

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.

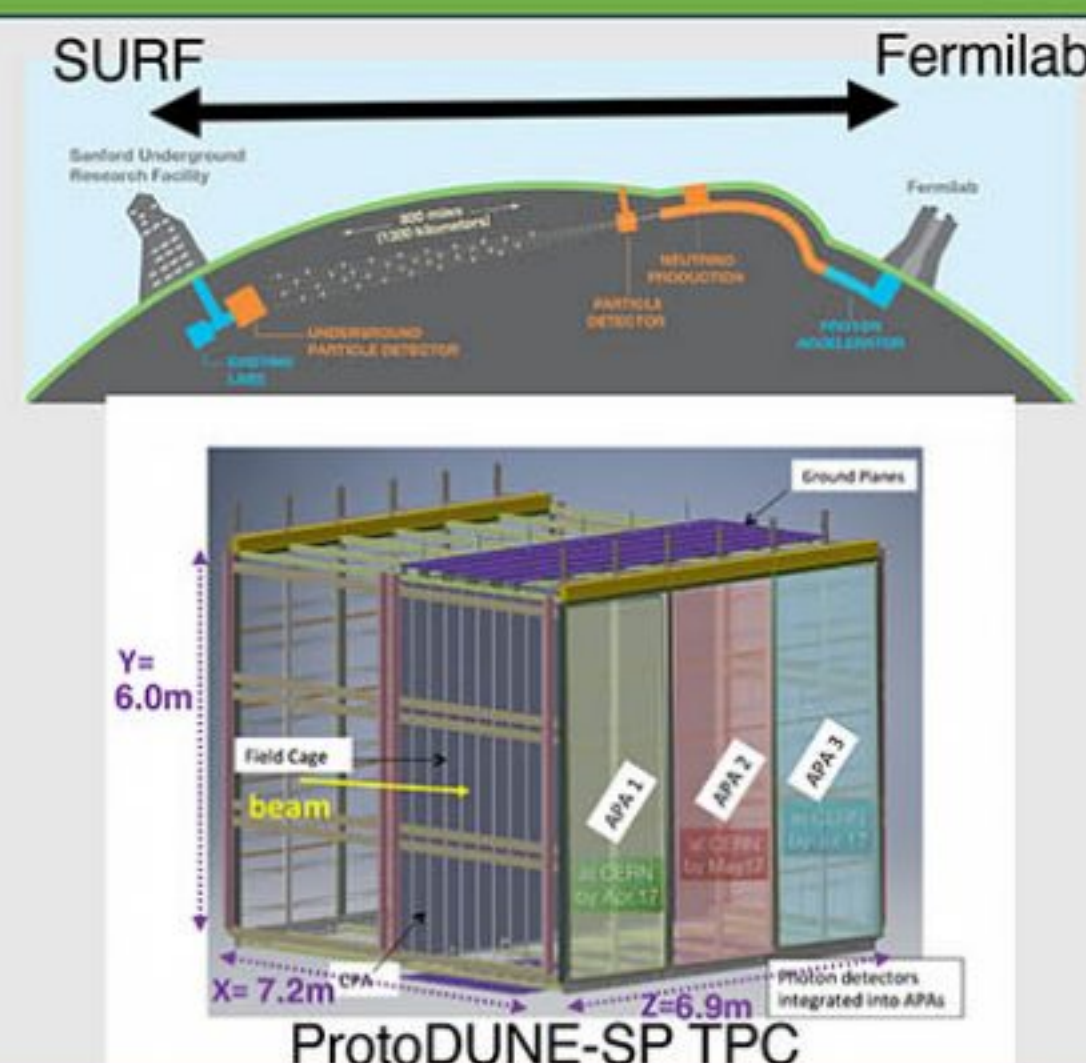
2. DUNE/ProtoDUNE Experiment

DUNE:

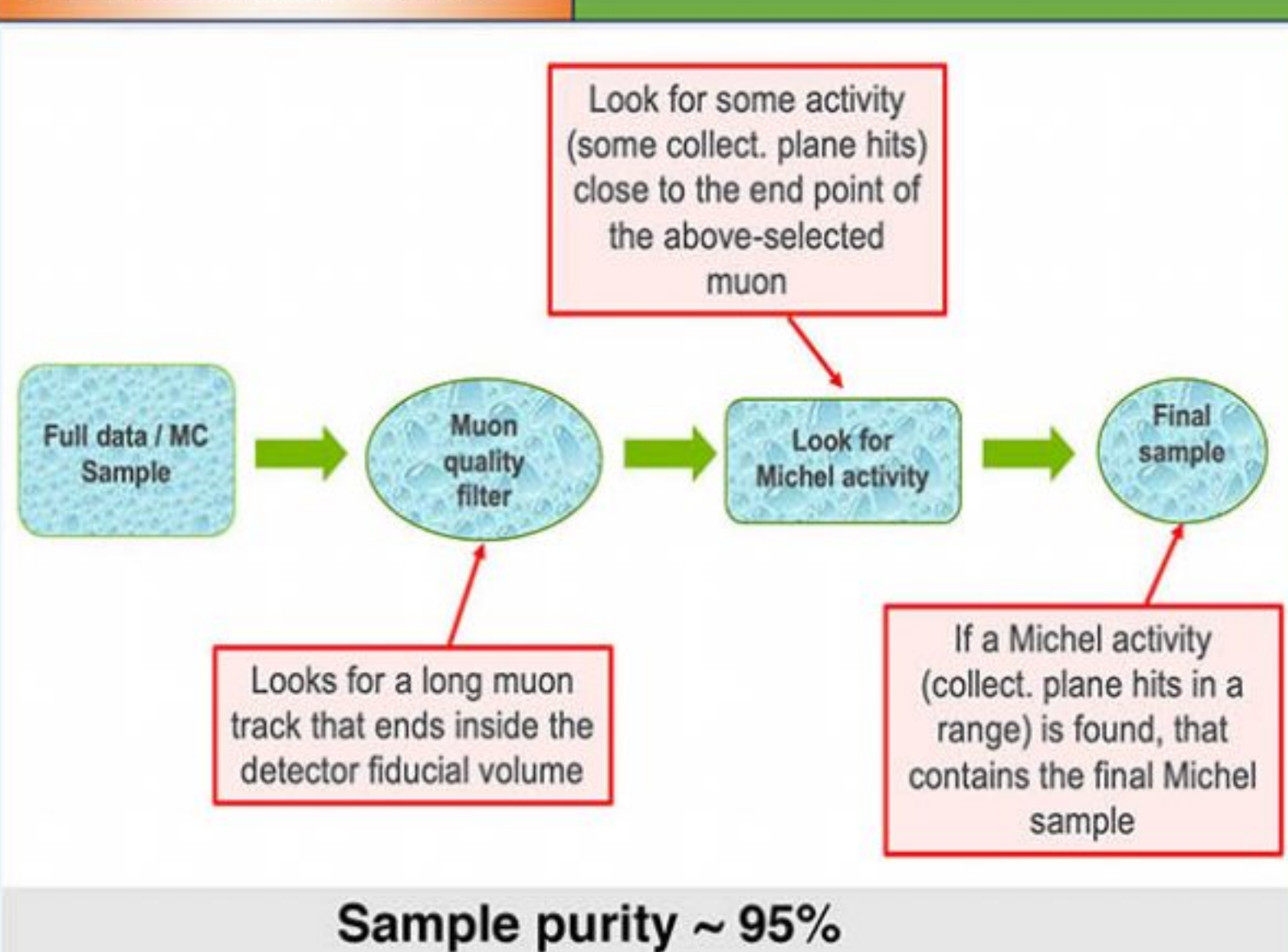
- 1300 km baseline
- 70 kton Liquid Argon Time Projection Chamber (LArTPC) Far Detector (FD) at SURF, South Dakota, 1.5 km underground
- Multiple technologies for the Near Detector (ND) at Fermilab
- Will measure neutrino oscillation probability to determine mass ordering and CP violation phase; potential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

ProtoDUNE-single phase:

- ~7x6x7 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

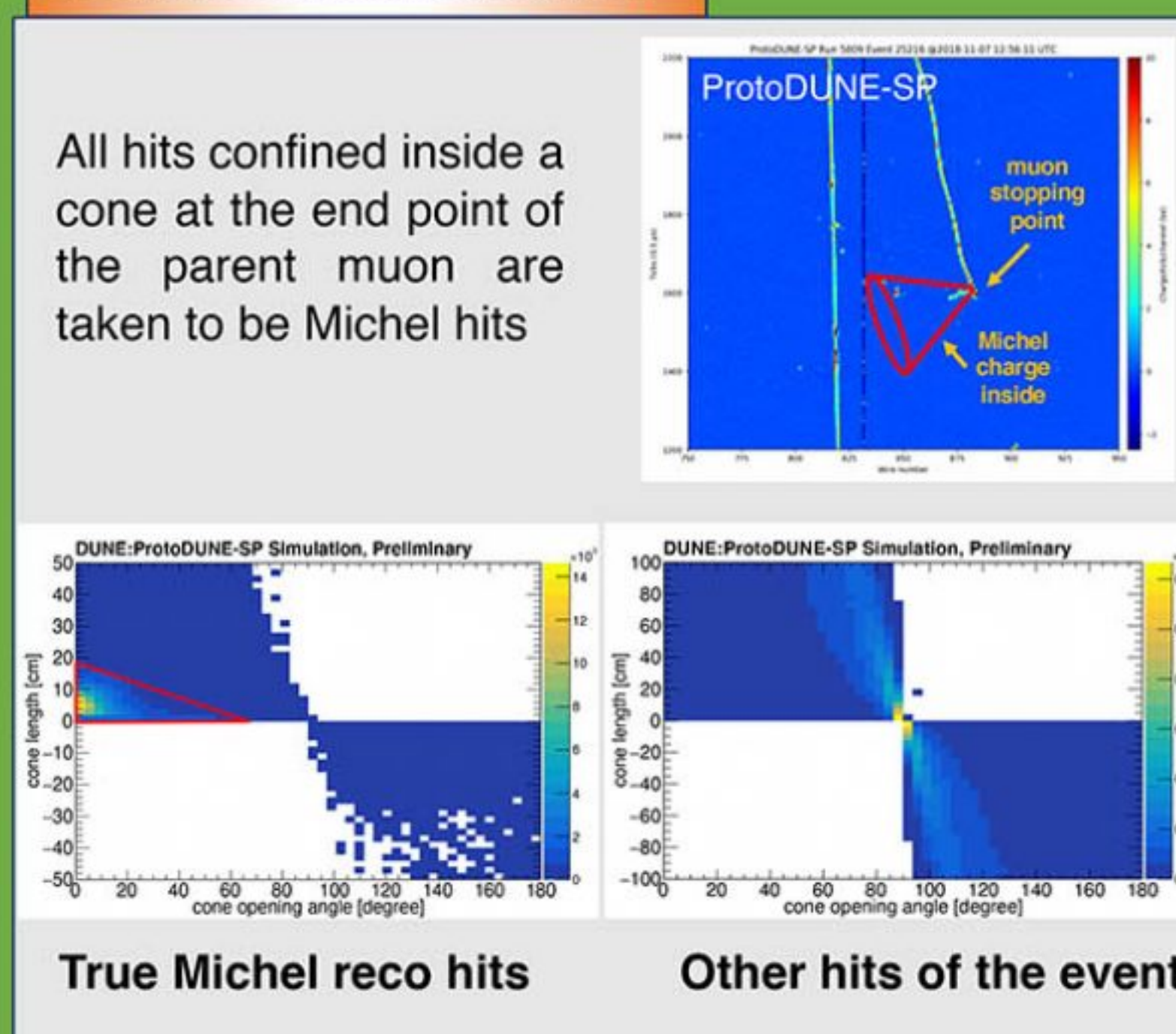


3. Event Selection



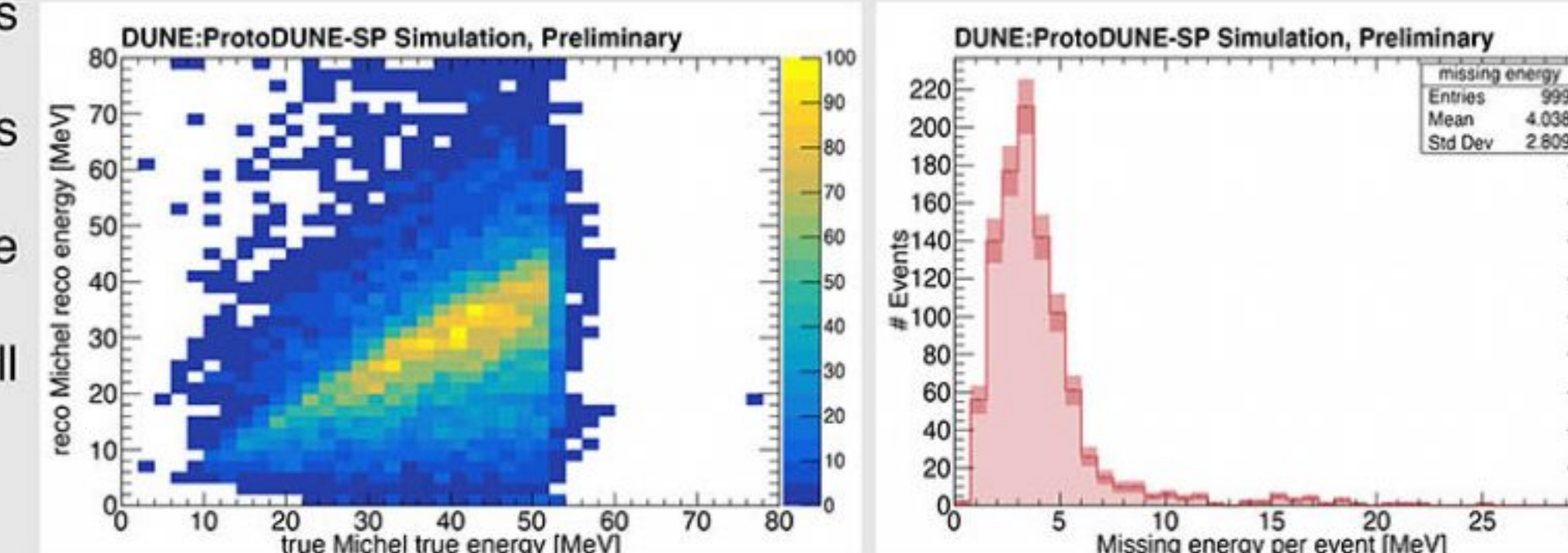
4. Michel Reconstruction

All hits confined inside a cone at the end point of the parent muon are taken to be Michel hits



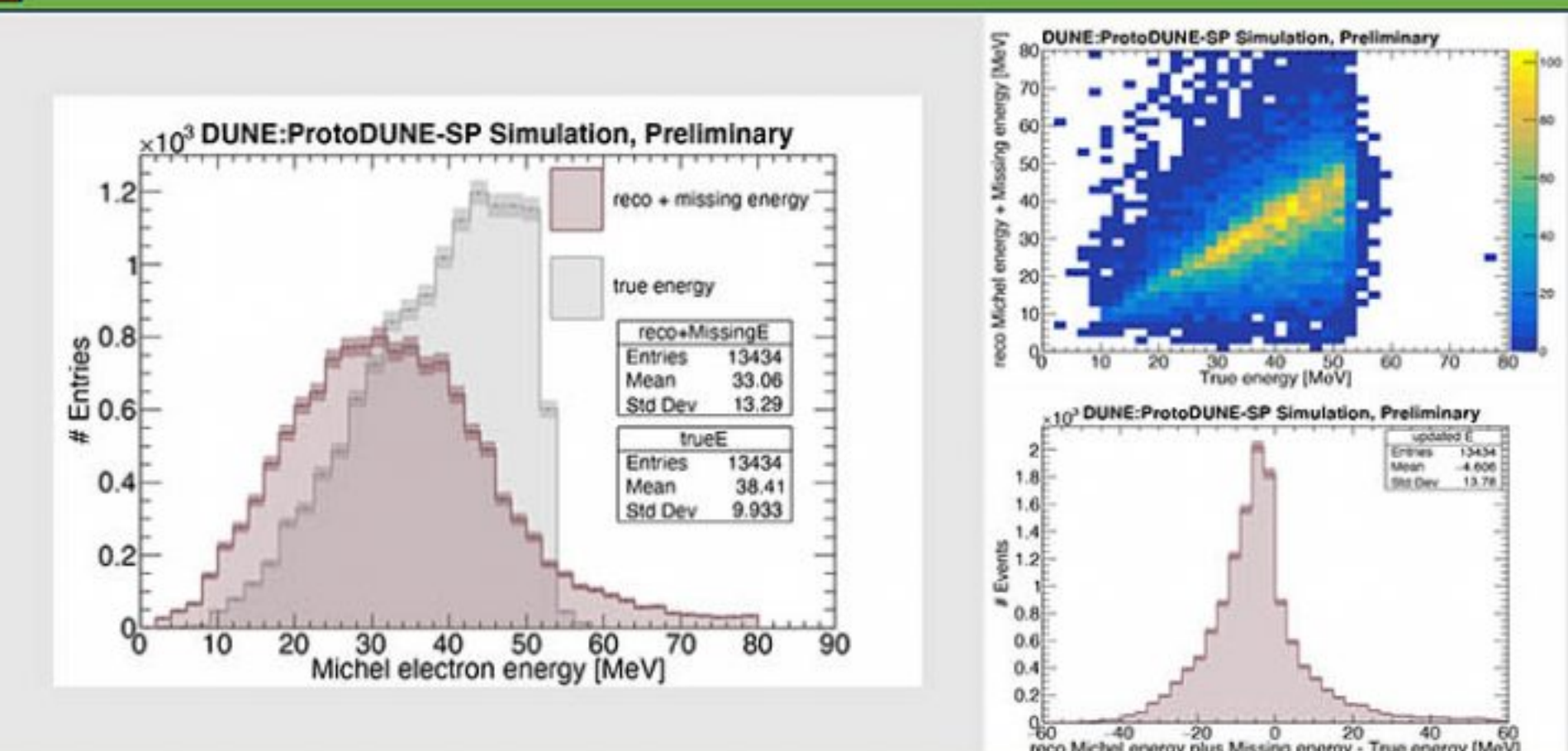
5. Missing Reconstructed Energy

- ~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



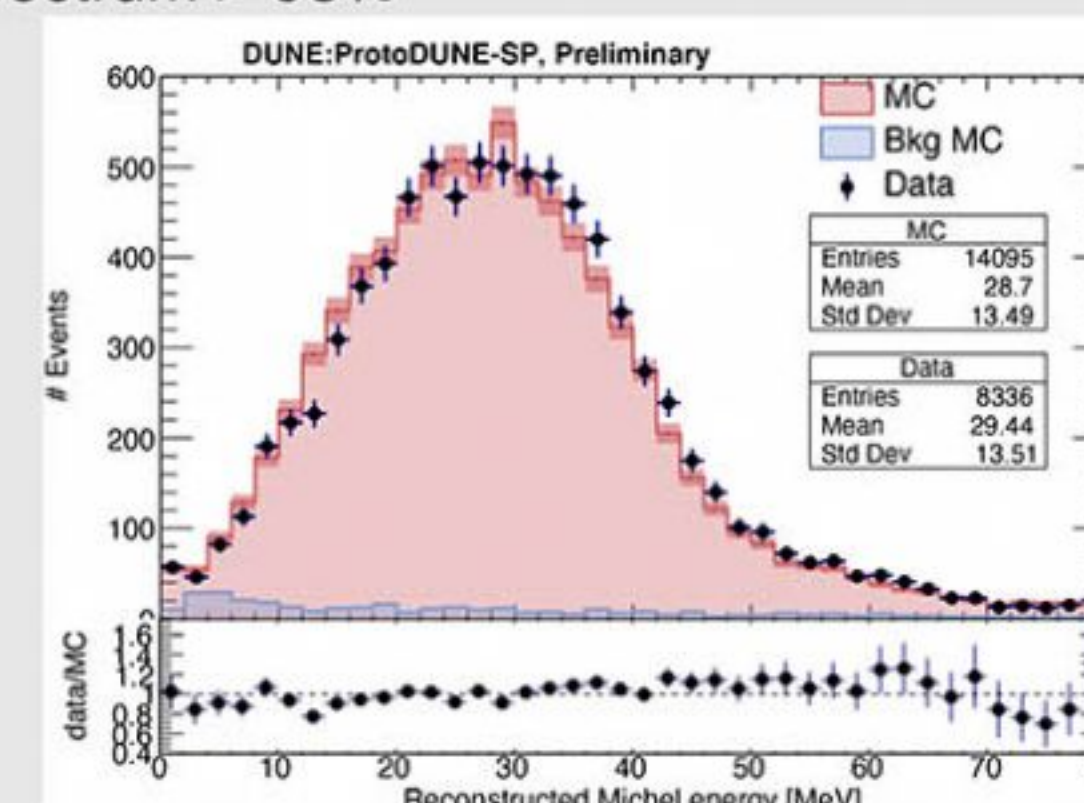
6. Updated MC Michel Energy

- MC Michel reconstructable energy after the addition of the MC missing energy per event and the true Michel energy spectrum are compared
- 11% energy due to hit reconstruction threshold effects was retrieved using MC studies
- The energy resolution improves



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 95% event purity
 - Michel electron energy accuracy is >98%
- Working on understanding the remaining source of missing energy
 - The energy outside Michel cone is another main reason of the energy loss
- Michel analysis in ProtoDUNE-SP paper is in progress