TDR Assessment Exercise – Atmospheric Neutrinos

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CDR MH Sensitivity Studies – MANY Assumptions!

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1. Low-level reco
   - Track/shower finding
   - Vertex determination

2. Flavor Determination
   - Particle ID
   - Flavor classification

3. Measurement
   - Lepton energy, angle
   - Hadronic system energy, angle

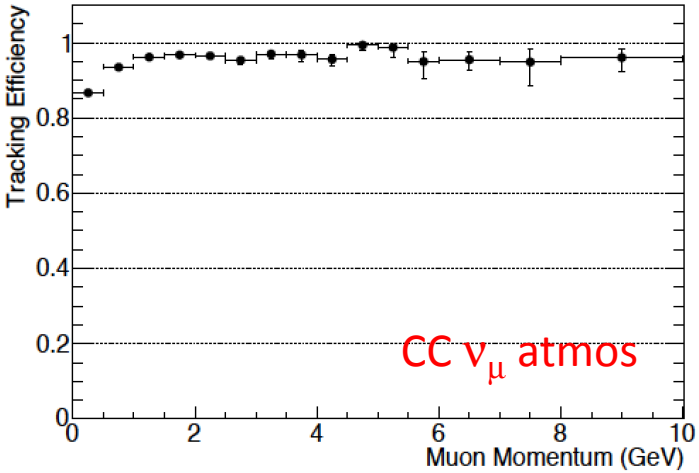
Angular Resolution	Electron	1°
	Muon	1°
	Hadronic system	10°
Energy Resolution	Stopping muon	3%
	Exiting muon	15%
	Electron	1%/√E + 1%
	Hadronic system	30%/√E
Signal Acceptance	Electrons	90%
	Muons	100%
Background Rejection	e-like (π^0, γ)	95%
	μ-like (π^+, π^-)	99%

Neutrino energy and direction resolution dominated by hadronic system measurements.

Atmospheric Neutrinos

- Risks and Direction Changes
  - Having CDR studies (MH determination) done with full sim/reco for TDR is unrealistic.
  - We do not see the continued use of some level of fast sim tools as a major problem, and also need to retain capacity for study of new (BSM?) physics ideas.
  - Would consider the absence of demonstrated progress as a risk.
  - If no significant effort on atmos reco:
    - Risk of developing software tools that are too beam-centric.
    - Risk of missed opportunities for analyses of proto-DUNE data and other data on the way to DUNE.

- Effort Allocation
  - Discussion at collaboration meeting
  - Piggybacking on other efforts:
    - reconstruction (beam vs. atmos),
    - LArIAT and ProtoDUNEs for single particle measurements, hadronic system studies.



A. Higuera, "Far Detector Tracking Efficiencies", https://indico.fnal.gov/getFile.py/access?contribId=63&sessionId=19&resId=0&materialId=slides&confId=10612

Atmospheric Neutrinos

- TDR Goalposts
  - Studies of atmos nu background to proton decay ***will*** require full sim/reco.
  - Significant progress on key aspects of the reconstruction
    - Track/shower finding, vertex determination
    - Flavor Identification
  - "Significant progress" means fully automated, even if not meeting ultimate physics goals.