Probing Heavy Dark Matter Decays with Multi-Messenger Astrophysical Data

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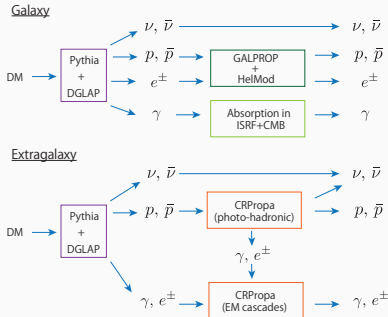November 11, 2019

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Outline of the procedure to obtain constraints on decaying DM

Production/propagation of CRs from DM:

- $M_\chi = 10^4 - 10^{16}$ GeV, decaying into the $b\bar{b}$ channel.
- Galactic/extragalactic CRs from DM were considered.

CR data and statistical approach:

- Used measurements/upper limits of γ, ν, p, $\bar{p}$ and $e^\pm$ CRs.
- Constraints were obtained by requiring that the predicted fluxes do not overshoot CR measurements.

CRs	Observations	Energy [GeV]	Detected	CL upper limits
Gamma (γ)	Fermi-LAT	$10^{-2} - 10^3$	✓	
	CASA-MIA	$10^5 - 10^7$		90%
	KASCADE	$10^5 - 10^7$		90%
	KASCADE-Grande	$10^7 - 10^8$		90%
	PAO	$10^9 - 10^{10}$		95%
	TA	$10^9 - 10^{11}$		95%
Proton (p)	PAO	$10^9 - 10^{11}$	✓	84%
Anti-proton ($\bar{p}$)	PAO	$10^9 - 10^{11}$	✓	84%
	AMS-02	$10^{-1} - 10^2$	✓	
Positron (e^+)	AMS-02	$10^{-1} - 10^3$	✓	
Neutrino (ν)	IceCube	$10^5 - 10^8$	✓	90%
	IceCube	$10^6 - 10^{11}$		90%
	PAO	$10^8 - 10^{11}$		90%
	ANITA	$10^9 - 10^{12}$		90%

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Main Results:
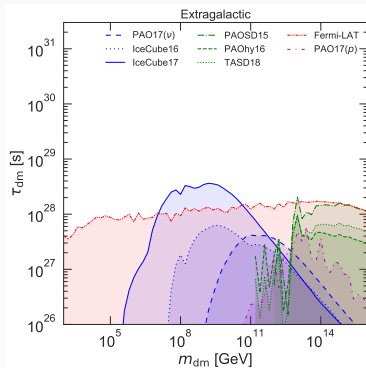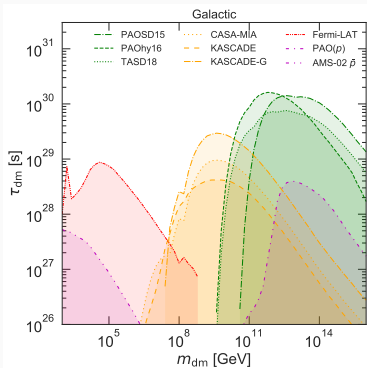
Used γ, ν, p, $\bar{p}$ and $e^{\pm}$ CRs measurements:

- We excluded dark matter lifetimes of 10^{28} s or shorter for all the masses investigated in this work.

- The most stringent constraints reach 10^{30} s for very heavy dark matter of masses of $\sim 10^{11}$–10^{14} GeV.