Decaying dark matter in dwarf spheroidal galaxies: Prospects for x-ray and gamma-ray telescopes

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Introduction

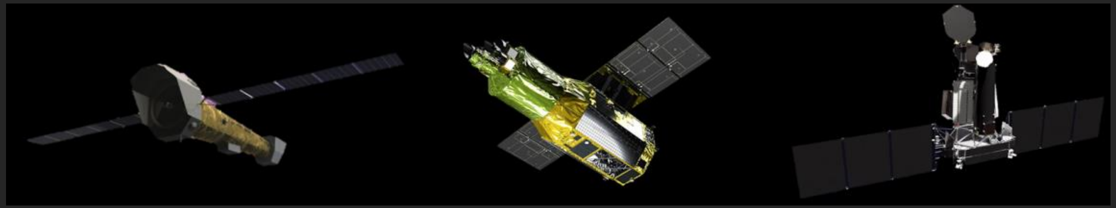
Light Dark Matter

Process:

$$\nu_s \rightarrow \nu_e + \gamma$$

Instruments:

Athena XRISM eROSITA



Heavy Dark Matter

Process:

$$\chi \rightarrow \begin{cases} b\bar{b} \\ \tau^+\tau^- \end{cases} \rightarrow \cdots \rightarrow \gamma$$

Instruments:

HAWC

CTA

Analytical Framework

Flux:

$$\frac{dF}{dE} = \frac{\Gamma_\chi}{4\pi m_\chi}\frac{dN_{\rm decay}}{dE}D\,, \quad D = \int d\Omega \int d\ell \rho_\chi(r[\ell,\psi])$$

D-Factor

Number of Events:

$$N = T\int_{E_1}^{E_2} dE\, A_{\rm eff}(E)\int dE'\, P(E,E')\frac{dF}{dE'}$$

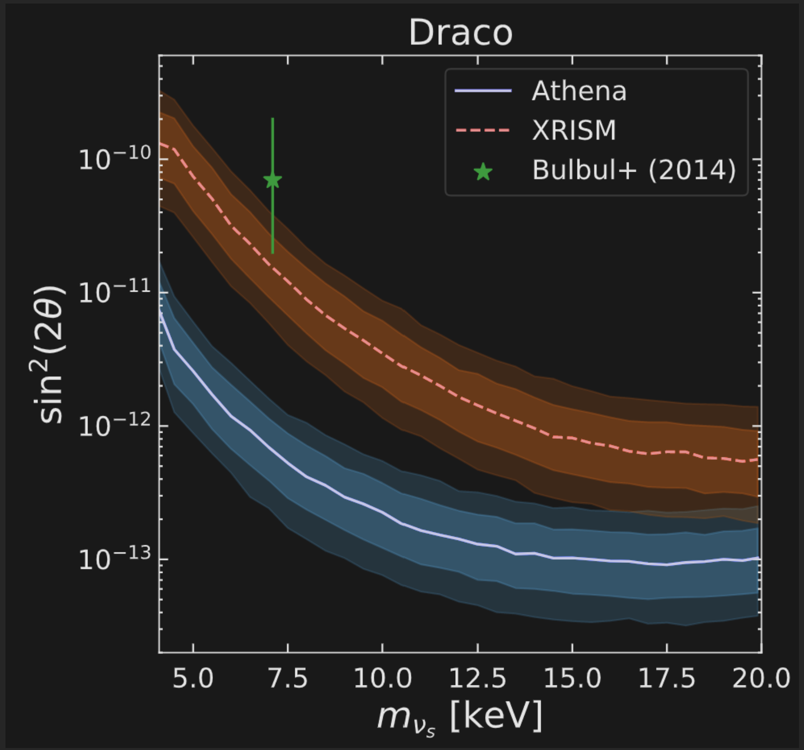
Exposure Time — Effective Area — Energy Resolution

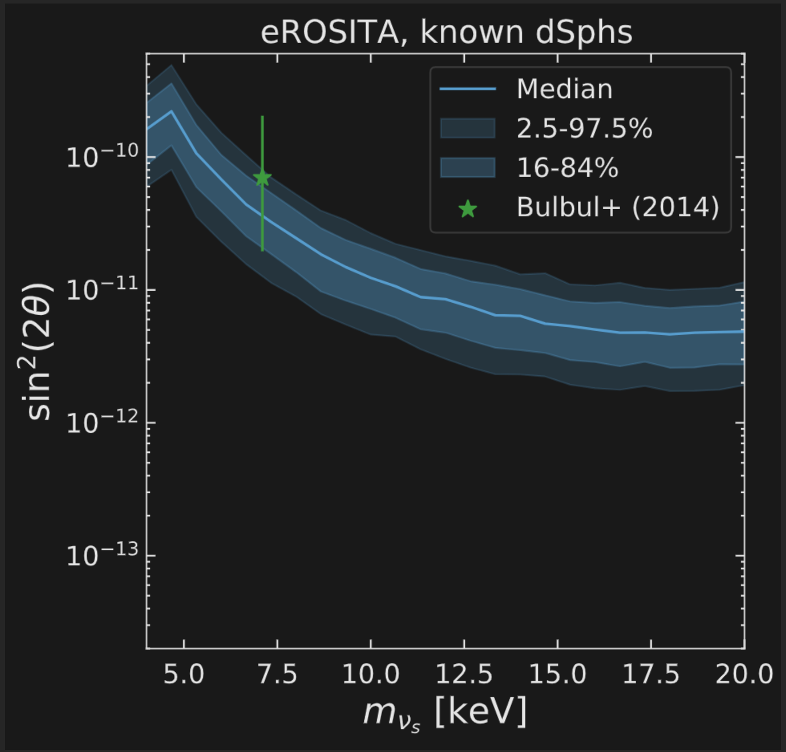
Decay Rate:

$$\mathcal{L}(\Gamma) = \prod_i P[n_i|\mu_i(\Gamma)] = \prod_i \frac{\mu_i(\Gamma)^{n_i}e^{-\mu_i(\Gamma_{\nu_s})}}{n_i!}$$

MCMC Counts (Γ=0) — Model Counts — Poisson Likelihood

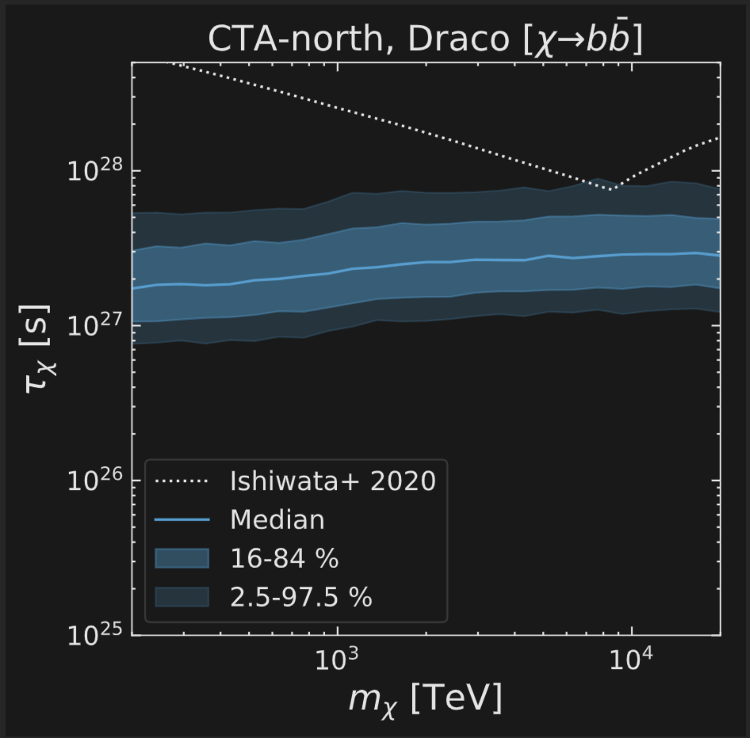
Results & Conclusions — Light Dark Matter

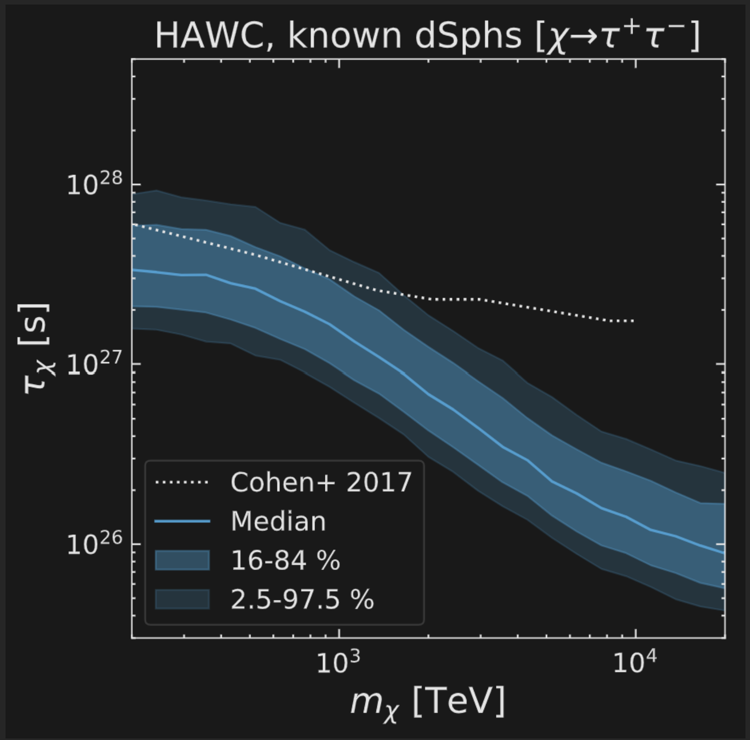




- We explored DM masses between 4 – 20 keV
- Shape influenced by cosmic x-ray background, more dominant at lower energies
- Sensitive enough to assess much debated 3.5-keV lines, suggesting mixing angles of $\sin^2(2\theta) = 7 \times 10^{-11}$, for a 7.1 keV sterile neutrinos

Results & Conclusions — Heavy Dark Matter





- We explored DM masses between 200 TeV – 20 PeV
- Detectors sensitive up to 10^{27} – 10^{28} s, lower for higher masses for the $\tau^+\tau^-$ channel
- HAWC and CTA will complement neutrino detectors probing similar parameter space regions