

The Impact of IceCube Data on Global Fits to Light Sterile Neutrinos

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Invisibles17 Workshop

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Introduction

What is a sterile neutrino?

- **Lepton**
- **Singlet** under all gauge groups (of the SM)

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- All common descriptions of a neutrino mass invoke a **sterile neutrino**



Detecting Sterile Neutrinos in Oscillation Experiments



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Anomalies in short baseline (SBL) experiments

- $\bar{\nu}_\mu$ **appearance**: **Excess** in SBL **beam experiments** (LSND and MiniBooNE) $\bar{\nu}_\mu \rightarrow \bar{\nu}_e$
- $\bar{\nu}_e$ **disappearance**: **Deficit** in **reactor flux** measurements $\bar{\nu}_e \rightarrow \bar{\nu}_e$
- ν_e **disappearance**: **Deficit** in **radioactive source experiments** (GALLEX, SAGE) $\nu_e \rightarrow \nu_e$

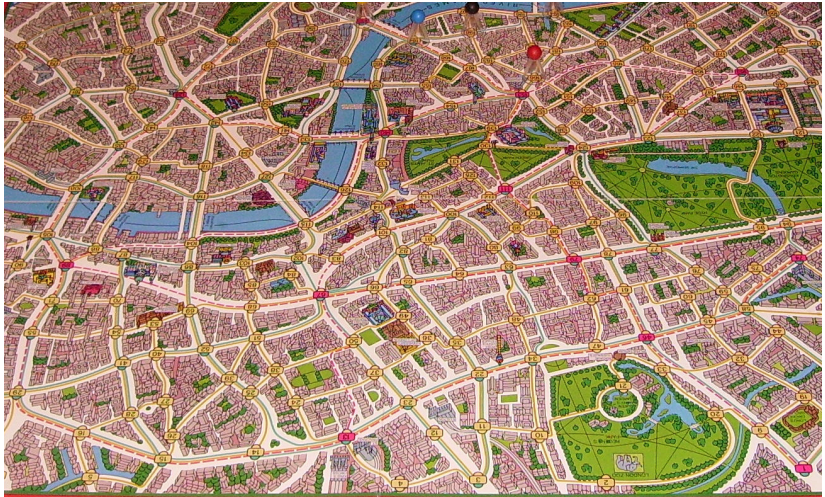
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Global Fits to Light Sterile Neutrinos



Global Fits to Light Sterile Neutrinos

Global fit to $\bar{\nu}_e$ disappearance

Kopp, Machado, Maltoni, Schwetz, 1303.3011

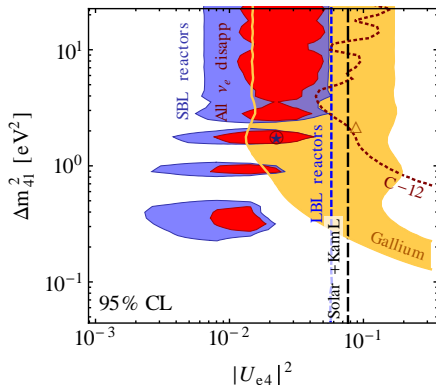
Data

- SBL reactor experiments ($L \ll 1$ km)
- Radioactive source experiments (gallium)
- Long BL (**LBL**) reactor experiments ($L \sim 1$ – 2 km)
- Very long-baseline reactor experiments ($L \gg 1$ km)
- Solar neutrino experiments
- ν_e scattering on C-12 ($\nu_e + {}^{12}\text{C} \rightarrow e^- + {}^{12}\text{N}$)

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Global Fits to Light Sterile Neutrinos

Update Global fit to $\bar{\nu}_e$ disappearance

MD, Kopp, Machado, Maltoni, Martinez, Schwetz, in preparation

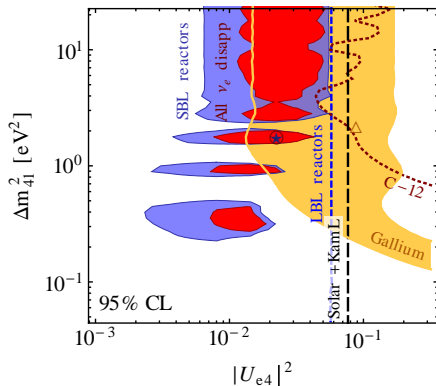
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DANSS, NEOS, including spectral analysis
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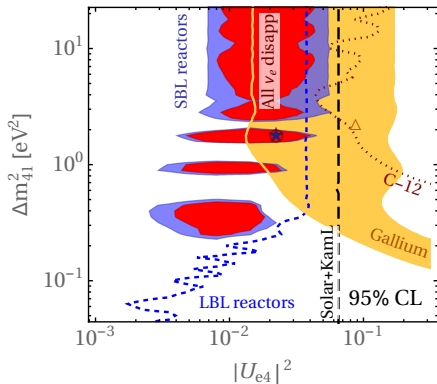
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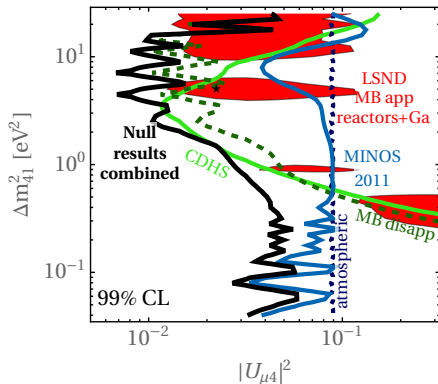
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- Nova (high energy beam, LBL, off-axis)
- IceCube (atmospheric ν' + NC matter effects)

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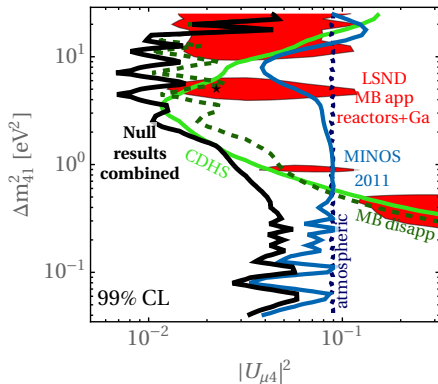
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NEW FEATURE

The Impact of IC on Global Fits to Sterile ν

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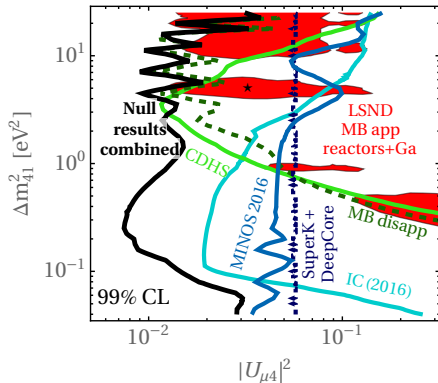
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The Impact of IC on Global Fits to Sterile ν

Statistics

Global fit 2013 Kopp, Machado, Maltoni, Schwetz, 1303.3011

	$\chi_{\min}^2 / \text{dof}$	GOF
3+1	712/(689 - 9)	19%
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1+3+1	694/(689 - 14)	30%

strong tension in data sets **not reflected** by **GOF parameter**, because a large number of data points is **not sensitive** to tension
 \Rightarrow **"dilution"** of **GOF**

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Maltoni Schwetz hep-ph/0304176

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"improves" limit **by factor 3**

Summary

Light Sterile Neutrinos

- Sterile neutrinos are **theoretically well motivated**
- **Light** sterile neutrinos are **well motivated by experimental anomalies**
- (Updated) global fits to all oscillation data show **severe tension**

Thank you for your Attention!

