MILO VERMEULEN — 14-3-2019

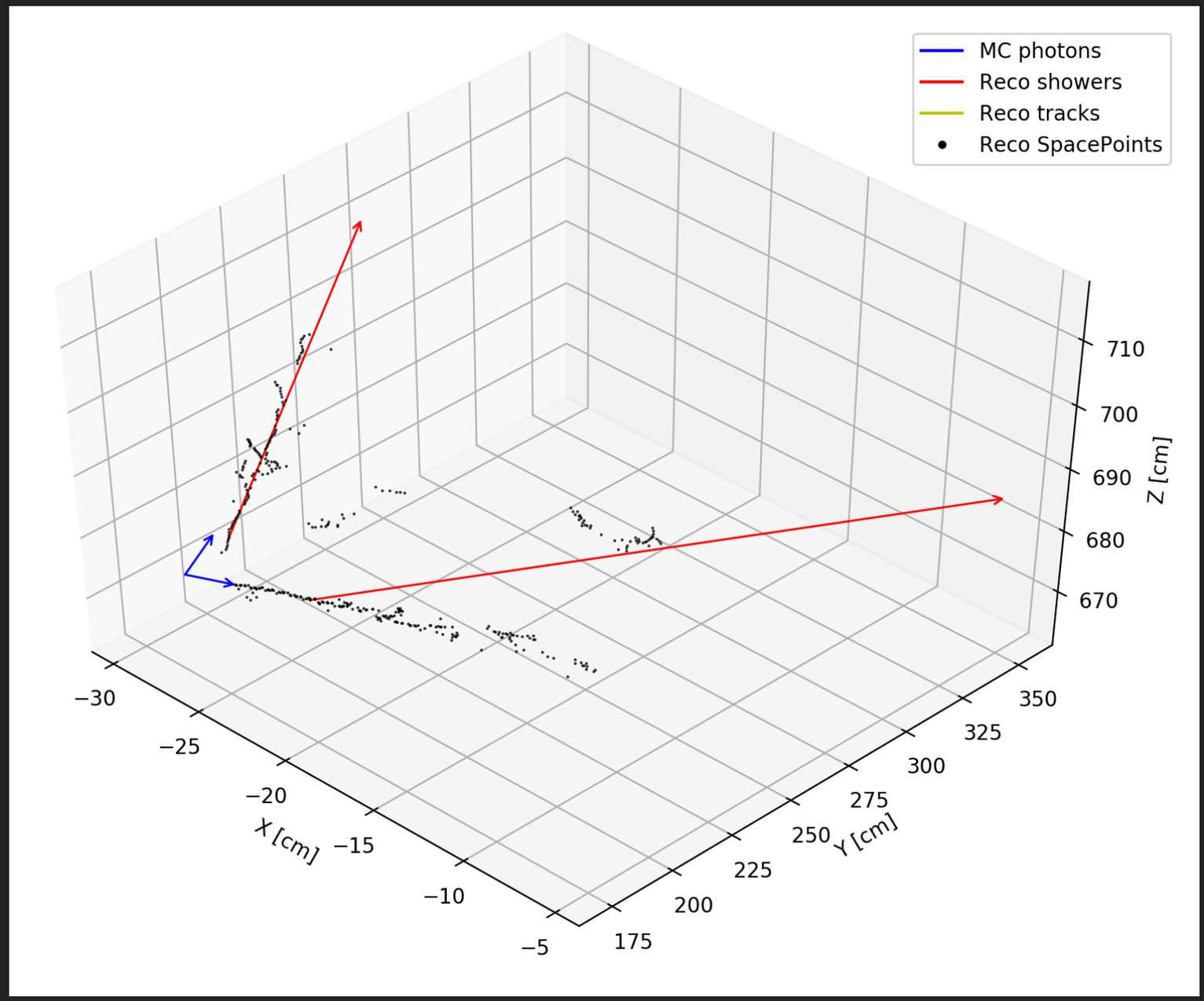
UPDATE ON Π^0 ANALYSIS USING PANDORA RECONSTRUCTION

BACKGROUND

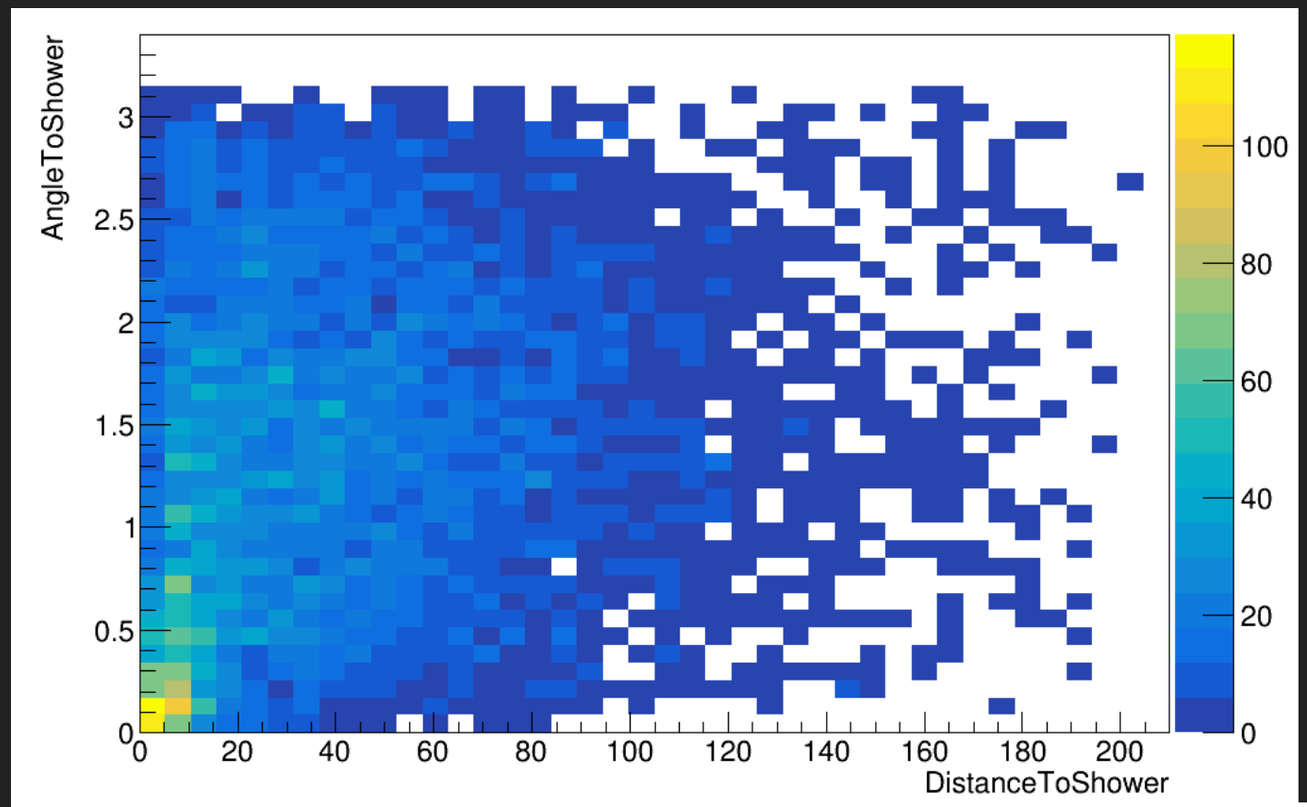
- Good shower reconstruction necessary for π^0 reconstruction
- Pandora currently the standard
- This presentation: π^0 shower accuracy in 10kt and ProtoDUNE models from analyst's perspective
- Preliminary π^0 reconstruction

VERY FIRST LOOK

- Simply compare MC photon and reco shower
  - Record distance, relative angle

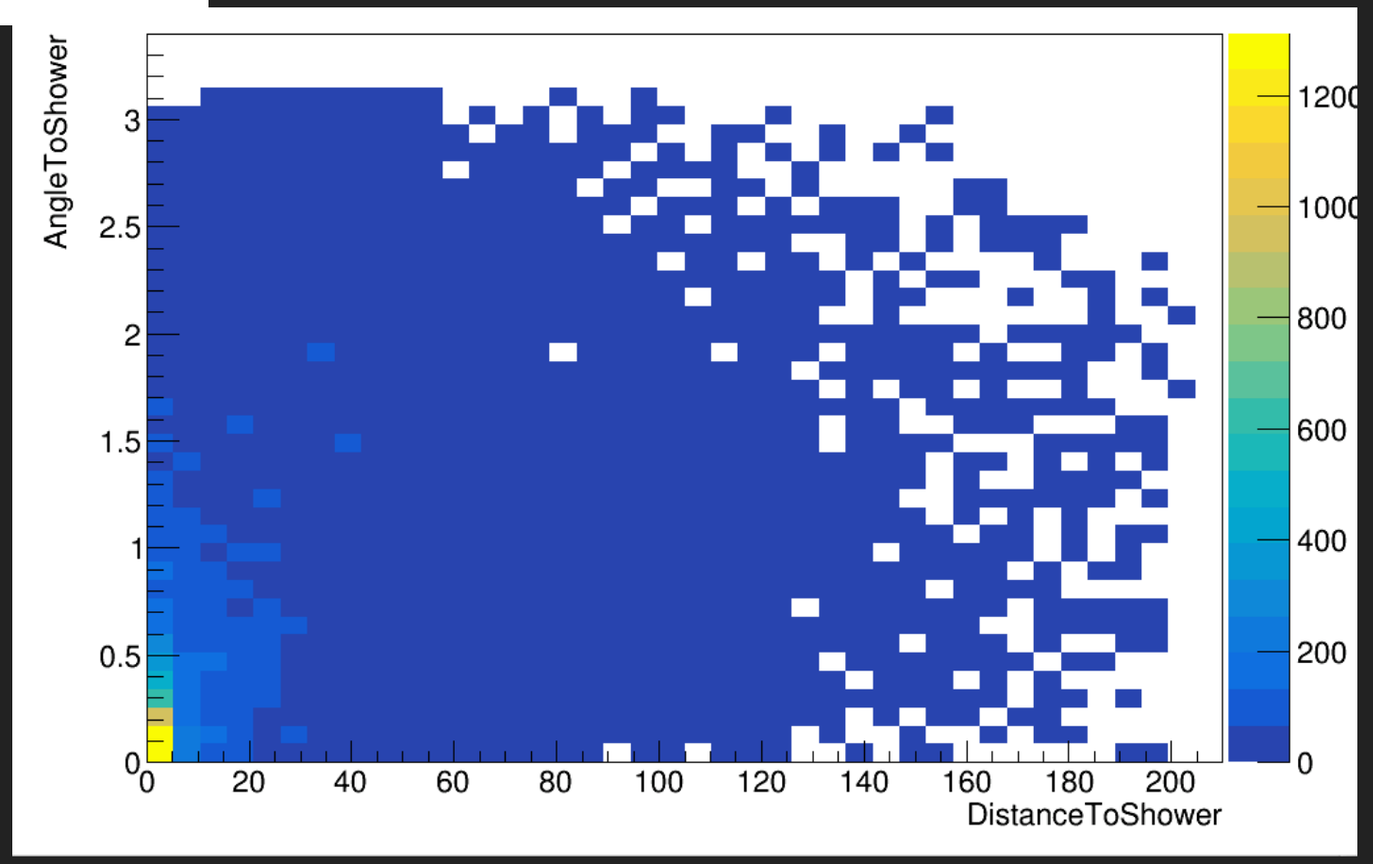


1 GeV π⁰ in DUNE

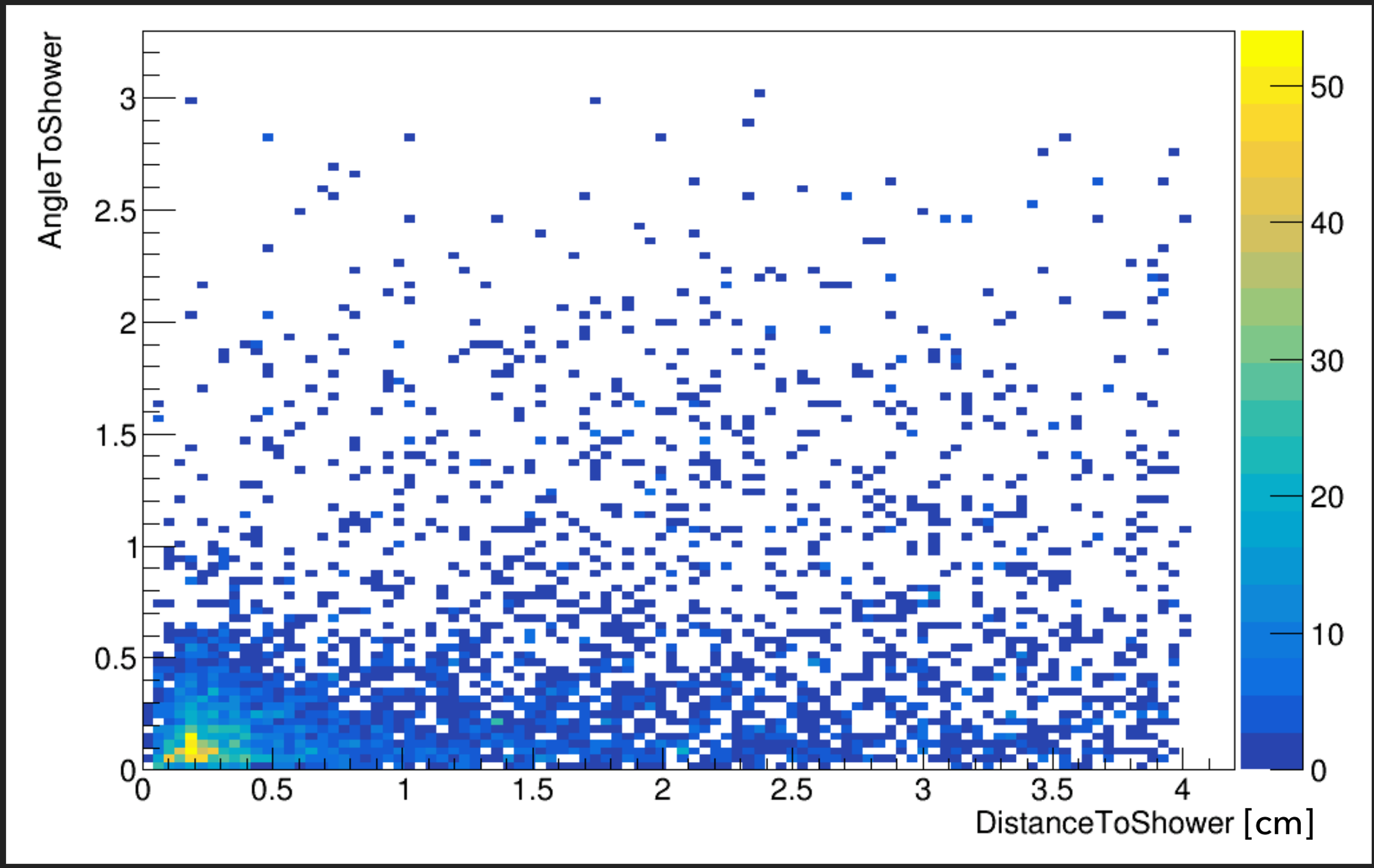


DUNE mcc11

ProtoDUNE mcc11



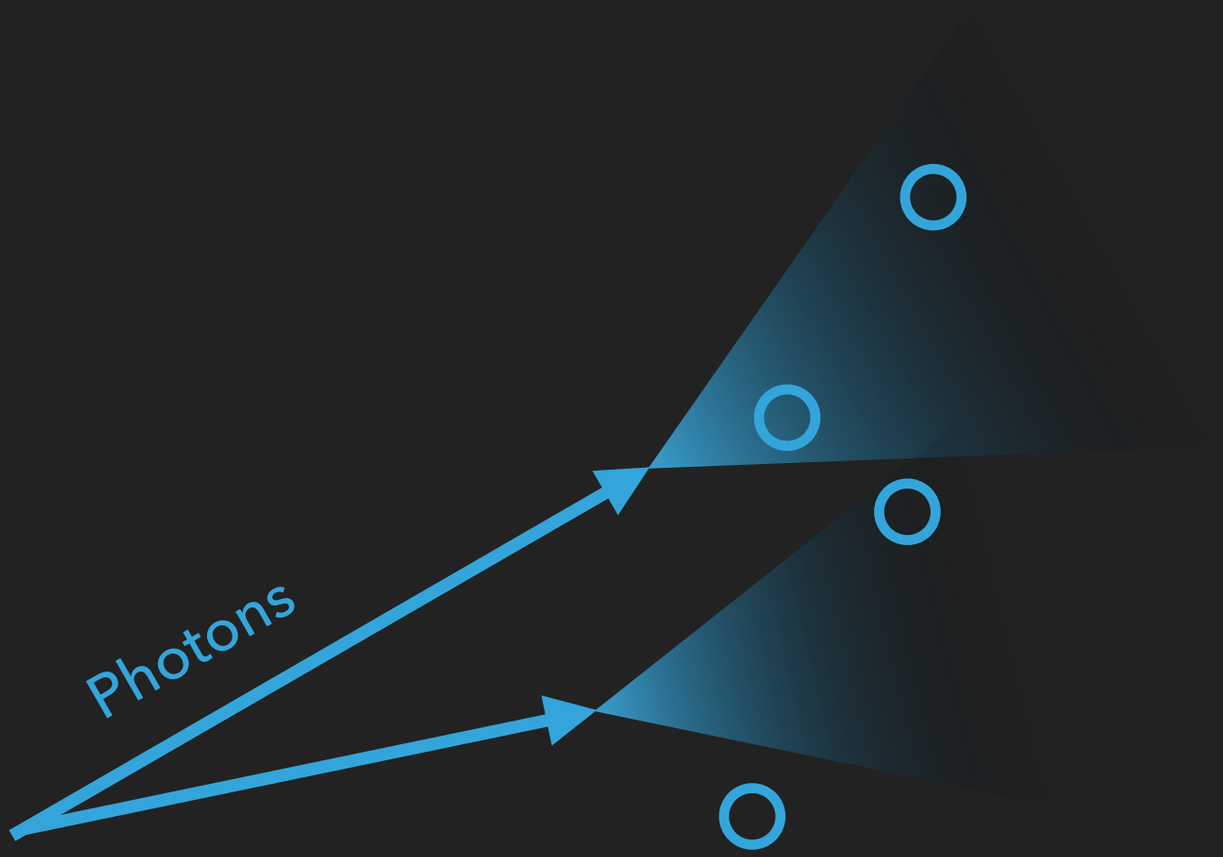
ZOOM AND ENHANCE!



DUNE mcc11 – 10000 events

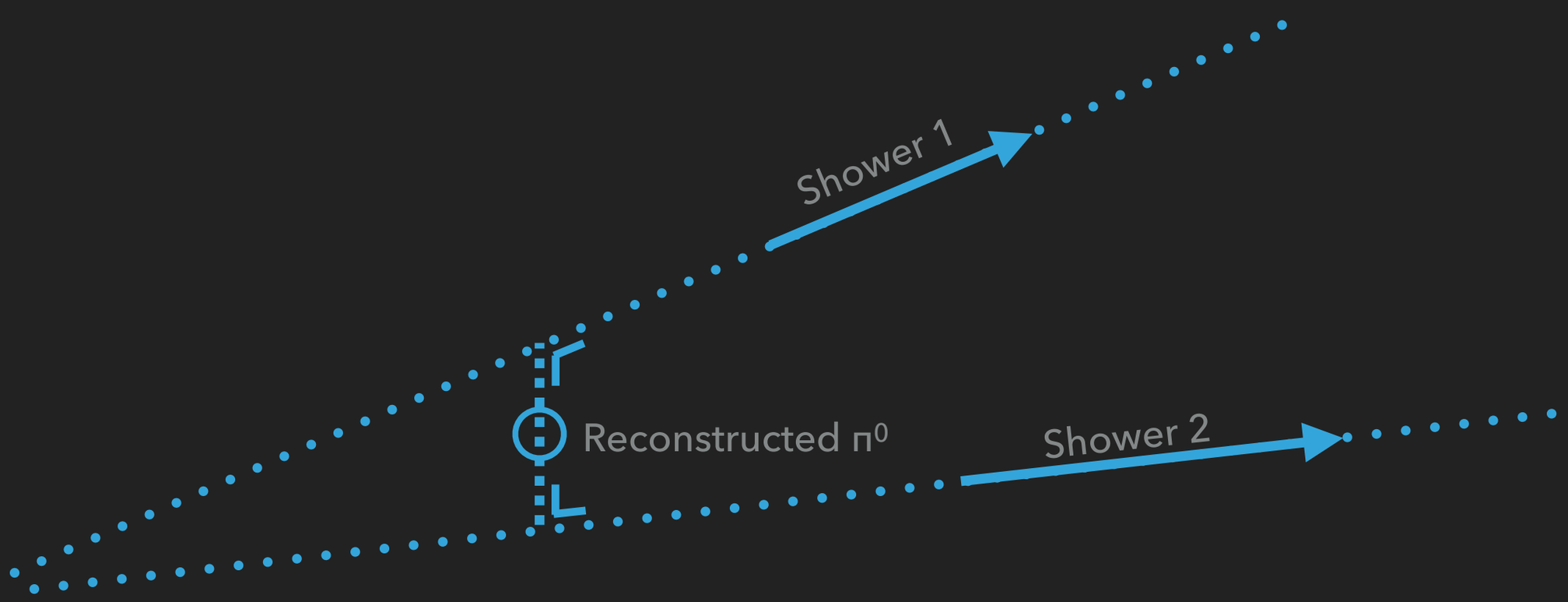
CHALLENGE 1: SHOWER MATCHING

- Could investigate more sophisticated matching including relative angle, energy
- Alternatively, link showers to photons via backtracker

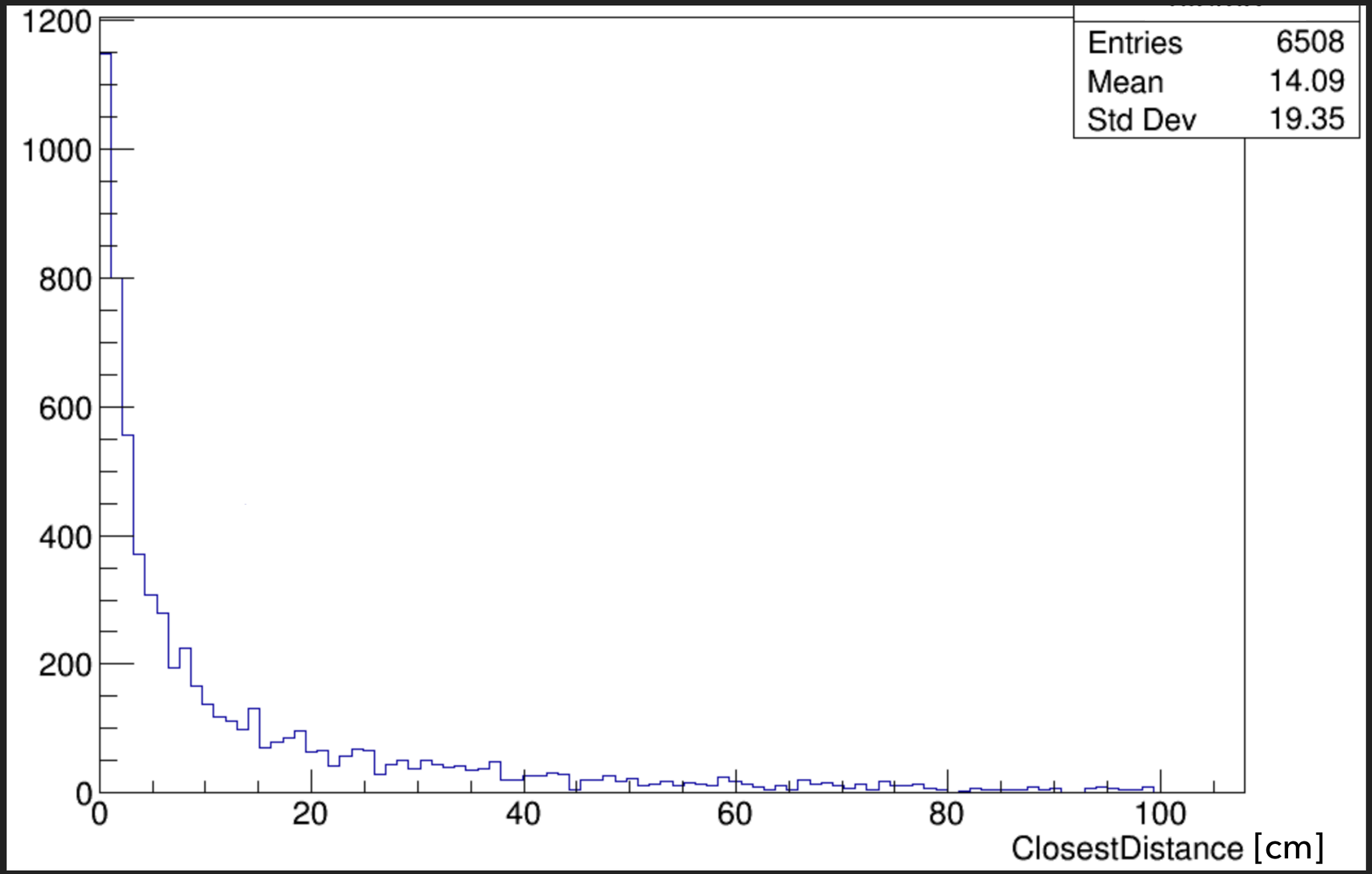


CHALLENGE 2: NEAREST POINT FINDING

- Find shortest distance between back-tracked matched showers to judge quality of reconstruction
  - Smaller closest distance points to a better π⁰ determination
- This is something that can be done without MC information

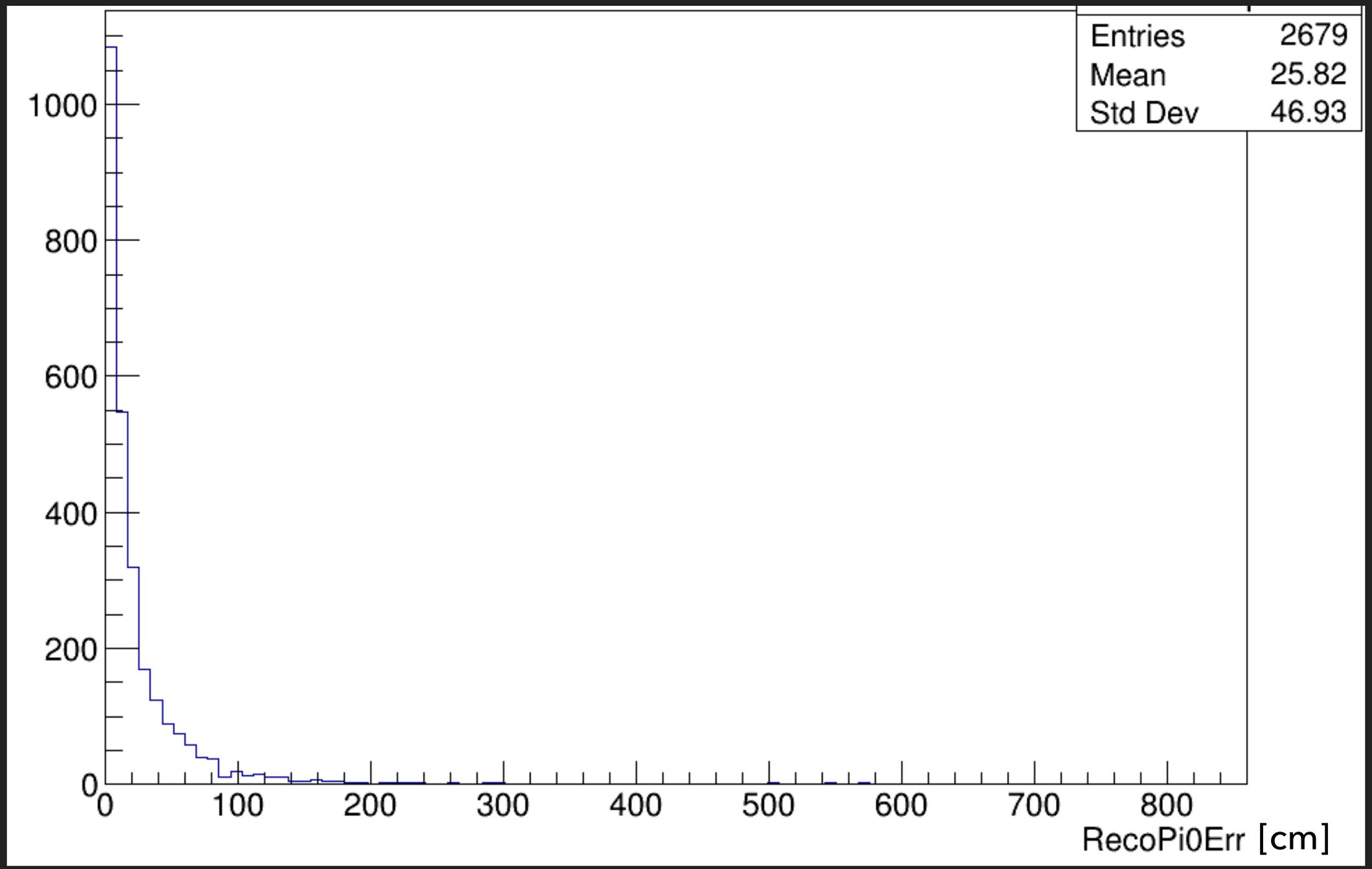


CHALLENGE 2: NEAREST POINT FINDING — CLOSEST DISTANCE



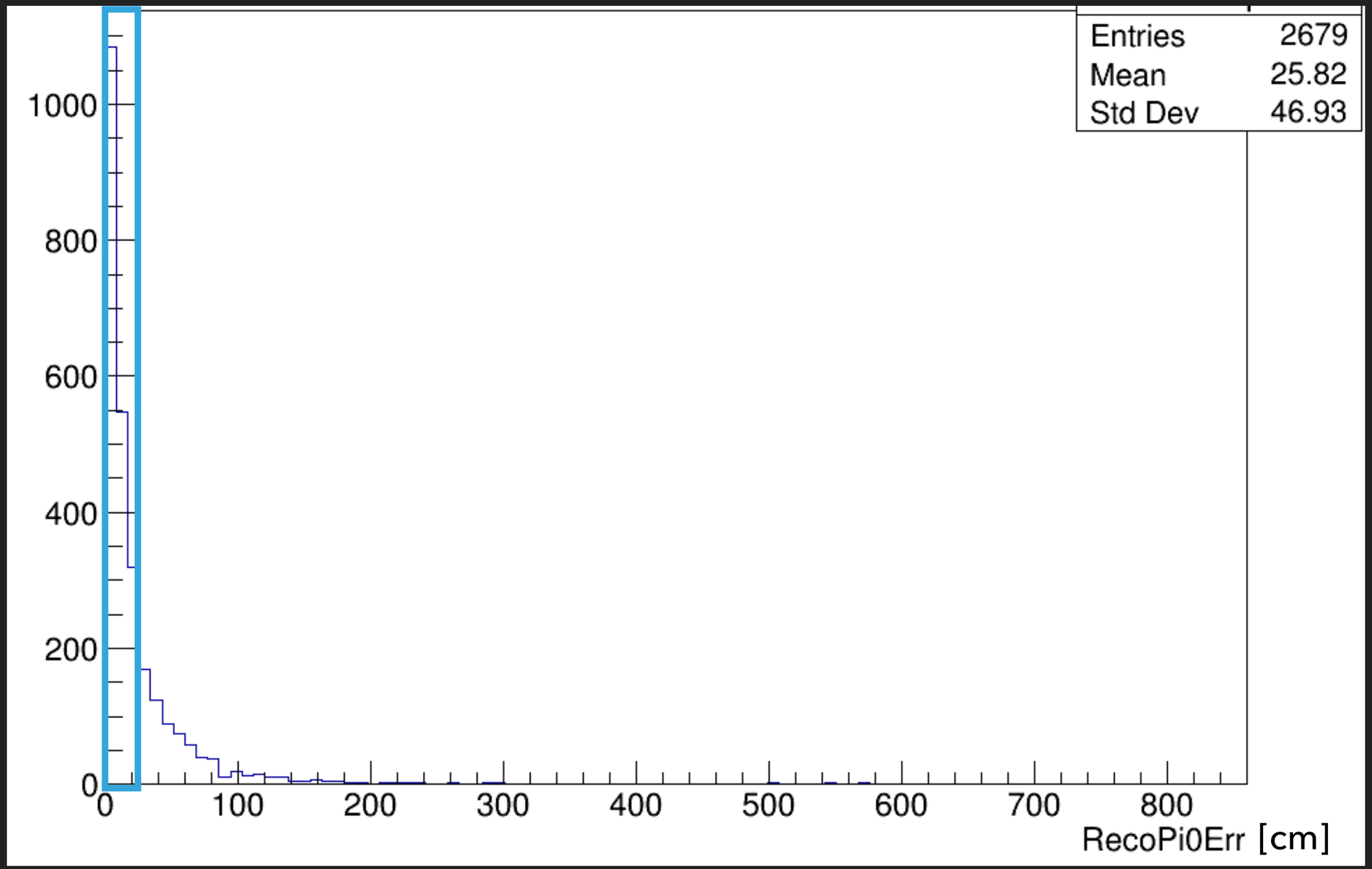
10000 10kt events

CHALLENGE 2: NEAREST POINT FINDING — MC/RECO COMPARISON



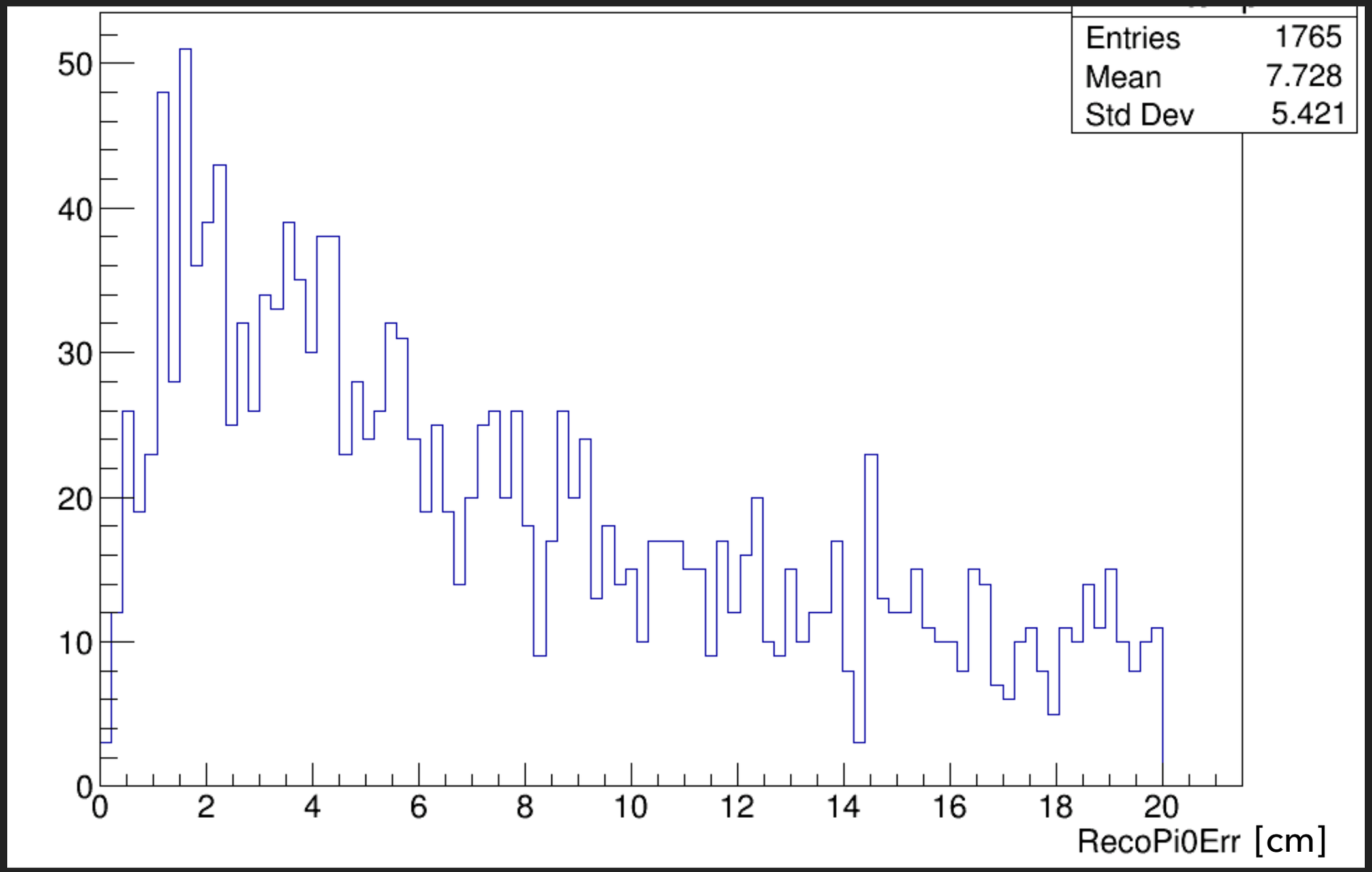
10000 10kt events

CHALLENGE 2: NEAREST POINT FINDING — MC/RECO COMPARISON



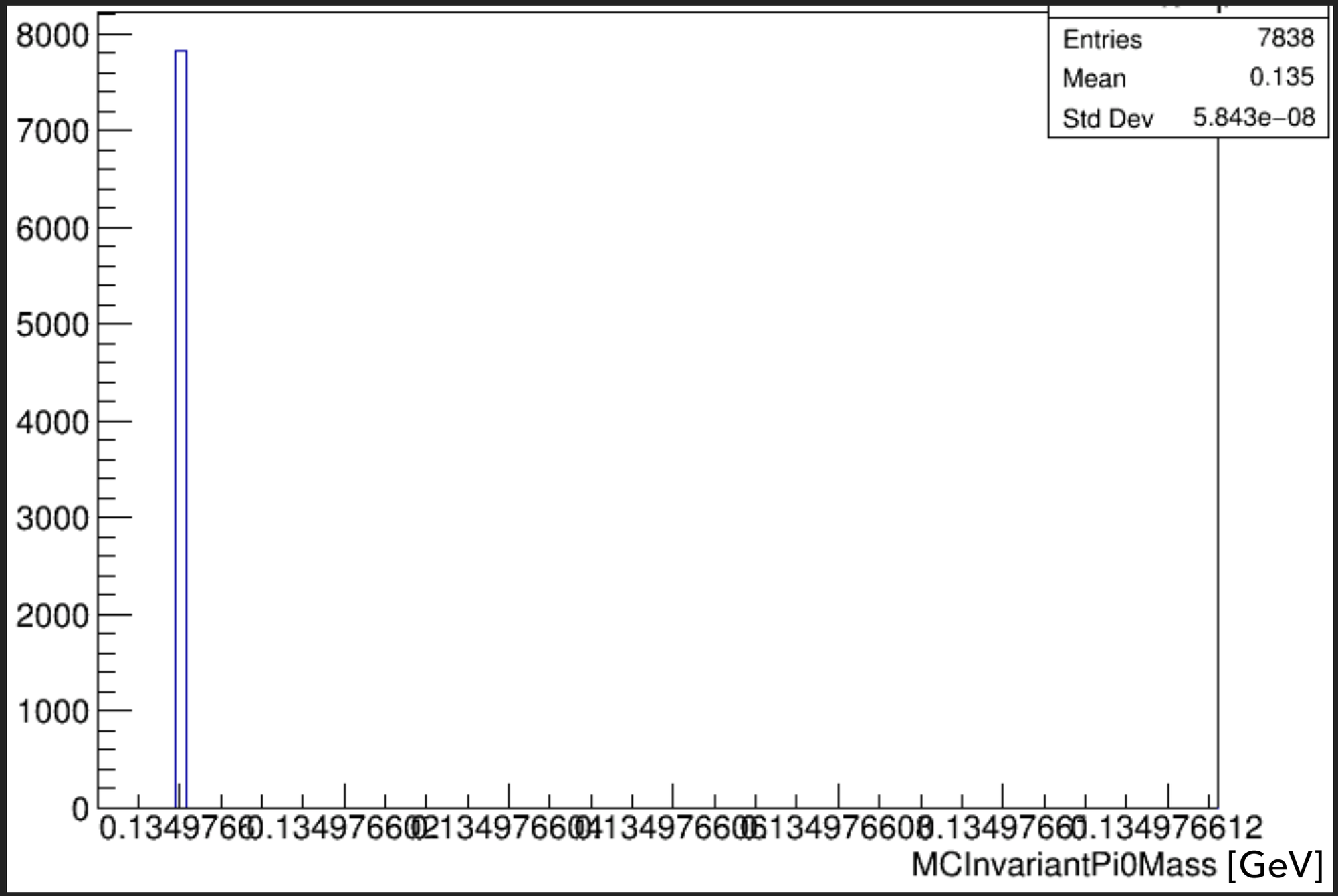
10000 10kt events

CHALLENGE 2: NEAREST POINT FINDING — MC/RECO COMPARISON



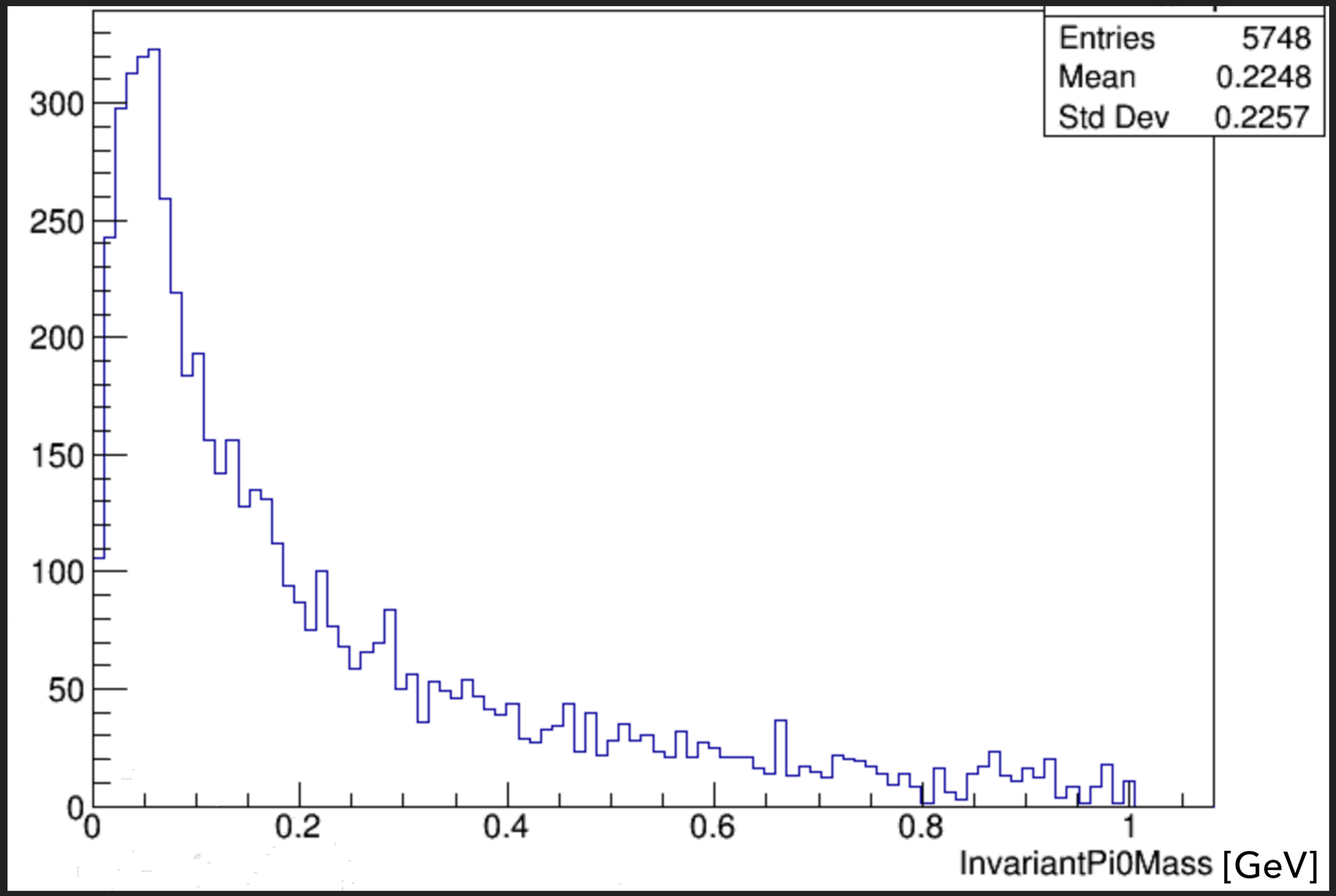
10000 10kt events

INVARIANT MASS FROM PHOTONS



10000 10kt events

INVARIANT MASS FROM SHOWERS

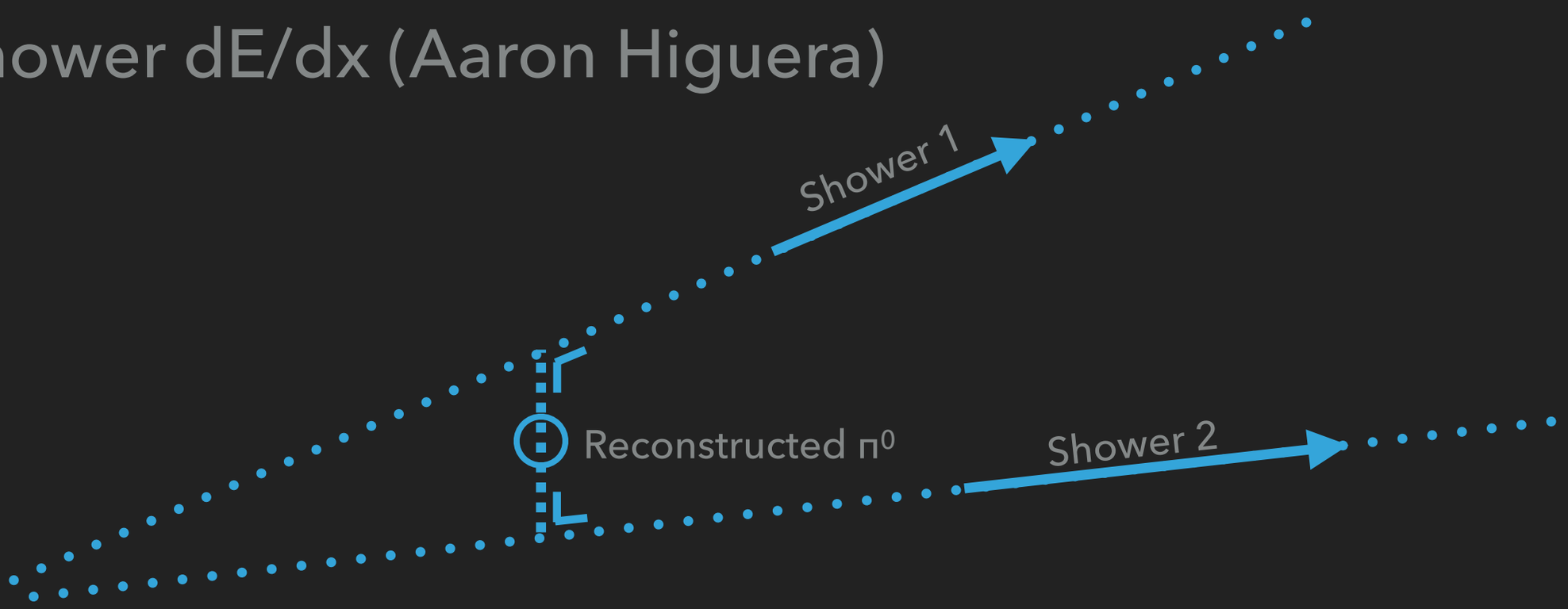


10000 10kt events

DATA-DRIVEN ANALYSIS

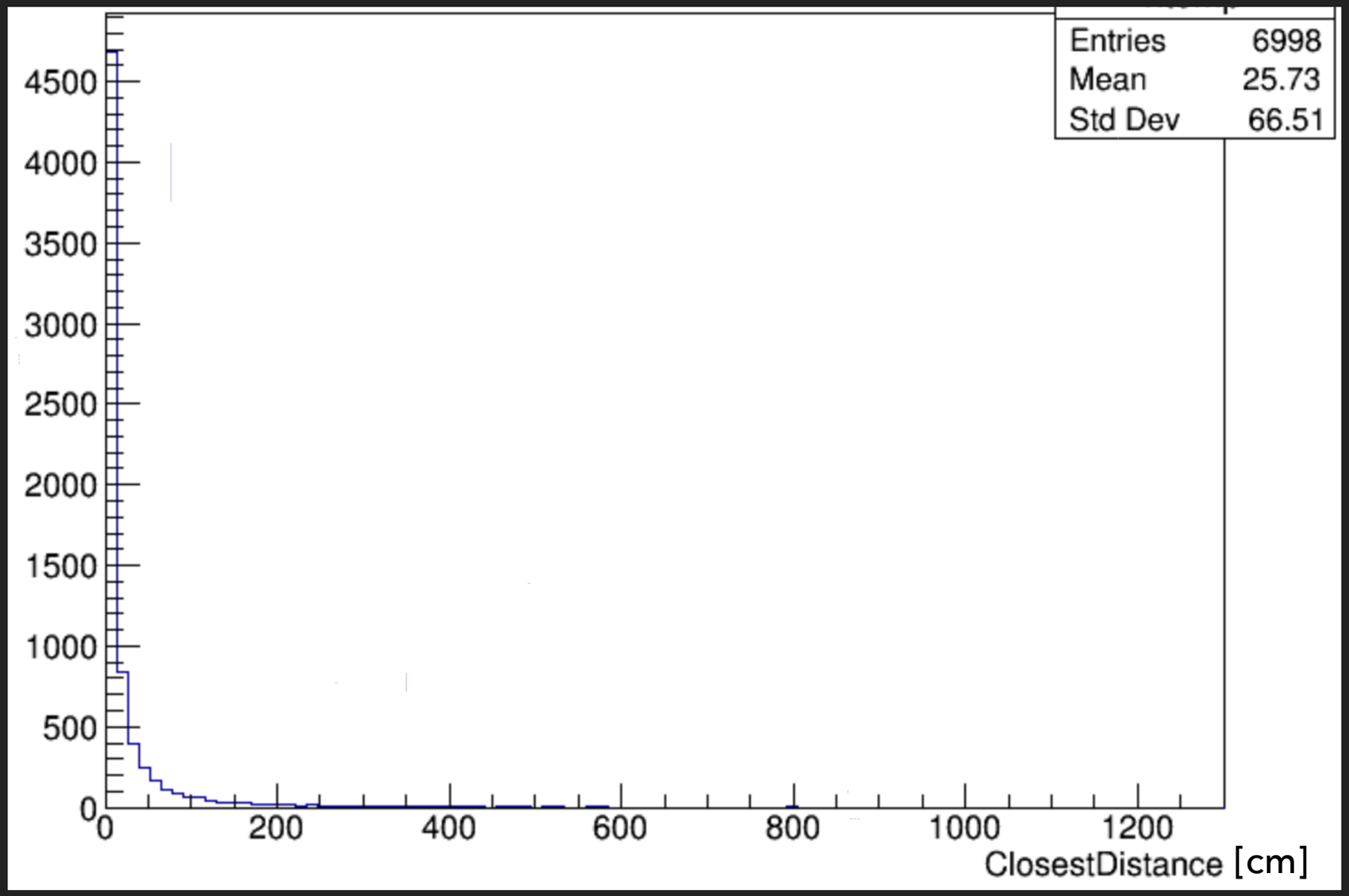
- Use purely reconstruction information to find π^0s

1. Shortest distance between shower lines
2. Reconstructed invariant mass
3. Shower dE/dx (Aaron Higuera)



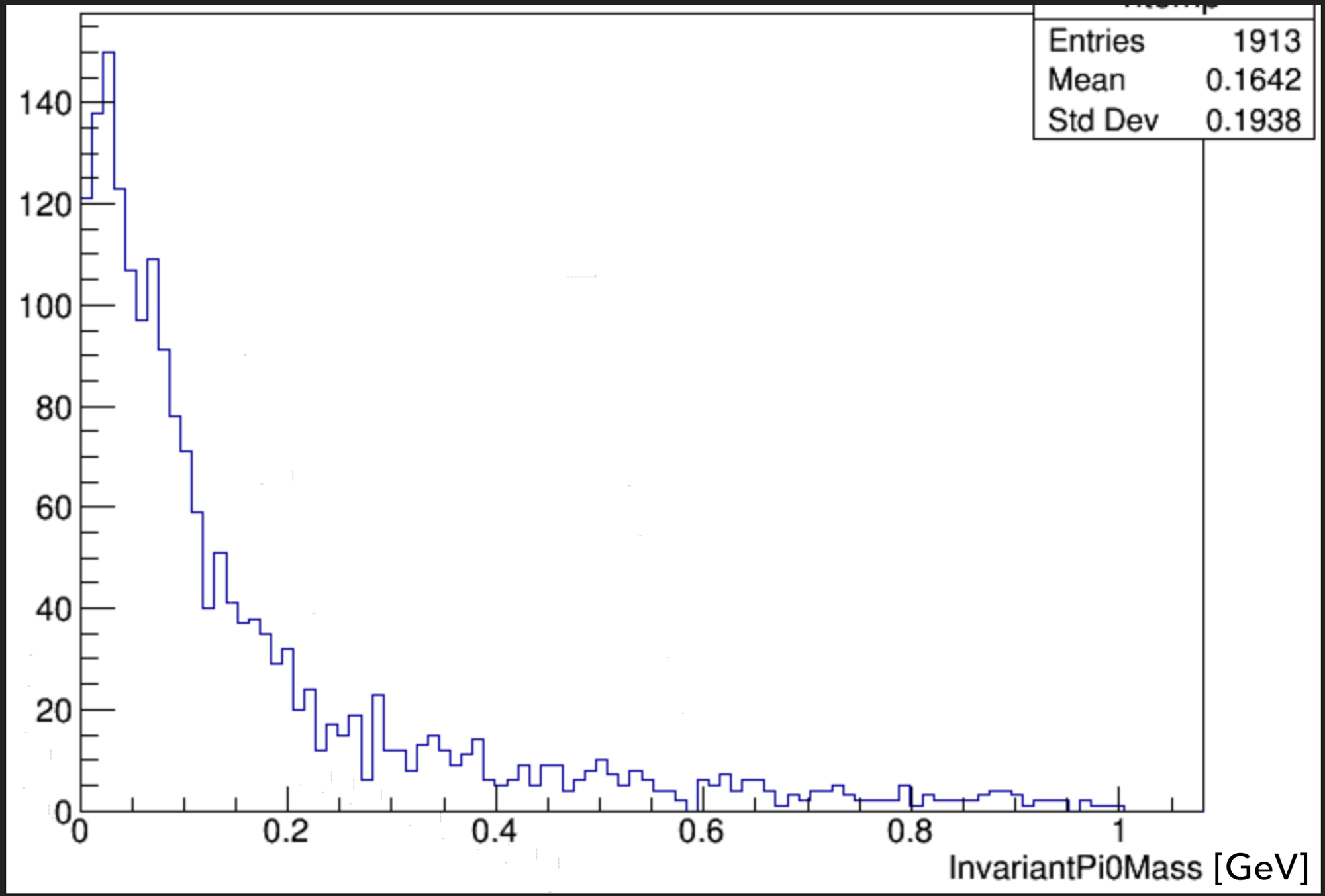
DATA-DRIVEN ANALYSIS — SHORTEST DISTANCE BETWEEN SHOWER LINES

- Same data set as before, now look at all shower pairs



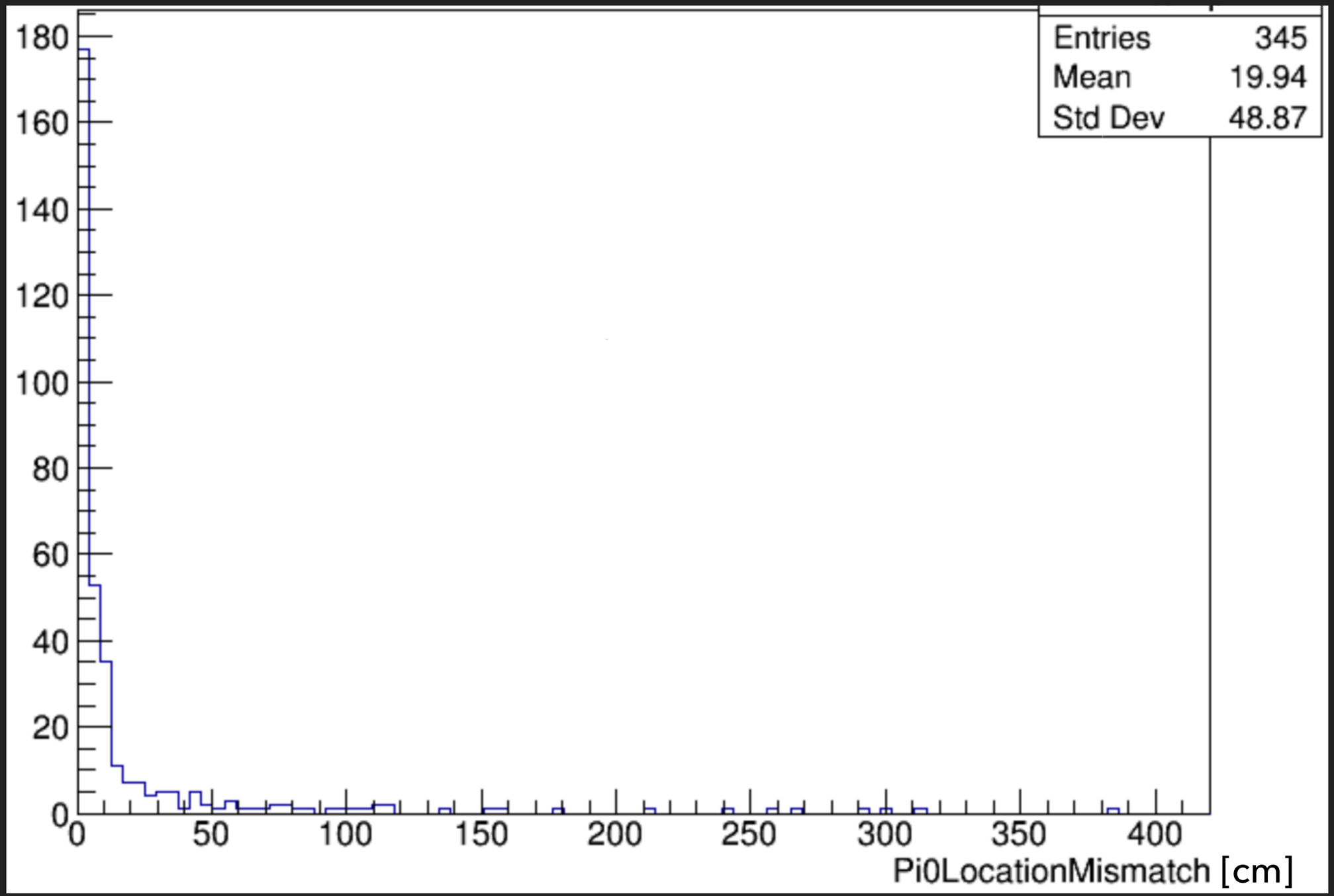
10000 10kt events

DATA-DRIVEN ANALYSIS — INVARIANT MASS



10000 10kt events – max 2 cm between shower lines

DATA-DRIVEN ANALYSIS — DISTANCE TO NEAREST MC Π⁰



10000 10kt events – max 1 cm between shower lines and inv. mass < 0.2 GeV

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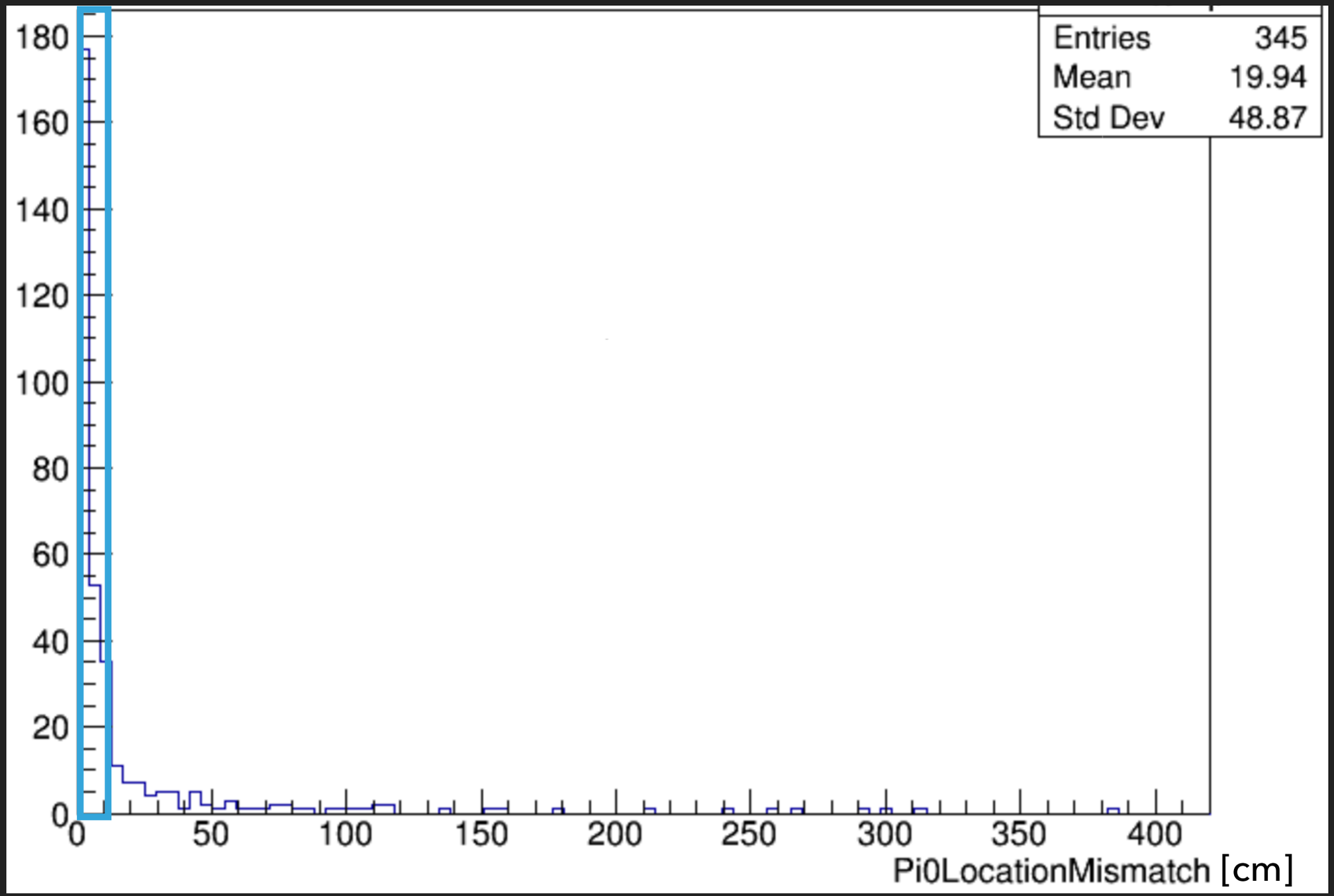

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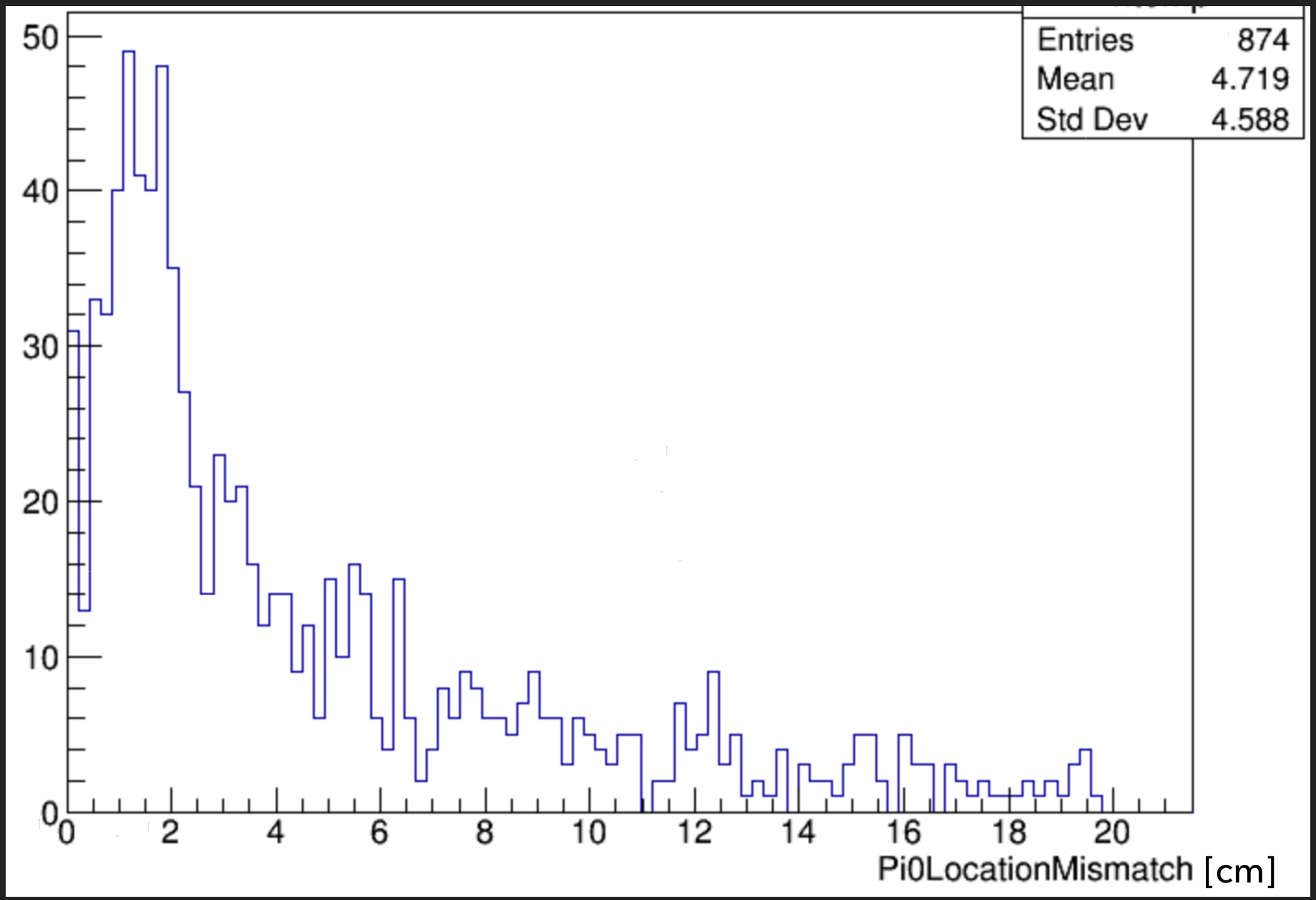

10000 10kt events – max 1 cm between shower lines and inv. mass < 0.2 GeV

FUTURE PLANS

- Investigate bad shower matching in ProtoDUNE
- Continue to develop shower matching algorithm
  - Distinguish photon showers from electron shower
- Refine cuts to have least false positives/negatives