Search for Secluded Dark Matter with H.E.S.S. and Fermi-LAT Telescopes and Planck Satellite

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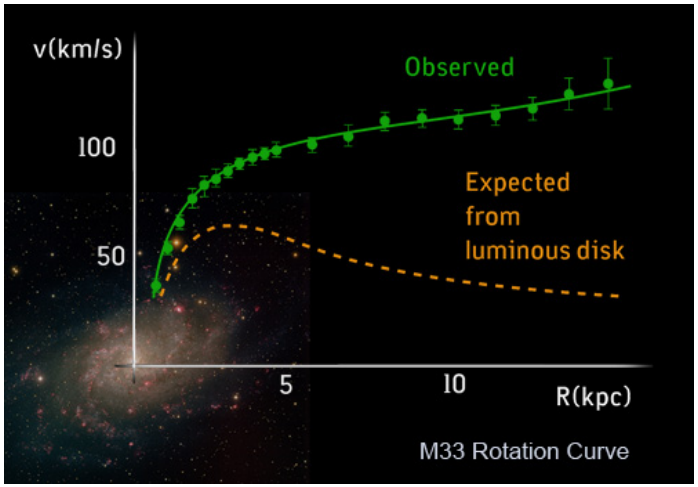
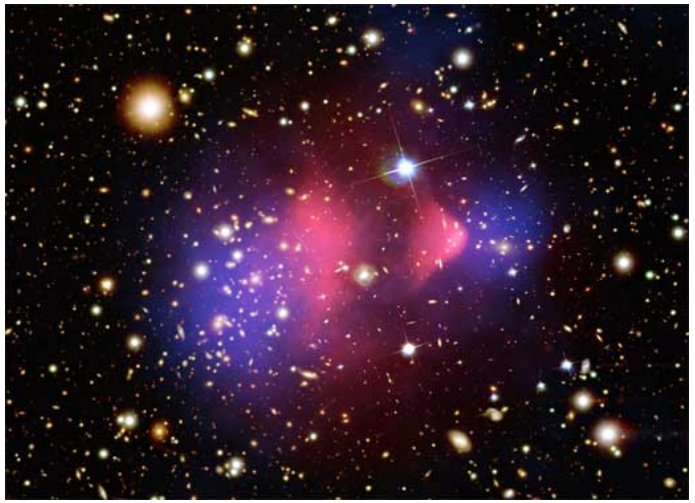
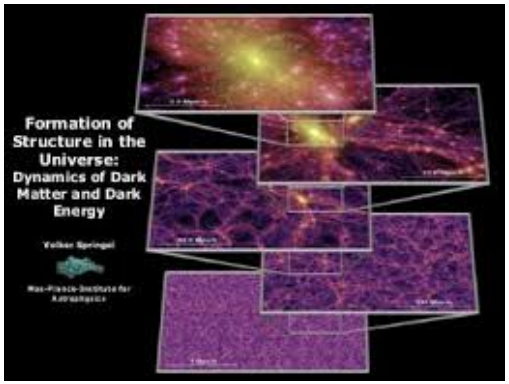
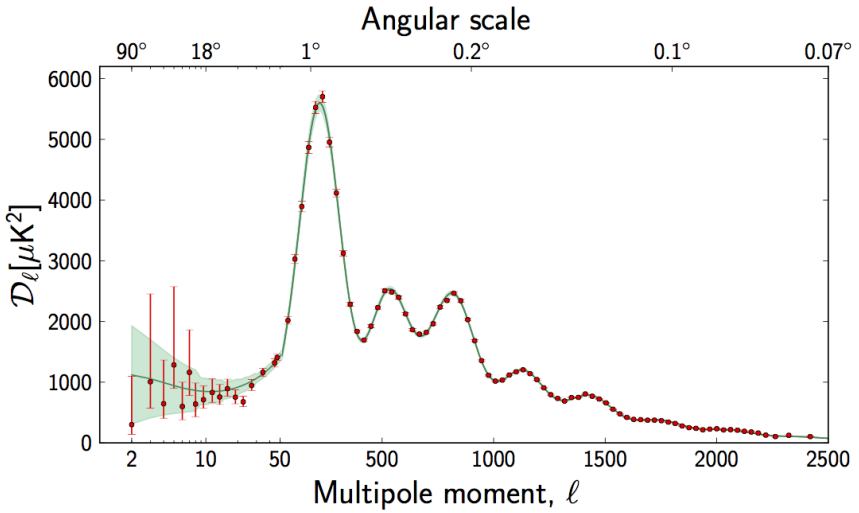
Introduction - The Dark Matter Problem









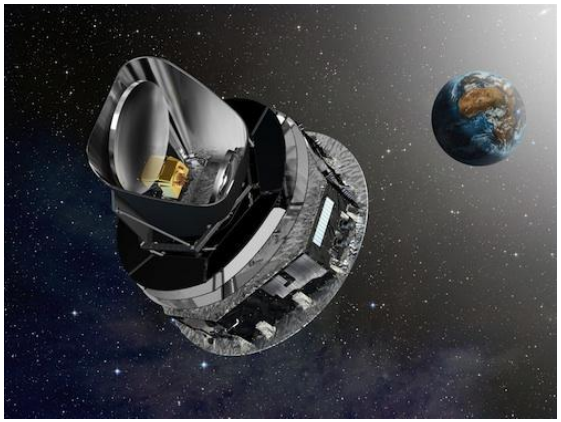
Motivation

- What is the importance of Secluded DM Models?
- How we can constrain this kind of Model?
- Which DM mass region is more constrained for what experiment?
- How the results can be affected by changing the mass of the mediator?

Experiments

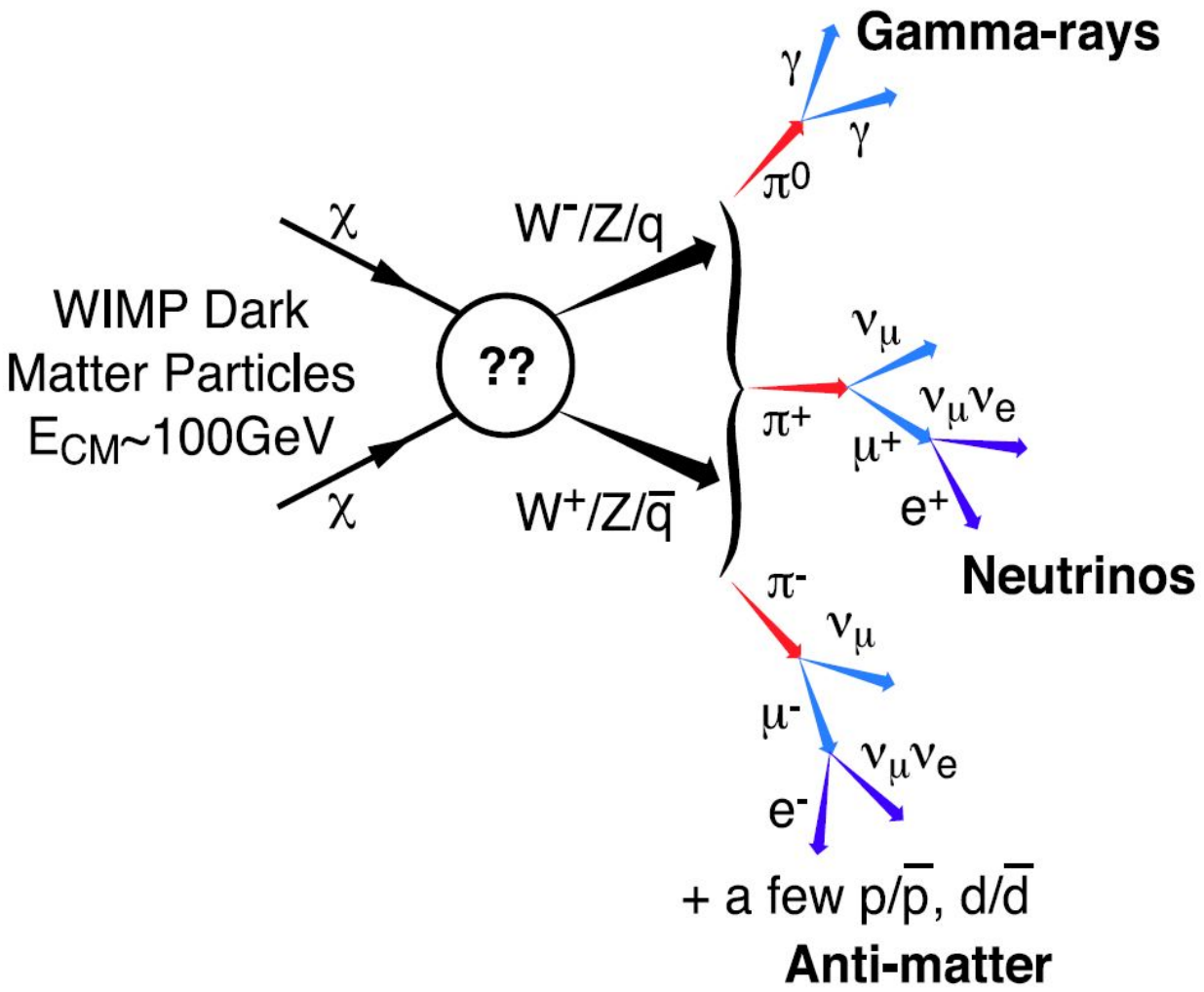
Fermi-LAT Telescope: energy 500 MeV - 500 GeV

HESS Telescope: energy 230 GeV - 30 TeV

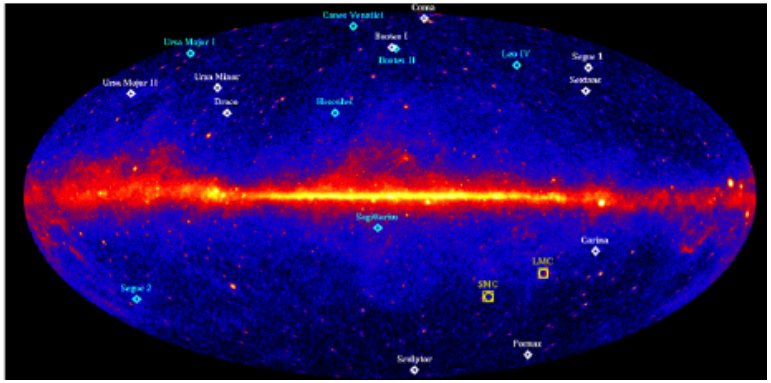


Planck Satellite

Indirect Detection



Targets: Dwarf Spheroidal Galaxies × Galactic Centre



dSph

- Predominantly composed by DM
- J-factor $\sim 10^{19}$ GeV^2/cm^{-5}
- Lack of background
- Conservative

GC

- J-factor $\mathcal{O}(100)$ times larger
- bright, structured background
- Optimistic

Indirect Detection

The photon flux is given by

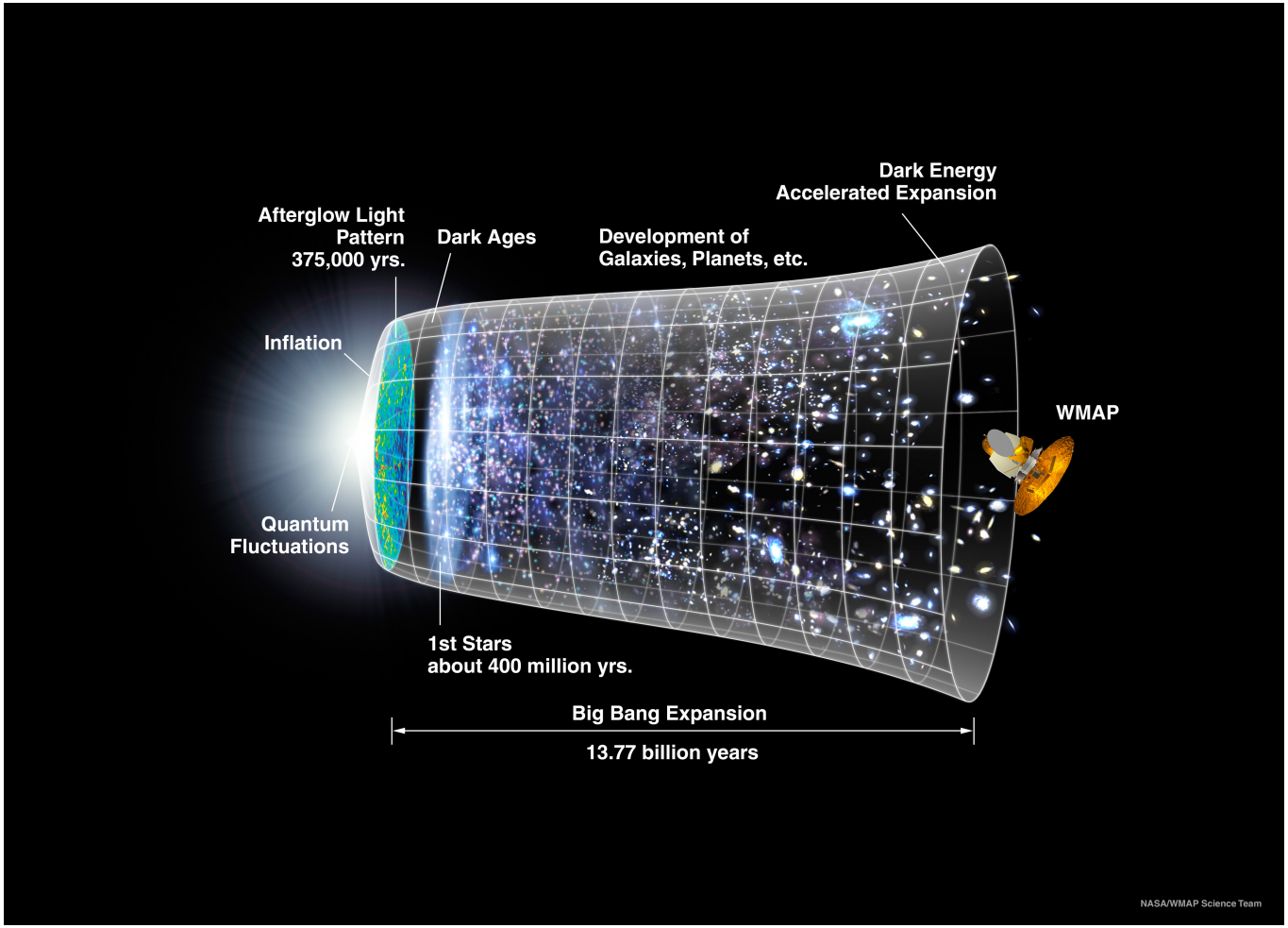
$$\frac{d\Phi_\gamma}{dE}(E_\gamma) = \frac{1}{4\pi}\frac{\langle\sigma v\rangle}{2M_{DM}^2}\frac{dN_\gamma}{dE_\gamma}J_{ann} \tag{1}$$

where J_{ann} is the annihilation J-factor,

$$J_{ann} = \int_{\Delta\Omega} d\Omega \int \rho_{DM}^2(s)ds \ , \tag{2}$$

with $s = s(\theta)$, and the integral is computed over the line of sight within the solid angle.

CMB constraints



CMB constraints

The energy injected in the IGM:

$$\frac{dE}{dtdV} = \rho_c^2 c^2 \Omega_\chi^2 (1+z)^6 P_{ann}(z) \tag{3}$$

whose P_{ann} (annihilation parameter) is given by

$$P_{ann} = f_{eff} \frac{\langle \sigma v \rangle}{m_{DM}} \tag{4}$$

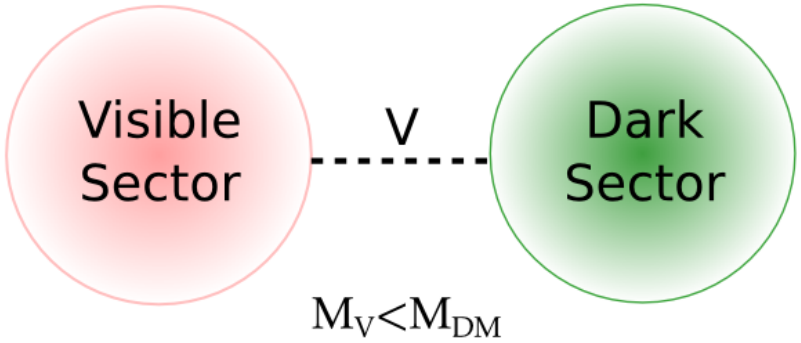
where f_{eff} is the effective efficiency function:

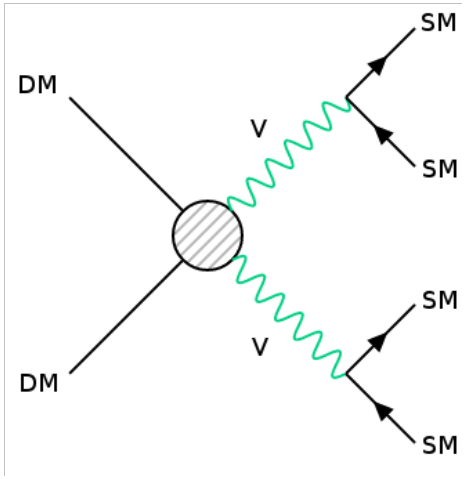
$$f_{eff} = \frac{1}{2m_{DM}} \int_0^{m_{DM}} EdE \left(f_{eff}^{\gamma}(E) \frac{dN}{dE^{\gamma}} + 2 f_{eff}^{e^+}(E) \frac{dN}{dE^{e^+}} \right). \tag{5}$$

The latest Planck constraint on P_{ann} is given by,

$$P_{ann} < 4.1 \times 10^{-28} cm^3 s^{-1} GeV^{-1}. \tag{6}$$

The Secluded DM Model

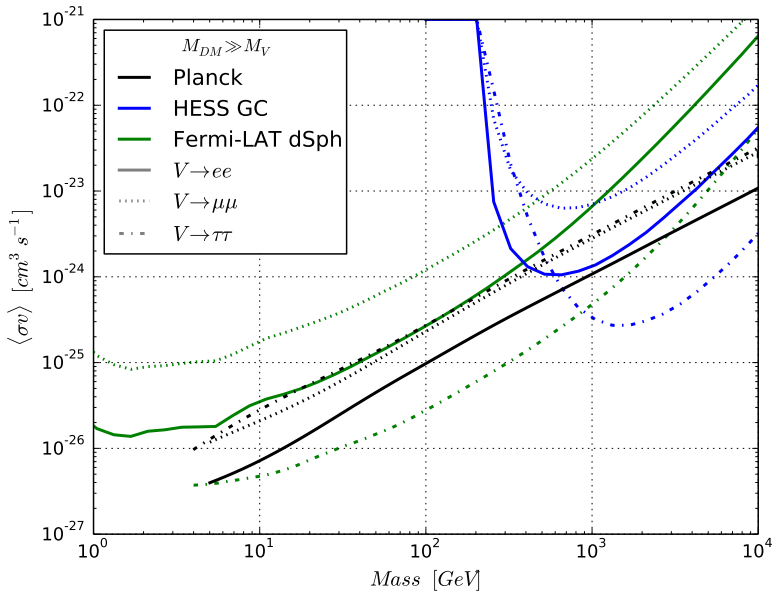


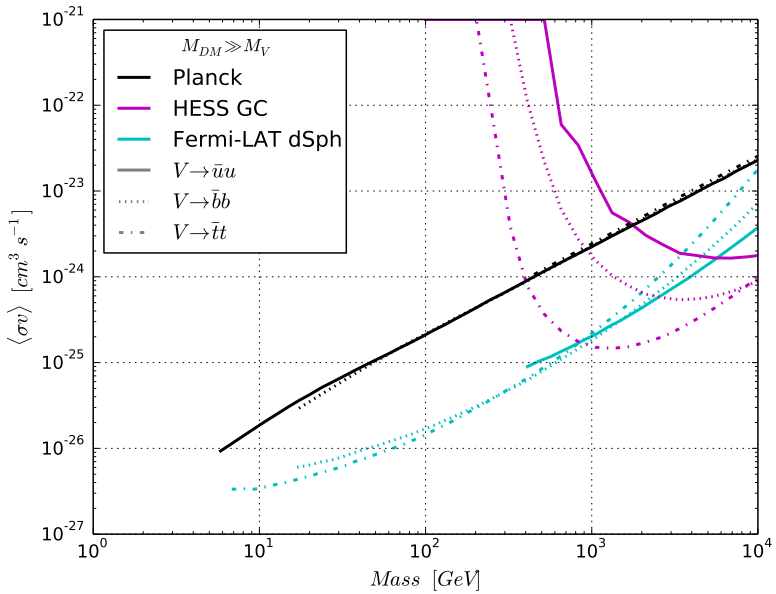


Motivation

- Can avoid Direct Detection and Collider Searches
- Distinct Indirect Searches Signatures
- We studied two different cases: $M_V \ll M_{DM}$ and $M_V \sim M_{DM}$
- Model independent approach

Results

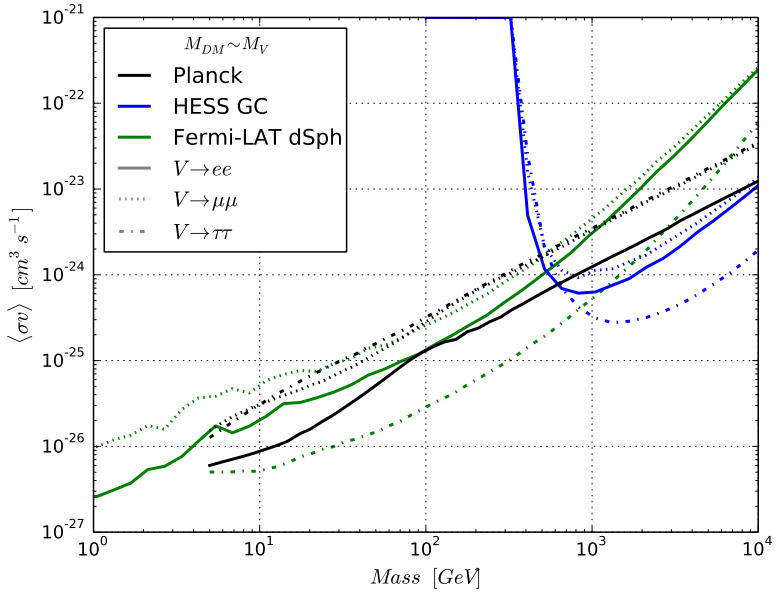


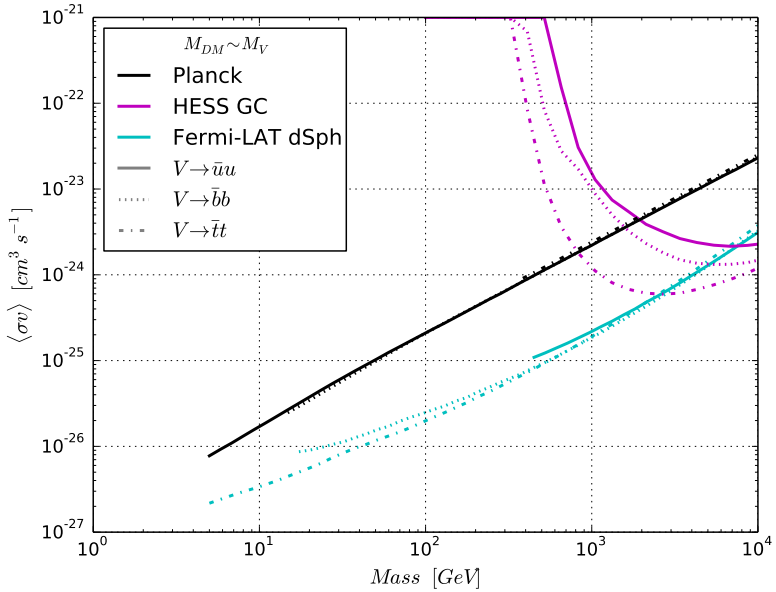


Packages

Pythia/PPPC, GamLike, Slatyer's routines

Results





Packages

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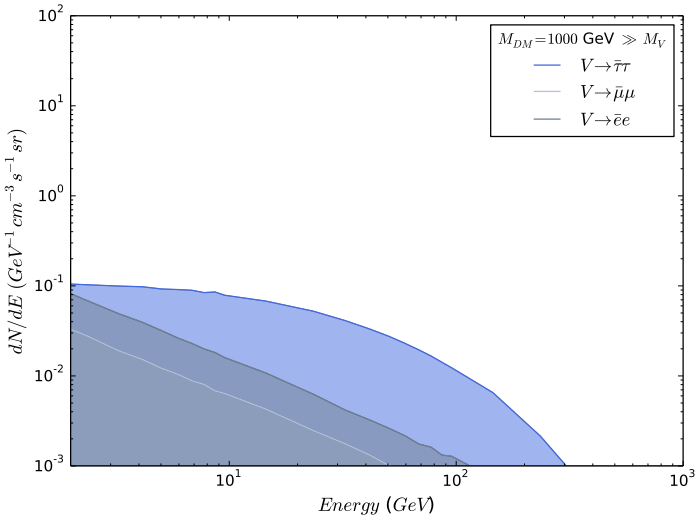
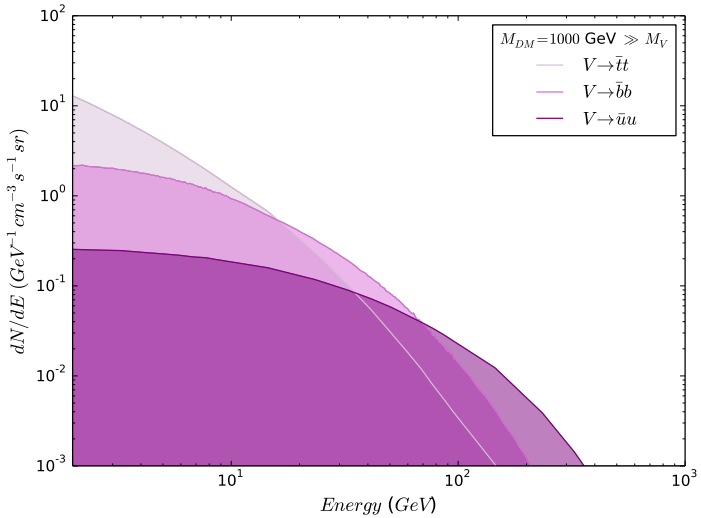
Conclusions

- We compute and compare constraints on Secluded DM Models via CMB and indirect detection experiments (Fermi-LAT dSph and HESS GC) for leptons and quarks channels;
- We use two different regimes, for $M_V \ll M_{DM}$ and $M_V \sim M_{DM}$.

Thank you for your attention!


M_{DM}=1000 GeV $\gg M_V$
$V\to\bar{\tau}\tau$
$V\to\bar{\mu}\mu$
$V\to\bar{e}e$
$dN/dE\ (GeV^{-1}\,cm^{-3}\,s^{-1}\,sr)$
$Energy\ (GeV)$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$V\to\bar{u}u$
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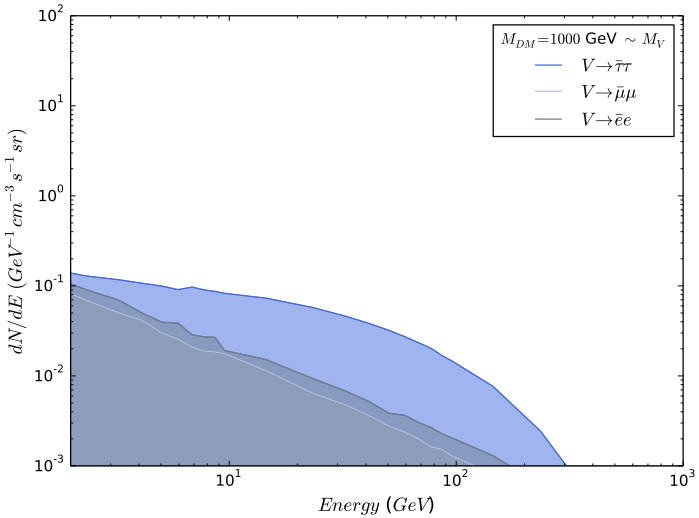
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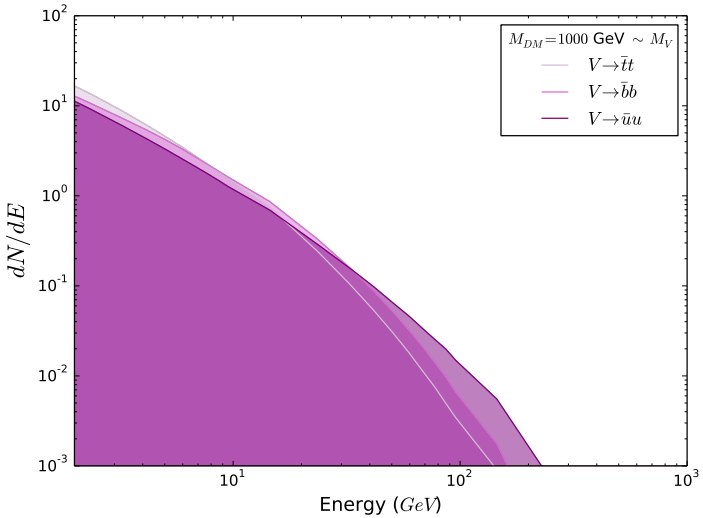
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