Relaxing Cosmological Neutrino Mass Bounds with Unstable Neutrinos

Stefan Sandner
stefan.sandner@ific.uv.es

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with Miguel Escudero, Jacobo López-Pavón and Nuria Rius

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IFIC INSTITUT DE FÍSICA CORPUSCULAR
CSIC CONSEJO SUPERIOR DE INVESTIGACIONES CIENTÍFICAS
VNIVERSITAT DE VALÈNCIA
"la Caixa" Foundation

Motivation & Main Result

- Cosmology set most stringent neutrino mass bound: $\Sigma m_\nu < 0.12$ eV

  —> Excludes many neutrino mass models; most 2-zero textures ruled out

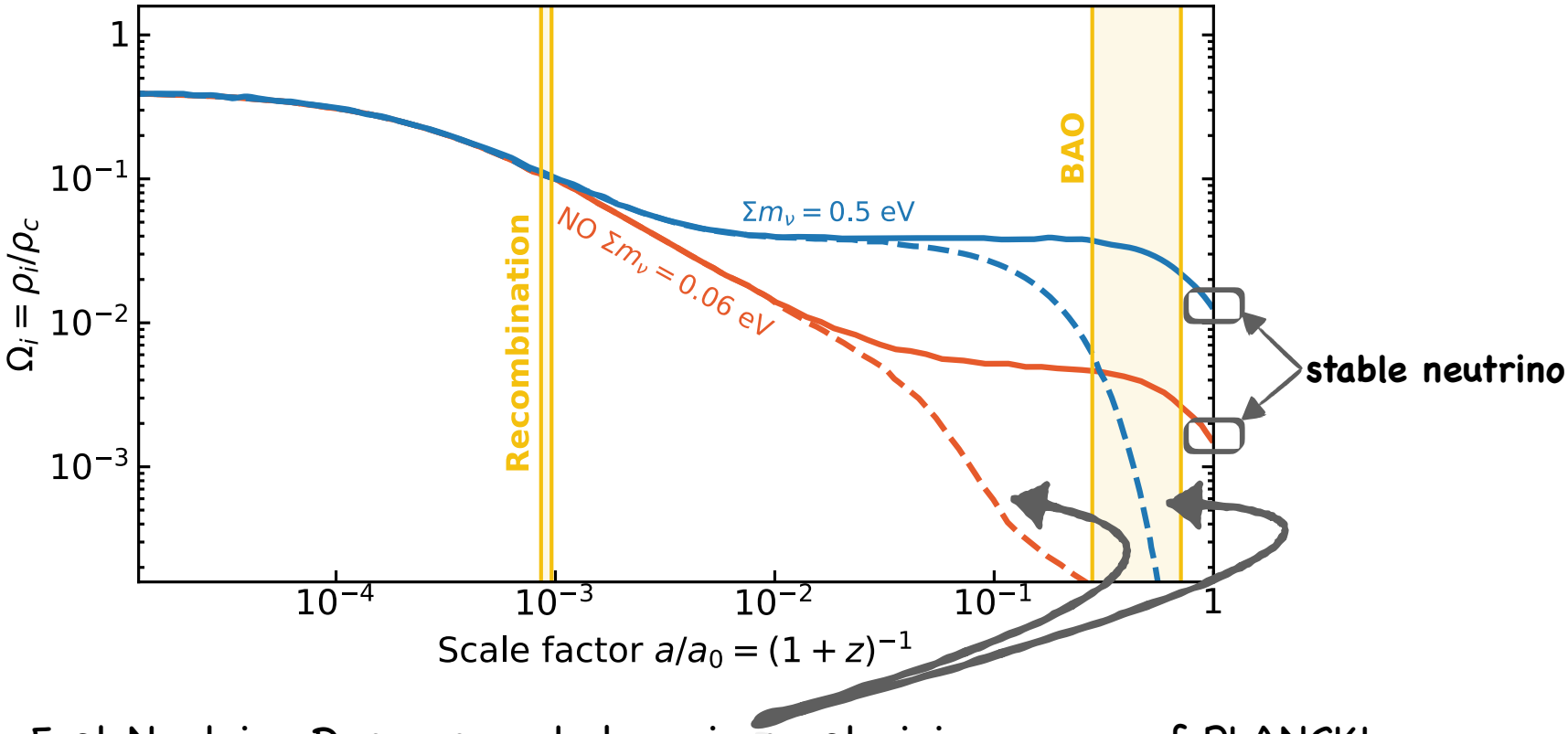
  (see e.g. Alcaide, Santamaría, Salvadó [1806.06785])

- The bound, however, assumes ΛCDM with stable neutrinos!

Generic Neutrino Decay with $\tau_\nu < t_U$ via light bosons can relax the bound to up to $\Sigma m_\nu \sim 1$ eV and can be incorporated into e.g. $U(1)_{\mu-\tau}$ models.

Preliminaries

PLANCK constraint on Σm_ν mainly arises from its contribution to non-cold Dark Matter today



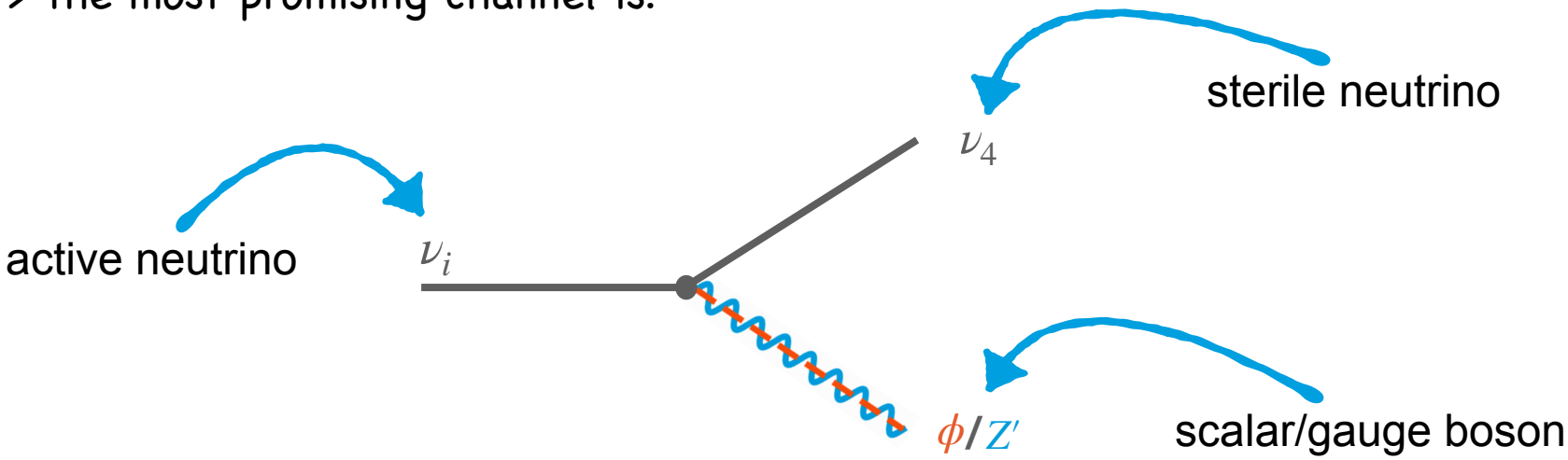
Hence: Fast Neutrino Decay can elude main constraining power of PLANCK!

How to achieve Neutrino Decay?

- Once they are massive they will decay, but within SM $\tau_\nu \gg t_U$ —> BSM needed

- Model Independent classification of all possible decay channels
  + confronting with experimental constraints

  —> the most promising channel is:



Model Building

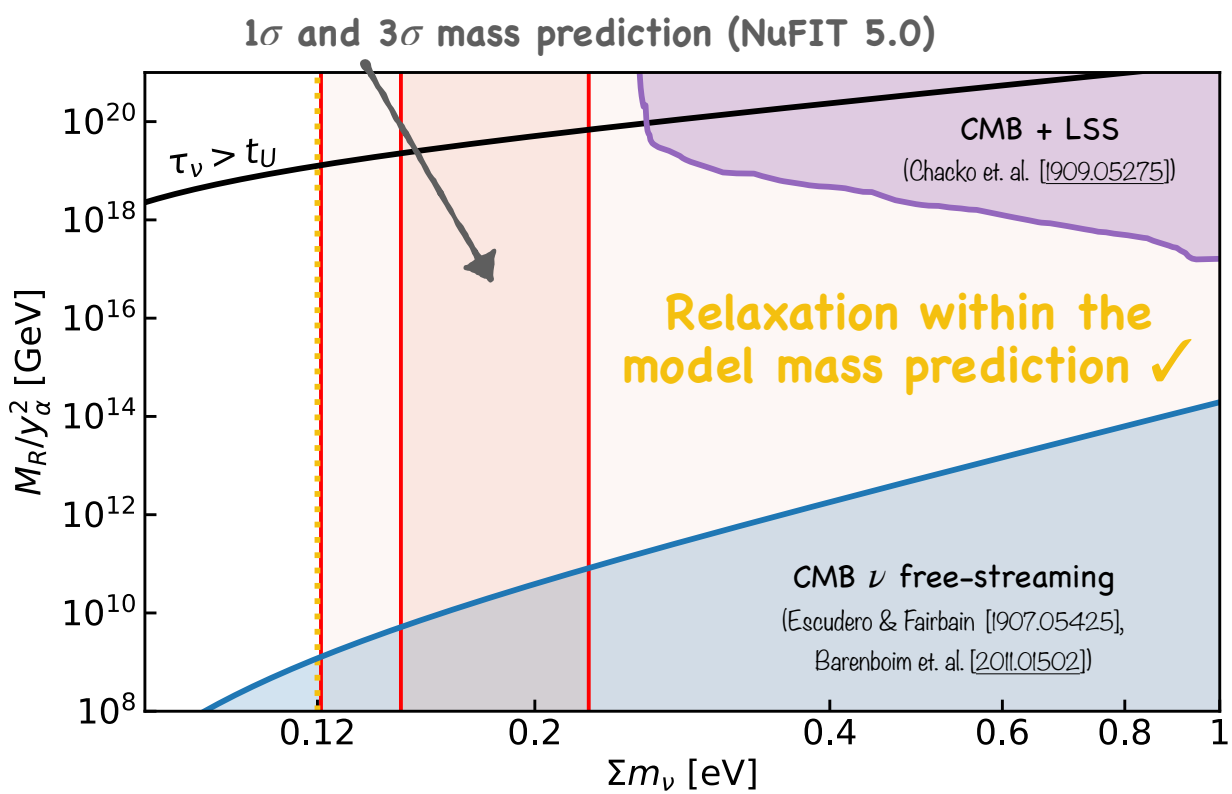
- Extend $U(1)_{\mu-\tau}$ model by scalar Φ + fermion singlet S_L charged under new $U(1)_X$

  —> unique new term: $\mathscr{L} \supset y\Phi\bar{N}_R S_L$ —> $M_\nu|^{7\times 7} = \begin{pmatrix} 0 & m_D & 0 \\ m_D & M_R & y_\alpha v_\Phi \\ 0 & (y_\alpha v_\Phi)^\dagger & 0 \end{pmatrix}$

- <u>Assume</u> $y v_\Phi \ll m_D \ll M_R$
  - **See-Saw at work**
  - **Right ν_4 properties:** $m_{\nu_4} \sim 0$, $U_{\alpha 4} \sim y v_\Phi / m_D \ll 1$

Model Building

Neutrino Decay Rate: $\Gamma(\nu_i \to \nu_4 \phi) \sim 10^6\, t_U^{-1}\, y^2 \left(\frac{m_\nu}{0.3eV}\right)^2 \left(\frac{10^{14} GeV}{M_R}\right)$



Outlook

A neutrino mass detection by KATRIN or no signal by DESI/EUCLID would strongly point to cosmological fast Neutrino Decay

Thank you for your attention :)