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Indirect detection of long-lived particles via a less-simplified dark Higgs portal



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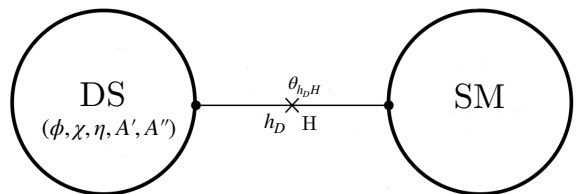
Goal

Heavy WIMP & LLP

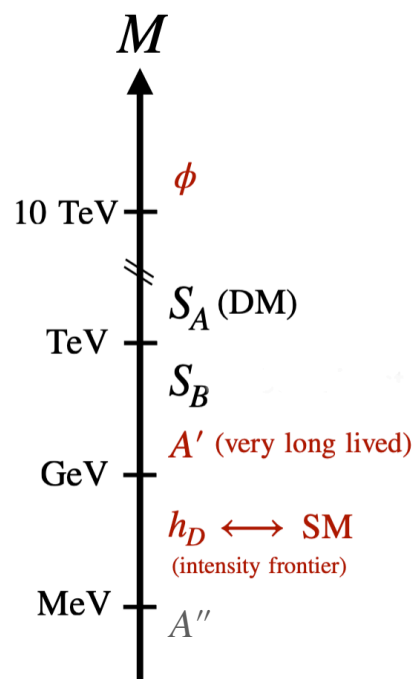
1. An interesting theoretical framework and a promising experimental target.
2. Study Indirect Detection of LLPs to constrain popular BSM scenario with *scalar-vector portal*.

Model

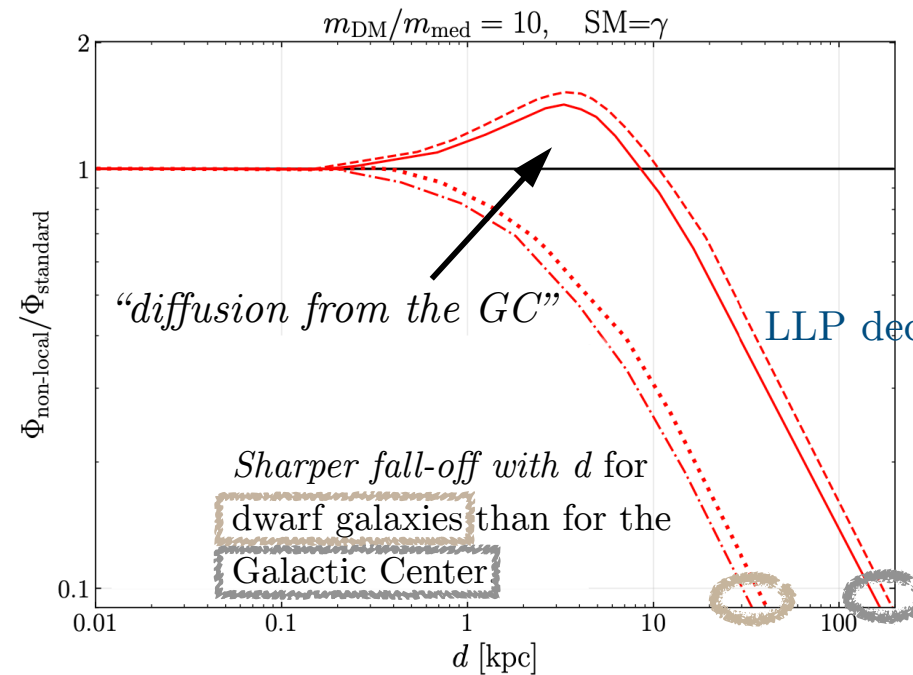
- ▶ Two-component heavy DM (χ, η) coupled to SM
- ▶ through *light dark-Higgs*—dark photon portal



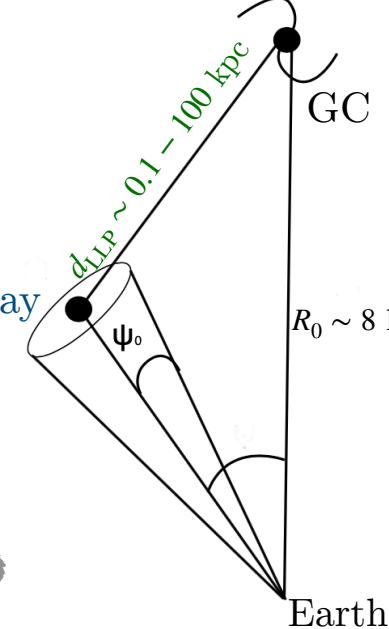
- ▶ χ is a secluded, heavy WIMP which *freezes-out in the DS*
- ▶ assisted freeze-out scenario with $\Omega_\chi h^2 \sim 0.1 \gg \Omega_\eta h^2$
- ▶ CMB bounds are evaded
- ▶ A' is very long lived, $\tau_{A'} \sim 10^{12} s$, therefore it is also necessary that $\Omega_{A'} h^2 \ll 0.1$



Non-local ID effects



LLP production

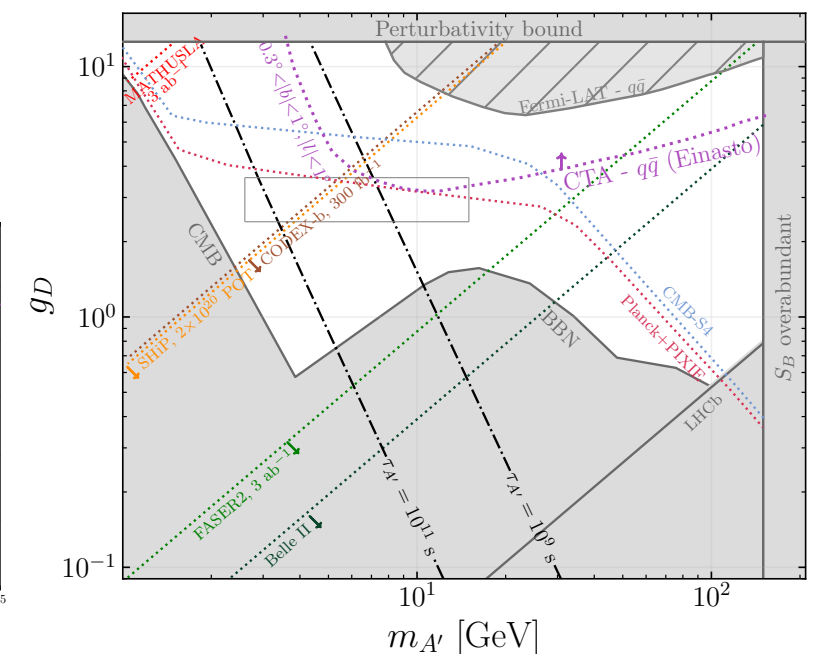
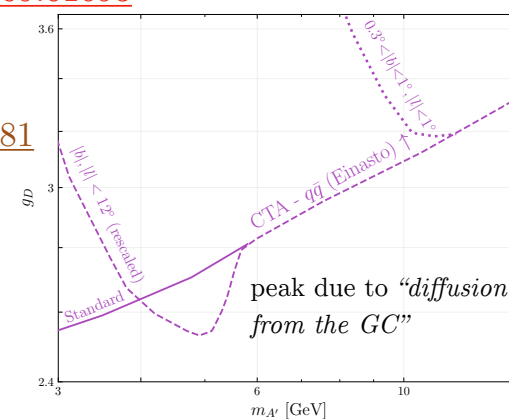


Extra contribution due to LLPs that are produced close to the GC and decay emitting photons along los.

For fixed observational angle θ , min distance of los to GC is $l_{min} = R_0 \sin \theta = (8 \sin \theta) \text{ kpc}$. If $d \sim l_{min}$, there is enhanced contribution coming from the GC.

ID, CMB & IFS complementarity

- ▶ Intensity frontier searches for h_D
 - ★ MATHUSLA: Alpigiani et al., [2009.01693](#)
 - ★ SHiP: Ahdida et al, [1504.04956](#)
 - ★ FASER: Feng et al, [1708.09389](#)
 - ★ CODEX-b: Aielli et al., [1911.00481](#)
- ▶ Indirect Detection
 - * dSph limits, [1503.02641](#)
 - * CTA GC sensitivity, [2007.16129](#)
- ▶ Future CMB limits
 - ❖ PIXIE, [1105.2044](#)
 - ❖ PRISM, [1310.1554](#)



Takeaway

- ▶ *Indirect Detection of LLPs* provides important coverage *complementary to the intensity frontier searches*, while *non-local effects* definitively distinguish LLPs from WIMPs: i) “diffusion from the GC” increases the flux and ii) the flux decreases faster as a function of d for dSph than for GC, which evades constraints.