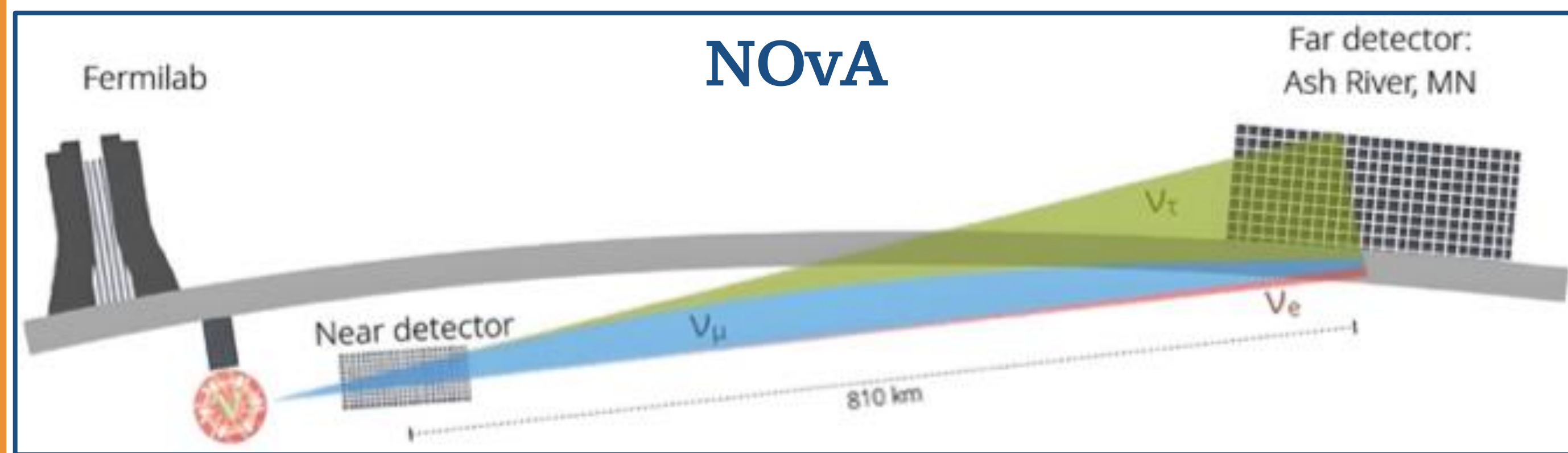


# Expanding NSI searches at NOvA

Mario A. Acero

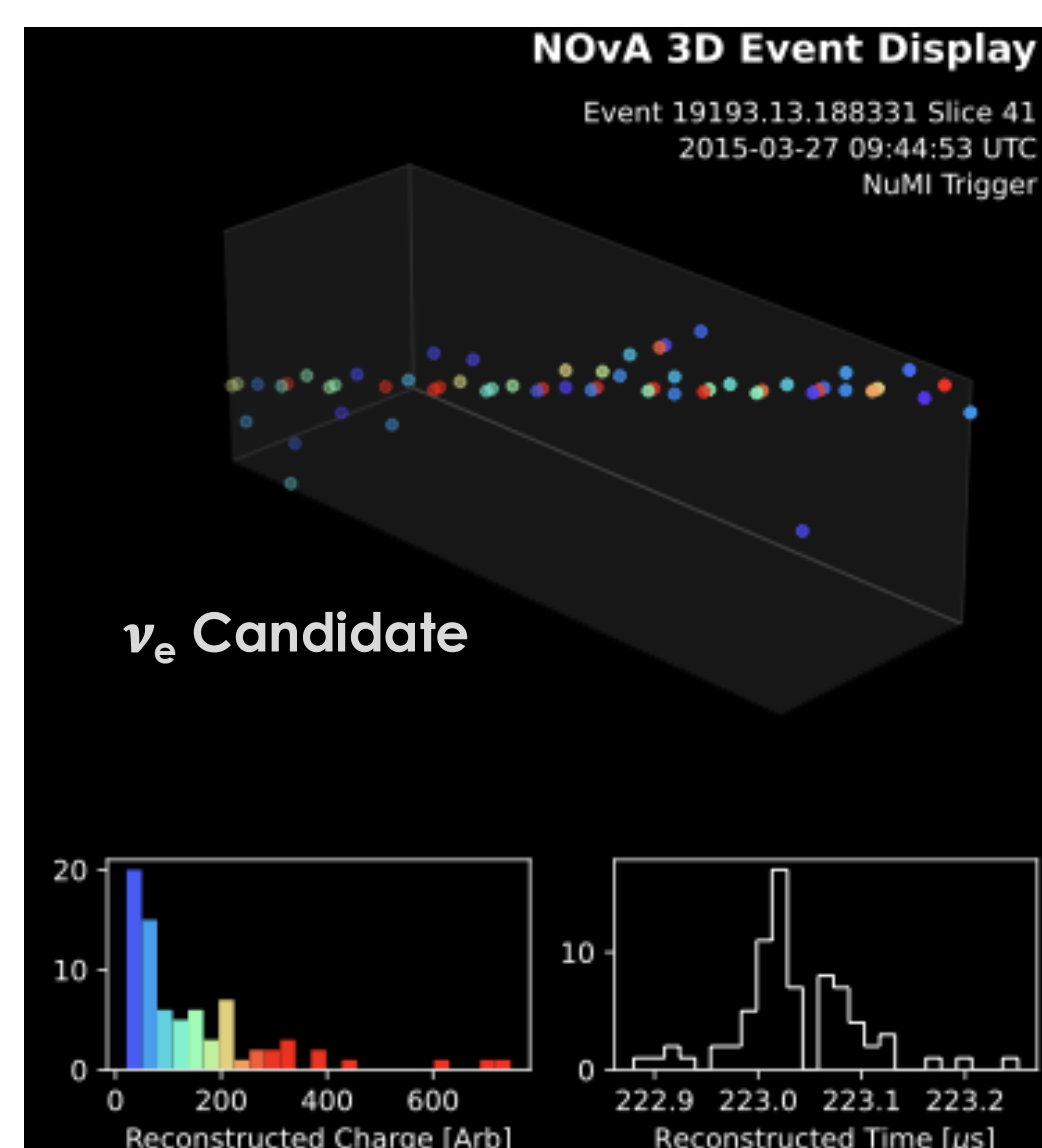
Programa de Física, Universidad del Atlántico  
On behalf of the NOvA Collaboration

Neutrino 2026 – XXXII International Conference on Neutrino Physics and Astrophysics - University of California, Irvine



The NUMI Off-axis  $\nu_e$ -Appearance Experiment

- Long-baseline neutrino oscillations
- Two off-axis detectors:
  - Near Detector – 1 km from source
  - Far Detector – 810 km from source
- Tracking calorimeters allowing 3D event reconstruction
- Measures three-flavor oscillation parameters
- Beam of muon (anti)-neutrinos
- Searches of new physics like Non-Standard Interactions



## Non-Standard Interactions

The presence of NSI modifies the Hamiltonian by including effective parameters

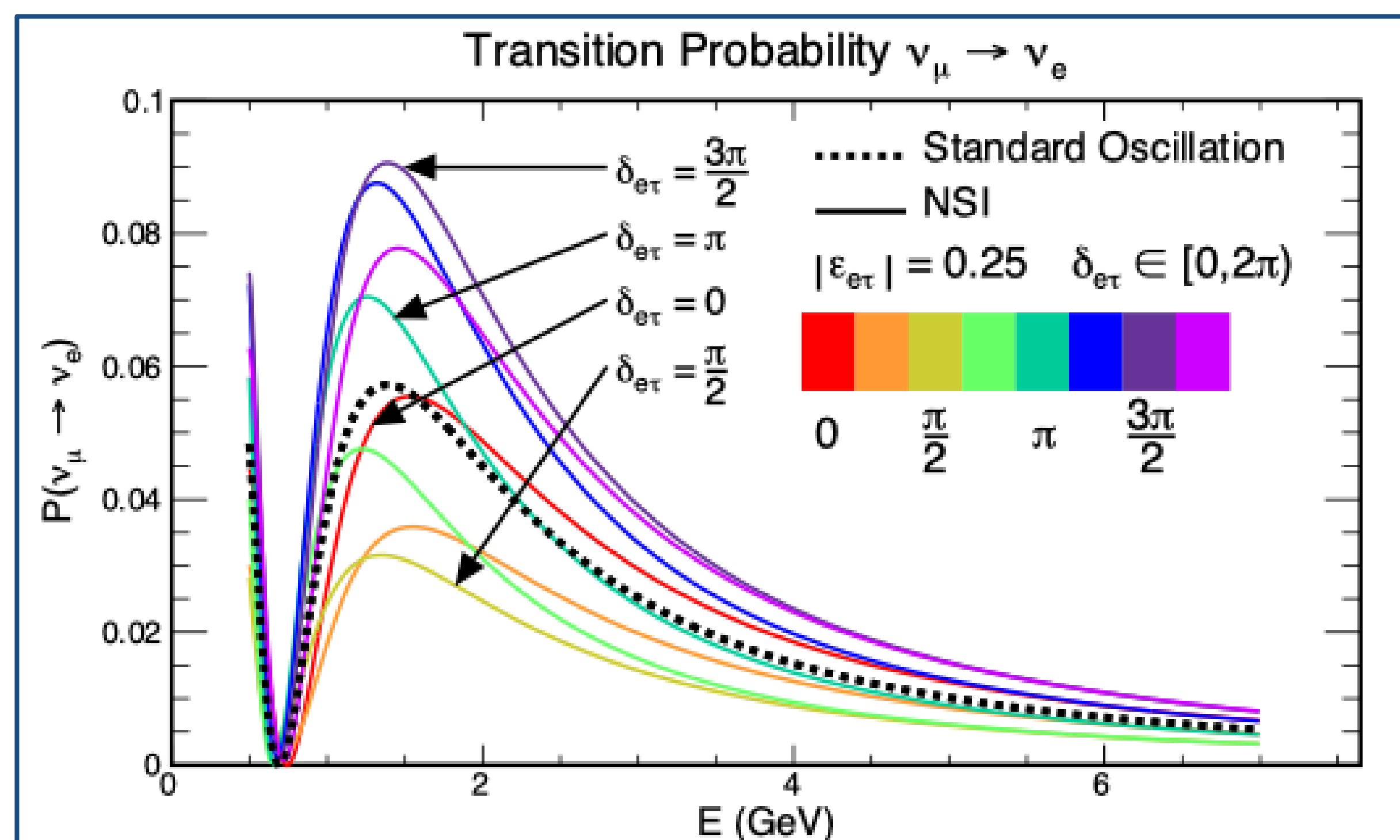
$$\mathcal{H} = U \begin{pmatrix} 0 & 0 & 0 \\ 0 & \Delta_{21} & 0 \\ 0 & 0 & \Delta_{31} \end{pmatrix} U^\dagger + V \begin{pmatrix} 1 + \varepsilon_{ee} & \varepsilon_{e\mu} & \varepsilon_{e\tau} \\ \varepsilon_{e\mu}^* & \varepsilon_{\mu\mu} & \varepsilon_{\mu\tau} \\ \varepsilon_{e\tau}^* & \varepsilon_{\mu\tau}^* & \varepsilon_{\tau\tau} \end{pmatrix}$$

$\Delta_{ji} = \Delta m_{ji}^2 / (2E)$        $\varepsilon_{\alpha\beta} = |\varepsilon_{\alpha\beta}| e^{i\delta_{\alpha\beta}}$

Measures the strength of the NSI

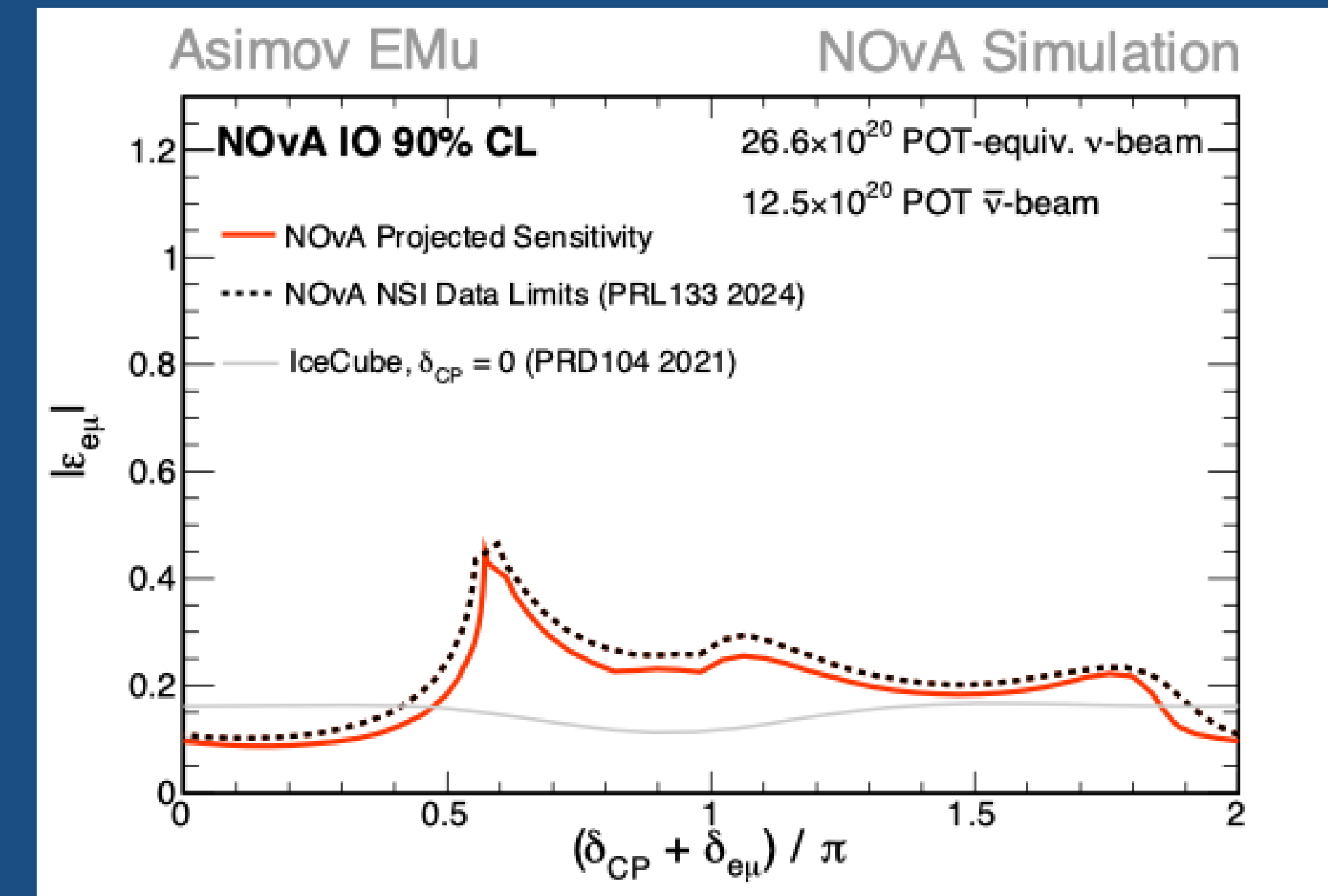
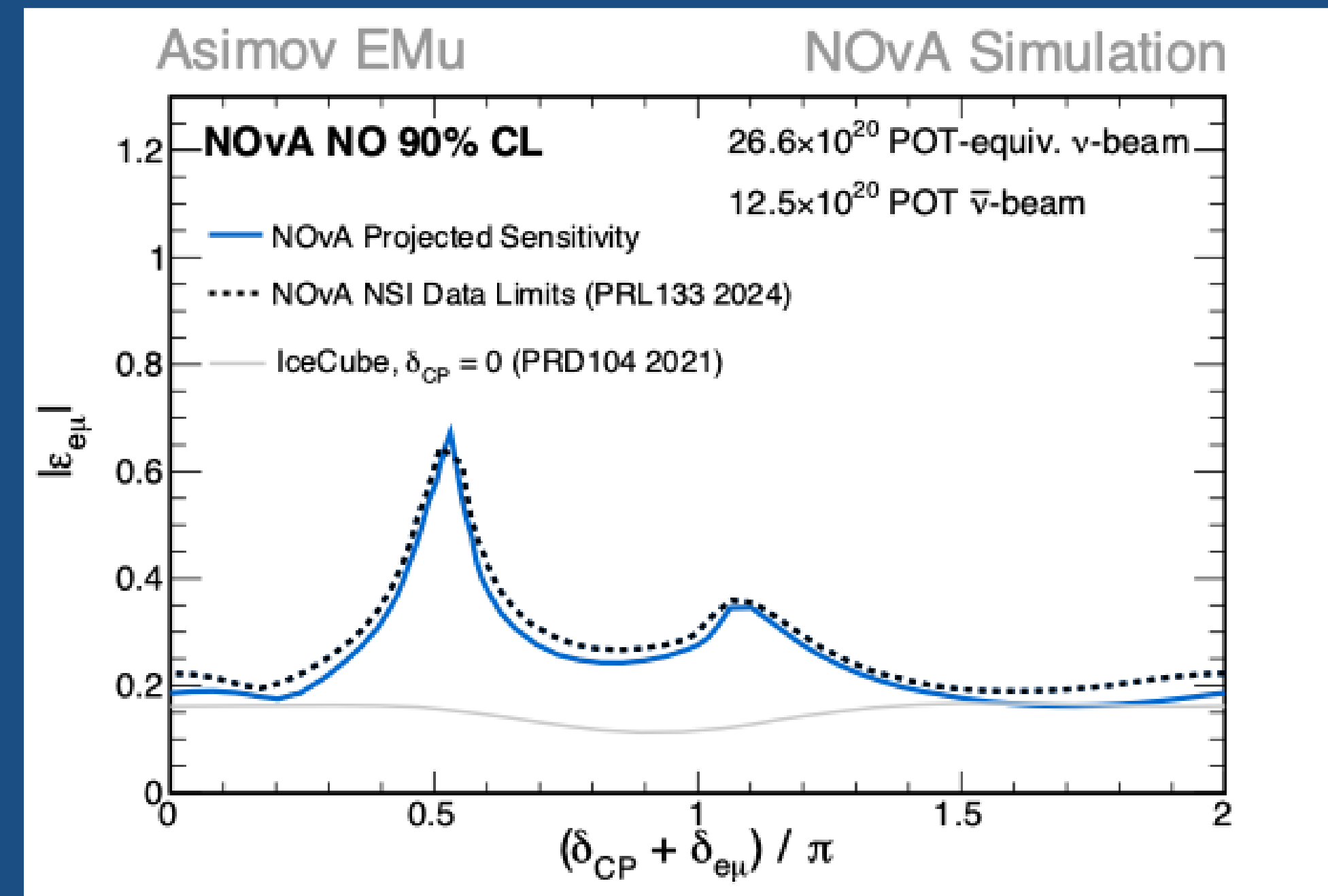
New CP-violation phase

Impact of the NSI phase  $\delta_{e\tau}$  on the  $\nu_e$  appearance at the NOvA baseline



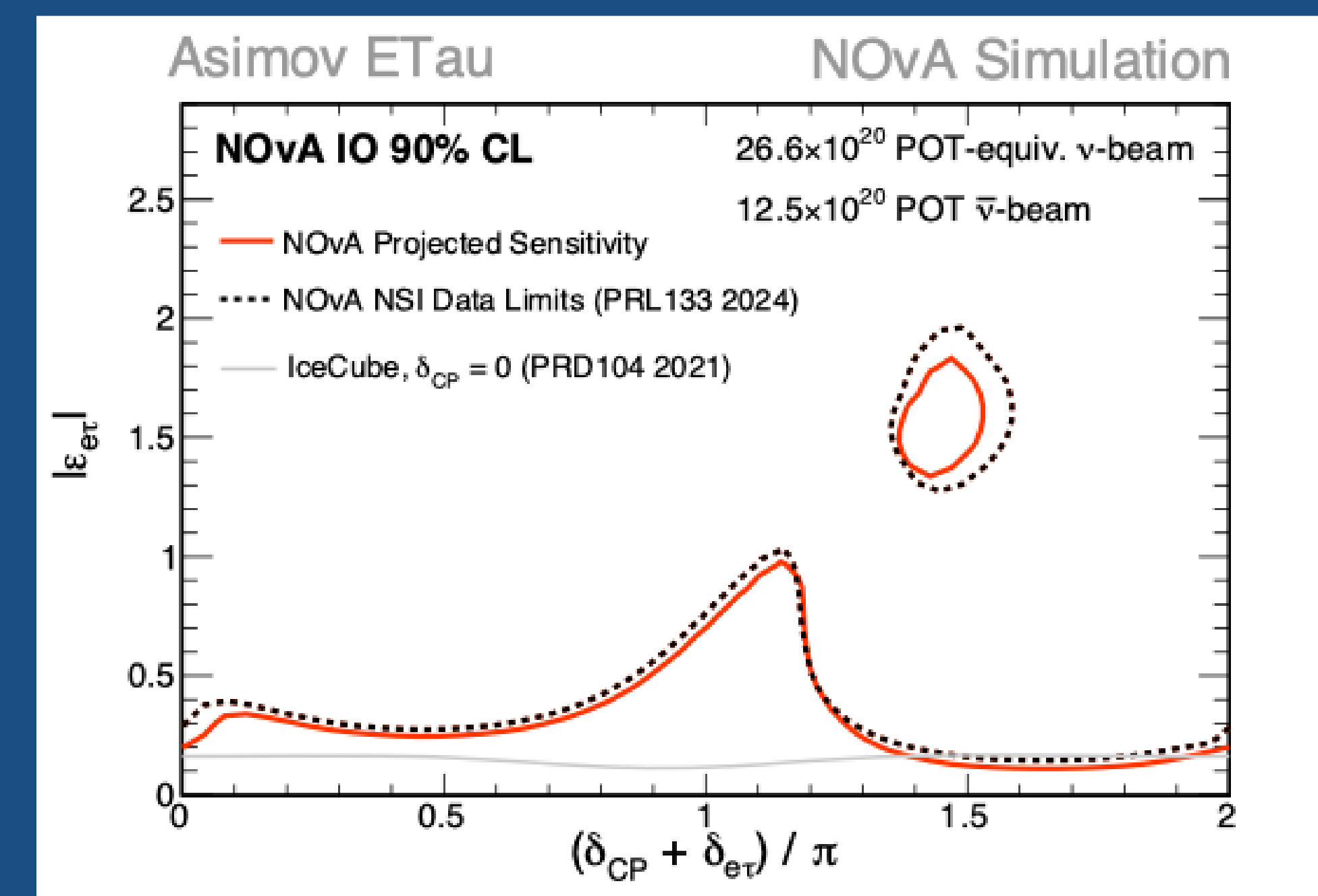
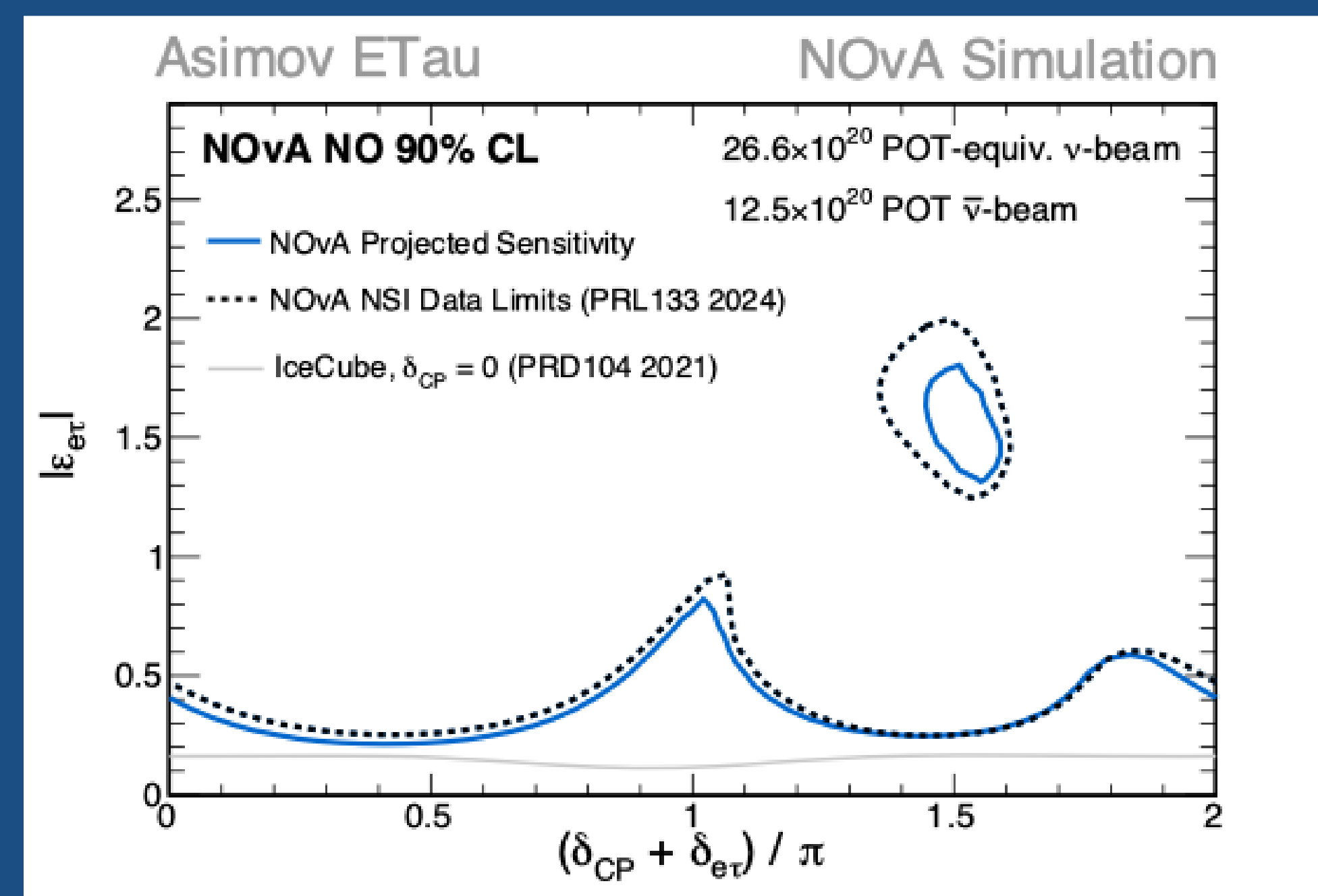
## Expected Sensitivity

NOvA 90% CL sensitivity for  $|\varepsilon_{e\mu}|$  vs.  $\delta_{CP} + \delta_{e\mu}$



At  $\varepsilon_{e\mu}$  best fit point (Asimov Eμ) [1].

NOvA 90% CL sensitivity for  $\varepsilon_{e\tau}$  vs.  $\delta_{CP} + \delta_{e\tau}$



At  $\varepsilon_{e\tau}$  best fit point (Asimov ETau) [1].

NOvA 90% CL expected sensitivity points to stronger constraints on the NSI parameters, reducing the large- $|\varepsilon_{e\tau}|$  allowed region and excluding some of the regions allowed by the IceCube results (obtained with fixed  $\delta_{CP} = 0$ ) [3].

Parameter (AsimovEμ)	NO
$\Delta m_{32}^2 (10^{-3} \text{ eV}^2)$	2.42
$\sin^2 \theta_{23}$	0.57
$\delta_{CP} (\pi)$	1.02
$ \varepsilon_{e\mu} $	0.07
$ \delta_{e\mu}  (\pi)$	1.83

Parameter (AsimovETau)	IO
$\Delta m_{32}^2 (10^{-3} \text{ eV}^2)$	-2.45
$\sin^2 \theta_{23}$	0.57
$\delta_{CP} (\pi)$	0.52
$ \varepsilon_{e\mu} $	0.59
$ \delta_{e\mu}  (\pi)$	0.56

**There is more to see!**  
Bayesian MCMC study of NSI by Xiaoyan, Poster No. 309  
Joint NOvA-T2K NSI study By Gavin, Poster No. 420

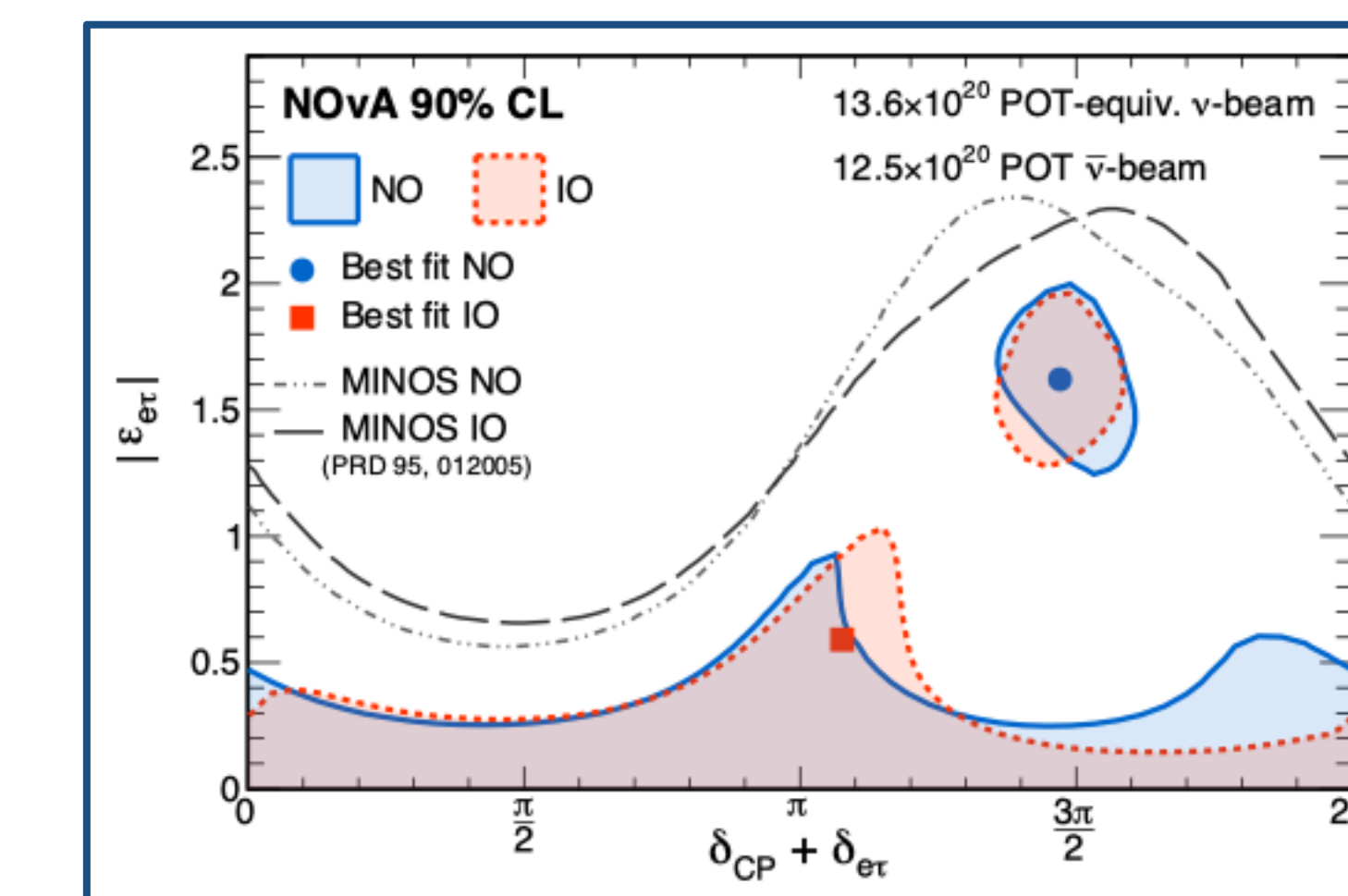
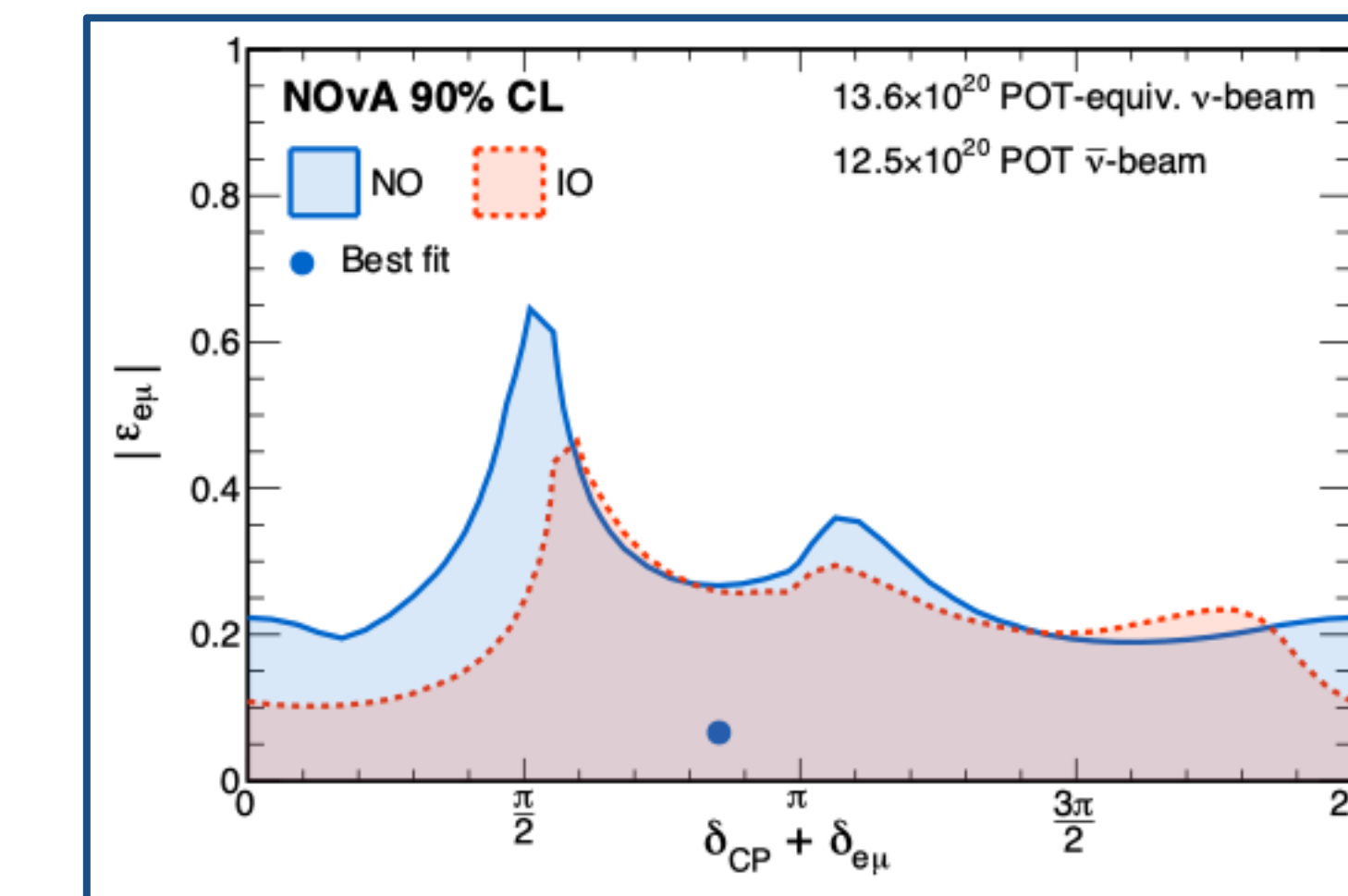
### References

- [1] NOvA Phys. Rev. Lett. 133 201802 (2024) [2] NOvA Phys. Rev. Lett. 136 011802 (2026) [3] IceCube, Phys. Rev. D104 072006 (2021)



## NSI as seen by NOvA

Our previous results as reported in [1].

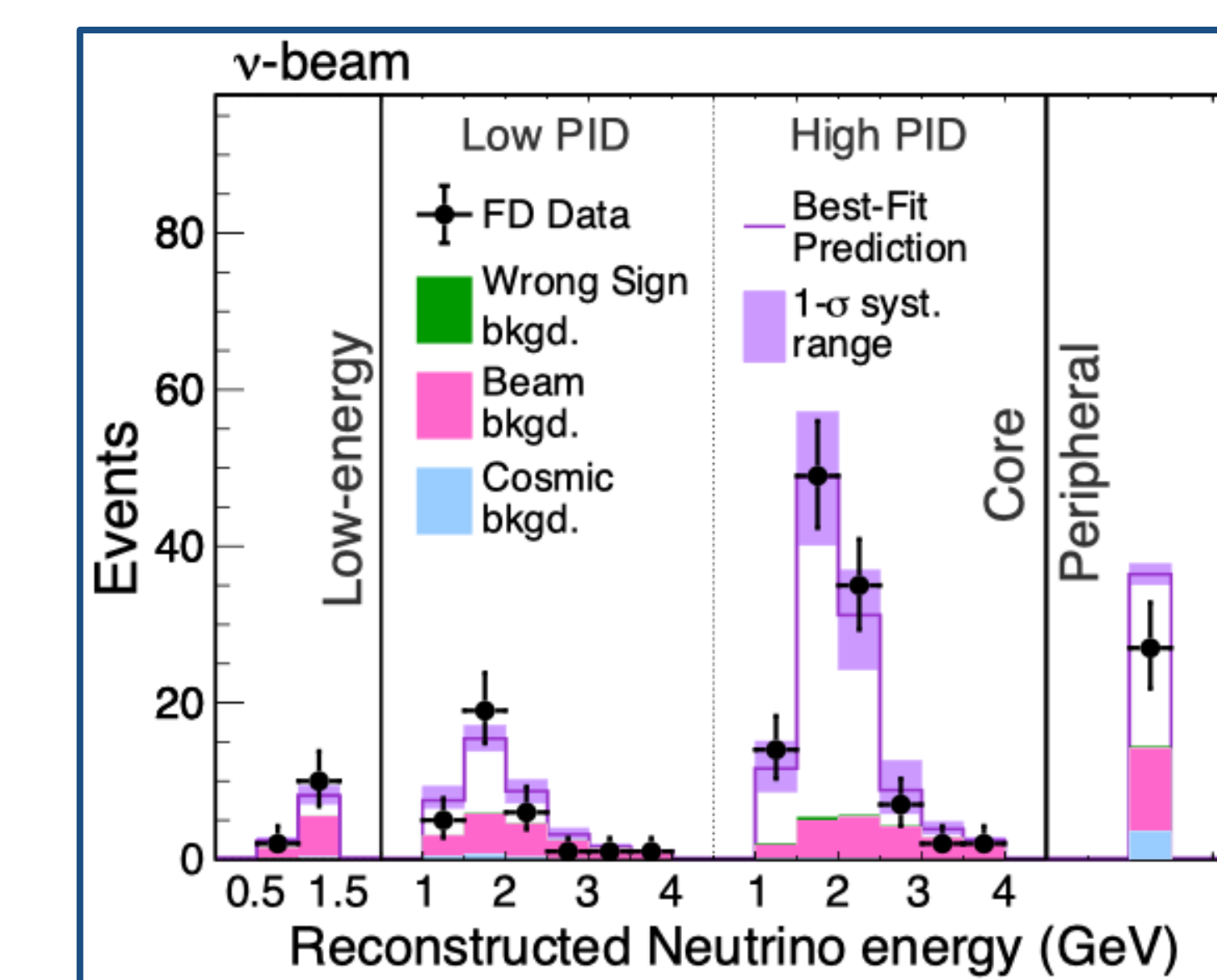


NOvA 90% CL allowed regions for two NSI parameters spaces

## The News and Upgrades

Additional neutrino data [2]:  
From  $13.6 \times 10^{20}$  POT to  $26.6 \times 10^{20}$  POT

New  $\nu_e$  Low-energy sample [2]:  
Covering the 0.5 to 1.5 GeV energy range



NOvA oscillation analysis [2], upgrades  
Updated simulation  
Improved systematic uncertainties  
Reoptimized energy reconstruction and event selection.

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https://novaexperiment.fnal.gov