Origin of Dark Matter

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118 publications!

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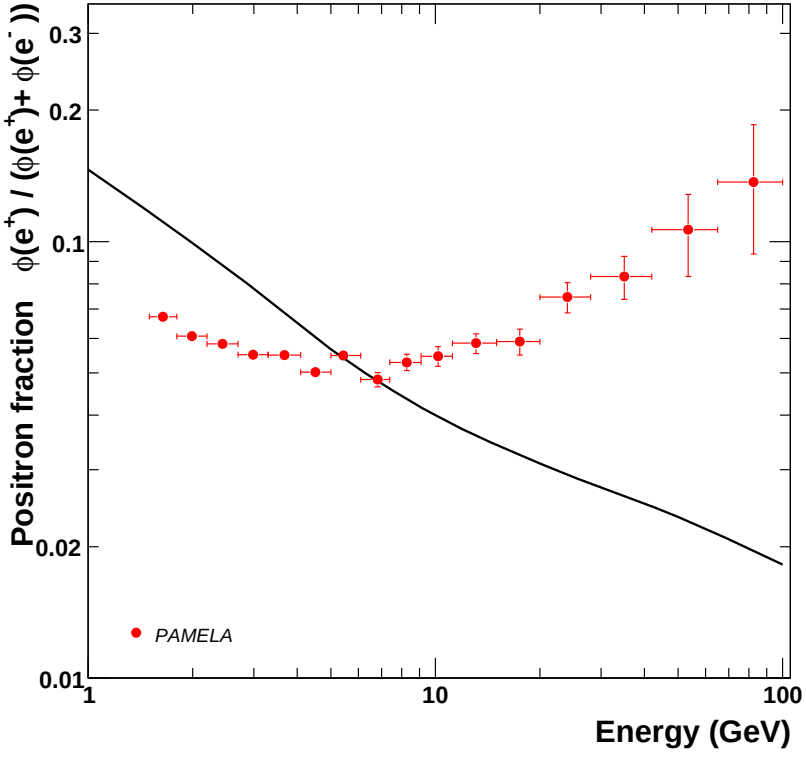
Highlight 1: $e^{\pm}$ "Excesses"

PAMELA



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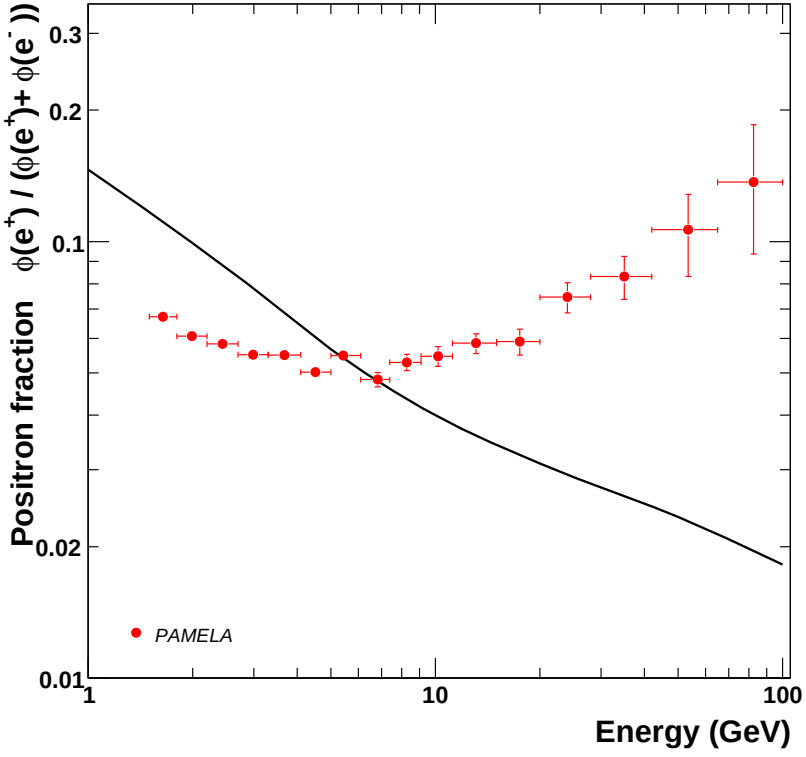
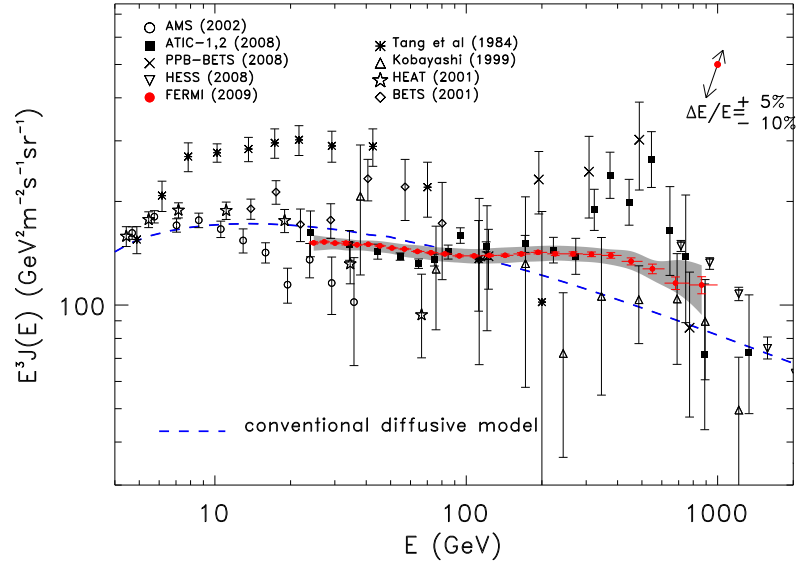


Fermi/LAT



Remarks on “Excesses”

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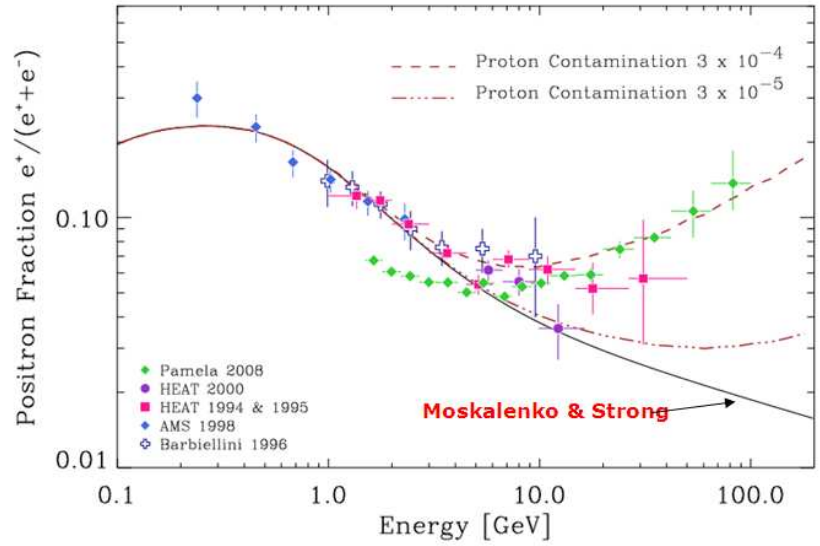

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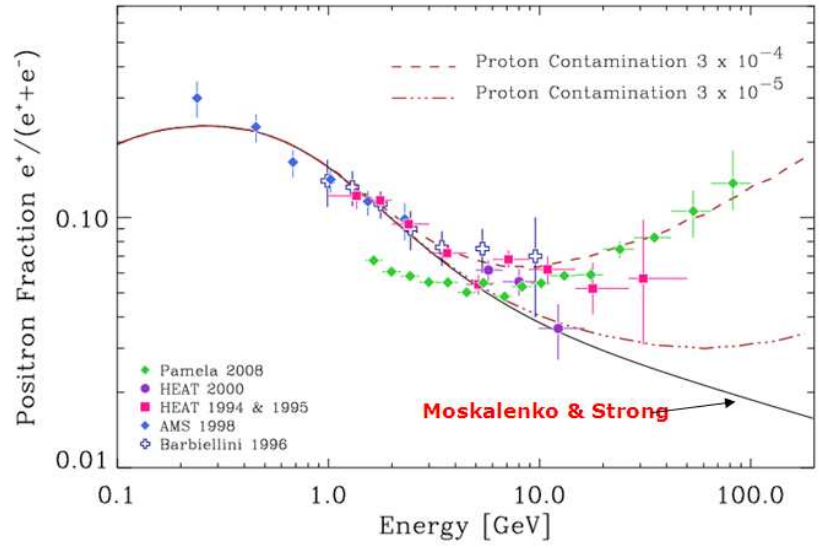

- Fermi/LAT large E excess is only about 1 *systematic* standard deviation! In this data set, deficit at lower E is nearly as likely as excess at high E.

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E.g. Cirelli, Kadastik, Raidal, Strumia: arXiv:0809.2409

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Examples:
Kohri, Mazumdar, Sahu, Stephens: arXiv:0907.0622;
Fairbairn, Zupan: arXiv:0810.4147;
Kohri, McDonald, Sahu: arXiv:0905.1312

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Constraints and other explanations

- Fermi/LAT diffuse γ flux: Cirelli, Panci, Serpico: arXiv:0912.0663; Papucci, Strumia: arXiv:0912.0742 Only annihaltion into $\mu^+\mu^-$ or $\ell^+\ell^-\ell^+\ell^-$ $(\ell = e, \mu)$ is allowed, and only if DM density not too strongly peaked at galactic center!

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- Many other constraints have been discussed in 2008/9; e.g. BBN Hisano, Kawasaki, Kohri, Nakayama: arXiv:0810.1892; CMB Galli, Iocco, Bertone, Melchiorri: arXiv:0905.0003; ν bounds Hisano, Kawasaki, Kohri, Nakayama: arXiv:0812.0219

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- Several astrophysical explanations have been suggested; e.g. Uncertainties in "standard" background Delahaye et al.: arXiv:0809.5268, arXiv:0905.2144; Nearby Supernova Fujita, Kohri, Yamazaki, Ioka: arXiv:0903.5298; Pion production in nearby CR source: Mertsch, Sarkar: arXiv:0905.3152

My conclusion

- The “background prediction” is based on an over–simplified model. Our galaxy is not a homogeneous cylinder! This model has sufficiently many parameters to reproduce some data, (e.g. the B/C ratio) but there’s no guarantee that other predictions of this model are accurate.

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- Clearcut identification of Dark Matter using charged cosmic rays or photons requires refined modelling of entire cosmix ray spectrum!

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  - No effort made to isolate nuclear recoil events

Light WIMPs (cont'd)

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- Quite difficult to find models giving required large scattering cross sections

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Network members explored relations between DM and traditional astrophysics!

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- 5 GeV *non–annihilating* (e.g. "asymmetric") WIMPs with very large scattering cross section might conceivably affect helio–seismology. Frandsen, Sarkar: arXiv:1003.4505

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Upshot:

$$\rho_{\rm DM}^{\rm here} = (0.39 \pm 0.08) \frac{\rm GeV}{\rm cm^3}$$

Highlight 5: Sterile keV neutrinos

Network members constrained simplest warm Dark Matter model.

- Simplest model (thermal production, no asymmetry) declared excluded in Lesvos rapporteur talk: lower bound on m_{ν_s} from Ly$-\alpha$ "forest" incompatible with upper bound from X–ray searches ($\nu_s \to \nu\gamma$) Palazzo et al.: arXiv:0707.1495

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- But: needs additional "new physics"

Highlight 6: TeVeS and Dark Matter

Network members showed that “modified Newtonian gravity” still requires Dark Matter!

TeVeS (modified theory of Newtonian gravity) cannot simultaneously explain galactic rotation curves and lensing data! Ferreras, Mavromatos, Sakellariadou, Yusaf: arXiv:0901.3932 and arXiv:0907.1463

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- People have been constructing complicated models, and will continue to do so, but simple ones are still fine.
- Experiment may give clues soon: LHC, Xenon–100, AMS–02, ...