(Two) Considerations on the orientation of readout strips (truth studies)

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Part -1

- In this study we're looking at NC interactions containing pi0-> yy -> 4e

- Aim is to identify and quantify events that have a charged particle track overlapping a gamma conversion, in which case we may misreconstruct the event

- For each gamma conversion we look at the vertical, orthogonal, and angular distance between the conversion and any PV tracks, in the xy, yz, yu and yv planes

- Definitions:

  - dphi: angular distance between y and track

  - dy: y_V - y_T in image
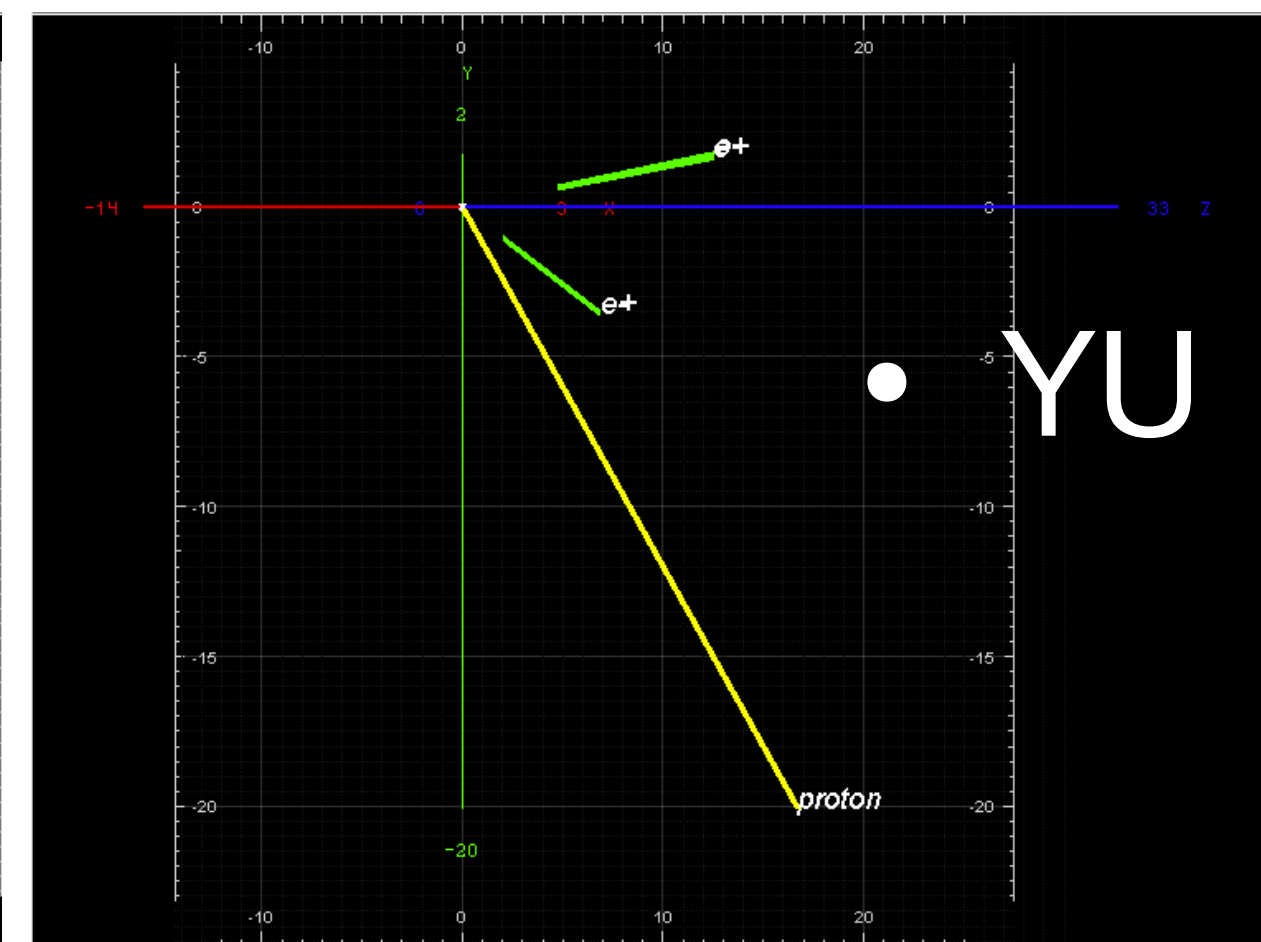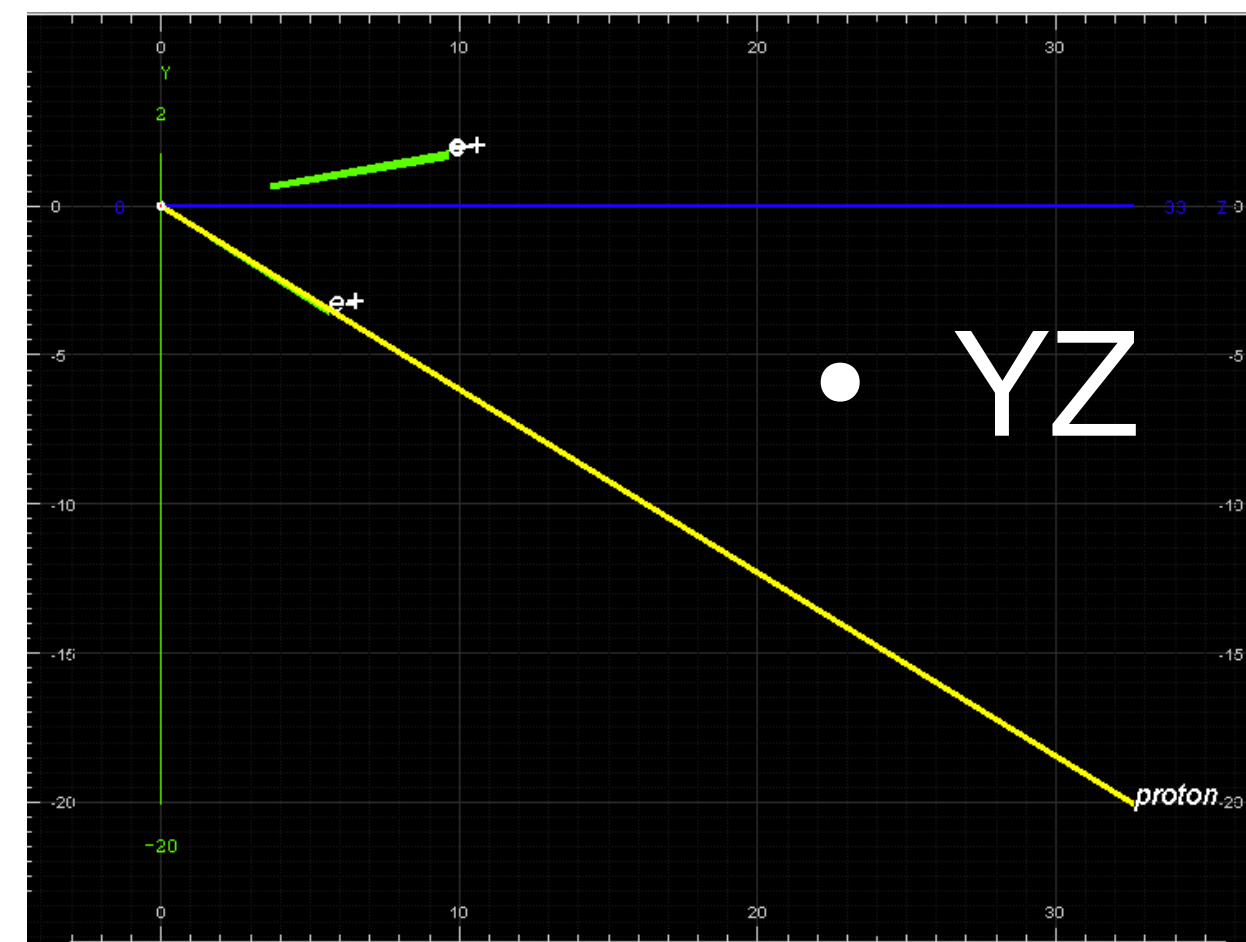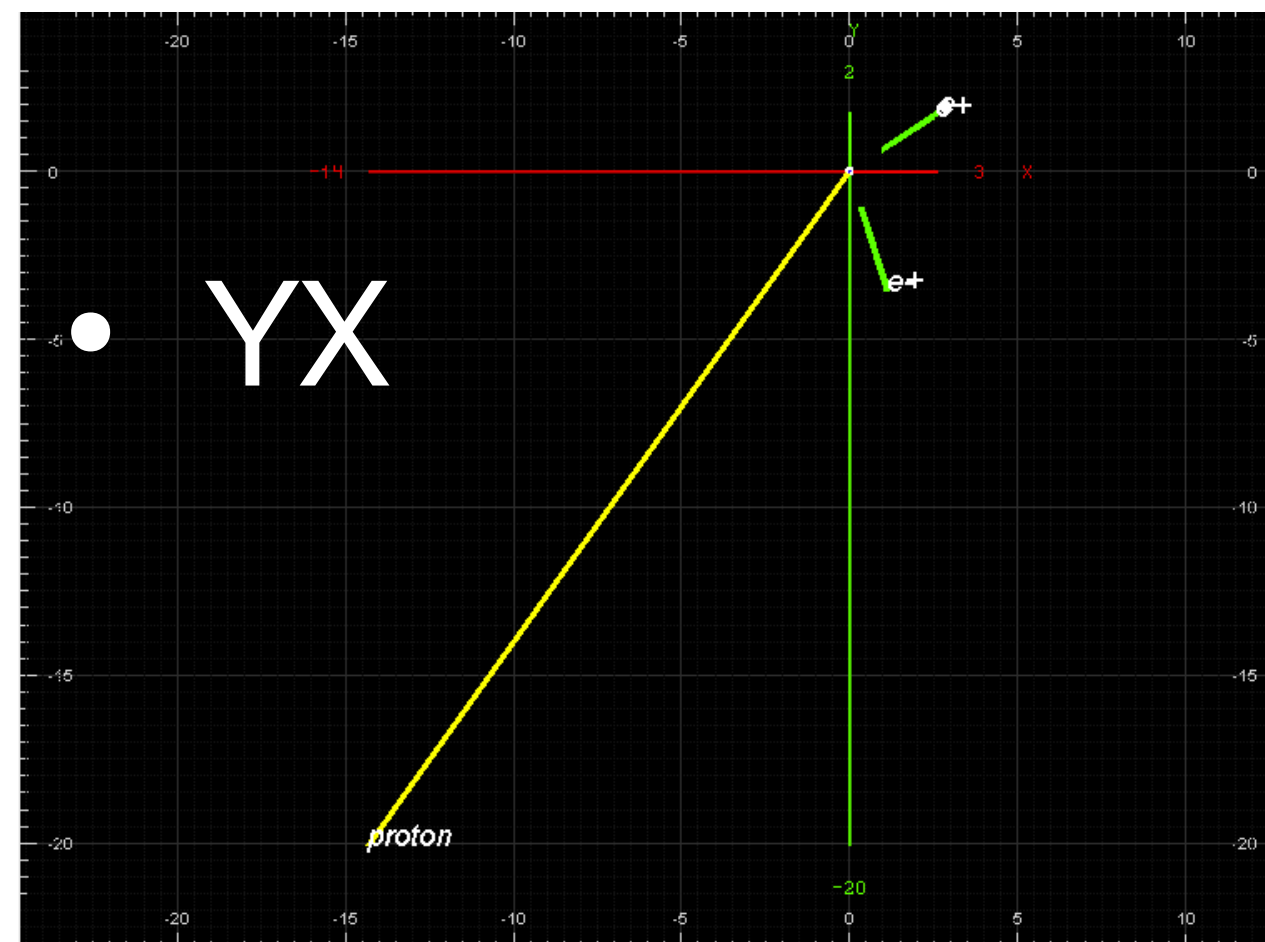
  - orthogonal distance: purple line in image

- Potentially problematic events:

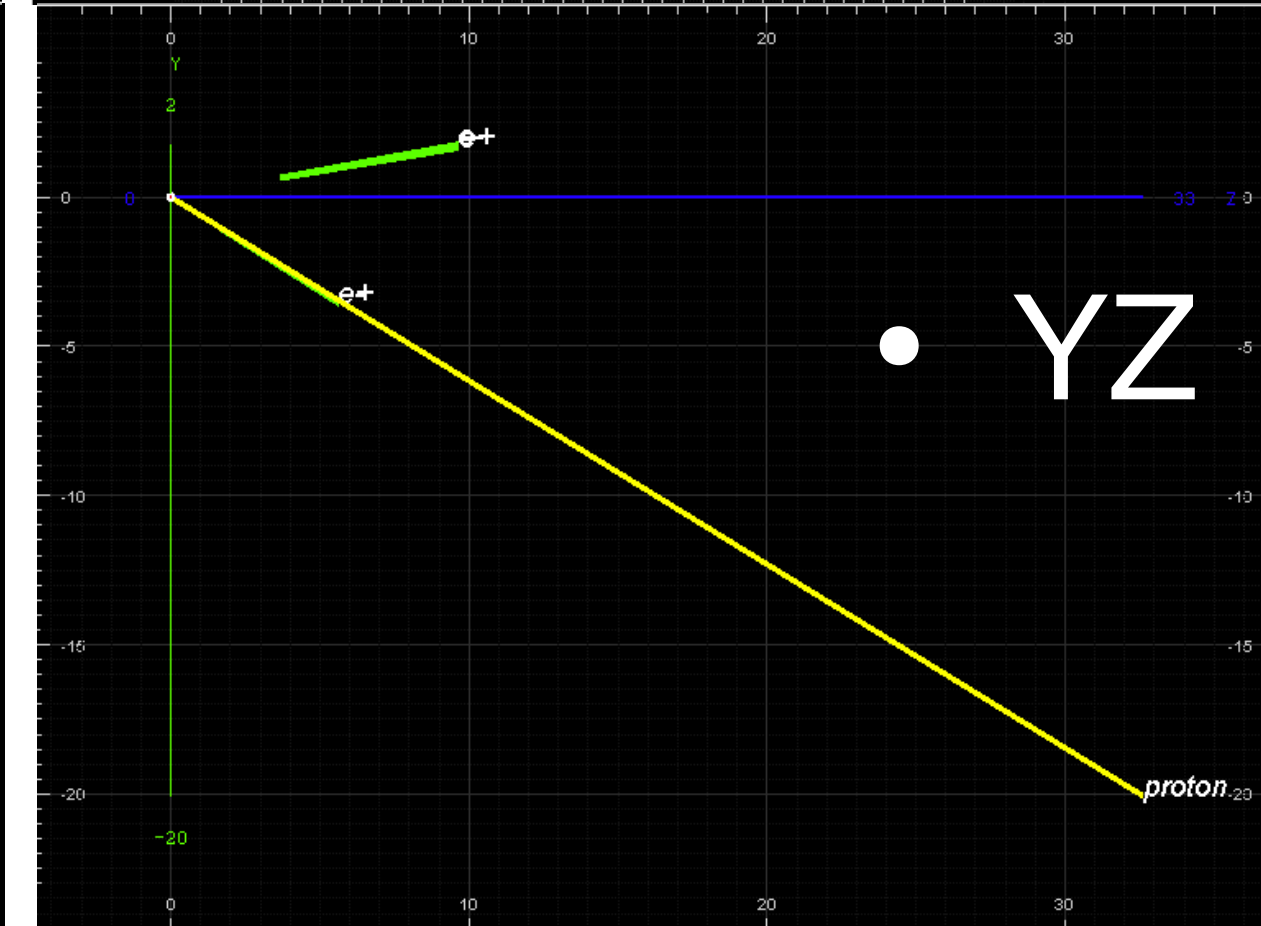 - d_orthog) < 1cm &&
  - dphi < 20 degrees

  for each of the gammas, any track, in all projected planes
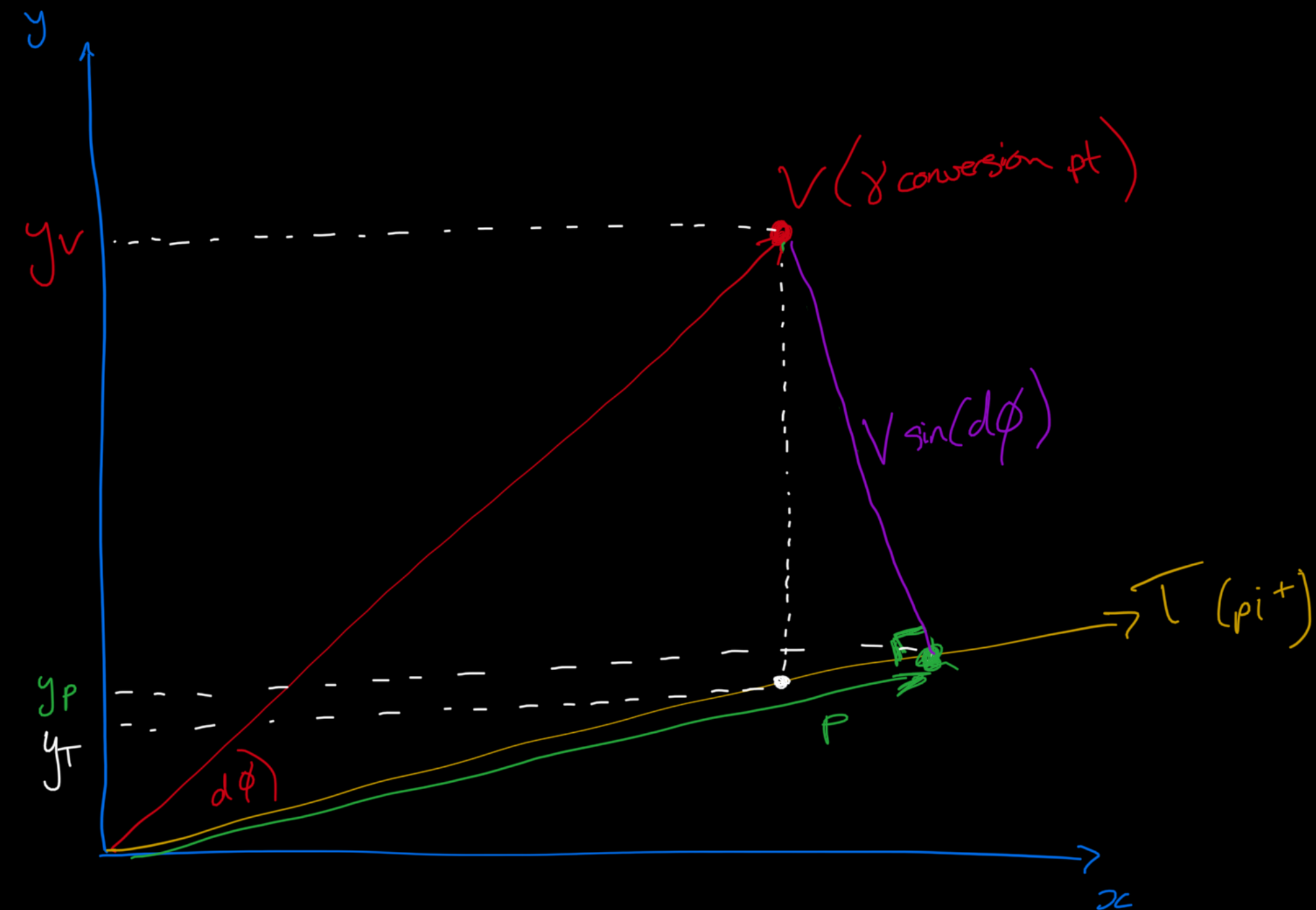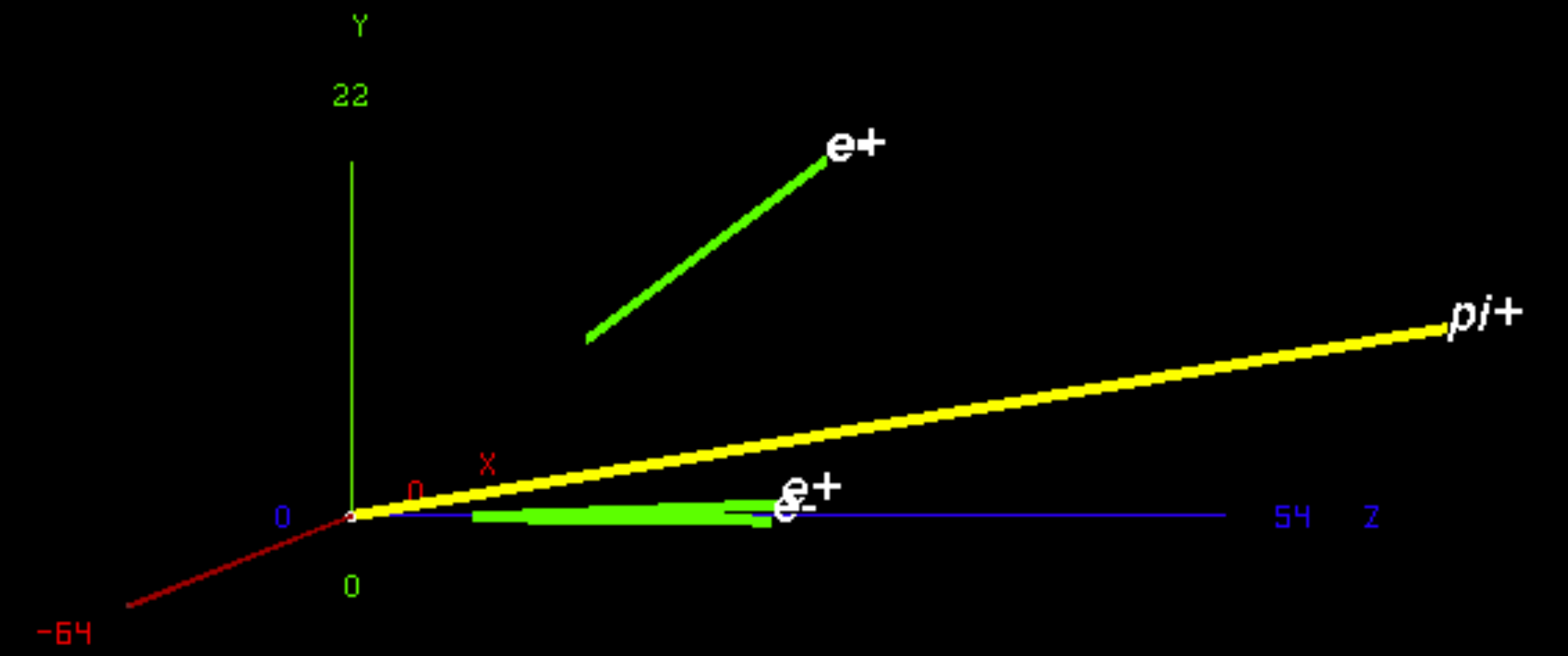
Event 99813 flagged as problematic
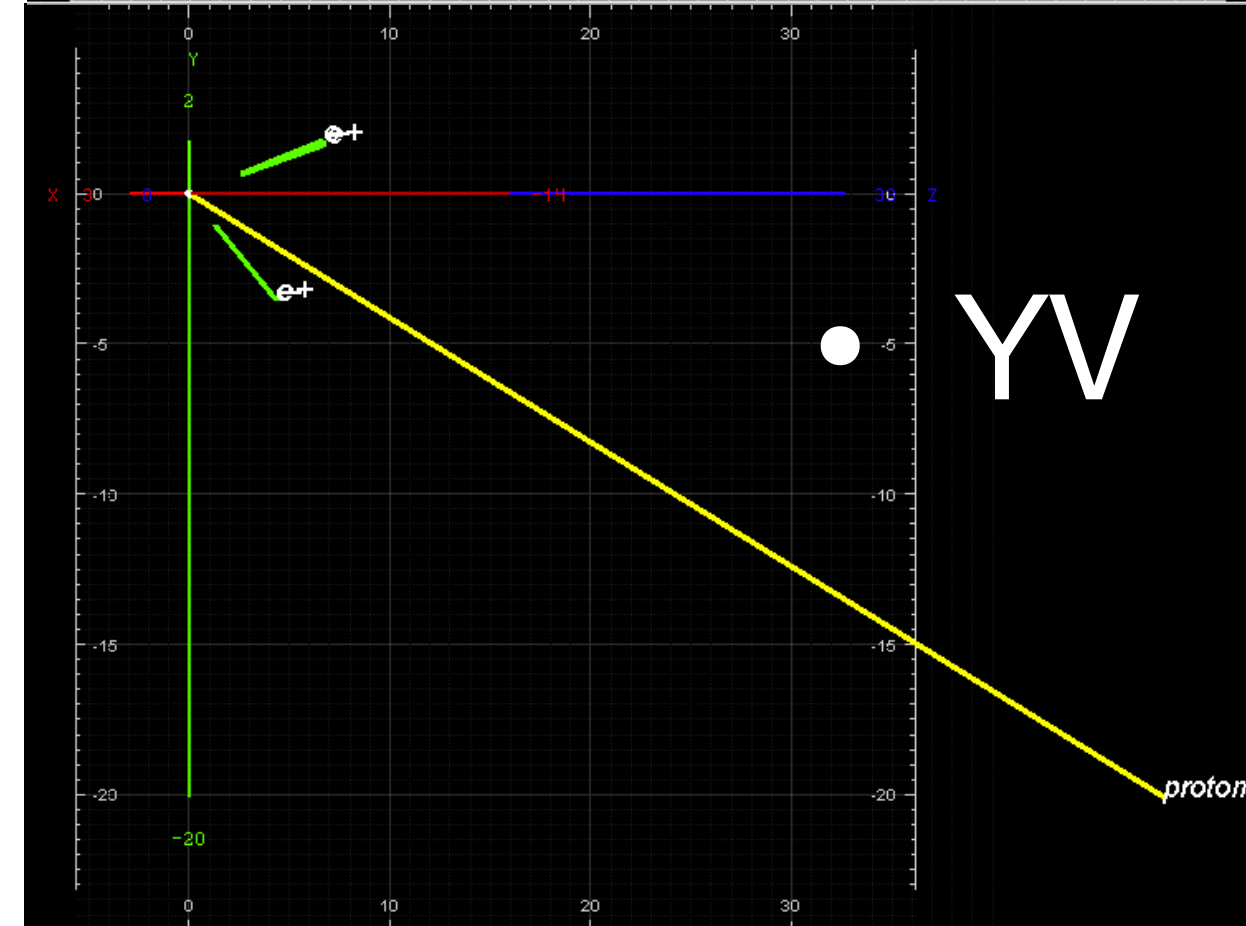
- (0, 90, -48)
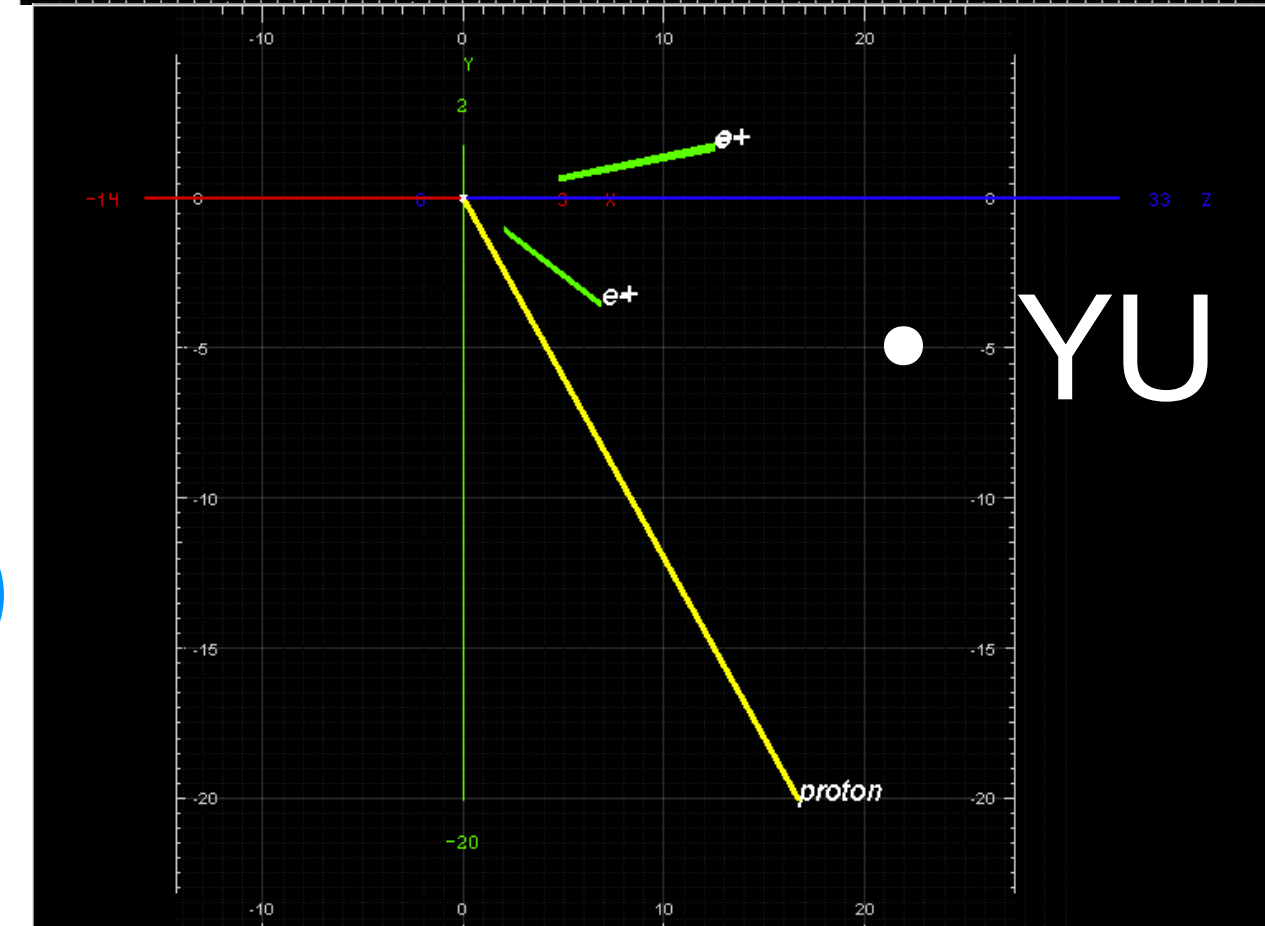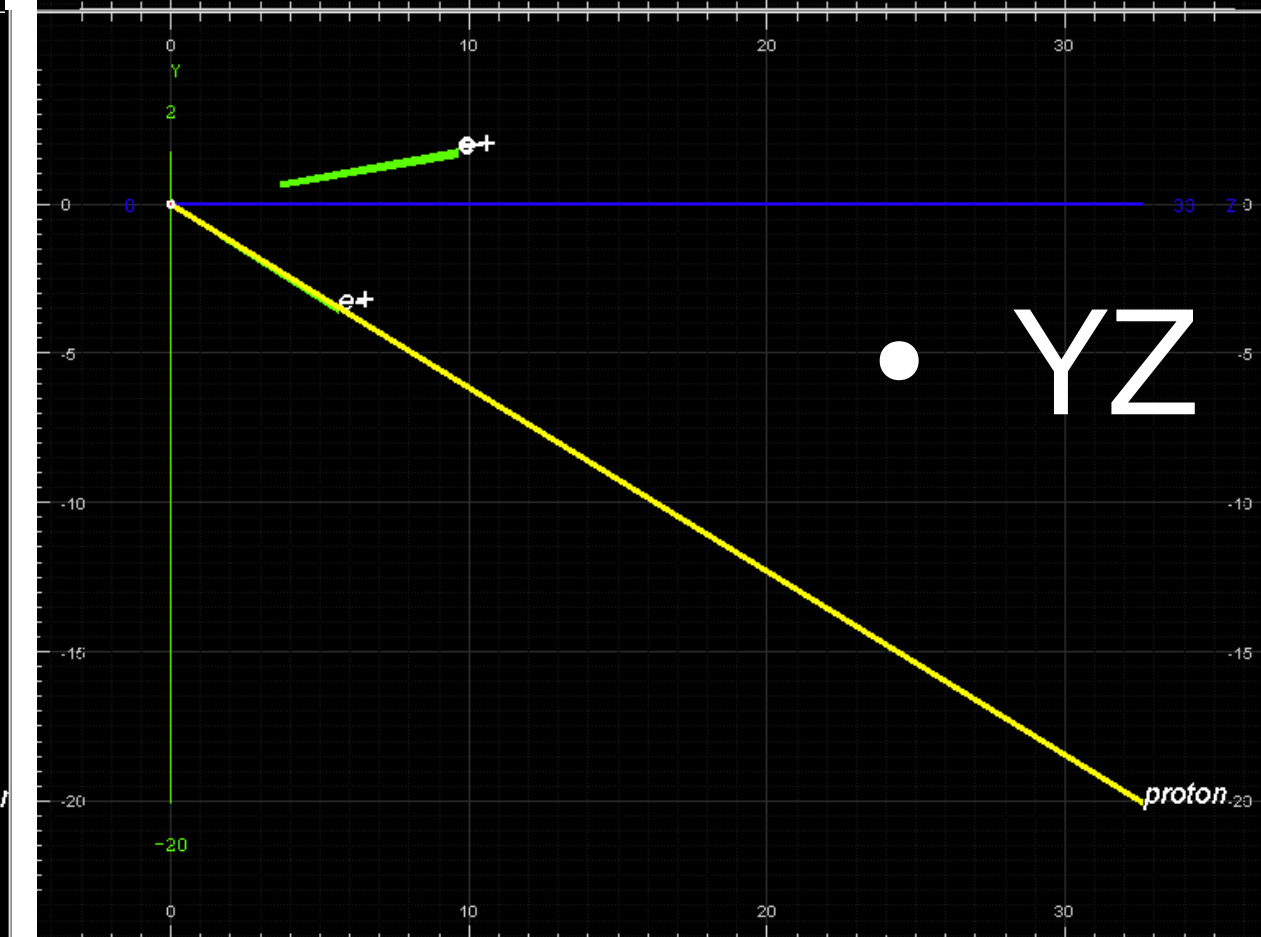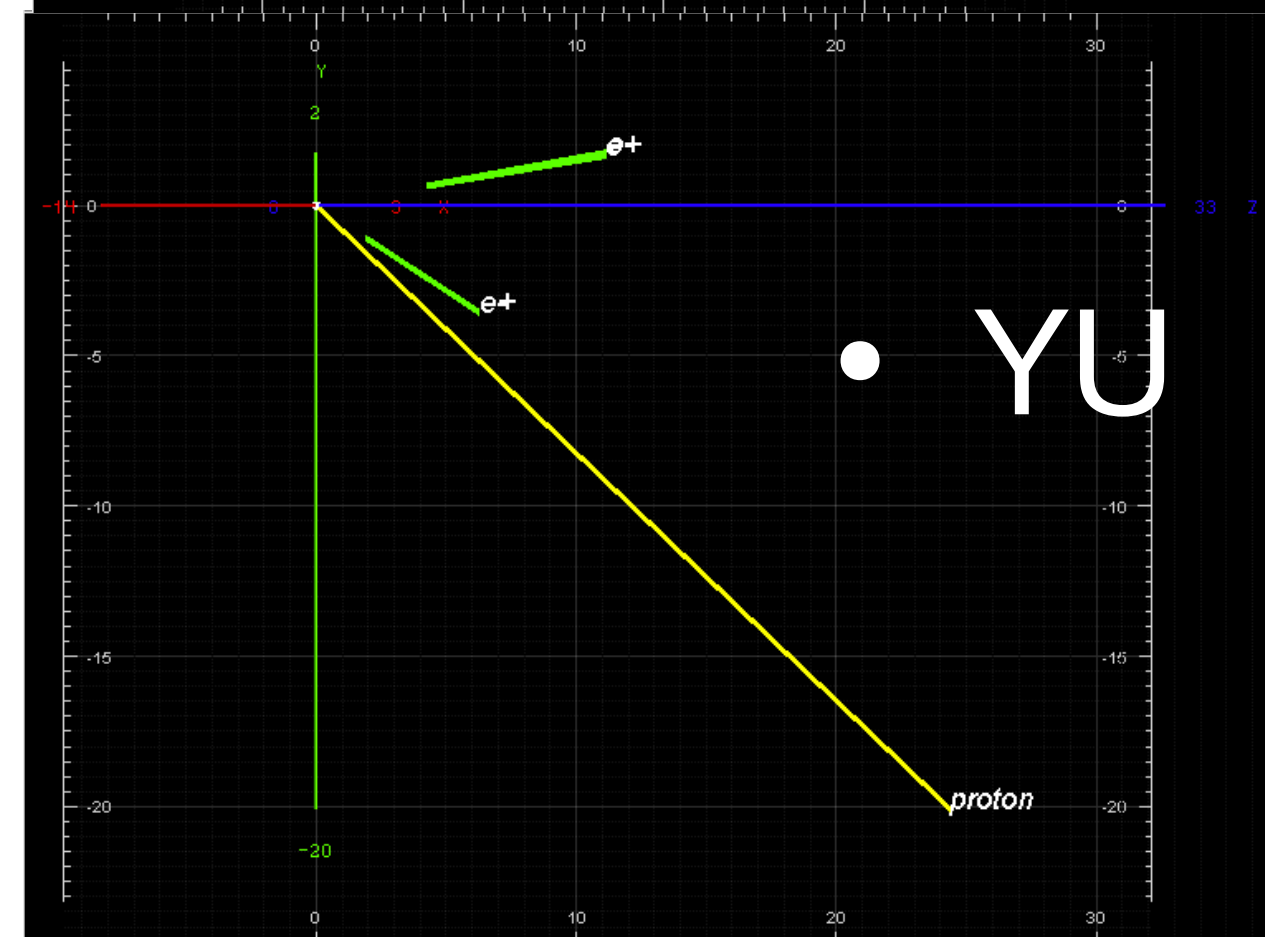- (-48, 48, 90)
- (-30, 30, 90)

Event 99813 flagged as problematic

- (0, 90, -48)

- (-48, 48, 90)

- (-30, 30, 90)

YX

proton

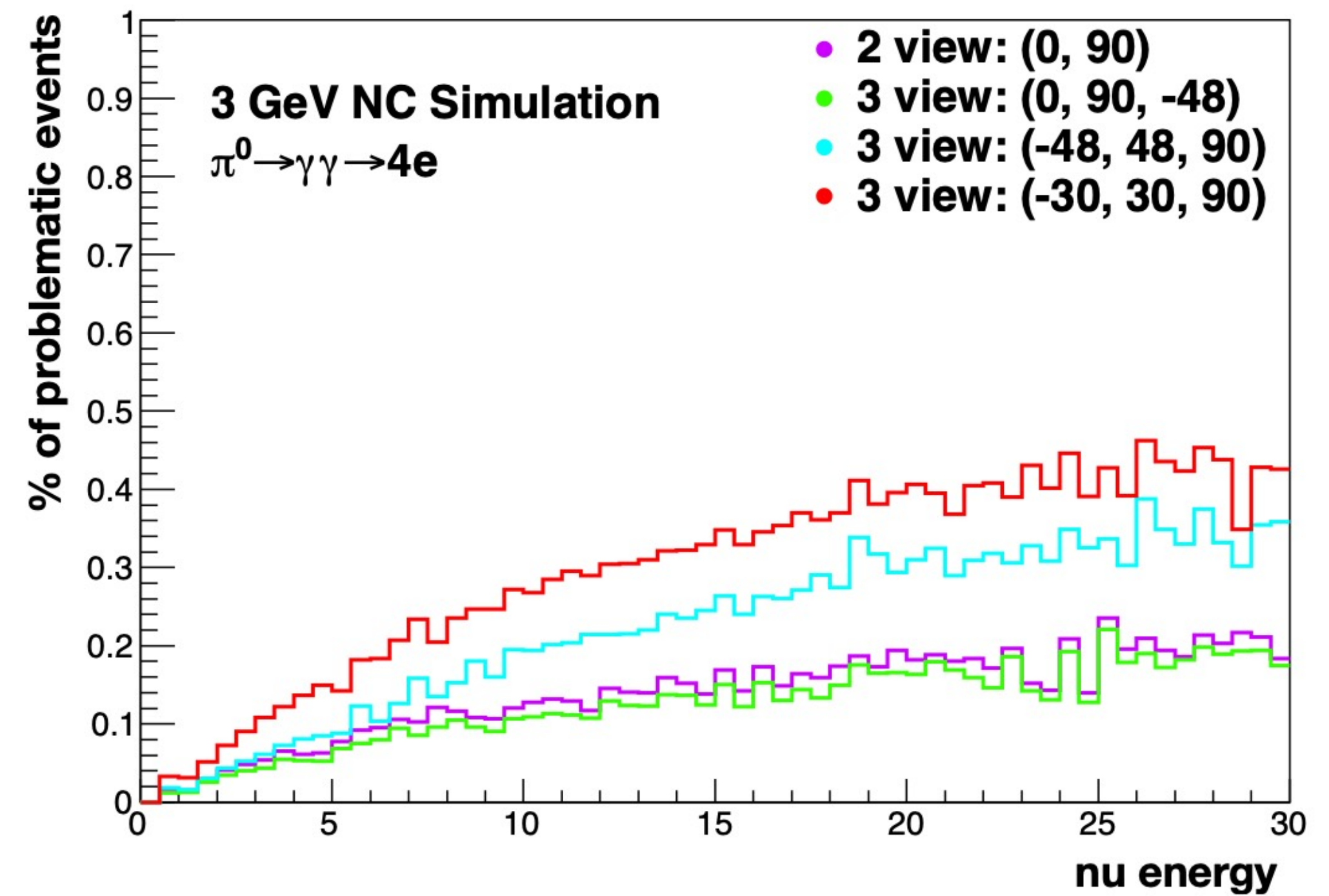e+

e+

e+

e+
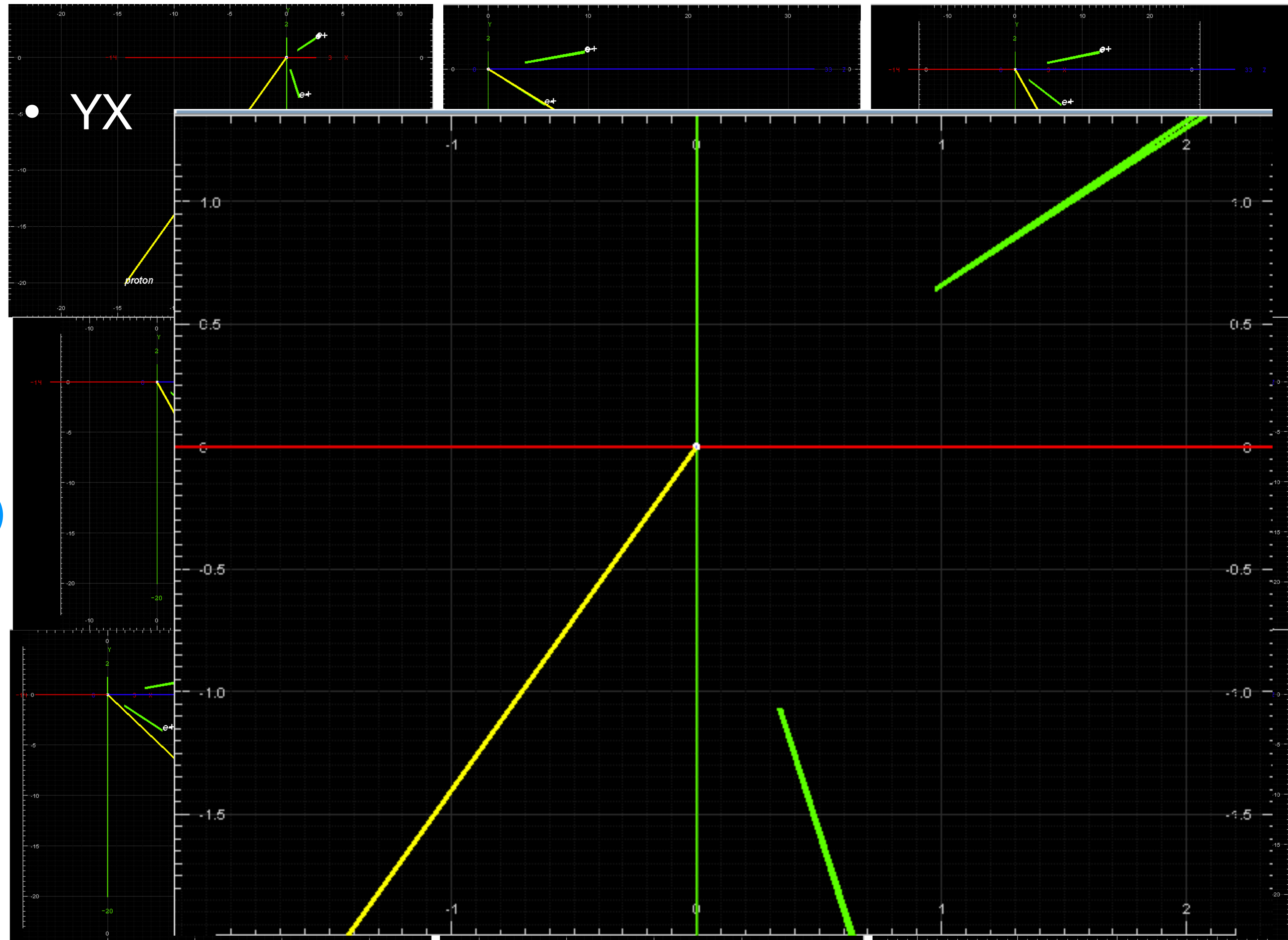
- 500000 truth events with 84840 pi0->γγ->4e:

% Problematic events vs pi0 energy (orthogonal distance)
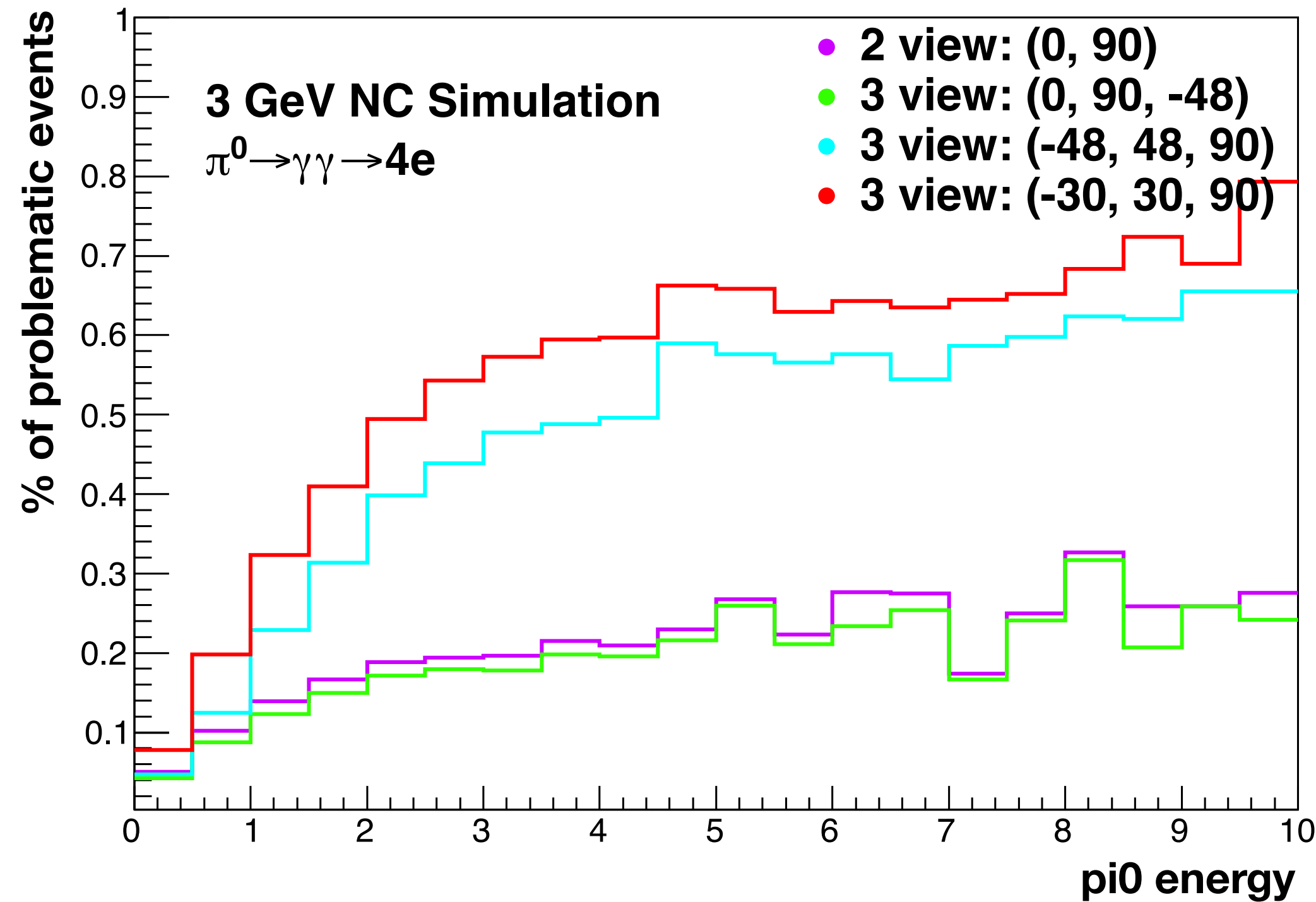
% Problematic events vs neutrino energy (orthogonal distance)

- 7997 total (0, 90)

- 6992 total (0, 90, -48)

- 11855 total (-48, 48, 90)

- 16779 total (-30, 30, 90)

- 7997 total (0, 90)

- 6992 total (0, 90, -48)

- 11855 total (-48, 48, 90)

- 16779 total (-30, 30, 90)

- 2 view (0, 90) is better than any 3 views without the 0° plane.

Part - 2 : Second type of considerations:

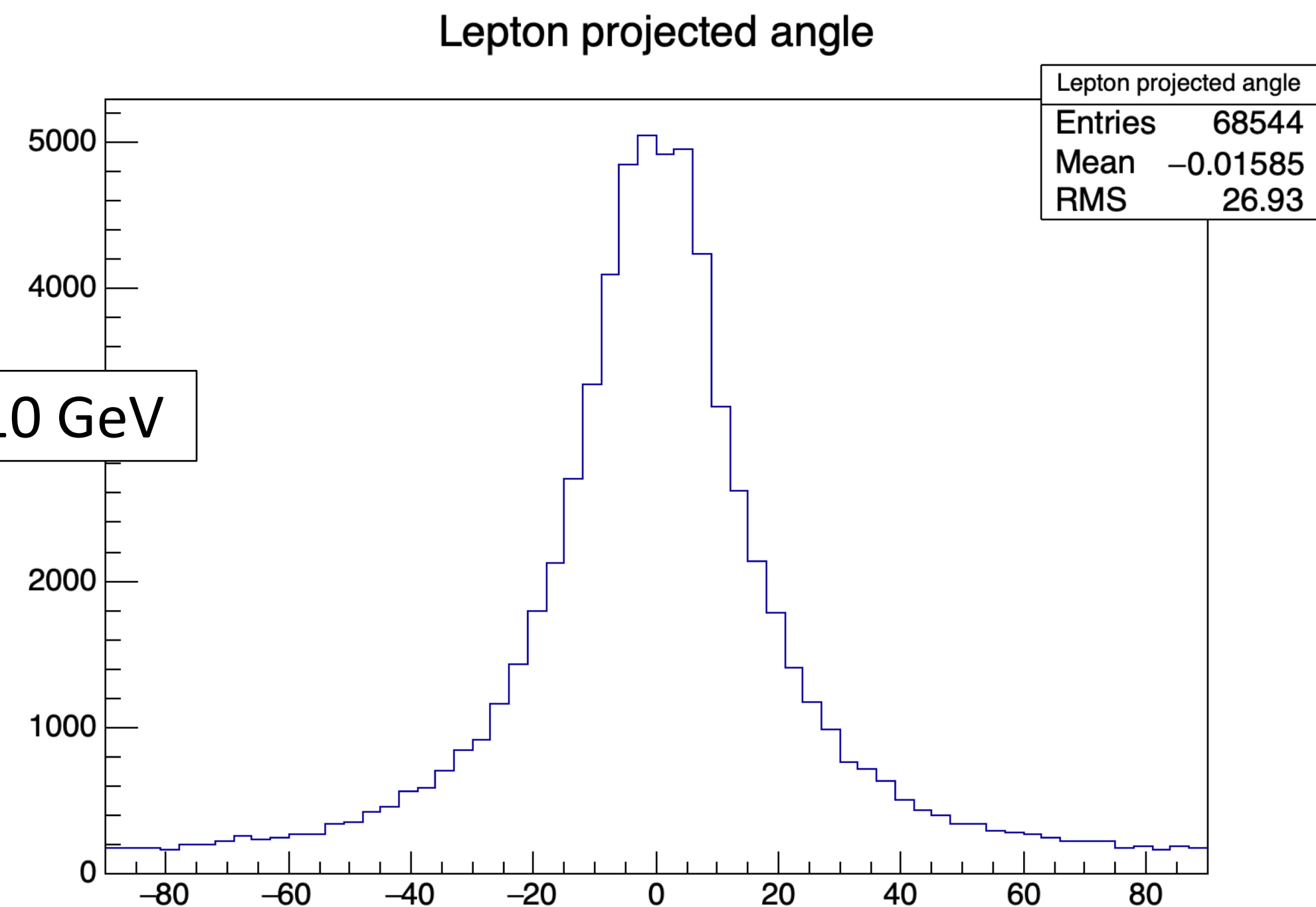In CC interaction, a good quality measurement of the lepton is desirable.
Reconstruction is degraded if the projection of the electron direction on the readout plane is close to the direction of the readout strip.
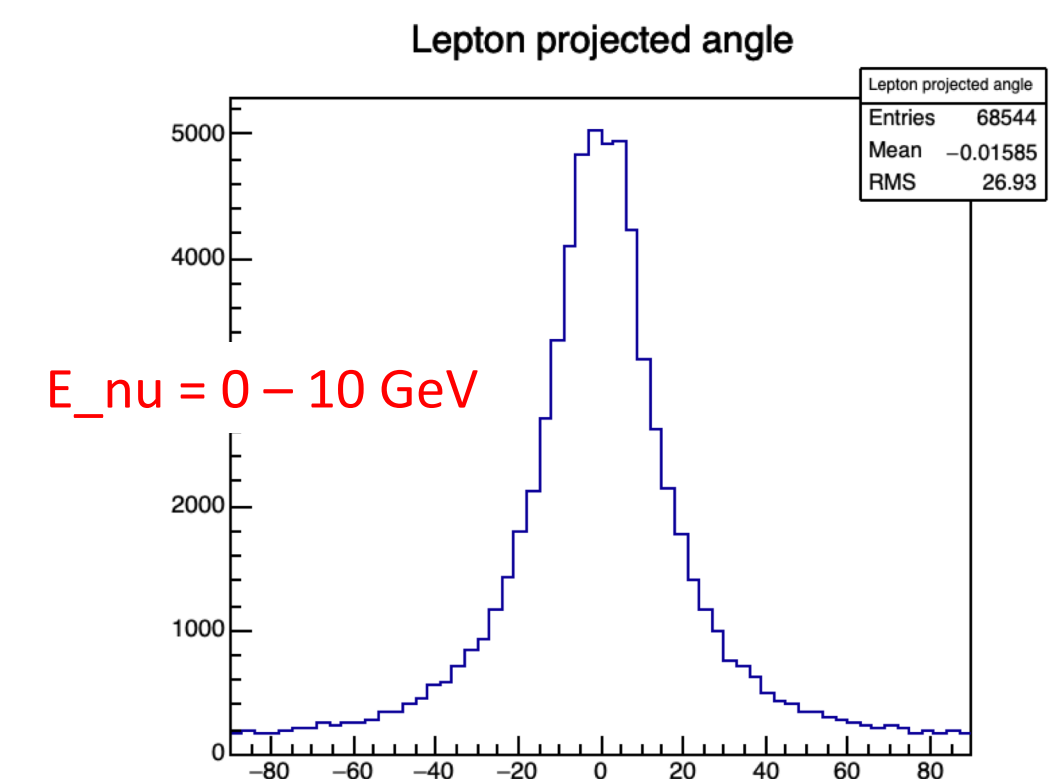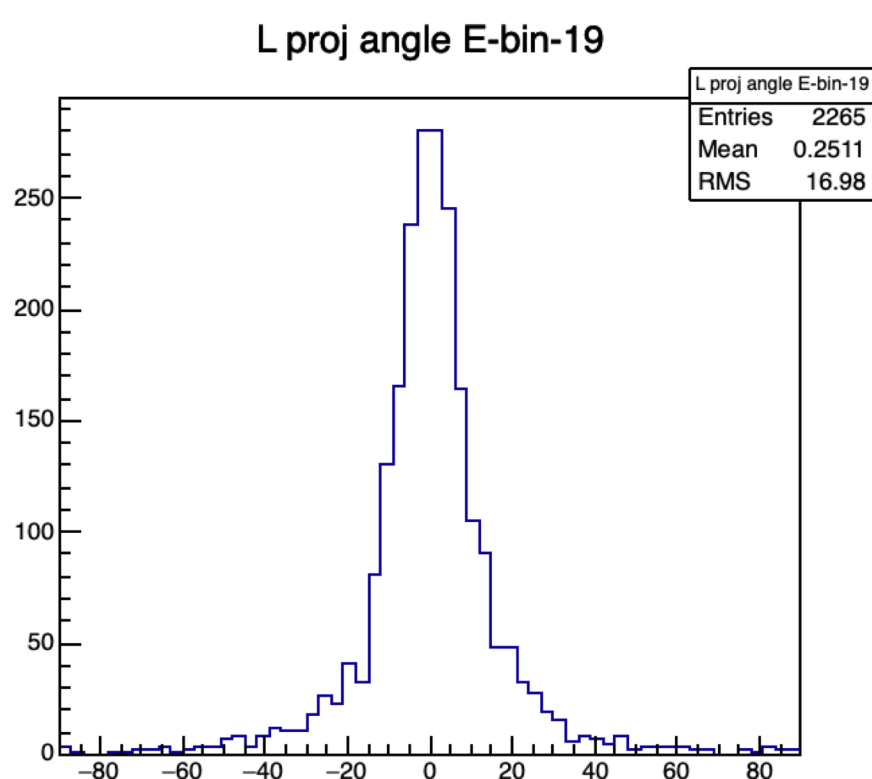
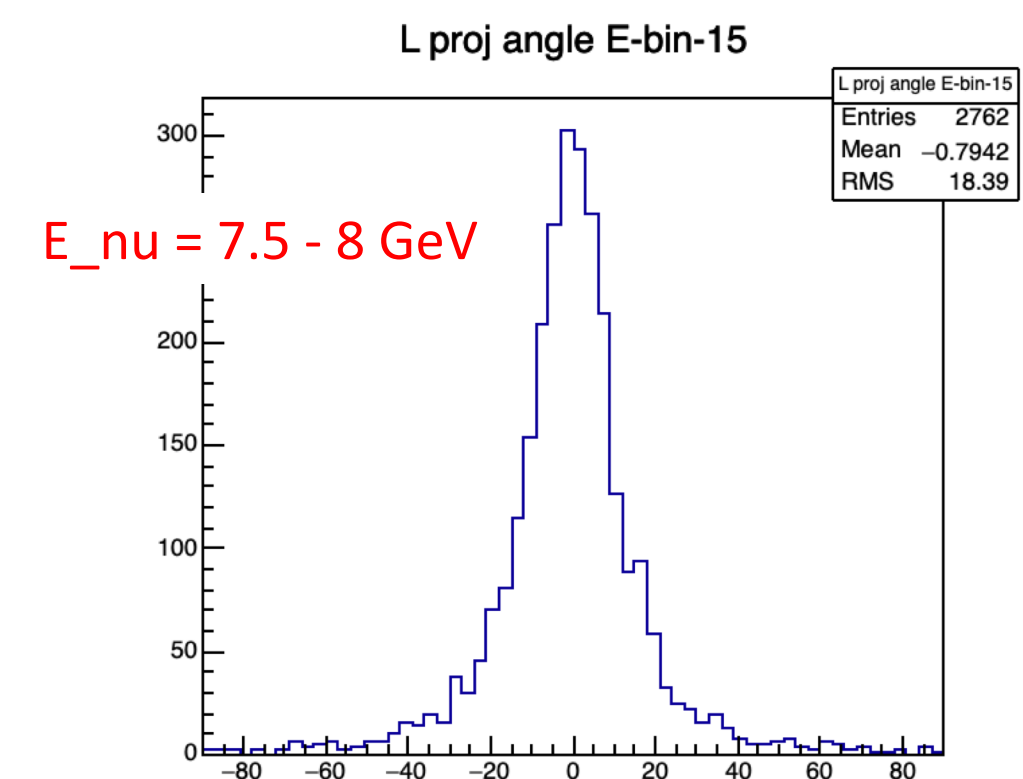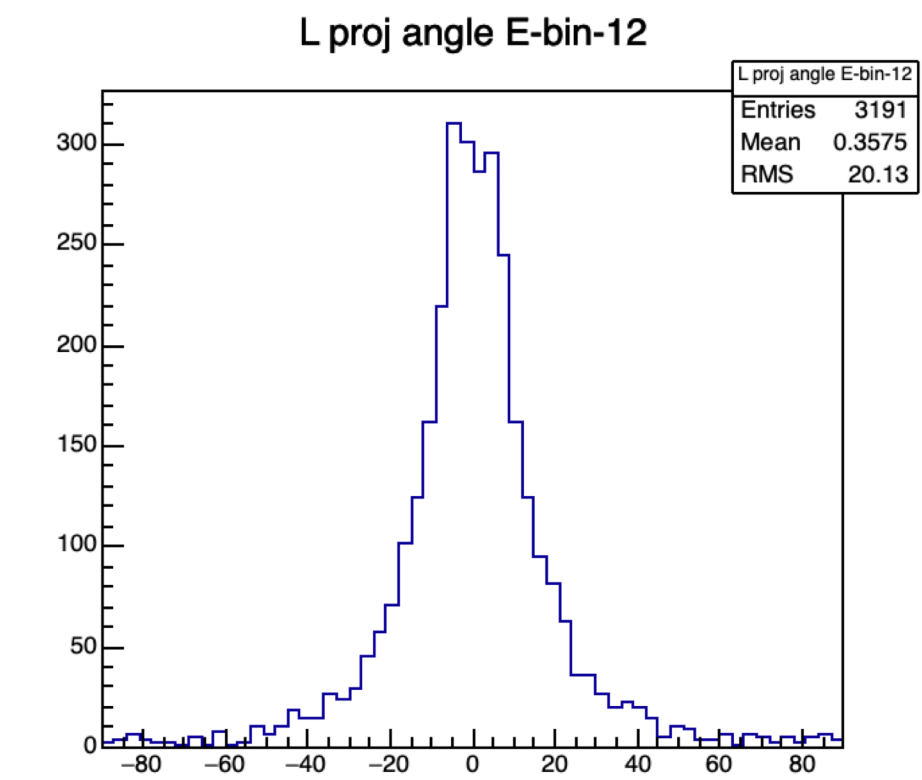⇒ Count the frequency of the electron projected angle (xz plane) being within +-6 degree of the strip direction

(Ignore the angle in the yz plane)
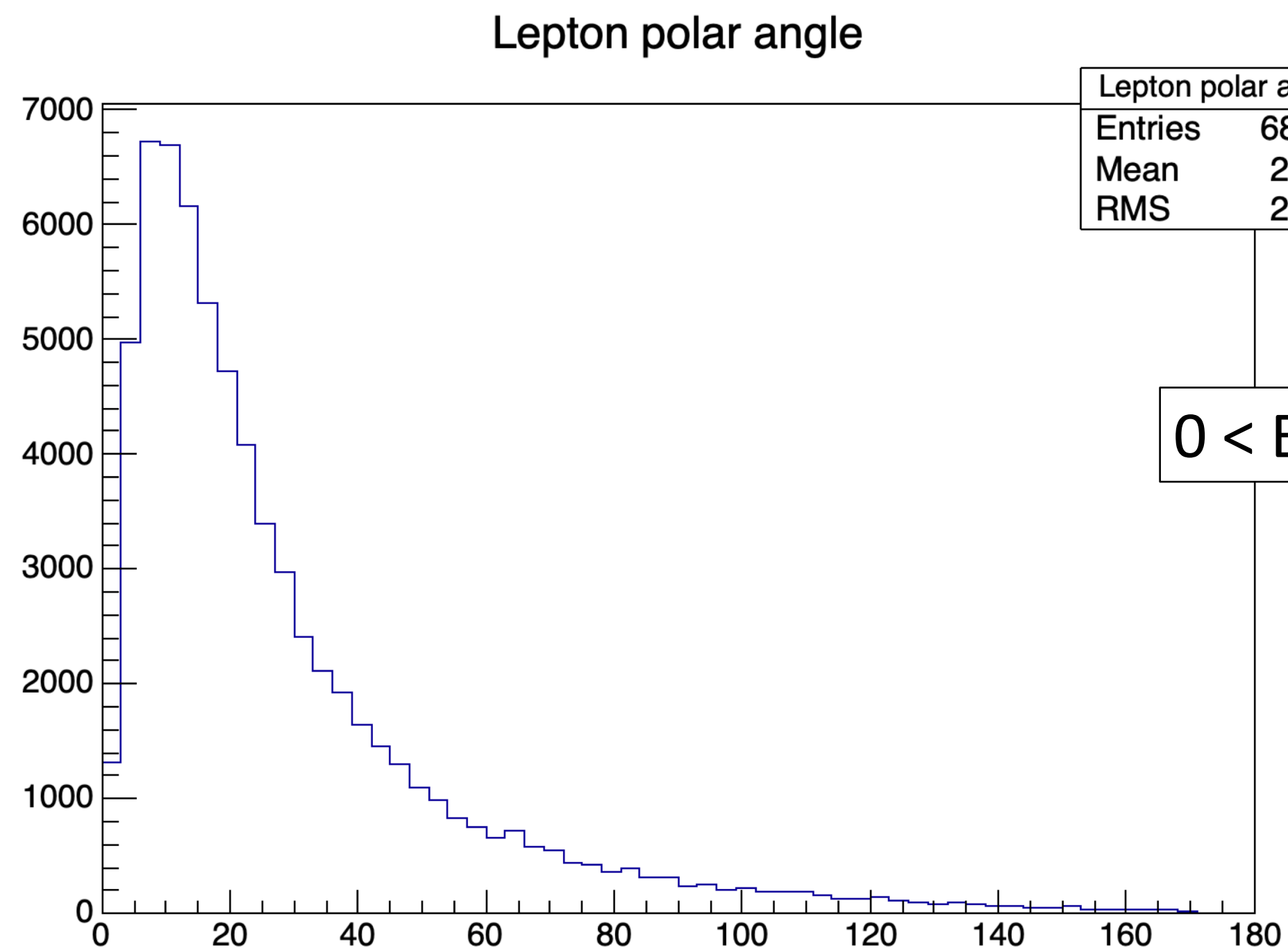
0 < E_nu < 10 GeV
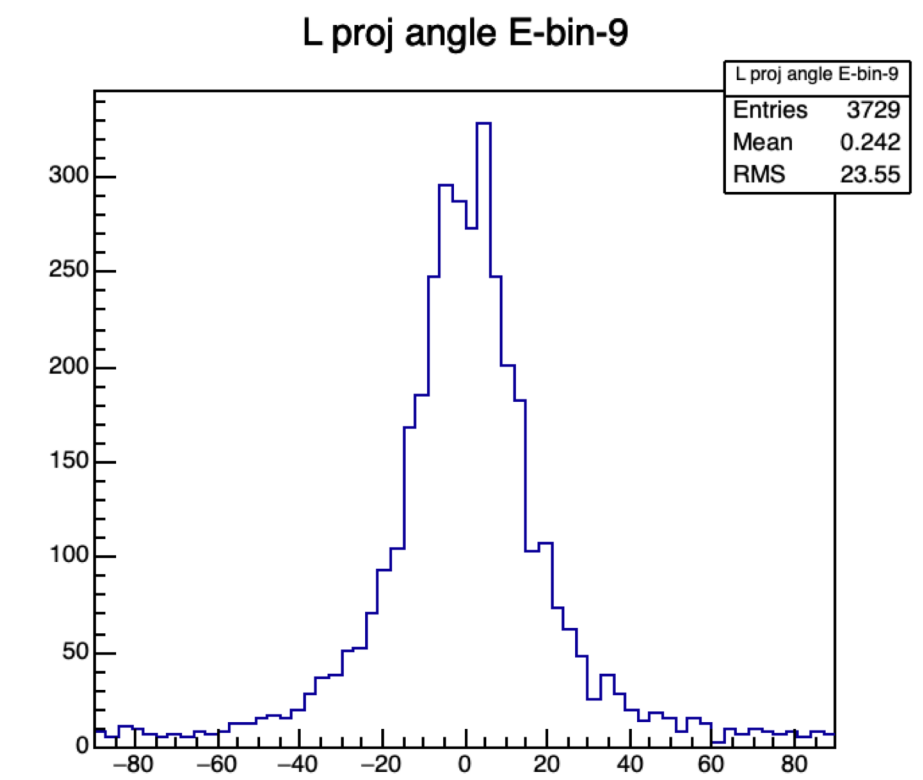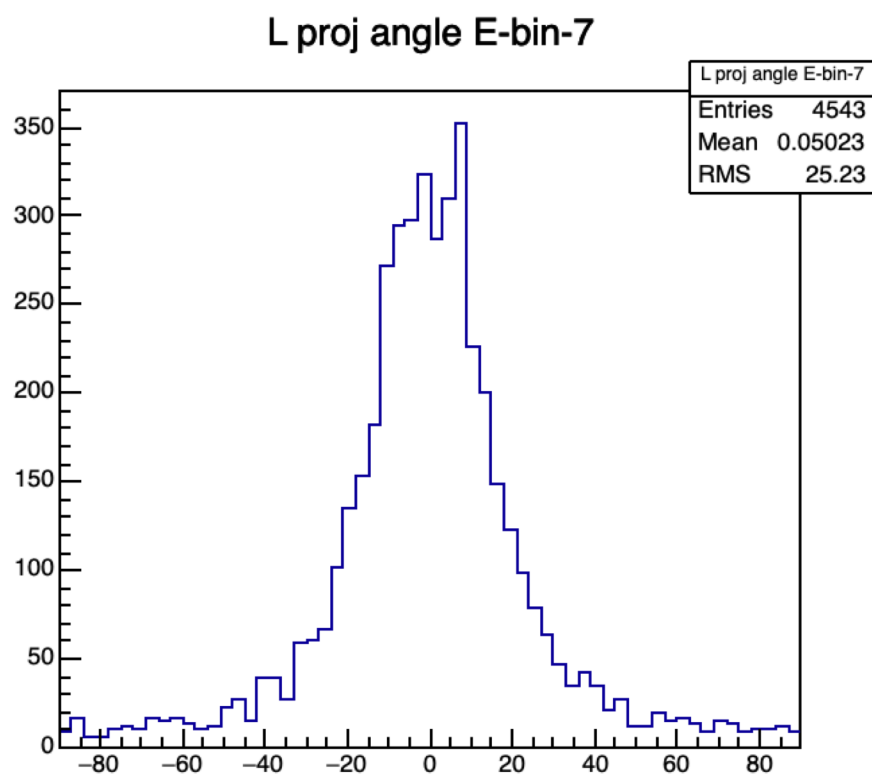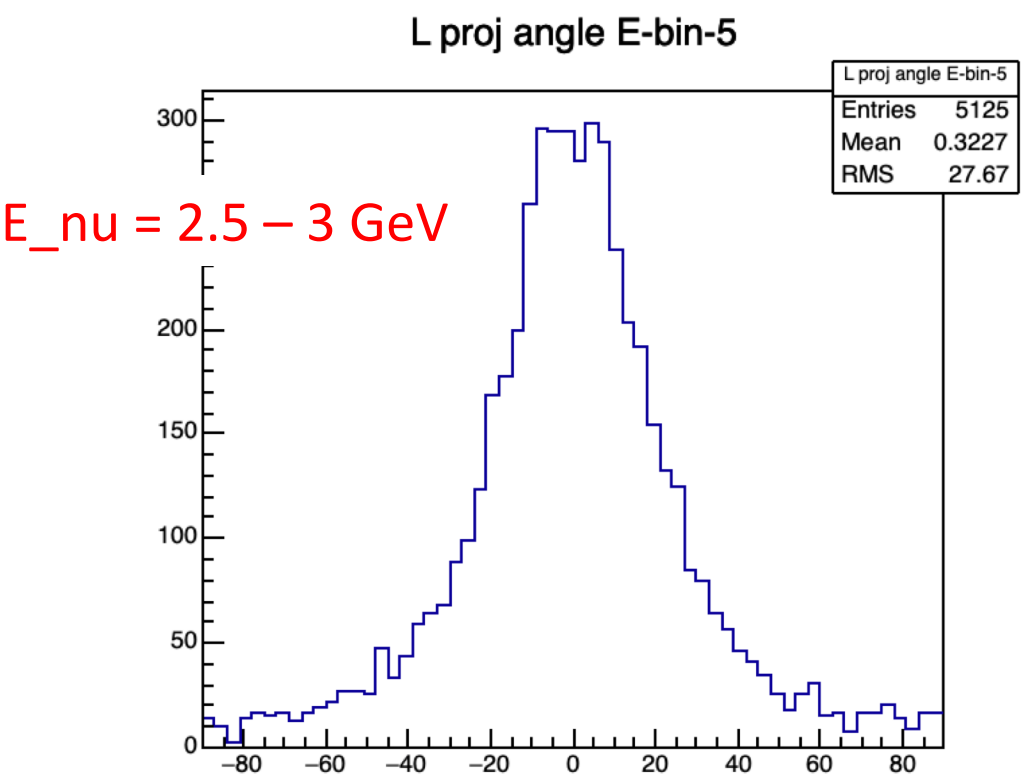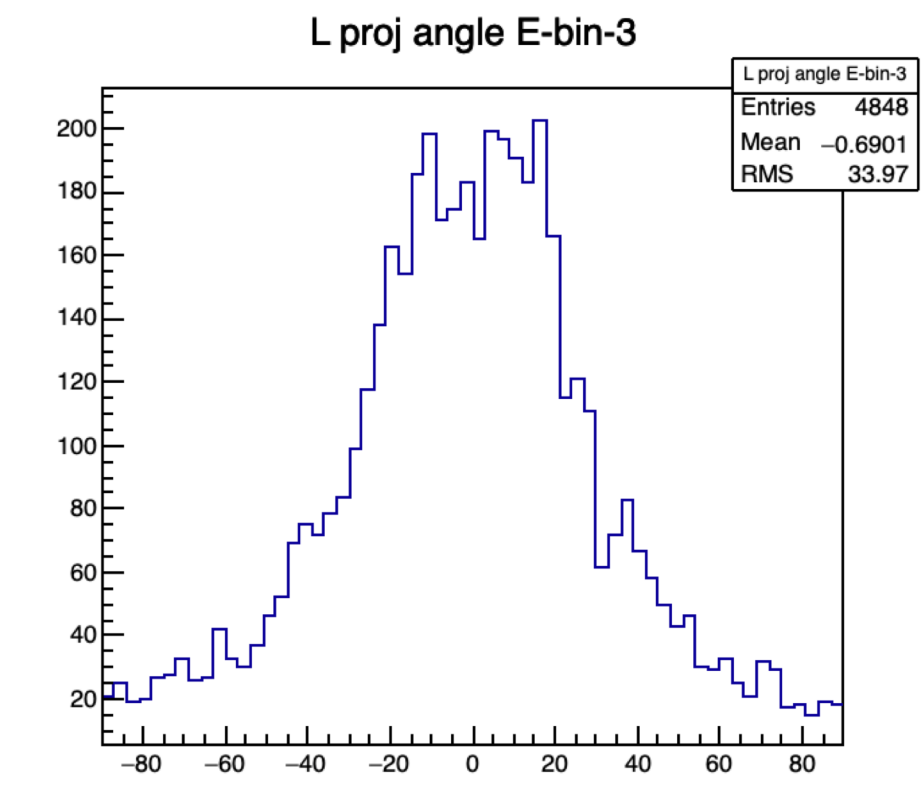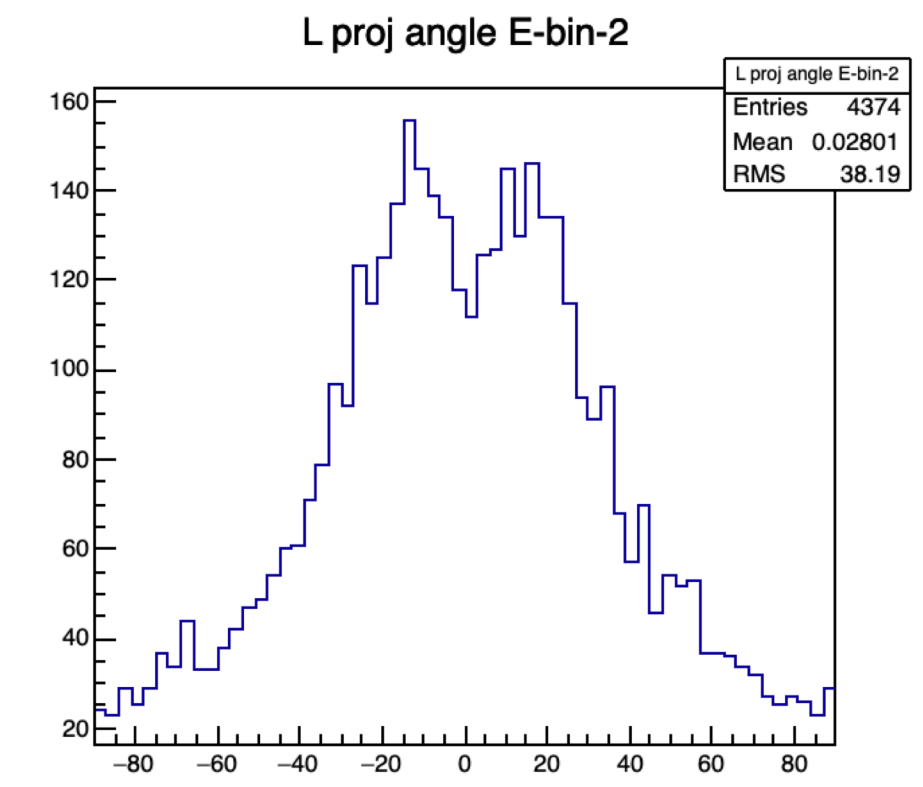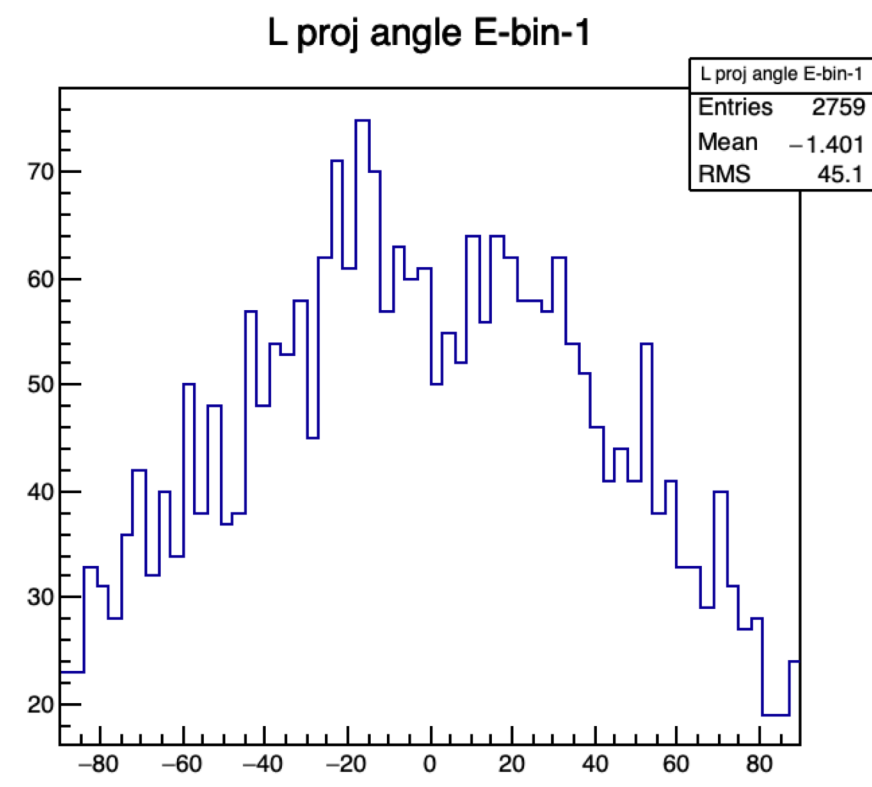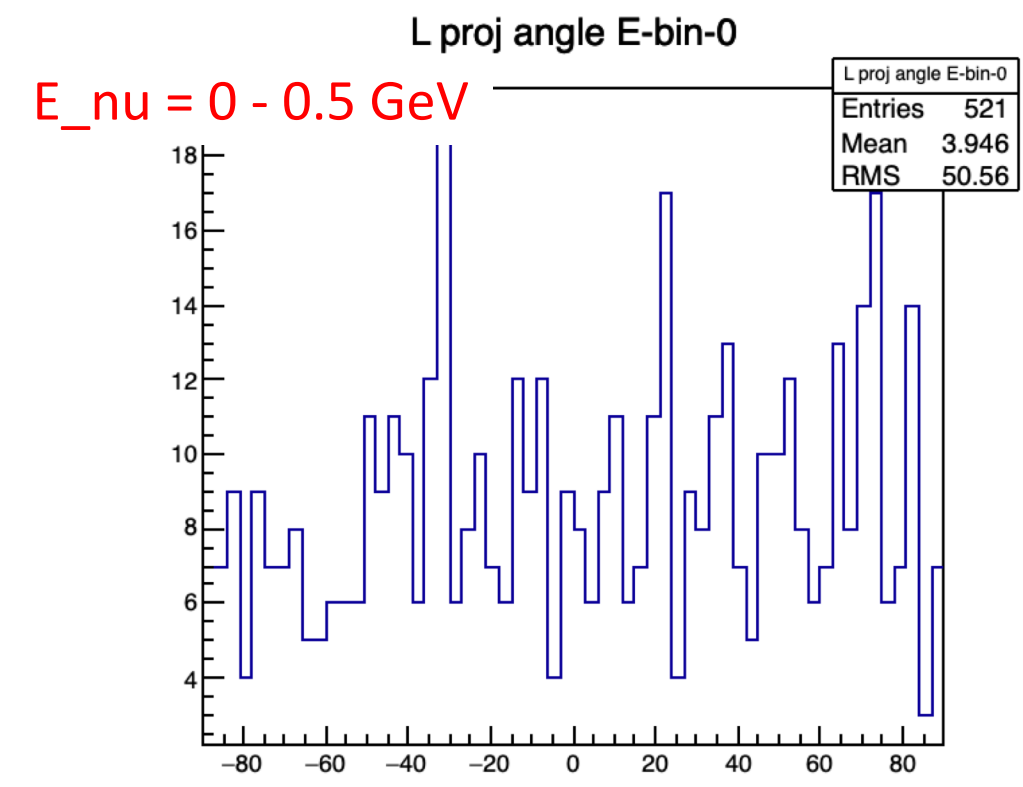
Electron projected angle in neutrino energy bins of 0.5 GeV

Fraction of events with electron
within +-6 deg of strip direction

0 deg   +30/-30 deg   +48/-48 deg   90 deg

nu energy
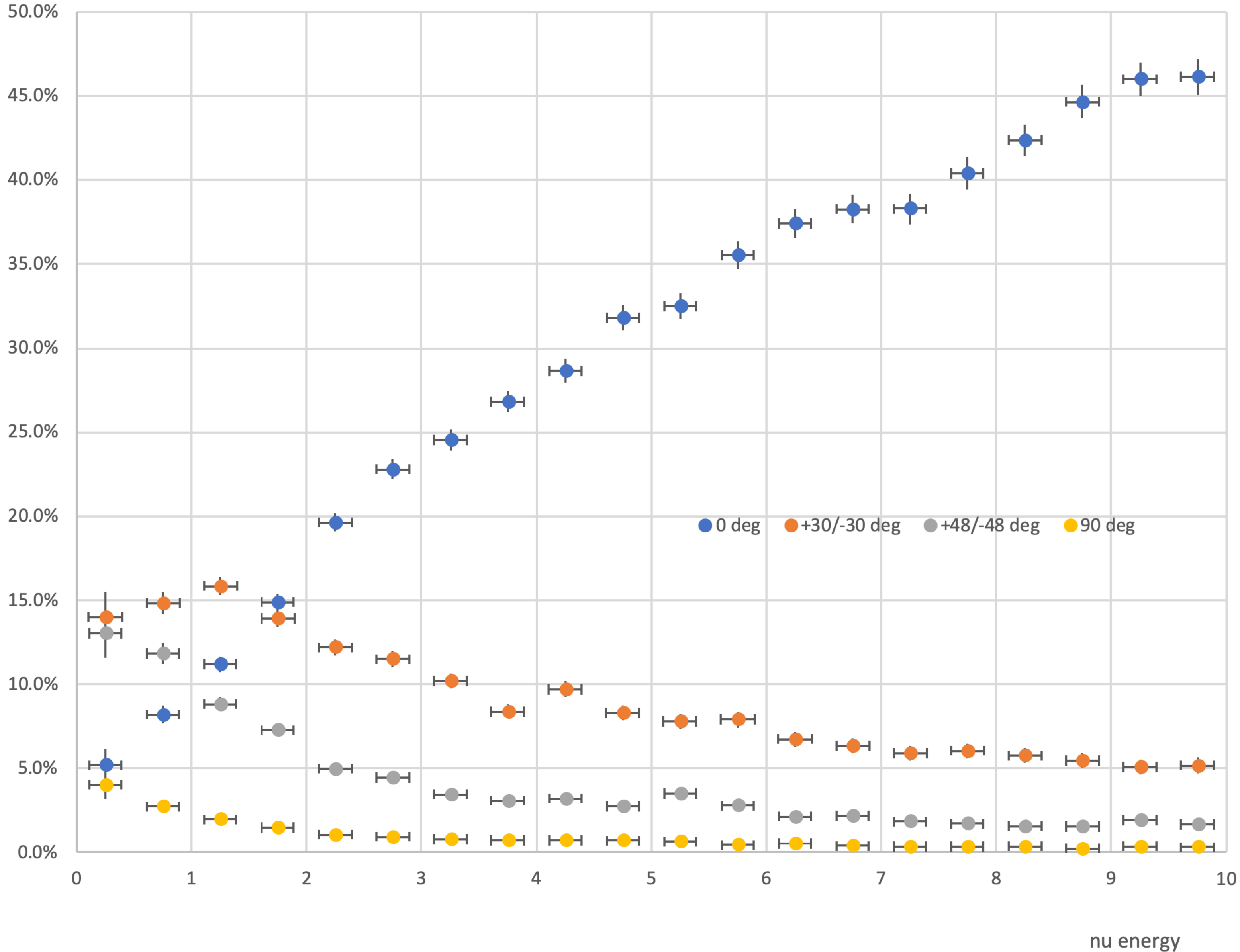
Above E_nu=1.5 GeV the frequency of the electron projected angle being within +- 6 deg of the beam direction is high.
The 48 deg strips are significantly less affected by this issue than the 30 deg strips.

The level of concern has to be studied in full simulation and comparison with real data.

Backup

- **500000 truth events with 84840 pi0->yy->4e:**

- Using orthogonal distance:

- Problematic events yx yz (0, 90): 7997

- Problematic events yx yz yu (0, 90, −48): 6992

- Problematic events yz yu yv (90, −48, 48): 11855

- Problematic events yz yu yv (90, −30, 30): 16779

- All 3 problematic events: 5269

- UVZ only problematic events: 6472

- Using dy:

- Problematic events yx yz (0, 90): 3183

- Problematic events yx yz yu (0, 90, −48): 2939

- Problematic events yz yu yv (90, −48, 48): 6772

- Problematic events yz yu yv (90, −30, 30): 10125

- All 3 problematic events: 1838

- UVZ only problematic events: 4903

Problematic Events (orthog)

3 GeV NC Simulation
$\pi^0 \rightarrow \gamma\gamma \rightarrow 4e$

- **2 view: (0, 90)**
- **3 view: (0, 90, -48)**
- **3 view: (-48, 48, 90)**
- **3 view: (-30, 30, 90)**

h_nevents_v_energy_piyyevent	
Entries	84840
Mean	0.8767
Std Dev	1.12

nevents v energy

pi0 energy

% Problematic events vs pi0 energy (orthogonal distance)

% of problematic events

3 GeV NC Simulation
$\pi^0 \rightarrow \gamma\gamma \rightarrow 4e$

- **2 view: (0, 90)**
- **3 view: (0, 90, -48)**
- **3 view: (-48, 48, 90)**
- **3 view: (-30, 30, 90)**

pi0 energy

Problematic Tracks (orthog)

3 GeV NC Simulation
$\pi^0 \to \gamma\gamma \to 4e$

- 2 view: (0, 90)
- 3 view: (0, 90, -48)
- 3 view: (-48, 48, 90)
- 3 view: (-30, 30, 90)

Number of problematic tracks

pi0 energy

nTracks as a function of pi0 energy

h_ntracks_v_energy_piyyevent	
Entries	559750
Mean	1.057
Std Dev	1.317

Problematic Tracks (orthog)

3 GeV NC Simulation
$\pi^0 \to \gamma\gamma \to 4e$

- 2 view: (0, 90)
- 3 view: (0, 90, -48)
- 3 view: (-48, 48, 90)
- 3 view: (-30, 30, 90)

% of problematic tracks

pi0 energy

Min dphi in each plane

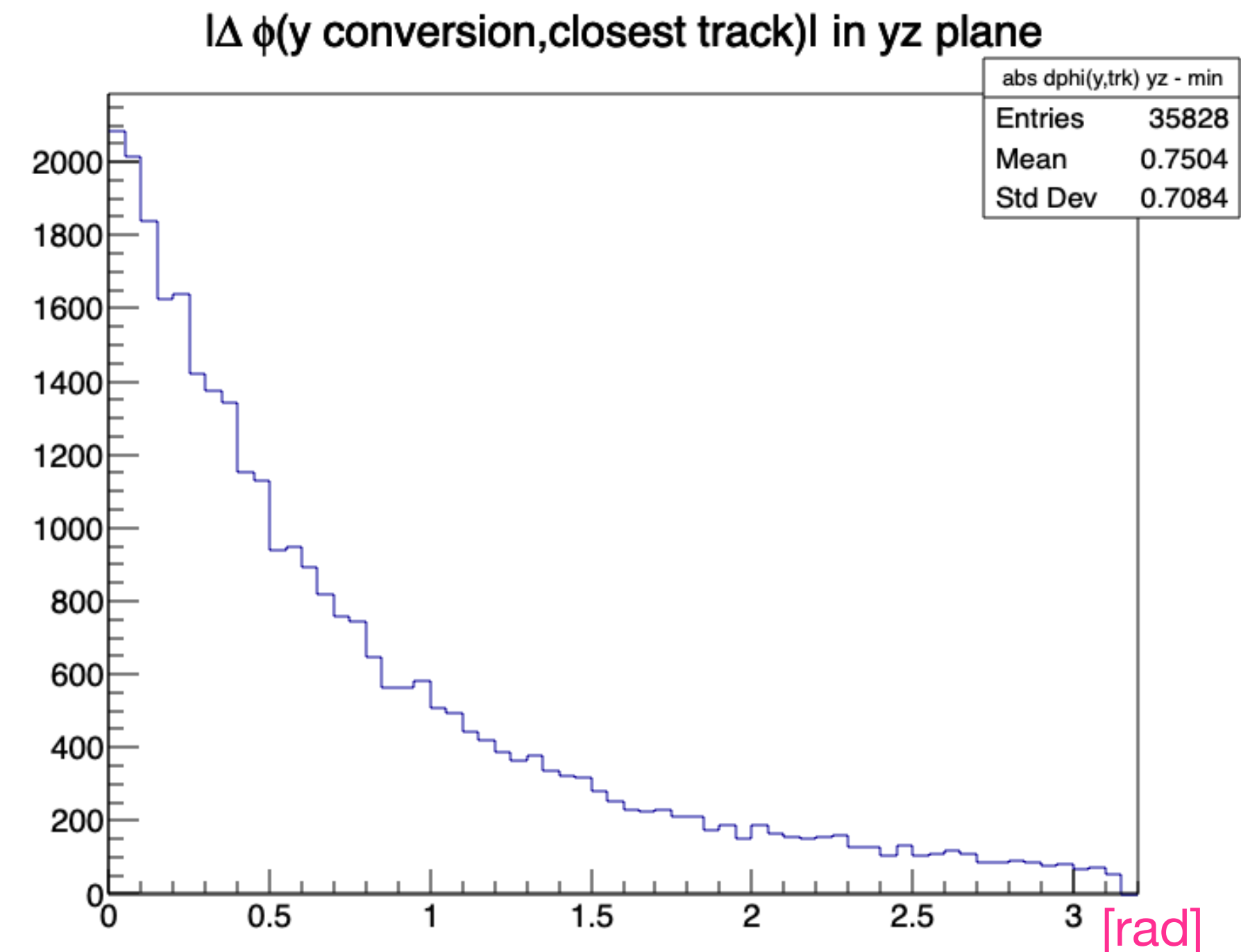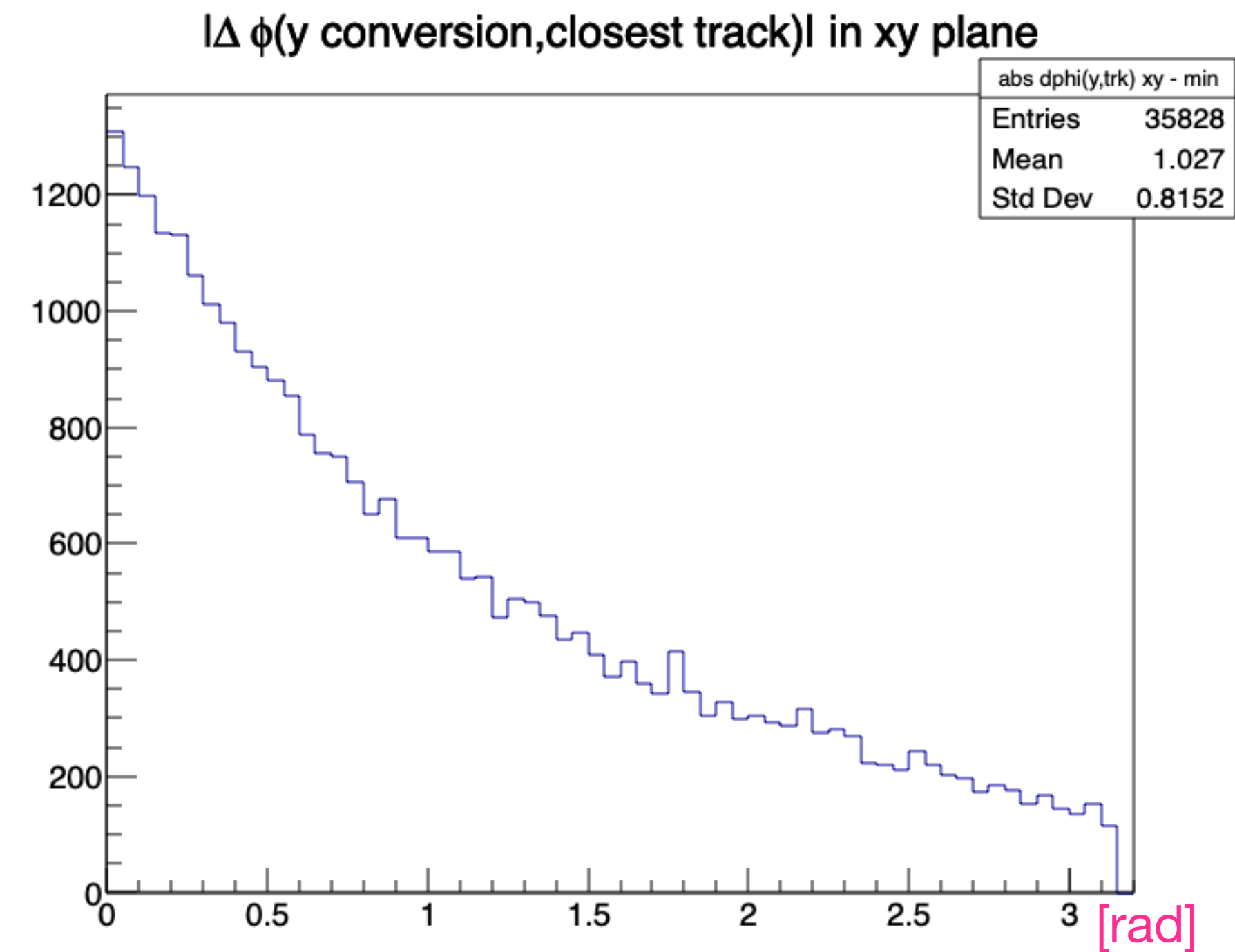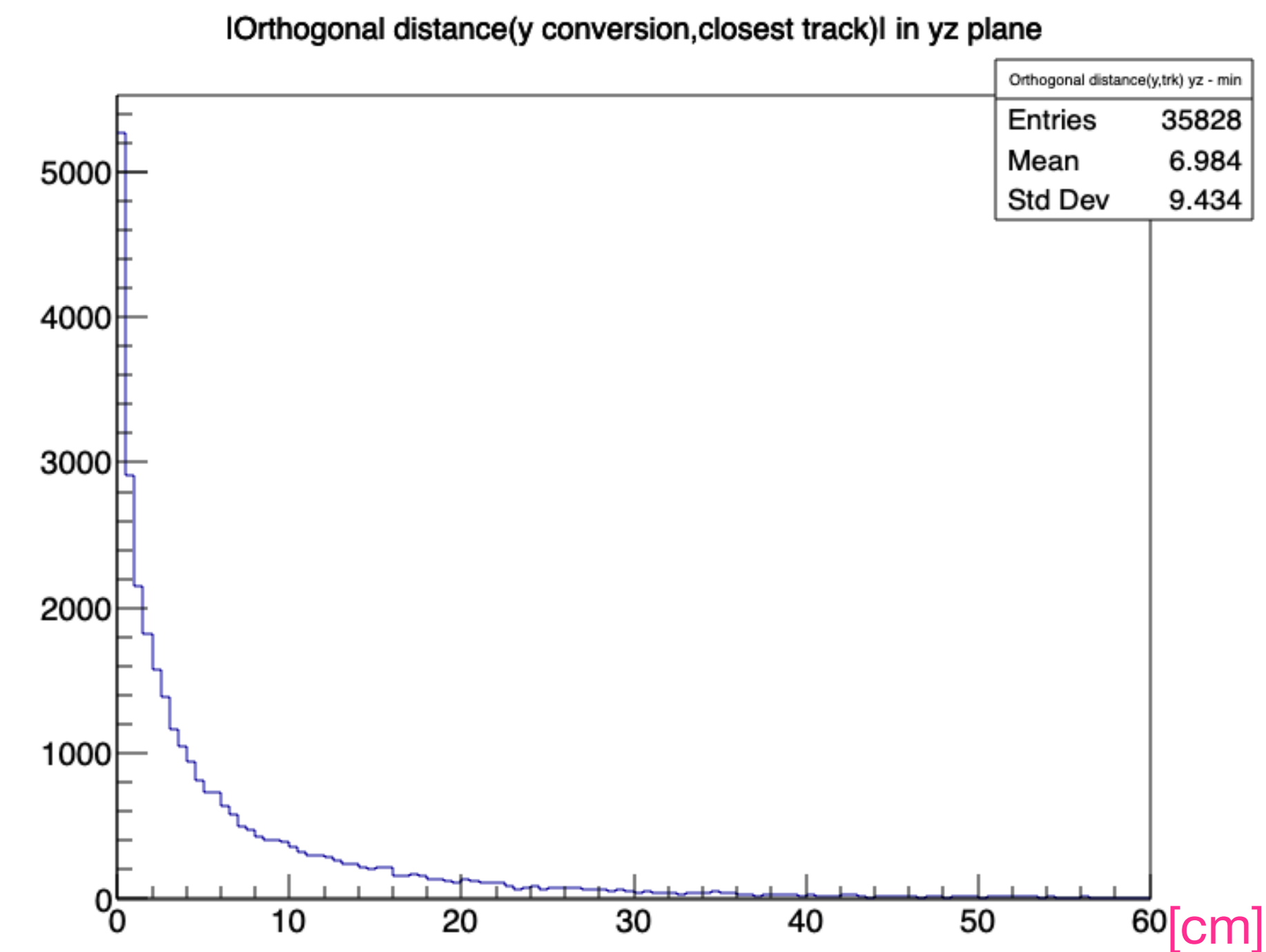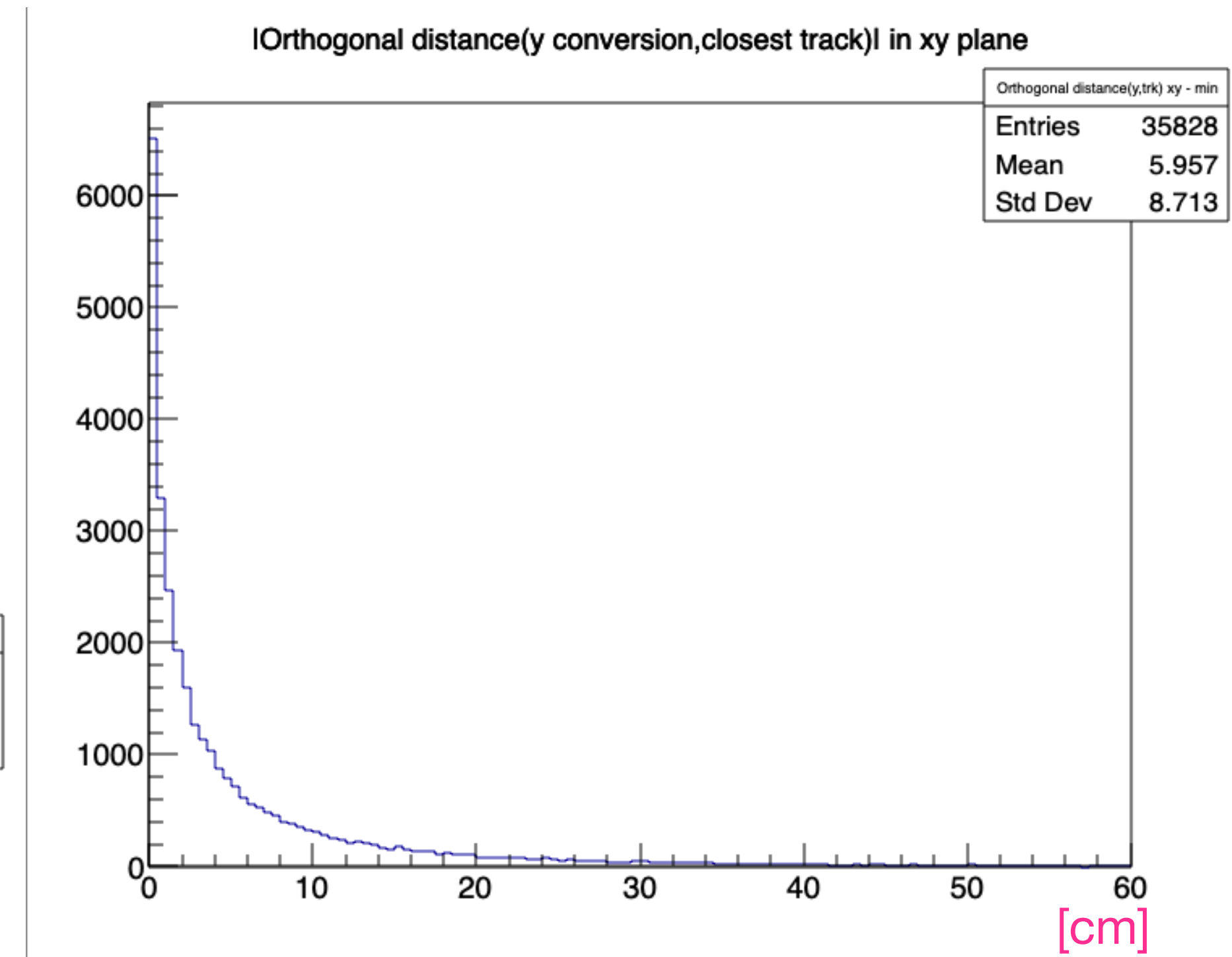- Note: the angle is always called phi in the 2D plane, but the planes are different :-)

- Sample of 100k nu NU interactions at 3 GeV

|Δ φ(y conversion,closest track)| in yu plane

abs dphi(y,trk) yu - min
Entries 35828
Mean 0.9131
Std Dev 0.779

|Δ φ(y conversion,closest track)| in xy plane

abs dphi(y,trk) xy - min
Entries 35828
Mean 1.027
Std Dev 0.8152

|Δ φ(y conversion,closest track)| in yz plane

abs dphi(y,trk) yz - min
Entries 35828
Mean 0.7504
Std Dev 0.7084
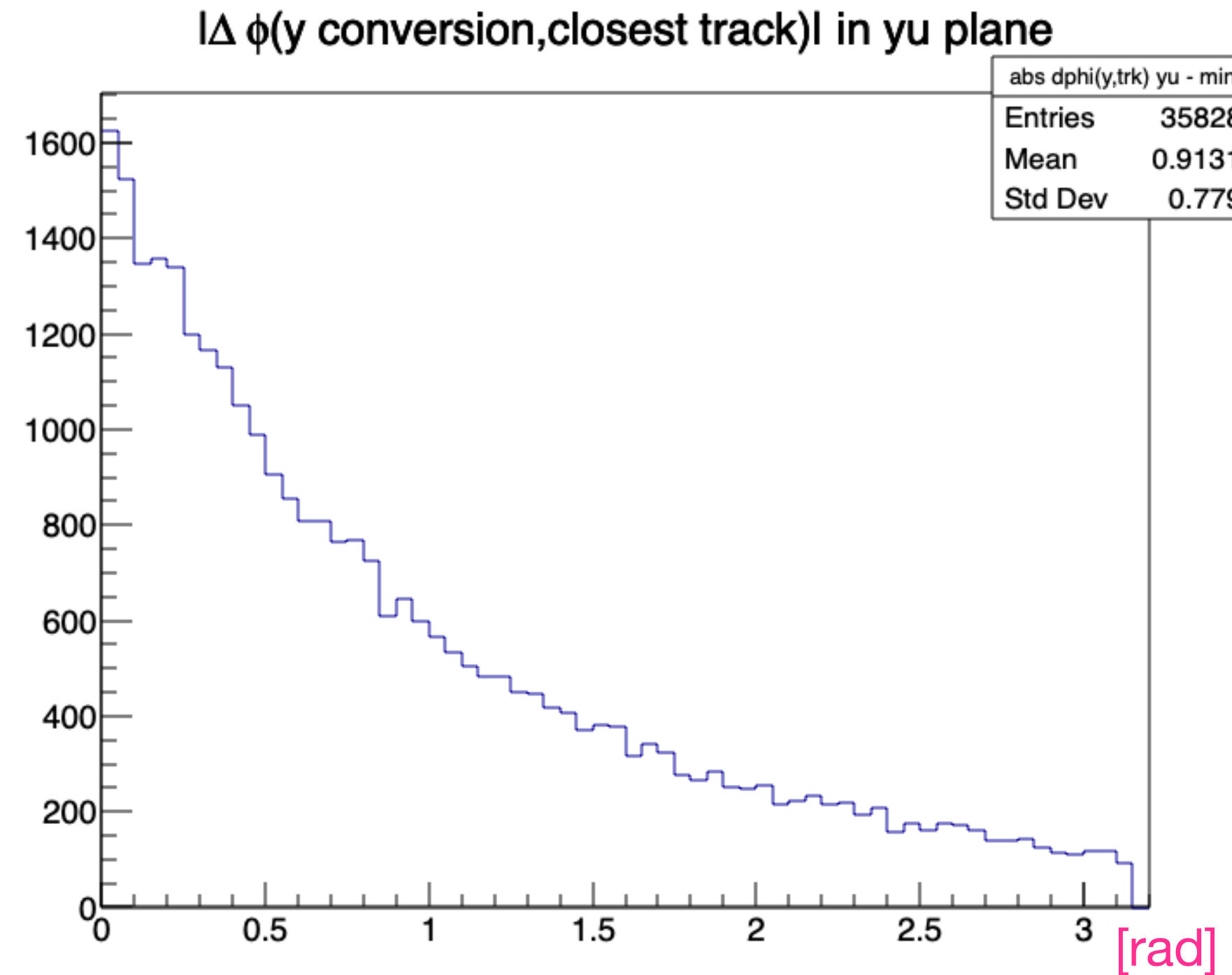
Min orthogonal distance in each plane

|Orthogonal distance(y conversion,closest track)| in xy plane

Orthogonal distance(y,trk) xy - min	
Entries	35828
Mean	5.957
Std Dev	8.713

[cm]

|Orthogonal distance(y conversion,closest track)| in yu plane

Orthogonal distance(y,trk) yu - min	
Entries	35828
Mean	6.715
Std Dev	9.277

[cm]

|Orthogonal distance(y conversion,closest track)| in yz plane

Orthogonal distance(y,trk) yz - min	
Entries	35828
Mean	6.984
Std Dev	9.434

[cm]

Potentially problematic events:

- d_orthog < 1cm in all planes

  - &&

- dphi < 20 degrees in all planes
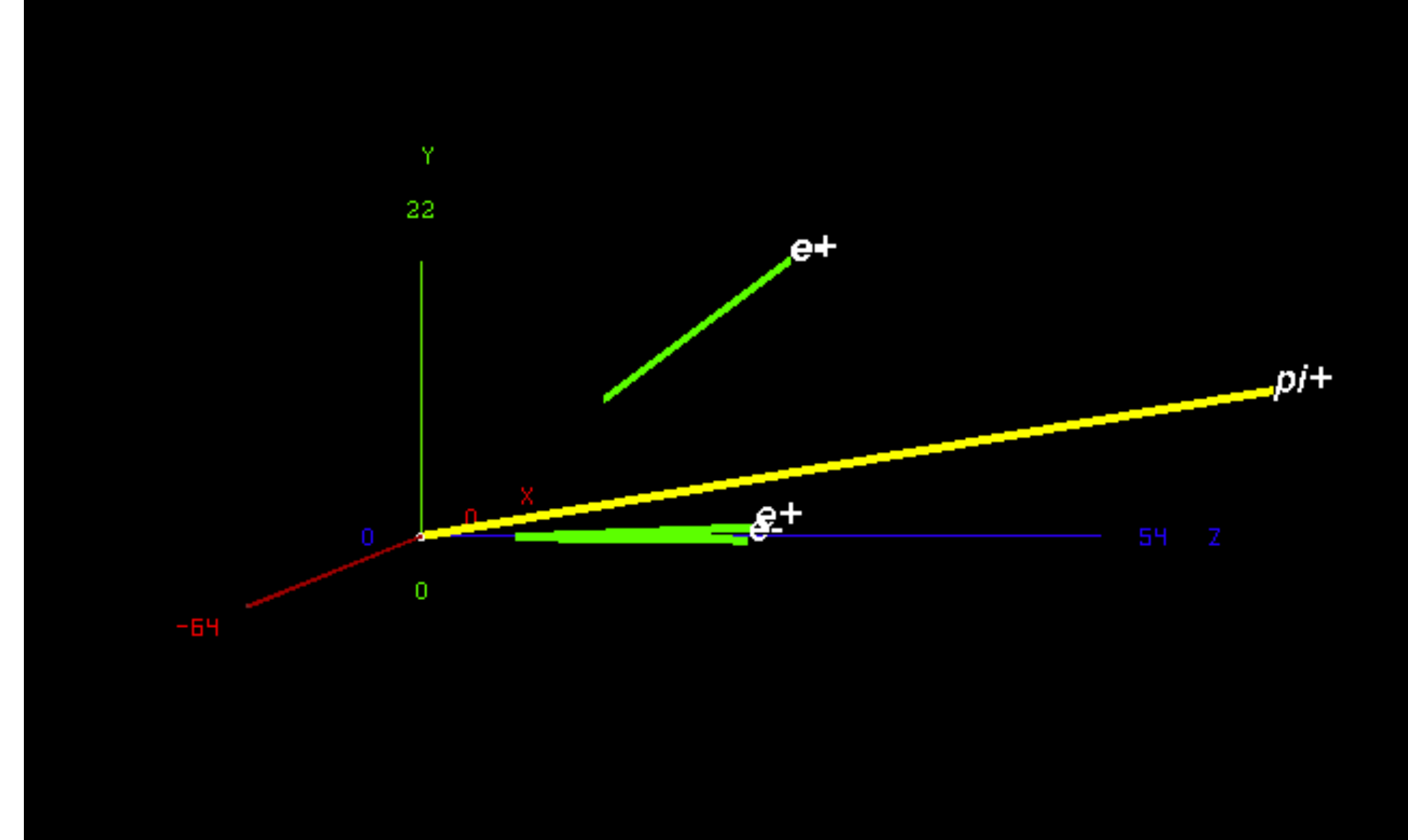
Orthogonal distance in xy vs yz planes

| Orthogonal distance xy yz	
Entries	87638
Mean x	8.201
Mean y	9.982
Std Dev x	10.16
Std Dev y	11.29
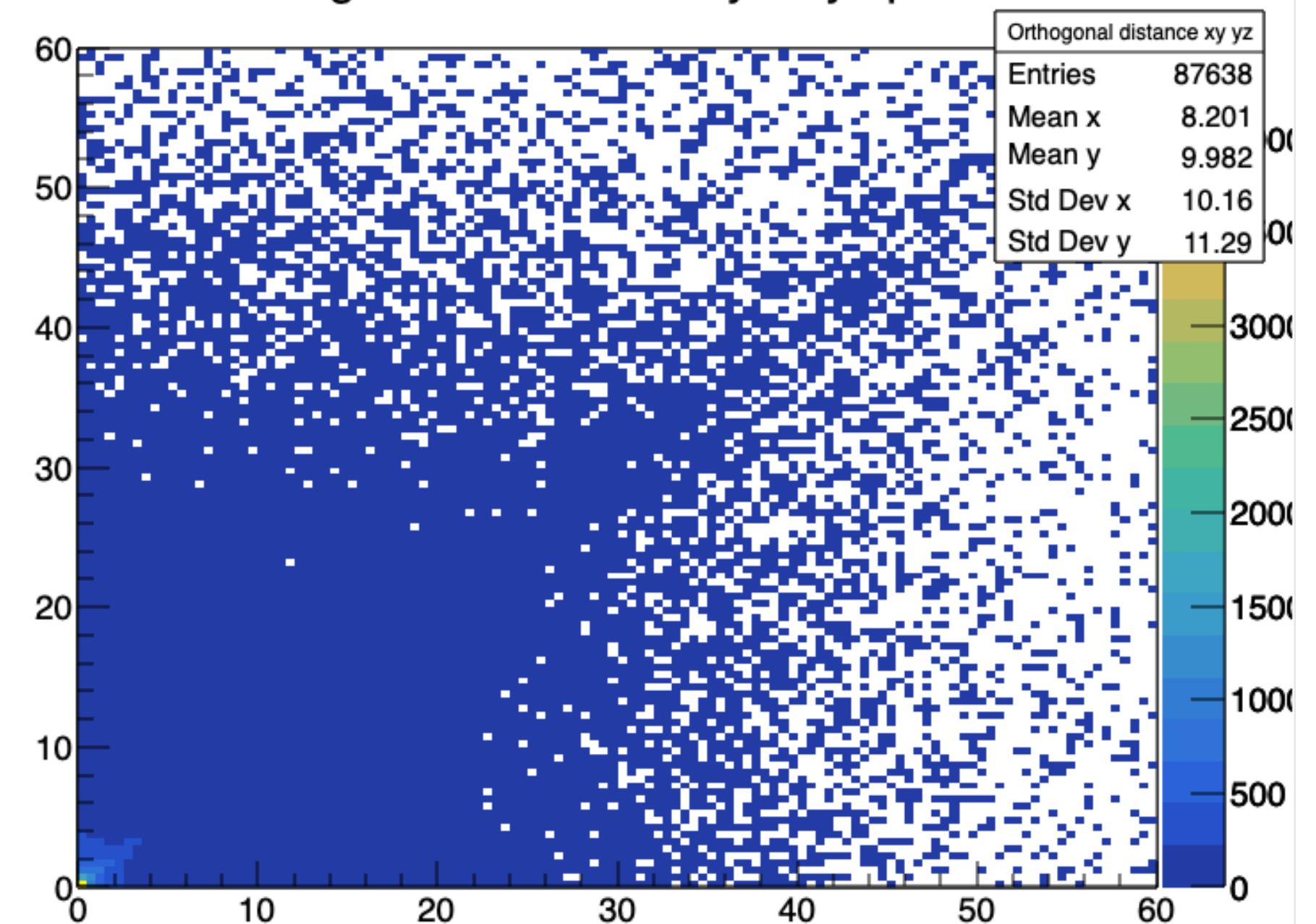
Problematic events in Strips_nc_spec001_Out.root

(first 1000 events)

- **(-48, 48, 90) problematic event: 51**
- (-48, 48, 90) problematic event: 58
- (-48, 48, 90) problematic event: 87
- (-48, 48, 90) problematic event: 147
- (-48, 48, 90) problematic event: 157
- (-48, 48, 90) problematic event: 208
- (-48, 48, 90) problematic event: 213
- (-48, 48, 90) problematic event: 233
- (-48, 48, 90) problematic event: 235
- (0, 90, -48) problematic event: 264
- (-48, 48, 90) problematic event: 276
- (-48, 48, 90) problematic event: 277
- **(0, 90, -48) problematic event: 287**
- (-48, 48, 90) problematic event: 287
- (-48, 48, 90) problematic event: 301
- (-48, 48, 90) problematic event: 326

- (-48, 48, 90) problematic event: 380
- (0, 90, -48) problematic event: 393
- (-48, 48, 90) problematic event: 393
- (-48, 48, 90) problematic event: 477
- (-48, 48, 90) problematic event: 615
- (0, 90, -48) problematic event: 618
- (-48, 48, 90) problematic event: 618
- (-48, 48, 90) problematic event: 658
- (0, 90, -48) problematic event: 681
- (-48, 48, 90) problematic event: 704
- (-48, 48, 90) problematic event: 759
- (0, 90, -48) problematic event: 872
- (-48, 48, 90) problematic event: 872

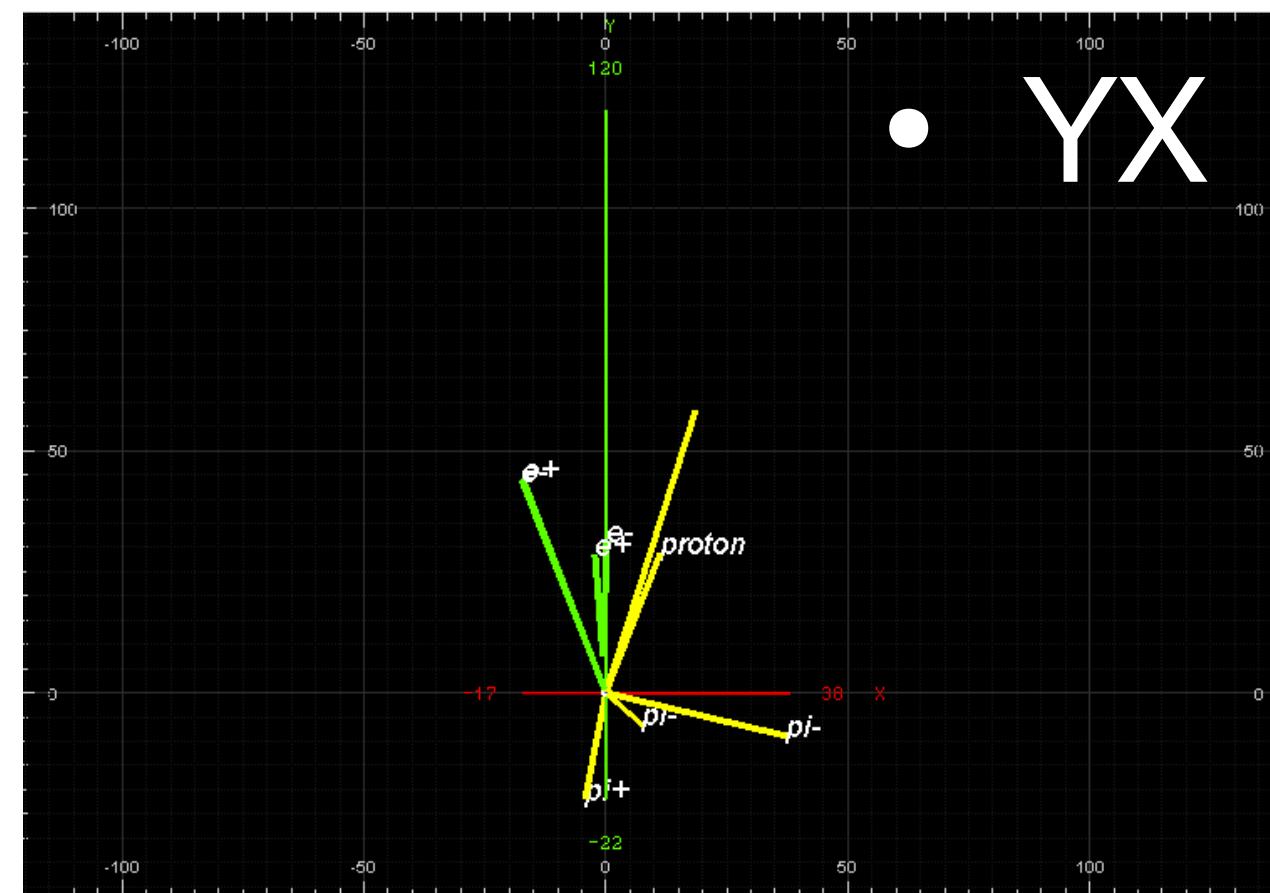- **(-48, 48, 90) problematic event: 51**
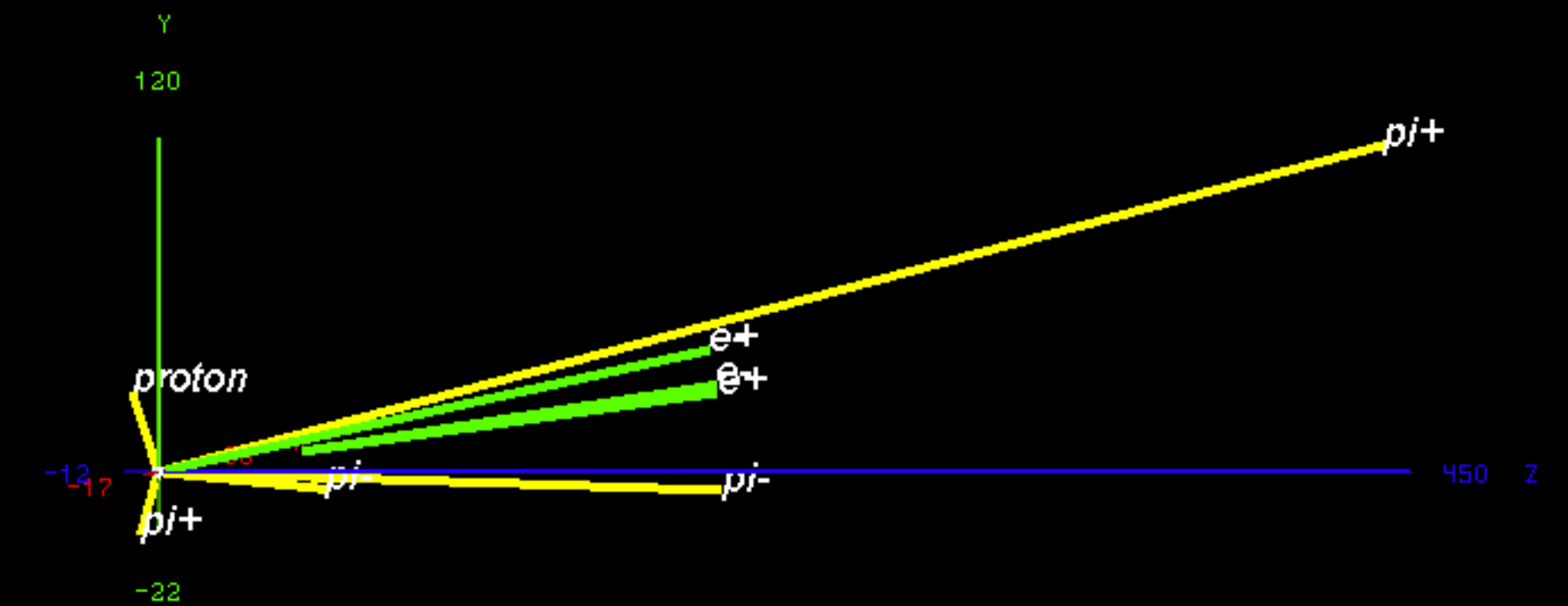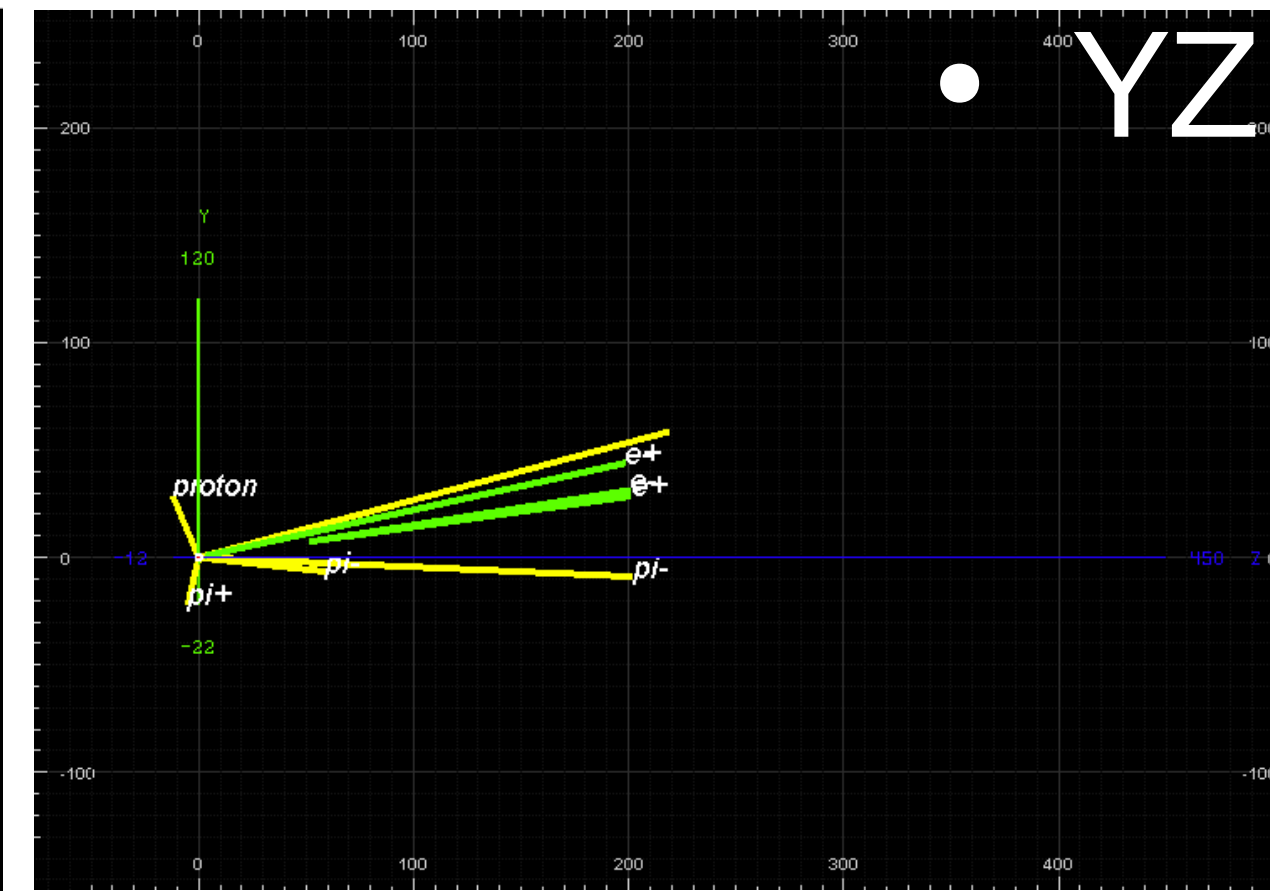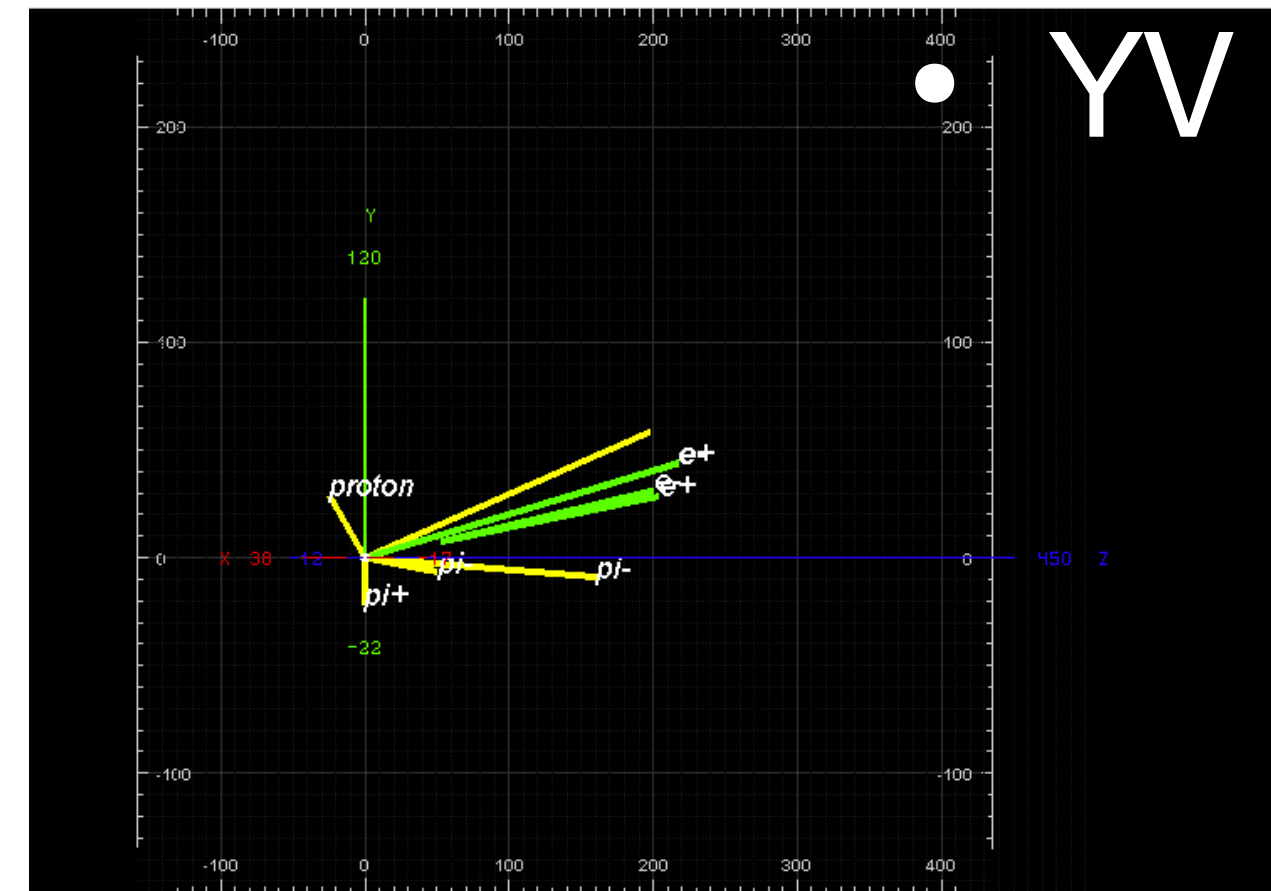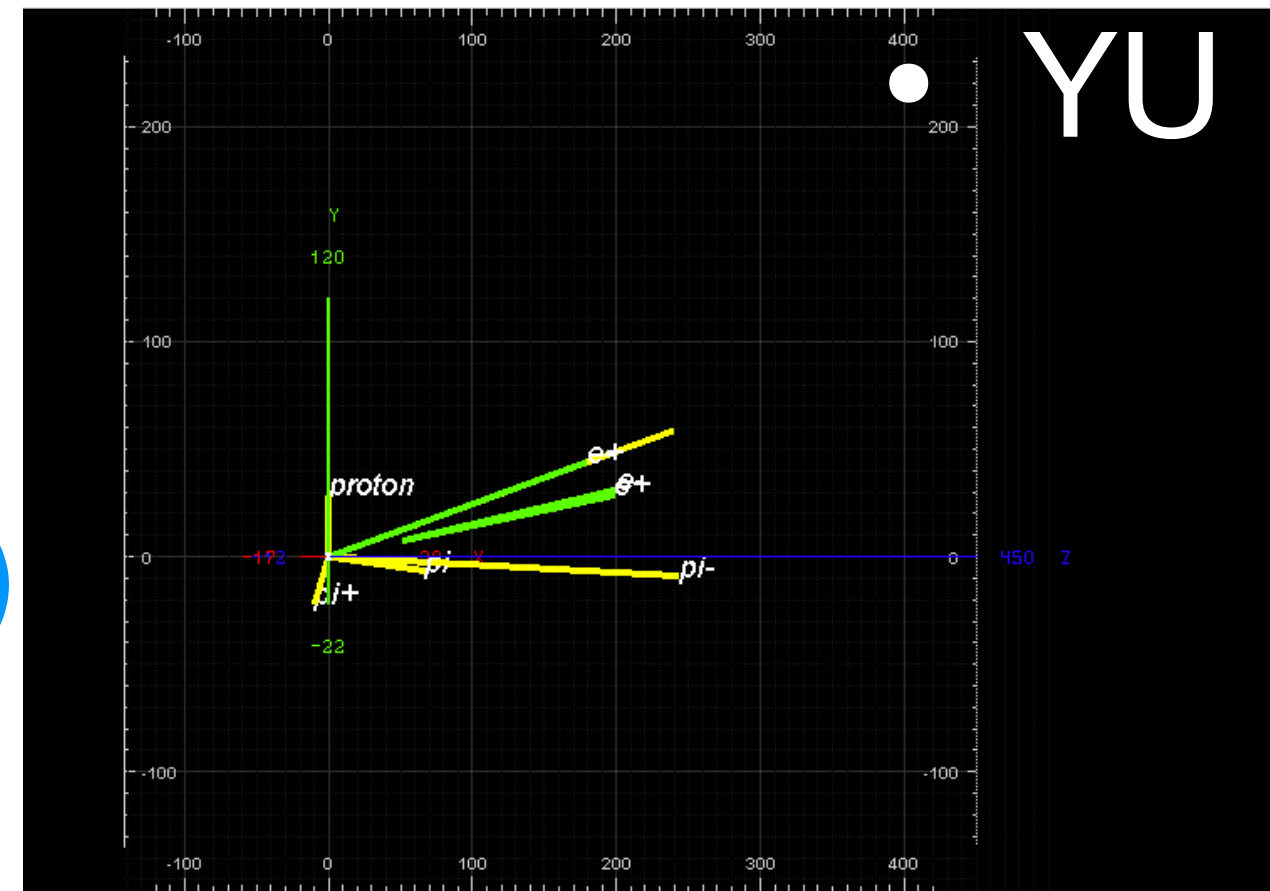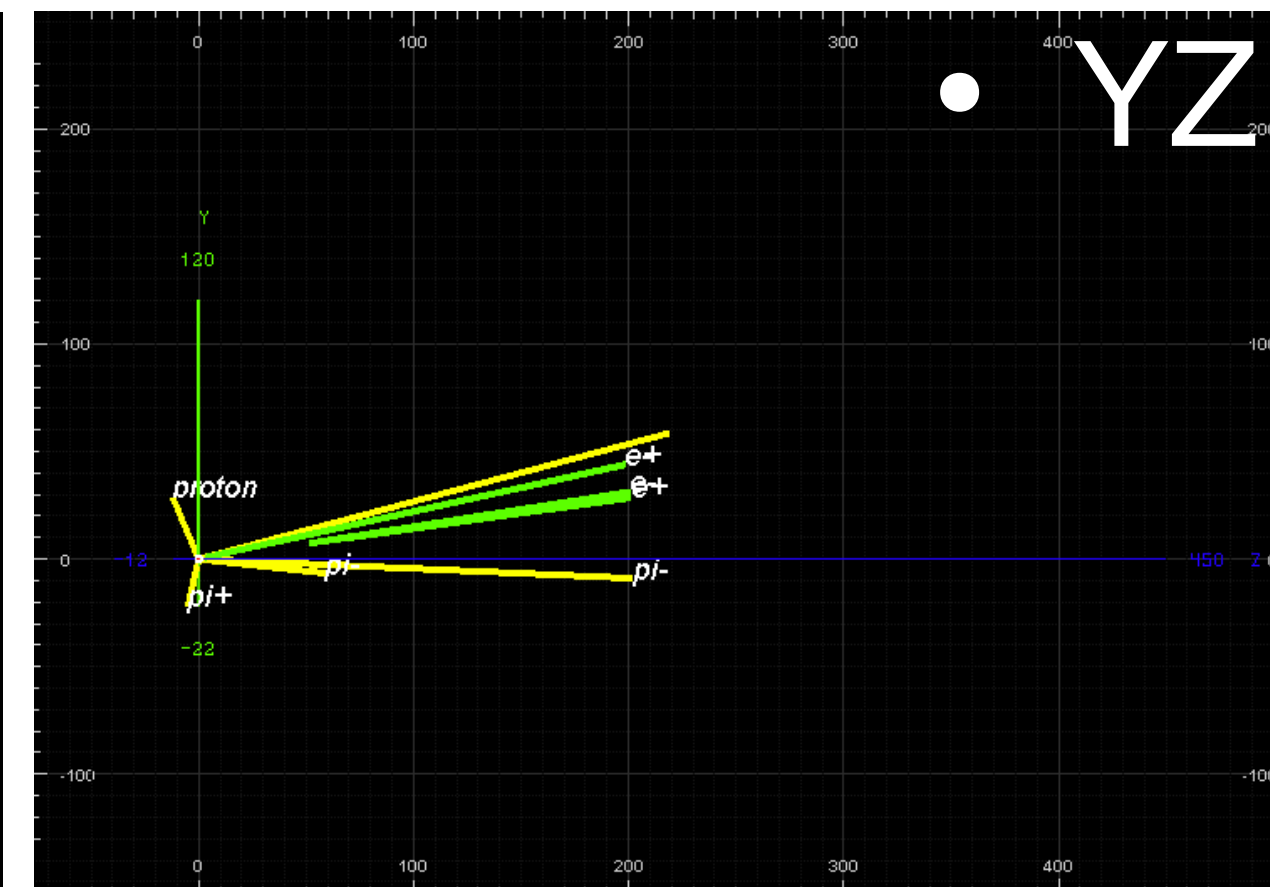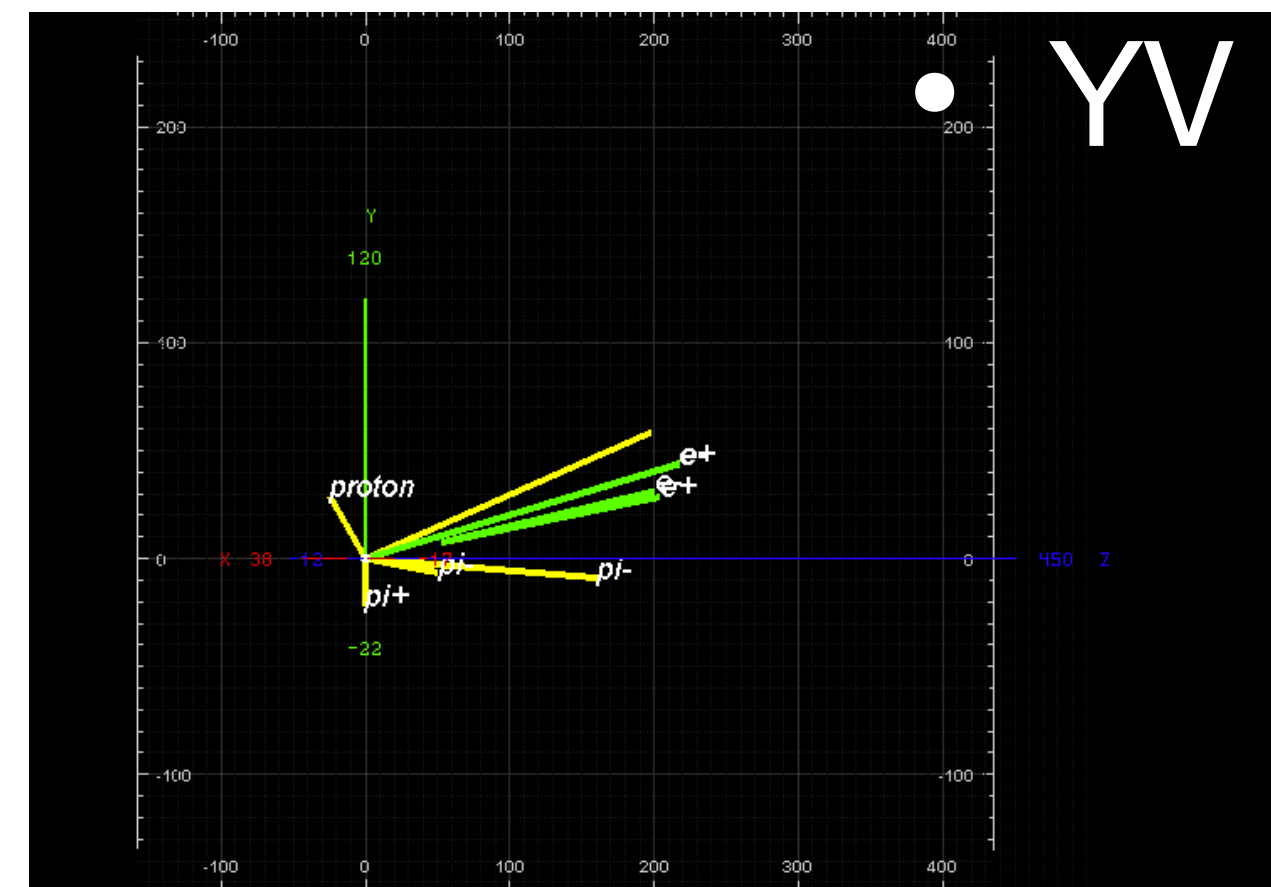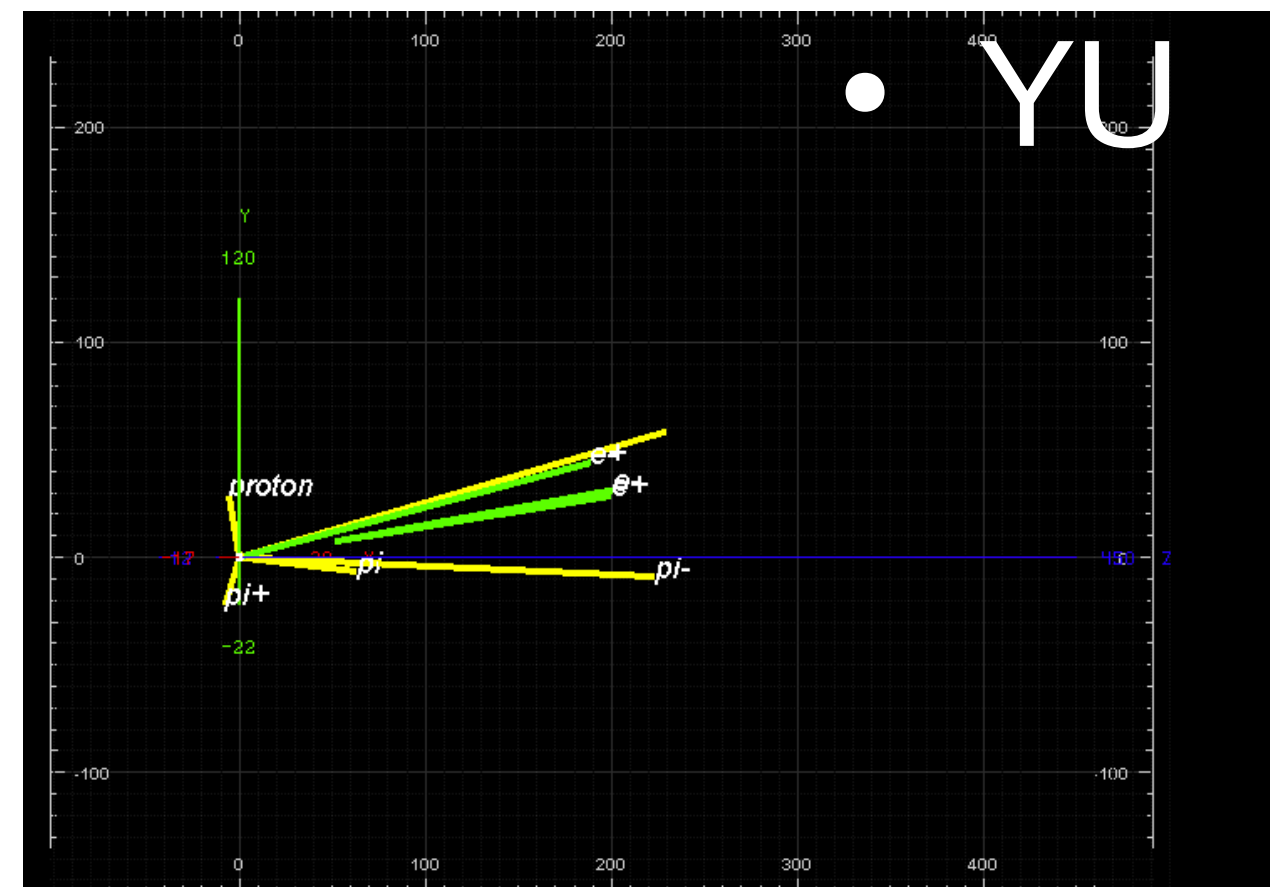
- **(0, 90, -48) problematic event: 287**
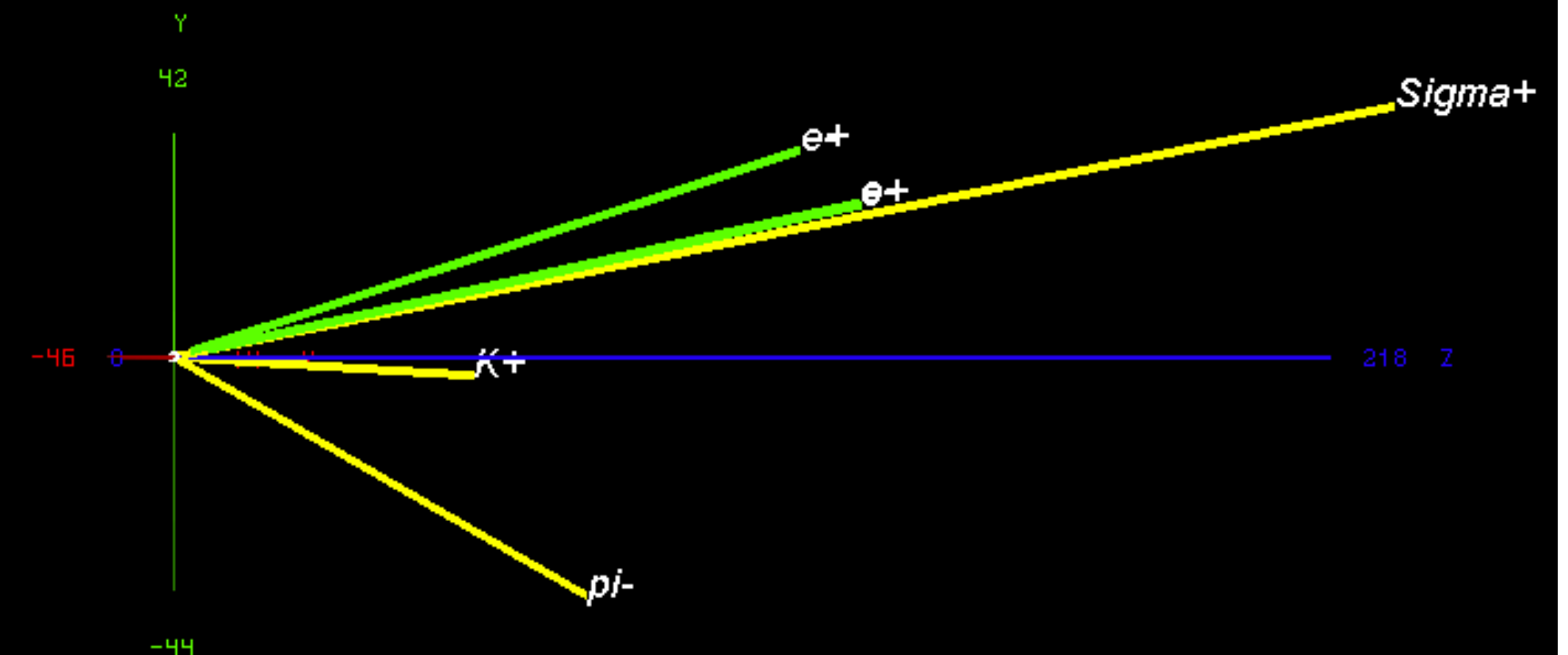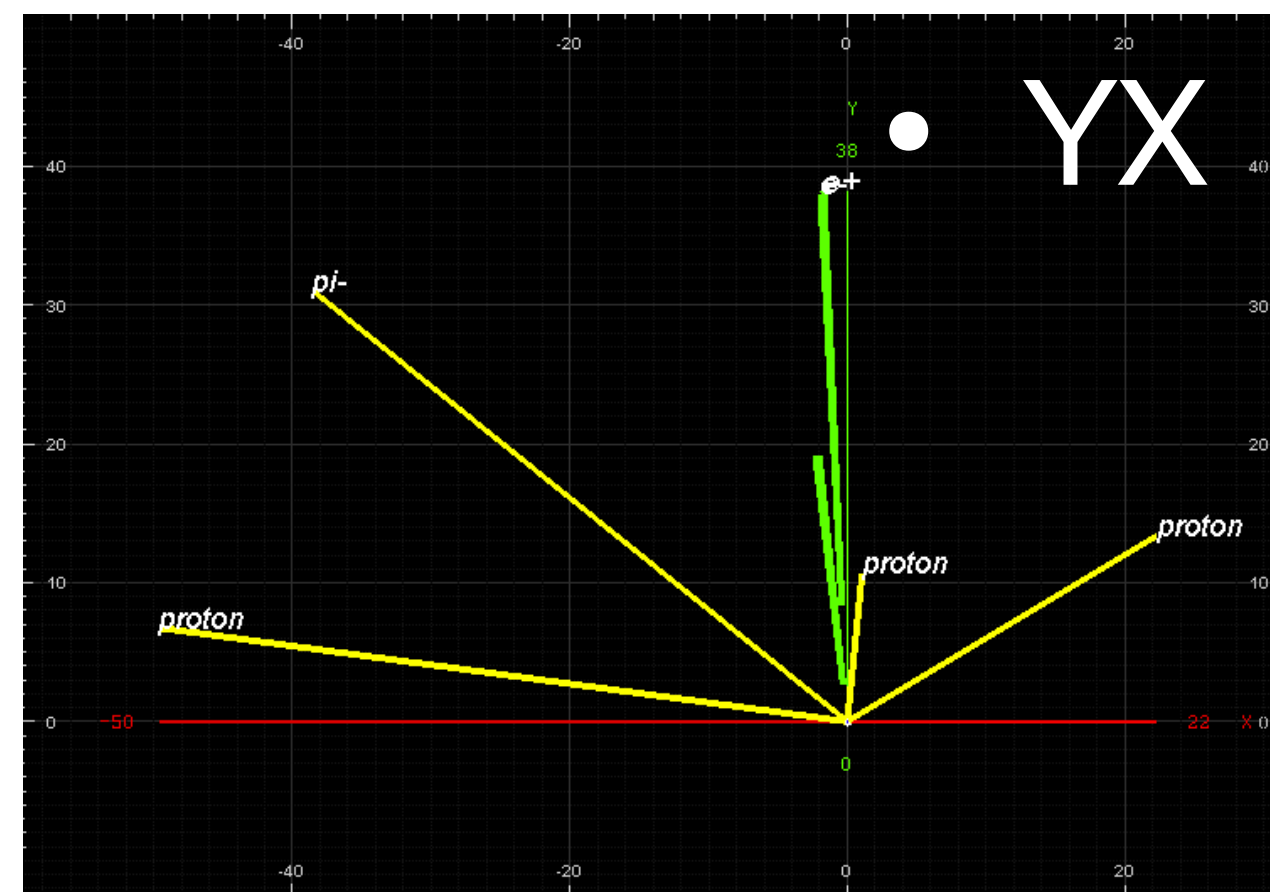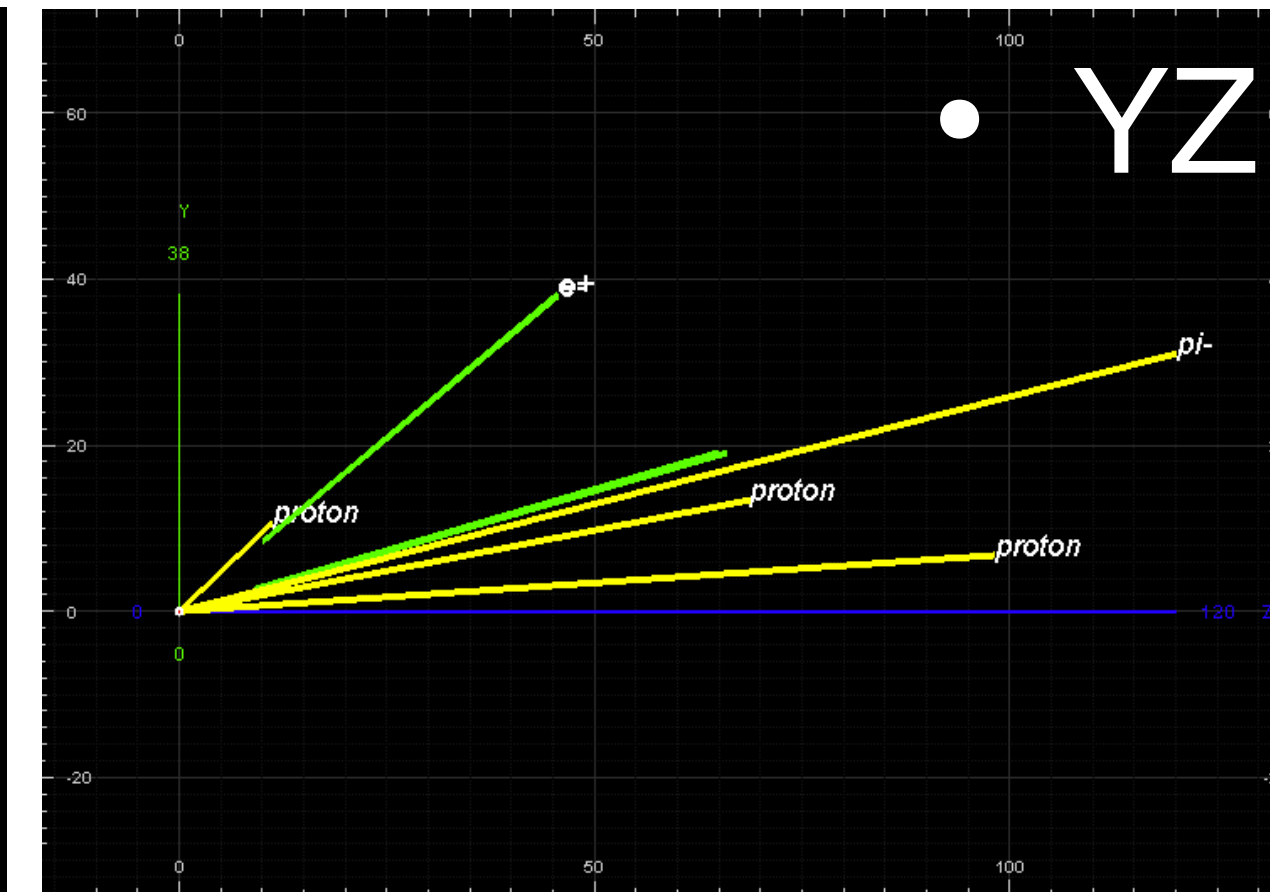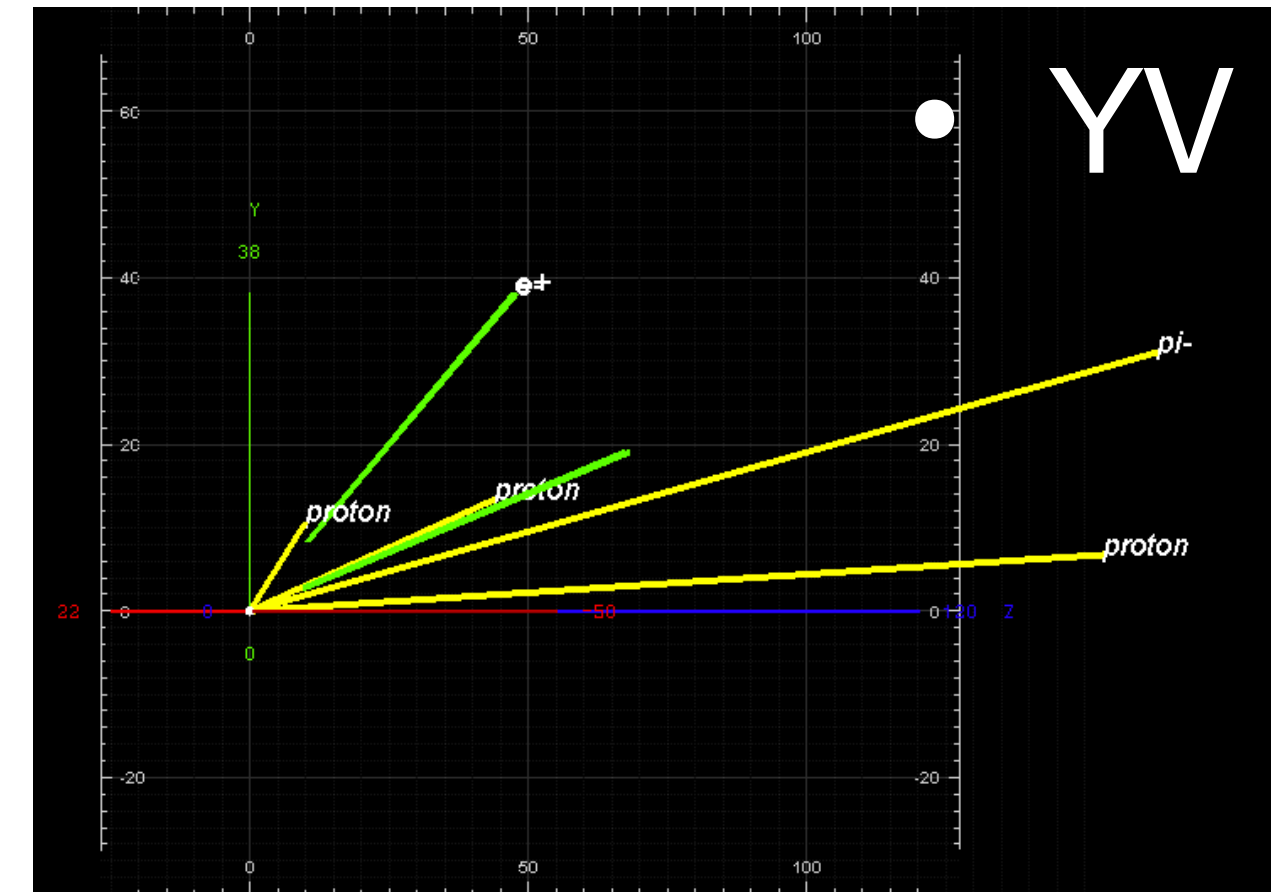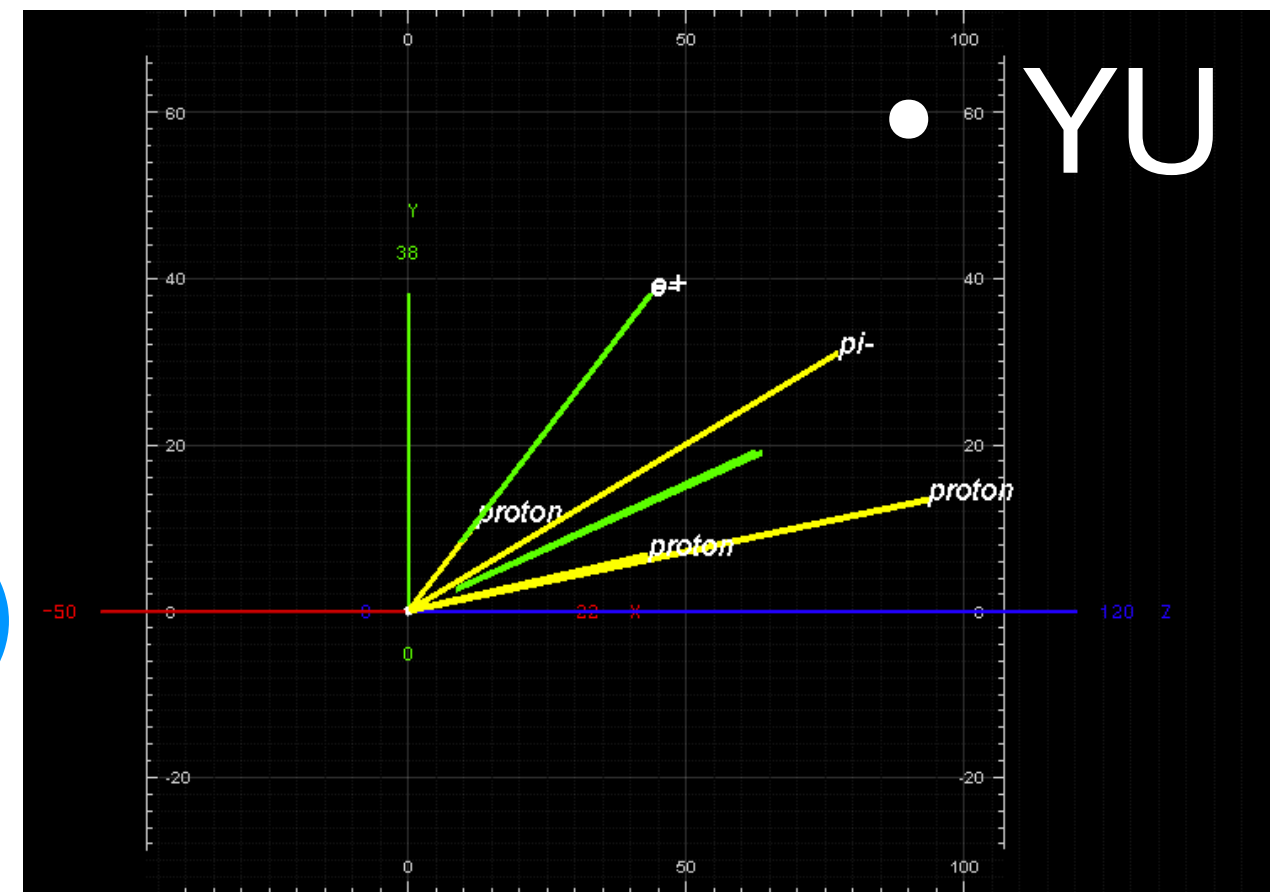
Event 51

- (0, 90)

- (-48, 48, 90)

- (-30, 30, 90)

Event 58
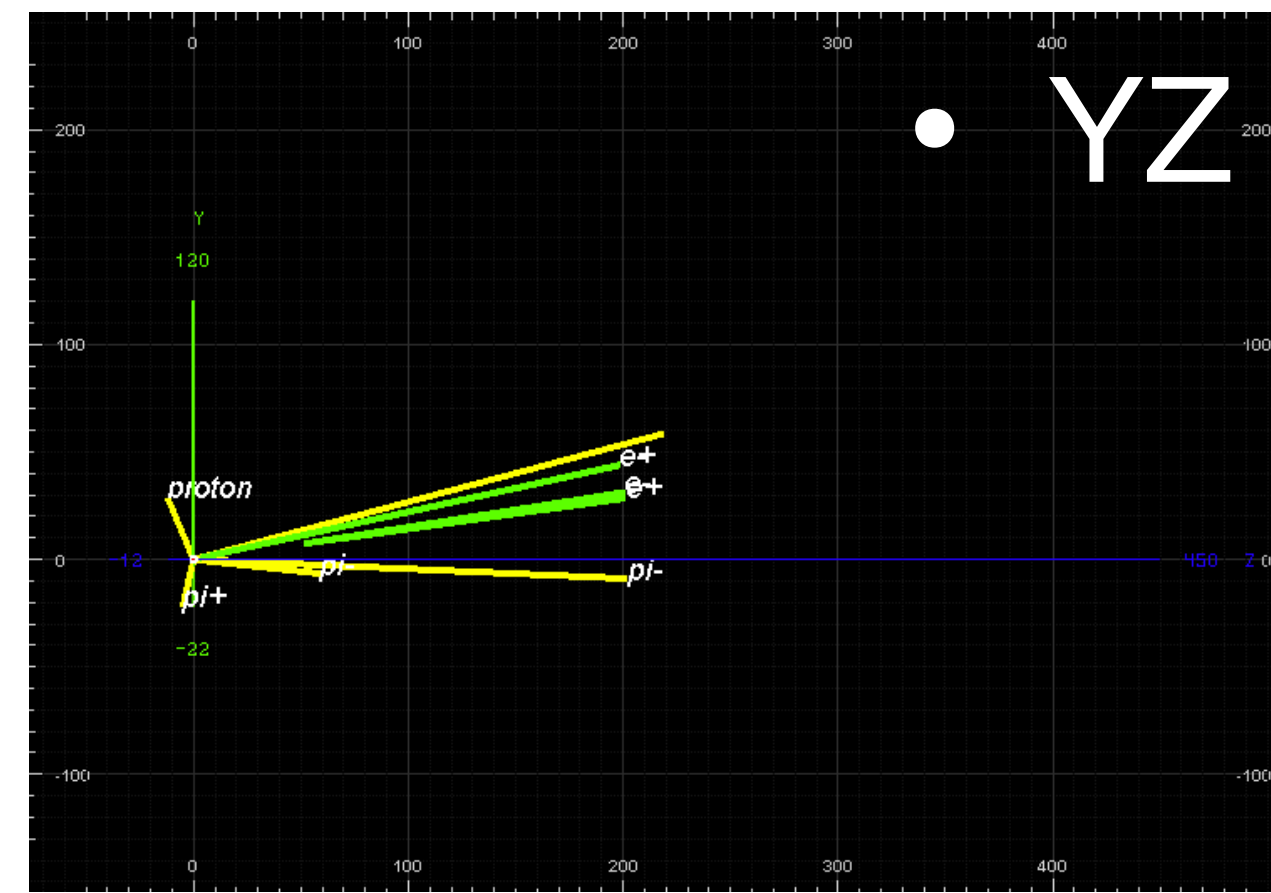
- (0, 90)
- (-48, 48, 90)
- (-30, 30, 90)

Event 213

- **(0, 90)**
- **(-48, 48, 90)**
- **(-30, 30, 90)**