

14 years Fermi-LAT constraint on DM

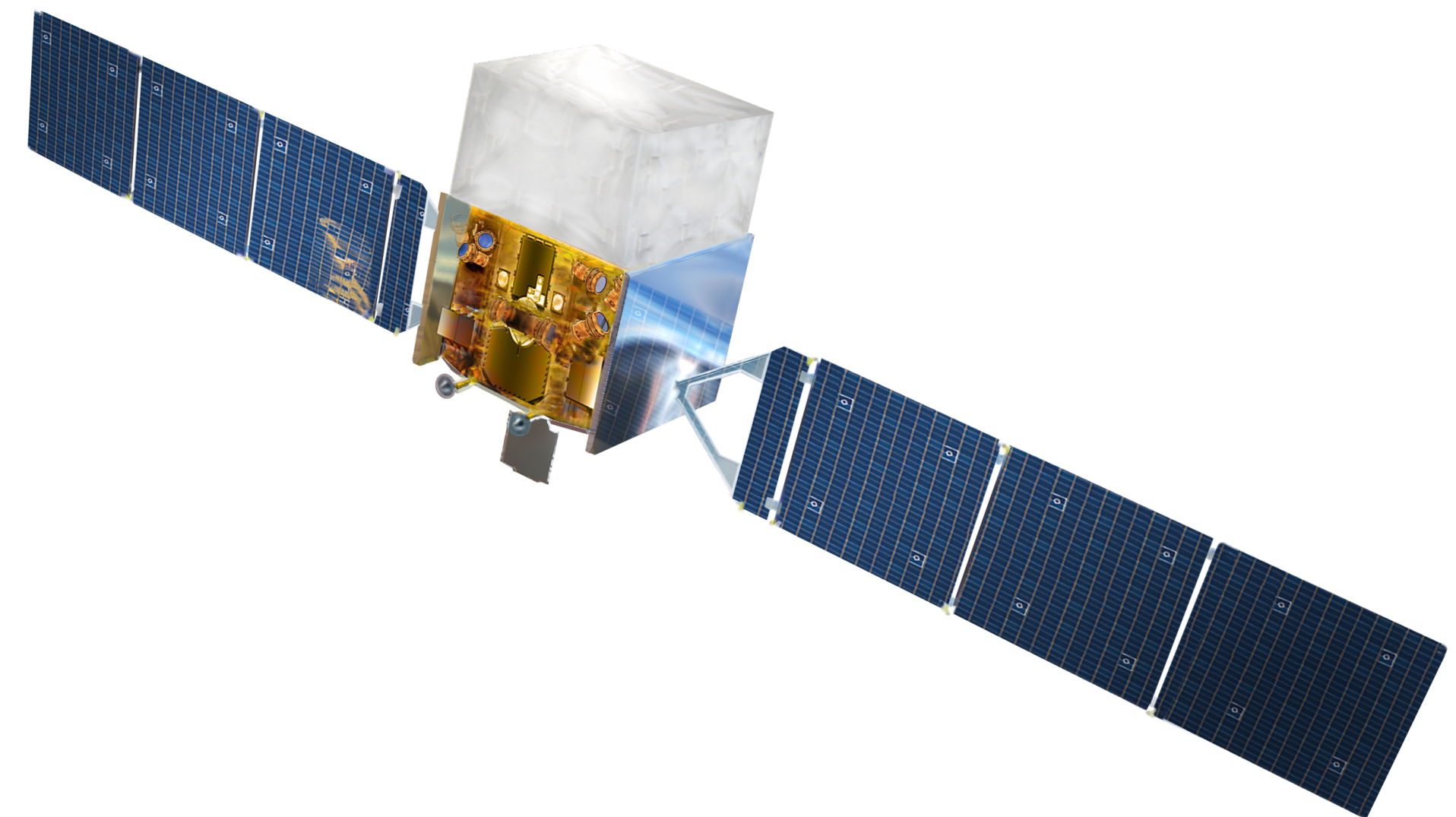
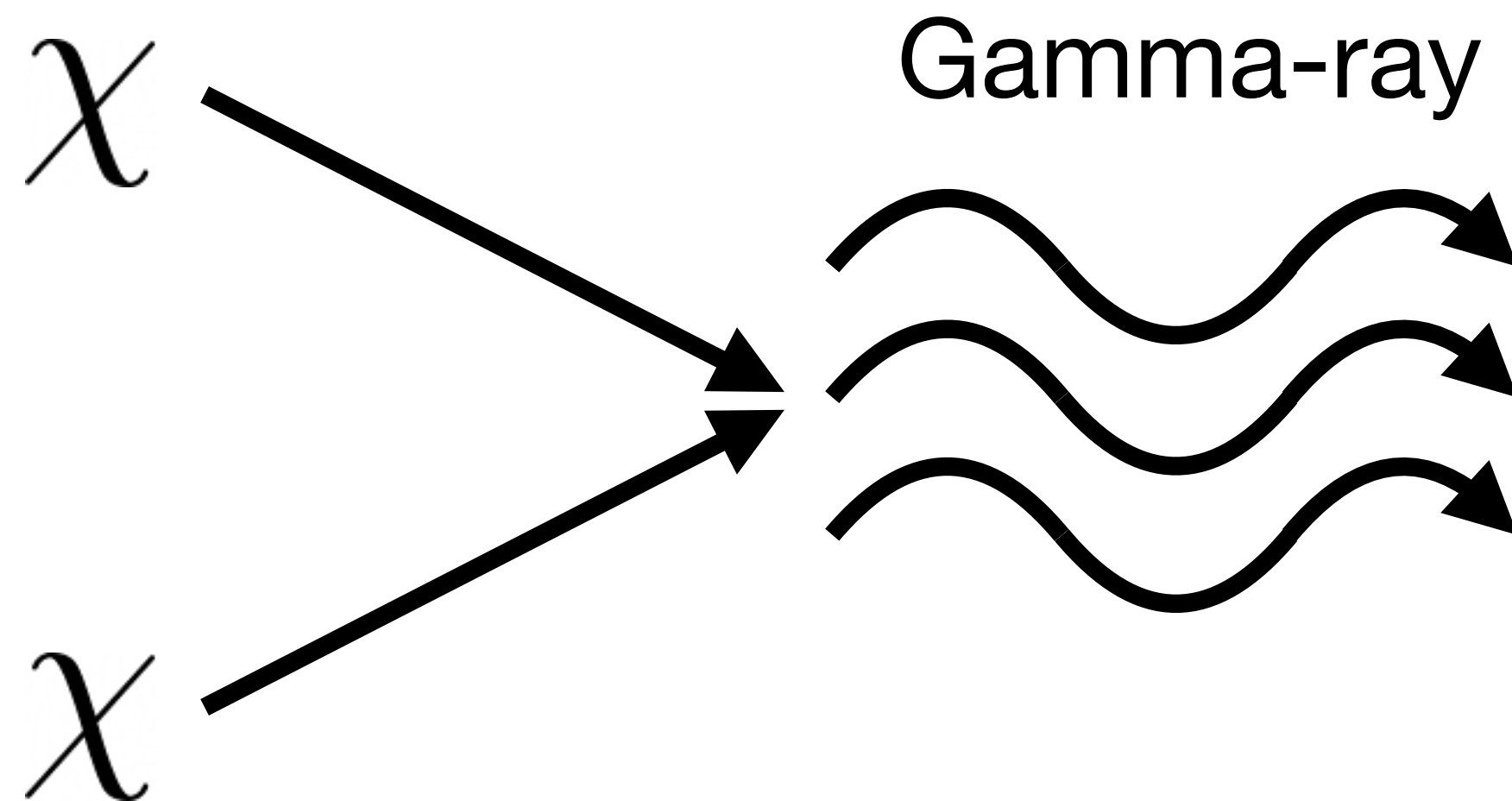
PPC 2023, June 13, 2023

Yujin Park, UC Berkeley

Papers : [arXiv:2207.10090](#)(Dessert, Foster, Park, Safdi, Xu), [arXiv:2212.07435](#)(Foster, Park, Safdi, Soraq, Xu)

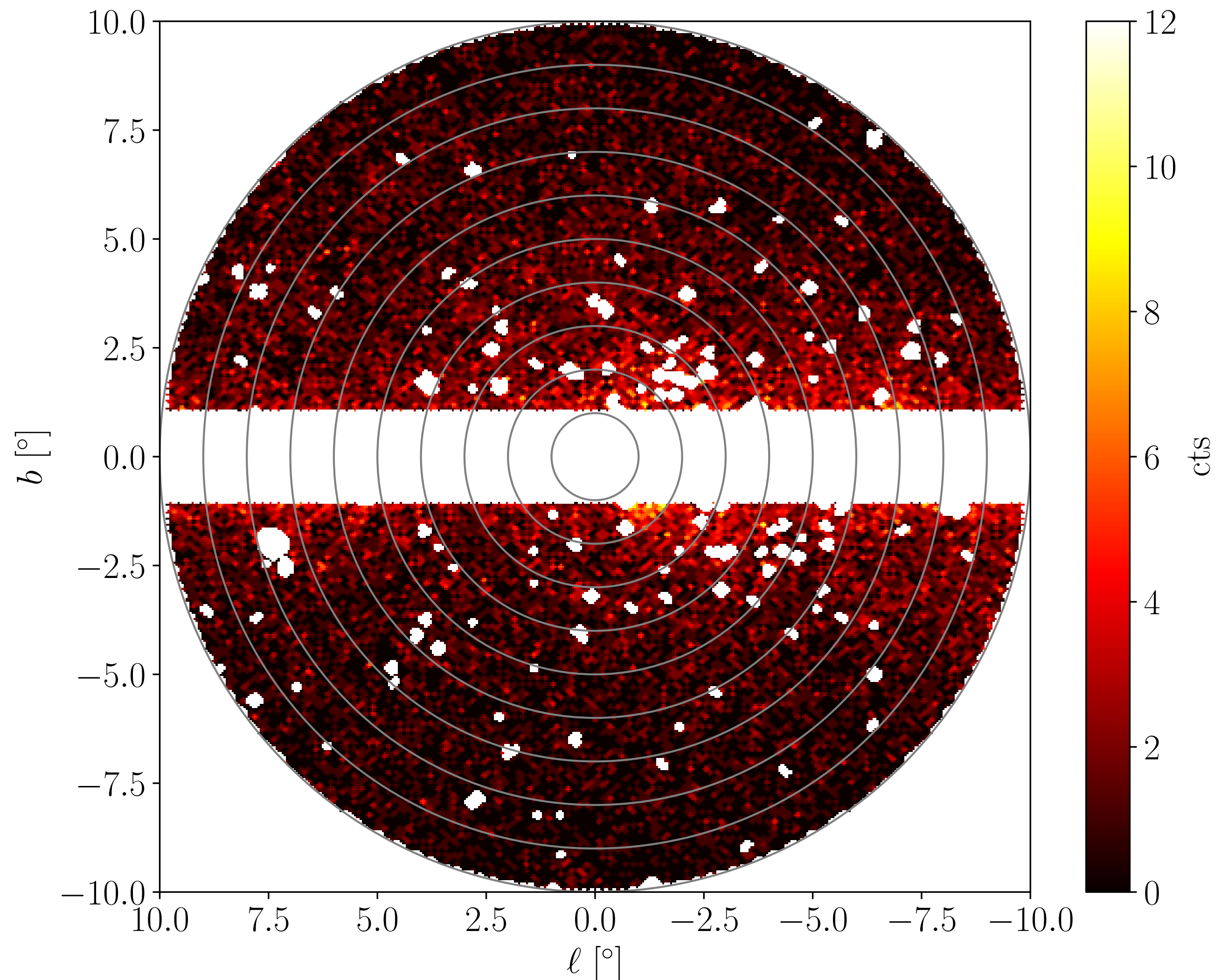
Thermal higgsino

- Well-motivated WIMP candidate from supersymmetric extension of the Standard Model
- $m_\chi \approx 1.08\text{TeV}$ for observed relic abundance
- Expect signal from DM annihilation to final states of W^+W^- and ZZ
- Continuum gamma-ray signals observable through *Fermi*-LAT



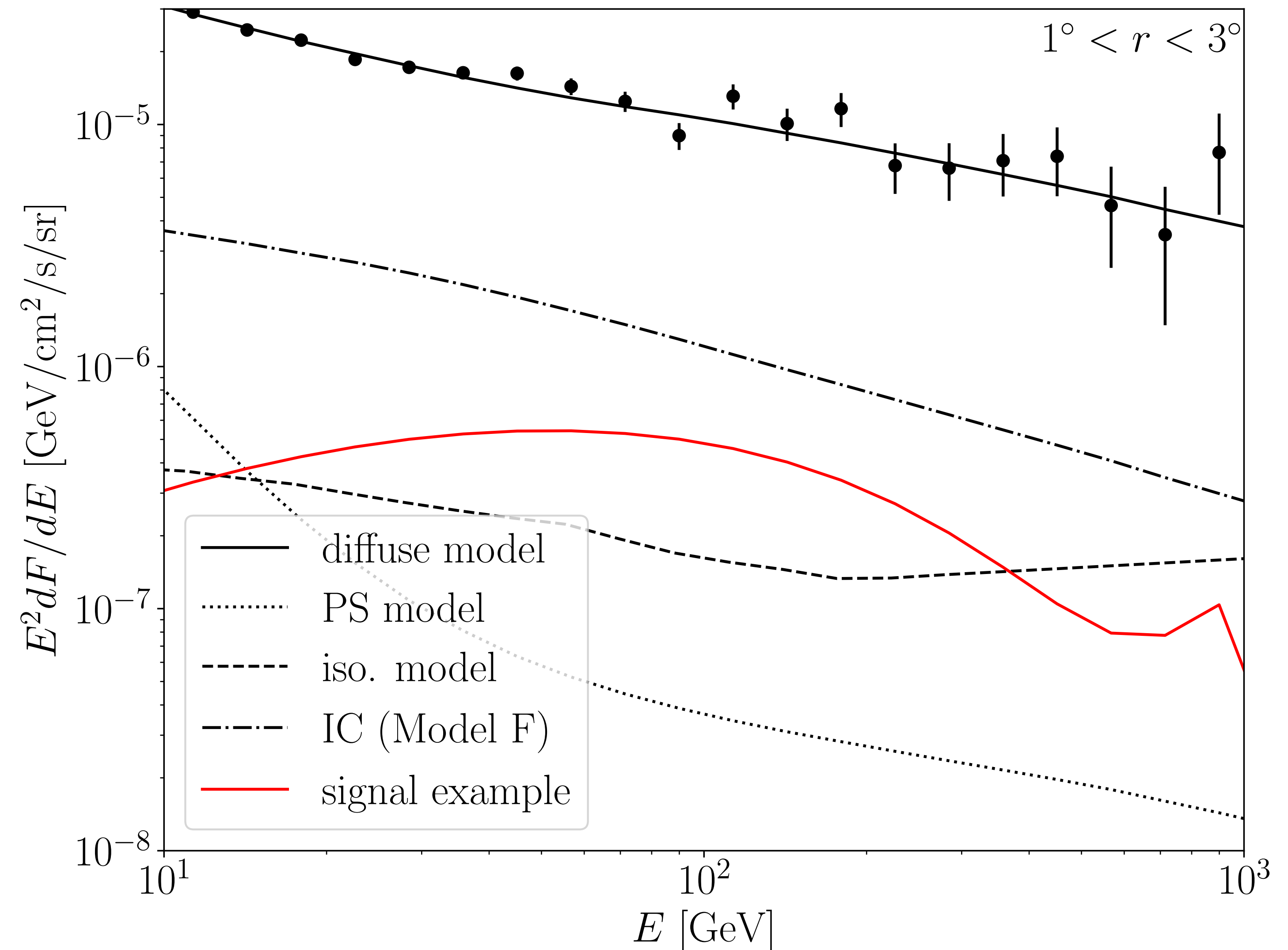
Data selection for continuum search

- Data with SOURCE selection criterion from August 4, 2008 to June 10, 2022
- 10 GeV - 1 TeV energy range
- 9 concentric annuli to 10 degrees of the galactic center
- Masked galactic plane



Data Analysis

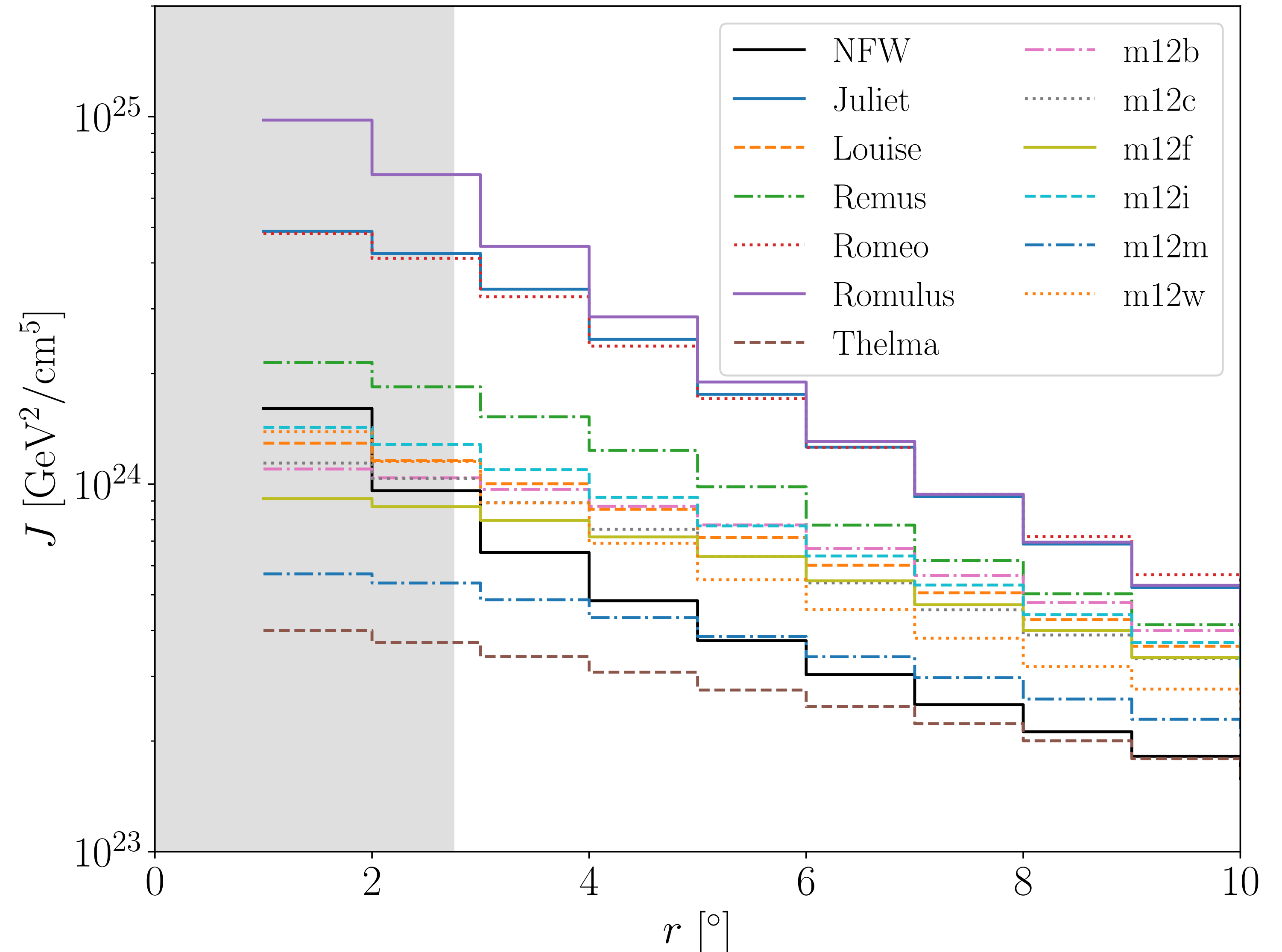
- Model the spectral data for the individual annuli
- Linear combination of continuum components
- Rescaled by nuisance parameter
- Joint profile likelihood



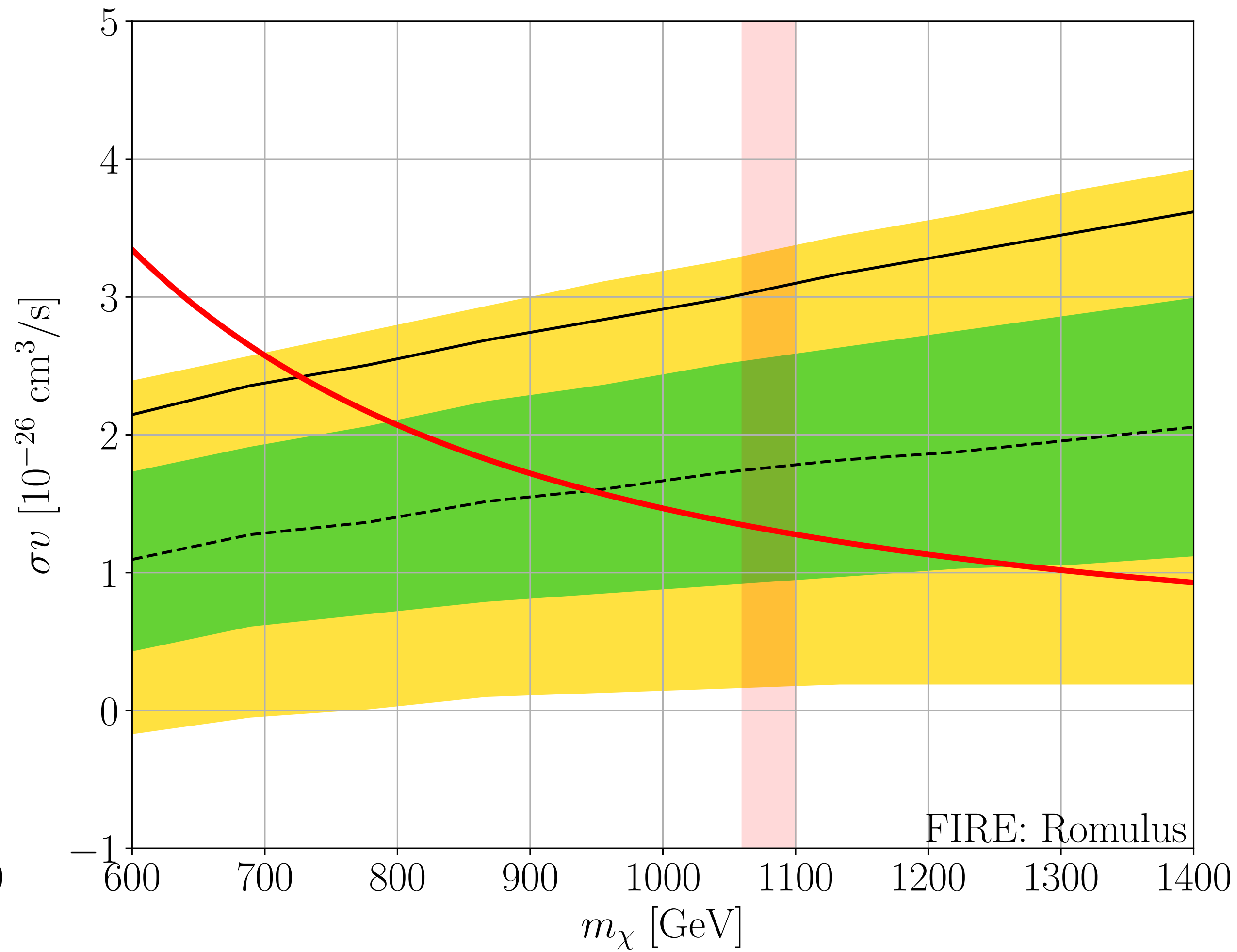
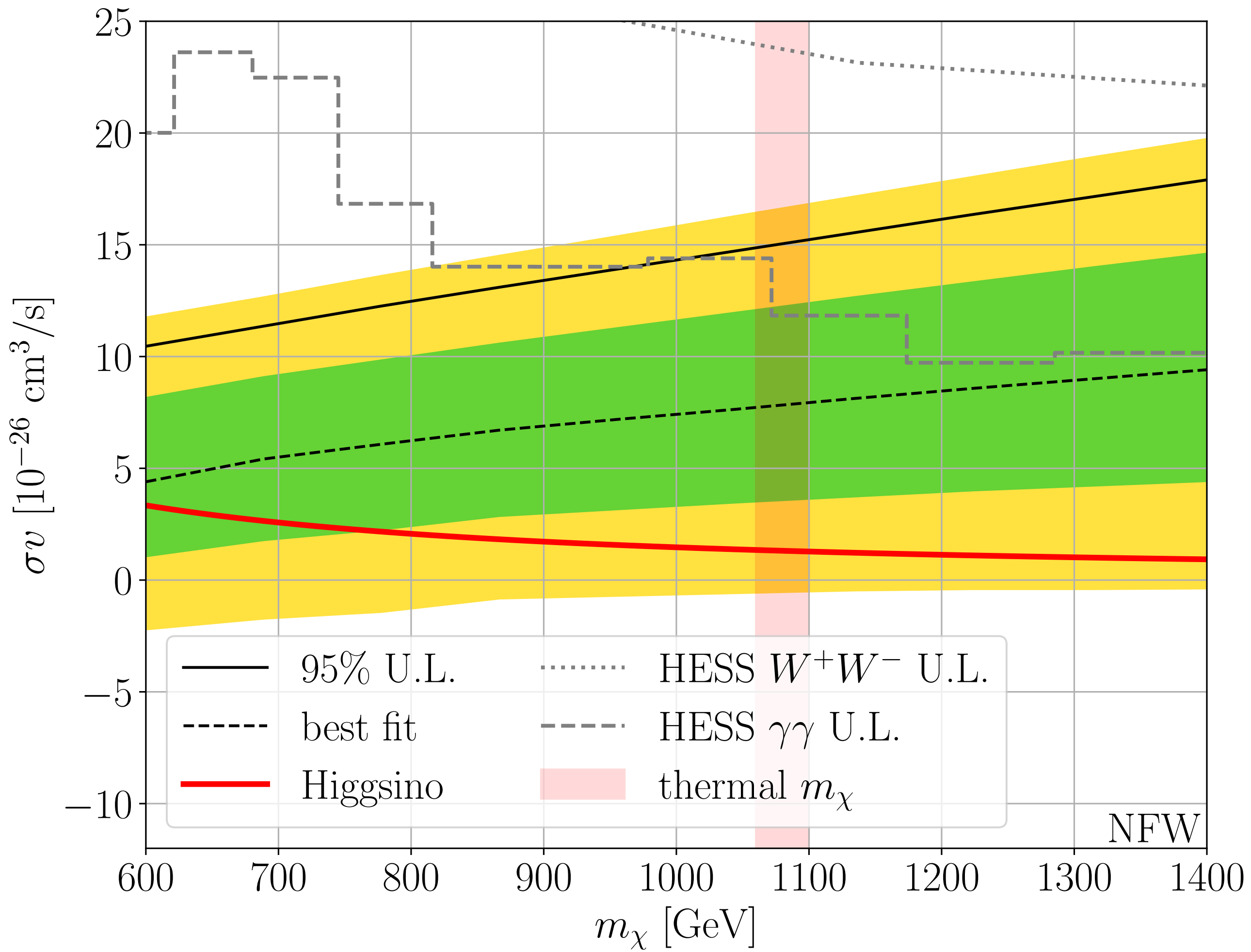
J factor for analysis

$$J \equiv \int ds \rho_{\text{DM}}^2(s)$$

- Other J -factor profiles from 12 FIRE-2 zoom-in simulations (arXiv:1702.06148)
- Highest angular resolution J -factor profile



Result of continuum search

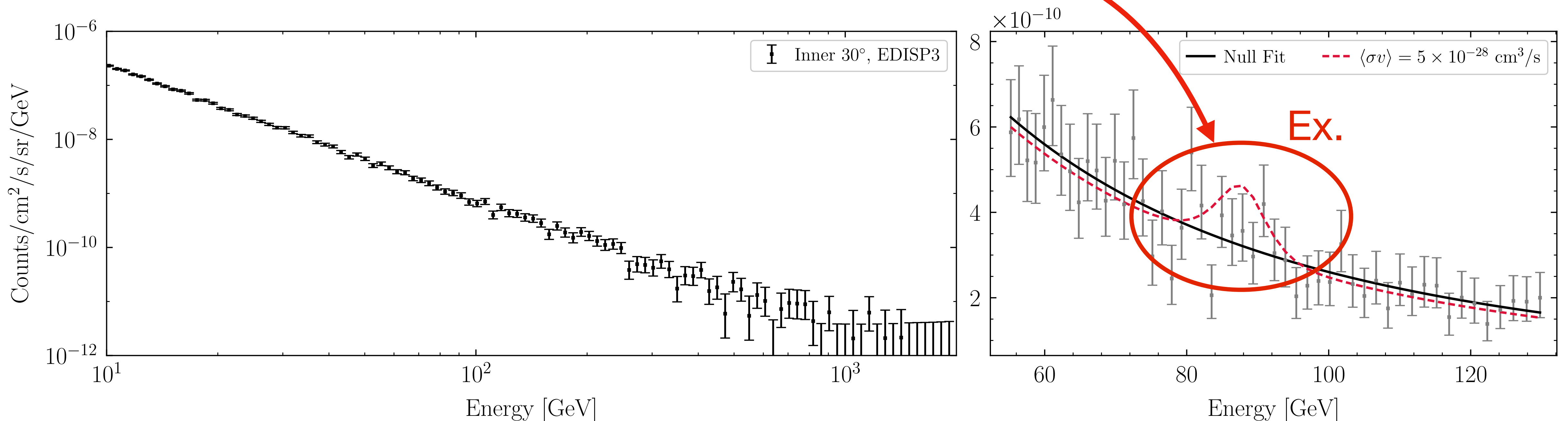


DM decay annihilation

- DM in Milky Way halo may decay or annihilate to photons
- Observable gamma-rays from such source with Fermi Telescope
- Monochromatic line search for possible excess

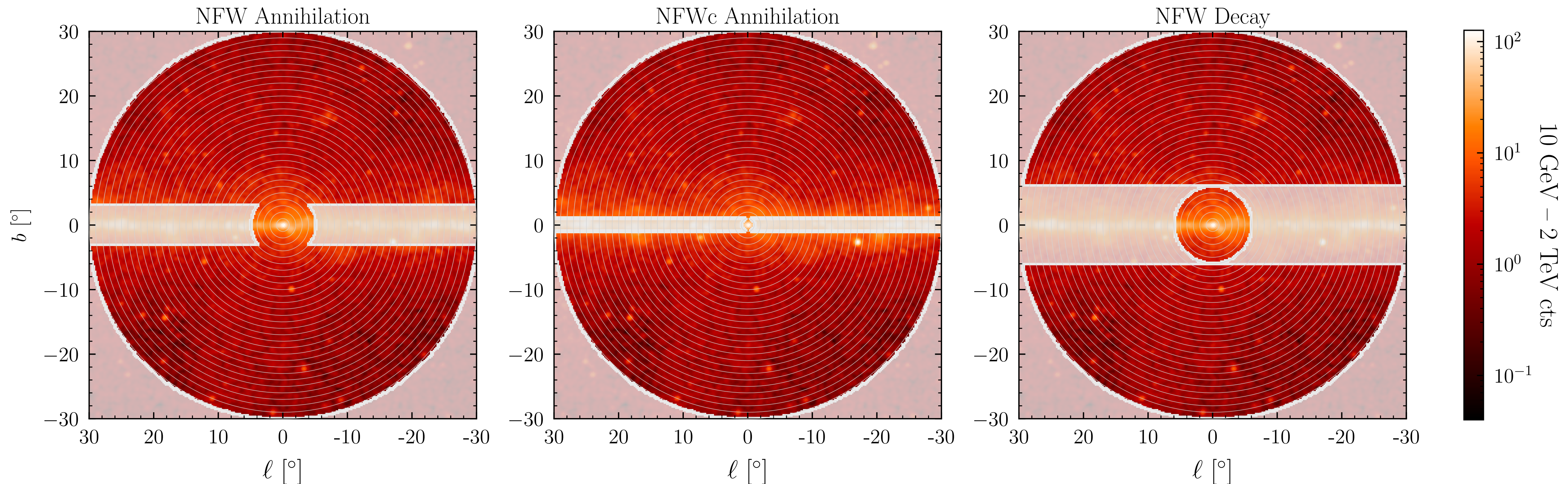
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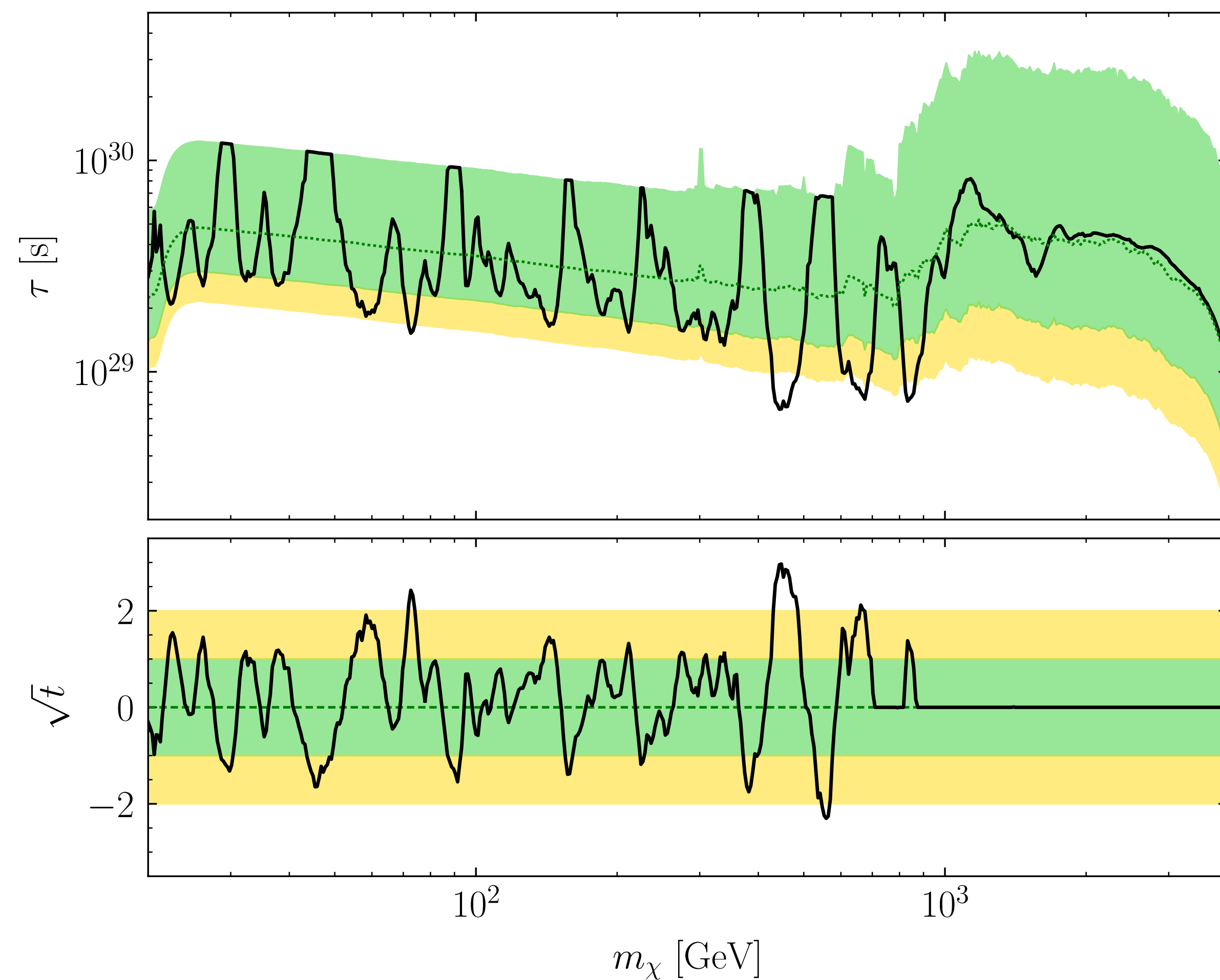
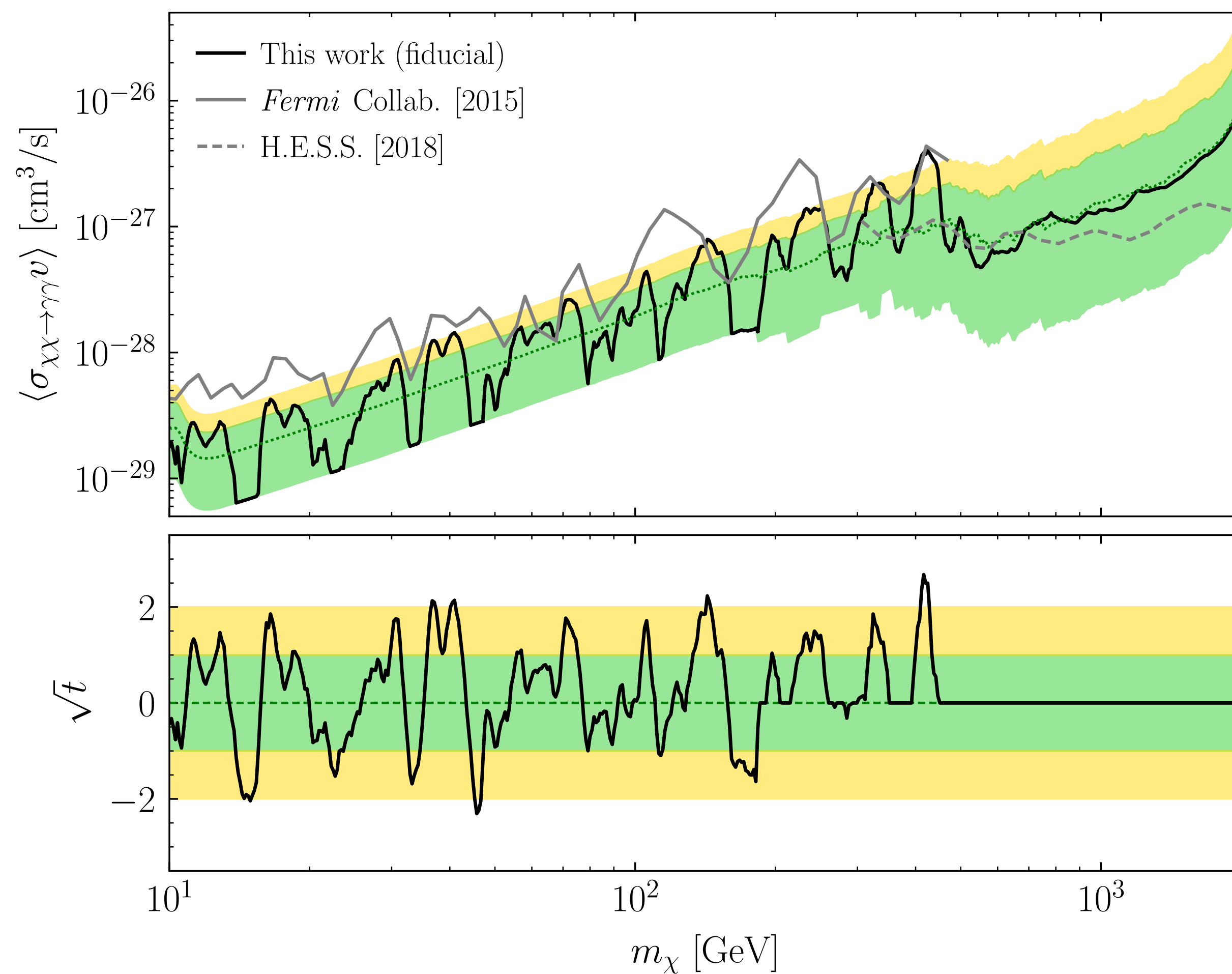


Data selection for line search

- *Fermi*-LAT data from 2008 - 2022
- 10 GeV - 2 TeV energy range
- $r < 30^\circ$ with galactic plane masked



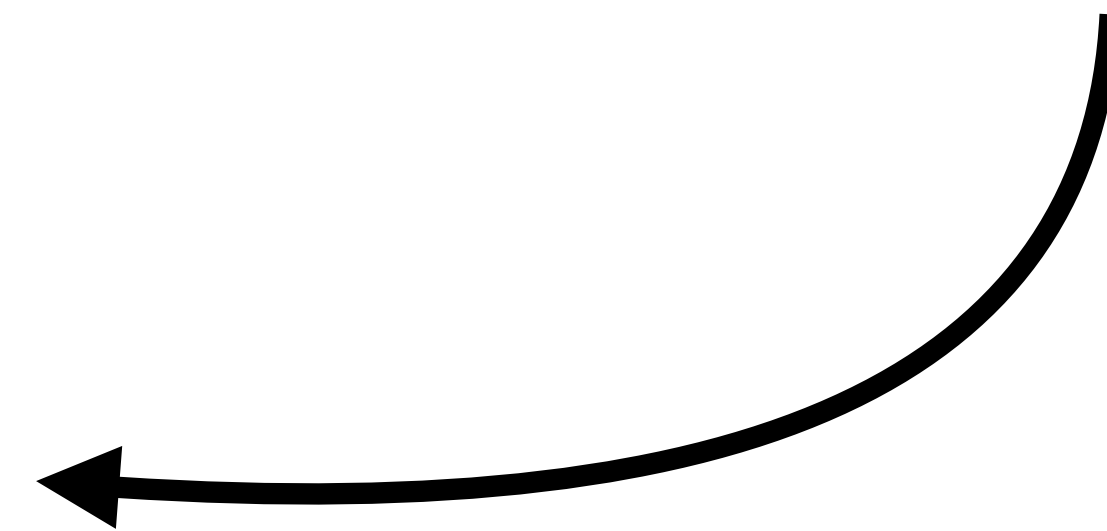
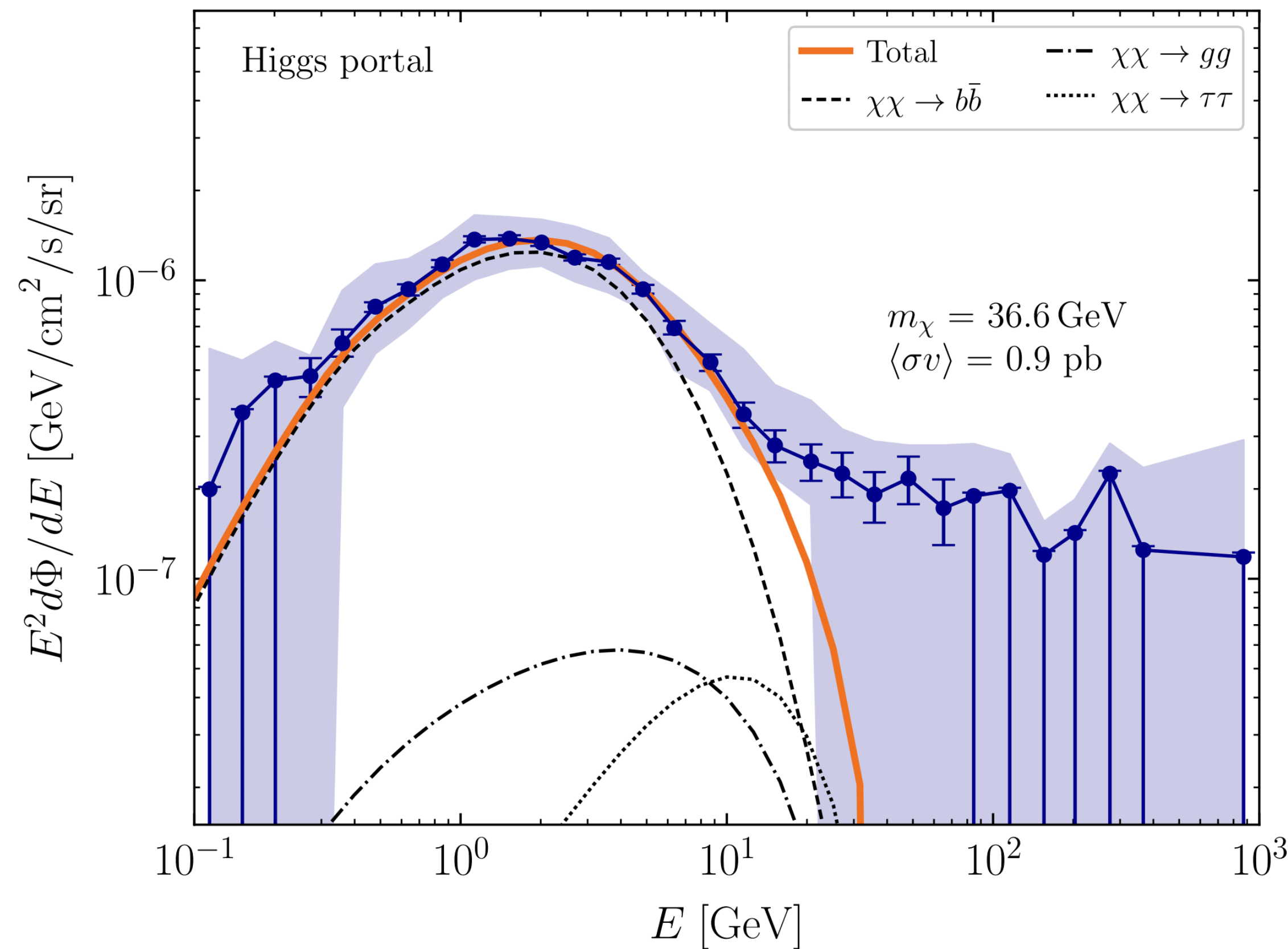
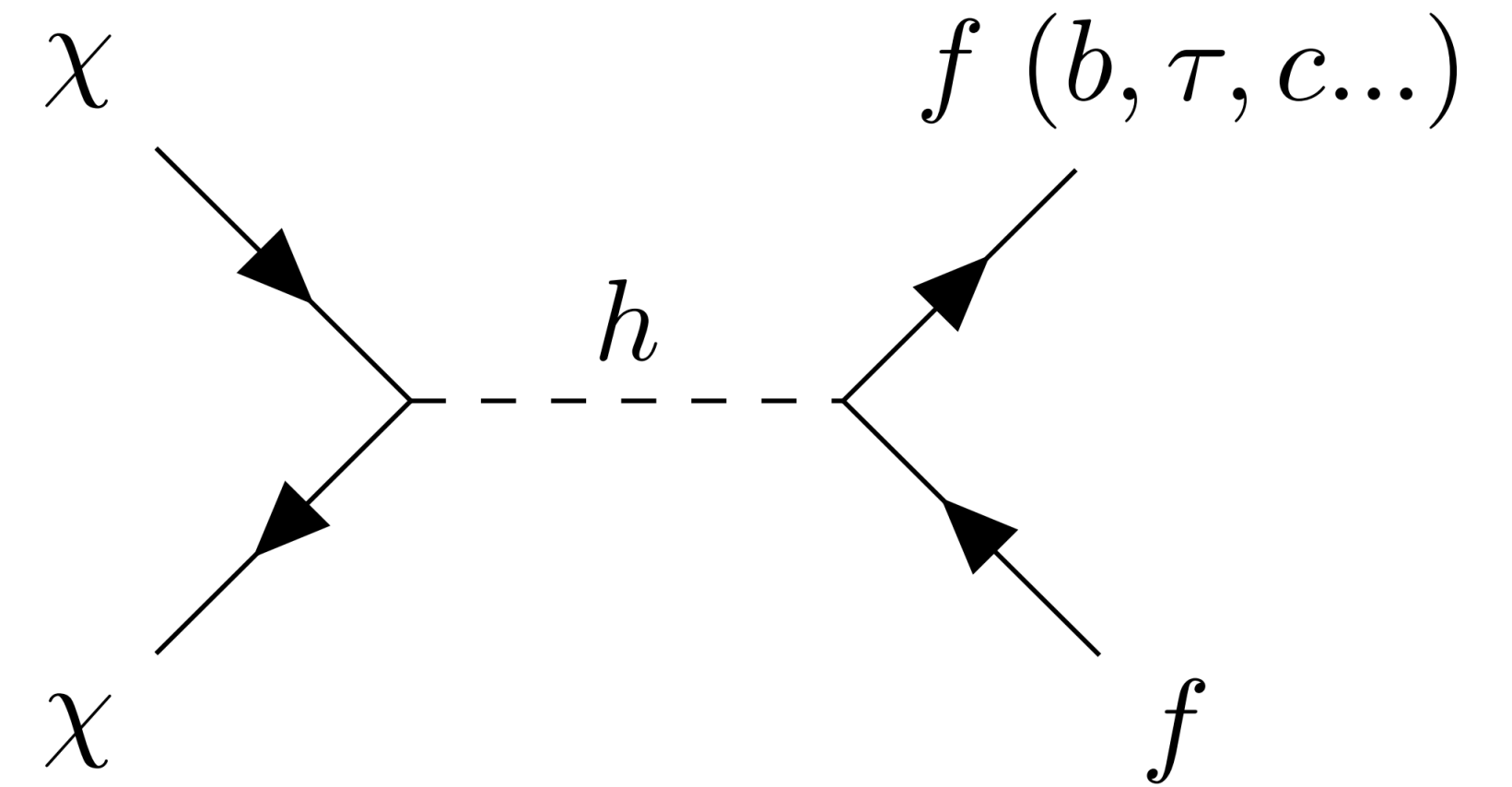
No evidence of DM decay/annihilation



GCE from Higgs Portal DM

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$$\mathcal{L} \supset -\frac{m_\chi}{2} \bar{\chi}\chi + i\frac{y_{\chi h}}{\sqrt{2}} h \bar{\chi}\gamma_5\chi$$

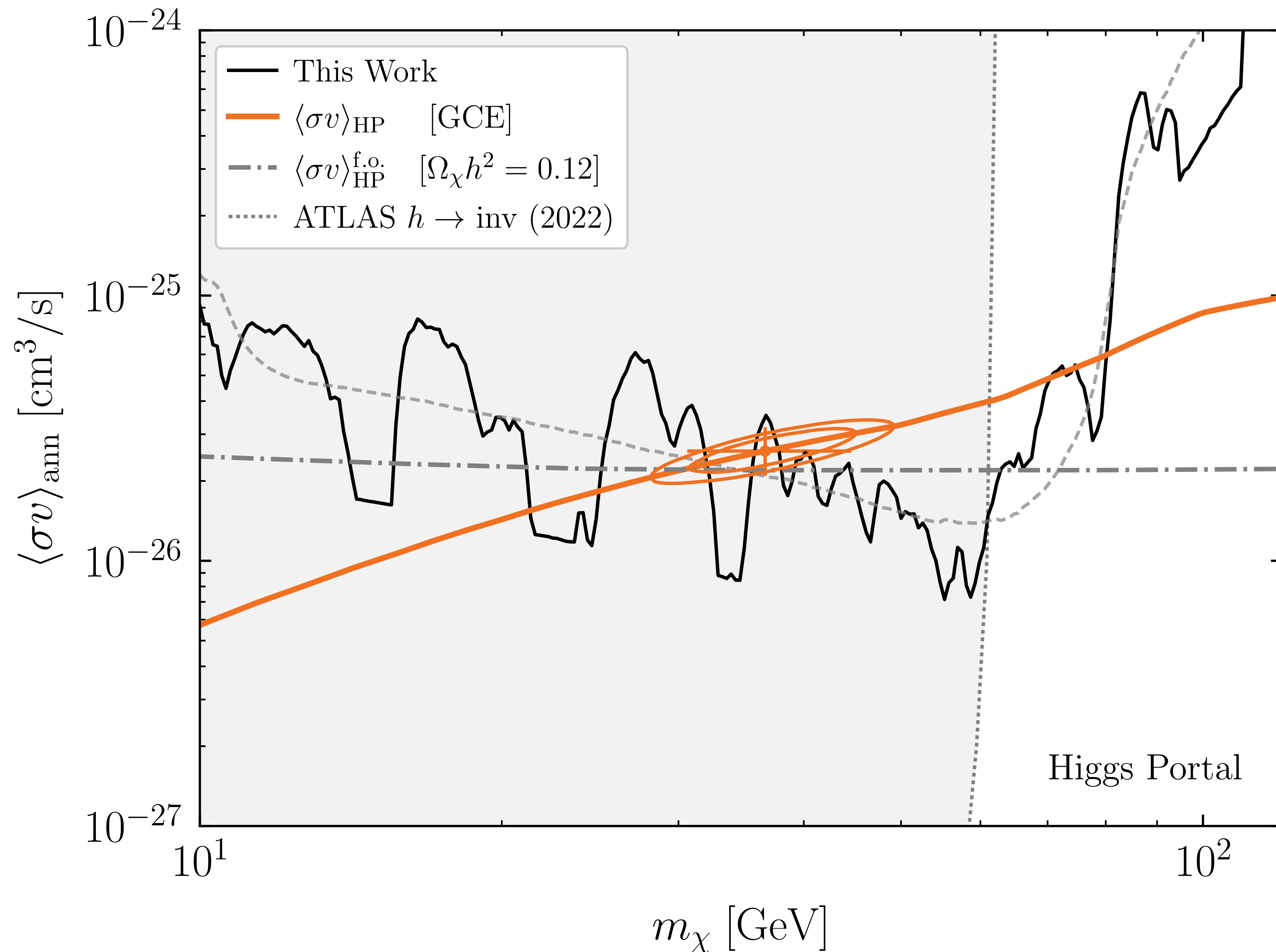
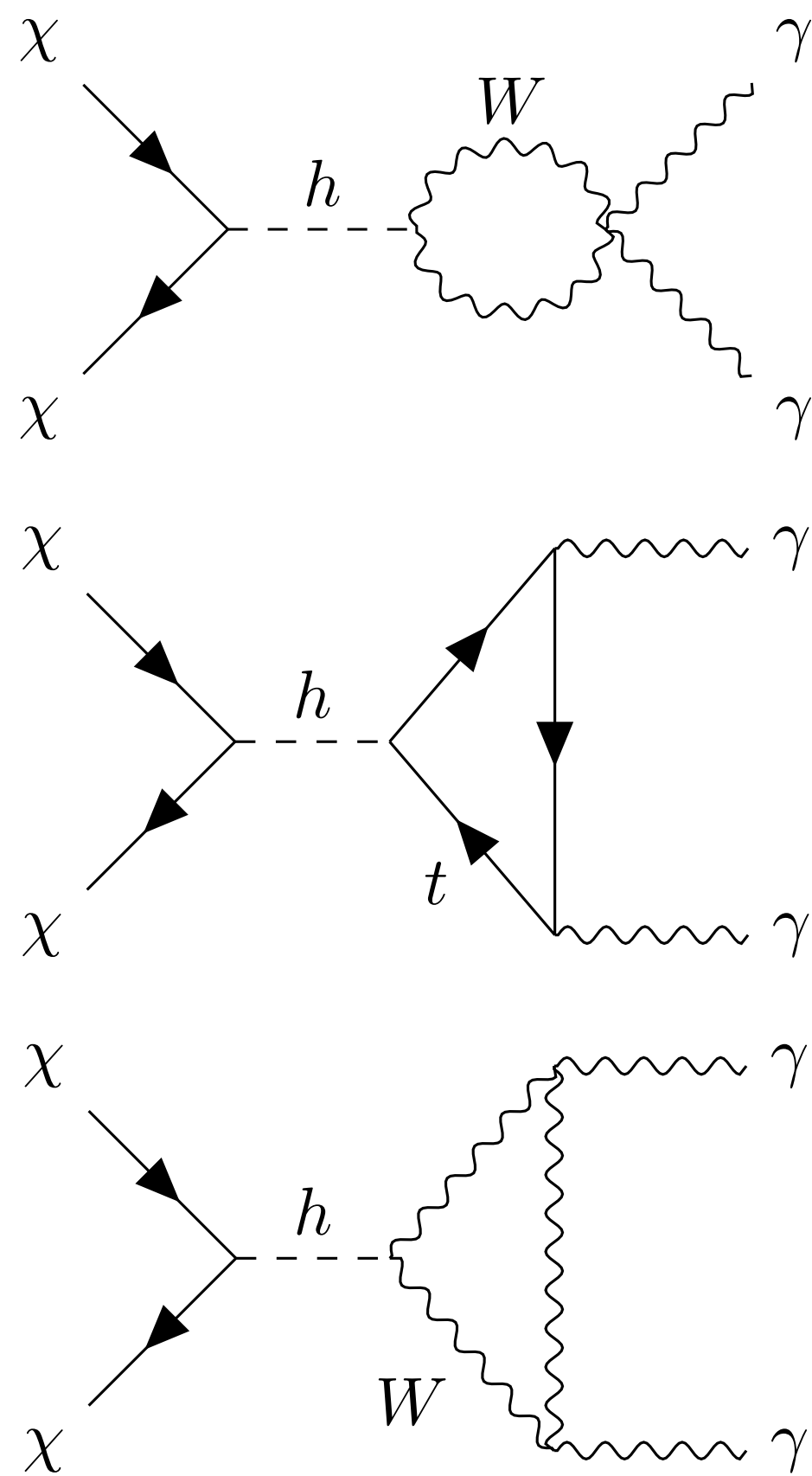


Tree-level annihilation gives
continuum

GCE from Higgs Portal DM

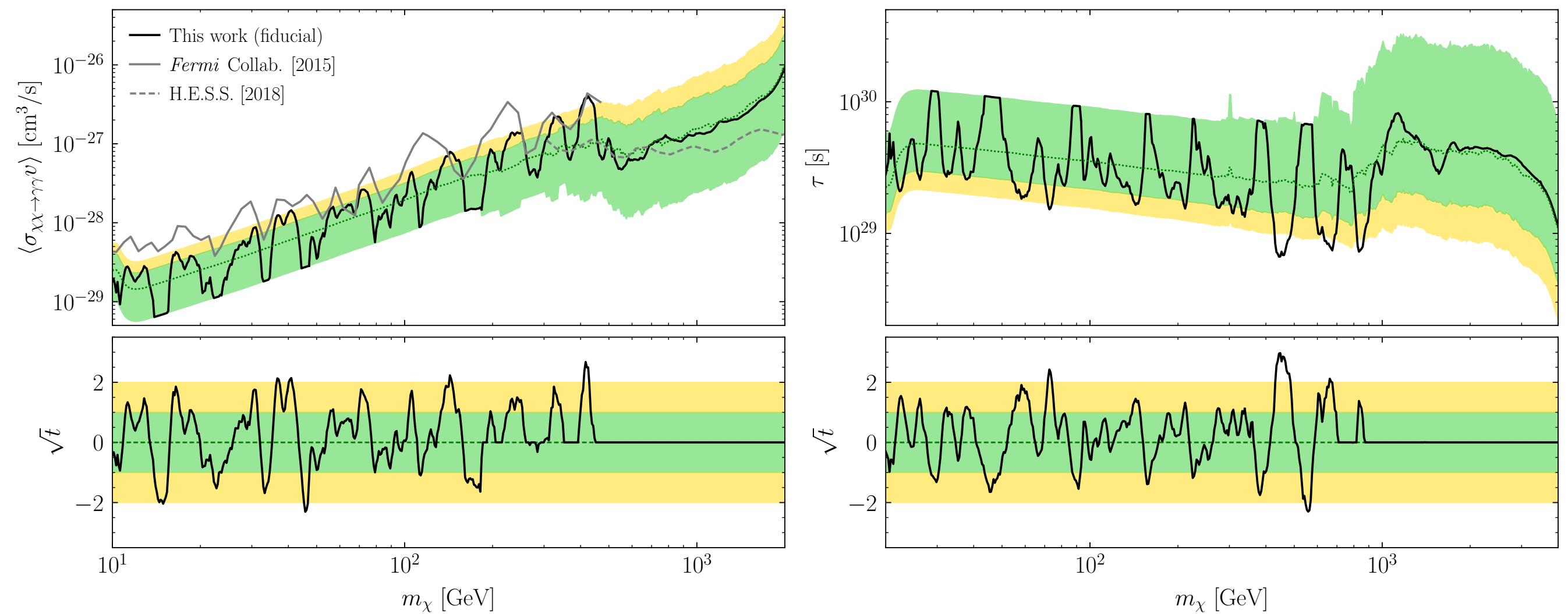
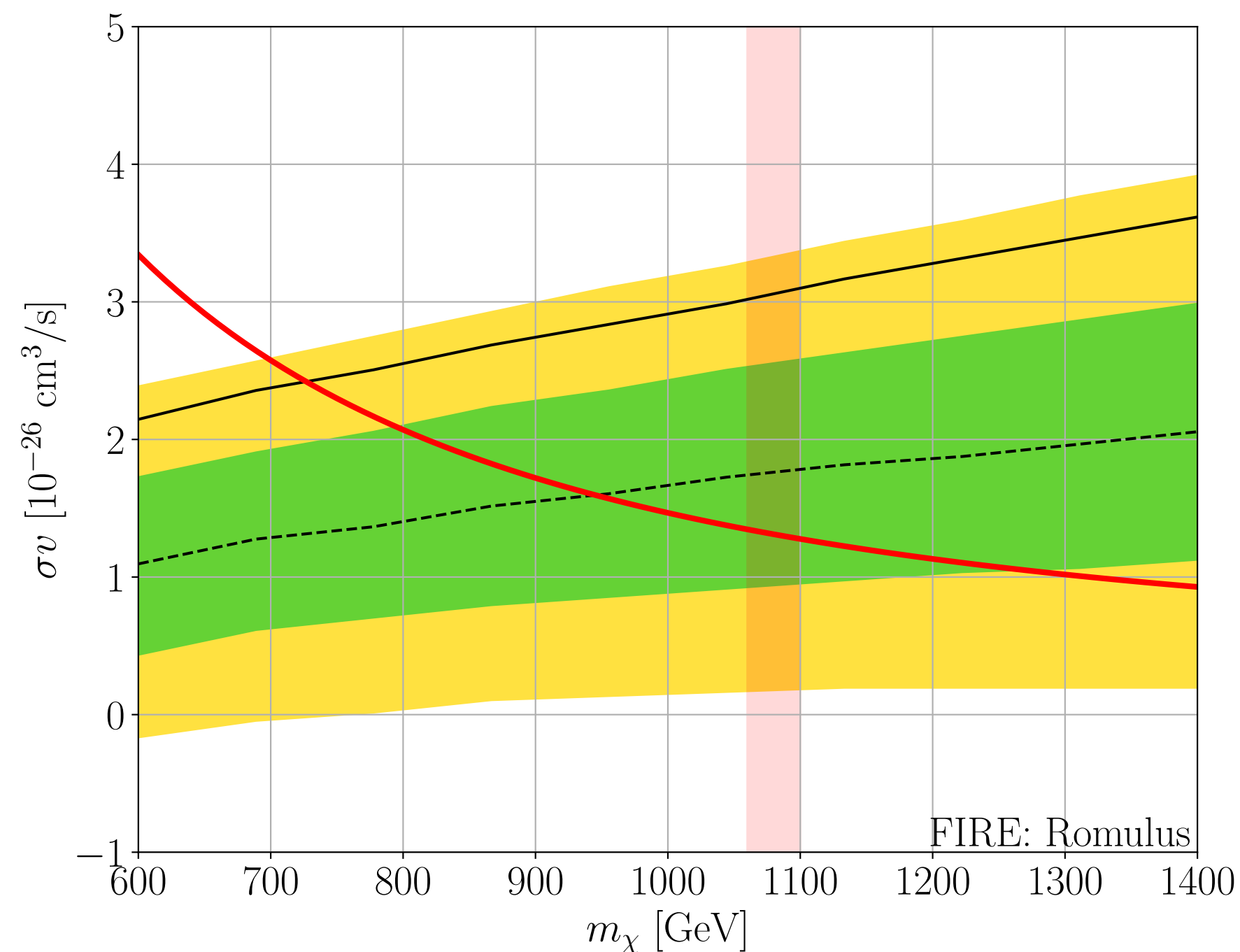
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Loop diagram for
processes of $\chi\chi \rightarrow \gamma\gamma$



Conclusion

- Stronger limits set on the annihilation cross section and decay lifetime of DM in Milky Way halo
- Small 2σ excess observed for the thermal higgsino in continuum search
- Stronger limits expected with future observatories, such as the Cherenkov Telescope Array



Thank you!