

# **What UV Evolution Can Tell Us About The Dark Sector**

Aidan Reilly & Natalia Toro

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- Introduce the models we analyze
- Why we care about UV evolution
- Where do the theories become non-perturbative & what does it imply
- Recap & concluding remarks

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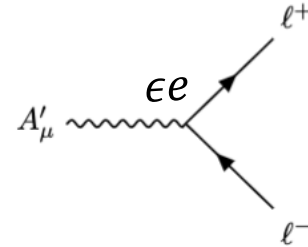
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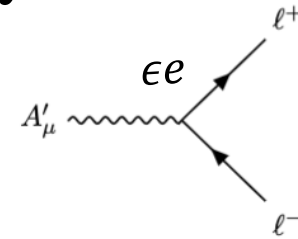
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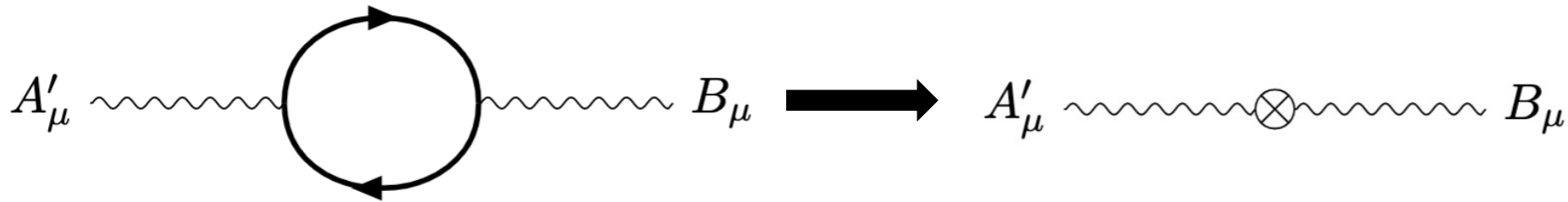
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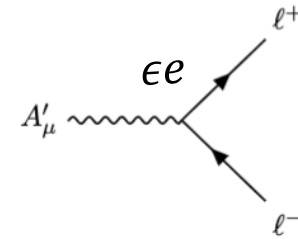
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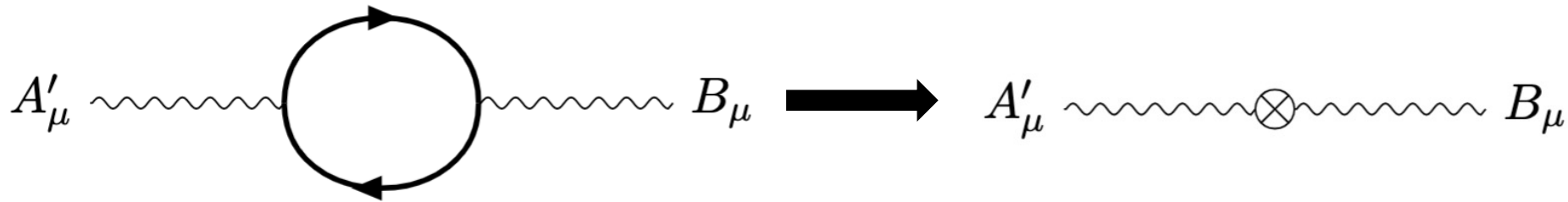
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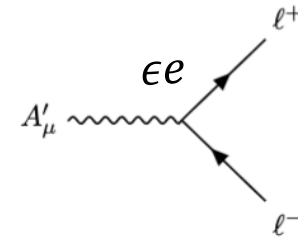
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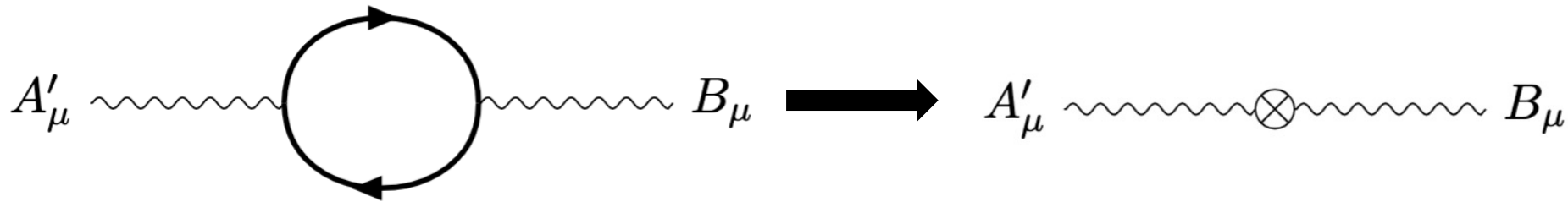
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- Fermionic DM with coupling  $e_D$  to  $A'$
- Higgs field with coupling  $e_D Q_\phi$

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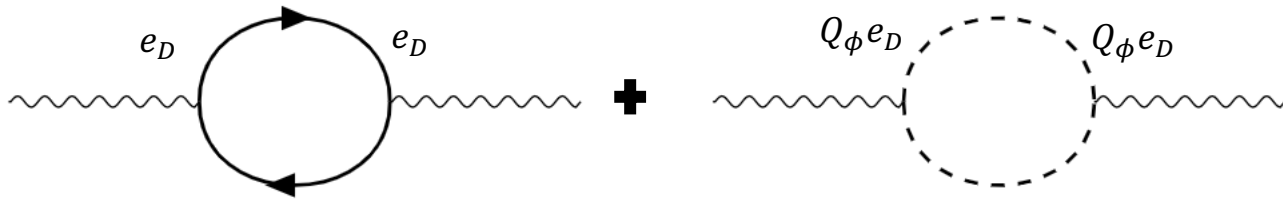
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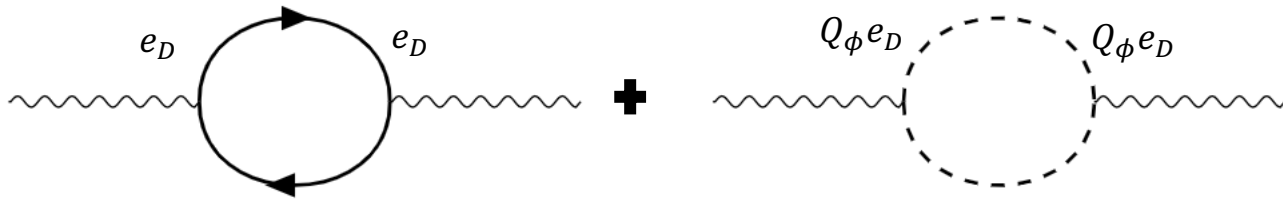
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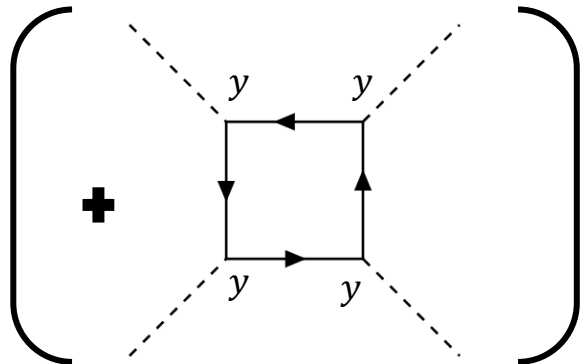
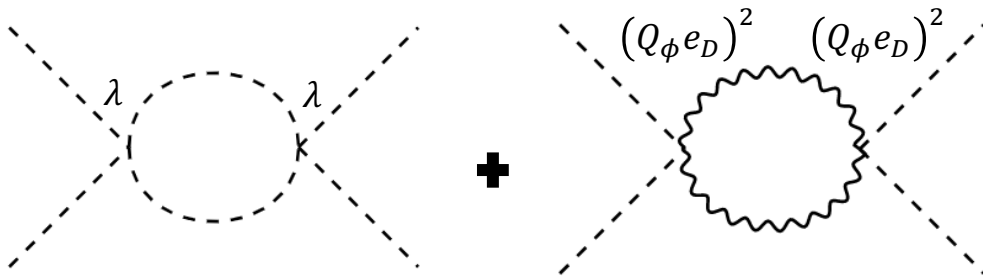
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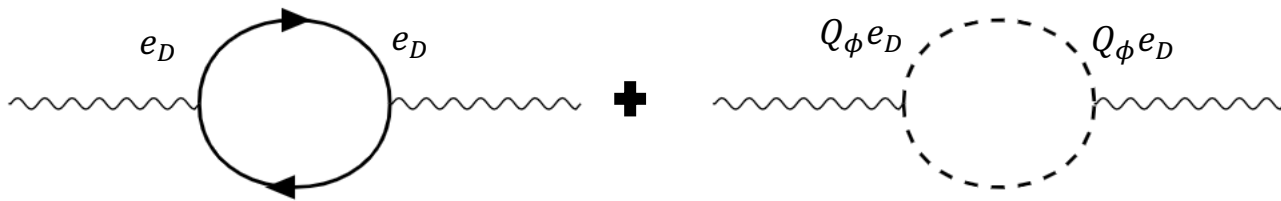


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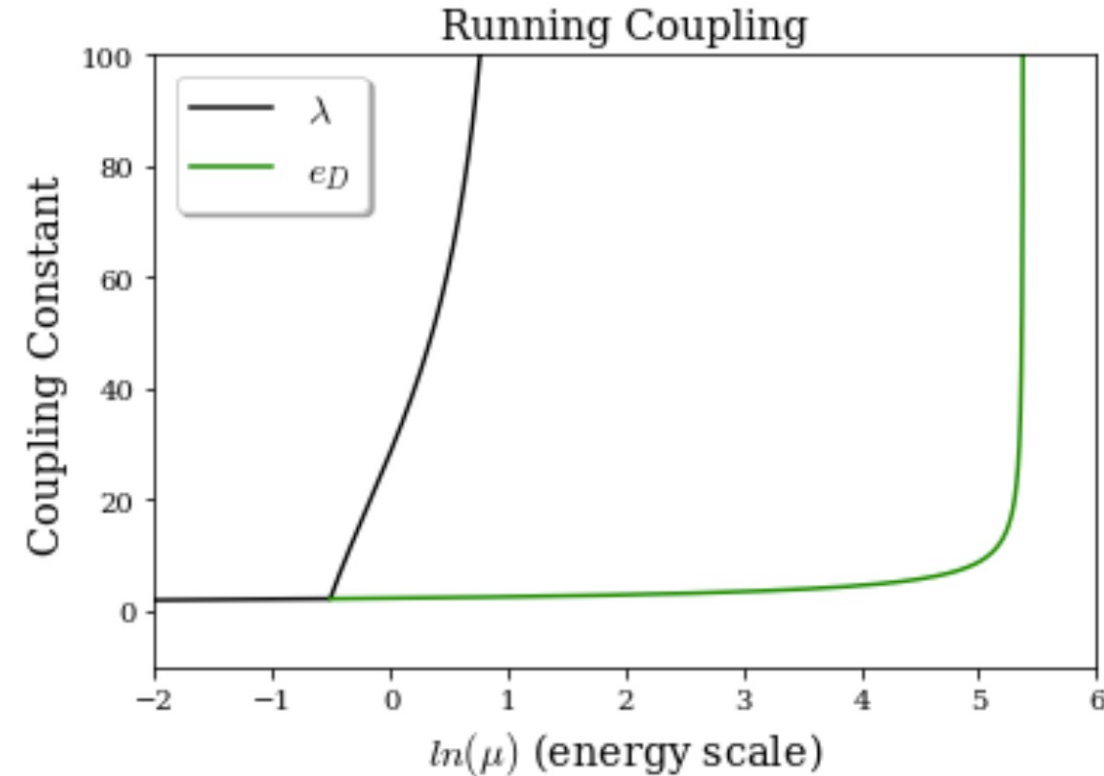
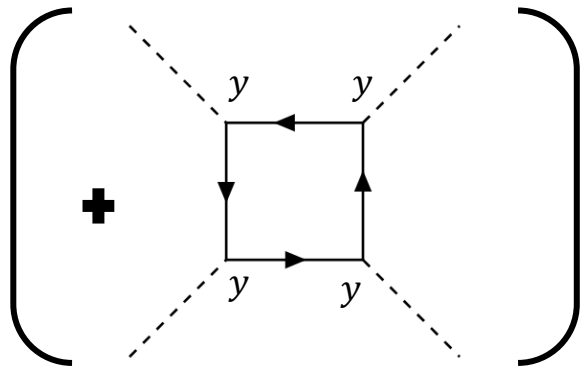
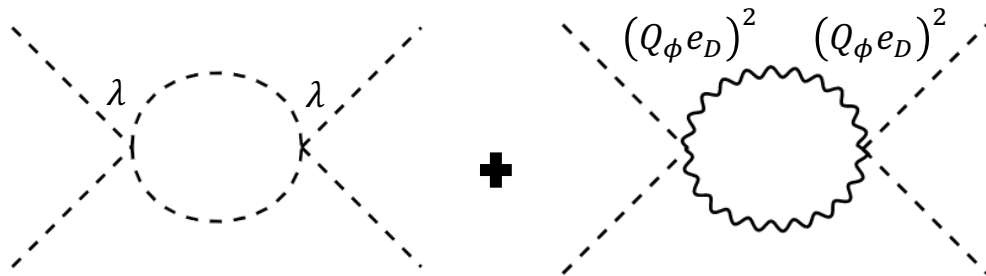


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**Why Do We Care About  $\alpha_D$ ?**

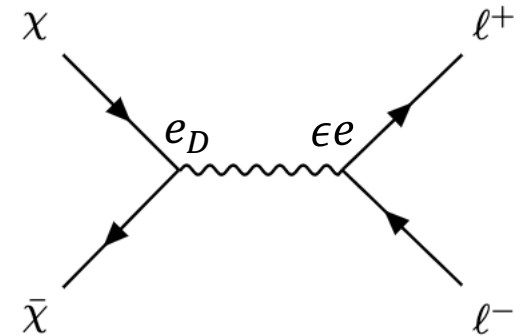
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- The combination  $\alpha_D \epsilon^2$  is set by thermal freezeout
- Many experiments scale with only  $\epsilon$



# Why Do We Care About $\lambda$ ?

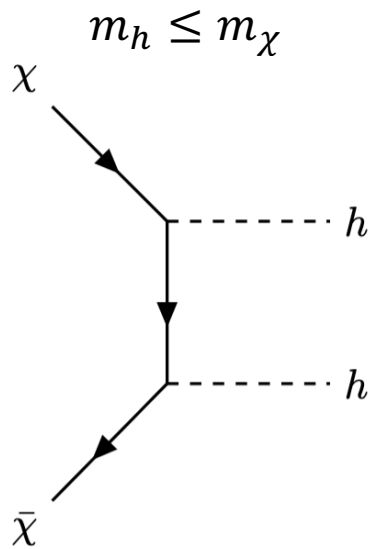
- Size of  $\lambda$  affects DM and DH phenomenology via the Higgs to dark photon mass ratio:  
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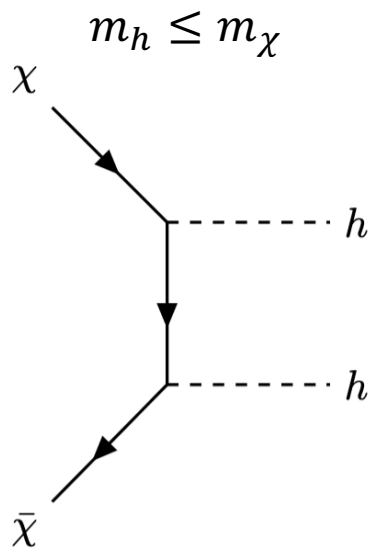
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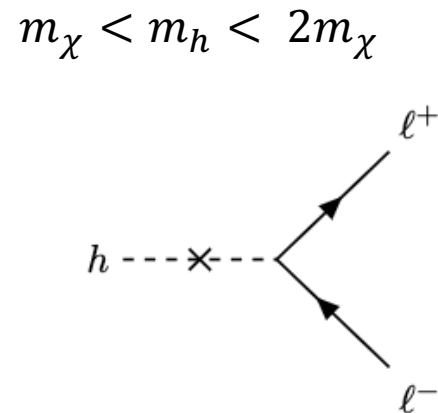
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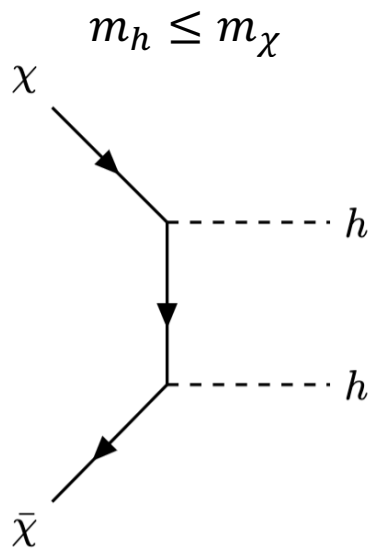
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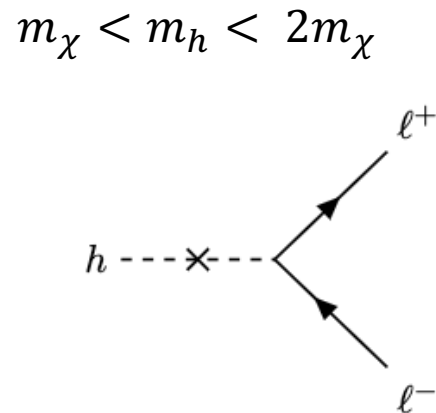
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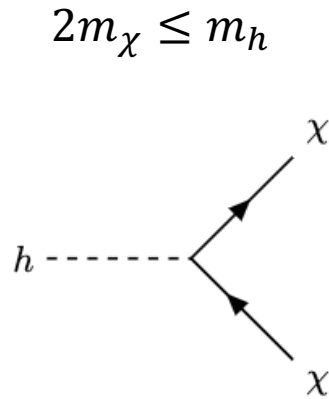
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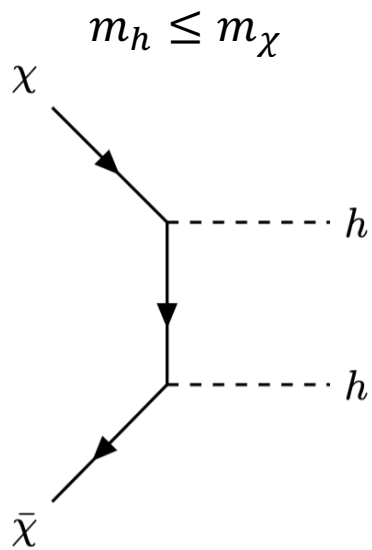
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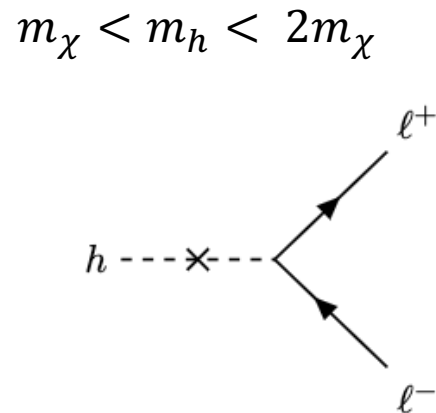
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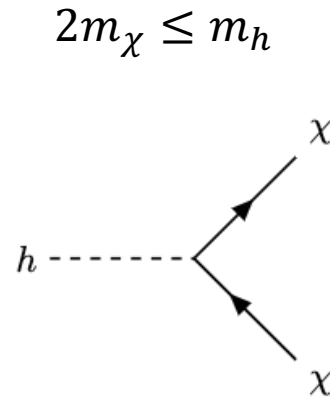
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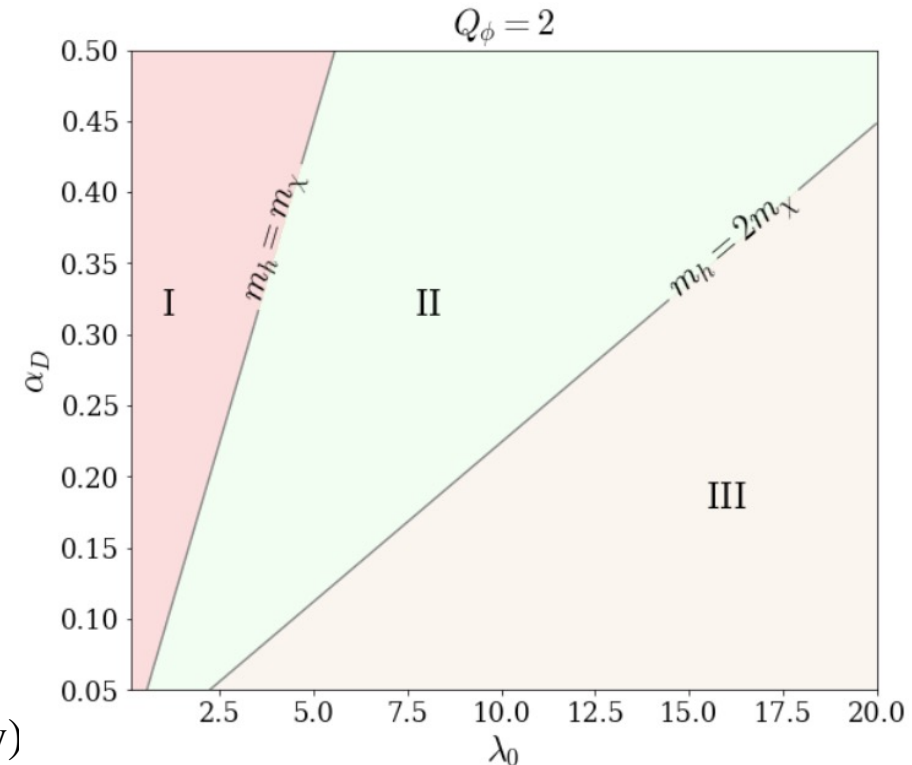
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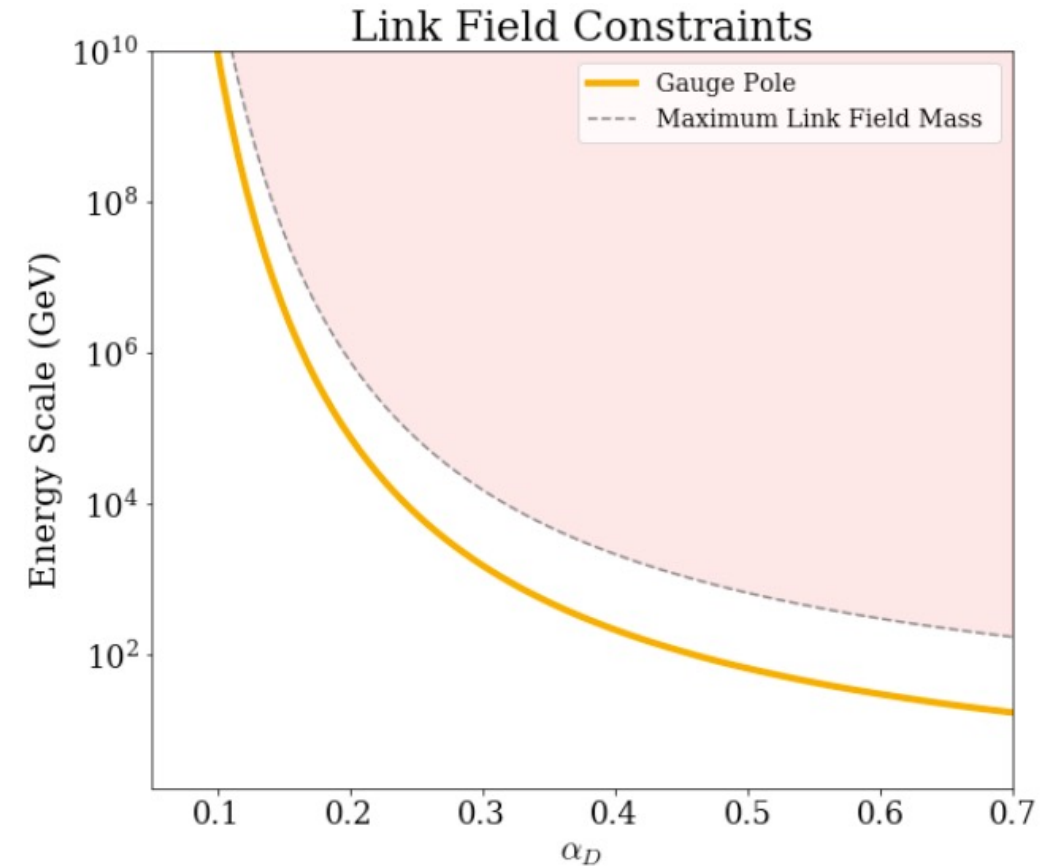
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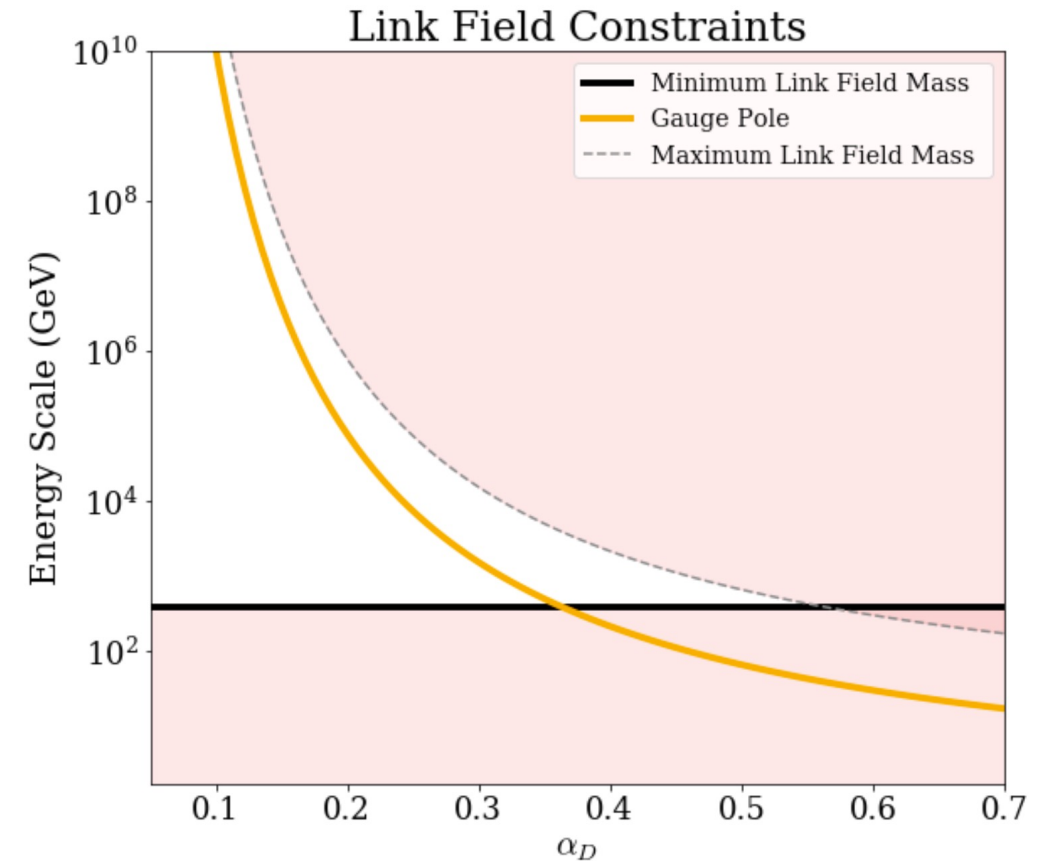
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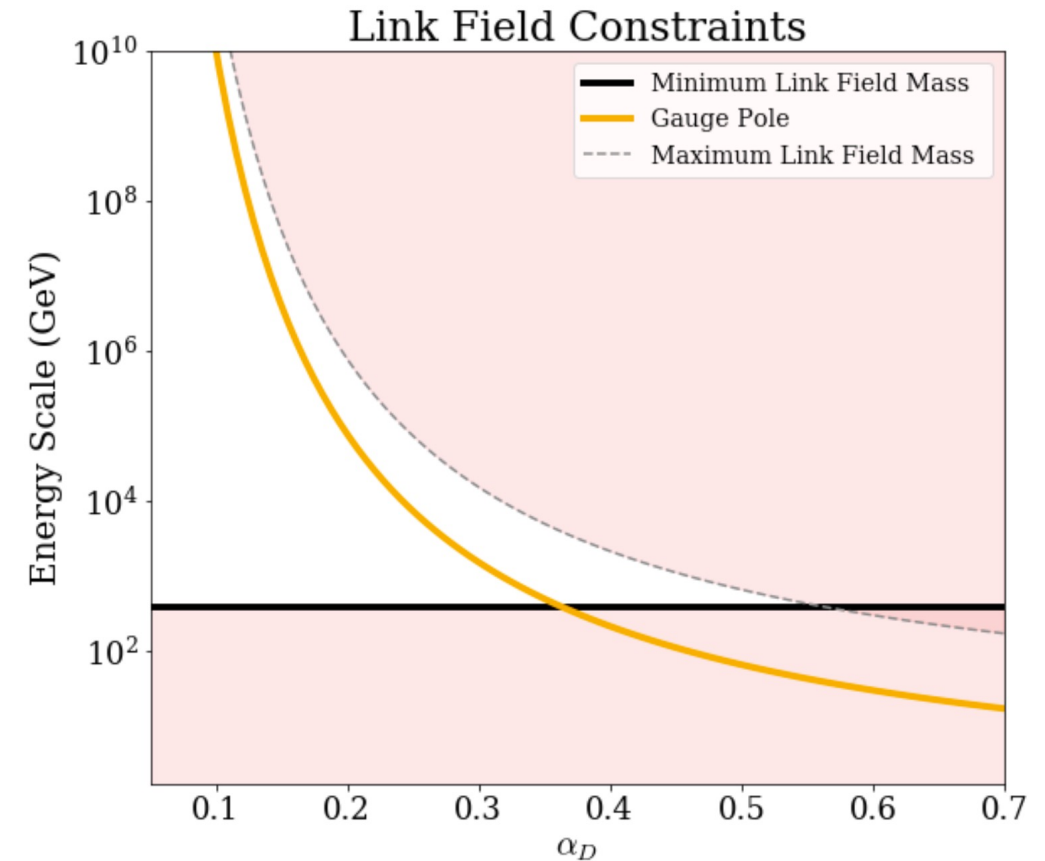
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- Upper bound on  $\alpha_D$

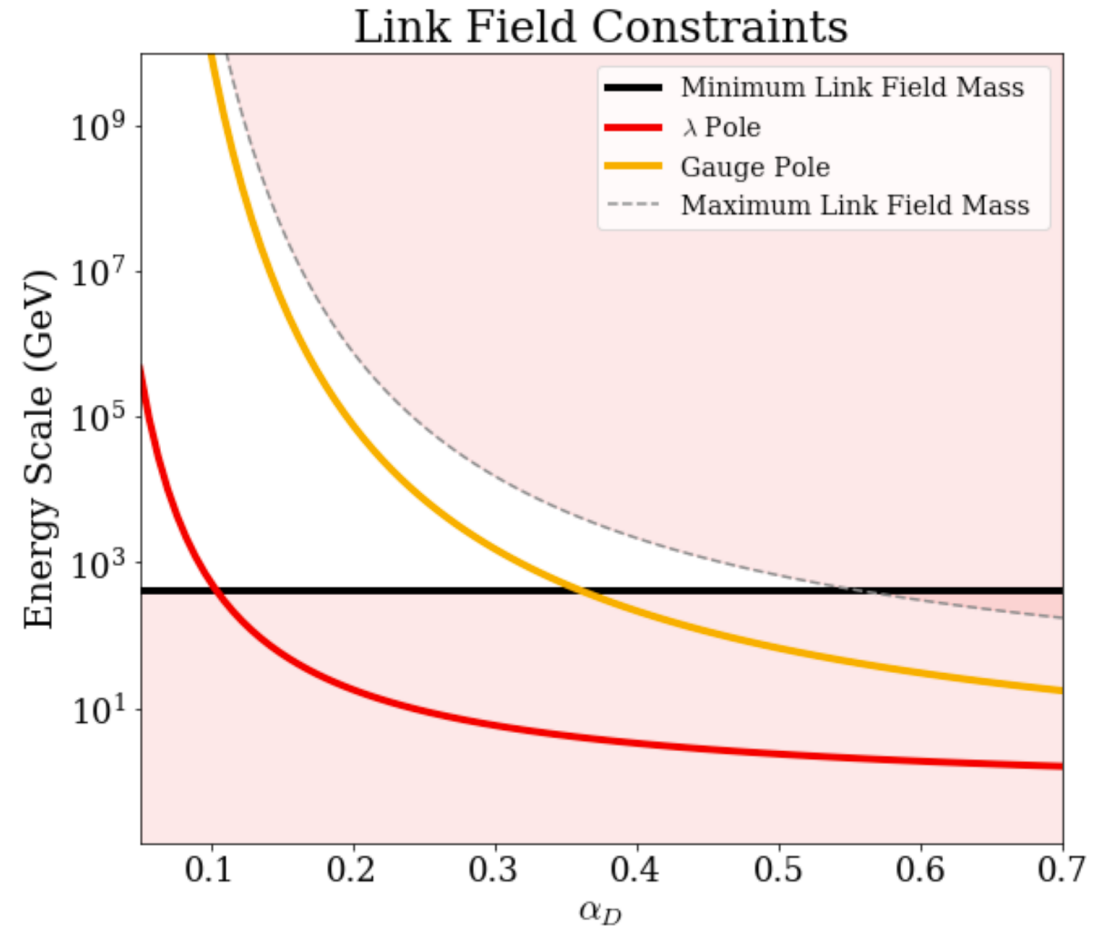




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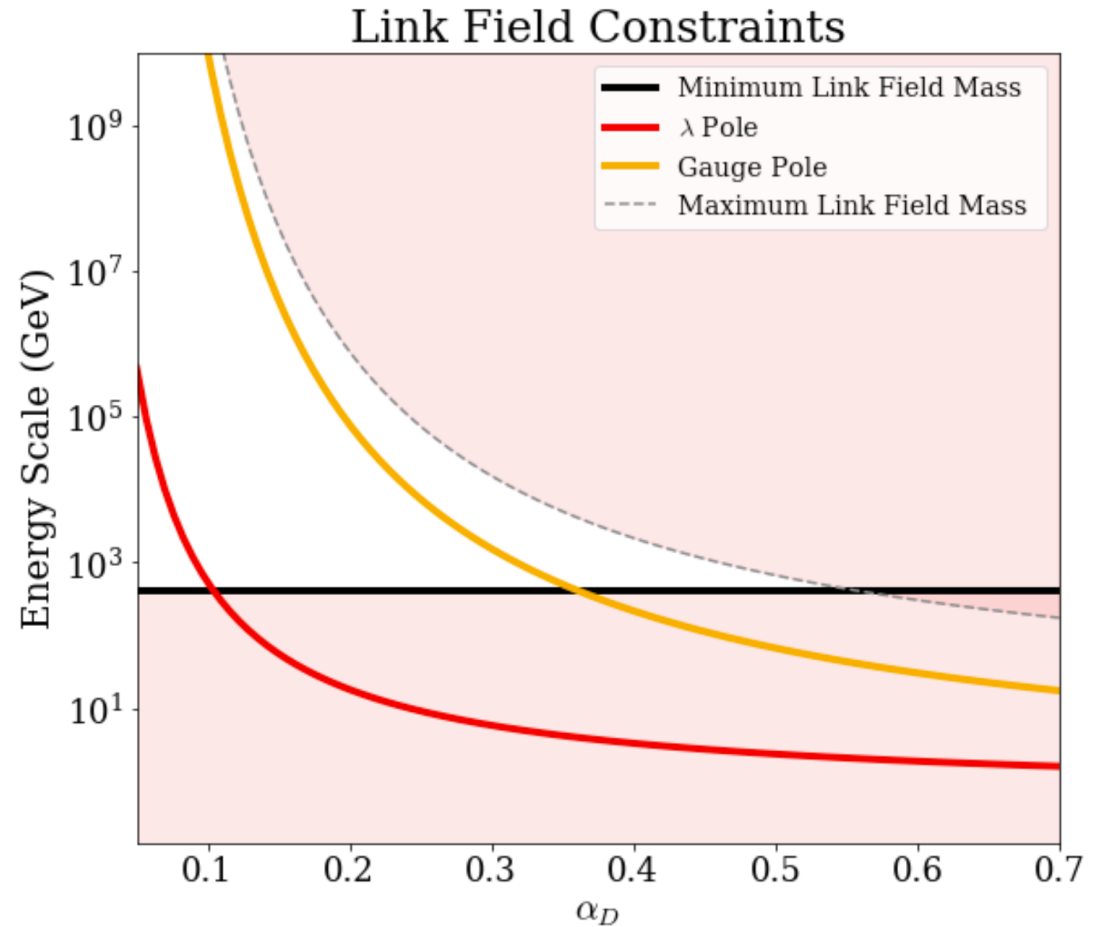
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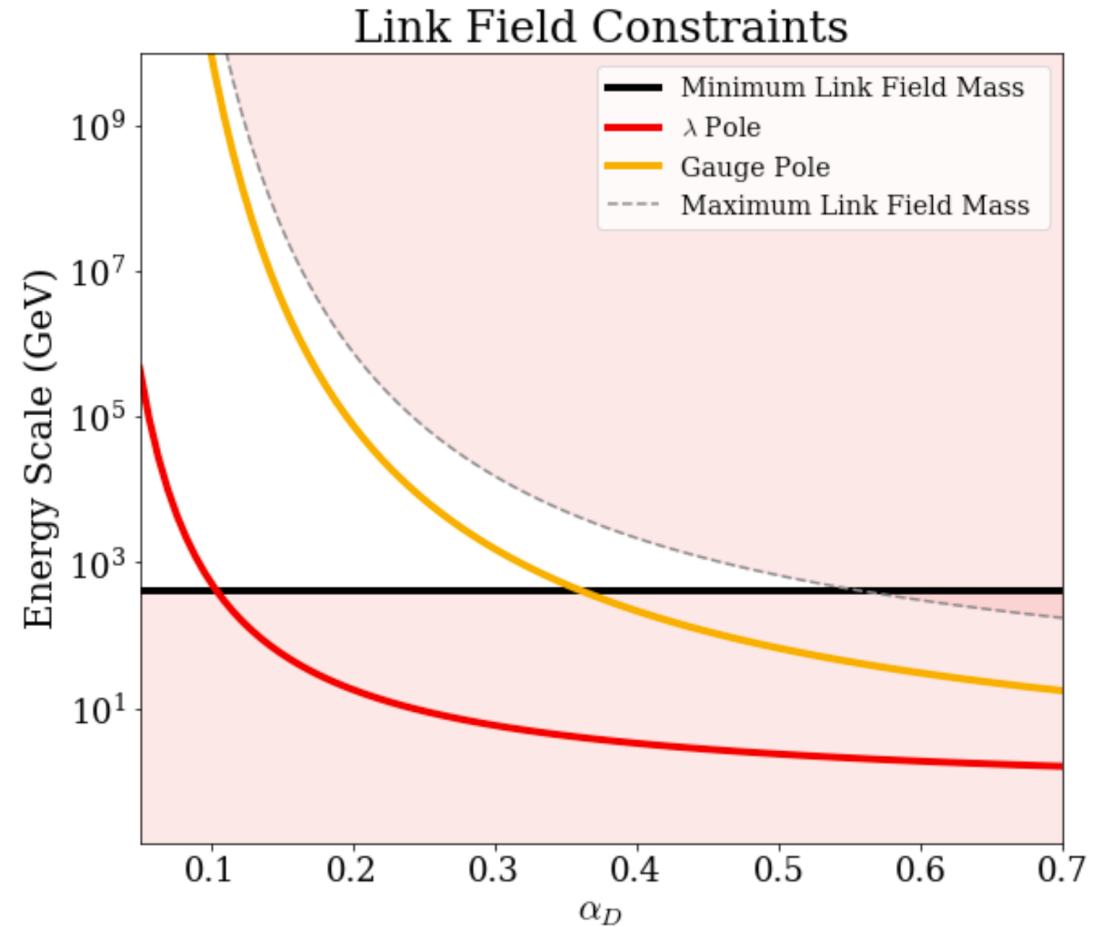
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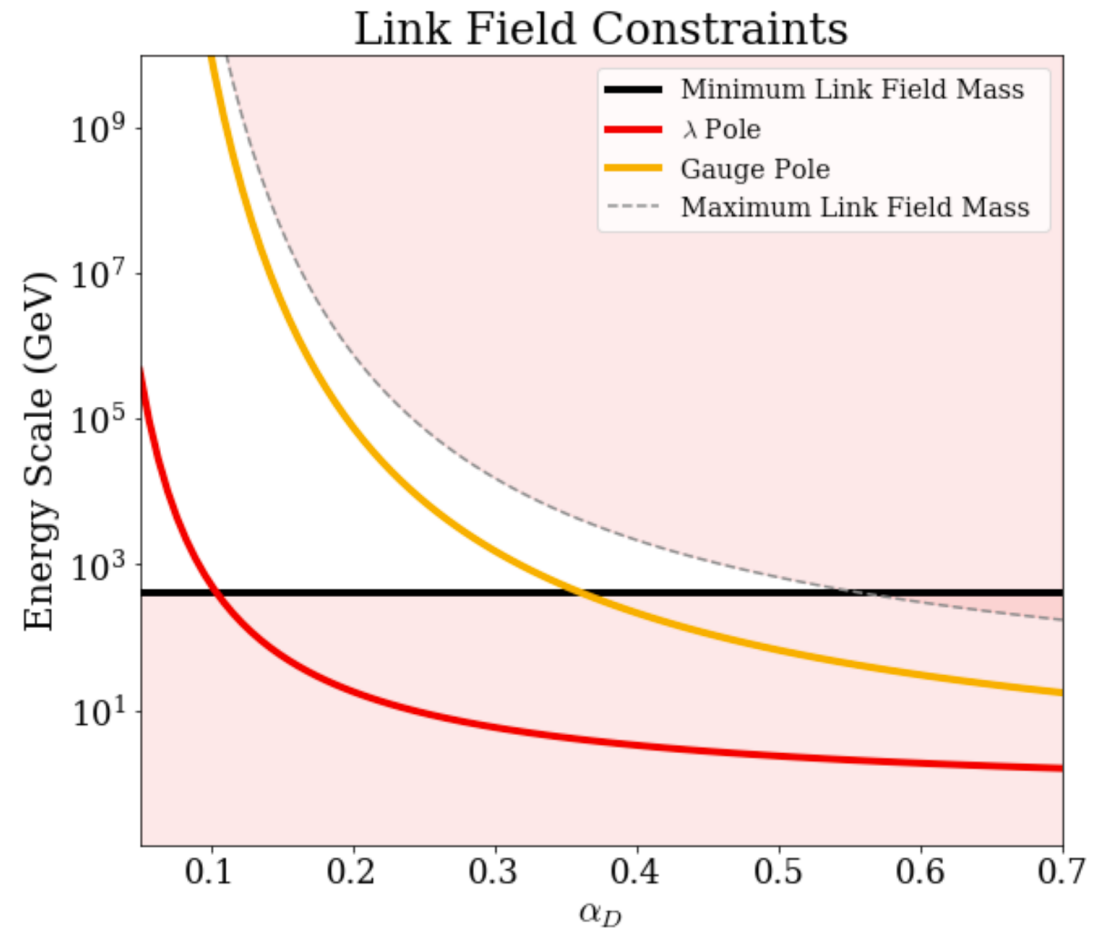
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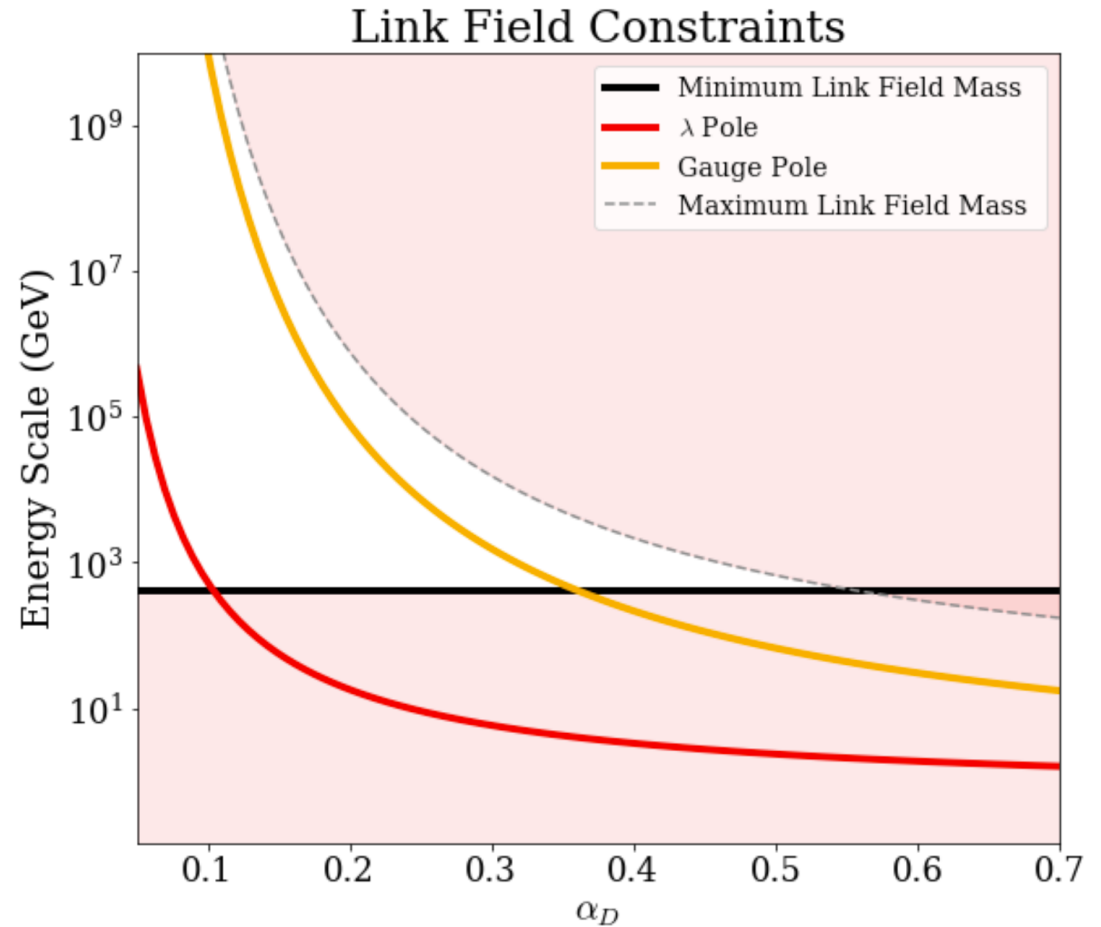
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- Assume the same factor of 10 ratio between  $M_\psi$  and the lambda pole
  - Current constraints suggest poles  $\geq 50$  GeV



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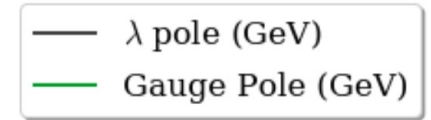
$Q_\phi = 1 \rightarrow \underline{\text{Pseudo-Dirac DM}}$

$$j^\mu = i\bar{\chi}_1\gamma^\mu\chi_2$$

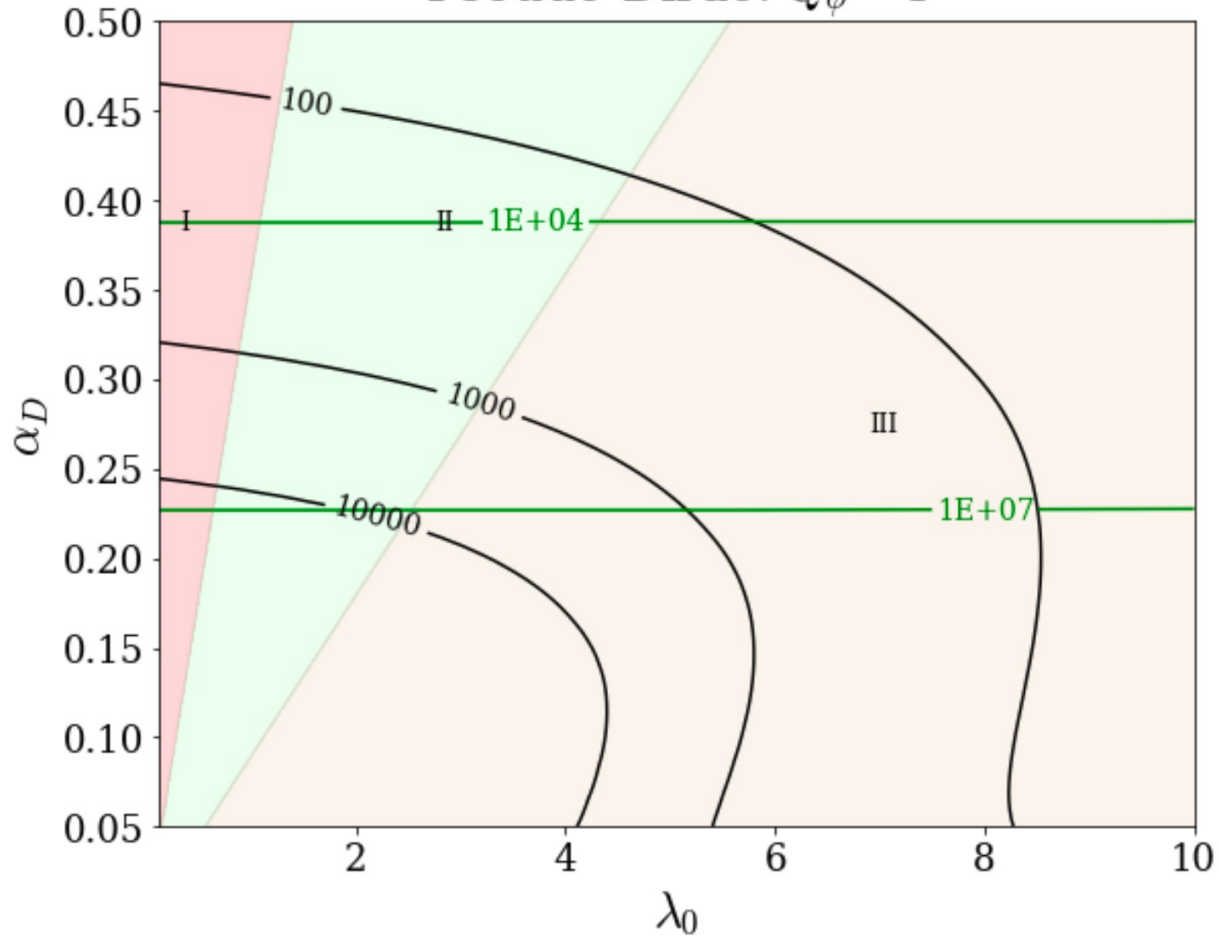
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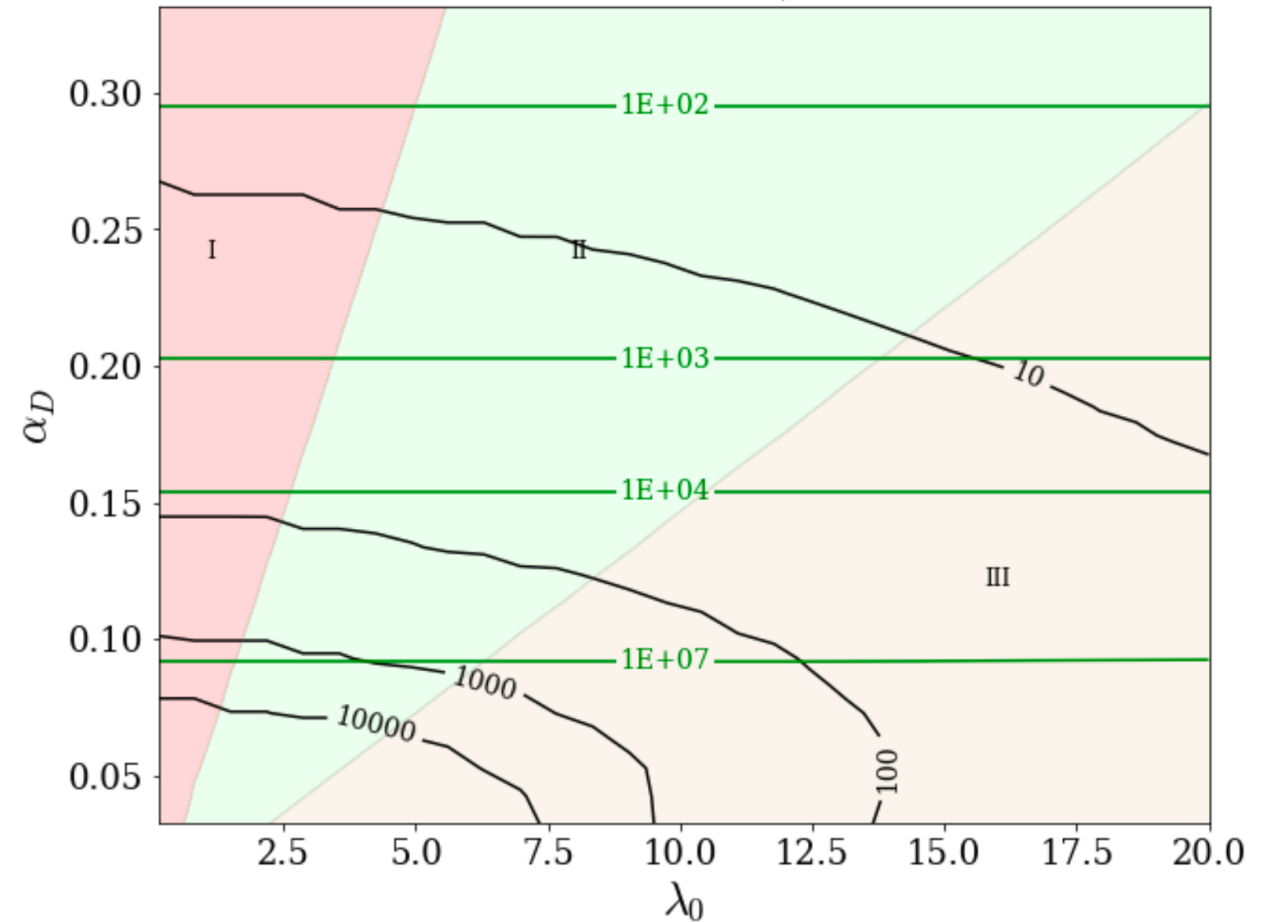
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Pseudo-Dirac:  $Q_\phi = 1$

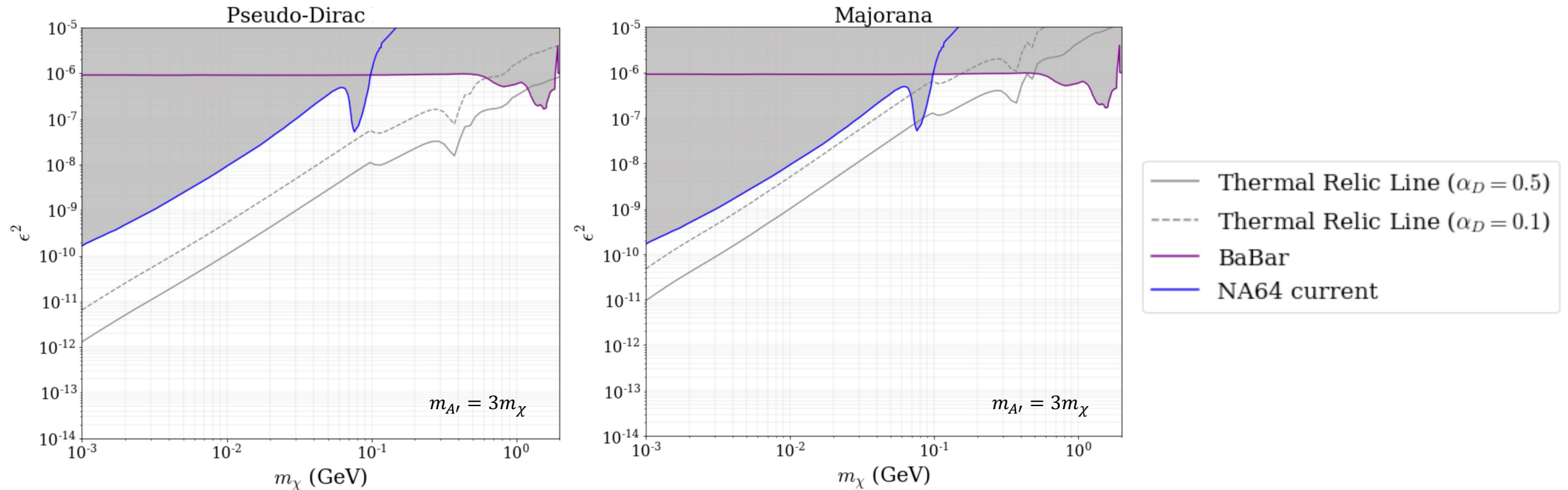


Majorana:  $Q_\phi = 2$



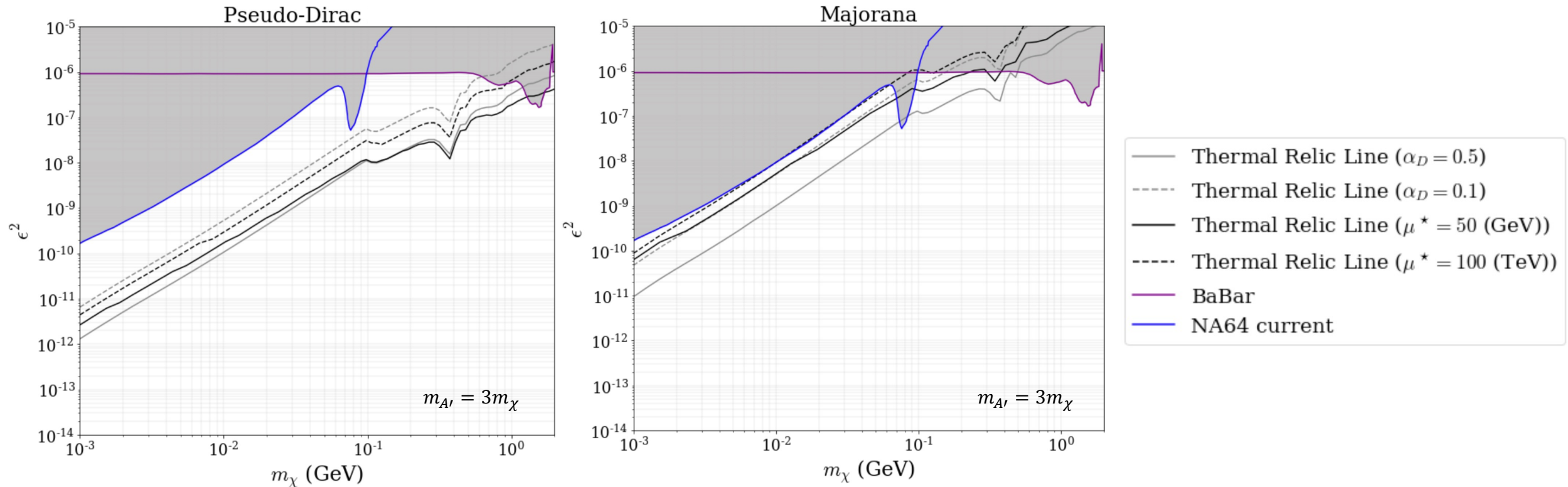
- Not much preference for region II over region III because  $\lambda$  running driven by  $\alpha_D$
- Tightest perturbativity constraint on  $\alpha_D$  comes from  $\lambda$  pole not its own landau pole

# What Do These Constrained Values of $\alpha_D$ Mean for Experiment?



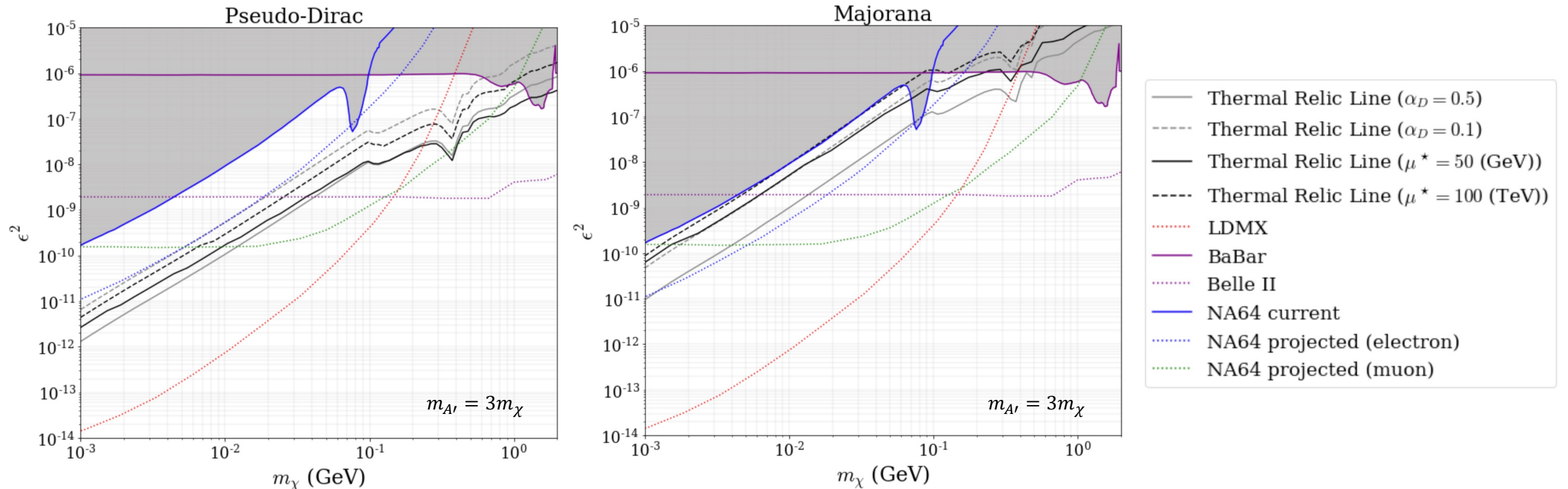
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- Future experiments probe whole parameter space



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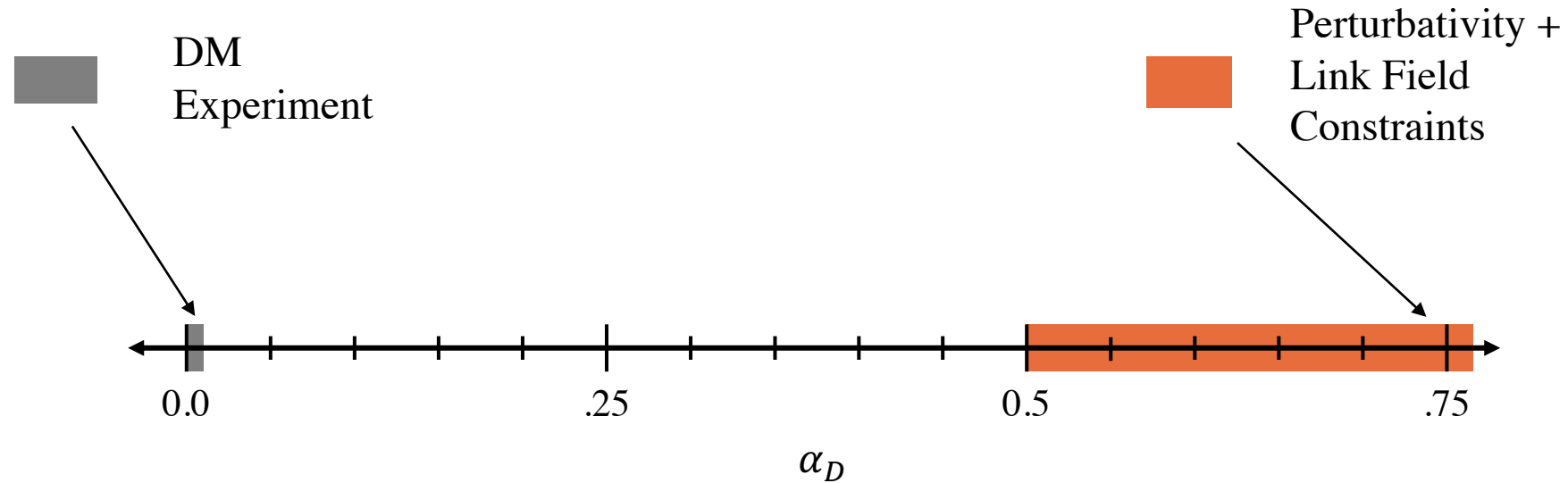
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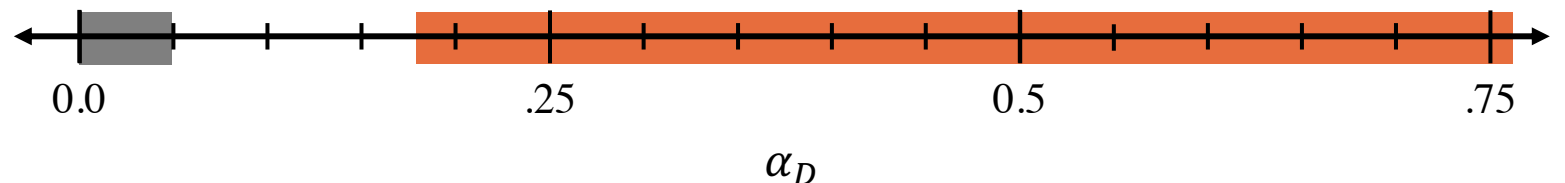
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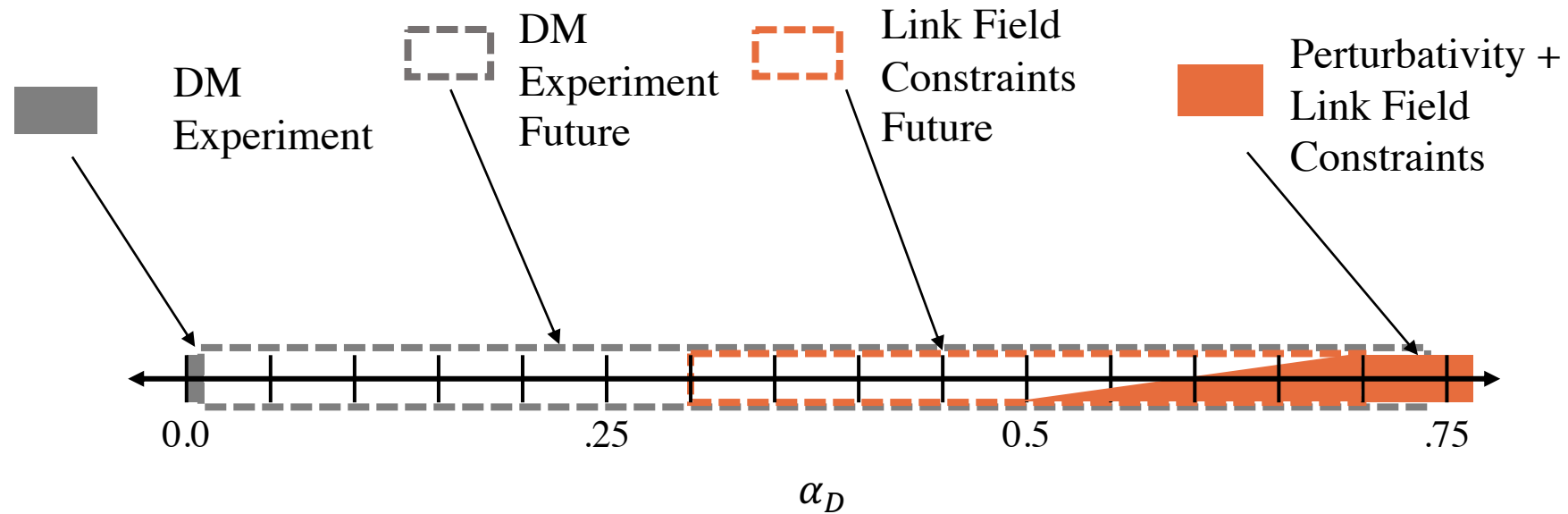
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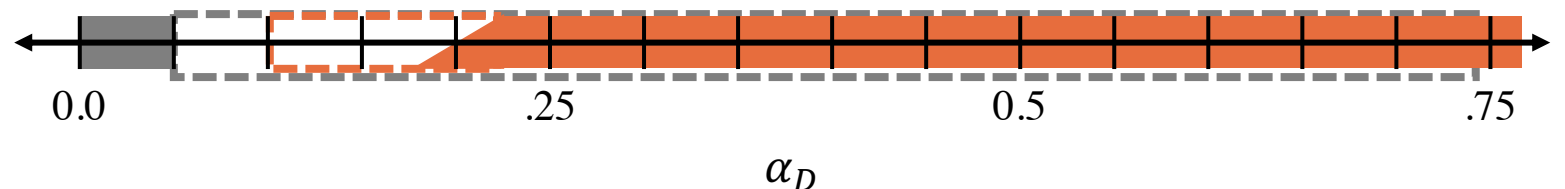
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**THANK YOU!**