

Multi-messenger lifetime constraints on heavy decaying dark matter

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1. High energy ν and γ fluxes from DM

NEUTRINO GENERATION FROM DM SCHEME:



HDMSpectra generates DM neutrino and gamma-ray fluxes C.W. Bauer et. Al. JHEP 06, 121 (2021), arXiv:2007.15001

NEUTRINO GALACTIC CONTRIBUTION:

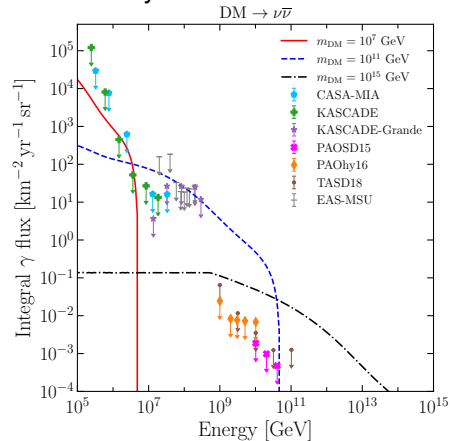
$$\frac{d\Phi_{\nu_{\alpha}+\bar{\nu}_{\alpha}}^{\text{gal.}}}{dE_{\nu}d\Omega} = \frac{1}{4\pi m_{\text{DM}}\tau_{\text{DM}}} \frac{dN_{\alpha}}{dE_{\nu}} \int_0^{\infty} ds \rho_{\text{DM}}[r(s, \ell, b)]$$

GAMMA-RAY GALACTIC CONTRIBUTION:

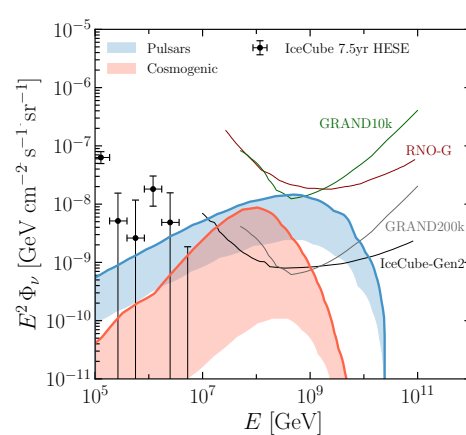
$$\frac{d\Phi_{\gamma}}{dE_{\gamma}d\Omega}(E_{\gamma}, b, l) = \frac{1}{4\pi m_{\text{DM}}\tau_{\text{DM}}} \frac{dN_{\gamma}}{dE_{\gamma}}(E_{\gamma}) \int_0^{\infty} \rho_{\text{DM}}[r(s, b, l)] e^{-\tau_{\gamma\gamma}(E_{\gamma}, s, b, l)} ds$$

2. Gamma ray and neutrino high energy scenario

Gamma-ray:



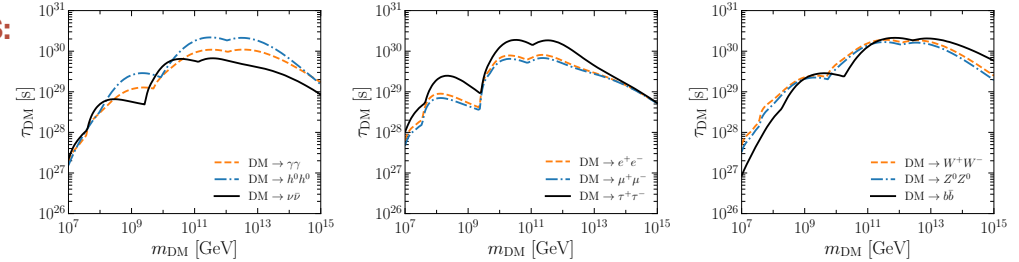
Neutrino:



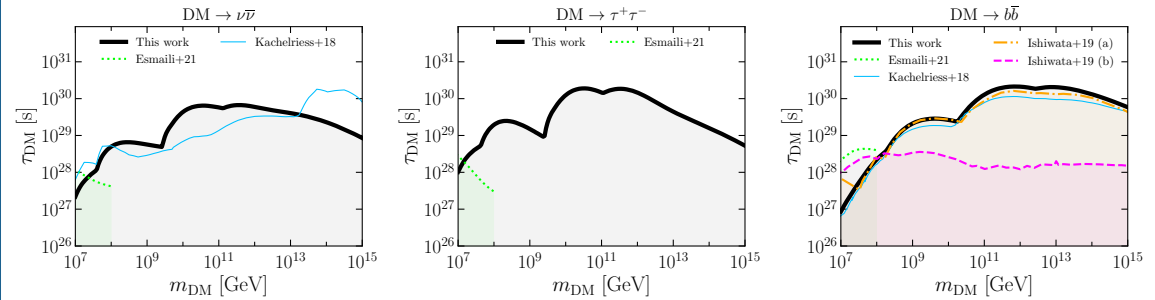
3. New gamma-ray HDDM limits and complementarity

LIMITS:

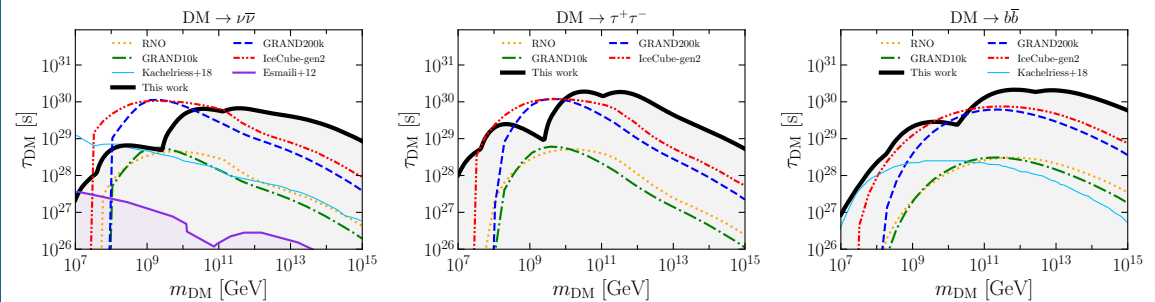
γ -ray limits



Gamma-ray scenario:



Neutrino scenario:



EXISTING LIMITS:

[1] Arman Esmaili+21 Phys. Rev. D 104, L021301 (2021).

[2] M. Kachelriess+18 Phys. Rev. D 98, 083016 (2018).

[3] Koji Ishiwata+19 JCAP 01, 003 (2020).

[4] Arman Esmaili+12 JCAP 11, 034 (2012).

[5] Marco Chianese+21 JCAP 05, 074 (2021).

CONCLUSIONS:

We place conservative upper limits for the DM mass range $m_{\text{DM}} = 10^7 - 10^{15}$ GeV for 9 decay channels, opening 7 channels that were not studied on the literature. Future neutrino telescopes will complement gamma-ray limits providing robustness.