

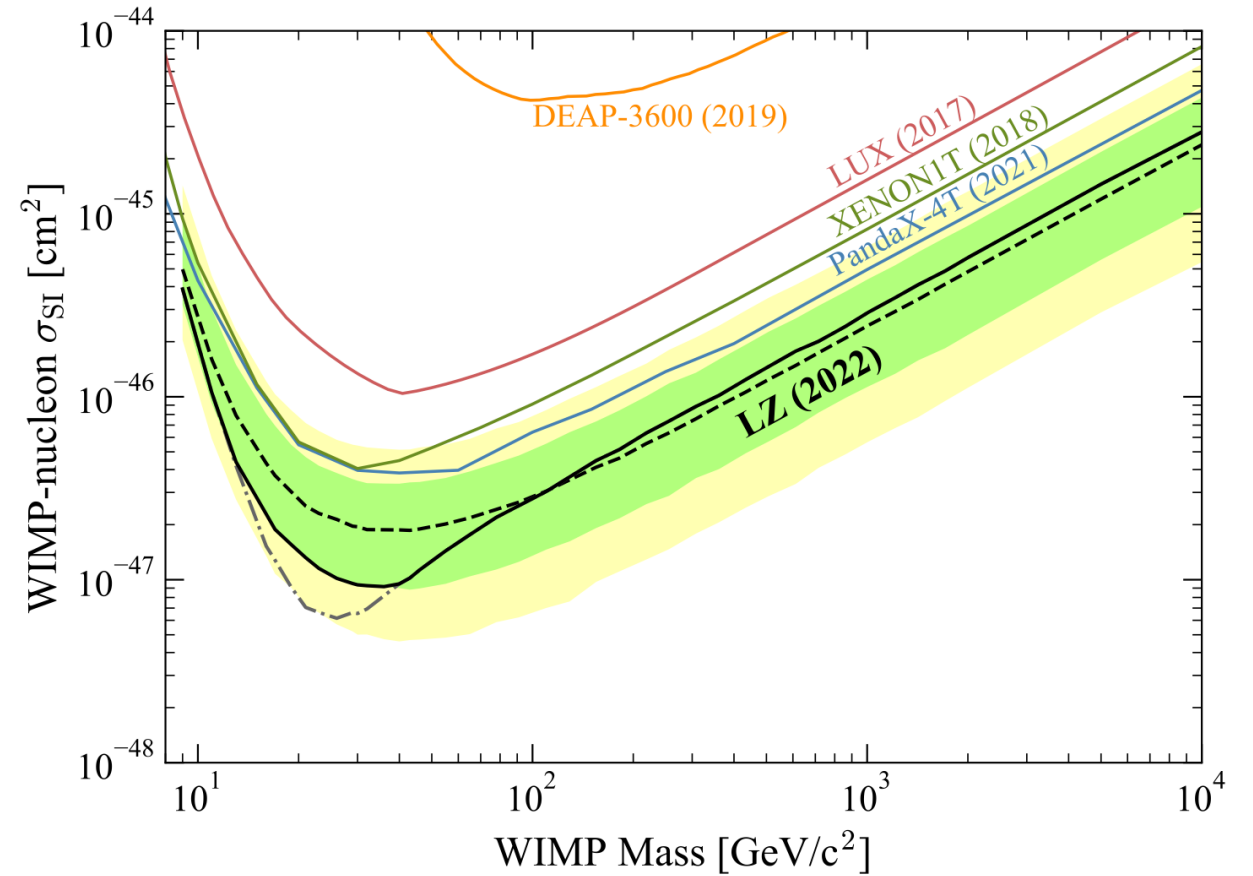
# The Power of the Dark Sink

Robert McGehee  
UNIVERSITY OF MINNESOTA

arXiv:2311:XXXXX w/ Prudhvi N. Bhattiprolu & Aaron Pierce

Particle Physics on the Plains 10/14/23

# Direct Detection Today

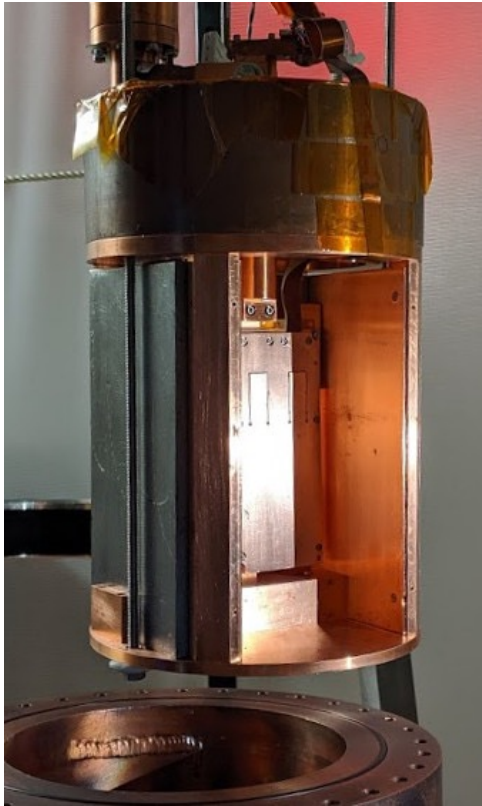


LZ Collaboration  
Phys. Rev. Lett. 131 (2023) 041002  
[2207.03764]

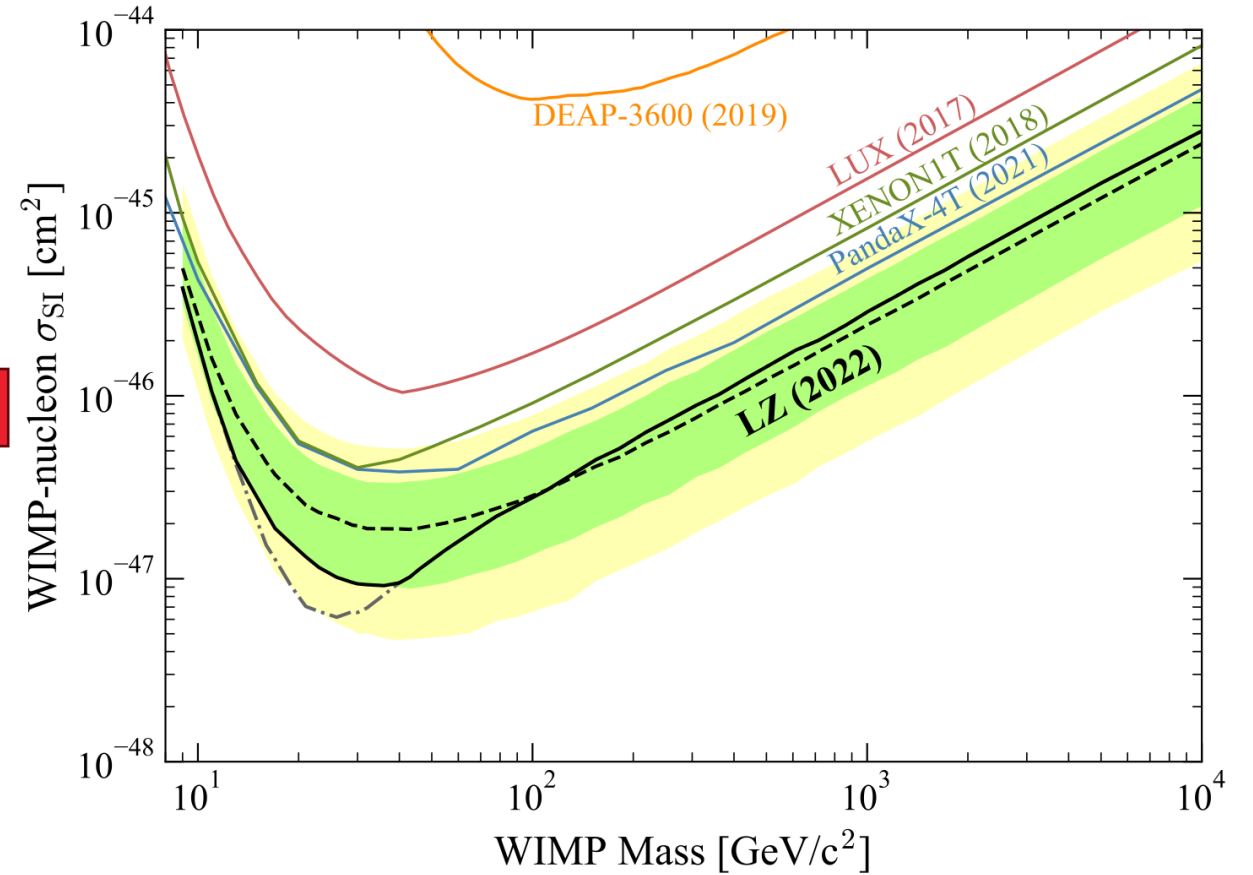
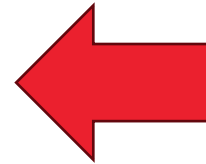
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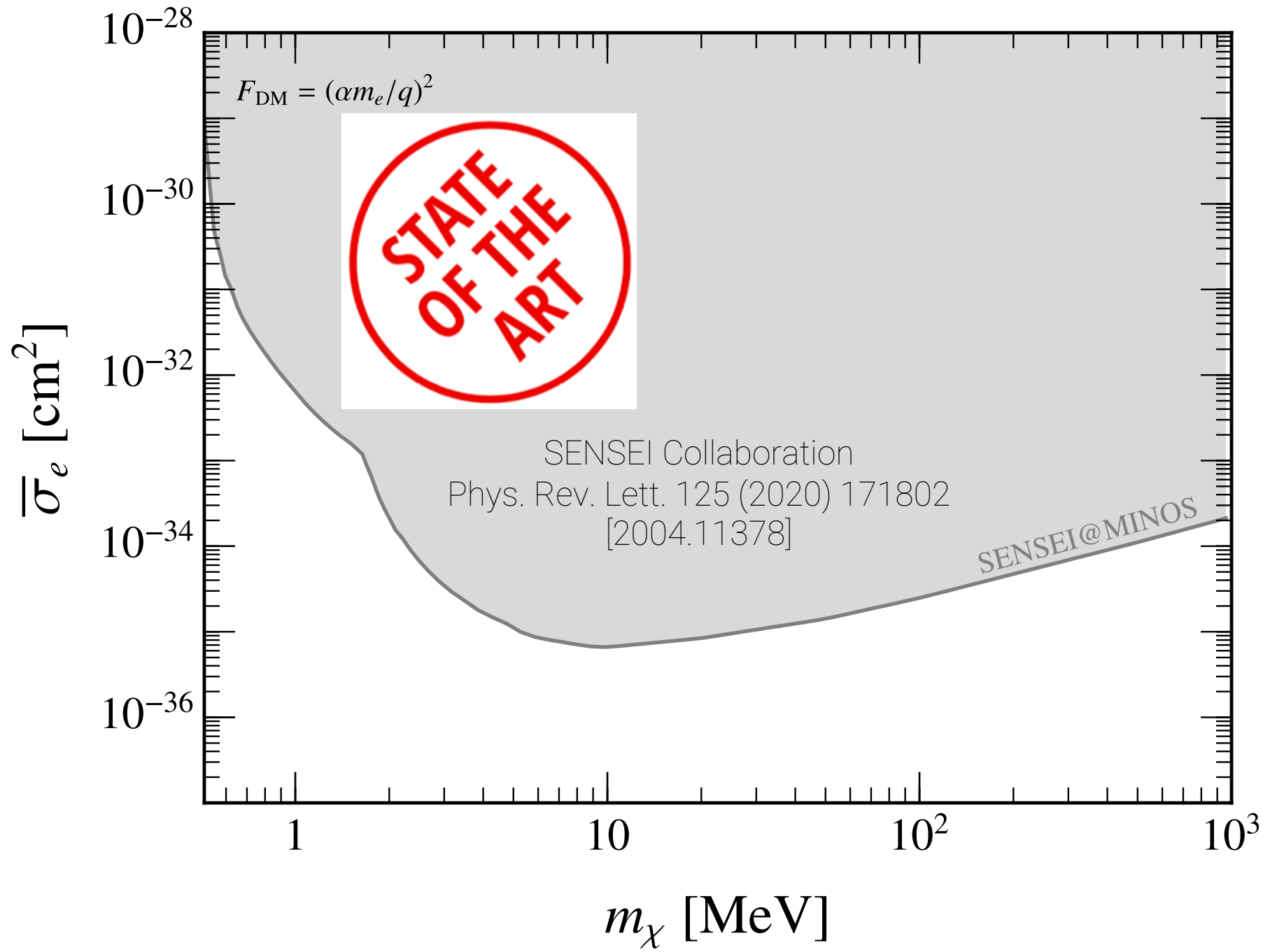
# Direct Detection Today

New technology

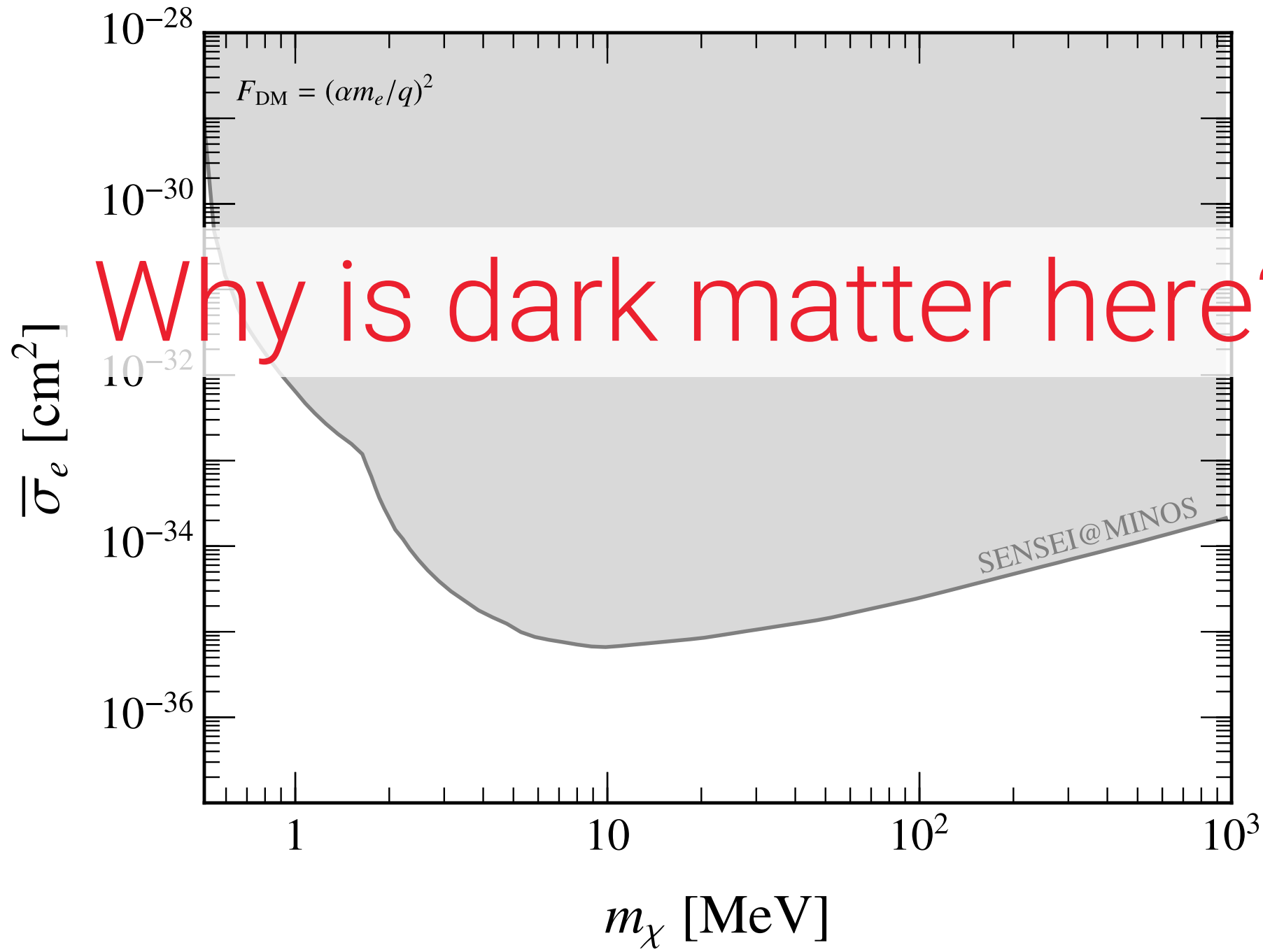


SENSEI

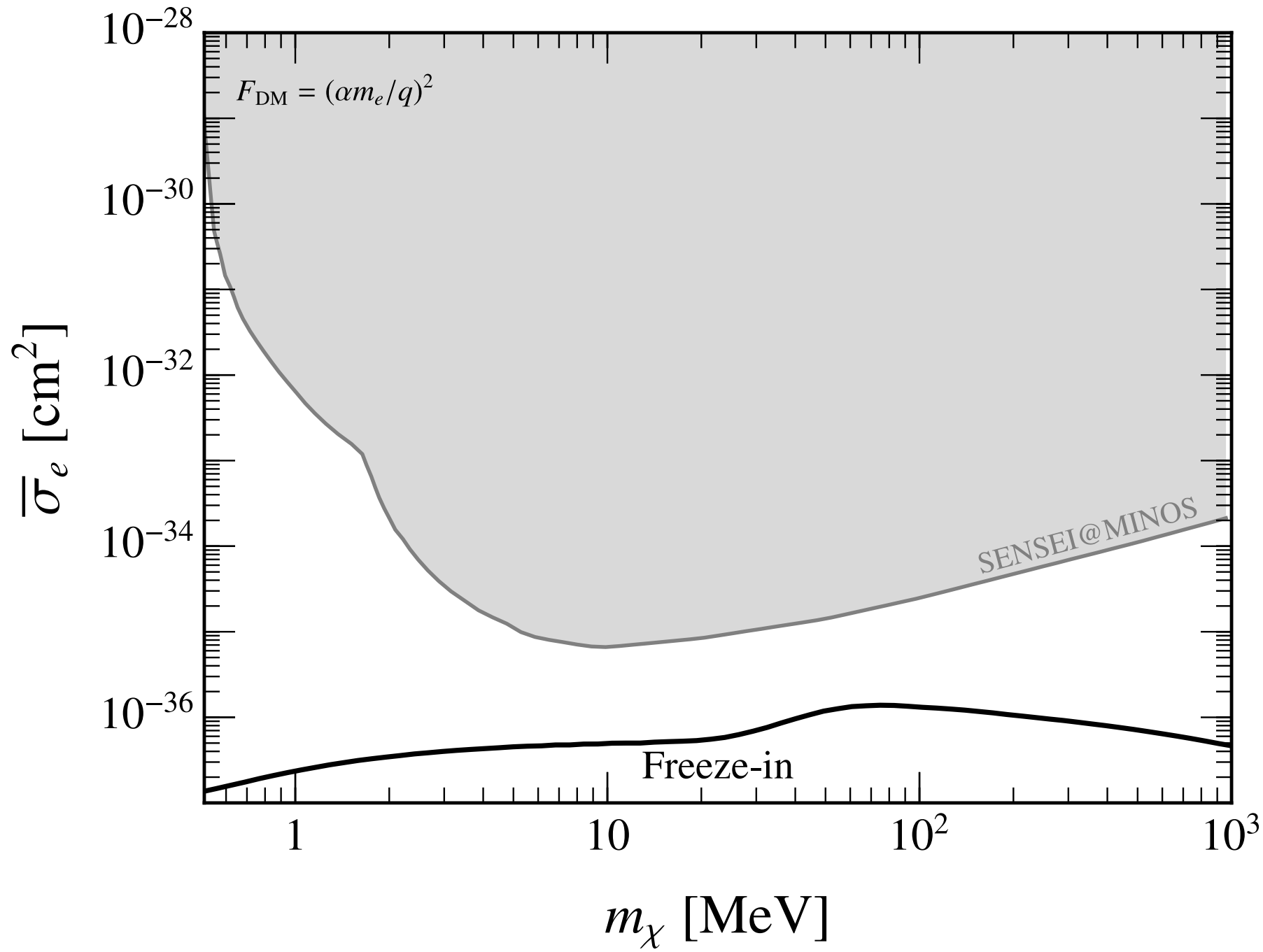




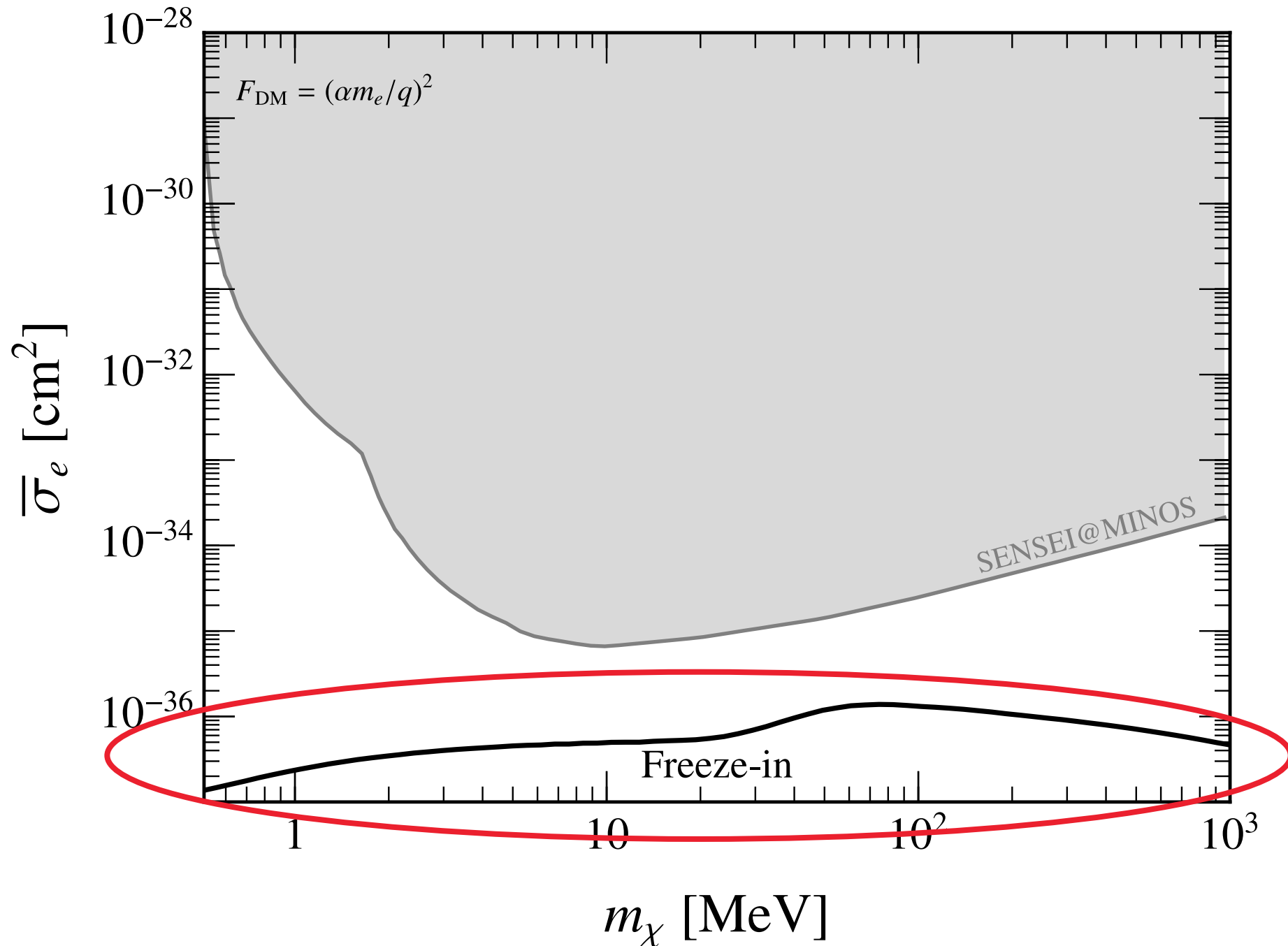
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Why is dark matter here?



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# Freeze-In

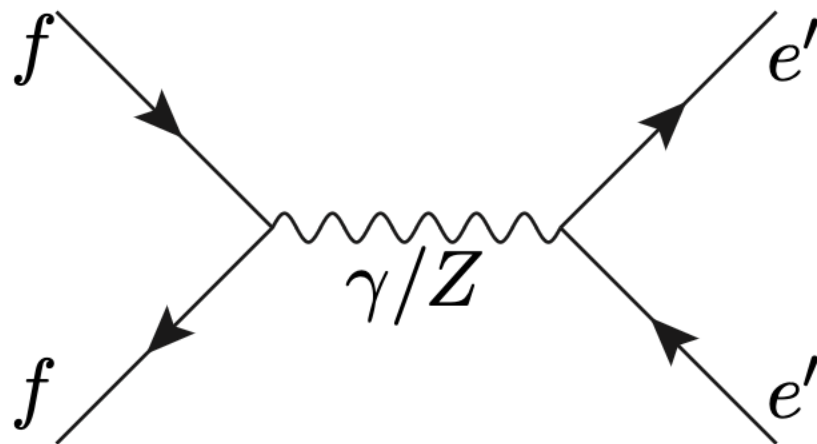
$$\mathcal{L} \supset -\frac{\epsilon}{2} F'_{\mu\nu} F^{\mu\nu}$$



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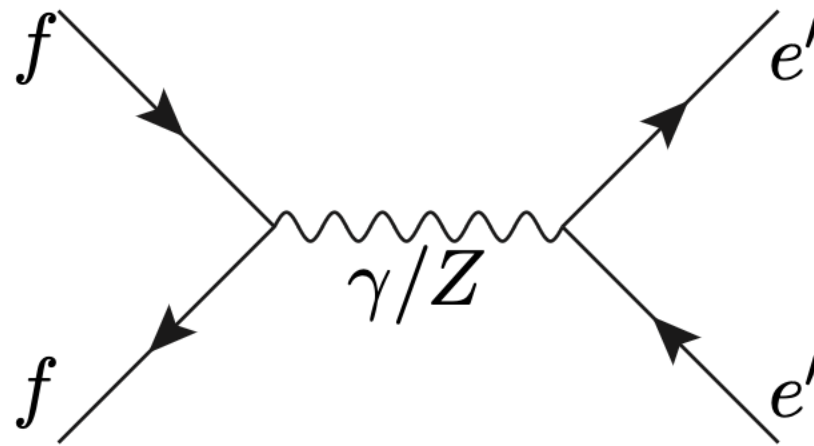
SM SM  $\rightarrow \bar{e}' e'$



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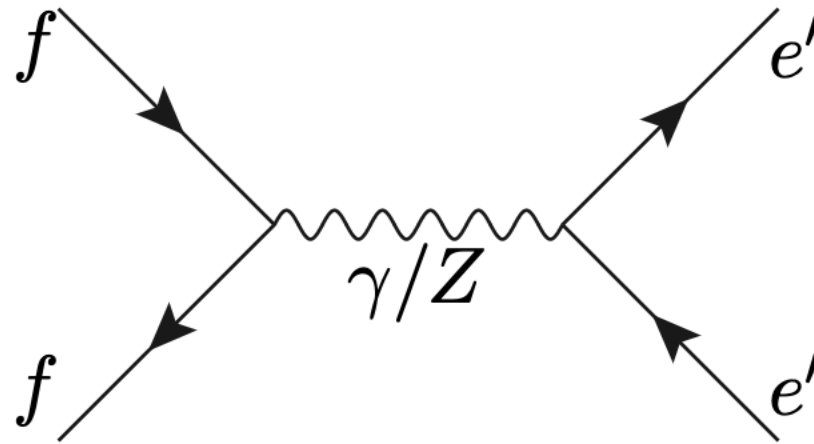


$$\kappa \equiv \epsilon \sqrt{\alpha'/\alpha} \approx \mathcal{O}(10^{-11})$$

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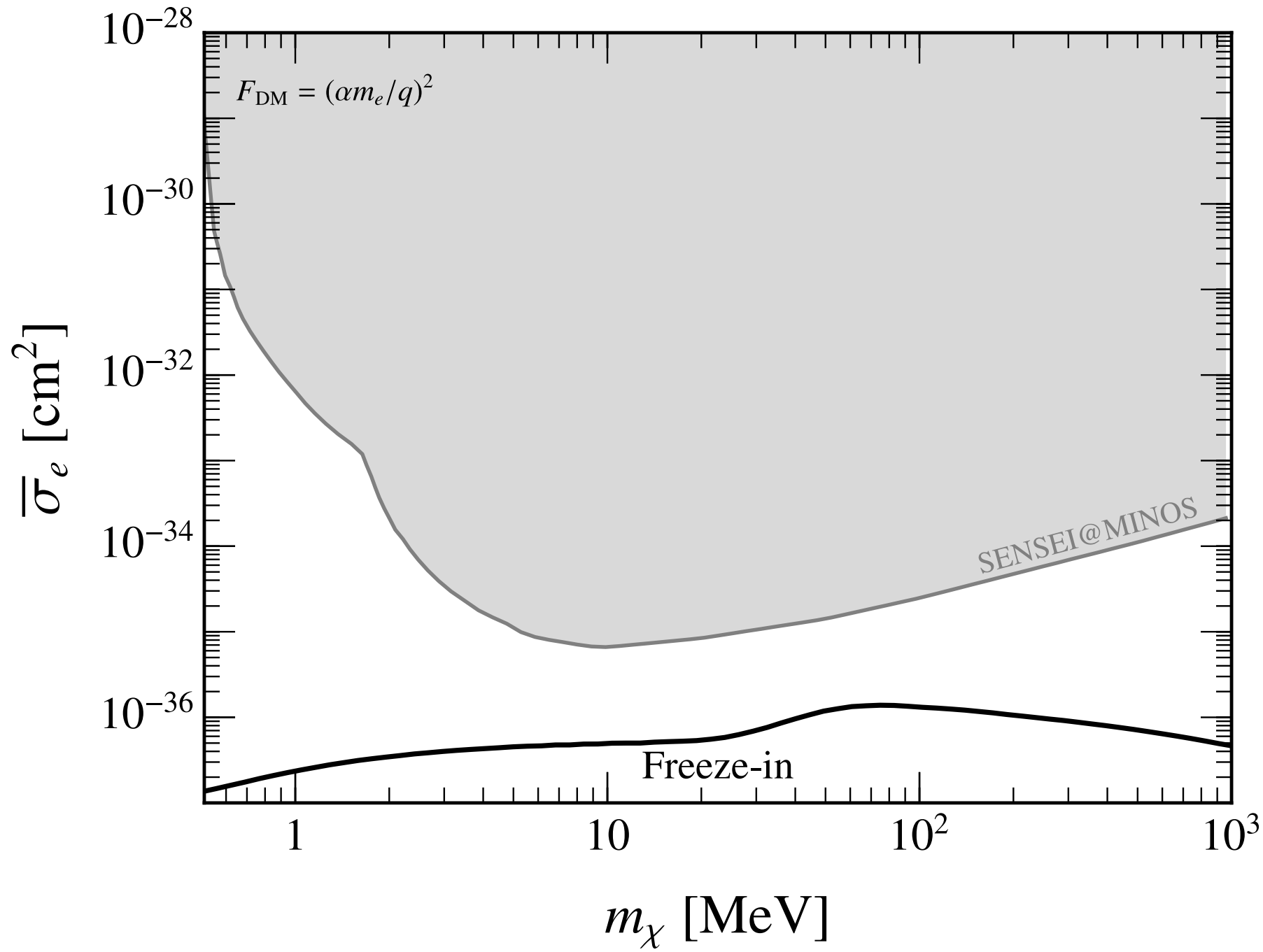
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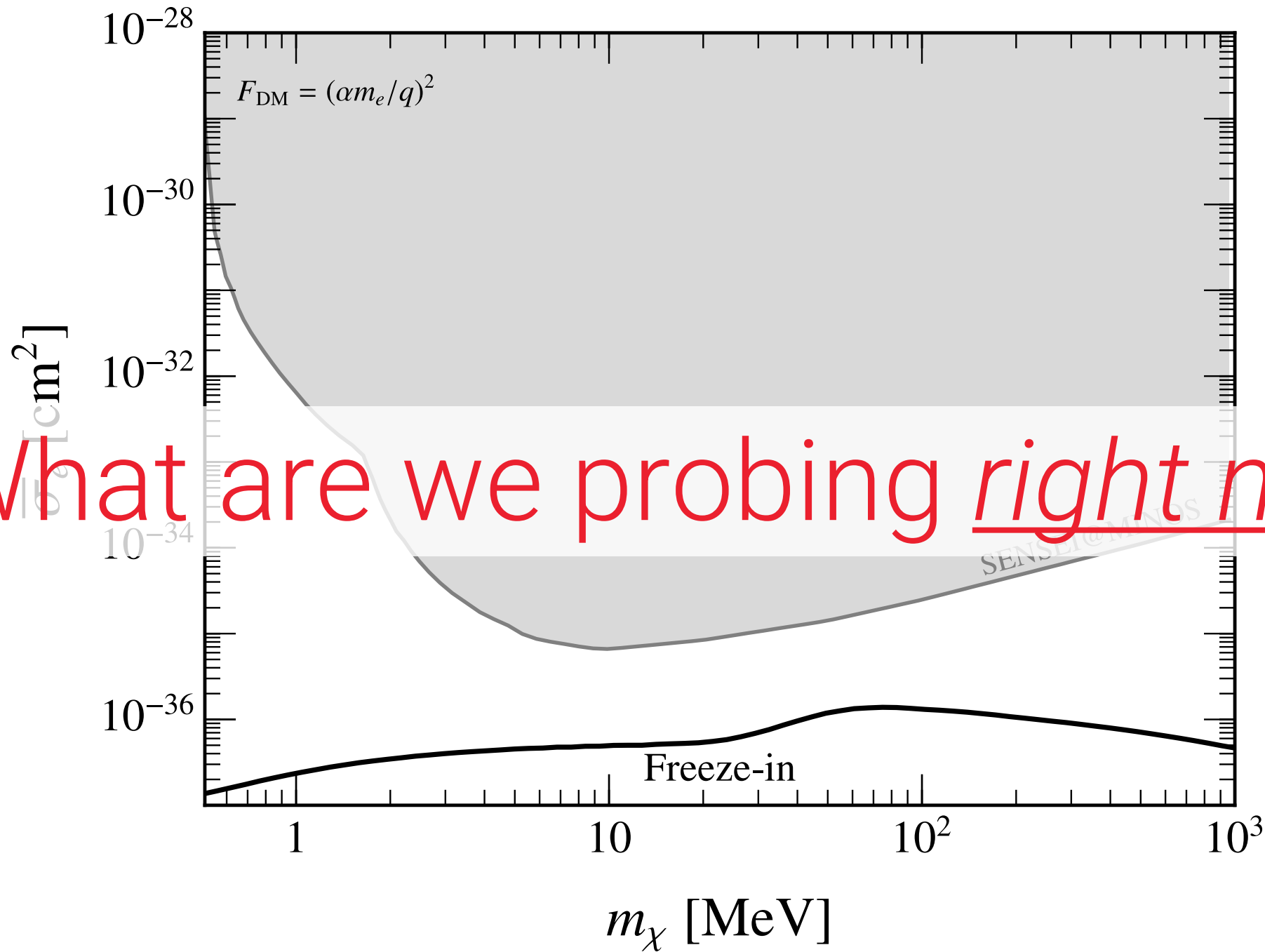
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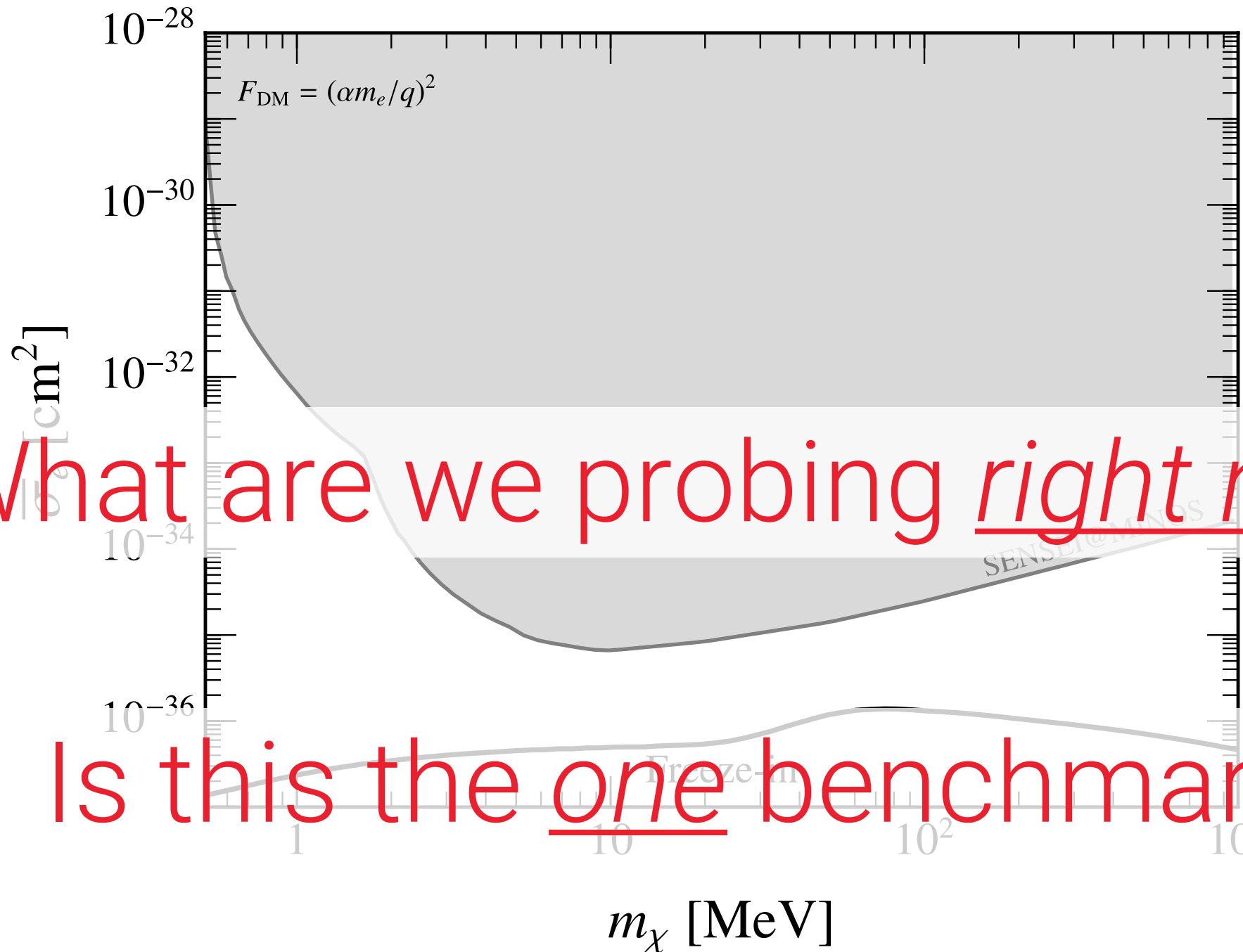
$$\bar{\sigma}_e \approx \frac{16\pi\mu_{\chi e}^2 \kappa^2 \alpha^2}{(\alpha m_e)^4}$$



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What are we probing right now?



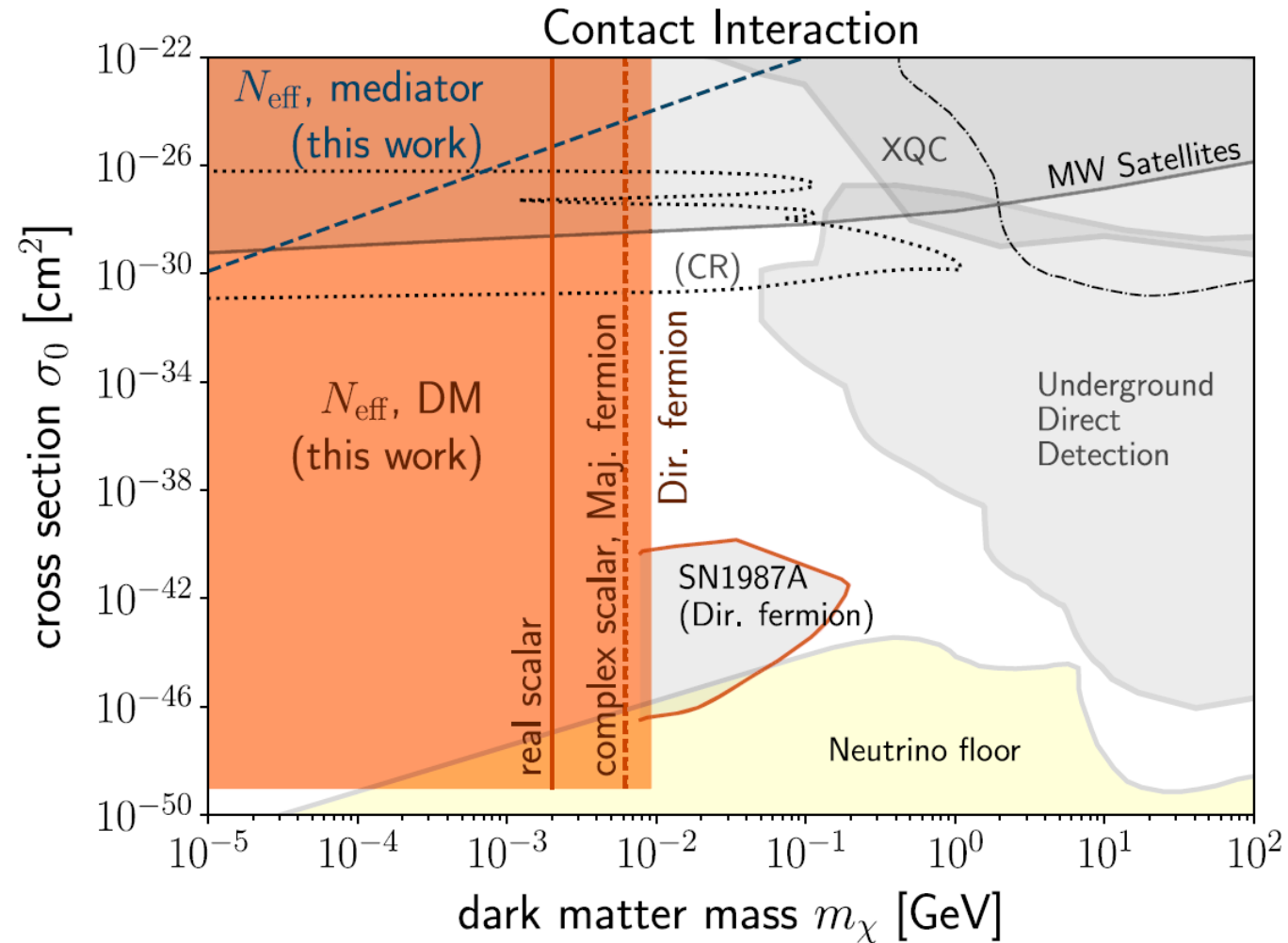


What are we probing right now?

Is this the one benchmark?

# Model-building Challenge: BBN

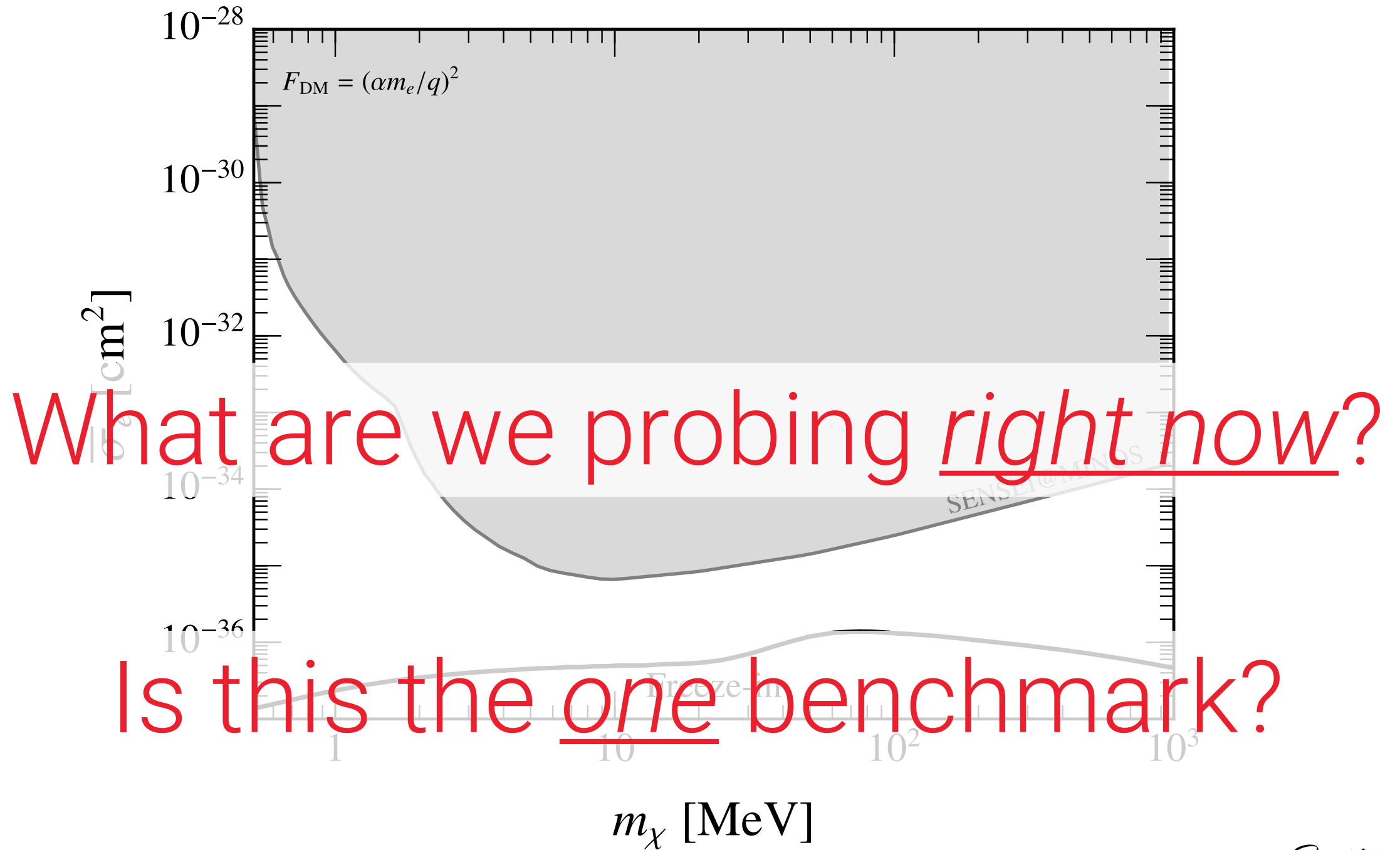
# Model-building Challenge: BBN

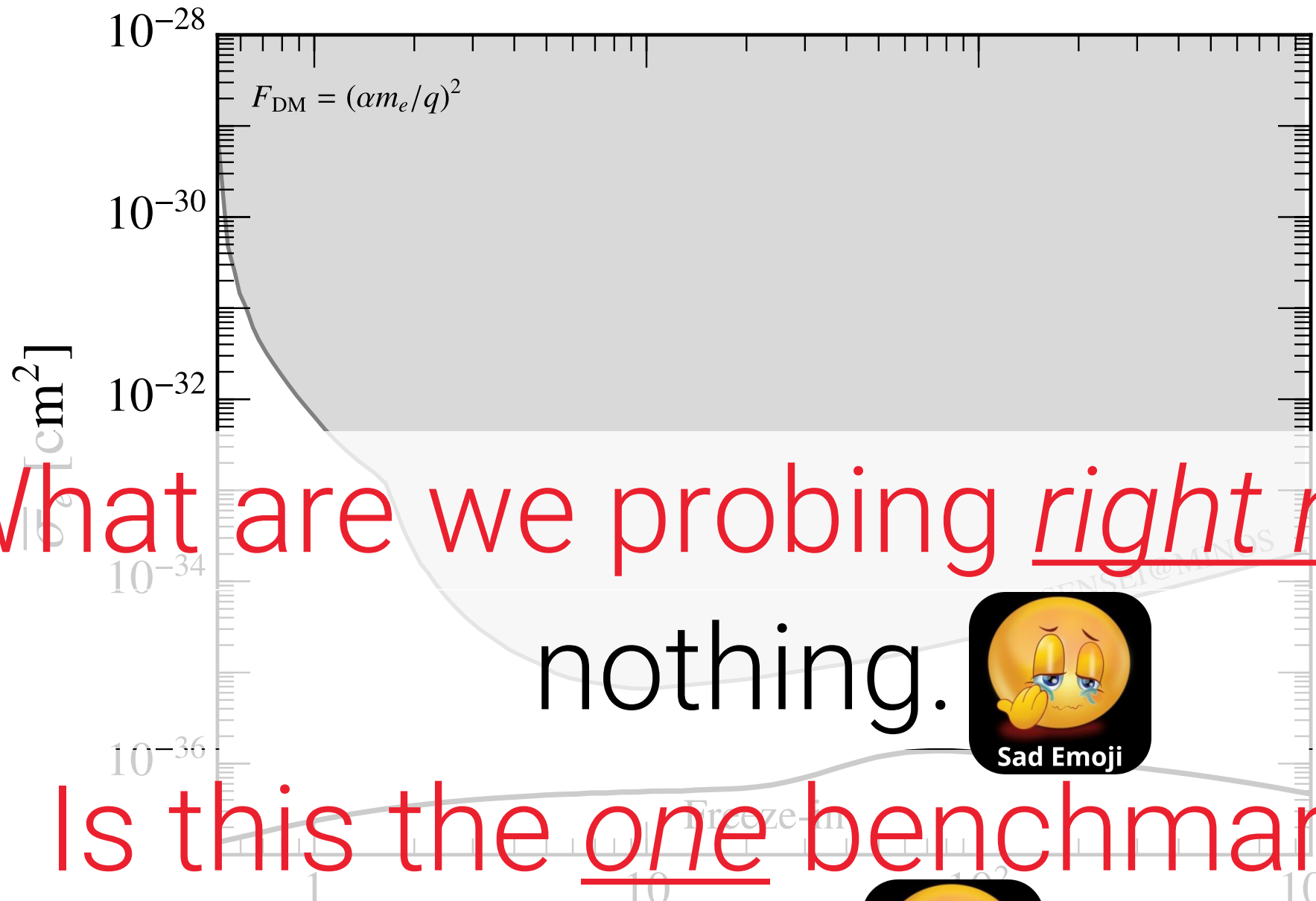


G. Krnjaic and S. McDermott [1908.00007]

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What are we probing right now?

nothing.



Is this the one benchmark?

yes.





# The Power of the Dark Sink

# ~~Freeze In~~ Dark Sink

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$$\kappa \lesssim \kappa_{\text{th}} \approx 8 \times 10^{-7} \frac{\sqrt{m_\chi}}{g_*(T = m_\chi)^{3/8}}$$

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Larger cross sections @ current direct detection exps

Temperature



# The Story

- SM produces dark matter

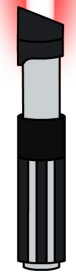


Temperature



# The Story

- SM produces dark matter
- Dark matter thermalizes with Dark Sink

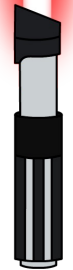


Temperature



# The Story

- SM produces dark matter
- Dark matter thermalizes with Dark Sink
- Dark Matter Annihilates away; SM continues to produce it

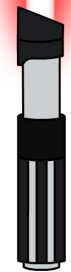


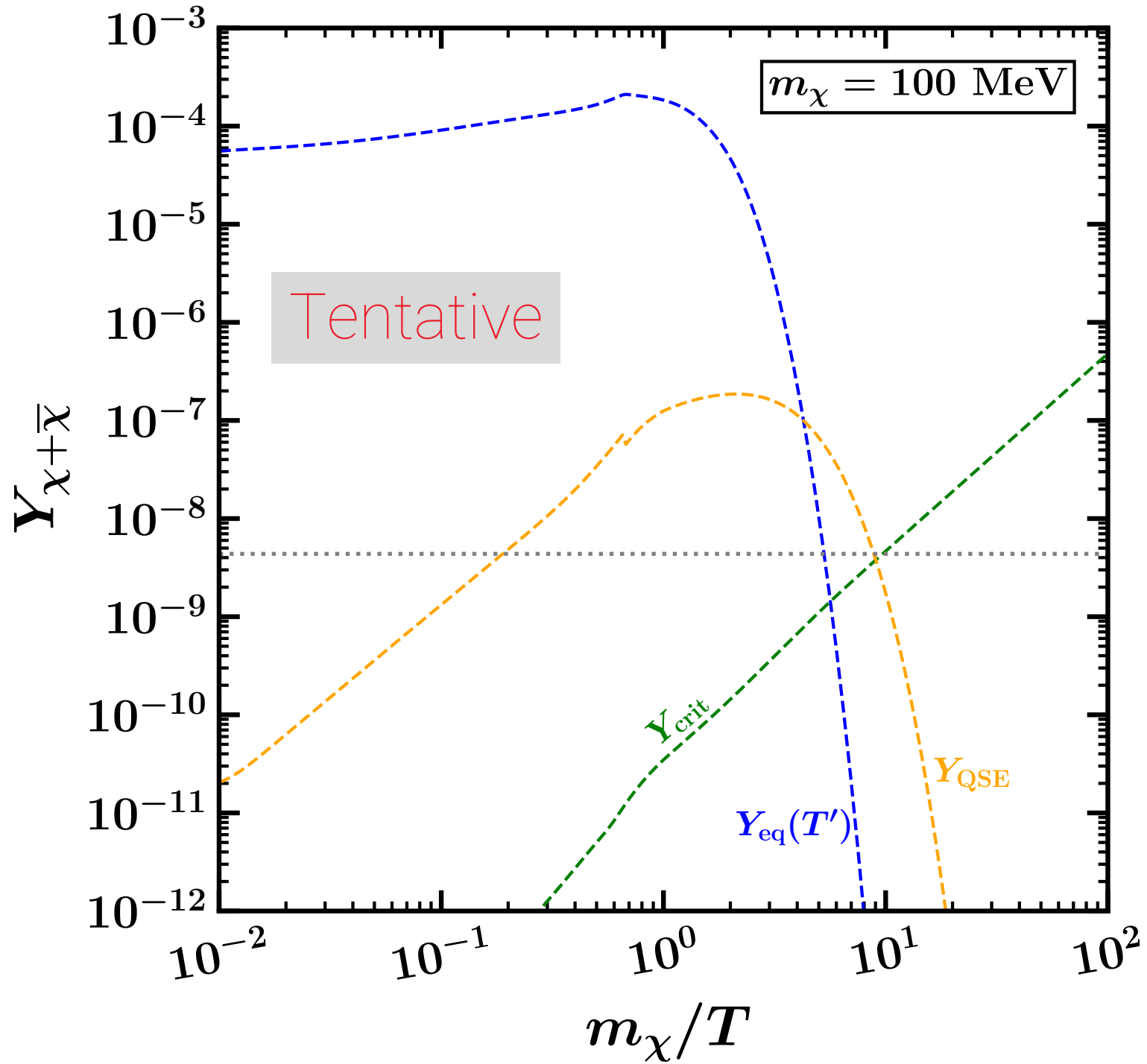
Temperature

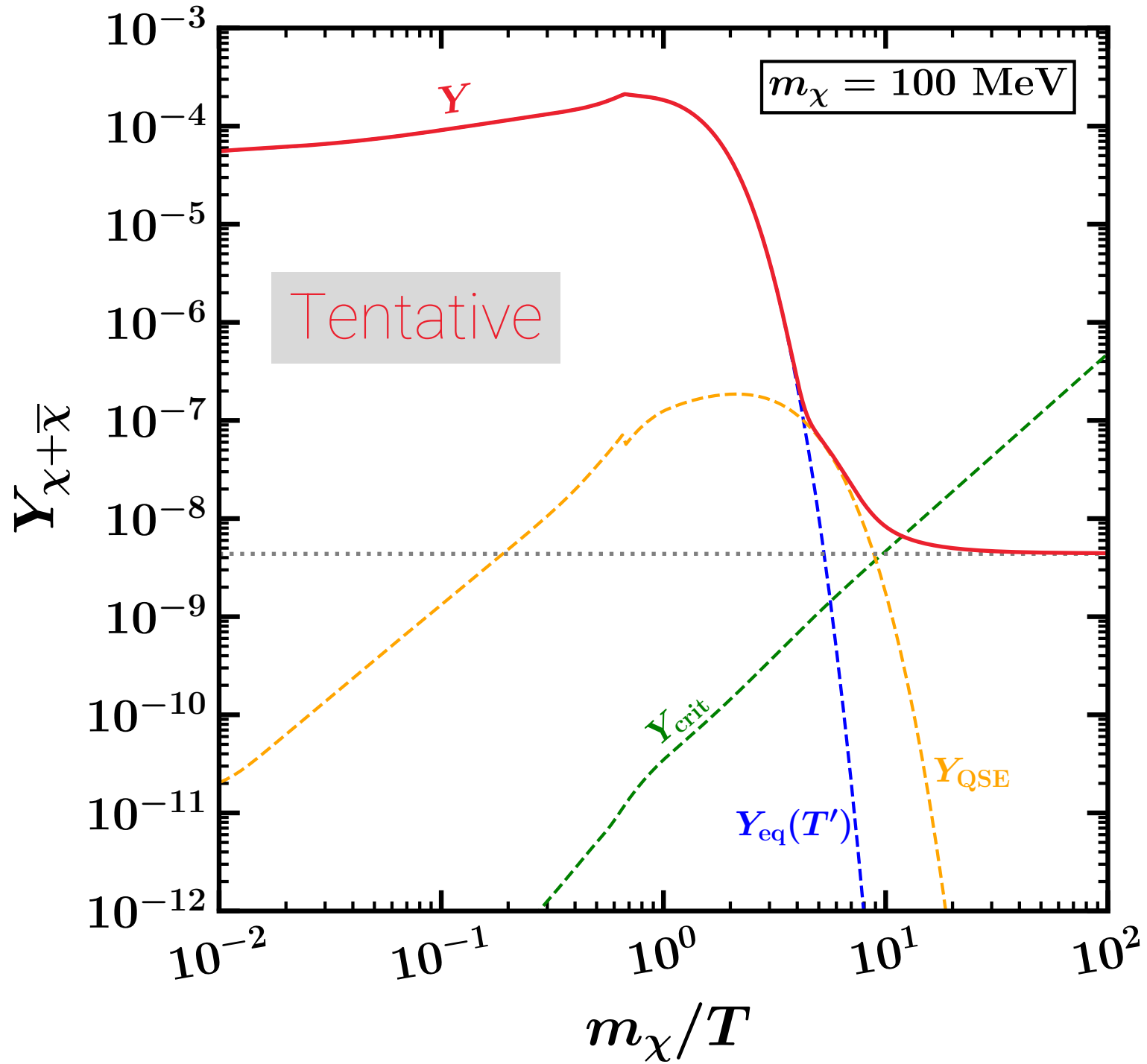


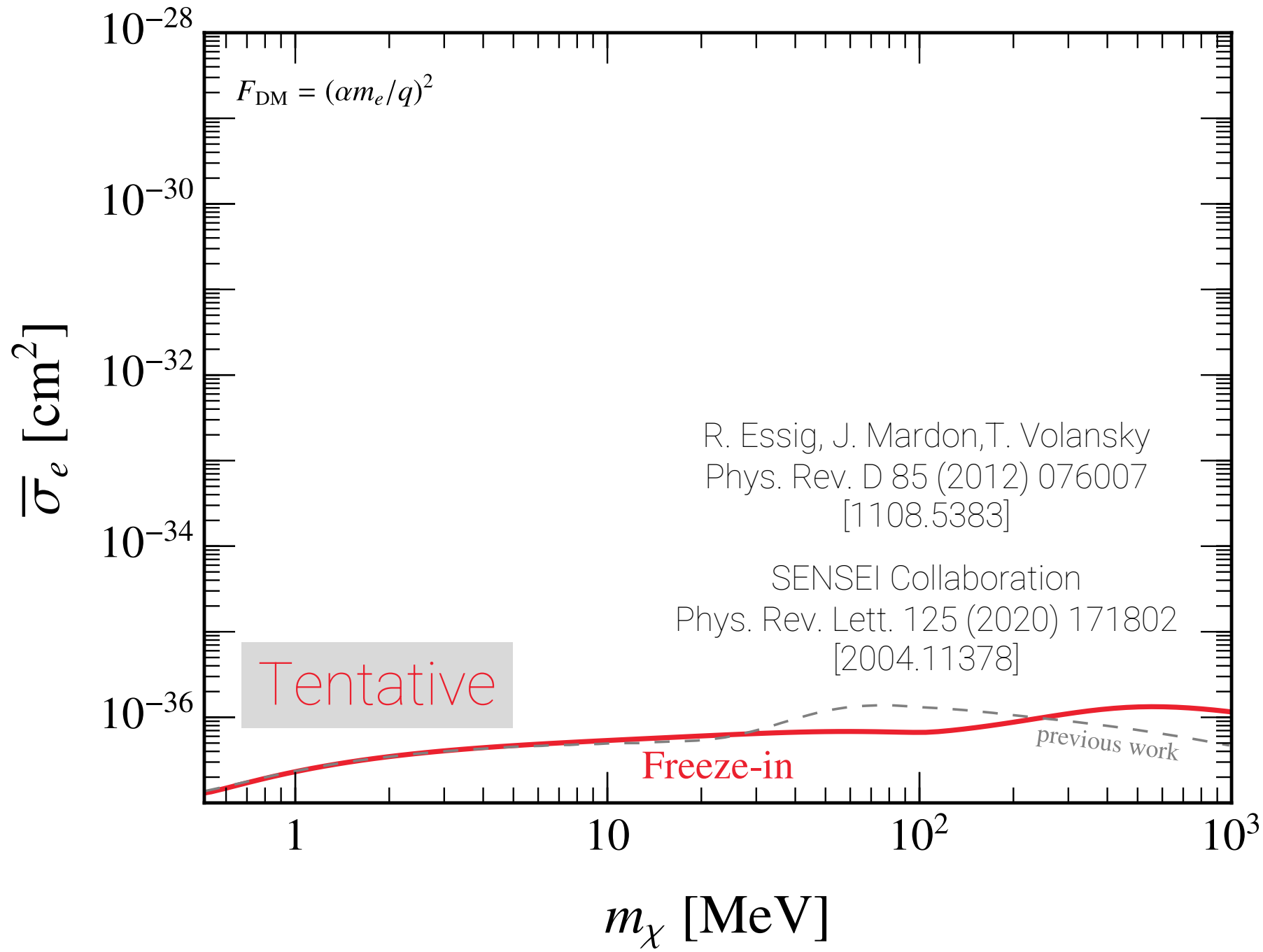
# The Story

- SM produces dark matter
- Dark matter thermalizes with Dark Sink
- Dark Matter Annihilates away; SM continues to produce it
- Annihilations and SM freeze-in both lose to Hubble

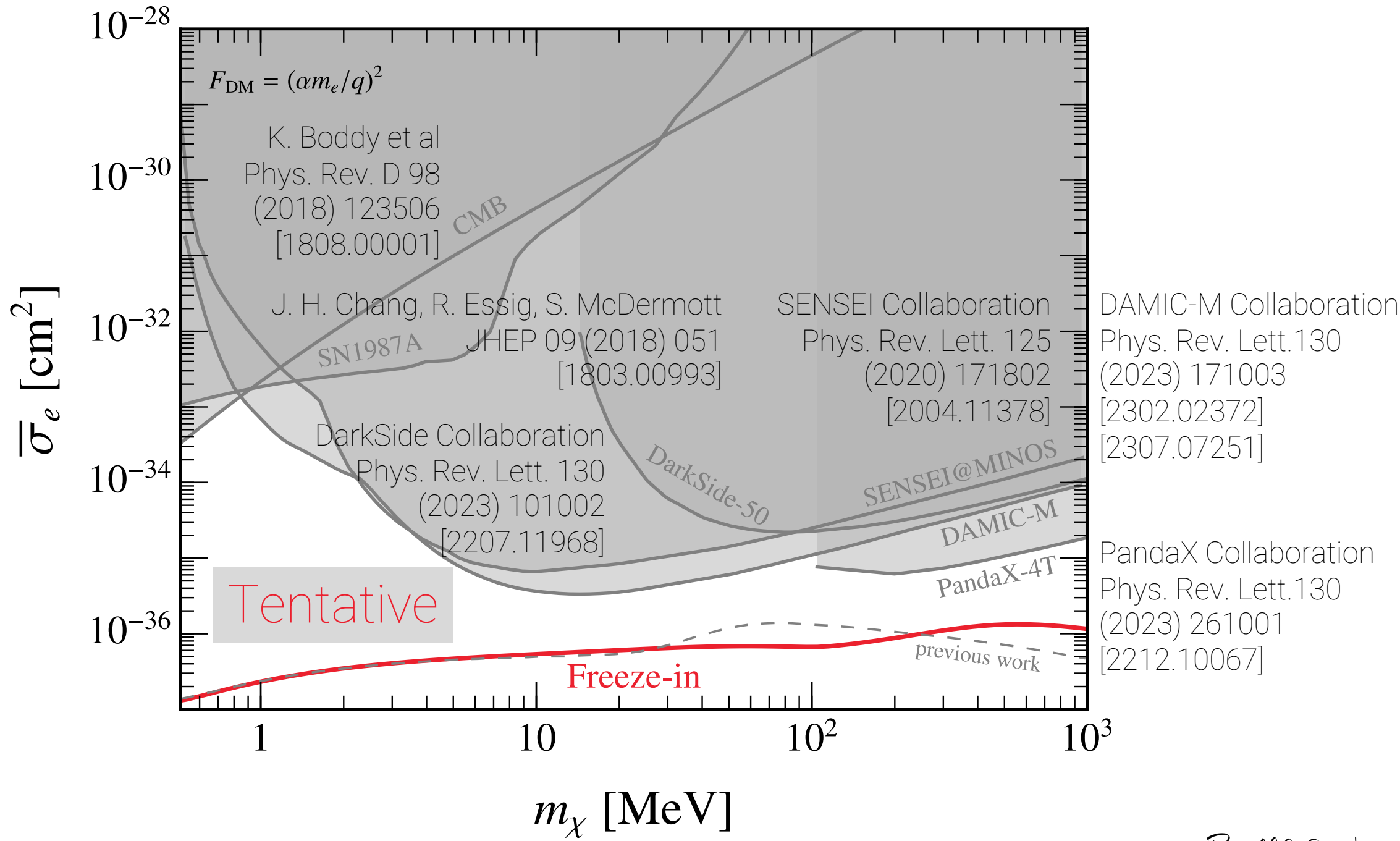




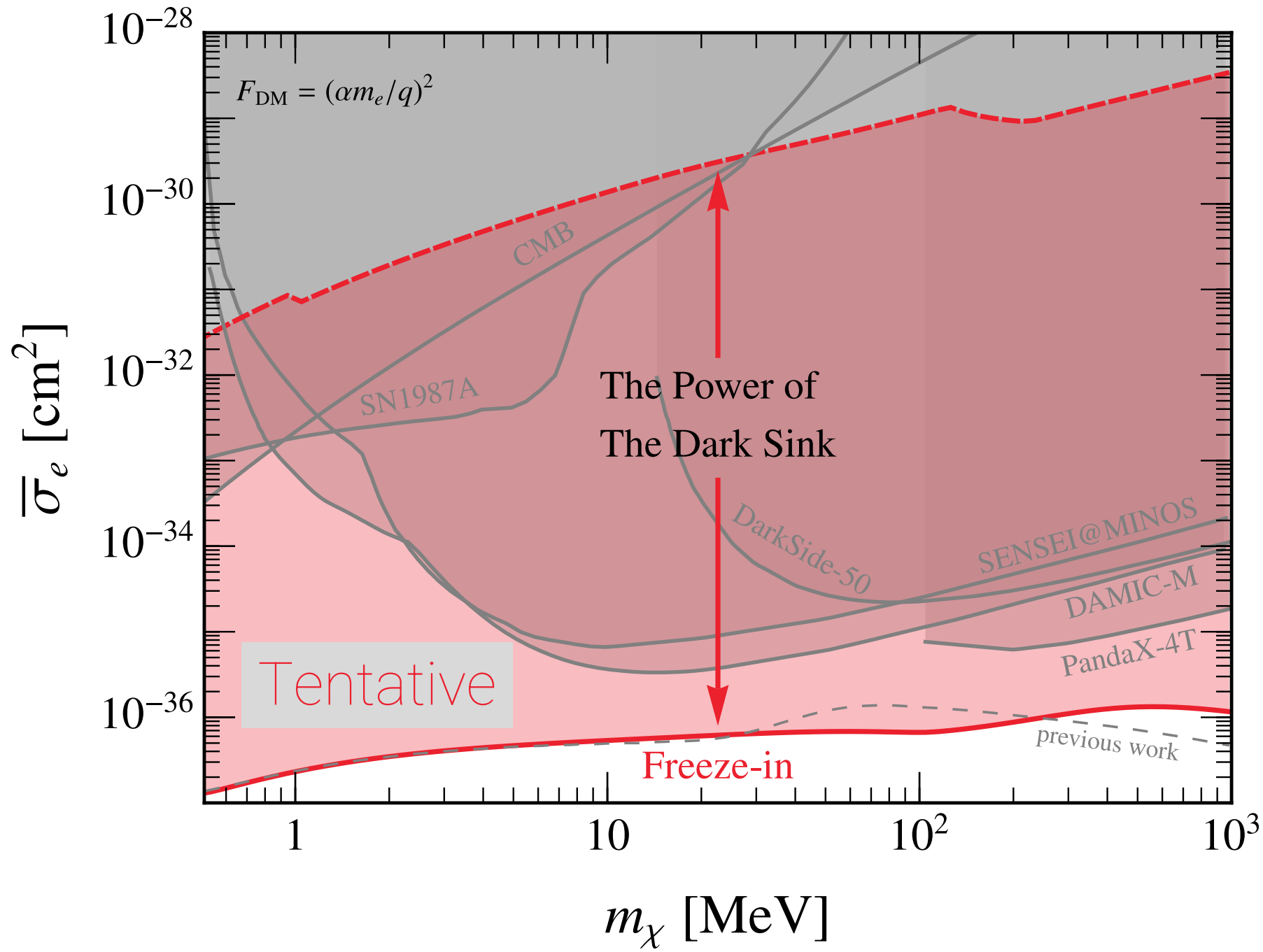




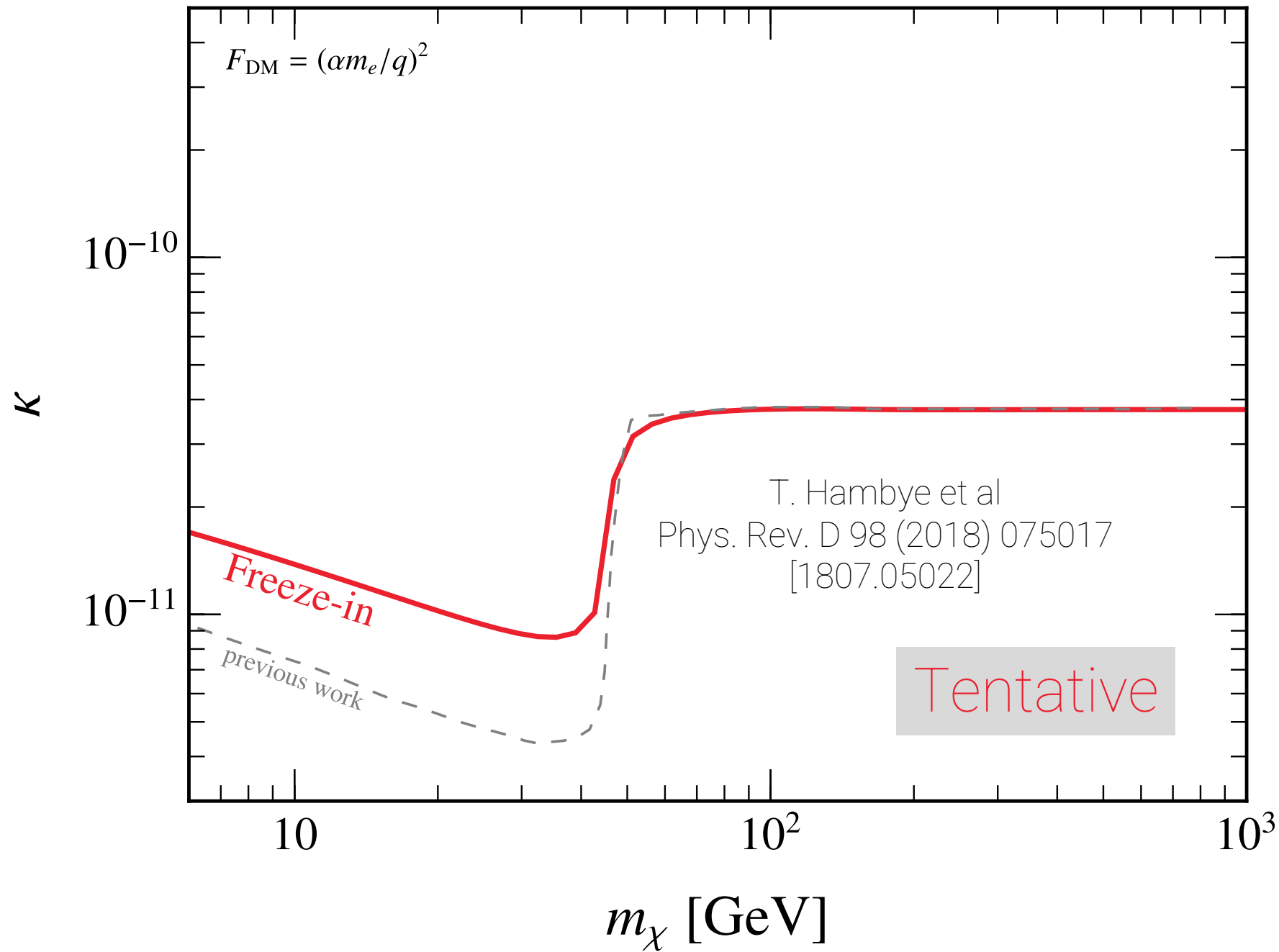
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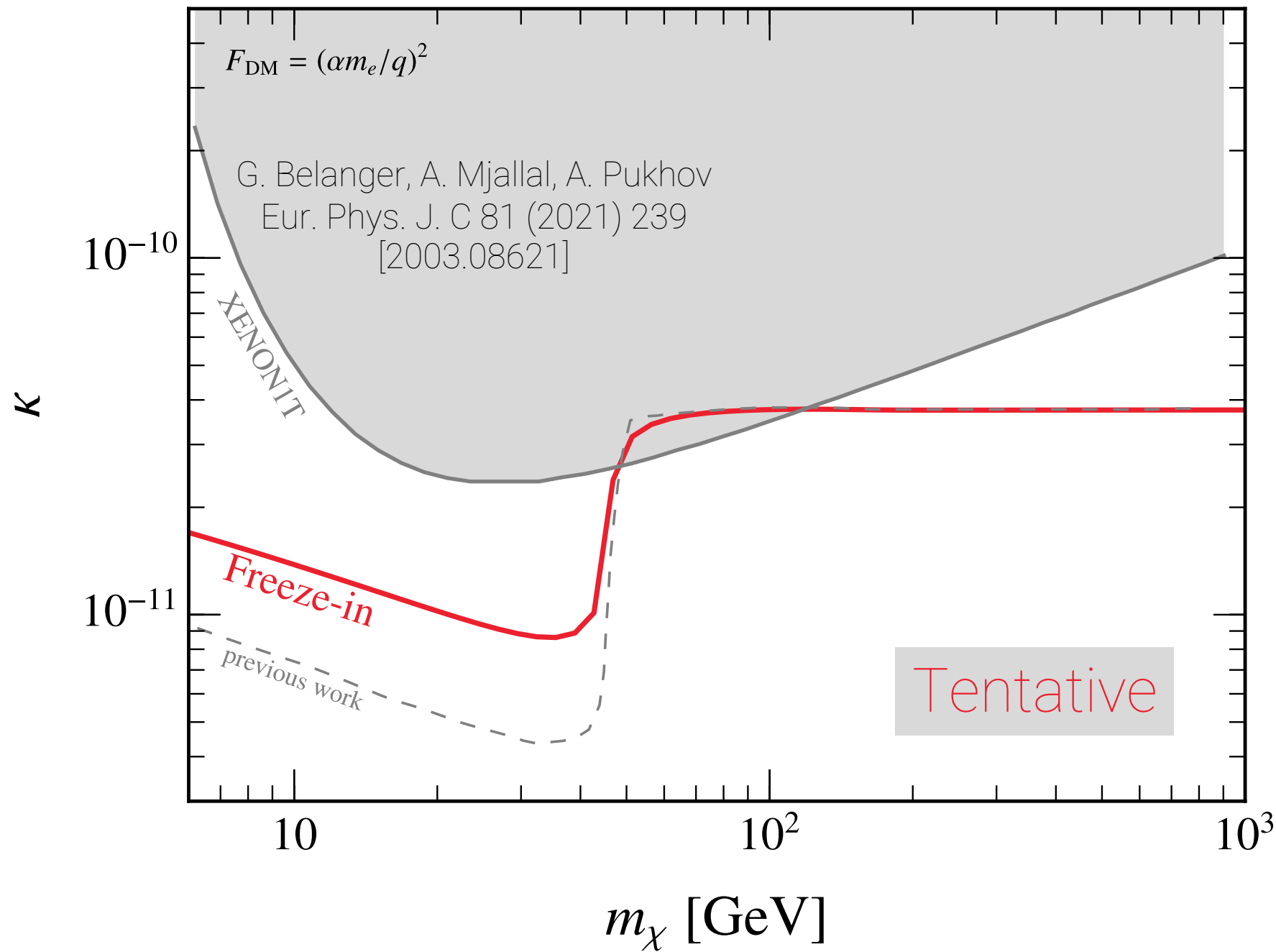


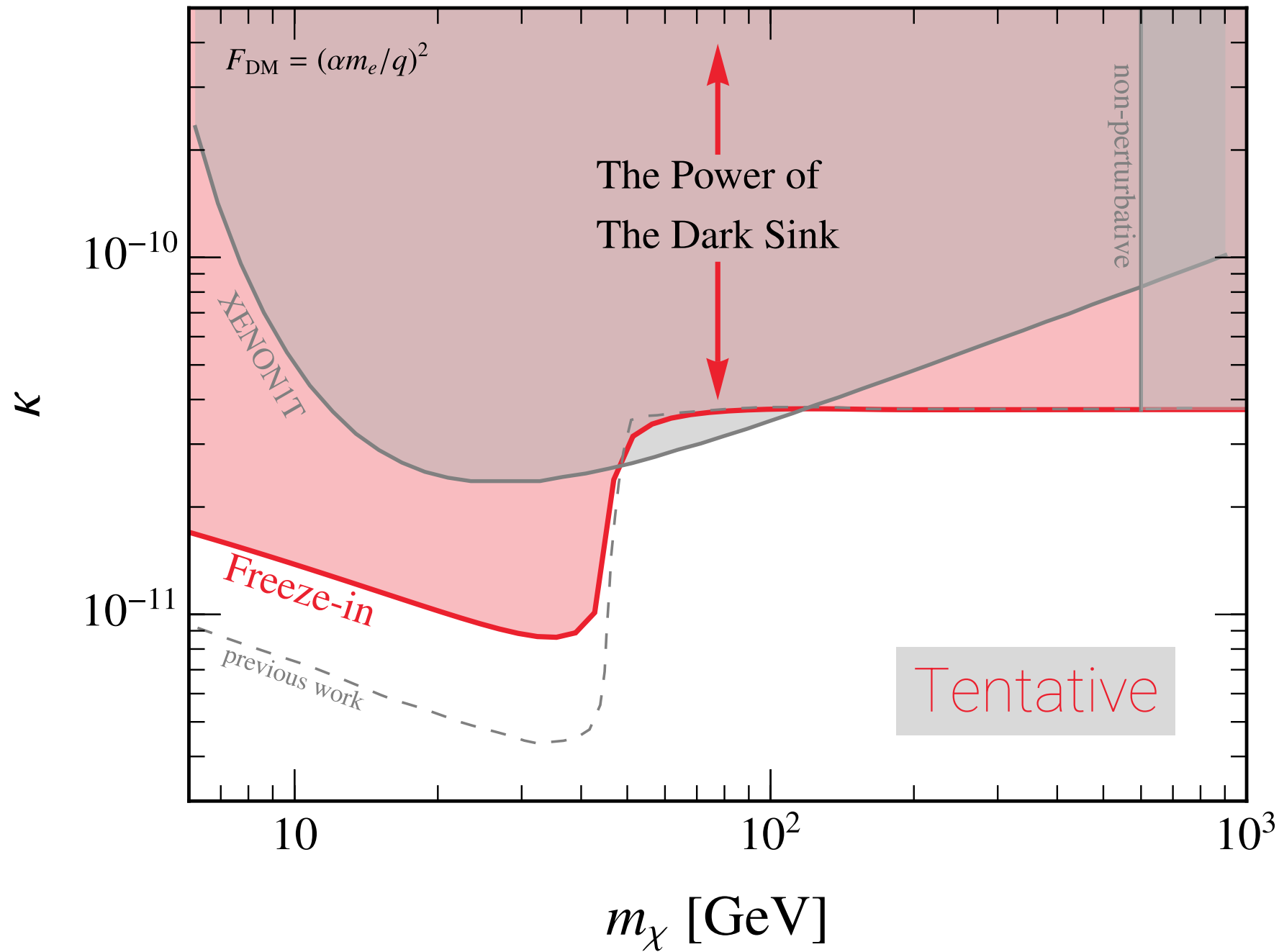
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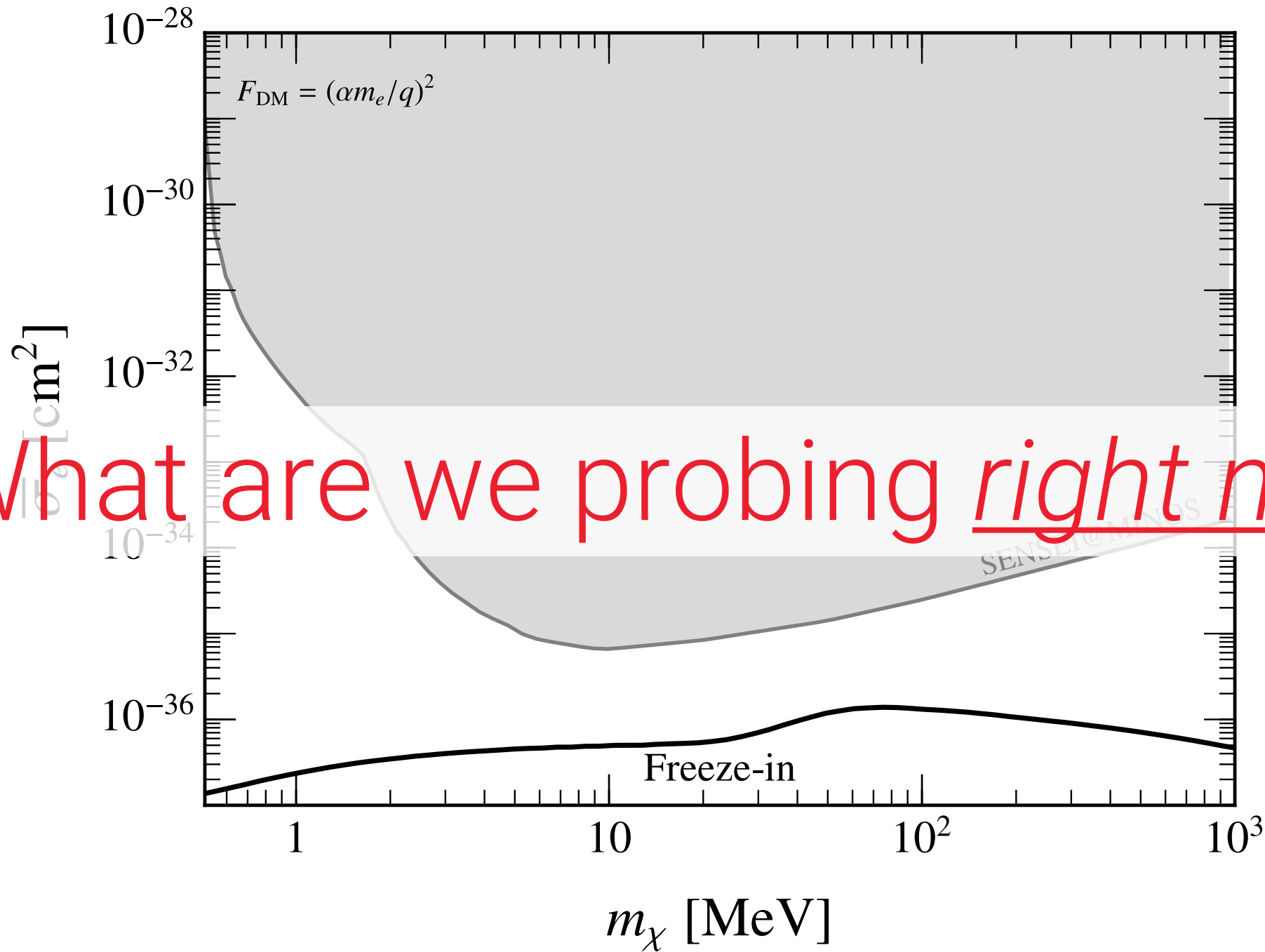


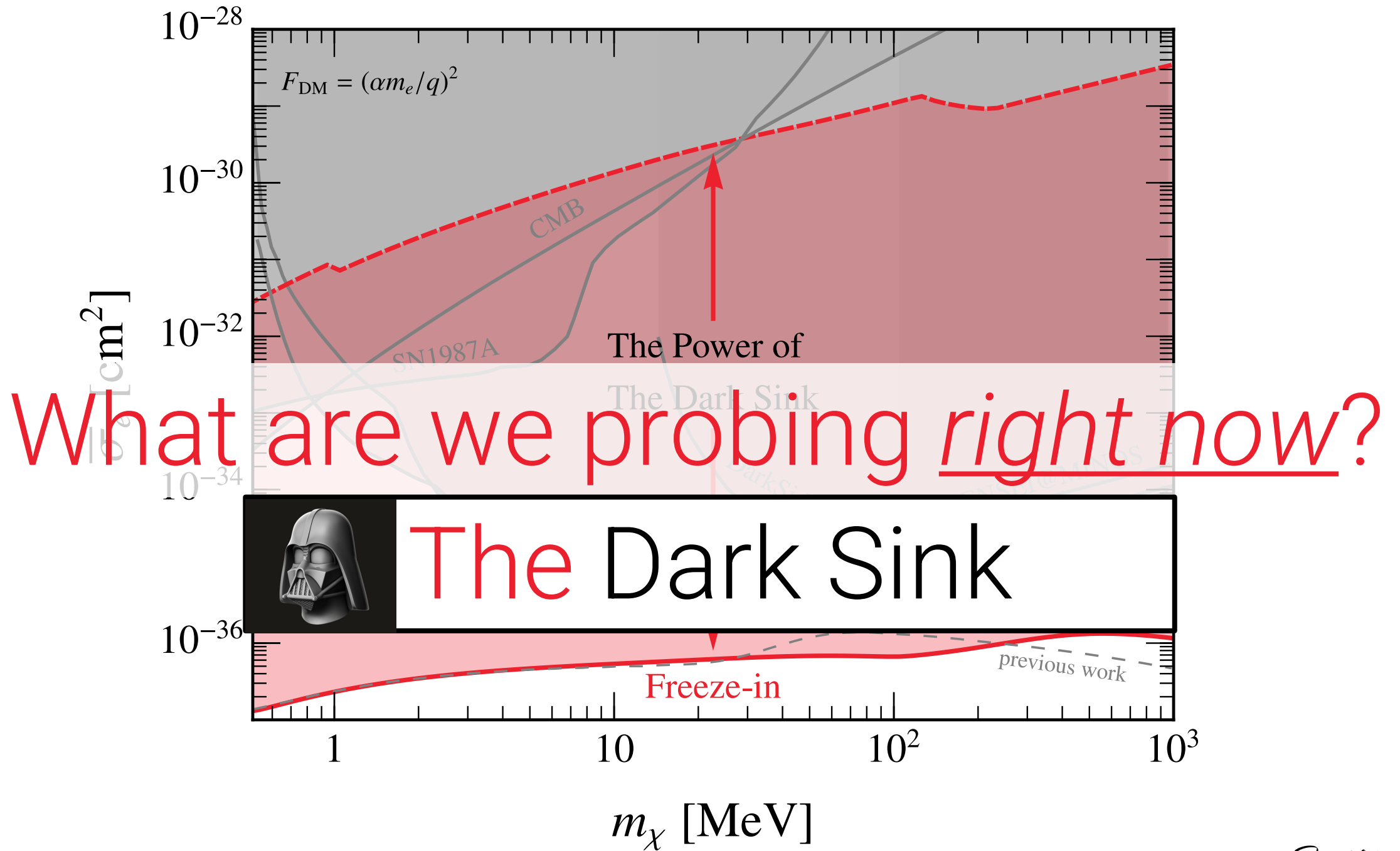






What are we probing right now?





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The Dark Sink