

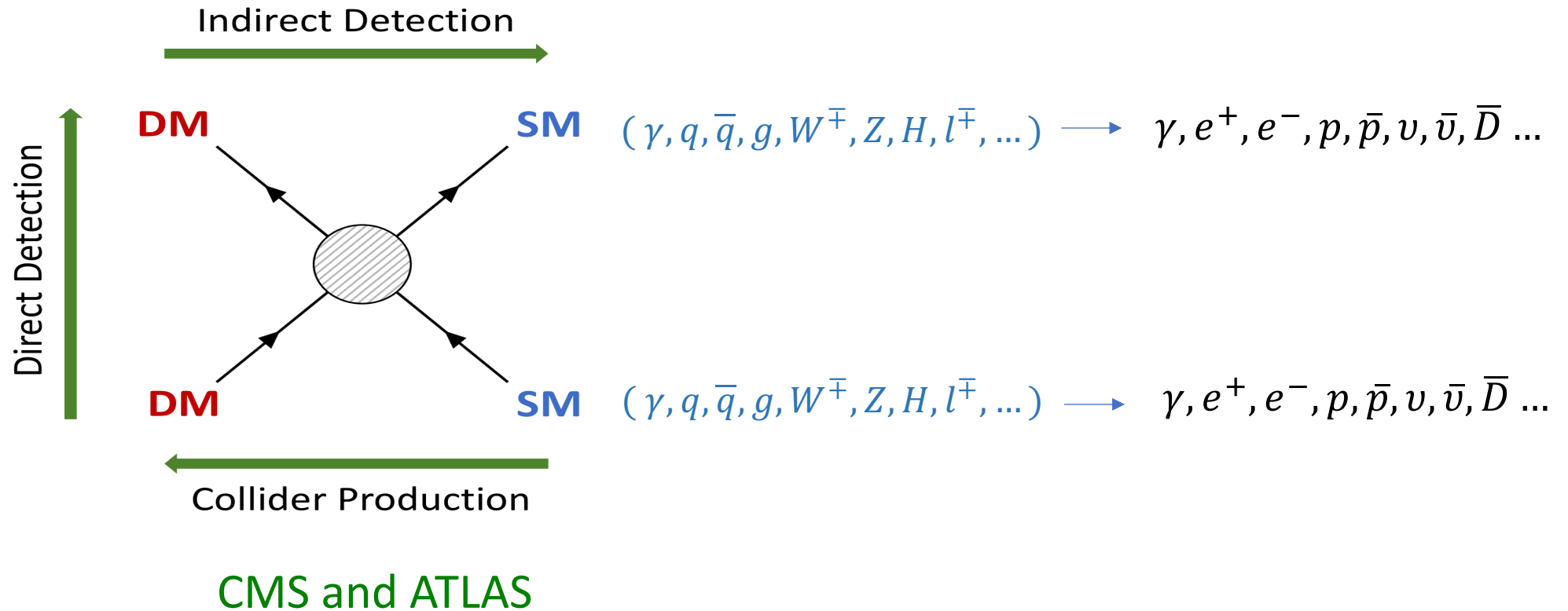
DM Detections with Cosmic Rays

Suzan B. du Pree

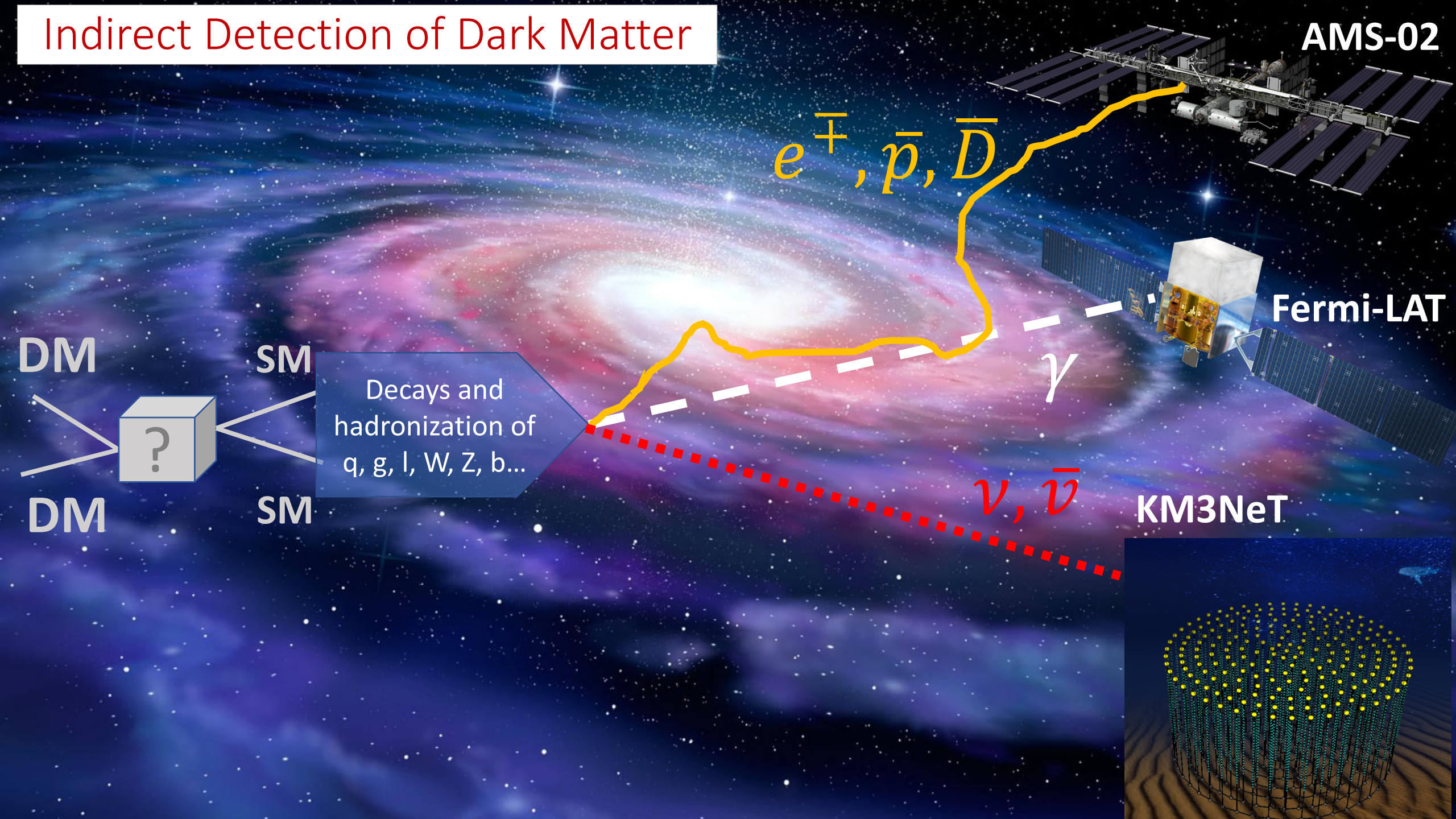
WIMP Particle Dark Matter Searches

HESS, HAWC, VERITAS, MAGIC, IceCube, ...
 PAMELA, FERMI, CALET, DAMPE, AMS, ... + KM3NeT

XENON
 CDEX
 CDMS
 CRESST
 DARKSIDE
 DEAP
 LUX
 PandaX
 PICO
 ...

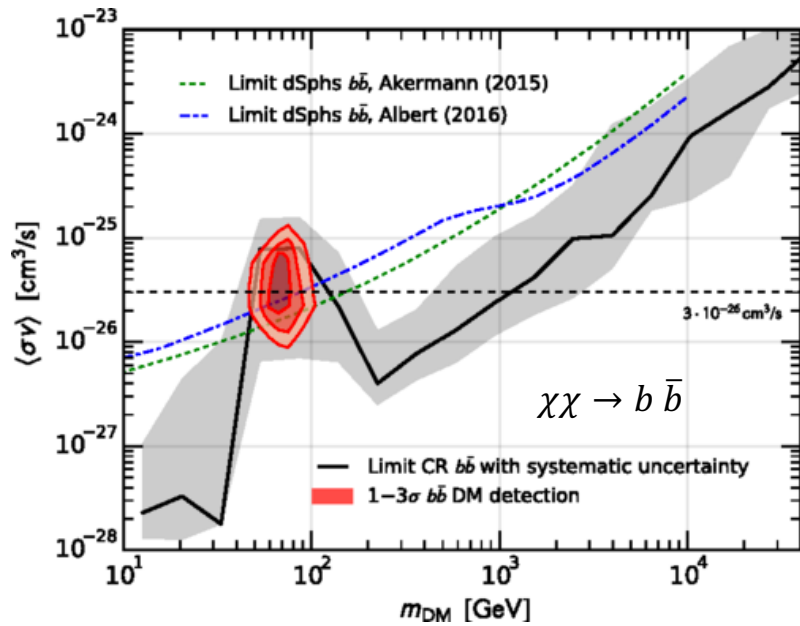


Indirect Detection of Dark Matter

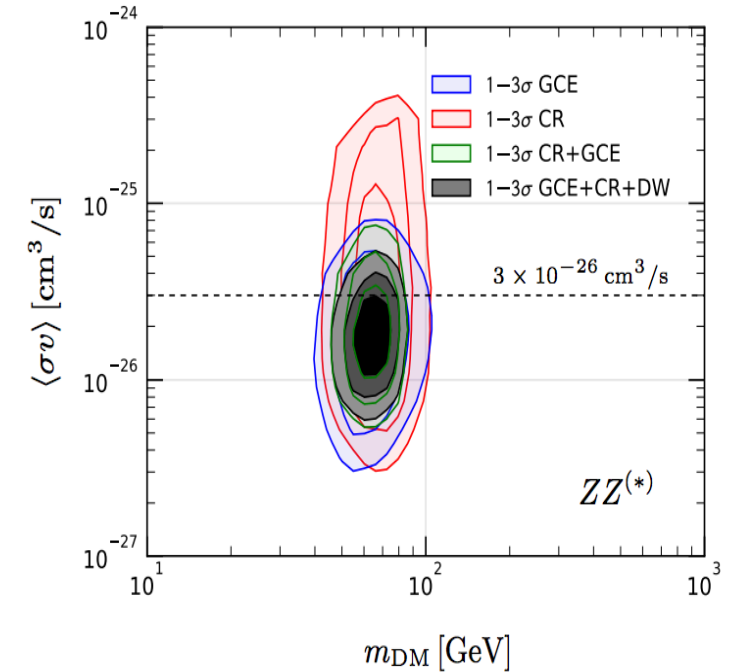
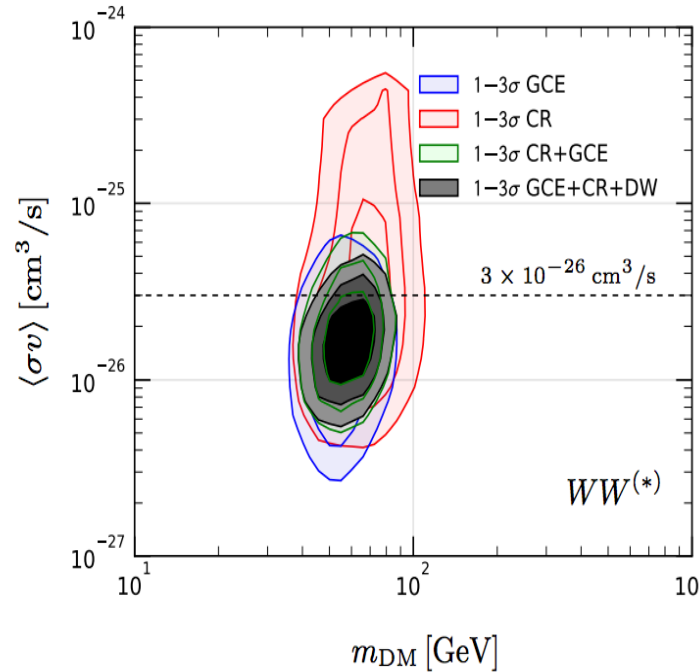


Limits on Annihilation Cross Section

A.Cuoco et al., Phys. Rev. Lett. **118**, 191102 (2017)



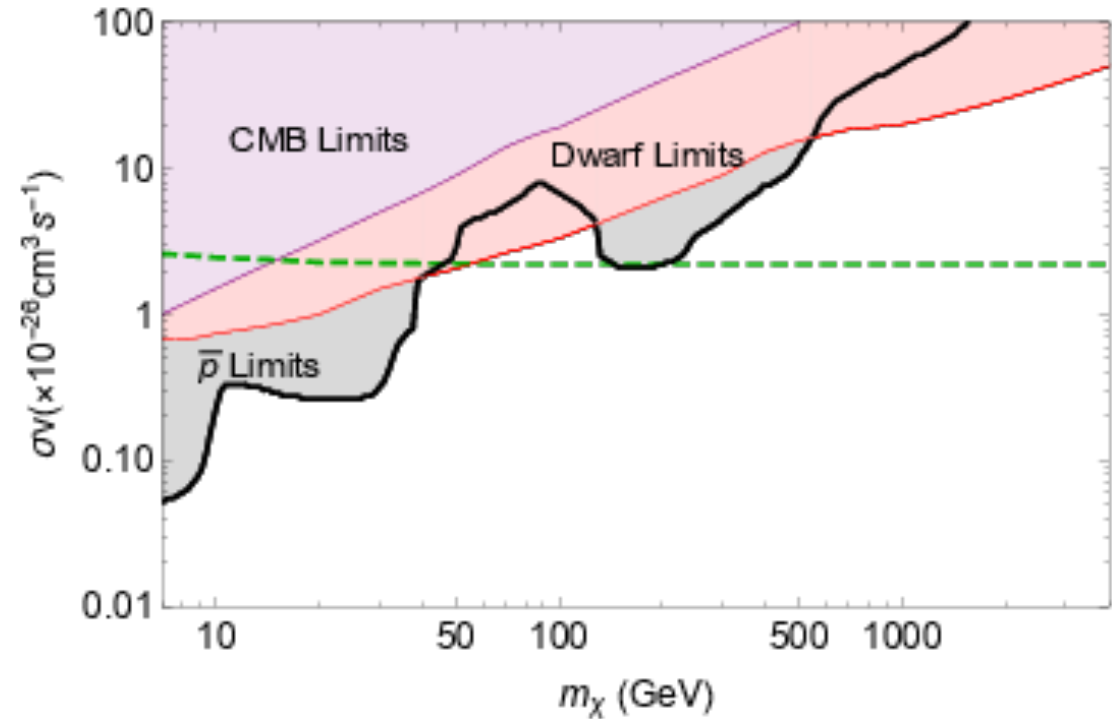
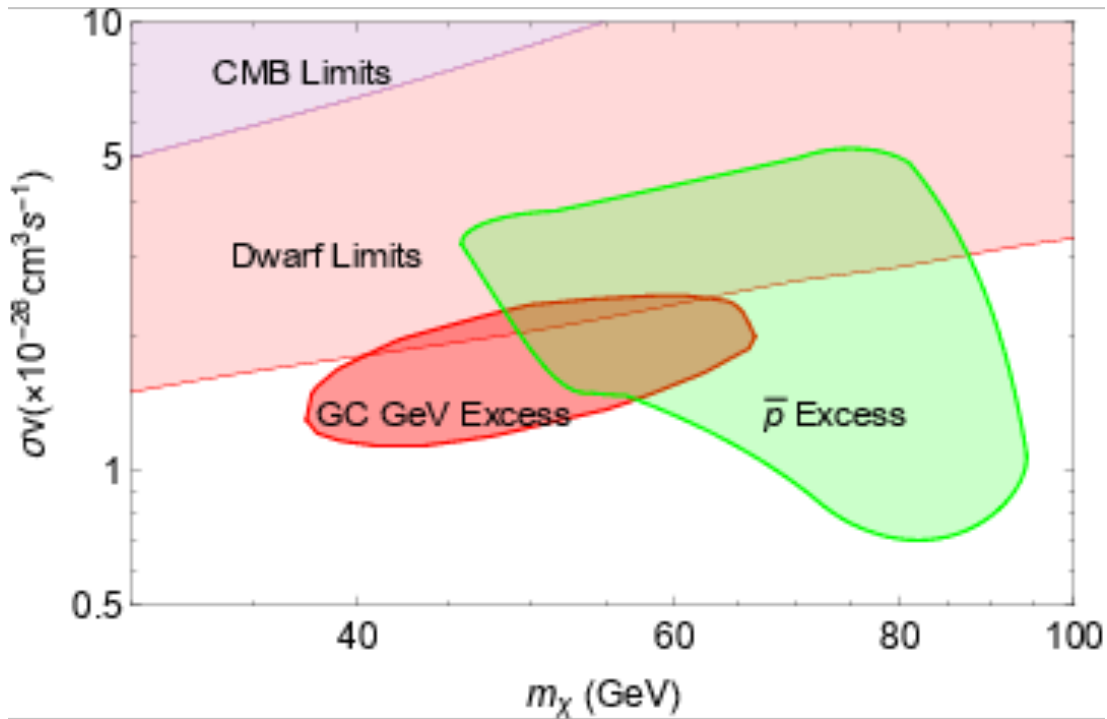
JCAP10, 053 (2017)



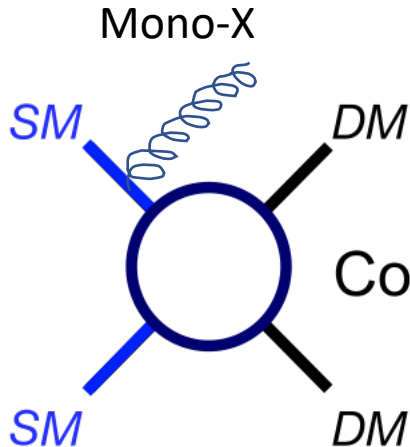
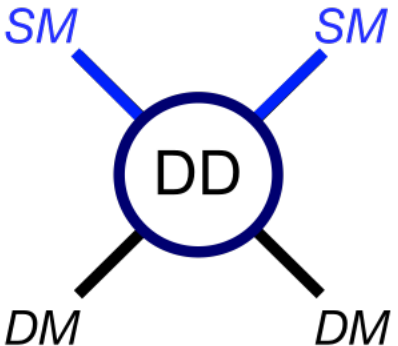
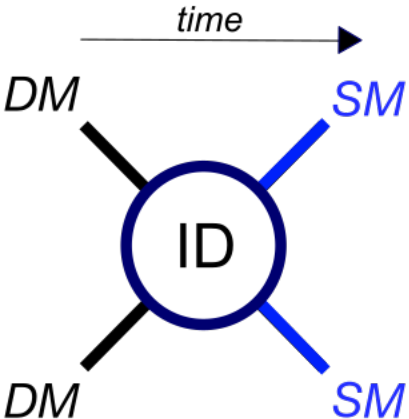
An example of AMS \bar{p} data interpretation (NFW halo profile)

Recent Models for \bar{p} Interpretation

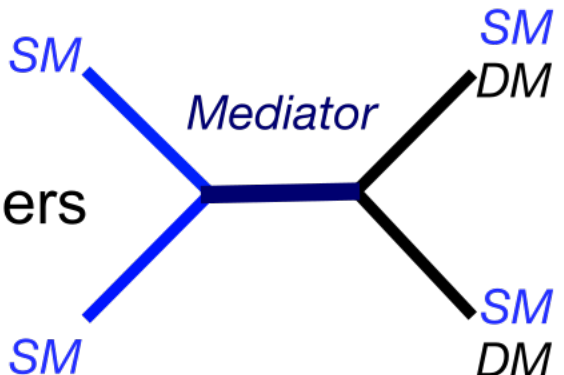
- Scrutinizing the evidence for dark matter in cosmic-ray antiprotons, A. Cuoco et al., 2019, arXiv: 1903.01472
- A Robust Excess in the Cosmic-Ray Antiproton Spectrum: Implications for Annihilating Dark Matter, D. Hooper et al., 2019, arXiv:1903.02549



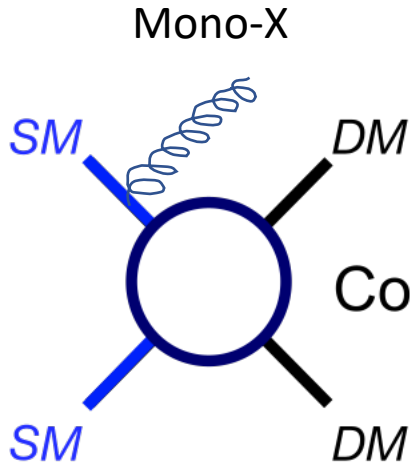
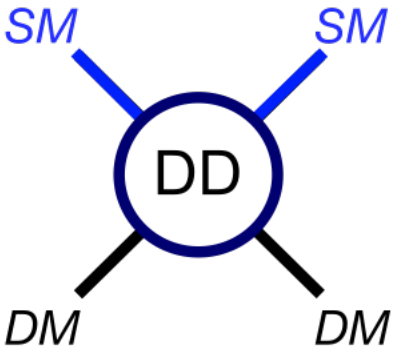
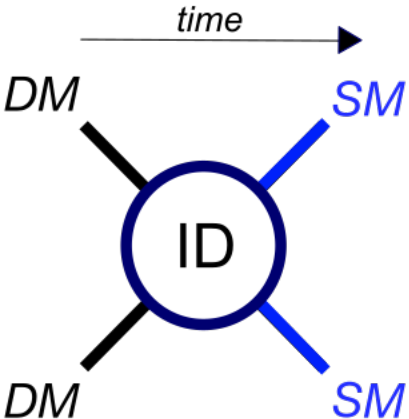
DM Detections



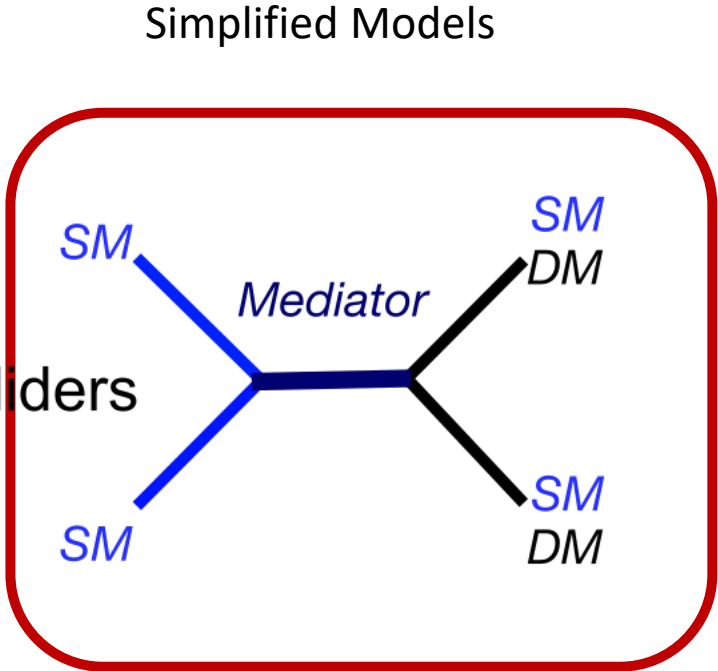
Simplified Models



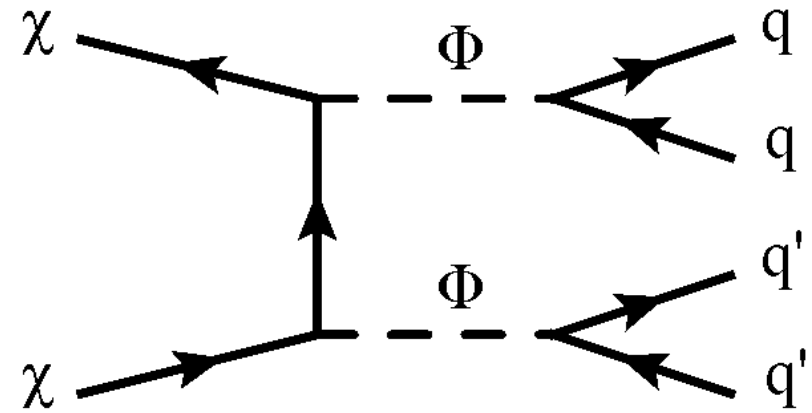
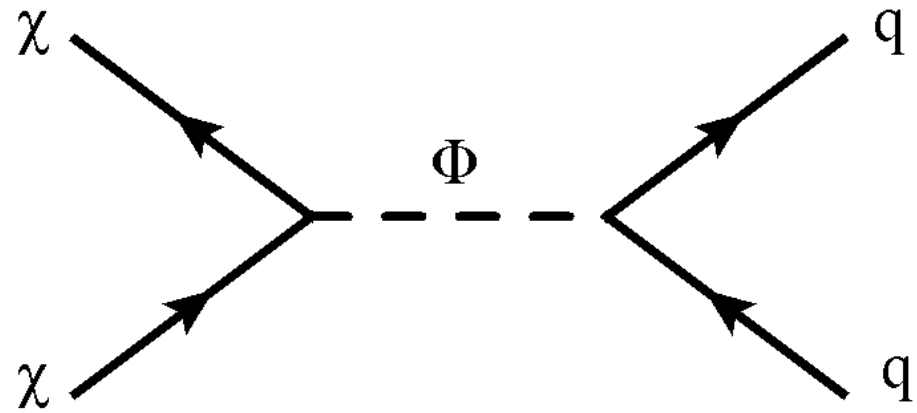
DM Detections



Colliders



DM Detections



Indirect DM Detections for Annihilating DM

$$\frac{d\Phi}{dE_\gamma}(E_\gamma, \psi) = \frac{\langle\sigma v\rangle}{2m_\chi^2} \sum_i B_i \frac{dN_\gamma^i}{dE_\gamma} \frac{1}{4\pi} \int_\psi \frac{d\Omega}{\Delta\psi} \int_{\text{los}} \rho^2(\psi, l) dl.$$

Indirect DM Detections for Annihilating DM

Particle Physics

Dark Matter Density, J-Factor

$$\frac{d\Phi}{dE_\gamma}(E_\gamma, \psi) = \frac{\langle\sigma v\rangle}{2m_\chi^2} \sum_i B_i \frac{dN_\gamma^i}{dE_\gamma} \frac{1}{4\pi} \int_\psi \frac{d\Omega}{\Delta\psi} \int_{\text{los}} \rho^2(\psi, l) dl.$$

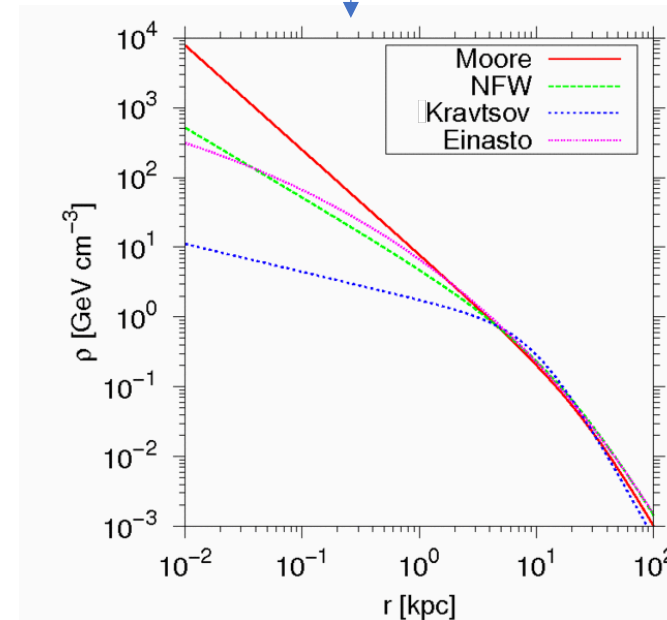
Model dependent -> DM mass, mediator mass, couplings, mediator width, etc.

MadGraph_5@NLO:MADDM:

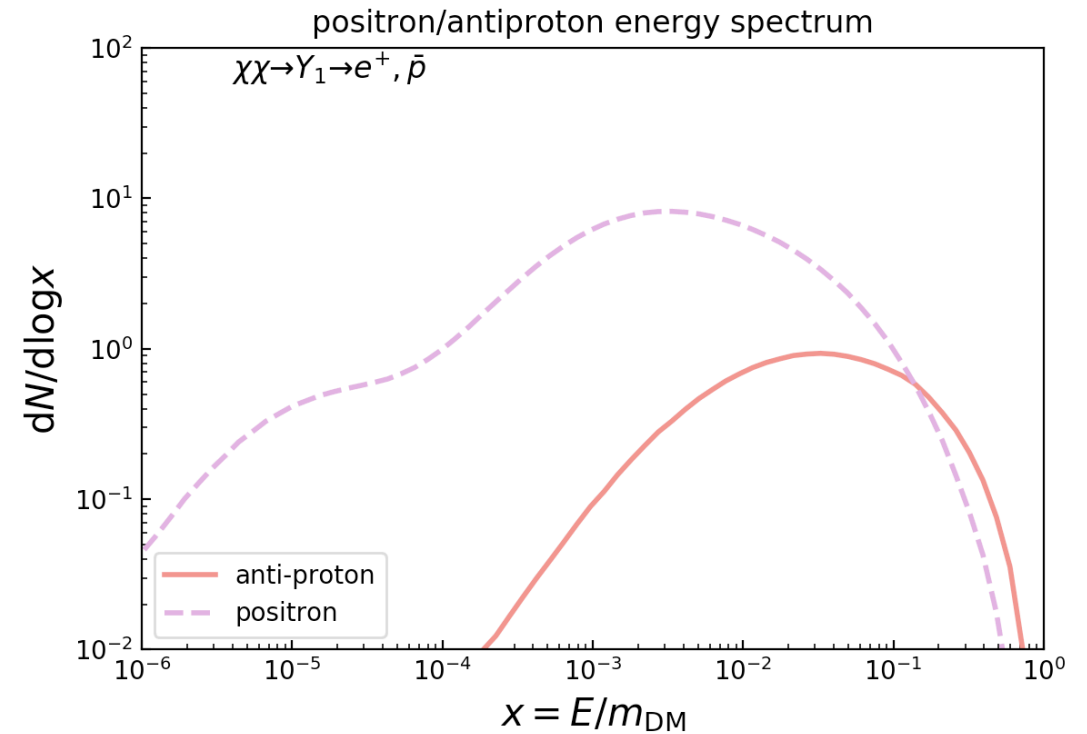
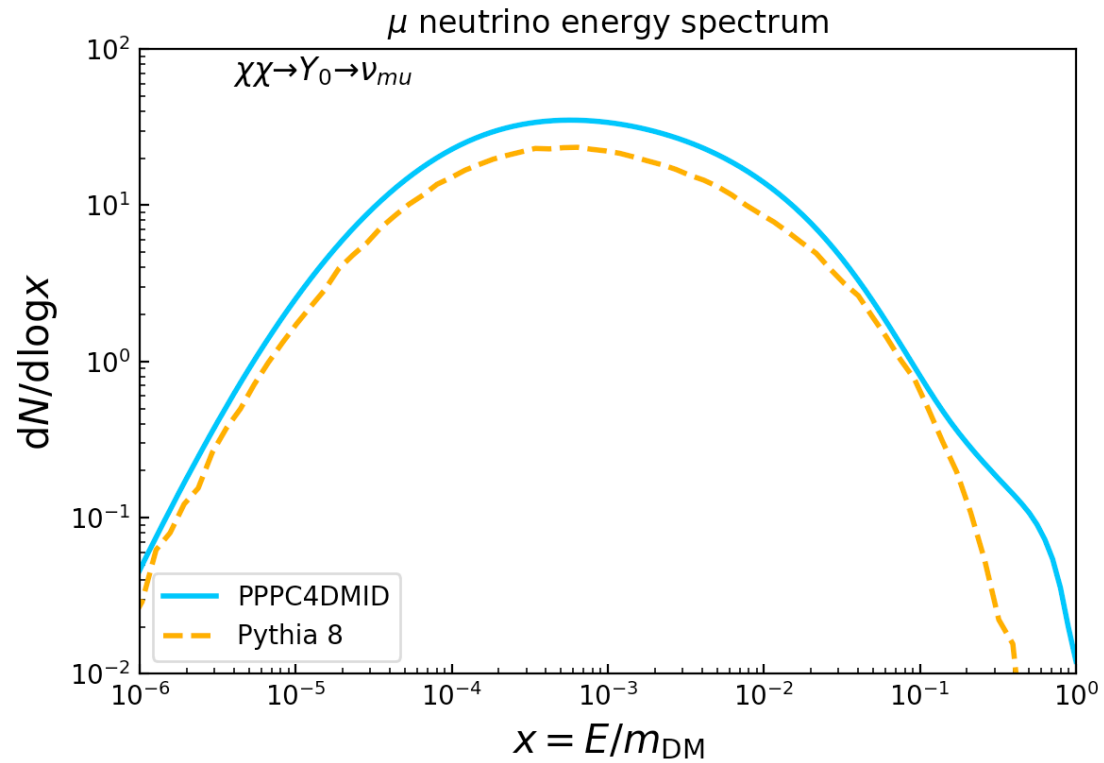


Pythia 8: Parton showering and Hadronization

DRAGON: Cosmic Ray Propagations



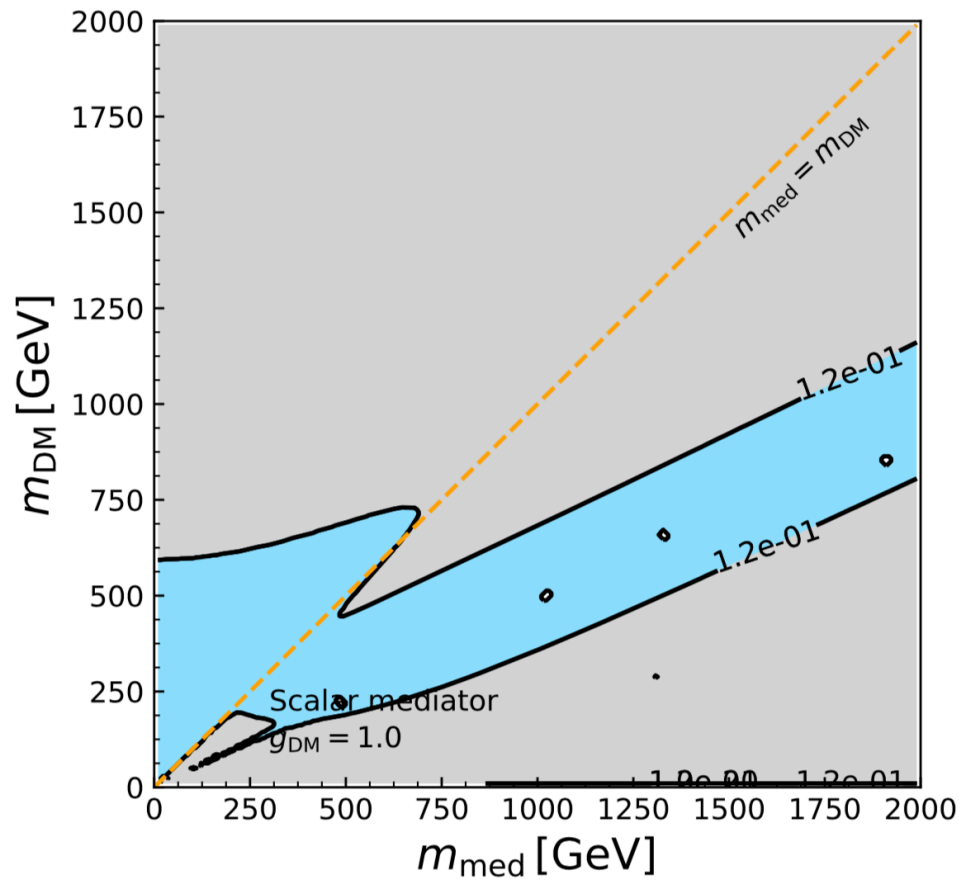
DM DM \rightarrow Med \rightarrow SM SM energy spectra



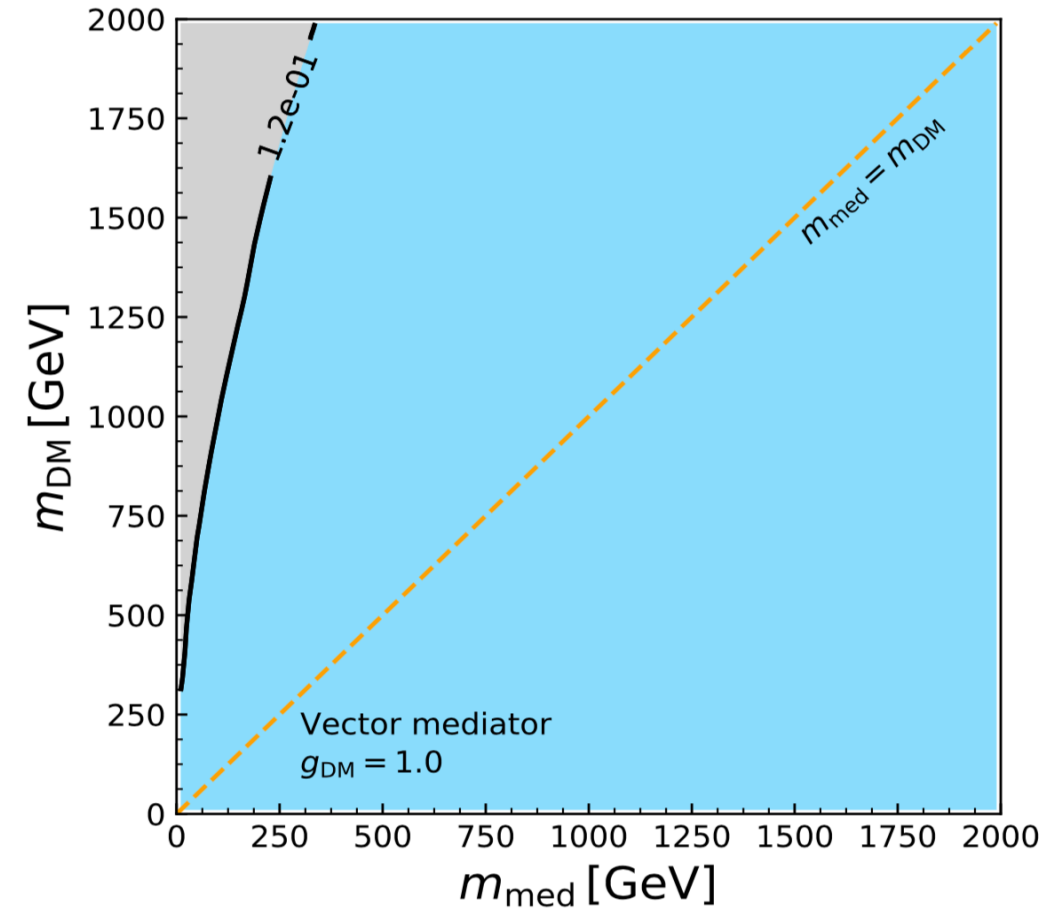
DM Detections: Relic Density



Scalar Mediator



Vector Mediator



What can be done?

- Thermal relic
- Full parameter scan (couplings, widths, mass plane)
- Effects of EW and (possibly QCD $2 \rightarrow n$)
- Cross-check the PPPCB4DMID tables
- Experimental sensitivity of KM3NeT for a given model
- Complementarity and comparison of the DD, ID and LHC searches for a given model
- Test the direct link to astrophysical observations (e.g AMS positrons, antiprotons, Fermi-LAT gamma rays)