2x2 Demonstrator in 10 Minutes

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New Perspectives 2023

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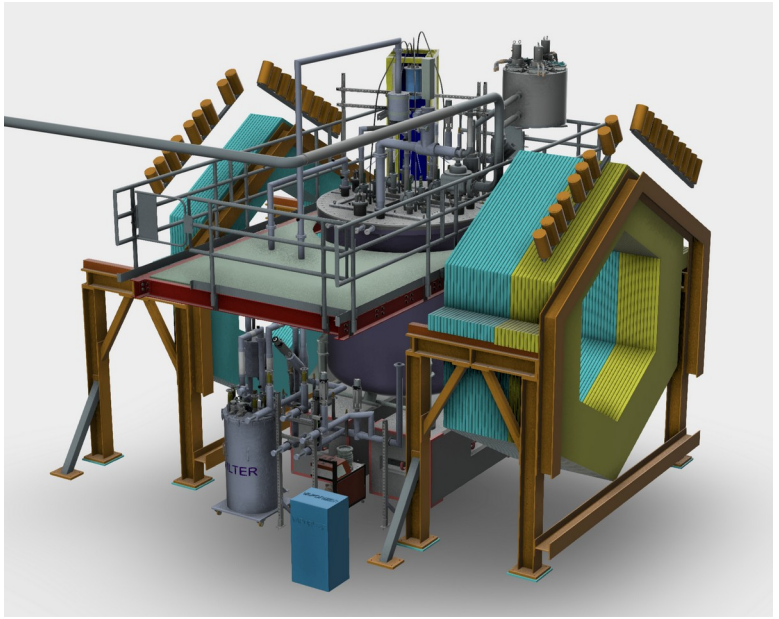
Introduction

- Motivation.
- What is the 2x2.
- Current status of hardware.
- Simulation and Reconstruction.
- Analysis efforts.

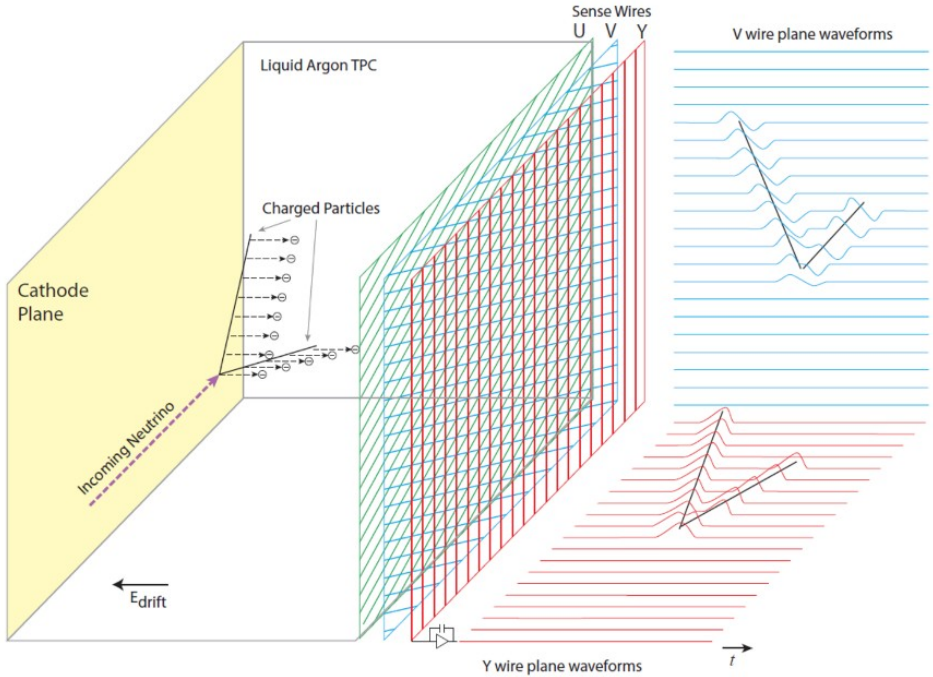
2x2 – ND-LAr Prototype

- Prototype for the Deep Underground Near Detector (DUNE) Near Detector (ND).
- The DUNE ND will be a modular-pixelated Liquid Argon Time Projection Chamber (LArTPC).
- Modular and pixelated design aides in pile-up issues.



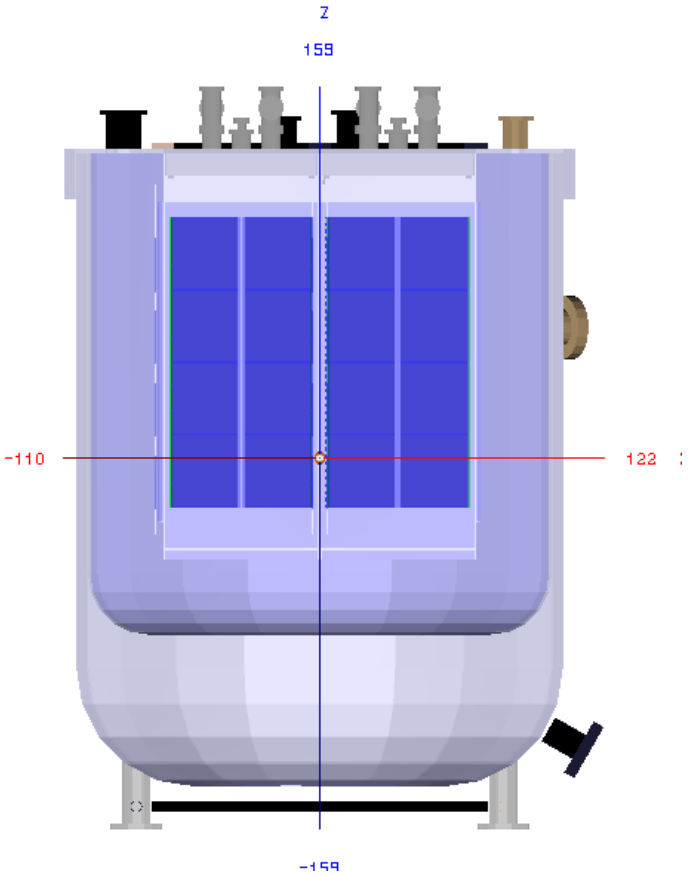
Liquid Argon TPCs

- As a charged particle passes through the argon, it will produce ionization charge and scintillation light.
- A large electric field drifts the charge to the anode plane where it is read out.
- We use pixels not wire planes.



2x2 Design

- 4 Modules arranged 2 by 2.
- Sits between MINERvA planes.
- Will be sit on-axis in NuMI beam line.
- Aims of the experiment:
  - Gain insight into the capabilities of the DUNE ND.
  - Produce publishable physics results.

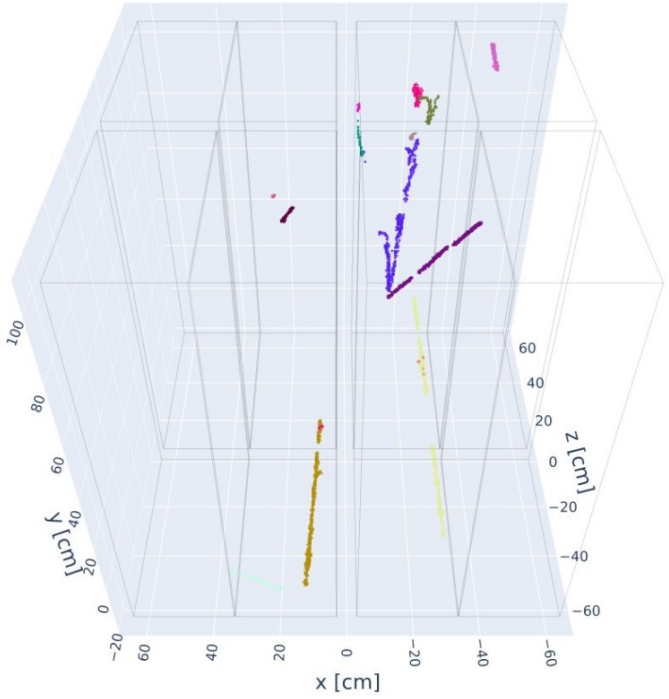


Current Status of the 2x2

- All the modules are at Fermilab.
- Acceptance tests:
  - All of them have been completed.
  - Everything came back as expected.
- Electronics and installation:
  - Currently working on electronics infrastructure.
  - Should be installed later this year.

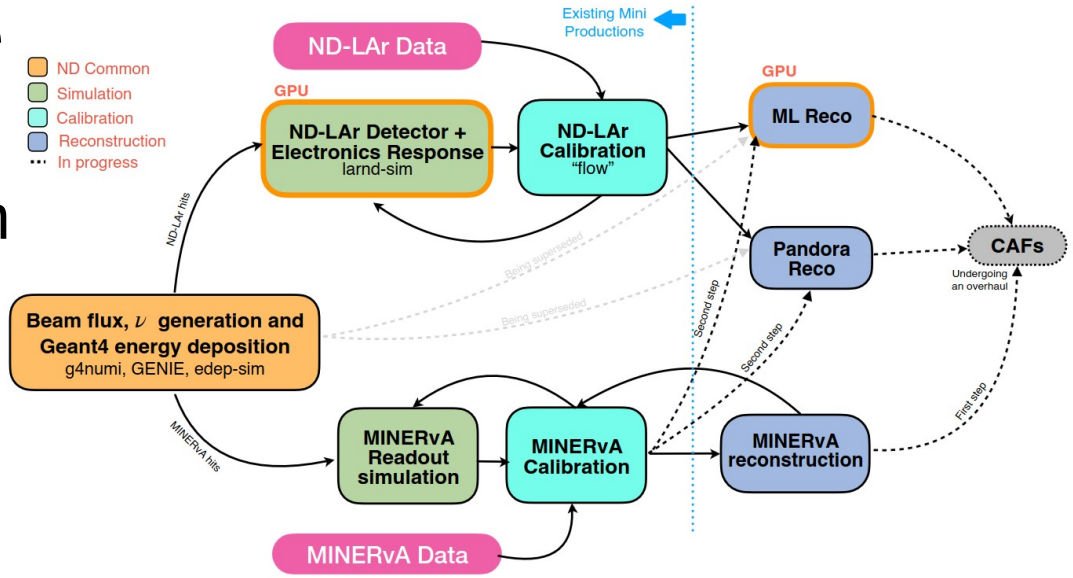
2x2 Sim-Reco

- “Mini-productions” have enabled initial investigations into possible analyses.
- Two ongoing reconstruction efforts:
  - Pandora.
  - ML-reco.
- Both simulation and reconstruction efforts represent significant bodies of work.



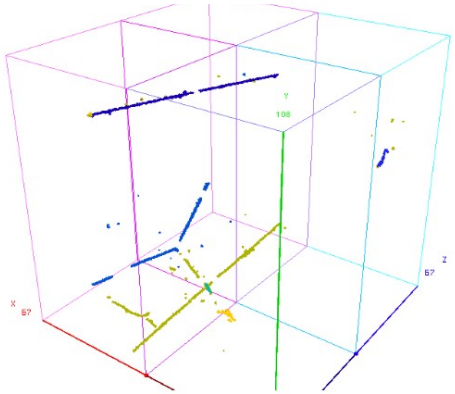
Simulation Efforts

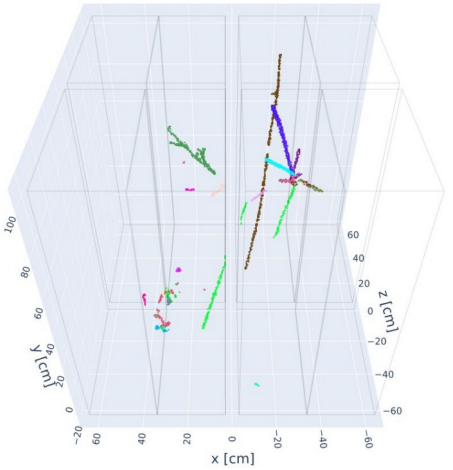
- Refining the geometry of the detector.
- Comparison of light between MC/data.
- Beam window optimization.
- Light and charge matching.



Reconstruction Efforts

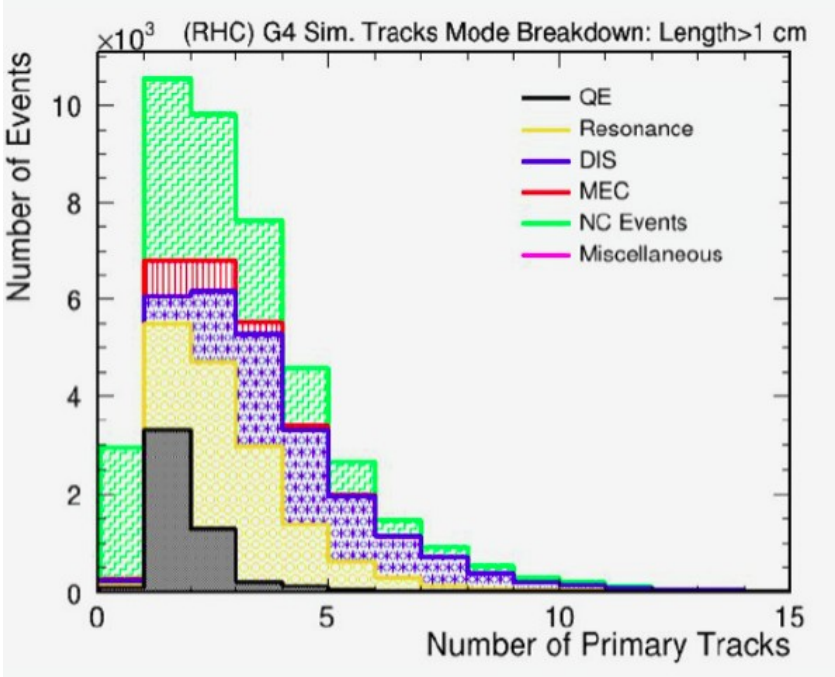
- Pandora:
  - Adapting the 3x2D reconstruction used in other LArTPCs for full 3D reconstruction.
  - Currently reconstructing “2.8 D”.
- ML-reco
  - Using Machine Learning to do reconstruction.





First Analyses

- Charged track multiplicities.
- N-P inelastic scattering.
- Calibration using ^{39}Ar beta decays.
- MeV scale energy resolution with radioactive sources.
- Mesonless $\bar{\nu}_\mu$ CC cross section.
- Search for π_0 decays involving Compton scattering photons.



Conclusions

- Work is still ongoing.
- We should be able to start collecting data this year.
- Our goals are to produce publishable physics results and to characterize the performance and capabilities of the DUNE ND.

2x2 Team