

Primordial Black Holes as Silver Bullets for WIMPS

[arXiv:1905.01238](https://arxiv.org/abs/1905.01238)

Adam Coogan

With Gianfranco Bertone, Daniele Gaggero,
Bradley Kavanagh, Christoph Weniger

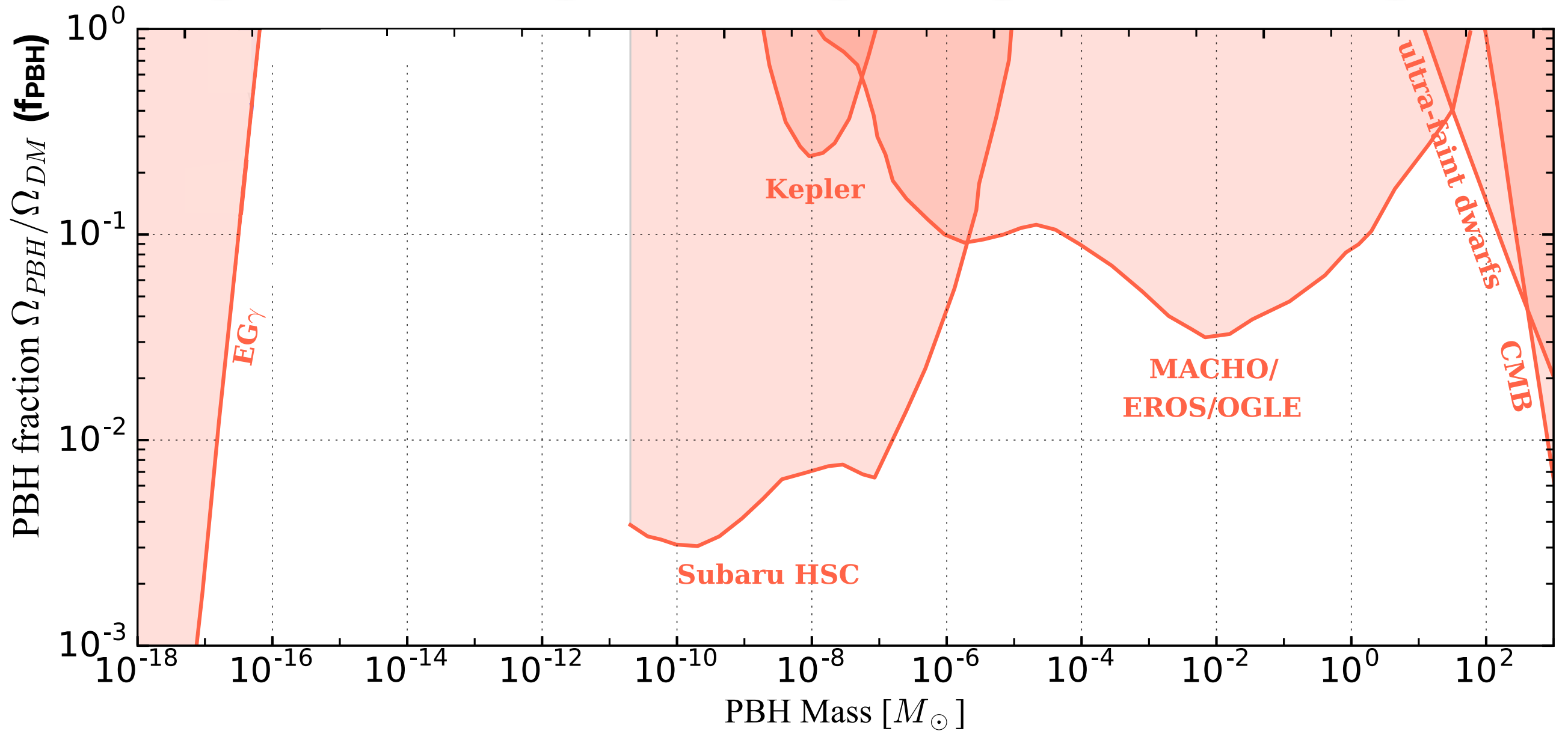


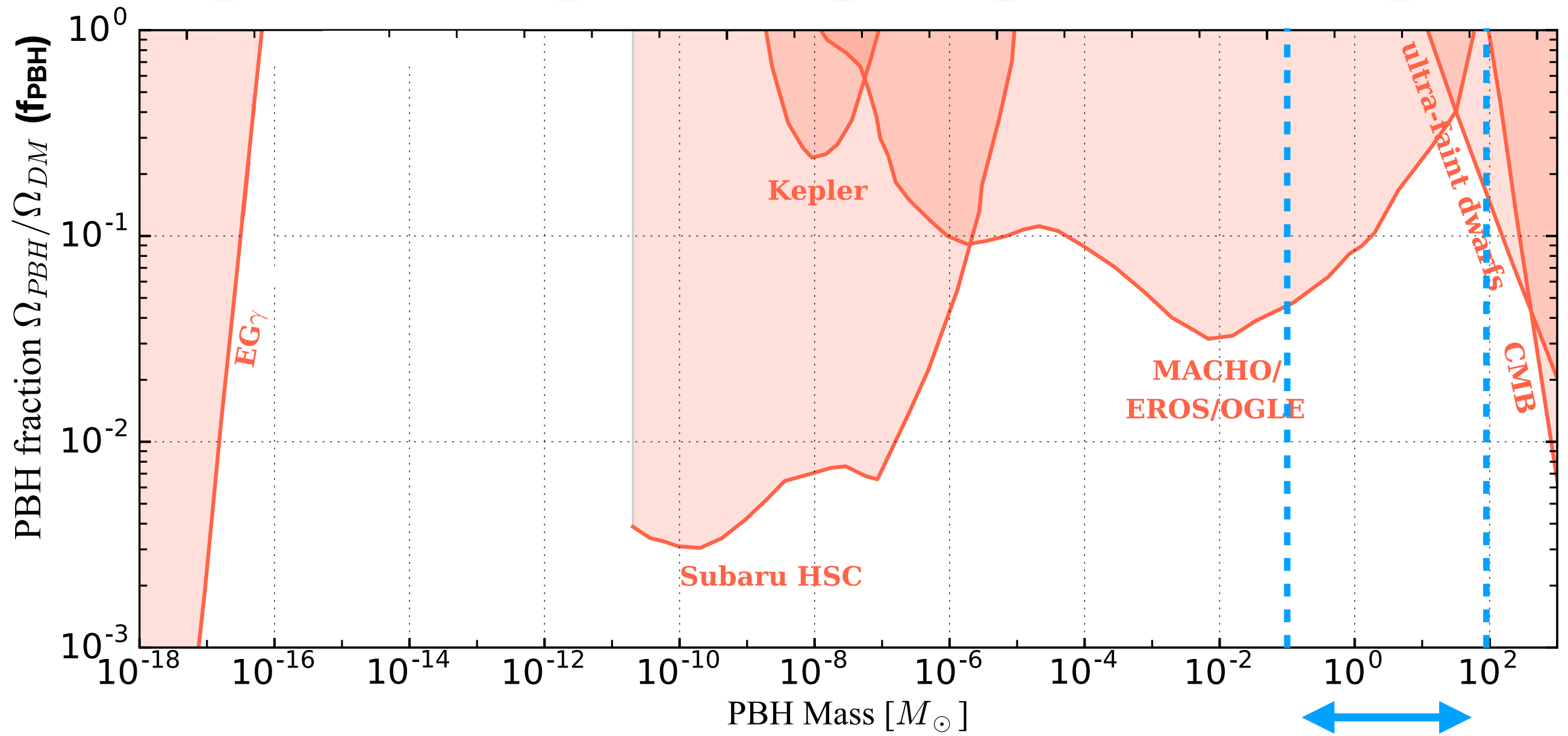
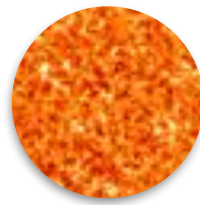
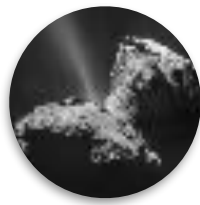
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OF AMSTERDAM

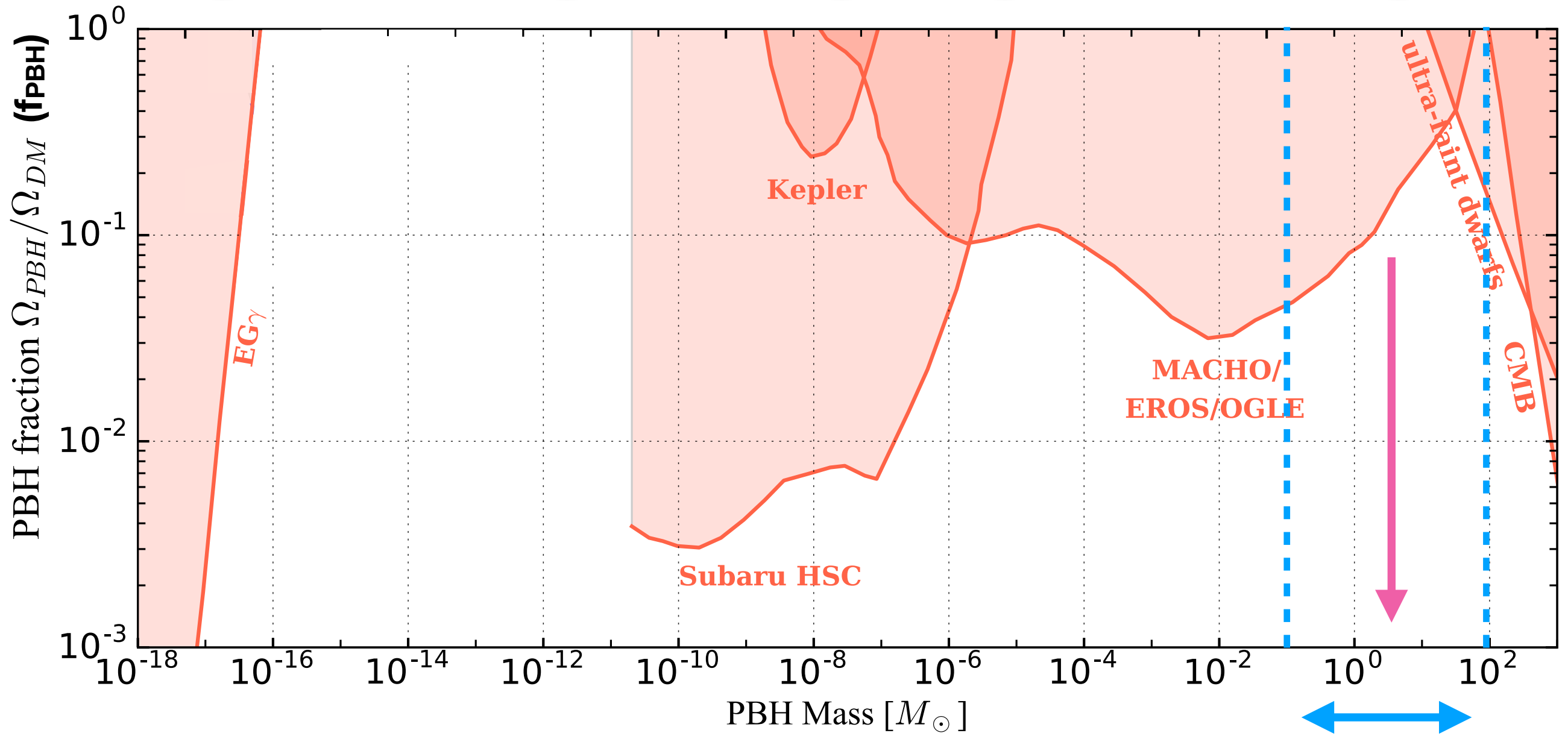
GRAPPA 

GRavitation AstroParticle Physics Amsterdam

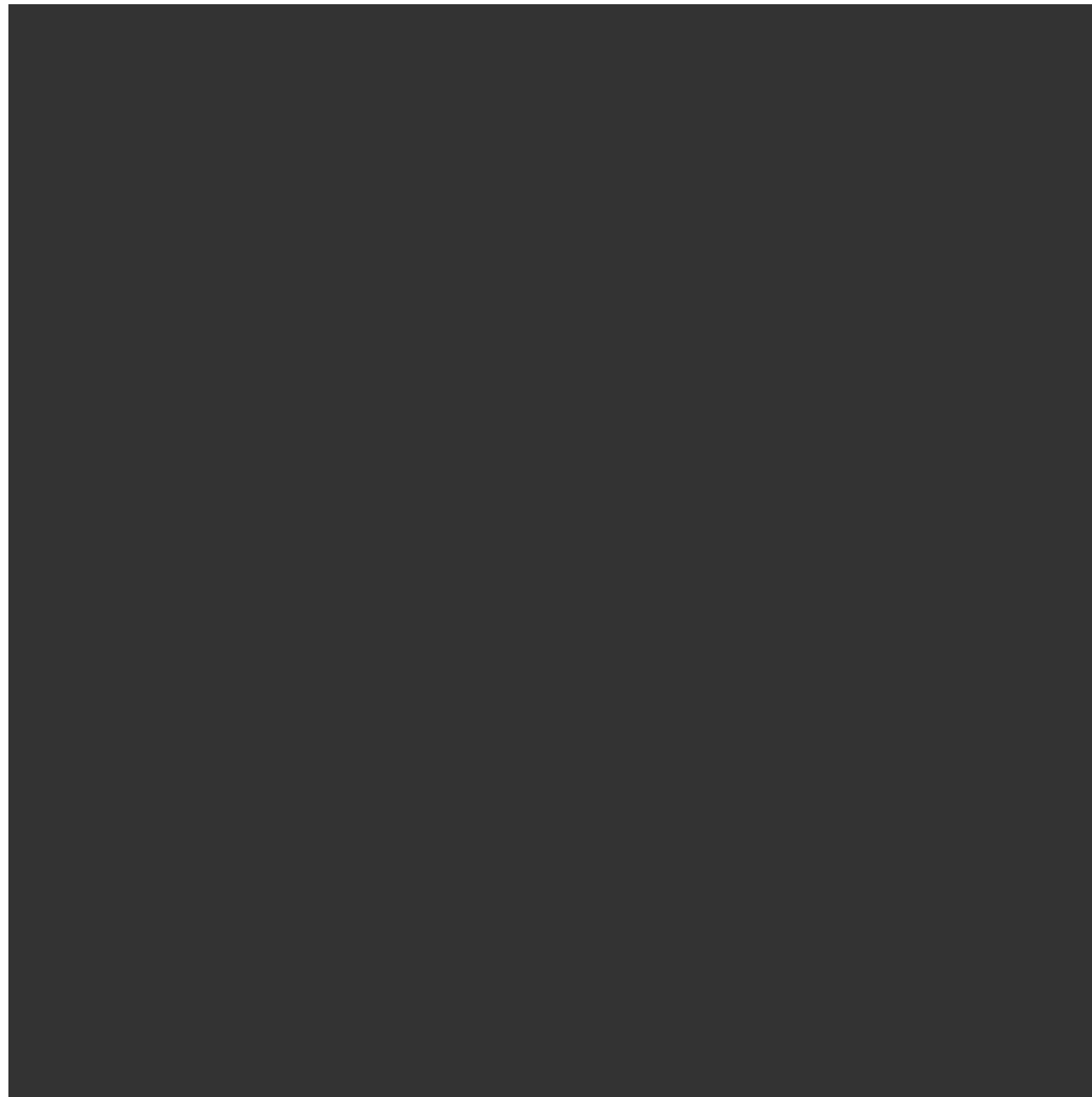






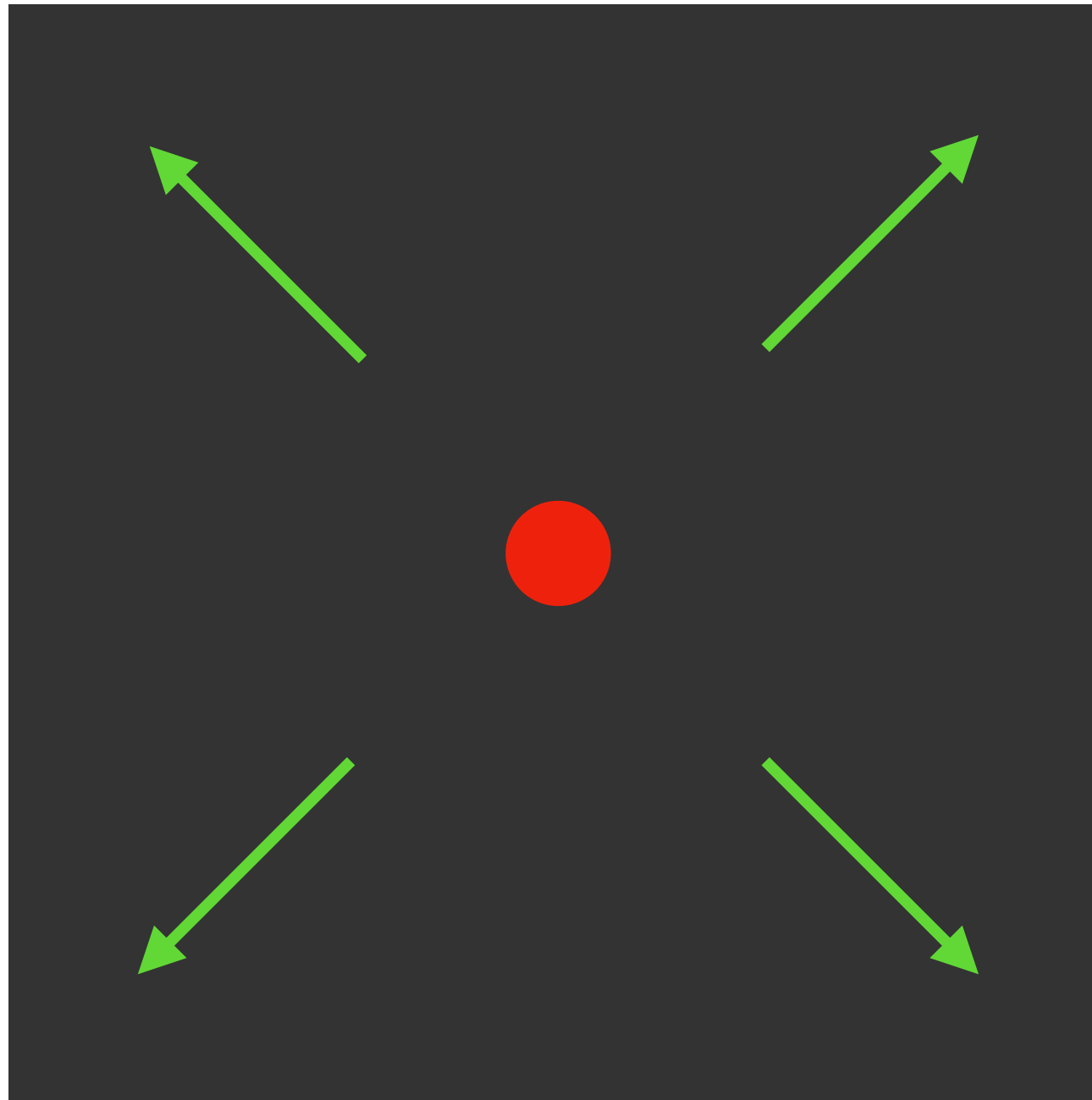


**In PBH + WIMP scenario,
PBHs accumulate halos**



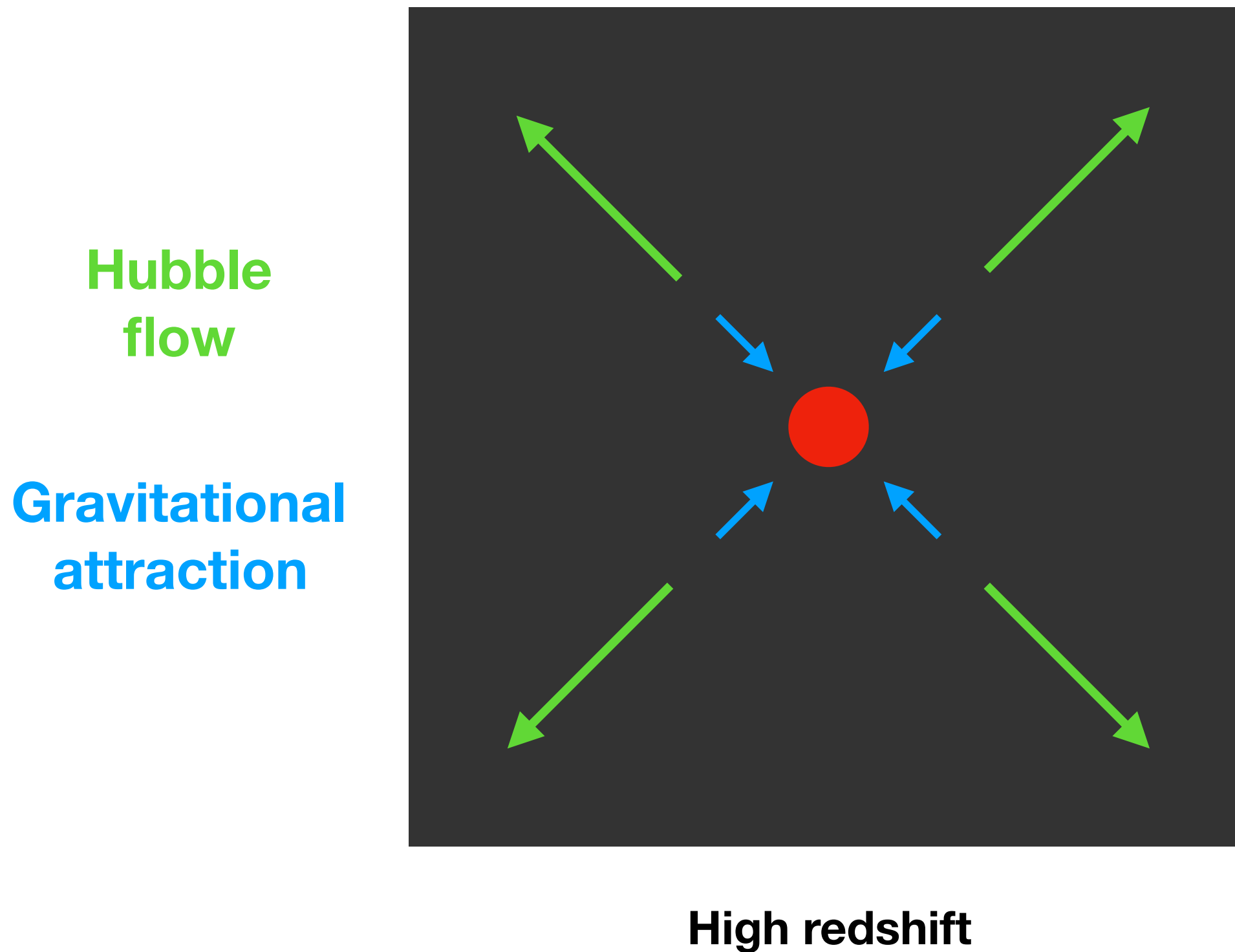
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Hubble
flow

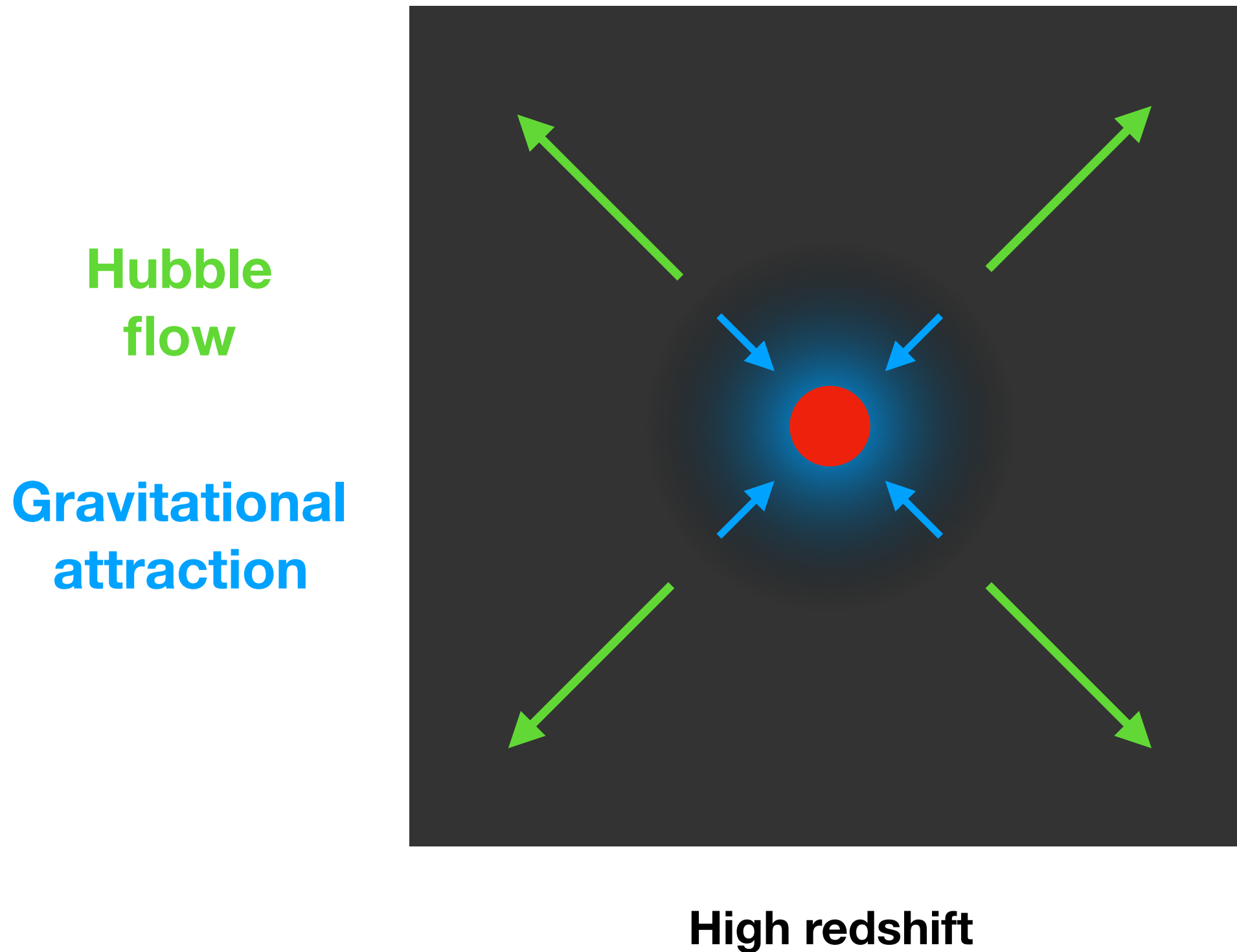


High redshift

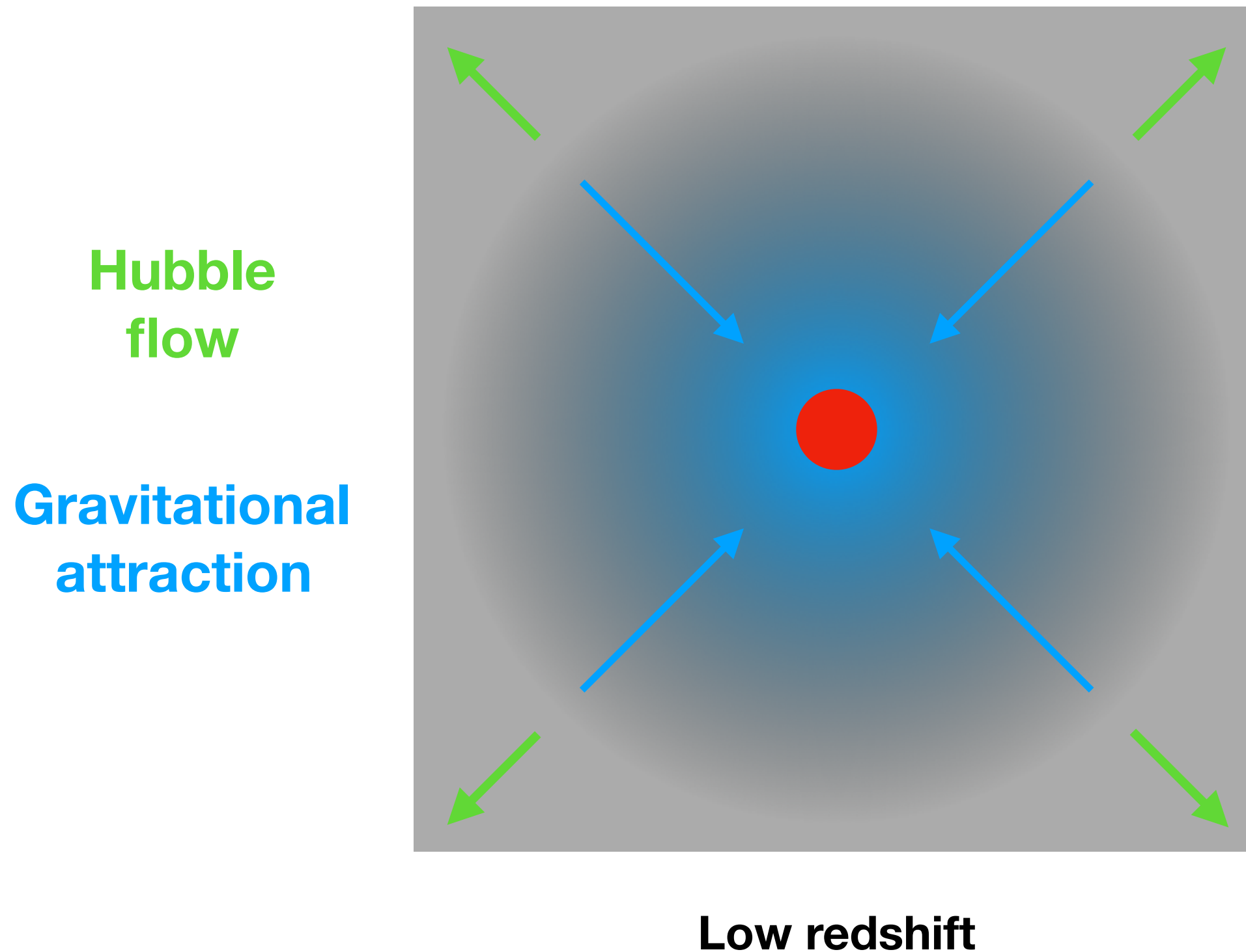
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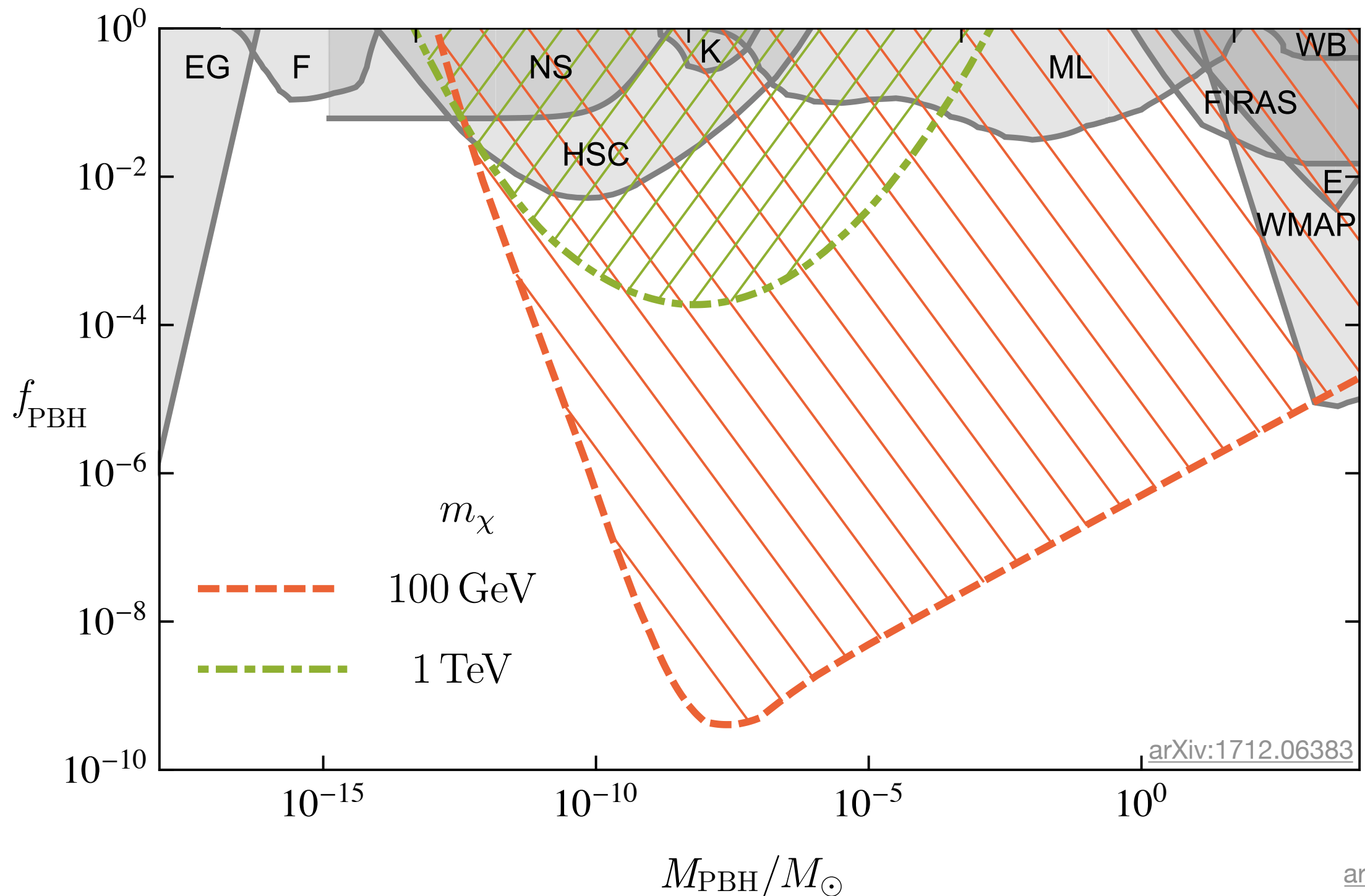
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Thermal WIMP \Rightarrow PBH constraint



arXiv:1712.06383

arXiv:1003.3466,
arXiv:1607.00612,
arXiv:1901.08528

PBH detection \Rightarrow WIMP constraint

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1. Detection scenario: M_{PBH} , N_{PBH}

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2. Infer **PBH** abundance f_{PBH}

PBH detection \Rightarrow WIMP constraint

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2. Infer **PBH** abundance f_{PBH}
3. For **WIMP** model (m_χ & final state),
constrain $\langle \sigma v \rangle$ with γ -ray observations

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$p(f_{\text{PBH}}|N_{\text{PBH}})$: depends on $\int dz$ (merger rate) \times (sensitivity)

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PBH merger rate

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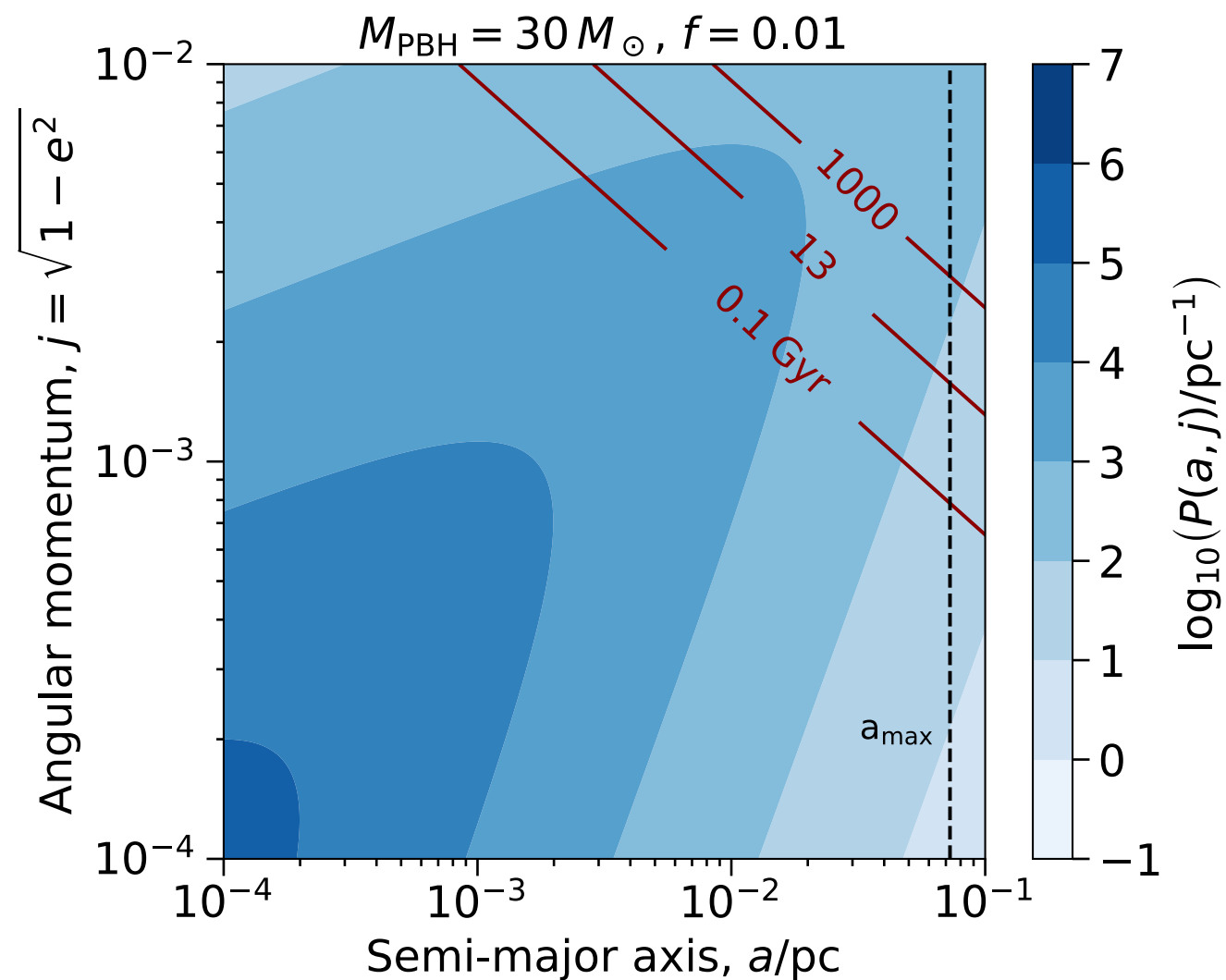
PBH merger rate

- Binaries form before z_{eq}

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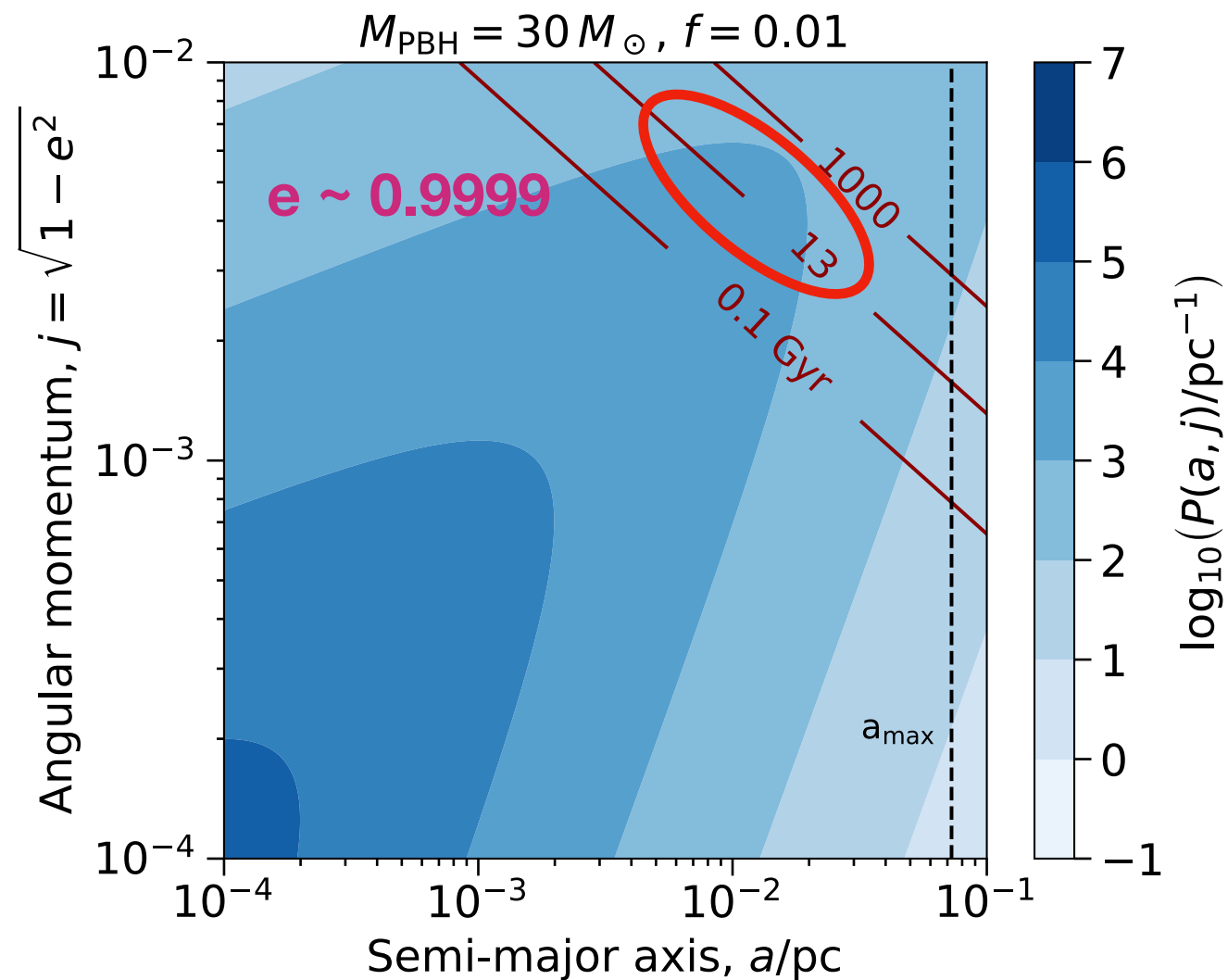
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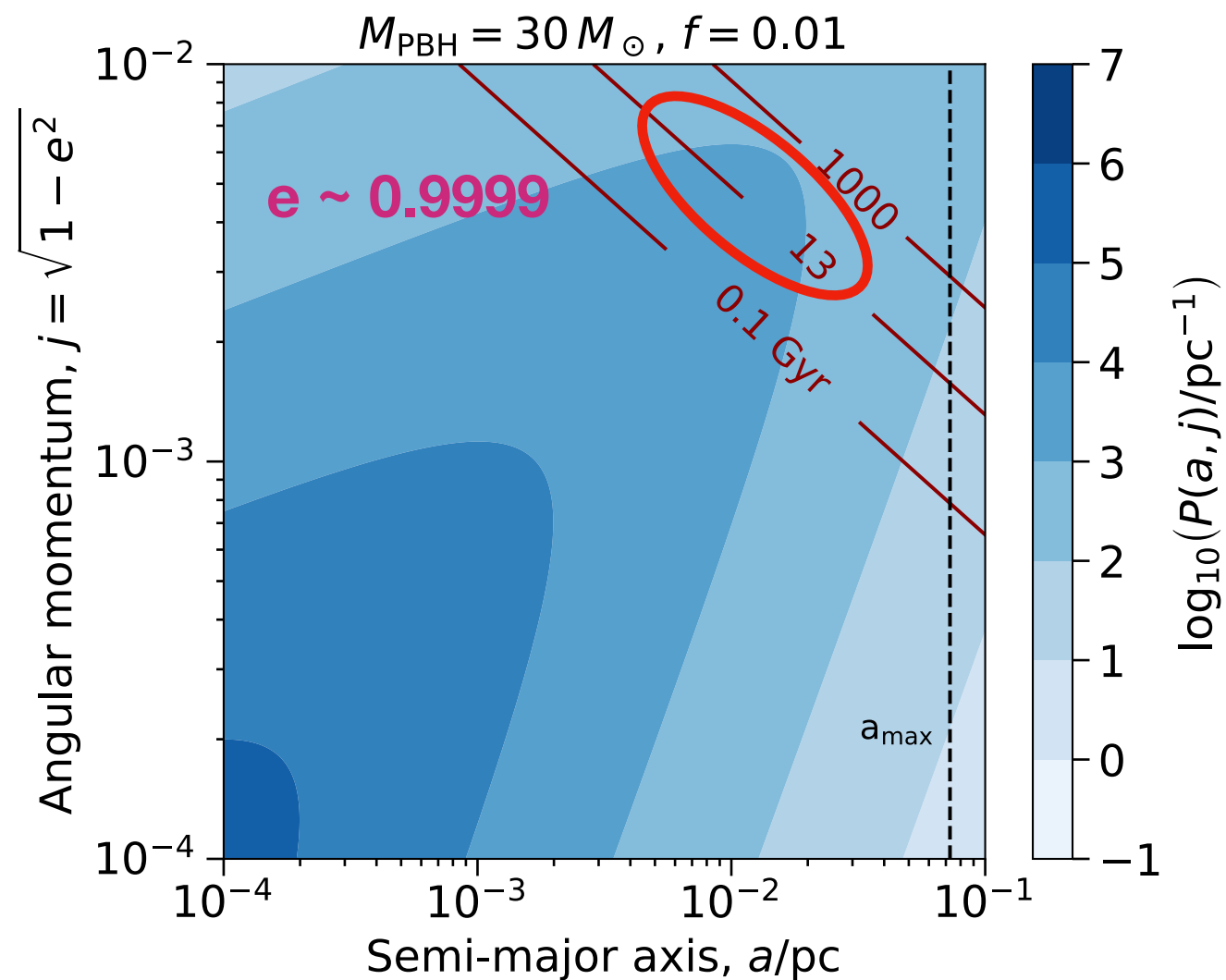
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PBH merger rate

- Binaries form before z_{eq}
- Need to account for torques from **all** other PBHs, density perturbations
- Close, eccentric binaries merge today
- Full calculation accounts for the WIMP halo



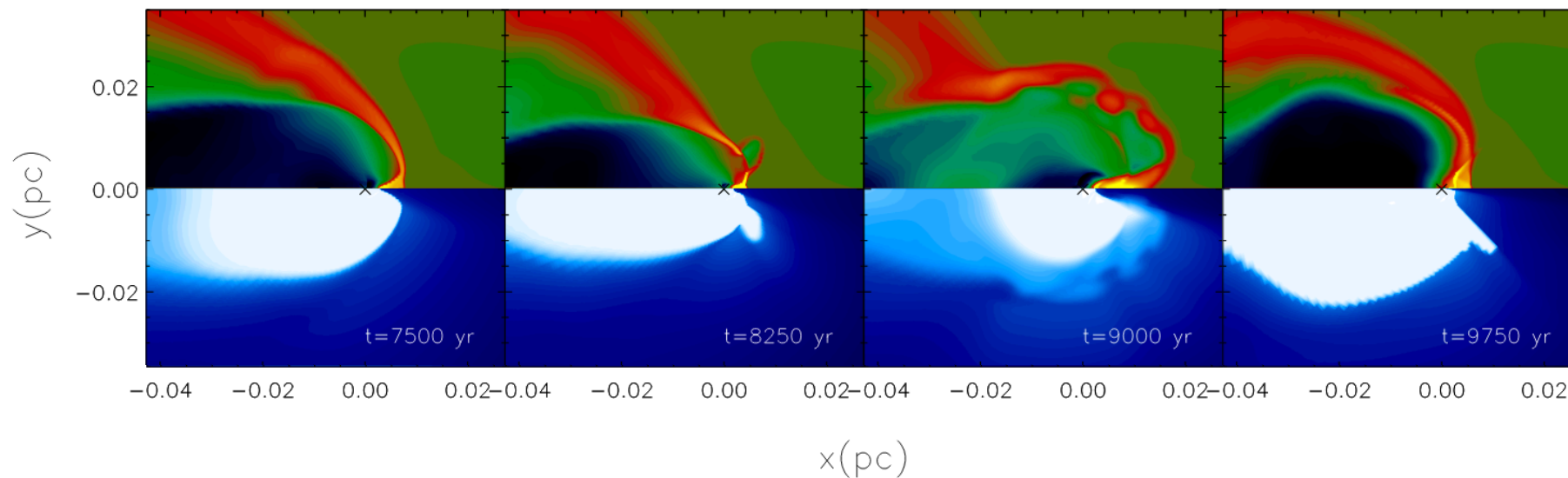
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- *Square Kilometer Array* detects radio emission from gas accretion by **100 M_{\odot}** galactic PBHs

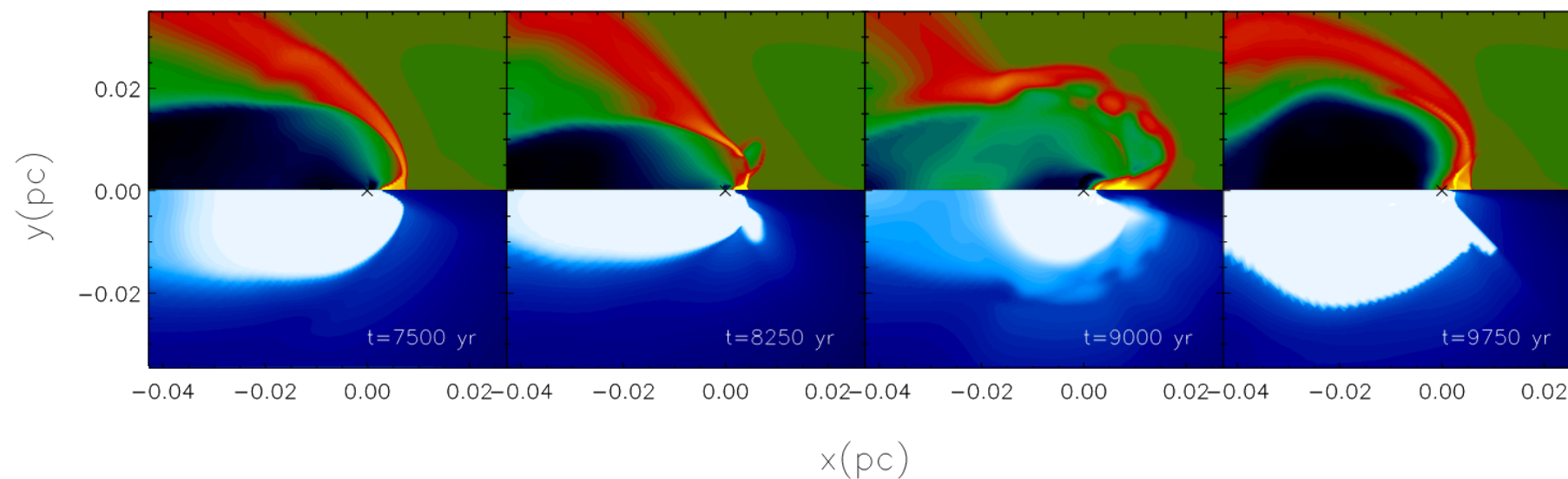
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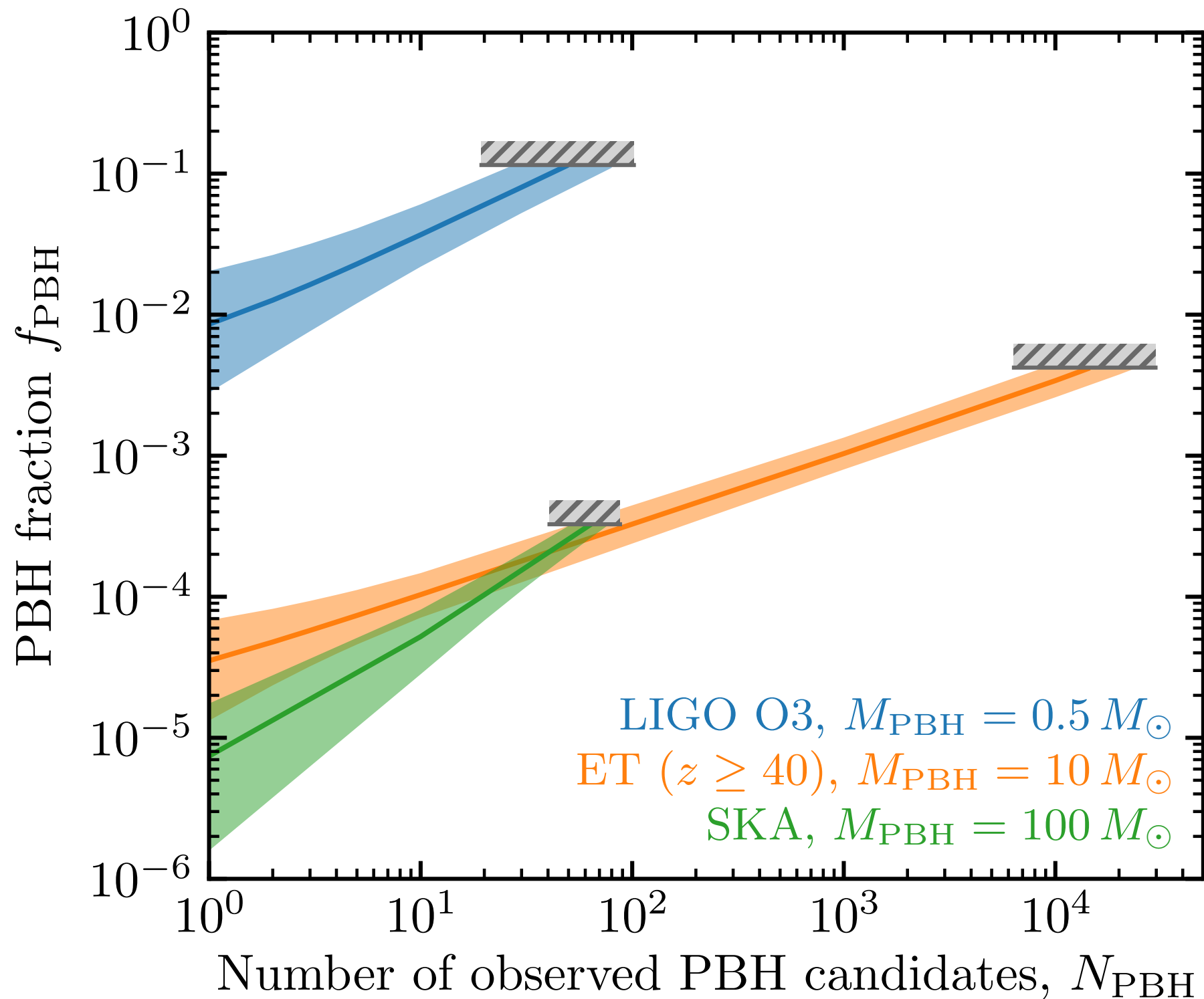
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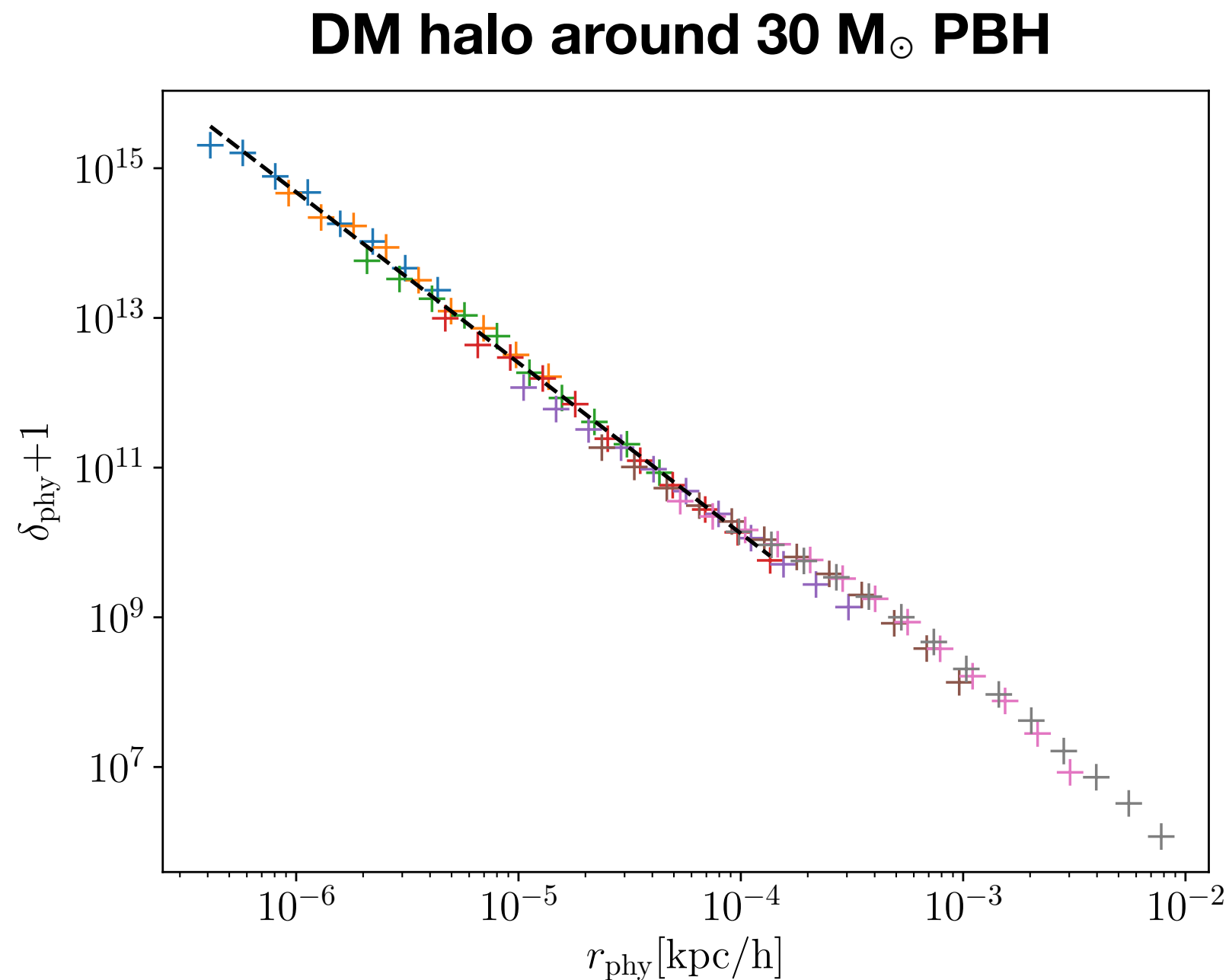


Compute $p(f_{\text{PBH}}|N_{\text{PBH}})$ with Monte Carlo simulation

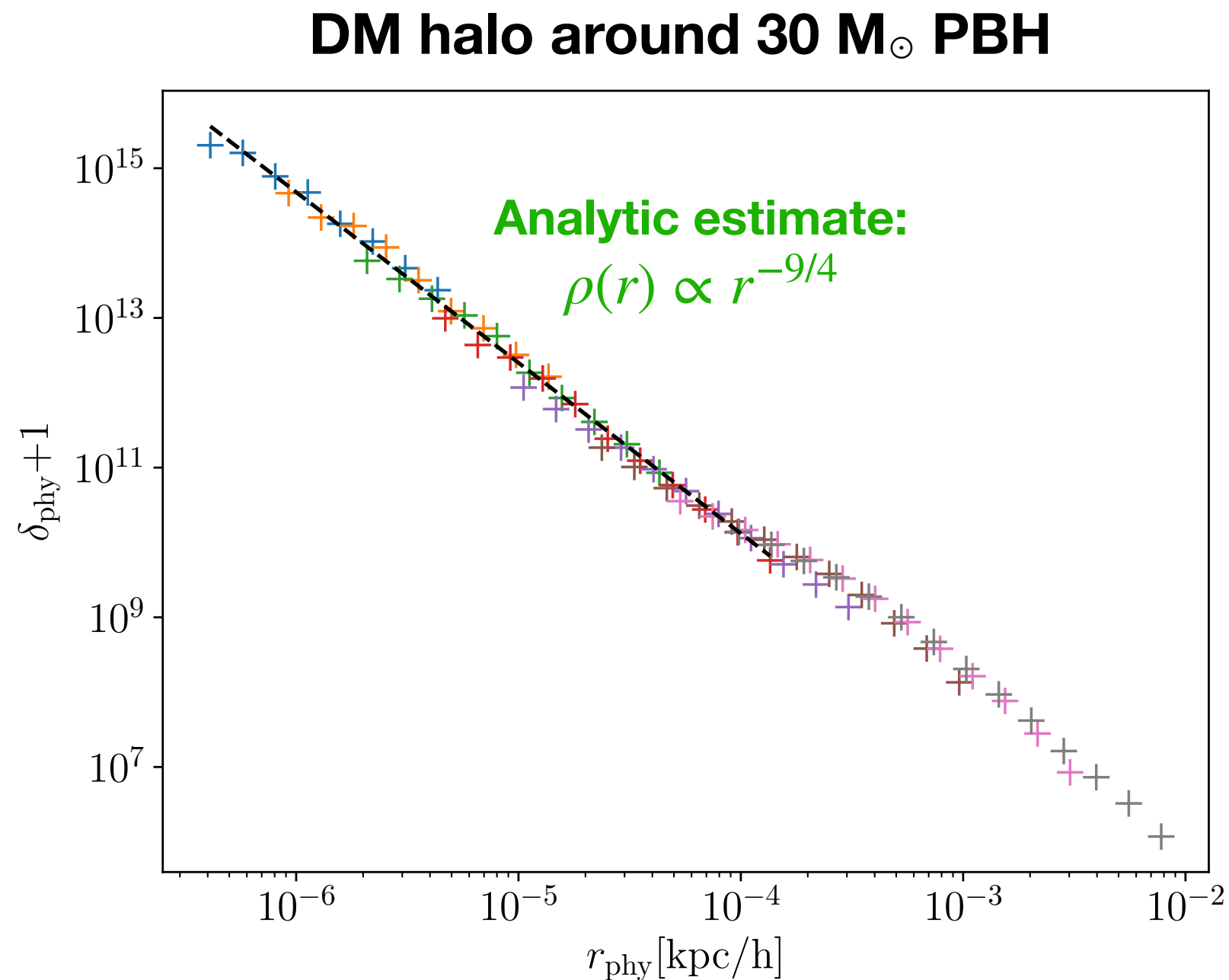
2. Detection \rightarrow abundance



3. Ann. rate around PBH

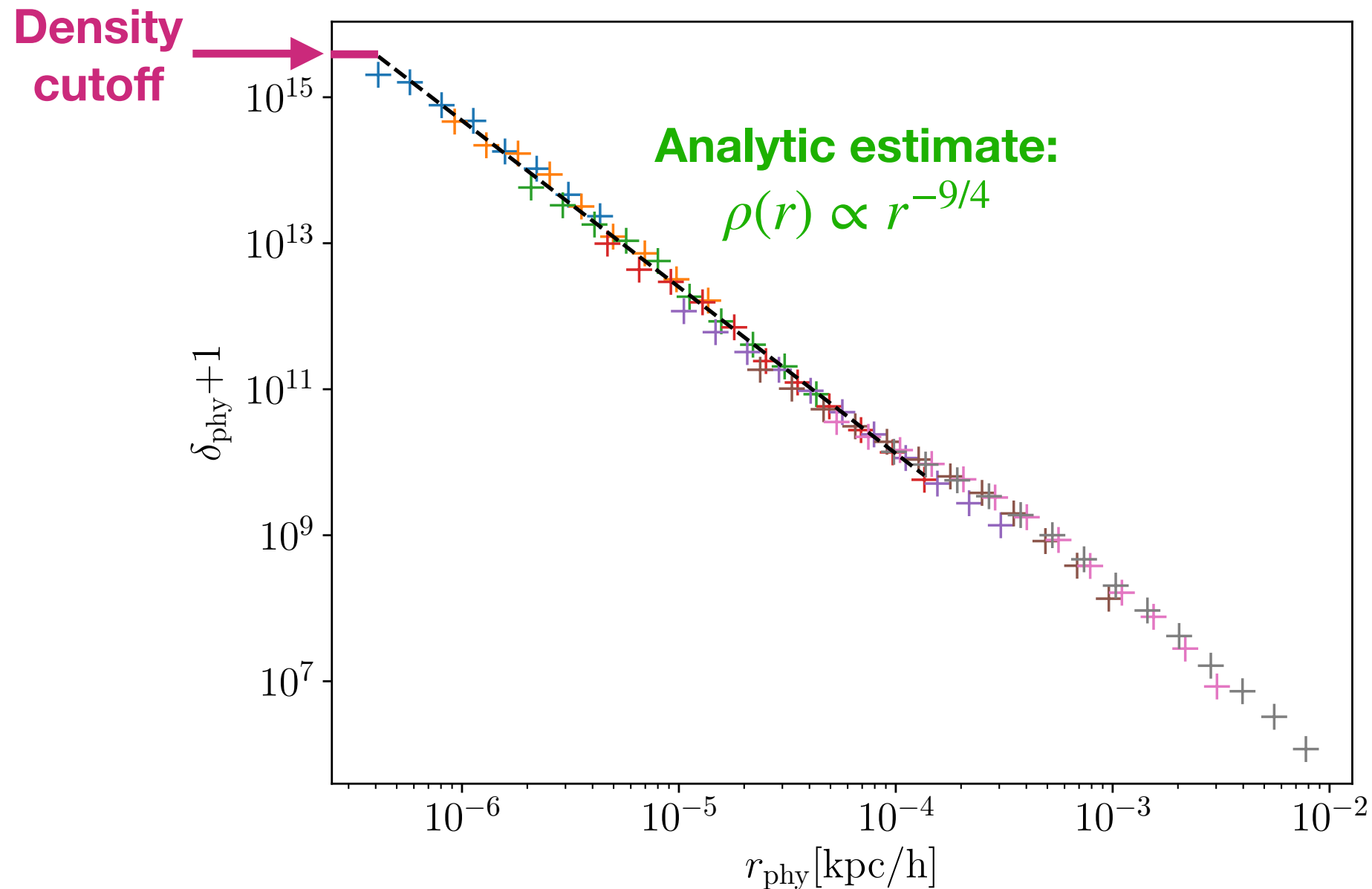


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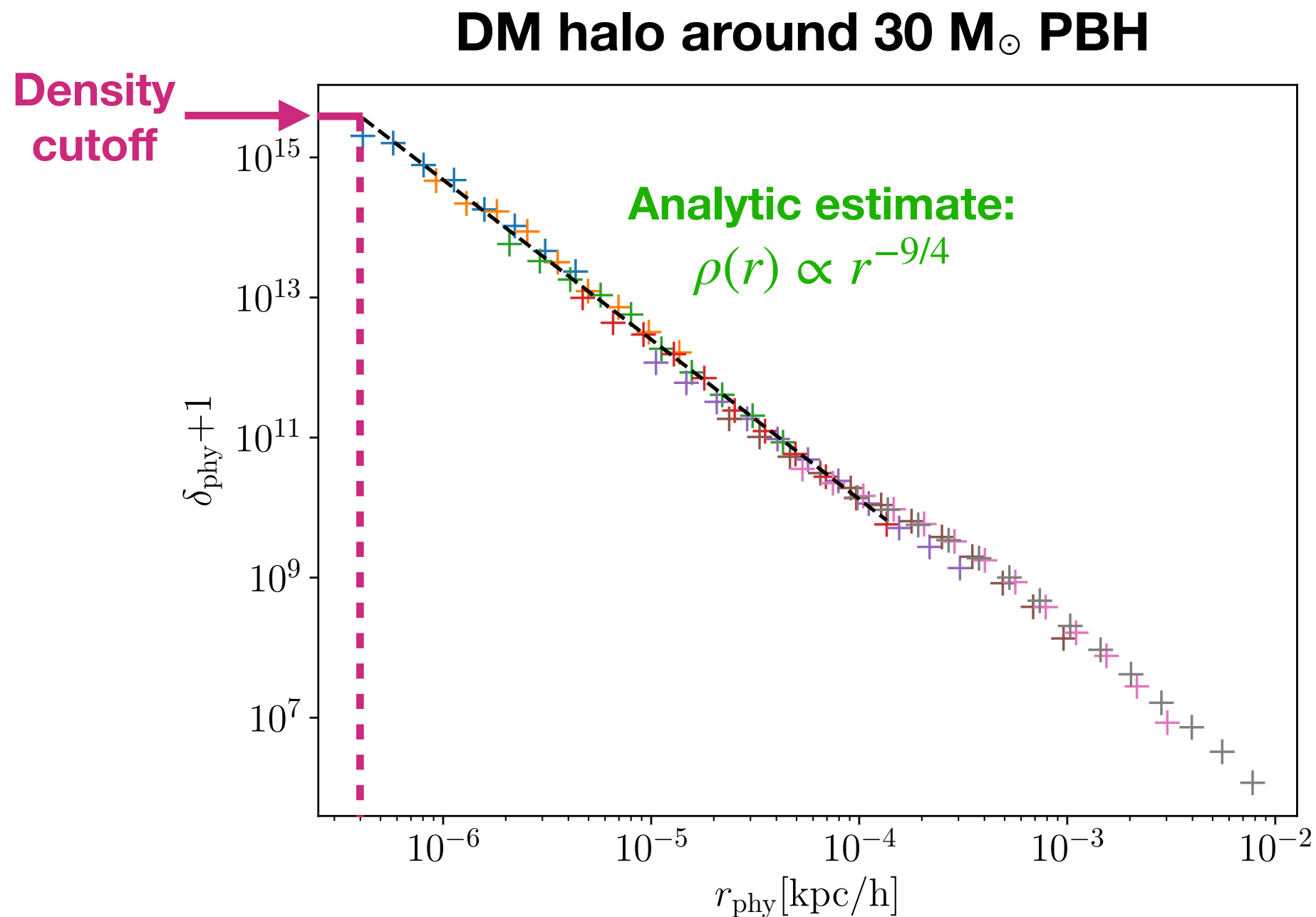


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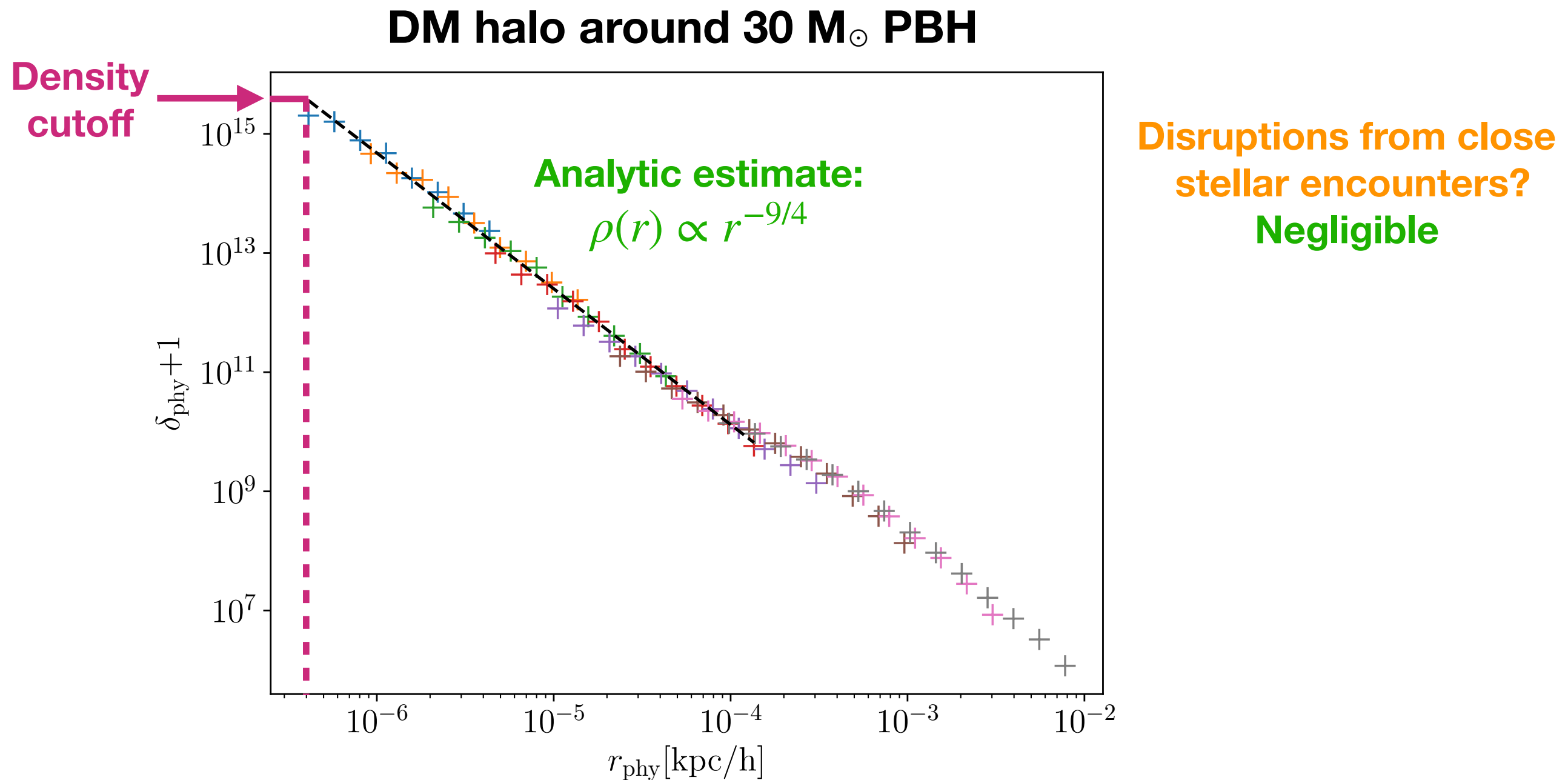
DM halo around 30 M_{\odot} PBH



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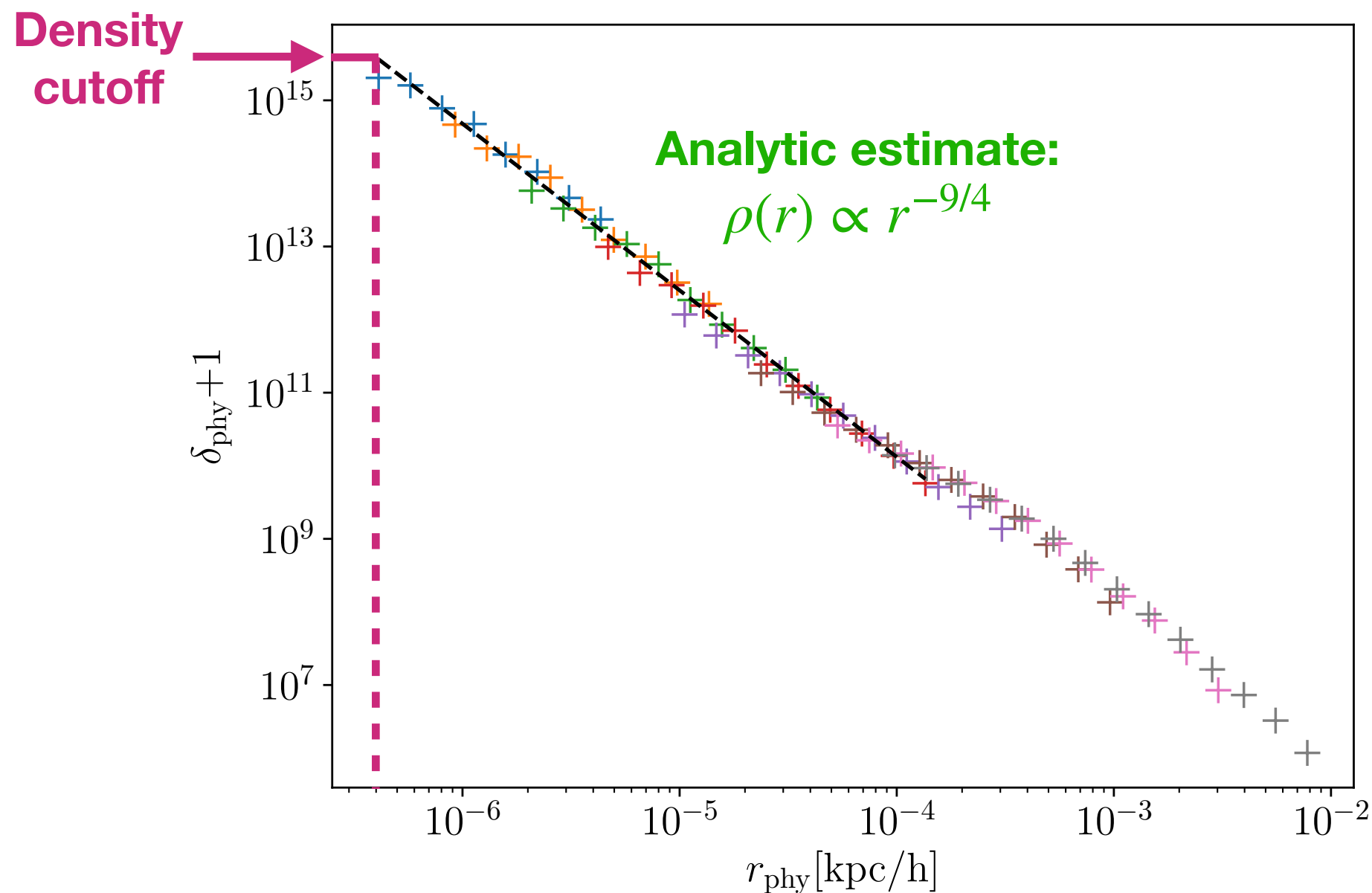


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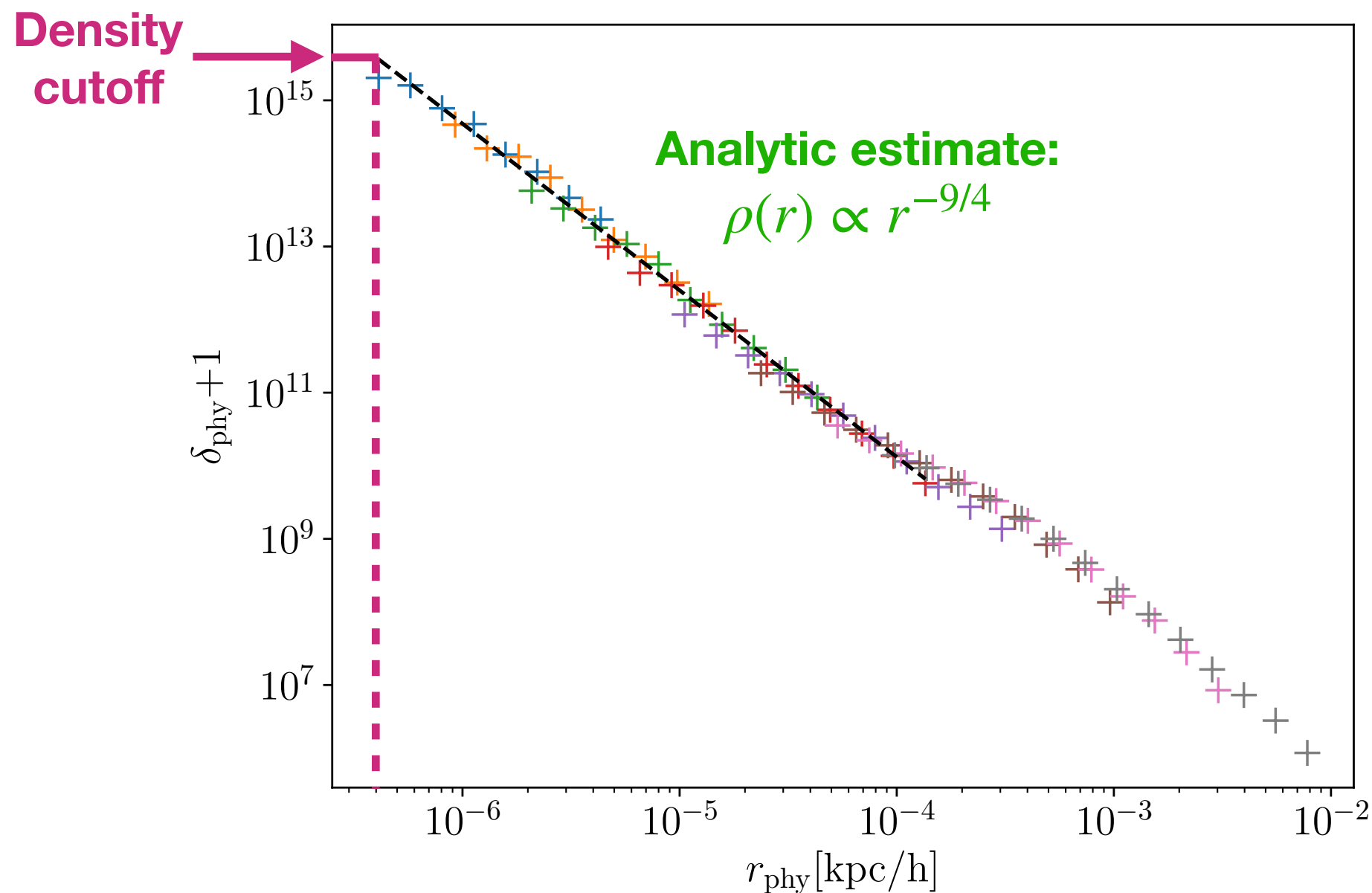


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Negligible

Tidal disruption by
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Can now compute gamma-ray flux from PBH's halo!

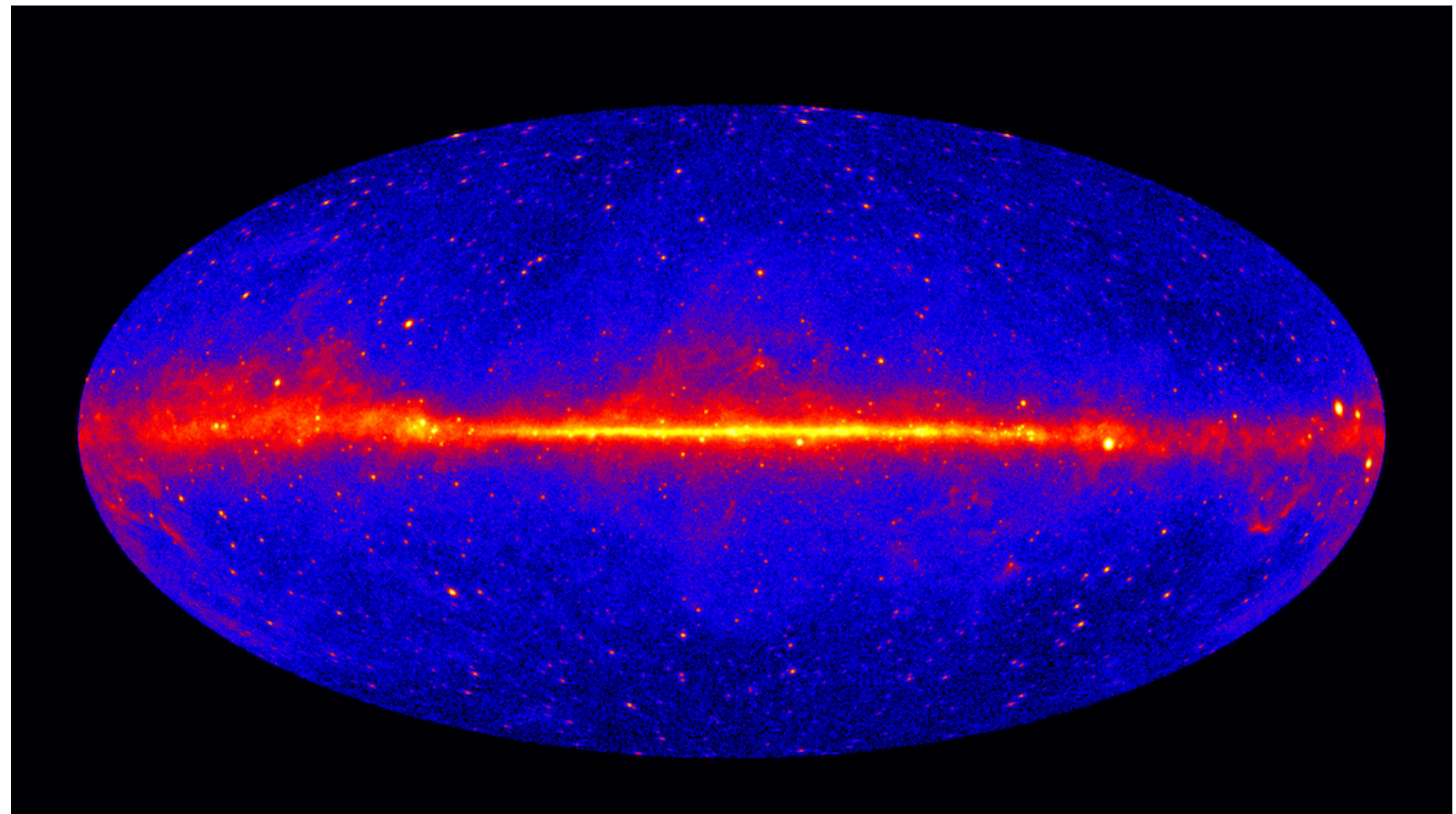
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Constraint: PBH halos as γ -ray *galactic point sources*

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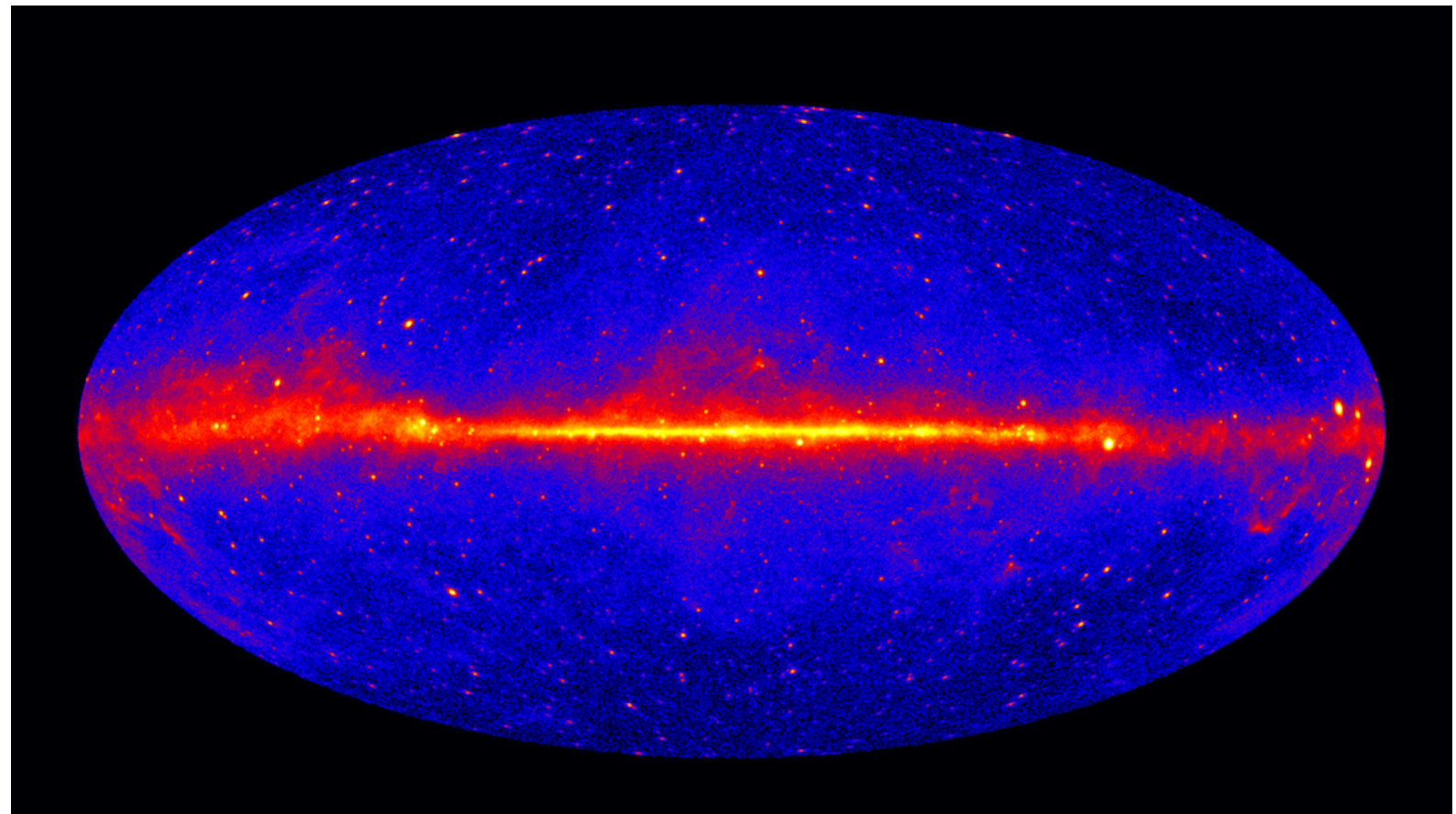
Fermi/NASA

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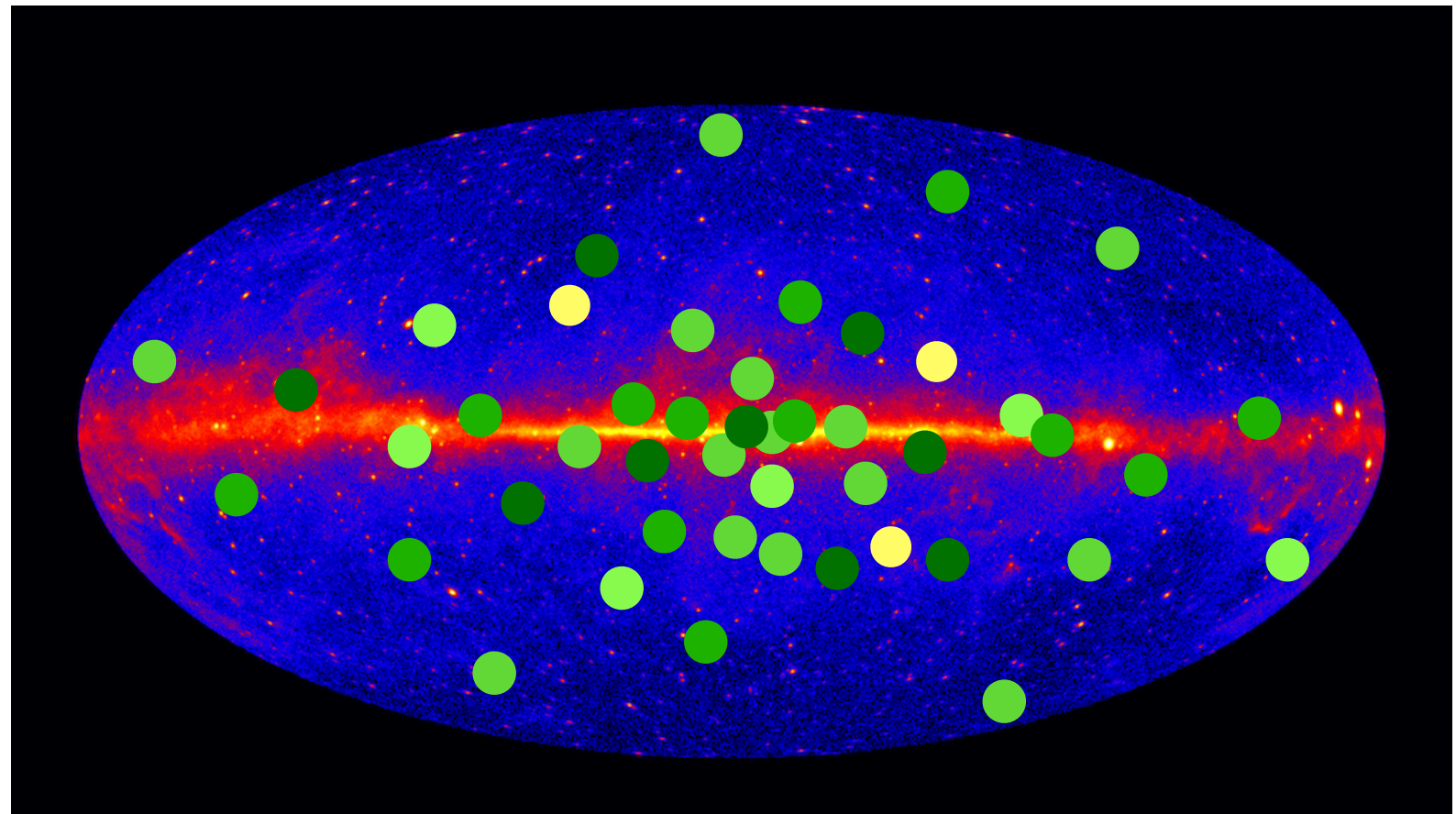
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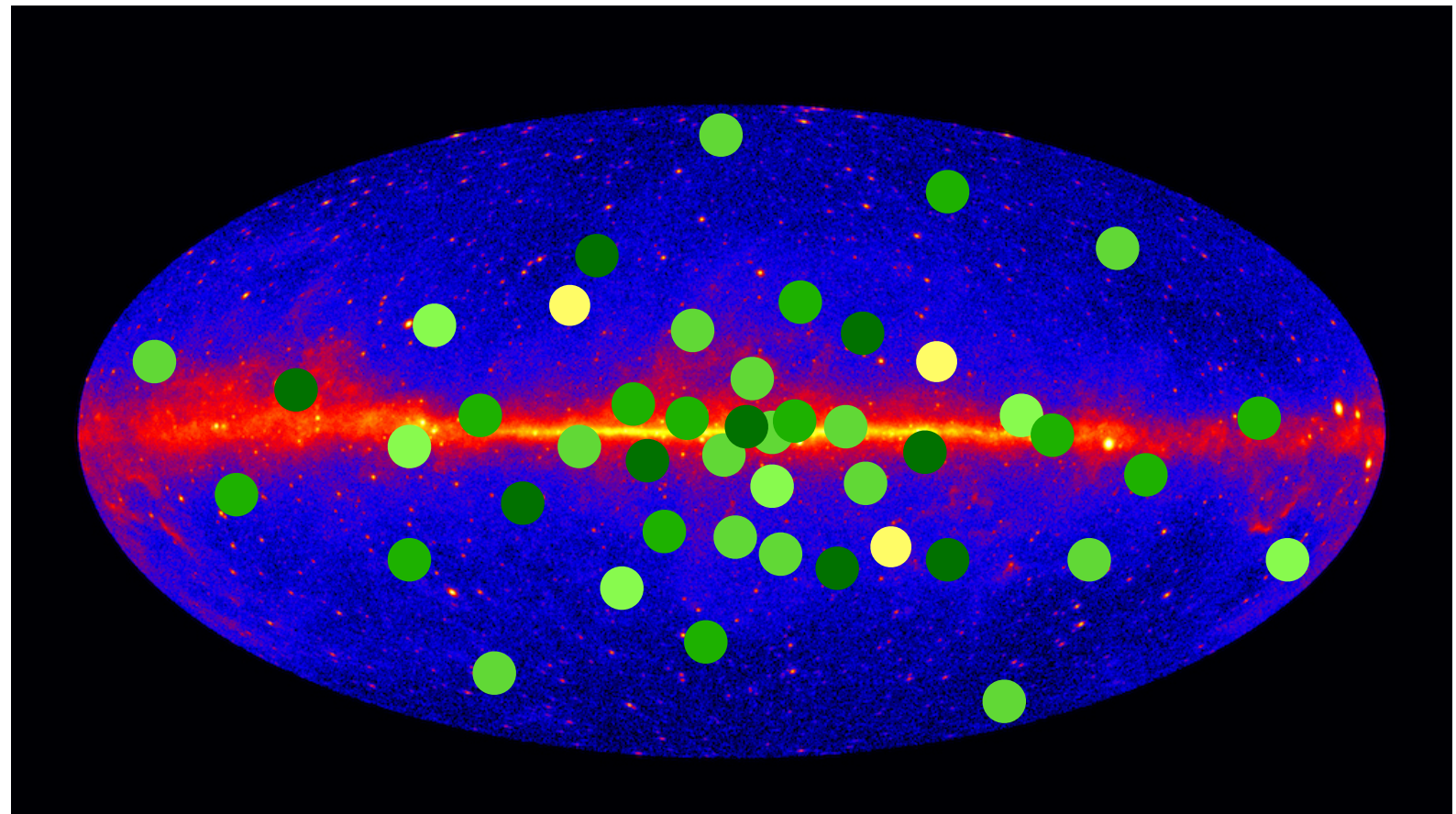
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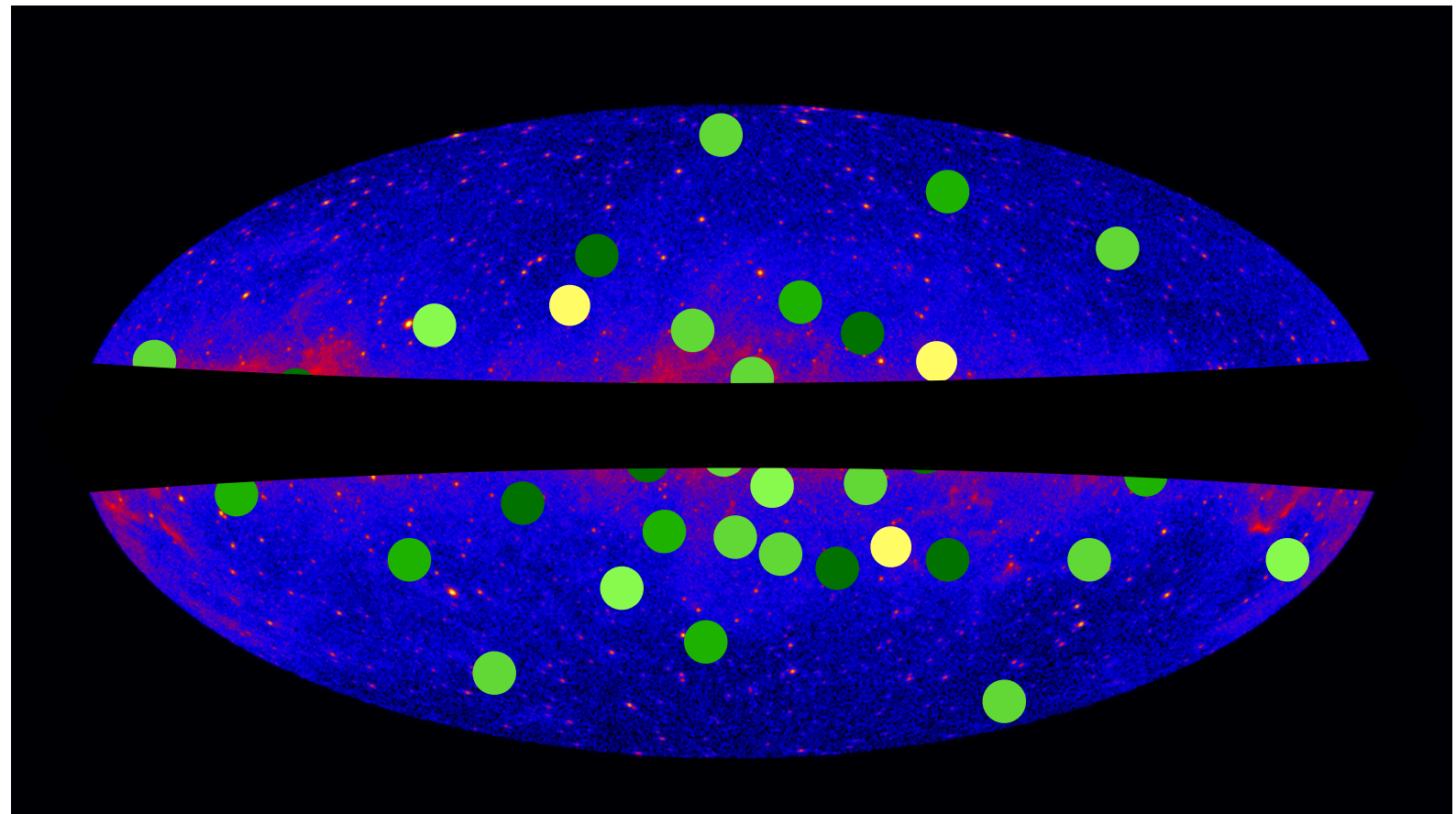
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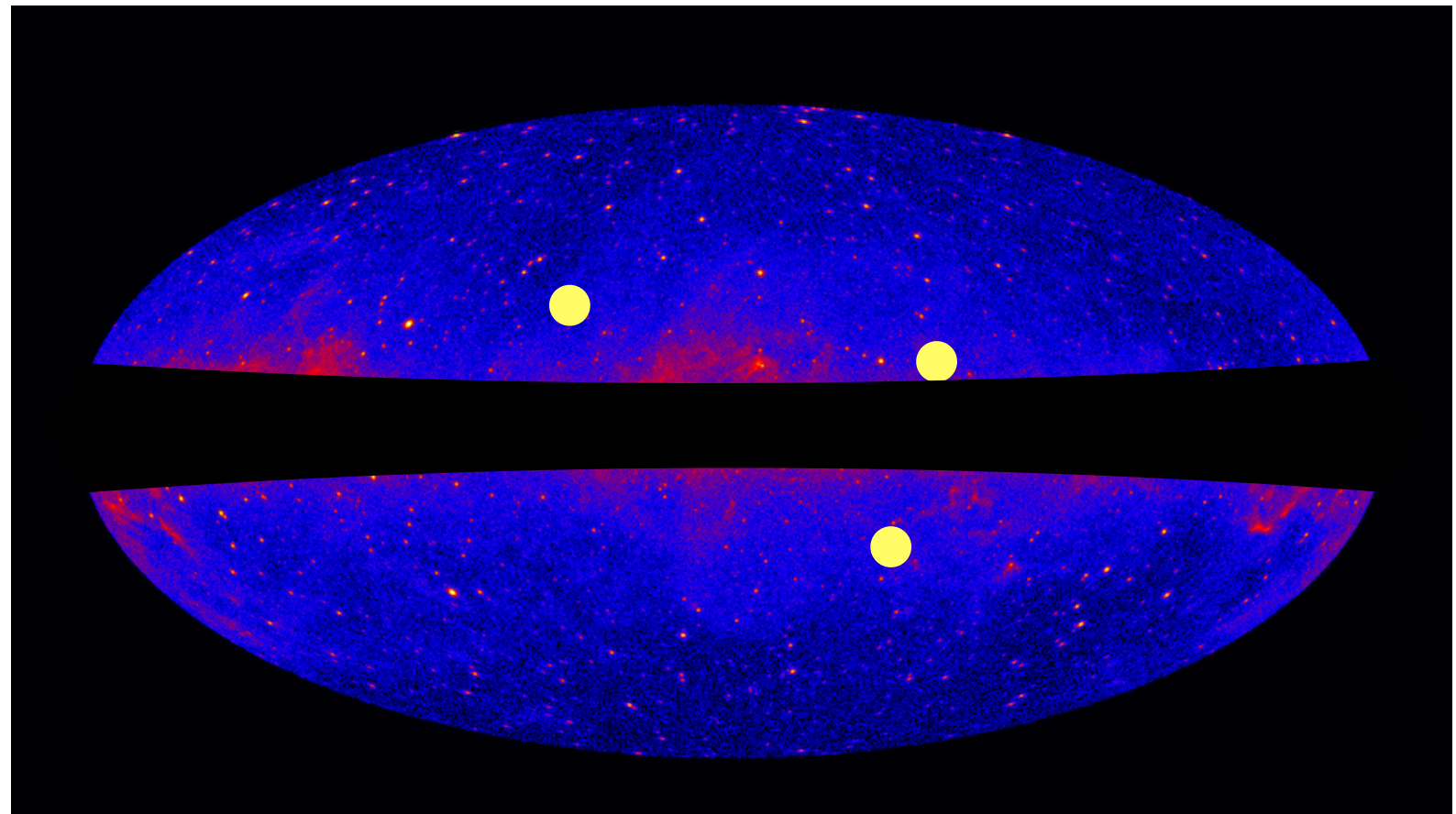
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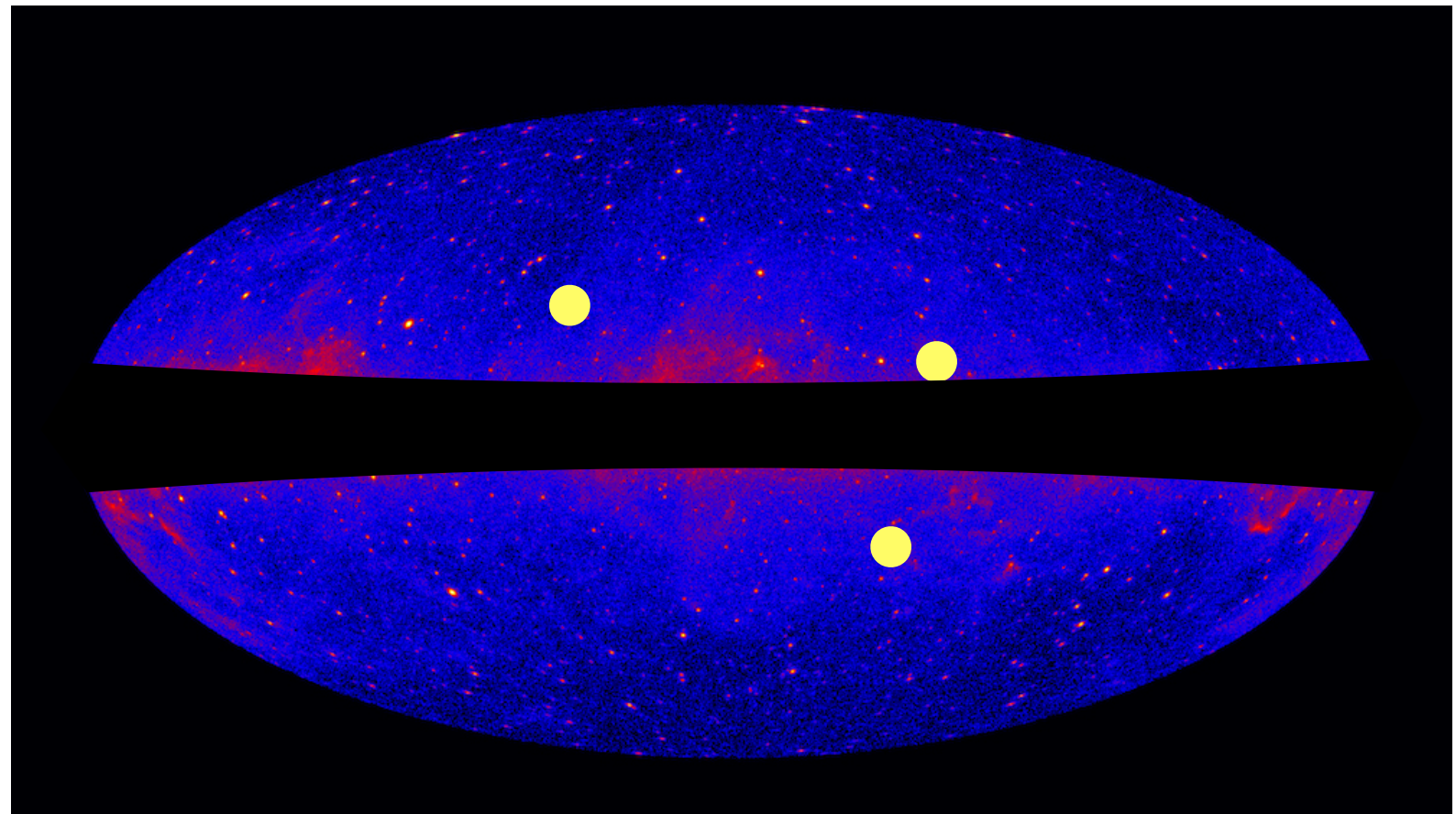


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Fermi/NASA

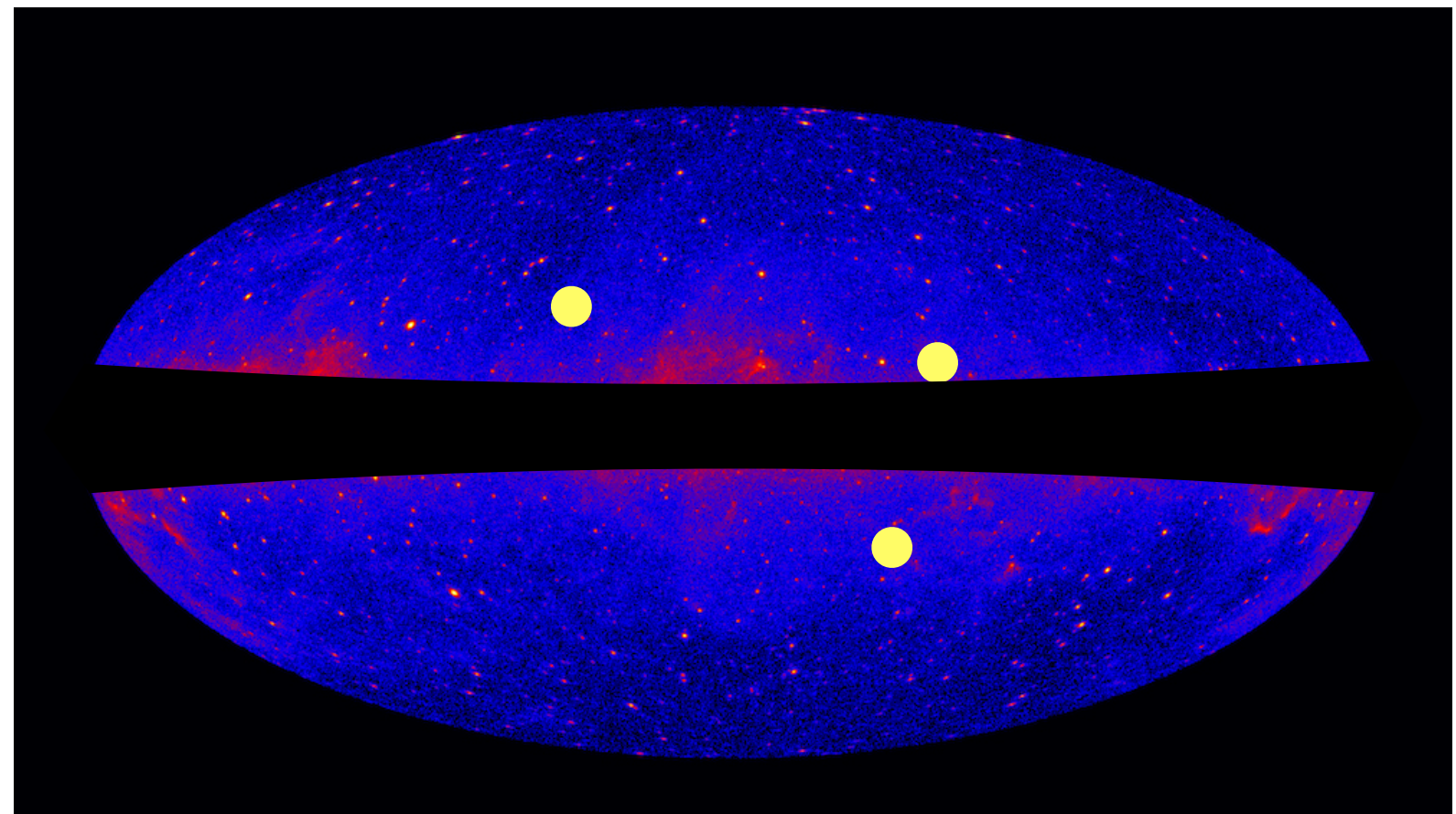
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Number of 3FGL unassociated
sources compatible with
DM annihilation



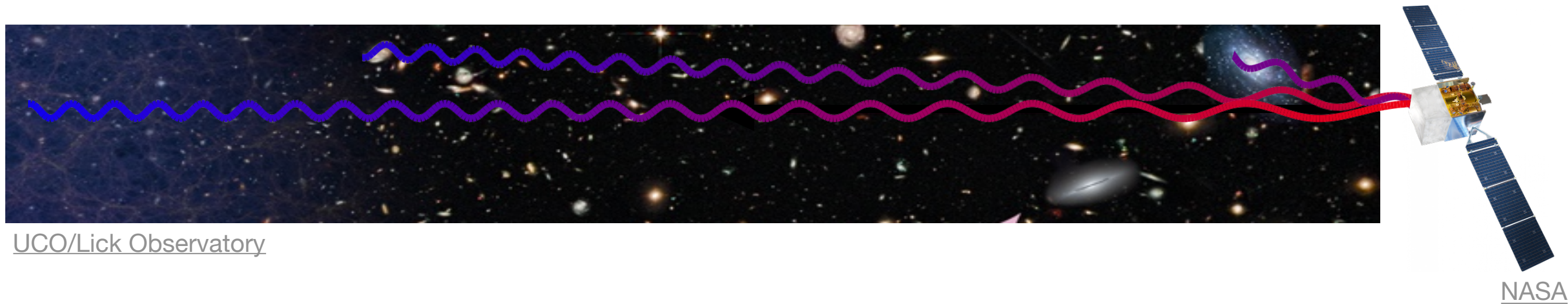
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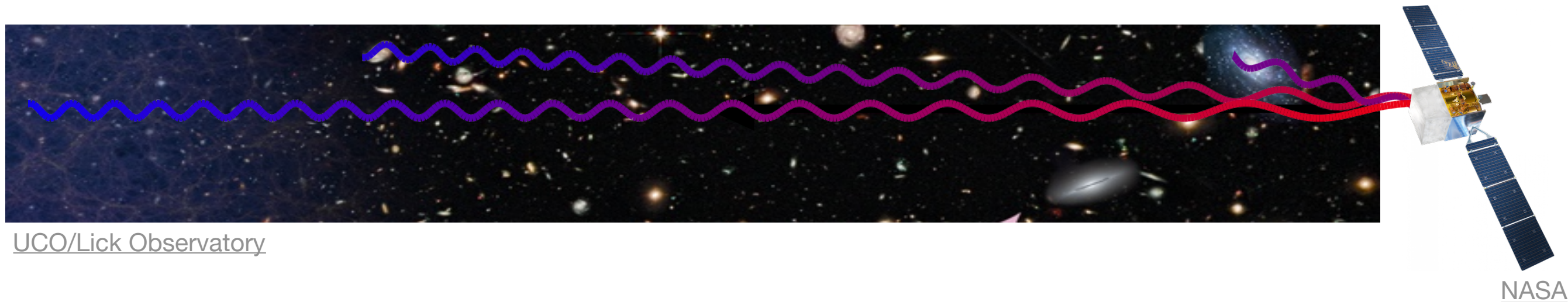
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Ingredients: *Ann. spectrum*
from PBH halo

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Ingredients: *Ann. spectrum* *Cosmological*
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UCO/Lick Observatory

NASA

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Attenuation

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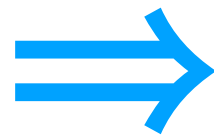
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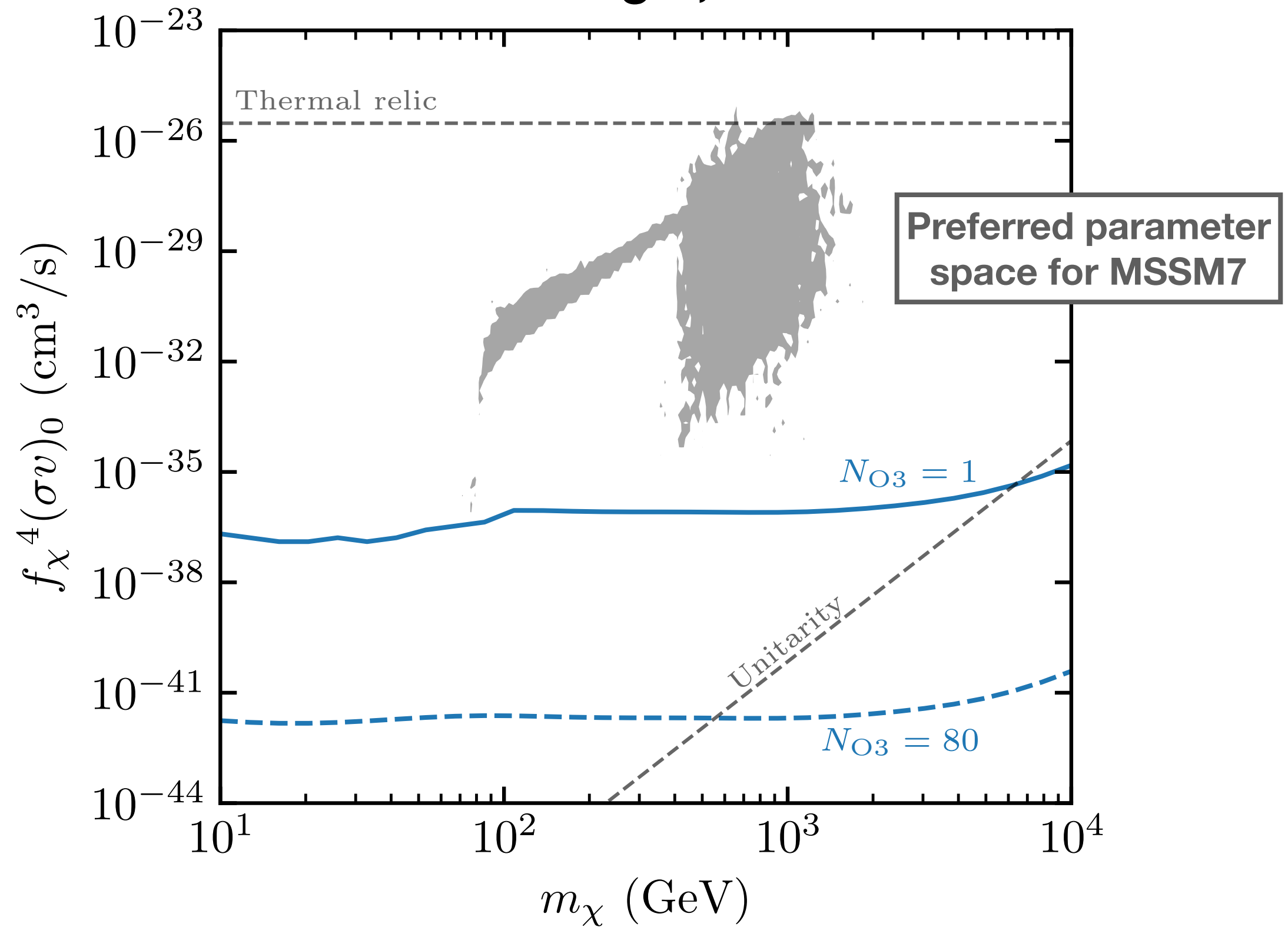
Robust constraint with few assumptions

**PBH
detection**

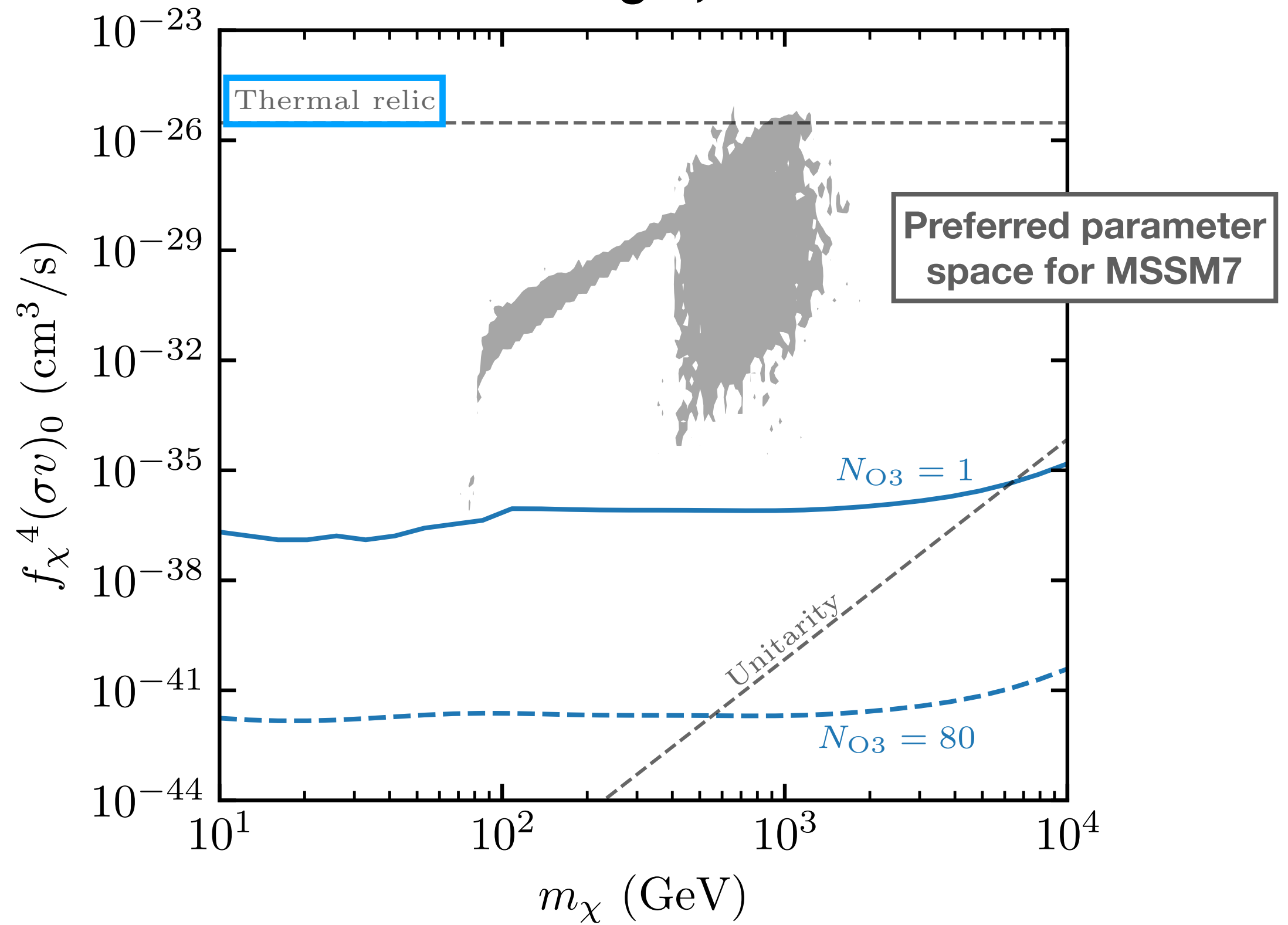


**WIMP
constraint**

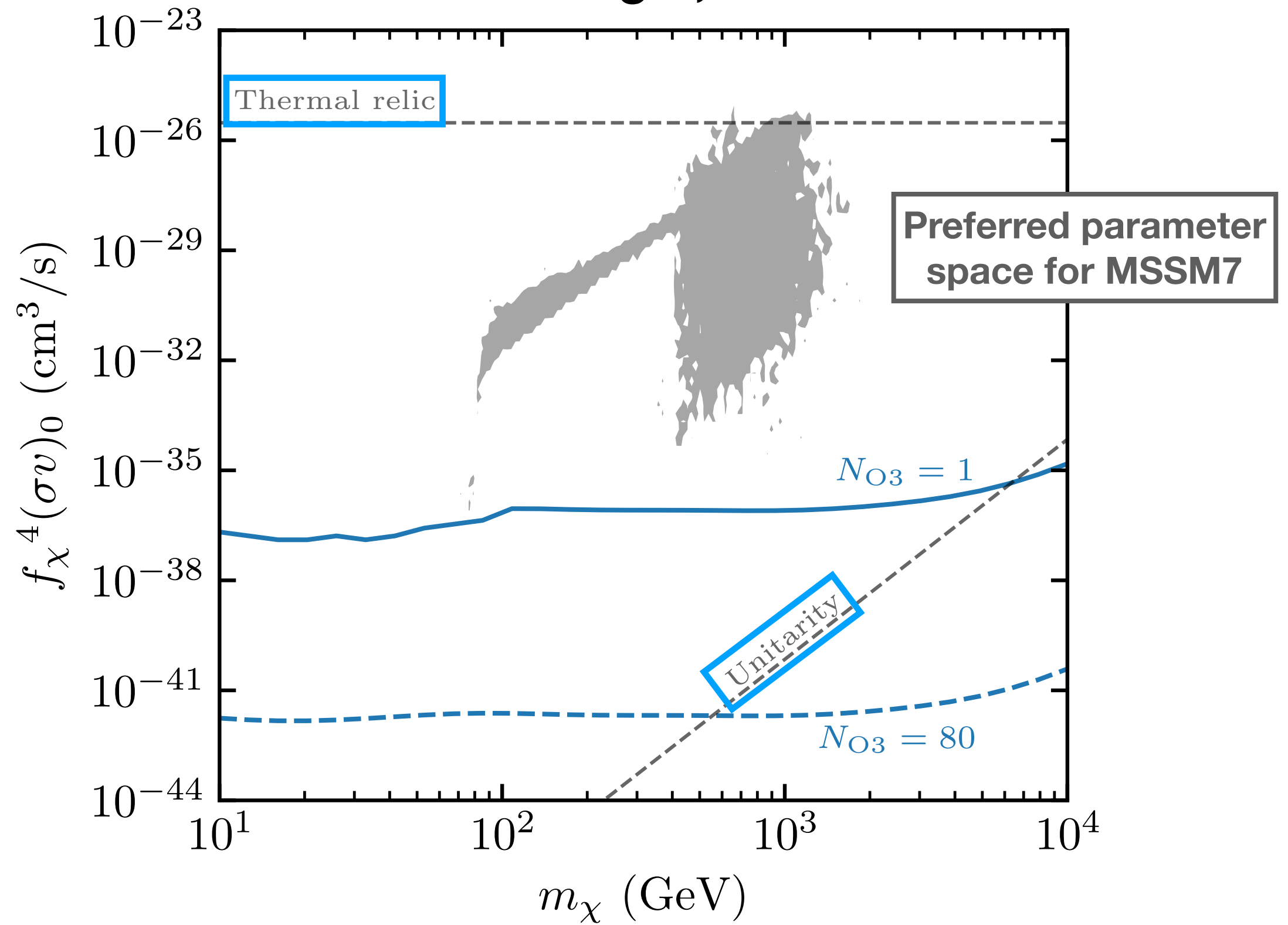
0.5 M_⊙ merger, LIGO O3



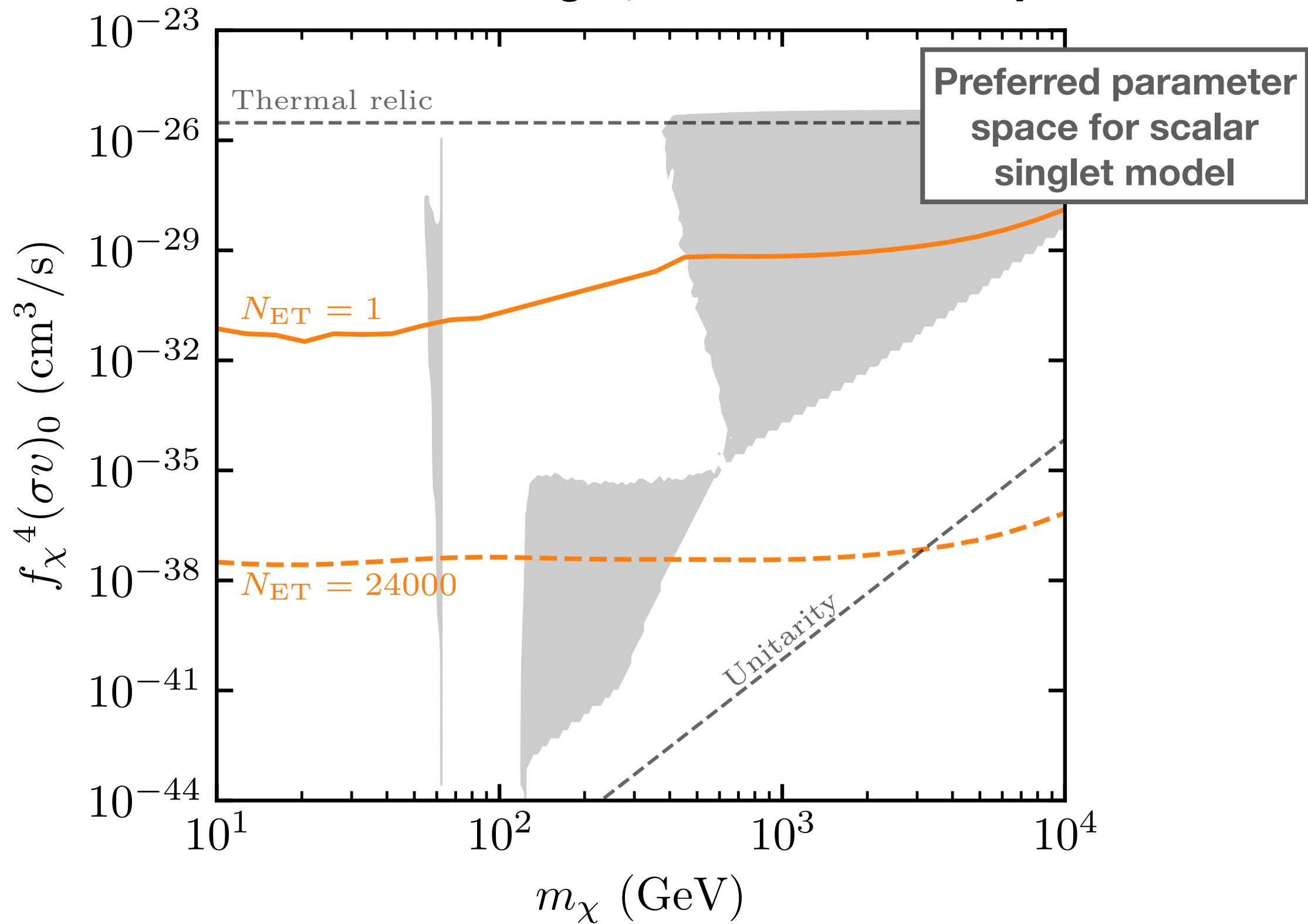
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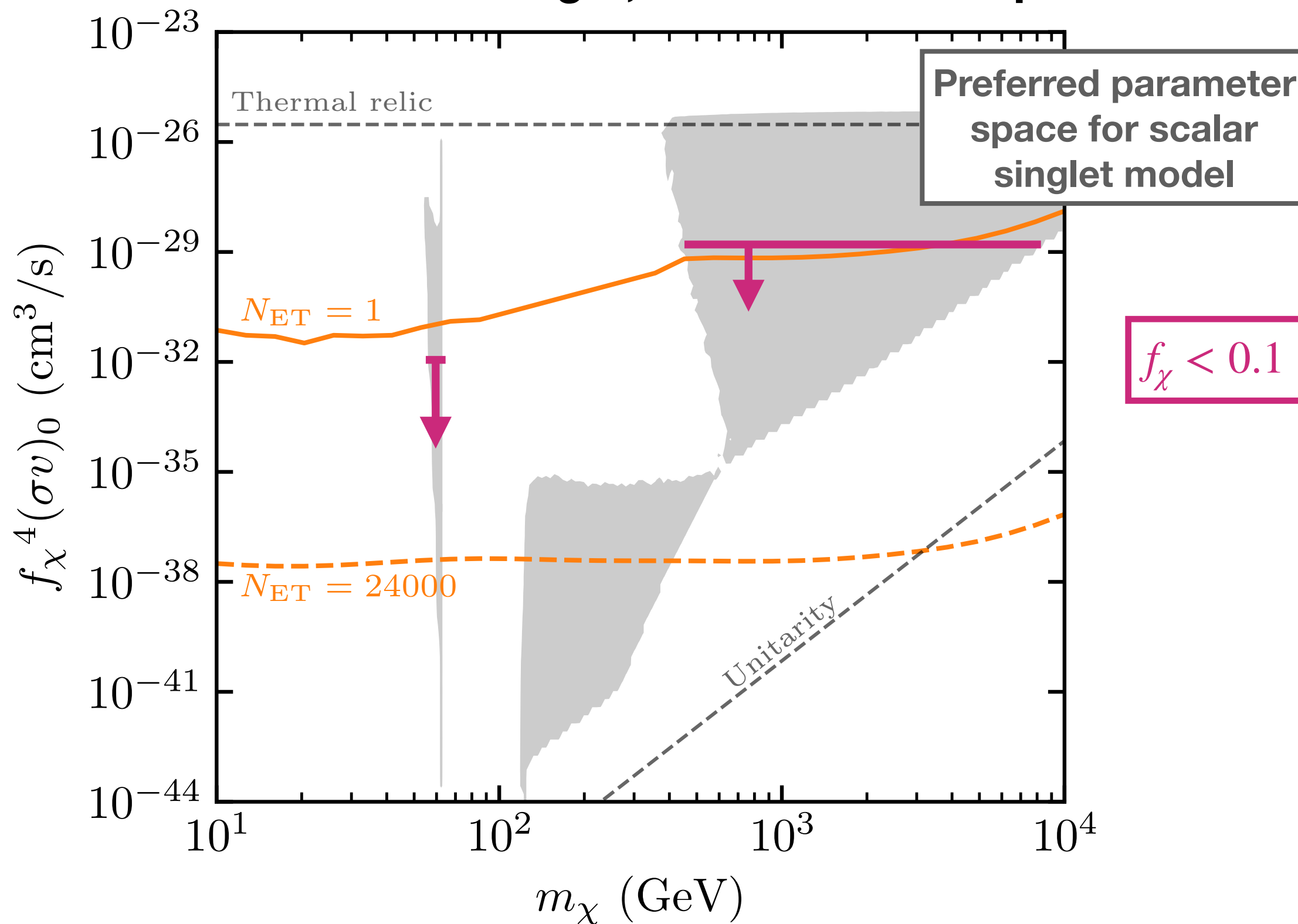
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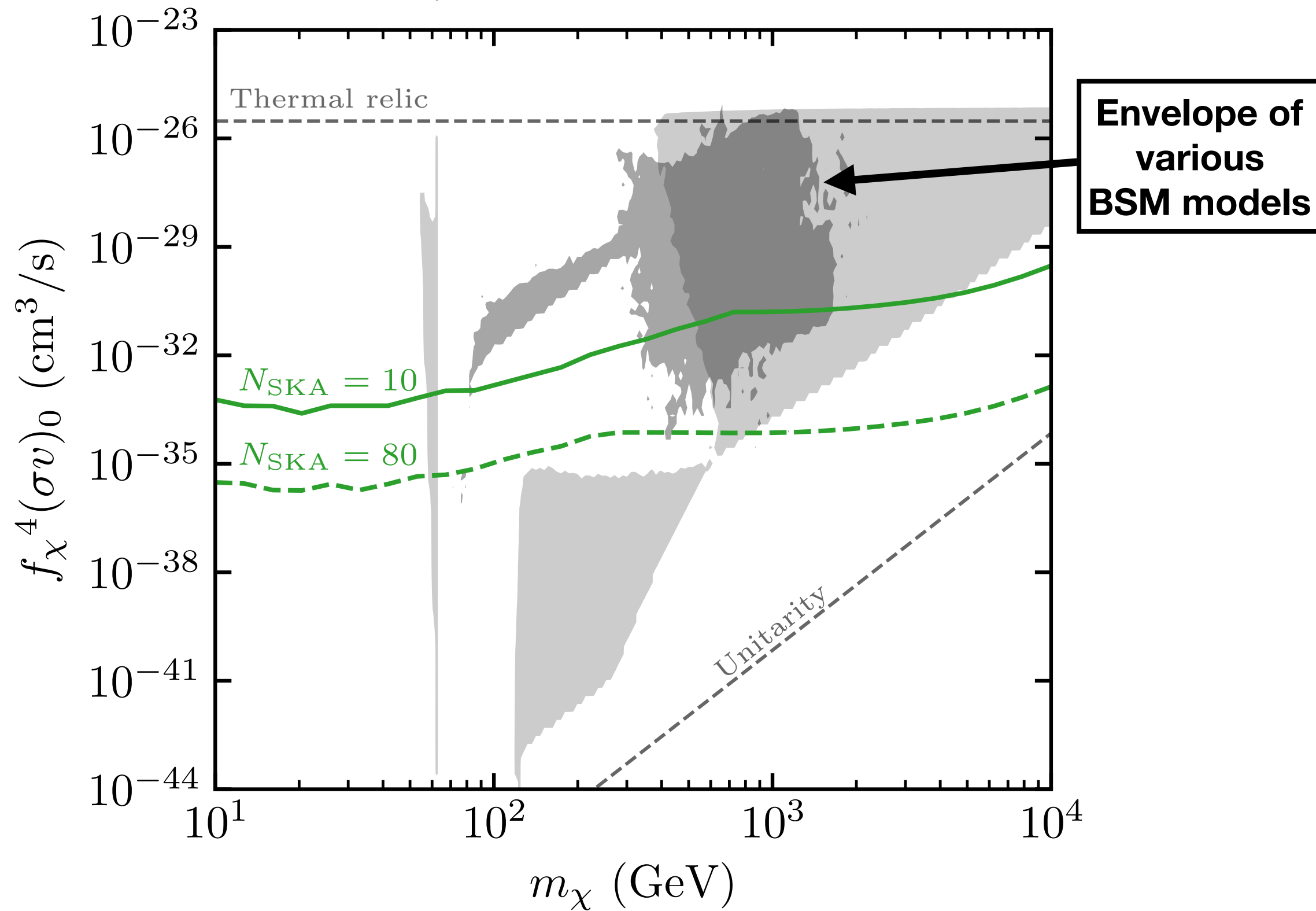
10 M_⊙ z≥40 merger, Einstein Telescope



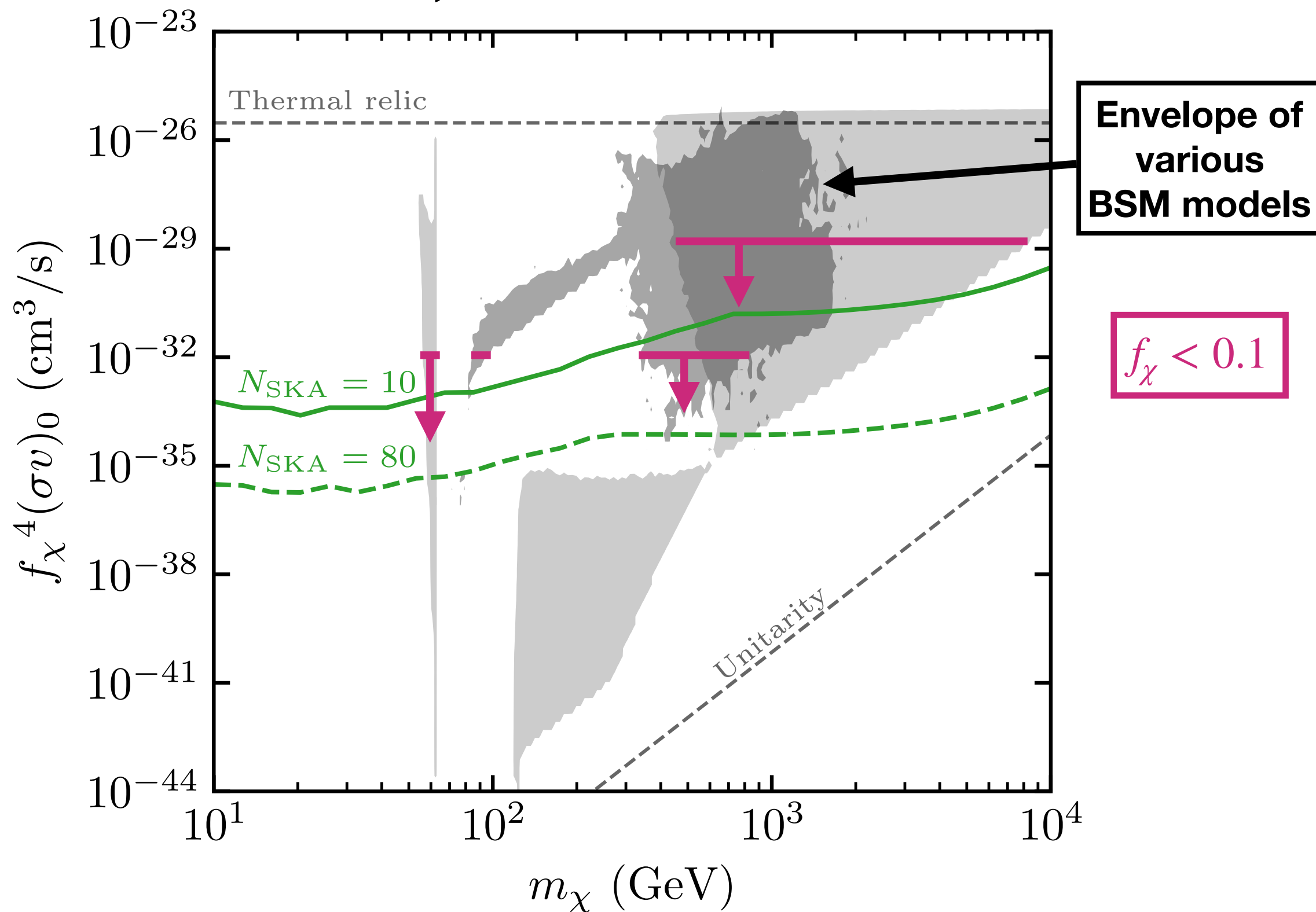
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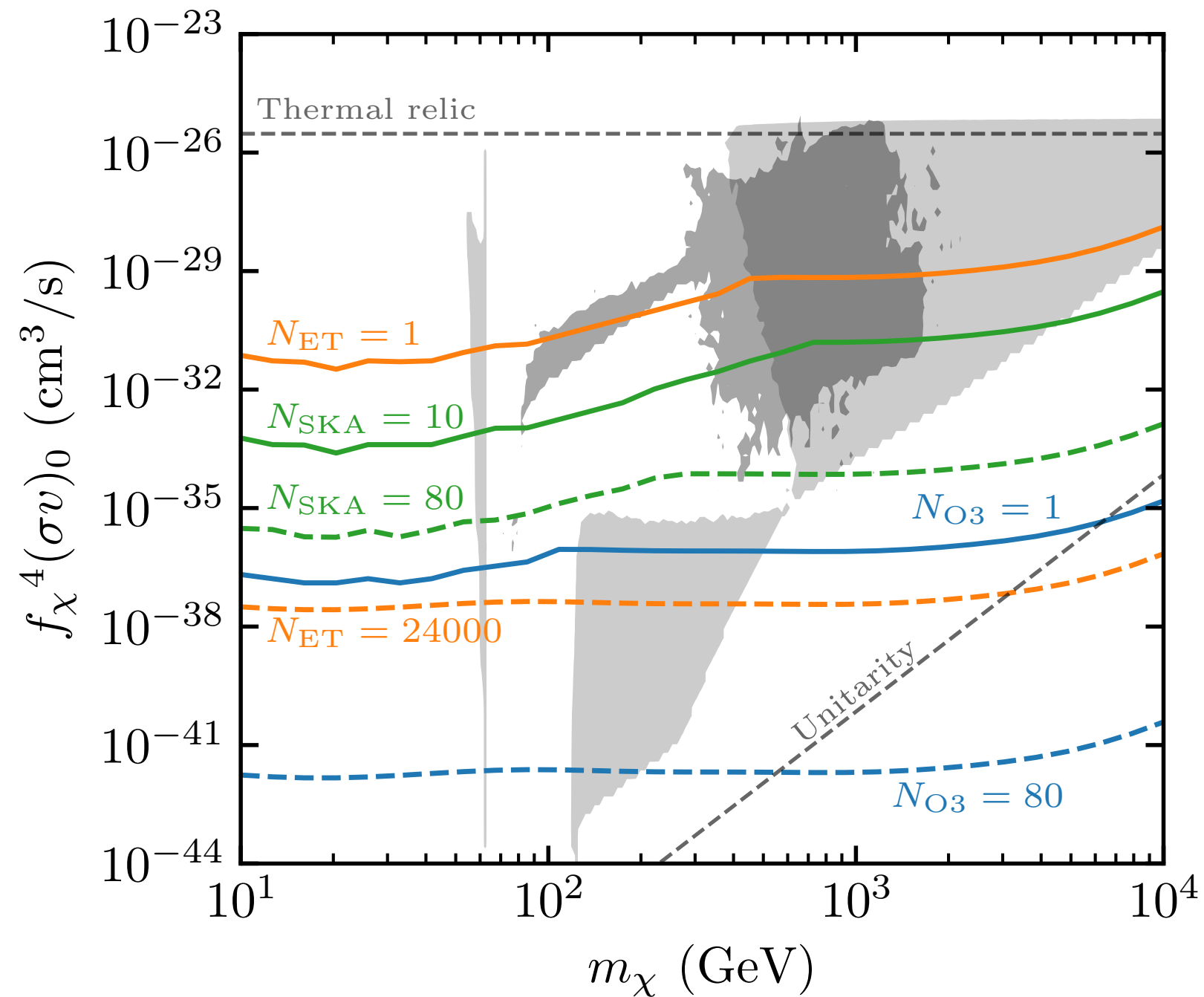
100 M_⊙, radio detections at SKA



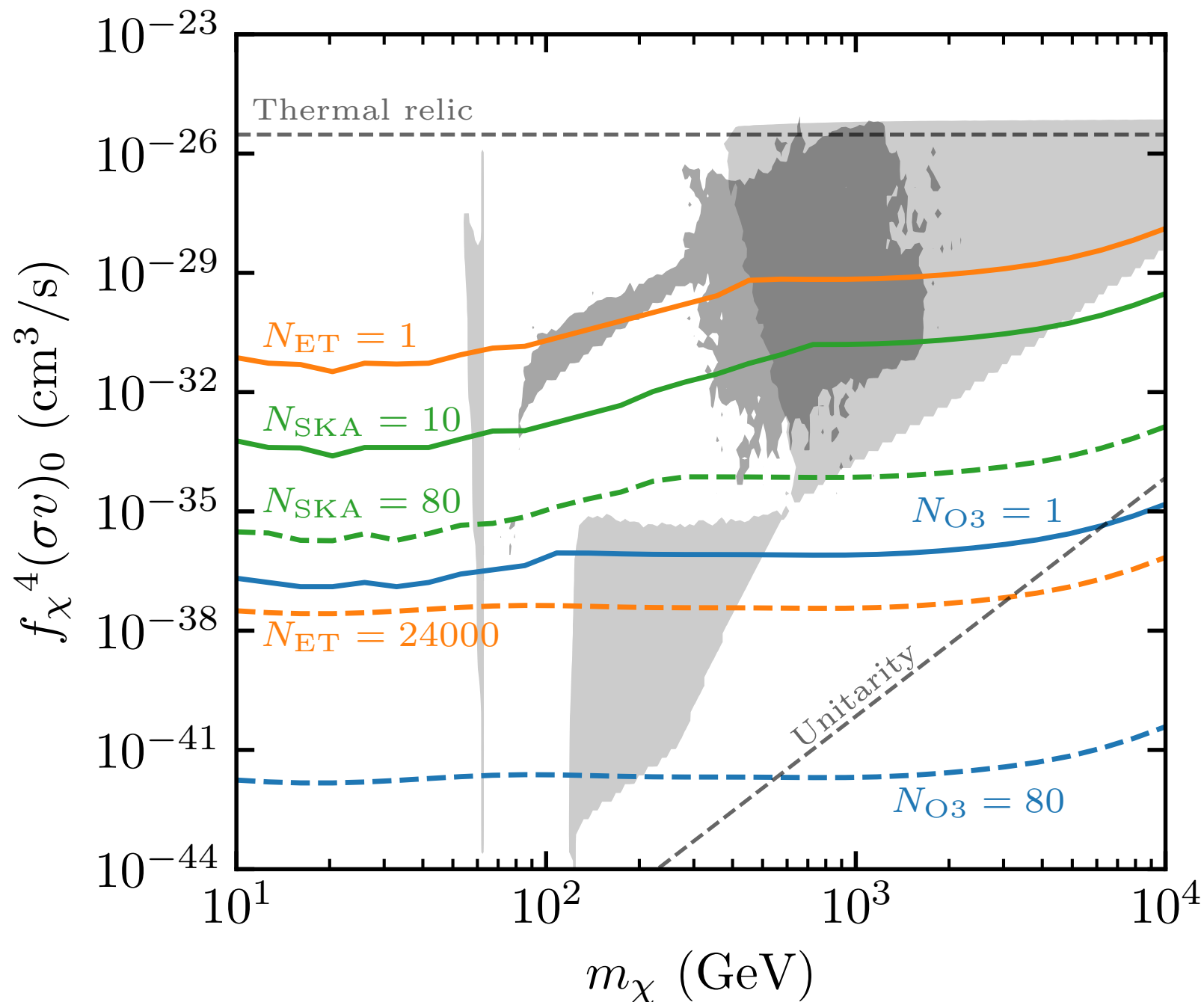
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Conclusion

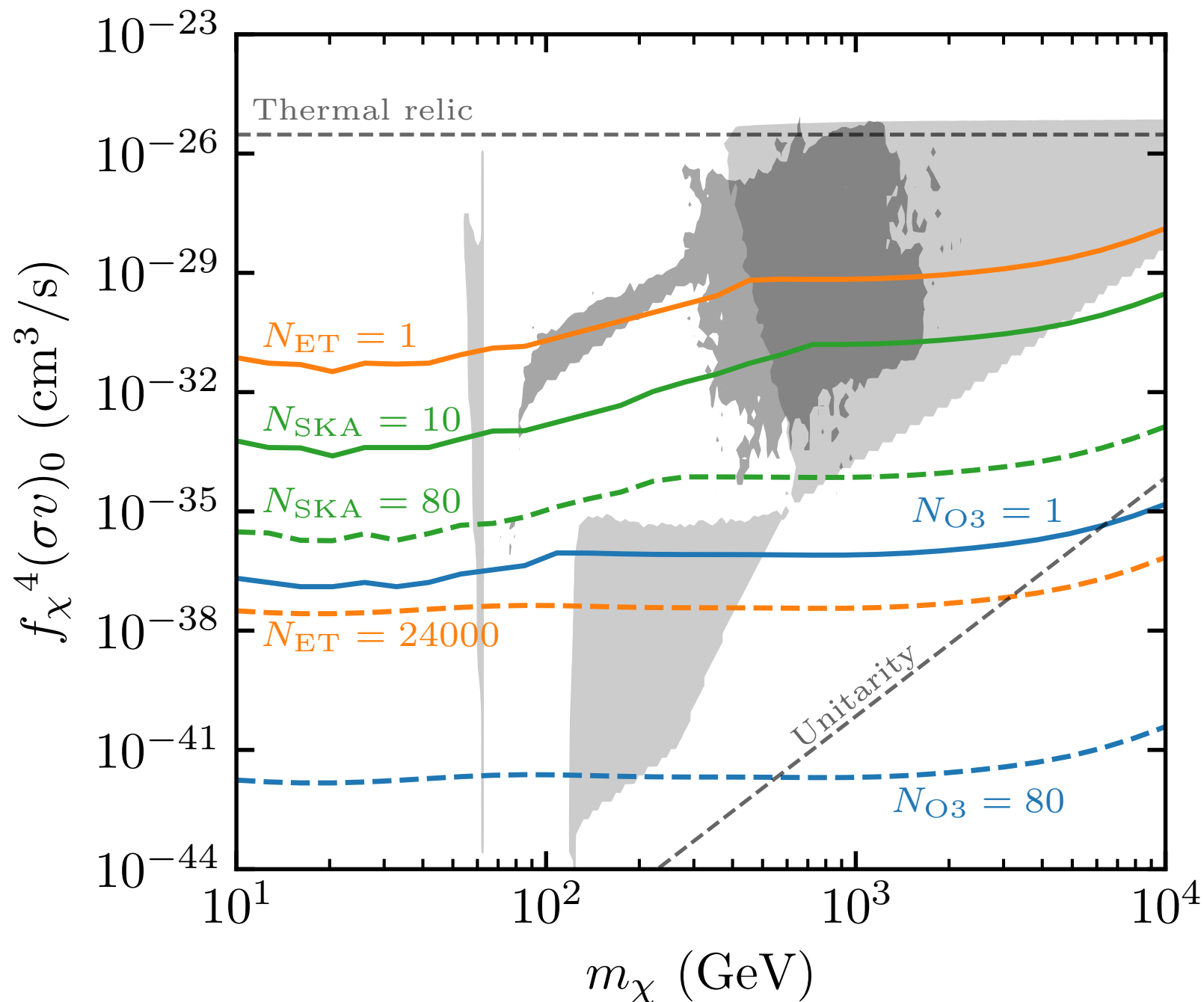


Conclusion



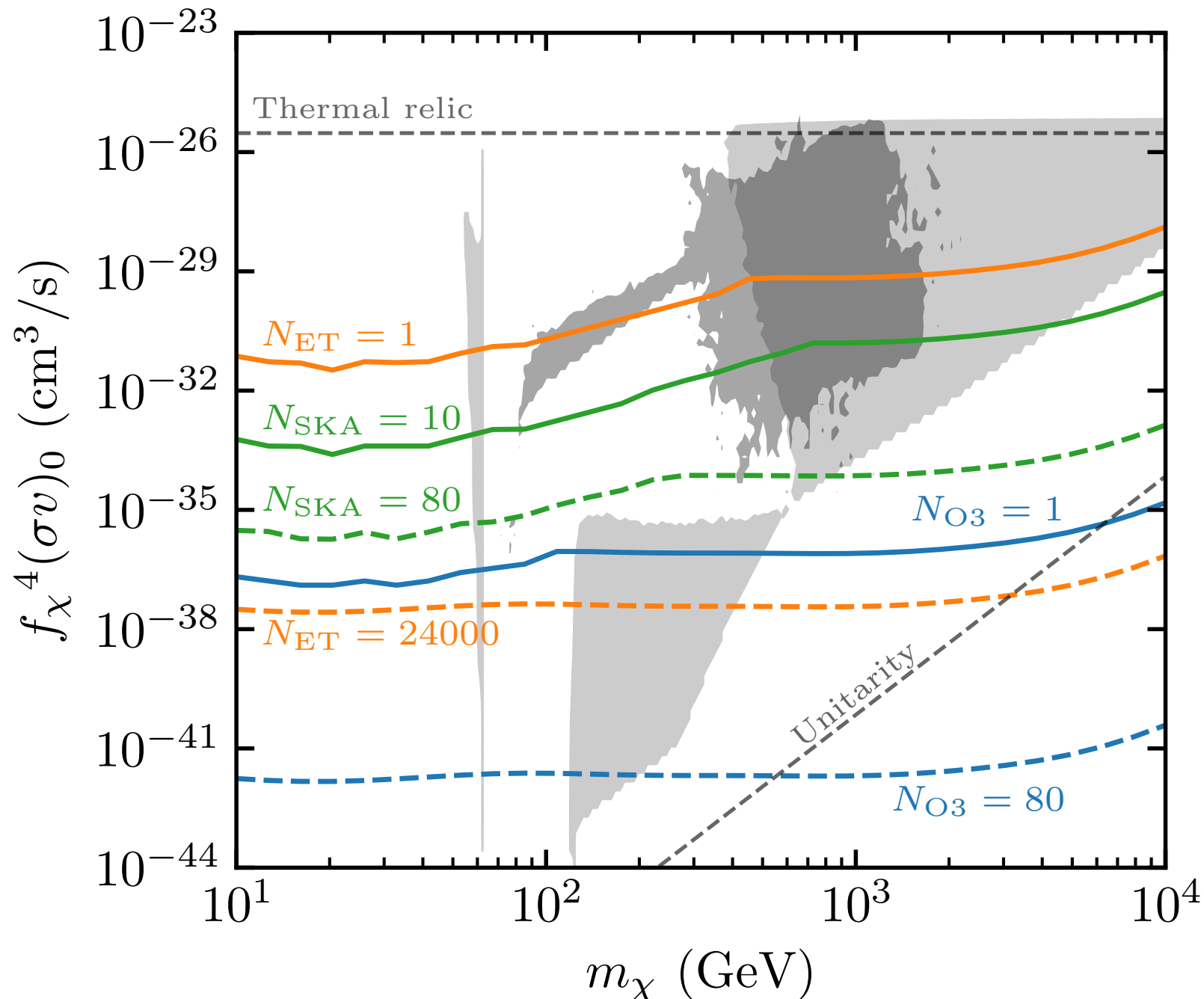
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Thank you!