Stopping Muon Selection Performance

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Stopping Muon Online Filter

- Working on filter for eliminating throughgoing muons developed by Michelle
- Intention is to be as simple and rough as possible for speed so that filter can be implemented online
- Filter looks for exit points in TPCs on bottom of detector in (y,z) plane of muon
- Angles corrected to geometrical polar and azimuthal angles (ϕ in horizontal XZ plane, $\cos\theta$ in vertical direction)

35t Map

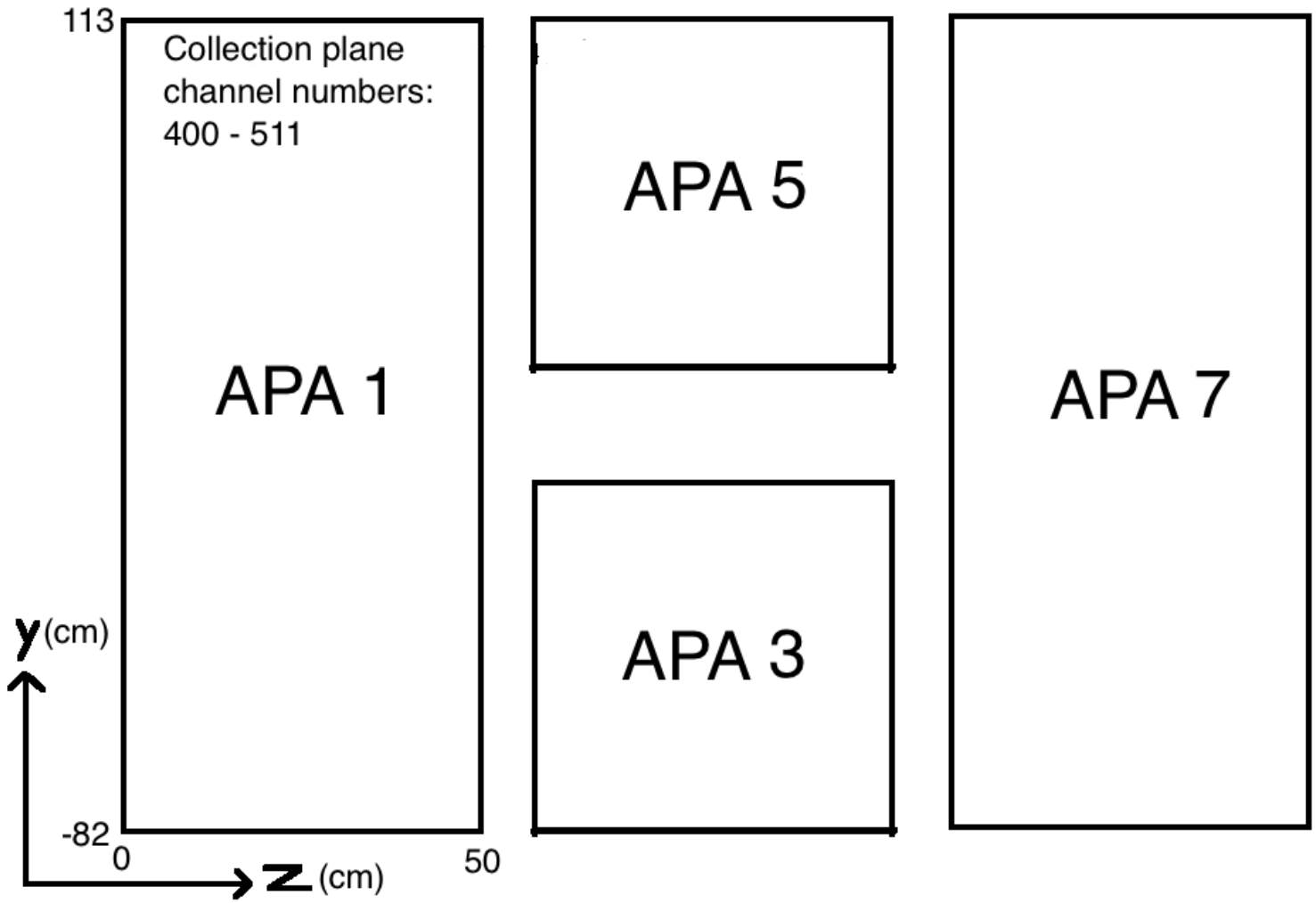

Figure 1: 35t TPCs on long side of drift

Stopping Muon Filter Algorithm

- Load wire endpoints and wire-to-channel maps
- Calculate total charge on collection planes in each TPC
- Cut 1: reject events with significant ($>$ 1000) charge deposition in TPCs on short drift side and without greater ($<$ 50000) charge in TPCs on long drift side
- Cut 2: reject events with hits on very first and/or last collection plane channels (400 and 2047)
- Get endpoint positions of first and last collection plane wires with hits - one of these should be exit point
- Scan over all induction plane channels in TPCs 1, 3, and 7
  - If induction plane channel has at least one hit, check location of its wire endpoints against two exit point candidates (bottoms of first and last collection wires with hits) within offset of 5 cm
- Cut 3: If both induction planes have at least one channel with hits that has an endpoint matching an exit point candidate, reject event as throughgoing

Event Sample and Results

- 9000 μ^+ from MCC 2 LSU AntiMuon sample (DetSim)
- Cut 1: reject events with significant ($>$ 1000) charge deposition in TPCs on short drift side and without greater ($<$ 50000) charge in TPCs on long drift side
- Cut 2: reject events with hits on very first and/or last collection plane channels (400 and 2047)
- Cut 3: If both induction planes have at least one channel with hits that has an endpoint matching an exit point candidate, reject event as throughgoing

Table 1: Muons after Cuts

Cumulative Cut(s) Applied	Throughgoing	Stopping
None	8287	515
Cut 1	3641	425
Cut 2	816	148
Cut 3	156	75

Throughgoing Muons

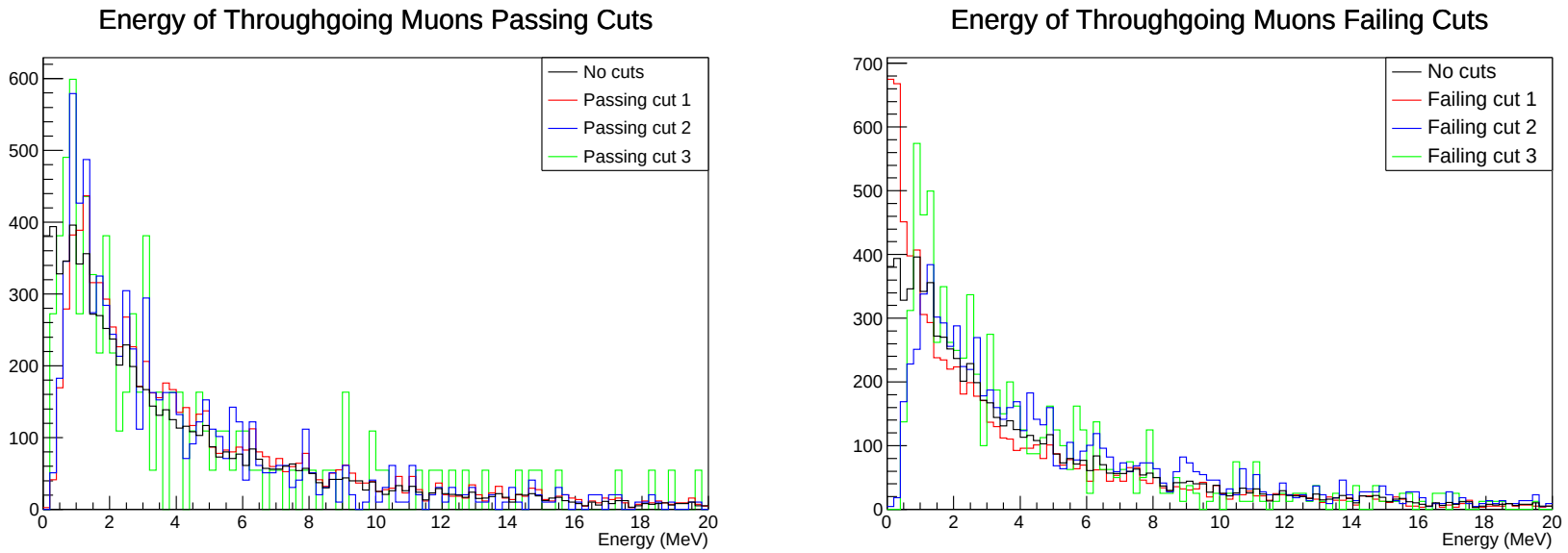

Figure 2: Throughgoing muon energies passing and failing cuts (areas normalized)

Throughgoing Muons

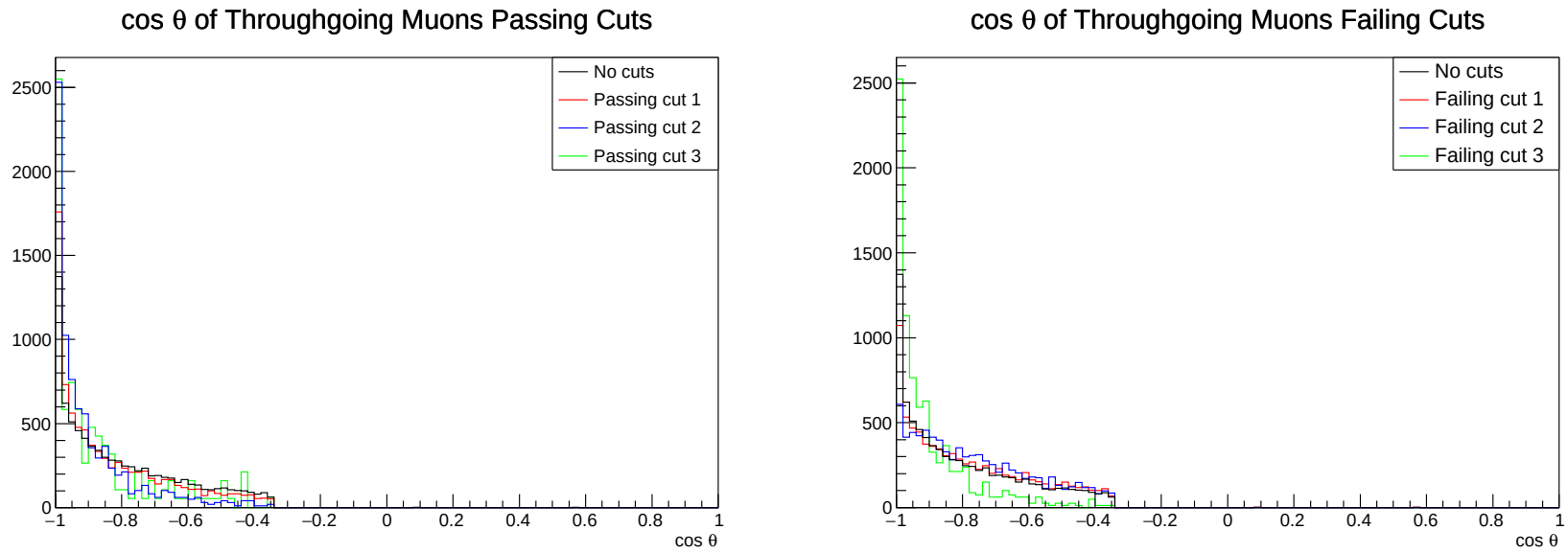

Figure 3: Throughgoing muon angles passing and failing cuts (areas normalized)

Throughgoing Muons

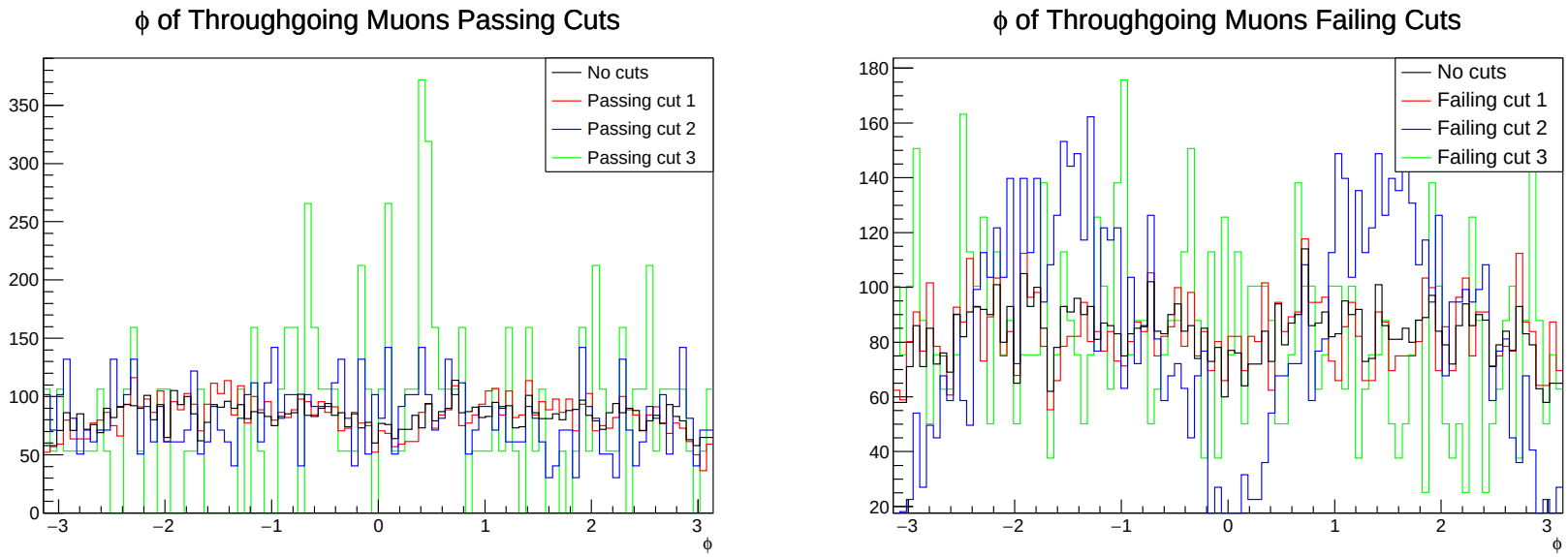

Figure 4: Throughgoing muon angles passing and failing cuts (areas normalized)

Stopping Muons

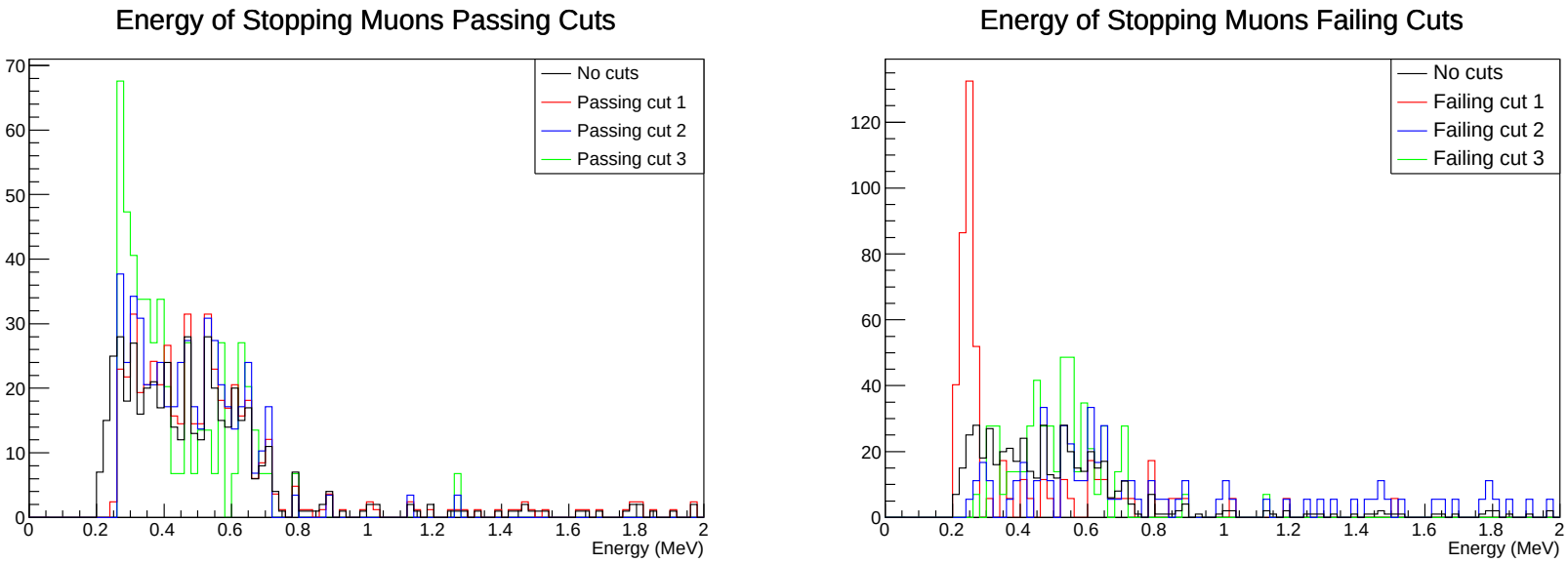

Figure 5: Stopping muon energies passing and failing cuts (areas normalized)

Stopping Muons

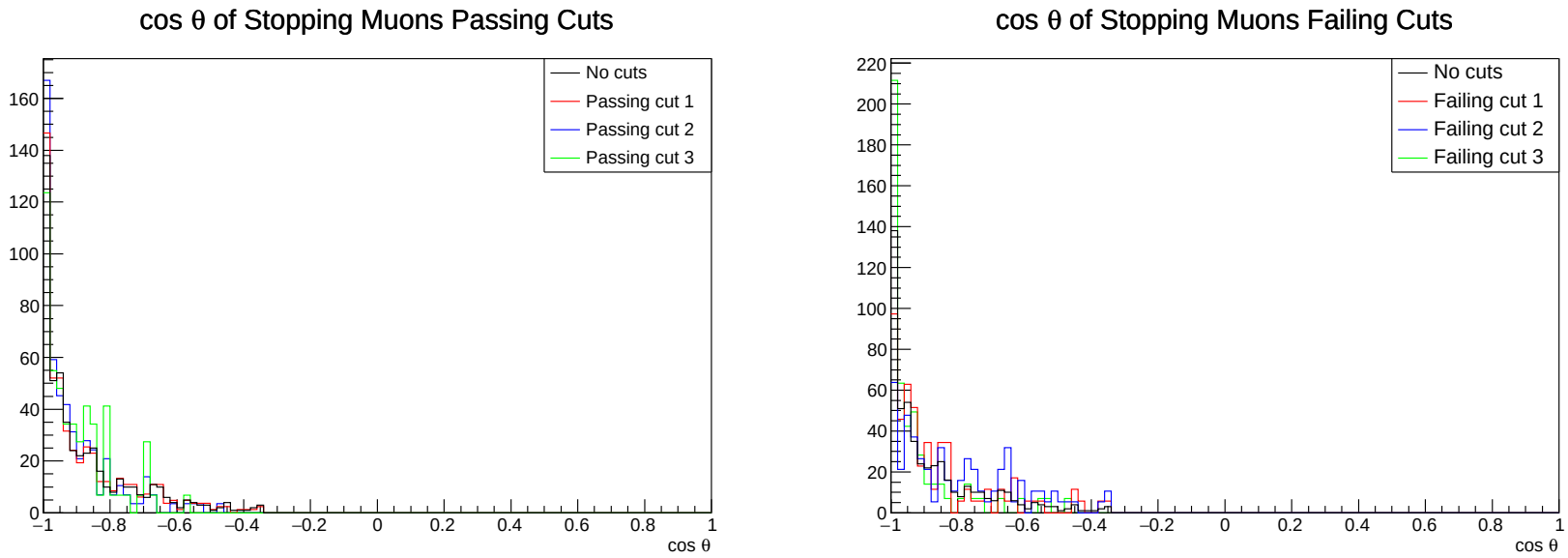

Figure 6: Stopping muon angles passing and failing cuts (areas normalized)

Stopping Muons

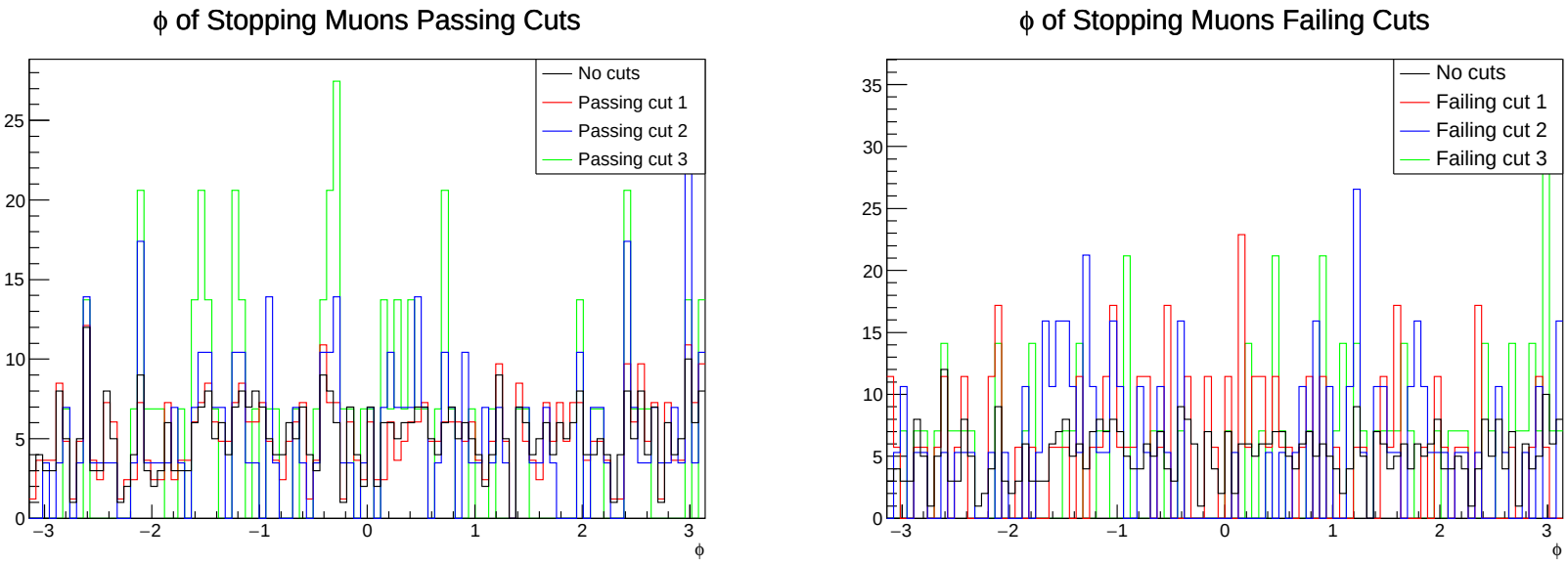

Figure 7: Stopping muon angles passing and failing cuts (areas normalized)

Next Steps

- Look at exit points of stopping and throughgoing muons
- Use hit time to match collection plane hits with induction plane hits and determine entry and exit points along all four sides of YZ plane
- Measure efficiency and purity with samples of throughgoing and stopping muons of diverse energies and directions

Simulating Pedestals in the 35t Discussion

- Pedestals currently zero in simulation
- Do we want to simulate nonzero pedestals?
- What sort of variation should we use?
- MicroBooNE doesn't use pedestal value in RawDigit object; instead, they subtract channel-by-channel pedestals from a database