

μ BooNE

MicroBooNE's beyond the Standard Model physics program



*XXI Workshop on
Neutrino Telescopes*

M. Nebot-Guinot
for the
MicroBooNE
Collaboration



THE UNIVERSITY
of EDINBURGH

Outline

- The MicroBooNE experiment
- BSM searches in MicroBooNE



Outline

- The MicroBooNE experiment
- BSM searches in MicroBooNE



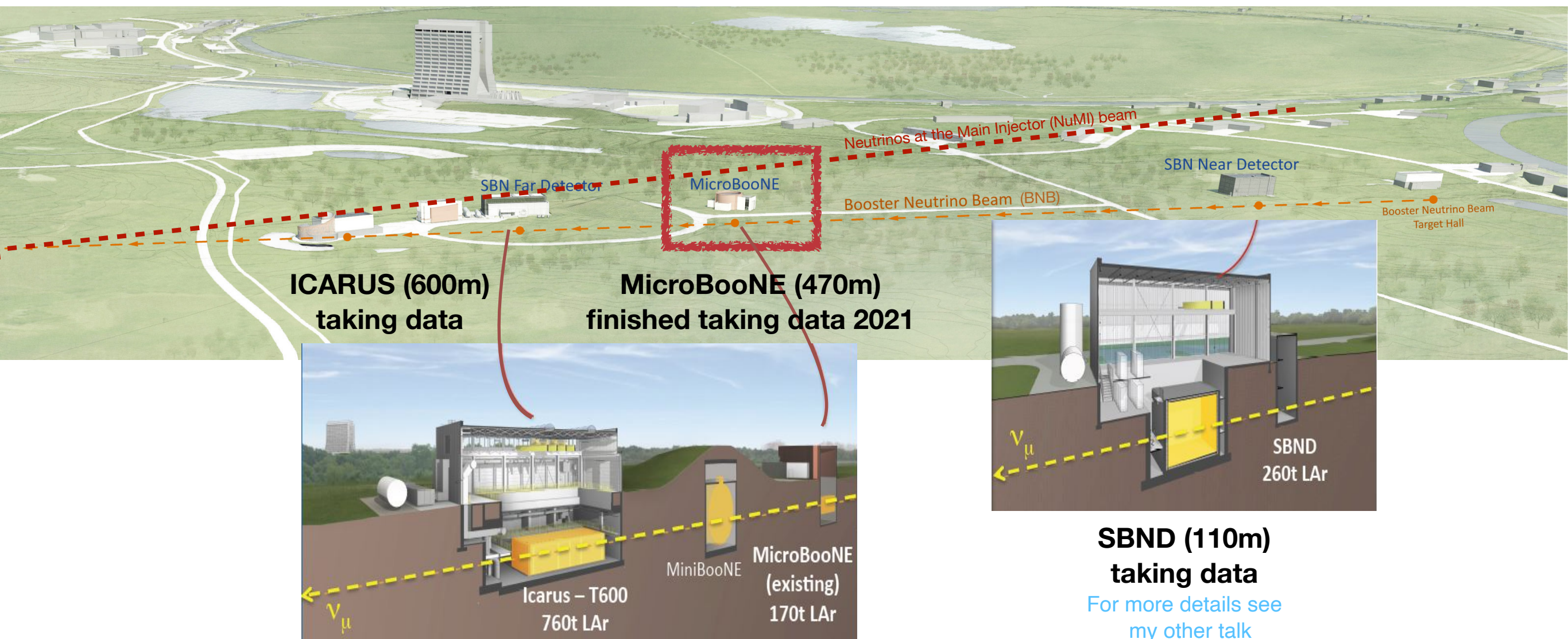
The MicroBooNE experiment

The Short Baseline Neutrino (SBN) program at Fermilab

A multi-detector and multi-beam facility on the Booster Neutrino Beam (& Neutrinos at the Main Injector beam) at Fermilab to test MiniBooNE's anomaly.

It uses the same neutrino beam, nuclear target, detector technology to reduce systematic uncertainties.

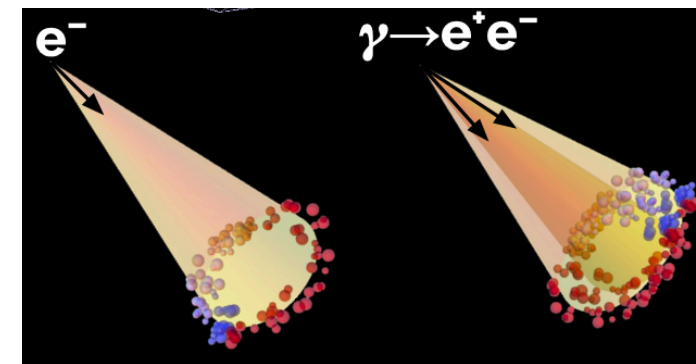
- Neutrino beam from pion decay-in-flight mostly. Well-known beam, same as MiniBooNE (PRD 79, 072002). The same mechanisms that produce neutrinos are great sources of potential BSM particles.
- 3 Liquid Argon Time Projection Chamber (LArTPC) detectors.



The MicroBooNE experiment

Why LArTPCs?

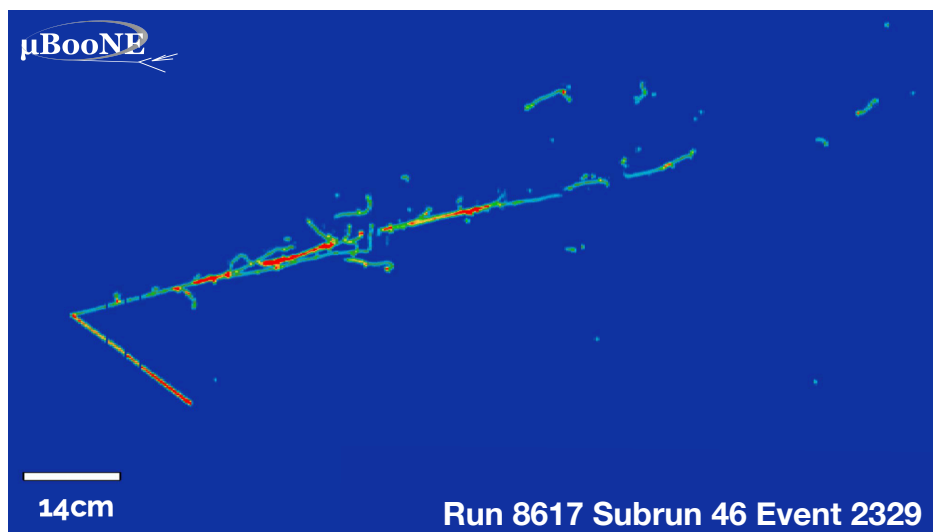
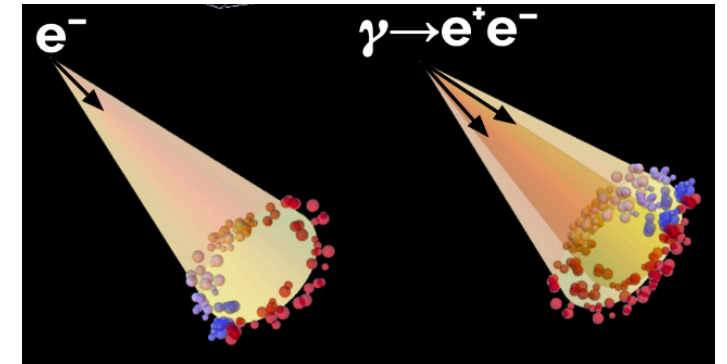
- MiniBooNE: 600t active volume mineral oil Cherenkov detector
→ poor e/ γ separation and most hadronic activity missed.
- LArTPCs are capable of identifying different species of particles
reconstructing 3D images with fine-grained information.
Neutrino vertex, particle flow, track vs. shower...



The MicroBooNE experiment

Why LArTPCs?

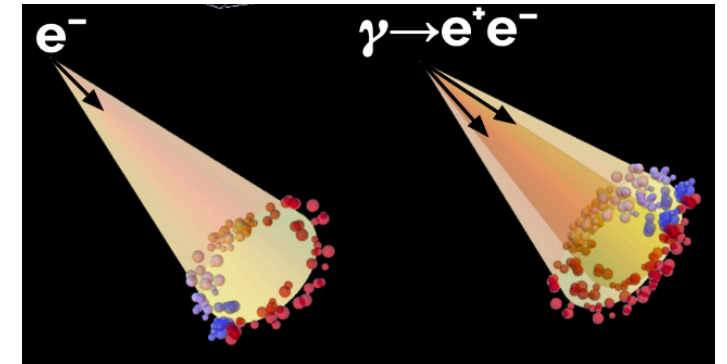
- MiniBooNE: 600t active volume mineral oil Cherenkov detector
→ poor e/γ separation and most hadronic activity missed.
- LArTPCs are capable of identifying different species of particles reconstructing 3D images with fine-grained information. Neutrino vertex, particle flow, track vs. shower...
- Tracks: Simple line segments → single higher-mass particle (p , $\pi^\pm$, $\mu^\pm$, etc.)
- Showers: Branching clusters of line segments
 $e^\pm$ or $\gamma \rightarrow e^+e^-$ pair leads to a cascade of electromagnetic activity (γ , e^+ , e^-)



The MicroBooNE experiment

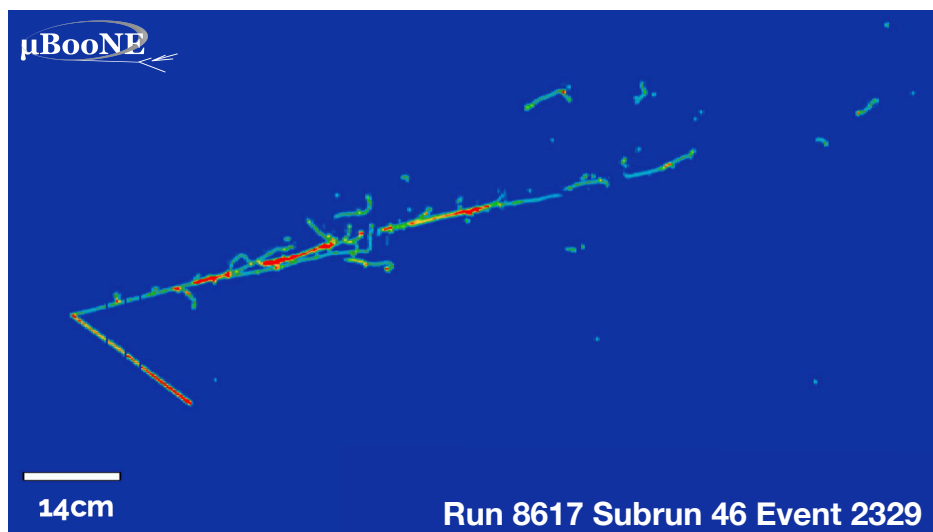
Why LArTPCs?

- MiniBooNE: 600t active volume mineral oil Cherenkov detector
→ poor e/γ separation and most hadronic activity missed.
- LArTPCs are capable of identifying different species of particles reconstructing 3D images with fine-grained information. Neutrino vertex, particle flow, track vs. shower...
- Tracks: Simple line segments → single higher-mass particle (p , $\pi^\pm$, $\mu^\pm$, etc.)
- Showers: Branching clusters of line segments
 $e^\pm$ or $\gamma \rightarrow e^+e^-$ pair leads to a cascade of electromagnetic activity (γ , e^+ , e^-)



Electron vs gamma discrimination:

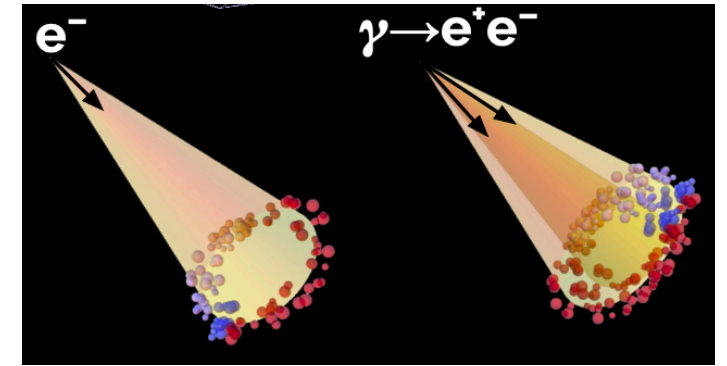
- Conversion gap
- dE/dx at start of shower



The MicroBooNE experiment

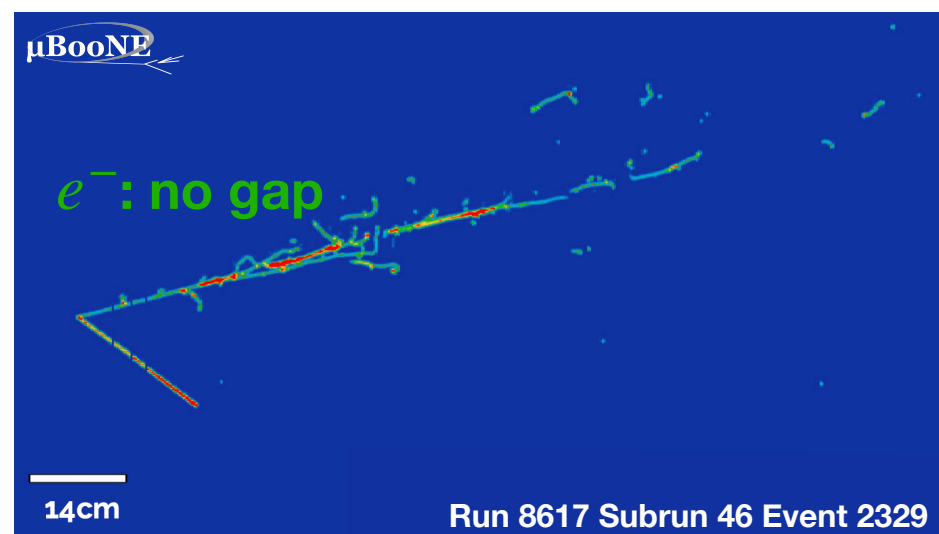
Why LArTPCs?

- MiniBooNE: 600t active volume mineral oil Cherenkov detector
→ poor e/ γ separation and most hadronic activity missed.
- LArTPCs are capable of identifying different species of particles reconstructing 3D images with fine-grained information. Neutrino vertex, particle flow, track vs. shower...
- Tracks: Simple line segments → single higher-mass particle (p , $\pi^\pm$, $\mu^\pm$, etc.)
- Showers: Branching clusters of line segments
 $e^\pm$ or $\gamma \rightarrow e^+e^-$ pair leads to a cascade of electromagnetic activity (γ , e^+ , e^-)



Electron vs gamma discrimination:

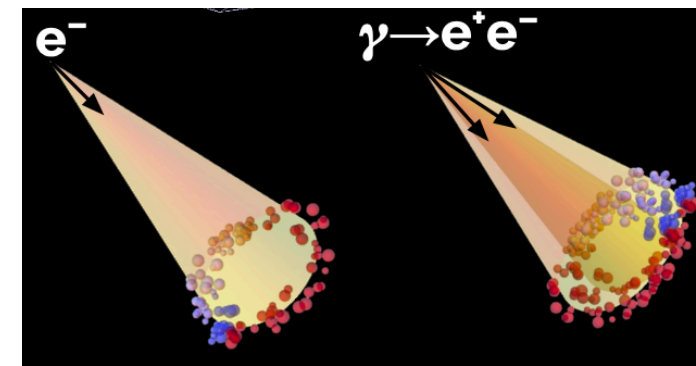
- Conversion gap
- dE/dx at start of shower



The MicroBooNE experiment

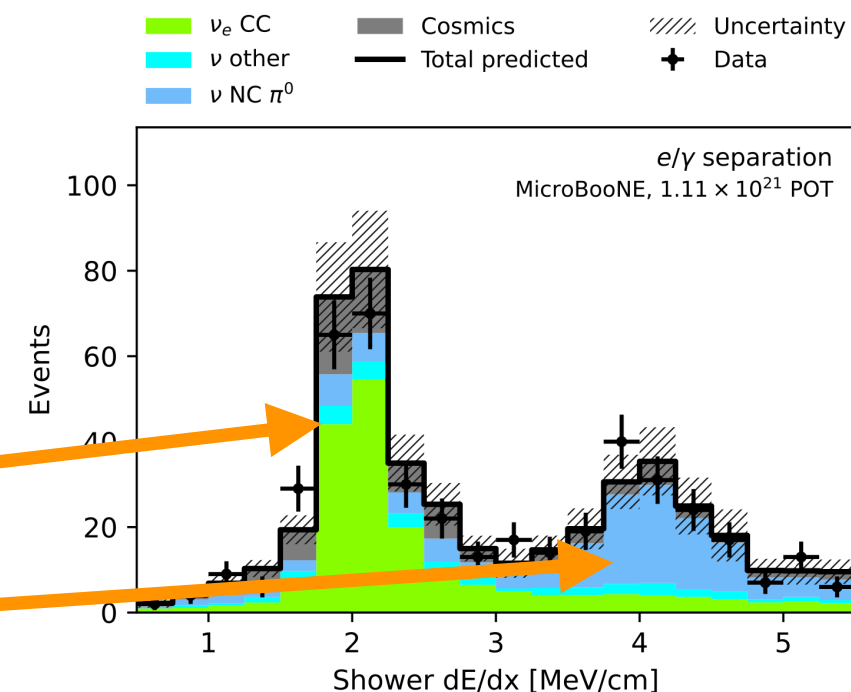
Why LArTPCs?

- MiniBooNE: 600t active volume mineral oil Cherenkov detector
→ poor e/γ separation and most hadronic activity missed.
- LArTPCs are capable of identifying different species of particles reconstructing 3D images with fine-grained information. Neutrino vertex, particle flow, track vs. shower...
- Tracks: Simple line segments → single higher-mass particle (p , $\pi^\pm$, $\mu^\pm$, etc.)
- Showers: Branching clusters of line segments
 $e^\pm$ or $\gamma \rightarrow e^+e^-$ pair leads to a cascade of electromagnetic activity (γ , e^+ , e^-)

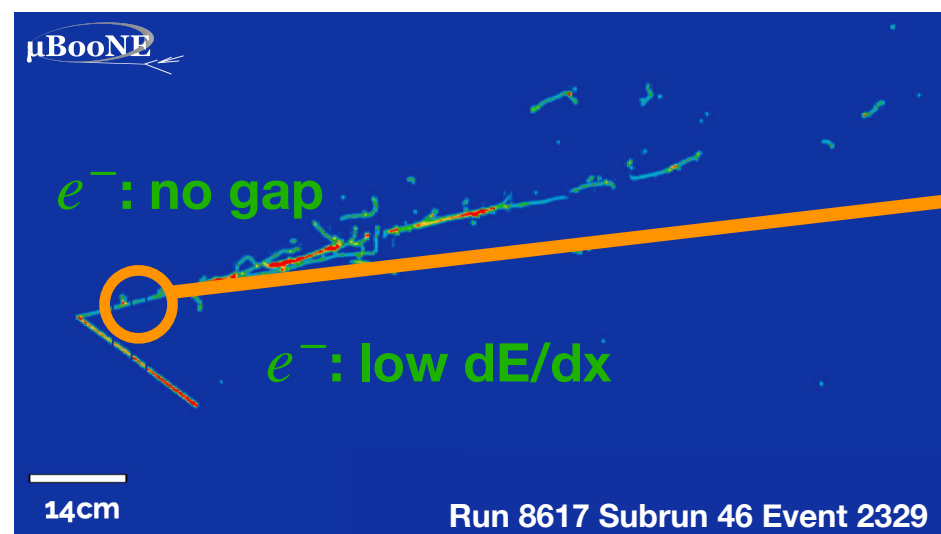


Electron vs gamma discrimination:

- Conversion gap
- dE/dx at start of shower



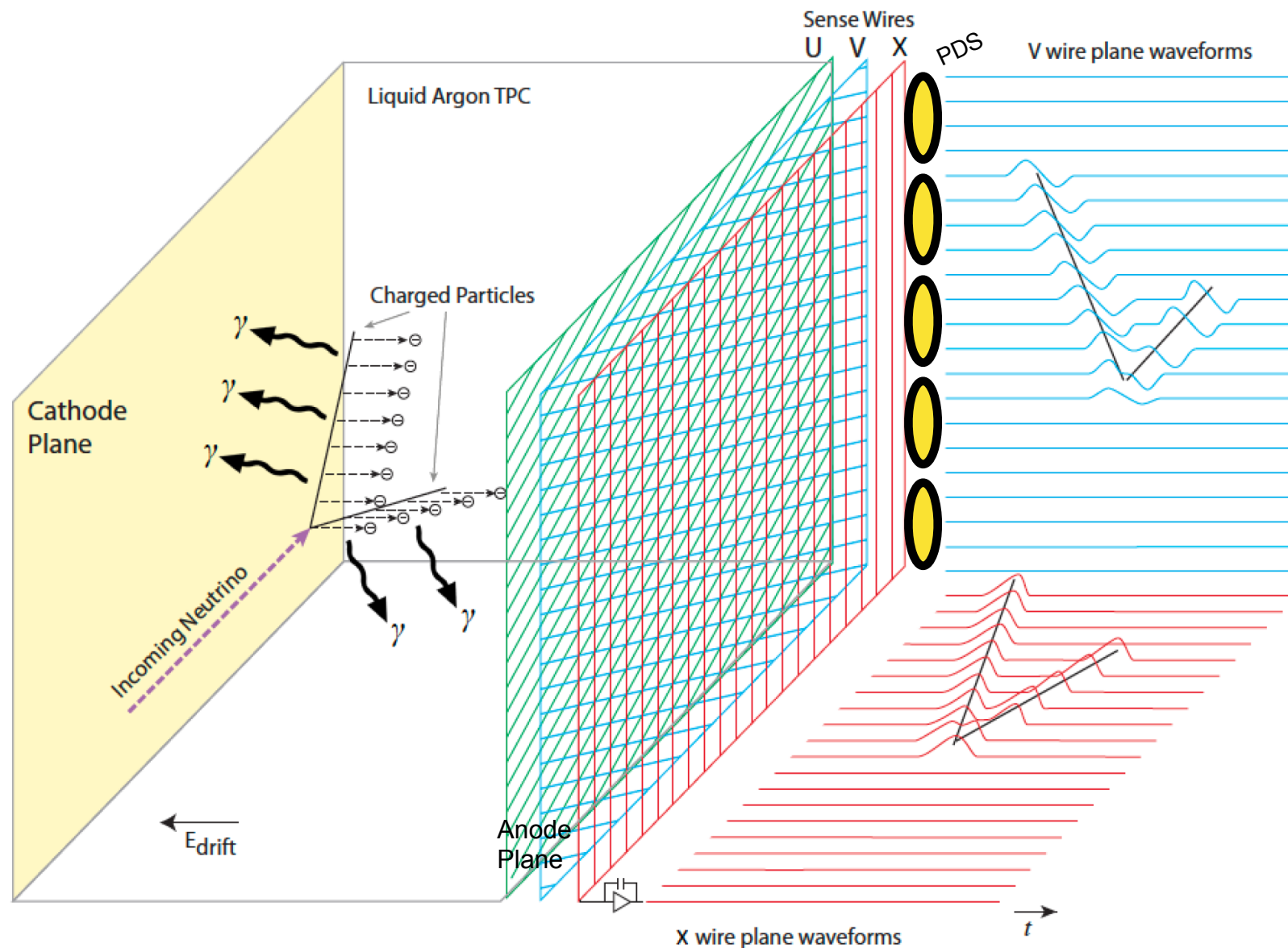
[Aux. material Phys.Rev.Lett. 135 \(2025\) 8, 081802](#)



The MicroBooNE experiment

Operation of LArTPC

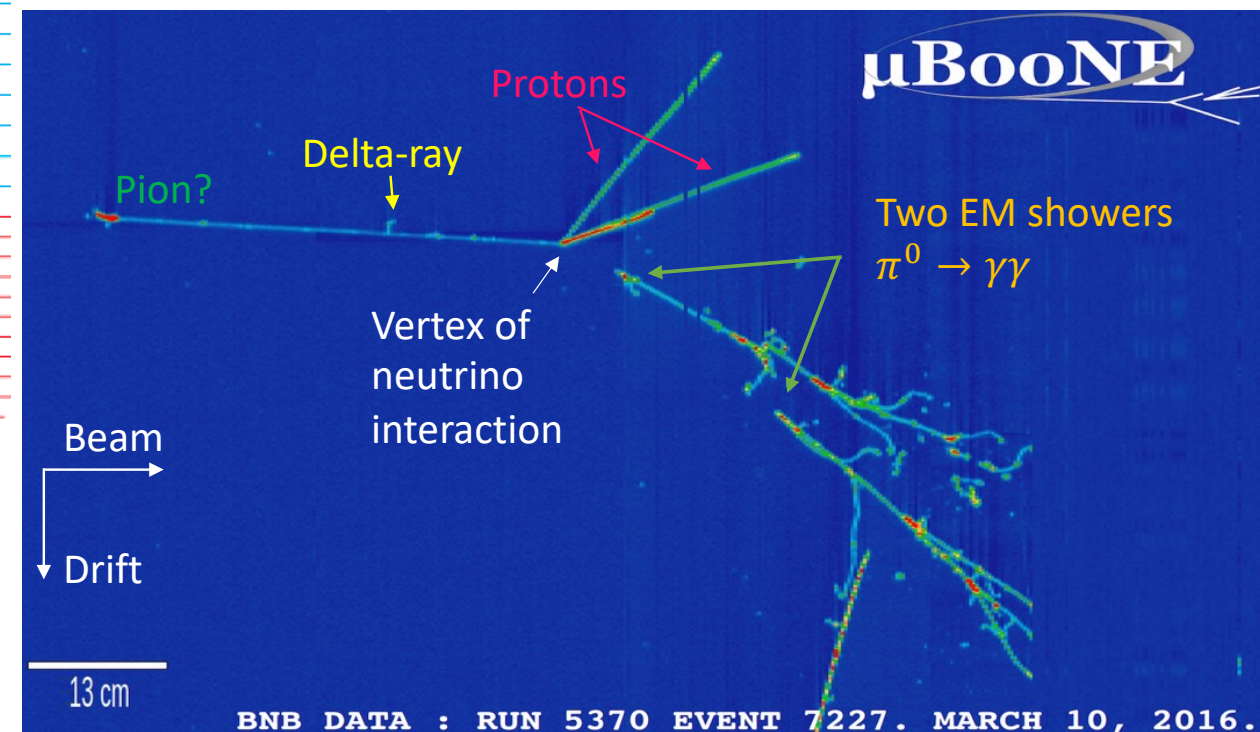
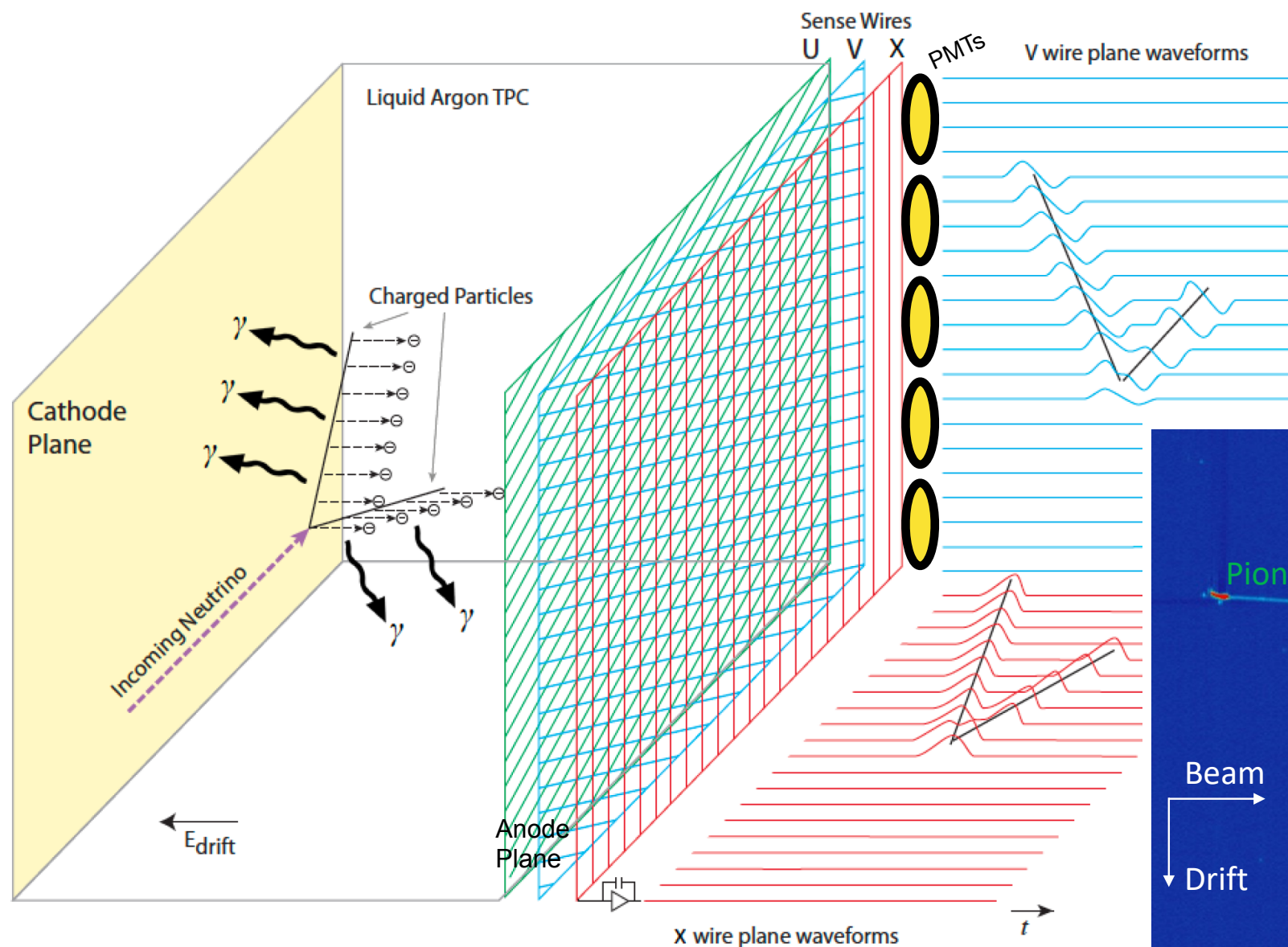
Homogeneous target that combines large mass with accurate spatial and calorimetric reconstruction.



The MicroBooNE experiment

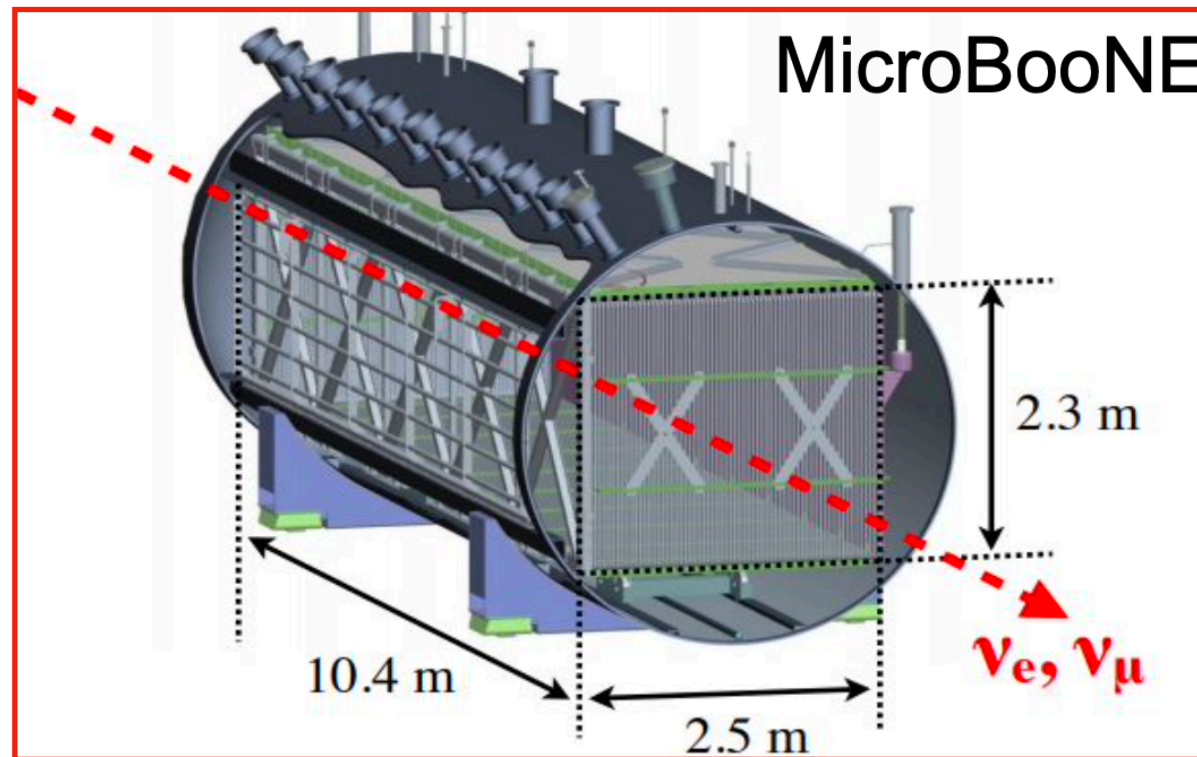
Operation of LArTPC

Homogeneous target that combines large mass with accurate spatial and calorimetric reconstruction.



The MicroBooNE experiment

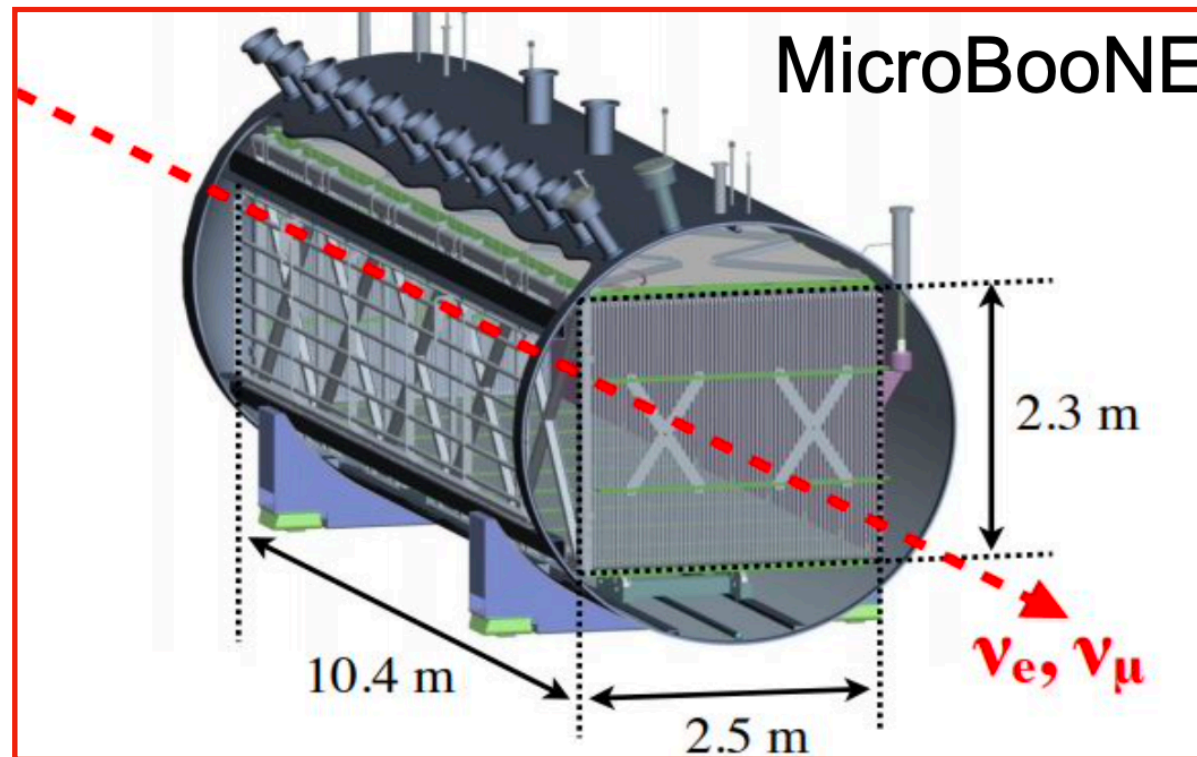
MicroBooNE detector



- MicroBooNE is a surface-level, 85 active LAr tonne ($10 \times 2.5 \times 2.5$ m³) LArTPC neutrino experiment.
- Scintillation light collected by 32 PMTS and ionization charge by 3 wire planes.

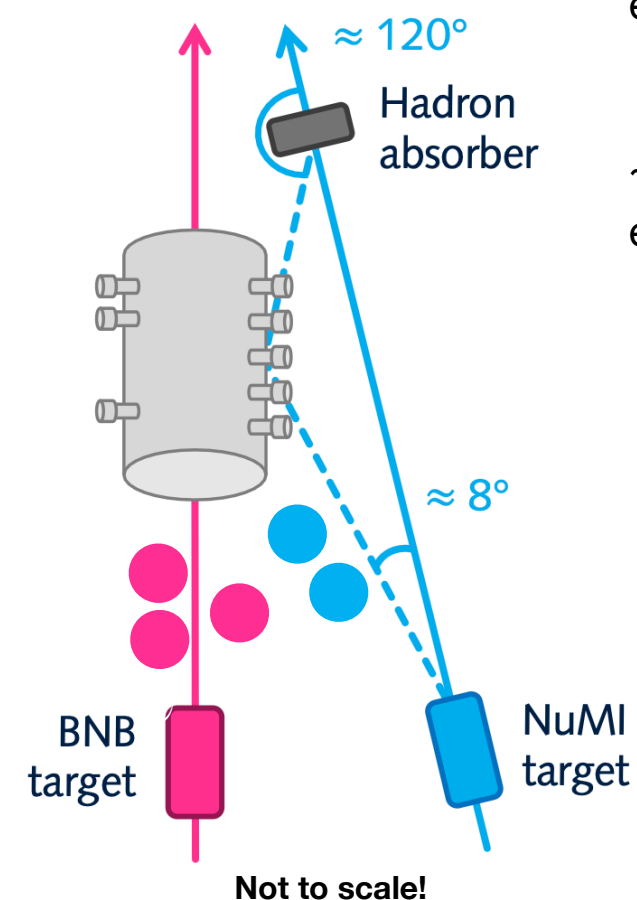
The MicroBooNE experiment

MicroBooNE detector



- MicroBooNE is a surface-level, 85 active LAr tonne (10×2.5×2.5 m³) LArTPC neutrino experiment.
- Scintillation light collected by 32 PMTS and ionization charge by 3 wire planes.

- ~6 years of data @ Fermilab '15 - '21
- Large and well-understood sample of neutrino interactions on argon.



~500,000 BNB neutrino events ($1.11 \cdot 10^{21}$ POT)

~300,000 NuMI neutrino events ($2.0 \cdot 10^{21}$ POT)

The MicroBooNE experiment

MicroBooNE goals

- Investigate the MiniBooNE Low Energy Excess and search for BSM physics
- Improve our understanding of ν -Ar interactions
- LArTPC hardware and software R&D

Investigations of the MiniBooNE anomaly and sterile neutrinos with MicroBooNE

Oct 2, 2025, 9:10 AM

20m

Spazio 35 (Centro Culturale Altinate San Gaetano)

Contributed Talk

Neutrino Properties

Neutrino Physics

Speaker

Fan Gao

MicroBooNE's cross-section program for future long-baseline oscillations

Oct 1, 2025, 9:10 AM

20m

Main Auditorium (Centro culturale Altinate San Gaetano)

Contributed Talk

Neutrino Properties

Neutrino Physics

Speaker

London Cooper Troendle

Recent cross-section results from MicroBooNE

Oct 1, 2025, 9:30 AM

20m

Main Auditorium (Centro culturale Altinate San Gaetano)

Contributed Talk

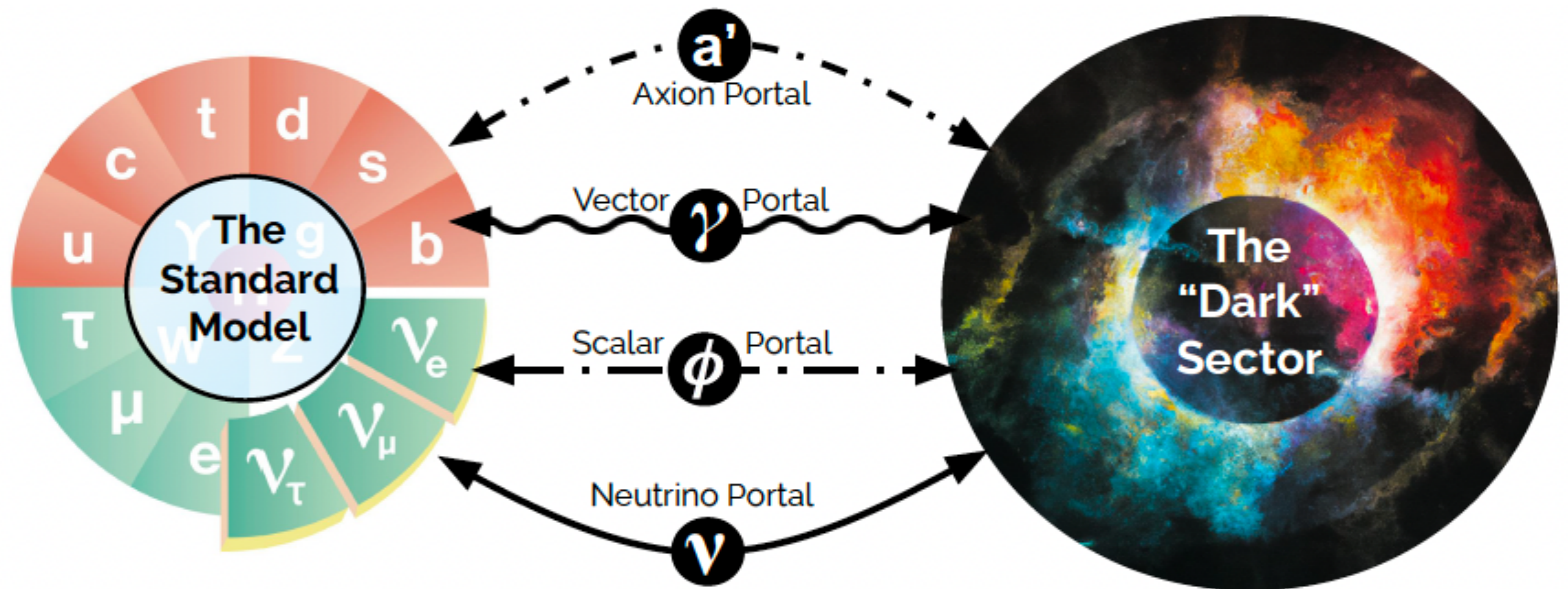
Neutrino Properties

Neutrino Physics

Speaker

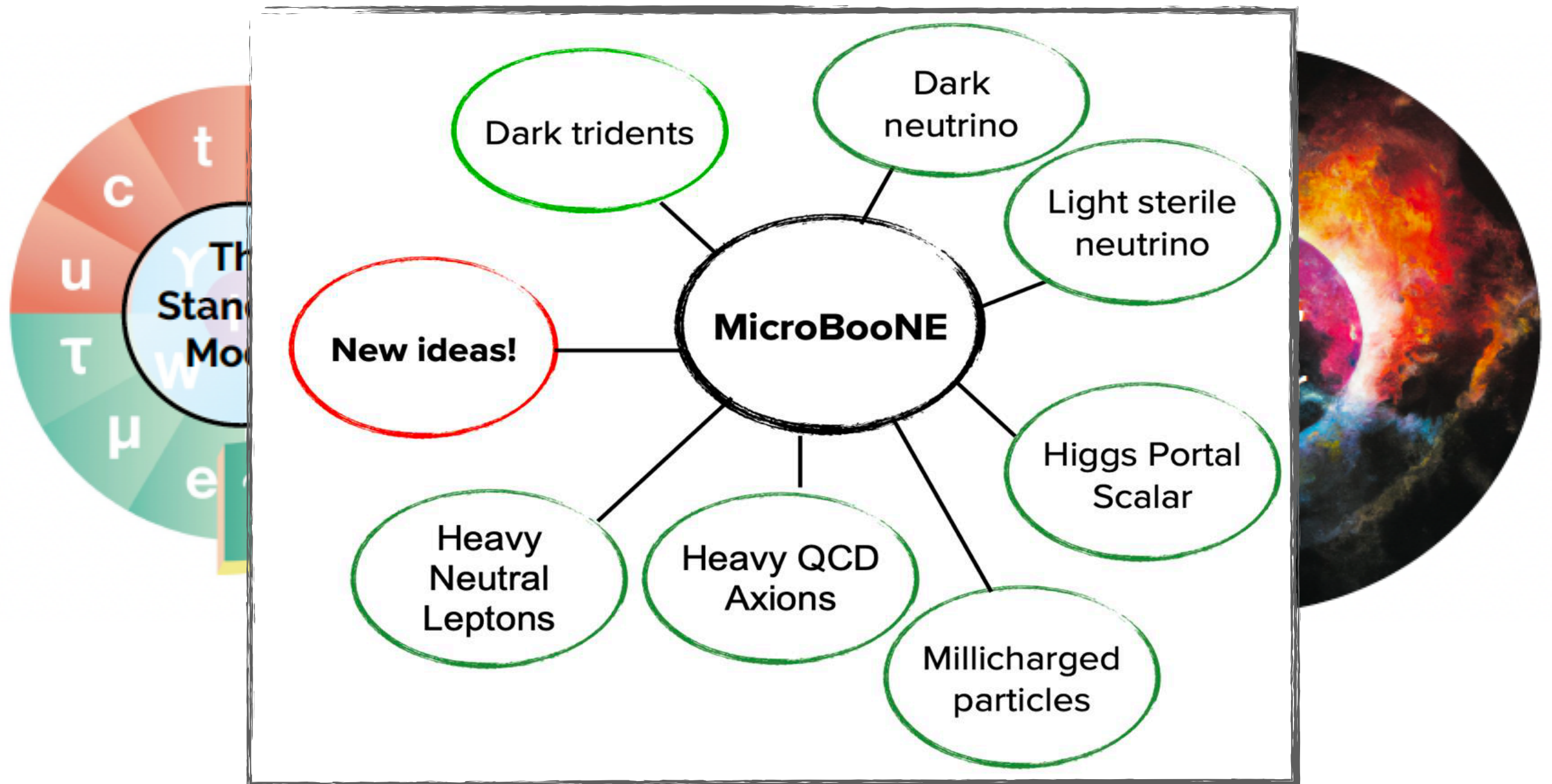
Jairo Rodriguez Rondon

MicroBooNE BSM program



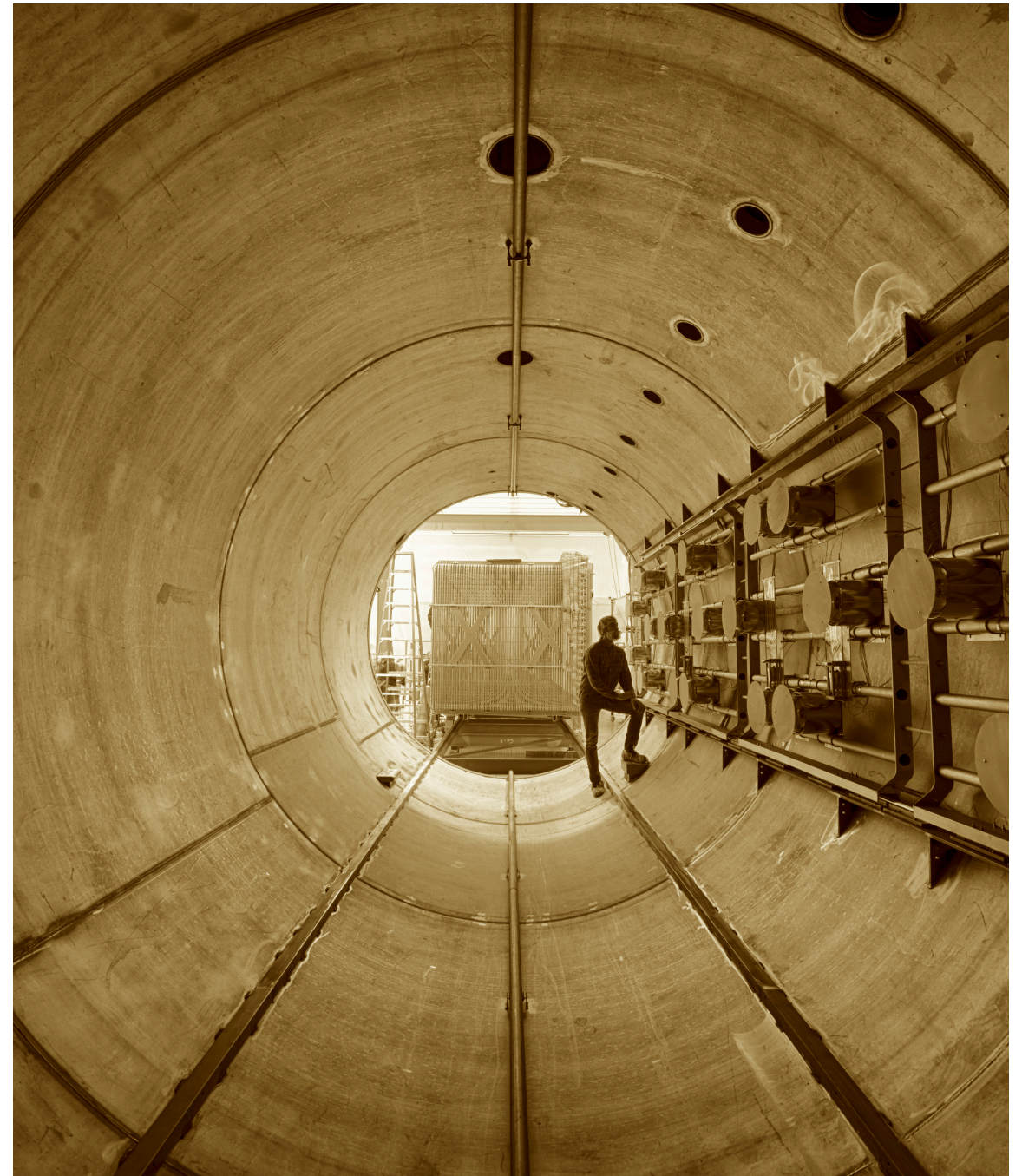
Minimal extensions of the Standard Model (SM) featuring a single new light mediator particle coupled through one of these portals. This implies that both the production of the mediator and its visible decay to SM particles occur due to the portal interaction.

MicroBooNE BSM program



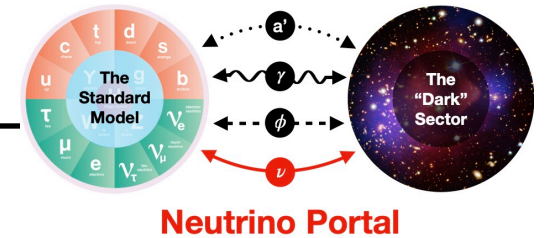
Outline

- The MicroBooNE experiment
- BSM searches in MicroBooNE

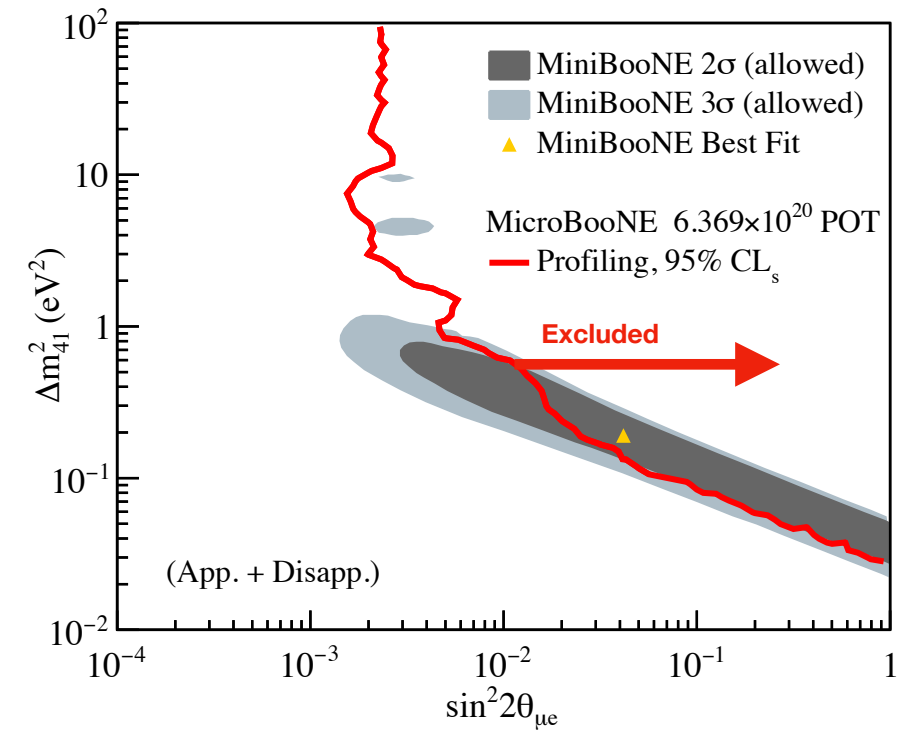


BSM searches in MicroBooNE

Light sterile neutrino



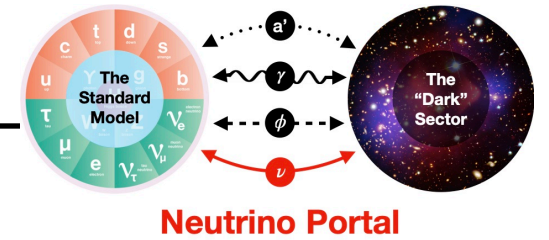
- Search for 3+1 (eV) sterile neutrino oscillation.
- Using BNB ν_e inclusive search to look at 3+1 model, large phase space rejected at 95% CLs
- Degeneracy when $\sin^2 \theta_{24} \approx 0.005$ given (BNB) $R_{\nu_\mu/\nu_e} \approx 185$



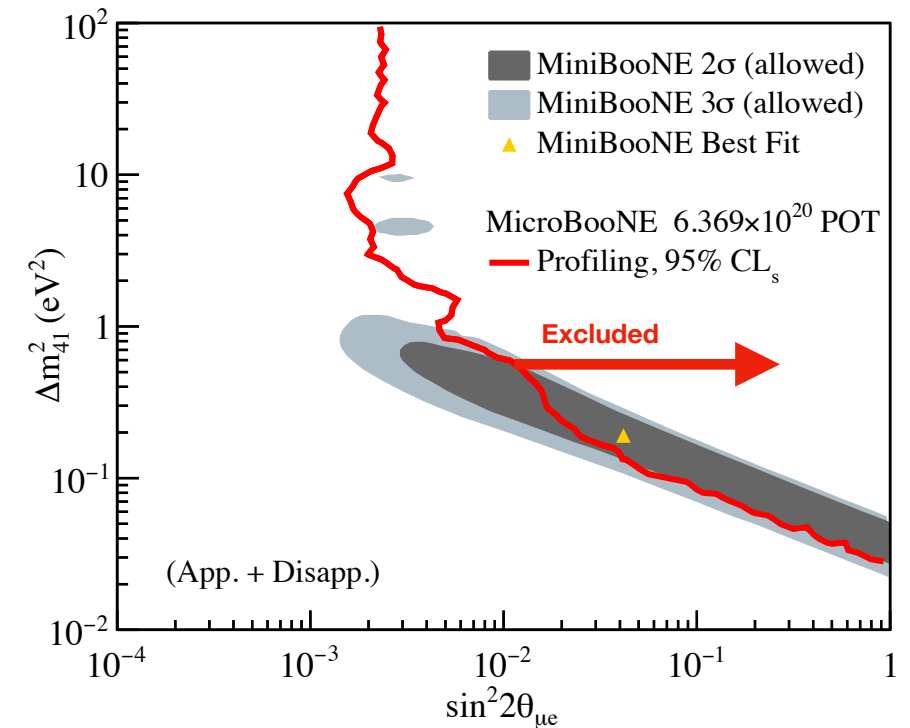
[Phys. Rev. Lett. 130, 011801 \(2023\)](#)

BSM searches in MicroBooNE

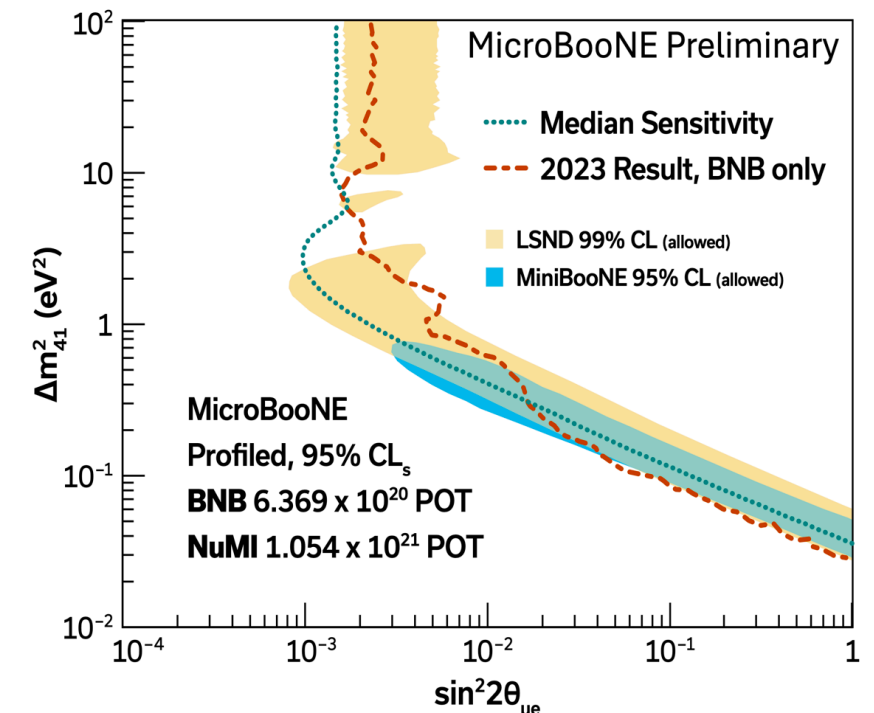
Light sterile neutrino



- Search for 3+1 (eV) sterile neutrino oscillation.
- Using BNB ν_e inclusive search to look at 3+1 model, large phase space rejected at 95% CLs
- Degeneracy when $\sin^2 \theta_{24} \approx 0.005$ given (BNB) $R_{\nu_\mu/\nu_e} \approx 185$
- Degeneracy mitigated by adding data from NuMI beamline $R_{\nu_\mu/\nu_e} \approx 21$



[Phys. Rev. Lett. 130, 011801 \(2023\)](#)

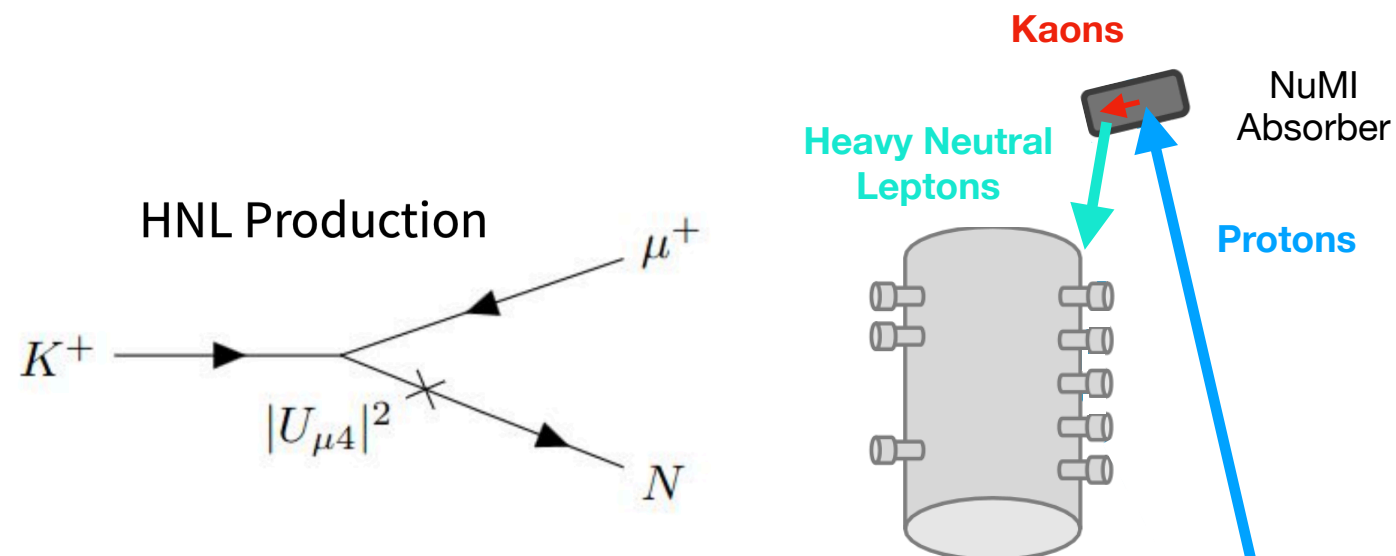
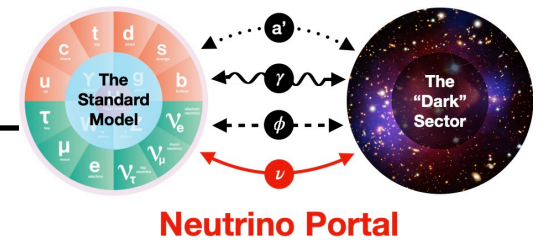


[MICROBOONE-NOTE-1132-PUB](#)

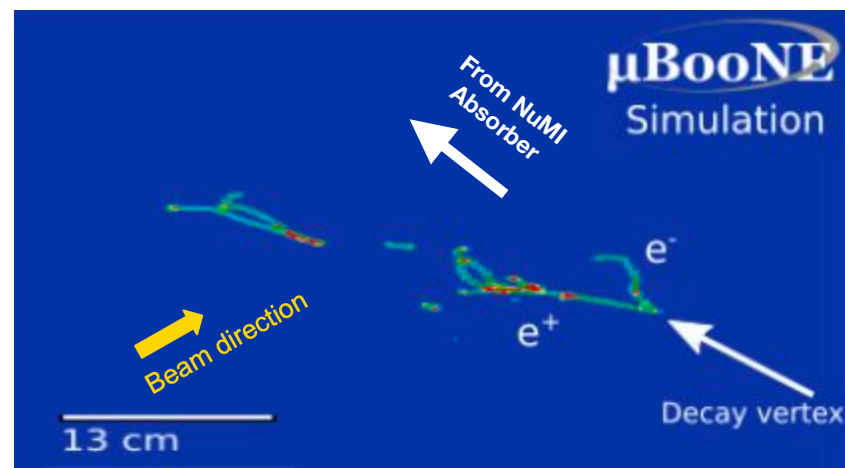
Stay tuned for the full result!

M.Nebot-Guinot

Heavy Neutral Leptons (HNL)

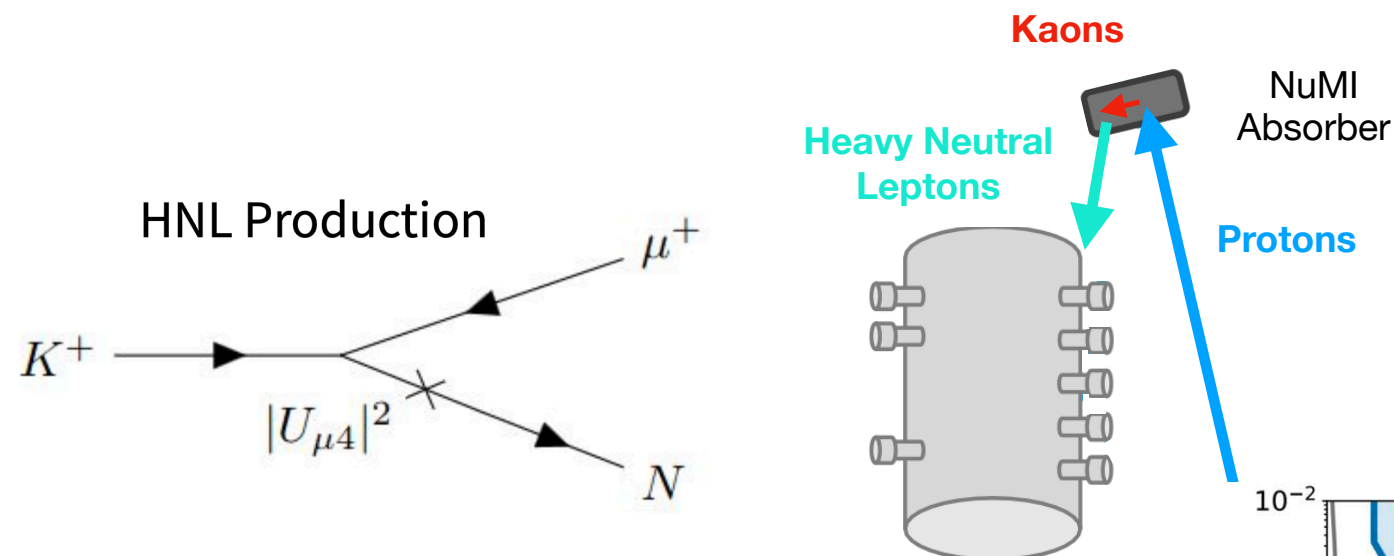
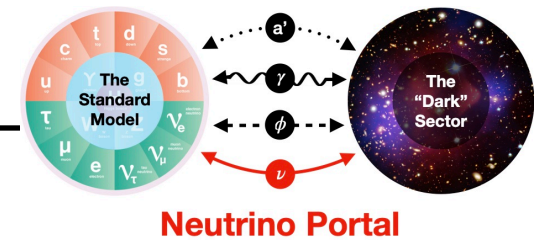


- First search for $N \rightarrow \nu e^+ e^-$ or $N \rightarrow \nu \pi^0$ final states in a LArTPC

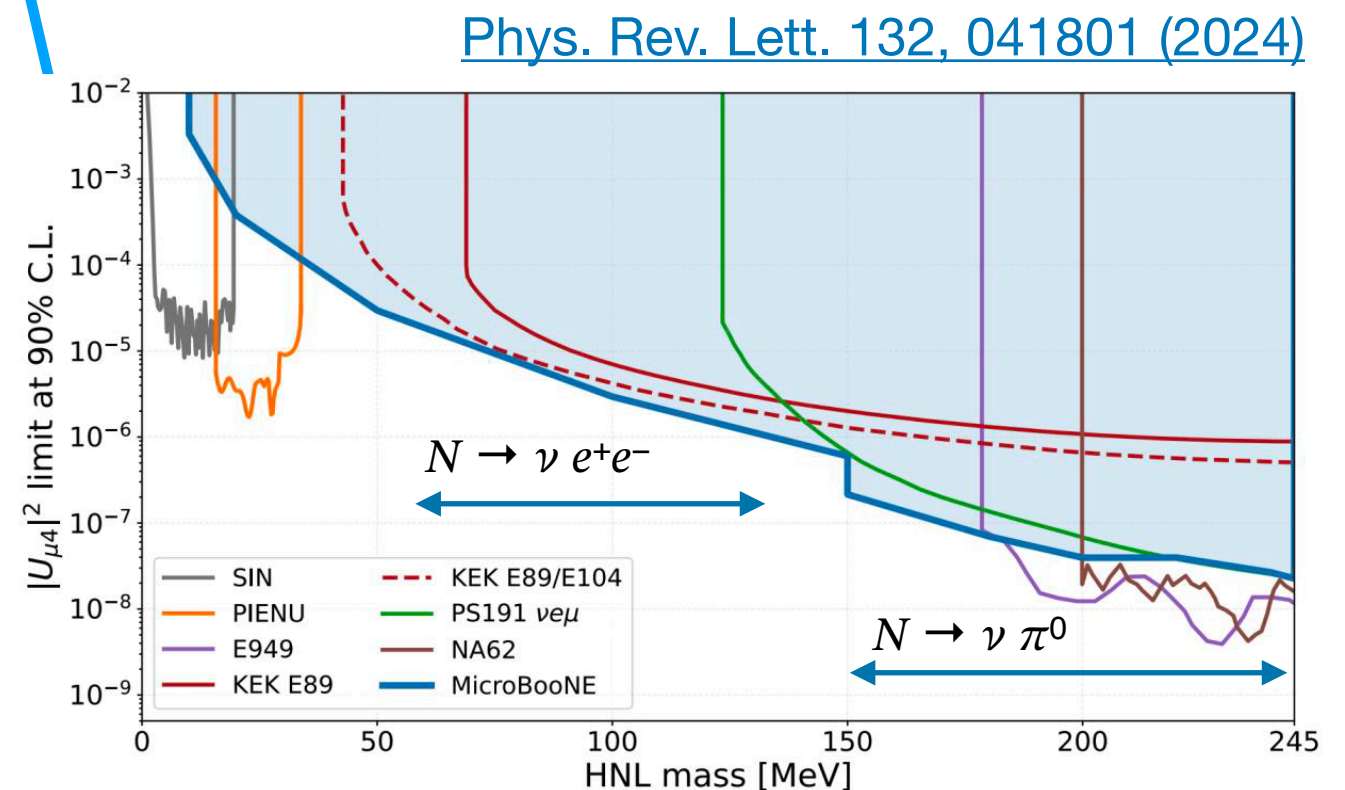
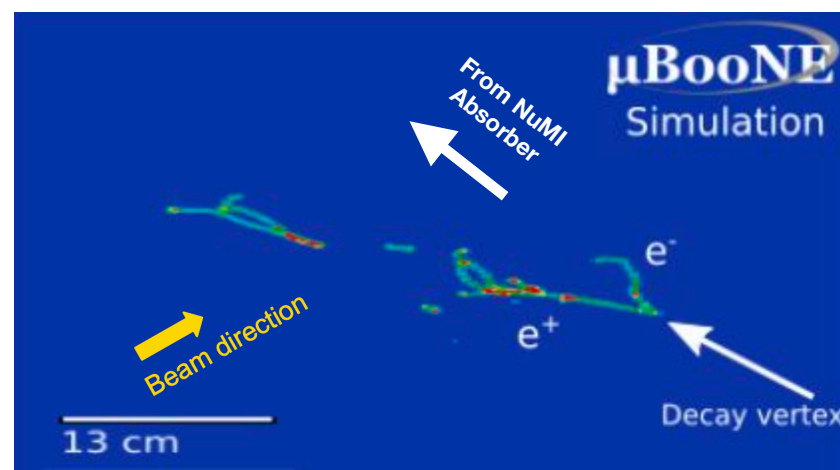


BSM searches in MicroBooNE

Heavy Neutral Leptons (HNL)



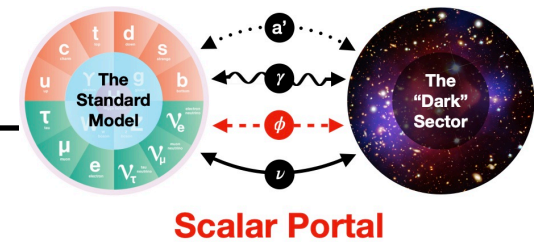
- First search for $N \rightarrow \nu e^+e^-$ or $N \rightarrow \nu \pi^0$ final states in a LArTPC



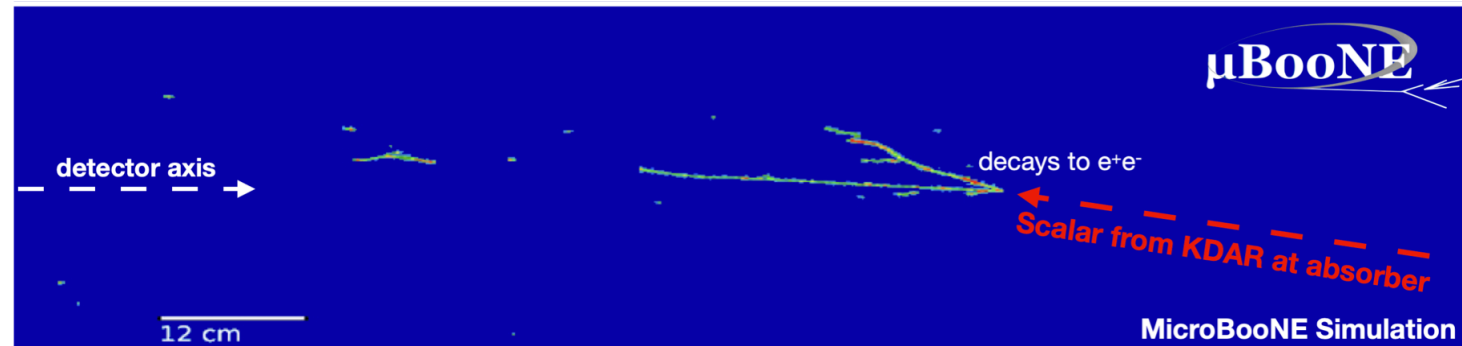
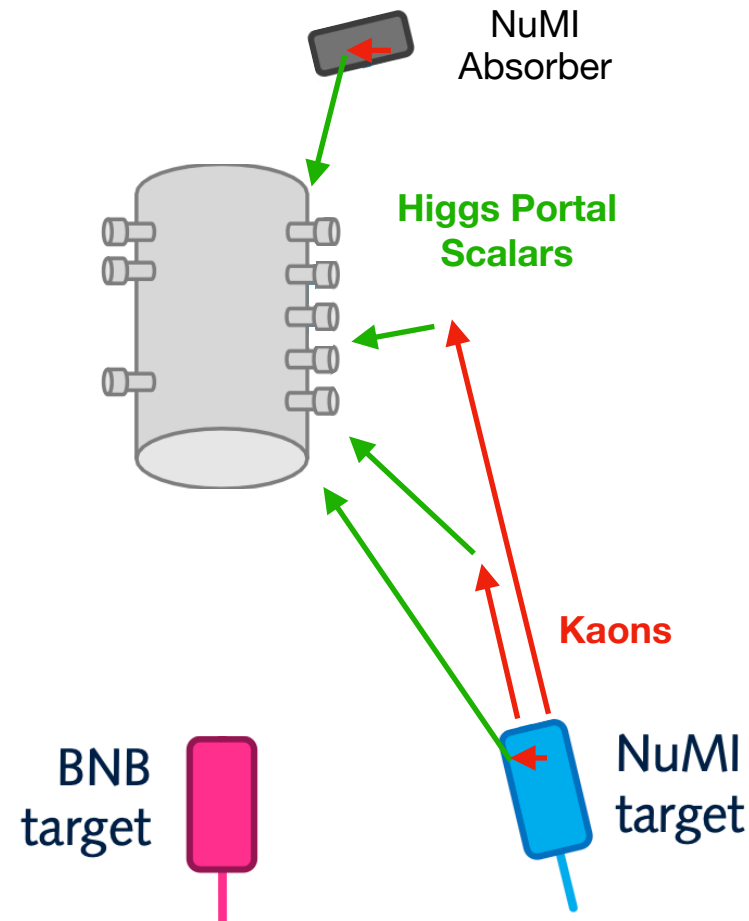
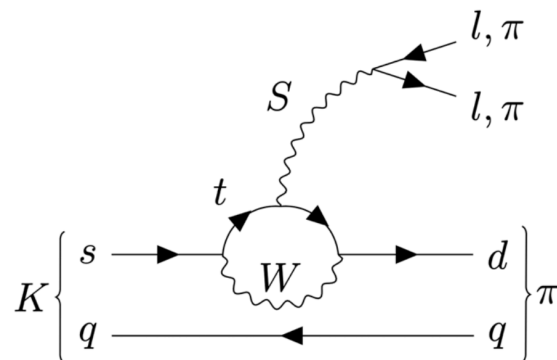
- Set limits on $|U_{\mu 4}|^2$ as a function of HNL mass
 $10 \leq m_{\text{HNL}} \leq 150$ MeV (νe^+e^- channel)
 $150 \leq m_{\text{HNL}} \leq 245$ MeV ($\nu \pi^0$ channel)

BSM searches in MicroBooNE

Higgs Portal Scalars

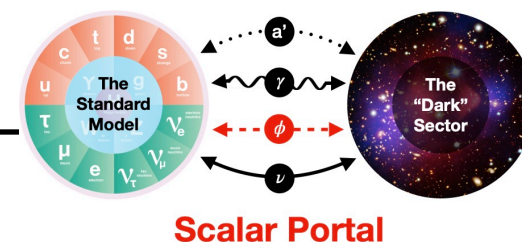


- Neutral scalar singlet S , mixing angle θ with the Higgs boson
- Production from kaon decay
- Signature: $S \rightarrow e^+e^-$

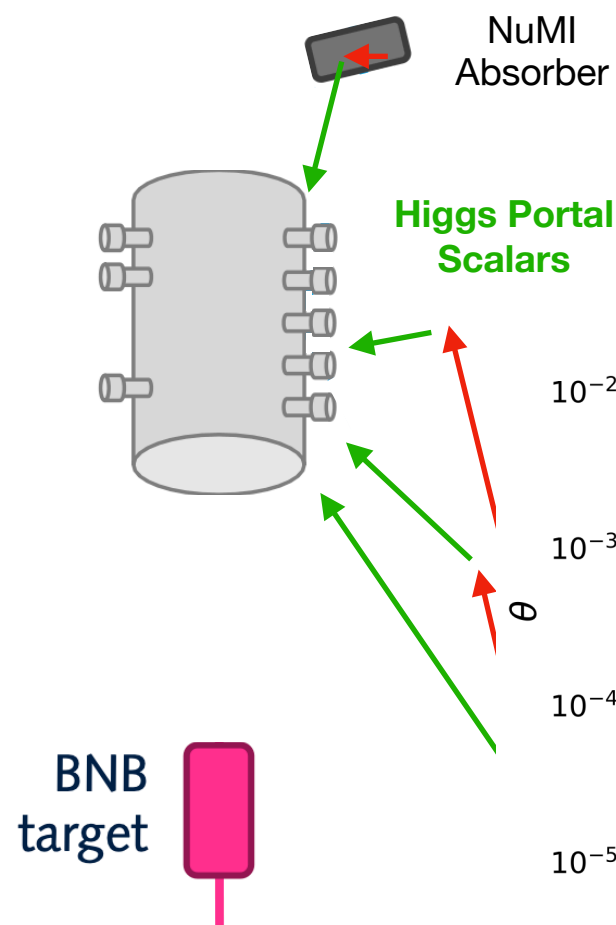
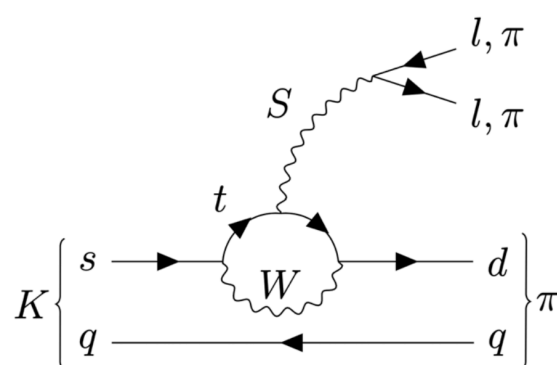


BSM searches in MicroBooNE

Higgs Portal Scalars

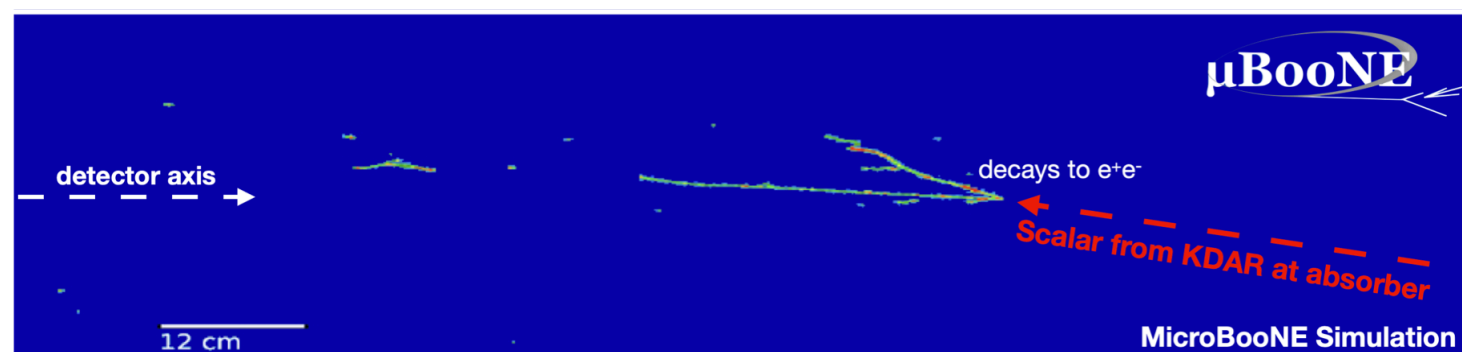
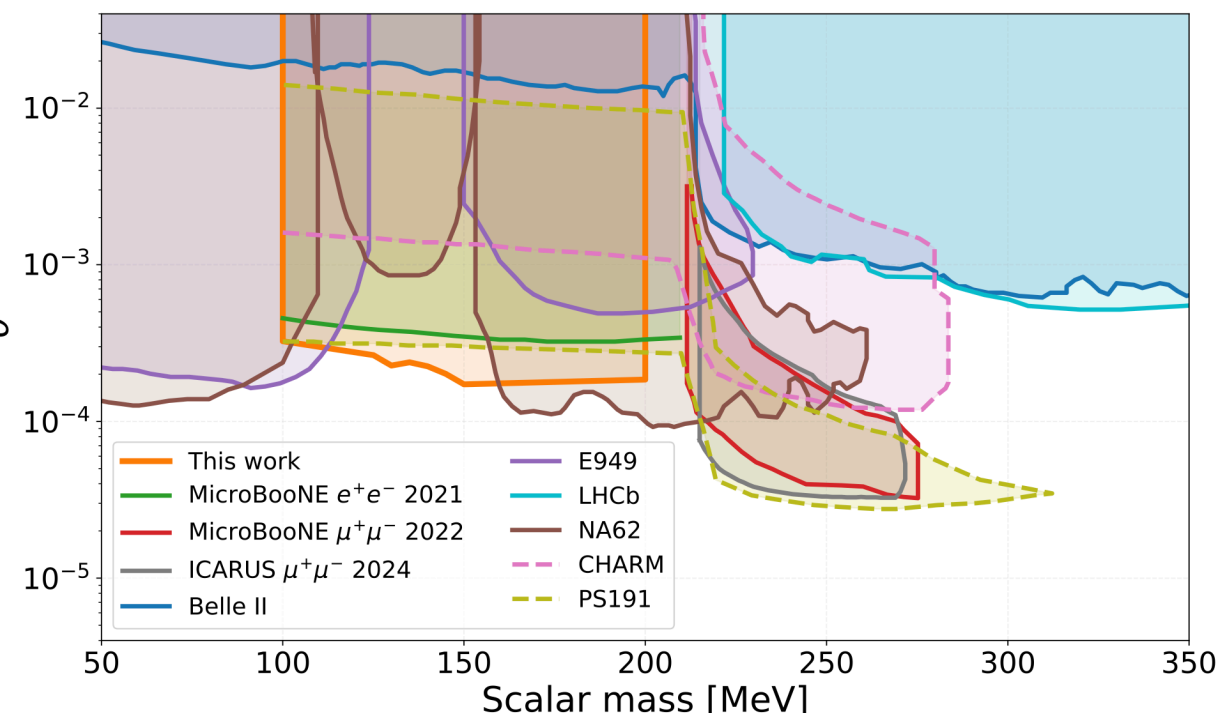


- Neutral scalar singlet S , mixing angle θ with the Higgs boson
- Production from kaon decay
- Signature: $S \rightarrow e^+e^-$



New!

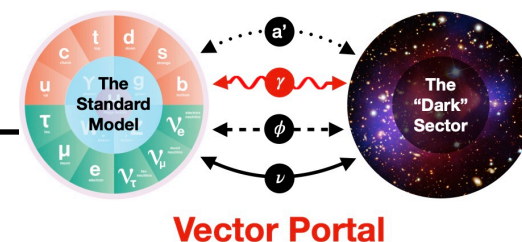
[arXiv:2501.08052](https://arxiv.org/abs/2501.08052)



- Set strongest limits to date at 95% CL:
At $m_S = 125$ MeV, $\theta < 2.65 \times 10^{-4}$
At $m_S = 150$ MeV, $\theta < 1.72 \times 10^{-4}$

BSM searches in MicroBooNE

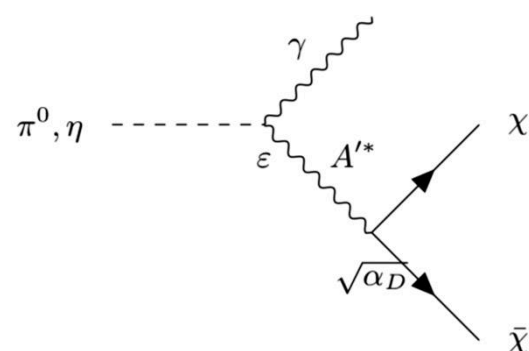
Light dark matter



- First search for dark-trident using a LArTPC

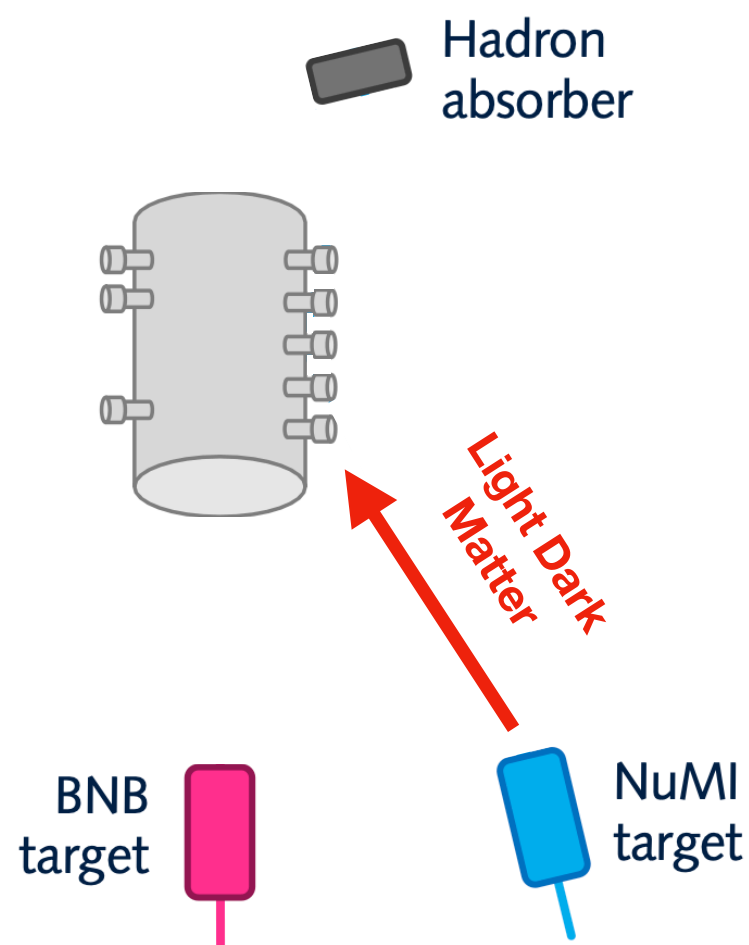
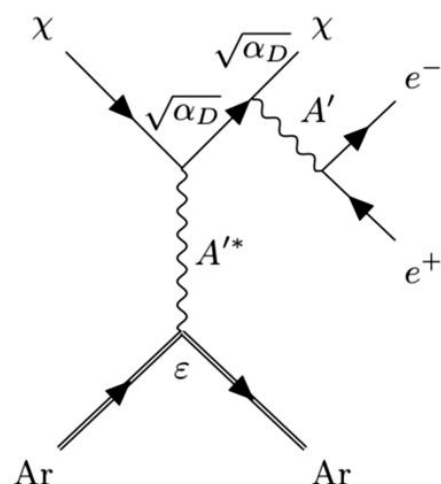
Production

DM particle produced in beam and interacts in MicroBooNE Dark photon mediator A'



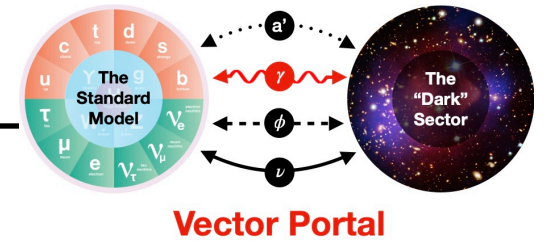
Scatter

Dark photon mediator $A' \rightarrow e^+e^-$



BSM searches in MicroBooNE

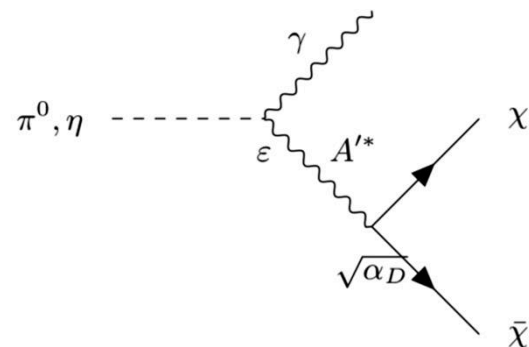
Light dark matter



- First search for dark-trident using a LArTPC

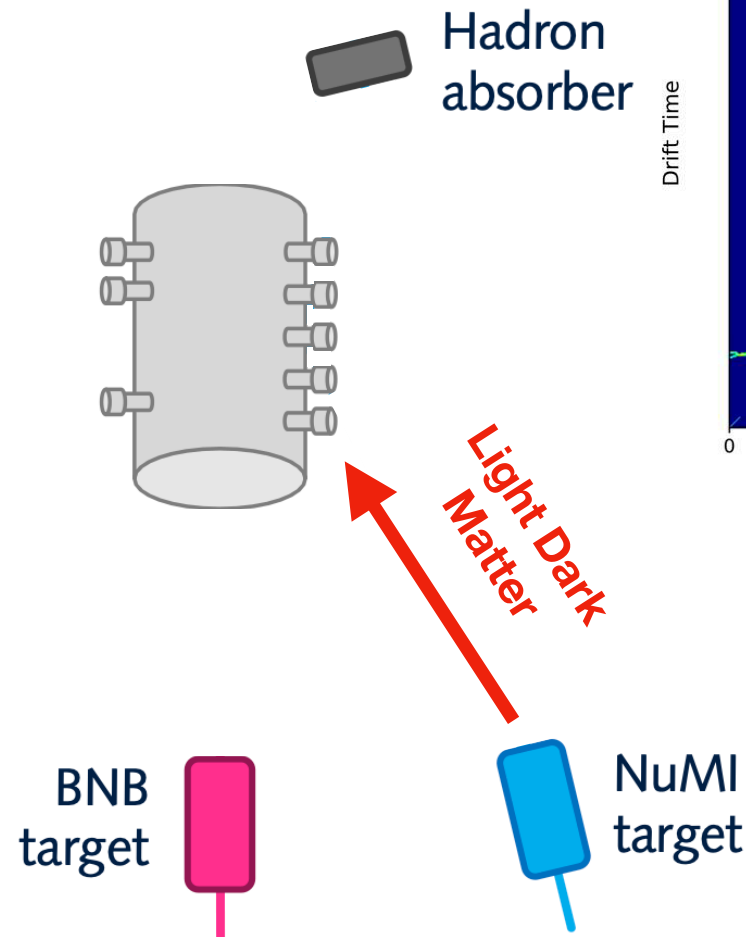
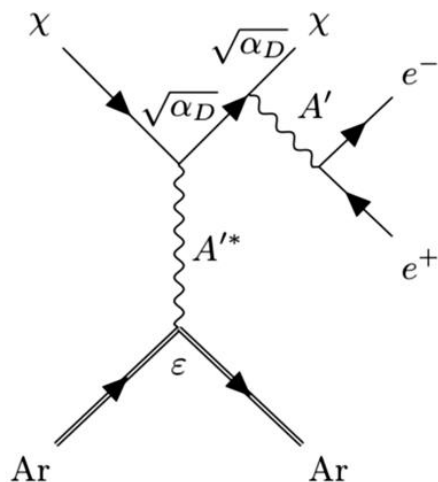
Production

DM particle produced in beam and interacts in MicroBooNE Dark photon mediator A'

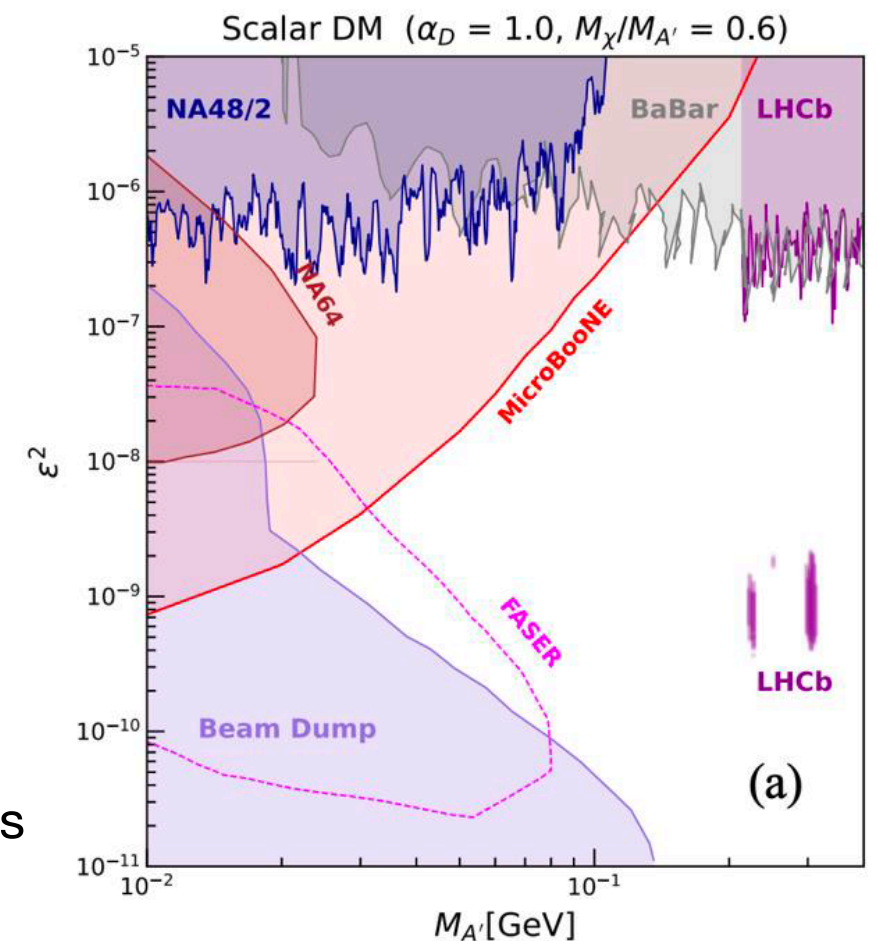
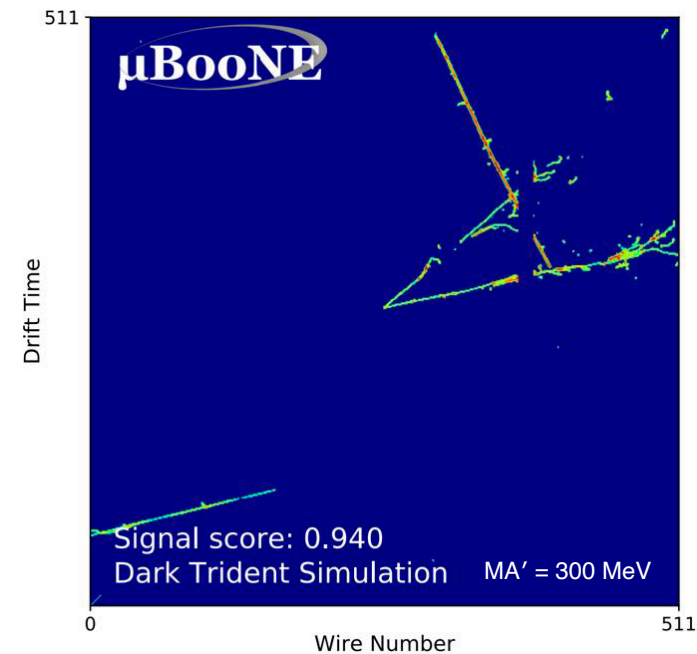


Scatter

Dark photon mediator $A' \rightarrow e^+e^-$

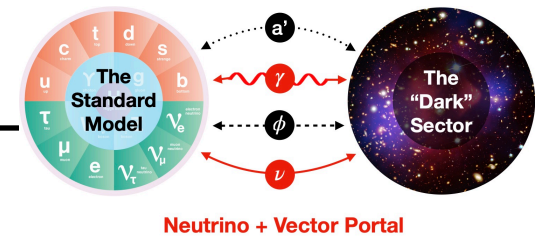


- Parameters of the model:
 - dark photon (MA')
 - dark scalar (or fermion) (M_χ)
- Set world-leading limits on this Light Dark Matter model



BSM searches in MicroBooNE

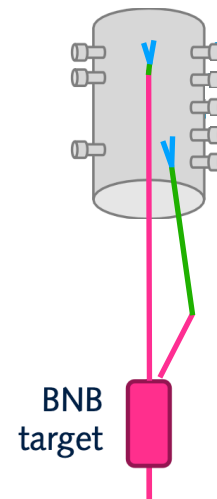
Dark Neutrino e^+e^- -like LEE signal



Non-minimal portal: neutrino and vector

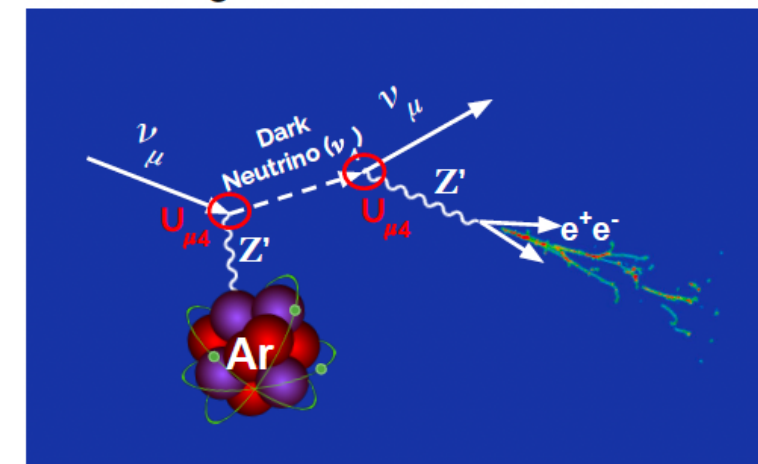
- Two main possibilities for the MiniBooNE LEE:

- Single electron
- Single photon, pair-converting to e^+e^-

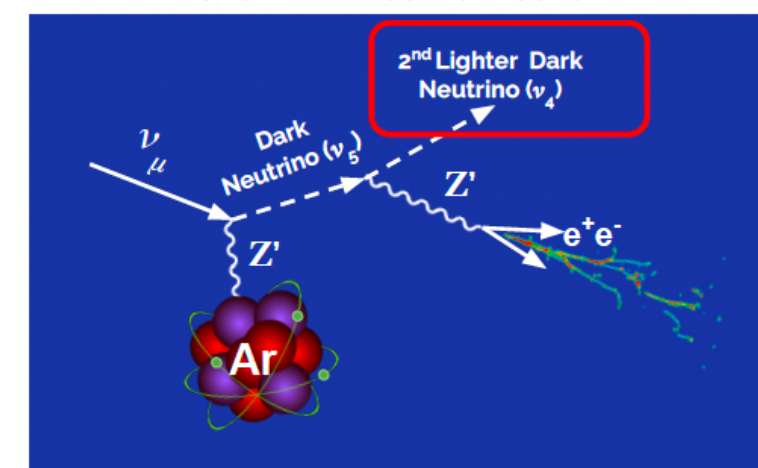


- Possible e^+e^- solutions to the MiniBooNE excess
 - *Dark Neutrino Portal to Explain MiniBooNE excess*
[10.1103/PhysRevLett.121.241801](https://arxiv.org/abs/10.1103/PhysRevLett.121.241801) Light Z' regime $m_{Z'} < m_4$
 - *$U(1)'$ mediated decays of heavy sterile neutrinos in MiniBooNE*
[10.1103/PhysRevD.99.071701](https://arxiv.org/abs/10.1103/PhysRevD.99.071701) Heavy Z' regime $m_{Z'} > m_4$
- Neutrinos up-scatter to a heavy dark neutrino ν_4 via a new dark gauge boson Z' .
 - ν_4 is unstable and decays $\nu_4 \rightarrow \nu_\alpha e^+e^-$
 (or to a 2nd lighter dark neutrino, dual dark neutrino model)

Single Dark Neutrino Model

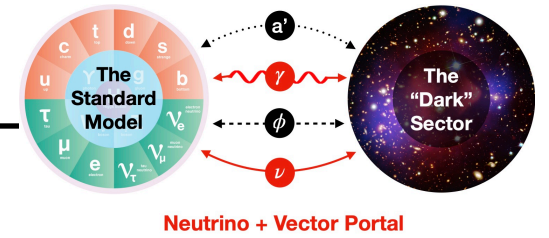


Dual Dark Neutrino Model



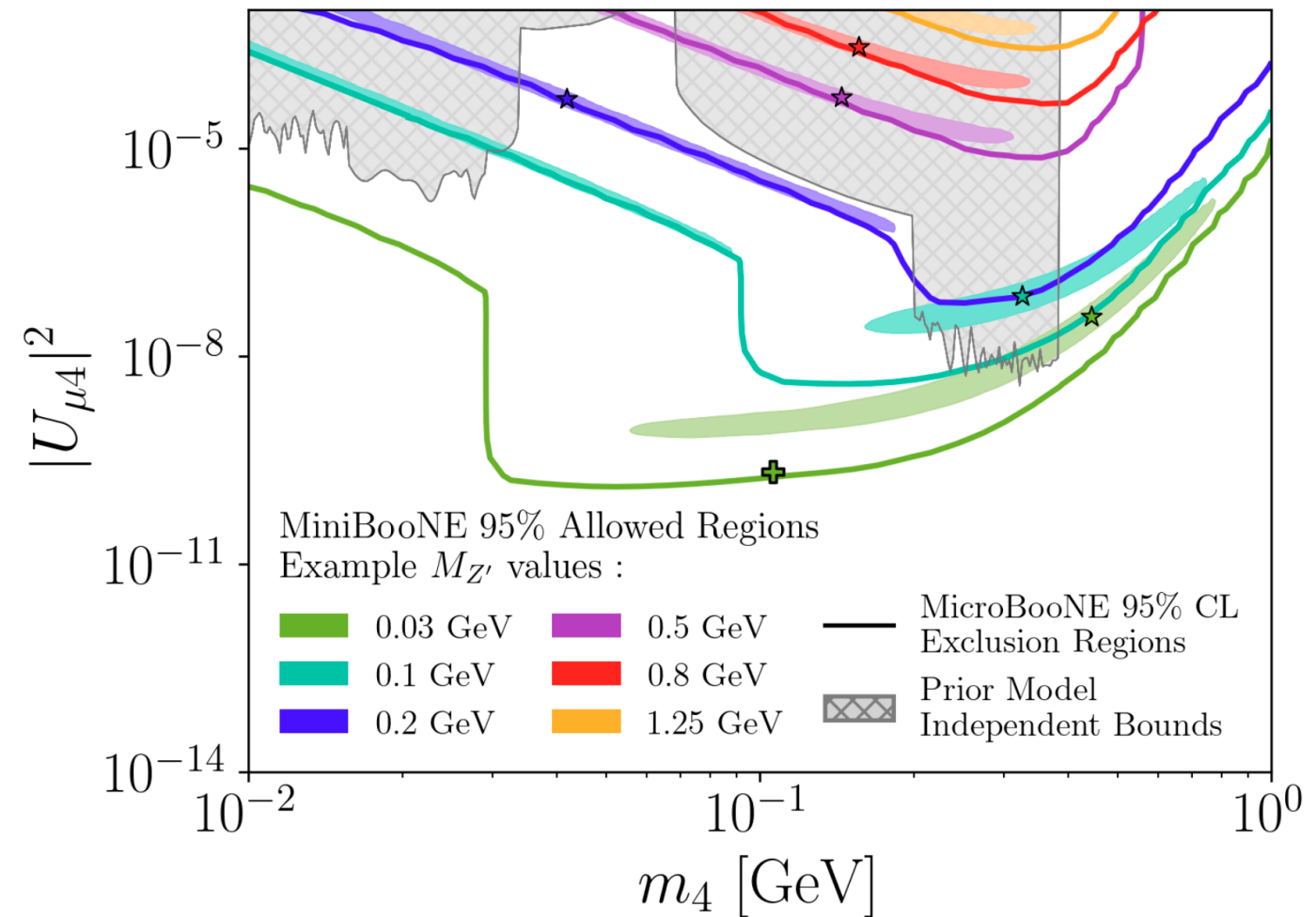
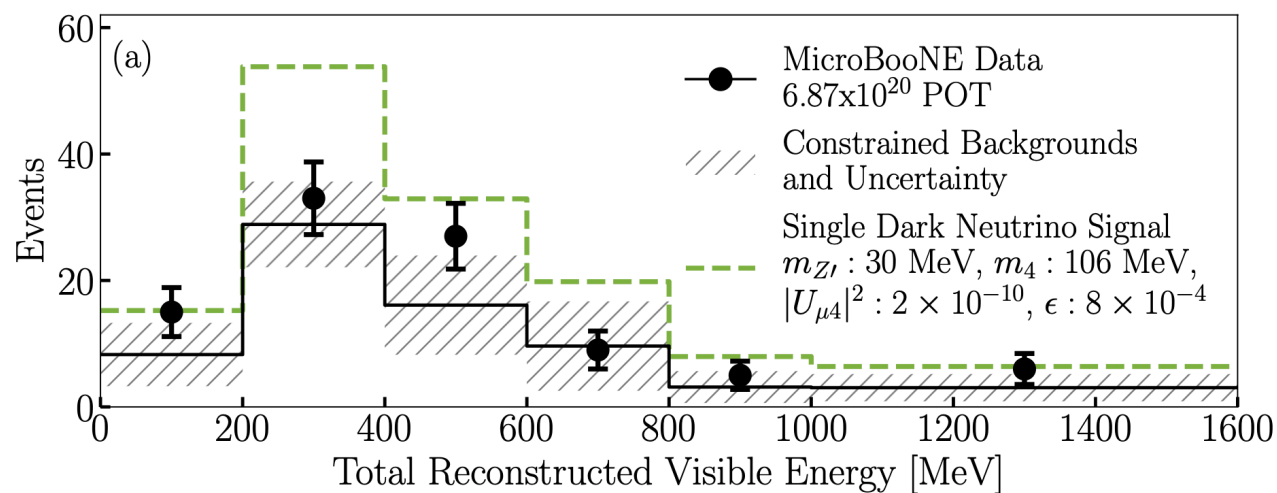
BSM searches in MicroBooNE

Dark Neutrino e^+e^- -like LEE signal



Non-minimal portal: neutrino and vector

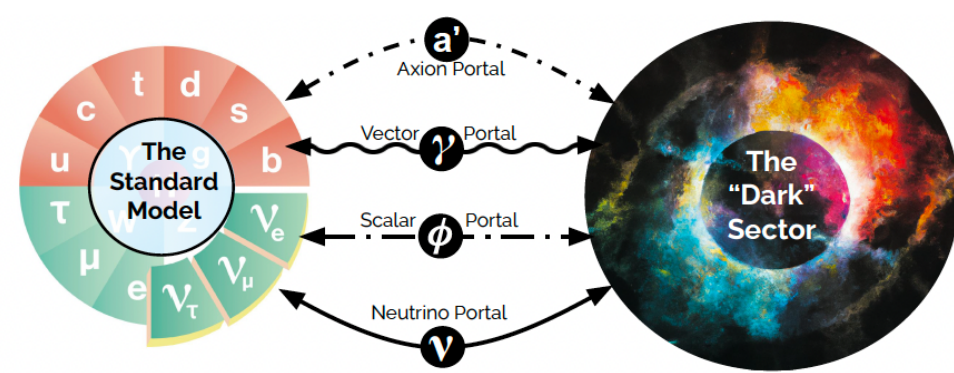
- 95 events seen; 69.7 ± 17.3 predicted. Agreement at 1.5σ
- We exclude almost all of the MiniBooNE-allowed phase space of this model
- In general, we expect small changes to assumptions in this model to affect MiniBooNE and MicroBooNE in similar ways



[arXiv:2502.10900](https://arxiv.org/abs/2502.10900)

BSM summary

MicroBooNE is powerful probe of minimal dark sector portals



Neutrino Portal

$$\mathcal{L} \supset -y^\alpha L_\alpha H N + \text{h.c.}$$

Light 3+1 sterile Neutrino

Heavy Neutral Leptons

Scalar Portal

$$\mathcal{L} \supset (A S + \lambda S^2) H^\dagger H$$

Higgs Portal Scalars

Vector Portal

$$\mathcal{L} \supset \epsilon F'_{\mu\nu} B^{\mu\nu}$$

Light Dark Matter

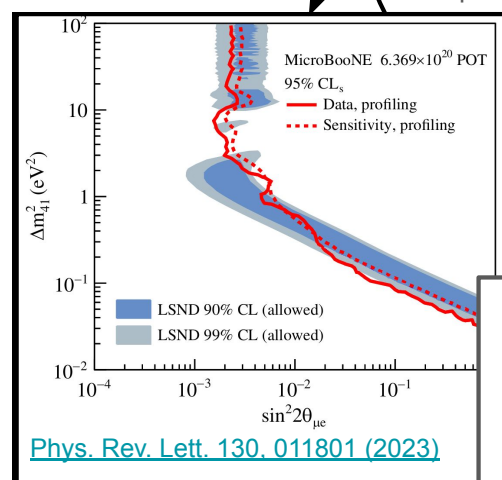
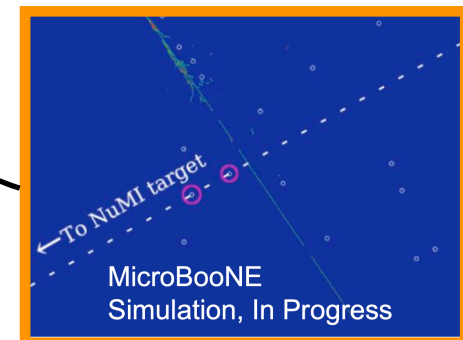
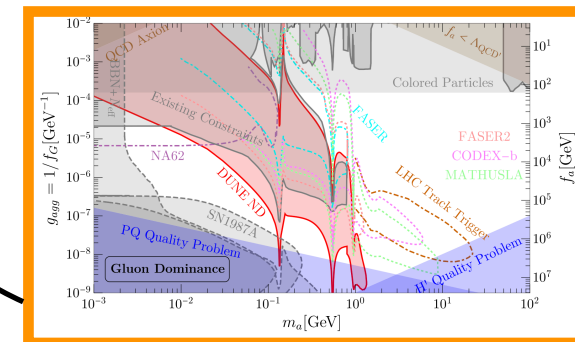
Millicharged Particles

Axion Portal

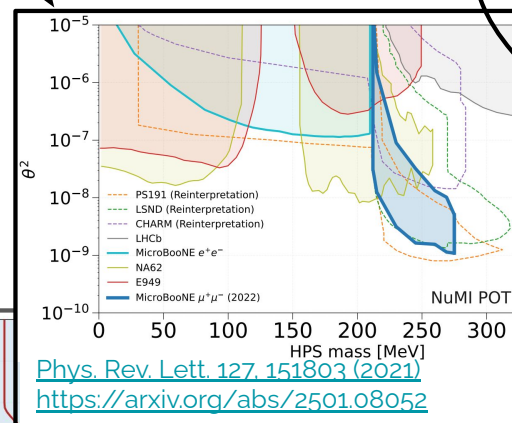
$$\mathcal{L} \supset c_{GG} \frac{\alpha_s}{4\pi} \frac{a}{f} G_{\mu\nu}^a \tilde{G}^{a, \mu\nu}$$

Heavy QCD Axions

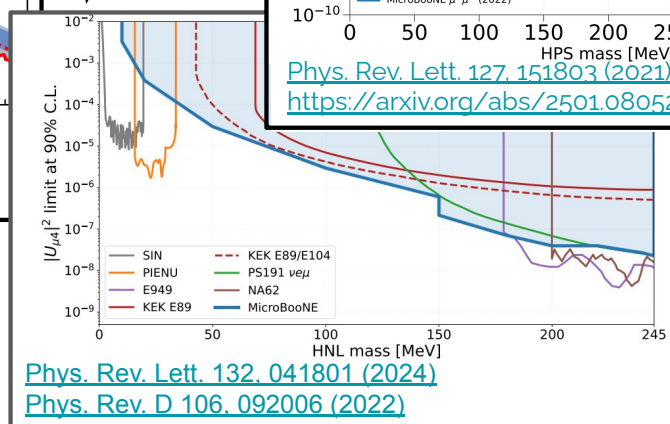
QCD axion and milli-charged particle analyses ongoing!



[Phys. Rev. Lett. 130, 011801 \(2023\)](#)

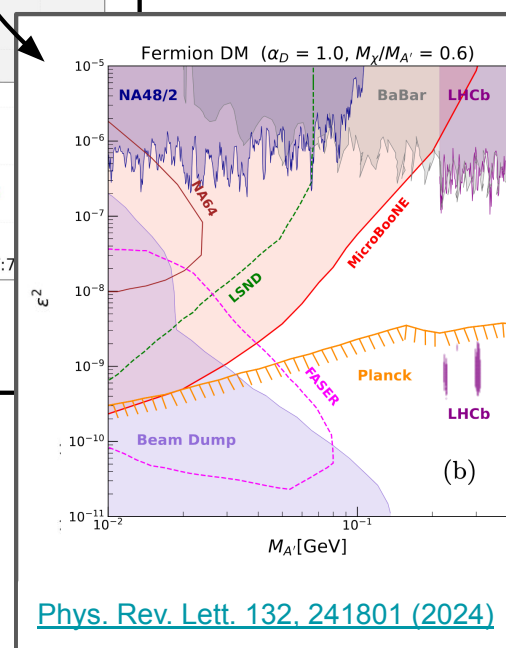


[Phys. Rev. Lett. 127, 151803 \(2021\)](#)
<https://arxiv.org/abs/2501.08052>



[Phys. Rev. Lett. 132, 041801 \(2024\)](#)

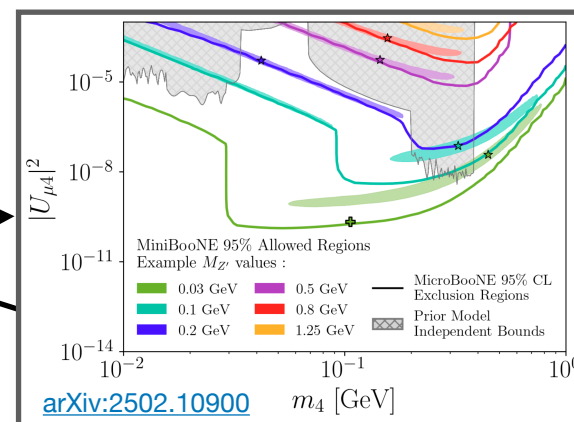
[Phys. Rev. D 106, 092006 \(2022\)](#)



[Phys. Rev. Lett. 132, 241801 \(2024\)](#)

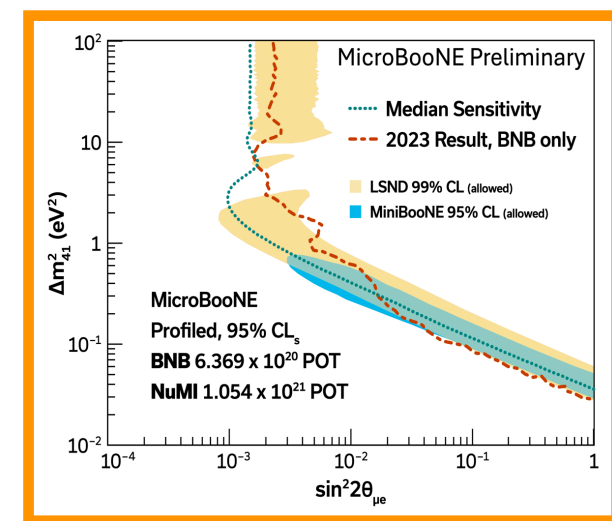
Combined and Non-Minimal Portals

Dark Neutrino



[arXiv:2502.10900](#)

sterile neutrino oscillations comming soon!

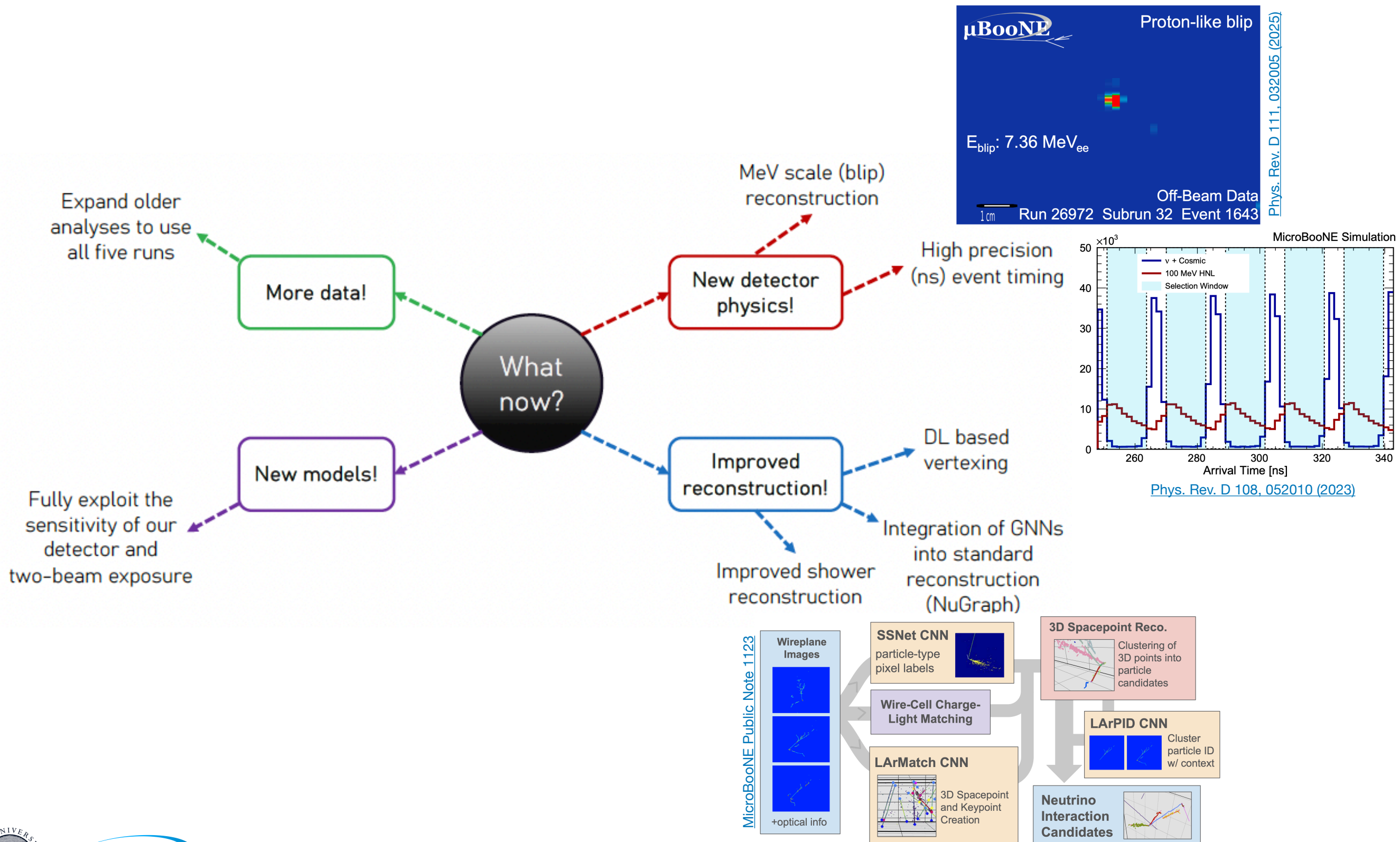


MicroBooNE
Profiled, 95% CL_s
BNB 6.369 $\times 10^{20}$ POT
NuMI 1.054 $\times 10^{21}$ POT

M.Nebot-Guinot

MicroBooNE Public Note 1132

Future of MicroBooNE BSM Searches



MicroBooNE's beyond the Standard Model physics program

Summary

- MicroBooNE collected BNB and NuMI neutrino beams data for ~6 years producing >80 papers.
- Extensive inclusive physics program:
Pioneering BSM searches, ν -Ar cross-sections (see London's and Jairo's xsec talks tomorrow) and LArTPCs R&D
Many BSM explanations of prior anomalies ruled out (see Fan's talk on Thursday for more discussion of the MiniBooNE anomaly)
- Strong constraints placed on many other models! (HNLs, HPSs, Dark Tridents, Dark Neutrinos...)
- Incorporation of new techniques into BSM searches! AI/ML based, Ns timing, MeV-scale reconstruction ...
Lots of exciting results to come!



MicroBooNE Collaboration Meeting - Oxford, Sept.25

Backup



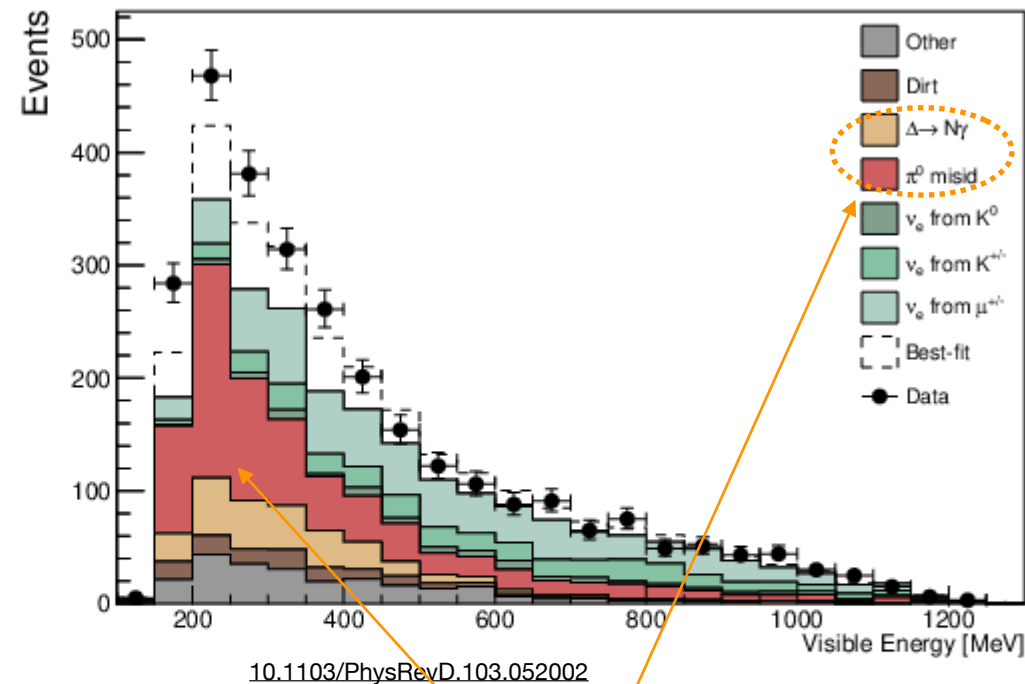
Short-Baseline neutrino anomalies

- MiniBooNE was built to test LSND anomaly.
- With data collected from 2002 to 2019, sees a 4.8σ excess of ν_e candidate events
- Neutrino and anti-neutrino final fits consistent with LSND allowed regions.

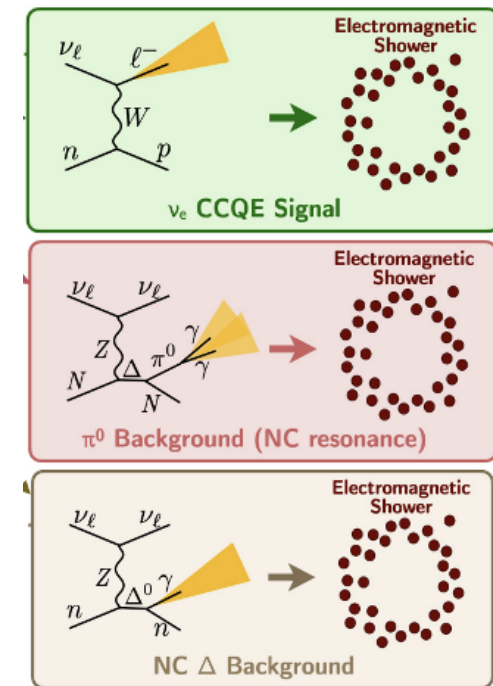
If excess is truly electron neutrinos from oscillation then could be evidence of a 3+N sterile neutrino theory

- MicroBooNE main physics goal:
Investigate the MiniBooNE “Low Energy Excess”
 - Same BNB beam, baseline but new detector!
- Additional physics program:
BSM, ν -Ar interactions, LArTPC R&D

MiniBooNE ν_e



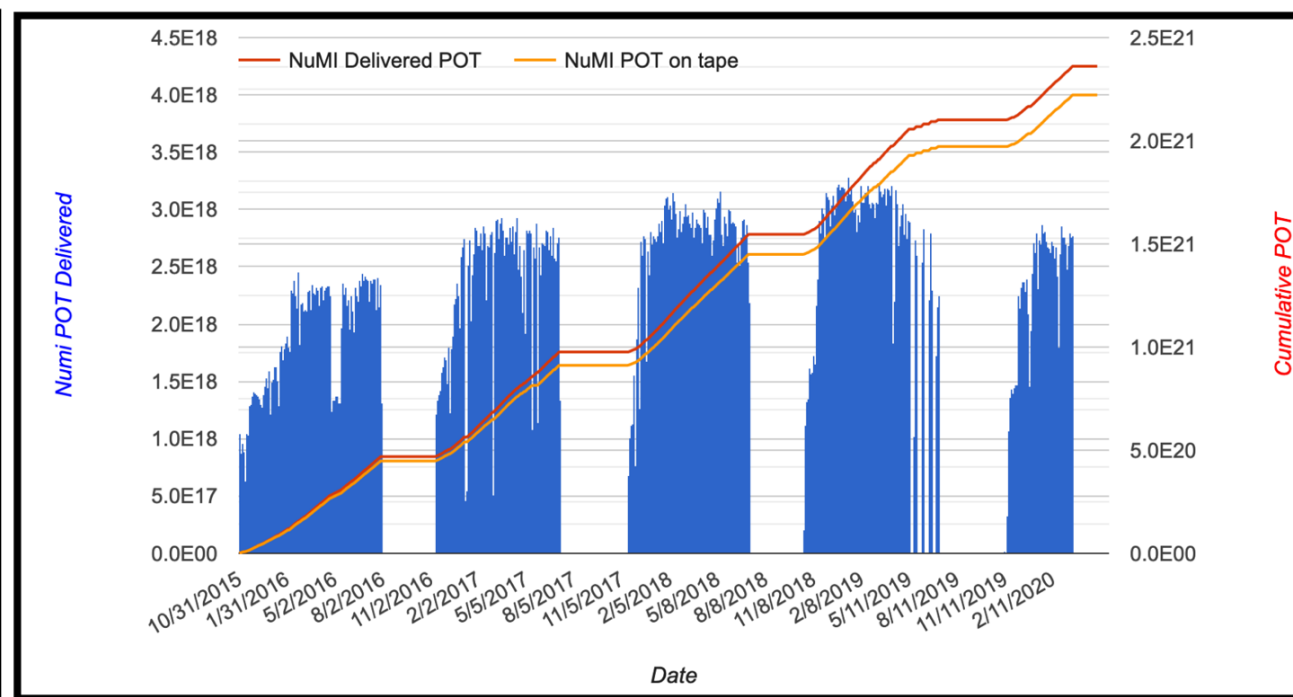
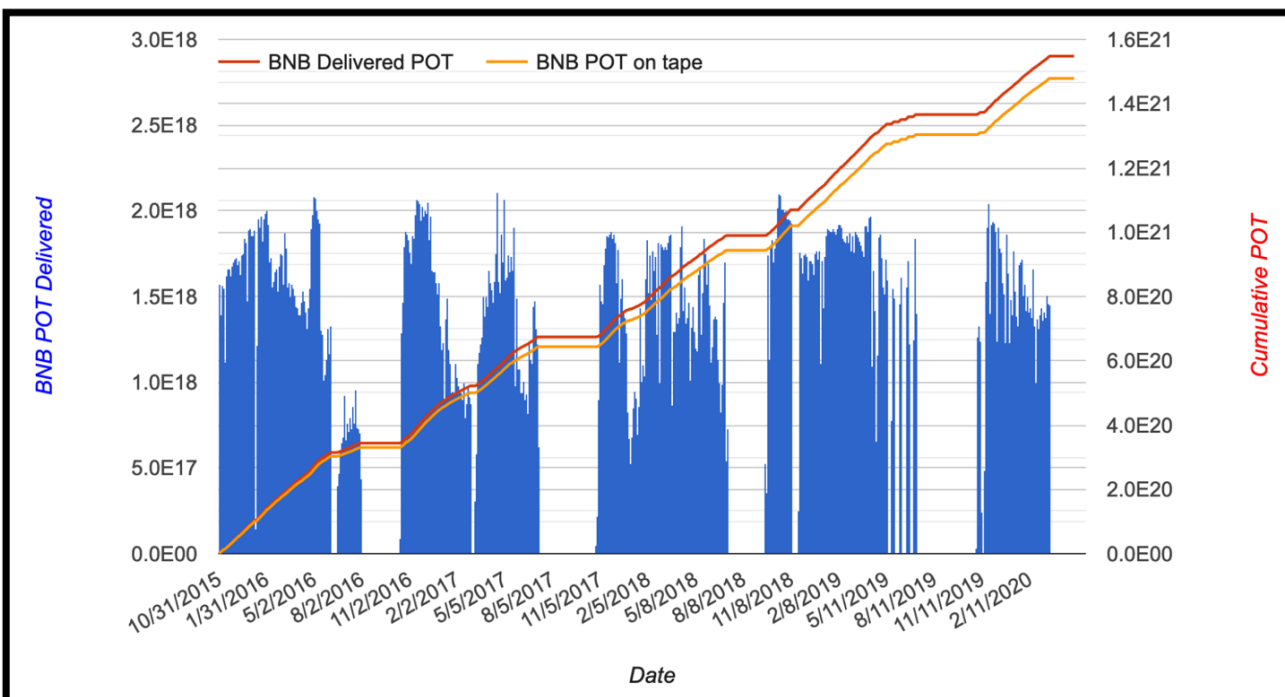
Main backgrounds:



■ Data taking

■ **BNB** Full Dataset: 1.1×10^{21} POT

■ **NuMI** Full Dataset: 2.37×10^{21} POT



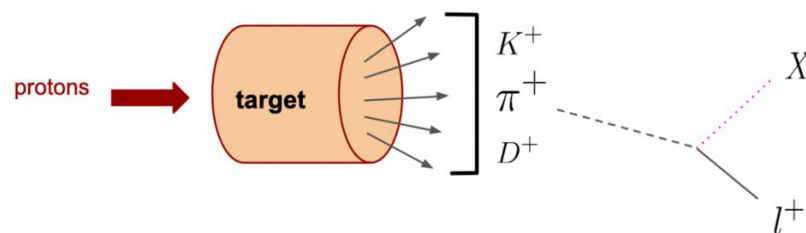
- MicroBooNE collected BNB and NuMI data between 2015 and 2021 split into five runs

■ Neutrino Beamlines at Fermilab

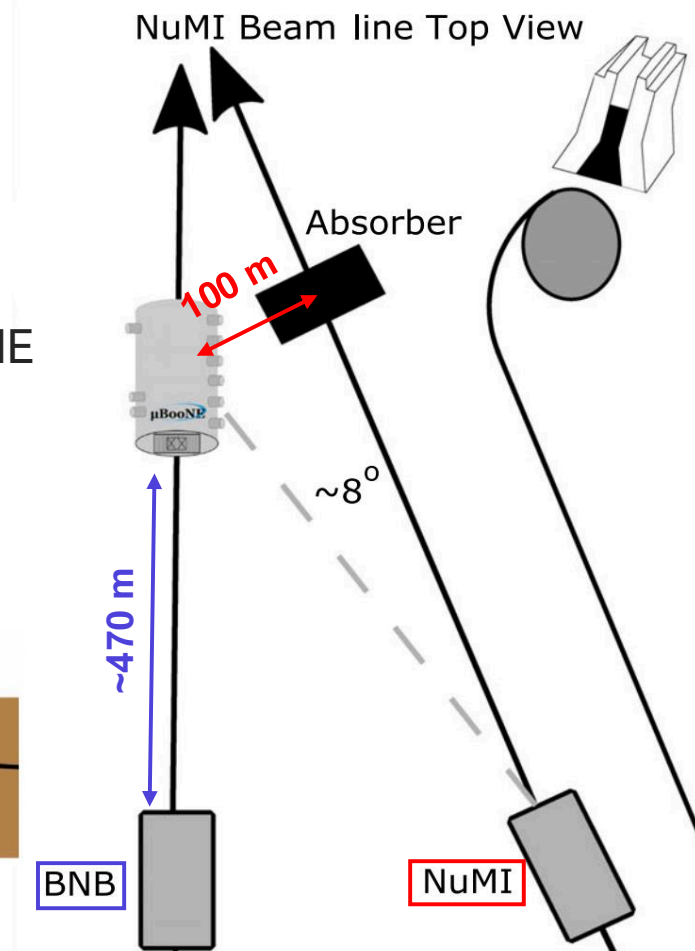
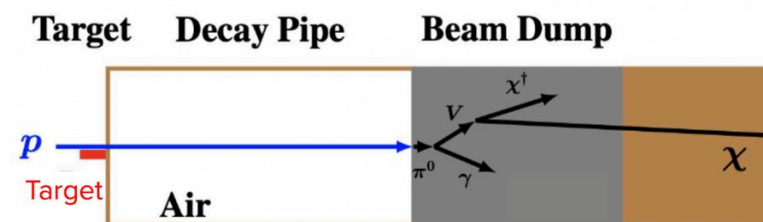
Beamlines

- Large flux of **charged/neutral mesons** from high intensity proton beams
- New particles can be produced from meson decays
- Proximity to the **NuMI absorber**
→ Particles survive long enough to reach MicroBooNE

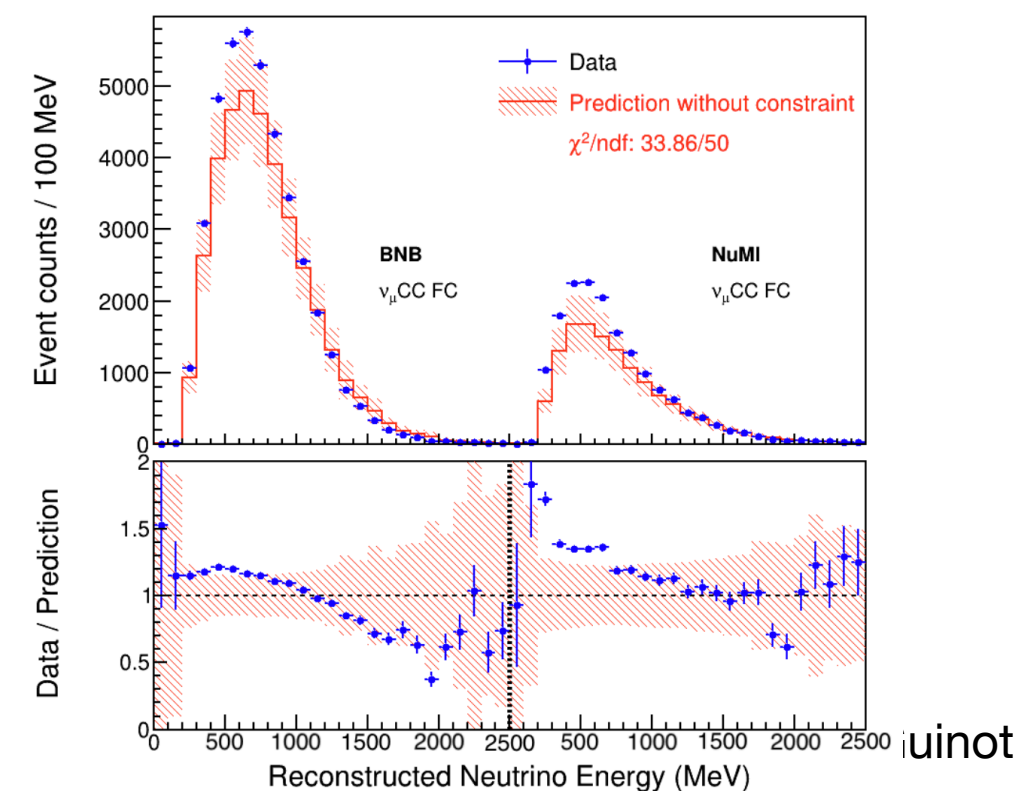
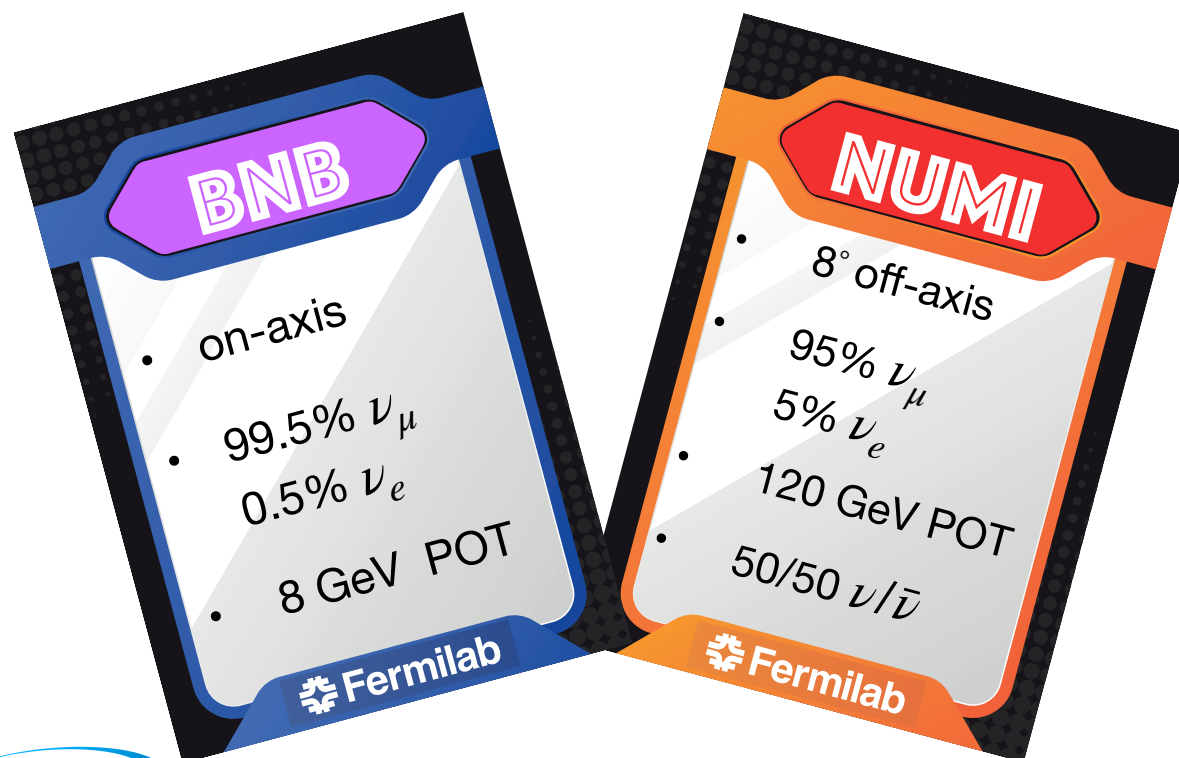
Meson decay in flight



Beam dump

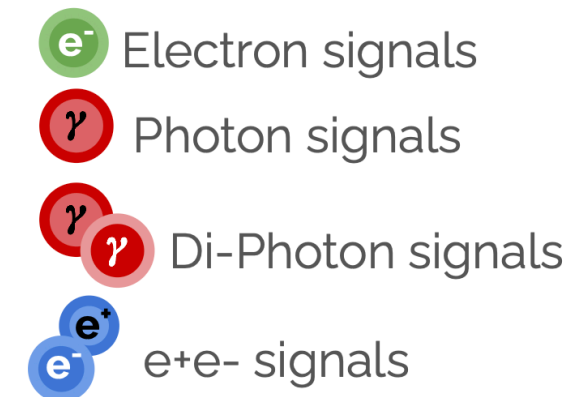


MicroBooNE BNB 6.369×10^{20} POT / NuMI 1.054×10^{21} POT



BSM Possibilities for the LEE

- The MiniBooNE LEE has often been interpreted as an excess of e^- events, potentially from sterile neutrino short baseline $\nu_\mu \rightarrow \nu_e$ oscillations
- But there are lots of well motivated beyond-standard-model possibilities for γ and e^+e^- events as well



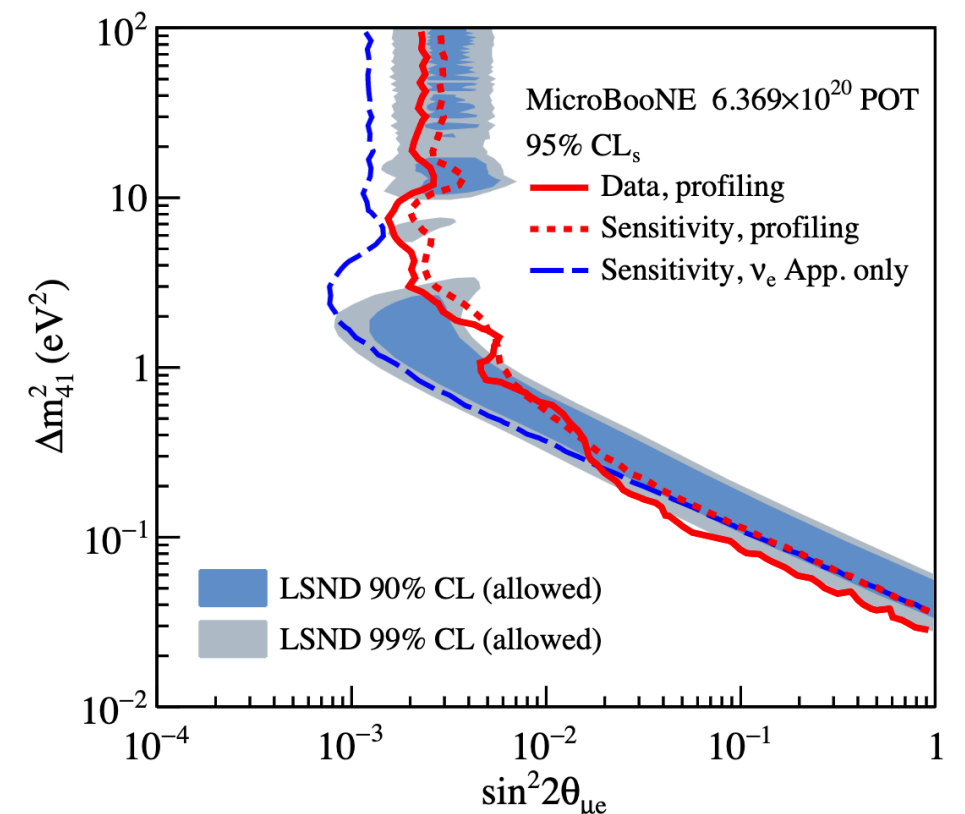
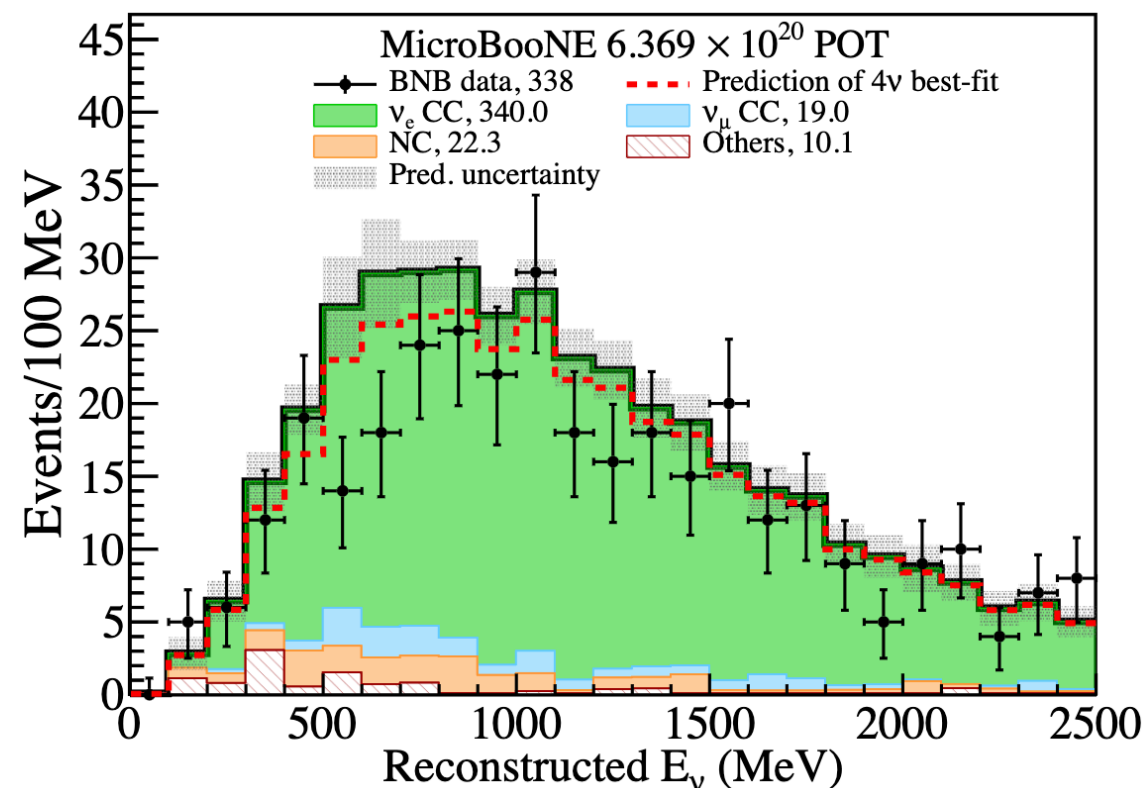
Category	Model	Signature	Anomalies			References
			LSND	MiniBooNE	Sources	
Flavor transitions Secs. 3.1.1-3.1.3, 3.1.5	(3+1) oscillations	ν oscillations	✓	✓	✓	Reviews and global fits [93, 103, 105, 106]
	(3+1) w/ invisible sterile decay	oscillations w/ ν_4 invisible decay	✓	✓	✓	[151, 155]
	(3+1) w/ sterile decay	$\nu \rightarrow \nu + \gamma$	✓	✓	✓	[159–162, 270]
Matter effects Secs. 3.1.4, 3.1.7	(3+1) w/ anomalous matter effects	$\nu_\mu \rightarrow \nu_e$ via matter effects	✓	✓	✗	[143, 147, 271–273]
	(3+1) w/ quasi-sterile neutrinos	$\nu_\mu \rightarrow \nu_e$ w/ resonant ν_s matter effects	✓	✓	✓	[148]
Flavor violation Sec. 3.1.6	Lepton-flavor-violating μ decays	$\mu \rightarrow e + \nu_\alpha \bar{\nu}_e$	✓	✗	✗	[174, 175, 274]
	neutrino-flavor-changing bremsstrahlung	$\nu_\mu A \rightarrow \nu_e A + e^-$	✓	✓	✗	[275]
Decays in flight Sec. 3.2.3	Transition magnetic mom., heavy ν decay	$N \rightarrow \nu \gamma$	✗	✓	✗	[207]
	Dark sector heavy neutrino decay	$N \rightarrow e^+ e^- \gamma$	✗	✓	✗	[208]
Neutrino Scattering Secs. 3.2.1, 3.2.2	neutrino-induced upscattering	$N + e^- \rightarrow \nu_e + e^- + \gamma$	✓	✓	✗	[205, 206, 209–216]
	neutrino dipole upscattering	$N + e^- \rightarrow \nu_e + e^- + \gamma$	✓	✓	✗	[40, 185, 187, 188, 190, 193, 233, 276]
Dark Matter Scattering Sec. 3.2.4	dark particle-induced upscattering	$\chi + e^- \rightarrow \chi + e^- + \gamma$	✗	✓	✗	[217]
	dark particle-induced inverse Primakoff	$\chi + \gamma \rightarrow \chi + e^+ e^-$	✓	✓	✗	[217]

Title Text

MicroBooNE's '22 analysis: 3+1 with BNB

- Reinterpret LEE ν_e analysis under 3+1 sterile neutrino oscillation framework

inclusive ν_e analysis. performed with BNB data. Sensitivity not statistics limited!



PRL 130 (2023) 1, 01180

eV-scale sterile neutrino searches BNB + NuMI

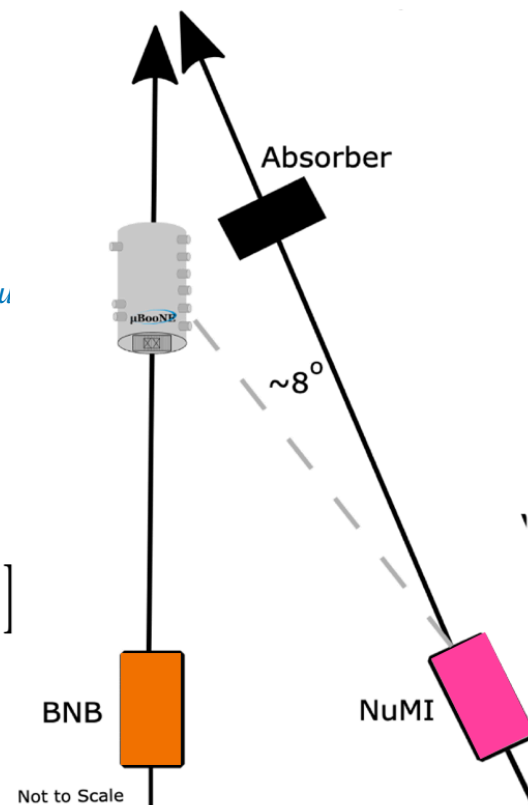
- 3+1 degeneracy:
 ν_e appearance cancels out ν_e disappearance
- Degeneracy depends on intrinsic rate of ν_e vs. ν_μ
For BNB $\frac{N_{\nu_\mu}}{N_{\nu_e}} \sim 200$

$$N_{\nu_e} = N_{\text{intrinsic } \nu_e} \cdot P_{\nu_e \rightarrow \nu_e} + N_{\text{intrinsic } \nu_\mu} \cdot P_{\nu_\mu \rightarrow \nu_e}$$

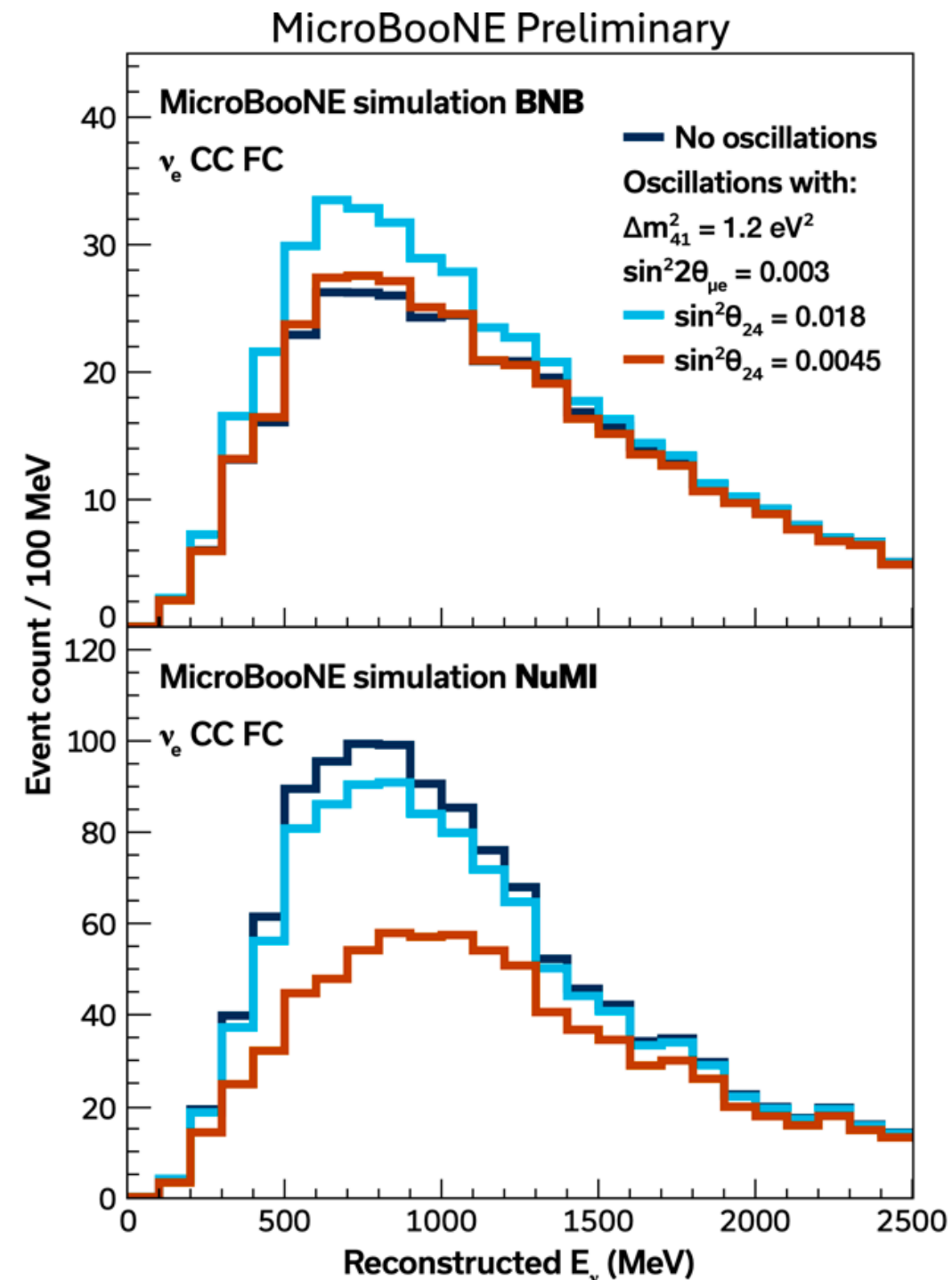
$$= N_{\text{intrinsic } \nu_e} \cdot \left[1 + (R_{\nu_\mu/\nu_e} \cdot \sin^2 \theta_{24} - 1) \cdot \sin^2 2\theta_{14} \cdot \sin^2 \Delta_{41} \right]$$

- Impact on NuMI ν_e spectrum is large due to the different $\frac{N_{\nu_\mu}}{N_{\nu_e}} \sim 25$

- NuMI beam allows us to break the degeneracy



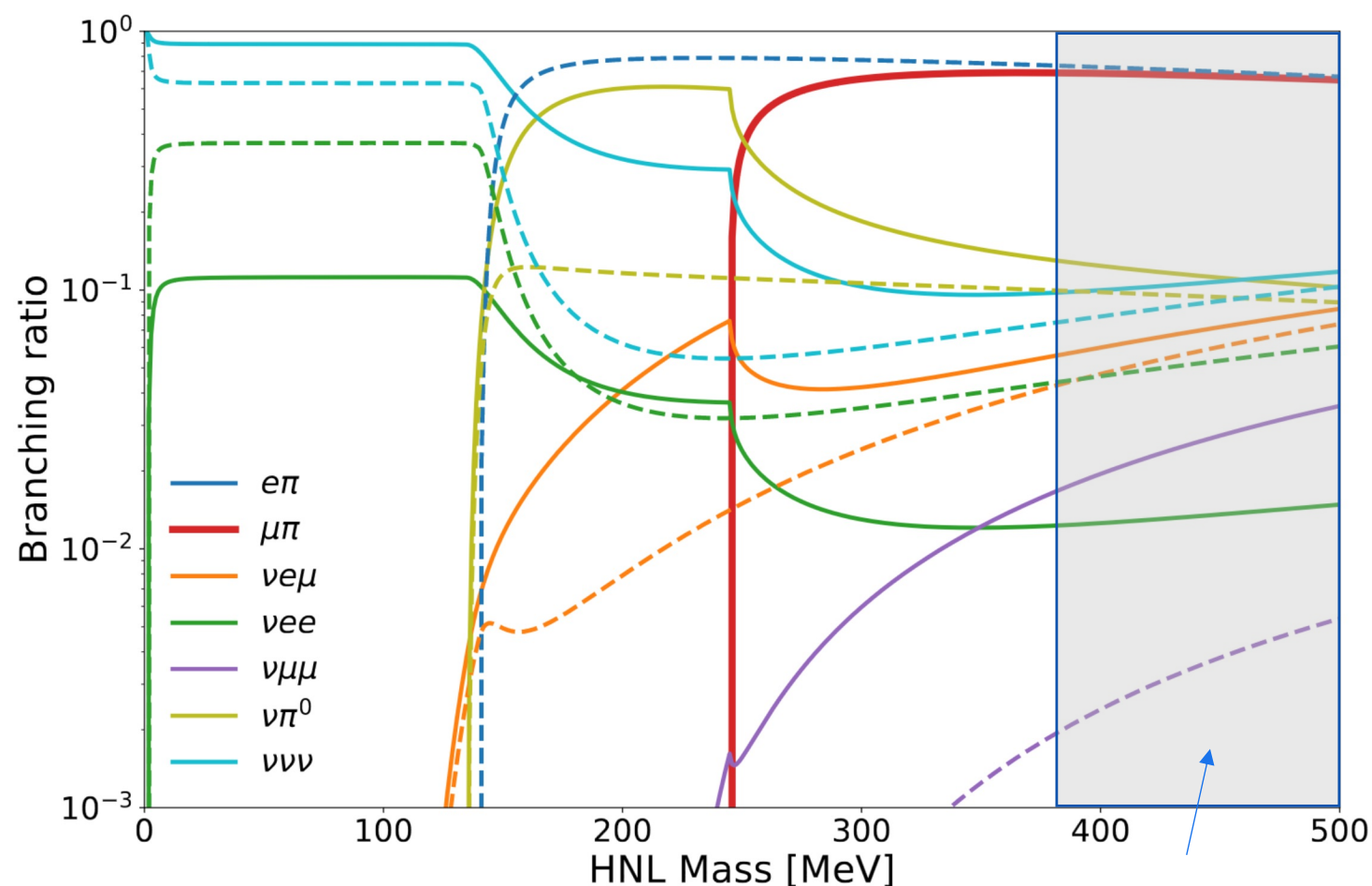
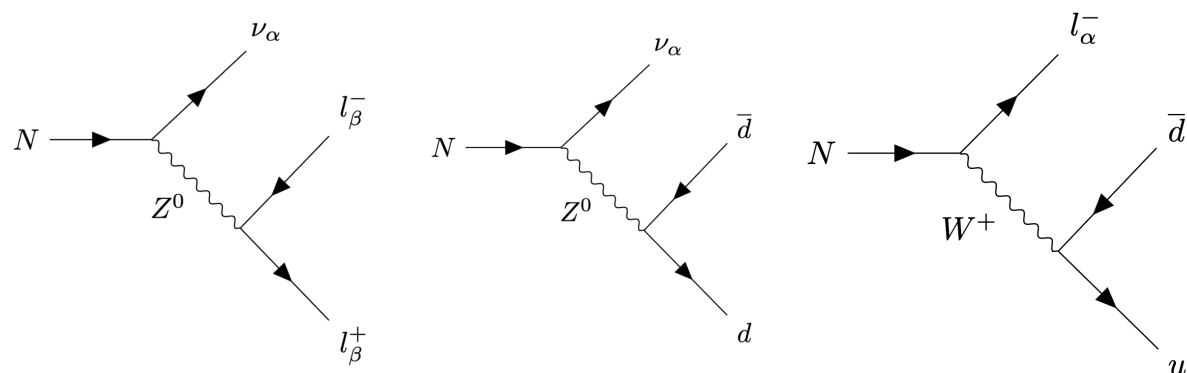
Updated NuMI flux at
MicroBooNE
[MICROBOONE-
NOTE-1129-PUB](#)



Heavy Neutral Leptons (HNLs)

- Kinematic upper bound of ~ 390 MeV to the HNL masses we can probe at uBooNE
- Dominant visible states below this are:

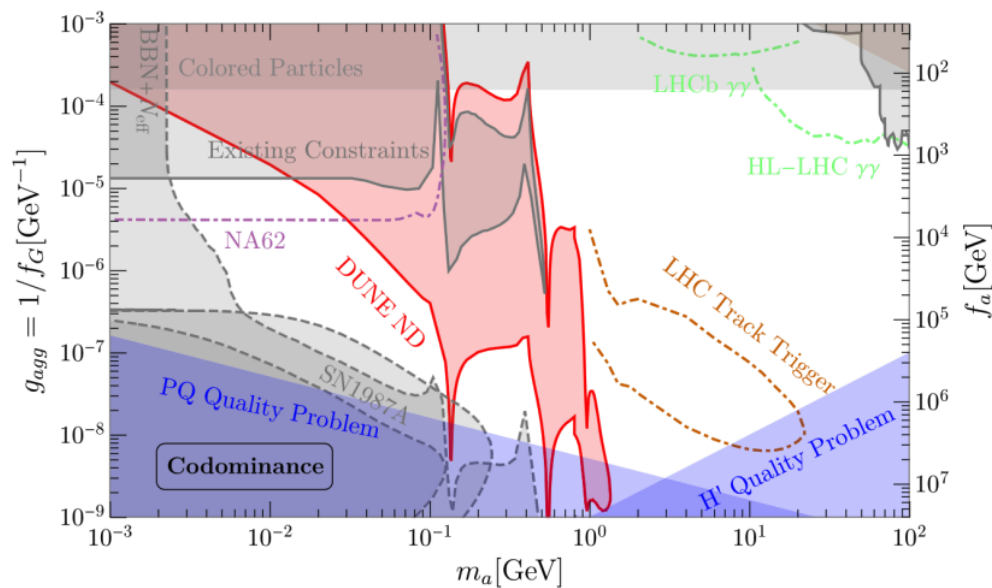
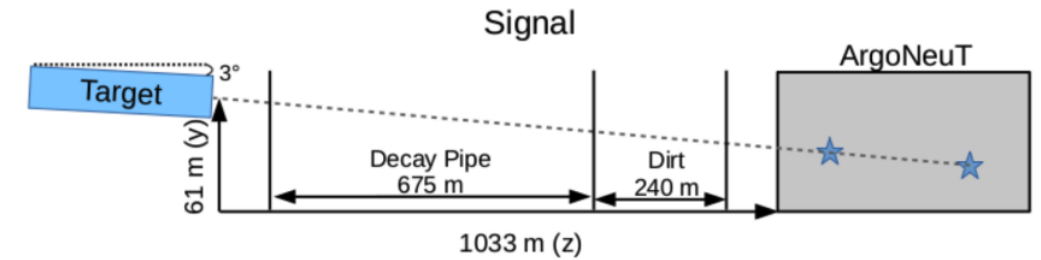
- e^+e^- , $m_N < m_{\pi^0}$
- π^0 , $m_{\pi^0} < m_N < m_{\pi\mu}$
- $\mu\pi$, $m_N > m_{\pi\mu}$



Ongoing BSM searches

Millicharged particles

- Particles with a **fraction of electric charge**
- **Scatter off atomic electrons** and cause “blips” of ionisation in LAr
- Leverages MeV-scale reconstruction



Heavy QCD Axions

- Axions produced via **mixing with neutral mesons**
- Decay to **di-photon pairs** in MicroBooNE

MicroBooNE Collaboration

August 2025

Argonne National Laboratory: Z. Djurcic, A. Rafique
University of Bern, Switzerland: R. Diurba, S. Mulleriababu, M. Weber
Brookhaven: M. Bishai, J. Calcutt, W. Gu, J.H. Jo, M. Kirby, Y. Li, S. Martynenko, N. Nayak, X. Qian, V. Radeka, D. Torbunov, B. Viren, H. Yu, C. Zhang
University of California, Santa Barbara: S. Brickner, D. Caratelli, C. Fang, F. Gao, X. Luo, L. Nguyen, C. Sauer
University of Cambridge: S. Dennis, P. Detje, M. Handley, K. Wresilo
University of Chicago: A. Bhat, A. Ereditato (joint with FNAL), B.T. Fleming, D. Franco, D.W. Schmitz, A. White
CIEMAT: J. Crespo
University of Cincinnati: R.A. Johnson
Colorado State University: D. Carber, M. Mooney, D. Totani
Columbia University: L. Camilleri, S. Chung, D. Kalra, L. Hagaman, G. Karagiorgi, K. Kumar, N. Oza, M. Ross-Lonergan, W. Seligman, M. Shaevitz
University of Edinburgh: C. Batchelor, M. Nebot-Guinot, H. Parkinson, A.M. Szelc, W. Wang
Fermilab: V. Basque, M. Bhattacharya, F. Cavanna, G. Cerati, M. Del Tutto, A. Ereditato (joint with Chicago), S. Gardiner, H. Greenlee, C. James, W. Ketchum, T. Kobilarcik, J. Li, L. Liu, C. Moore, O. Palamara, Z. Pavlovic, J.L. Raaf, A. Schukraft, R. Sharankova, E. Snider, M. Stancari, J. St. John, T. Strauss, M. Toups*, S. Wolbers, G.P. Zeller, J. Zennamo
University of Granada: D. Gamez
Illinois Institute of Technology: D. Andrade Aldana, O. Rodriguez, B. Littlejohn, M. G. Manuel Alves
Imperial College London: A. Hergenhan, A. Navrer-Agasson, S. Söldner-Rembold, M. Uchida
Indiana University: A. Binau, A. Johnson, A. Kelly, F. Martinez Lopez, B. McConnell T. Mohayai
Kansas State University: T. Bolton, G. Horton-Smith, A. Hussain, N. Majeed, J. Tyler
University of Kansas: M. B. Brunetti
Lancaster University: A. Blake, I. Mawby, J. Nowak, N. Patel, I. Pophale
Los Alamos: V. Bhelande, W Foreman, S. Gollapinni, W.C. Louis, A. Papadopoulou, L. Silva, E. Yandel
Louisiana State University: J. Mendez, H. Wei
University of Manchester: J. Bateman, J. Burrige, J.J. Evans*, E. Gramellini, R. Guenette, N. Lane, M. Moudgalya, C. Thorpe, A. Trettin
MIT-HEP: J.M. Conrad, J. Micallef (joint with Tufts)
MIT-NP: O. Hen
Michigan State University: S. Berkman, S. Hawkins, L. Mellet, K. Pletcher
University of Michigan, Ann Arbor: B. Bogart, J. Spitz
University of Minnesota: J. Barrow, A. Furmanski, K. Hildebrandt, B. Irwin, N. Pallat
Nankai University: X. Ji, , S. Liu, S. Zhai
New Mexico State University: V. Papavassiliou, S.F. Pate, L. Ren
University of Notre Dame: L. Yates
University of Oxford: A. Bamard, G. Barr, D. Barrow, K. Duffy, P. Green
University of Pittsburgh: L. Cooper-Troendle, S. Dytman, M. Ismail, D. Naples, V. Paolone, W. Wu
Queen Mary University of London: N. McConkey
Rutgers: P. Englezos, K. Lin, A. Mastbaum, C. Nguyen
SLAC: Y. Chen, M. Convery, K. Terao, Y-T. Tsai, T. Usher
South Dakota School of Mines & Technology : B. Behera, D. Martinez, J. Rodriguez Rondon,
University of Southern Maine: B. Eberly
Tel Aviv University: A. Ashkenazi, A. Gruber, L. Ralte
University of Texas at Arlington: J. Asaadi
Tufts University: P. Abratenko, O. Alterkait, V. DaSilva, Z. Imani, , J. Micallef (joint with MIT), M. Rosenberg, T. Wongjirad
Virginia Tech: C. Mariani
University of Warwick: A. Chappell, R. Cross, J. Marshall

185 collaborators

41 institutions

42 postdocs

52 grad students

(33% international students)

note: also includes Masters, post-bacc

*spokespeople



MicroBooNE papers

2025

2024

2023

2022

2021

2020

2019

2018

2017

2016



μBooNE

- Measurement of single charged pion production in charged-current ν_μ -Ar interactions with the MicroBooNE detector
- Measurement of charged-current muon neutrino-argon interactions without pions in the final state using the MicroBooNE detector
- First study of neutrino angle reconstruction using quasielastic-like interactions in MicroBooNE
- First measurement of ν_μ and $\bar{\nu}_\mu$ charged current single charged pion production differential cross sections on argon using the MicroBooNE detector
- First Measurement of Charged Current Muon Neutrino-Induced K^+ Production on Argon using the MicroBooNE Detector
- First Search for Dark Sector e^+e^- Explanations of the MiniBooNE Anomaly at MicroBooNE

Inclusive Search for Anomalous Single-Photon Production in MicroBooNE
 First Search for Neutral Current Coherent Single-Photon Production in MicroBooNE
 Enhanced Search for Neutral Current Δ Radiative Single-Photon Production in MicroBooNE
 Search for the production of Higgs-portal scalar bosons in the NuMI beam using the MicroBooNE detector
 Search for an Anomalous Production of Charged-Current ν_e Interactions Without Visible Pions Across Multiple Kinematic Observables in MicroBooNE
 Data-driven model validation for neutrino-nucleus cross section measurements
 Demonstration of new MeV-scale capabilities in large neutrino LArTPCs using ambient radiogenic and cosmogenic activity in MicroBooNE

Demonstration of neutron identification in neutrino interactions in the MicroBooNE liquid argon time projection chamber
Improving neutrino energy estimation of charged-current interaction events with recurrent neural networks in MicroBooNE
First double-differential cross section measurement of neutral-current π^0 production in neutrino-argon scattering in the MicroBooNE detector
Measurement of the differential cross section for neutral pion production in charged-current muon neutrino interactions on argon with the MicroBooNE detector
Measurement of double-differential cross sections for mesonless charged-current muon neutrino interactions on argon with final-state protons using the MicroBooNE detector
First Simultaneous Measurement of Differential Muon-Neutrino Charged-Current Cross Sections on Argon for Final States with and Without Protons Using MicroBooNE Data
Inclusive cross section measurements in final states with and without protons for charged-current ν_μ -Ar scattering in MicroBooNE

Search for Heavy Neutral Leptons in Electron-Positron and Neutral-Pion Final States with the MicroBooNE Detector

First Measurement of η Meson Production in Neutrino Interactions on Argon with MicroBooNE
 First demonstration of O(1 ns) timing resolution in the MicroBooNE liquid argon time projection chamber
 Multifidirectional cross section measurements of ν_μ -argon quasielasticlike reactions with the MicroBooNE detector
 First Double-Differential Measurement of Kinematic Imbalance in Neutrino Interactions with the MicroBooNE Detector
 First Measurement of Quasielastic A Baryon Production in Muon Antineutrino Interactions in the MicroBooNE Detector
 First Measurement of Differential Cross Sections for Muon Neutrino Charged Current Interactions on Argon with a Two-proton Final State in the MicroBooNE Detector
 First Constraints on Light Sterile Neutrino Oscillations from Combined Appearance and Disappearance Searches with the MicroBooNE Detector
 Search for long-lived heavy neutral leptons and Higgs portal scalars decaying in the MicroBooNE detector
 Differential Cross Section Measurement of Charged Current ν_μ Interactions Without Pions in MicroBooNE
 Measurement of neutral current single π^0 production on argon with the MicroBooNE detector

Observation of radon mitigation in MicroBooNE by a liquid argon filtration system

Novel approach for evaluating detector-related uncertainties in a LA-TPC using MicroBooNE data

Search for an Excess of Electron Neutrino Interactions in MicroBooNE using Multiple Final-State Topologies

Wire-cell 3D pattern recognition techniques for neutrino event reconstruction in large LA-TPCs: algorithm description and quantitative evaluation with MicroBooNE simulation

Search for an anomalous excess of inclusive charged-current ν_e interactions in the MicroBooNE experiment using Wire-Cell reconstruction

New CC or CBHE model tune for MicroBooNE

Search for an anomalous excess of charged-current quasielastic ν_e interactions with the MicroBooNE experiment using Deep-Learning-based reconstruction

Search for ν_e $\rightarrow$ ν_μ oscillations in ν_e interactions with pions in the first data set of the MicroBooNE experiment

First Measurement of Energy-Dependent Inclusive Muon Neutrino Charged-Current Cross Sections on Argon with the MicroBooNE Detector

First anisotropic Shower Reconstruction and Energy Validation with MicroBooNE and π^0 Samples from the Deep-Learning-Based Analysis on Argon

Search for Neutrino-Induced Neutral Current β -Radiative Decay in MicroBooNE, and a First Test of the MicroBooNE Low Energy Process under a Single-Photon Hypothesis

First measurement of inclusive electron-neutrino and antineutrino charged current differential cross sections in charged lepton energy on argon in MicroBooNE

Calorimetric classification of track-like signatures in liquid argon TPCs using MicroBooNE data

Search for a Higgs Pseudo Scalar Decaying to Electron-Positron Pairs in the MicroBooNE Detector

Measurement of the longitudinal diffusion coefficient of ionization electrons in the MicroResist detector

Measurement of the fluence-averaged inclusive charged-current electron neutrino and antineutrino cross section on argon using the hNuR beam and the MicroResist detector

Measurement of the atmospheric muon rate with the MicroResist liquid argon TPC

Measurement of differential cross sections for $\nu\mu$ -charged current interactions with protons and/or pions in the first side wall with the MicroResist detector

The continuous real-time view of the MicroResist liquid argon time projection chamber for detection of supernova burst neutrinos

Supernova signal charge effects in the MicroResist LArTPC using cosmic muons

Super-resolution analysis with Sparse Convolutional Neural Network for Event Discrimination in MicroResist

Covariant Kernel Network for Multiple Pions Identification in the MicroResist Liquid Argon Time Projection Chamber

Event-Level Selection in the MicroResist Liquid Argon Time Projection Chamber using Wto $K^0 S$ Mixing, Clustering and Charge Light Matching

Real-Time Background Rejection with Wto $K^0 LArTPC$ Event Reconstruction in MicroResist

Beam Characterization for the MicroResist Liquid Argon Time Projection Chamber Using eMuR Beam

A New Approach of Detector Current Correction Based on the Angular Distribution of Neutrons in the MicroResist Detector

Abstract: We have developed a new algorithm for the detection of signal transduction events in the Ras/Mitf-1 pathway. The algorithm is based on the analysis of the time course of the expression of the genes involved in the pathway. The algorithm is able to detect the activation of the pathway in the presence of a signal. The algorithm is able to detect the activation of the pathway in the presence of a signal. The algorithm is able to detect the activation of the pathway in the presence of a signal.

Background: Various background fields influence charged ion transport through ionotropic membranes, studied in the liquid-phase MFC, a case study with the Woodhill-III desalter.
 Summary: Model of a $2 \times 2 \times 2$ charge distribution in production as an input with the Woodhill-III desalter.
 They used an output to plot local electrostatic potential distribution in the Woodhill-III liquid-phase ion-exchange membrane.
 They used the $2 \times 2 \times 2$ results by distributions obtained by Woodhill-III as a 1000 model in order to

[illegible]

The Fourier well-disposition approach to automated pattern-recognition of events in wave and radar returns is the Waveform (WF) detector. Measurement of events in nonstationary returns is the Waveform (WF) using a small selected events set method.

Visit www.pearsoncmg.com for more information on this and other products.

2016

Downloaded from <http://ml.oxfordjournals.org/> by University of California, San Diego on 06/11/15. See the Terms and Conditions (<http://ml.oxfordjournals.org/page/termsandconditions>) on Oxford Journals Online for rules of use; OA articles are governed by the applicable Creative Commons License

82 papers