

1. Motivations

- ▶ Key demonstration for DUNE electron selection and energy reconstruction and to demonstrate DUNE far detector capability to identify and reconstruct low-energy electron events.
- ▶ The analysis is important to show that ProtoDUNE can use the topological / calorimetric information provided by the TPC to identify a specific topology.

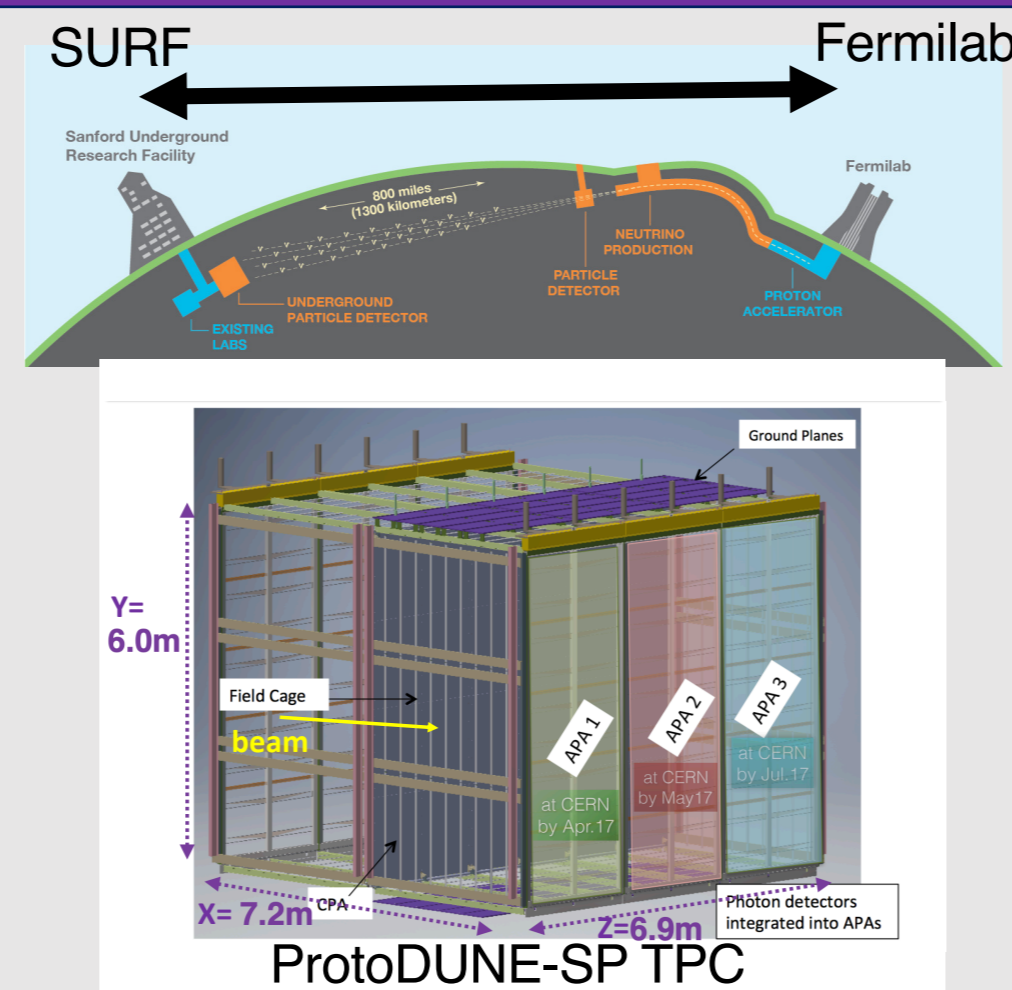
2. DUNE/ProtoDUNE Experiment

DUNE:

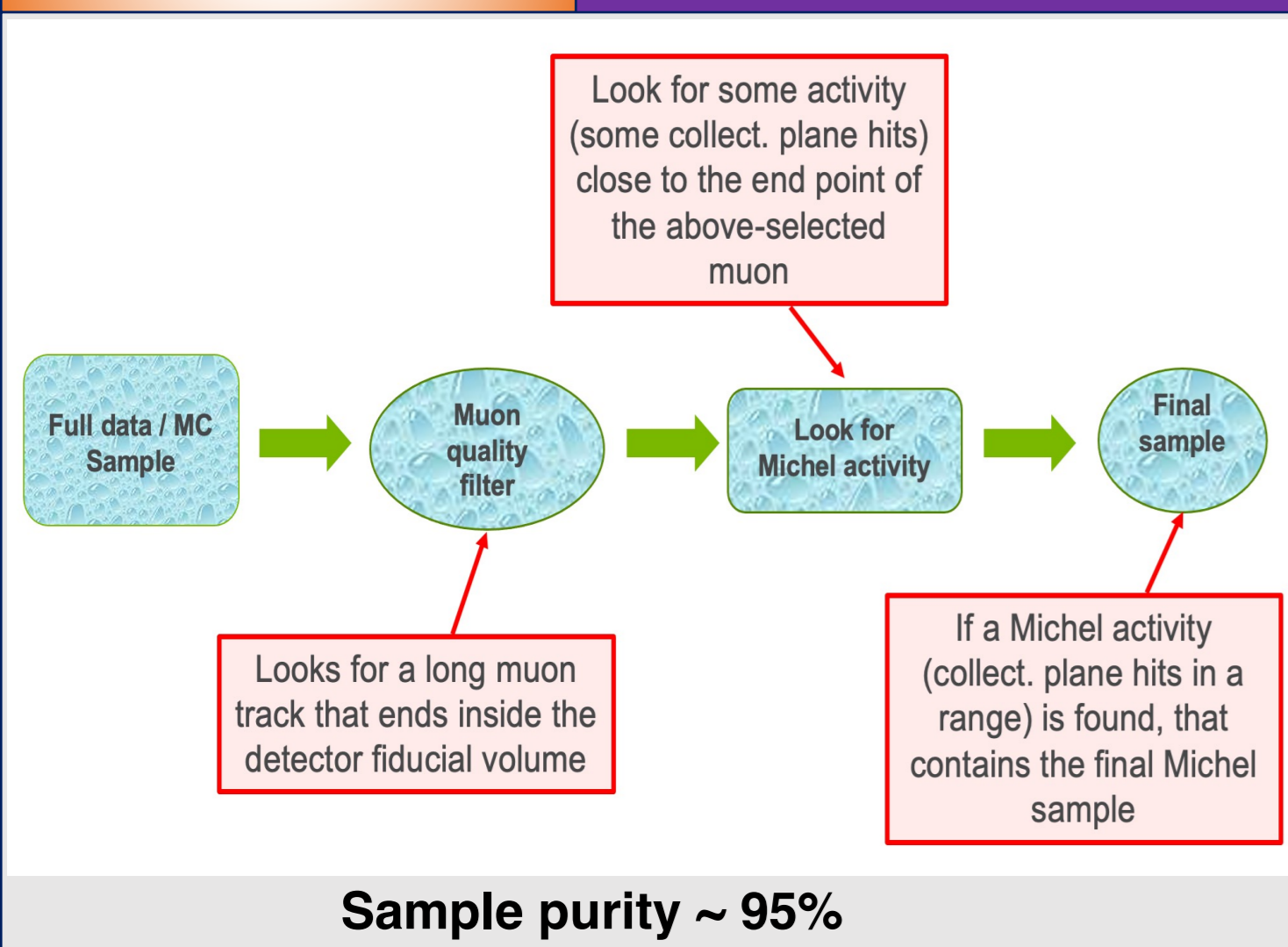
- 1300 km baseline
- 70 kton Liquid Argon Time Projection Chamber (LArTPC) Far Detector (FD) at SURF, South Dakota, 1.5 km underground
- Multiple technologies for the Near Detector (ND) at Fermilab
- Will measure neutrino oscillation probability to determine mass ordering and CP violation phase; potential for BSM physics and supernova neutrinos

ProtoDUNE-single phase:

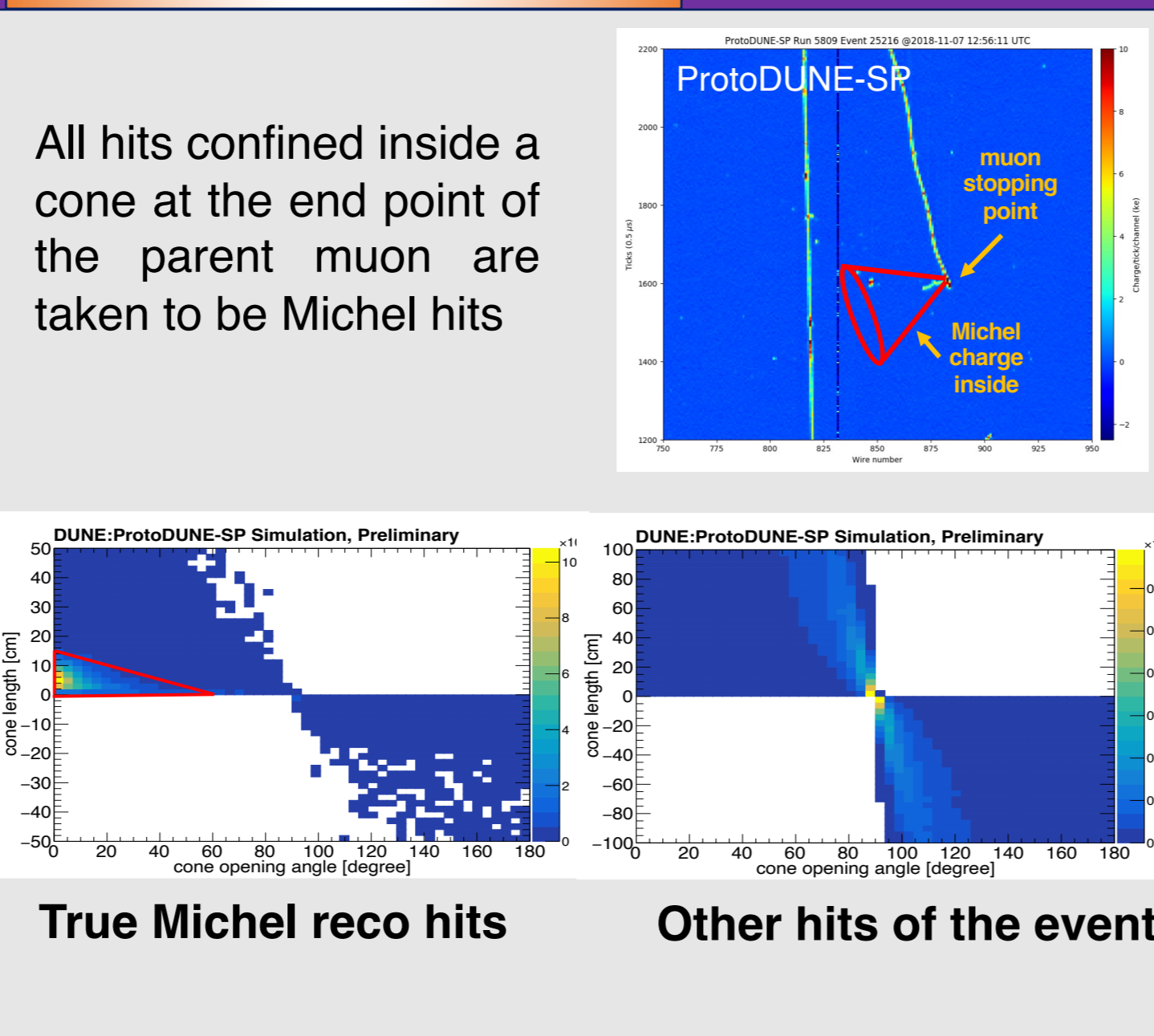
- ~6x6x7 m³ in charged test beam at CERN
- A crucial part of the DUNE effort towards the construction of the first DUNE far detector module
- ProtoDUNE-SP I operated from September 2018 to July 2020



3. Event Selection

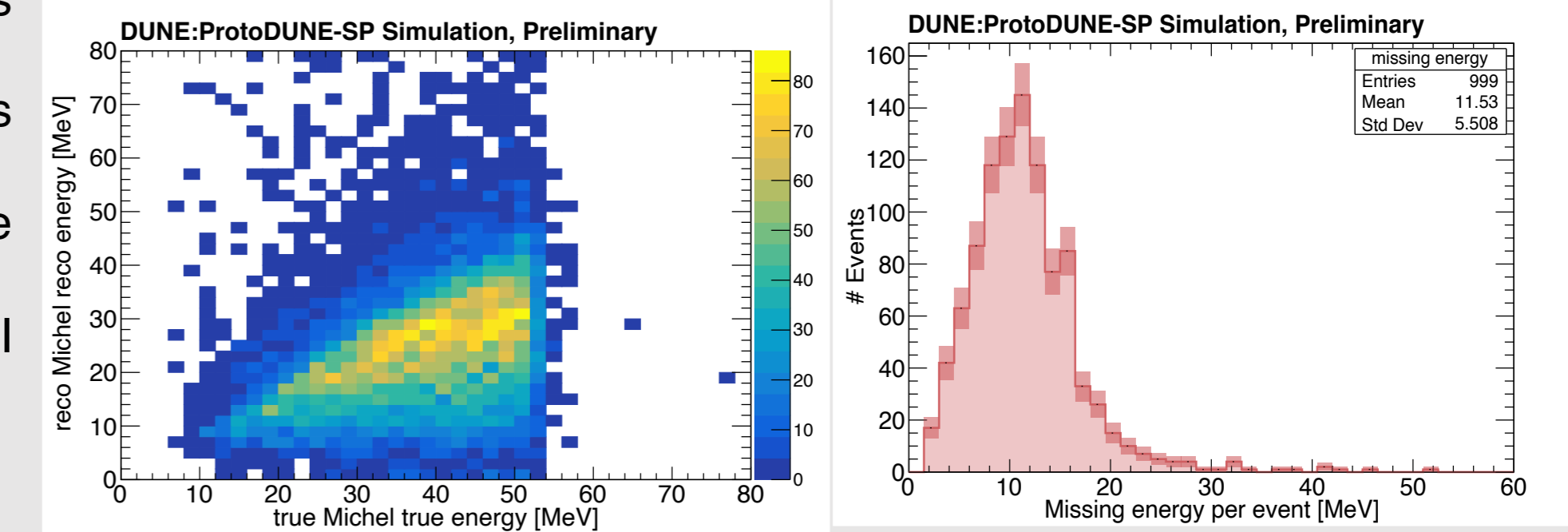


4. Michel Reconstruction



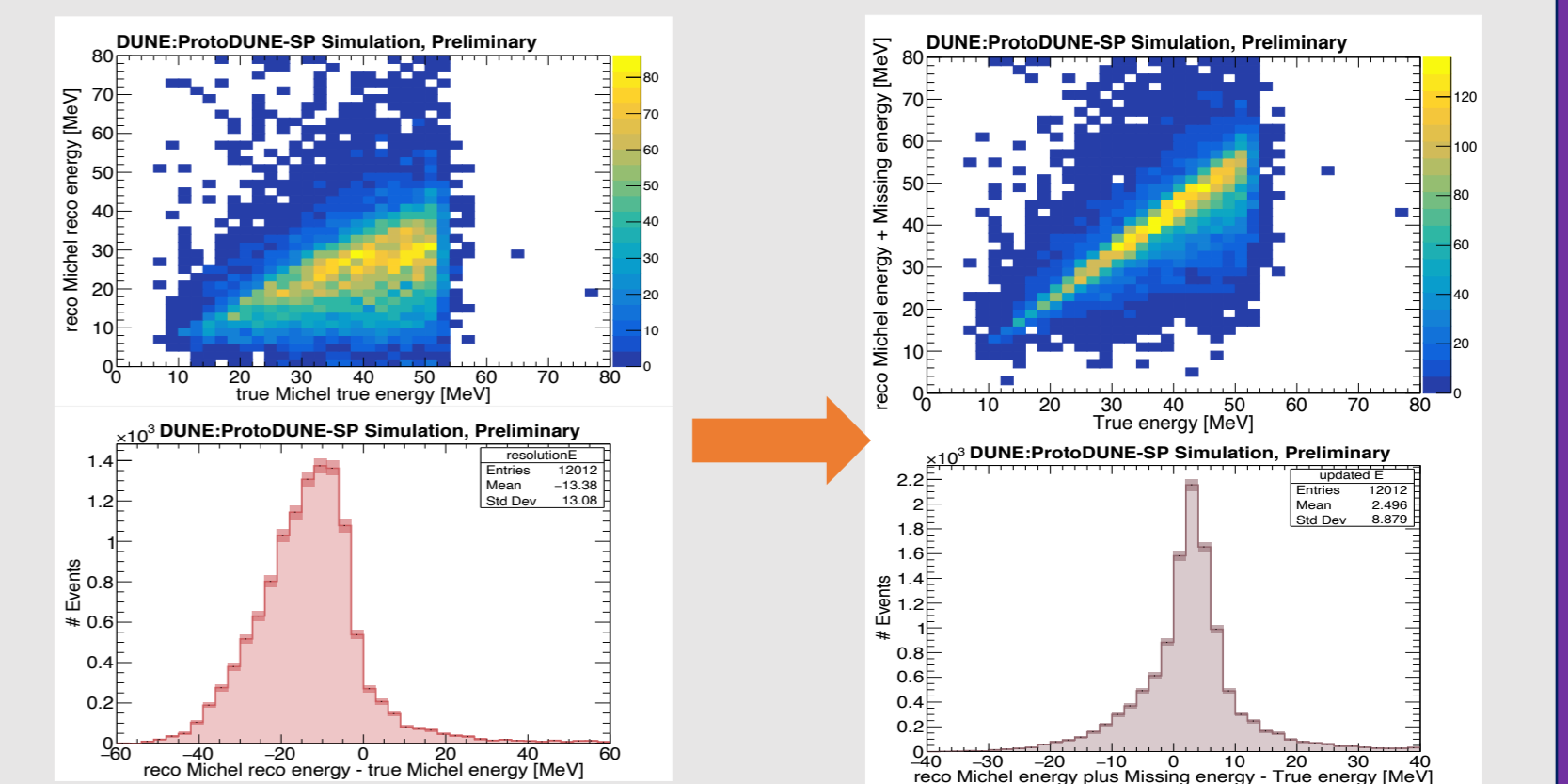
5. Missing Reconstructed Energy

- ▶ ~35% of Michel true energy is missing
- ▶ Some of the true Michel hits are not getting reconstructed
- ▶ Computed the average missing energy per event
- ▶ All low energy analyses will get impacted by this effect



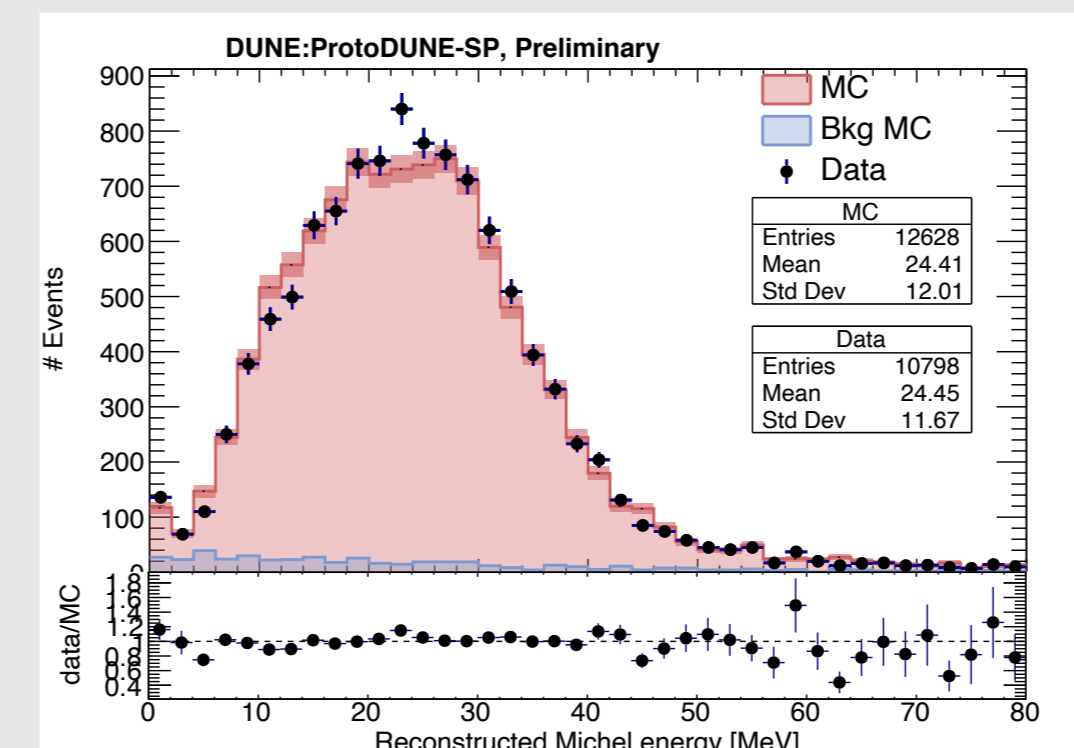
6. Updated MC Michel Energy Resolution

- ▶ Compared MC reconstructable energy resolution plots before and after the addition of the MC missing energy per event
- ▶ Energy resolution:
 - Before: $\delta(E)/E = 26\%$ at 50 MeV
 - After: $\delta(E)/E = 18\%$ at 50 MeV



7. Michel Reconstructed Energy

- ▶ Accuracy of the reconstructed Michel energy spectrum > 98%



8. Conclusions and Future Direction

- ▶ Developed Michel selection, reconstruction, and energy calibration tools important for DUNE LArTPCs.
 - Achieved 96% event purity
 - Michel electron energy accuracy is >98%
- ▶ Working on lowering the hit reconstruction thresholds to retrieve as much energy as possible
- ▶ Michel analysis in ProtoDUNE-SP paper is in progress