Discussion session on neutrinos

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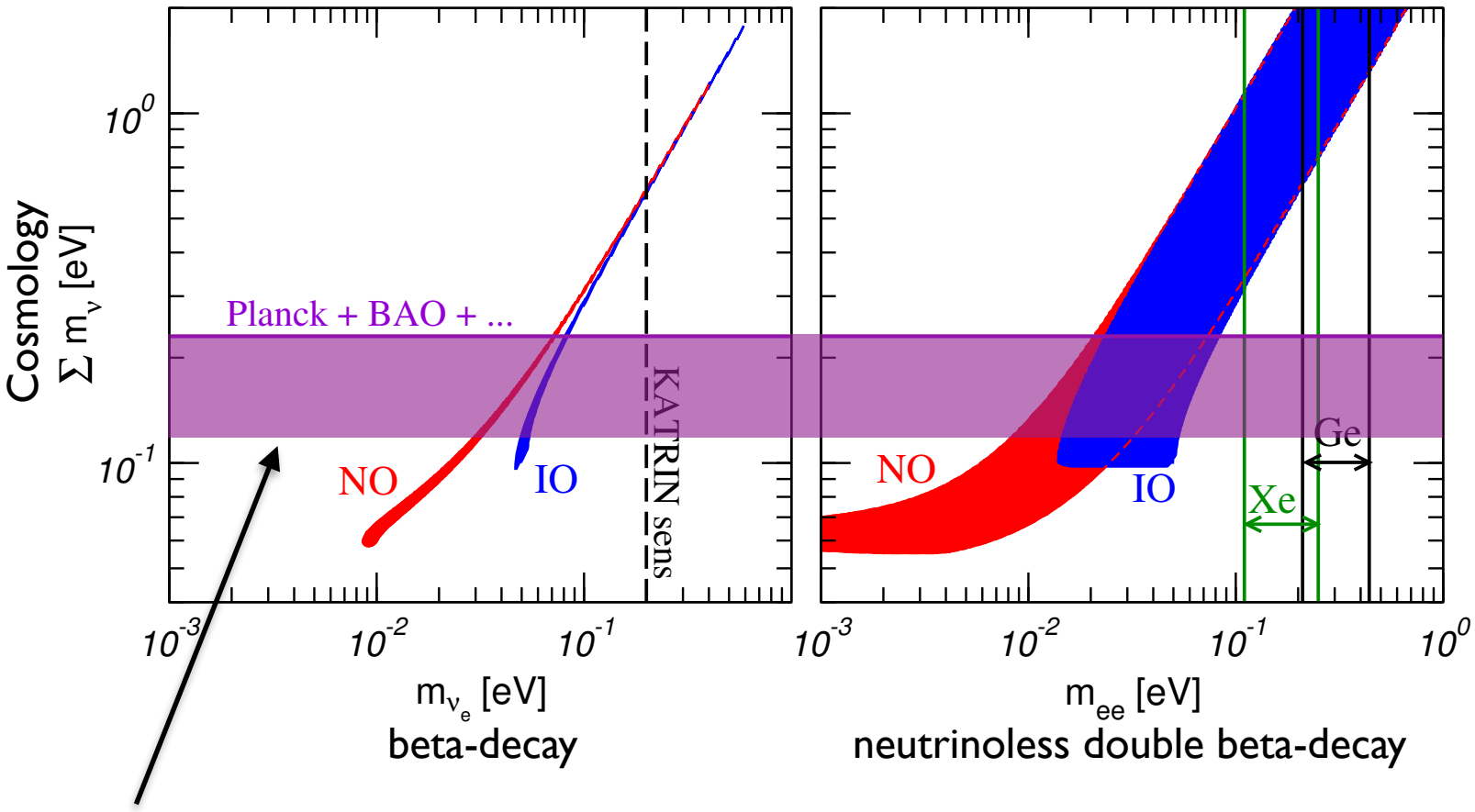
elusives neutrinos, dark matter &

Proposed questions

- absolute neutrino mass observables
- are sterile neutrinos at the eV-scale still interesting?
- are non-standard neutrino interactions interesting?
- are TeV-scale neutrino models interesting?
- is type-I seesaw our „default“ choice?

Absolute neutrino mass observables

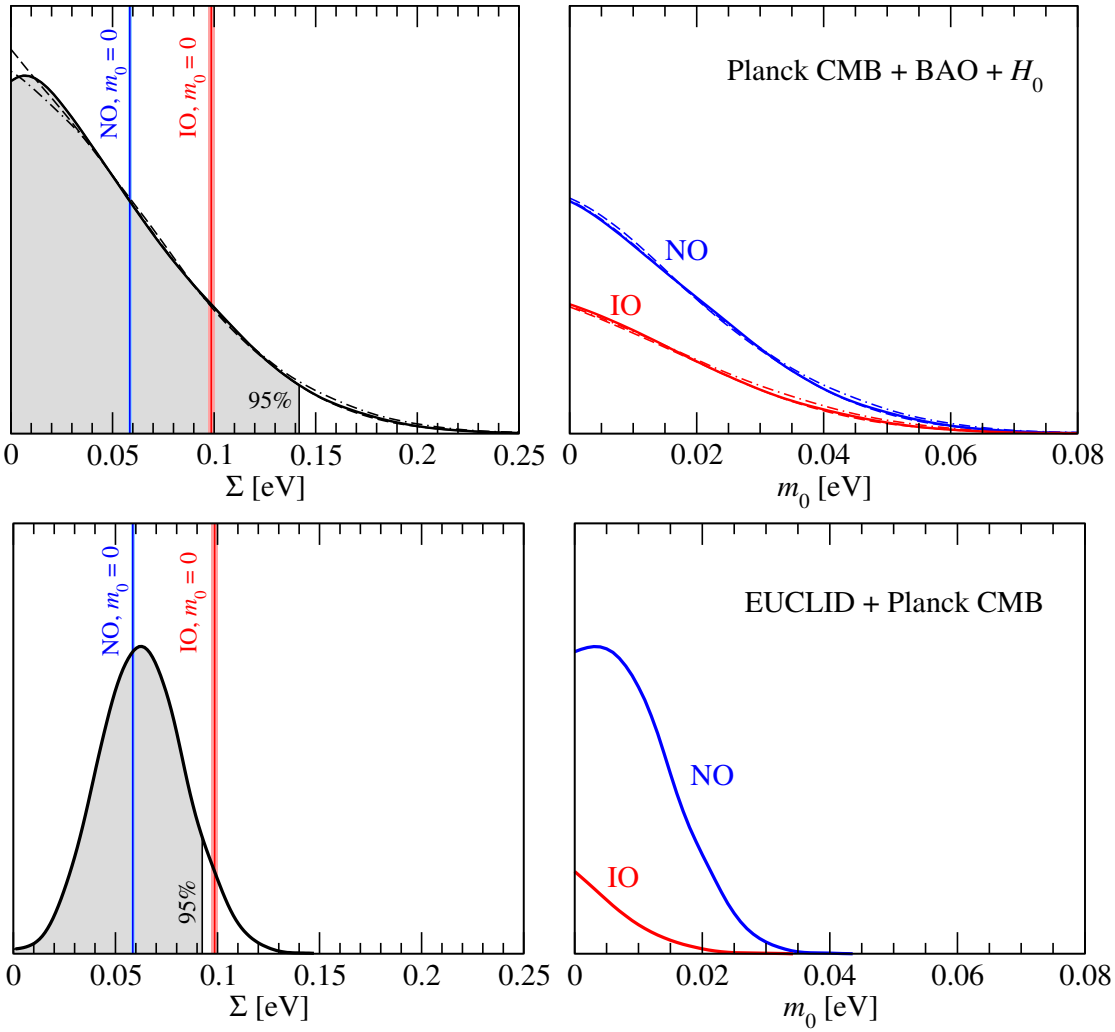


incl. Lyman-α

Baur et al., 1506.05976

talks by E. Lisi, M. Gerbino

Mass ordering from cosmology

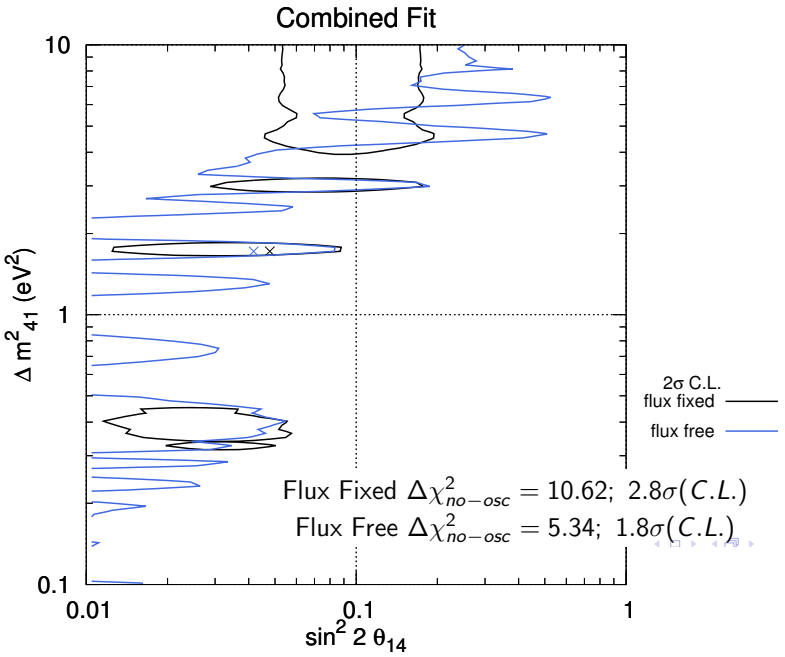


talk by M. Gerbino

Hannestad, Schwetz, 16

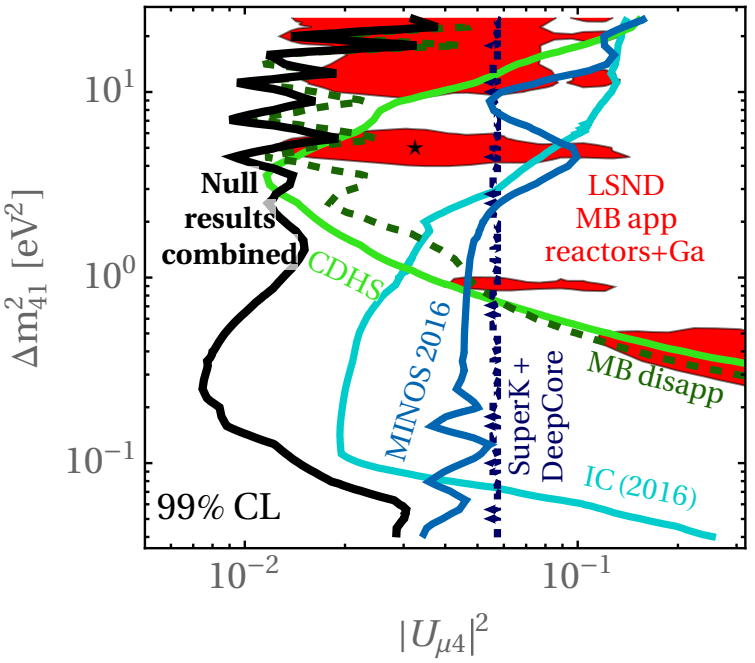
eV-scale sterile neutrinos

reactor experiments



Alvaro H. Cabezudo

ν_μ disappearance



Mona Dentler

Nonstandard interactions

assume presence of NC-like dim-6 effective operators:

$$H_{\mathrm{NSI}} = \frac{G_F}{\sqrt{2}} \bar{\nu}_\alpha \gamma_\mu (1-\gamma_5) \nu_\beta \sum_f \bar{f} \gamma^\mu \epsilon^f_{\alpha\beta} f$$

- phenomenological parameterization
- new interactions relative to standard weak interaction
- rich phenomenology (oscillation physics, new CP phases, „confusion“ problem, astrophysics,…)

talk by M. Sen, L. Duarte, huge literature,….

NSI constraints from oscillation data

Gonzalez-Garcia, Maltoni, 1307.3092

		90% CL	
Param.	best-fit	LMA	LMA ⊕ LMA-D
$\varepsilon^u_{ee} - \varepsilon^u_{\mu\mu}$	$+0.298$	$[+0.00, +0.51]$	$\oplus\ [-1.19, -0.81]$
$\varepsilon^u_{\tau\tau} - \varepsilon^u_{\mu\mu}$	$+0.001$	$[-0.01, +0.03]$	$[-0.03, +0.03]$
$\varepsilon^u_{e\mu}$	-0.021	$[-0.09, +0.04]$	$[-0.09, +0.10]$
$\varepsilon^u_{e\tau}$	$+0.021$	$[-0.14, +0.14]$	$[-0.15, +0.14]$
$\varepsilon^u_{\mu\tau}$	-0.001	$[-0.01, +0.01]$	$[-0.01, +0.01]$
$\varepsilon^d_{ee} - \varepsilon^d_{\mu\mu}$	$+0.310$	$[+0.02, +0.51]$	$\oplus\ [-1.17, -1.03]$
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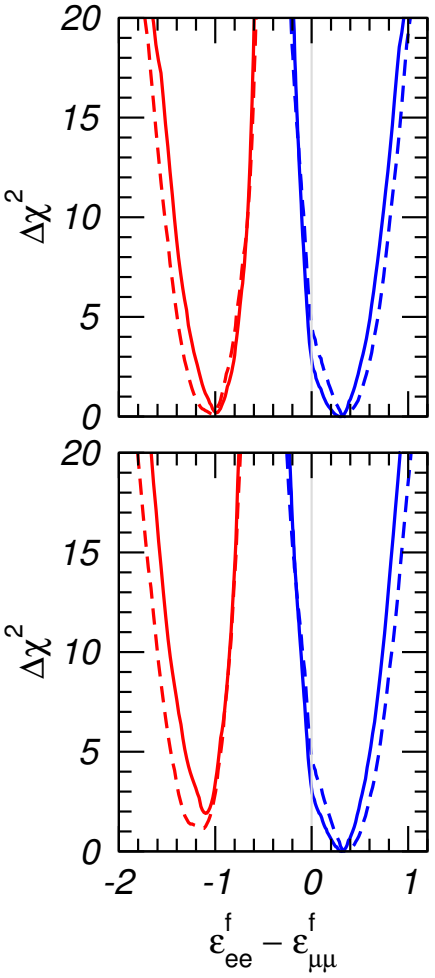

- limits of few %,
- exceptions: $\varepsilon_{e\tau}$, ε_{ee}-$\varepsilon_{\mu\mu}$

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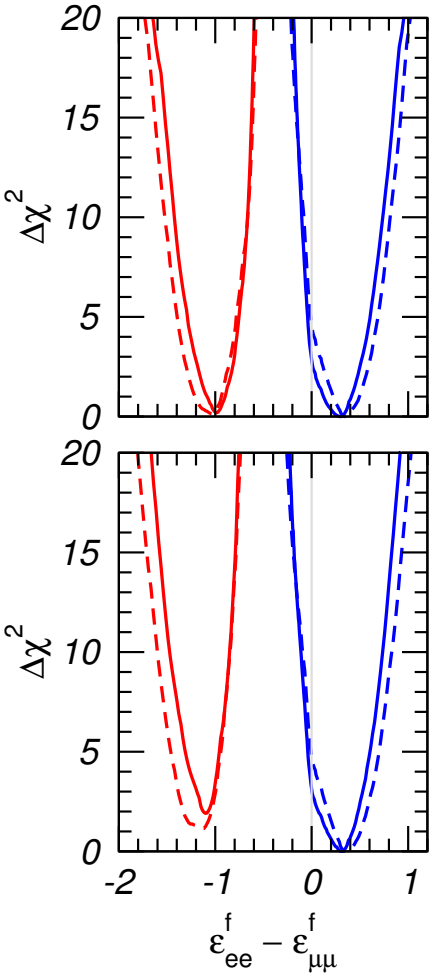

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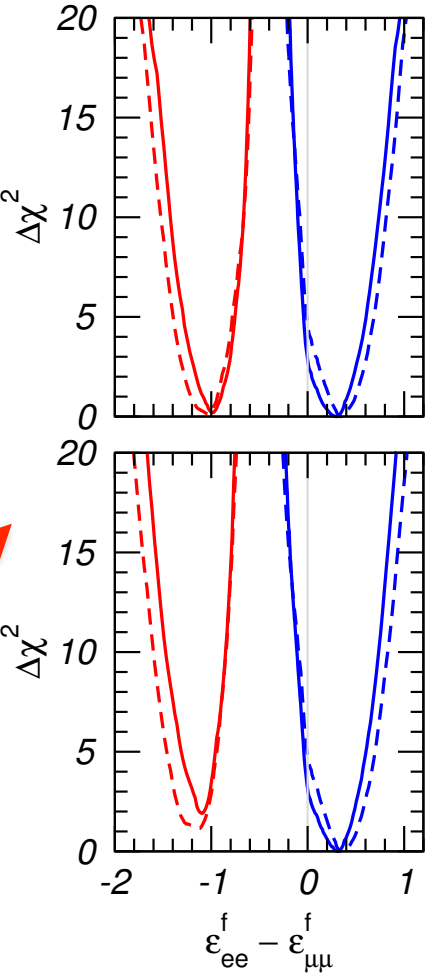

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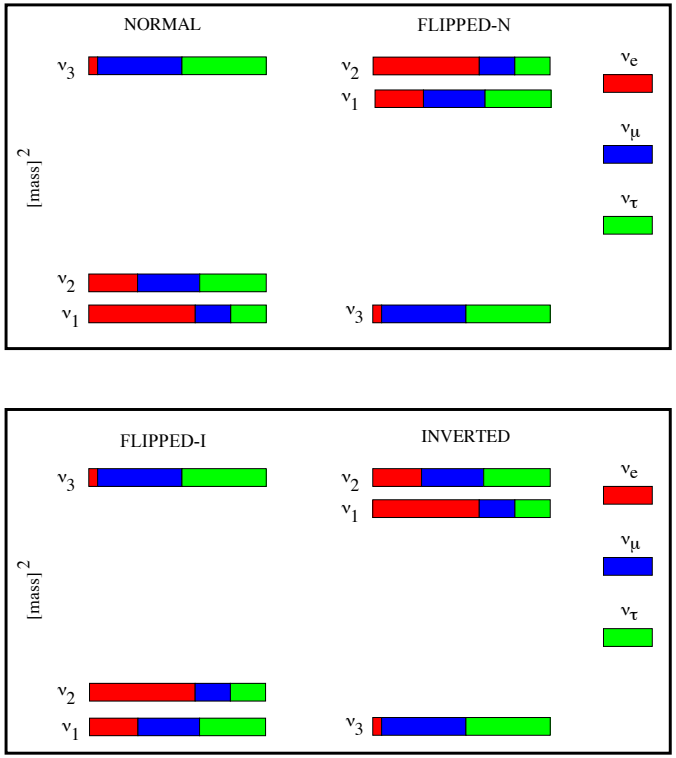
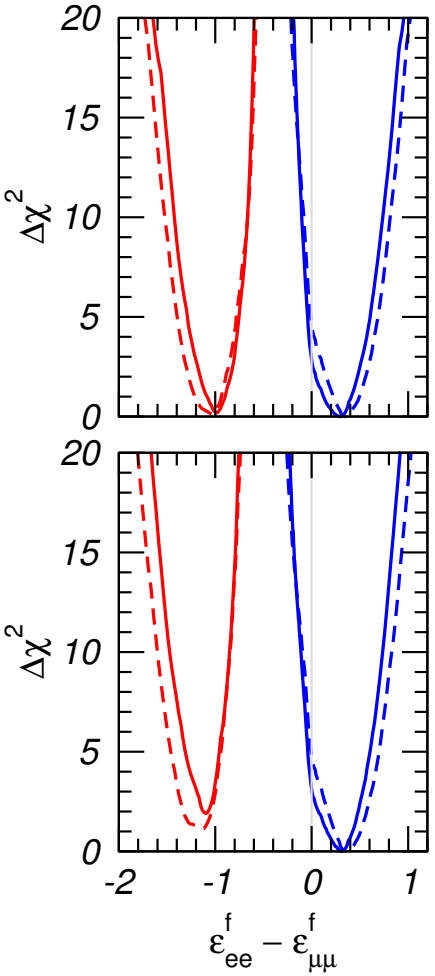
LMA-dark degeneracy





Coloma, Schwetz, 16, Coloma et al 17

LMA-dark degeneracy makes determination of mass ordering by oscillation experiments impossible! Need data from scattering experiments.

Is this interesting at all?

$$H_{\rm NSI} = \frac{G_F}{\sqrt{2}} \bar{\nu}_\alpha \gamma_\mu (1-\gamma_5) \nu_\beta \sum_f \bar{f} \gamma^\mu \epsilon^f_{\alpha\beta} f$$

- not gauge invariant
- generically not directly related to neutrino mass generation (dim-6,8,.. vs dim-5,7,…)
- strong constraints from charged leptons
- can we expect under any circumstance O(1) NSI?

Biggio, Blennow, Fernandez-Martinez, …

- light mediators ~ 10 MeV?

  explicit expample for O(1) NSI: Farzan 15; Farzan, Shoemaker, 15

TeV scale neutrino mass models

- Tiplet, Zee, Zee-Babu, Ma, L-R,…
- testable at LHC, LFV
- are they theoretically motivated?
- L-number violation at TeV:
  is it a challenge for Baryogenesis?

Type-I seesaw

- Is it the „default“ model?
- Does it make sense without SUSY?
  contribution to EW fine-tuning vs Leptogenesis,
  hierarchy problem: EW ↔ seesaw ↔ GUT
- Is low-scale type-I preferred (as low as GeV)?