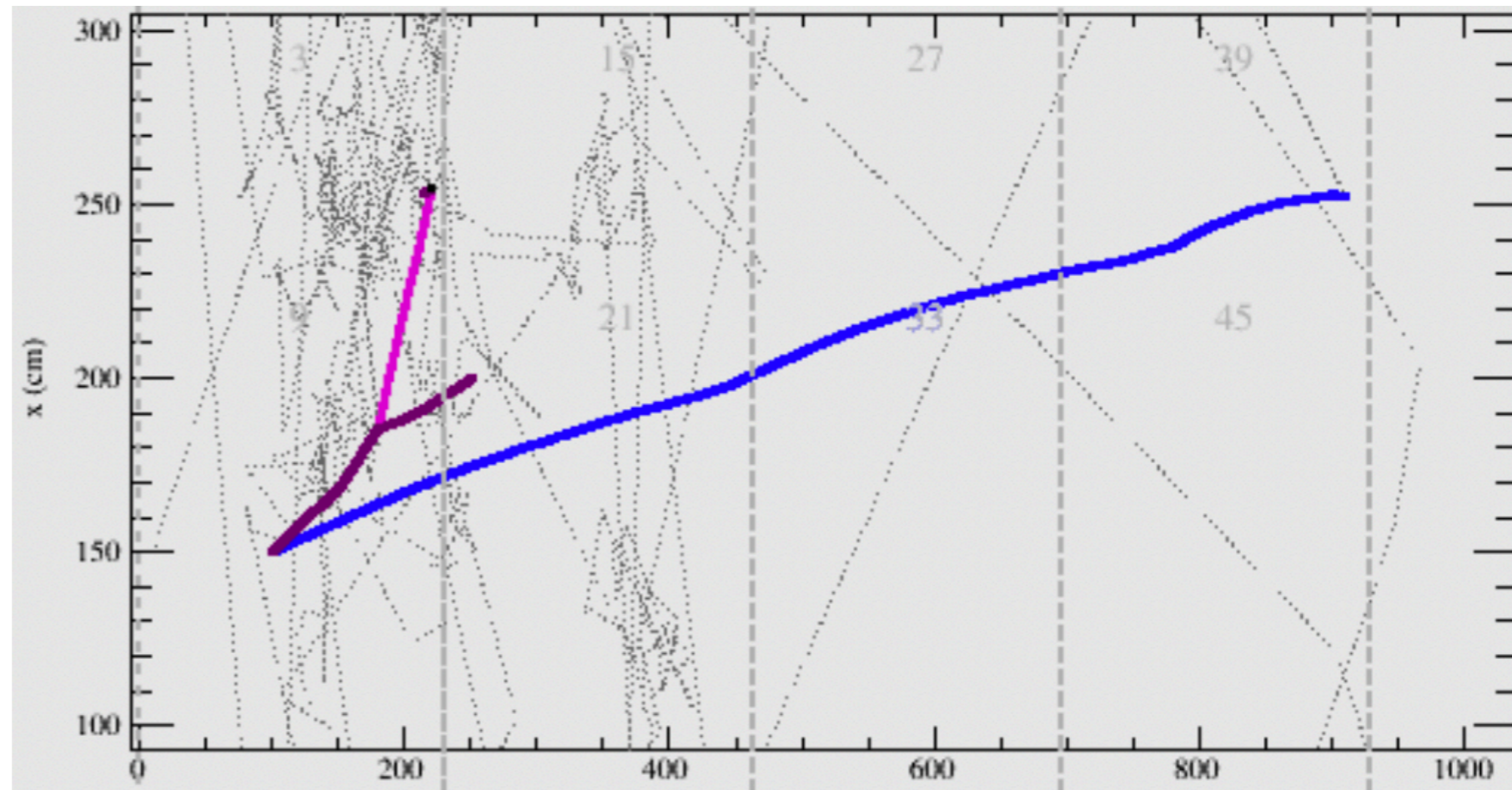
Sample 1

- Forward going di-muon sample
- 2 GeV muons
- Fixed start position
- Θ_{0XZ} : 10, 13
- Θ_{0YZ} : 0,0

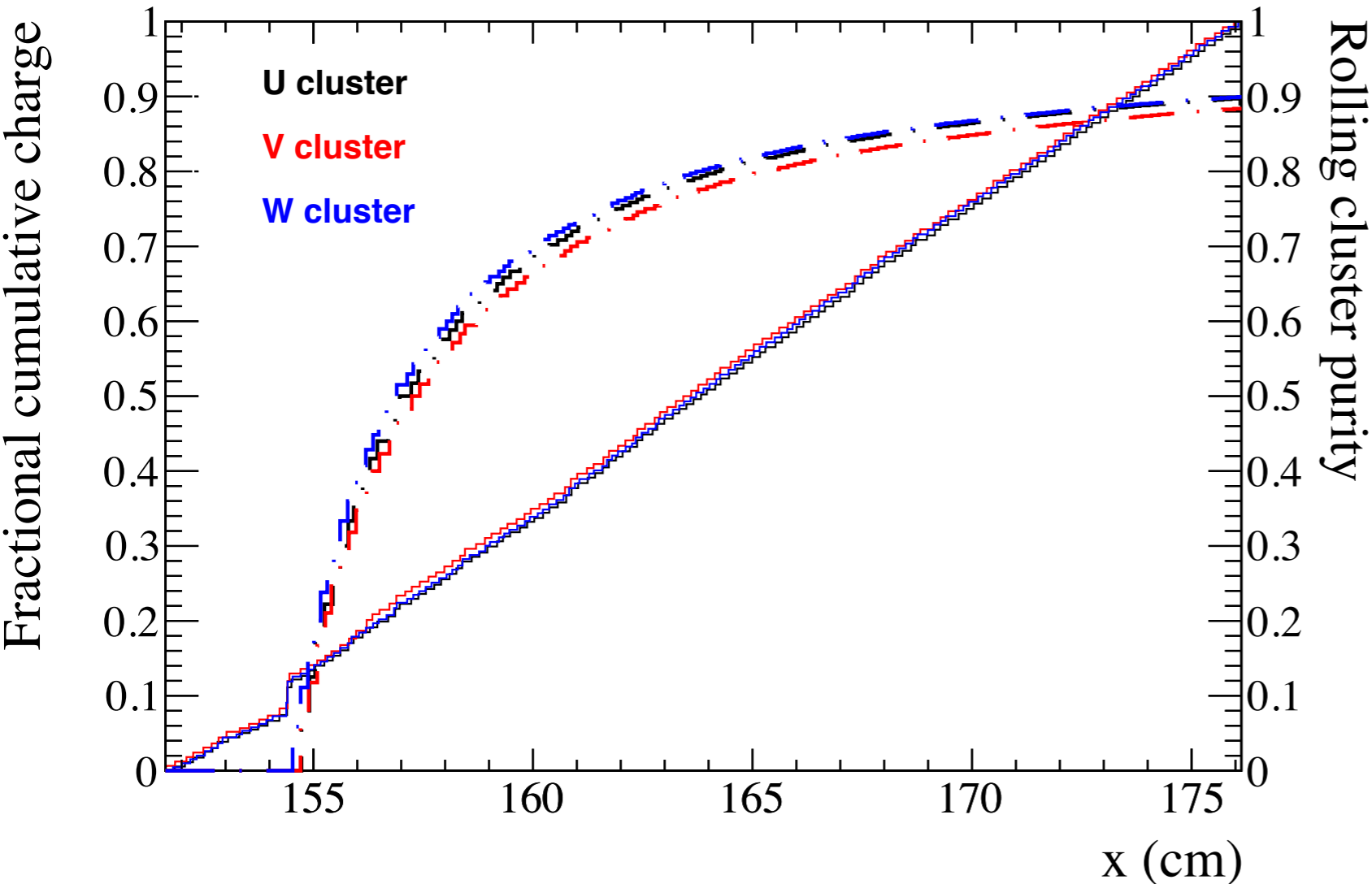


Sample 2

- Forward going muon (2 GeV) and proton (2 GeV)
- Fixed start position
- Θ_{0XZ} : 10, 20
- Θ_{0YZ} : 0,0



Correct matching triplet



- All three views match
- Matching fraction == 1
- Start of cluster truth-matched to the muon
- Cumulative distributions sensitive to particle path separation

- Taken from 1mu + 1p particle gun

