

# Not-So-Light Sterile Neutrinos at NuSTORM

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Based on upcoming work with Peter Ballett and Silvia Pascoli



# INTRODUCTION

**Sterile neutrinos:**

$$1 \text{ eV} \lesssim m_\nu \lesssim 1 \text{ MeV}$$

**Short baseline accelerator experiments:**

$$L \approx \mathcal{O}(1) \text{ km} \quad E \approx \mathcal{O}(1) \text{ GeV}$$

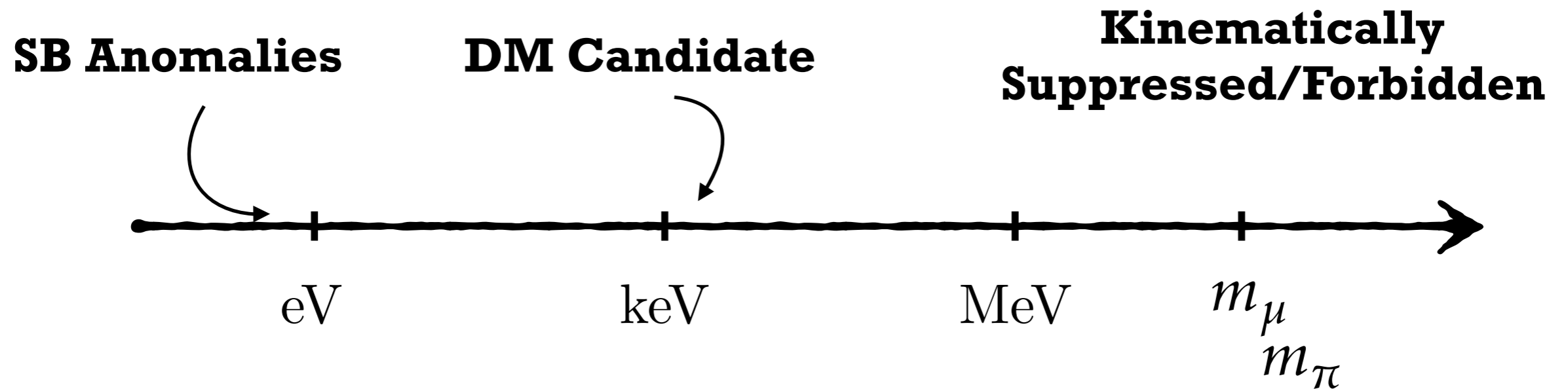
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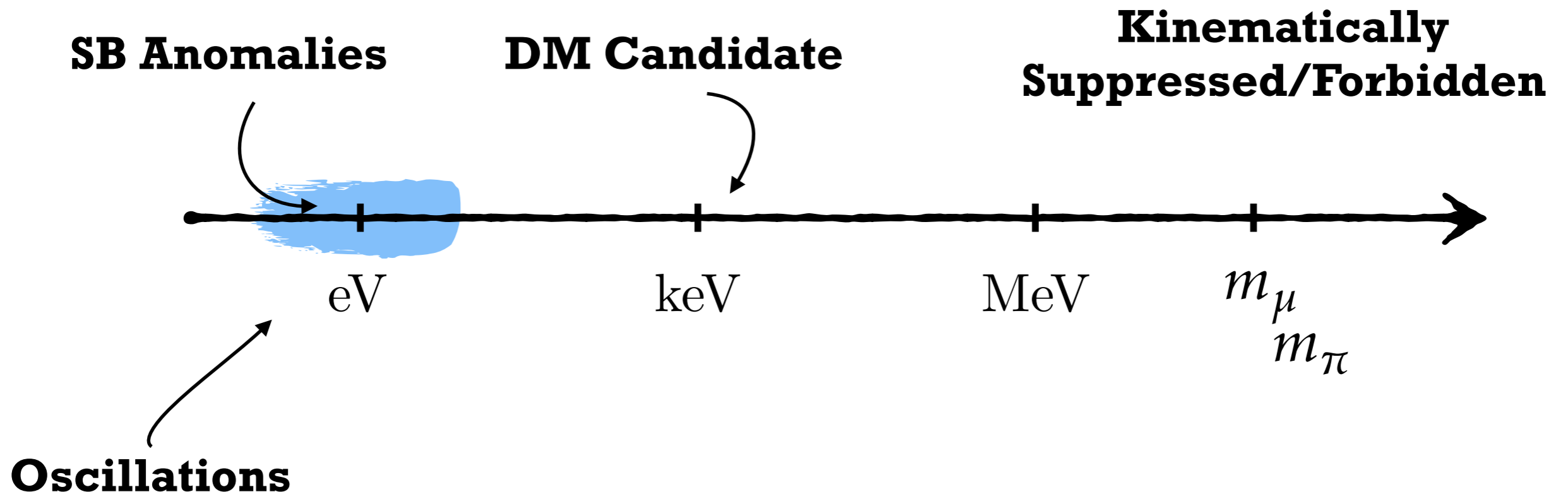
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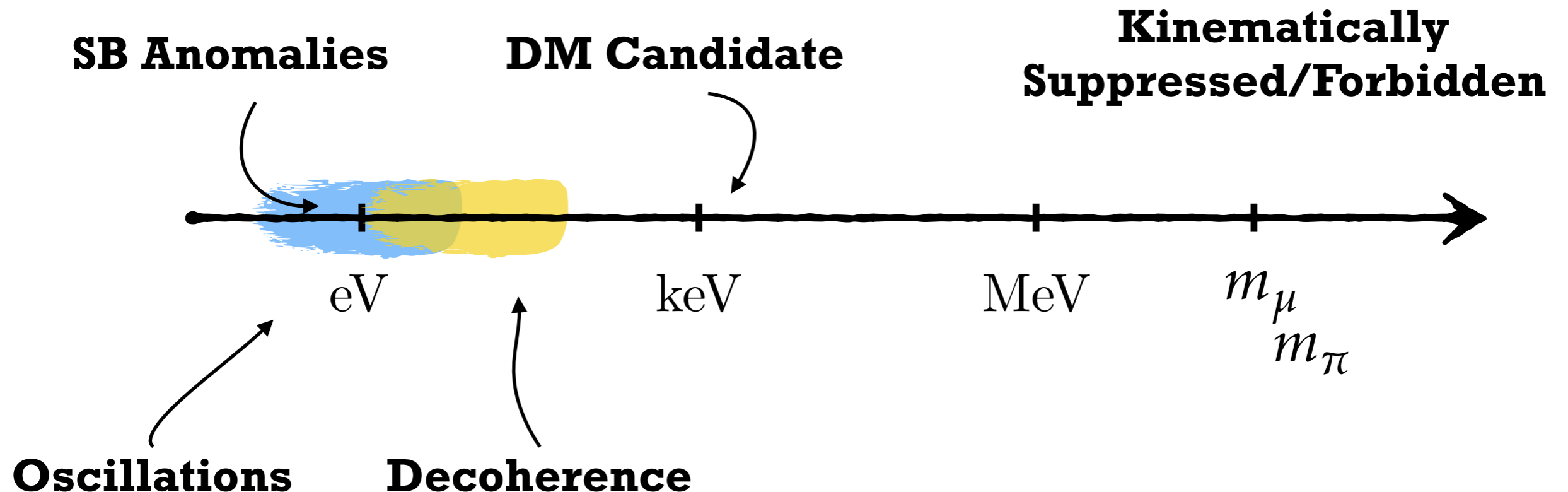
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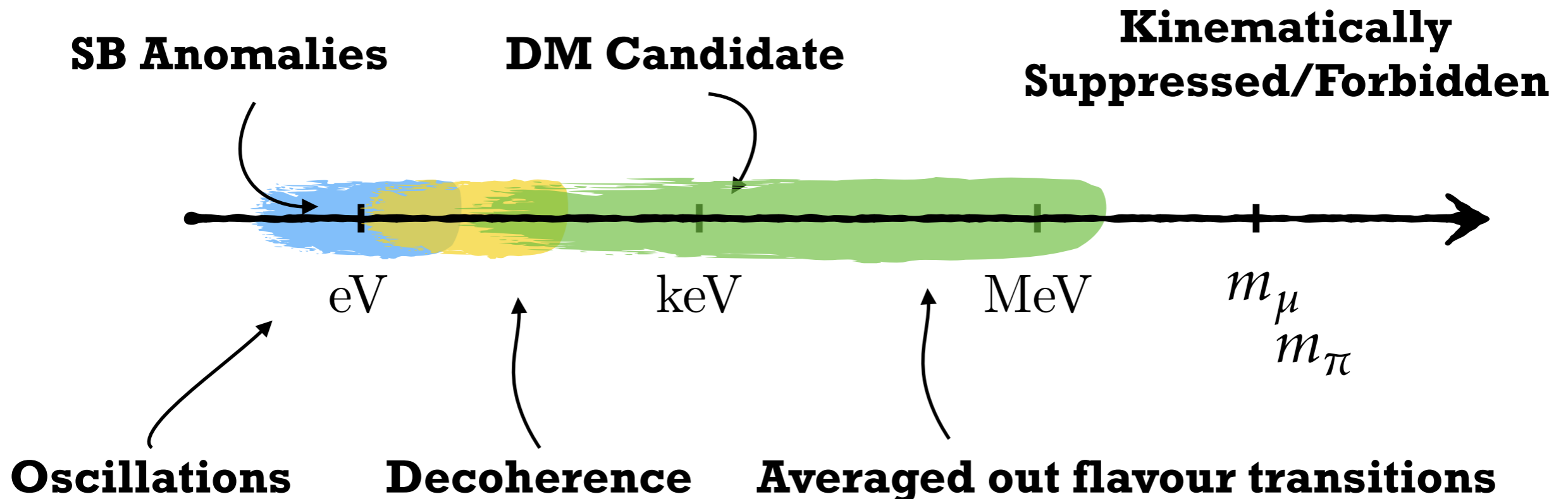
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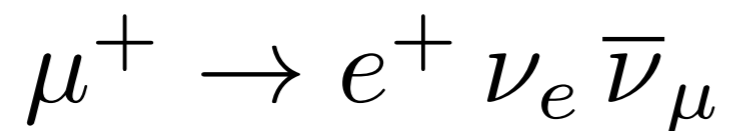
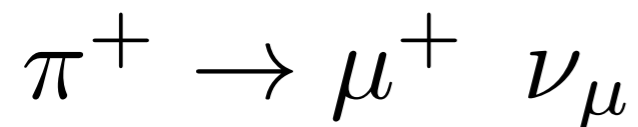
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# $\nu$ STORM

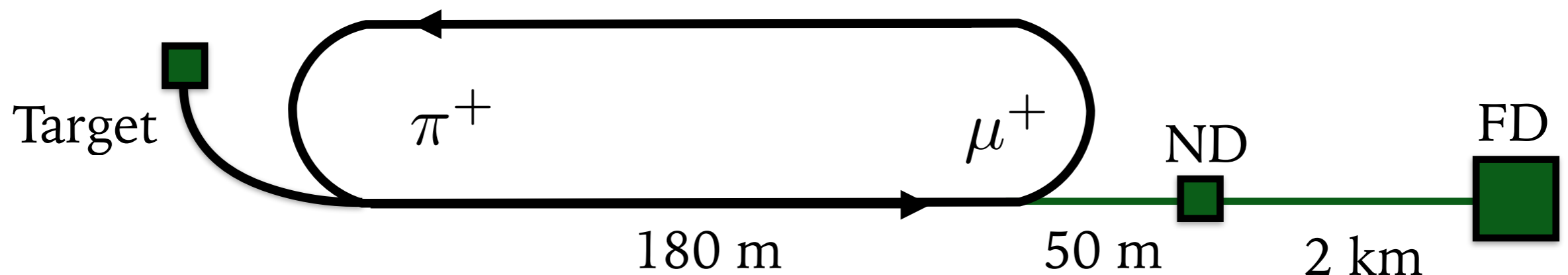
## Neutrinos from STORed Muons

The next generation short baseline facility



Low systematics

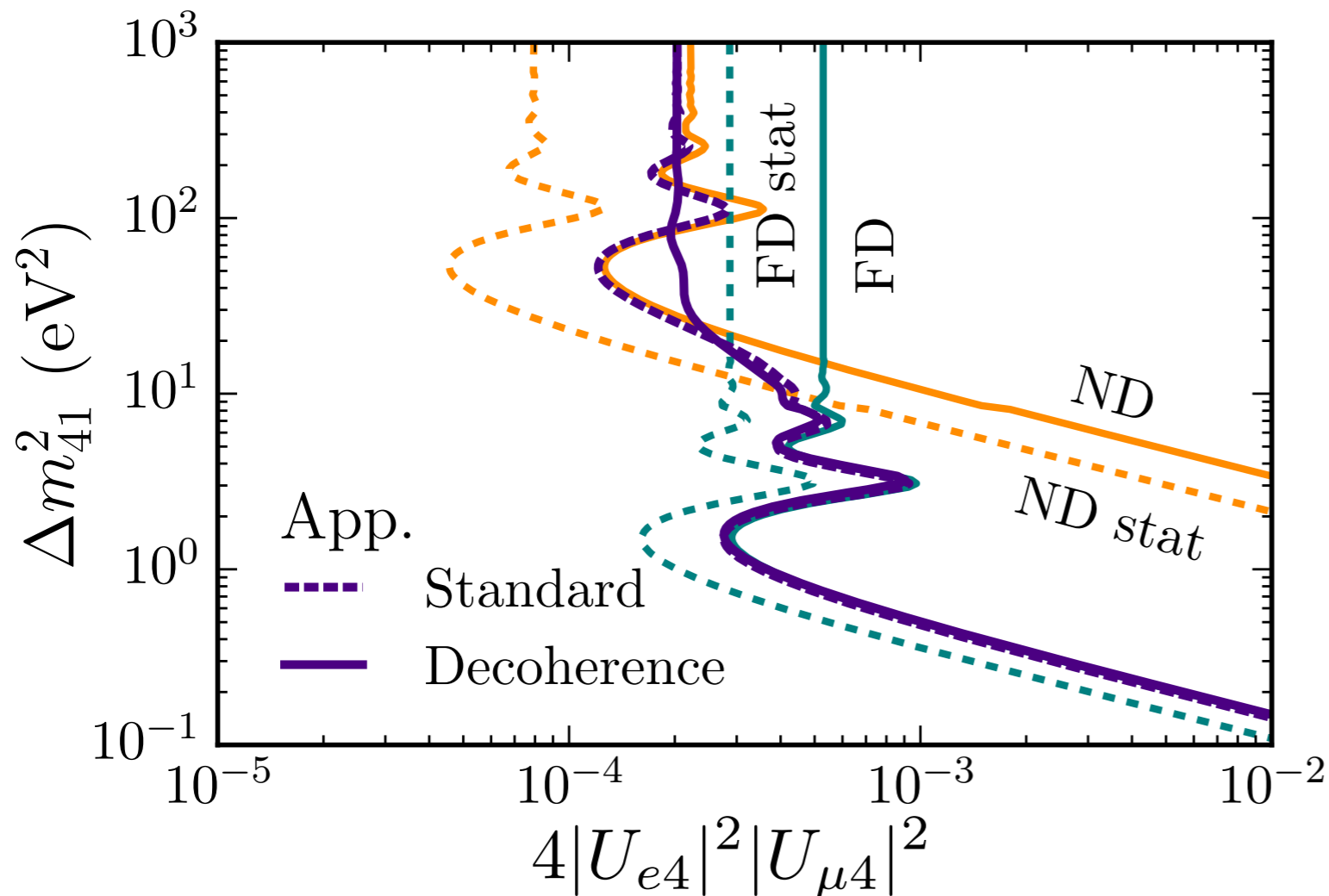
Low backgrounds



# 3+1 MODELS

## Short Baseline Oscillations

$$P_{\nu_e \rightarrow \nu_\mu} = 4|U_{e4}|^2|U_{\mu4}|^2 \sin^2\left(\frac{\Delta m^2 L}{4E}\right)$$



Full production coherence  
treatment

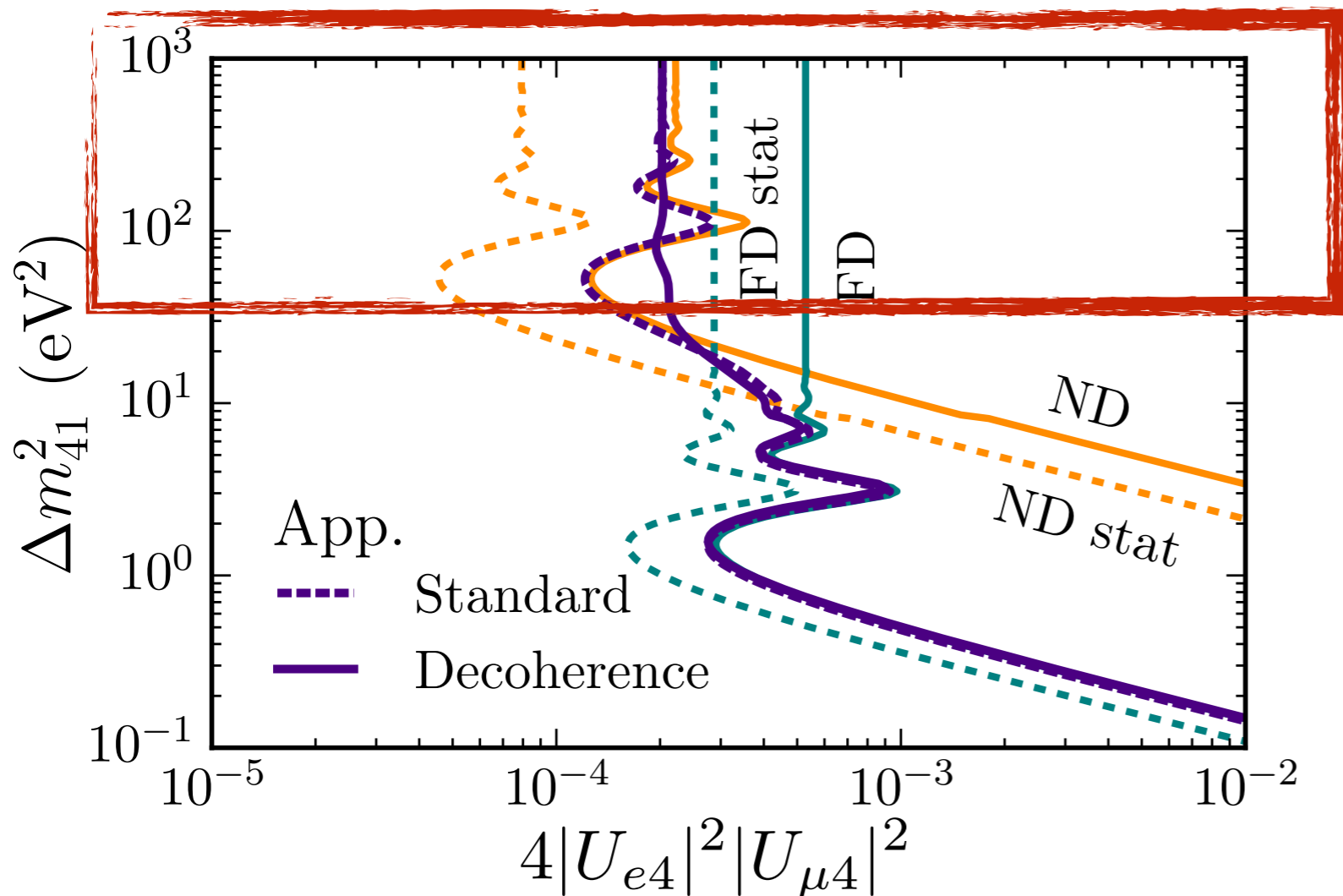
[Akhmedov, Hernandez &  
Smirnov, 2012]



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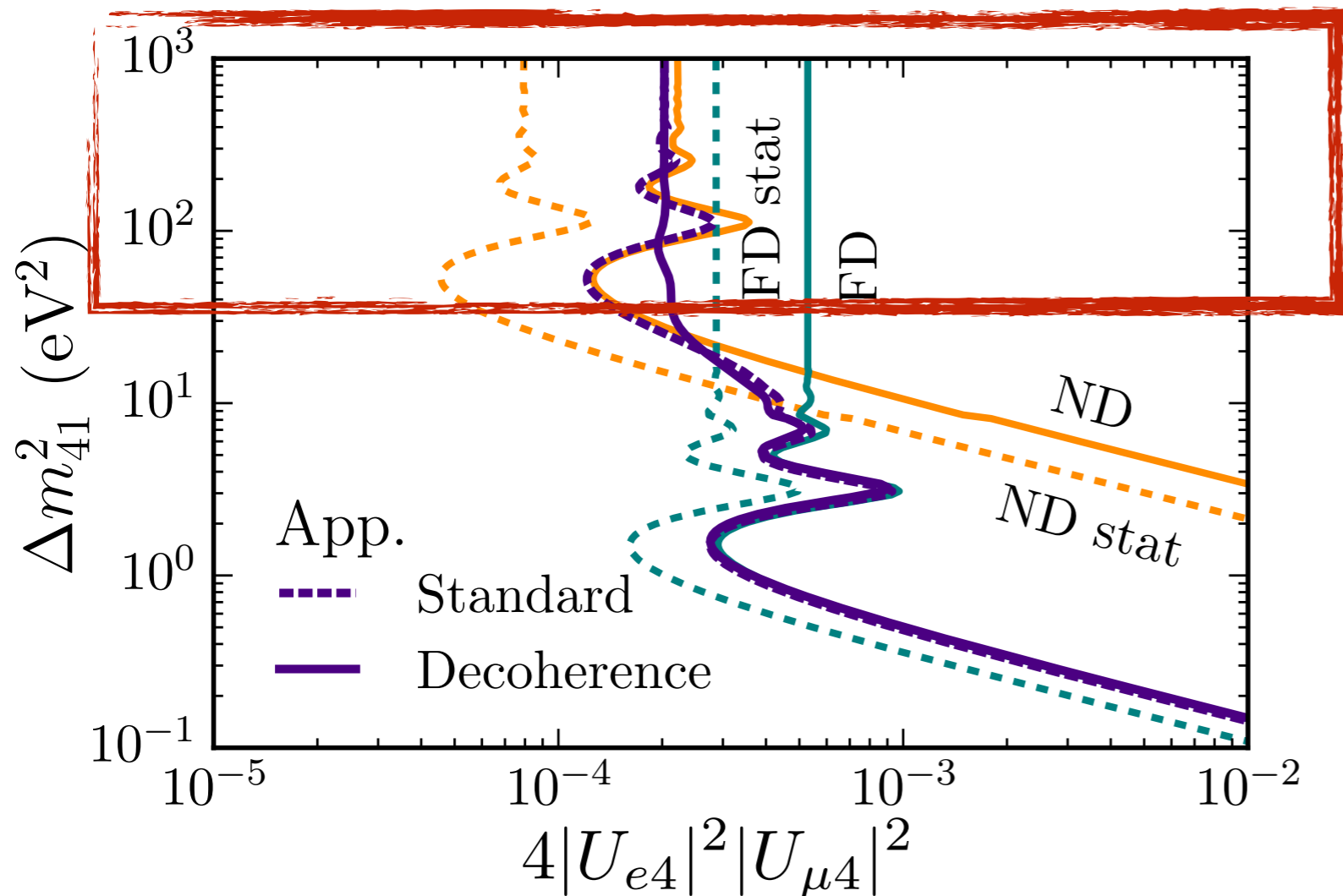
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# 3+1 MODELS

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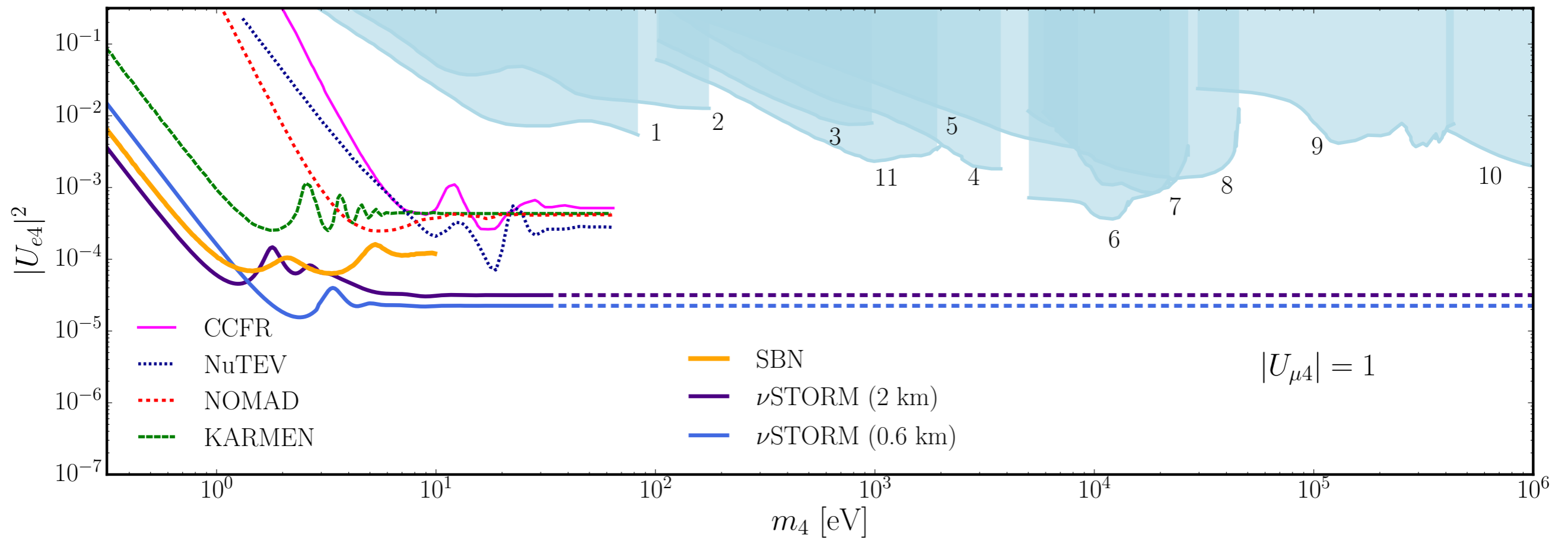
$$P_{\nu_e \rightarrow \nu_\mu} = 2|U_{e4}|^2|U_{\mu4}|^2$$



Full production coherence  
treatment

[Akhmedov, Hernandez &  
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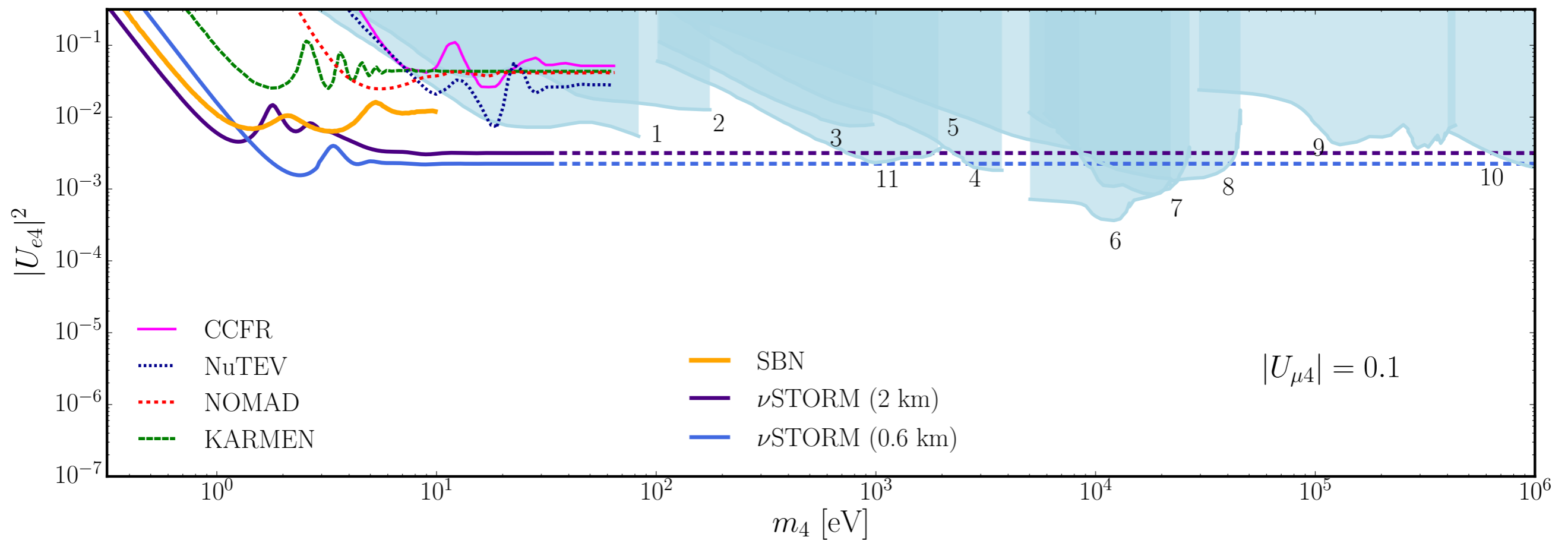
# LARGE MASSES



All oscillation bounds are at 90% C.L.

Bounds from 1 - 11 are all 95% C.L., except 2 and 9, which are 90 % C.L.

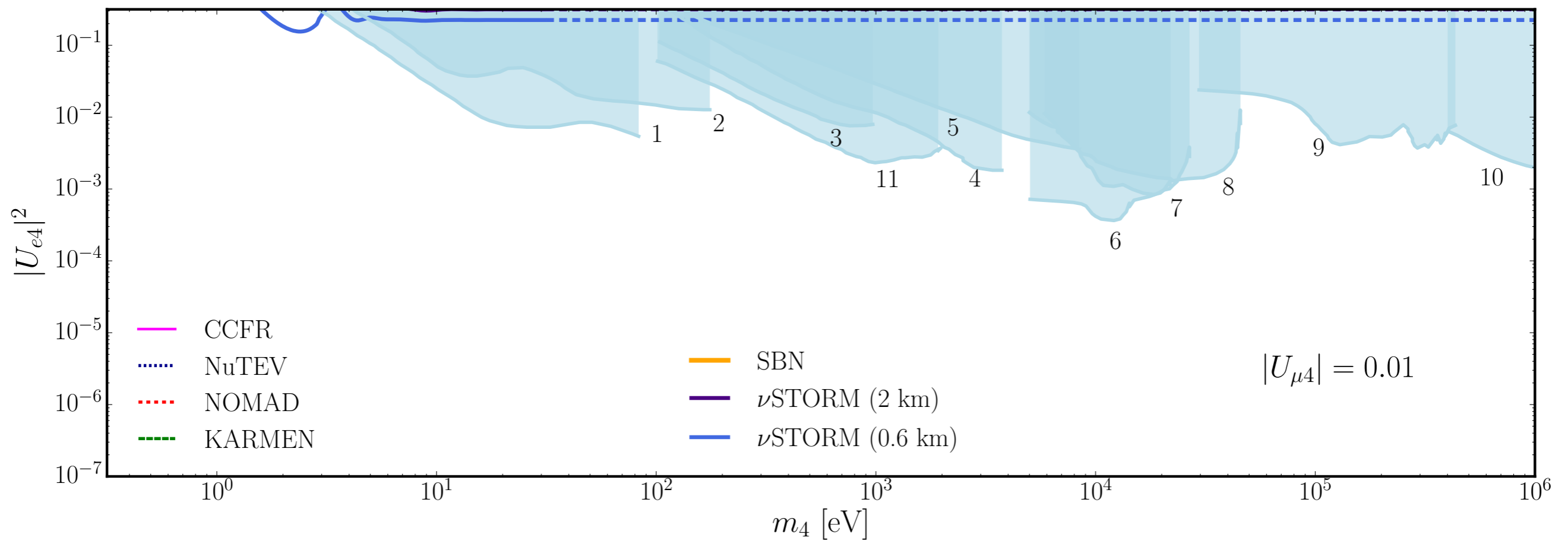
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# NON-UNITARITY

$$UU^\dagger = U^\dagger U = \mathbb{1} \qquad m_\nu \gtrsim 100 \text{ eV}$$

Oscillation data

$$|U_{e1}U_{\mu 1}^* + U_{e2}U_{\mu 2}^* + U_{e3}U_{\mu 3}^*| \leq 0.07 \text{ at } 3\sigma$$

[S. Parke, M. Ross-Lonergan, 2015]

$\nu$ STORM

$$|U_{e1}U_{\mu 1}^* + U_{e2}U_{\mu 2}^* + U_{e3}U_{\mu 3}^*| \leq 0.008 \text{ at } 3\sigma$$

**THANK YOU!**

# CONCLUSIONS AND OUTLOOK

The clean environment at NuSTORM offers an ideal place for light sterile searches

Appearance searches are very sensitive to wide range of sterile masses

## **What I did not tell you about:**

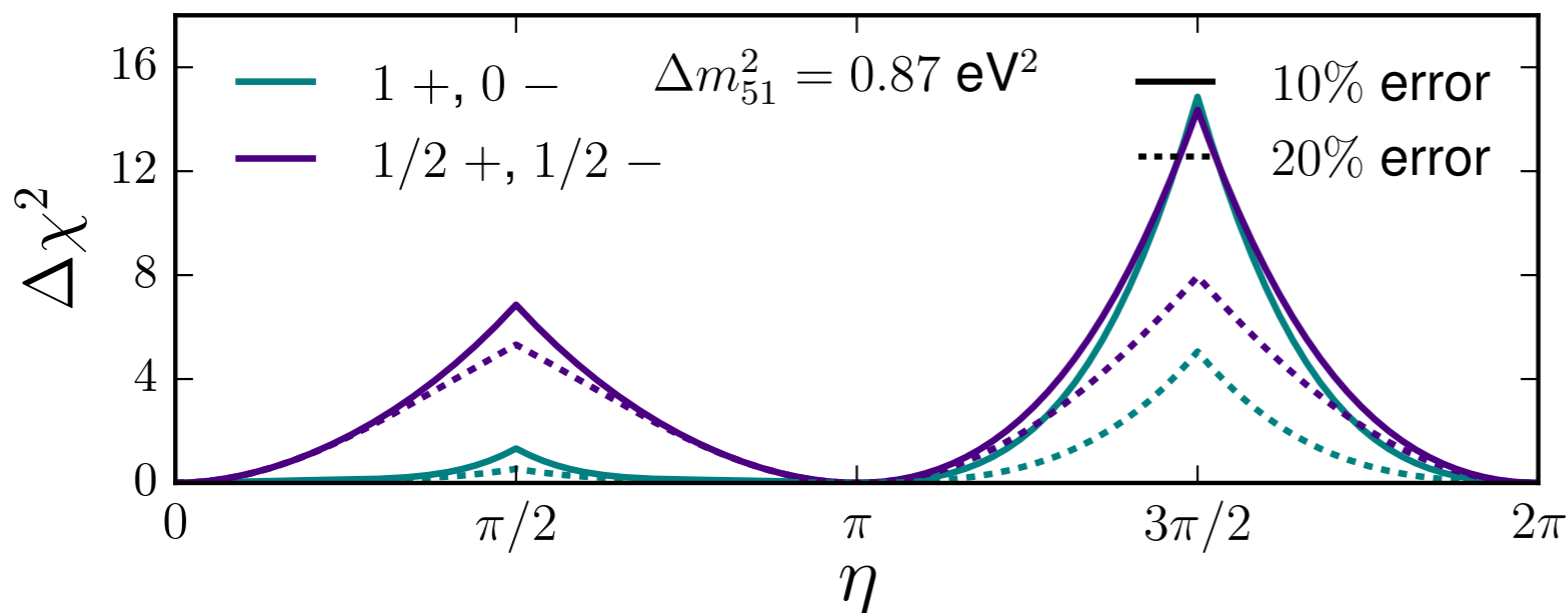
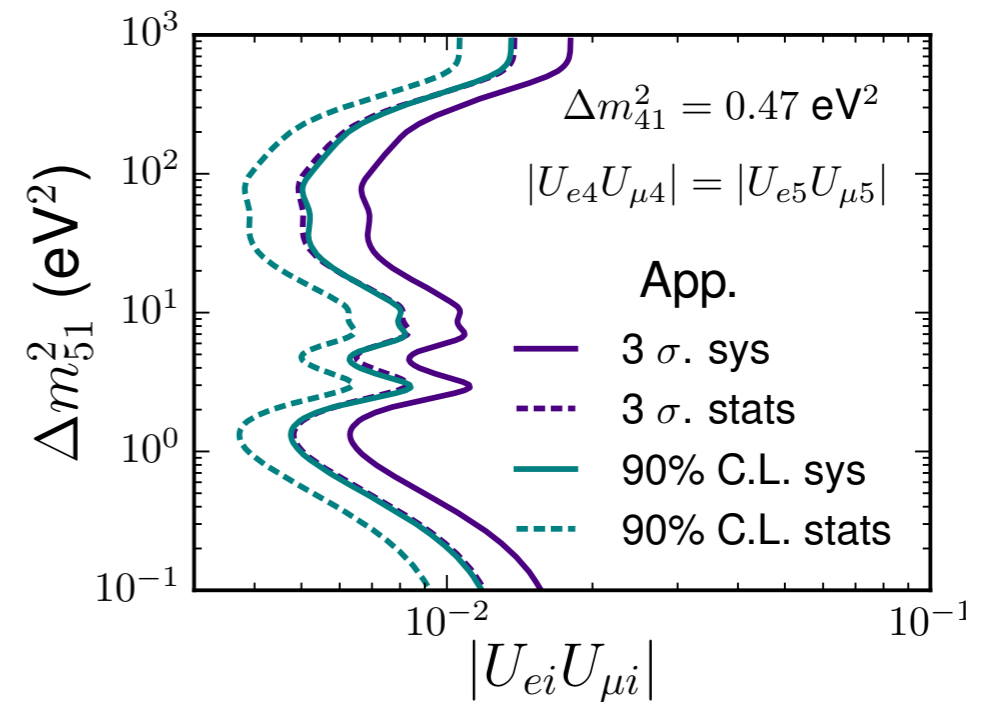
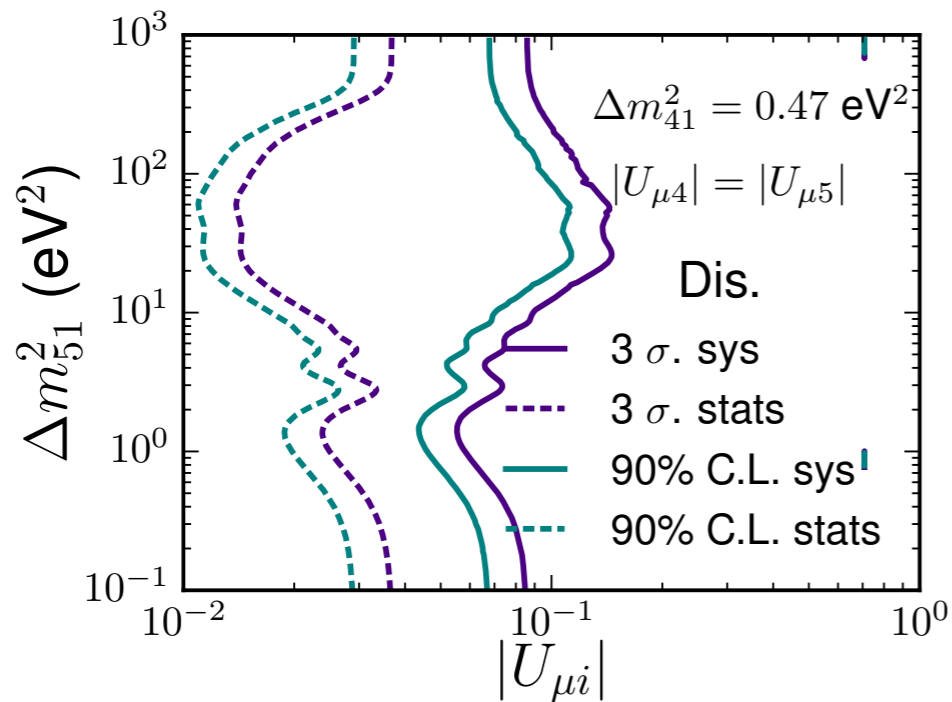
Decoherence

3+2 analysis

CP violation sensitivity



# 3+2 MODELS



CP sensitivity for:

$$\begin{aligned}
 \Delta m_{41}^2 &= 0.47 \text{ eV}^2, \\
 |U_{e4}| &= 0.13, \quad |U_{e5}| = 0.14, \\
 |U_{\mu 4}| &= 0.15, \quad |U_{\mu 5}| = 0.13.
 \end{aligned}$$