Ensuring Precision Measurements of Neutrino Properties in the Deep Underground Neutrino Experiment

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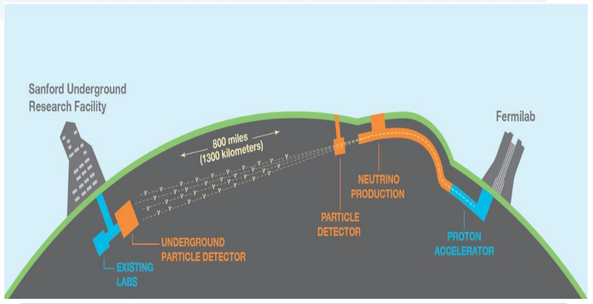
Introduction

Neutrinos are among the most mysterious particles in the Standard Model, capable of passing through matter almost undisturbed. Their behavior may hold clues to some of the most profound questions in physics, including the matter-antimatter asymmetry in the universe. The Deep Underground Neutrino Experiment (DUNE) is designed to study these particles with unprecedented precision using massive Liquid Argon Time Projection Chambers (LArTPCs).



Scientific Motivation:

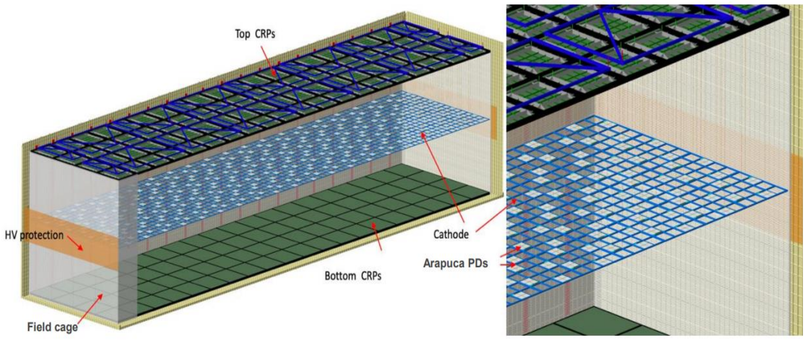
1. Neutrino Oscillation and Mass Hierarchy
2. CP Violation in the Lepton Sector
3. Precision Neutrino Interaction Measurements
4. Search for Proton Decay
5. Supernova Neutrino Detection
6. Beyond Standard Model Physics

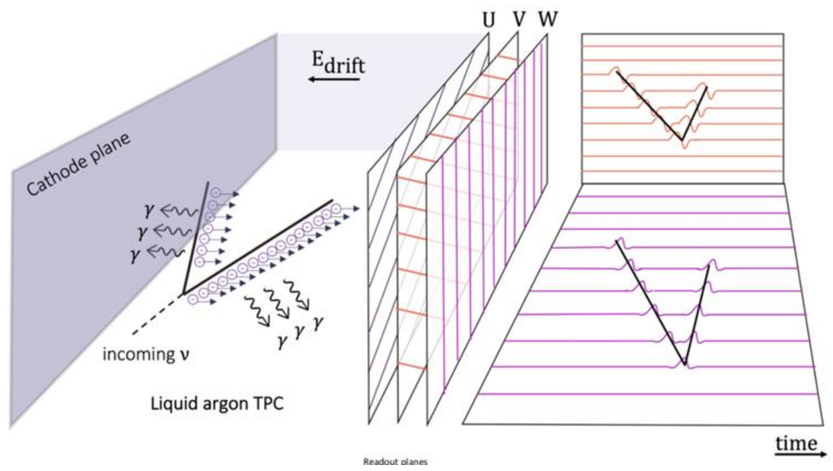
References

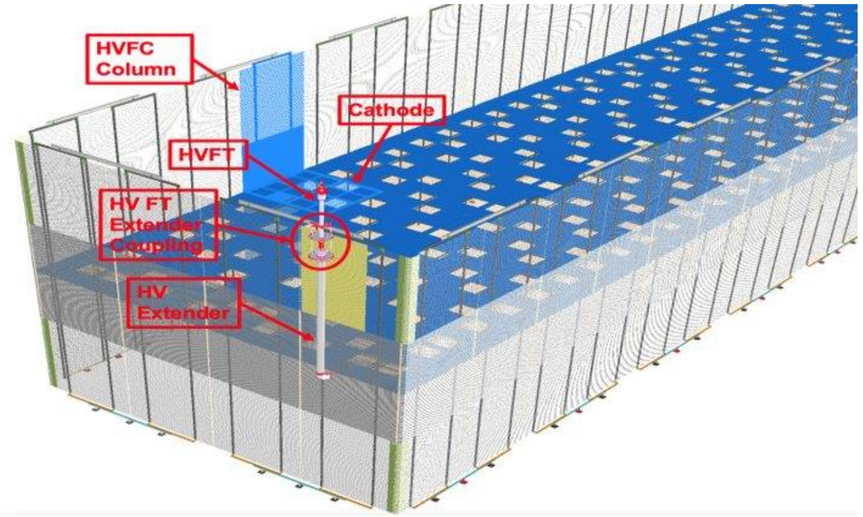
- *Background information on the DUNE project, detector design, and international collaboration.* https://en.wikipedia.org/wiki/Deep_Underground_Neutrino_Experiment
- *Context on neutrino mass hierarchy, CP violation, and physics motivations for long-baseline experiments.* https://web.slac.stanford.edu/neutrino/experiments/dune

Detector Overview:

- **FD2** is located **1.5 km underground** at **SURF**
- Uses **Vertical Drift configuration** in LArTPC
- **Ionization electrons drift vertically** to anode planes
- **Field Cage creates a uniform electric field**
- Enables **precise 3D reconstruction** of neutrino events







UTA's Role in Field Cage Construction:

- **Procurement** and **inventory tracking** of mechanical components
- Detailed **quality control (QC)** procedures for aluminum profiles and FRP box beams
- **Mechanical assembly** of field cage modules
- **Packaging and shipment** of verified components to SURF
- Participation in **on-site installation** at SURF during final detector assembly

Why QA/QC is Critical:

- Cryostat holds **17,000+ tons of liquid argon**
- **Filling or draining takes ~1 year**, making changes extremely difficult

Conclusion:

- Tackles **fundamental questions** in physics and cosmology
- Advances understanding of the **universe's structure and origins**
- Offers **hands-on experience** in frontier particle physics
- Provides a **unique opportunity** for early-career researchers in a global collaboration

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