

MILO VERMEULEN 13-2-2019

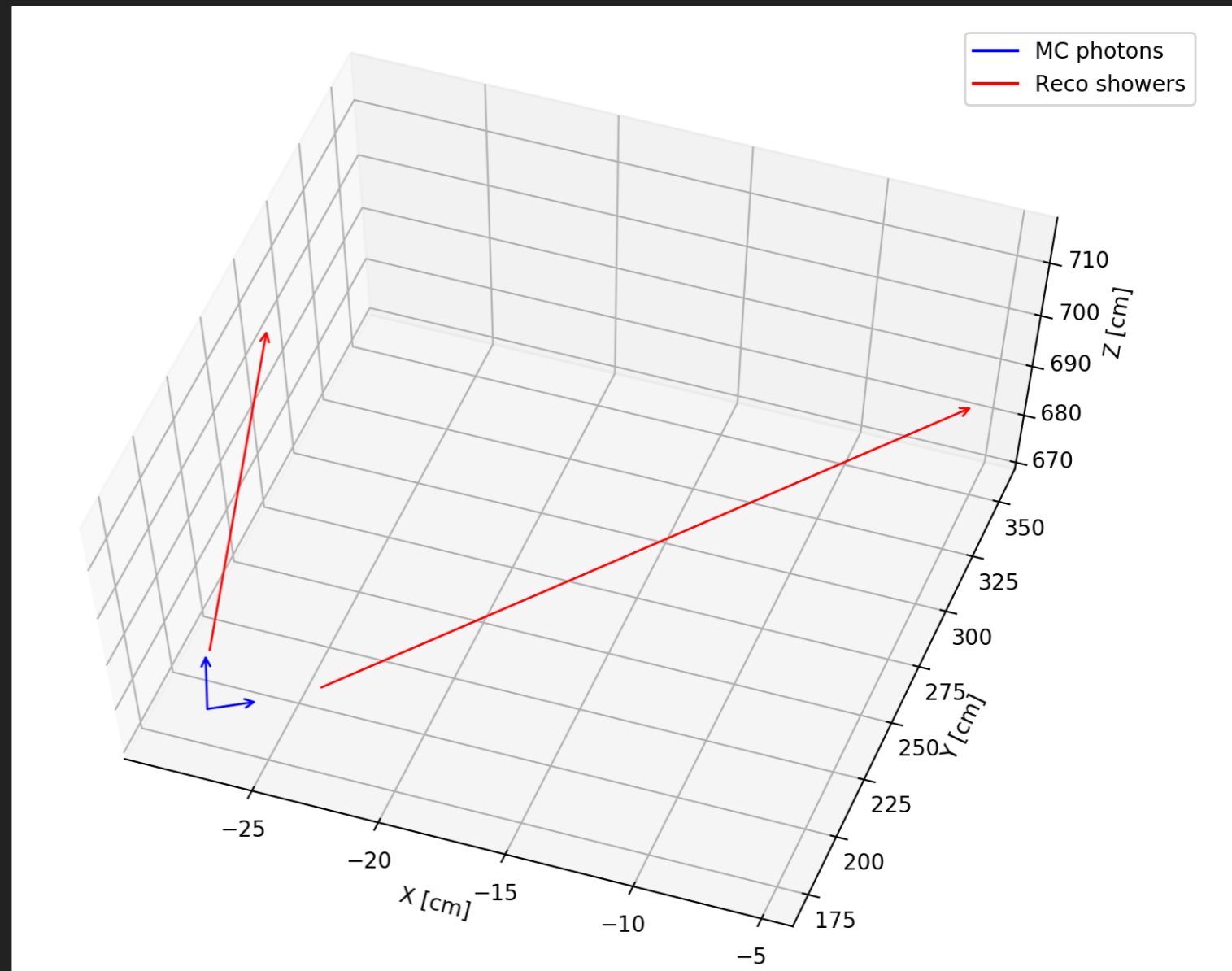
SHOWER RECONSTRUCTION FROM AN ANALYST'S PERSPECTIVE

BACKSTORY

- ▶ Search for π^0 particles (major DUNE background)
 - ▶ Look for $\pi^0 \rightarrow \gamma\gamma$ showers coming from the same vertex
 - ▶ Compare reconstruction with Monte Carlo
- ▶ Need to extract (Pandora) shower information
 - ▶ Position, length, direction, energy, best_plane, opening angle, etc. etc.

BACKSTORY

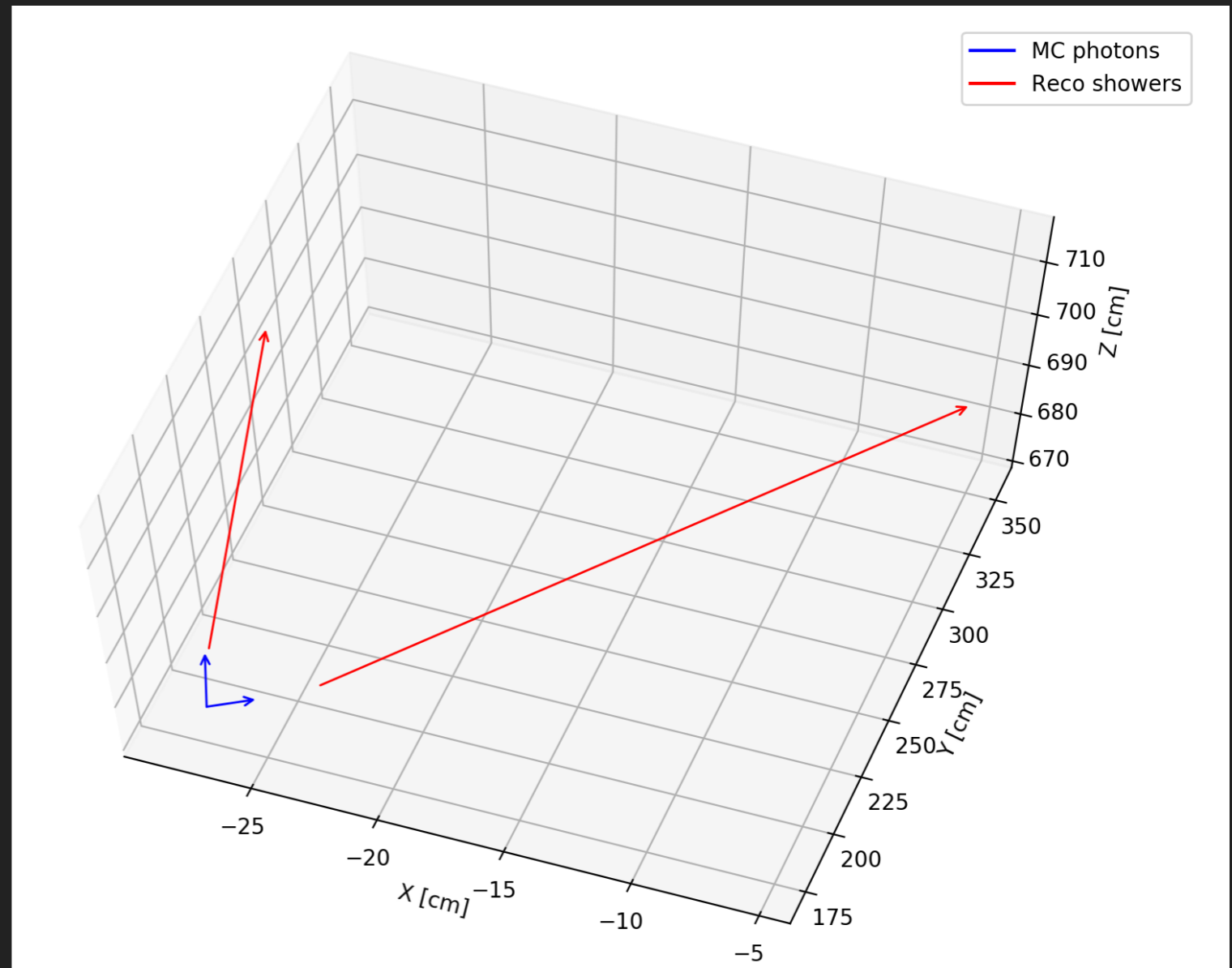
- ▶ Score: distance between MC photon endpoint and nearest reco shower start position
- ▶ Later incorporate angle, dEdx profile and others



1 GeV π^0 in DUNE

BACKSTORY

- ▶ Main point: good shower reconstruction is needed to reconstruct a π^0
- ▶ Thanks to Steve, Leigh and James



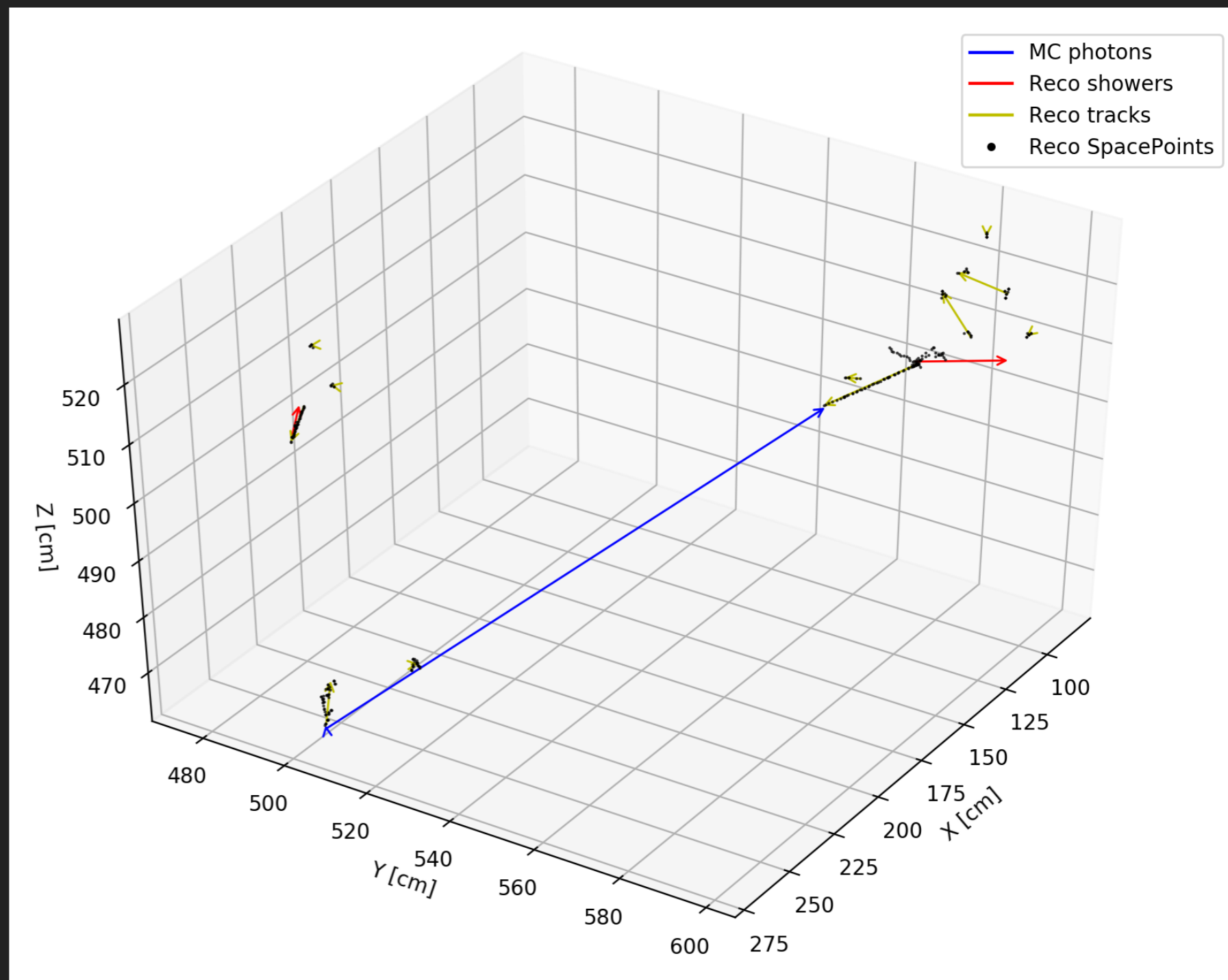
1 GeV π^0 in DUNE

DATA SETS

- ▶ ProtoDUNE single π^0 events with standard Geant4 and detector simulation
 - ▶ Standard ProtoDUNE reconstruction
 - ▶ Modified ProtoDUNE reconstruction
- ▶ DUNE single π^0 events with standard FD Geant4 and detector simulation
 - ▶ Standard DUNE FD reconstruction

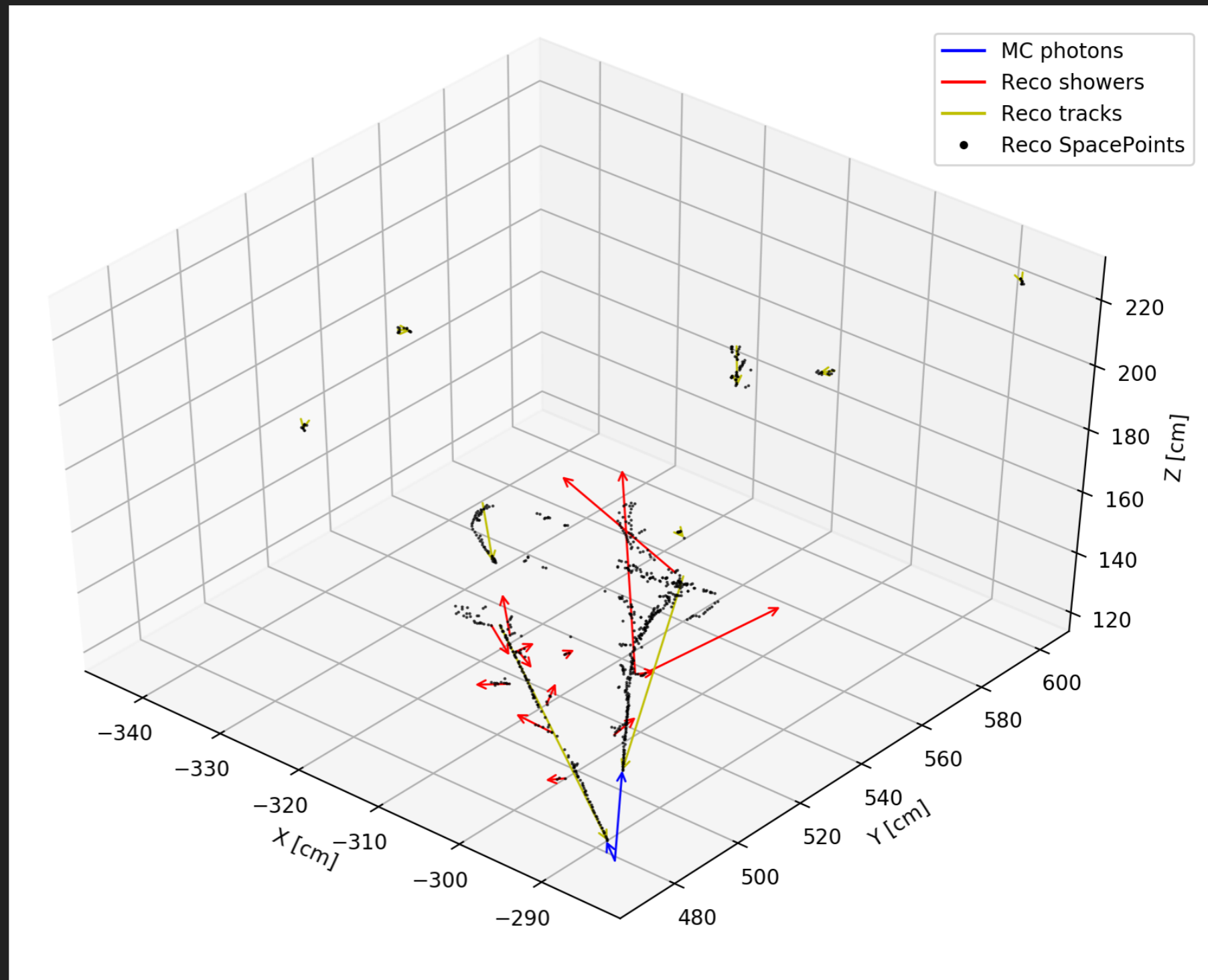
PROTODUNE STANDARD RECONSTRUCTION — 1 GEV π^0

- ▶ Confusion with tracks
- ▶ Tracks going in the wrong direction



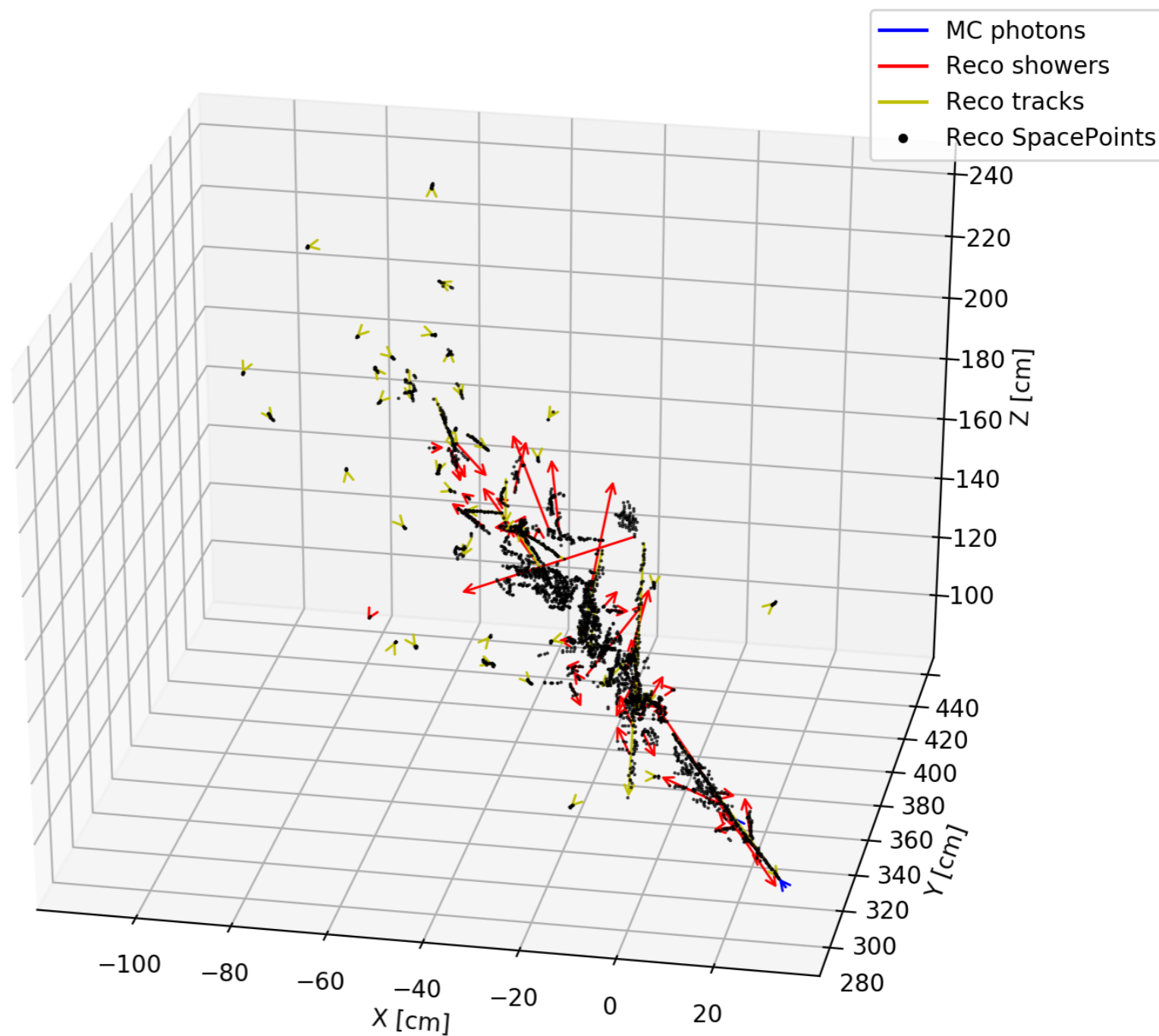
PROTODUNE STANDARD RECONSTRUCTION — 1 GEV π^0

- ▶ Mixing with tracks
- ▶ Segmentation into many smaller tracks and showers



PROTODUNE STANDARD RECONSTRUCTION — 5 GEV π^0

- ▶ Mixing with tracks
- ▶ Segmentation into many smaller tracks and showers



PROTODUNE MODIFIED RECONSTRUCTION

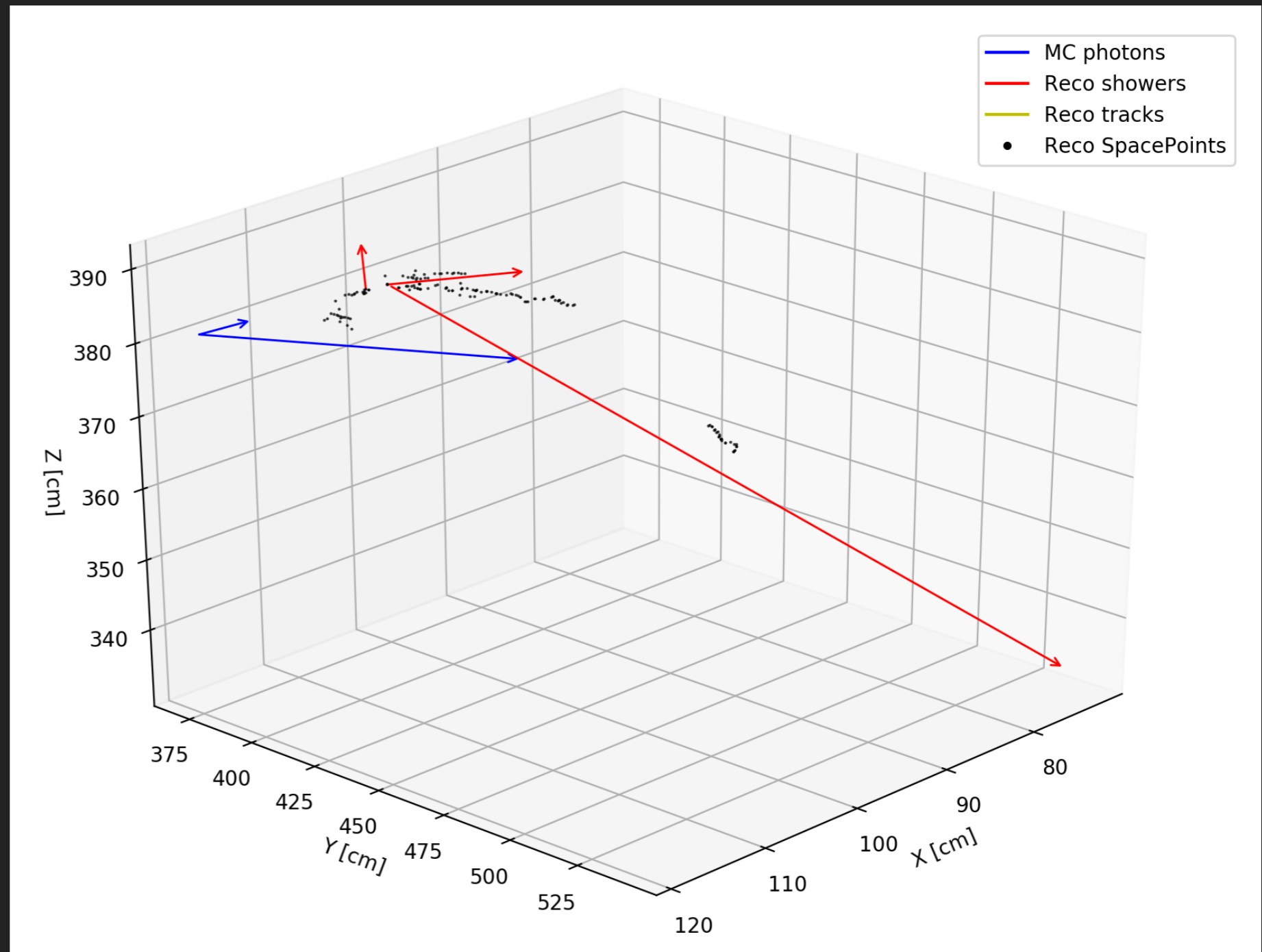
- ▶ Standard reco considers π^0 to be cosmic -> tries to split shower into cosmic rays
- ▶ Difference from standard reconstruction:

```
> physics.producers.pandora.ShouldRunAllHitsCosmicReco: false
> physics.producers.pandora.ShouldRunStitching: false
> physics.producers.pandora.ShouldRunCosmicHitRemoval: false
> physics.producers.pandora.ShouldRunSlicing: false
> physics.producers.pandora.ShouldRunNeutrinoRecoOption: true
> physics.producers.pandora.ShouldRunCosmicRecoOption: false
> physics.producers.pandora.ShouldPerformSliceId: false
```

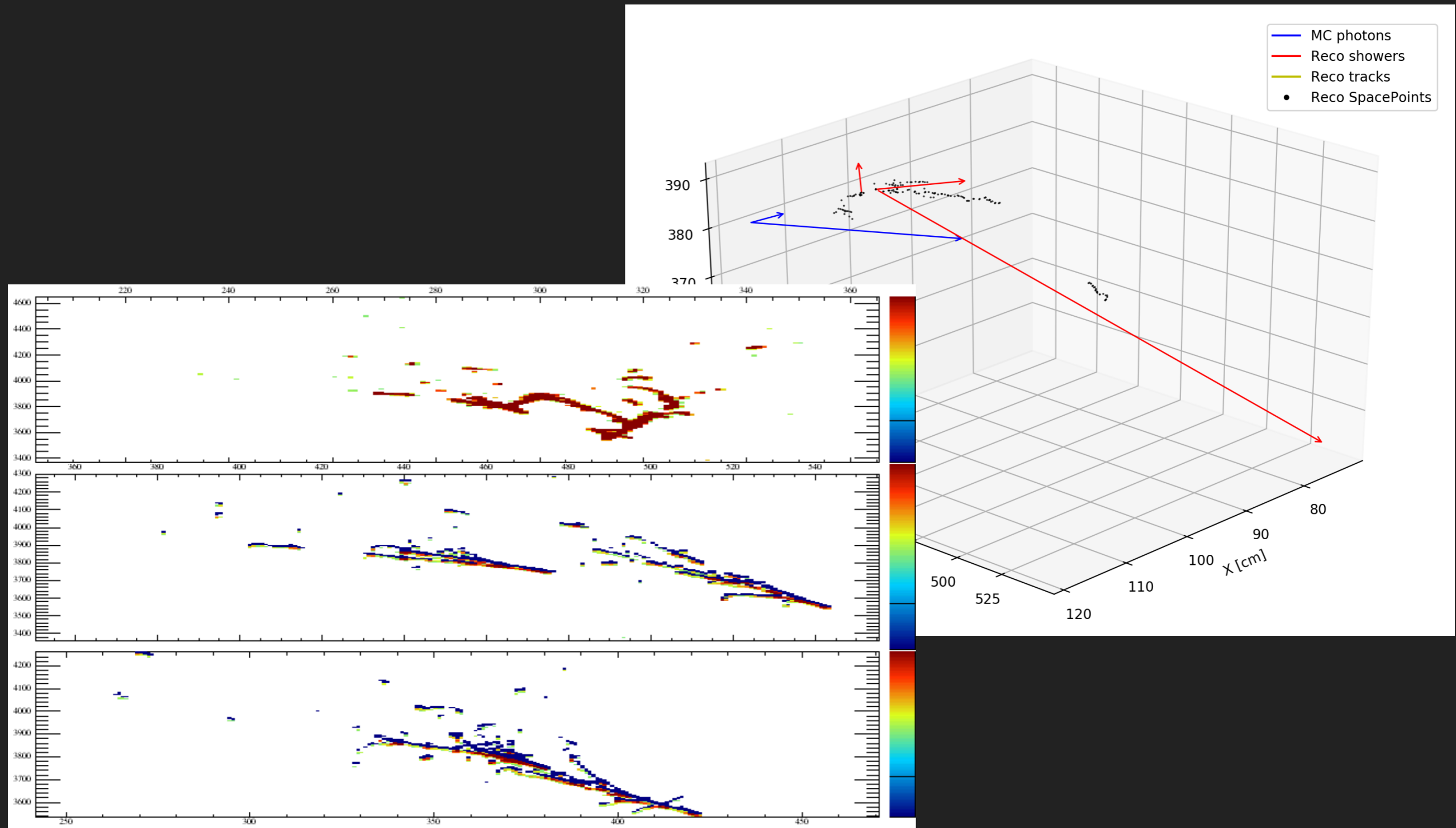
- ▶ ShouldRunNeutrinoRecoOption forces Pandora to consider the π^0 as a test beam particle instead of cosmic

PROTODUNE MODIFIED RECONSTRUCTION — 1 GEV π^0

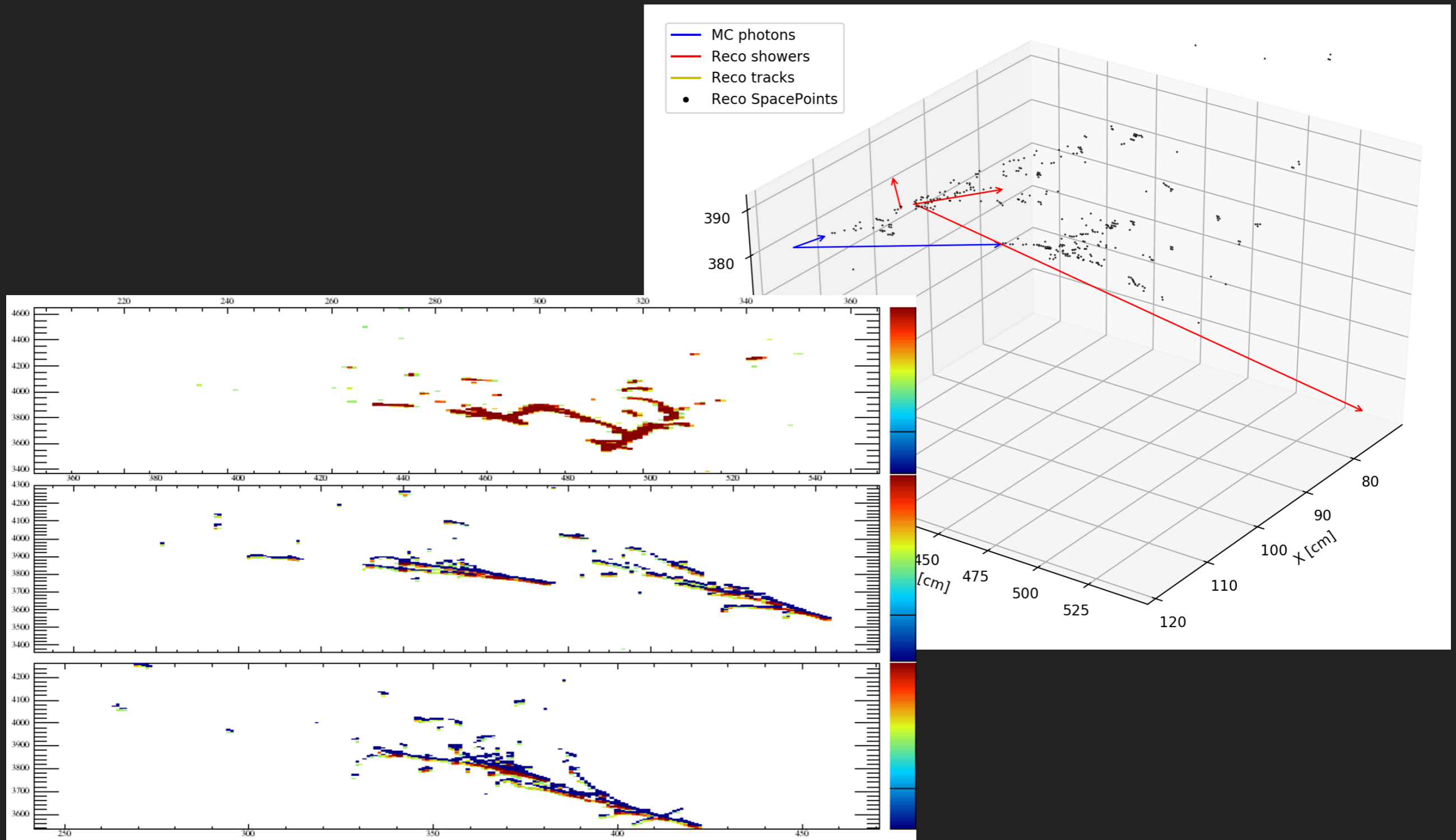
- ▶ Much fewer tracks
- ▶ Showers in roughly the right spot
- ▶ Tend to cross between showers



PROTODUNE MODIFIED RECONSTRUCTION — 1 GEV π^0

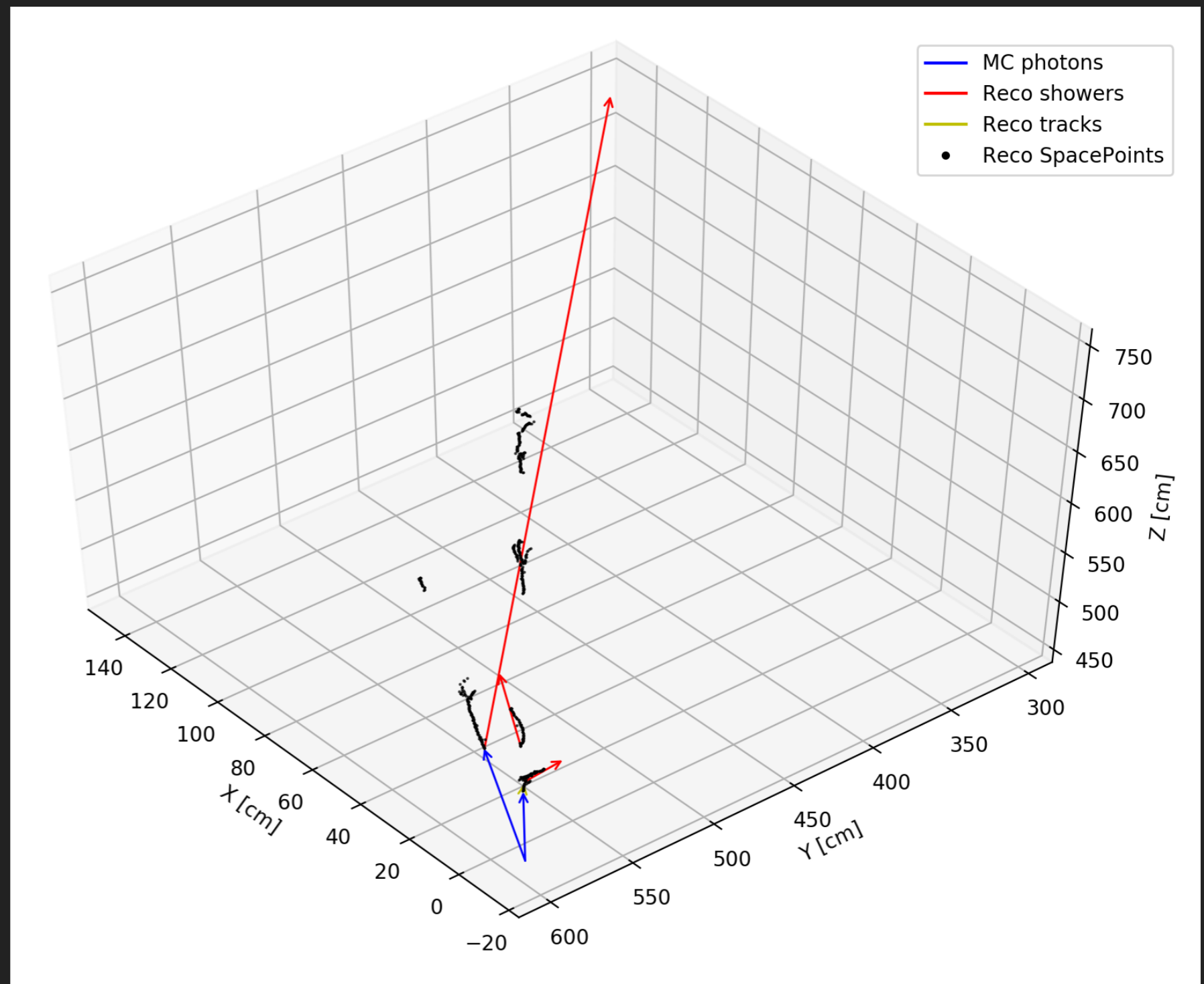


PROTODUNE MODIFIED RECONSTRUCTION — 1 GEV π^0

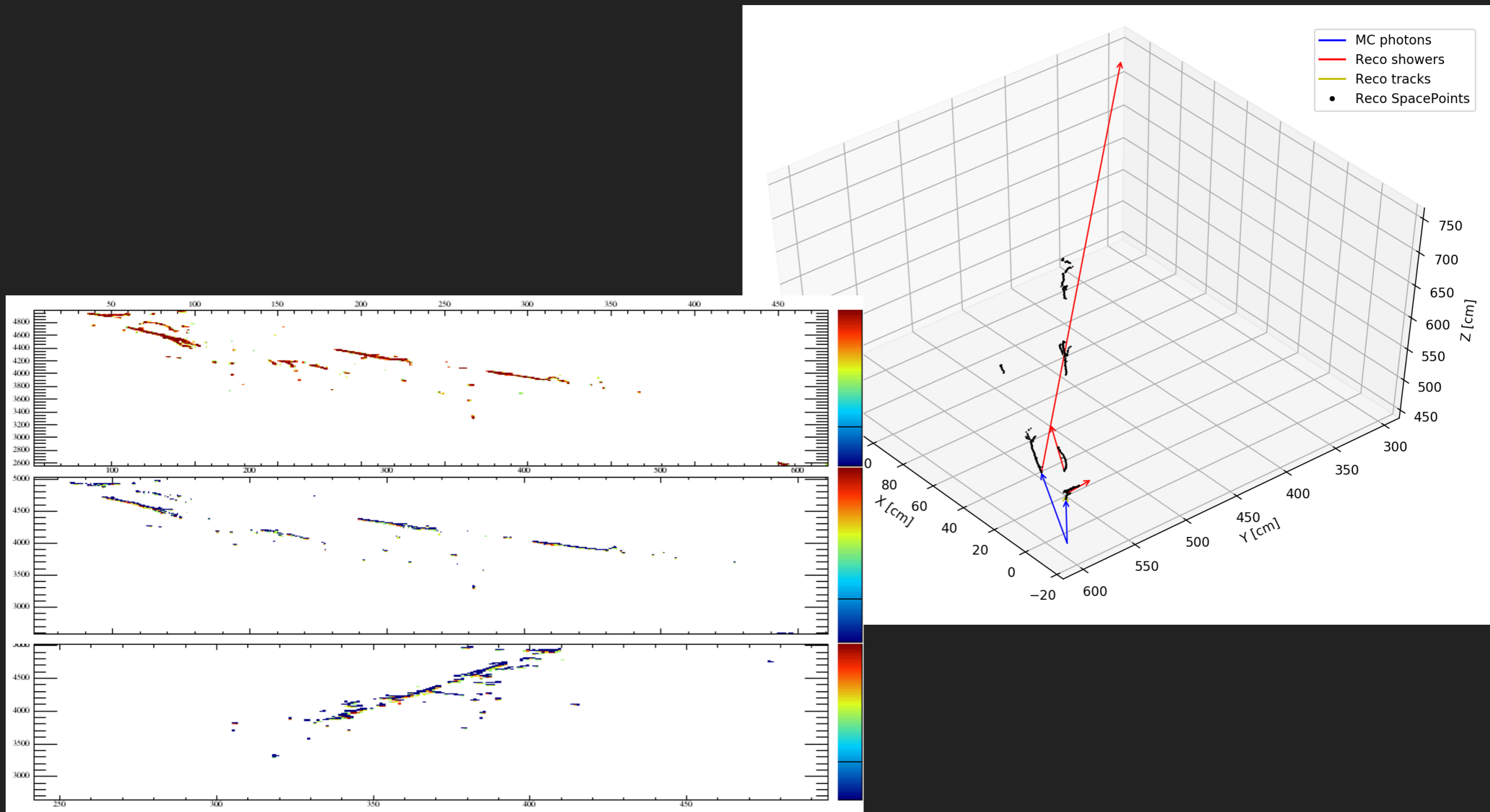


PROTODUNE MODIFIED RECONSTRUCTION — 1 GEV π^0

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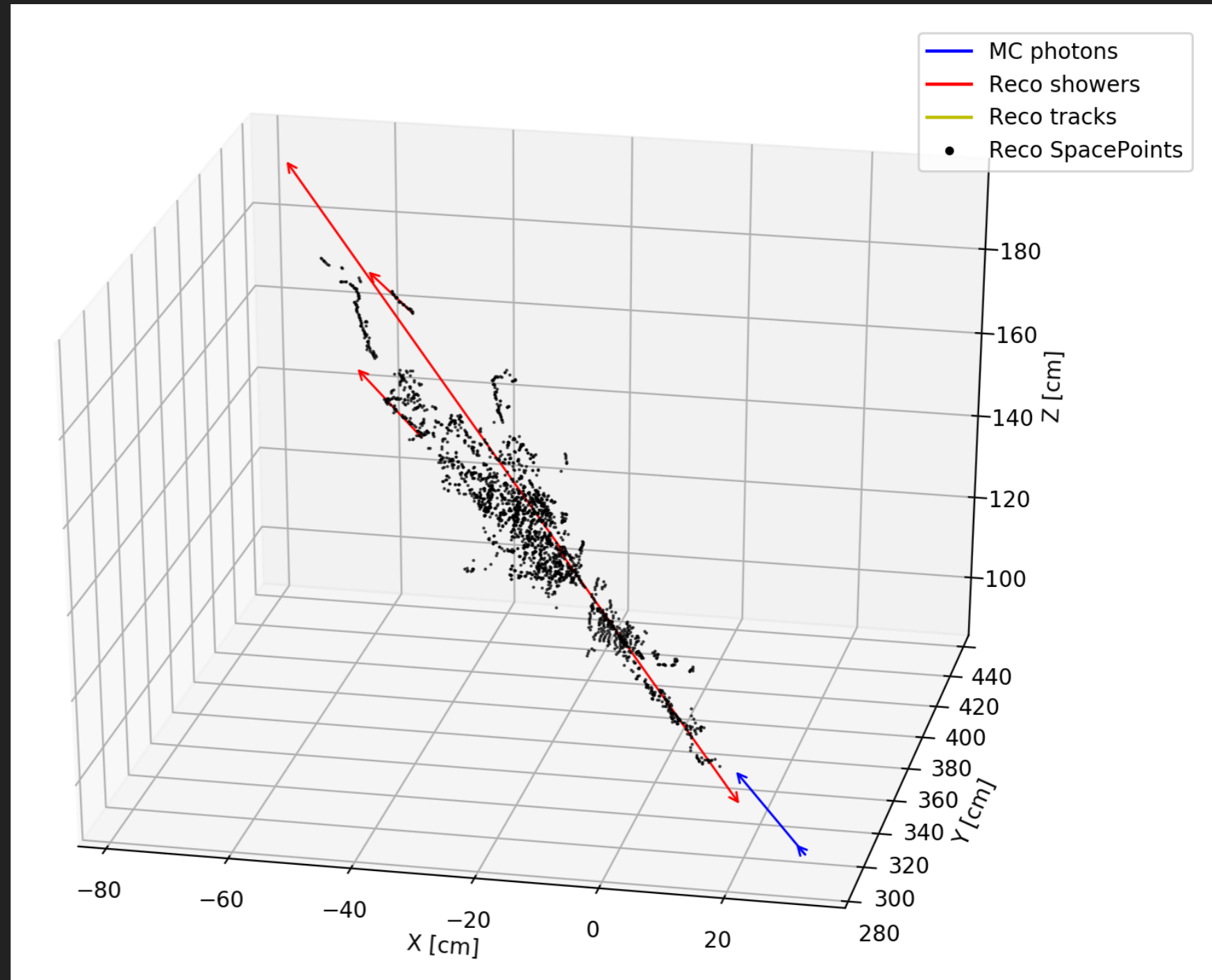


PROTODUNE MODIFIED RECONSTRUCTION — 1 GEV π^0



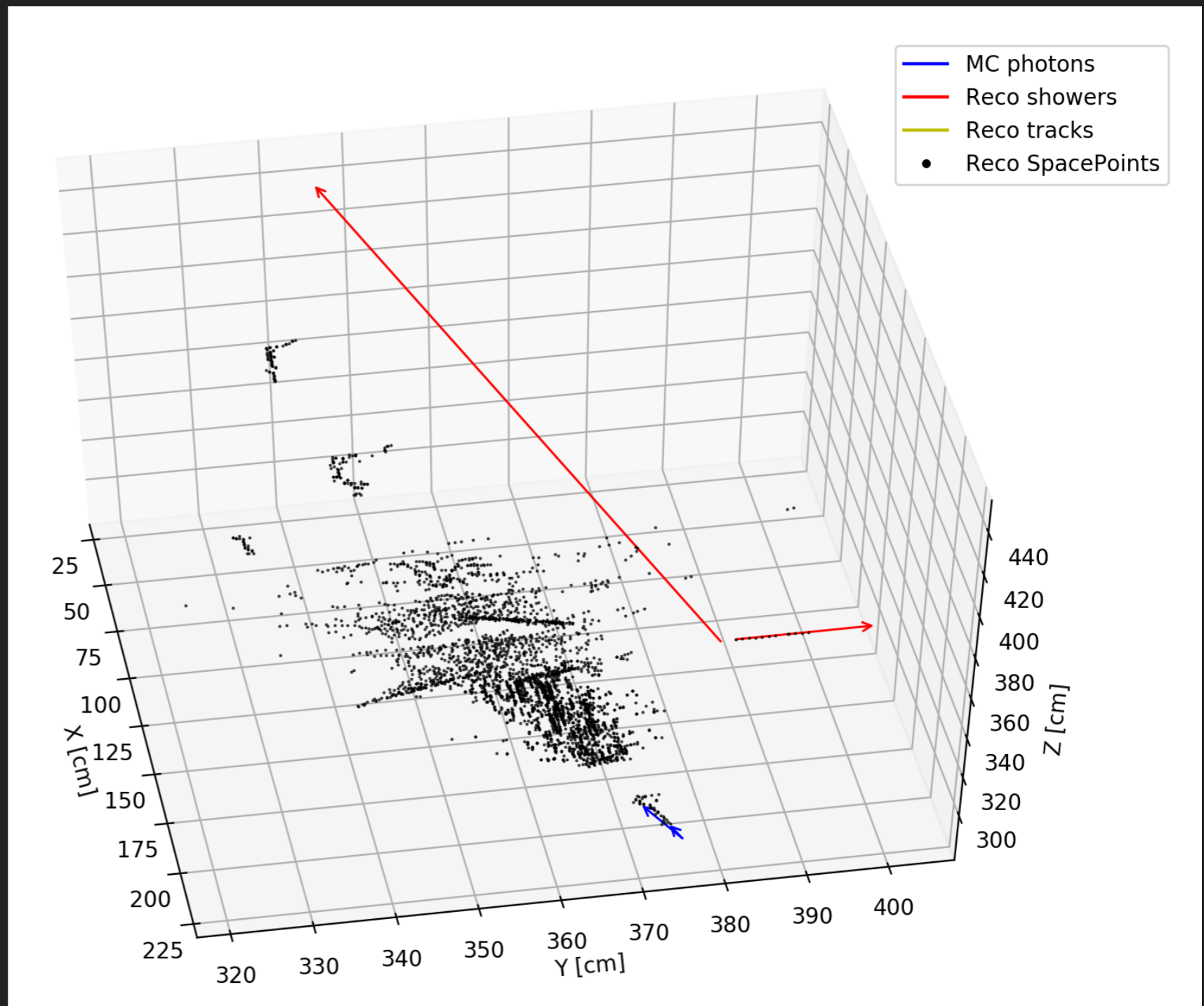
PROTODUNE MODIFIED RECONSTRUCTION — 5 GEV π^0

- ▶ Bigger showers recognised, but still split up



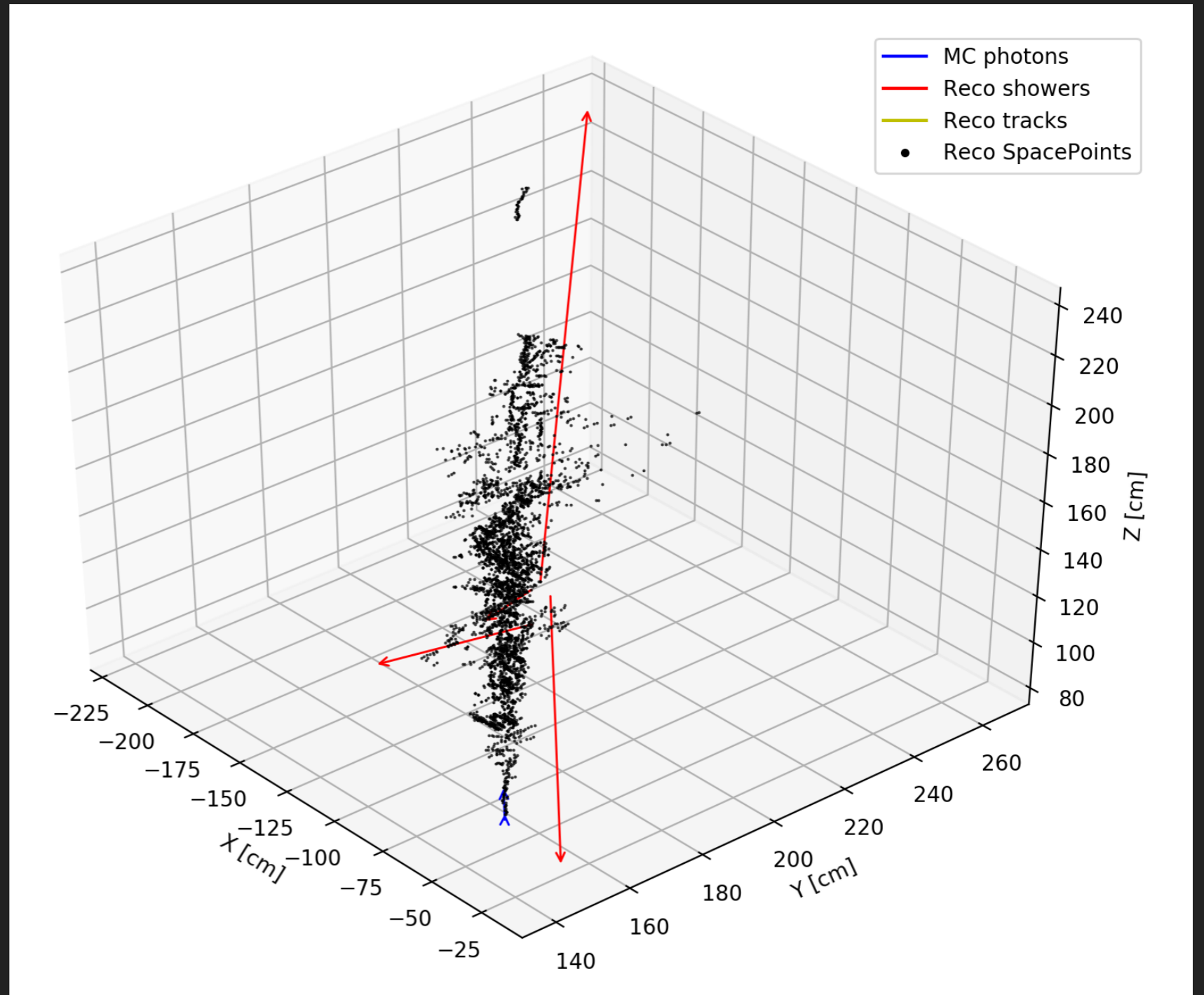
PROTODUNE MODIFIED RECONSTRUCTION — 5 GEV π^0

- ▶ Strangely misplaced showers in some events (in X, Y and Z)
- ▶ Otherwise good direction



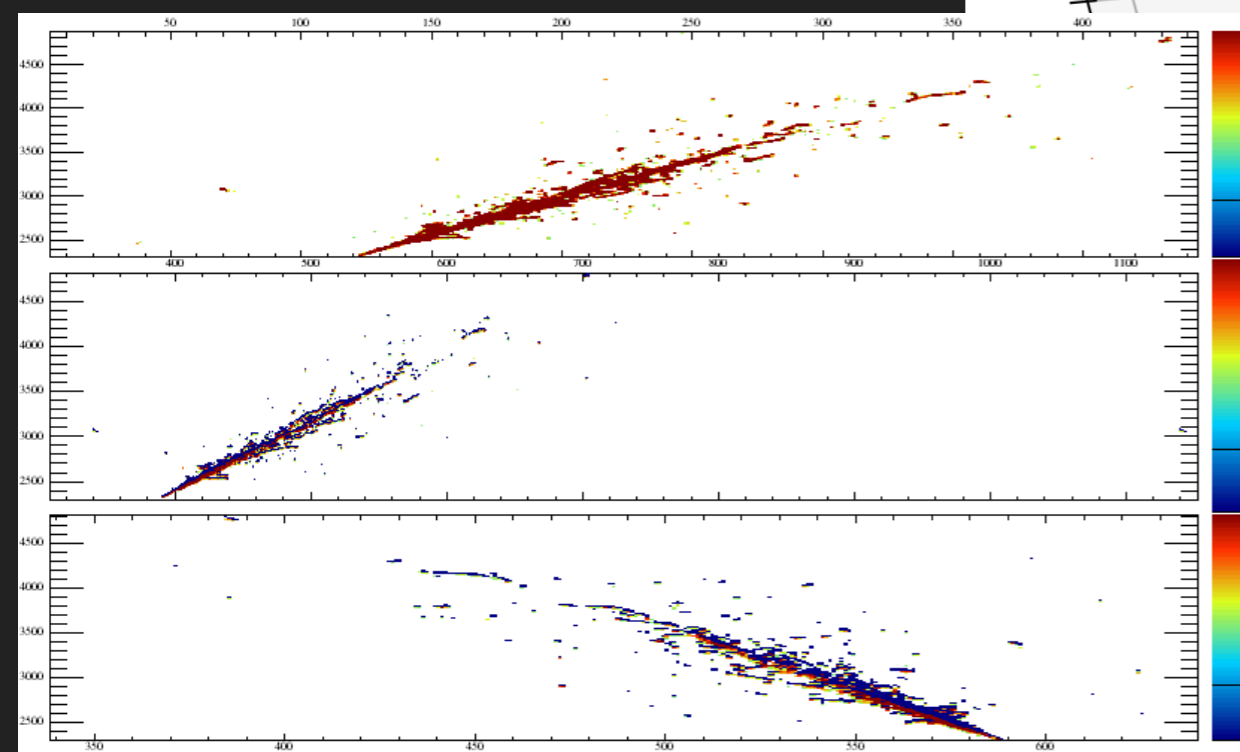
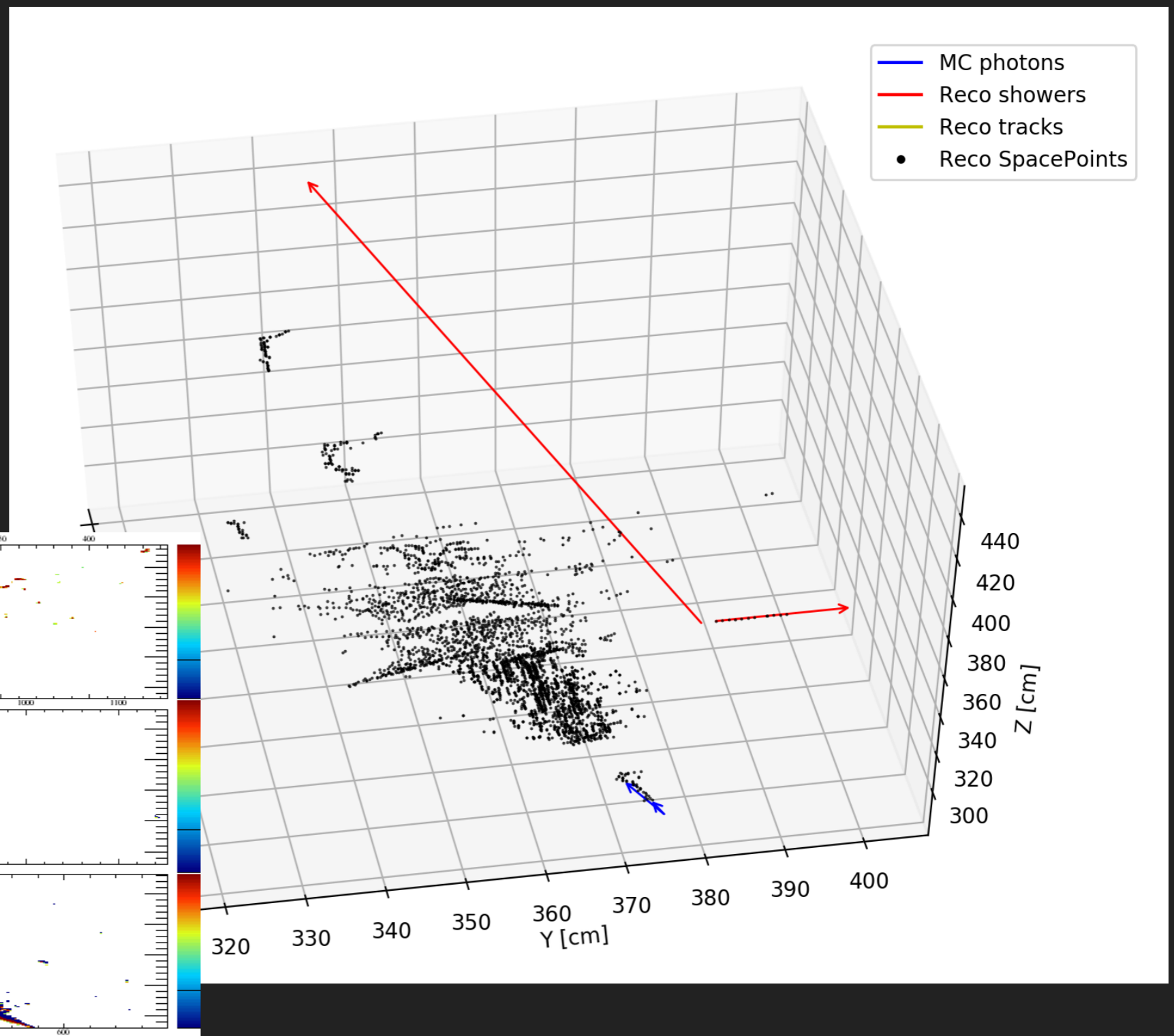
PROTODUNE MODIFIED RECONSTRUCTION — 5 GEV π^0

- ▶ Strangely misplaced showers in some events (in X, Y and Z)
- ▶ Otherwise good direction



PROTODUNE MODIFIED RECONSTRUCTION — 5 GEV π^0

- ▶ Nothing strange in event display

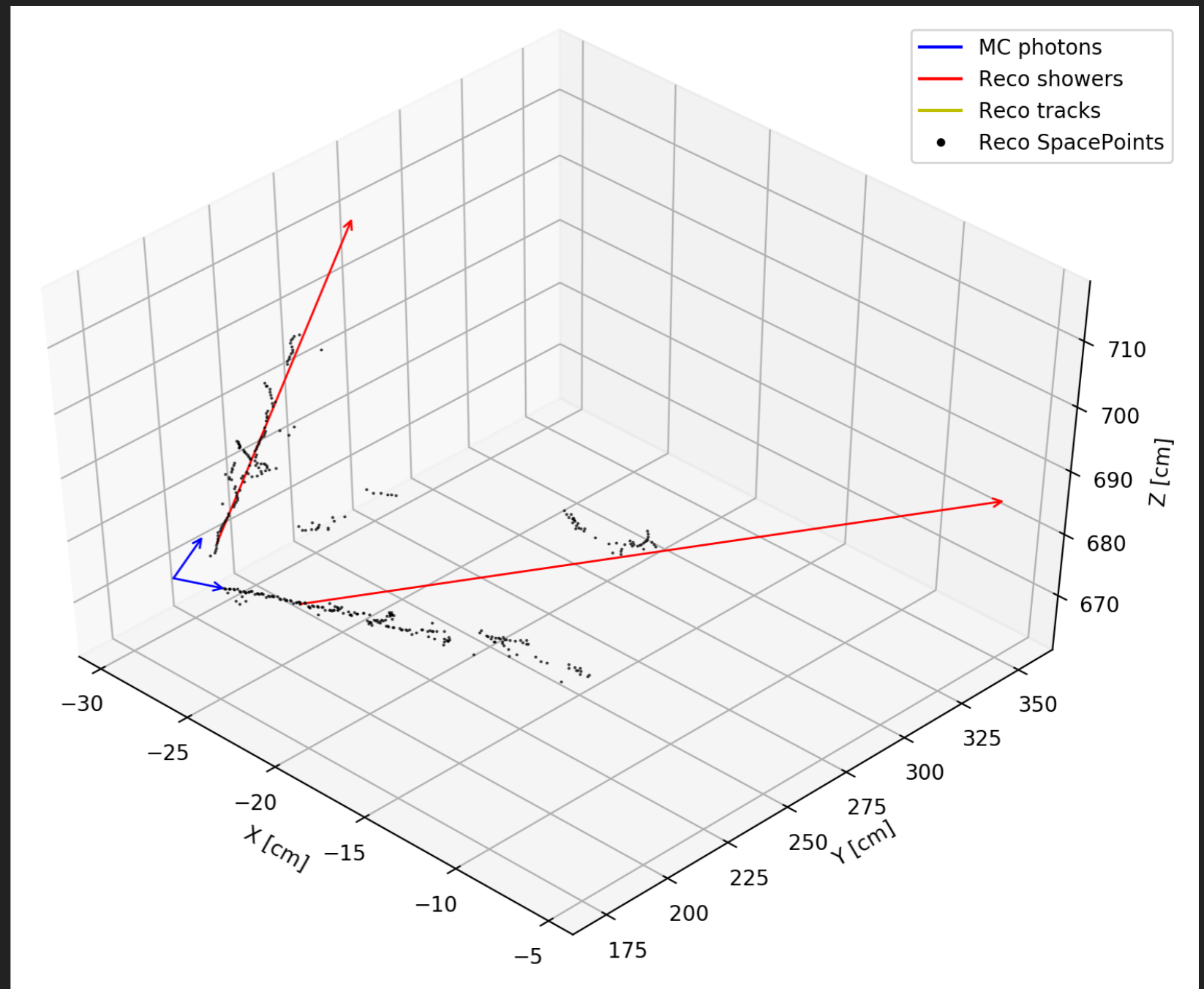


DUNE STANDARD RECONSTRUCTION

- ▶ Single π^0 events generated with standard 10kt fcl parameters

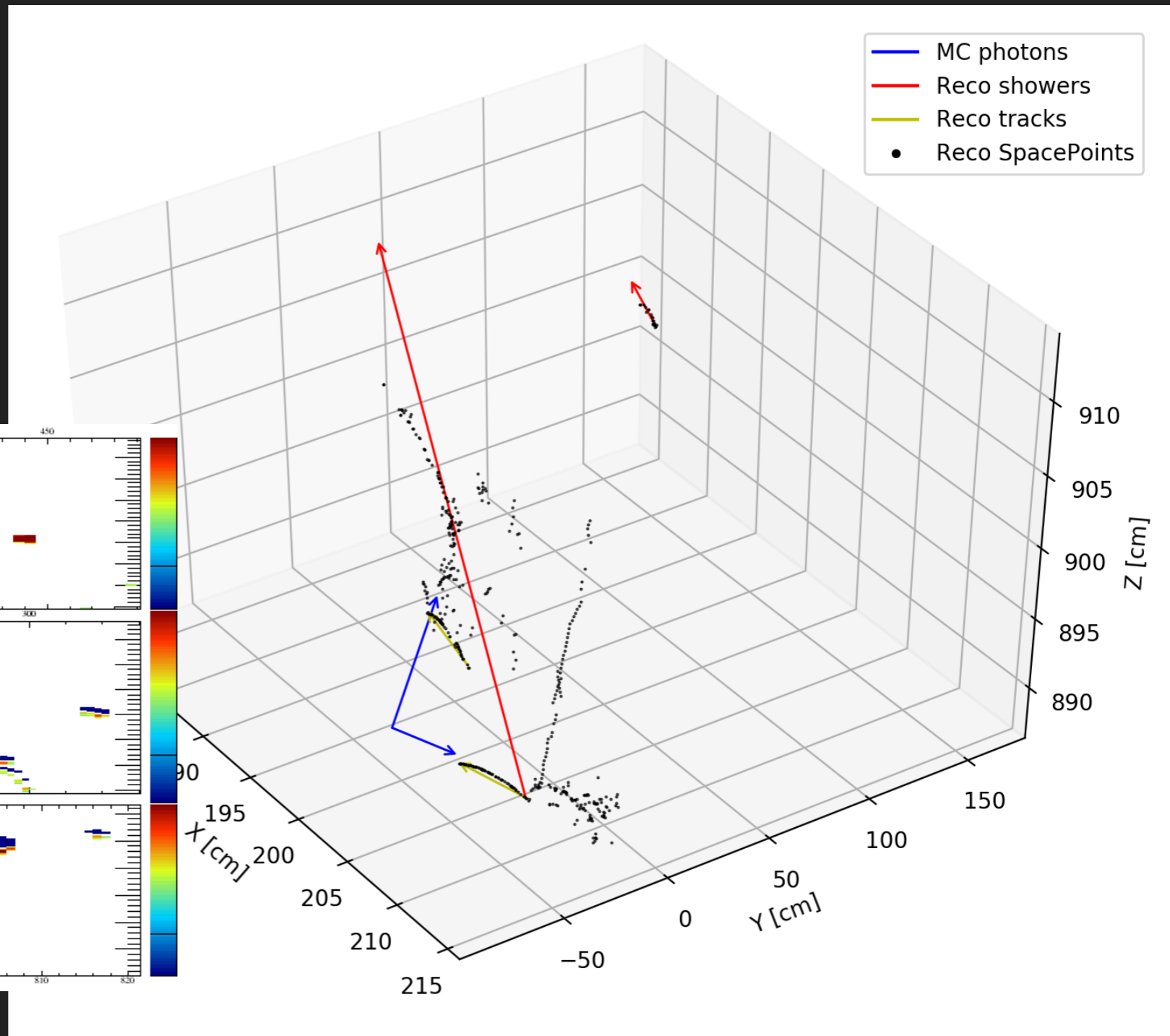
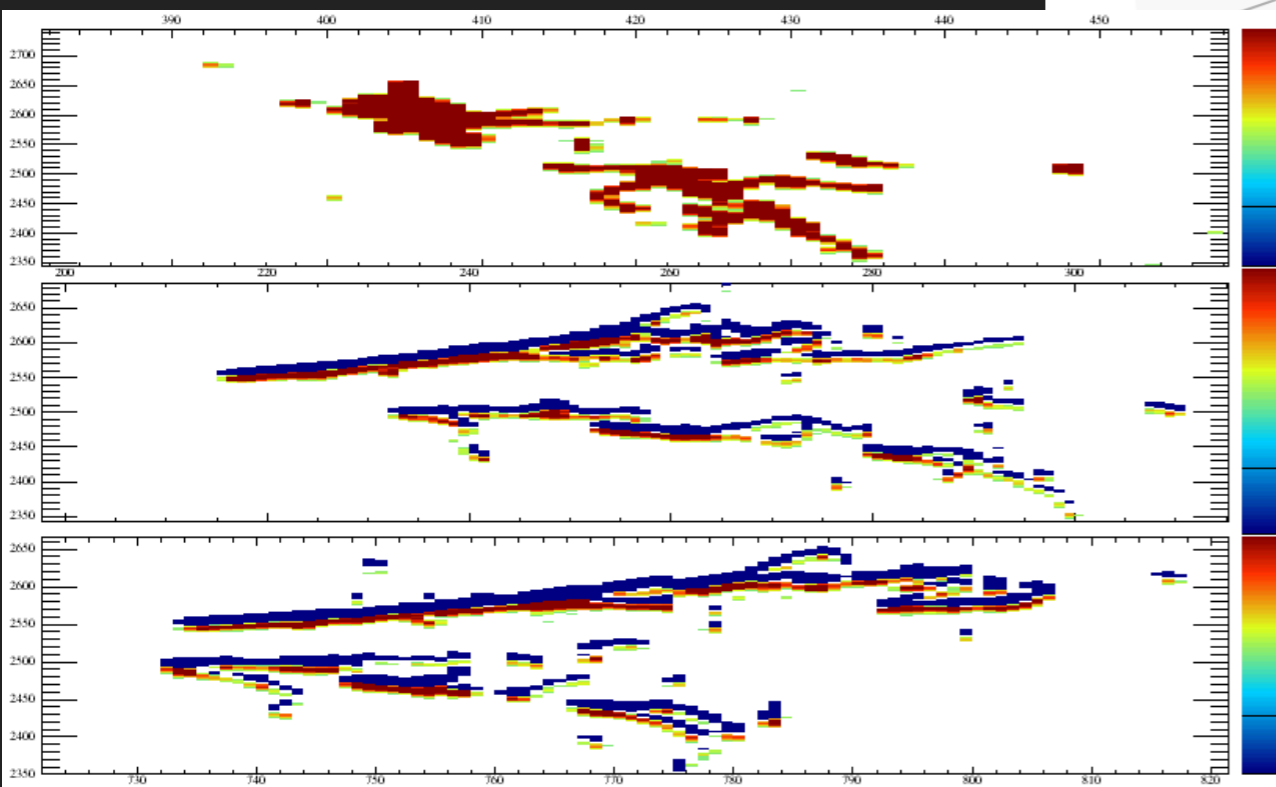
DUNE STANDARD RECONSTRUCTION — 1 GEV π^0

- ▶ Looks more like the modified than standard ProtoDUNE reco
- ▶ Few tracks, showers mostly in the right place



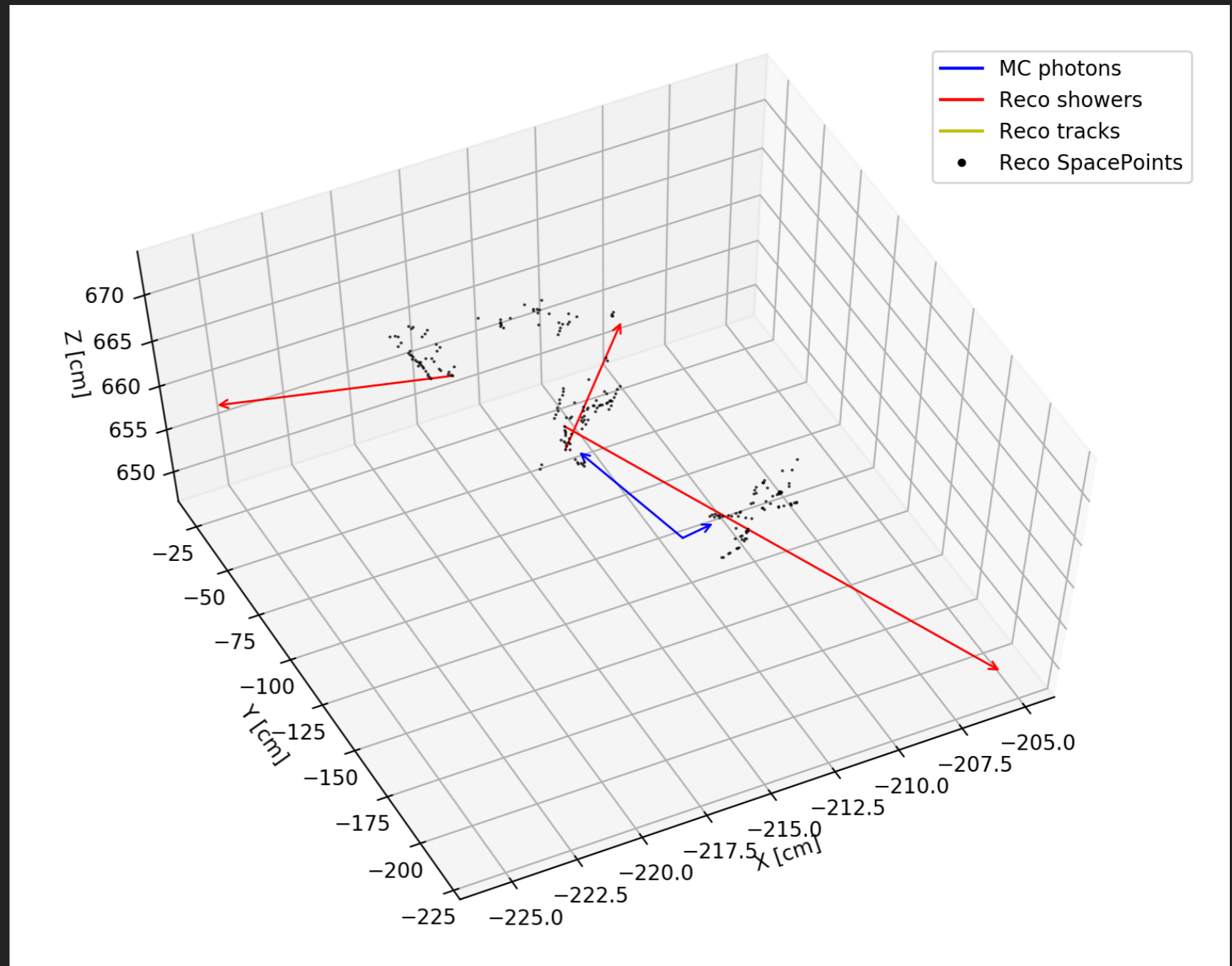
DUNE STANDARD RECONSTRUCTION — 1 GEV π^0

- ▶ Reco still has the tendency to link showers together



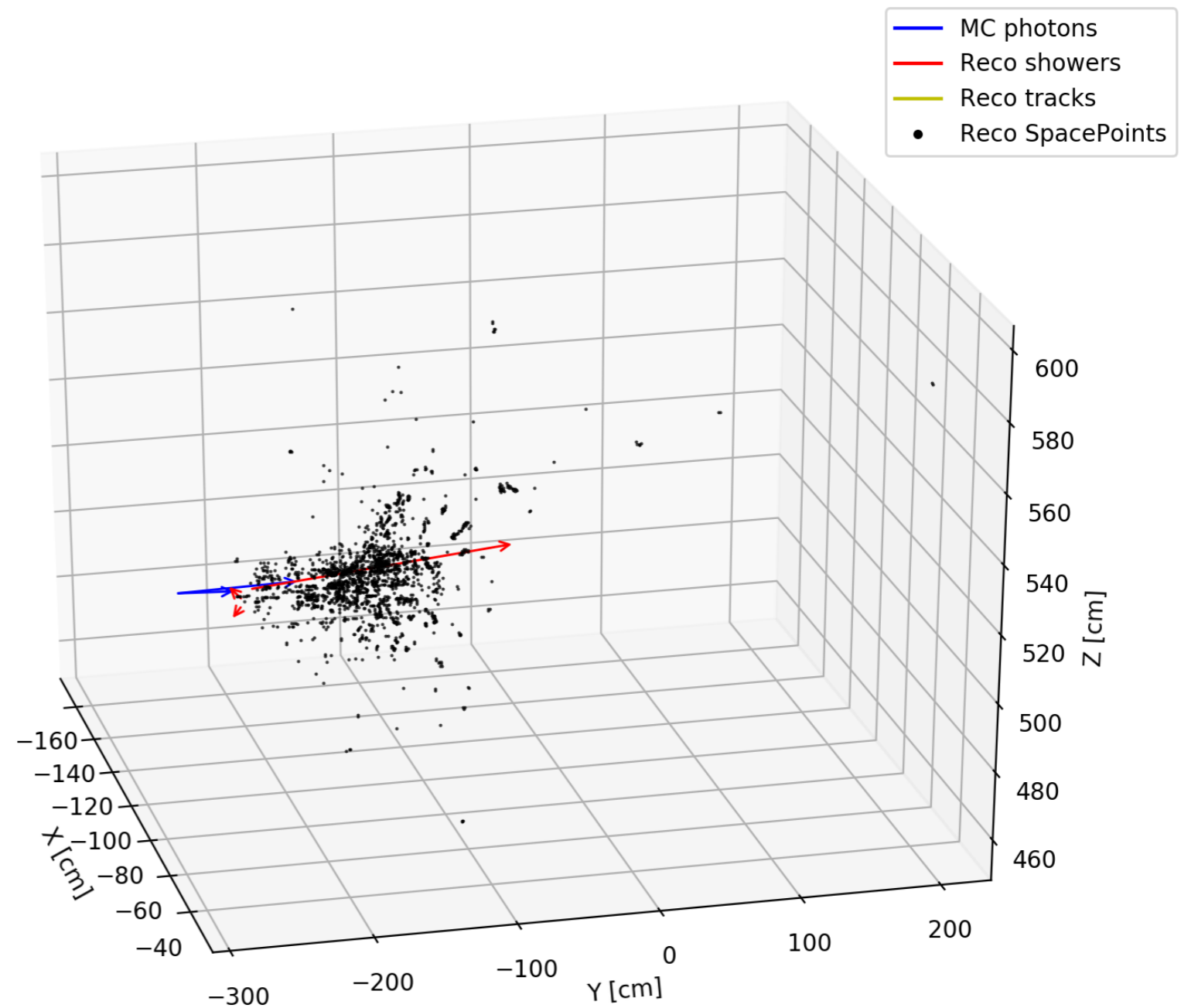
DUNE STANDARD RECONSTRUCTION — 1 GEV π^0

- ▶ Reco still has the tendency to link showers together



DUNE STANDARD RECONSTRUCTION — 1 GEV π^0

- ▶ Found a couple good events as well



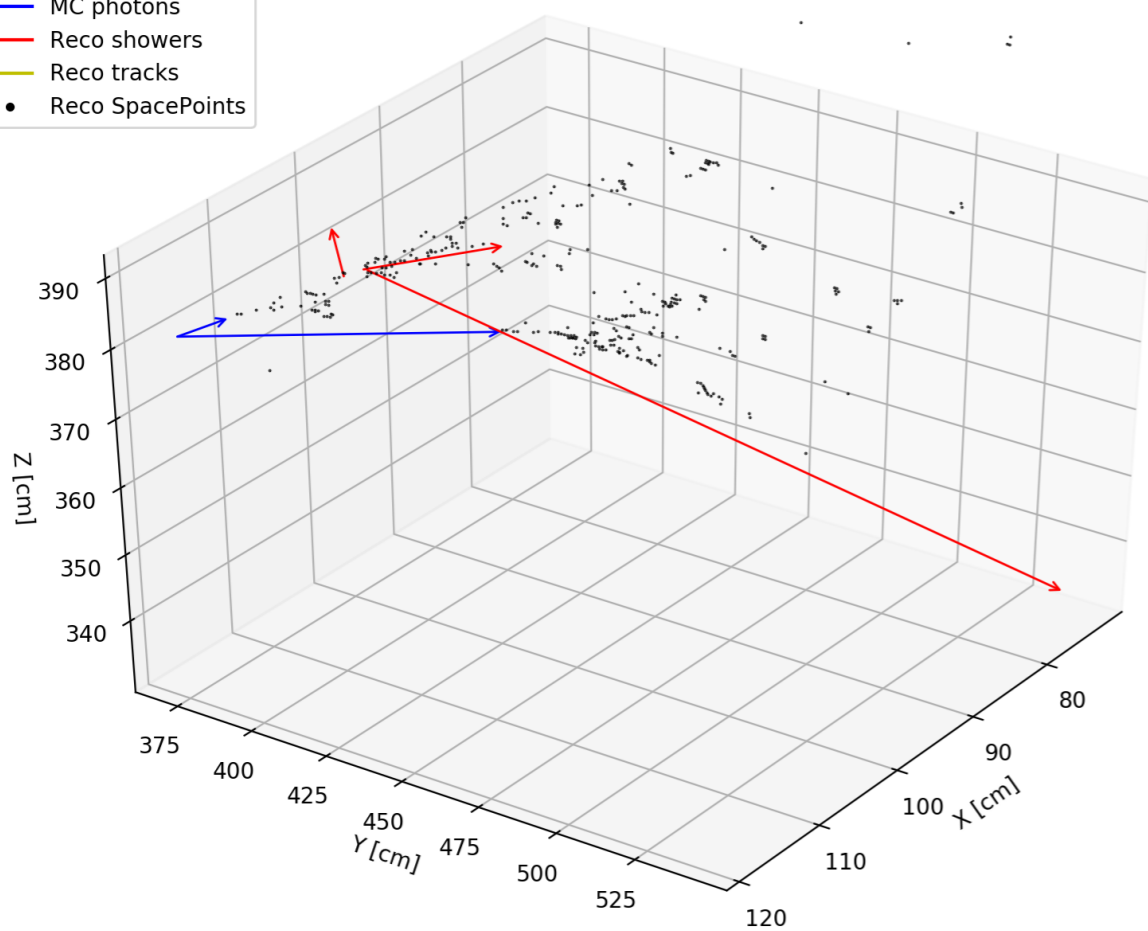
SUMMARY AND PLANS

- ▶ Reconstructed showers in the form shown here often do not seem to match actual showers
- ▶ Look more into Pandora shower reconstruction if needed
- ▶ π^0 reconstruction cannot proceed without accurate shower reconstruction

BACKUP

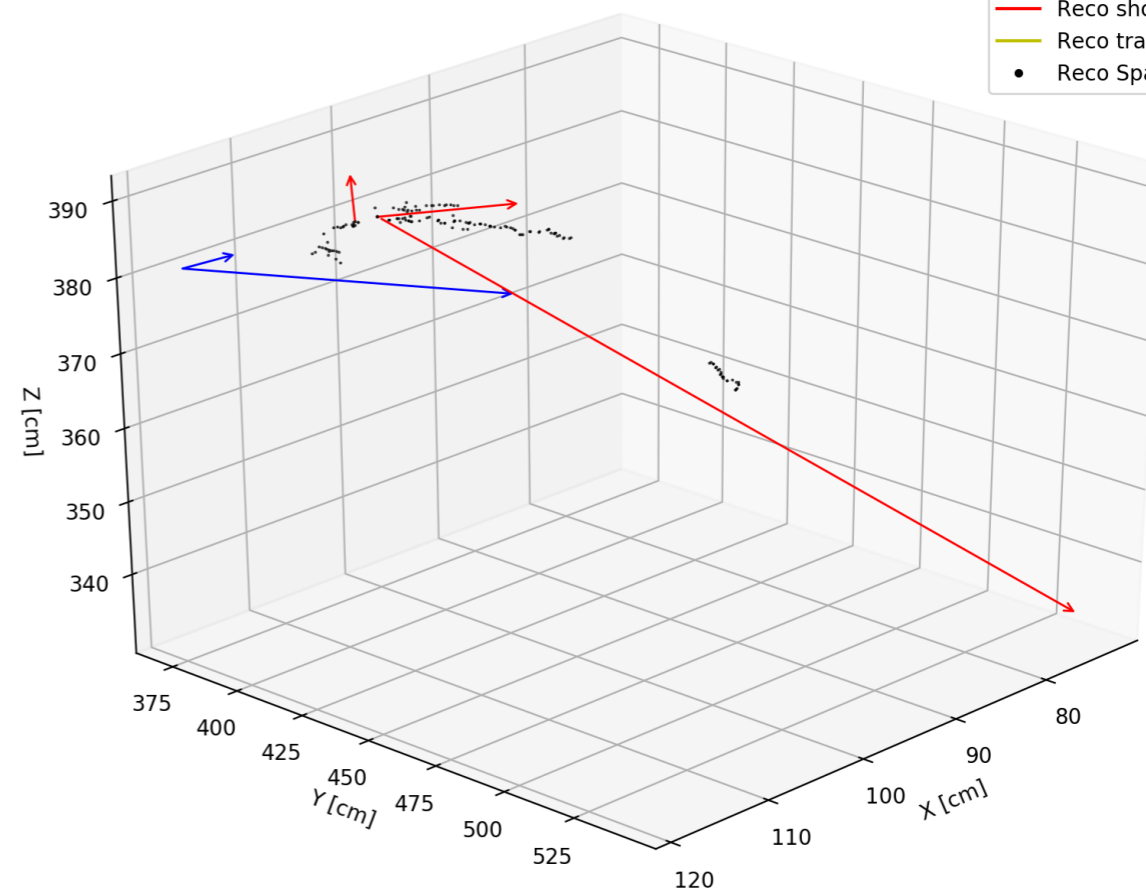
COMPARISON RECO3D AND PANDORA SPACEPOINTS

- MC photons
- Reco showers
- Reco tracks
- Reco SpacePoints



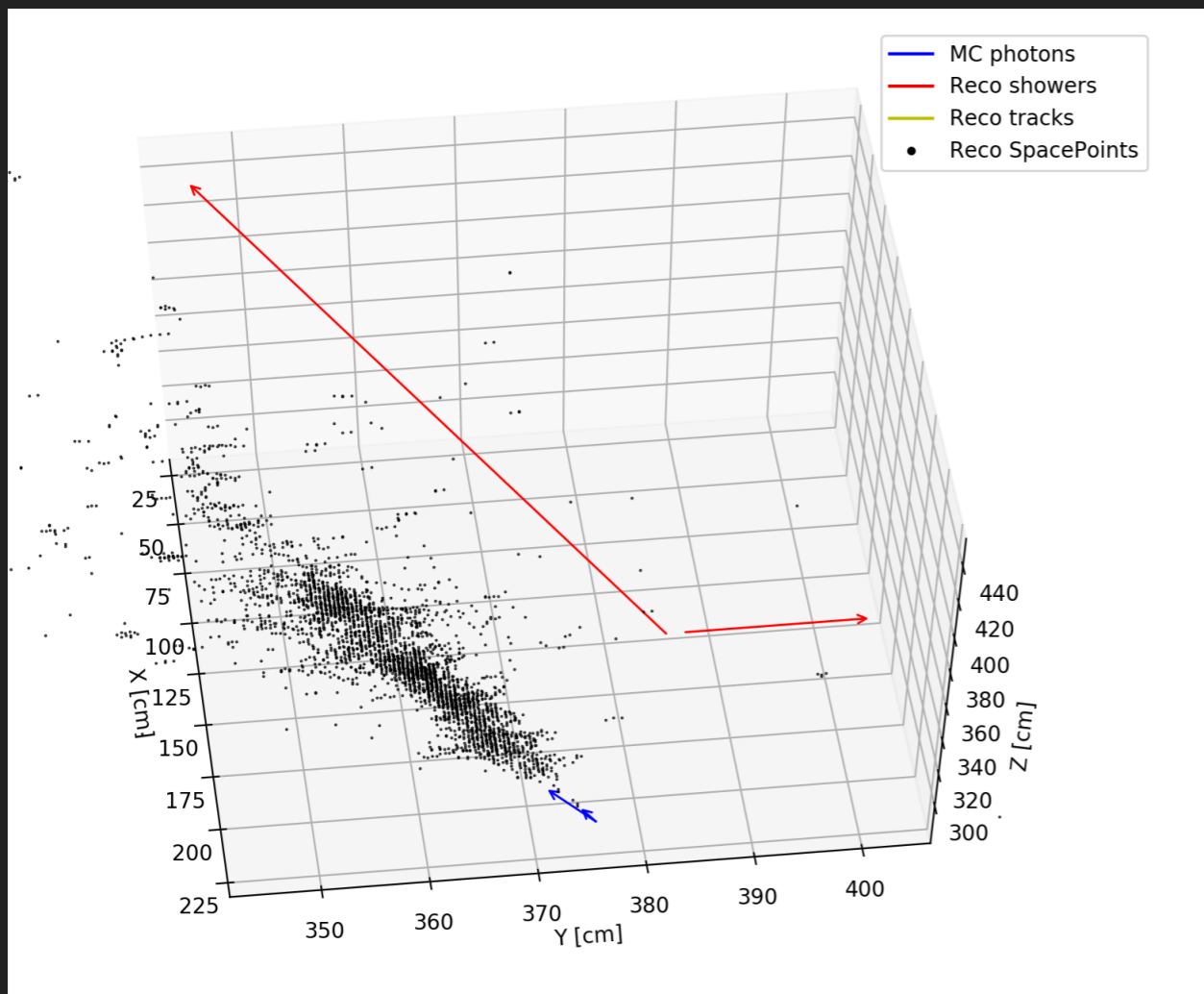
reco3d

- MC photons
- Reco showers
- Reco tracks
- Reco SpacePoints

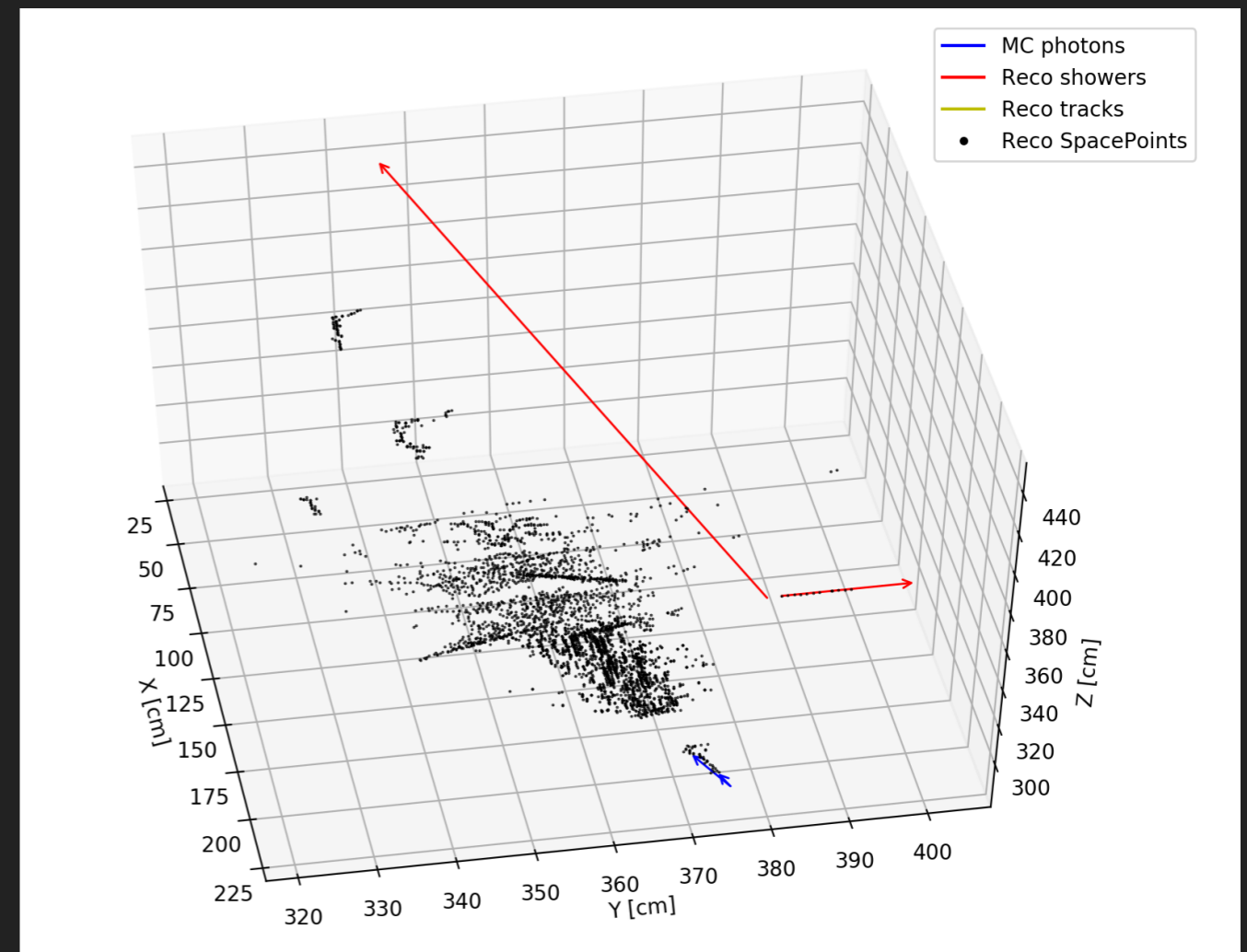


pandora

COMPARISON RECO3D AND PANDORA SPACEPOINTS

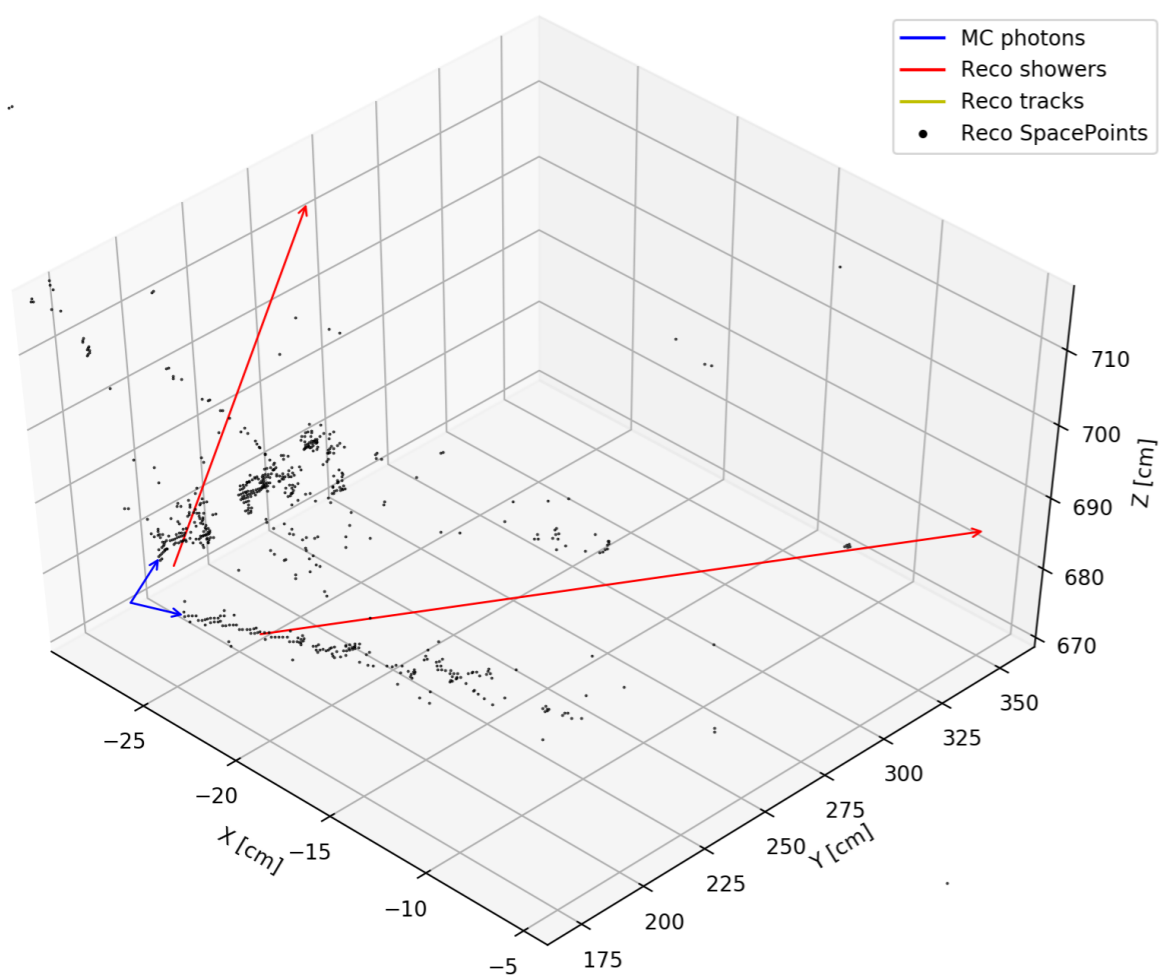


reco3d

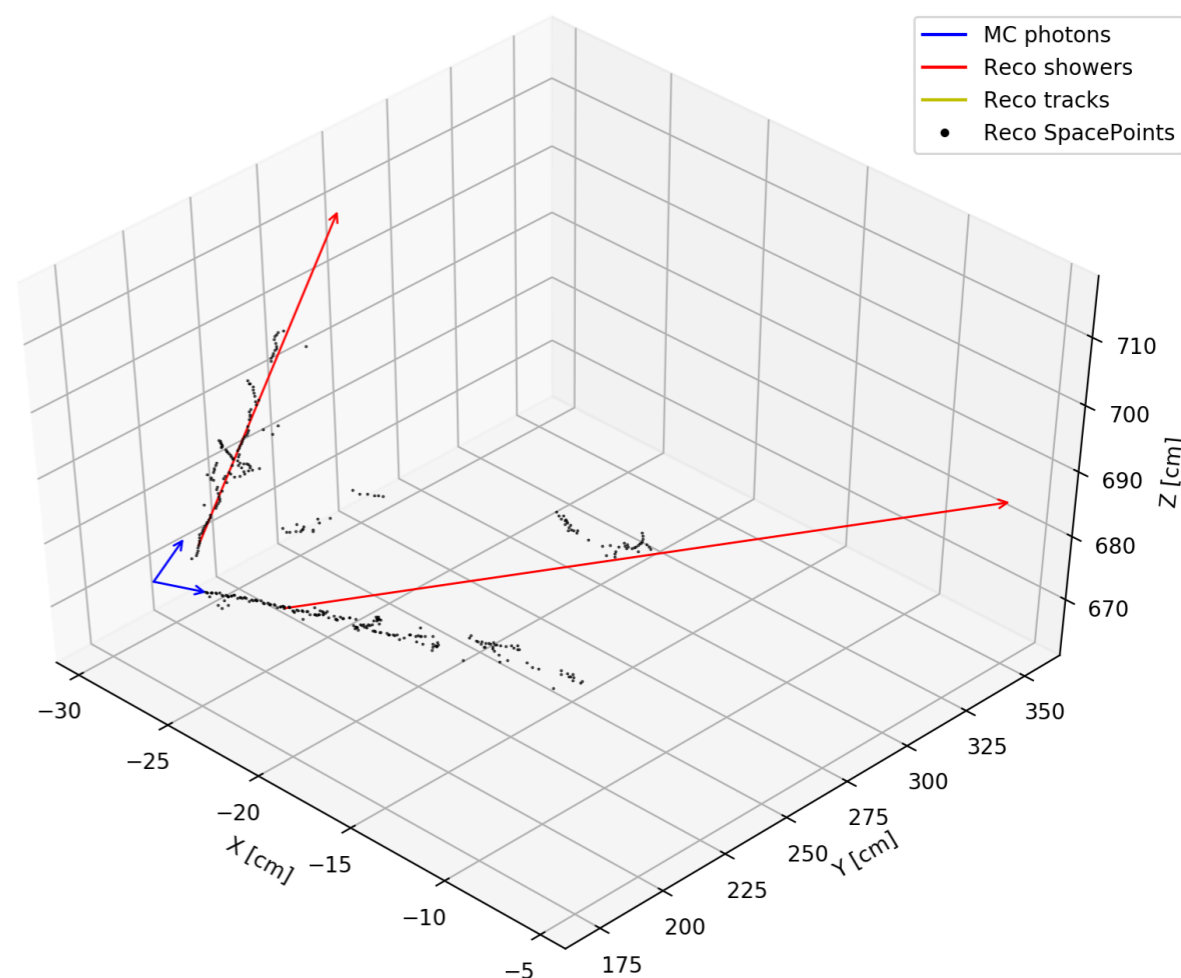


pandora

COMPARISON RECO3D AND PANDORA SPACEPOINTS



reco3d



pandora