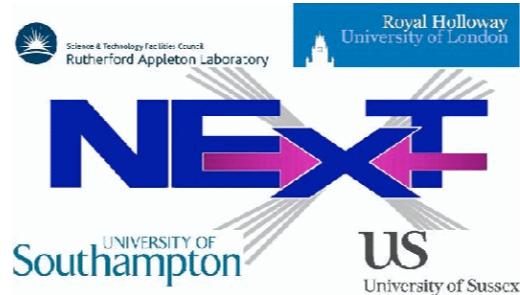


Luca Marzola



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Southampton

Strong SO(10)-inspired leptogenesis

– predictions and justification –

Reference papers:

- E. Bertuzzo, P. Di Bari, L.M. - Nucl.Phys.B849:521-548,2011
- P. Di Bari, L. M. - in preparation

The model:

- Seesaw type I, 3 RH neutrinos N_{Ri}

$$\mathcal{L} = \mathcal{L}_{SM} + i\overline{N_{Ri}}\partial^\mu\gamma_\mu N_{Ri} - h_{\alpha i}\overline{\ell_{L\alpha}}N_{Ri}\tilde{\Phi} - \frac{1}{2}\sum_{i=1}^3\overline{N_{Ri}^c}D_{Mi}N_{Ri} + \text{H.c.}$$

→ 18 new parameters: $h_{\alpha i}, M_i$.

$$D_x := \text{diag}(X_1, X_2, X_3)$$

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- Seesaw algebra:

assuming diagonalised charged leptons

$$m_D = vh \quad m_\nu = -m_D \frac{1}{D_M} m_D^T \quad -D_m = U^\dagger m_\nu U^*$$

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- Our choice:

$$15 + 3 \rightarrow 6 + 3 + 6 + 3$$

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neutrino oscillation
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SO(10)-inspired leptogenesis:

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- V_L mixing angles not larger than CKM ones
- light neutrino Dirac masses proportional to the up-type quark ones:

$$D_{m_D} = \begin{pmatrix} \alpha_1 m_u & 0 & 0 \\ 0 & \alpha_2 m_c & 0 \\ 0 & 0 & \alpha_3 m_t \end{pmatrix}$$

m_D parametrized by $\alpha_i \sim O(1)$...but only α_2 matters!

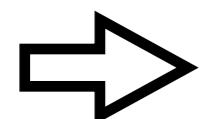
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Strongly hierarchical RH neutrino mass spectrum:

$$M_3 > 10^{12} \text{ GeV} > M_2 > 10^9 \text{ GeV} \gg M_1$$

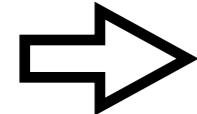
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- **Leptogenesis process: N_2 dominated scenario**

P. Di Bari, A. Riotto; 2010

$$N_{B-L}^{lep,f} \simeq \frac{P_{2e}^0}{P_{\tilde{\tau}_2}^0} \varepsilon_{\tilde{\tau}_2} \kappa(K_2, K_{\tilde{\tau}_2}) e^{-\frac{3\pi}{8} K_{1e}} + \frac{P_{2\mu}^0}{P_{\tilde{\tau}_2}^0} \varepsilon_{\tilde{\tau}_2} \kappa(K_2, K_{\tilde{\tau}_2}) e^{-\frac{3\pi}{8} K_{1\mu}} + \varepsilon_{2\tau} \kappa(K_2, K_{2\tau}) e^{-\frac{3\pi}{8} K_{1\tau}}$$

- N_3 : no active role
- N_2 : asymmetry production in a 2-flavour regime
- N_1 : asymmetry wash-out ($M_1 < 10^9$ GeV) in a 3-flavour regime

Strong thermal leptogenesis:

- Why $\eta_B^{CMB} \sim 10^{-9}$?
 - 10^{-9} is the natural order for $\eta_B^{lep} \sim 10^{-2} N_{B-L}^{lep,f}$
 - Neglected possible *preexistent contributions!!* $N_{B-L}^{preex,0} \sim \mathcal{O}(1)$
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 - Flavour effects impose restrictive conditions on the seesaw parameter space, respected ONLY by the *τ - N_2 dominated scenario*

E. Bertuzzo, P. Di Bari,
L.M.; 2011

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E. Bertuzzo, P. Di Bari,
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Asymmetric washout from NI:

$$K_{1e}, K_{1\mu} \gg 1; K_{1\tau} \sim 1$$

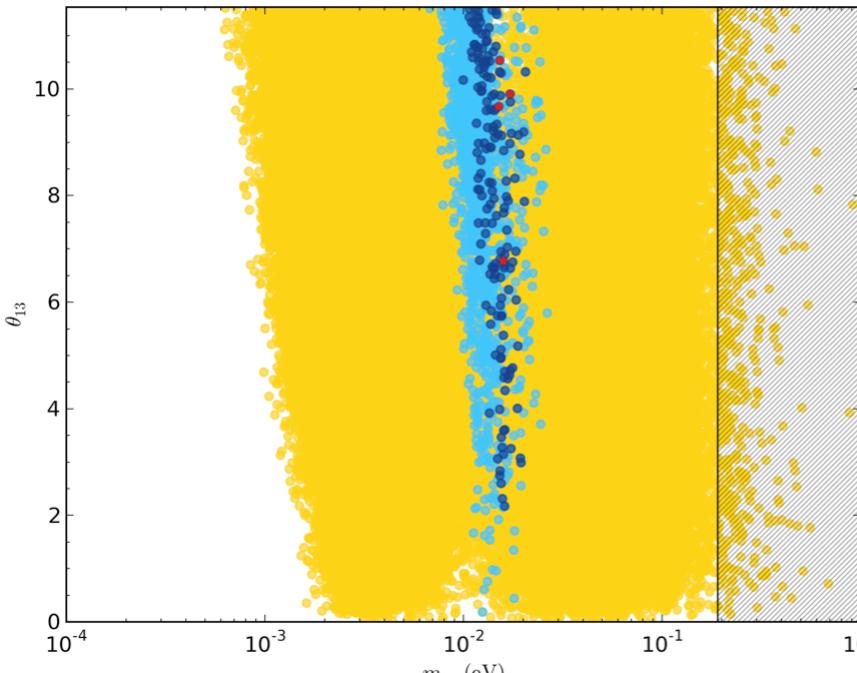
N₂ dominated leptogenesis +
strong washout: $K_2 \gg 1$

Strong SO(10)-inspired leptogenesis:

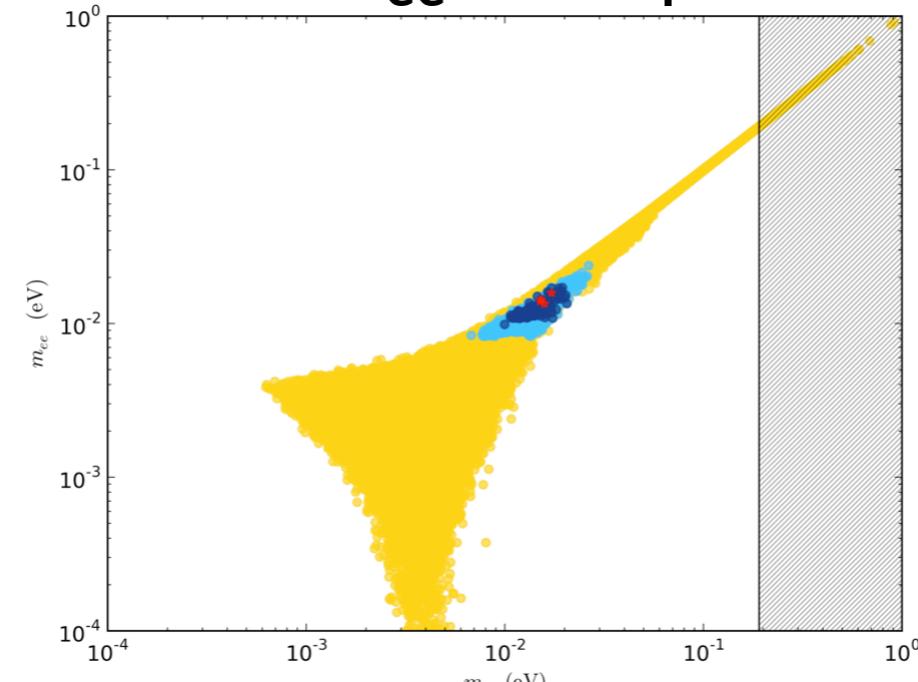
$\alpha_2 = 5$, $1 \leq V_L \leq \text{CKM}$, normal ordering.

$N_{B-L}^{preex,0} = 0, 10^{-3}, 10^{-2}, 10^{-1}$

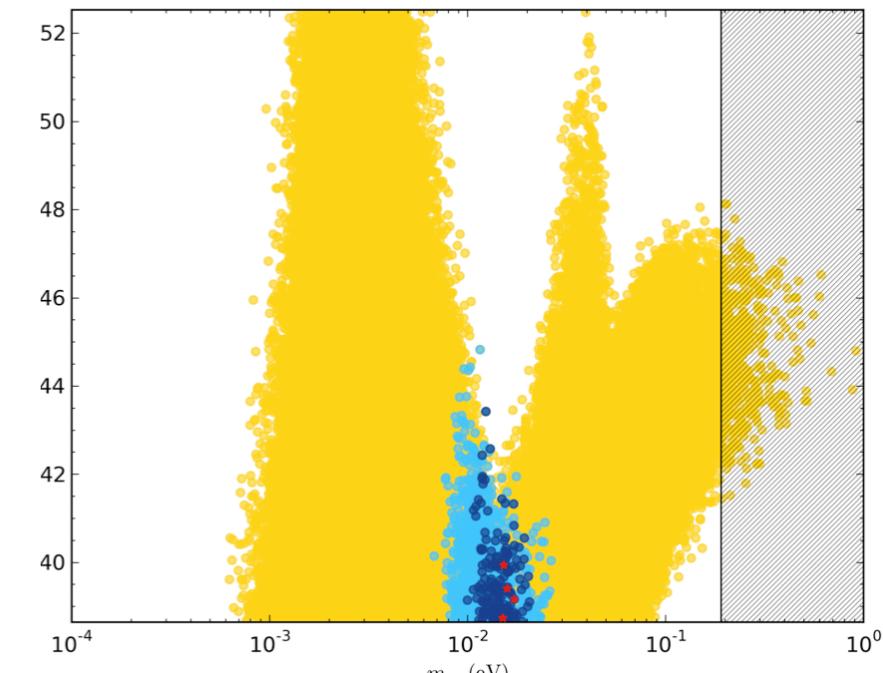
θ_{13} vs m_i



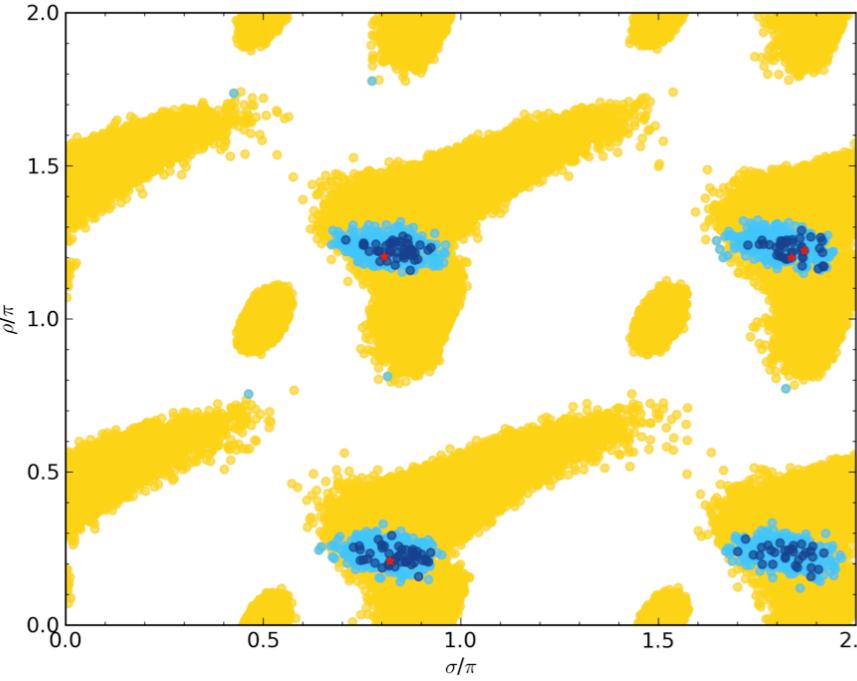
m_{ee} vs m_i



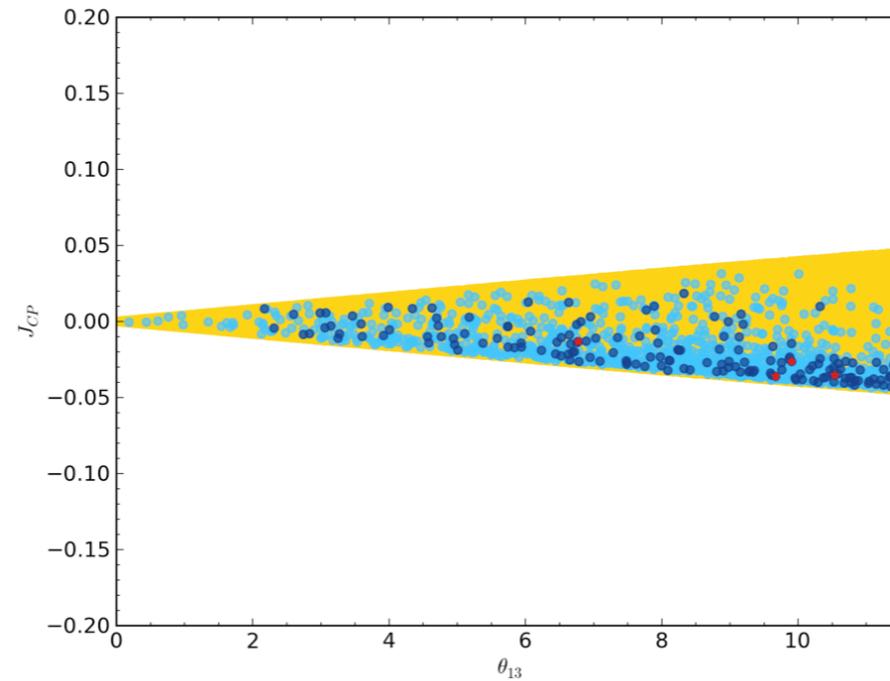
θ_{23} vs m_i



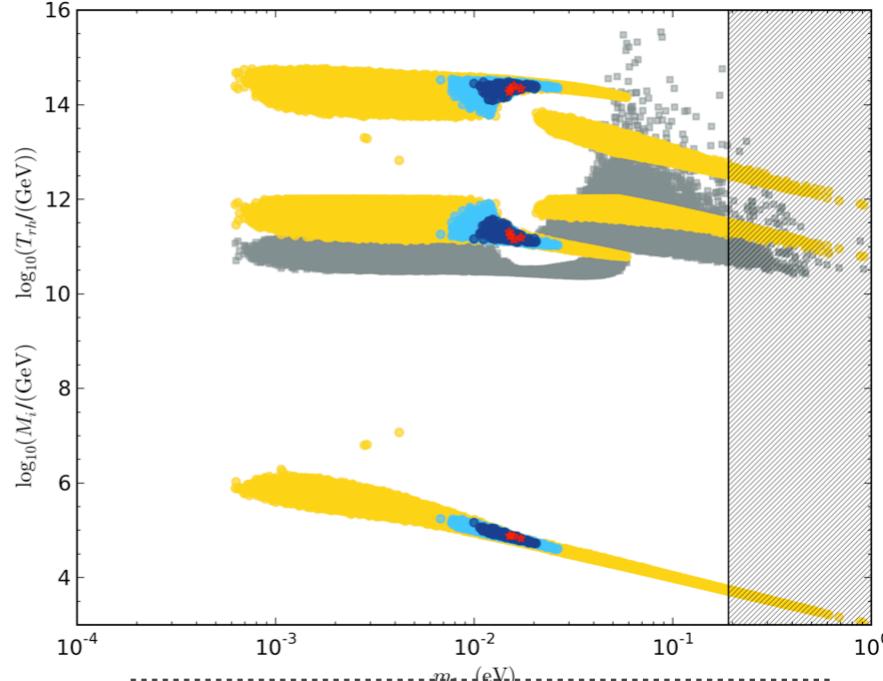
ρ vs $\sigma(\Gamma/\pi)$



J_{CP} vs θ_{13}



M_i vs m_i



Epilogue:

SO(10)-inspired model:

- minimal SM extension
- implement flavour effects
- consistent with current experimental results

Strong leptogenesis:

- independence of initial conditions
- justifies value of BAU
- ensures predictability of the model

Strong SO(10)-inspired leptogenesis:

- phenomenological test of the Seesaw parameter space
- no inverted ordering
- sharp predictions:
 - $m_1 \simeq m_{ee} \sim 10^{-2}$ eV
 - large θ_{13} , non-maximal θ_{23}