Indirect dark matter searches in ultra faint dwarf galaxies

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- Dark matter (DM) may self-annihilate → gamma-ray signal.
- Dwarf galaxies (DG) are promising targets.
- LSST, DECam, PanSTARRS and MagLiteS: many new DGs.
- Improvement in the sensitivity by the Cherenkov Telescope Array (CTA).

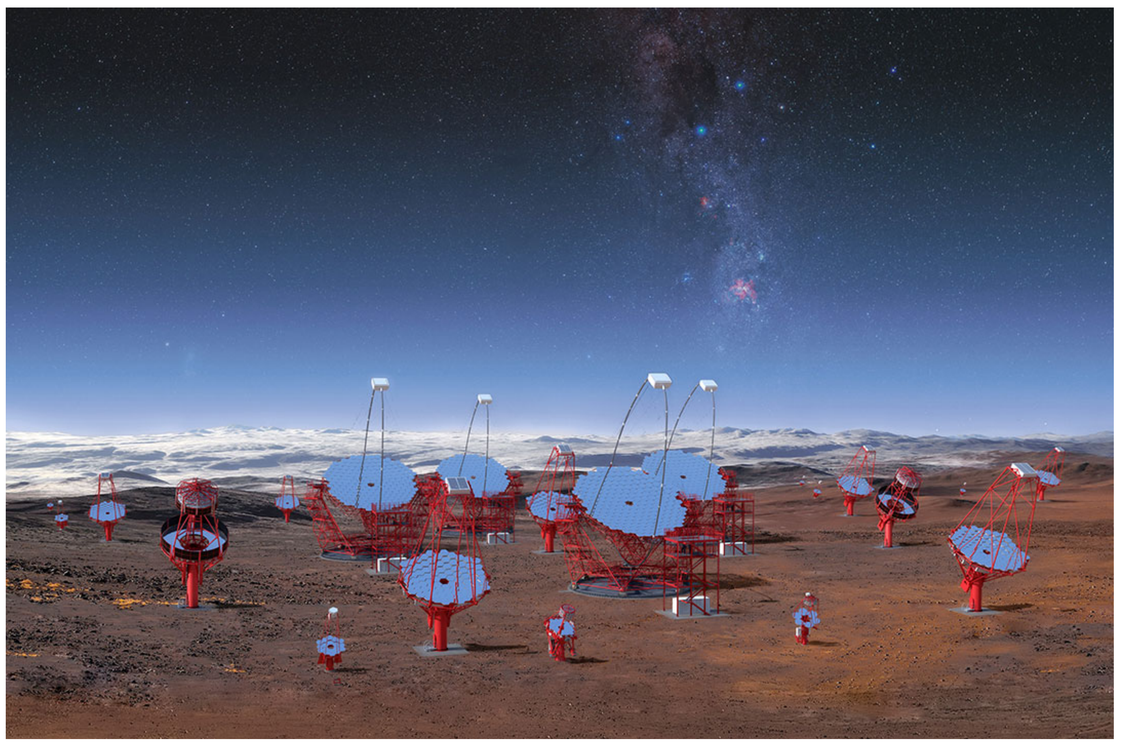

Figure 1: Artist view of the three classes of the 99 telescopes planned for the southern hemisphere at ESO's Paranal Observatory. Credit: CTA/M-A. Besel/IAC (G.P. Diaz)/ESO

The total satellite population of the Milky Way

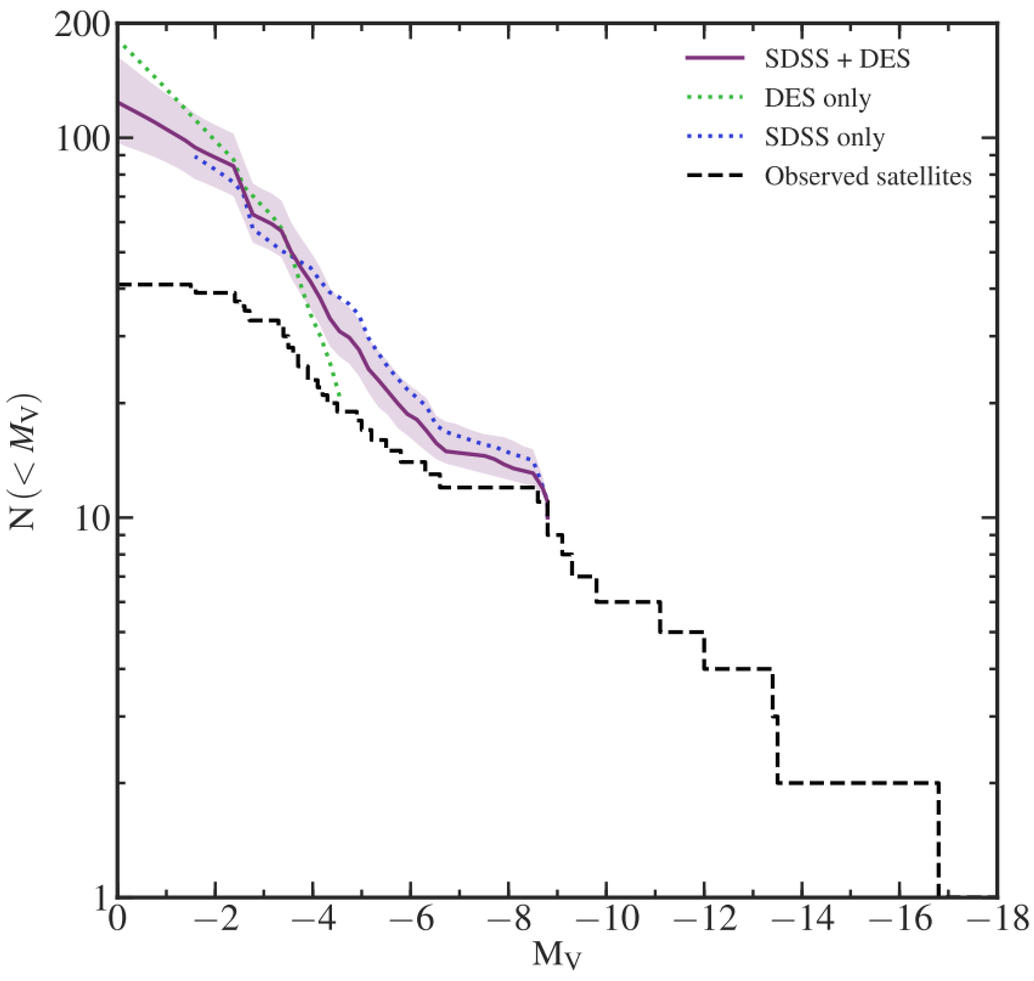

Figure 2: The total luminosity function of dwarf galaxies within a radius of 300 kpc from the Sun calculated by combining the SDSS and DES data. Credit: [2].

Spatial distribution of satellites:

$$\rho_{SH}(r) = 2192.085 \times exp\left\{-\frac{2}{0.678}\left[\left(\frac{r}{209.912}\right)^{-0.678} - 1\right]\right\} \qquad (1)$$

Gamma-rays

Expected gamma-ray differential flux from DM annihilation [4]:

$$\frac{\mathrm{d}\Phi_{\gamma\gamma}(m_\chi, E_\gamma, M, r, \Delta\Omega)}{\mathrm{d}E} = \frac{\mathrm{d}\Phi_{PP}(m_\chi, E_\gamma)}{\mathrm{d}E} \times \Phi_{los}(M, r, \Delta\Omega), \qquad (2)$$

$$\frac{\mathrm{d}\Phi_{PP}(m_\chi, E_\gamma)}{\mathrm{d}E} = \frac{1}{8\pi}\frac{\sigma v}{m_{DM}^2} \times \frac{dN}{dE}, \qquad (3)$$

$$\Phi_{los}(\psi, \Delta\Omega) \;\alpha\; \int_c dc \int\int_{\Delta\Omega} d\theta d\phi \int_\lambda \lambda^2 \times \\ \times[\rho_{sh}(M_h, R(R_\odot, \lambda, \psi, \theta, \phi)) \times P(c) \times J_{sh}]. \qquad (4)$$

Results

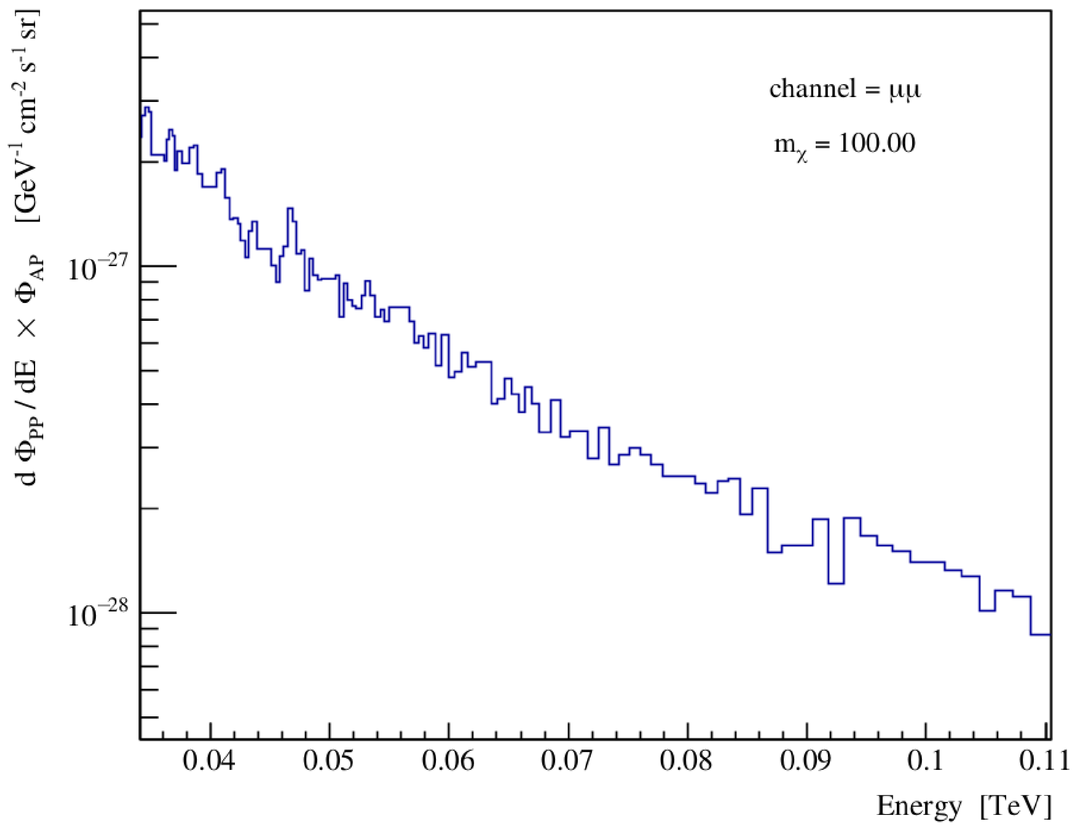

Figure 3: Differential gamma-ray flux (Eq. 2) produced by the annihilation of DM as a function of energy.

Next steps

- Apply the sensitivity curves of CTA to the flux generated by the DGs.

References

[1] CTA Consortium. Science with the cherenkov telescope array. 2017. doi: 10.1142/10986.

[2] Newton et al. The total satellite population of the milky way. *Monthly Notices of the Royal Astronomical Society*, 479:2853–2870, 2018.

[3] Pieri et al. Dark matter annihilation in substructures revised. *Monthly Notices of the Royal Astronomical Society*, 384(4):1627–16–37, 2008.

[4] Pieri et al. Implications of high-resolution simulations on indirect dark matter searches. *Physical Review D - Particles, Fields, Gravitation and Cosmology*, 83, 2011.

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