2x2 analysis for summer 2023

Weber, Jan 2023

2x2 analysis workshop

2x2 use for ND-LAr

2x2 neutrino beam test

We are here!

Pre-production

Published July 2021

CDR
Conceptual design review

Single Cube

Single Module

June 2022

PDR
Preliminary design review

Q1 2024 (calendar)

FDR
Final design review

2024

PRR
Production readiness review

Full size demonstrator

Production x35
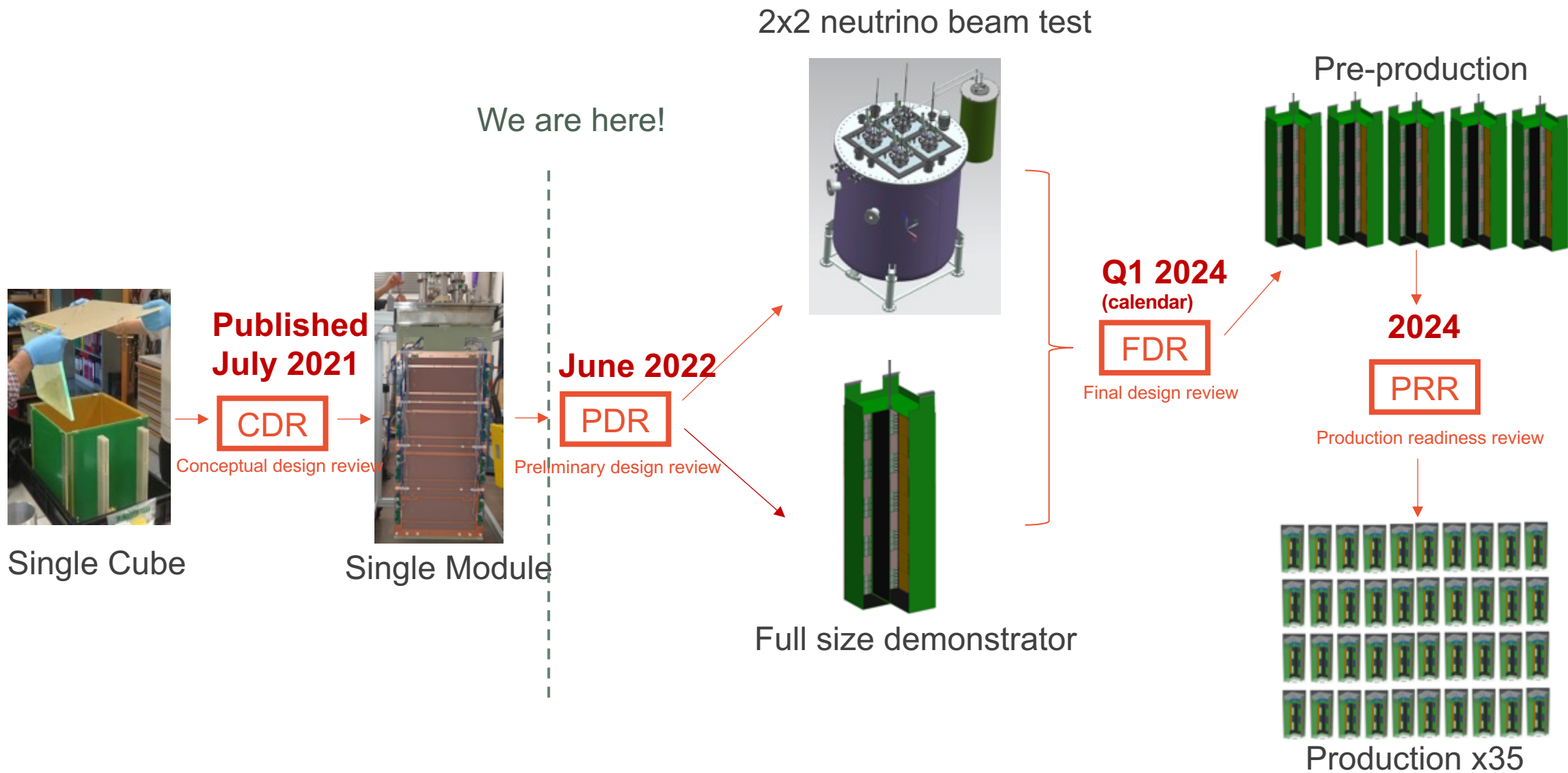
u^b Requirement for the FDR

- Goal is to demonstrate that physics can be extracted frm a modular LArTPC with pixelated readout

  - The only acceptable demonstration is a physics paper

- Dependencies

  - Define "an analysis" on one week of NUMI data
    (one week because that is what we may obtain in summer)

  - Drive simulation for "one week"

  - Drive reconstruction for the analysis

Charge track multiplicity

u^b

- Requires vertices, tracks

- Requires distinguishing neutrino vertices from rock muons

- No PID, limited needs on calibration

- Can test matching of tracks among modules

- Done previously at NUMI and MicroBooNE

Multiplicity papers

Comparison of numu-Ar multiplicity distributions observed by MicroBooNE to GENIE model predictions
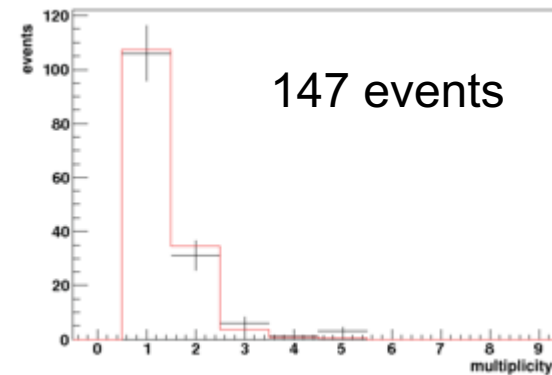EPJC 79, 248 (2019)
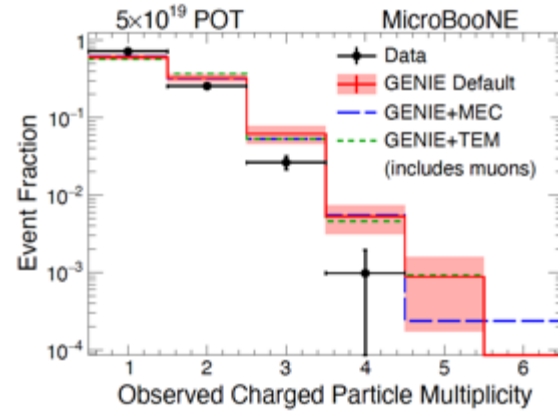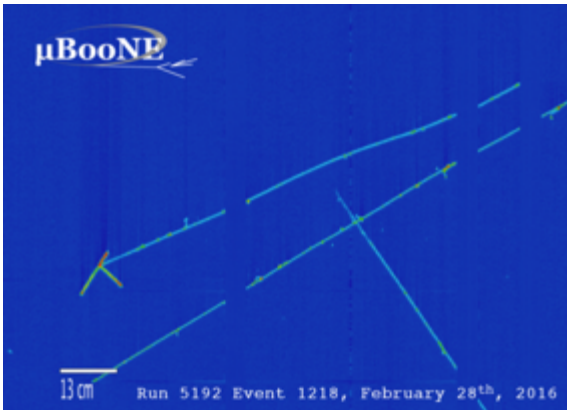
Challenges are the definition of thresholds and bin-to-bin migrations

Measurement of low-energy neutrino cross-sections with the PEANUT experiment
NJP 12, 113028 (2010)

1 mm

Emulsions based

147 events
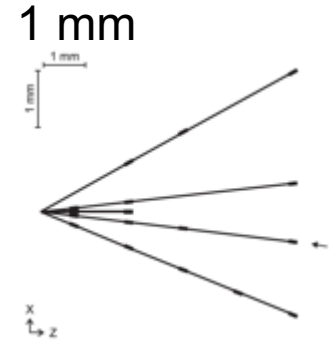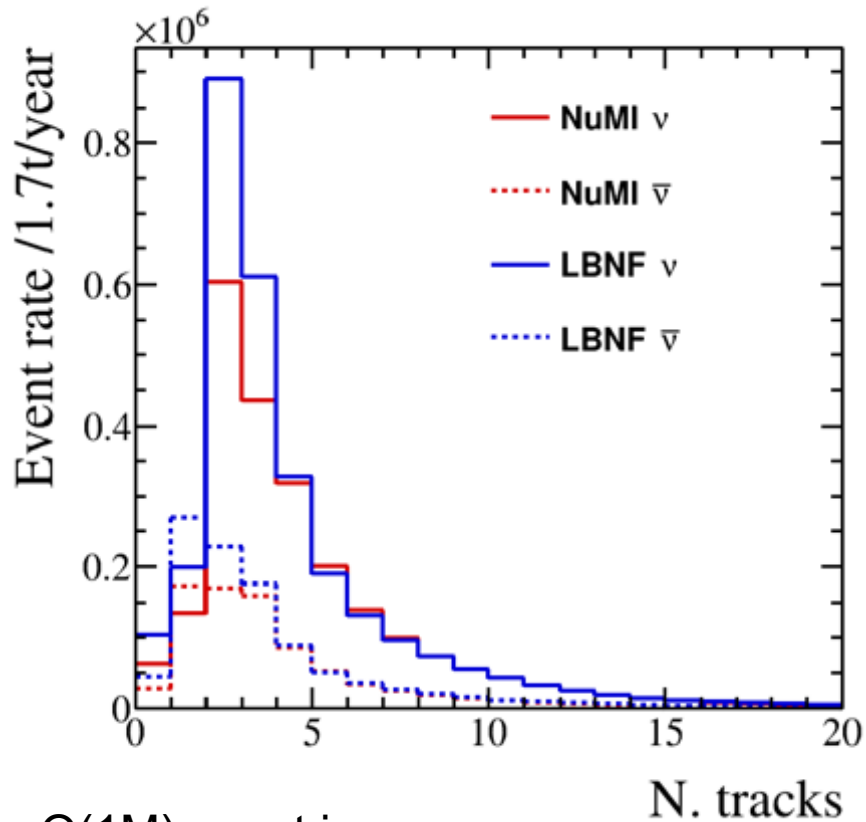
$$a_{dis} = 0.68^{+0.09}_{-0.11}(stat) \pm 0.02(syst)$$
$$a_{qe} = 0.20^{+0.06}_{-0.07}(stat) \pm 0.02(syst)$$
$$a_{res} = 0.12 \pm 0.04(stat) \pm 0.02(syst).$$

2x2 analysis workshop

From the 2x2 proposal 2018

Figure 8: The expected yearly rates of minimum and highly ionizing particles expected in the 2x2 Demonstrator module's 1.7t LAr volume for the NuMI ME and LBNF fluxes, produced using GENIE v2.12.10 with the "ValenciaQEBergerSehgalCOHRES" configuration [20].

"In order to be a relevant test for the full ArgonCube near detector, which will be in the LBNF beamline, it is useful to verify that the basic properties of the events are similar, despite the NuMI ME beam being somewhat higher energy than the planned LBNF beam (as shown in Figure 1). Figure 8 shows the expected multiplicity of minimum or highly ionizing tracks at the vertex for both the LBNF and NuMI ME beams, in neutrino and antineutrino mode, produced with the GENIE generator. The track multiplicities are similar, which indicates that the scale of the reconstruction problem is similar, and the proposed ProtoDUNE-ND test will be a useful benchmark for developing the ArgonCube reconstruction software."

O(1M) event in one year

We can get a few 1000 vertices in a week

Conclusion

u[b]

1. Having an analysis defined for a "one week" dataset is useful focus the simulaitona and reconstruction effort over the next months

2. Having a published result in 2023 is necessary for ND-LAr to proceed with detector construction

3. A track multiplicity measurement may be possible

4. We should extract many more physics results