

Anti-matter in cosmic rays: backgrounds or signals ?

Rencontres de Moriond

Timur DELAHAYE

With P. Salati, N. Fornengo, R. Lineros, J. Lavalle,
F. Donato, P. Brun, D. Maurin, & R. Taillet



UNIVERSITÀ
DEGLI STUDI
DI TORINO
ALMA UNIVERSITAS
TAURINENSIS



What is Dark Matter indirect detection?

$\chi + \chi \rightarrow q\bar{q}, W^+W^-, \dots \rightarrow \gamma, \bar{p}, \bar{D}, e^+ & \nu's$



Have we discovered Dark Matter already ?

The New York Times

A Whisper, **Perhaps**, From the Universe's Dark Side

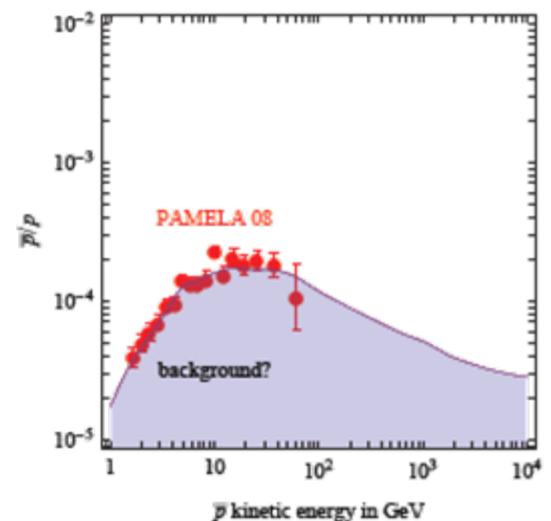
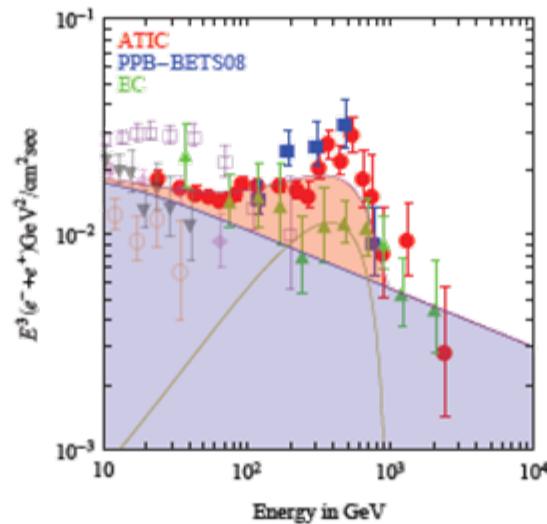
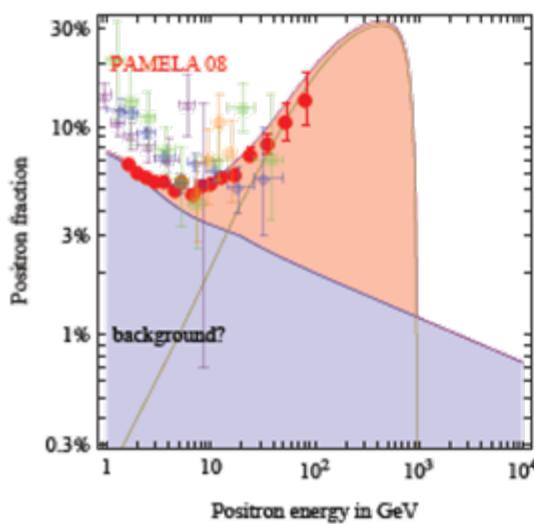


NATIONAL GEOGRAPHIC

Dark Matter Proof Found Over Antarctica?

Have we discovered Dark Matter already ?

DM with $M = 1$ TeV that annihilates into $\mu^+ \mu^-$



M. Cirelli, M. Kadastik, M. Raidal & A. Strumia
[arXiv:0809.2409](https://arxiv.org/abs/0809.2409)

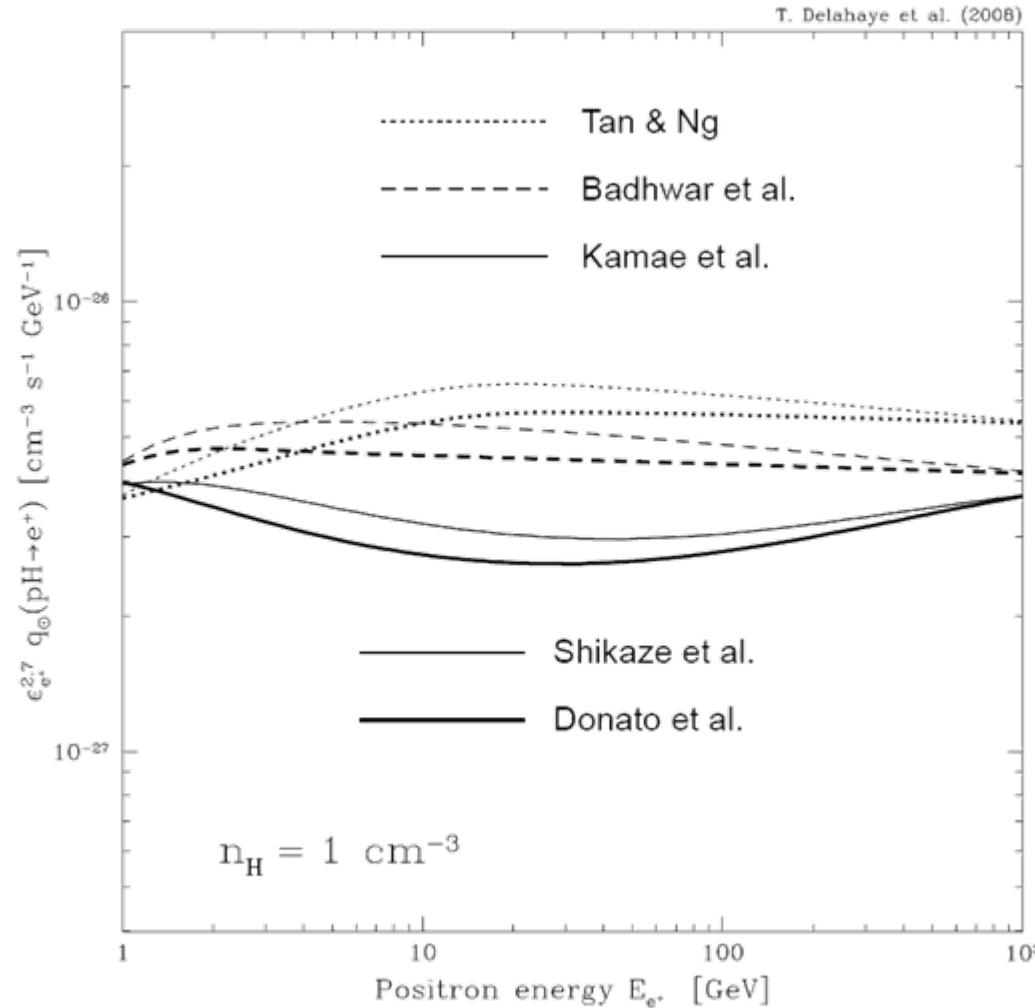
What is the background ?

p or α (CR) + ISM $\rightarrow \gamma, \bar{p}, \bar{D}, e^+ \& \nu' s$

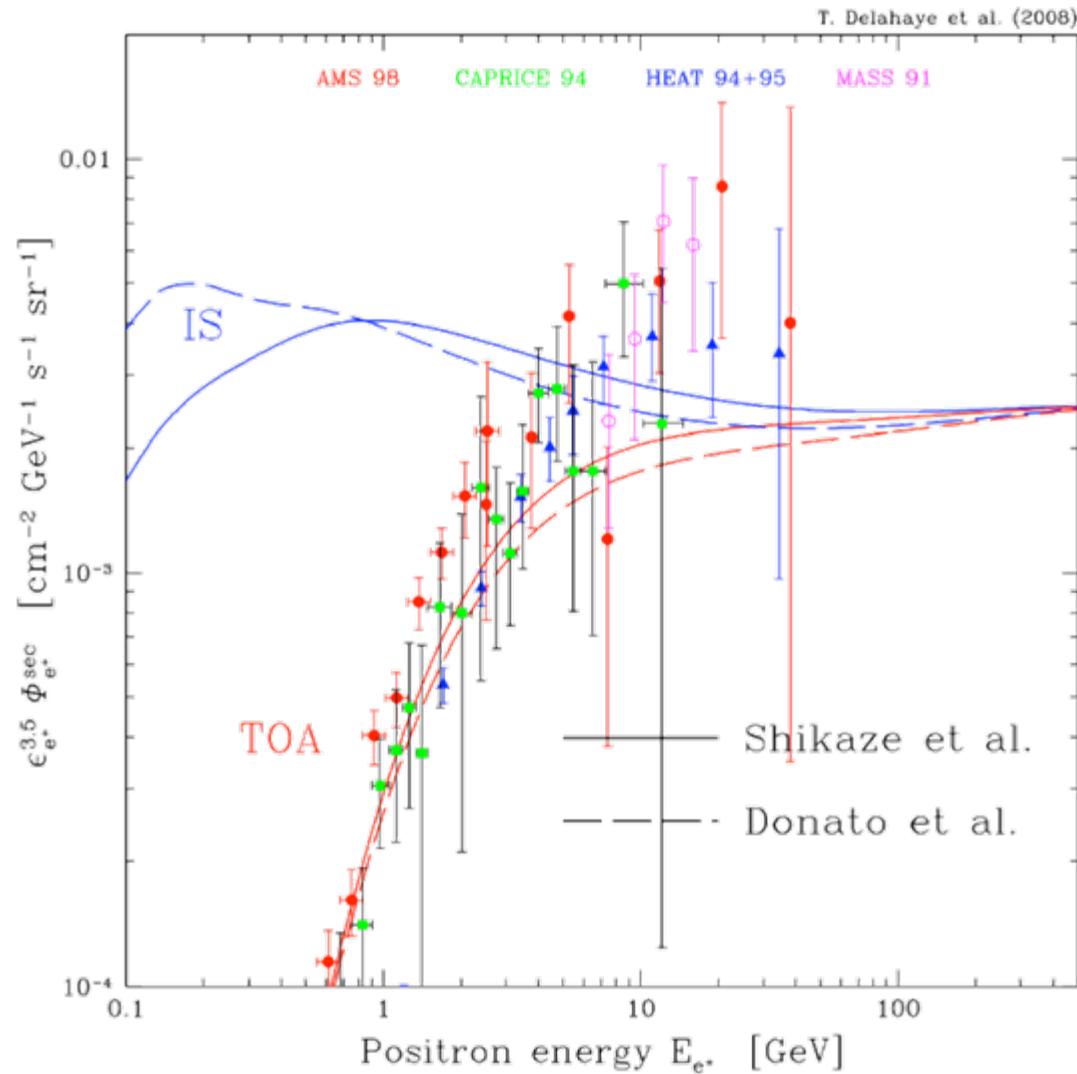
Positrons: the uncertainties

- Cross sections
 - Badhwar et alii 1977, Phys. Rev. D, 15, 820
 - Tan & Ng 1983, Journal of Physics G Nuclear Physics, 9, 1289
 - Kamae et alii 2006, ApJ, 647, 692
- Proton flux
 - Shikaze et alii 2007, Astroparticle Physics, 28, 154
 - Donato et alii 2001, ApJ, 563, 172
- Propagation parameters
 - Boron/Carbon analysis: Maurin et alii 2001, ApJ, 555, 585

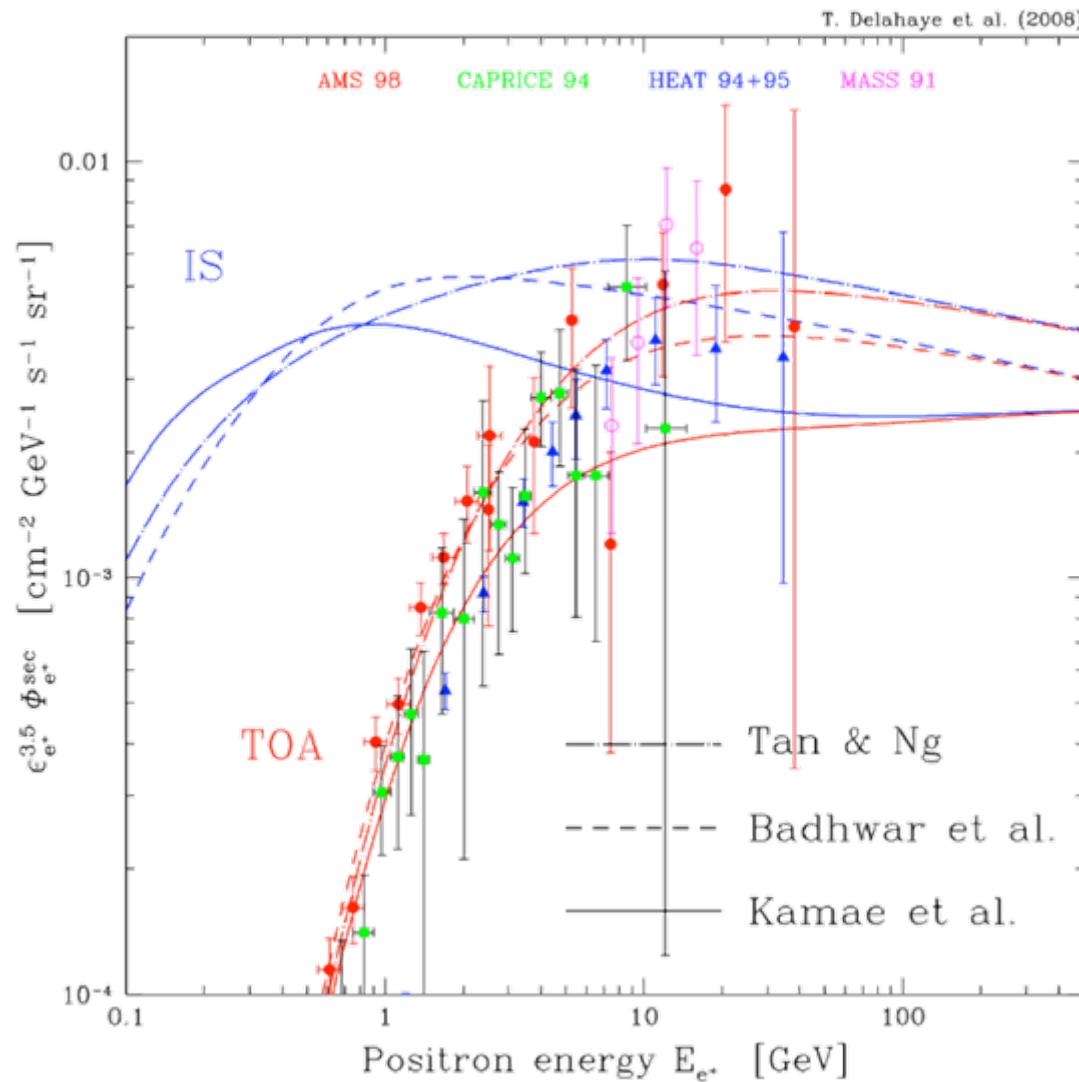
Positrons: source



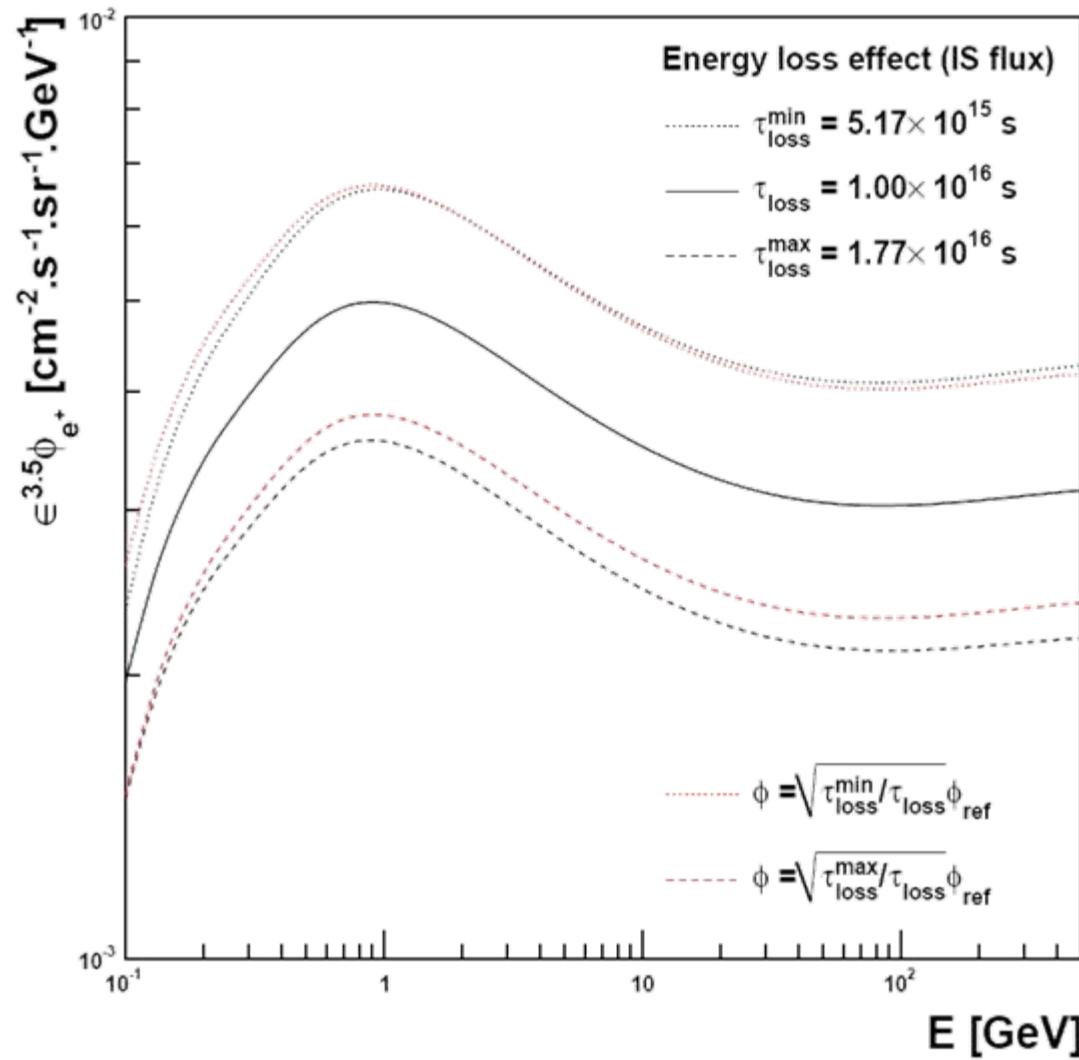
Proton flux influence



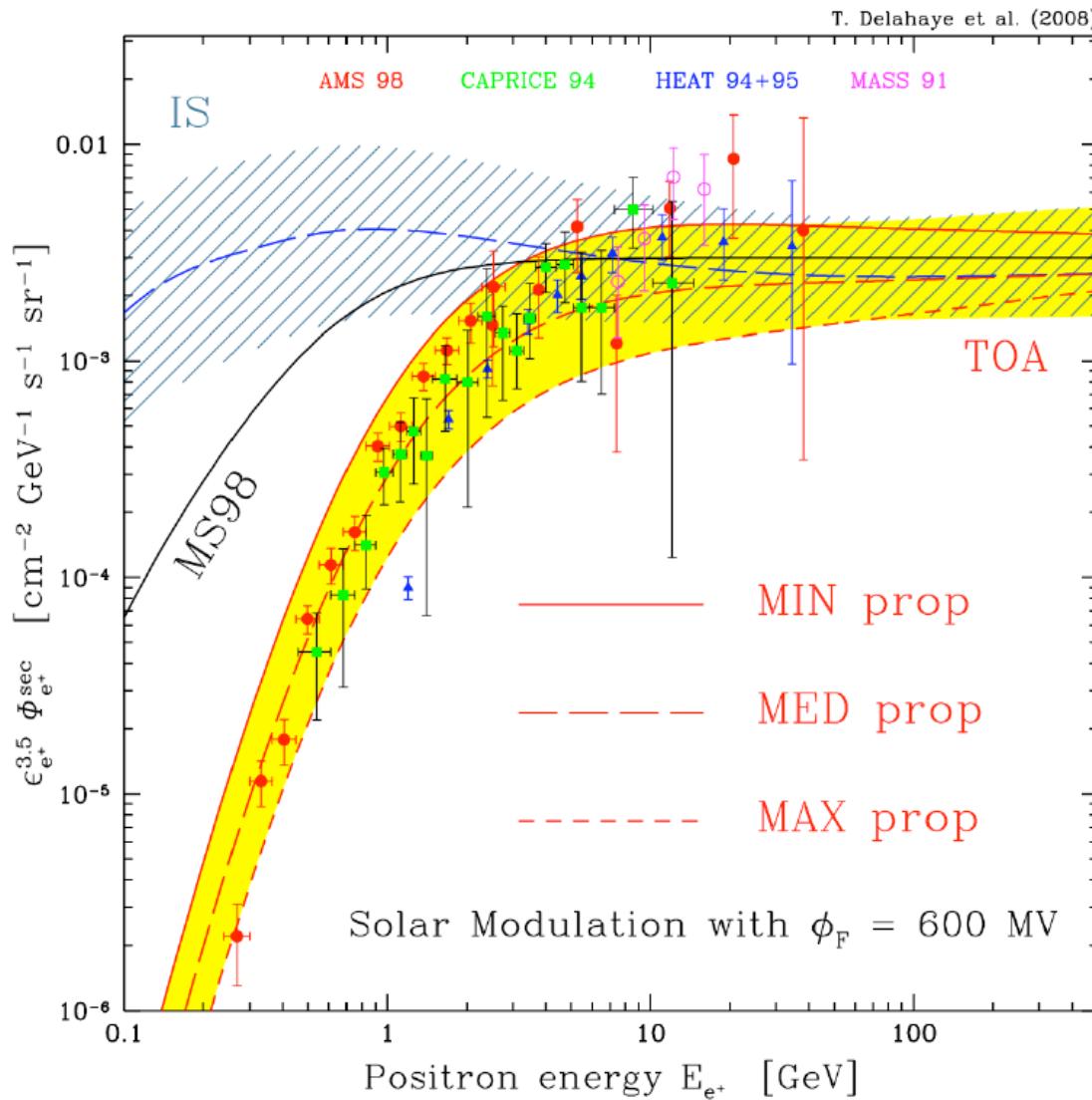
Cross-section influence



Energy losses influence



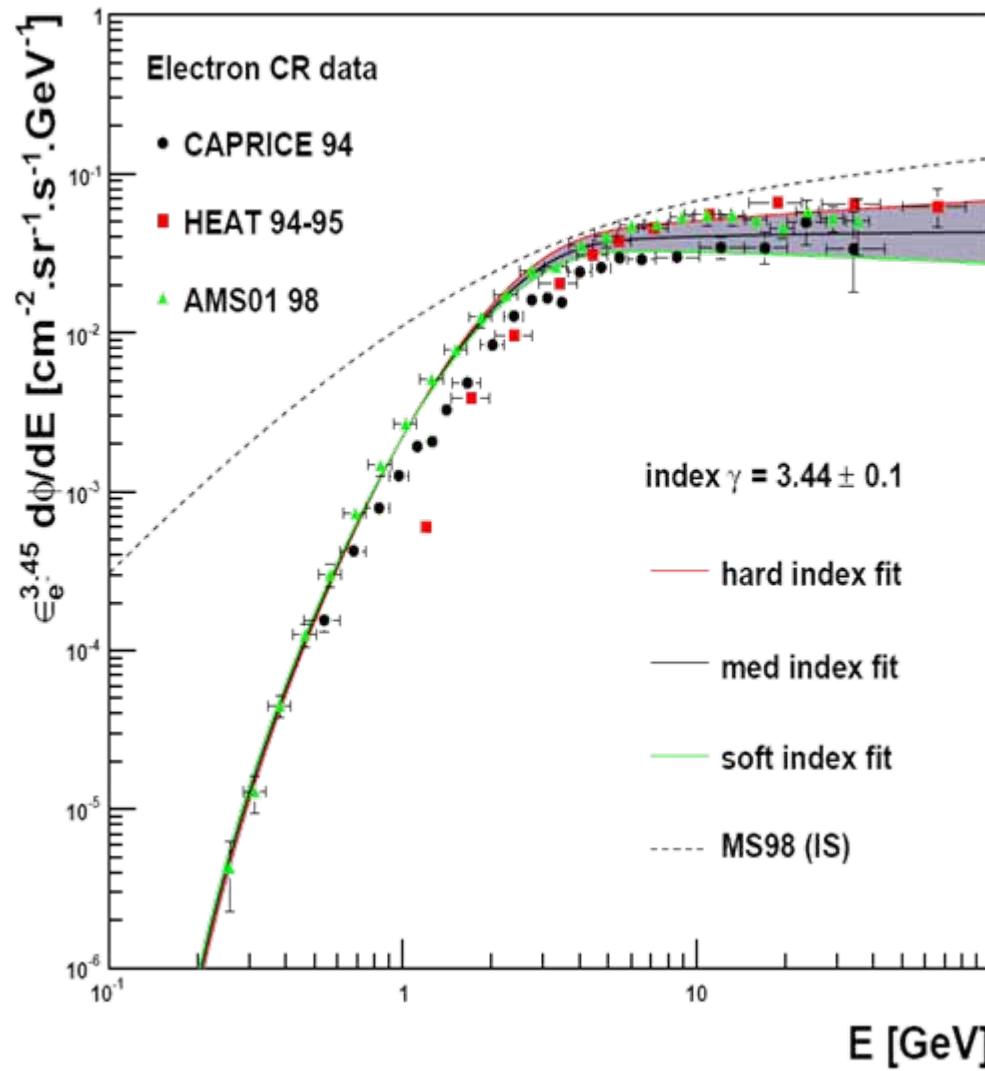
The propagation



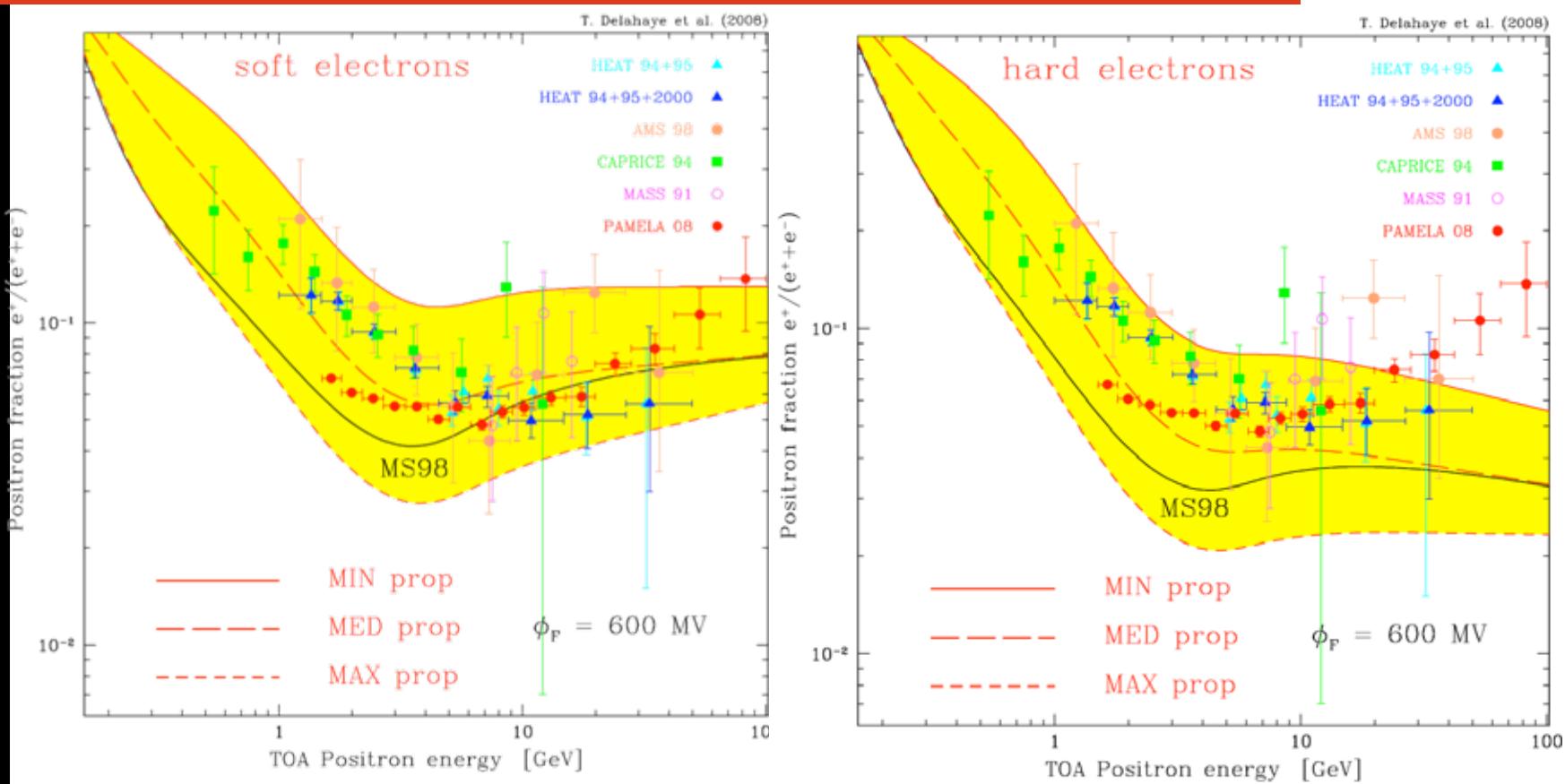
PAMELA



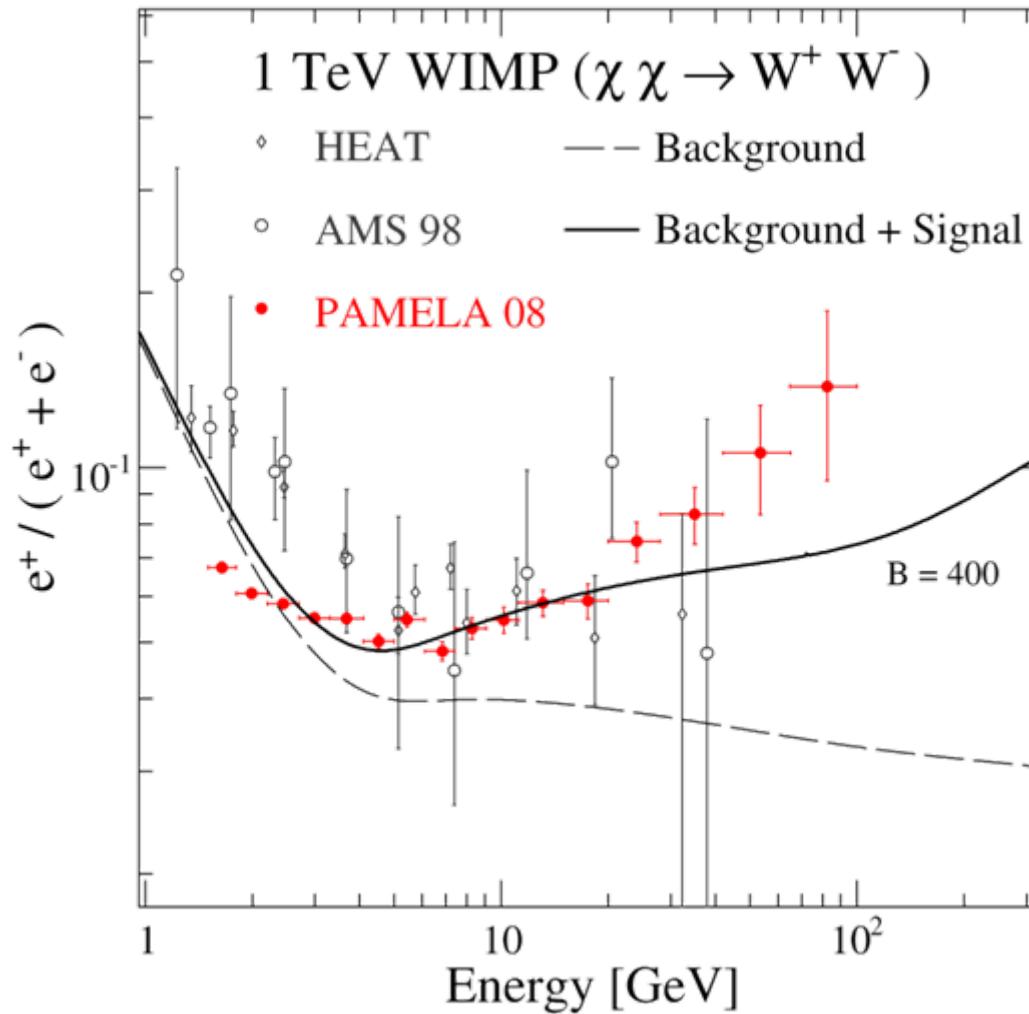
Electrons



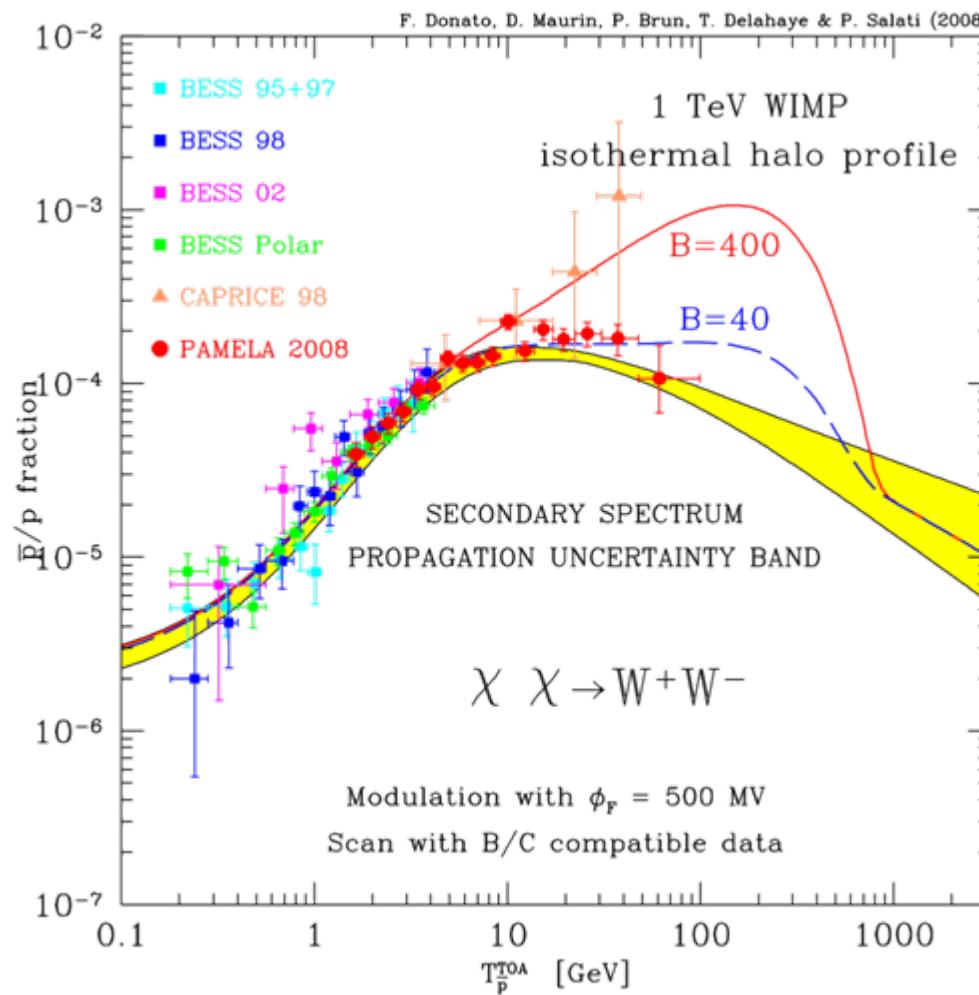
Positron fraction



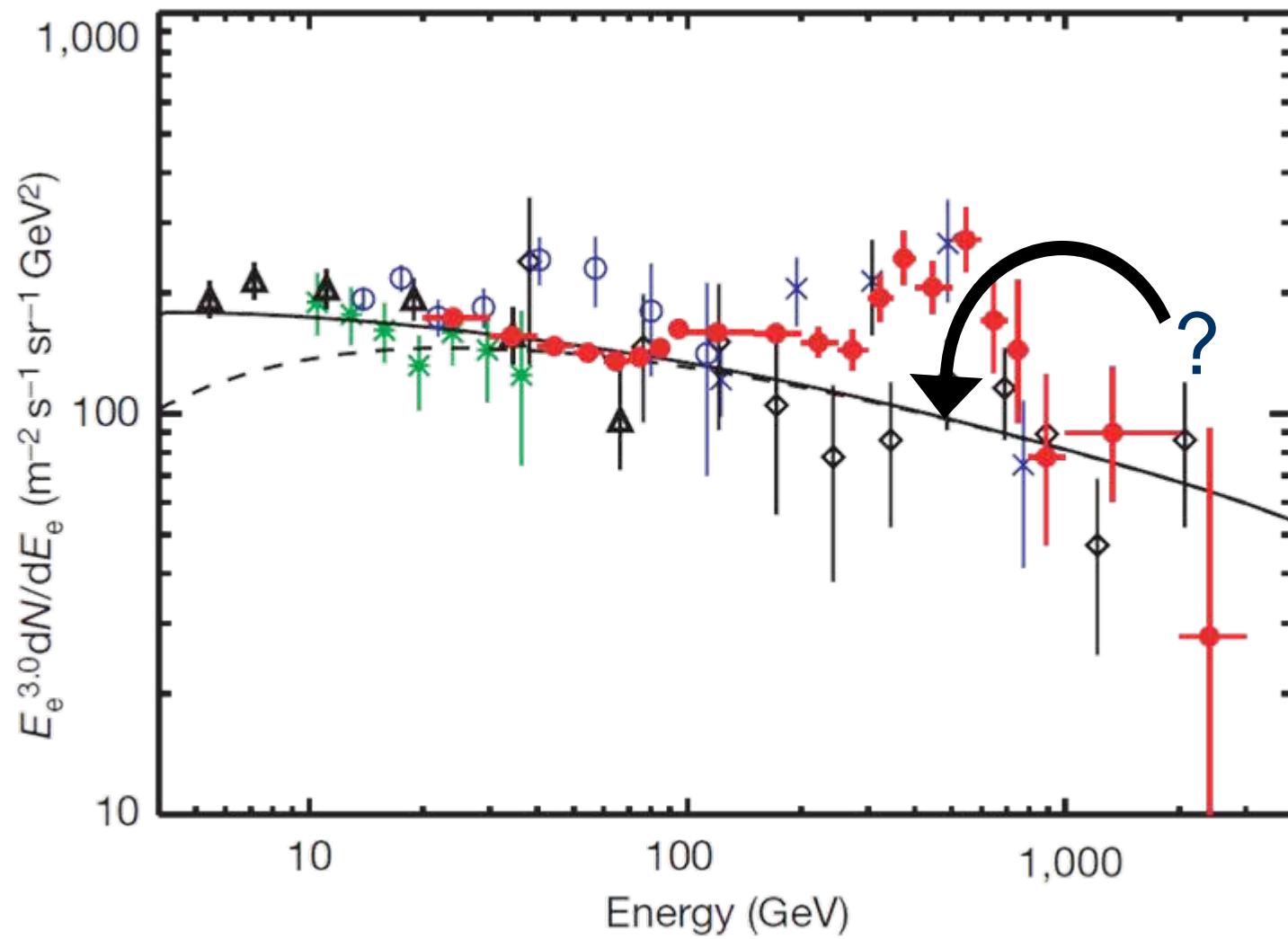
Positrons: Dark Matter ?



Anti-protons



ATIC



What else do we need ?

- Absolute fluxes

- Positrons
- Protons
- Anti-protons

- Other data

- Boron/Carbon
- Anisotropy

References

- Primary e+ : Phys.Rev.D77:063527,2008
- Secondary e+ : [arXiv:0809.5268](https://arxiv.org/abs/0809.5268)
submitted to A&A.
- Secondary pbar : Astrophys.J.563:172-184,2001
- Dark Matter analysis :
Phys.Rev.Lett.102:071301,2009



You want more ?

The propagation 2

