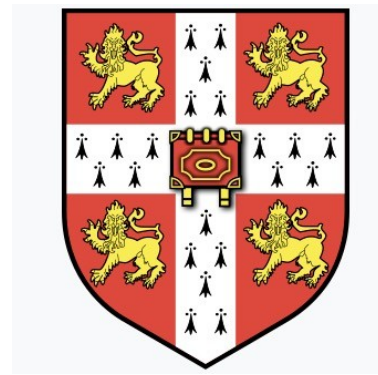


INTENSE: particle physics experiments at the intensity frontier. A cooperative Europe – United States effort.



Neutrino Physics Data Analysis WP 3

MidTerm Review Meeting, June 24, 2022

Melissa Uchida

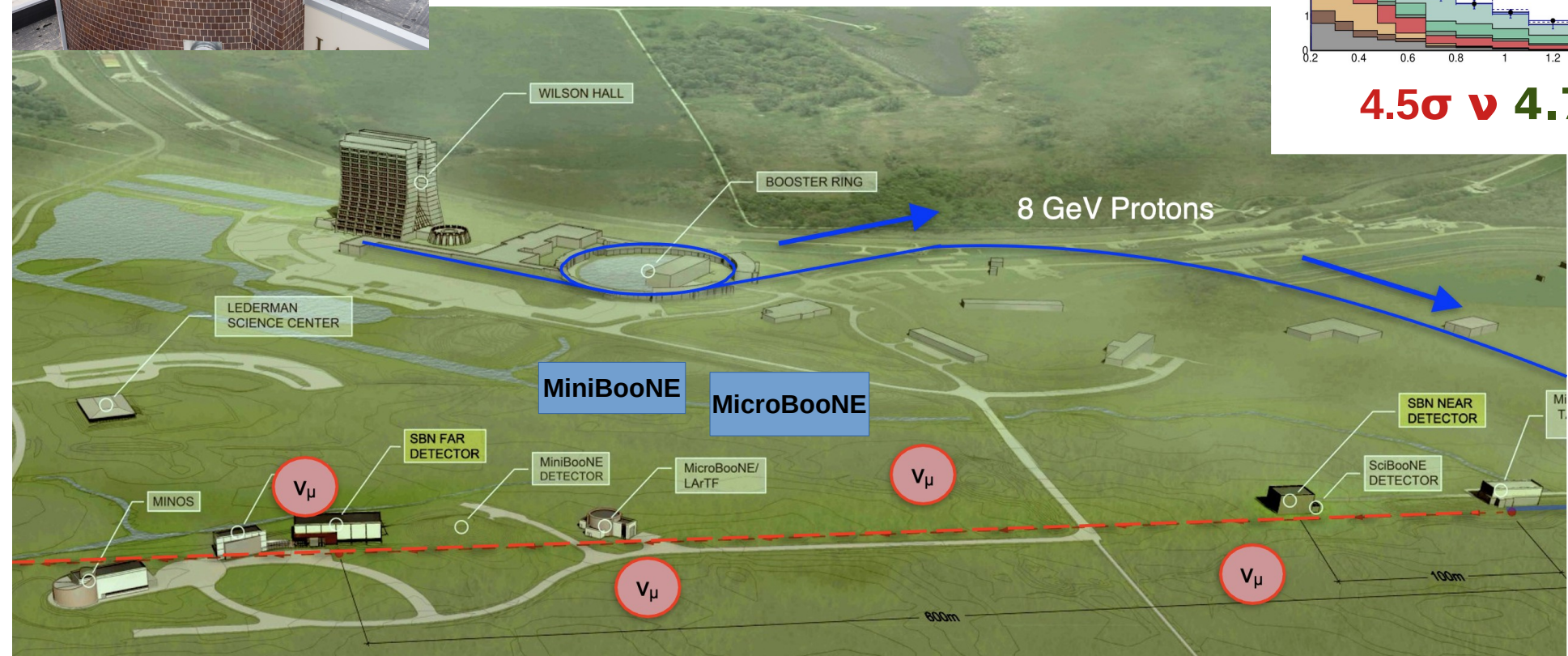
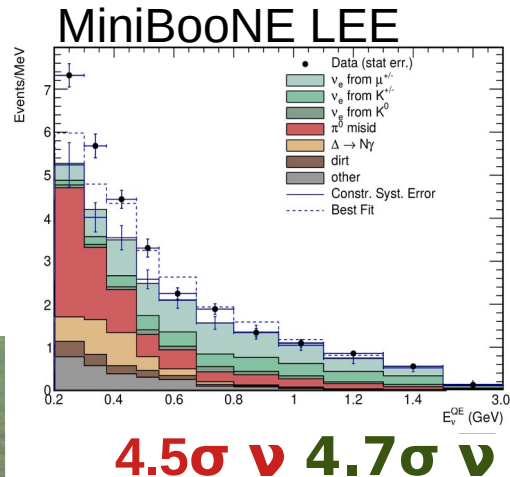
Short Baseline Neutrino Program

All LarTPC detectors → more interaction and detector uncertainties can be cancelled.

Powerful near-detector to drastically reduce systematic uncertainties on **baseline-dependent** physics.



MicroBooNE



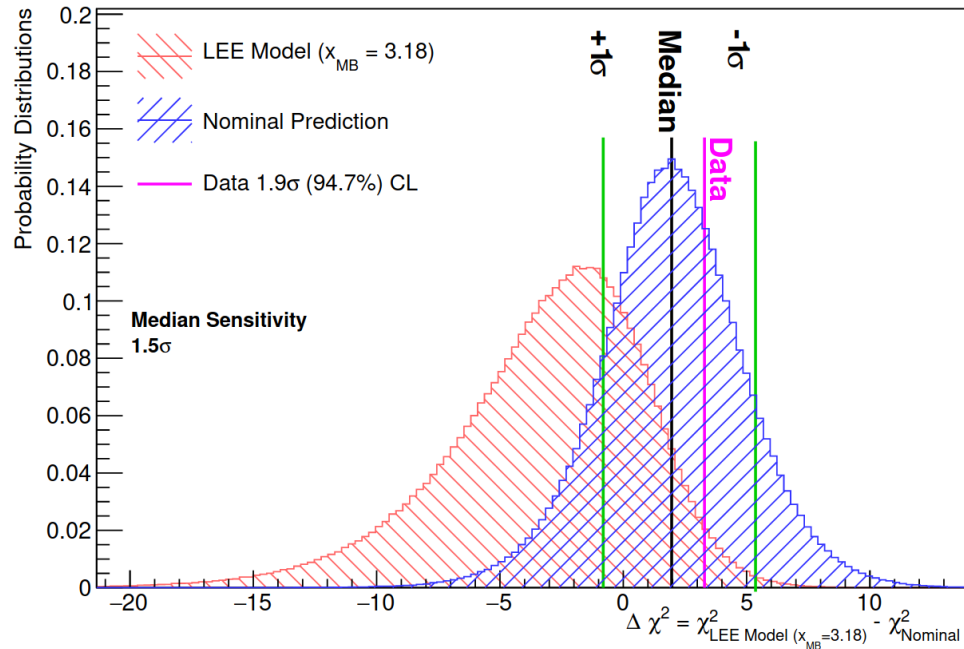
MicroBooNE LEE Exploration so far...

First series of results (1/2 the MicroBooNE data set)

Reco topology \ Models	1e0p	1e1p	1eNp	1eX	e ⁺ e ⁻ + nothing	e ⁺ e ⁻ X	1γ0p	1γ1p	1γX
eV Sterile ν Osc	✓	✓	✓	✓					
Mixed Osc + Sterile ν	✓ _[7]	✓ _[7]	✓ _[7]	✓ _[7]			✓ _[7]		
Sterile ν Decay	✓ _[13,14]	✓ _[13,14]	✓ _[13,14]	✓ _[13,14]			✓ _[4,11,12,15]	✓ _[4]	✓ _[4]
Dark Sector & Z' *	✓ _[2,3]				✓ _[2,3]	✓ _[2,3]	✓ _[1,2,3]	✓ _[1,2,3]	✓ _[1,2,3]
More complex higgs *					✓ _[10]	✓ _[10]	✓ _[6,10]	✓ _[6,10]	✓ _[6,10]
Axion-like particle *					✓ _[8]		✓ _[8]		
Res matter effects	✓ _[5]	✓ _[5]	✓ _[5]	✓ _[5]					
SM γ production							✓	✓	✓

*Requires heavy sterile/other new particles also

MicroBooNE Single Photon Hypothesis



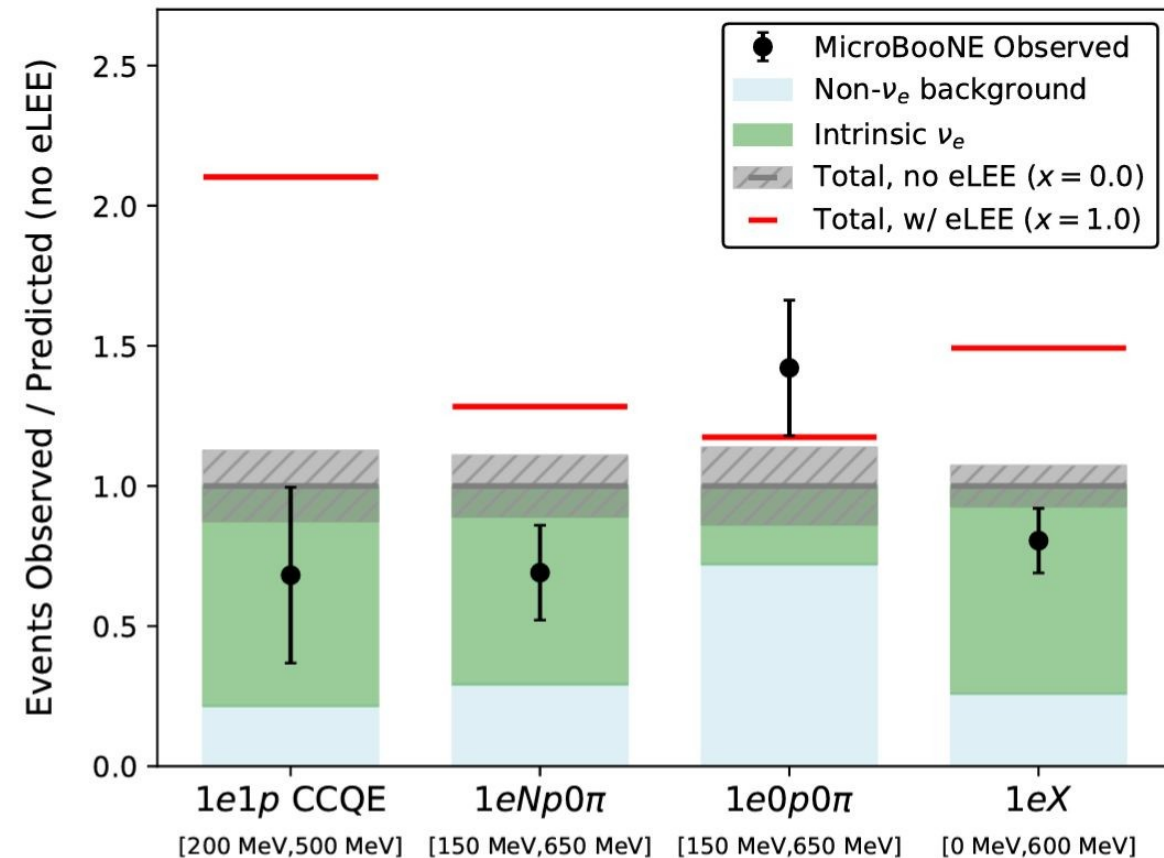
50-fold improvement over prior limit on rate of this interaction.

Phys.Rev.Lett. 128 (2022) 11, 111801

Disfavours the $NC\Delta \rightarrow N\gamma$ explanation of LEE at 94.8% confidence level.

	$1\gamma 1p$	$1\gamma 0p$
Unconstr. bkgd.	27.0 ± 8.1	165.4 ± 31.7
Constr. bkgd.	20.5 ± 3.6	145.1 ± 13.8
NC $\Delta \rightarrow N\gamma$	4.88	6.55
LEE ($x_{MB} = 3.18$)	15.5	20.1
Data	16	153

MicroBooNE's electron-like LEE Results



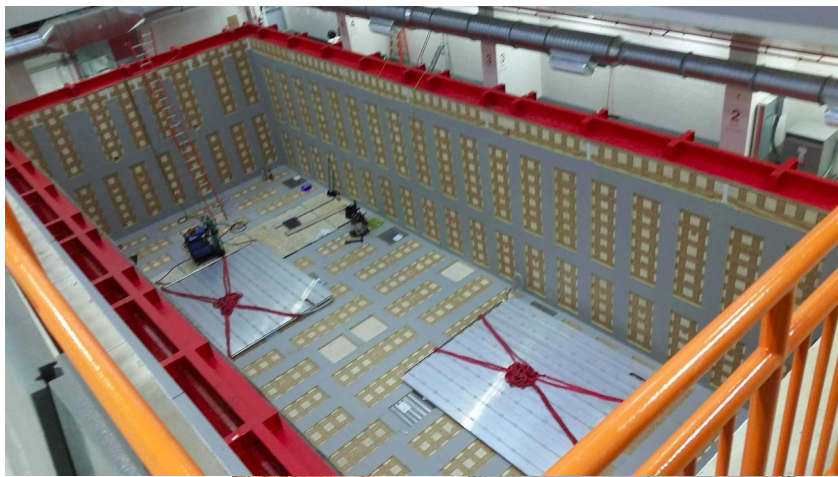
All analyses observe ν_e event rates:

- agree with or are below the predicted rates from 3-flav ν osc,
- over full analysis energy range and
- in the signal-enhanced low-energy region defined by each analysis prior to unblinding,
- (with the exception of the 1e0p0 π , which is background dominated).

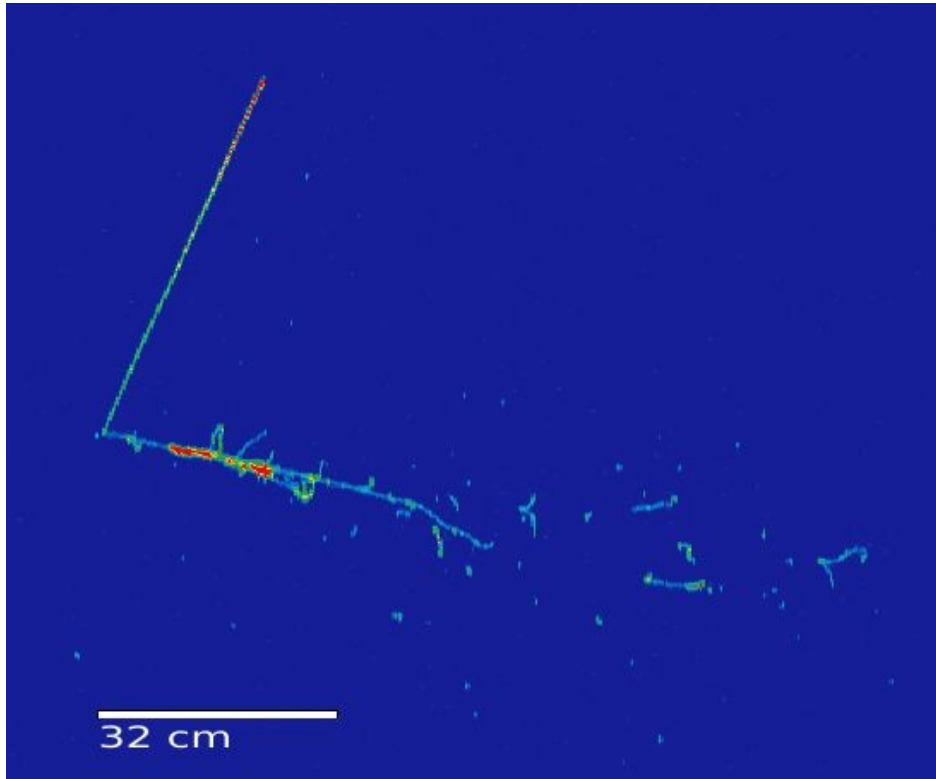
Reject the hypothesis that simple charged current ν_e fully explains the MiniBooNE excess at >97% CL in all analyses.

ICARUS

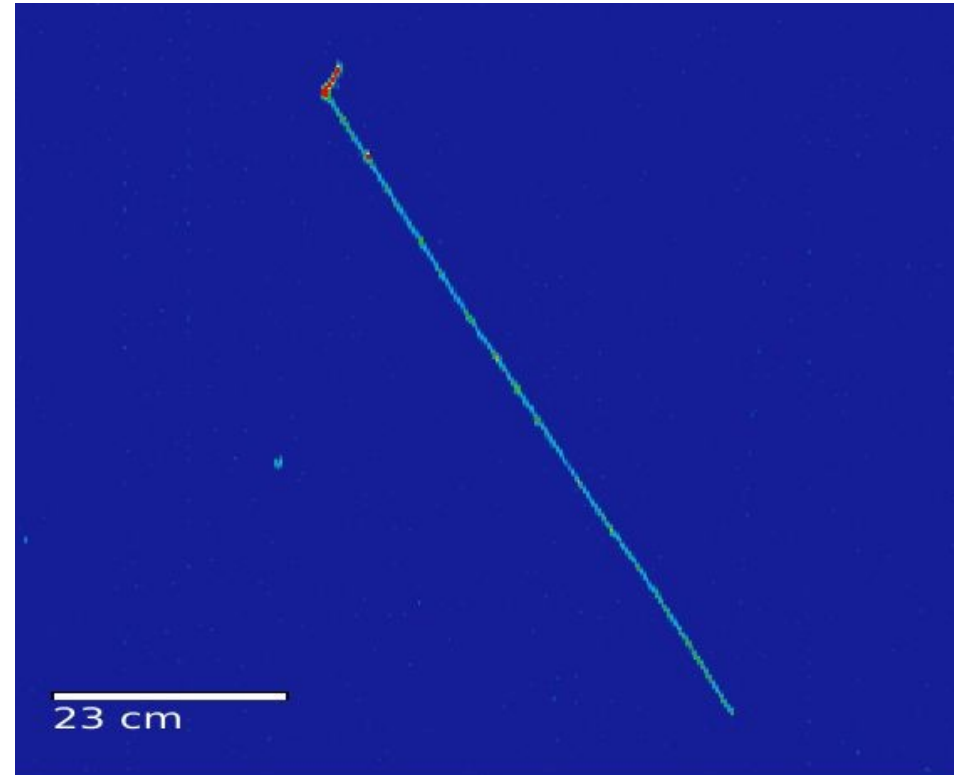
- ICARUS (Imaging Cosmics And Rare Underground Signals).
- LAr TPC: 760 tons total /476 tons active liquid argon.
- Operated at Gran Sasso in Italy from 2010-2013,
- was refurbished at CERN from 2014-2017 and
- shipped to Fermilab in the summer of 2017.
- Commissioning of the detector is now completed, with physics data being recorded this month!
- ICARUS seeks to test the claim of the Neutrino-4 experiment's evidence for a ~ 7 eV² sterile neutrino using 2022/2023 data.



1st ICARUS ν candidate at FNAL



NuMI ν_e charged current candidate



BNB ν_μ charged current candidate