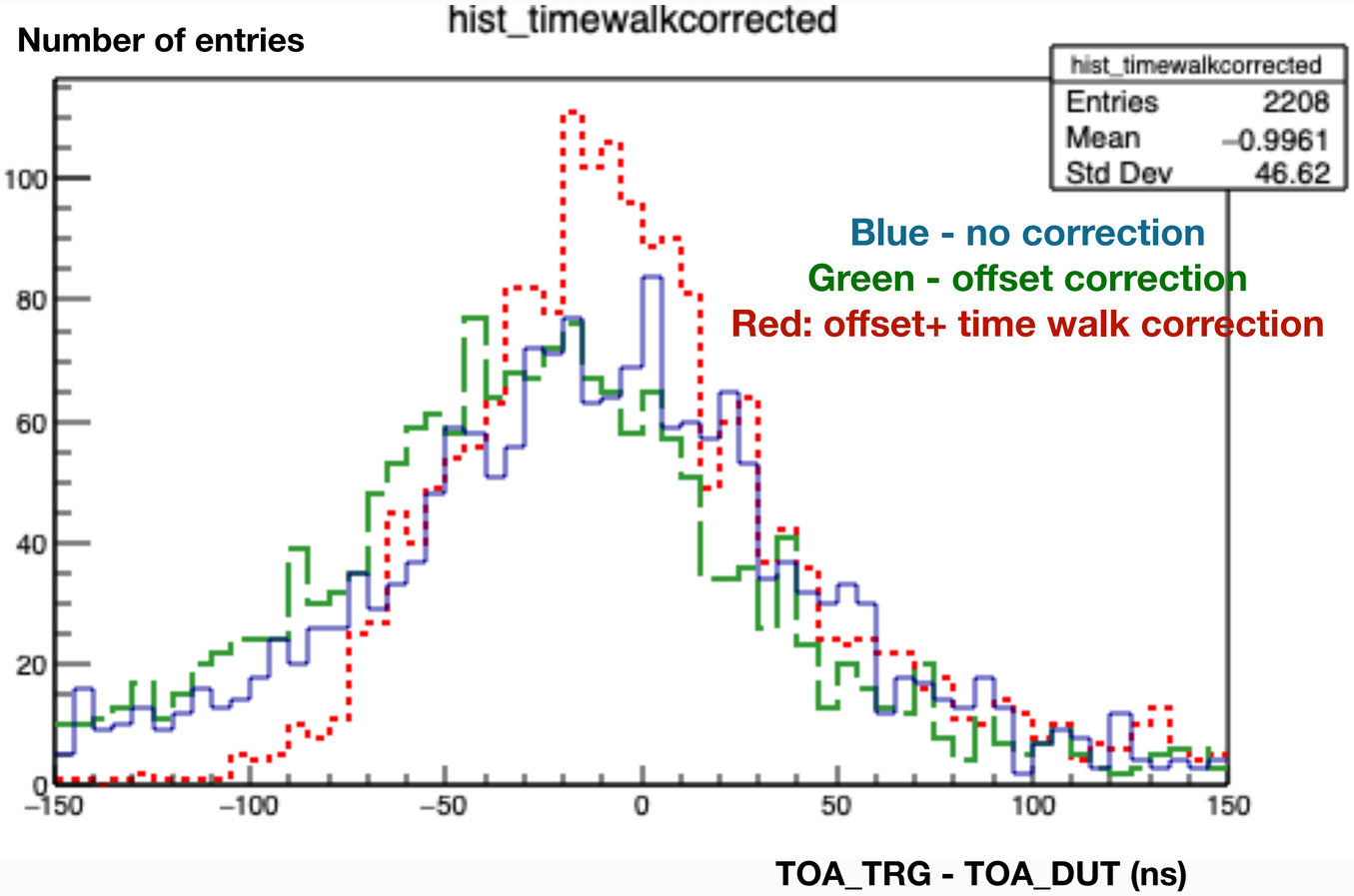
Update on DPTS and tracking performance

Berkeley EIC meeting

21. 11. 2023

Minjung Kim

Timing resolution



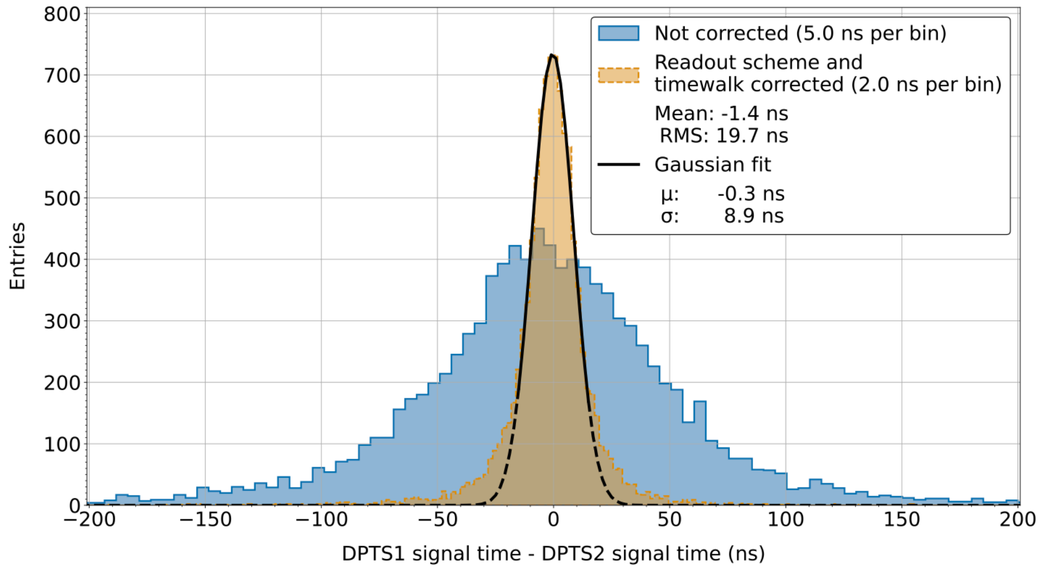
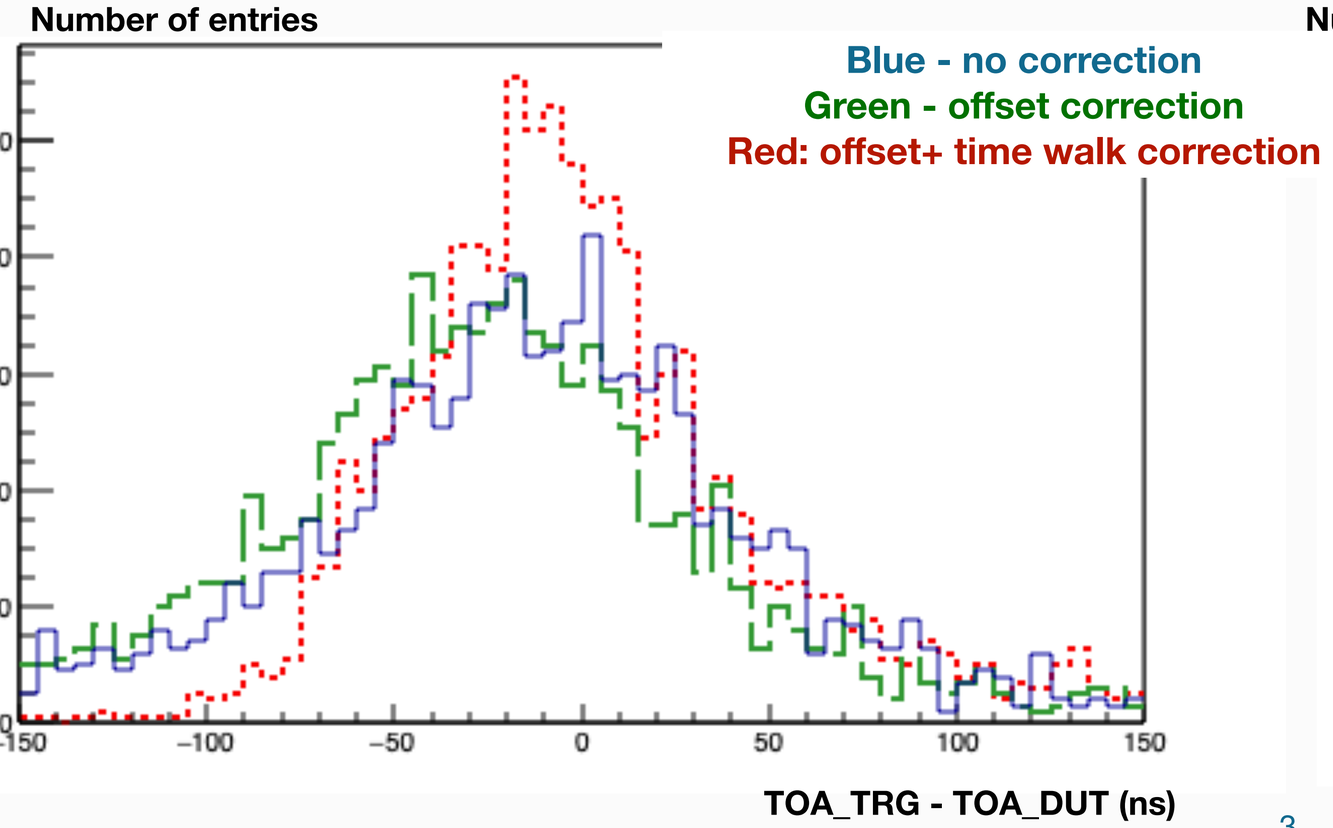
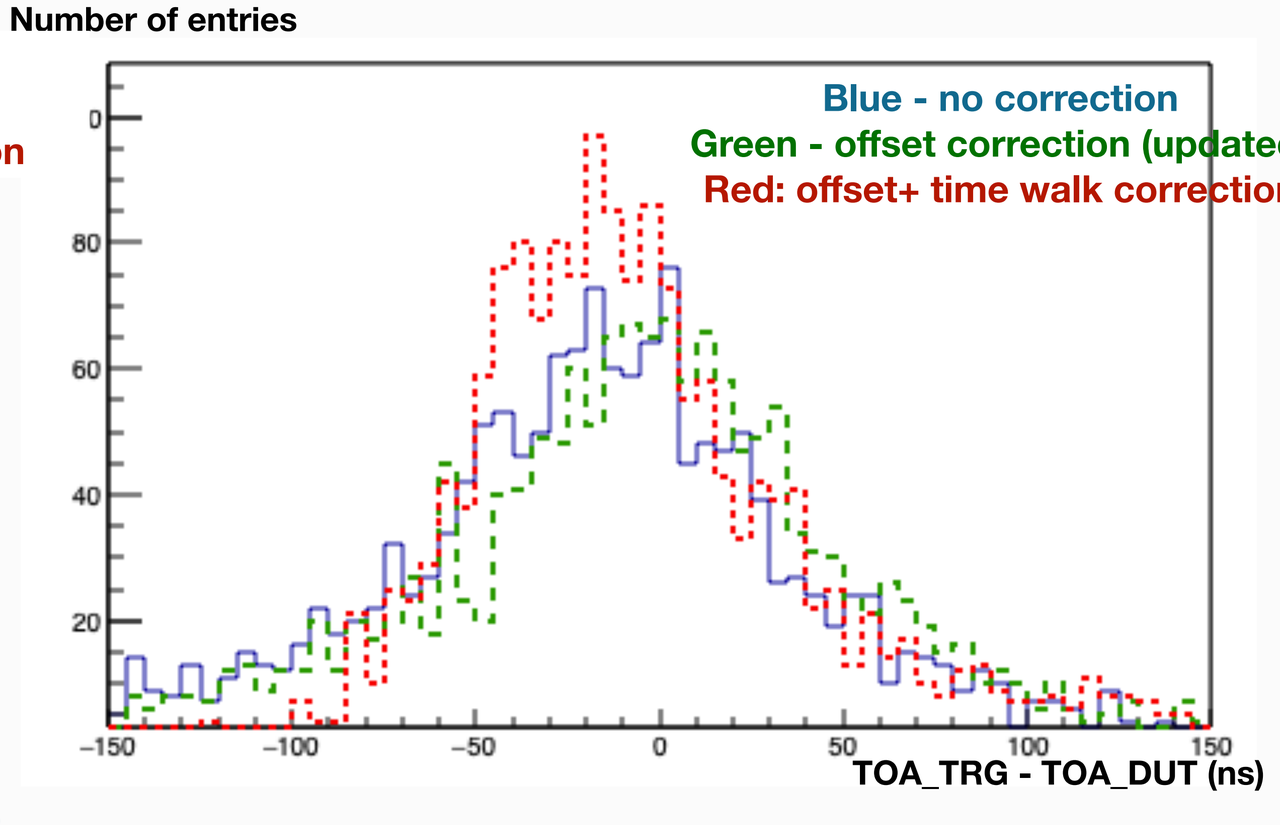


Figure 20: Time residuals distributions of two DPTSs measured with 5.4 GeV/c electrons w
no corrections (blue) and with readout scheme and time walk corrections applied (orang
The corrected distribution is fitted with a Gaussian function in the time residuals range fr
−15 ns to 15 ns (black solid line, dashed line for points outside the fit range).

To do

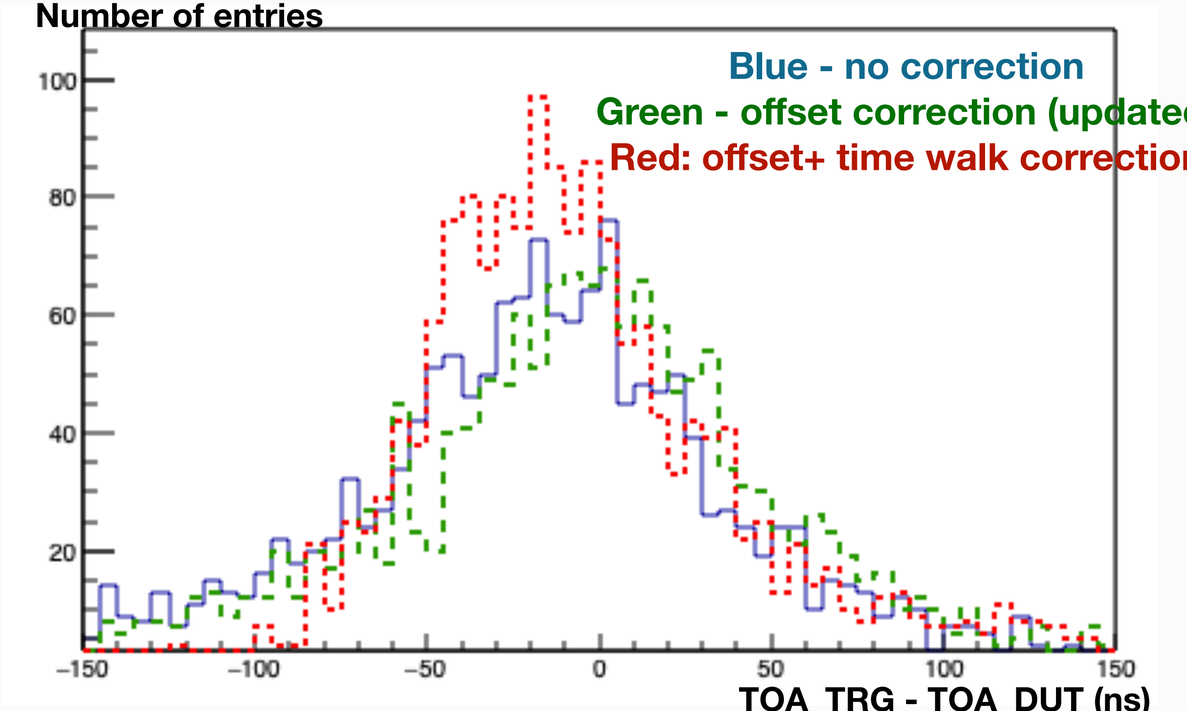
- Improve fit quality: Move to the sample with larger statistics (with a lower threshold (higher VCASB, say 350 mV))
- Update raw data processing (time and spatial cuts adjustment)

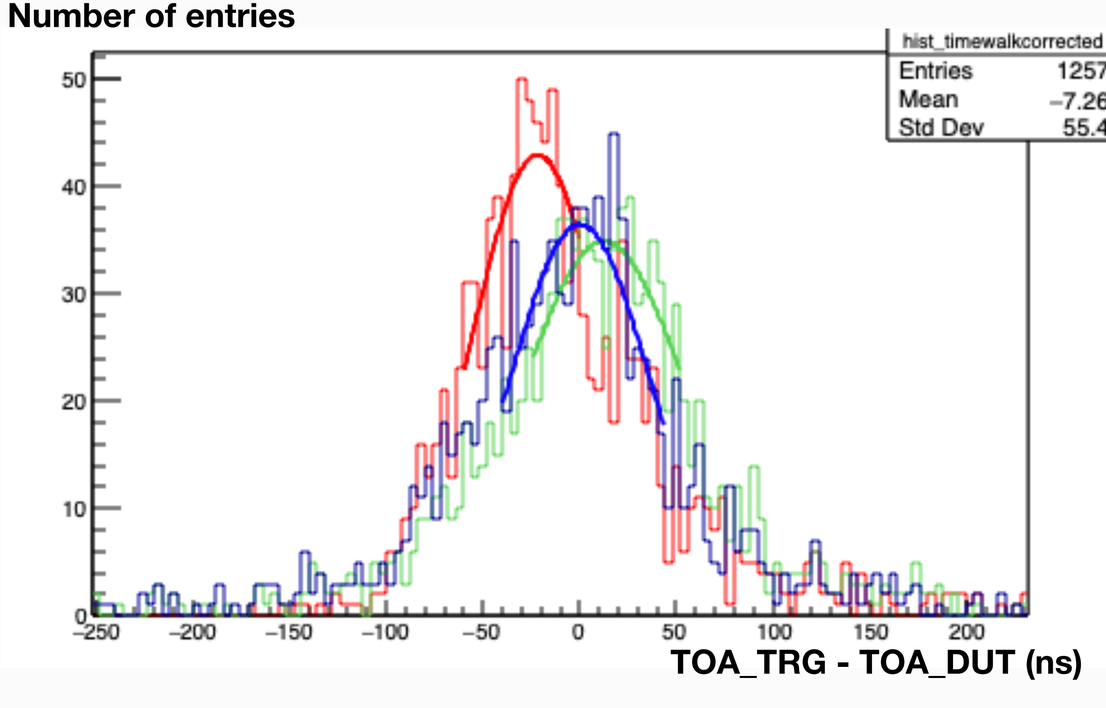




Update from last meeting

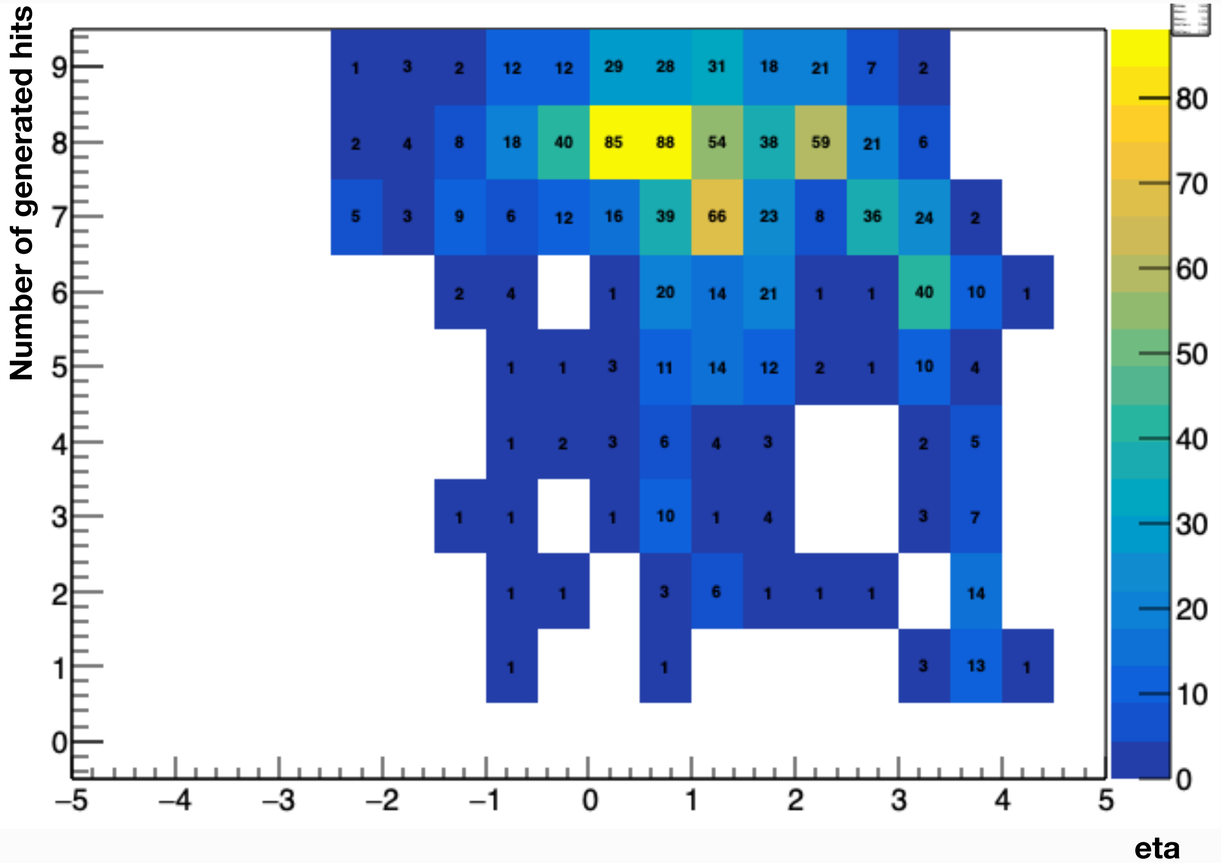
- Improve fit quality: Move to the sample with larger statistics (with a lower threshold (higher VCASB, say 350 mV))
- No gain in the statistics -> similar trend as for higher threshold due to the smaller coincident hits
- All available dataset (~380 distinguished sets) processed on NERSC; checking systematic trend first (as a function of threshold) and come back to fine tune the fit for final results
- Plan to present in WG meeting next week

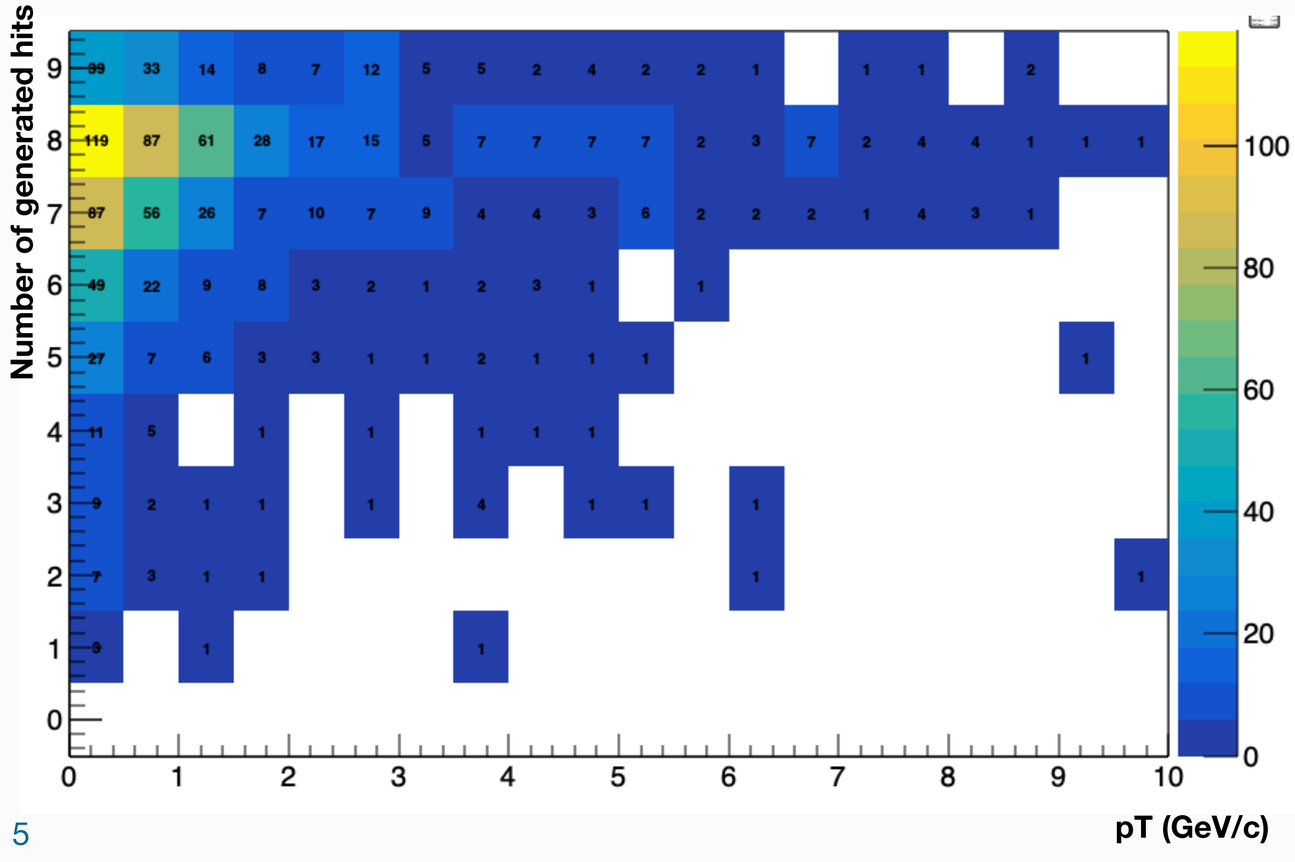




of generated hits: MC particles in DIS events

- MC charged particles flagged as “stable particles”
- Various track qualities in the event w.r.t. single particle gun or VM photoproduction
- True seeding is not reliable as tracks are not required to have at least 3 hits for making seed-> initial parameters are taken from truth information leading unrealistic reco tracks without seed or even misreconstruction from random association



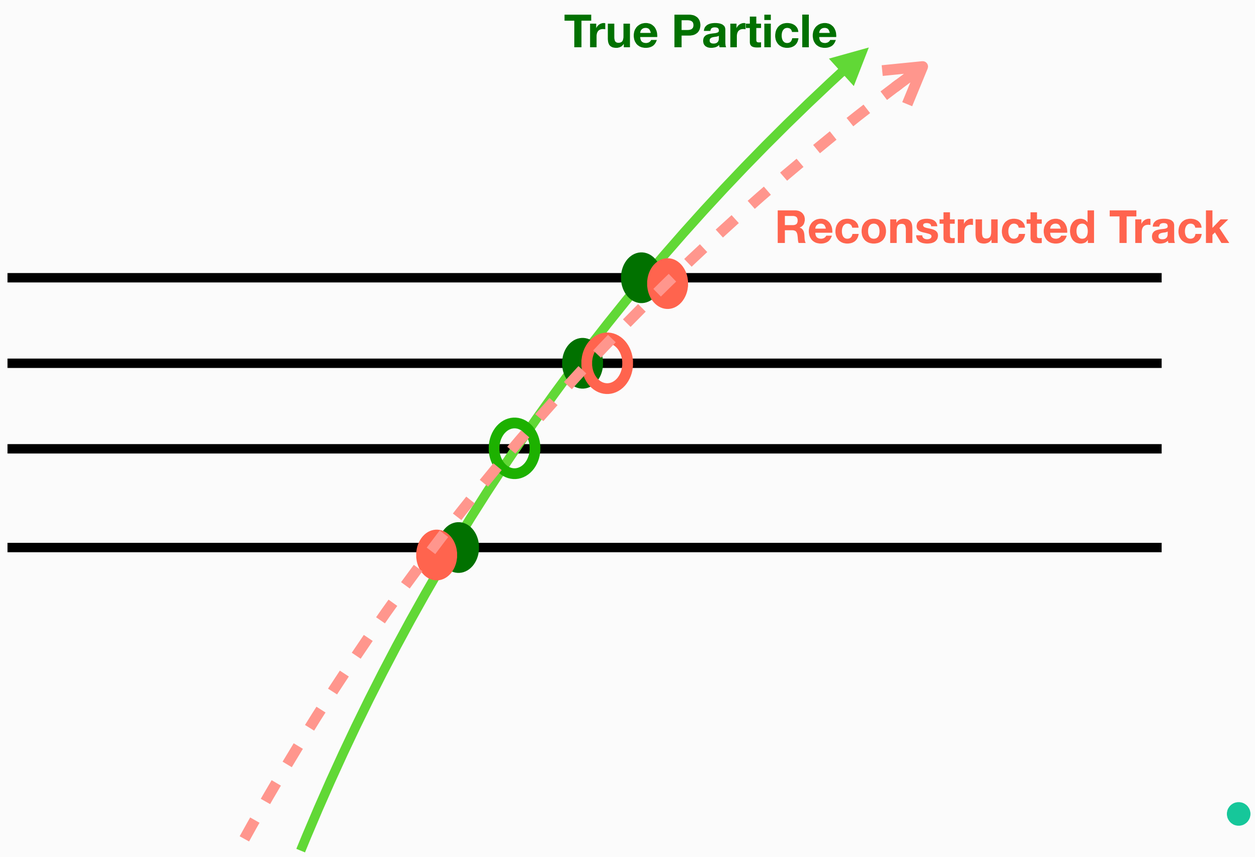


backup

Tracking performance study @ Berkeley

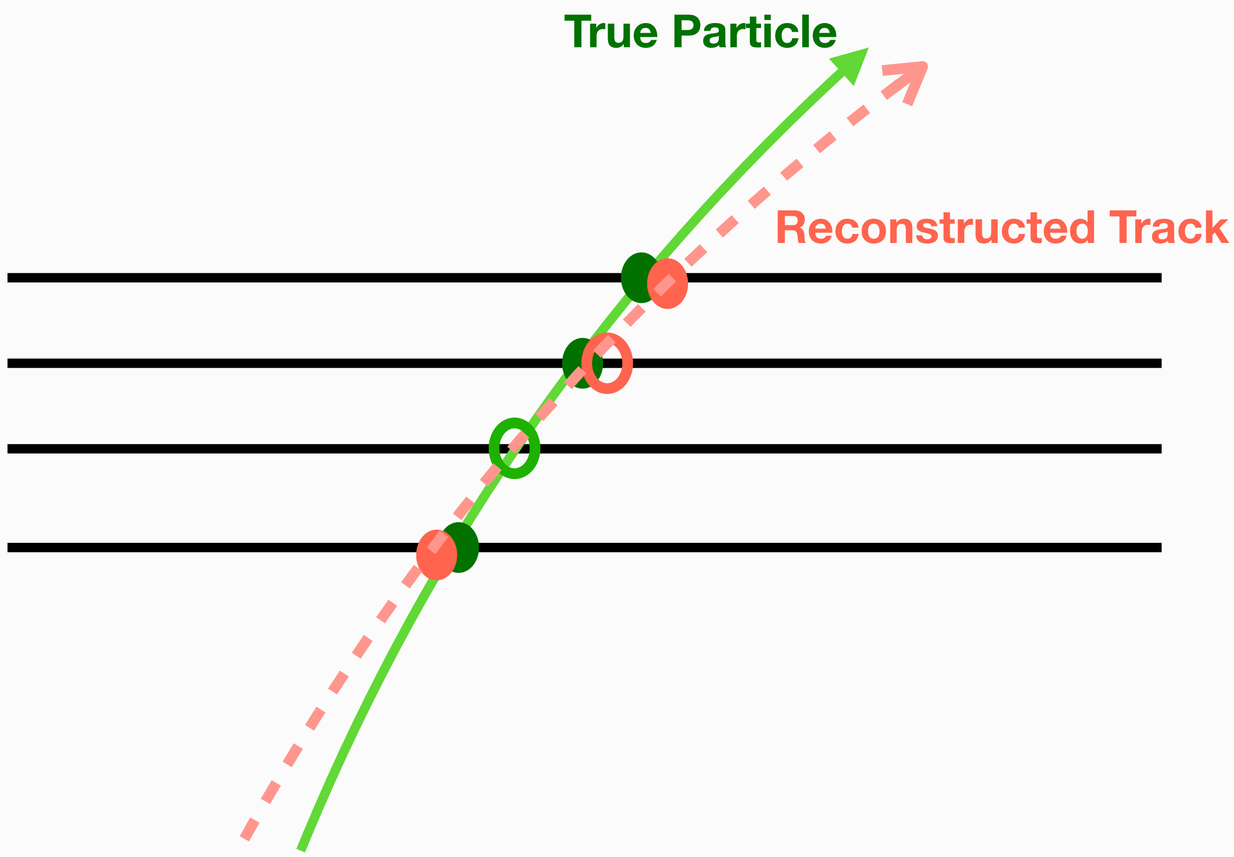
- Efficiency and purity studies for different physics cases
  - Minjung - Vector meson photoproduction (focusing on handling duplicate trks)
  - Beatrice - high Q^2/Jet-Jet events
  - Ben- DIS+Background
- To-Do:
  1. Set-up common working framework for tracking study on Perlmutter: installing my version of EIC-recon and share some macros for plotting (Minjung) 1 - 2 days
  2. ***Make common checklist for the basic performance of tracking and study for different event classes:*** purity and efficiency as a function of pseudo-rapidity, pT,… what else? 2 - 3 weeks
  3. Integration to standard EICrecon: Make factory or plugin for standard eicrecon for removal of duplicates + tracking QA 1 week + α
  - Possible extensions:
    - impact of additional tracking sources (MPGD, TOF,..), clustering in tracker (is it necessary?), usage of timing information?, …..
    - Update physics projection plots relying on tracking performance

Status and outlook



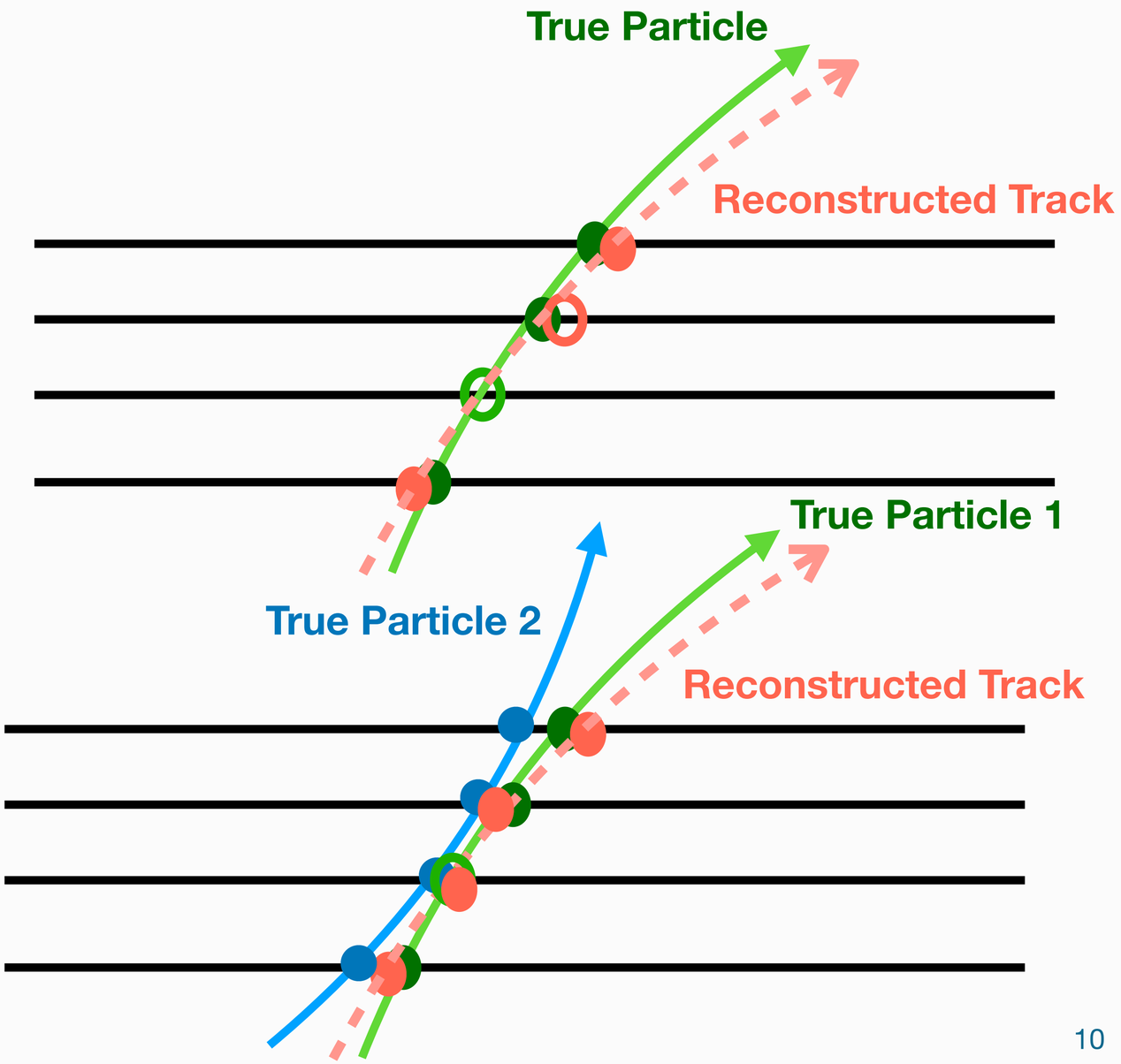
- Missing information in standard “EICrecon” output:
  - Link between generated hits and true particle trajectory
    - ➡ Available in npsim output; hard wiring to EICrecon output
  - Link between measured hit and reconstructed track
    - ➡ Private modification of EICrecon (parallel to Shujie’s update) without modification of data models
- Solving duplicate track issue (ambiguity resolution) + tracking performance study including efficiency

Tracking performance evaluation



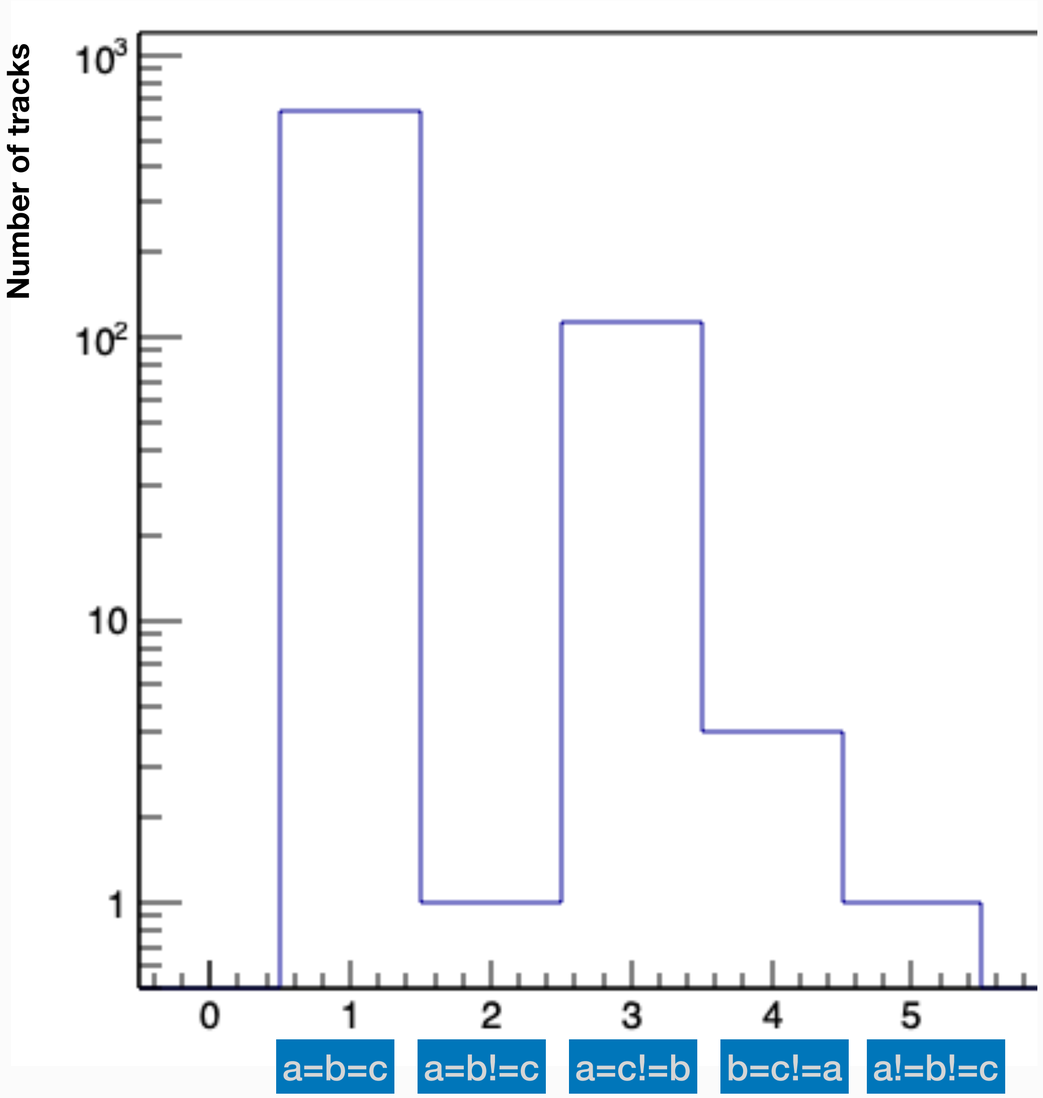
- From true particle (signal):
  - Generated hits
  - Particle trajectory represented by track parameters
- Track reconstruction:
  - Reconstructed (measured) hits
  - Reconstructed track from reconstructed (measured) hits
- Questions:
  - How many generated hits reconstructed (measured)?
  - How good does reconstructed track reproducing true particle?
  - How to distinguish the best track out of a set of duplicate tracks?

Matching between particle and track



- Matching can be complicated for the with high multiplicity events (having many signal particles)
- Matching using geometrical properties, i.e. eta and/or phi might be not enough
- Hit level matching: Association of reconstructed (measured) hits to generated hits: Matching with the particle giving largest contribution of hits for given track

Consistency between different matching methods

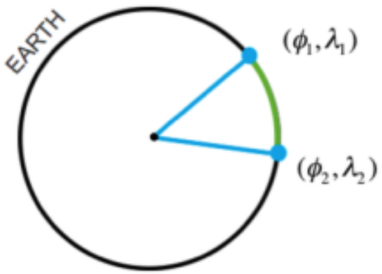


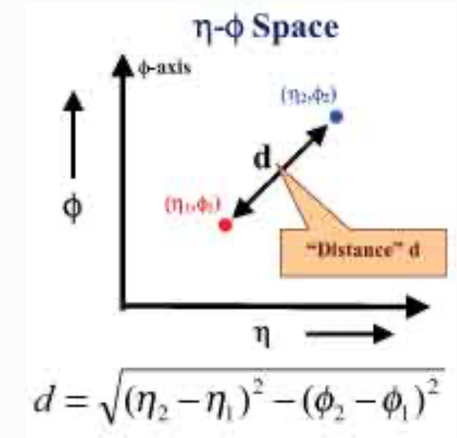
- Three different matching methods used:

  a) Hit level matching: check the source of hits in the track and matching to the particle giving maximum contribution

  b) pT based matching: matching reconstructed track with the particle having the closest value of pT

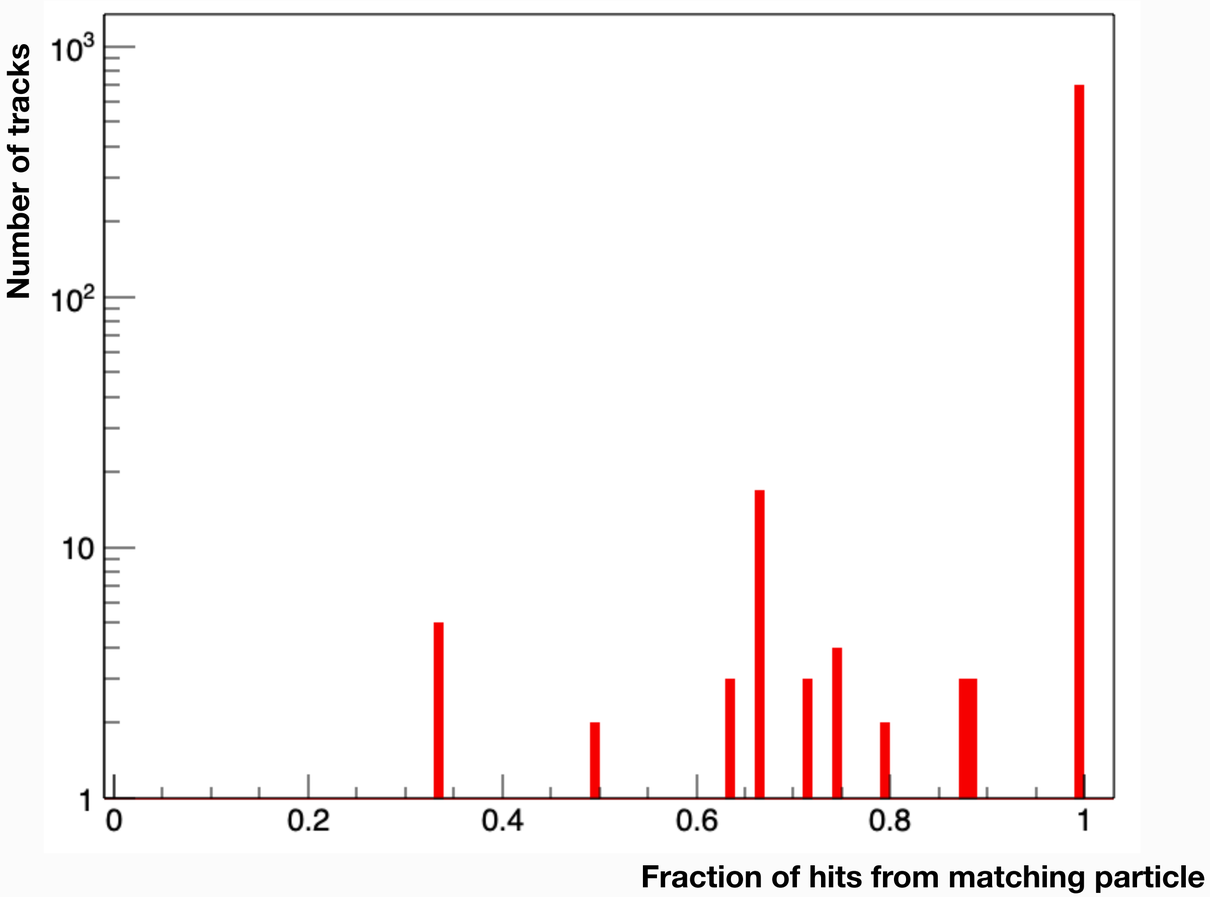
$$\text{haversine}\left(\frac{d}{r}\right) = \text{haversine}(\phi_2 - \phi_1) + \cos(\phi_1)\cos(\phi_2)\text{haversine}(\lambda_2 - \lambda_1)$$



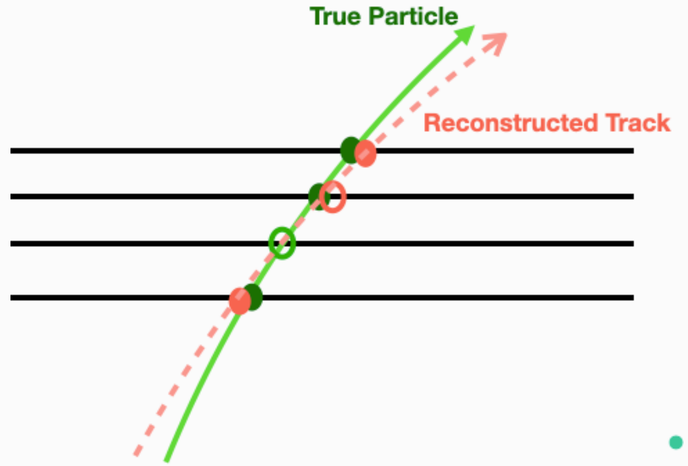


- Angular distance based matching gives more than 98% consistent result with hit level matching

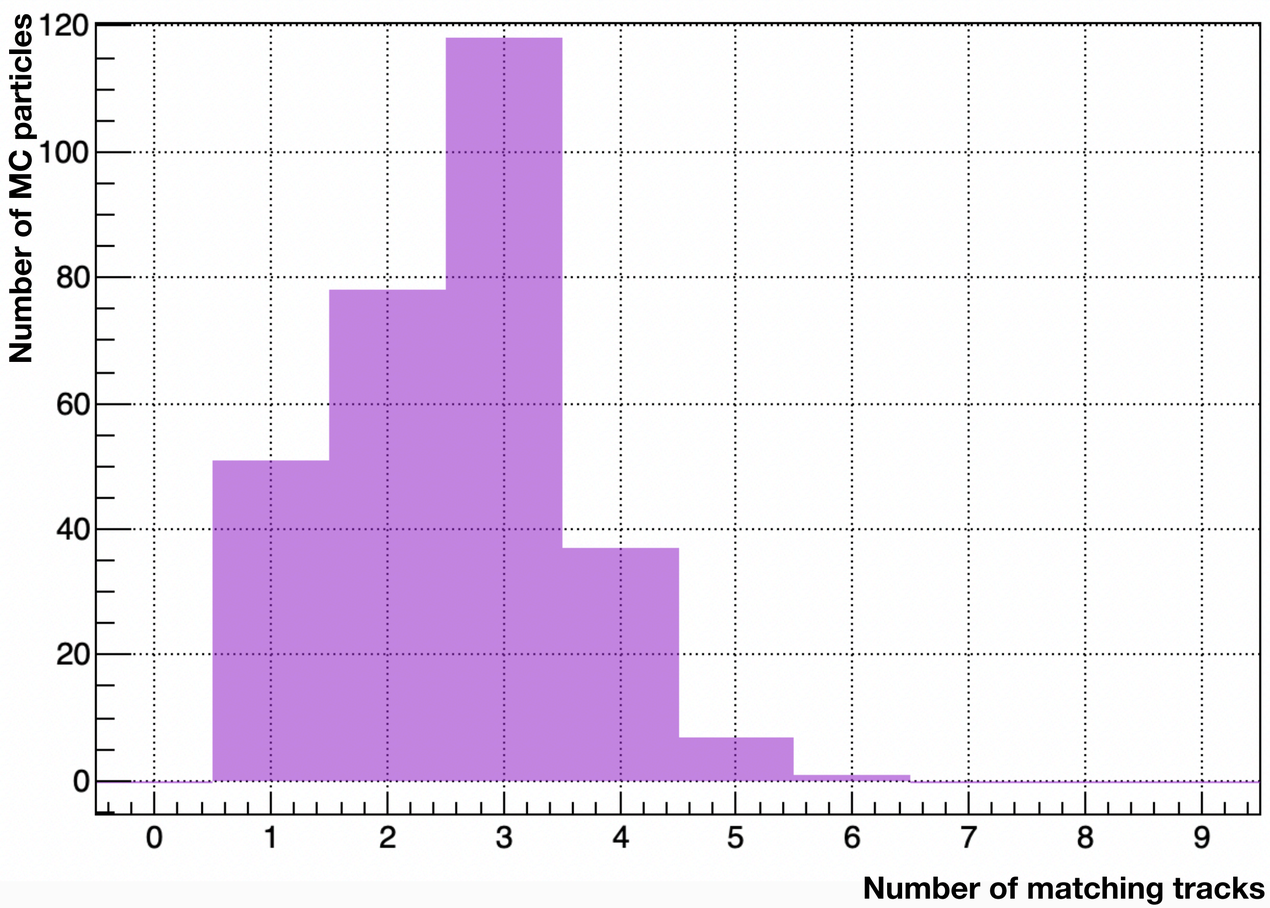
Fraction of hits from matching particle

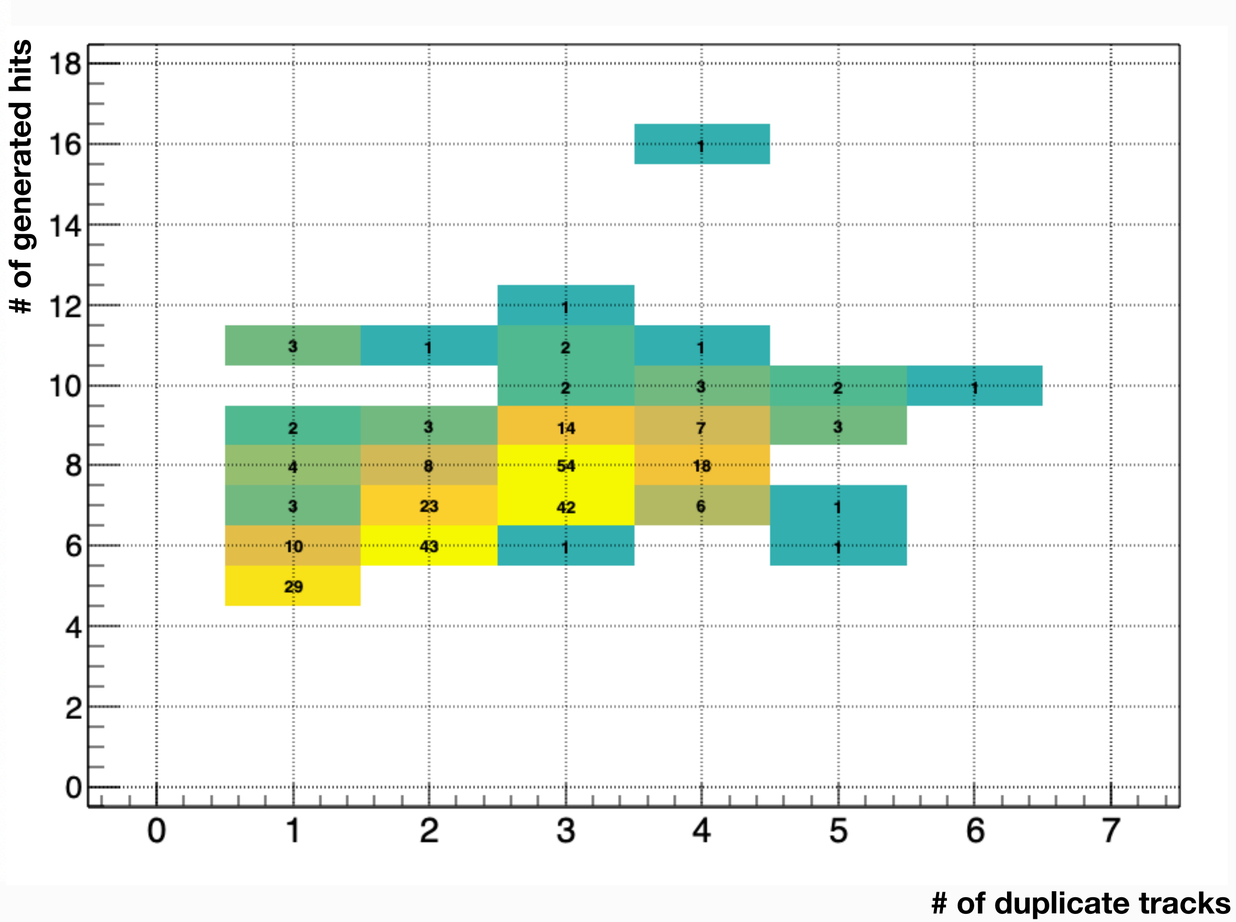


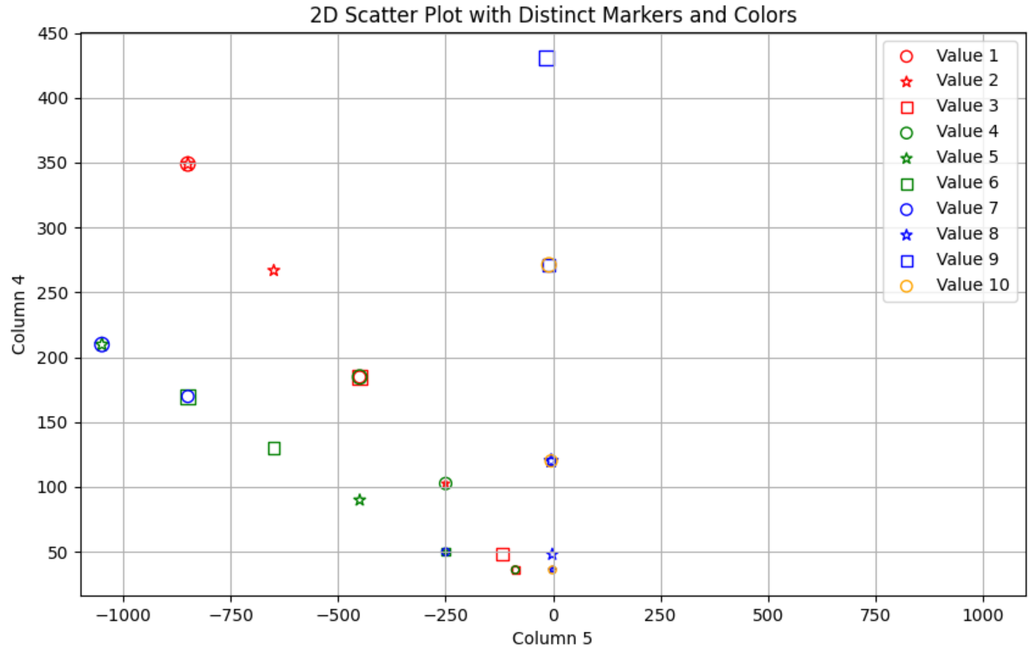
- Most of tracks from one matching MC particle
- interesting to see how it is in more complicated events (i.e. high Q^2 DIS)
- Hit reconstruction efficiency, as well as track reconstruction efficiency should be accessed in other direction, from MC particle to reconstructed track



Duplicated tracks






2D Scatter Plot with Distinct Markers and Colors
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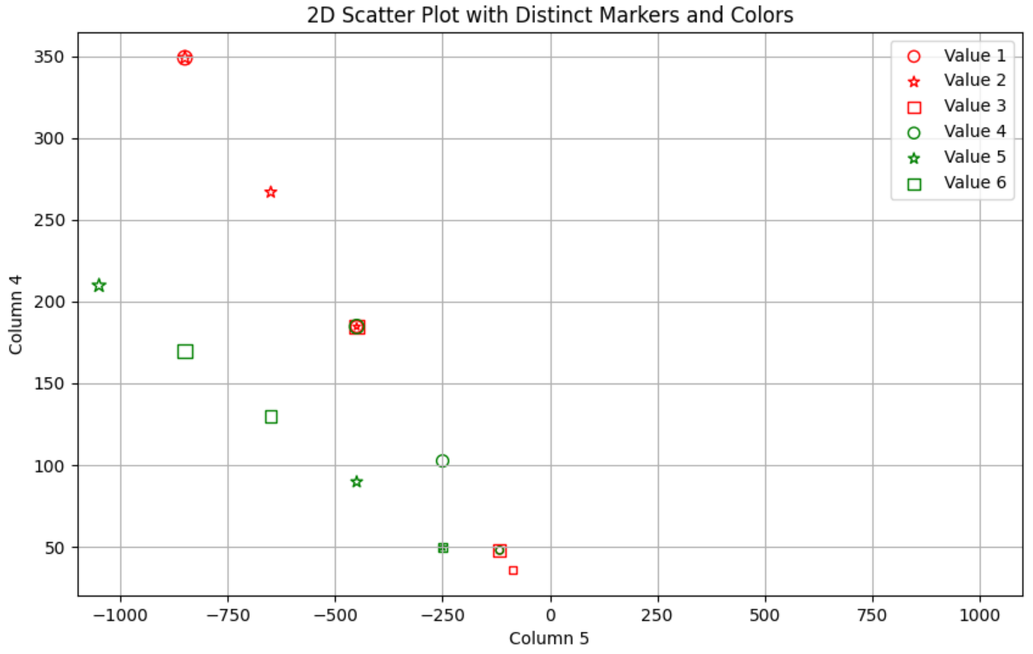
Column 5
Value 1
Value 2
Value 3
Value 4
Value 5
Value 6
Value 7
Value 8
Value 9
Value 10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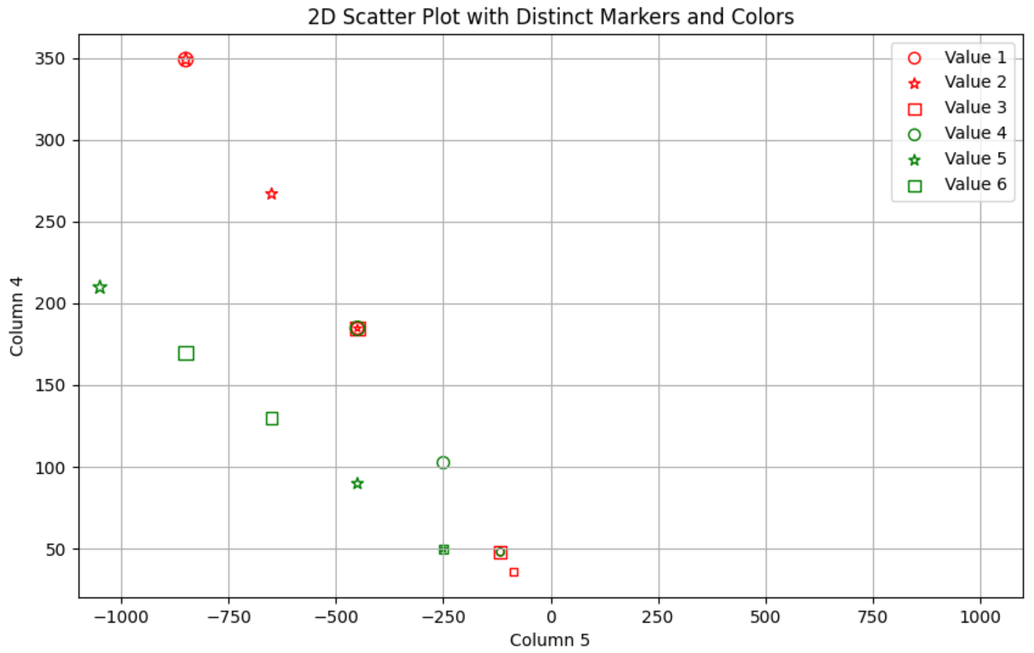
Column 4
Column 5
Value 1
Value 2
Value 3
Value 4
Value 5
Value 6


2D Scatter Plot with Distinct Markers and Colors
Value 1
Value 2
Value 3
Value 4
Value 5
Value 6
Column 4
Column 5
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250
200
150
100
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−1000
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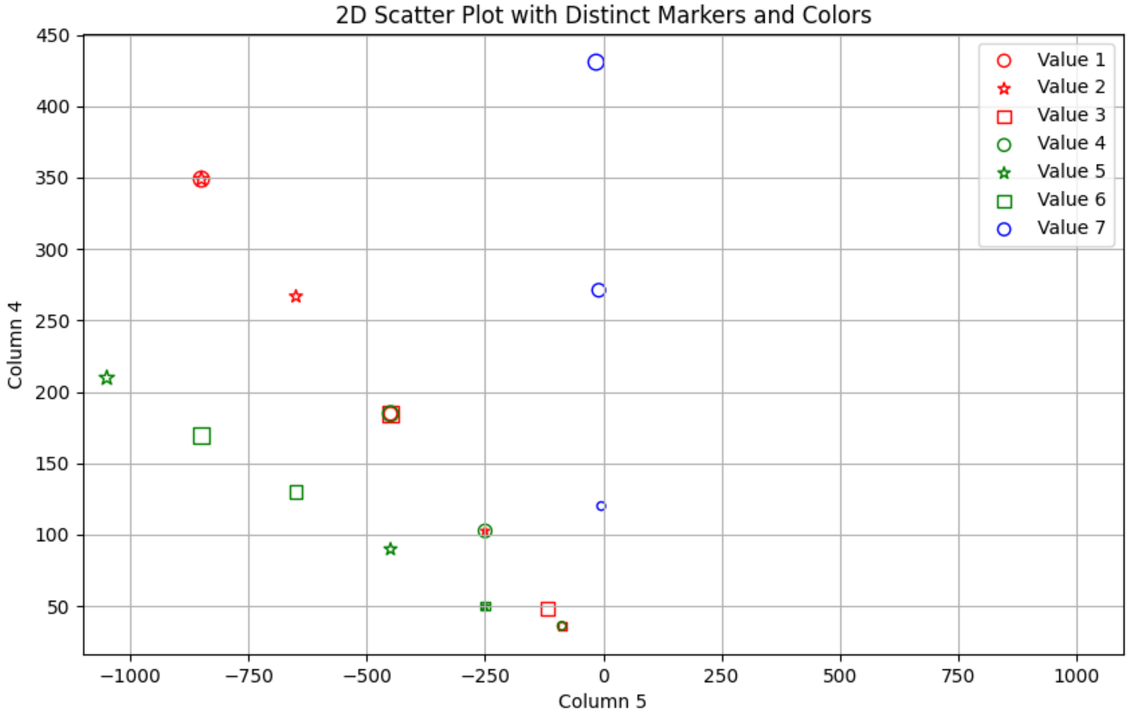
−500
−250
0
250
500
750
1000


2D Scatter Plot with Distinct Markers and Colors
Value 1
Value 2
Value 3
Value 4
Value 5
Value 6
Value 7
Column 4
Column 5
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250
200
150
100
50
−1000
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−500
−250
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500
750
1000