

# Radiative & dark-Higgs effects on complex scalar dark matter

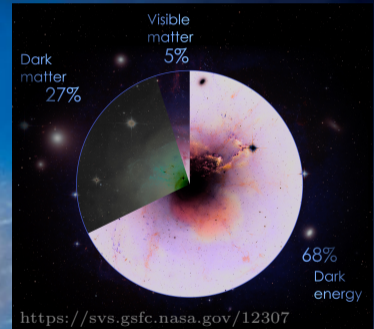
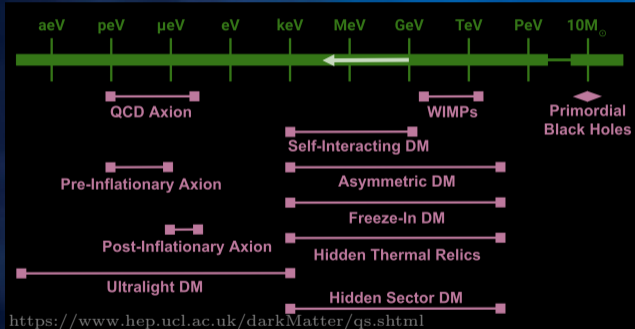
Lilianna Hariasz

Simon Fraser University

June 19, 2026

Theory Canada 18, June 19-20, 2026, Université de Montréal

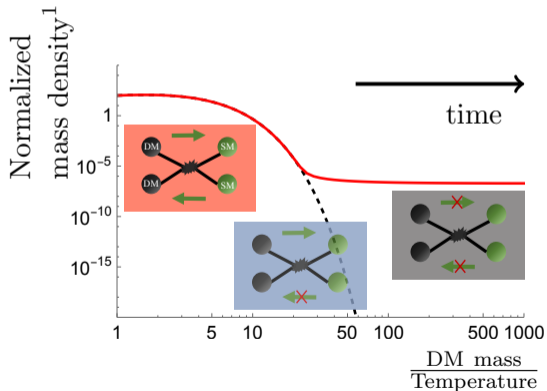
# Light Dark Matter (LDM)



# Extending the Standard WIMP Scenario

## Weakly Interacting Massive Particle

- Thermal relic, one new fermion

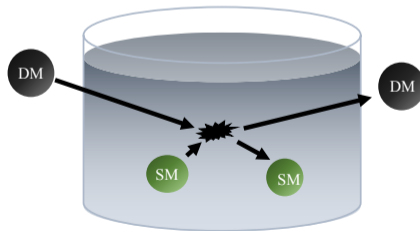
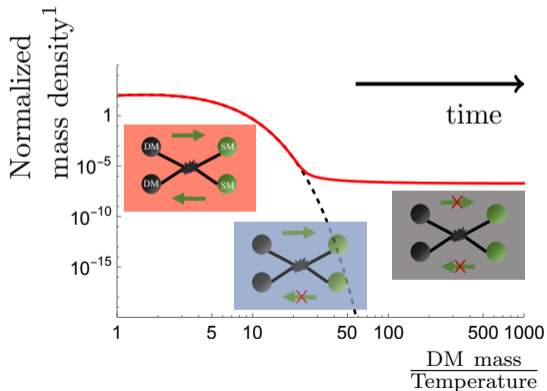


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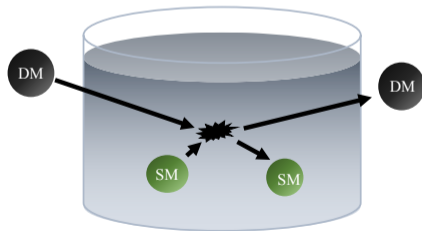
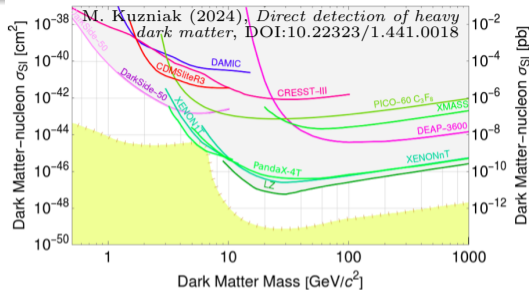
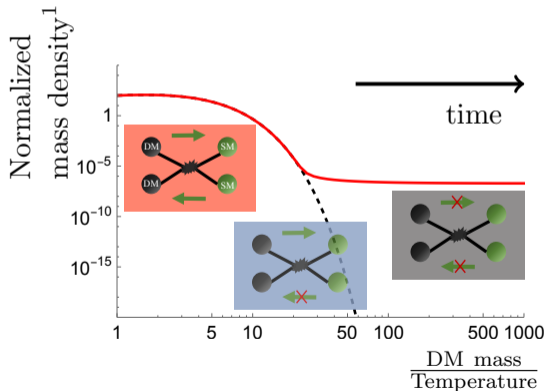


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# Extending the Standard WIMP Scenario

## Weakly Interacting Massive Particle

- Thermal relic, one new fermion
- Extensively studied

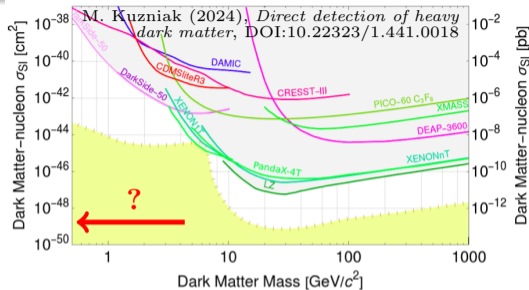
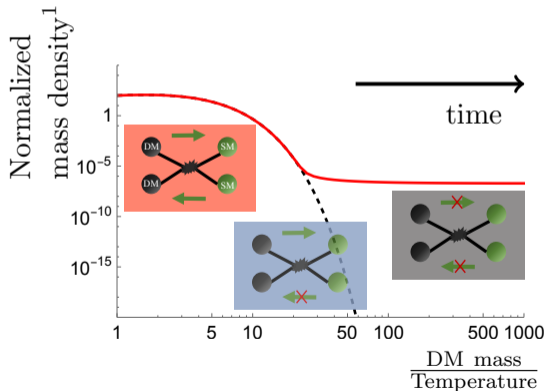


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# Extending the Standard WIMP Scenario

## Weakly Interacting Massive Particle

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## sub-GeV extension (LDM)

- Maintain thermal relic scenario
- New light mediator
- New models & experimental prospects

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# A dark sector and light dark matter

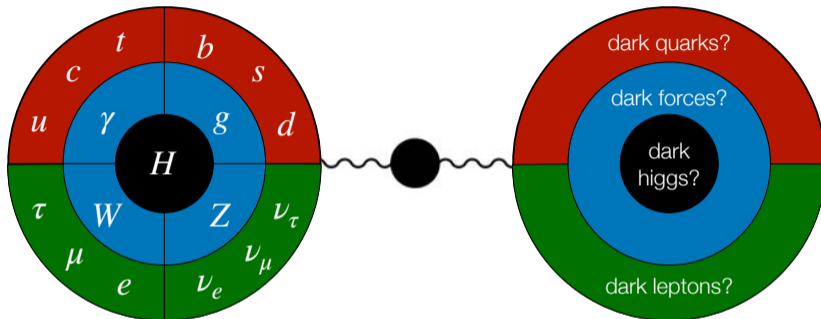
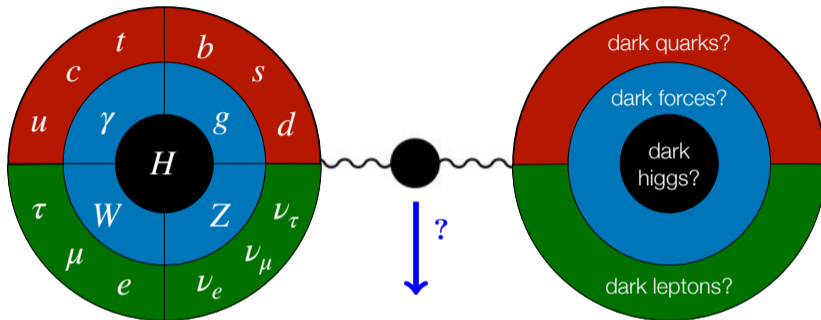


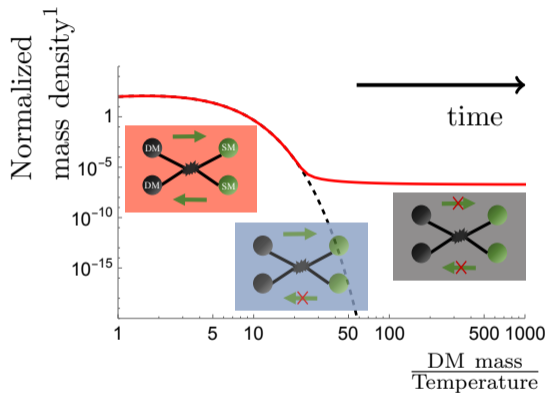
Image adapted from Gori & Williams (2022), *Dark Sector Physics at High Intensity*, arXiv:2209.04671.

# A dark sector and light dark matter



## New light mediator (“dark photon”)

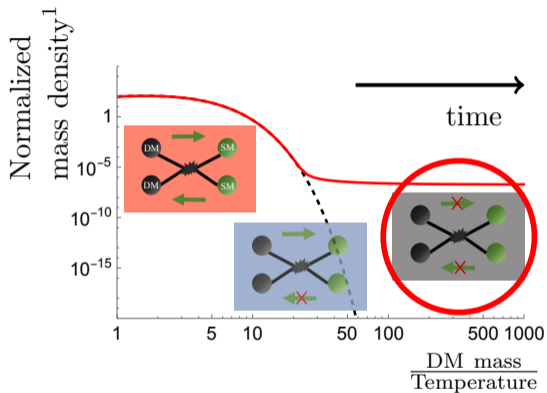
- Maintain freeze-out: matches observed relic abundance in sub-GeV range
- DM abundance provides experimentally accessible scenarios



- DM does not completely stop annihilating at freeze-out
- sub-GeV Dirac DM  $\implies$  re-ionization of hydrogen at re-combination

## Some viable alternatives

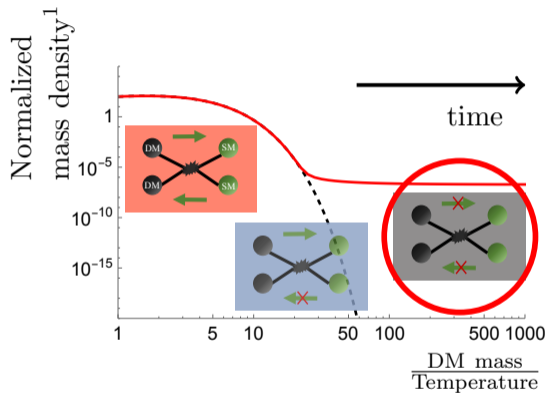
- Late-time asymmetry
- Velocity suppression:  
 $\text{Complex scalar } \langle \sigma_{\text{ann}} v \rangle \propto v_{\text{rel}}^2$



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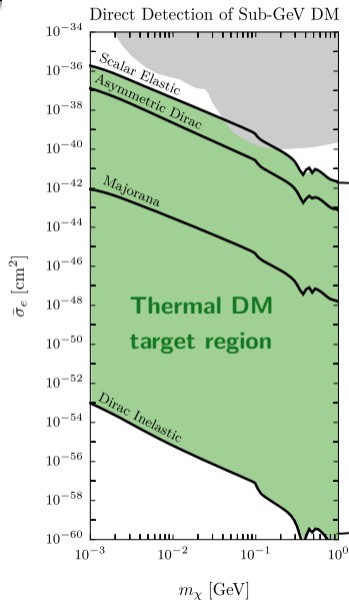


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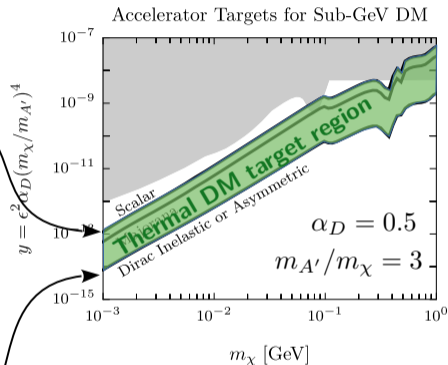
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# LDM thermal relics: direct detection & accelerator targets



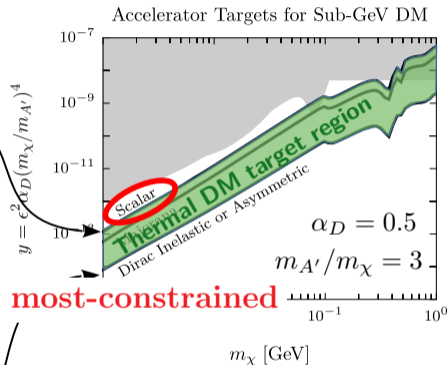
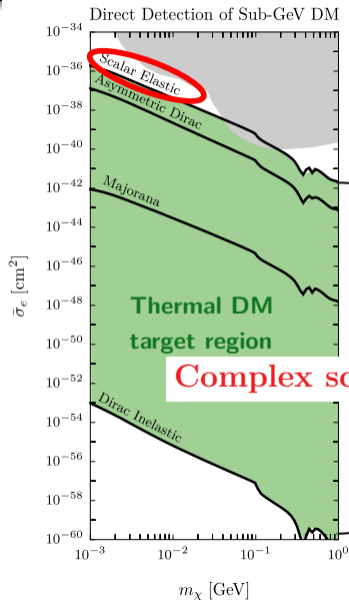
## Opportunities identified at Snowmass 2021



Krnjaic et al. (2022), *A snowmass whitepaper: Dark matter production at intensity-frontier experiments.*

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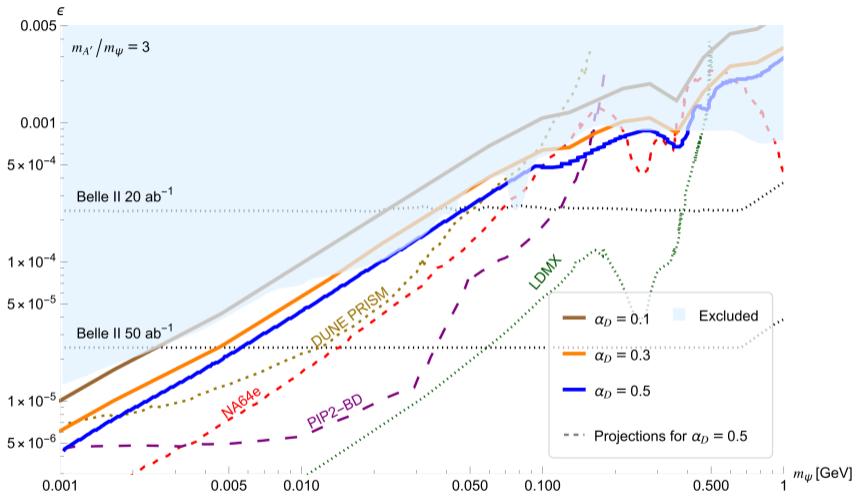
## Opportunities identified at Snowmass 2021



**Complex scalars most-constrained**

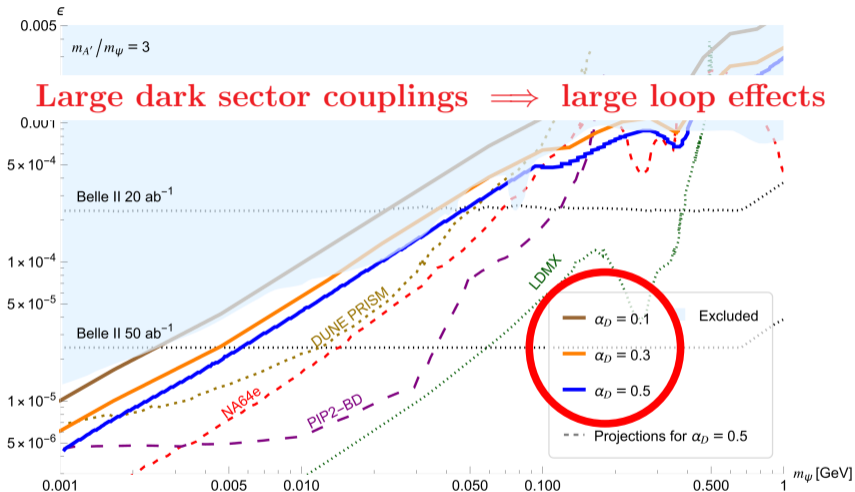
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# Expected mixing strengths with the SM: complex scalars



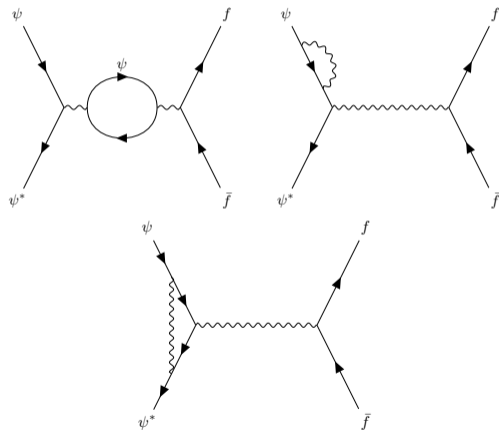
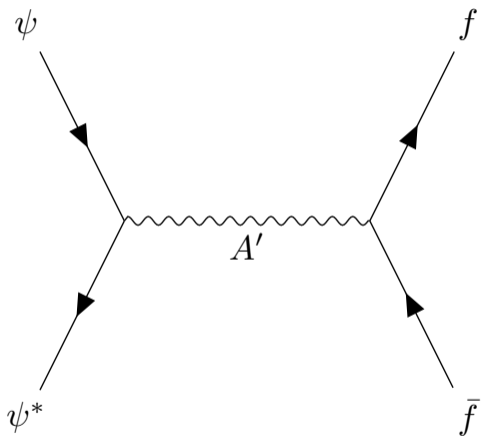
LH, G. Mohlabeng, A. Mondol, & T.M.P. Tait (2026), *in prep.*. Excluded region & projections from Krnjaic et al. (2022), *A snowmass whitepaper: Dark matter production at intensity-frontier experiments.*

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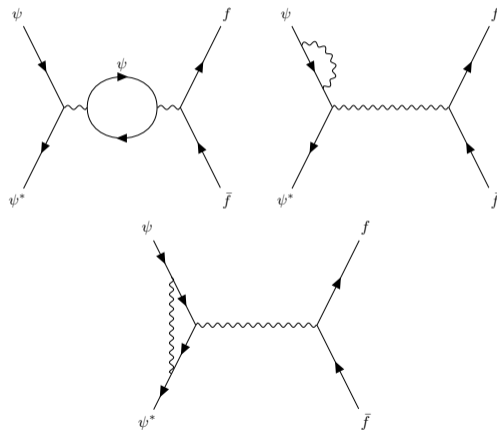
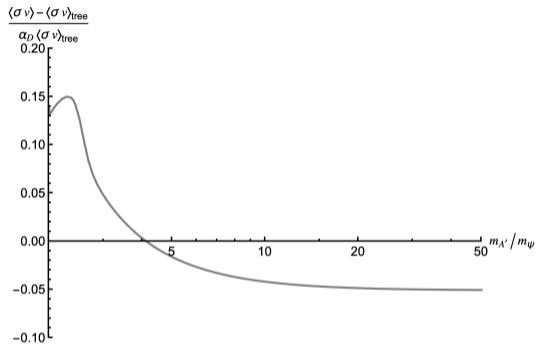


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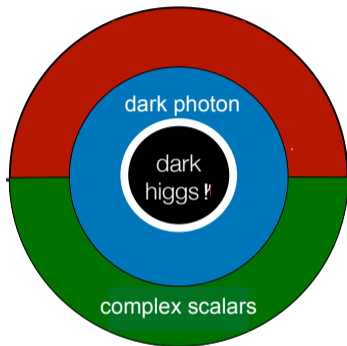
# Effects at loop level



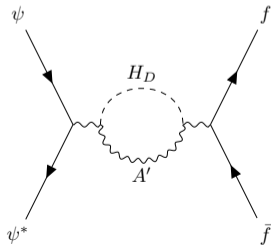
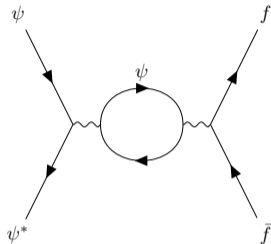
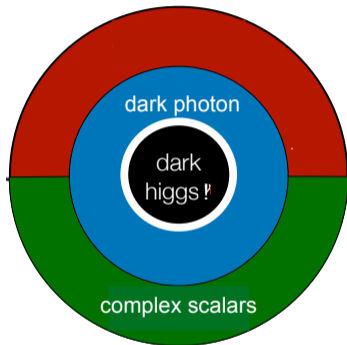
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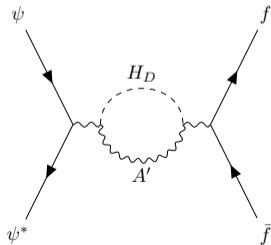
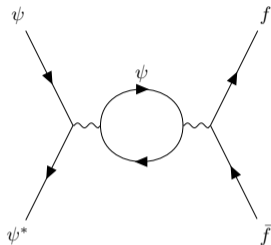
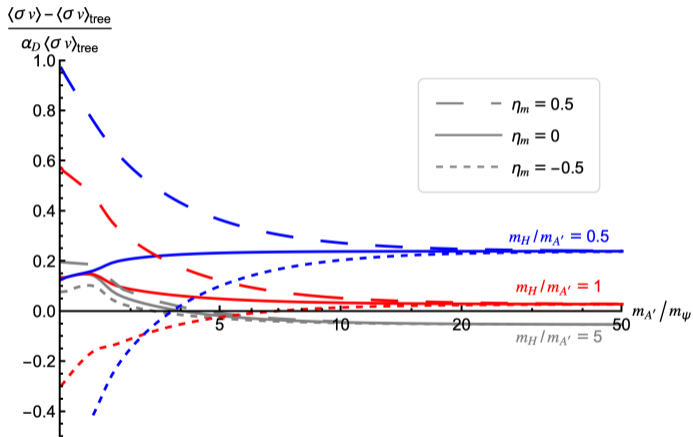
# An explicit origin of the dark photon's mass



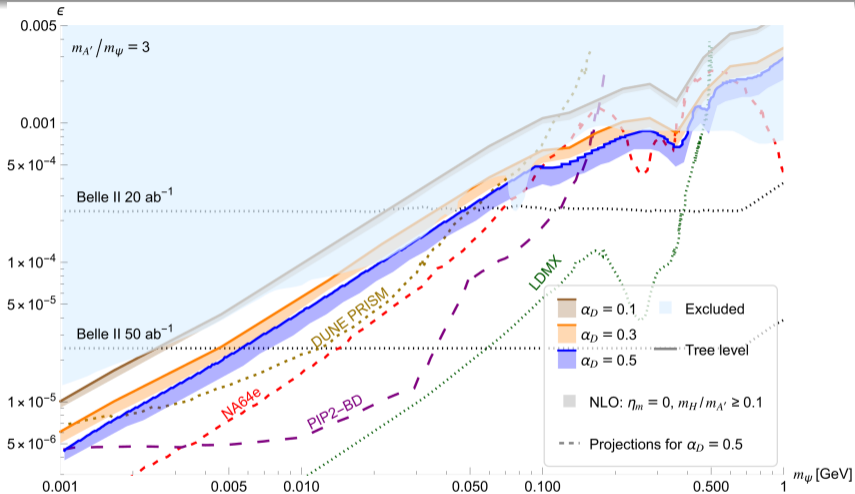
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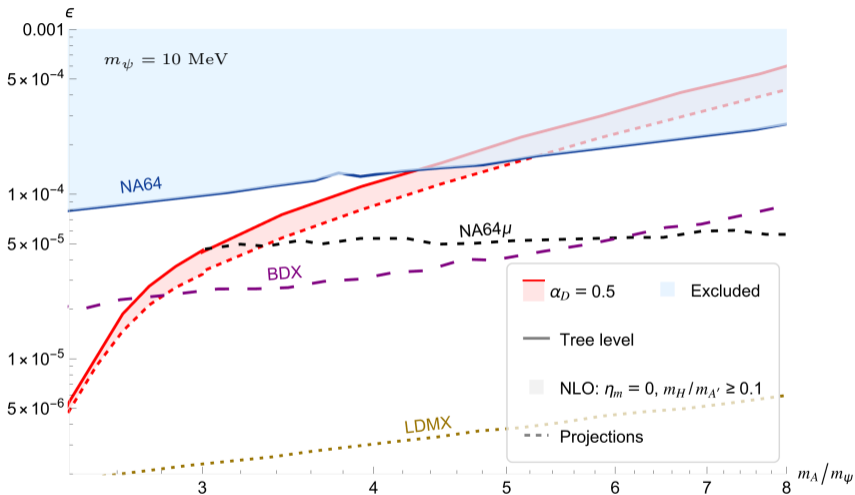


# Loops & the dark Higgs



LH, G. Mohlabeng, A. Mondol, & T.M.P. Tait (2026), *in prep.*. Excluded region & projections from Krnjaic et al. (2022), *A snowmass whitepaper: Dark matter production at intensity-frontier experiments.*

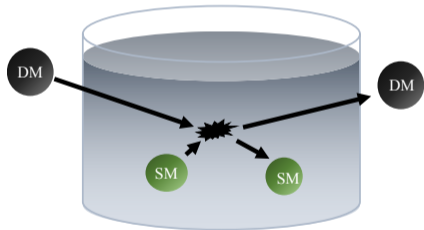
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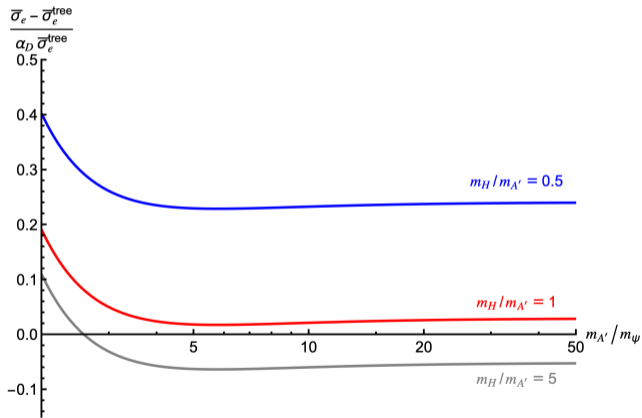
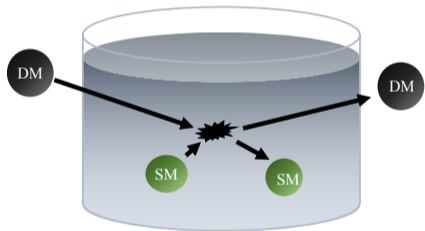
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# Direct detection

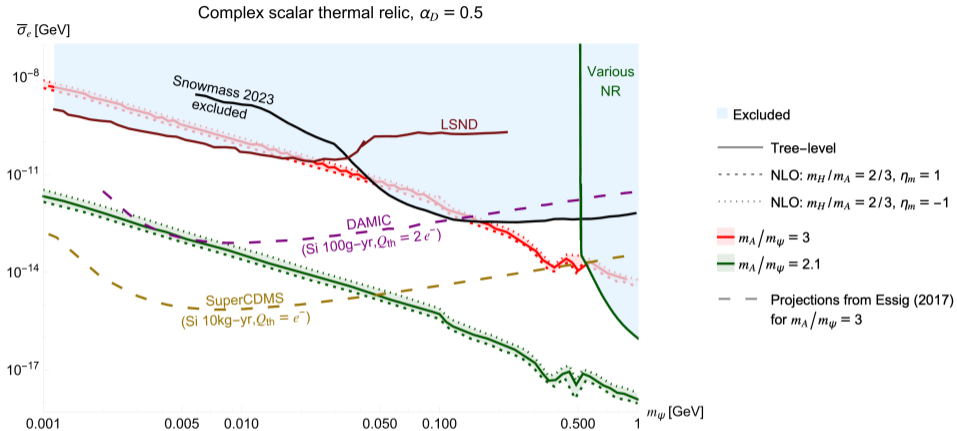
Reference cross-section,  $\psi + e^- \rightarrow \psi + e^-$



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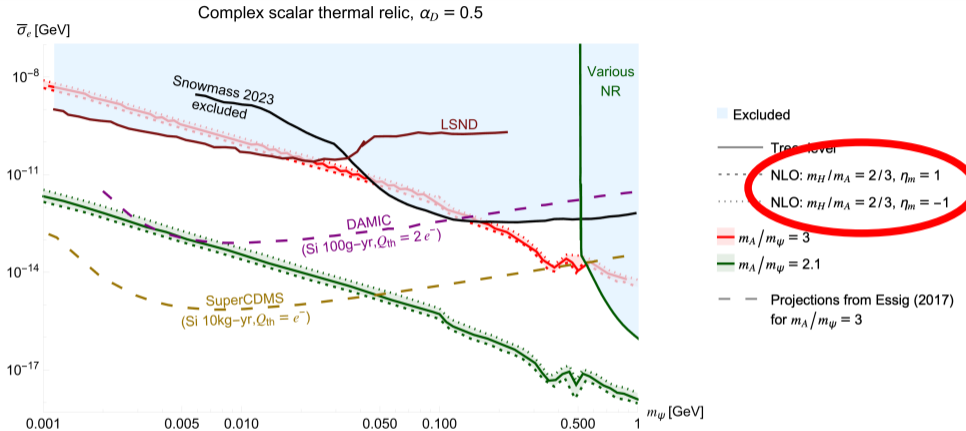


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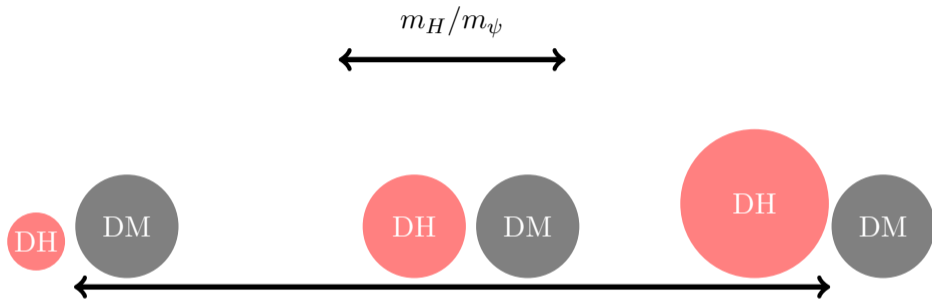
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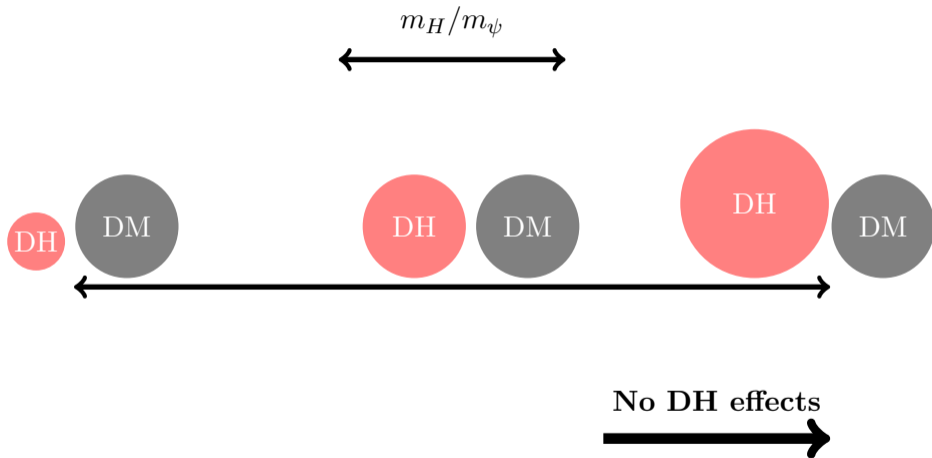
## Usual scenario: no DH effects at tree level

LH, G. Mohlabeng, A. Mondol, & T.M.P. Tait (2026), *in prep.*. Excluded region & projections from Essig et. al (2022), *Snowmass2021 Cosmic Frontier: The landscape of low-threshold dark matter direct detection in the next decade* and Essig et. al (2016), *Direct Detection of sub-GeV Dark Matter with Semiconductor Targets*.

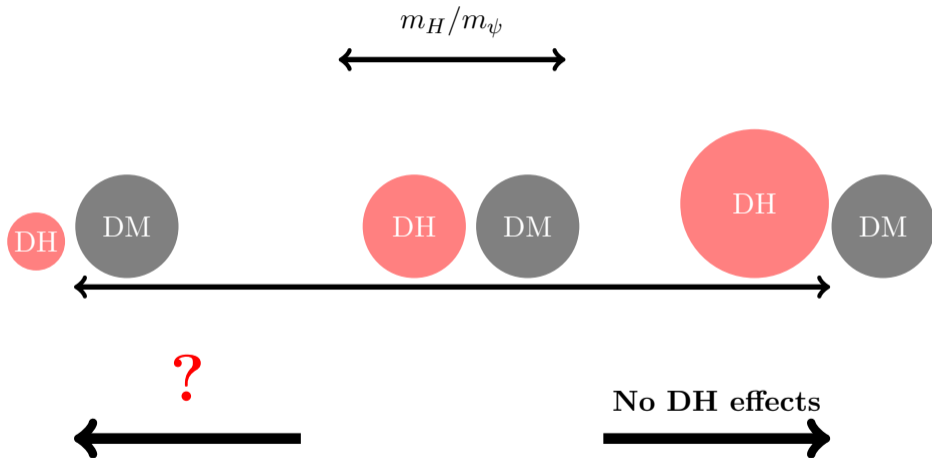
# Additional effects involving the dark Higgs?



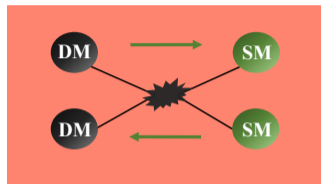
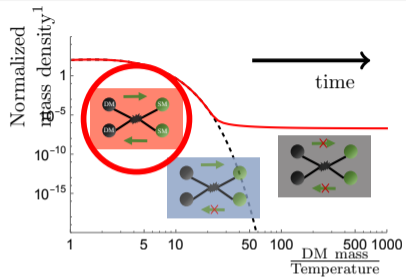
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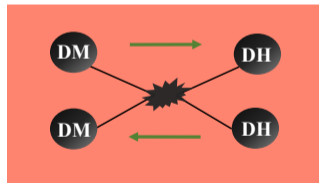
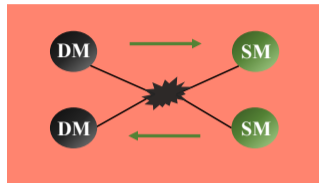
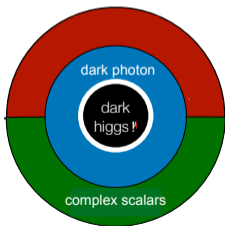
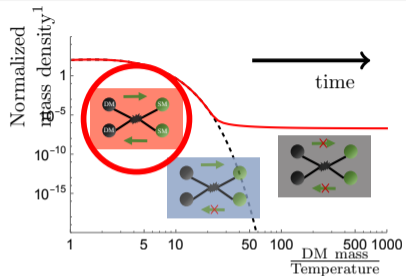
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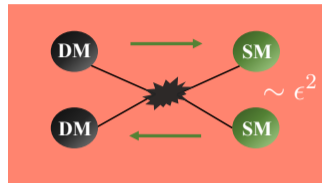
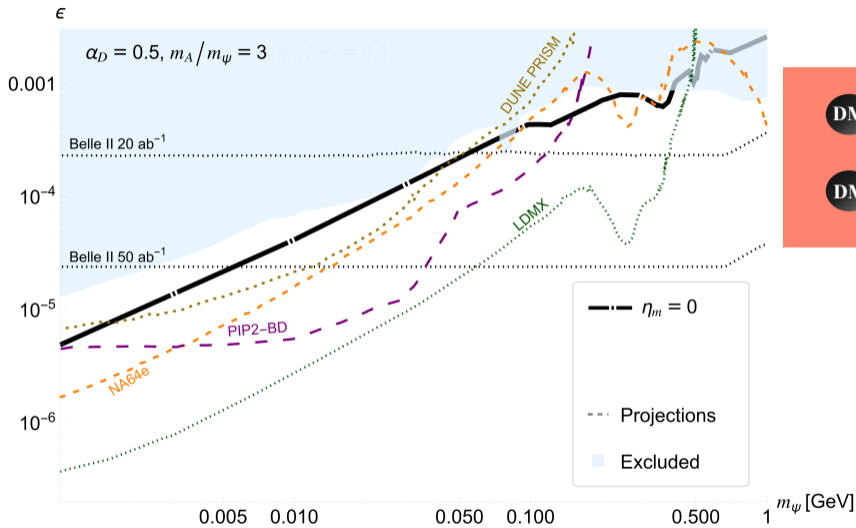
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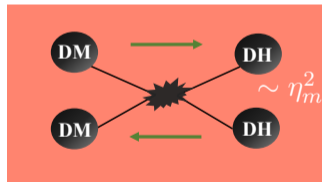
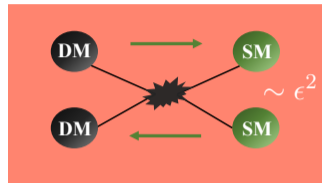
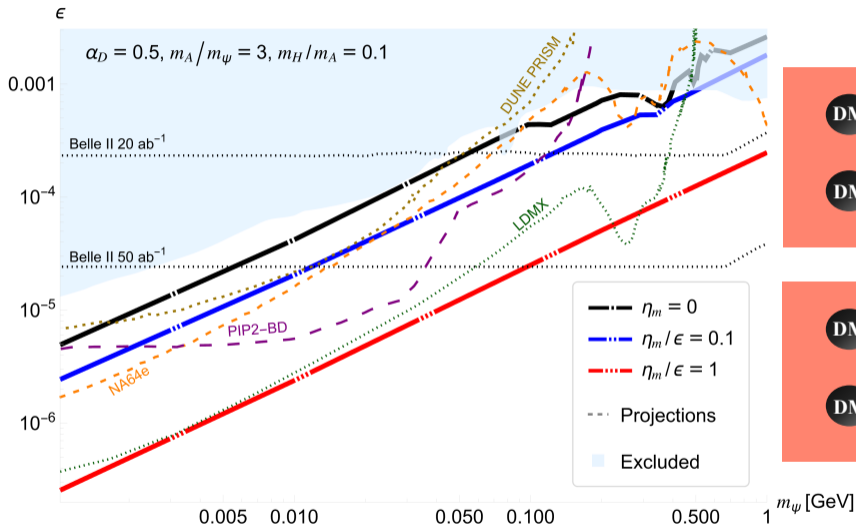


# A light dark Higgs... and its effect\*



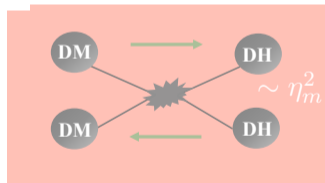
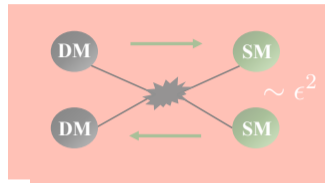
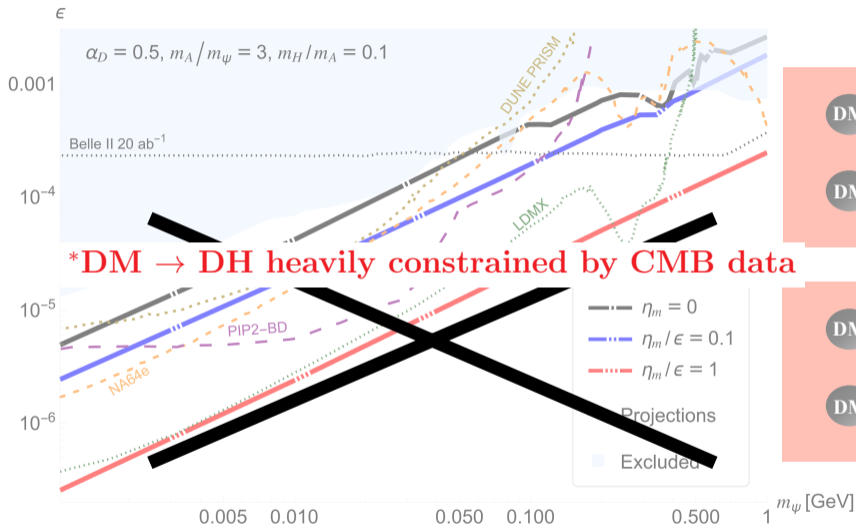
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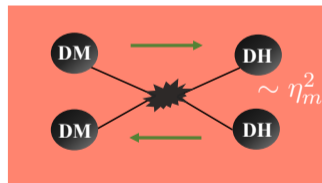
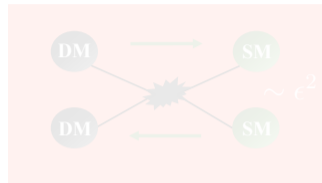
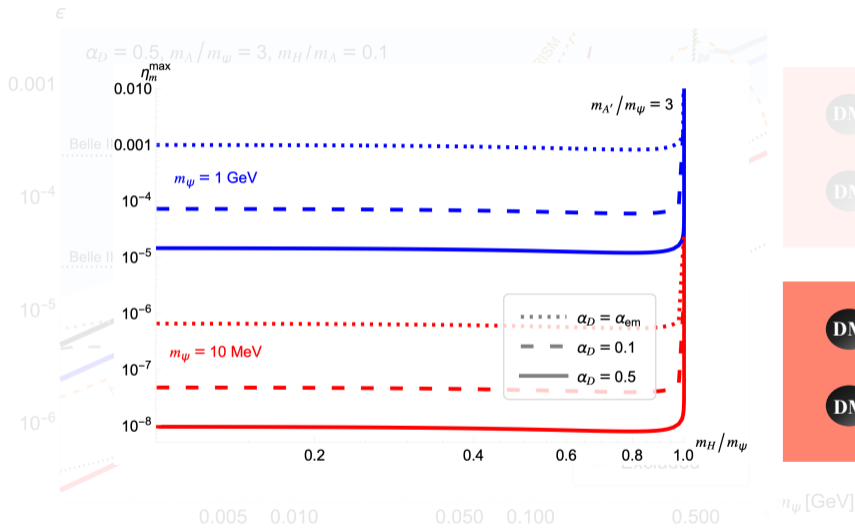
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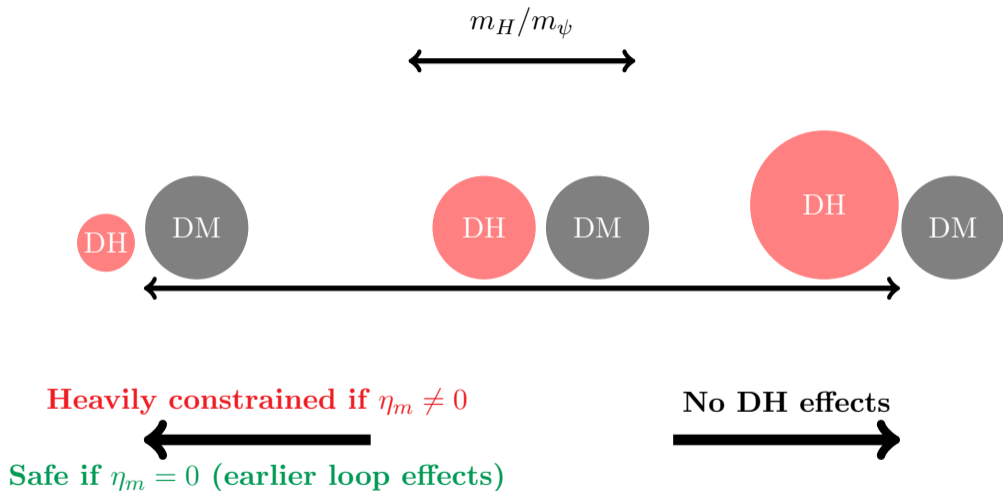
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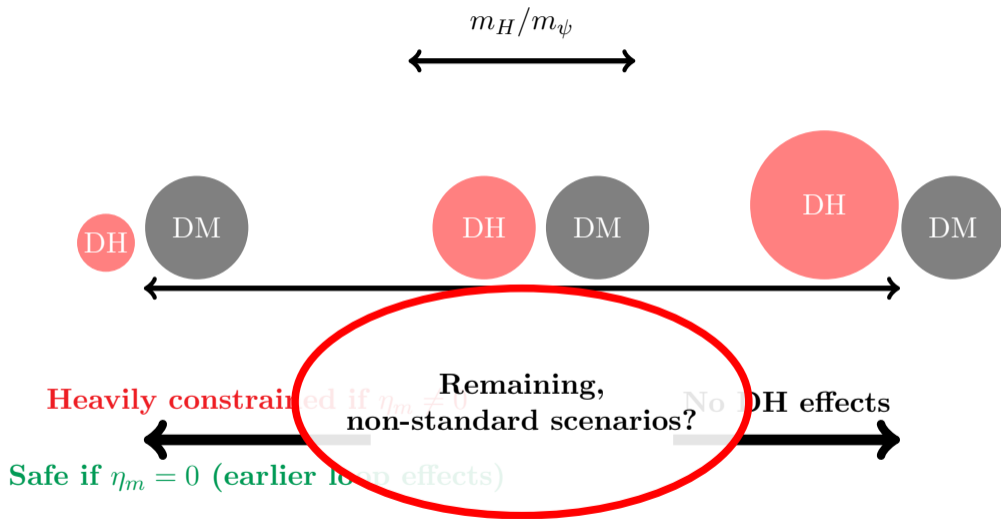


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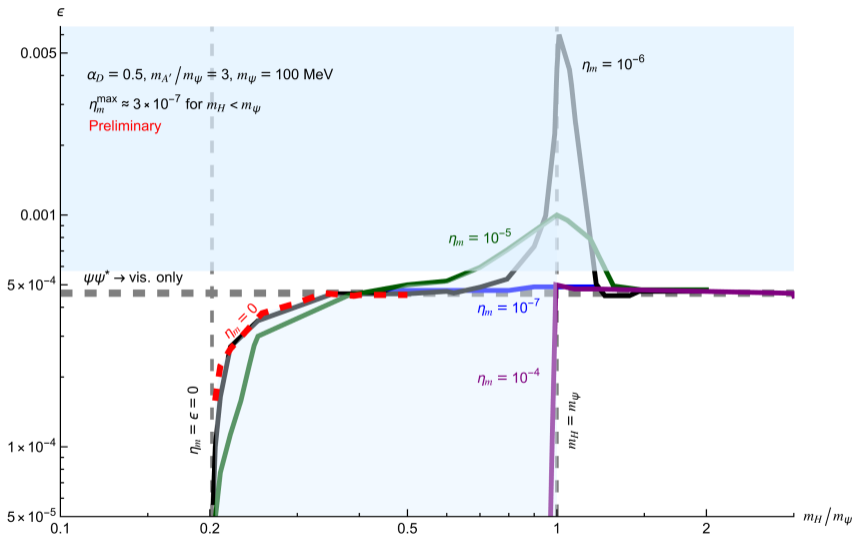
# Tree-level dark Higgs scenarios



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