

LFV in a radiative seesaw model and RG running of the dark matter part

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Based on O. Seto, T.S., and T. Tsuyuki, Phys. Rev. D105, 095018 (2023); Phys. Rev. D113, 095048 (2025)

1. Introduction

There are a few problems unsolved in the SM

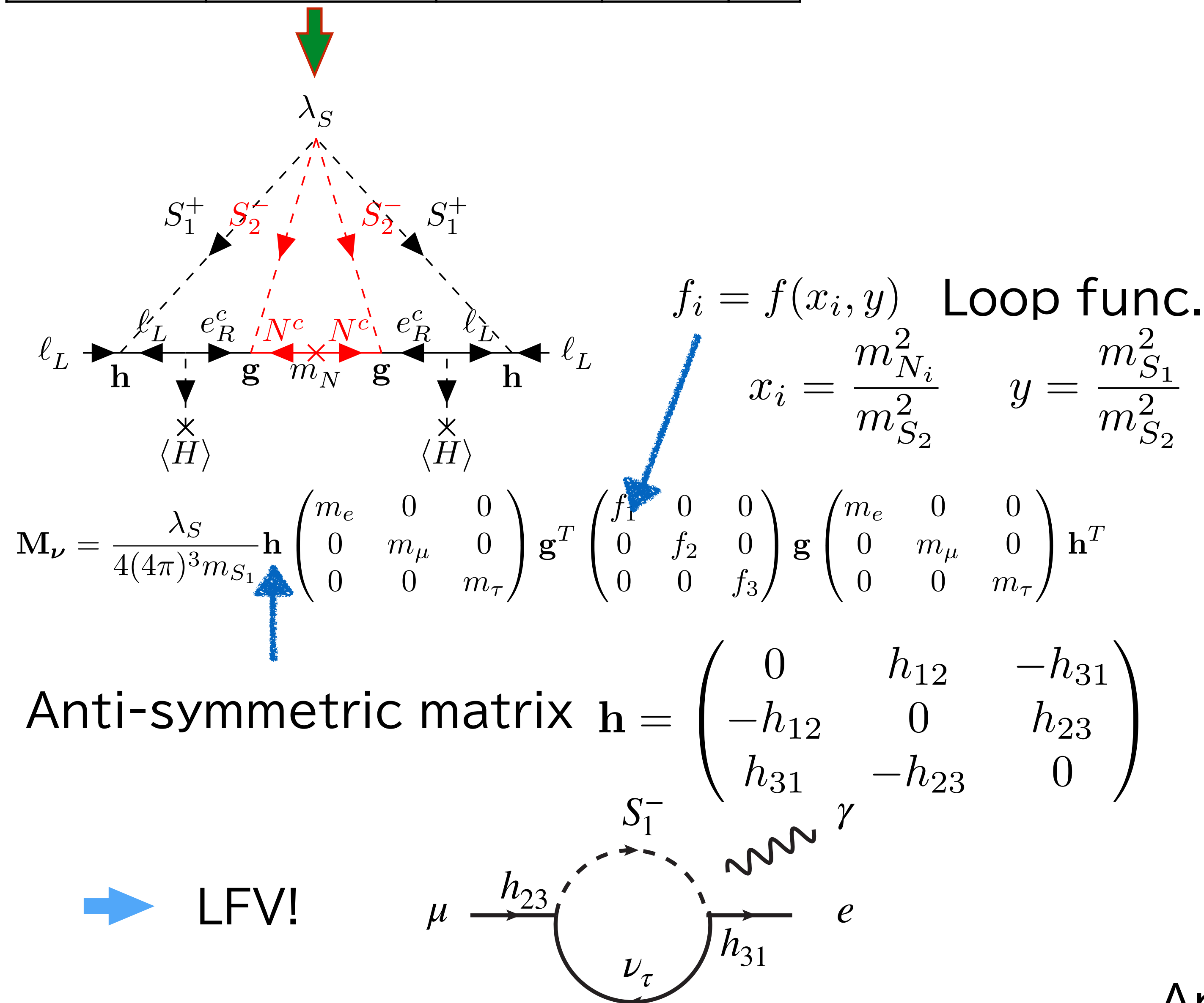
- Origin of tiny neutrino masses
- Dark Matter candidate
- Baryon asymmetry of the Universe
- ...

An attractive model: **Krauss-Nasri-Trodden model**

L. Krauss, S. Nasri, and M. Trodden, PRD67, 085002 (2003)

	SU(3)	SU(2)	U(1)	Z ₂
N_i	1	1	0	-
S_1^+	1	1	1	+
S_2^-	1	1	-1	-

→ DM

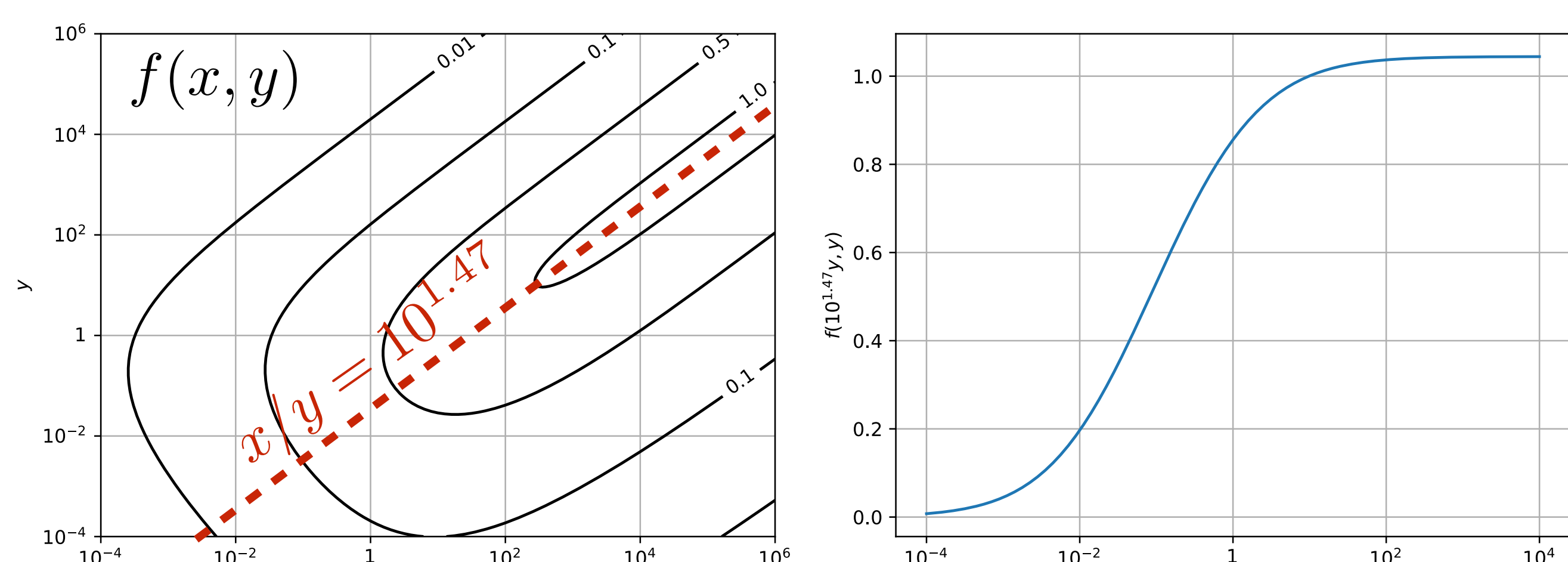


2. Perturbativity and LFV

Let's consider the case

- Consistent with the neutrino oscillation data
- LFV bounds are satisfied
- All the dimensionless couplings are less than 1

It's a very rough condition for perturbativity



$m_{S_2}^2 \ll m_{S_1}^2 \simeq 30m_{N_i}^2 \rightarrow$ Maximized $f(x, y) \simeq 1.05$

$$(M_\nu)_{\tau\tau} = \frac{\lambda_S m_\mu^2 h_{23}^2}{4(4\pi)^3 m_{S_1}} \sum_i g_{i2}^2 f(x_i, y)$$

$|g_{i2}| < 1$

$$\left| \sum_i g_{i2}^2 f(x_i, y) \right| \leq \sum_i f(x_i, y) < 1.05 n_{\text{eff}}$$

$m_{S_1} < 7.39 \times 10^4 \text{ GeV} \left(\frac{0.02 \text{ eV}}{|(M_\nu)_{\tau\tau}|} \right) |h_{23}|^2 n_{\text{eff}}$

Upper bound on m_{S_1} !

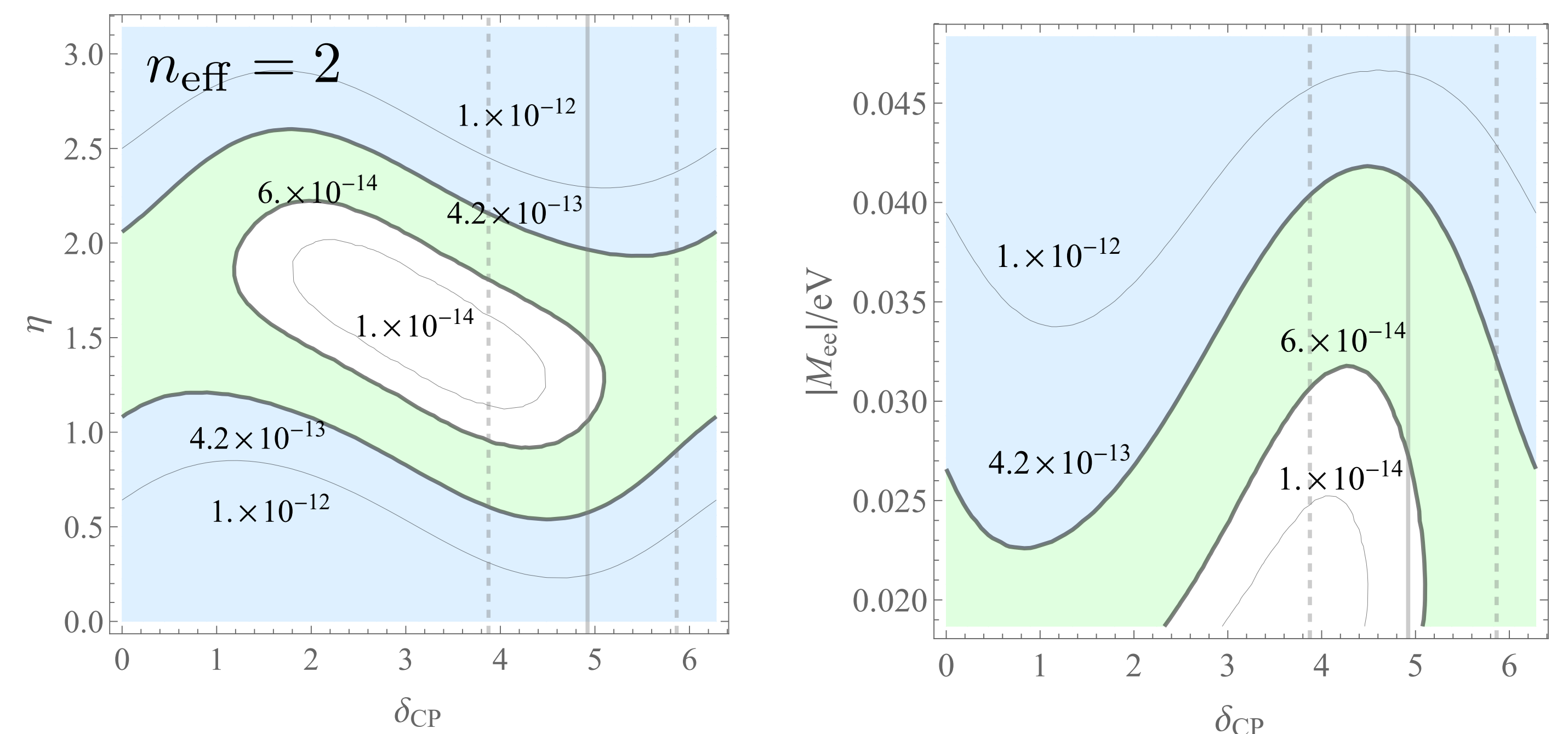
To suppress the LFV: $N_1 S_2^\pm \quad N_{2,3} S_1^\pm$

3. Neutrino parameters and LFV

In IO case ($m_3 < m_1 < m_2$)

Dirac and Majorana phases are constrained by $\mu \rightarrow e\gamma$

The bounds are much weaker in NO case



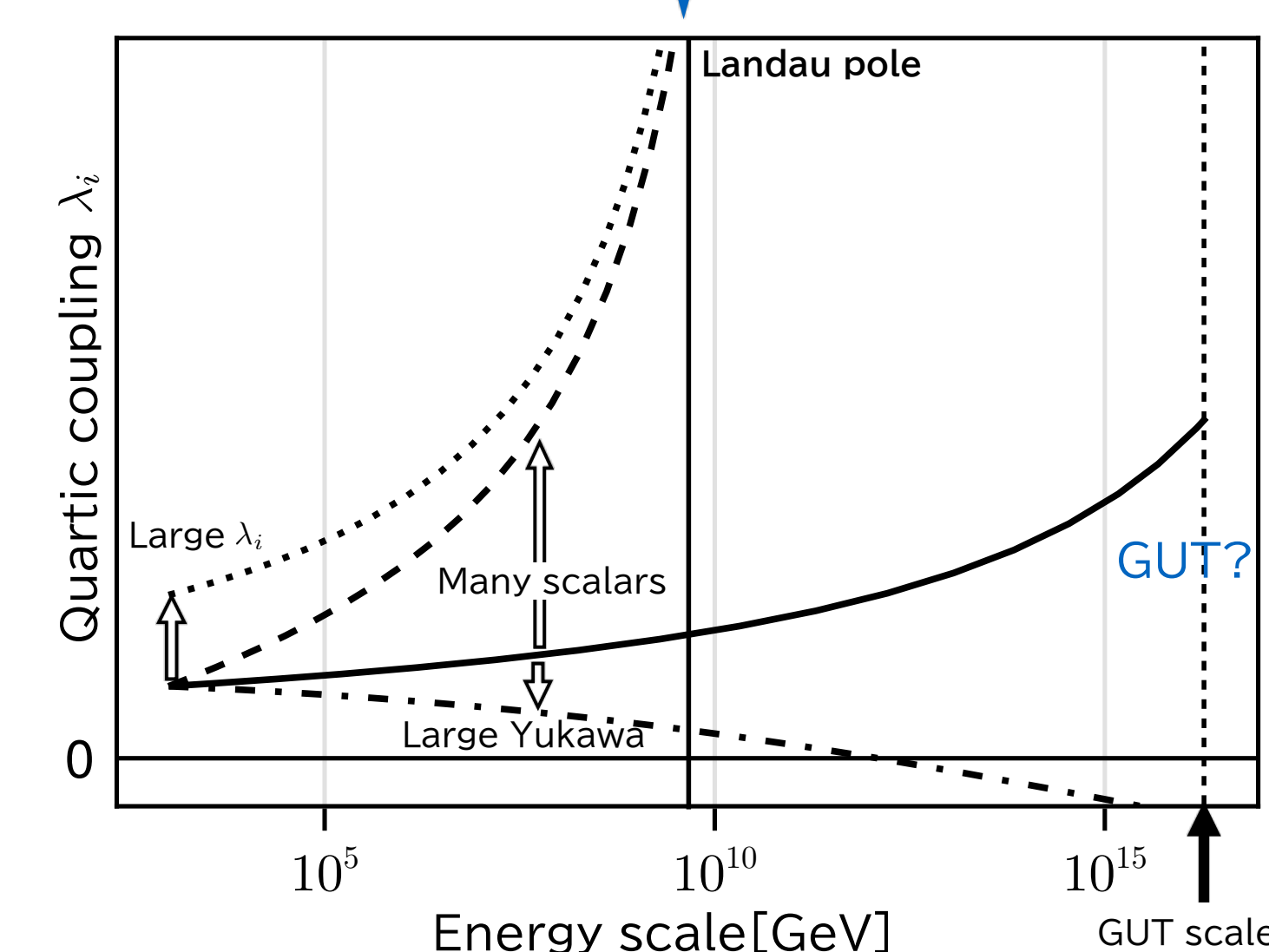
Other ν parameters are scanned in 2σ range

4. Considering the RG running

DM part of the KNT model: Leptophilic DM scenario

General behaviour of the RG evolution for λ_i

Some UV models, like one proposed in S. Kanemura, Y. Mura, TS, Phys. Rev. D113, 055020 (2026)

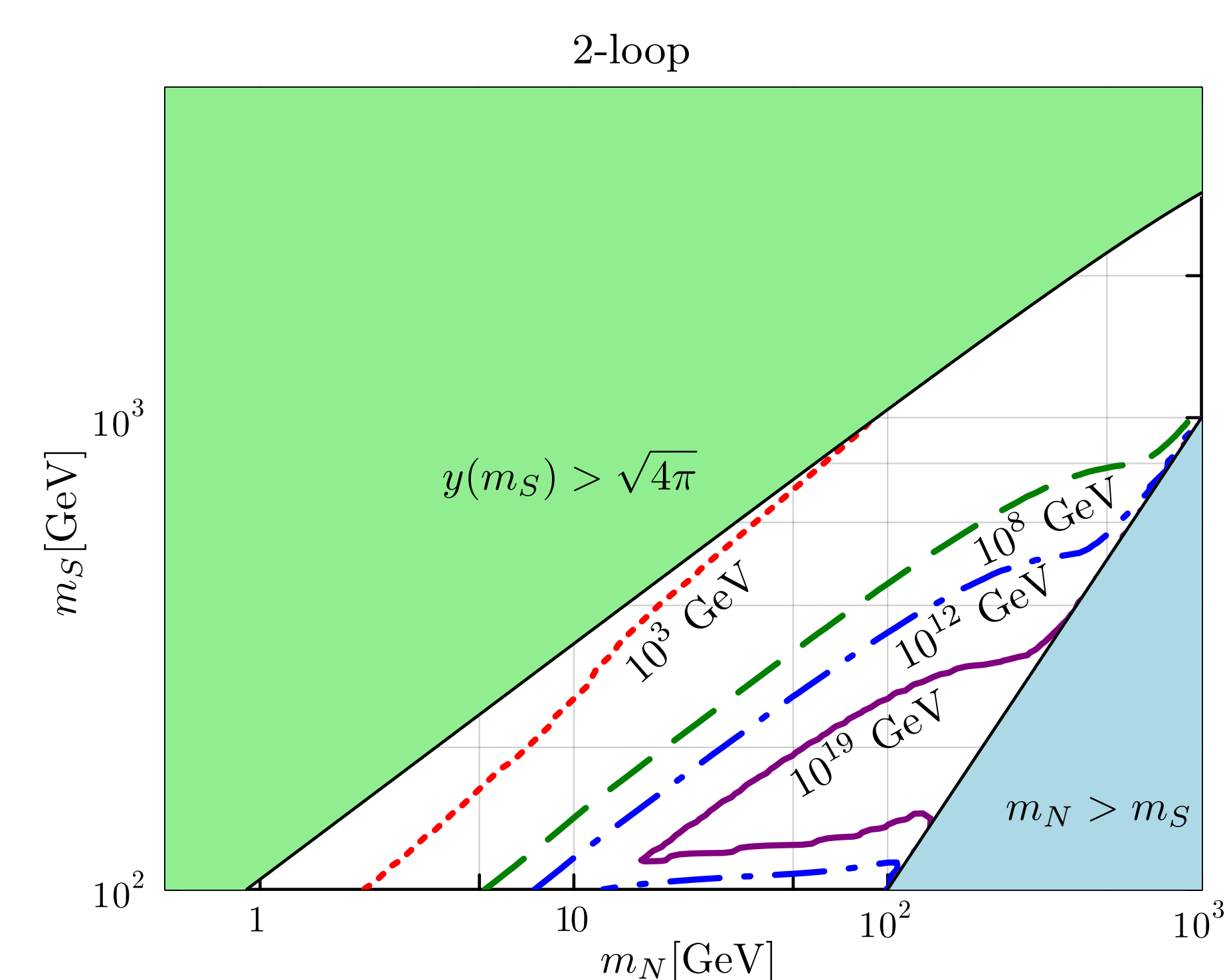
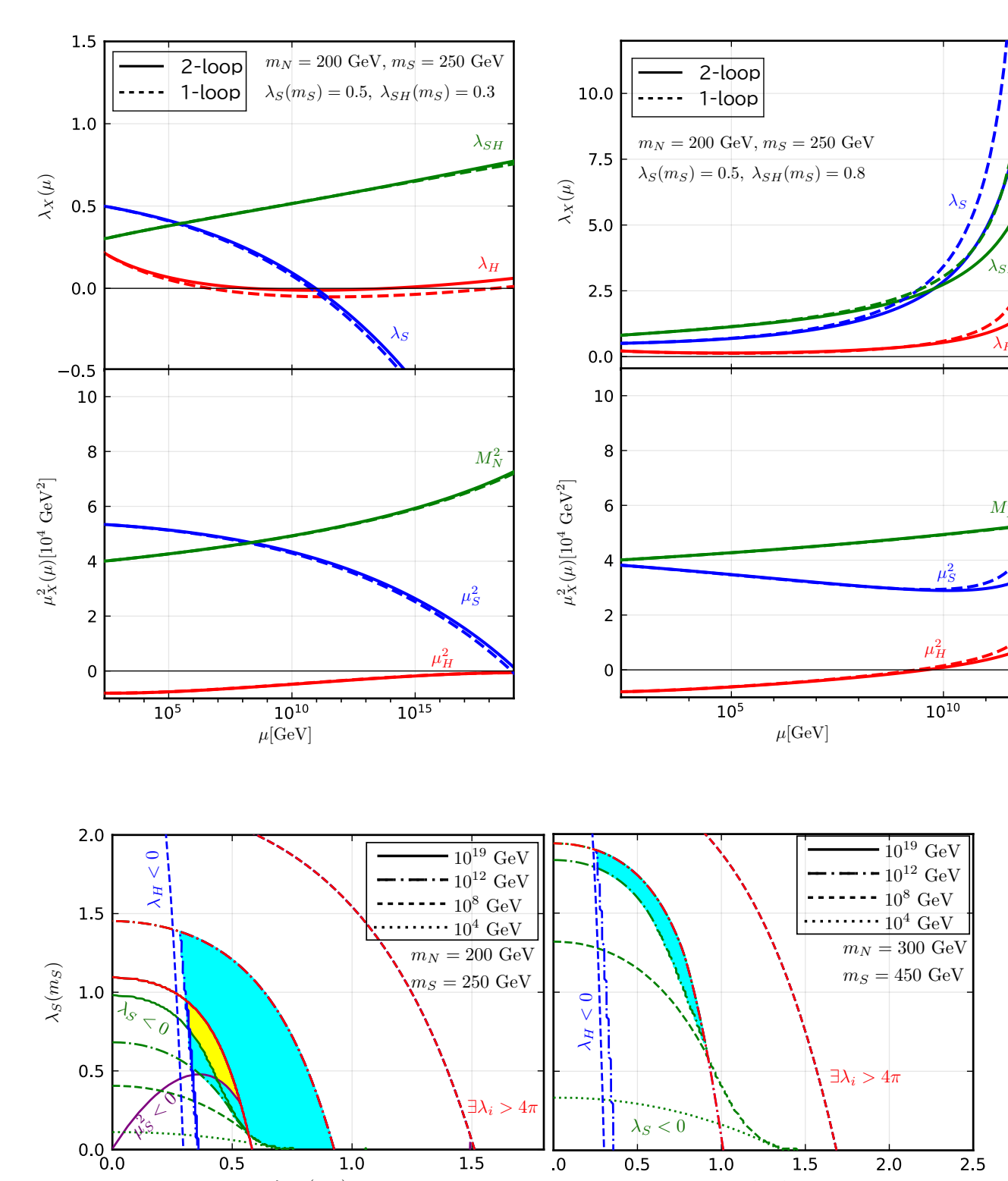


We can find an upper limit of the cutoff scale

It will be a strong clue for exploring the UV theory

Annihilation cross section: $\sigma v \simeq \frac{m_N^2 (m_N^4 + m_S^4)}{8\pi (m_N^2 + m_S^2)^4} x_f \sum_i \sum_j |y_i^* y_j|^2$

Large mass → Large Yukawa



5. Summary

In the KNT model, perturbativity & LFV leads to

- The mass of S_1 has an upper bound
- Constraints on neutrino parameters in the IO case
- Future LFV experiments may probe the model
- Thermal relics of the DM suggest rather light S_2

↑ Perturbativity & vacuum stability

In a new physics model with extended scalar sector, RG behaviour of the potential

→ a strong clue for the UV theory