

# INTERSECTIONS - CIPANP 2025



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## Neutrino Masses, Mixing, and Interactions

15<sup>th</sup> Conference on Intersections of Particle and Nuclear Physics  
(CIPANP 2025)

13 June 2025

INDIANA UNIVERSITY

# Thanks to All Neutrino Speakers

- ~50 talks
- 4 plenary talks
- 8 dedicated parallel sessions
- 3 tagged joint sessions

Results from SNO+	Logan Lebanowski
Great Hall	15:30 - 15:53
Recent Results from KamLAND-Zen and Future Prospects	Ömer Penek
Great Hall	15:53 - 16:16
Results from LEGEND-200 and Prospects for LEGEND-1000	CJ Barton
Great Hall	16:16 - 16:39
Results from CUORE and Progress towards CUPID	Vivek Sharma
Great Hall	16:39 - 17:02
Development of Selena	Alvaro Chavarria
Great Hall	13:30 - 13:53
Search for Neutrinoless Double Beta decay and tests of fundamental physics with the MAJORANA DEMONSTRATOR	Nafis Fuad
Searching for neutrinoless double decay	
Great Hall	
Status of NEXT100 and future prospects	
Great Hall	
First-principles nuclear theory for new physics searches	
Great Hall	
Ab initio calculations of neutrinoless double beta decay matrix elements	
Great Hall	16:23 - 16:46
Three-nucleon neutrinoless double beta decay potentials and their matrix elements in light nuclei	Graham Chambers-Wall
Flavor swapping and non-forward scattering in the neutrino-driven wind	Michael Cervia
Great Hall	17:09 - 17:32

Recent Results & Future Directions in Long-Baseline Neutrino Oscillations	Zoya Vallari
Great Hall	13:30 - 14:00
Latest Neutrino Oscillation Results from the NOVA Experiment	Andrew Sutton
Great Hall	14:00 - 14:21
Recent Results from the T2K Experiment	Alejandro Ramirez Delgado
Great Hall	
DUNE status and plans for first physics results	
Great Hall	
A Theory Overview of the Short Baseline Program	
Great Hall	
Latest MicroBooNE results	
Great Hall	
Latest Results from the ICARUS Experiment at the Short-Baseline Neutrino Program	Hanno Hallgrímsson
Great Hall	
SBND detector status and first results	
Great Hall	
The Accelerator Neutrino Neutron Interaction Experiment (ANNIE)	
Great Hall	
On the road to a broad program of neutrino physics with Theta	
Great Hall	
JUNO Status and Prospects	
Great Hall	16:46 - 17:09
Decoherence in neutrino oscillation	Ting Cheng
Great Hall	
Testing New Physics at CEvNS Experiments	Ian Shoemaker
Great Hall	19:00 - 19:23
Status and latest results from CONNIE with a skipper-CCD detector	Brenda Aurea Cervantes Vergara
Great Hall	19:23 - 19:46
Status of the Scintillating Bubble Chamber Liquid Argon 10 kg (SBC-LAr10) Detector, and Future Neutrino Physics Prospects	Gray Putnam
Search for Coherent Elastic Neutrino-Nucleus Scattering with the Ricochet Experiment	Emanuela Celli
Great Hall	20:09 - 20:32
Search for new physics on MINER using cryogenic and non-cryogenic detectors	SHARADA SAHOO
Great Hall	14:00 - 14:23
COHERENT Results and Status	Tulasi Subedi
Great Hall	14:23 - 14:46
Dark Sector Searches with Coherent CAPTAIN Mills	Austin Schneider
Great Hall	14:46 - 15:09
Quasielastic Lepton-Nucleus Scattering and the Correlated Fermi Gas Model	Gil Paz
Great Hall	15:09 - 15:32
Status of the Project 8 Neutrino Mass Experiment	Hannah Binney
Great Hall	14:00 - 14:23
Probing the Neutrino Mass with PTOLEMY	Andi Tan
Great Hall	14:23 - 14:46
The BEST Experiment	Steve Elliott
Great Hall	14:46 - 15:09



Four known unknown in particle physics: all neutrinos

Atmospheric mass ordering

$\theta_{23}$  octant

Complex phase

Absolute mass scale

Cosmology, scattering,  $0\nu\beta\beta$ , ...

## Parallel 1 (Monday afternoon)

<b>Recent Results &amp; Future Directions in Long-Baseline Neutrino Oscillations</b>	Zoya Vallari 
Great Hall	13:30 - 14:00
<b>Latest Neutrino Oscillation Results from the NOvA Experiment</b>	Andrew Sutton 
Great Hall	14:00 - 14:21
<b>Recent Results from the T2K Experiment</b>	Alejandro Ramirez Delgado 
Great Hall	14:21 - 14:42
<b>DUNE status and plans for first physics results</b>	Jaesung Kim 
Great Hall	14:42 - 15:03

## Parallel 4 (Tuesday afternoon)

<b>The Accelerator Neutrino Neutron Interaction Experiment (ANNIE)</b>	Dr Jingbo Wang 
Great Hall	16:00 - 16:23
<b>On the road to a broad program of neutrino physics with Theia</b>	Logan Lebanowski 
Great Hall	16:23 - 16:46
<b>JUNO Status and Prospects</b>	Roberto Mandujano 
Great Hall	16:46 - 17:09
<b>Decoherence in neutrino oscillation</b>	Ting Cheng 
Great Hall	17:09 - 17:32

## Parallel 9 (Tuesday evening)

<b>Latest Results from Super-Kamiokande</b>	Ed Kearns 
Great Hall	19:20 - 19:40

## Plenary 7 (Thursday morning)

<b>Modern Neutrino Oscillation Theory</b>	Peter Denton 
	08:20 - 08:50

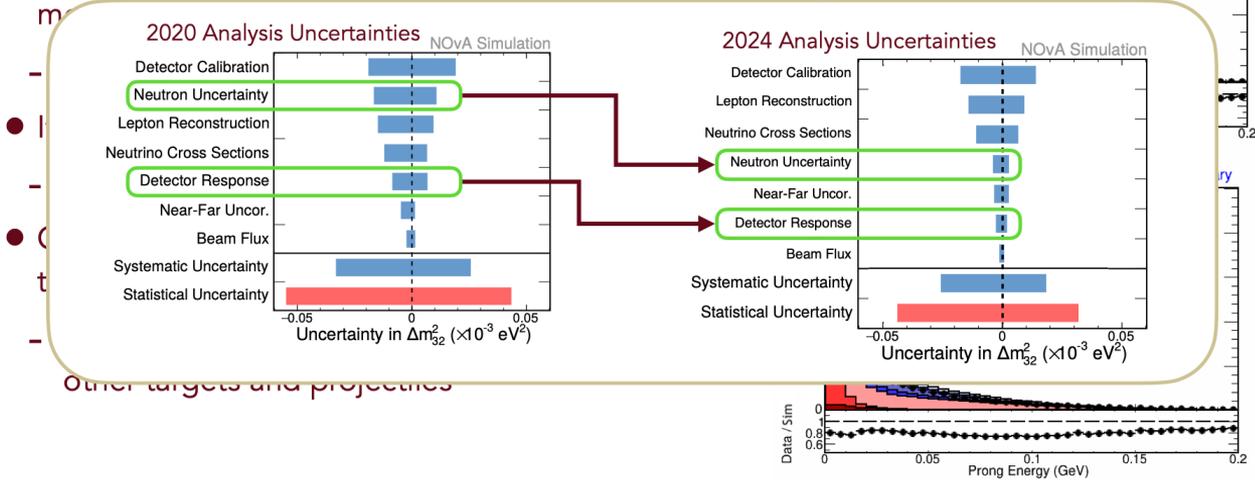


# NOvA – Andrew Sutton

x2 neutrino-mode statistics  
Most precise  $\Delta m_{32}^2$

## Comparing to data

• MENATE reduces the over-simulation in the



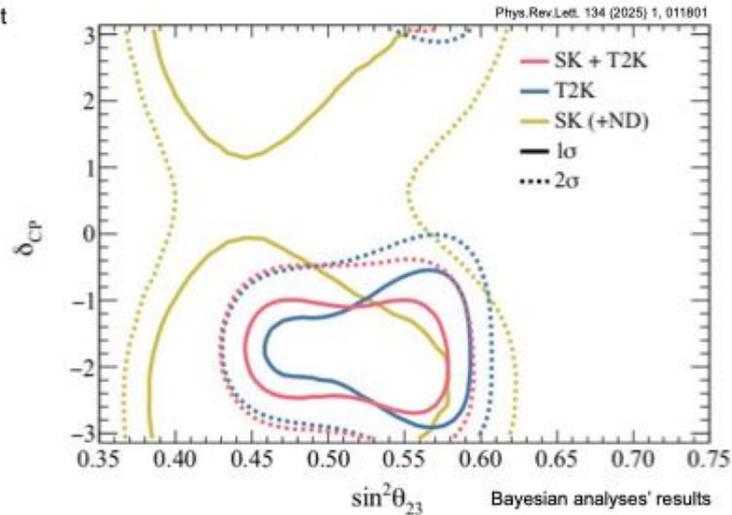
# T2K – Alejandro Ramírez Delgado



## T2K-SK joint analysis

- T2K and SK prefer different octant for  $\theta_{23}$ . Joint fit has a (weaker) preference for maximum mixing.
- Better constraint of  $\delta_{CP}$ .
- CP conserving values excluded at  $\sim 2\sigma$ .

+ ND280 upgrade  
Measurement of  $\nu_e\text{CCN}\pi^+$   
and  $\nu\text{NC}1\pi^+$



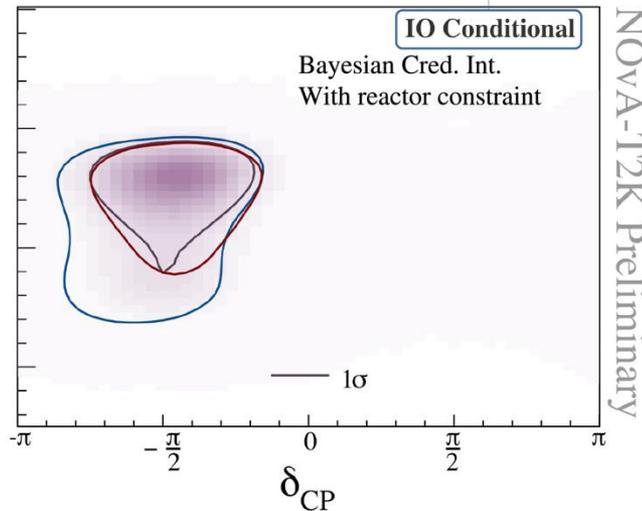
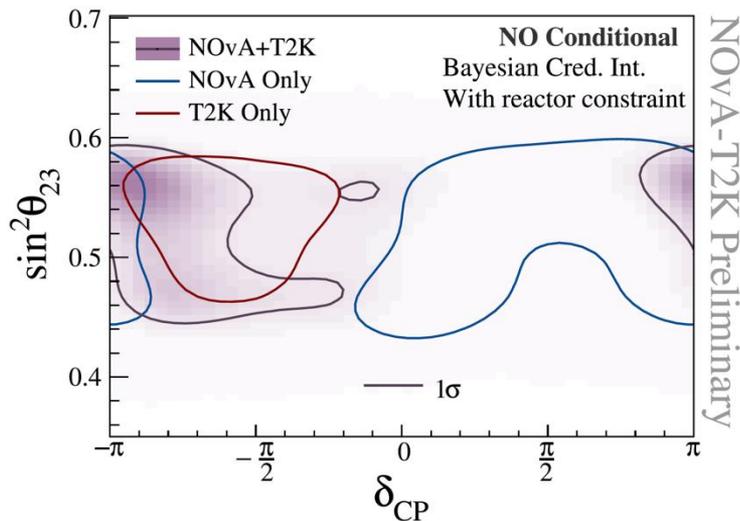
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Alejandro Ramírez



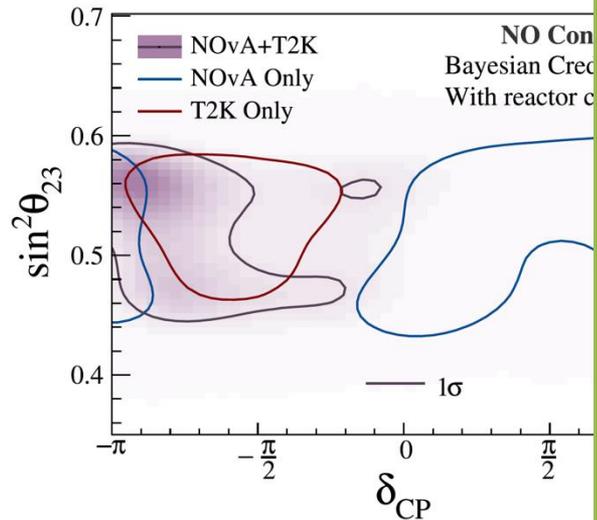
# Overview – Zoya Vallari

- Joint NOvA + T2K fit
  - Individual experiments prefer normal ordering
  - Joint fit mild preference for inverted ordering



# Overview – Zoya Vallari, Peter Denton

- Joint NOvA + T2K fit
  - Individual experiments prefer normal ordering
  - Joint fit mild preference



## Mass ordering current status: oscillations

1. NOvA and T2K both prefer **NO** over **IO**
2. NOvA+T2K prefers **IO** over **NO**
3. SK still prefers **NO** over **IO** – statistics complicated
4. NOvA+T2K+SK still prefers **NO** over **IO**
5. + Daya Bay & RENO  $\Rightarrow$  slight preference **NO**
6. = no significant preference either way; with SK  $\sim 2\sigma$

PBD, J. Gehrlein, R. Pestes [2008.01110](#)  
K. Kelly, et al. [2007.08526](#)  
I. Esteban, et al. [2007.14792](#)  
F. Capozzi, et al. [2107.00632](#)  
P. de Salas, et al. [2006.11237](#)  
I. Esteban, et al. [2410.05380](#)

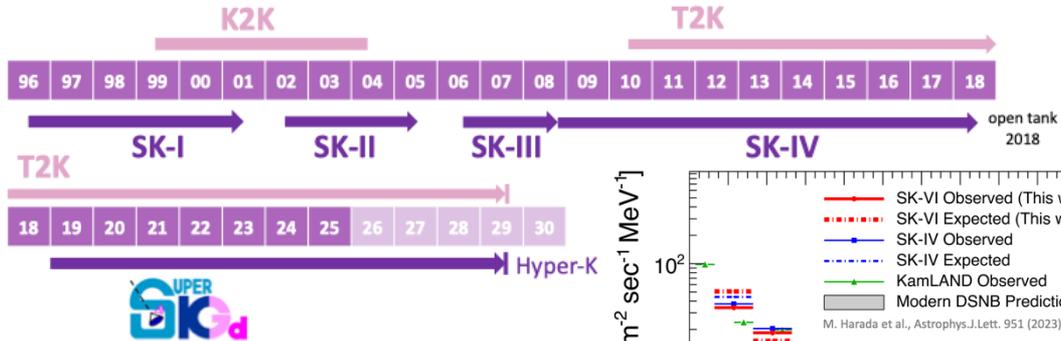
Peter B. Denton (BNL)

University of Wisconsin Madison: June 12, 2025 8/34

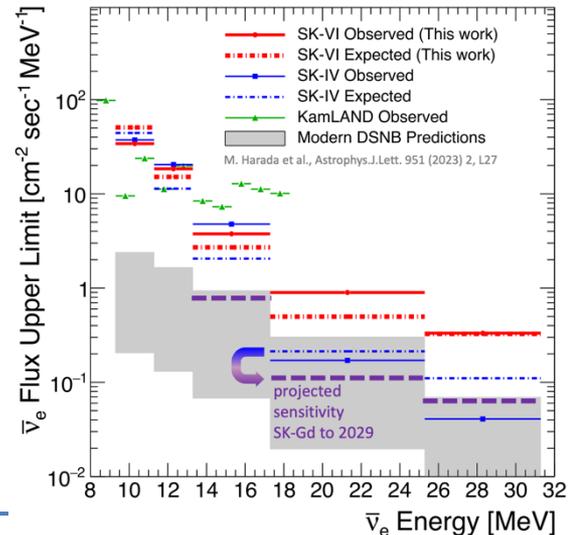


# Super-Kamiokande – Ed Kearns

## Super-Kamiokande Experimental Phases



	SK-Gd (gadolinium enhanced neutron capture)		$\epsilon_{capture}$
2019	SK-V	still pure water	25%
2020	SK-VI	0.011% Gd	50%
2022	SK-VII	0.033% Gd	75%
2024	SK-VIII	0.033% Gd after recovery of magnetic coil issue	75%



# New Experiments – Zoya, Roberto Mandujano

 **Hyper-Kamiokande**



June 09, 2025

Zoya Vallari, OSU

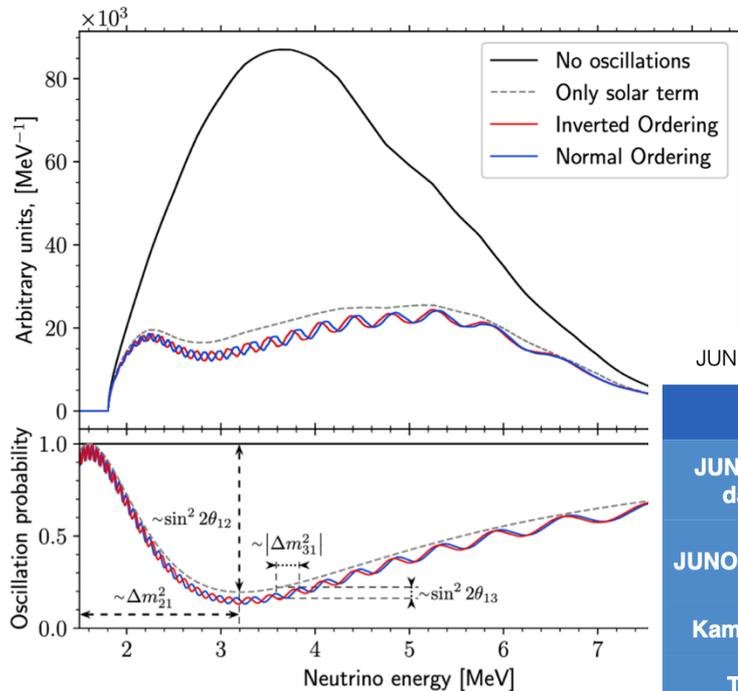
 **DEEP UNDERGROUND  
NEUTRINO EXPERIMENT**



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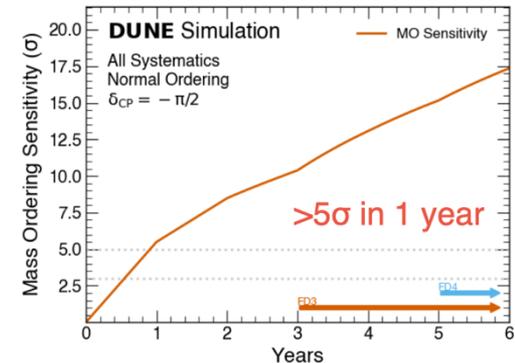
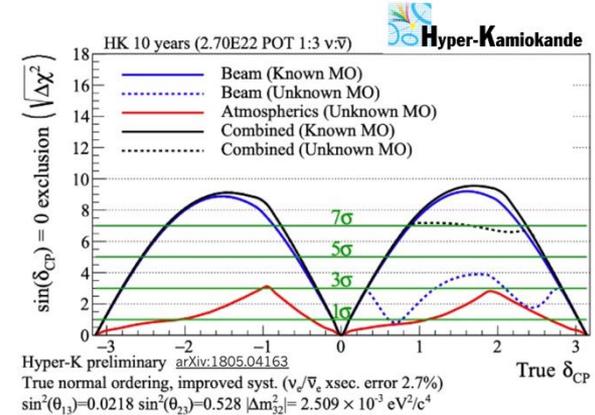


# New Sensitivity – Zoya, Roberto, Jaesung Kim



JUNO Relative Uncertainty vs. Current Precision

	$\Delta m_{21}^2$	$\Delta m_{31}^2$	$\sin^2\theta_{12}$	$\sin^2\theta_{13}$
<b>JUNO 100 days</b>	0.8%	1%	1.9%	47.9%
<b>JUNO 6 years</b>	0.3%	0.2%	0.5%	12.1%
<b>KamLAND</b>	2.4%	-	-	-
<b>T2K</b>	-	2.6%	-	-
<b>SNO+SK</b>	-	-	4.5%	-
<b>Daya Bay</b>	-	-	-	3.4%



# Detector Ideas – Jingbo Wang, Logan

Lebanowski

## Technology demonstrators

### • BNL: optics + engineering demonstrator (30 ton)

- Ton-scale production
- Optical transparency in an operating detector
- Optical stability over time
- Recirculation of WbLS (nanofiltration)



### • LBNL: performance demonstrator (EoS)

- Full event reconstruction in (Wb)LS
- Performance dependence on %LS, PMT properties
- Particle ID
- Background studies



### • Boulby: **BUTTON**

- Underground demonstration
- Low background purification
- Potential for scale-up

### Delaware: **NUDOT**

- Isotope doping, quantum dots
- Fast photosensors & readout

### FNAL: **ANNIE** See [talk by Jingbo Wang](#)

- Beam deployment with LAPPDs
- High-energy neutrino event reconstruction
- Potential for Phase III (fun WbLS fill)

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## Parallel 4 (Tuesday afternoon)

<b>A Theory Overview of the Short Baseline Program</b>	<i>Matheus Hostert</i> 
<i>Great Hall</i>	15:30 - 16:00
<b>Latest MicroBooNE results</b>	<i>Christian Nguyen</i> 
<i>Great Hall</i>	16:00 - 16:21
<b>Latest Results from the ICARUS Experiment at the Short-Baseline Neutrino Program</b>	<i>Harry Hausner</i> 
<i>Great Hall</i>	16:21 - 16:42
<b>SBND detector status and first results</b>	<i>Sungbin Oh</i> 
<i>Great Hall</i>	16:42 - 17:03

## Plenary 4 (Tuesday morning)

<b>Status Report on Short-Baseline Anomalies in Neutrino Physics</b>	<i>Prof. Bryce Littlejohn</i> 
	10:30 - 11:00
<b>Recent Results from Phase-III of the BeEST Experiment</b>	<i>Kyle Leach</i> 
	11:00 - 11:30

## Parallel 5 (Wednesday afternoon)

<b>The BEST Experiment</b>	<i>Steve Elliott</i> 
<i>Great Hall</i>	14:46 - 15:09

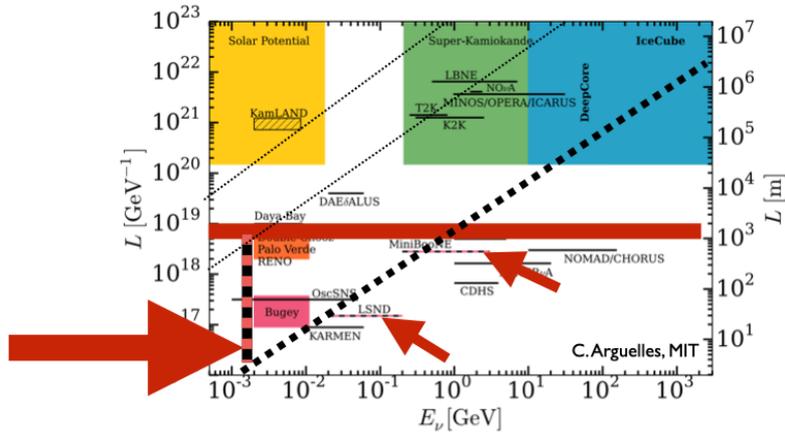
## Plenary 7 (Thursday morning)

<b>Modern Neutrino Oscillation Theory</b>	<i>Peter Denton</i> 
	08:20 - 08:50



# Overview – Bryce Littlejohn

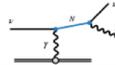
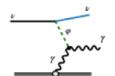
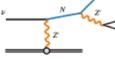
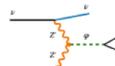
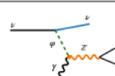
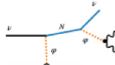
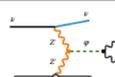
## A Low-Energy Neutrino Anomaly



$$P(\nu_a \rightarrow \nu_b) = \sin^2 2\theta \sin^2 \left[ 1.27 \Delta m^2 (eV^2) \frac{L(km)}{E_\nu (GeV)} \right]$$

# Overview – Matheus Hostert

A.M. Abdullahi, J. Hoefken Zink, M. Hostert, D. Massaro, S. Pascoli arXiv:2308.02543

Topology	Model	Diagram	Signal	References
single $\gamma$	neutrino upscattering		$N \rightarrow \nu\gamma$	[74–84]
	neutrino-induced inverse-Primakoff scattering		$\varphi^* A \rightarrow \gamma A$	[84]
$e^+e^-$	neutrino upscattering		$N \rightarrow \nu e^+e^-$ on-shell $N$	[36–44] Section IV
	neutrino-induced bremsstrahlung		$Z' \rightarrow e^+e^-$ off-shell $N$	not studied
	neutrino-induced Primakoff scattering		$\varphi \rightarrow e^+e^-$	[40]
	neutrino-induced inverse-Primakoff scattering		$Z' \rightarrow e^+e^-$	not studied
$\gamma\gamma$	neutrino upscattering		$N \rightarrow \nu\gamma\gamma$	[43]
	neutrino-induced Primakoff scattering		$\varphi \rightarrow \gamma\gamma$	not studied

## Constrained (indirectly)

Not directly searched for, but indirectly targeted by MicroBooNE single photon analyses. Can they explain the excess?

**Direct searches would be very interesting.**

## Constrained (directly)

MicroBooNE's  $e^+e^-$  excludes most of these, but not clear what happens in **scalar mediator** models where the angular distribution is wider.

## Constrained (indirectly)

Anomaly-mediated photon production and similar diagrams. Challenging model-building.

**See recent study:** B. Dutta, A. Karthikeyan, D. Kim, A. Thompson, R. G. Van de Water, arXiv:2504.08071

## Not constrained

We can call these “**pion impostors**”.

Two photons with  $m_{\gamma\gamma} \neq m_{\pi^0}$  and different kinematics. **Messes with the sidebands...**

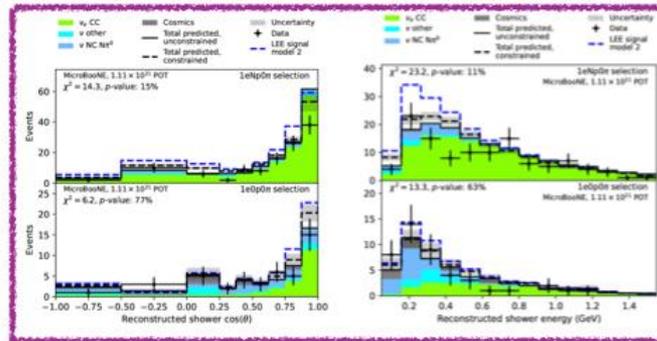
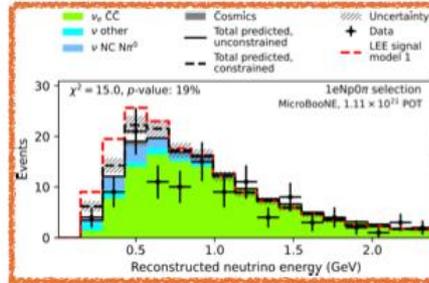


# MicroBooNE – Christian Nguyen

## Search for an Excess of Electron Neutrino Interactions

• [arXiv:2412.14407](https://arxiv.org/abs/2412.14407)

- Data from all five years of operation
- Reject the LEE **Signal Model 1** at  $2.9\sigma$
- Reject the LEE **Signal Model 2** at  $3.7\sigma$  and  $3.8\sigma$
- **MicroBooNE does not see an excess of  $\nu_e$  - Like interactions**



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# SBND, ICARUS – Harry Hausner, Sungbin Oh

## ICARUS Results NuMI Neutrino-Argon Cross Sections

### Short Baseline Neutrino (SBN) Program

Use the same neutrino source with MiniBooNE: Booster Neutrino Beam (BNB) @ Fermilab

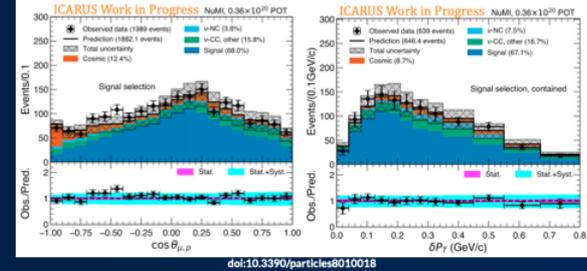
- Liquid argon time projection chamber (LArTPC) detector technology
- Three LArTPCs at different baselines



	Active Mass (ton)	Baseline (m)	Operation
SBND	112	110	2024 -
MicroBooNE	89	470	2015 - 2021
ICARUS	476	600	2021 -

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- Our NuMI data are critical for measuring neutrino-argon cross sections are energies applicable for DUNE
- Work in progress on a  $1\mu\text{Np}0\pi$  cross section result

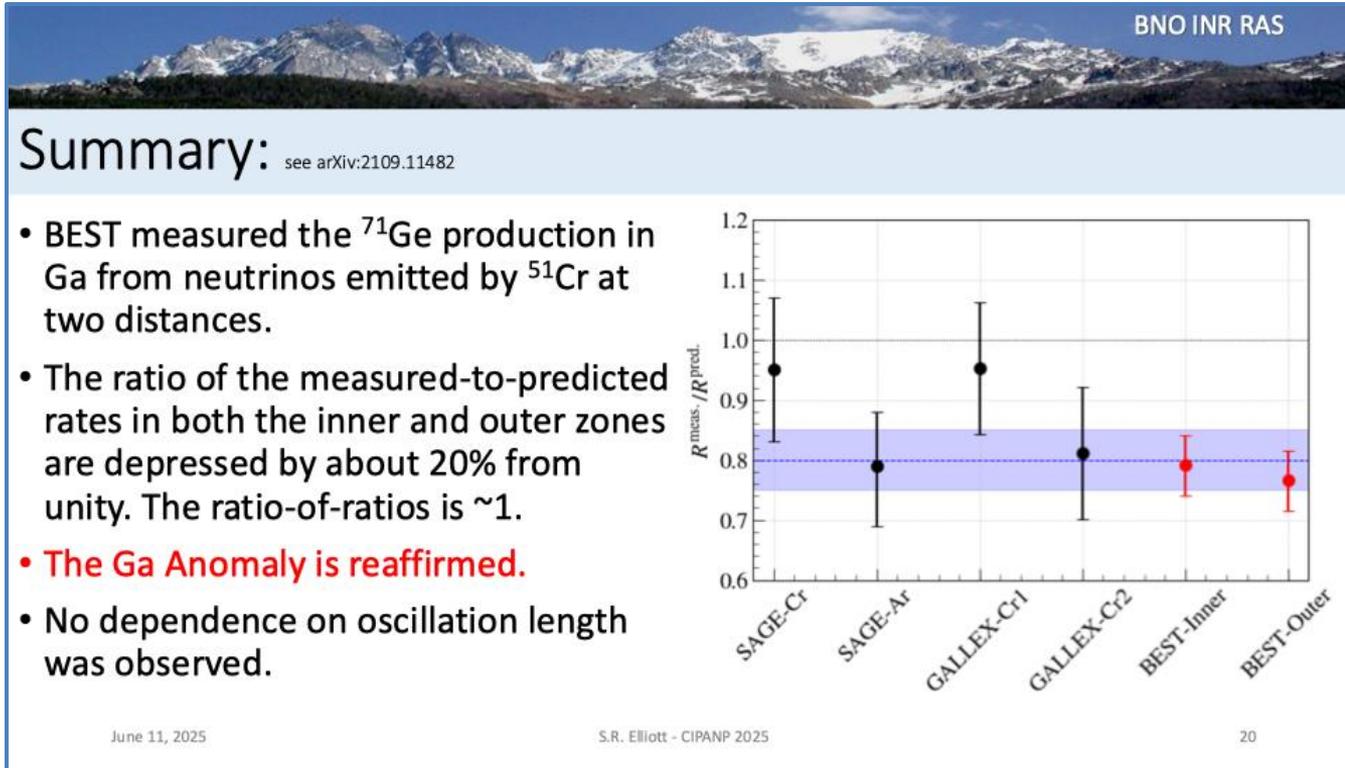
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# BEST – Steve Elliott

This is the lingering anomaly  
Rerun with different source?



## Parallel 2 (Monday afternoon)

<b>Results from SNO+</b>	Logan Lebanowski 
Great Hall	15:30 - 15:53
<b>Recent Results from KamLAND-Zen and Future Prospects</b>	Ömer Penek 
Great Hall	15:53 - 16:16
<b>Results from LEGEND-200 and Prospects for LEGEND-1000</b>	CJ Barton 
Great Hall	16:16 - 16:39
<b>Results from CUORE and Progress towards CUPID</b>	Vivek Sharma
Great Hall	16:39 - 17:02

## Parallel 3 (Tuesday afternoon)

<b>Development of Selena</b>	Alvaro Chavarria 
Great Hall	13:30 - 13:53
<b>Search for Neutrinoless Double Beta decay and tests of fundamental physics with the MAJORANA DEMONSTRATOR</b>	
Nafis Fuad	
<b>Searching for neutrinoless double decay with the nEXO experiment</b>	lin si 
Great Hall	14:16 - 14:39
<b>Status of NEXT100 and future prospects</b>	Enakshi Dey 
Great Hall	14:39 - 15:02

## Parallel 8 (Thursday afternoon)

<b>First-principles nuclear theory for new physics searches</b>	Jason Holt 
Great Hall	16:00 - 16:23
<b>Ab initio calculations of neutrinoless double beta decay matrix elements</b>	Antoine Belley 
Great Hall	16:23 - 16:46
<b>Three-nucleon neutrinoless double beta decay potentials and their matrix elements in light nuclei</b>	
Graham Chambers-Wall	

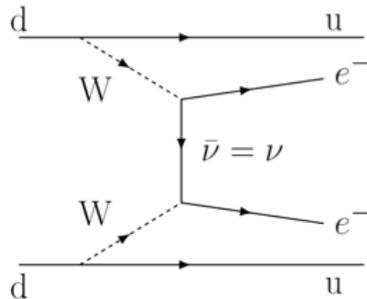
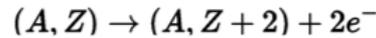


# Neutrinoless Double Beta Decay

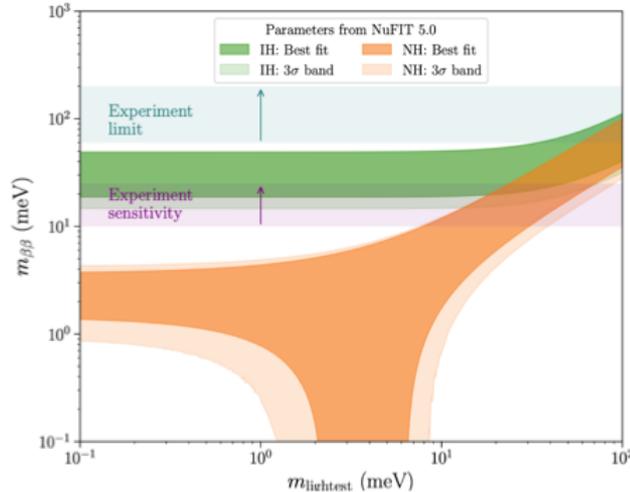
## NEUTRINOLESS DOUBLE BETA DECAY



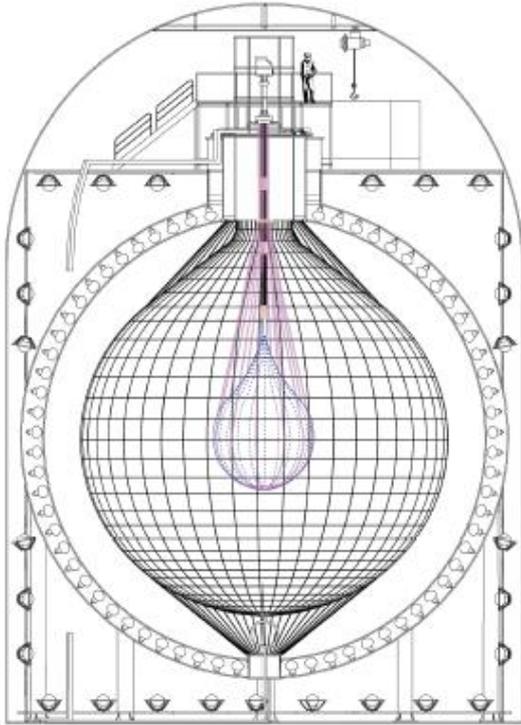
- Beyond Standard Model phenomenon, can occur if neutrinos are Majorana particles
- **Lepton number violating process**
- Potentially impact understanding of origins of matter/anti-matter asymmetry
- Constrains **neutrino mass hierarchy, scale** (model dependent)
- Experimental observable is **decay rate**
- Depends on **effective Majorana mass** ( $m\beta\beta$ )
- Directly related to absolute neutrino mass scale
- Limit on ( $m\beta\beta$ ) can help rule out **Inverted Hierarchy** (model dependent)



Light neutrino exchange model

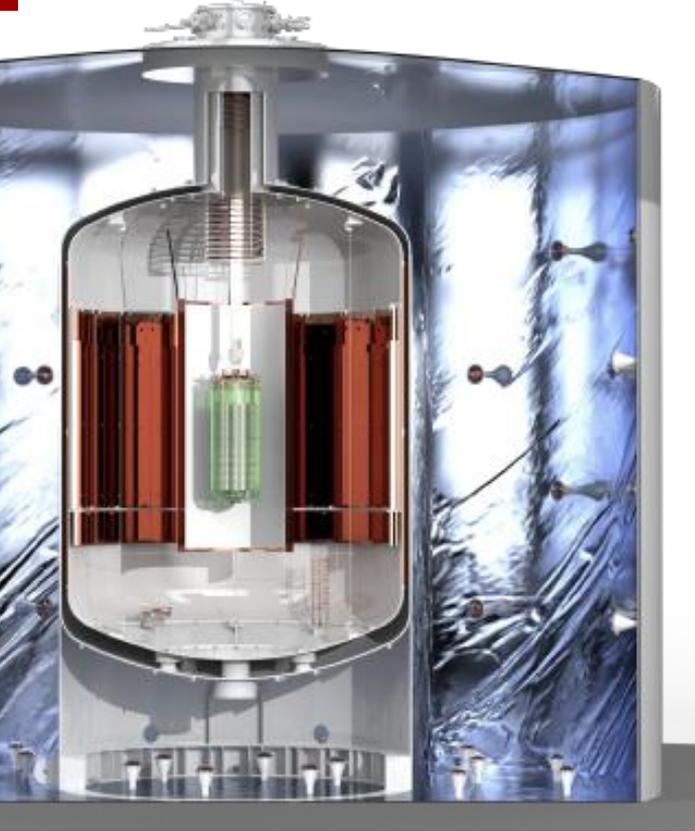


# KamLAND-Zen – Ömer Penek



- Enriched xenon-loaded volume within KamLAND detector
  - Monolithic liquid scintillator
- Most sensitive search,  $T_{1/2} > 3.8 \times 10^{26}$  yr
- Upgrading to KamLAND2-Zen
  - Datataking in 2027

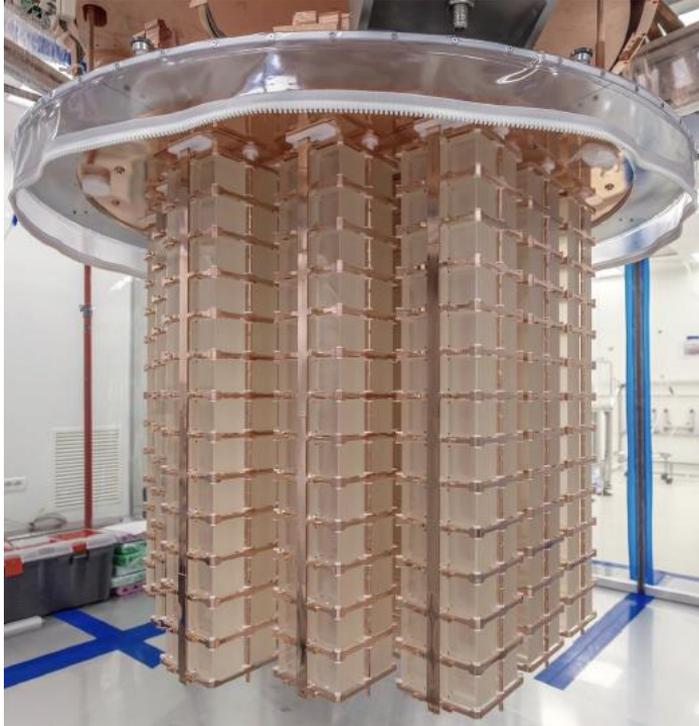
# LEGEND – CJ Barton



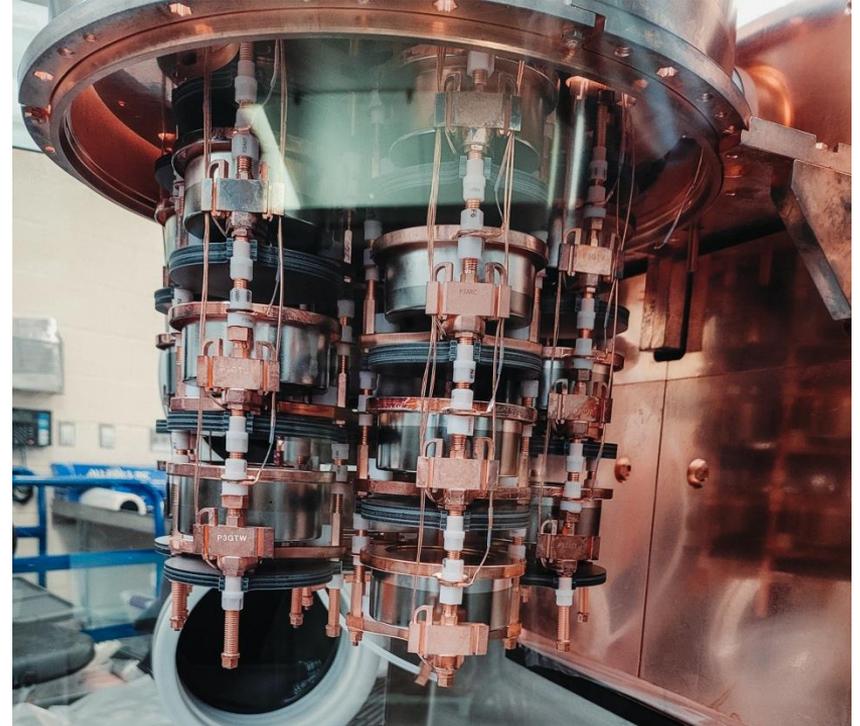
- Array of kg-scale germanium detectors deployed in liquid argon active veto
- Lowest background, highest resolution
  - $T_{1/2} > 1.9 \times 10^{26}$  yr
- Projected sensitivity to  $10^{27}$  yr with full 5-year exposure
- LEGEND-1000 upgrade planned under US tonne-scale program, start in ~2030
  - Full inverted mass ordering sensitivity



# CUORE, MAJORANA – Vivek Sharma, Nafis Fuad



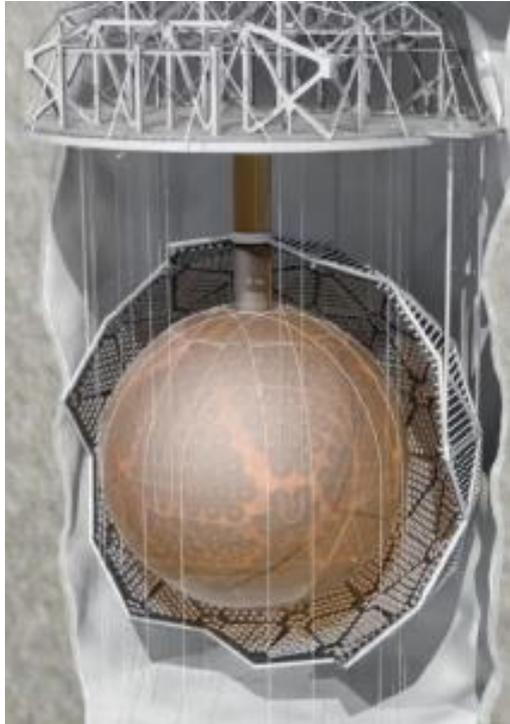
Operating through 2026



Operating special run through 2025



# SNO+, nEXO – Logan Lebanowski, Lin Si



Preparing to load  $\beta\beta$  isotope



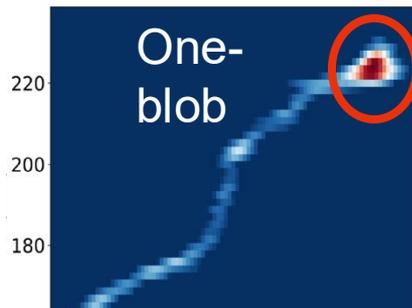
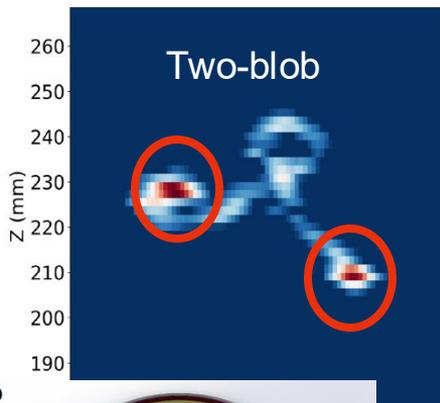
Tonne-scale concept



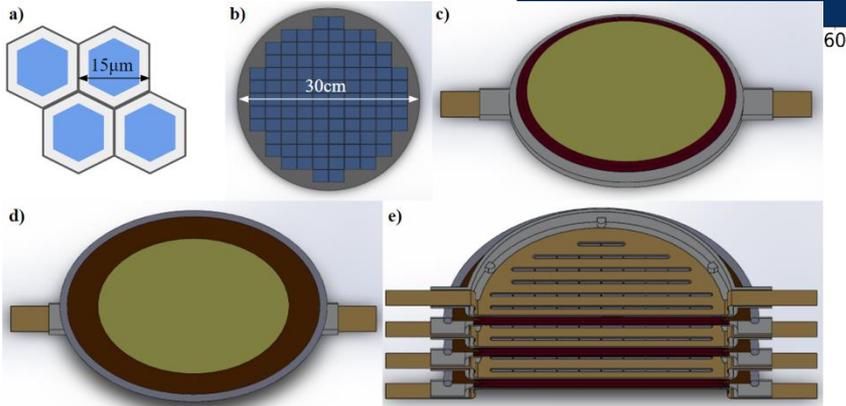
# SELENA, NEXT – Alvaro Chavarria, Enakshi Dey

Signal-Like

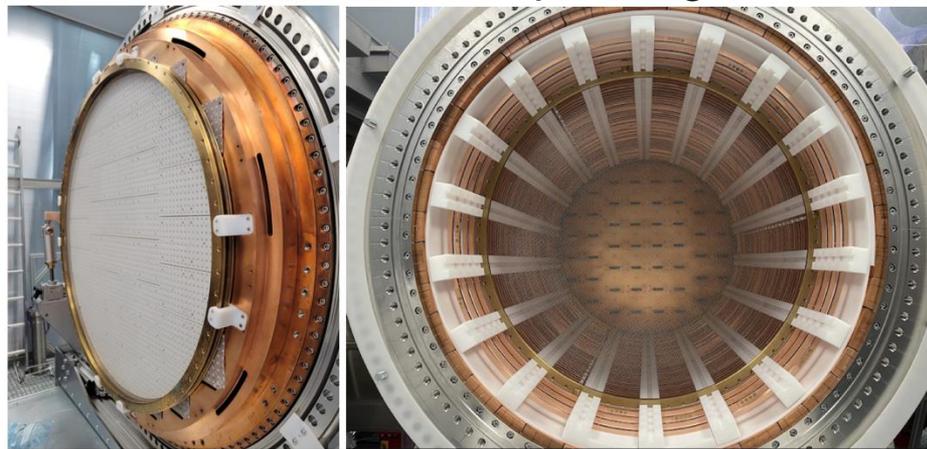
Background-Like



R&D



Operating NEXT-100





## Parallel 9 (Wednesday evening)

<b>Testing New Physics at CEvNS Experiments</b>	Ian Shoemaker	<a href="#">🔗</a>
Great Hall	19:00 - 19:23	
<b>Status and latest results from CONNIE with a skipper-CCD detector</b>	Brenda Aurea Cervantes Vergara	<a href="#">🔗</a>
Great Hall	19:23 - 19:46	
<b>Status of the Scintillating Bubble Chamber Liquid Argon 10 kg (SBC-LAr10) Detector, and Future Neutrino Physics Pros</b>	Gray Putnam	<a href="#">🔗</a>
Great Hall	20:09 - 20:32	
<b>Search for Coherent Elastic Neutrino-Nucleus Scattering with the Ricochet Experiment</b>	Emanuela Celi	<a href="#">🔗</a>
Great Hall	20:09 - 20:32	

## Parallel 7 (Thursday afternoon)

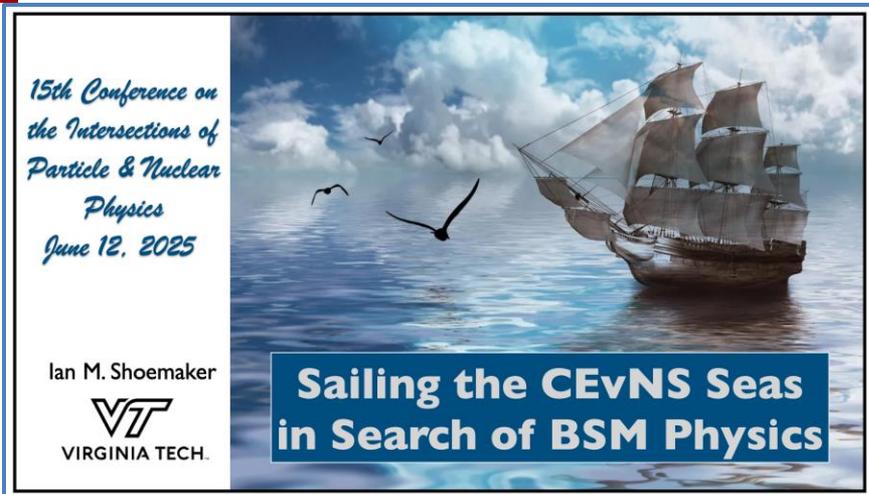
<b>Search for new physics on MINER using cryogenic and non-cryogenic detectors</b>	SHARADA SAHOO	<a href="#">🔗</a>
Great Hall	14:00 - 14:23	
<b>COHERENT Results and Status</b>	Tulasi Subedi	<a href="#">🔗</a>
Great Hall	14:23 - 14:46	
<b>Dark Sector Searches with Coherent CAPTAIN Mills</b>	Austin Schneider	<a href="#">🔗</a>
Great Hall	14:46 - 15:09	
<b>Quasielastic Lepton-Nucleus Scattering and the Correlated Fermi Gas Model</b>	Gil Paz	<a href="#">🔗</a>
Great Hall	15:09 - 15:32	

## Plenary 7 (Thursday morning)

<b>Modern Neutrino Oscillation Theory</b>	Peter Denton	<a href="#">🔗</a>
	08:20 - 08:50	



# Overview – Ian Shoemaker



15th Conference on  
the Intersections of  
Particle & Nuclear  
Physics  
June 12, 2025

Ian M. Shoemaker

**VT**  
VIRGINIA TECH.

**Sailing the CEvNS Seas  
in Search of BSM Physics**

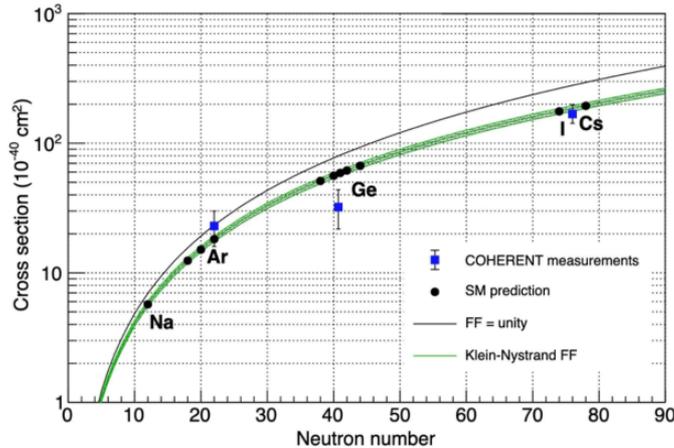
## Outline

- CEvNS general features
- **Neutrino BSM:**
  - Non-Standard Neutrino Interactions (NSI) and CEvNS impact on matter effect.
  - CEvNS data can break degeneracies and provide non-trivial oscillation information.
- **CEvNS experiments as DM source**
  - Test high-priority models where DM yields the relic abundance.

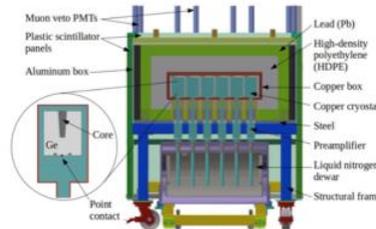


# COHERENT – Tulasi Subedi

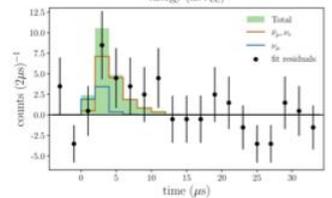
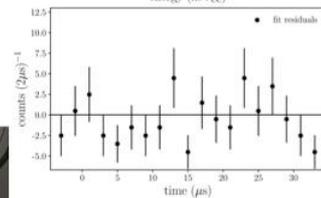
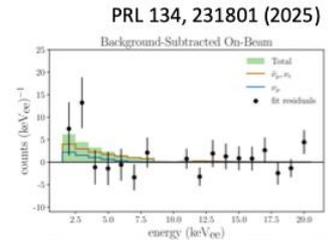
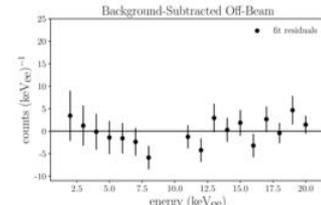
The COHERENT measurements are in agreement with the Standard Model within one sigma.



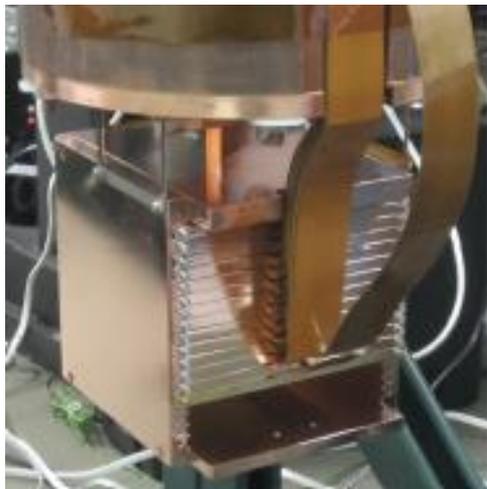
In 2024, COHERENT detected CEvNS on Ge with the Ge-Mini detector.



- 18 kg High-Purity Germanium detector
- Shielding: Cu, HDPE, Pb, muon veto

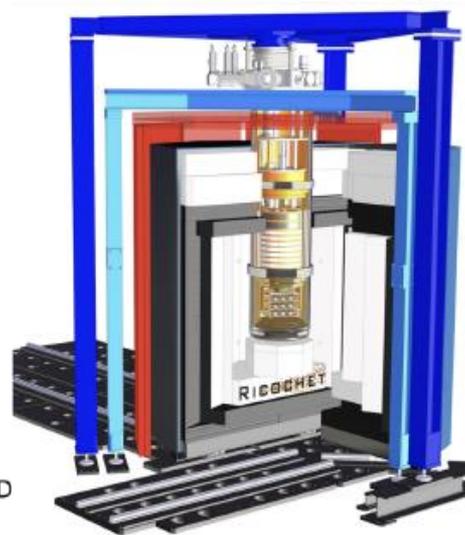
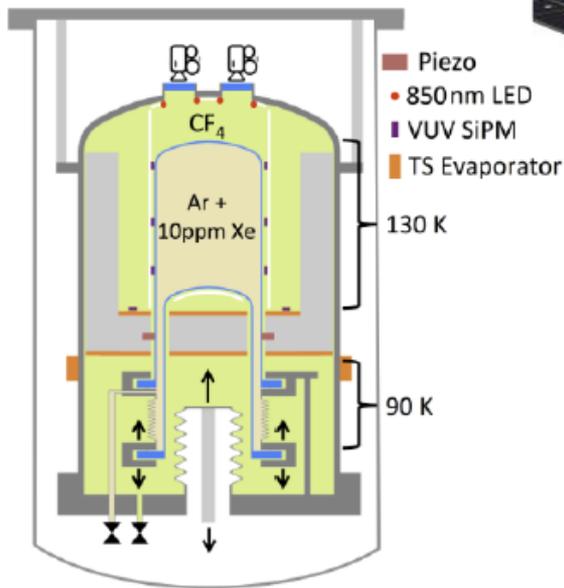


# Other Technologies (Reactor)



**CONNIE**  
(Brenda Aurea  
Cervantes Vergara)

**SBC**  
(Gray Putnam)



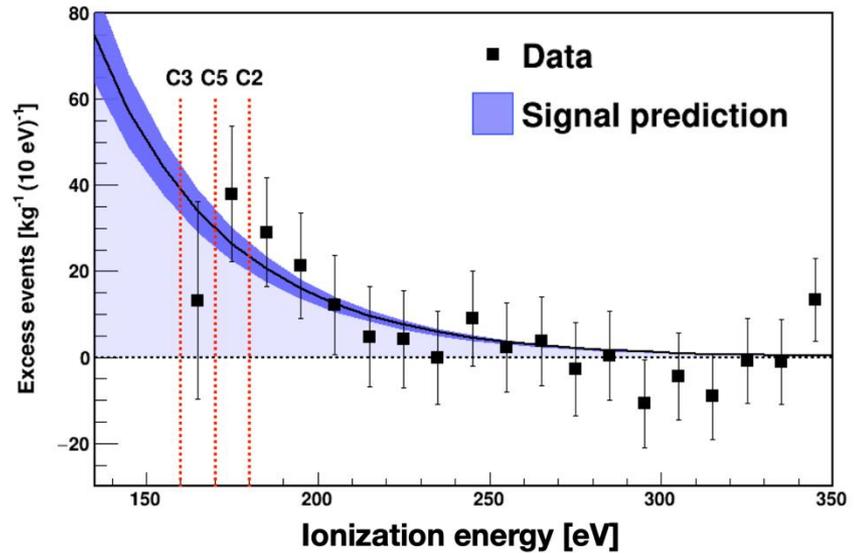
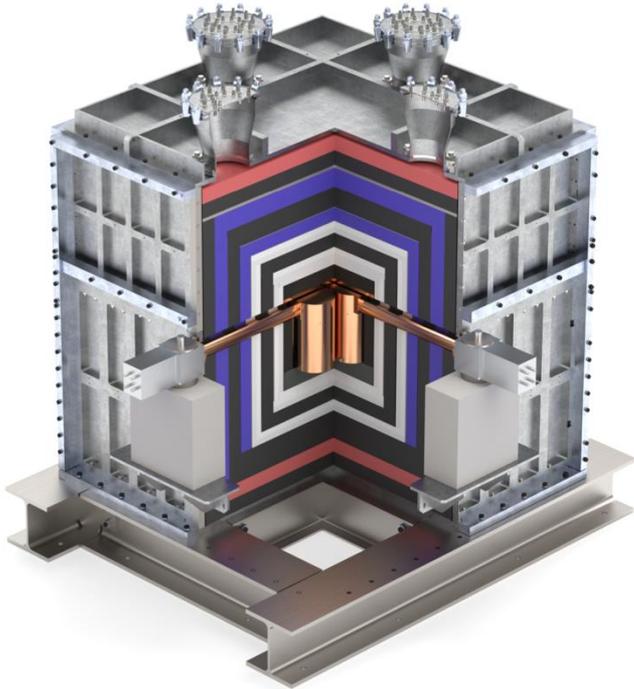
**RICOCHET**  
(Emanuela Celi)

**MINER**  
(Sharada Sahoo)

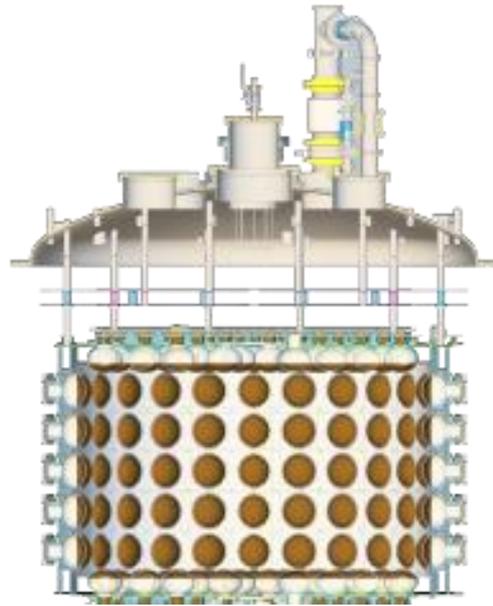


# First Reactor CEvNS Observation

- CONUS+ arXiv:2501.05206
- 3.7- $\sigma$  observation

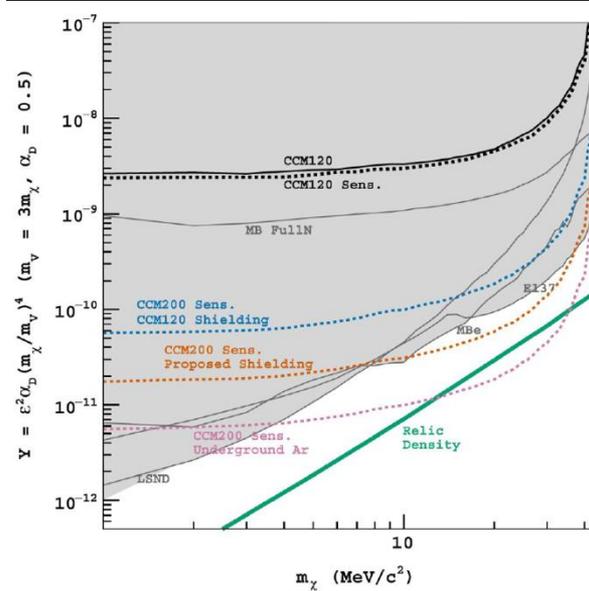


# Dark Sector Searches

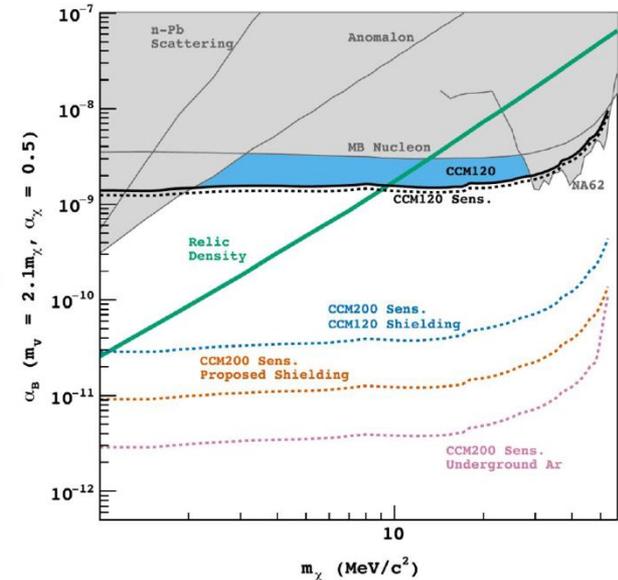


CCM  
(Austin Schneider)

[10.1103/PhysRevLett.129.021801]



(a) vector portal



(b) leptophobic



# Intersections with Dark Matter

**Important lesson:  
Don't re-invent the wheel**



If Dark Matter experiments can be a tool for neutrino physics,  
can neutrino experiments become a tool for DM?

XENONnT, PandaX, XLZD



$^8\text{B}$  Solar Neutrino via CEvNS,  $0\nu\beta\beta$  sensitivity

Detector Technology



SBC, RICOCHET (CDMS-style FID), ...

Dark Sector Physics



CEvNS Experiments  
 $0\nu\beta\beta$  Experiments  
Short Baseline Anomaly



## Parallel 5 (Wednesday afternoon)

**Status of the Project 8 Neutrino Mass Experiment**

Hannah Binney 

Great Hall

14:00 - 14:23

**Probing the Neutrino Mass with PTOLEMY**

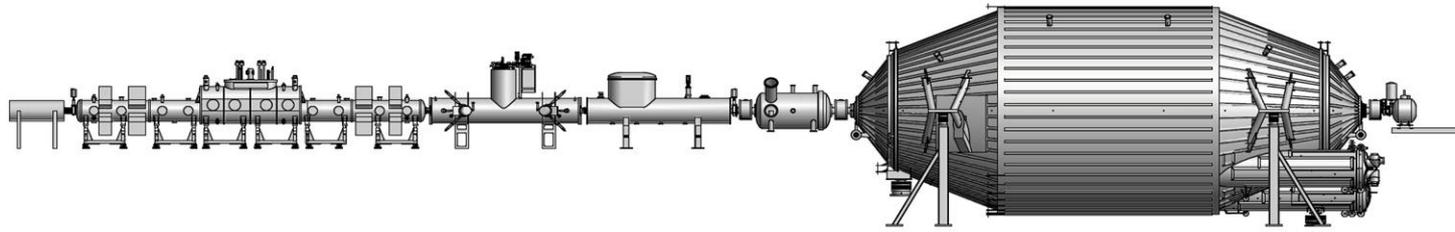
Andi Tan 

Great Hall

14:23 - 14:46



# KATRIN

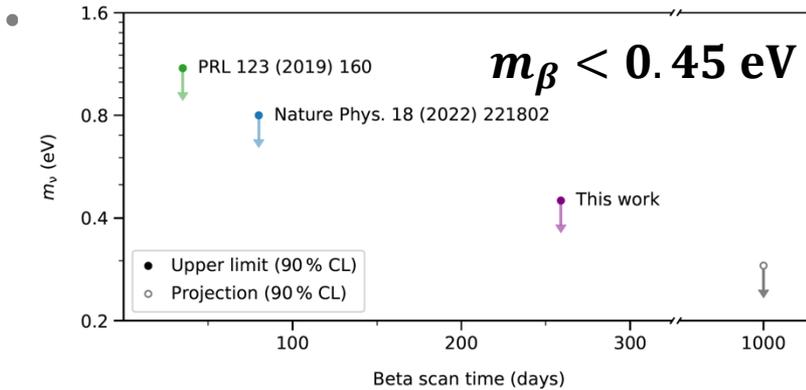
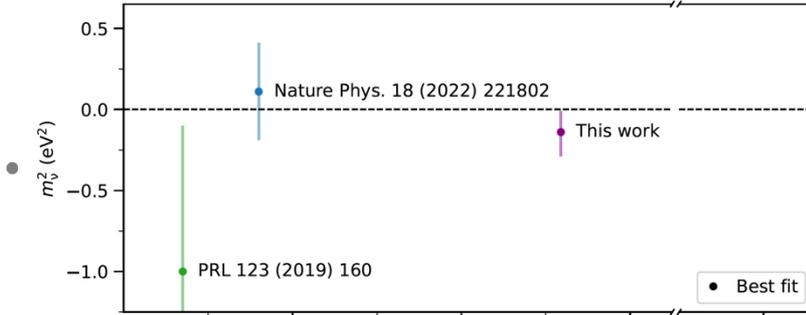


The New York Times

## Neutrinos Are Shrinking, and That's a Good Thing for Physics

A new estimate of the ghostly particle's maximum possible mass brings physicists a tad closer to understanding the universe.

Listen to this article · 5:20 min [Learn more](#) [Share full article](#) [Bookmark](#) [Comments](#) 26



KATRIN, Science 388 (2025) 6743



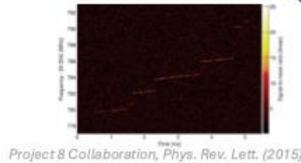
# Project 8 – Hannah Binney

**PROJECT 8**



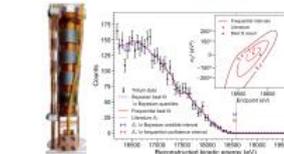
## The path to 40 meV sensitivity

**Phase I**  
First demonstration  
of CRES



Project 8 Collaboration, Phys. Rev. Lett. (2015)

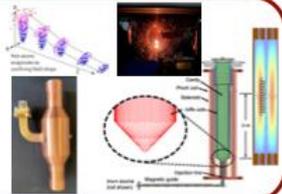
**Phase II**  
First CRES-based  
neutrino mass  
measurement



Project 8 Collaboration, Phys. Rev. Lett. (2023)  
Project 8 Collaboration, Phys. Rev. C (2024)

You are  
here

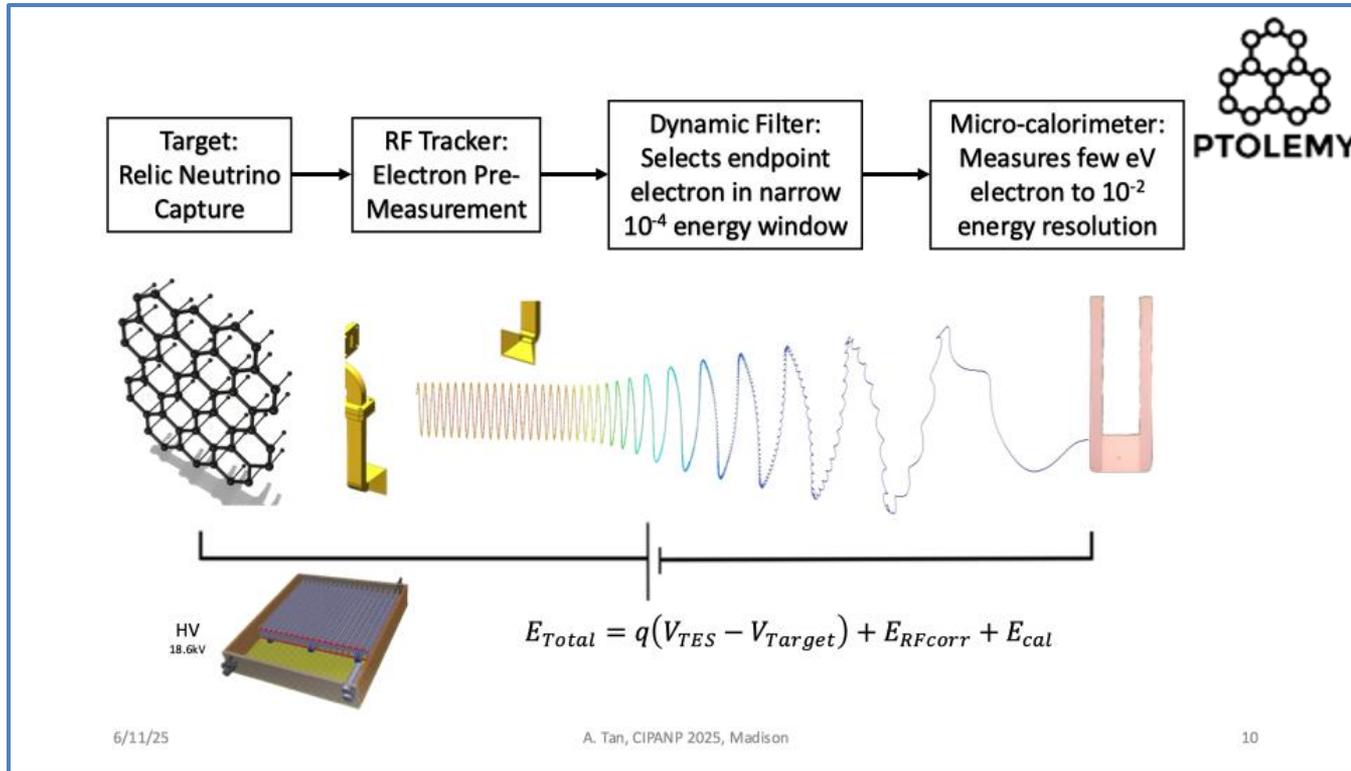
**Phase III**  
Technology development  
to achieve final sensitivity  
Neutrino mass sensitivity  
comparable to KATRIN



**Phase IV**  
0.04 eV sensitivity to  $m_\beta$



# PTOLEMY – Andi Tan



6/11/25

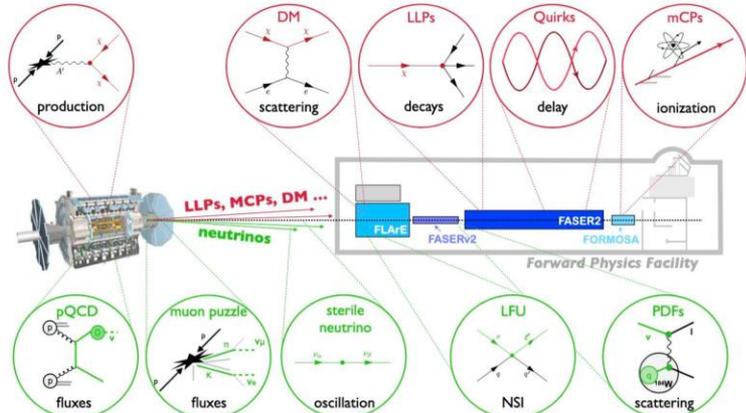
A. Tan, CIPANP 2025, Madison

10



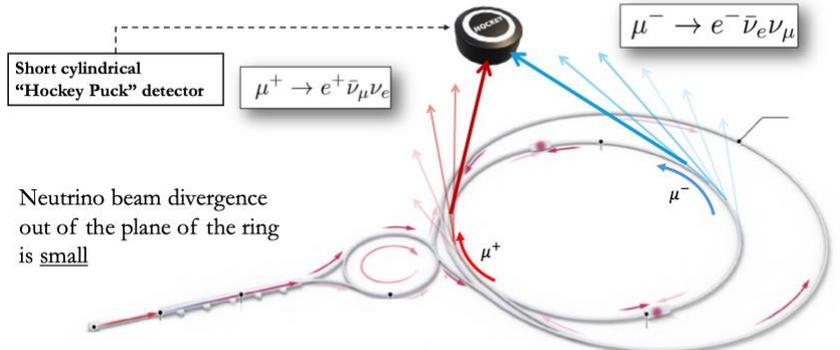
# Intersections with Colliders

## Physics Opportunities



[J. L. Feng, ..., D. Saldin et al., J. Phys. G: Nucl. Part. Phys. 50 (2023)]

## Concept: Companion Neutrino Detector Near the Muon Collider / Storage Ring



A. FISHER/SCIENCE

A. Thompson

CIPANP 2025 - June 11, 2025

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