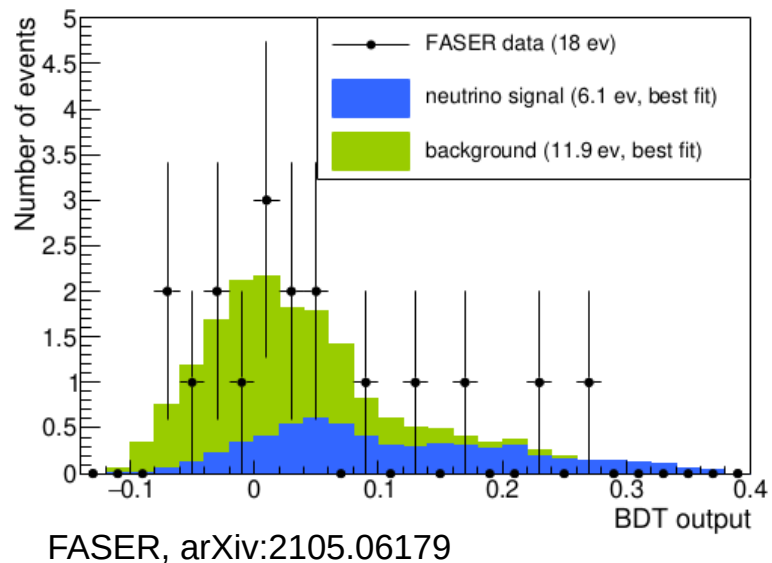
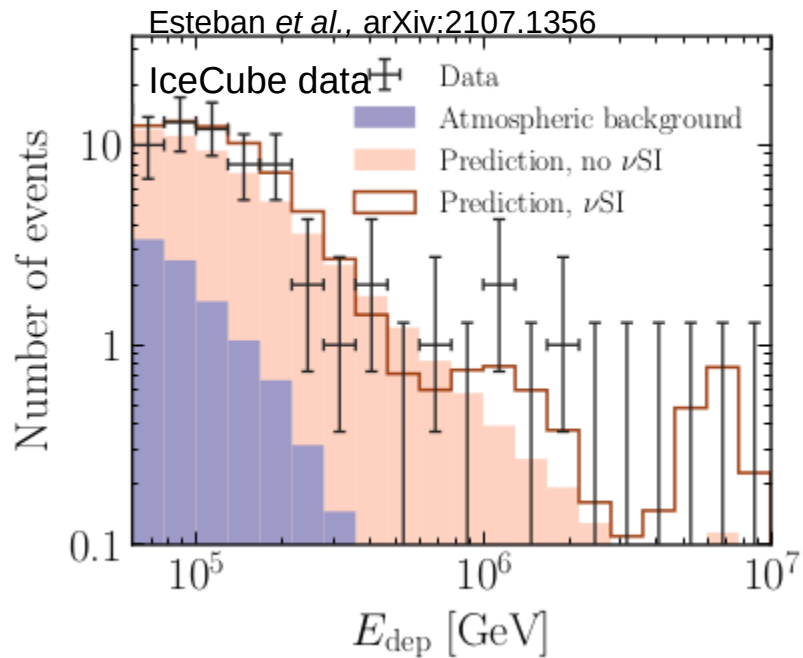
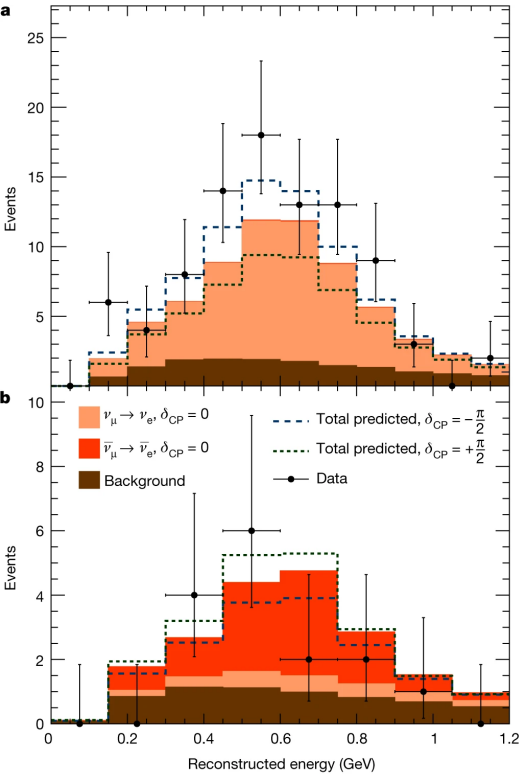


Updates from the Neutrino Frontier

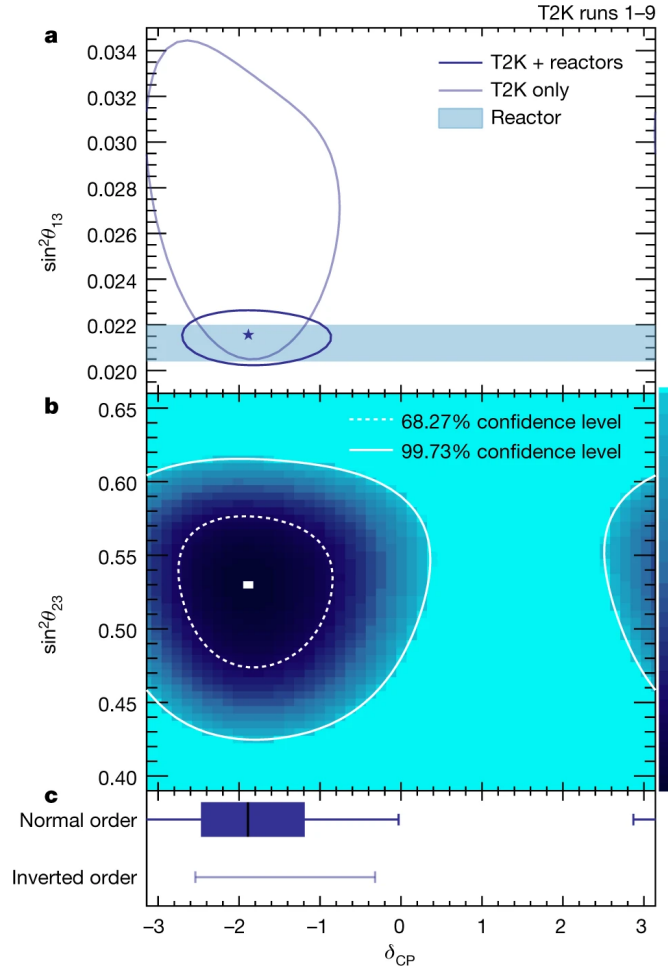
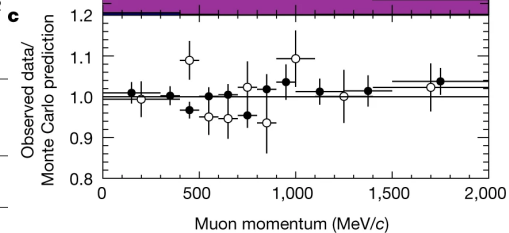
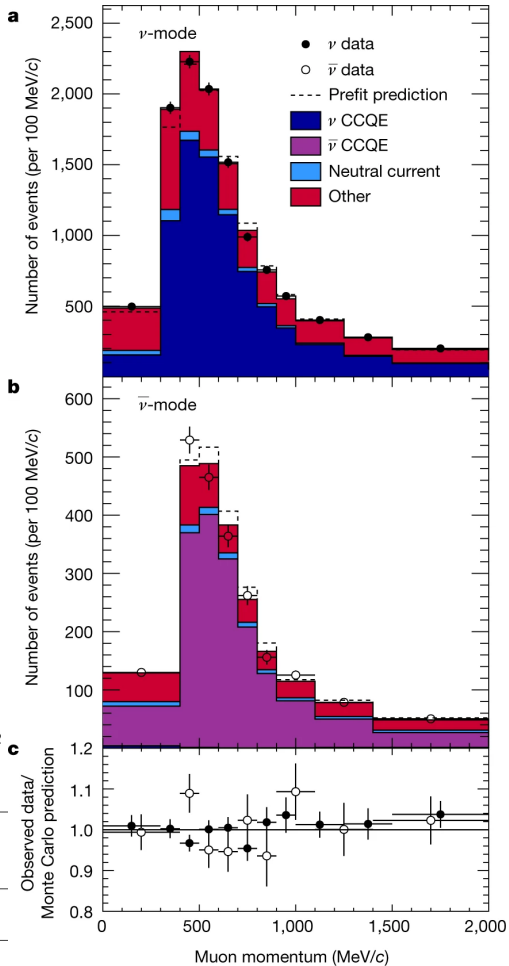


T2K

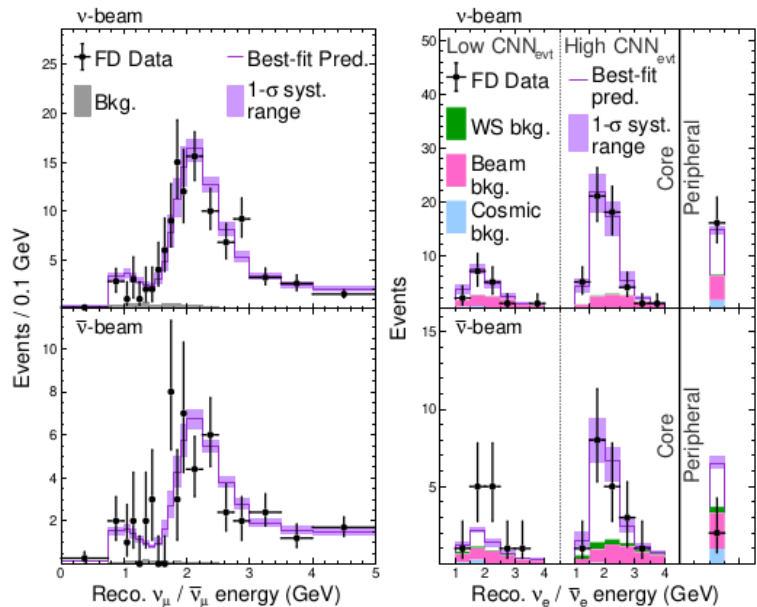
Nature 580, (2020) 339–344.



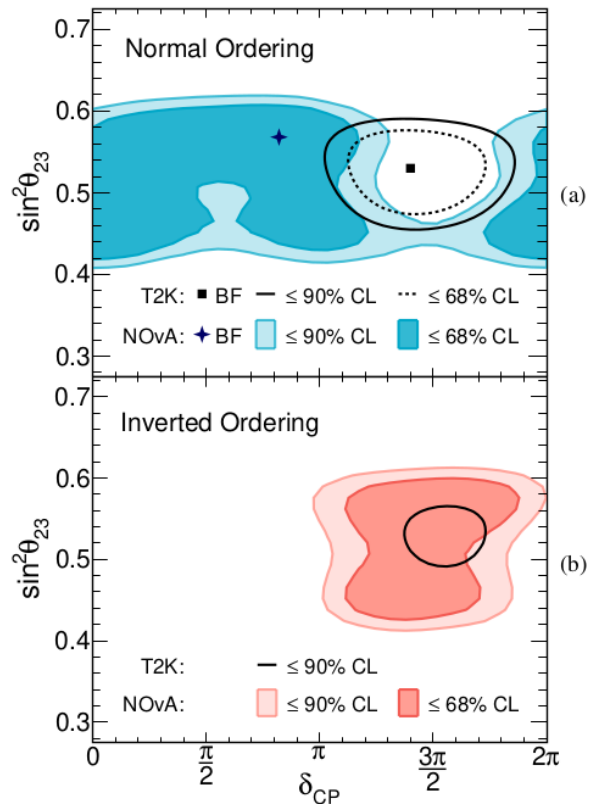
	1e0de ν -mode	1e0de $\bar{\nu}$ -mode	1e1de ν -mode
$\nu_\mu \rightarrow \nu_e$	59.0	3.0	5.4
$\bar{\nu}_\mu \rightarrow \bar{\nu}_e$	0.4	7.5	0.0
Background	13.8	6.4	1.5
Total predicted	73.2	16.9	6.9
Systematic uncertainty	8.8%	7.1%	18.4%
Data	75	15	15



Indication for CP violation?

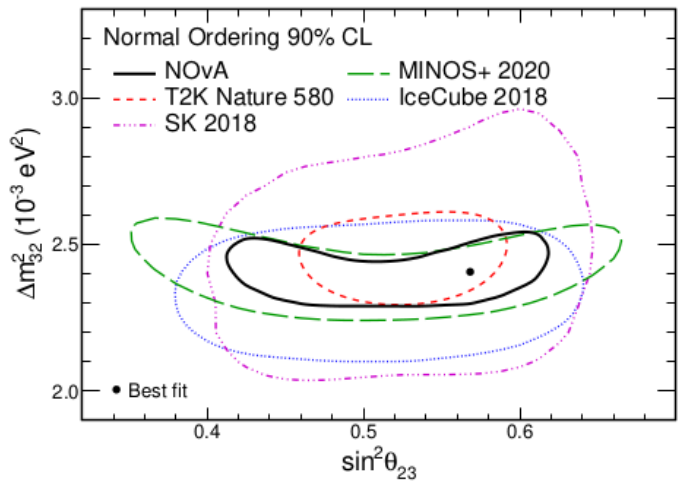


NOvA

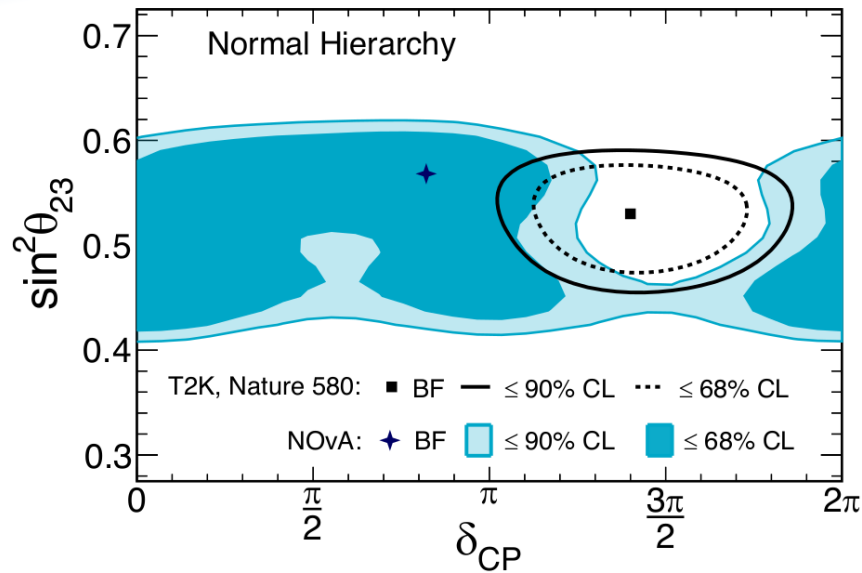


CP and mass hierarchy not independent.

Good agreement on the atmospheric data



T2K and NOvA

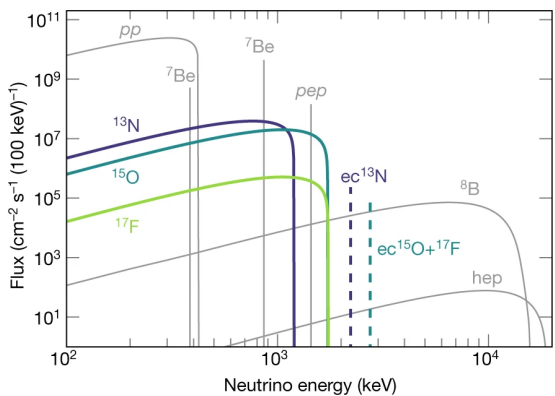
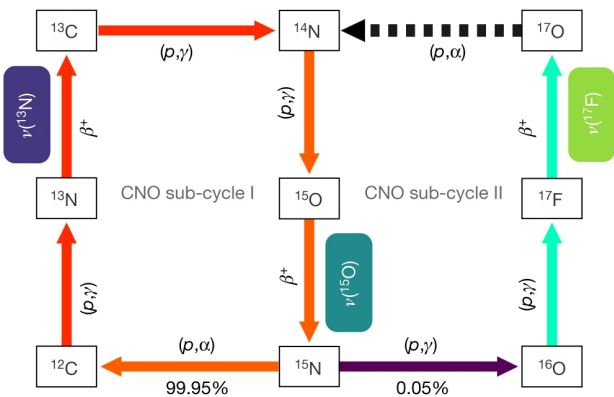
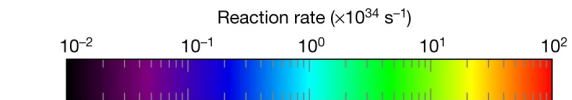


Maybe a statistical fluctuation

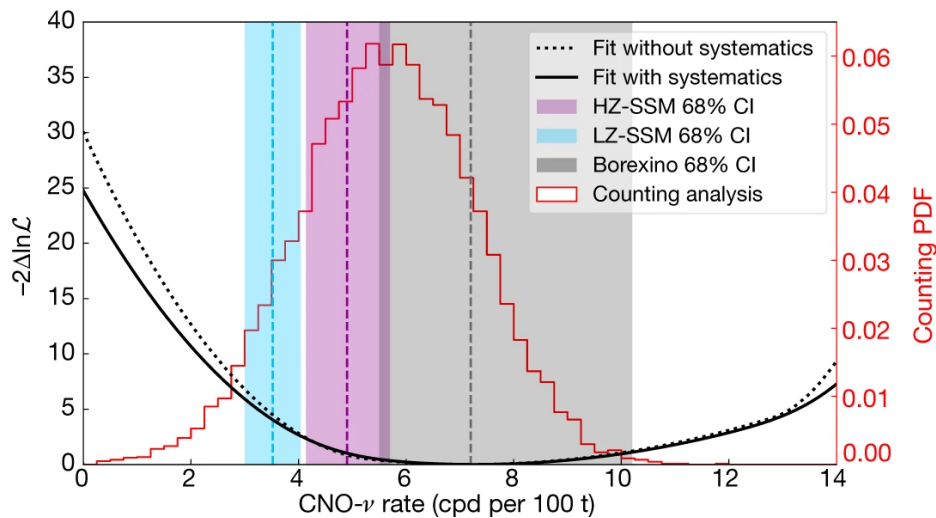
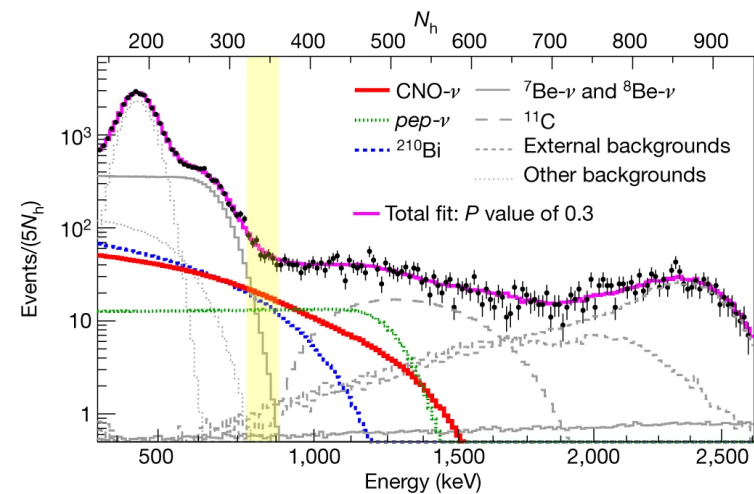
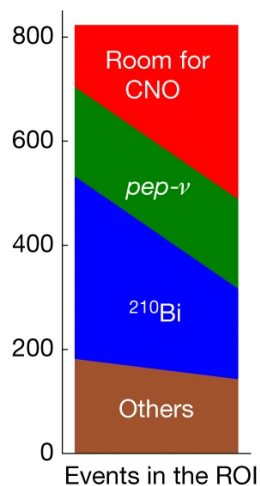
Could be exciting BSM (new matter effects etc.)

Also could be neutrino nucleus interaction systematic

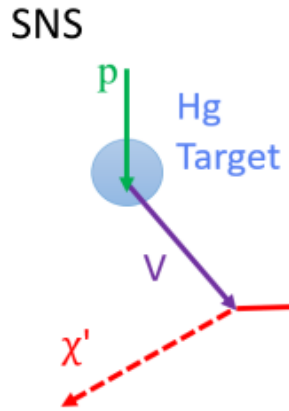
Borexino



Understanding fusion in stars was the original motivation for Davis and Bahcall to look at solar neutrinos.

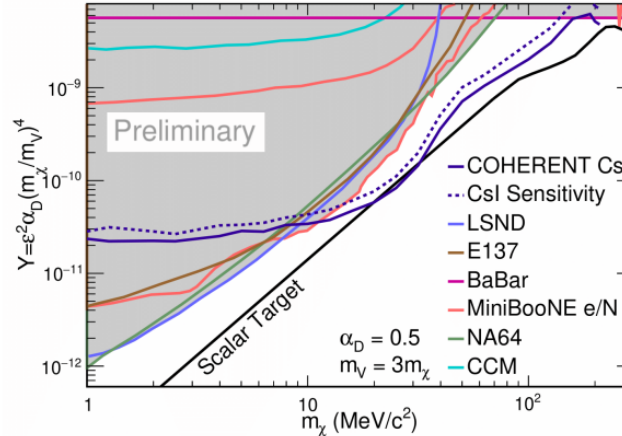
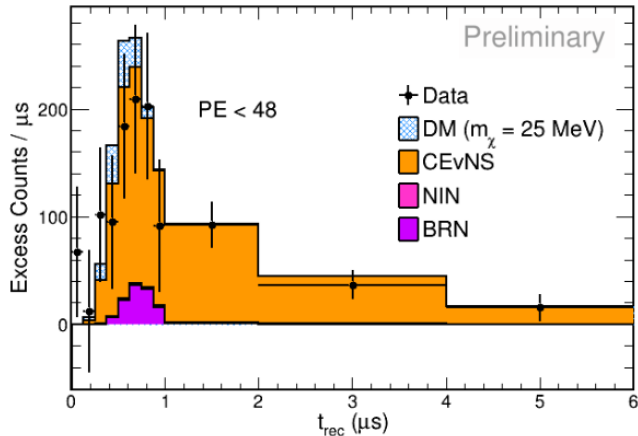
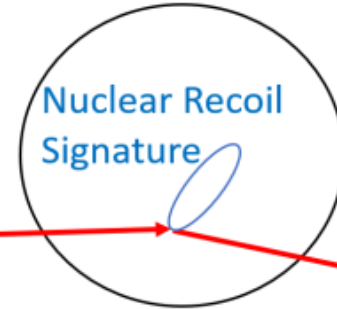


BSM at neutrino experiments



Recent COHERENT example at the SNS
Lots of theory activity

COHERENT detector



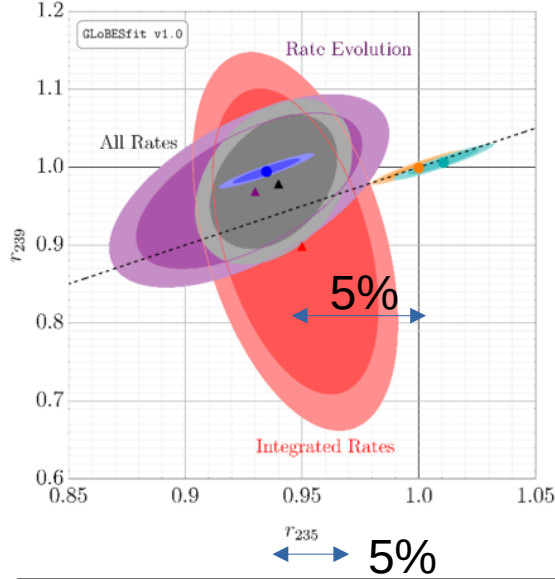
Intense flux of mesons/photons at neutrino beam target
→ light BSM states can be produced

Neutrino detectors ideal for detection (sub)weakly interacting particles.

SBN at FNAL very good at this and in the future DUNE

Reactor anomaly

Berryman, PH, JHEP 01 (2021) 167



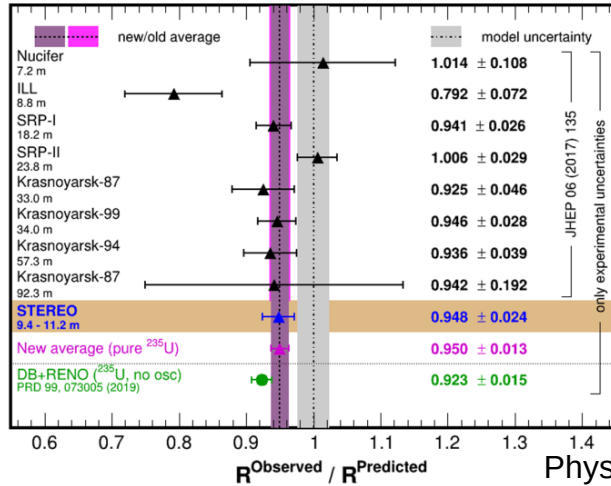
Overall RAA is about 6%

5% shift in U235 would nearly accommodate the RAA

Kopeikin *et al.* beta measurement moves 5% in the right way

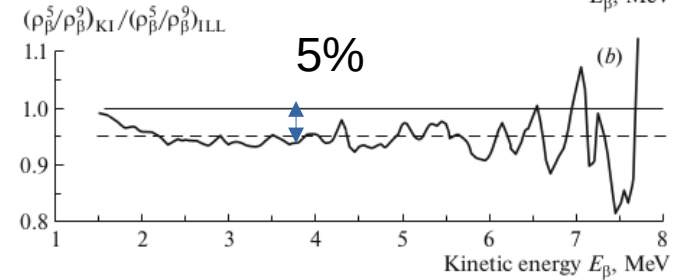
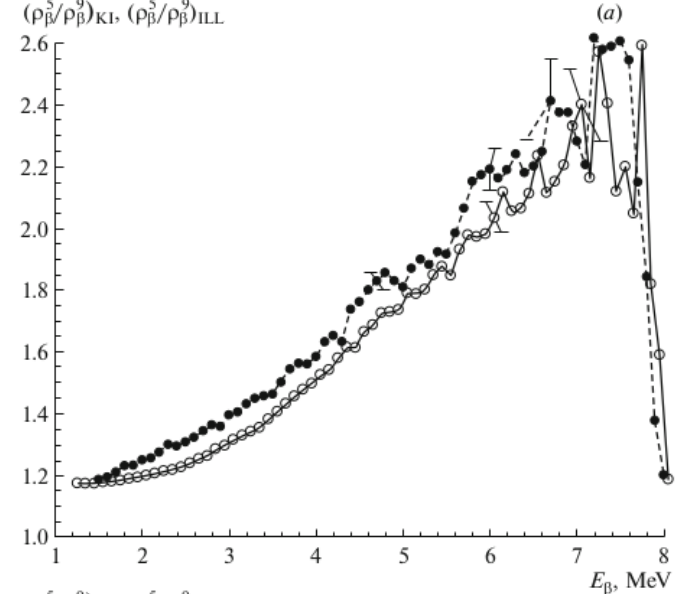
Which in turn would make HM flux prediction and neutrino flux measurement agree.

NB: 5 MeV bump remains...

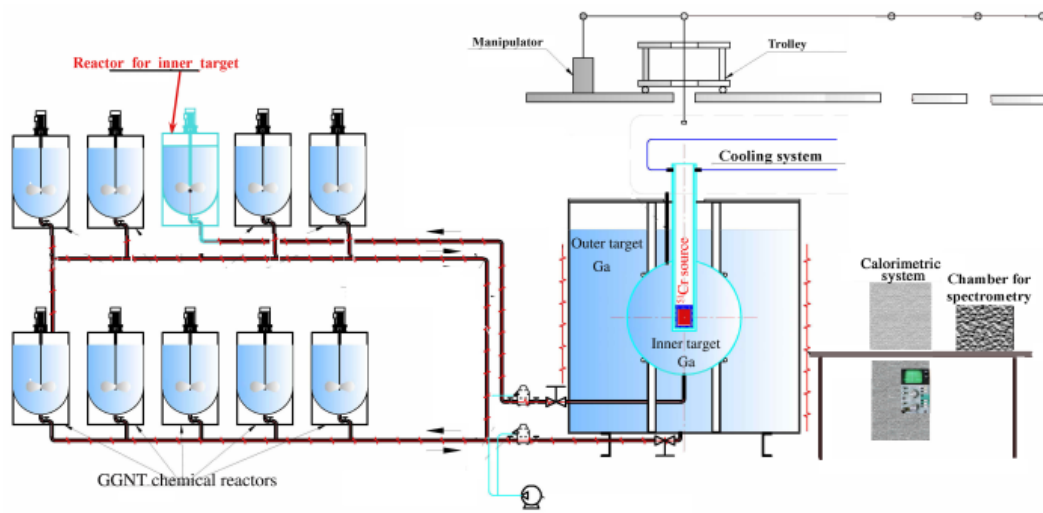


Phys.Rev.Lett. 125 (2020) 20, 201801

Kopeikin *et al.* Phys.Atom.Nucl. 84 (2021) 1

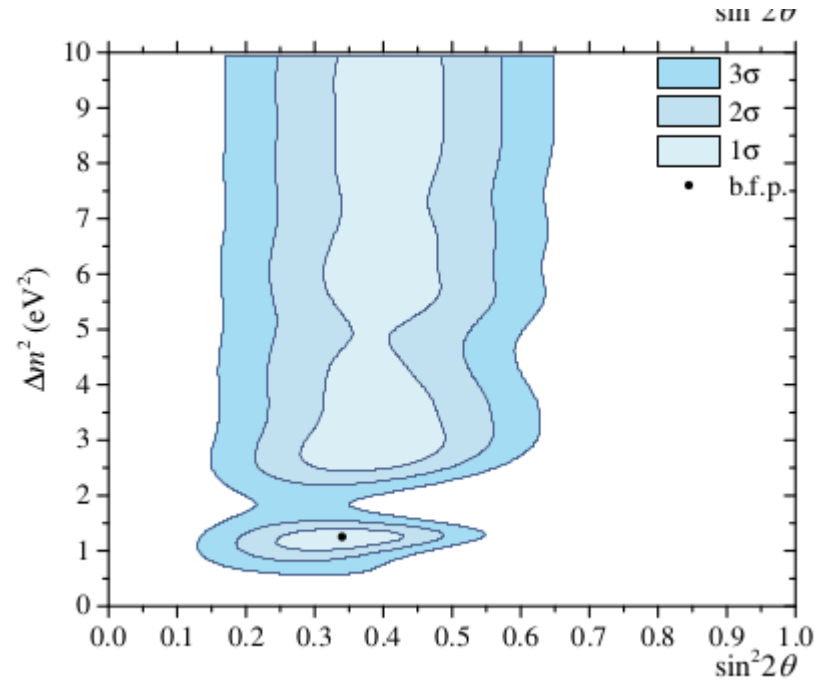


Gallium anomaly update



BEST collaboration, arXiv:2109.11482

$$R_{in} = 0.791 \pm 0.05 \text{ and } R_{out} = 0.766 \pm 0.05.$$



Consistent with previous gallium results, close to 4 sigma effect!

White paper coordination

Neutrino frontier is holding a series of short (~2 hour) workshops for coordination/discussion of particular Snowmass white paper topics

See NF calendar for dates/times <https://snowmass21.org/neutrino/start>

Date, Time (US Eastern)	Slot 1 Topic (contact)	Slot 2 Topic (contact)
July 28, 10 am	Kickoff	CEvNS (Louis Strigari, Phil Barbeau, Raimund Strauss)
August 27, 9 am	Tau neutrinos (Andre de Gouvea, Peter Denton, Irina Mocioiu)	Sterile neutrinos (Georgia Karagiorgi, Bryce Littlejohn, et al.)
Sept 7, 6 pm	Early career meeting (Jacob Zettlemoyer)	Early career meeting
September 22, 10 am	Neutrino Self-Interactions (Kevin Kelly, Nikita Blinov, Mauricio Bustamante, and Yue Zhang)	Open
October 7, 6 pm	STS Neutrinos (Kate Scholberg, Jason Newby)	Neutrino Cross Sections (Kendall Mahn) TBC
October 22, 9 am	Theory of Neutrinoless Double Beta Decay (TF11/NF09, Saori Pastore)	Reactor neutrinos (Nathaniel Bowden, Bryce Littlejohn, Pedro Ochoa)
November 2, 10 am [note: rescheduled from 6 pm]	Forward Physics Facility for the HL-LHC era (Jonathan Feng, Maria Vittoria Garzelli, Felix Kling, Milind Diwan)	Open
November 17, 10 am	Low Energy Physics in Liquid Argon (LEPLAr organizers)	NF Community Engagement (Claire Lee)
December 9, 6 pm	Neutrinos at ORNL (Kate Scholberg, Louis Strigari, Rex Tayloe, Jason Newby) TBC	Open

Contact NF conveners or topical group conveners if you'd like to organize in one of the open slots

NF report timeline

- Extended outline due (NF): Dec 18
- Report draft due (NF): Feb 28
- Contributed papers due: March 15
- NF Workshop: March 16-18
- Preliminary Report due (NF): May 10
- Preliminary Report due (Snowmass): May 31
- Final Report due (NF): Sept 9
- Final Report due (Snowmass): Sept 30, 2022

Neutrinos beyond HEP

- Panel discussion today at 2:30-4:30pm (ET) Zoom link
- Panelists:
- Laura Cadonati (gravitational waves)
- Rachel Carr (NuTools)
- Mark Kamionkowski (Astro 2020)
- Josh Klein (0NuBB NP panel)
- Manfred Lindner (IUPAP neutrino panel)