

# Sterile neutrino dark matter in $\nu$ SMEFT

Based on [arXiv 2405.00119](https://arxiv.org/abs/2405.00119)

With K. Fuyuto, J. Kumar, E. Mereghetti and C. Sun

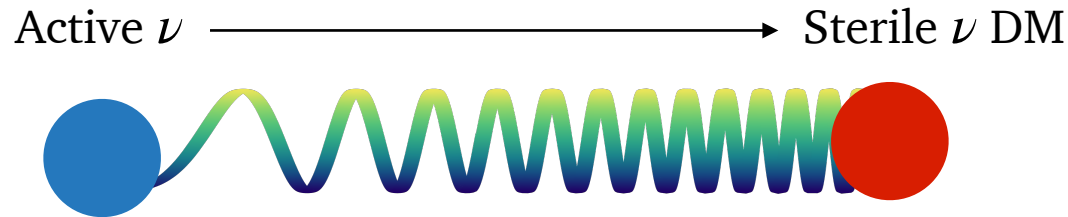
4th EuCAPT Symposium 2024, May 15, 2024

Prepared by  
**Stefan Sandner**

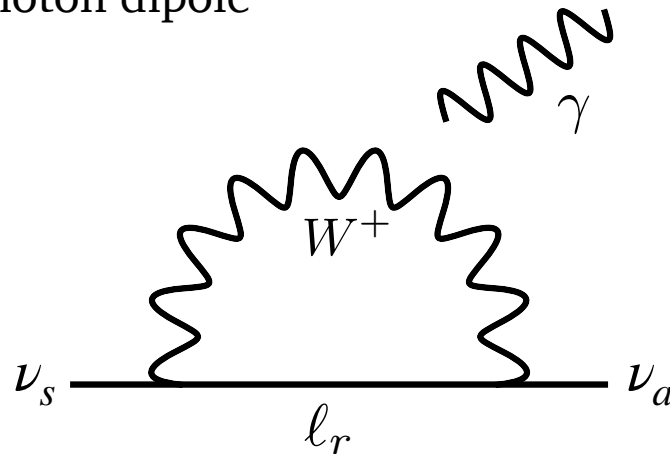
# Sterile neutrino DM

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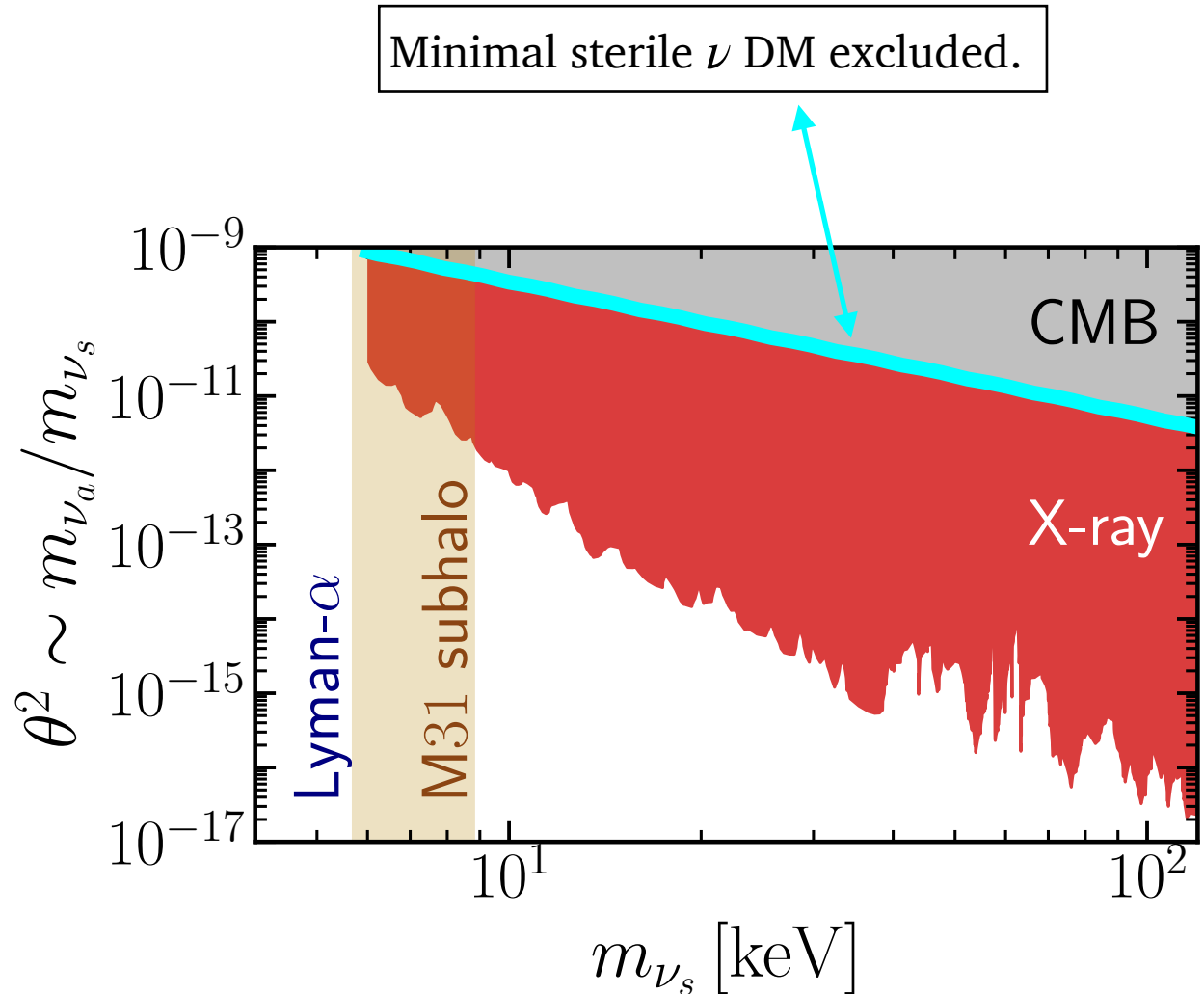
✱ Consider  $\mathcal{L} \supset -\frac{1}{2} (\nu_a \nu_s) M_\nu \begin{pmatrix} \nu_a \\ \nu_s \end{pmatrix} + \text{h.c.}$



✱  $\nu$  mass  $\rightarrow$  neutrino photon dipole



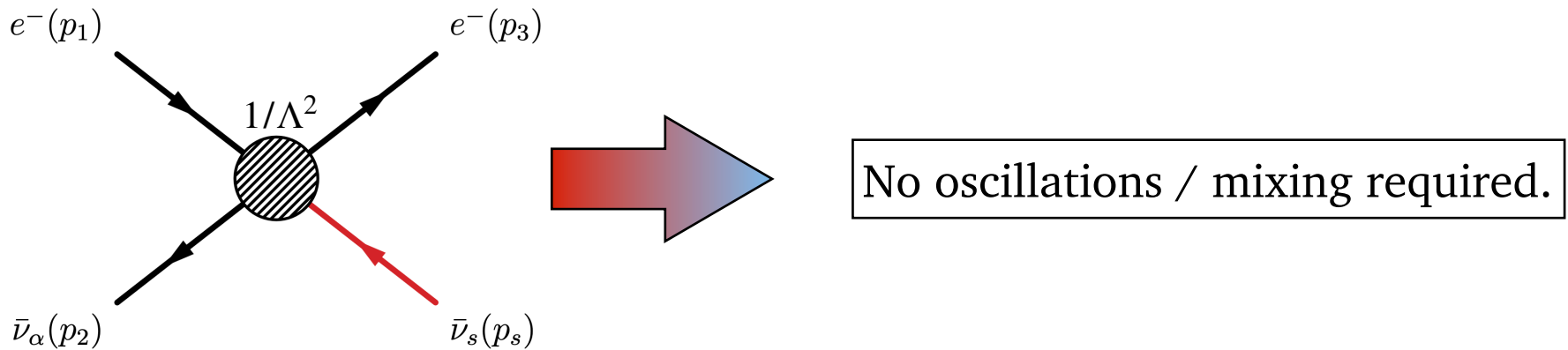
# Sterile neutrino DM



# $\nu$ SMEFT

$$\ast \mathcal{L}^{\nu\text{SMEFT}} = \mathcal{L}^{(d=4)} + \sum_{d=5} \sum_I \frac{\mathcal{C}_I^{(d)}}{\Lambda^{d-4}} \mathcal{O}_I^{(d)}$$

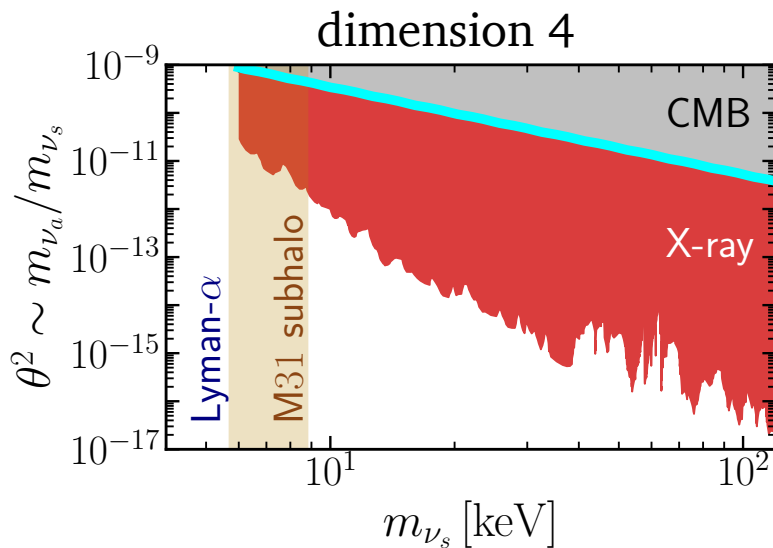
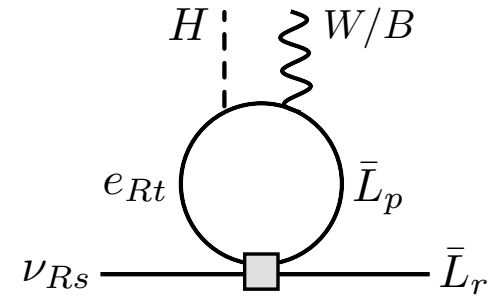
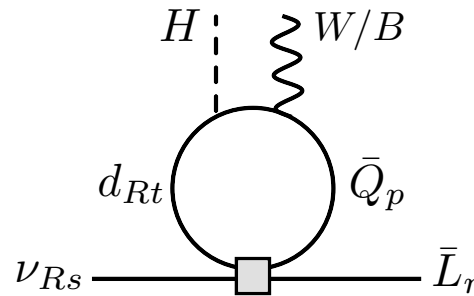
SM Fields  
+  $\nu_R$

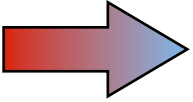


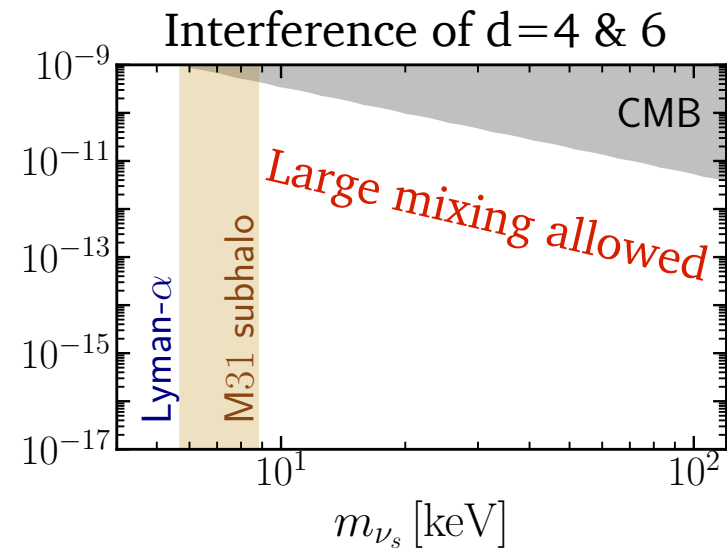
$\ast \Omega_{\text{DM}}$  can always be explained in  $\nu$ SMEFT.

# Sterile neutrino DM

☼ New neutrino photon dipole contributions, e.g.



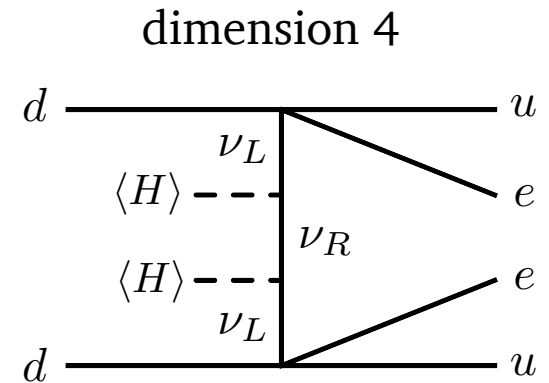
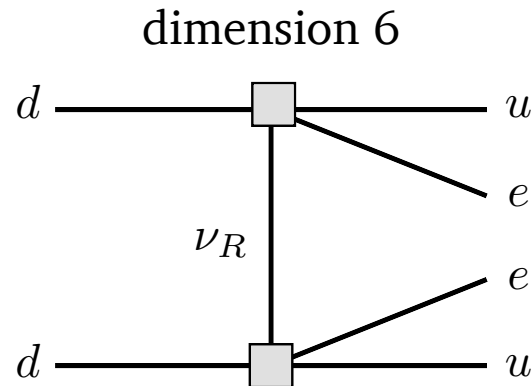
Amplitude  
  
 cancellation



For  $\Lambda = \mathcal{O}(10^3)$  TeV : evade X-ray bound and have DM.

# Testability

✱  $0\nu\beta\beta$  :



✱  $0\nu\beta\beta + \pi$  decay test up to  $\Lambda = \mathcal{O}(80) \text{ TeV} \ll 10^3 \text{ TeV}$

Evidence for sterile  $\nu$  with non-standard interaction from these operators would rule out the DM hypothesis.