Introduction

The DUNE long-baseline neutrino experiment will study different modes of neutrino oscillations to identify the CP properties of neutrinos, measure the neutrino mass hierarchy and perform precision measurements of neutrino (mixing) parameters. Other primary physics goals include a search for nucleon decay and the detection of Supernova burst neutrinos. DUNE will also pursue a variety of other measurements.

ProtoDUNE purpose and goals:

- Assess engineering aspects of DUNE far detector components
- Validate basic detector performance (cosmic rays)
- Study charged particle interactions in LAr (test beam)
- Validate event reconstruction algorithms and MC simulations

Detector Layout

ProtoDUNE Single-phase LAr Detector & Beam Measurement Program at CERN

T. Kutter for the DUNE Collaboration

LAr TPC Technology

Technology proven to work at different scales

- Ionization: ~ 60,000 e/cm for mip (for E ~ 500V/cm)
- Provides detailed imaging, calorimetric and particle identification (PID)
- Scintillation: ~24,000 MeV (for E ~ 500V/cm)
- Offers event trigger (L1) information + improved calorimetric information

Infrastructure + Beam

770 t total LAr mass

Beam composition:

Normalized to 10^8 pions on target per spill (4.8s duration)

- 3000 spills/day
- ~3600 eV/cm
- ~8600 MeV/cm
- ~15,000 eV/cm
- ~24,000 MeV/cm
- ~32,000 MeV/cm
- ~40,000 MeV/cm
- ~48,000 MeV/cm
- ~56,000 MeV/cm
- ~64,000 MeV/cm
- ~72,000 MeV/cm
- ~80,000 MeV/cm
- ~90,000 MeV/cm
- ~100,000 MeV/cm
- ~110,000 MeV/cm

Measurement Program

Beam and Cosmic Data Analysis Goals:

- Use information from TPC and PDS
- Evaluate basic detector performance (cosmic rays)
- Validate reconstruction tools and simulations
- Measure (energy) calibration constants (Michel electrons, v^2)
- Extract dE/dx of pions, protons and electrons
- Measure pion interaction cross sections (v^2 for differences; shower topologies)
- Measure neutral pions → NC backgrounds and calibration; e-gamma separation
- Study kaons → relevant for proton decay
- Quantify EM component of hadronic interactions
- Measure momentum via multiple Coulomb scattering
- Study missing energy recovery
- Study v^2 capture on Ar

Timeline/Outlook

Schedule summary extracted from detailed project schedule