

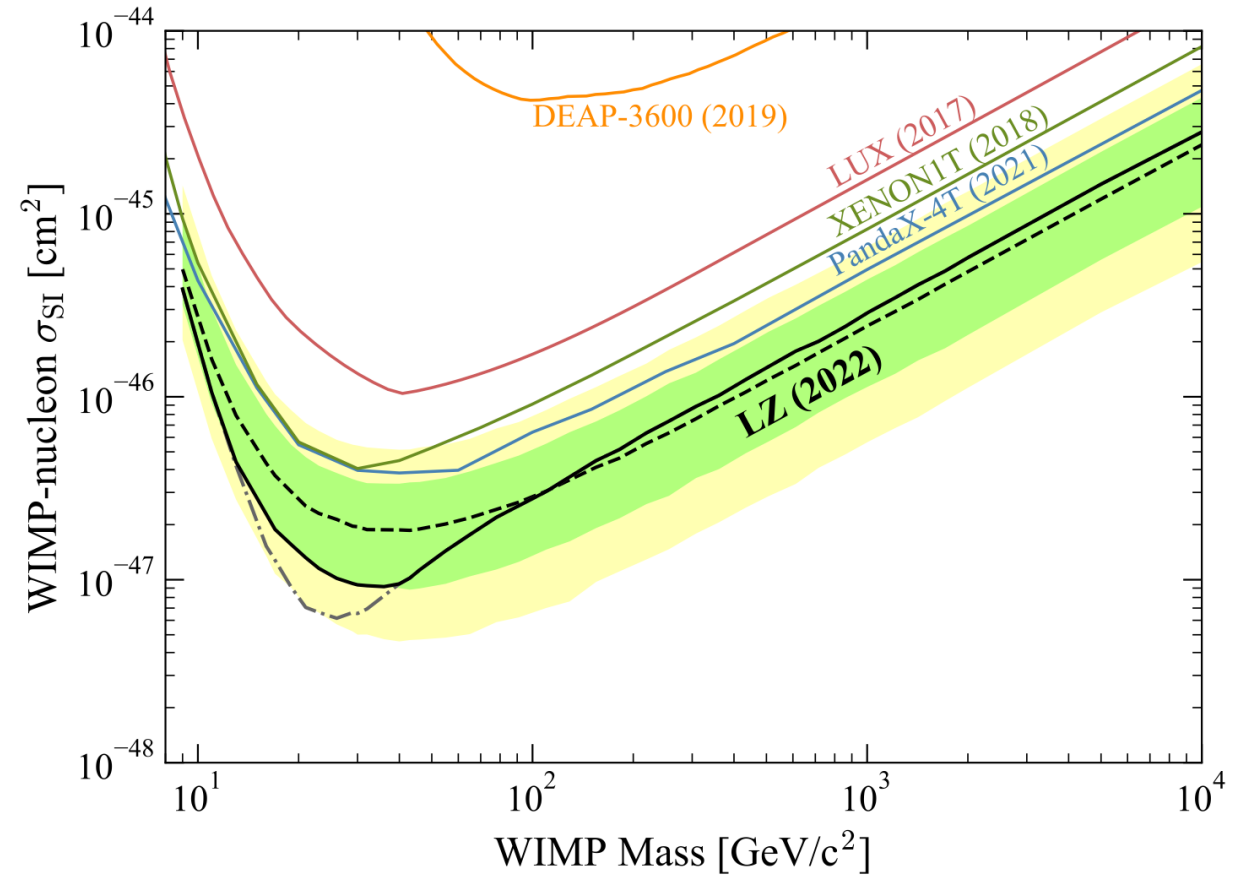
The Power of the Dark Sink

Robert McGehee
UNIVERSITY OF MINNESOTA

2312.14152 w/ Prudhvi N. Bhattachiprolu & Aaron Pierce

PHENO 24

Direct Detection Today

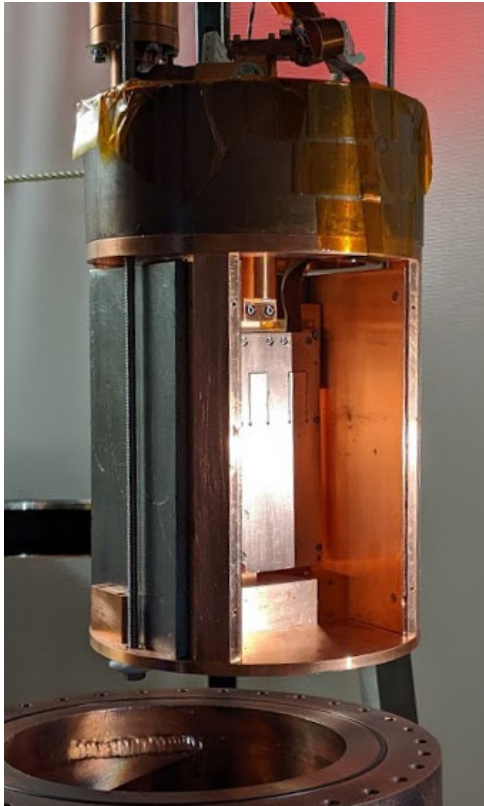


LZ Collaboration
Phys. Rev. Lett. 131 (2023) 041002
[2207.03764]

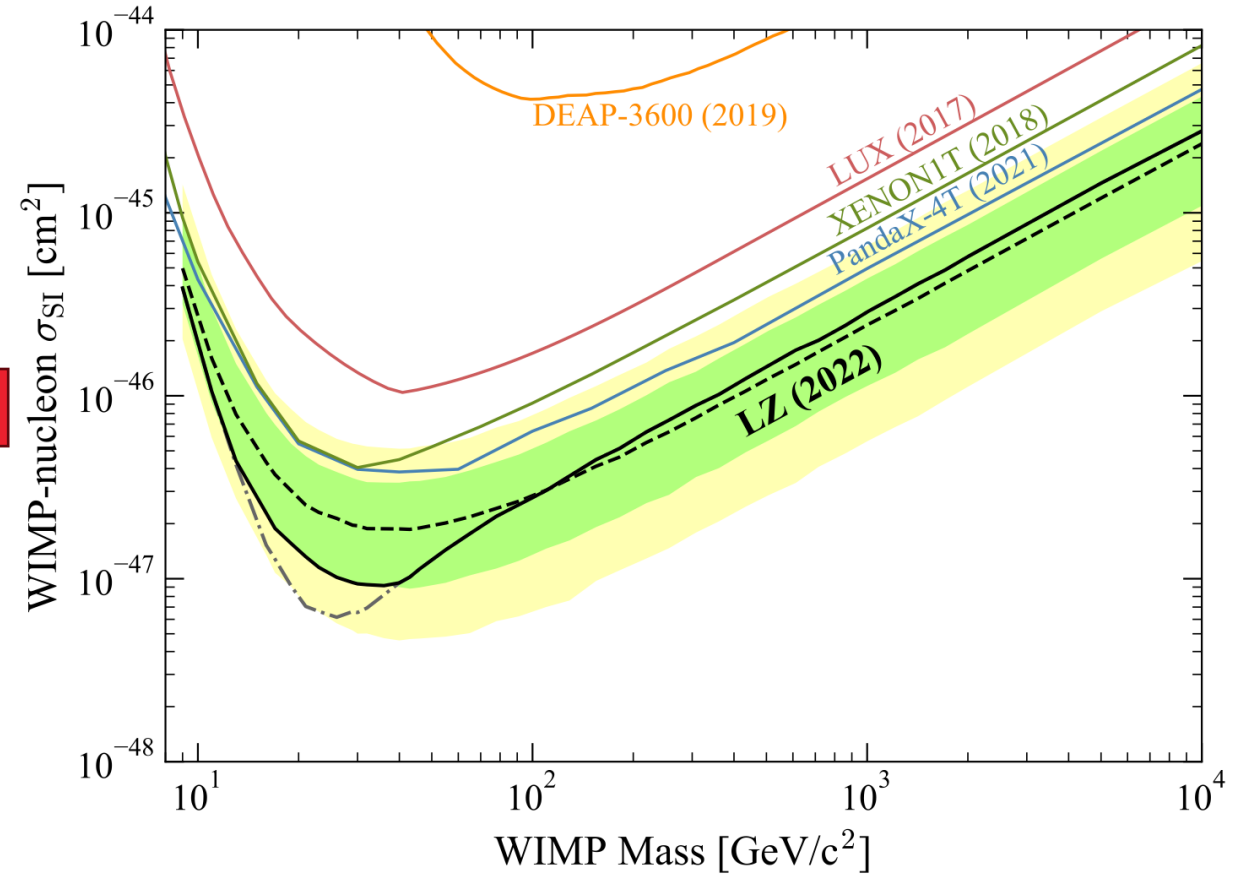
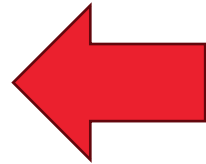
R McGehee

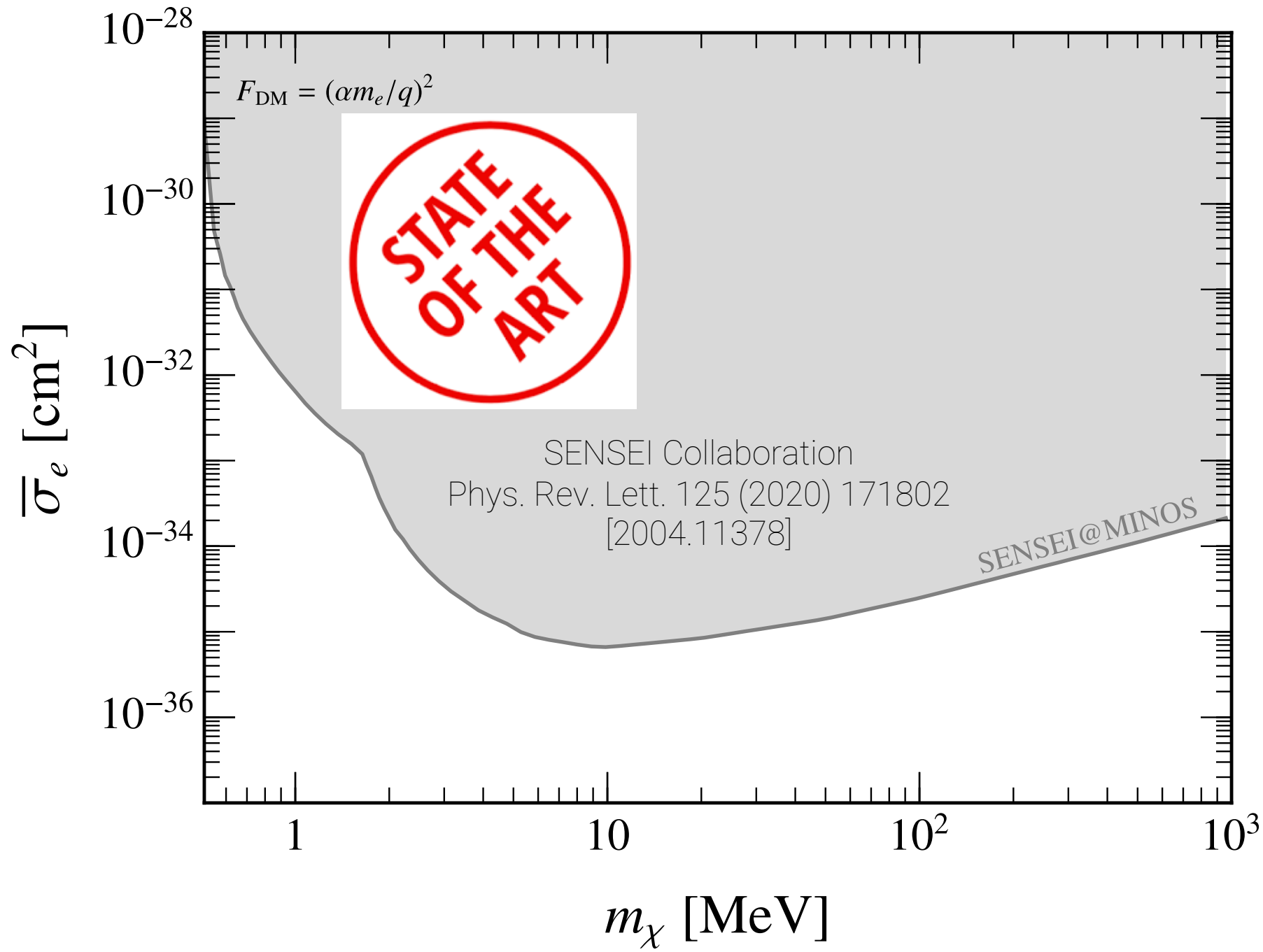
Direct Detection Today

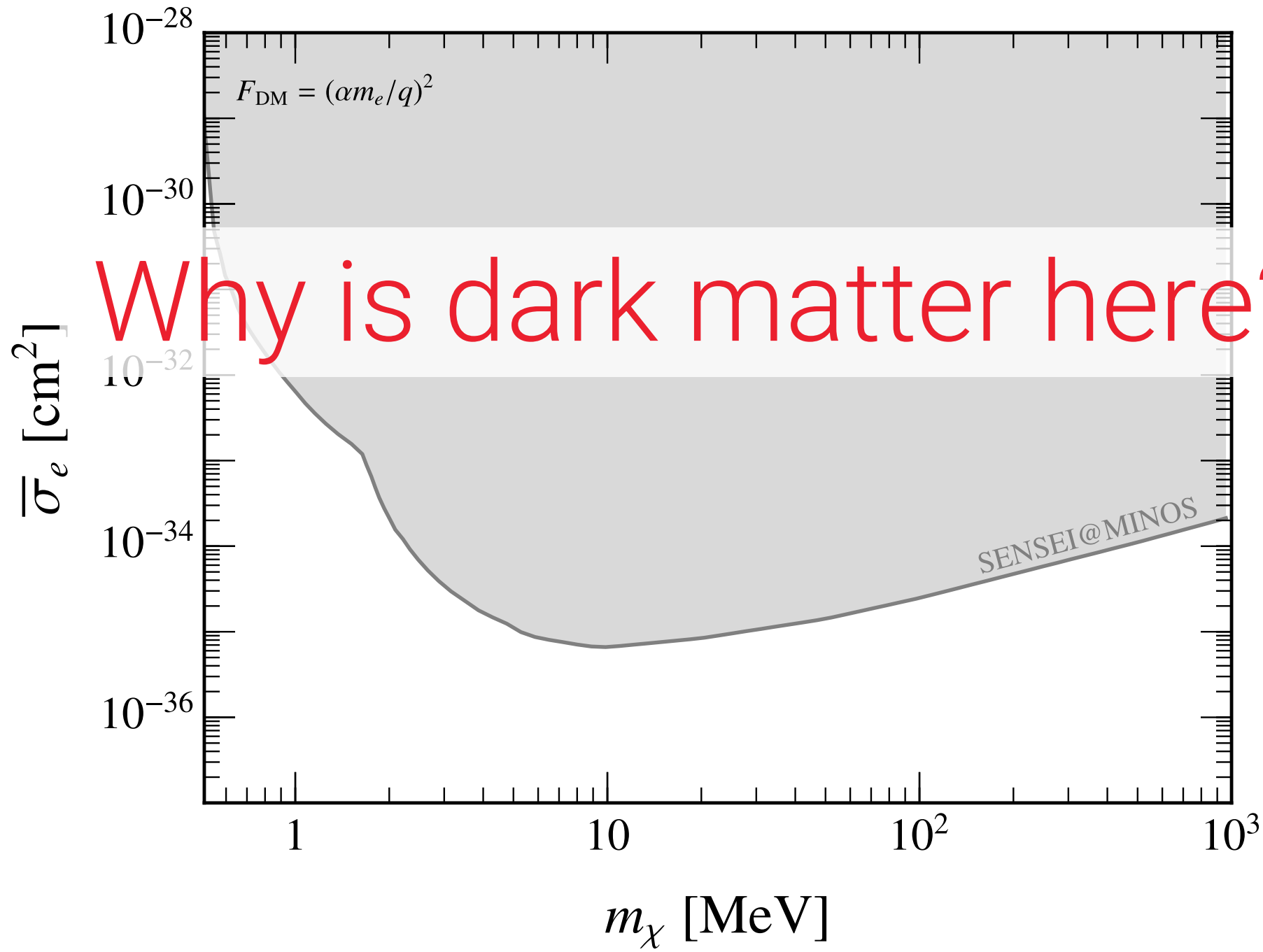
New technology



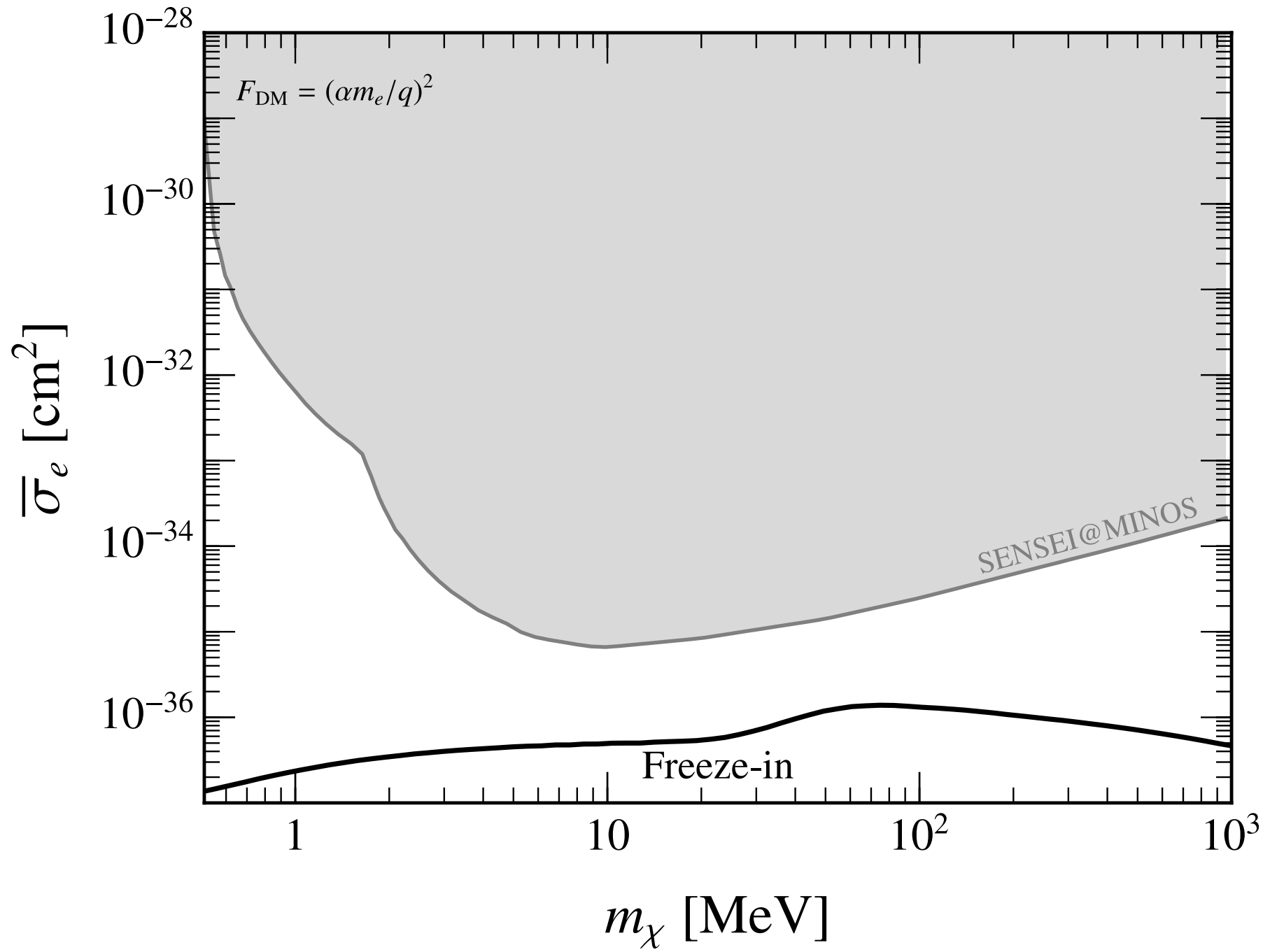
SENSEI



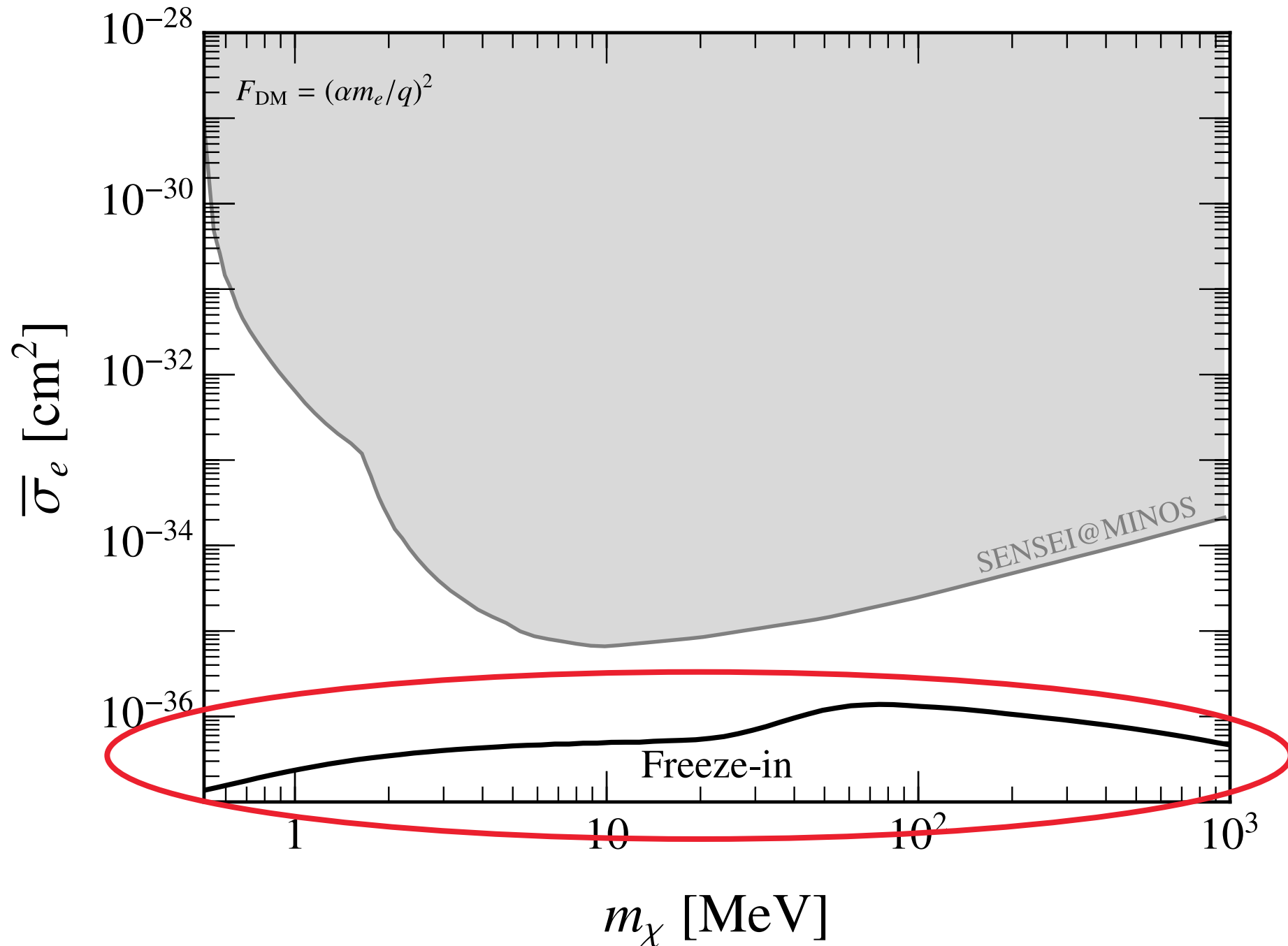




Why is dark matter here?



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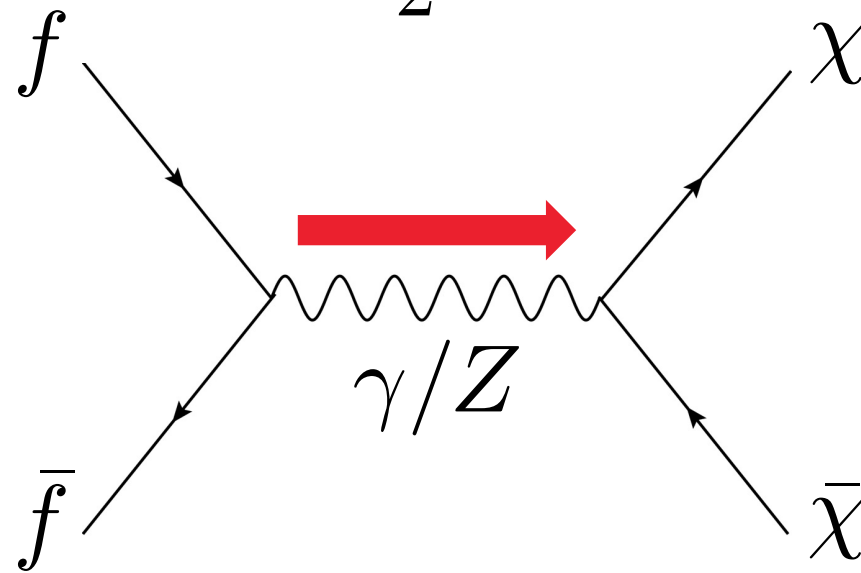
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Freeze-In

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

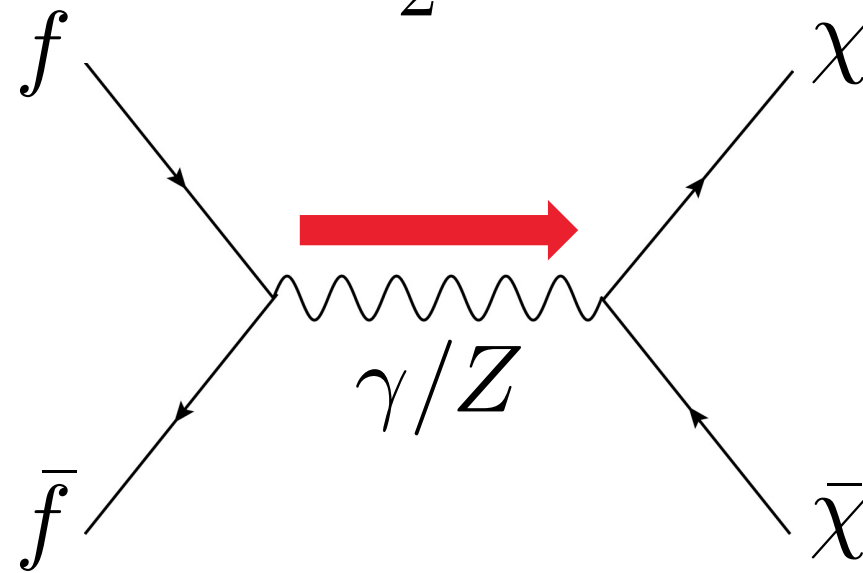
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Freeze-In

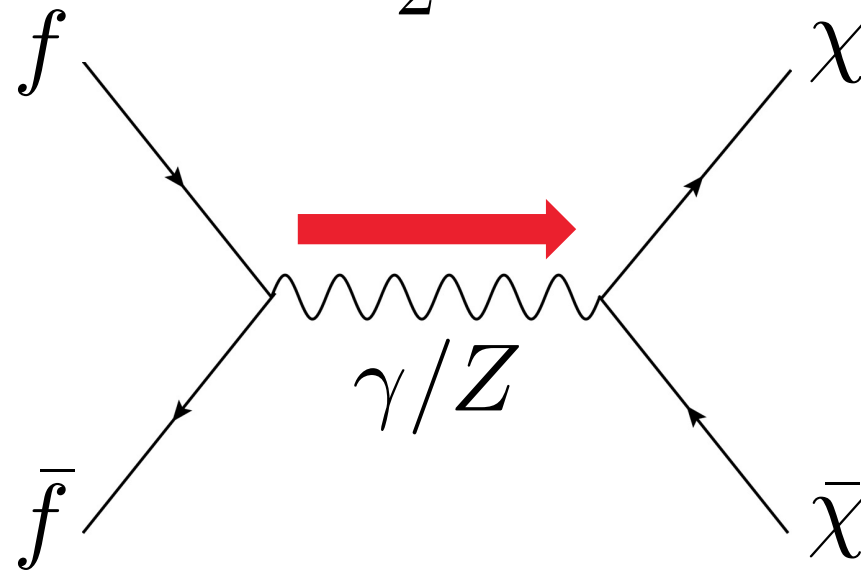
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$$\kappa \equiv \epsilon \sqrt{\alpha'/\alpha} \approx \mathcal{O}(10^{-11})$$

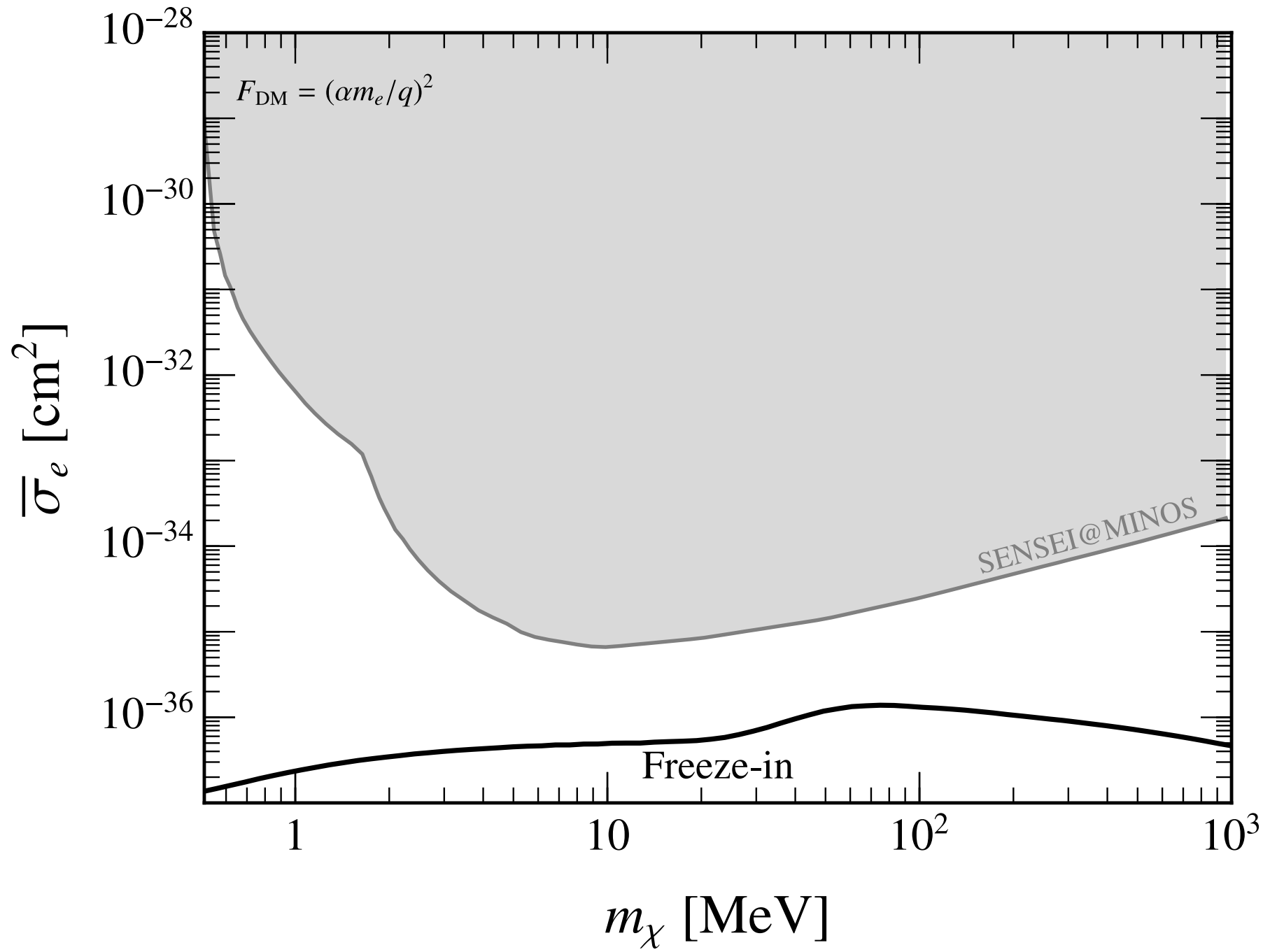
Freeze-In

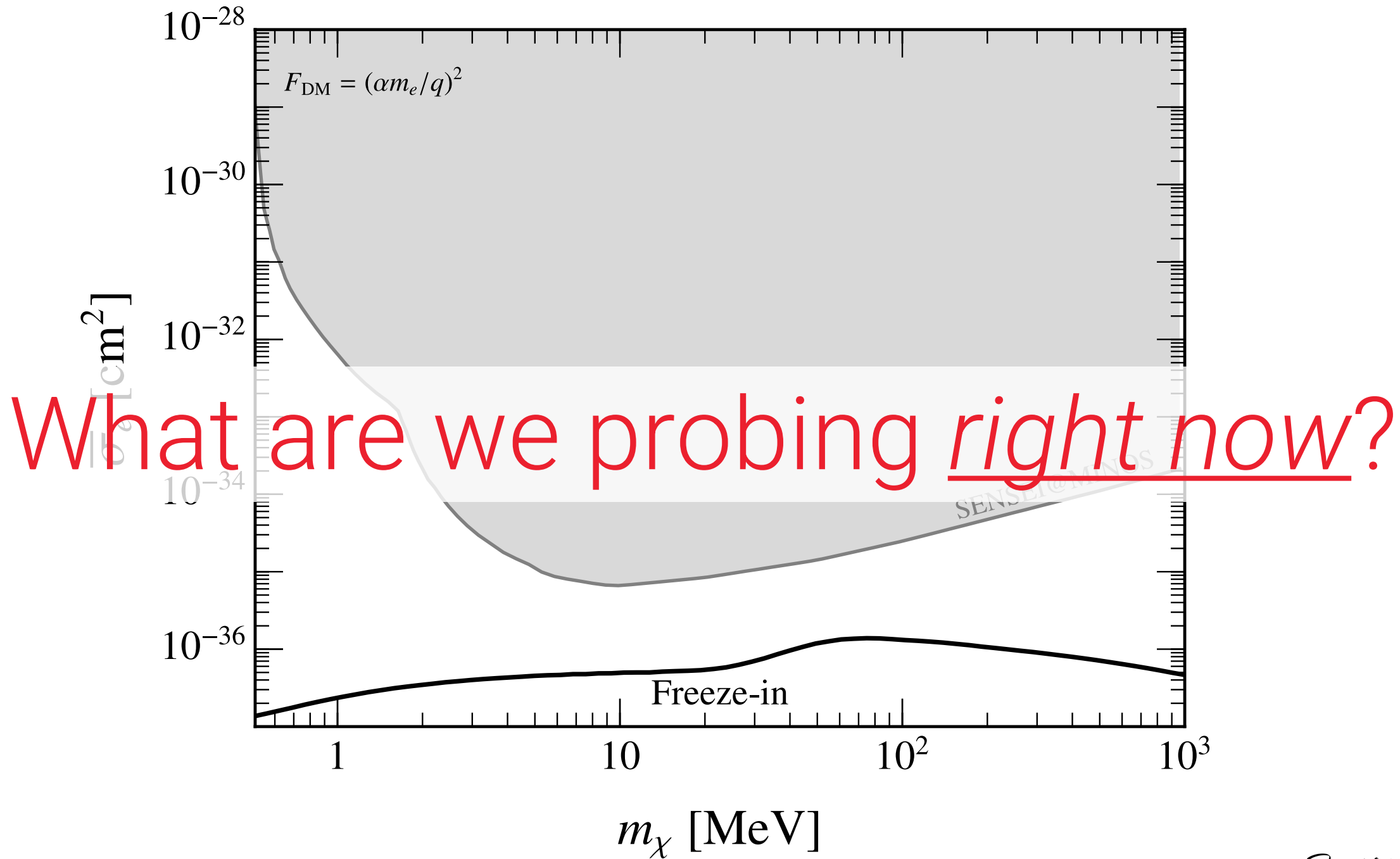
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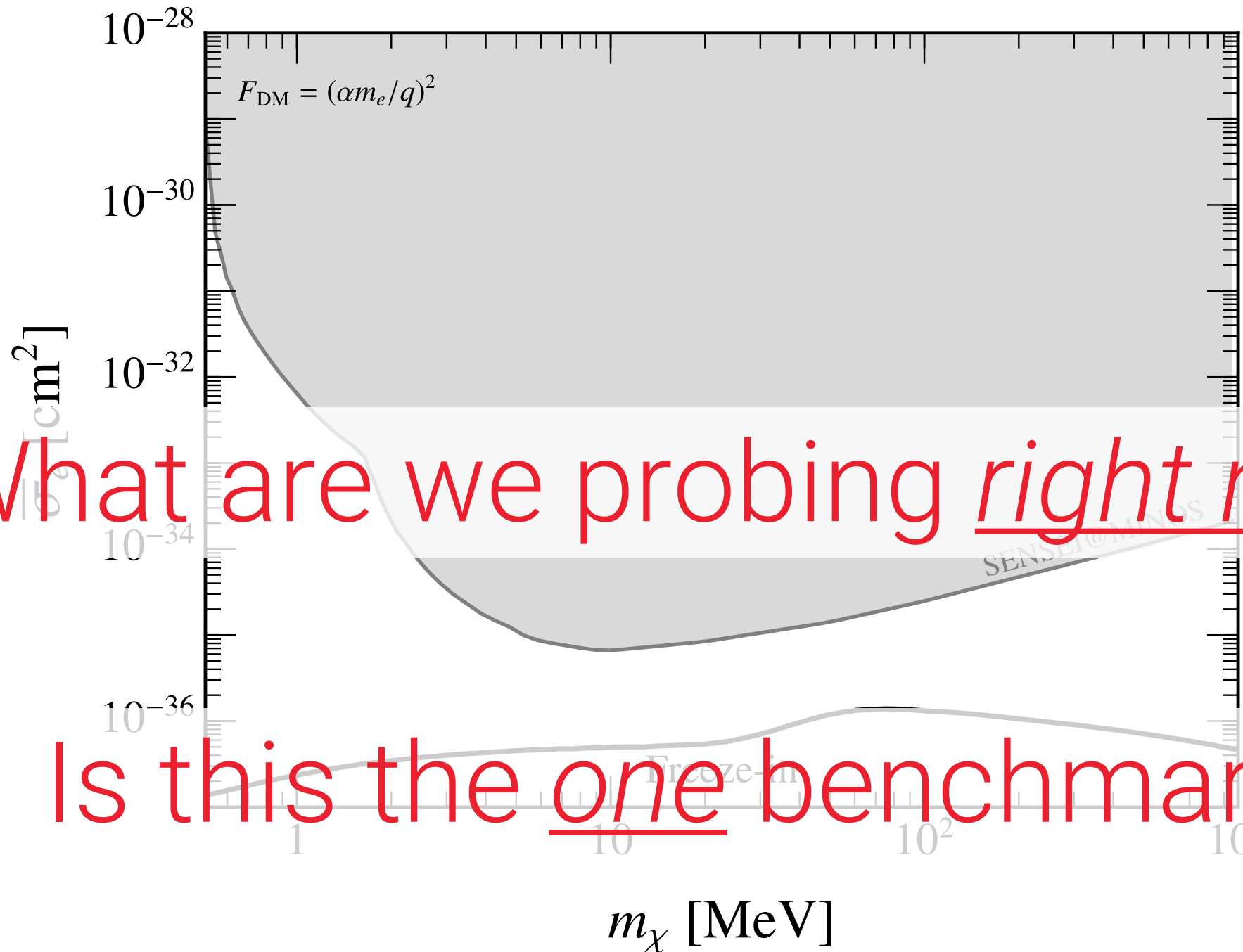


$$\kappa \equiv \epsilon \sqrt{\alpha'/\alpha} \approx \mathcal{O}(10^{-11})$$

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





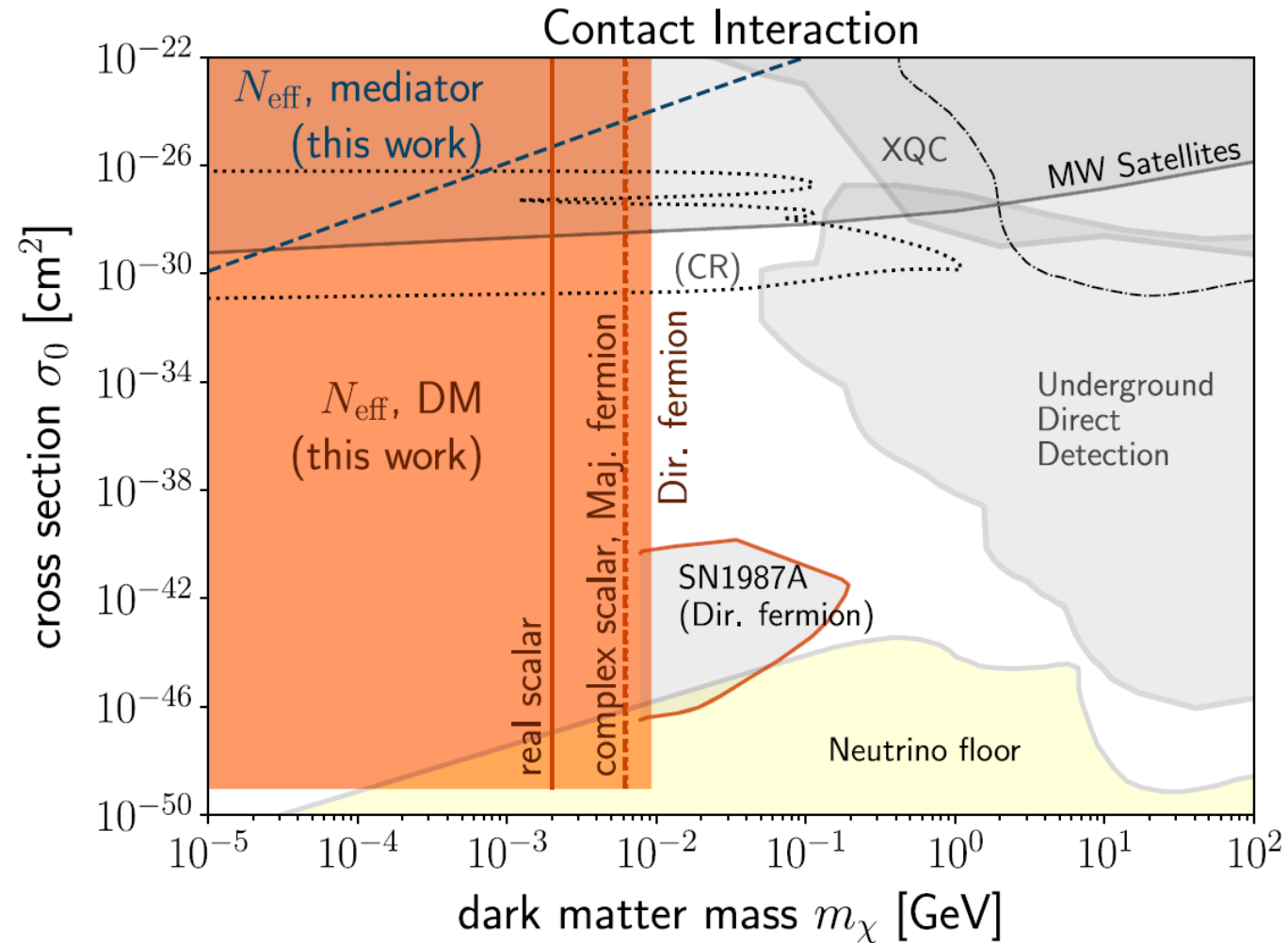


What are we probing right now?

Is this the one benchmark?

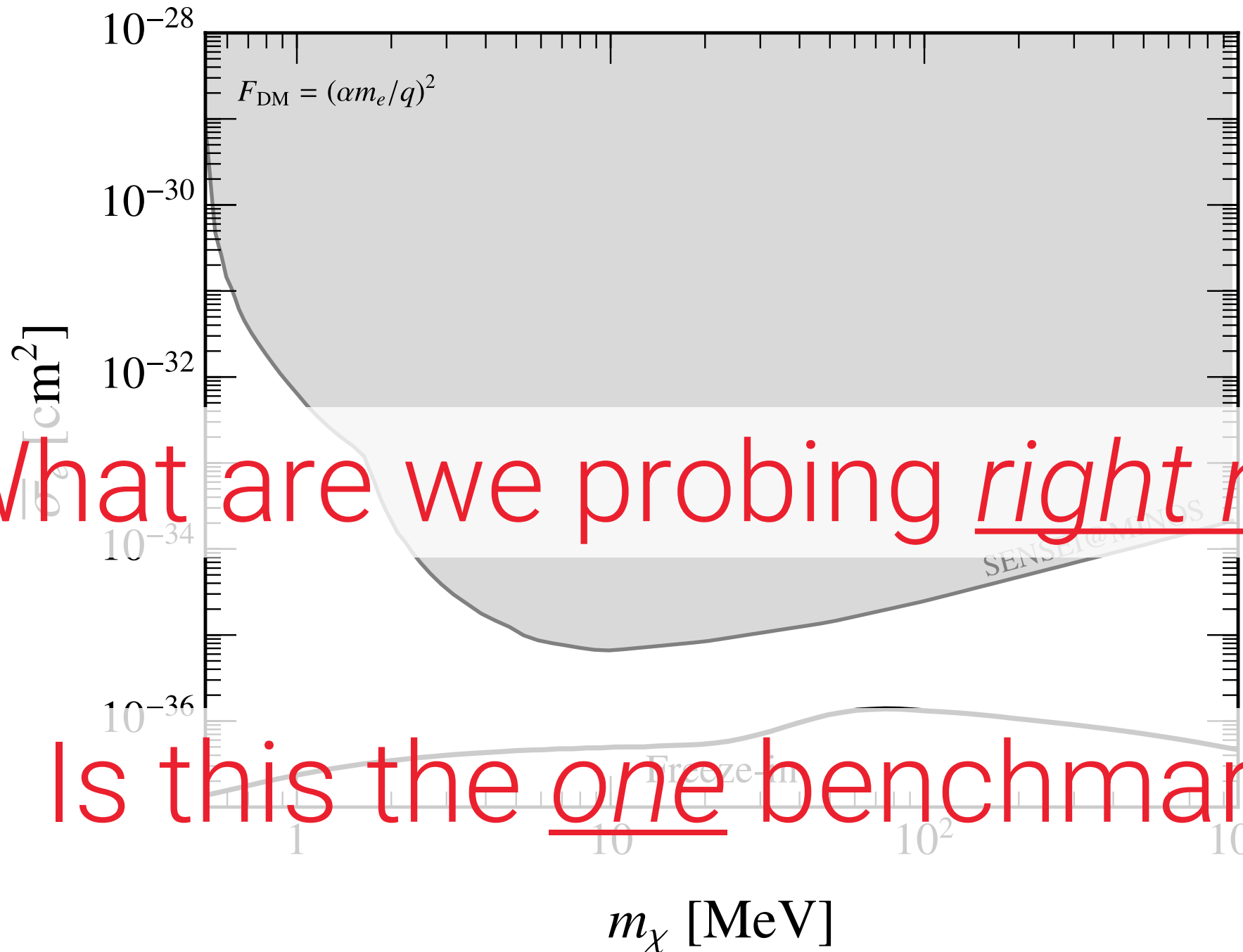
Model-building Challenge: BBN

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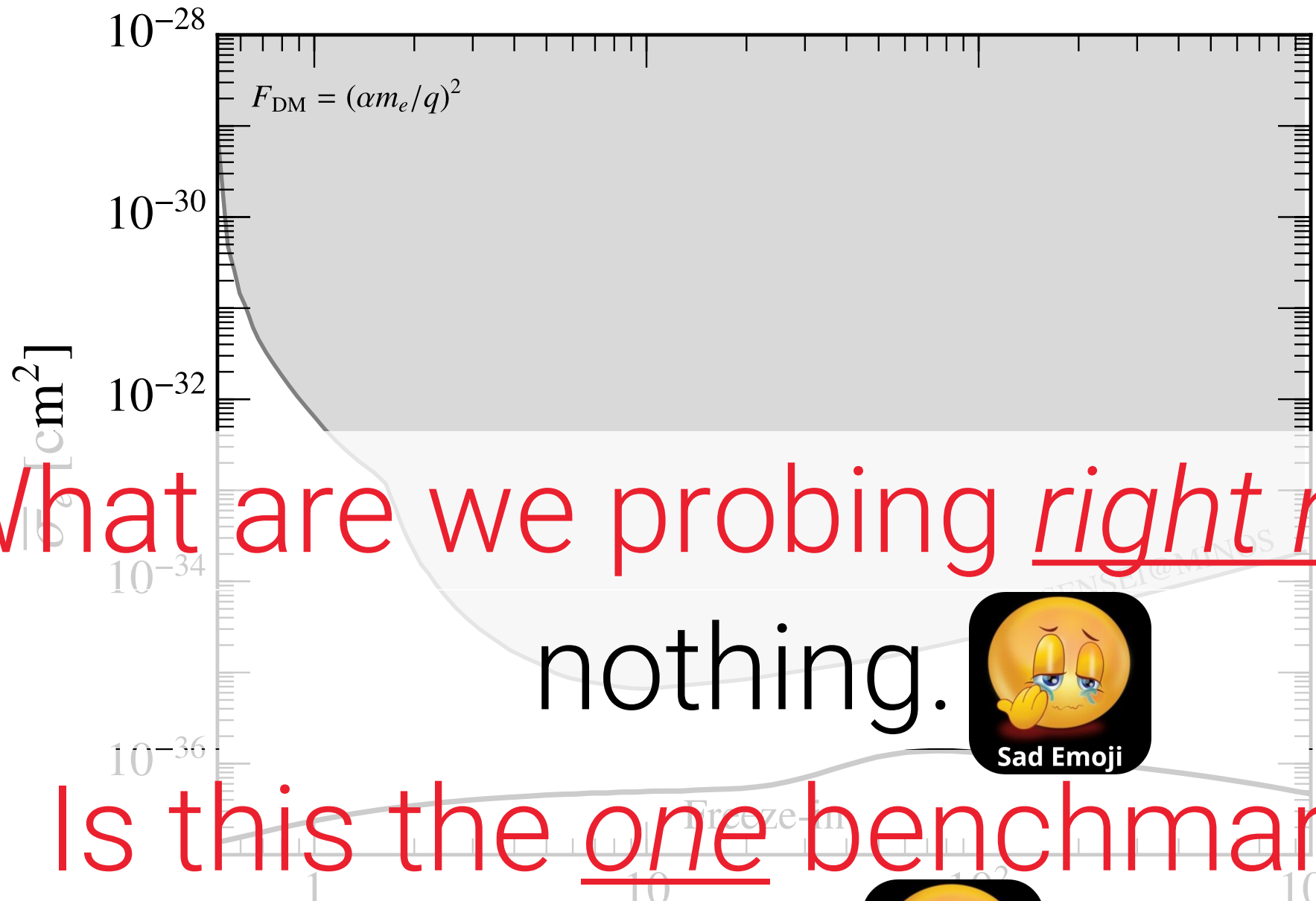
G. Krnjaic and S. McDermott [1908.00007]

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What are we probing right now?

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What are we probing right now?

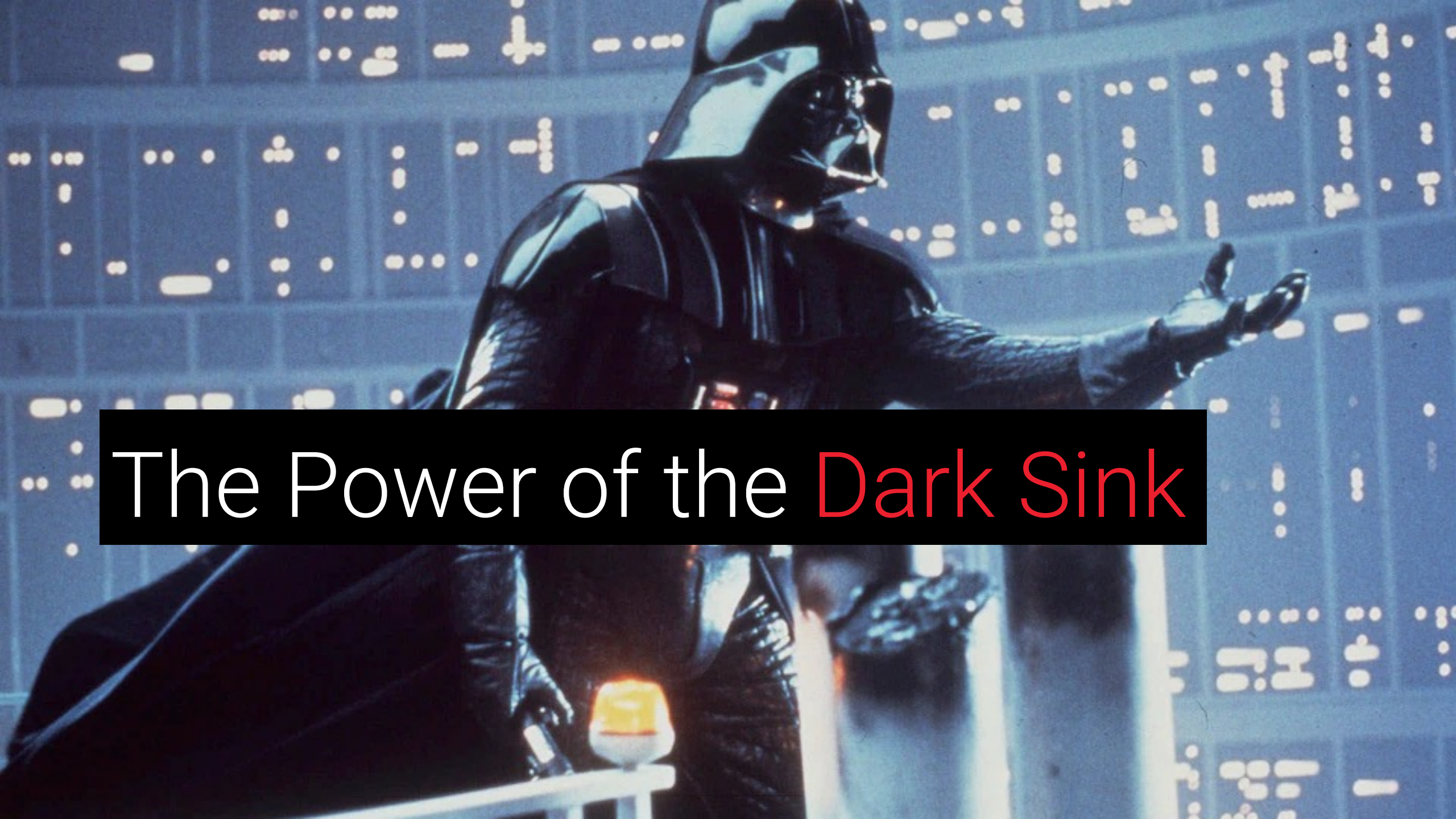
nothing.



Is this the one benchmark?

yes.





The Power of the Dark Sink

~~Freeze In~~ Dark Sink

$$\mathcal{L} \supset -\frac{\epsilon}{2} F'_{\mu\nu} F^{\mu\nu} \quad + \text{Light fermion } \psi$$

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Larger cross sections @ current direct detection exps

Temperature



The Story

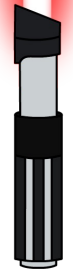
- SM produces dark matter

Temperature



The Story

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

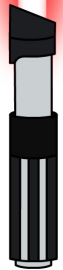


Temperature



The Story

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

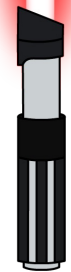


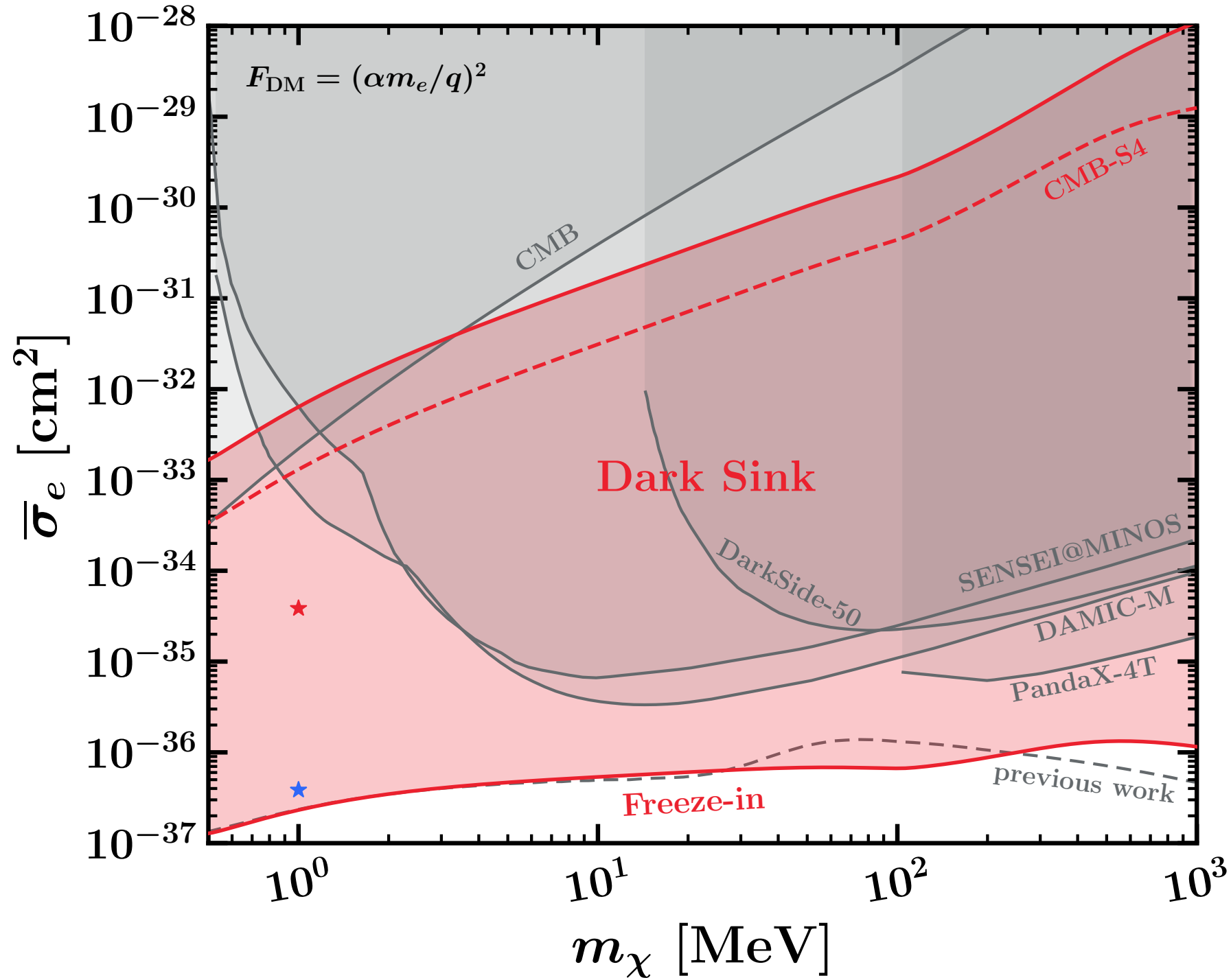
Temperature

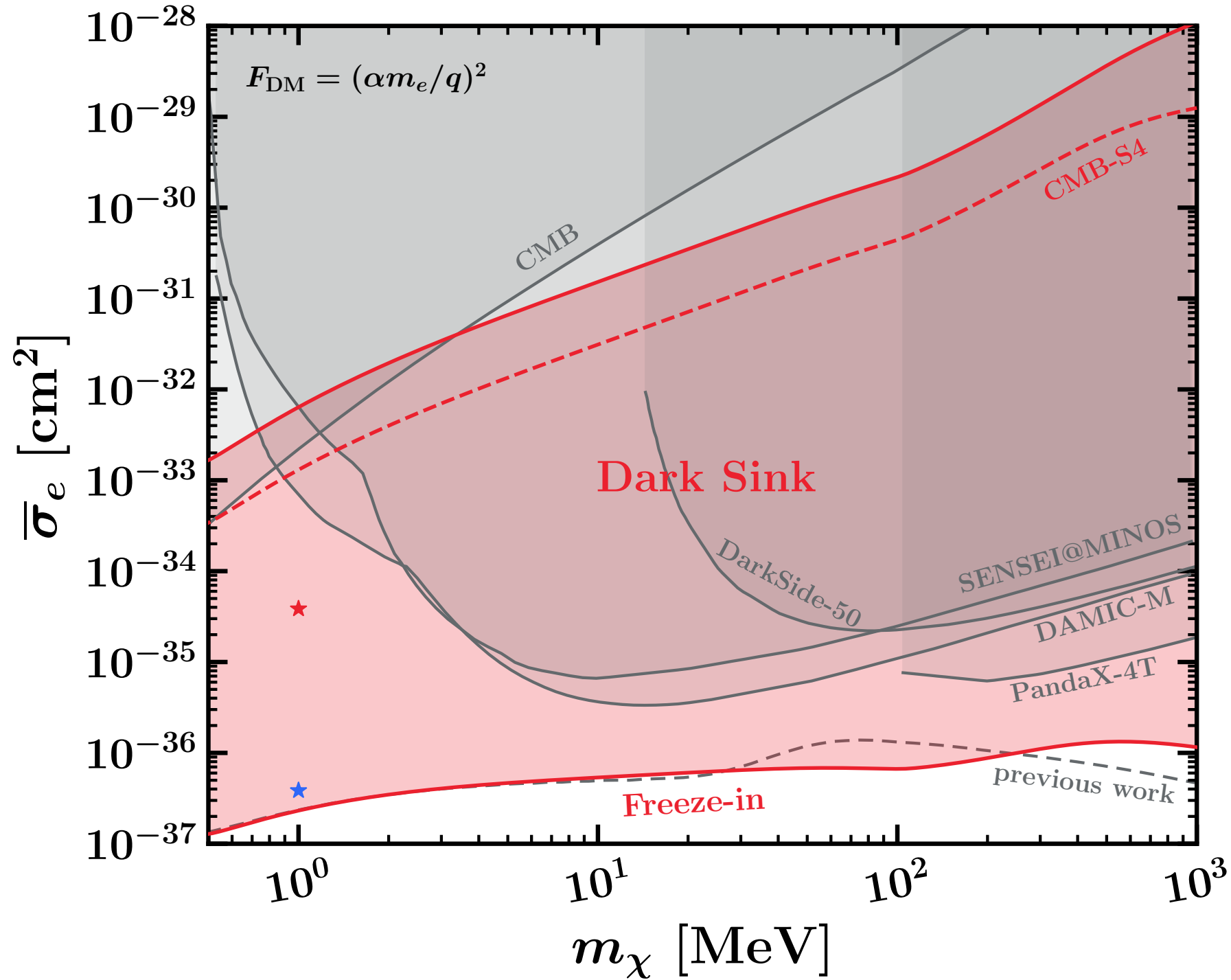


The Story

- 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



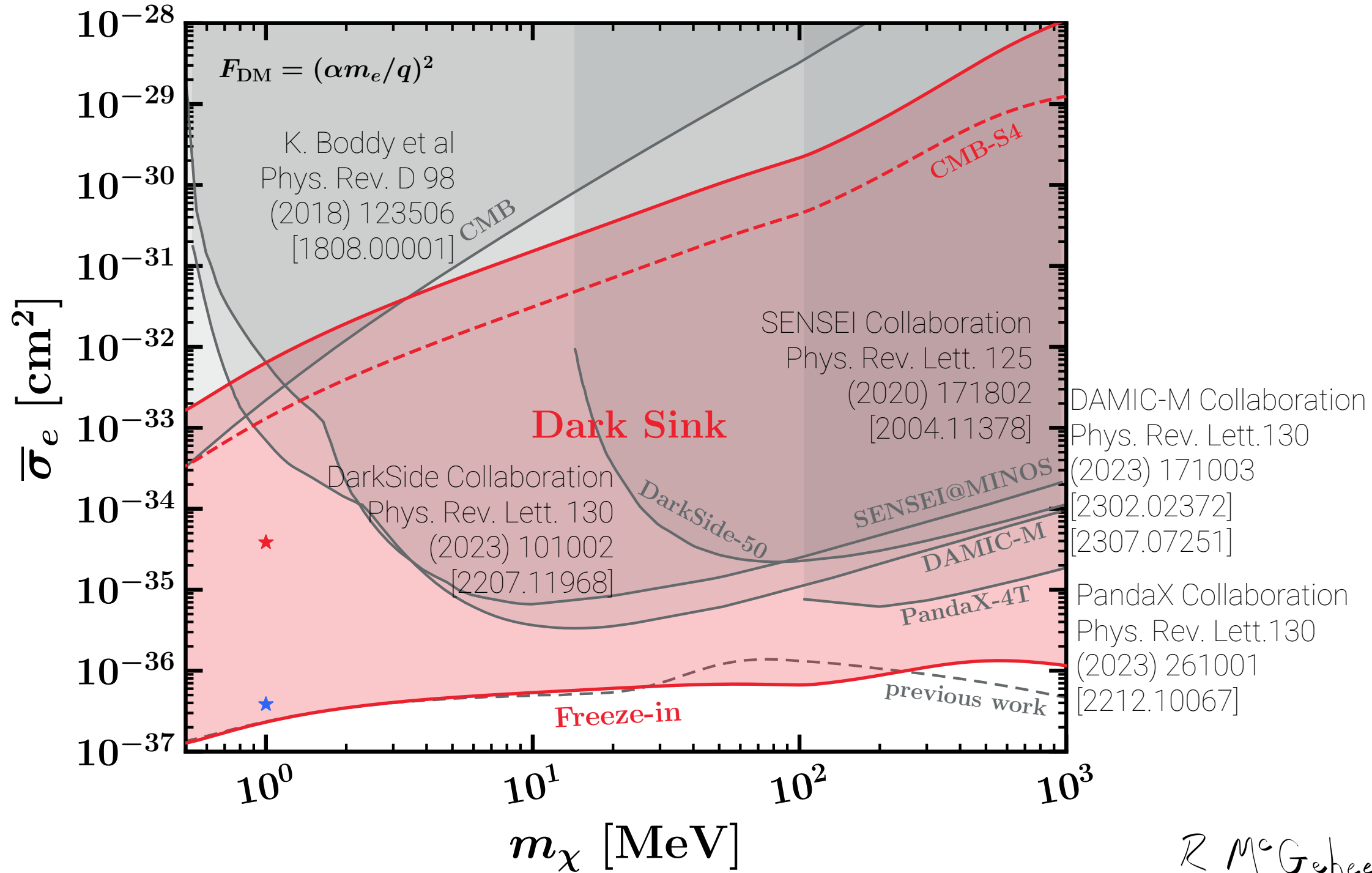




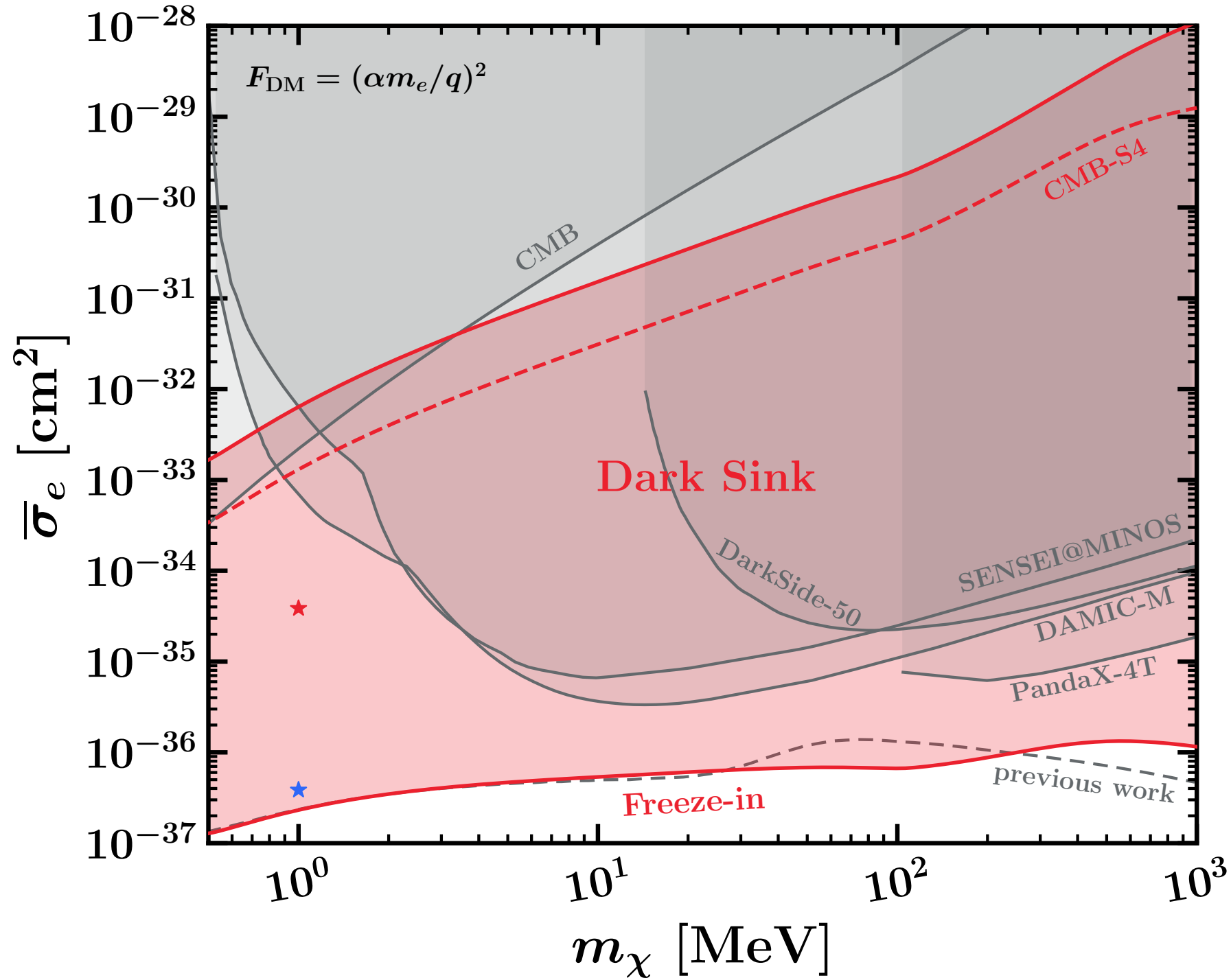
R. Essig, J. Mardon, T. Volansky
 Phys. Rev. D 85 (2012) 076007 [1108.5383]

SENSEI Collaboration
 Phys. Rev. Lett. 125 (2020) 171802 [2004.11378]

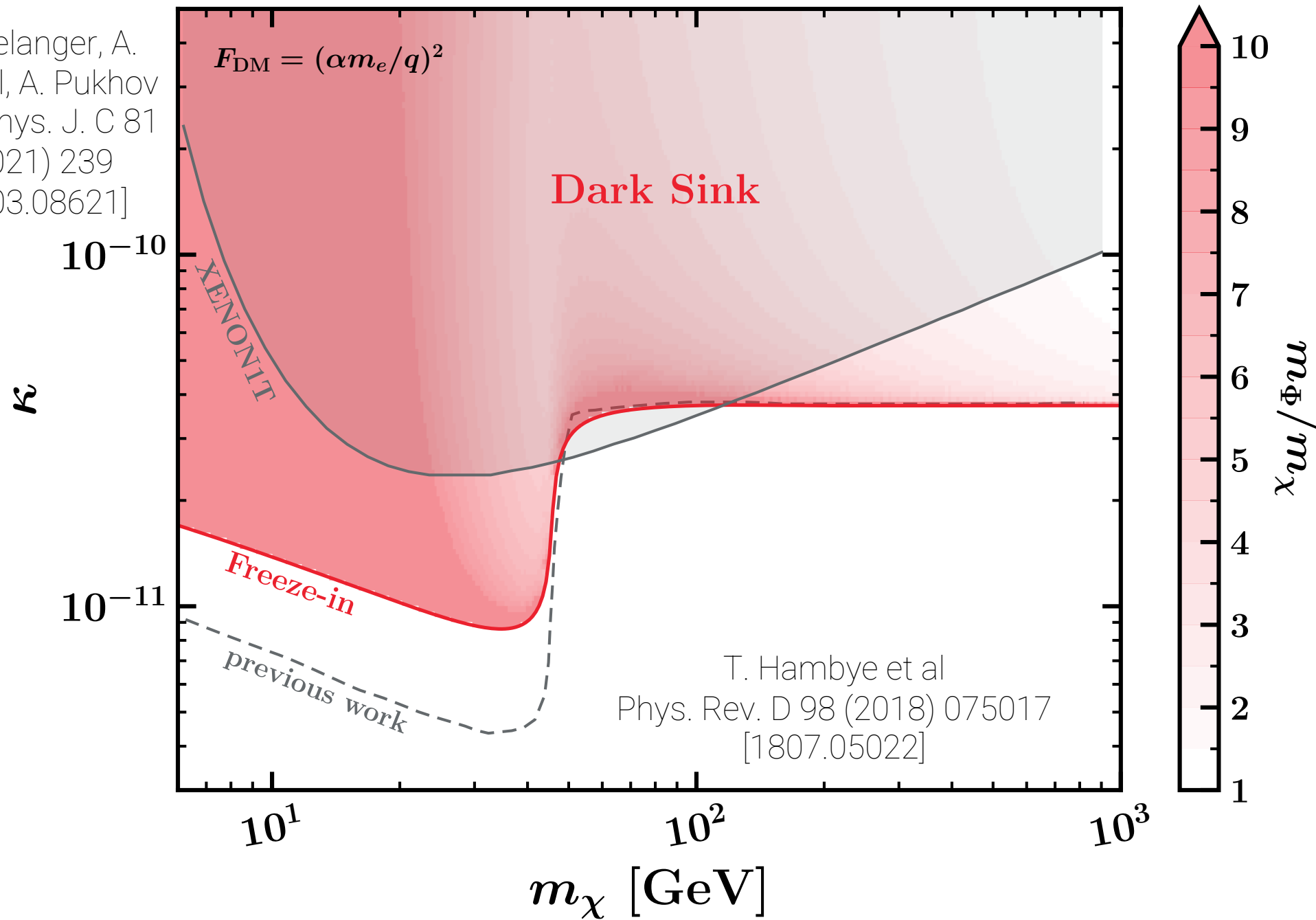
R McGehee



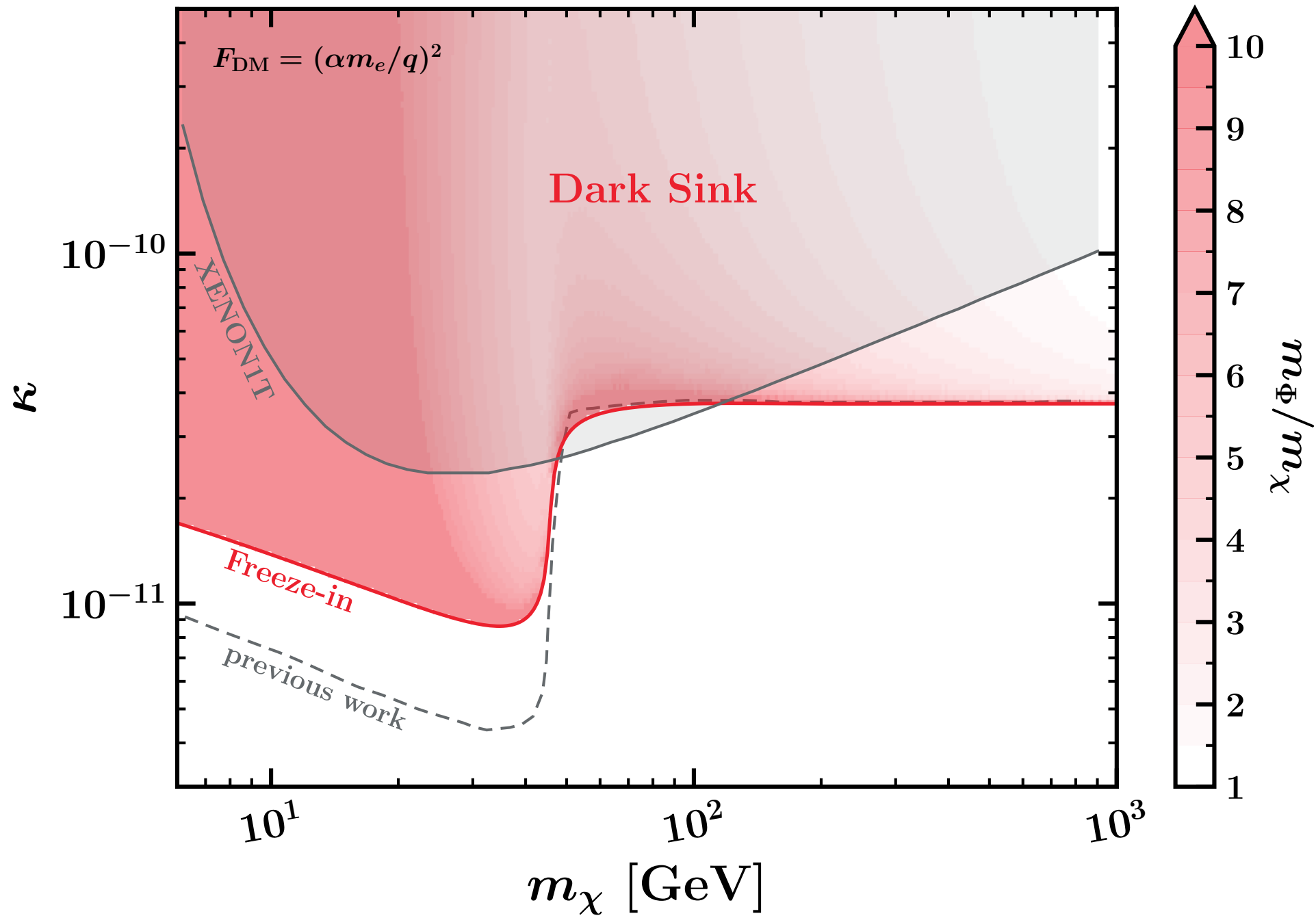
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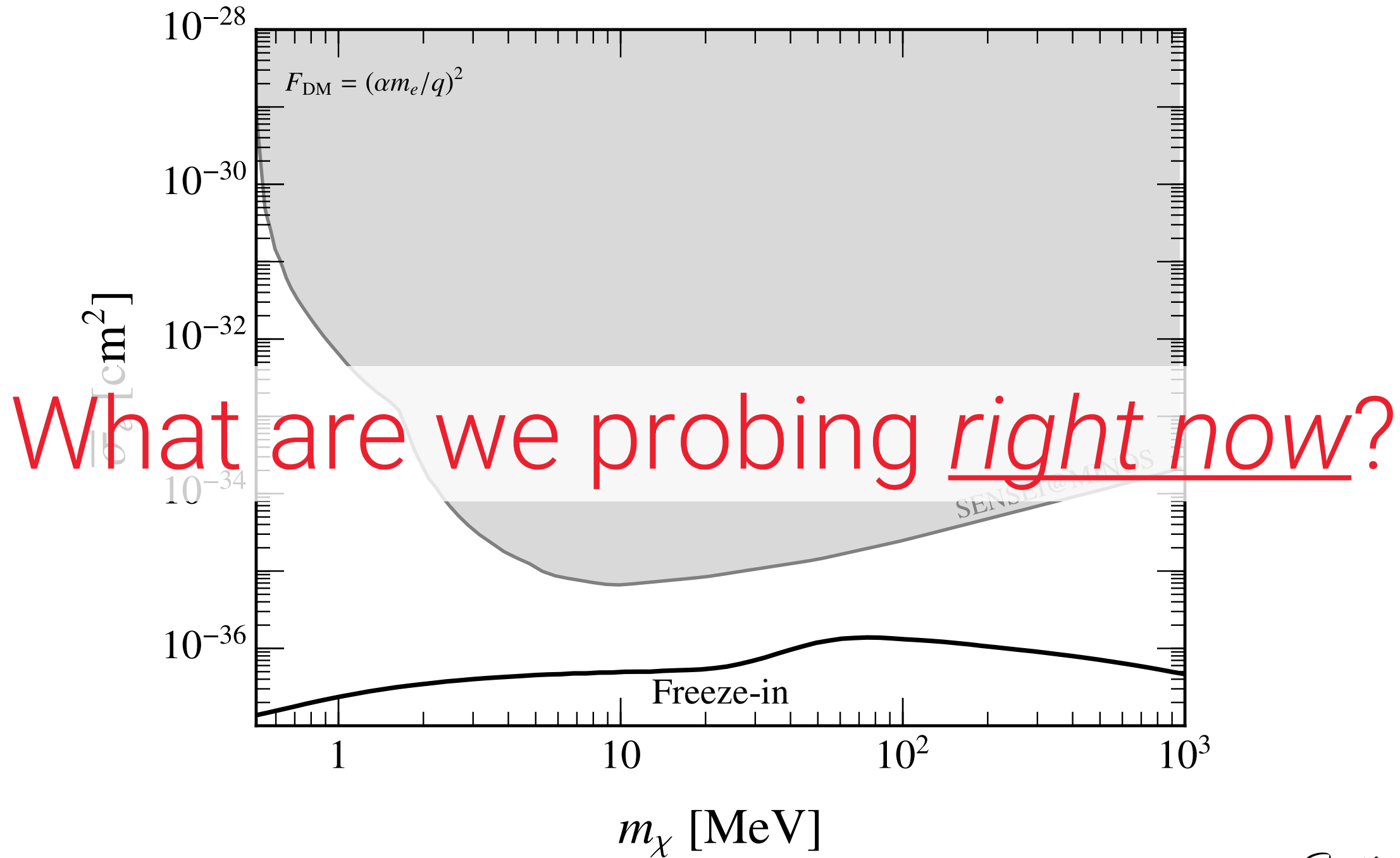


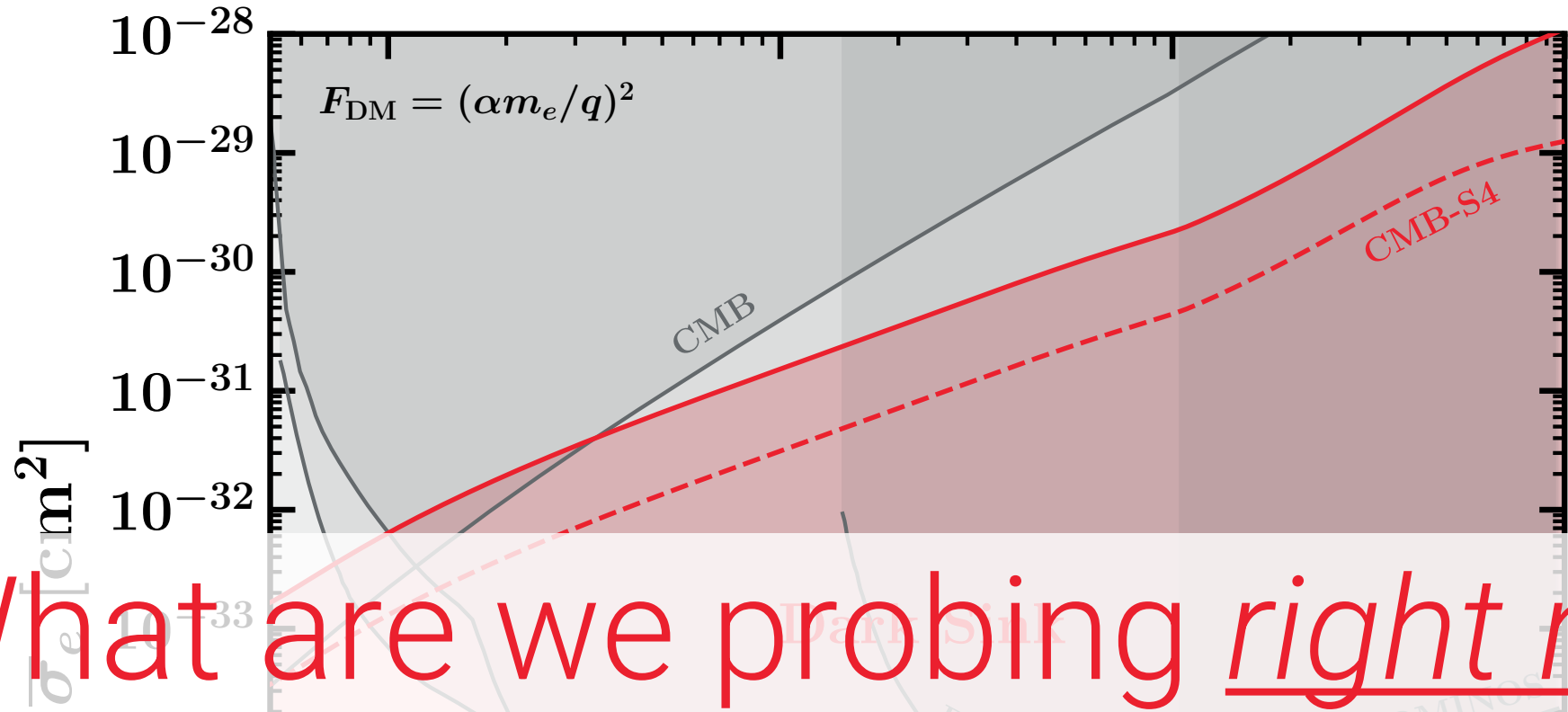
G. Belanger, A.
Mjallal, A. Pukhov
Eur. Phys. J. C 81
(2021) 239
[2003.08621]



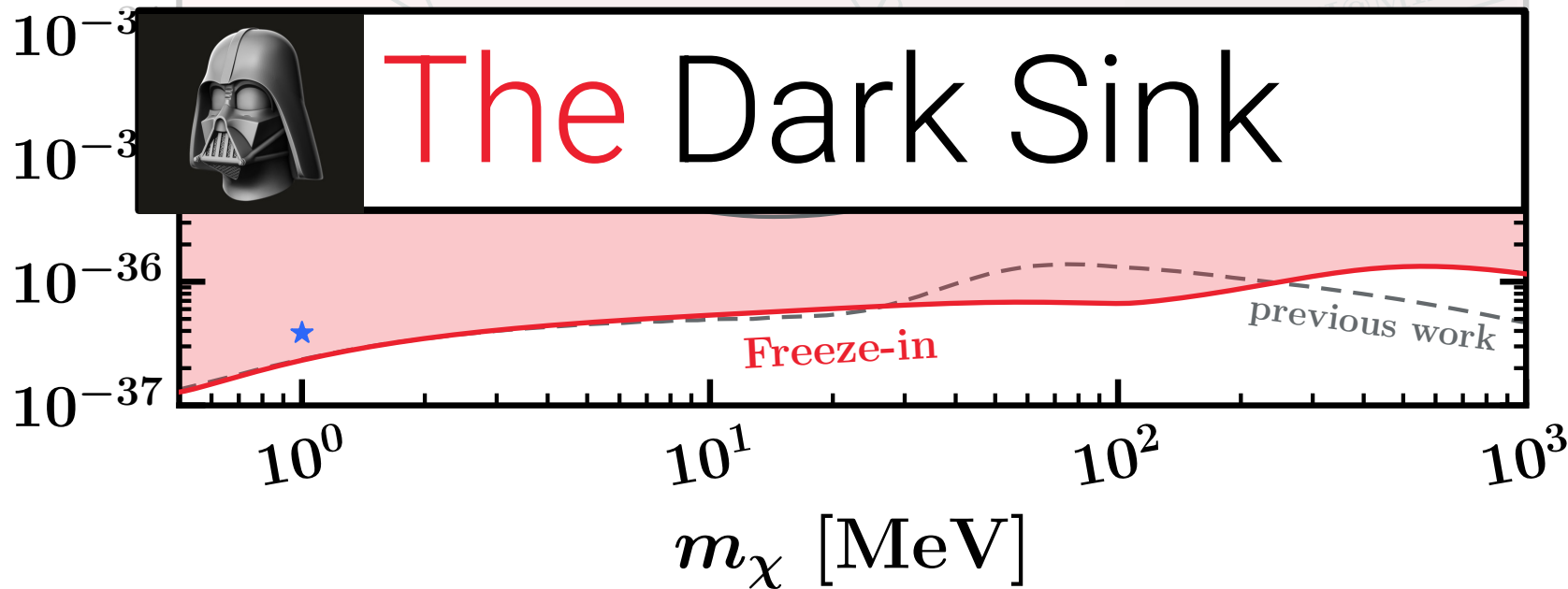
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What are we probing right now?





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Backup Slides

