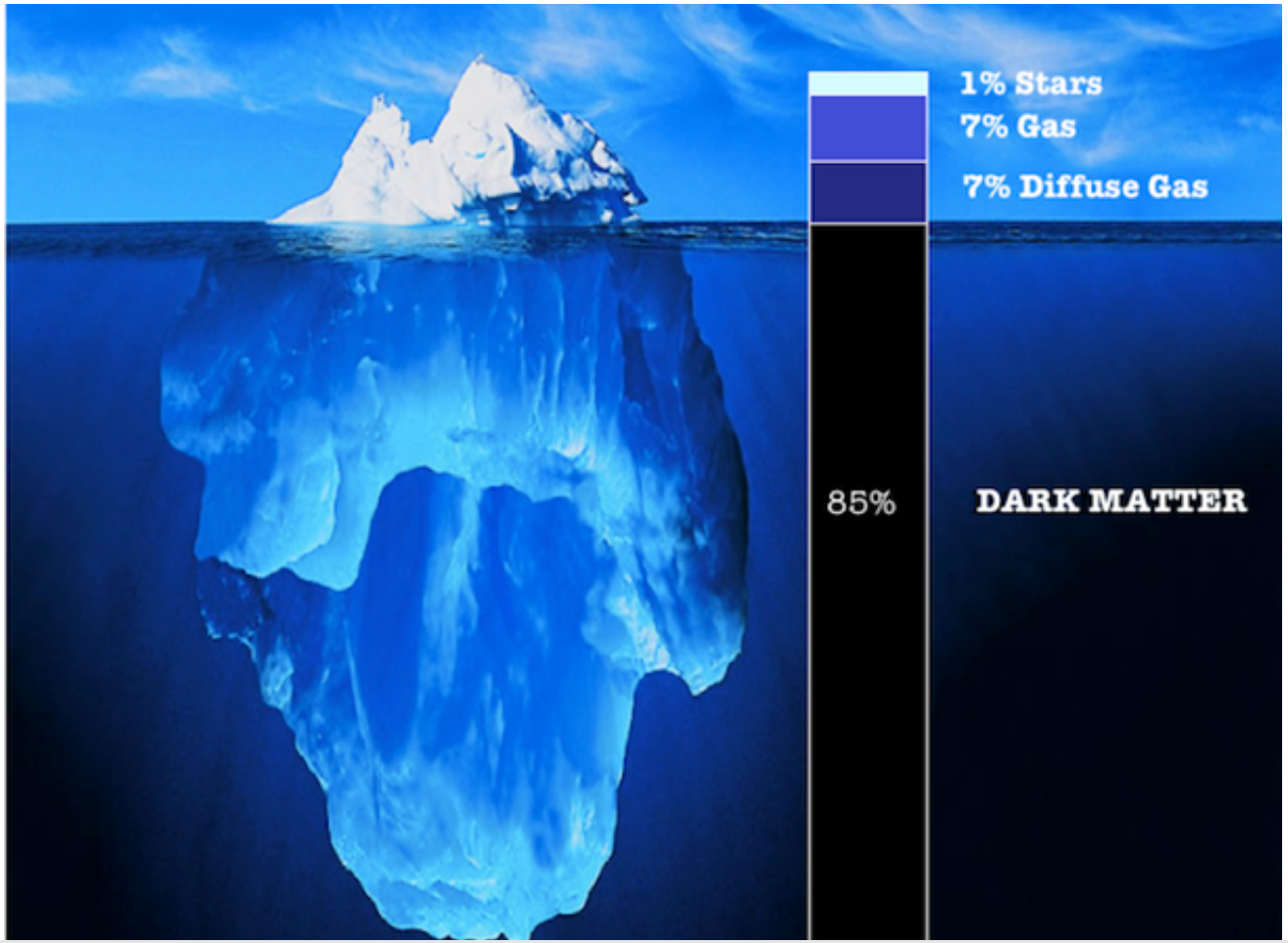
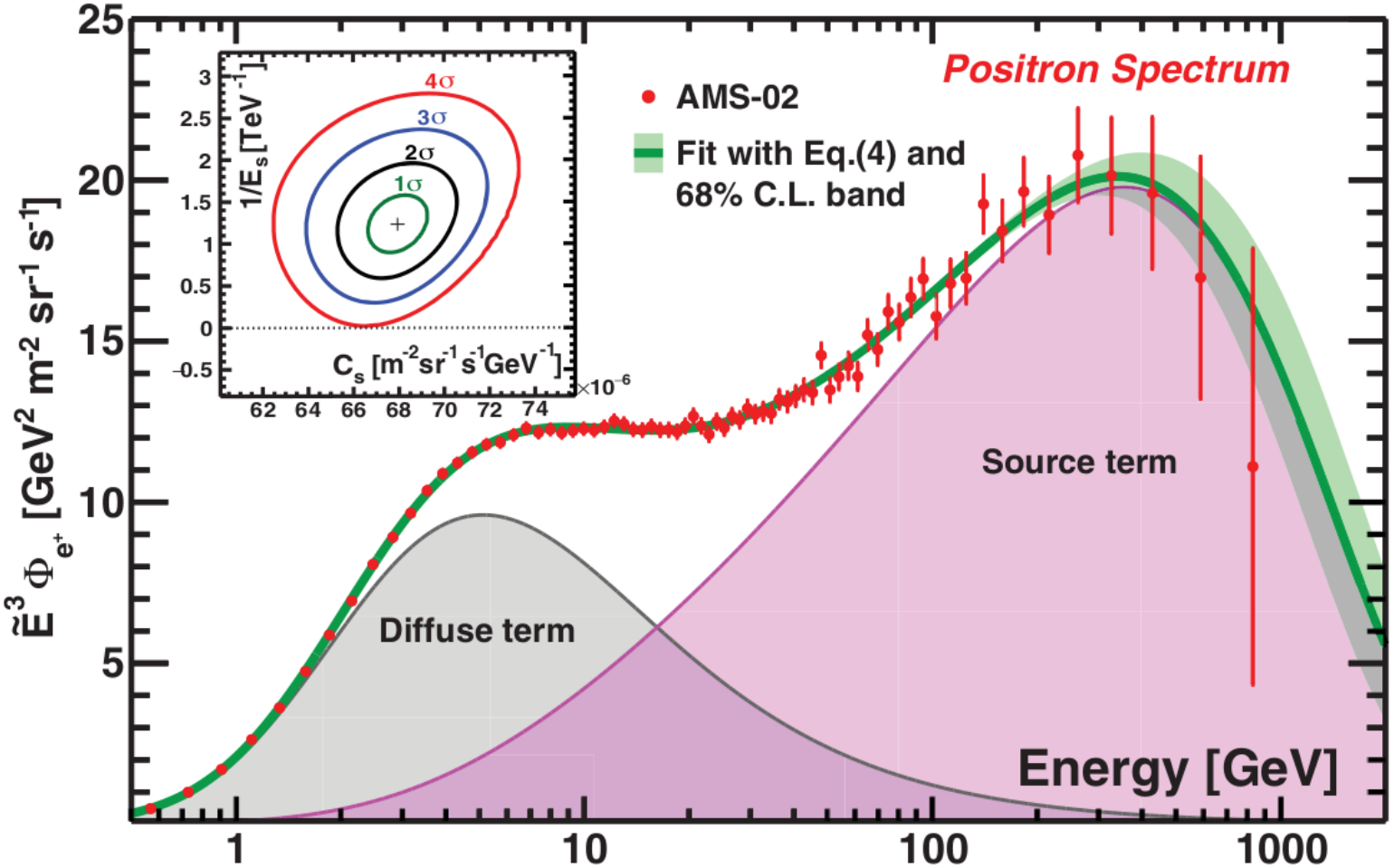
Has AMS-02 Observed Two-Component Dark Matter?

in collaboration with Stefano Profumo and Farinaldo Queiroz



Motivation - Results AMS-02

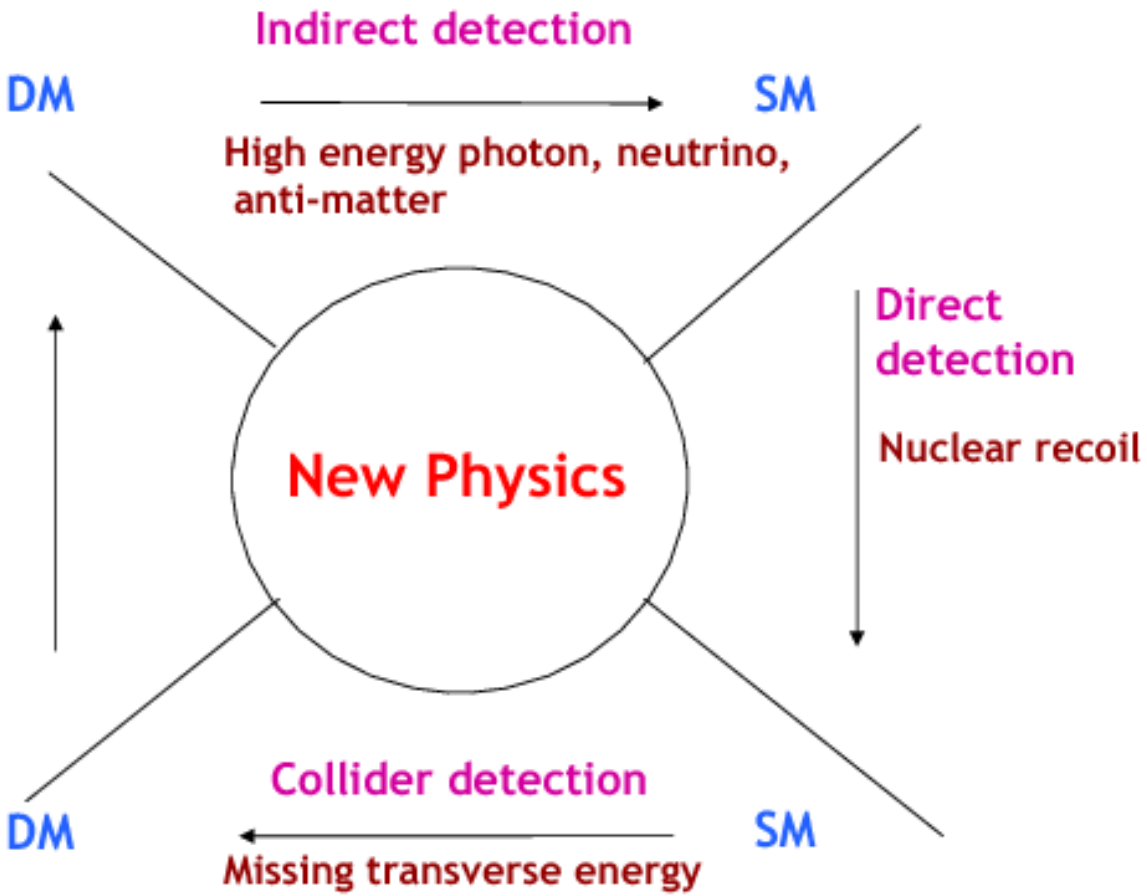


Aguilar *et al.*, 2019

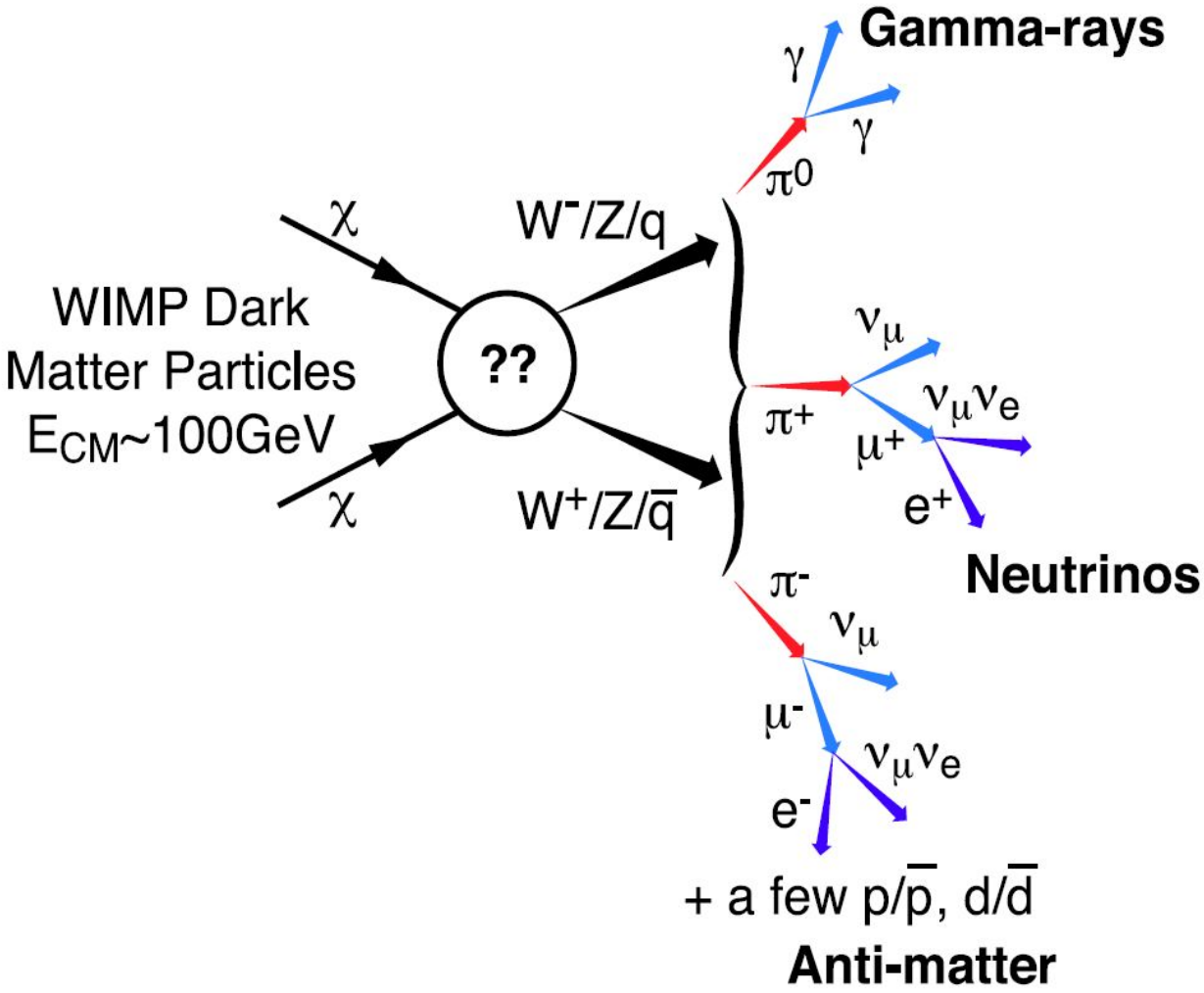
Several works trying to explain the data

- Pulsars: B1055-52 (Fang *et al.*, 2019), Milisecond (Bykov *et al.*, 2019)
- Annihilating or decaying DM (Geng *et al.*,2019)

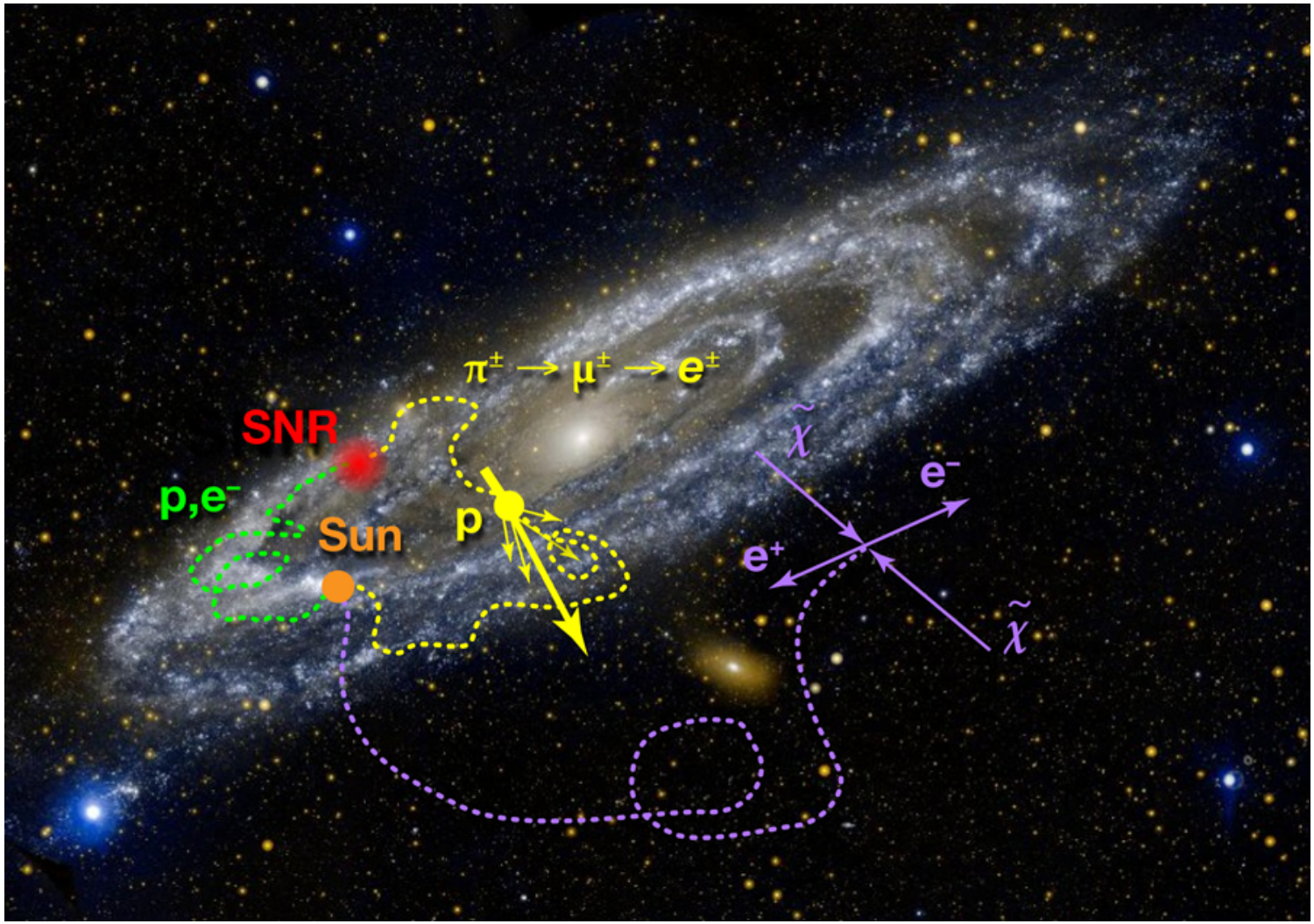
DM Particle - Detection Methods



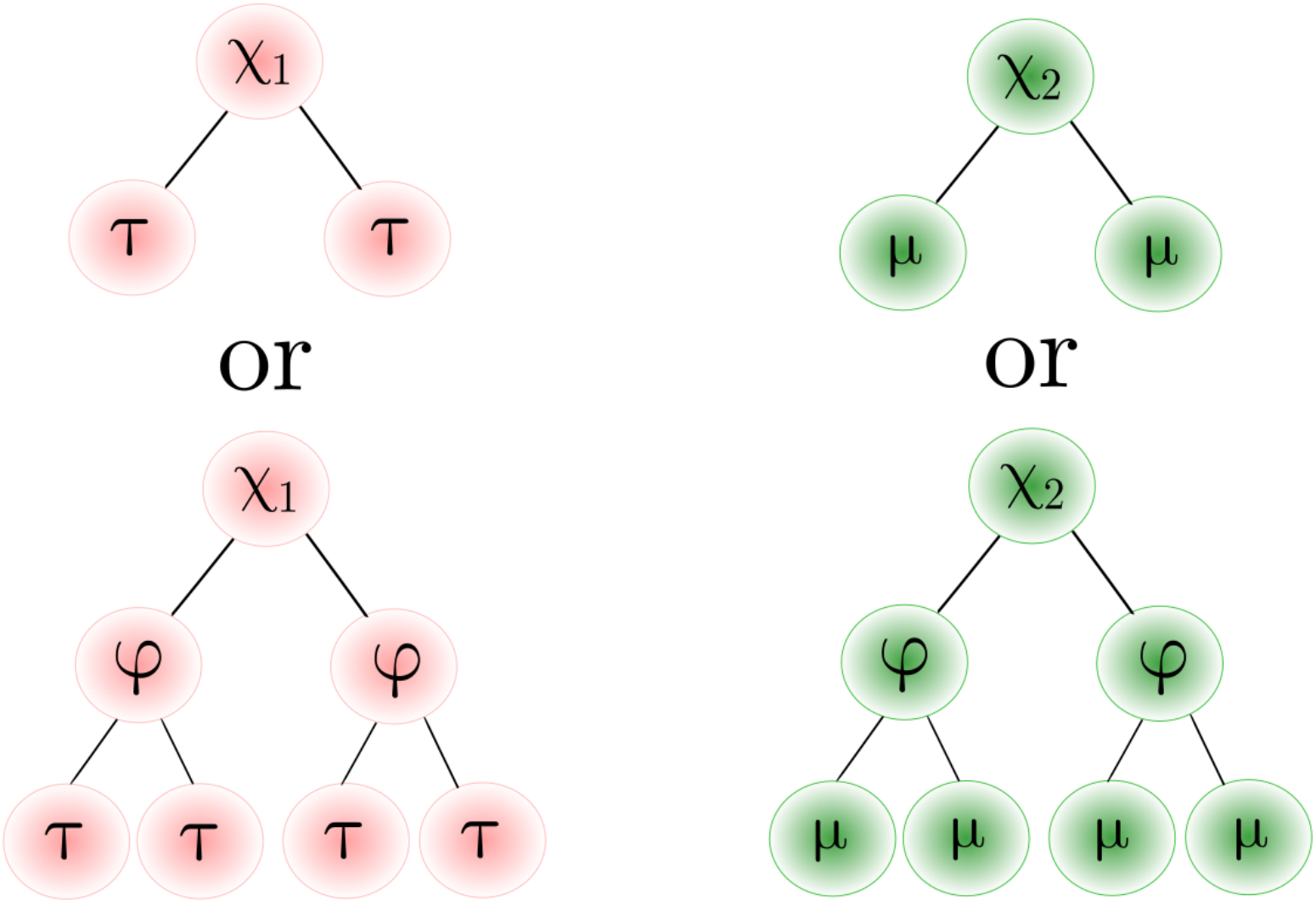
DM Indirect Searches



Propagation trough the Galaxy



Two-component DM Interpretation



The positron flux

The total expected flux:

$$\Phi_{pred}(E) = \Phi_{\chi}^{e^+}(E) + \Phi_{back}^{e^+}(E) \tag{1}$$

with,

$$\Phi_{\chi}^{e^+}(E) = \Phi_{\chi_1}^{e^+}(E) + \Phi_{\chi_2}^{e^+}(E) \tag{2}$$

The positron flux

- Background flux:

$$\Phi^{e^+}_{back}(E) = c_d \frac{E^2}{\hat{E}^2} \left(\frac{\hat{E}}{E_1} \right)^{\gamma_d} \tag{3}$$

We adopt $c_d = 6.9 \times 10^{-2} [\mathrm{m}^2\,\mathrm{sr}\,\mathrm{s}\,\mathrm{GeV}]^{-1}$, $\gamma_d = -3.98$, and $\hat{E}(E) = E + \varphi_{e^+}$ with $\varphi_{e^+} = 1.10$ GeV.

- Include interaction between cosmic rays and the gas in the intergalactic medium;
- takes into account effects of solar modulation.

The positron flux

- DM flux:

$$\Phi_\chi^{e^+}(E) = \frac{1}{4\pi} \frac{\rho_\odot}{b(E)} \frac{\Gamma}{m_\chi} \times$$

$$\times \int_E^{m_\chi/2} dE_s \sum_f BR_f \frac{dN_f^{e^+}}{dE}(E_s) \mathcal{I}(E, E_s) \quad (4)$$

The positron flux

Syncroton; ICS

DM mass; decay rate

- DM flux:

$$\Phi_\chi^{e^+}(E) = \frac{1}{4\pi\, b(E)} \frac{\rho_\odot}{m_\chi} \Gamma \times$$

$$\times \int_E^{m_\chi/2} dE_s \sum_f BR_f \frac{dN_f^{e^+}}{dE}(E_s) \quad \mathcal{I}(E, E_s) \quad (5)$$

Spectrum at production

Halo function (NFW profile)

The positron flux

Syncroton; ICS

DM mass; decay rate

- DM flux:

$$\Phi_\chi^{e^+}(E) = \frac{1}{4\pi\, b(E)} \frac{\rho_\odot}{m_\chi} \Gamma \times$$

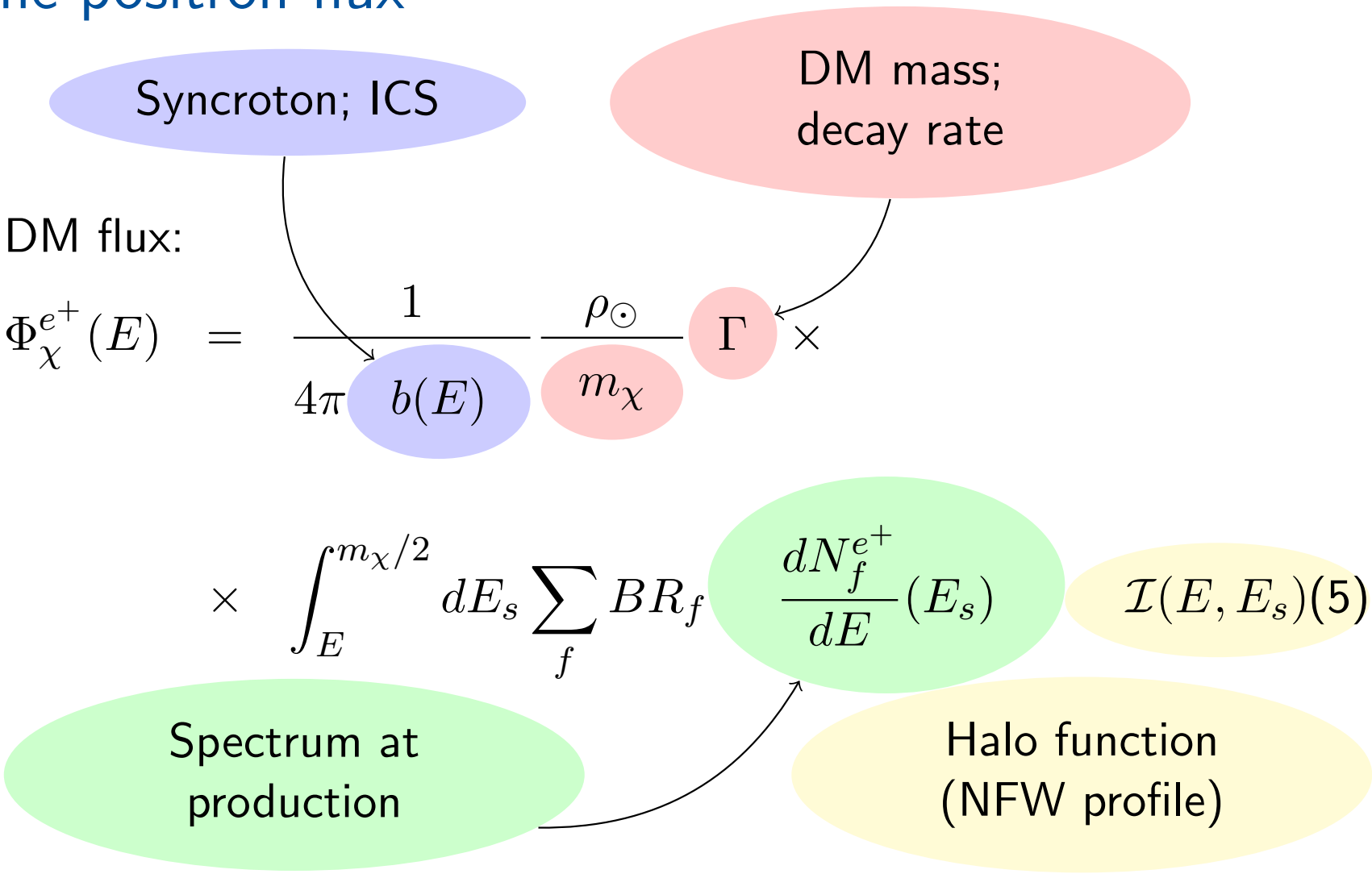
$$\times \int_E^{m_\chi/2} dE_s \sum_f BR_f \frac{dN_f^{e^+}}{dE}(E_s) \quad \mathcal{I}(E, E_s) \quad (5)$$

Spectrum at production

Halo function (NFW profile)

The positron flux

- DM flux:



The positron flux

- DM flux:

$$\Phi_\chi^{e^+}(E) = \frac{1}{4\pi}\frac{\rho_\odot}{m_\chi}\frac{\Gamma}{b(E)} \times \int_E^{m_\chi/2} dE_s \sum_f BR_f \frac{dN_f^{e^+}}{dE}(E_s)\, \mathcal{I}(E, E_s) \quad (5)$$

Syncroton; ICS

DM mass; decay rate

Spectrum at production

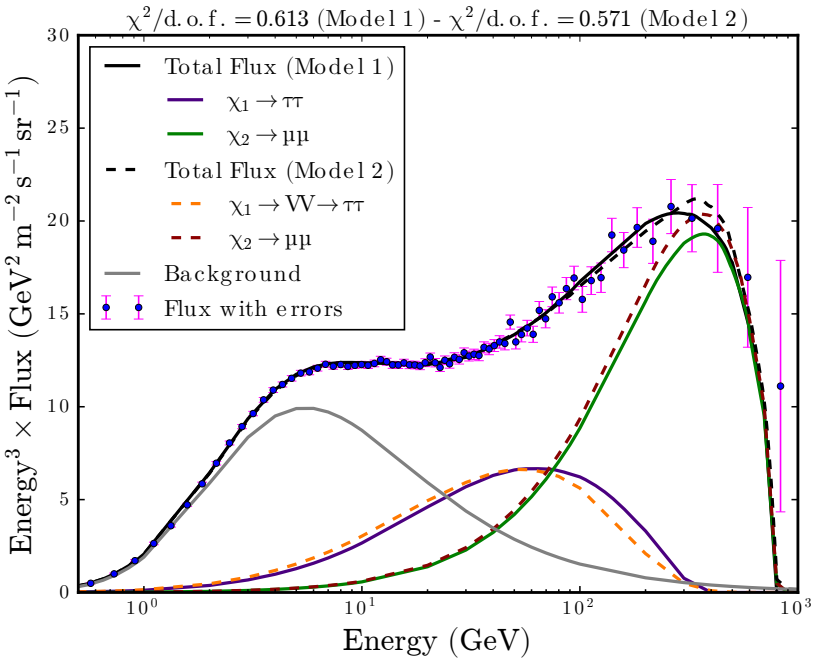
Halo function (NFW profile)

Compatibility with $\gamma-$ray data

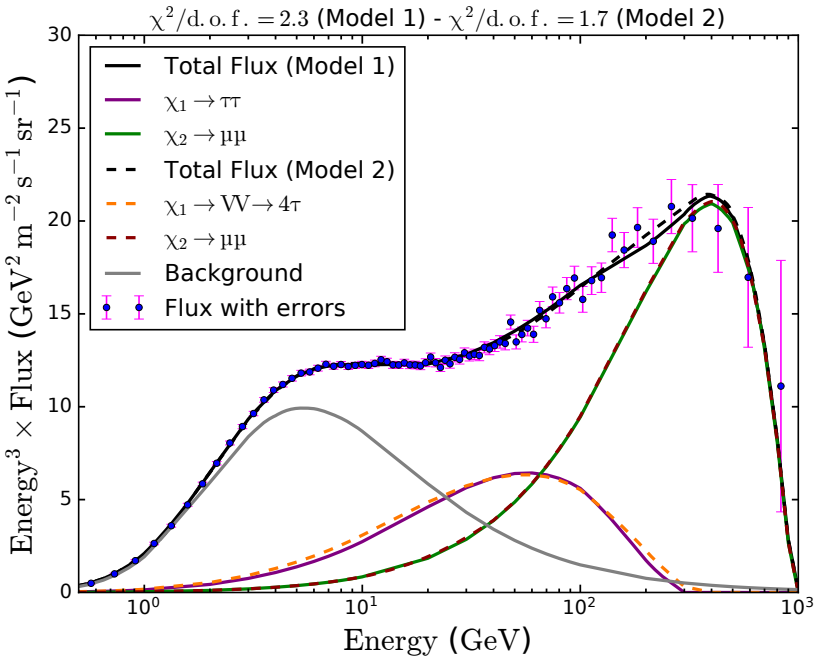
- Strong limits from $\gamma-$rays: Dwarf Spheroidal galaxies (Fermi-LAT) and the Galactic Center (H.E.S.S.).

Results

MED propagation

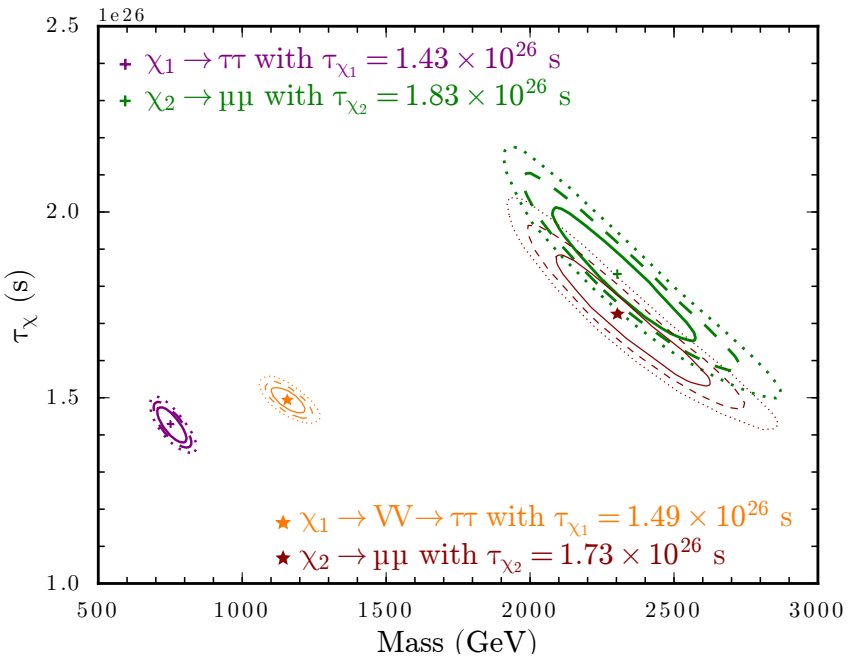


MAX propagation

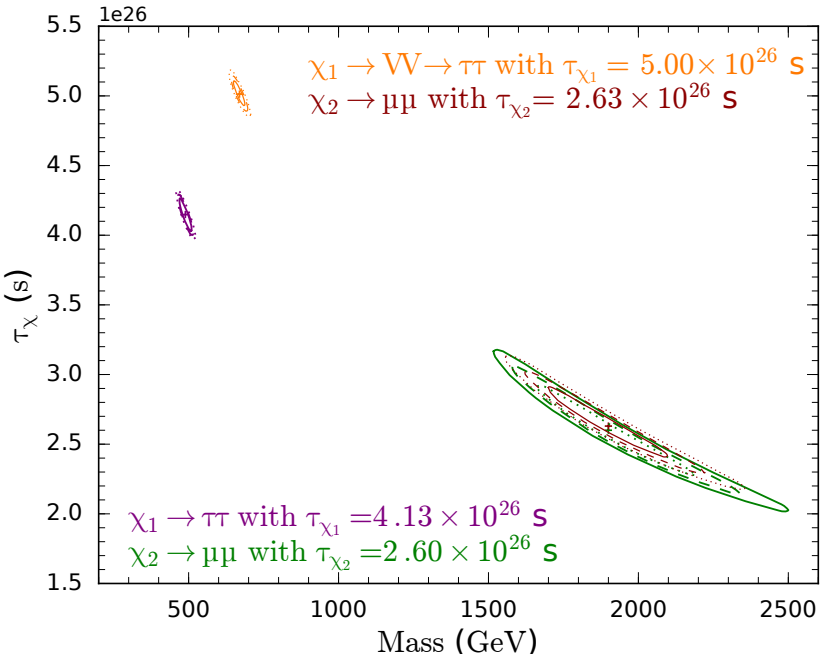


Results

MED propagation



MAX propagation



Conclusions

- The positron excess observed by AMS-02 remains unexplained;
- In this talk we show that a two-component DM scenario can provide a good fit to the data;
- We include three different approaches, including direct decay into SM particles and secluded scenarios;
- Direct annihilation is constrained by gamma-ray data, however the secluded case can escape.

Thank You!