Relaxing Cosmological Neutrino Mass Bounds with Unstable Neutrinos*

Miguel Escudero, Jacobo Lopez-Pavon, Nuria Rius, Stefan Sandner†

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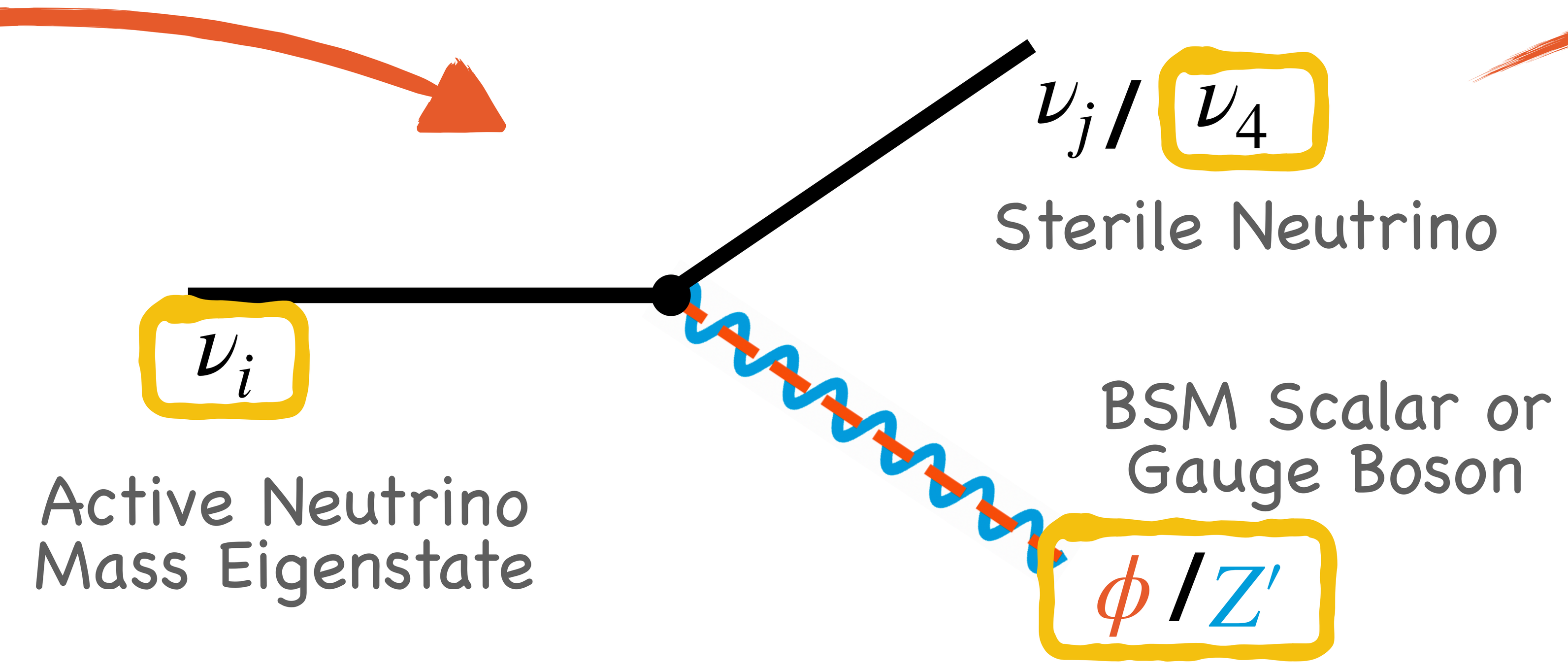
†Corresponding Author: stefan.sandner@ific.uv.es, "la Caixa" fellow LCF/BQ/DI19/11730034

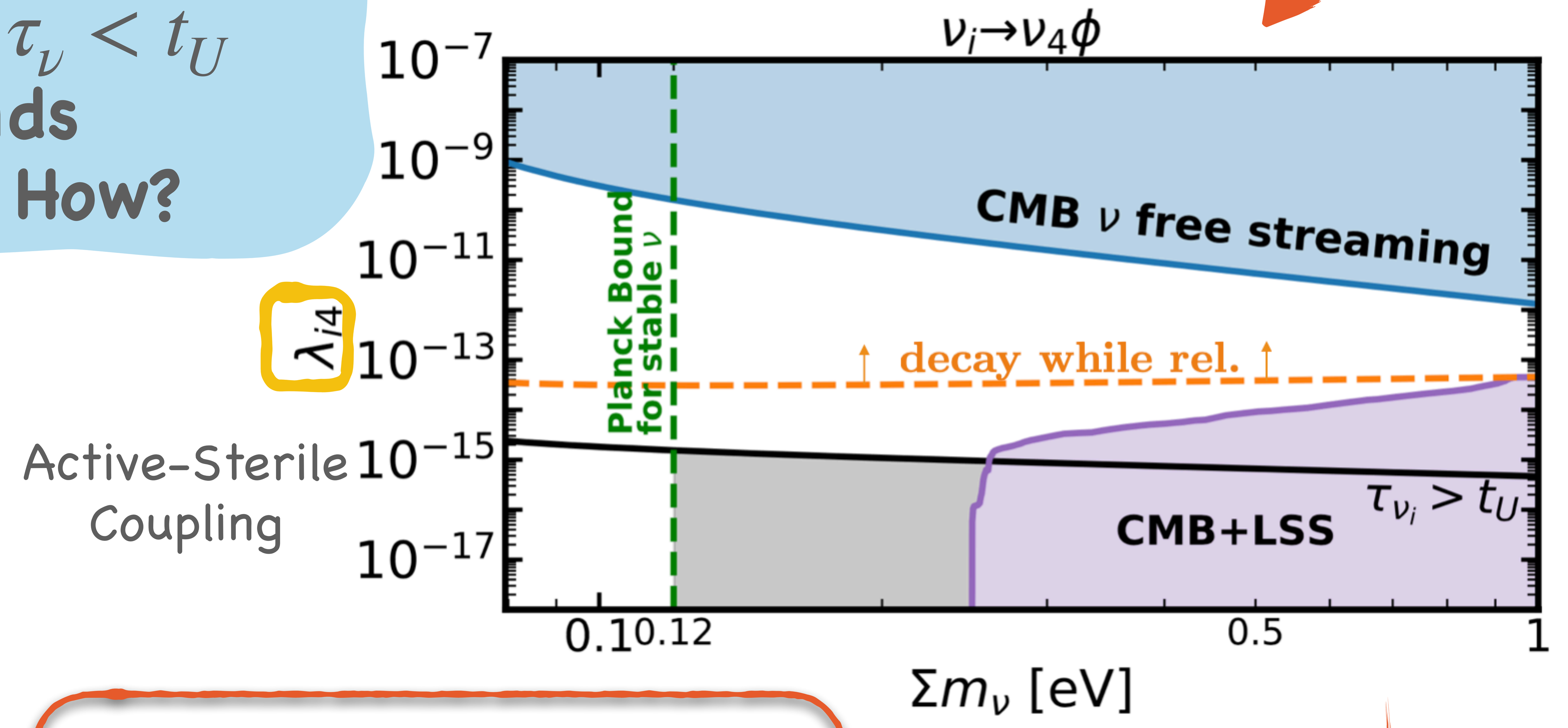
Decay into ultra-light bosons redistribute energy densities, suppressing the neutrino contribution to non-cold Dark Matter and alter CMB perturbations+lensing power



With an active neutrino final state the maximal relaxation of the mass bound is 0.1(0.06) eV for IO (NO), since lightest state is stable. With an additional sterile neutrino the parameter space opens up!

Most promising candidate is **2-body decay** — viable 3-body decays require coupling hierarchy which is difficult to realize in concrete model

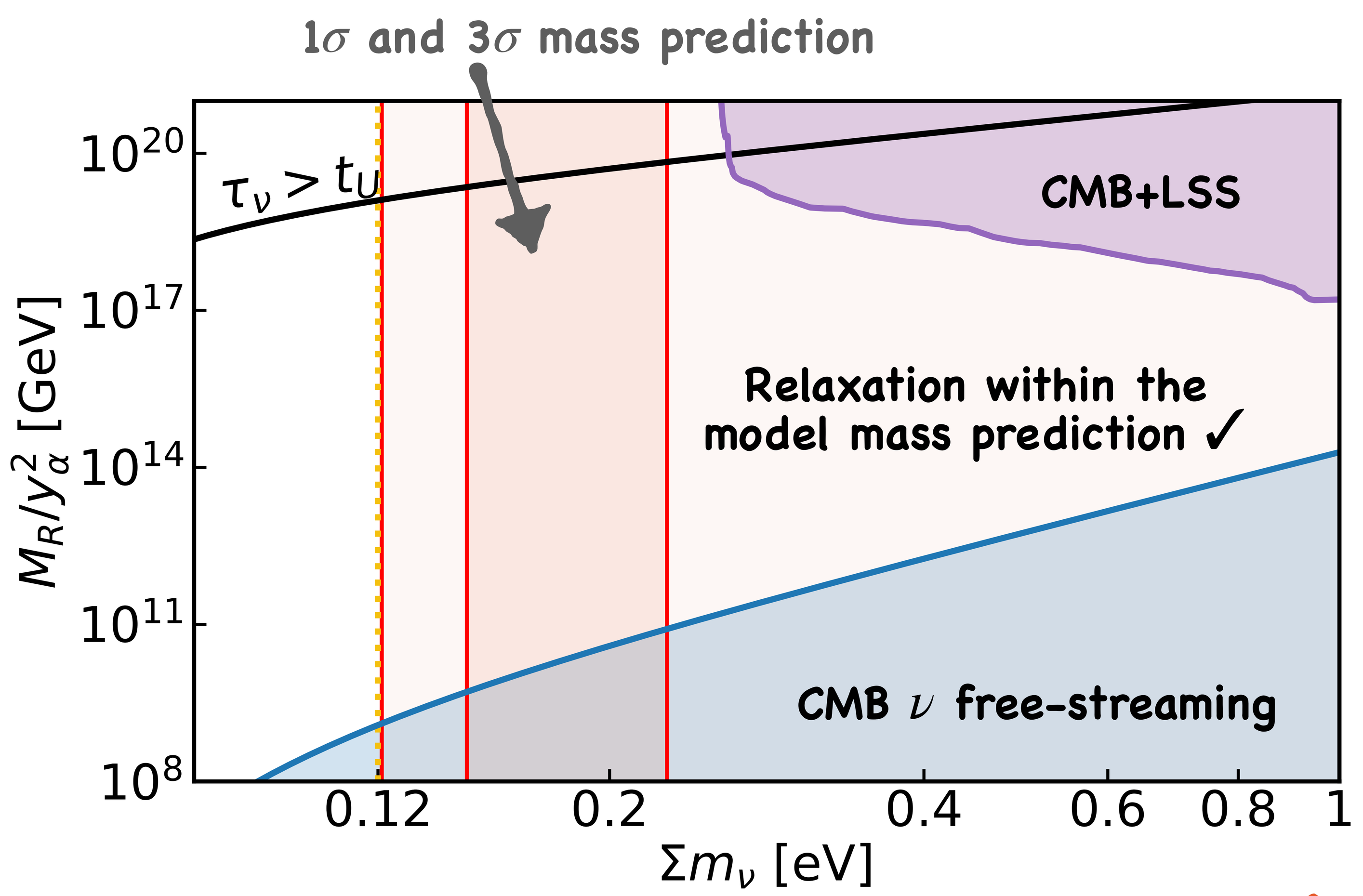
Many neutrino mass models are excluded by cosmological bounds! New light degrees of freedom can lead to Neutrino Decay with $\tau_\nu < t_U$ and alleviate these bounds from 0.12 eV to up to 1 eV. How?



All possible neutrino decay channels can be summarized by two **model independent** renorm. Lagrangians

DESI/EUCLID sensitive to both, m_ν and τ_ν

What about a concrete model realization?



Add global $U(1)_X$ w/ scalar+fermion singlet: $\mathscr{L} \supset y\Phi \bar{N}_R S_L$
Invoke: $yv_\Phi \ll m_D \ll M_R$
→See-Saw and $m_{\nu_4} \sim 0$,
$U_{\alpha 4} \sim y v_\Phi / m_D \ll 1$

Motivation: Make accidental SM $U(1)_{\mu-\tau}$ symmetry manifest; Neutrino data✓, but $\Sigma m_\nu > 0.126@3\sigma$ — **Excluded by PLANCK!**

$$\Gamma(\nu_i \to \nu_4 \phi) \sim 10^6\, t_U^{-1}\, y^2\, (m_\nu/(0.3eV))^2\, (10^{14} GeV/M_R)$$

Σm_ν relaxed and reconciled with PLANCK✓