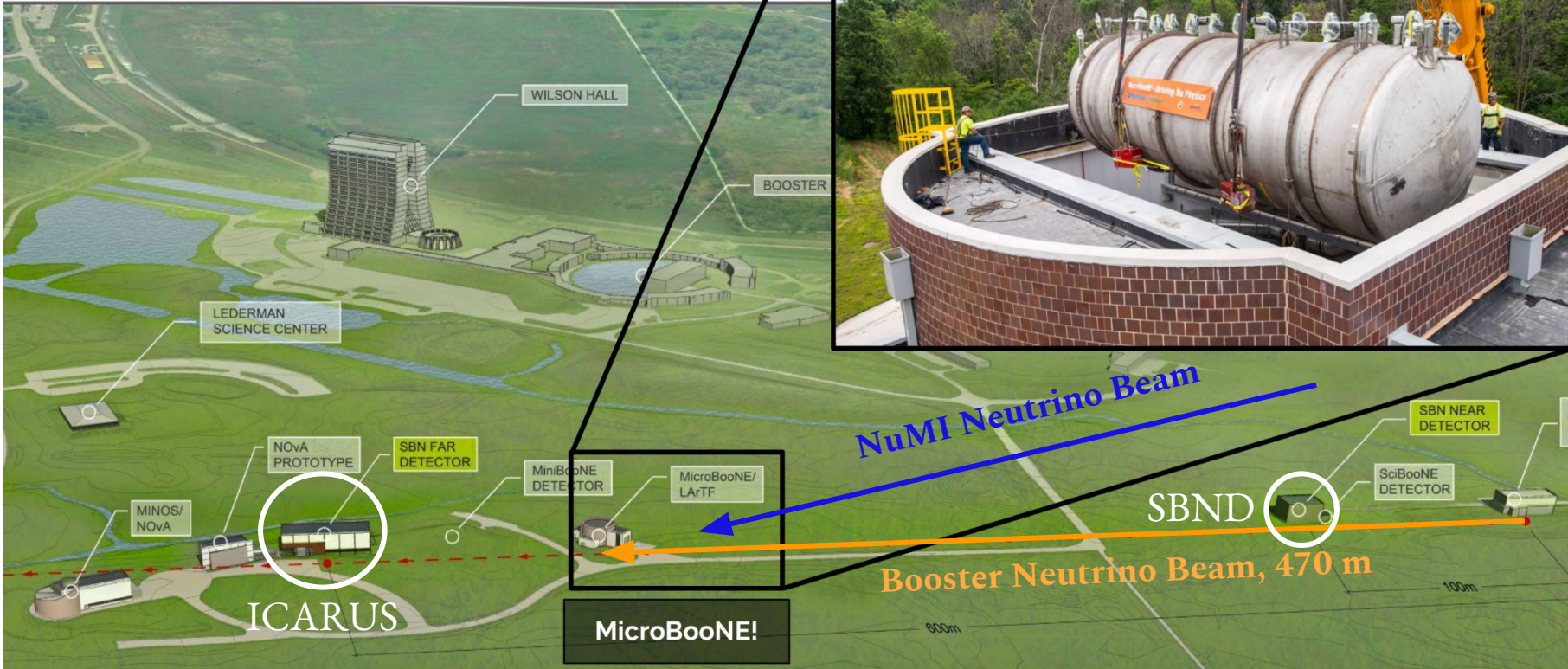


# Introduction to MicroBooNE

Afroditi Papadopoulou [apapadopoulou@anl.gov](mailto:apapadopoulou@anl.gov)  
on behalf of the MicroBooNE Collaboration  
10/2/2023, NuXTract, CERN



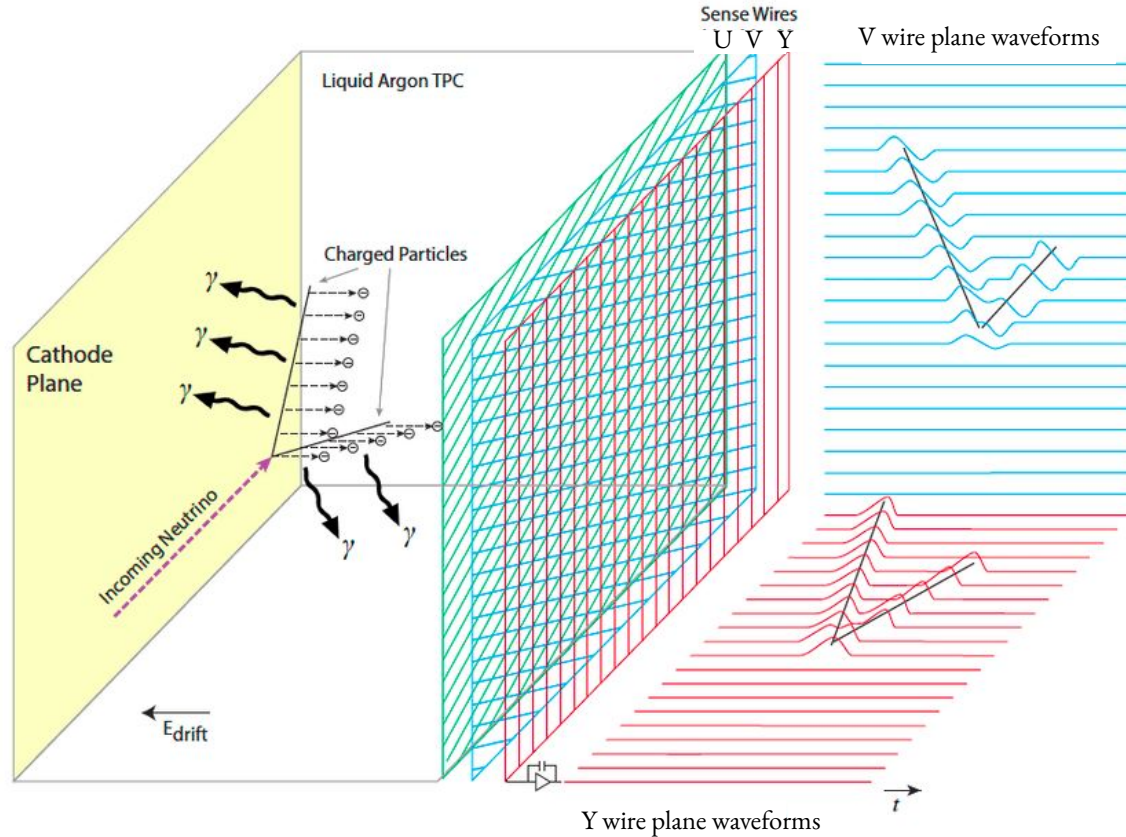
# MicroBooNE@FNAL



85 tonne Liquid Argon Time Projection Chamber (LArTPC)

[JINST 12, P02017 \(2017\)](#)

# LArTPC Operation Principle

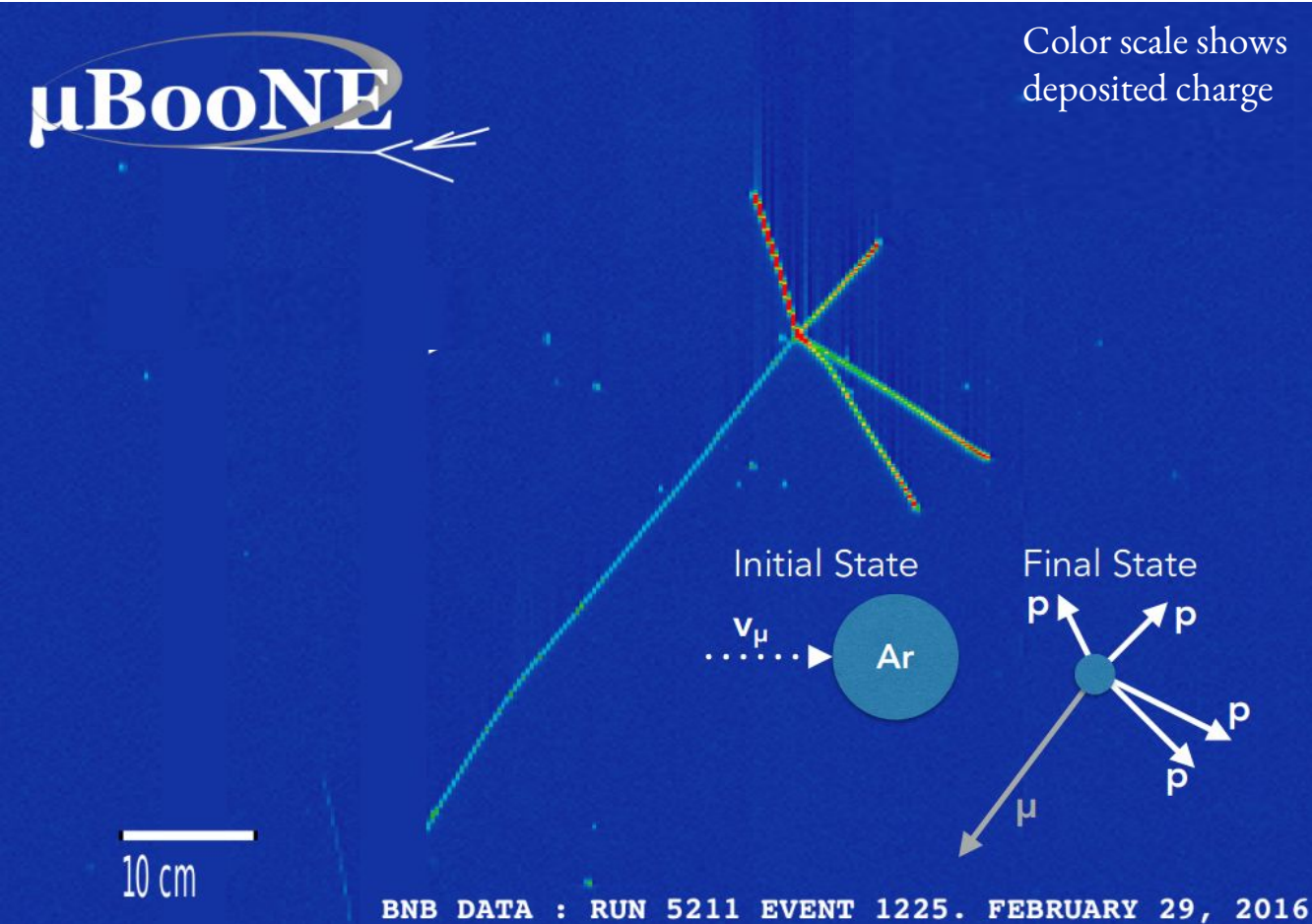


## MicroBooNE

- 3 wire planes
- 8192 gold coated wires
- 3 mm wire spacing
- 32 PMTs



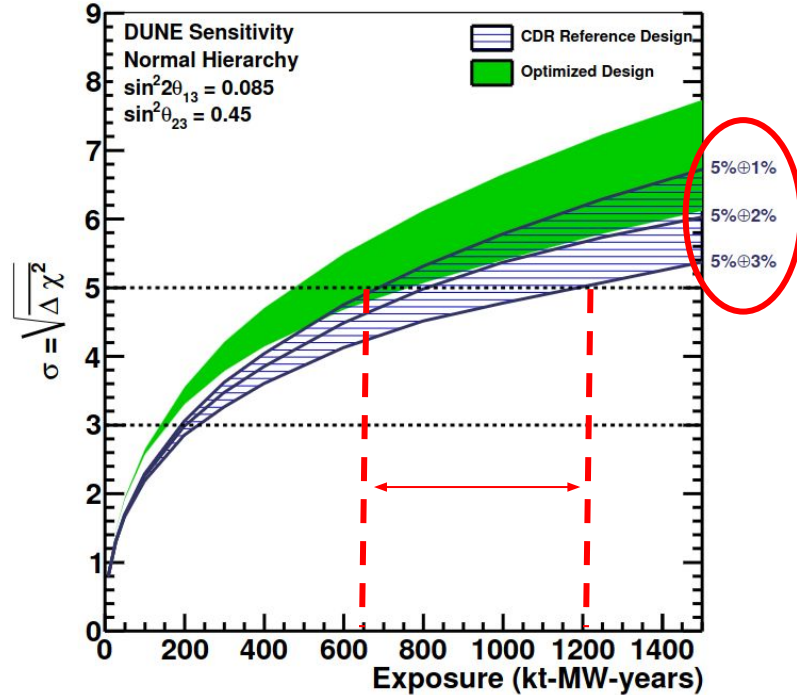
# MicroBooNE Data Events



- Largest available neutrino-argon data set with ~500k recorded neutrino interactions
- Over 10 released and more than 30 active MicroBooNE cross section analyses
- Multiple cross sections reported

# High Precision Cross Section Measurements Needed

50% CP Violation Sensitivity



- Mismodeling can impact required run time of forthcoming flagship experiments

- But ... head start with MicroBooNE to provide cross sections & uncertainties to be used by DUNE & HK

DUNE CDR, [arXiv:1512.06148](https://arxiv.org/abs/1512.06148)

# Already Public Results



## CC inclusive

- $1D \nu_{\mu}$  CC inclusive @ BNB  
[Phys. Rev. Lett. 123, 131801 \(2019\)](#)
- $1D \nu_{\mu}$  CC  $E_{\nu}$  @ BNB  
[Phys. Rev. Lett. 128, 151801 \(2022\)](#)
- $1D \nu_e$  CC inclusive @ NuMI  
[Phys. Rev. D105, L051102 \(2022\)](#)  
[Phys. Rev. D104, 052002 \(2021\)](#)

## Pion production

- $\nu_{\mu}$  NC  $\pi^0$  @ BNB  
[Phys. Rev. D 107, 012004 \(2023\)](#)

## CC0 $\pi$

- $1D \nu_e$  CCNp0 $\pi$  @ BNB  
[Phys. Rev. D 106, L051102 \(2022\)](#)
- $1D$  &  $2D \nu_{\mu}$  CC1p0 $\pi$  Kinematic Imbalance @ BNB  
[arXiv:2301.03700](#), [arXiv:2301.03706](#)  
submitted to PRL & PRD
- $1D \nu_{\mu}$  CC1p0 $\pi$  @ BNB  
[Phys. Rev. Lett. 125, 201803 \(2020\)](#)
- $1D \nu_{\mu}$  CC2p @ BNB  
[arXiv:2211.03734](#), submitted to PRL
- $1D \nu_{\mu}$  CCNp0 $\pi$  @ BNB  
[Phys. Rev. D102, 112013 \(2020\)](#)

## Rare channels

- $\eta$  production @ BNB, submitted to PRL  
[arXiv:2305.16249](#)
- $\Lambda$  production @ NuMI  
[arXiv:2212.07888](#), accepted by PRL

# Already Public Results



## CC inclusive

- $1D \nu_{\mu}$  CC inclusive @ BNB  
[Phys. Rev. Lett. 123, 131801 \(2019\)](#)
- $1D \nu_{\mu}$  CC  $E_{\nu}$  @ BNB  
[Phys. Rev. Lett. 128, 151801 \(2022\)](#)
- $1D \nu_e$  CC inclusive @ BNB  
[Phys. Rev. D105, L051801 \(2022\)](#)  
[Phys. Rev. D104, 052004 \(2021\)](#)

## Pion production

- $\nu_{\mu}$  NC  $\pi^0$  @ BNB  
[Phys. Rev. D 107, 012004 \(2023\)](#)

## CC0 $\pi$

- $1D \nu_e$  CCNp0 $\pi$  @ BNB  
[Phys. Rev. D 106, L051102 \(2022\)](#)
- $1D$  &  $2D \nu_{\mu}$  CC1p0 $\pi$  Kinematic Imbalance @ BNB  
[arXiv:2301.03700](#), [arXiv:2301.03706](#)

## MicroBooNE (& adjacent) talks

- Model validation (Nitish)
- Cross section extraction techniques (Afro)
- Block-wise unfolding (S. Gardiner)
- Tuning (M. Kirby)
- Wiener SVD unfolding (Xin)

## Rare channels

- $\eta$  production @ BNB  
[arXiv:2305.16249](#)
- Hyperon ( $\Lambda, \Sigma$ ) production @ NuMI  
[arXiv:2212.07888](#), accepted to PRL



$\mu$ BooNE



Thank you!



# Backup Slides