

# Introduction to WG5 "Beyond PMNS"

**WG5 Conveners:**

**Julia Harz (University of Mainz)**

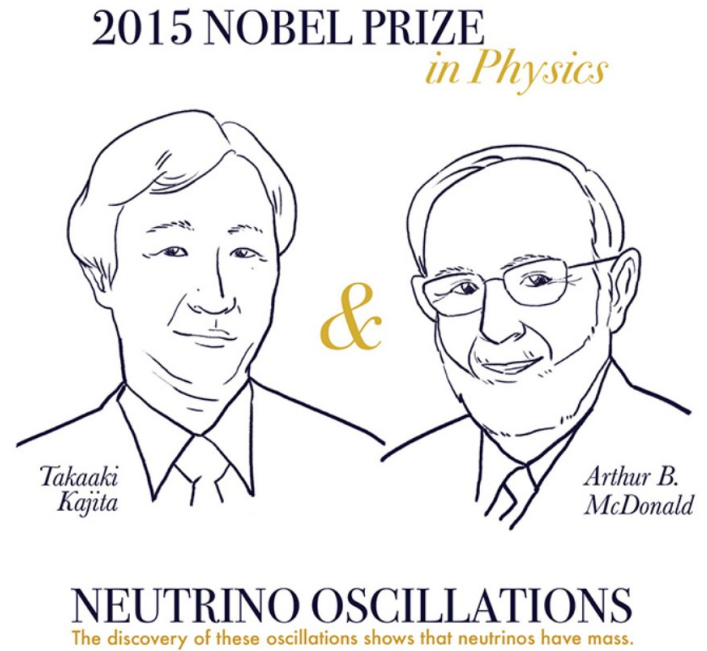
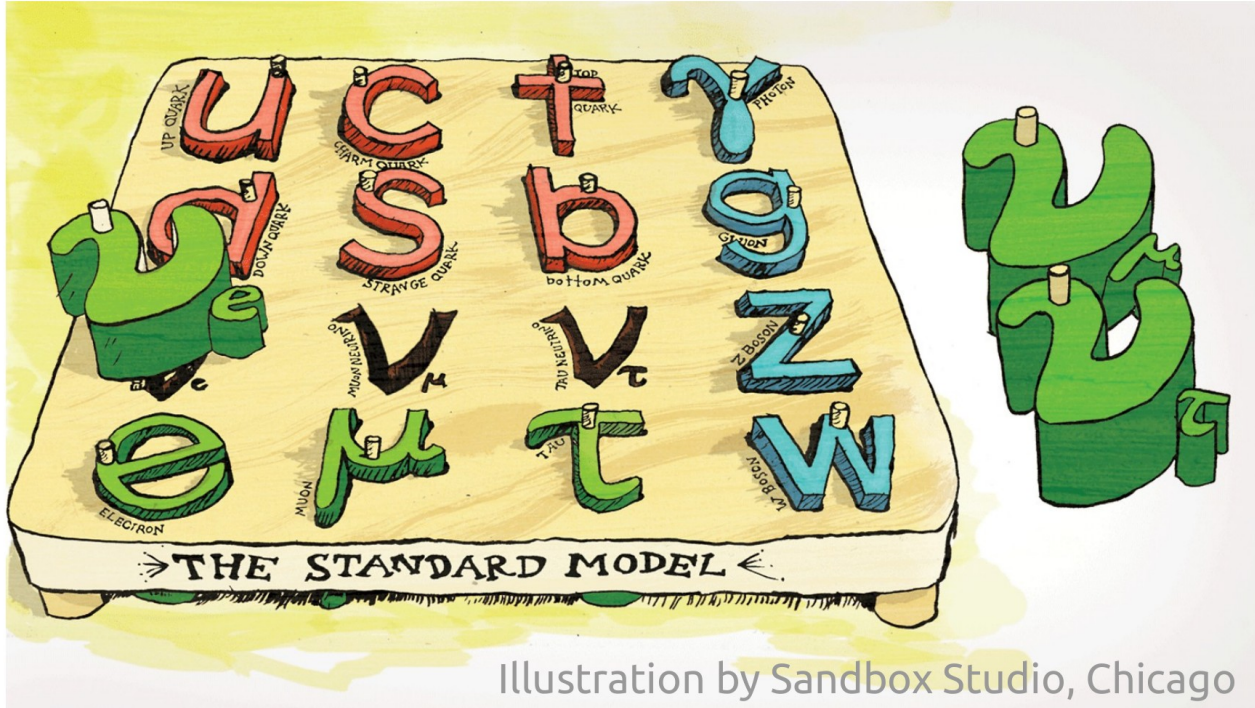
**Matheus Hostert (University of Iowa)**

**Donglian Xu (University of Shanghai)**

**NuFact 2025, September 1<sup>st</sup> - 6<sup>th</sup>  
University of Liverpool**



# Motivation of WG5: Neutrinos – the Standard Model misfits



SM describes massless neutrinos



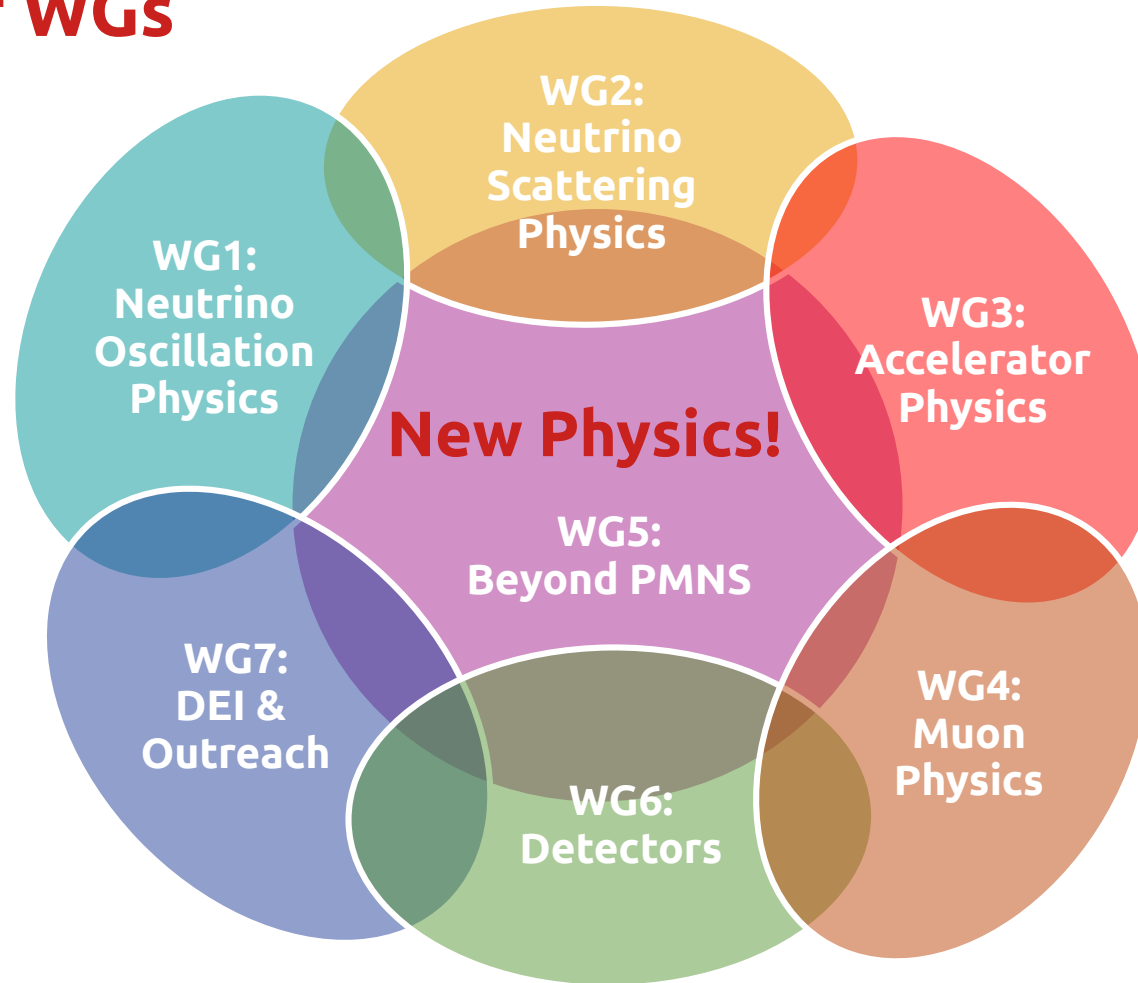
neutrino oscillations require massive ones

# Key questions of WG5

- What is the origin of the **neutrino masses**?
- Do **sterile neutrinos** exist?
- What is the nature of neutrinos – **Majorana or Dirac**?
- Do neutrinos feature **non-standard interactions**?
- Is there a link to the baryon asymmetry (→ **leptogenesis**)
- Is there a link to **dark matter**?

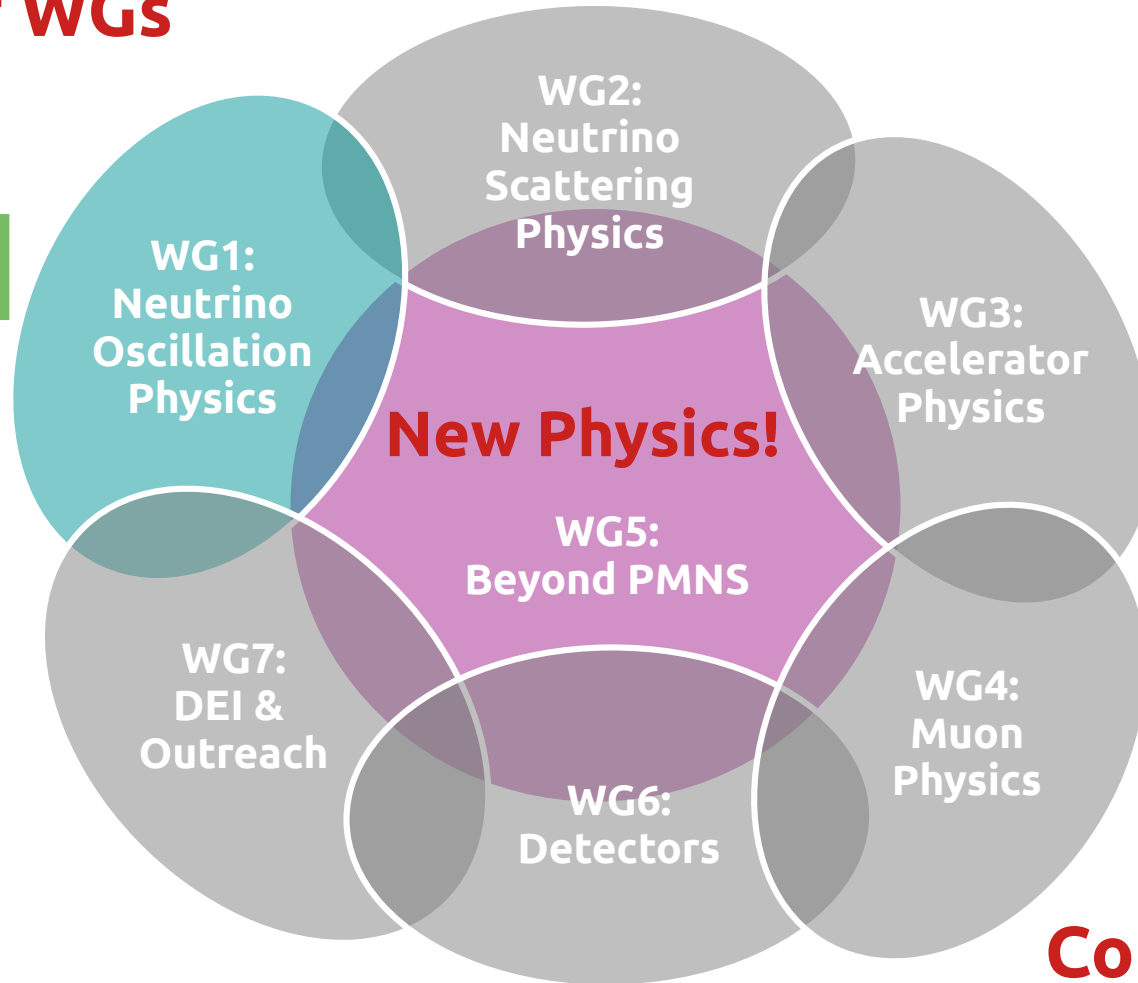


# Interplay of WGs



# Interplay of WGs

WG 1 + 5:  
Thursday, 13.45 -15.45



**Common session!**

# New physics in neutrino oscillations

- Non-standard interactions (**NSIs**) of neutrinos
- **CP, T Violation**
- **Neutrino mixing and unitarity test**
- **Specific models**, e.g. modular symmetries

**Neutrino Theory**

**Davide Meloni**

Friday 09:30 – 10:00

**Beyond PMNS at short-baselines**

**José I. Crespo-Anadón**

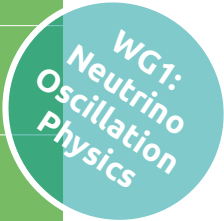
Friday 10:00 – 10:30

WG1:  
Neutrino  
Oscillation  
Physics

# New physics at long-baseline experiments

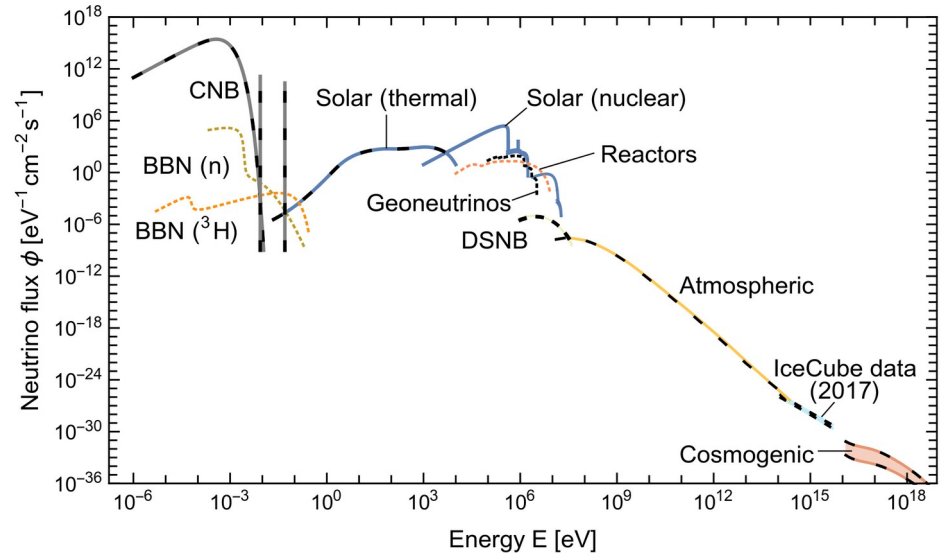
- Non-standard interactions (**NSIs**) of neutrinos
- **CP, T Violation**
- **Neutrino mixing and unitarity test**
- **Specific models**, e.g. modular symmetries

WG 5: Tuesday, 16:15 - 17.30	
T violation searches with DUNE and T2HK	Kiran Sharma (17:05 - 17:30)
WG 1 + 5: Thursday, 13:45 - 15.00	
Alternate presentations of neutrino oscillation results from T2K for the precision era	Marvin Pfaff (13:45 – 14:10)
Unitarity Test for Lepton Mixing	Sho Sugama (14:10 – 14:35)



# New physics with solar and atmospheric neutrinos

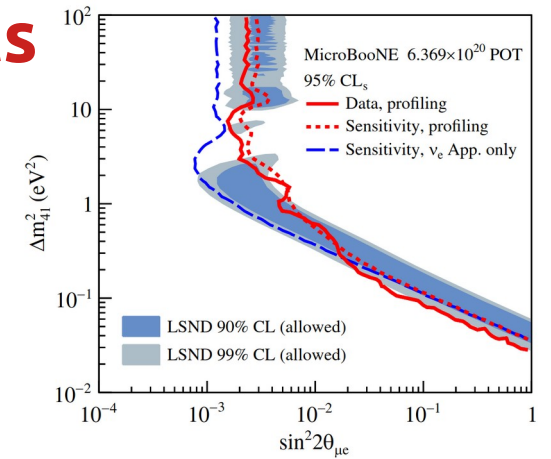
- Search for **non-standard interactions**
- **Mass hierarchy** and **mixing parameters**



<b>WG 5: Thursday, 11:00 - 12.00</b>	<b>guest convener:</b>	<b>Chandan Hati</b>
<b>Physics potential of solar neutrino detection with JUNO</b>		<b>Claudio Coletta (11:00 - 11:25)</b>
<b>Neutrino oscillation induced by a geometrical four-fermion interaction</b>		<b>Riya Barick (11:25 - 11:50)</b>

# New physics at short-baseline experiments

- short-baseline neutrino anomalies (e.g. MiniBooNE LEE, LNSD, gallium **anomalies**)
- Searches for **new (long-lived) BSM particles**
- Search for **sterile neutrinos**

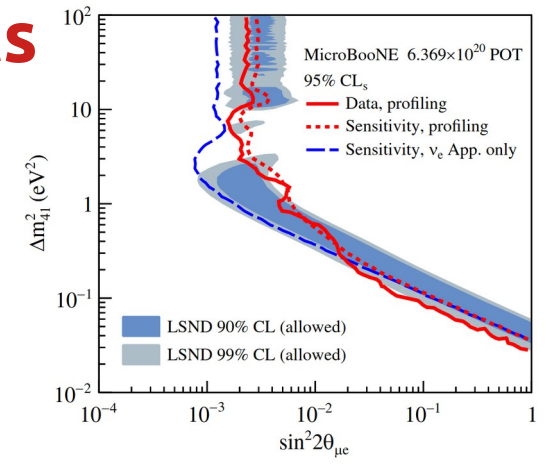


MicroBooNE collab. (2023)

WG 5: Tuesday, 13:45 - 15.00	guest convener:	José Crespo-Anadón
Searches for physics beyond the Standard Model with the Short-Baseline Near Detector		Rohan Rajagopalan (13:45 – 14:10)
MicroBooNE's beyond the Standard Model physics program		Magnus Handley (14:10 – 14:35)
WG 5: Tuesday, 16:15 - 17.30		
Searching for Generic Long-lived Particles with the SBND Cosmic-Ray Tagger Modules		Jiaoyang (16:40 - 17:05)

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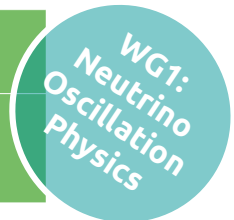


MicroBooNE collab. (2023)

WG 1+ 5: Thursday, 13:45 - 15.00

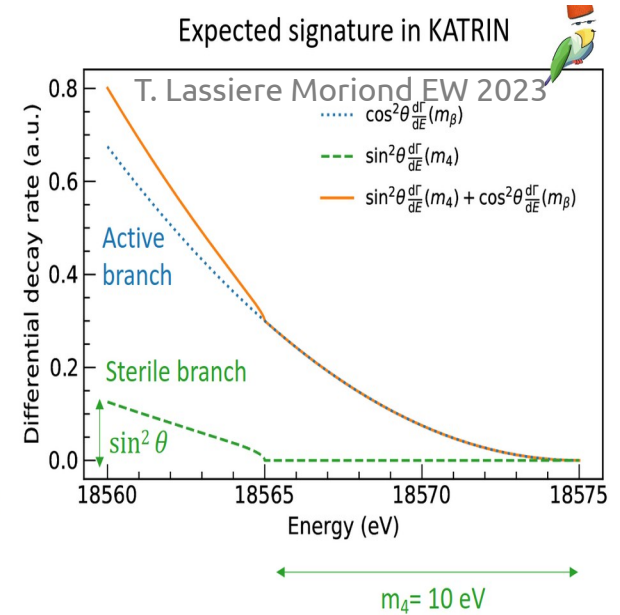
Investigations of the MiniBooNE anomaly and sterile neutrinos with MicroBooNE

Jessie Micallef  
(14:35 – 15:00)



# Absolute neutrino mass & search for sterile neutrinos

- search for **sterile neutrinos**
- Pin down absolute **neutrino mass**
- confront with **cosmology**



WG 5: Tuesday, 13:45 - 15.00

guest convener:

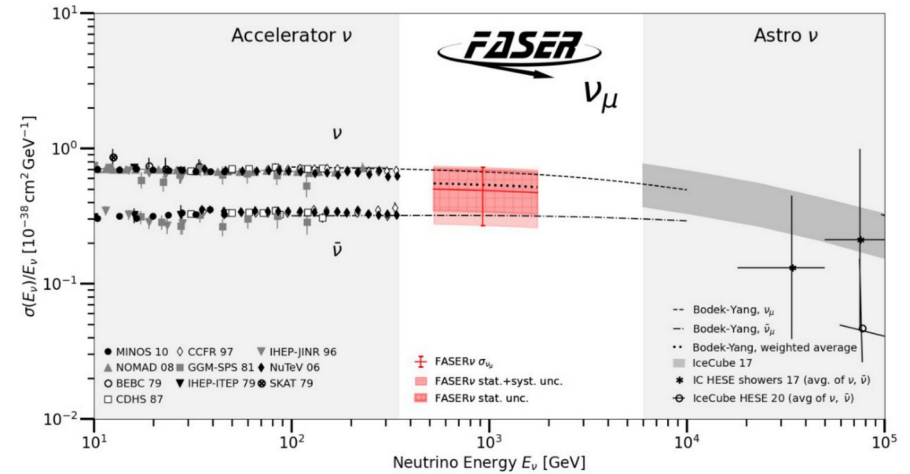
José Crespo-Anadón

eV and keV sterile neutrinos search with the KATRIN experiment

Anthony Onillon  
(14:35 - 15:00)

# Neutrinos at colliders

- Search for
- **right-handed neutrinos / HNLs**
  - **New mediators / interactions**
  - **Lepton-number violation**



→ **complementarity** with **neutrino oscillation** experiments, **astrophysical** neutrinos, **0νbb**, etc.

Neutrinos at Colliders

Felix Kling

Friday 11:30 – 12:00

WG 5: Tuesday, 16:15 - 17.30

Constraining neutrinophilic mediators at Forward Physics Facilities

Jiajun Liao  
(16:15 - 16:40)

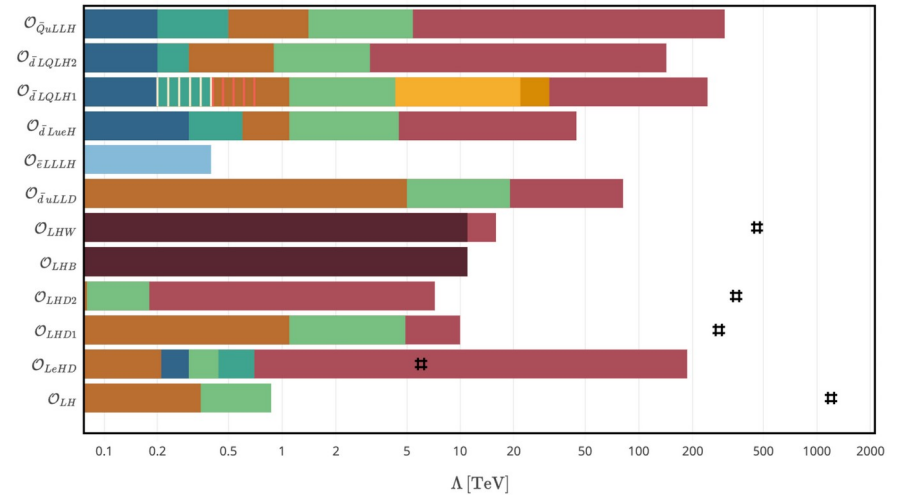
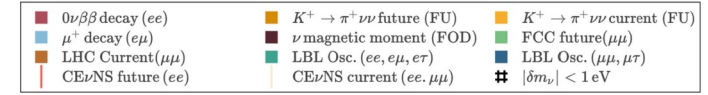
# Lepton Number Violation, SMEFT, and neutrino masses

- EFTs (SMEFT, LEFT) to constrain or discover novel neutrino interactions model independently

$$\mathcal{L} = \mathcal{L}_{\text{SM}} + C_5 \mathcal{O}_5 + \sum_i C_6^i \mathcal{O}_6^i + \sum_i C_7^i \mathcal{O}_7^i + \dots$$

LNC
LNV

- Link to neutrino mass models and leptogenesis

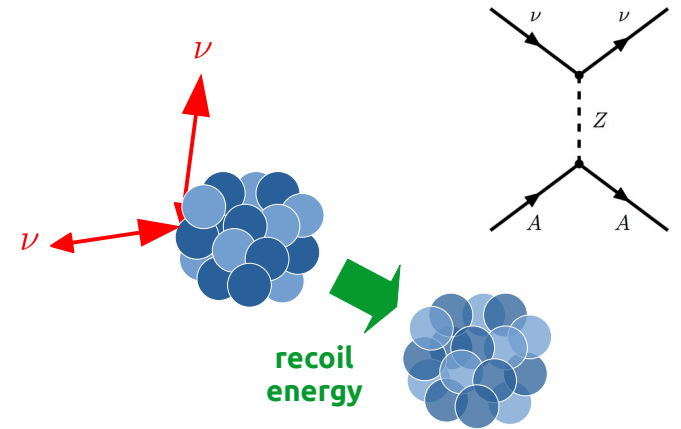


**Beyond PMNS with Lepton Number Violation** **Chandan Hati**

Wednesday 12:40 – 13:10

# Coherent Elastic Neutrino Nucleus Scattering: CEvNS

- Worldwide effort to run, build and develop new CEvNS experiments
- Vast theory efforts in exploiting CEvNS (**NSIs, magnetic moment, CPV, light scalars, etc...**)
- Connection to dark matter searches



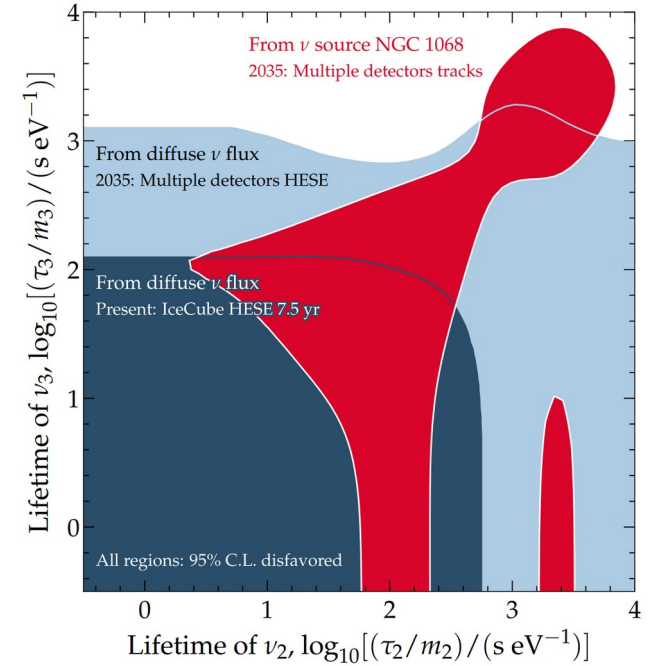
Physics Opportunities of Coherent Elastic Neutrino-Nucleus Scattering Phenomenology

Diego Aristizabal

Freitag 17:00 - 17:30

# Beyond PMNS with astrophysical neutrinos

- New limits on **neutrino decay**
- Probing **Lorentz invariance**
- **Flavour composition** of high-energy cosmic neutrinos
- Limits on **neutrino interactions**



Beyond PMNS with Astrophysical Neutrinos

Mauricio Bustamante

Thursday 09:30 – 10:30

# Summary

- **Many plenary talks tightly linked to new physics and WG5**
- **11 parallel talks in WG5 (incl. combined session with WG1)**
- **2 guest chairs in WG5: Chandan Hati (IFIC, University of Valencia), José I.Crespo-Anadón (CIEMAT Madrid)**

**Enjoy the program!**

