

# Constraints on Dark Matter leptophilic models from AMS-02 data.

**To be published soon!**

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Invisibles15

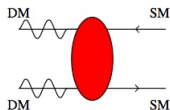
Madrid - June 24th, 2015

# Dark matter searches: experiments - theory interplay

Huge experimental and theoretical effort in investigating the nature of Dark Matter

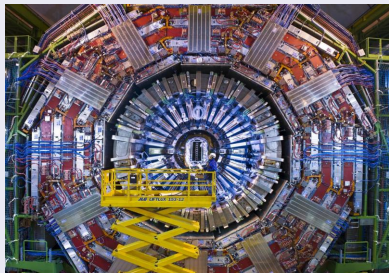
- Various theoretical models provide dark matter candidate(s)
  - No clear signal from experiments so far (but many anomalies...)
- ⇒ exclusion of models or regions of parameter space!

We consider a **leptophilic DM model** and place limits on the annihilation cross-section.



Many papers in the literature *e.g.* Bergström et al. arXiv:1306.3983, Salati et al. arXiv:1504.04276 and many others!

# Constraining dark matter models with AMS-02 data



Limits from colliders:

background model very well known:  
Standard Model

To place limits: 1 (few) free parameter(s),  
*e.g.* coupling or signal normalization.

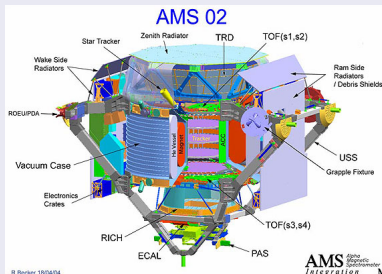
Limits from AMS-02:

background model poorly known:  
standard astrophysics does not provide  
appropriate description!

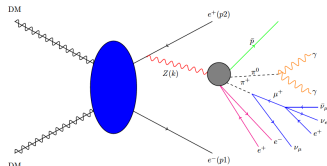
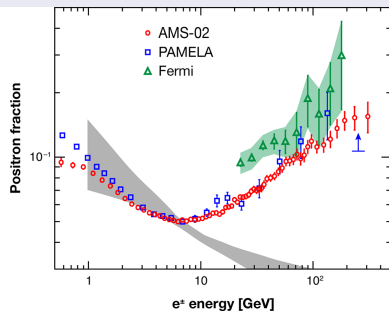
⇒ **phenomenological model**

⇒ **parameters are unknown!**

To place limits: 1 (few) free parameter(s)  
+ **fit of the background to extract the  
parameters.**



# Setting limits



- **Assumption:** AMS positron excess mainly due to astrophysical sources;
- $DM DM \rightarrow e^- e^+$  gives subdominant contribution.
- Absence of clear feature in the data  $\Rightarrow$  **limits setting**.
- **From EW radiation:**
  - small contribution to DM signal in leptonic channel;
  - **but** antiproton flux is induced  $\Rightarrow$  more constraints!

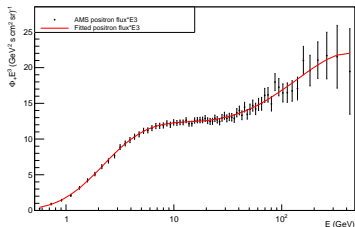
# Phenomenological background model

## New phenomenological background model

Appropriate description of the background  
needed to have reliable upper limits.

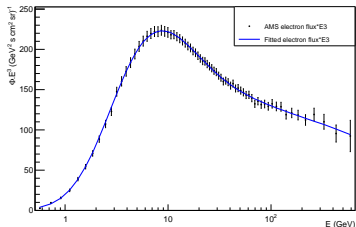
### Positron flux

$$\Phi_{e^+} = \frac{E^2}{\hat{E}^2} \left[ C_{e^+} \hat{E}^{-\gamma_{e^+}} + C_S \hat{E}^{-\gamma_S} e^{-\hat{E}/E_S} \right]$$

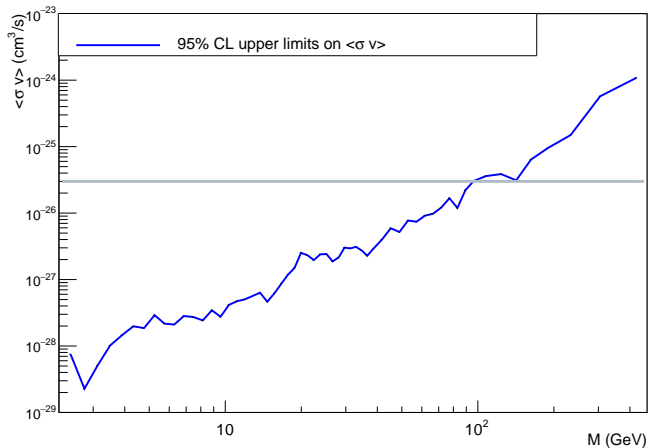


### Electron flux

$$\Phi_{e^-} = \frac{E^2}{\hat{E}^2} \left[ C_{e^-} \hat{E}^{-\gamma_{e^-}} + C_S \hat{E}^{-\gamma_S} e^{-\hat{E}/E_S} \right]$$

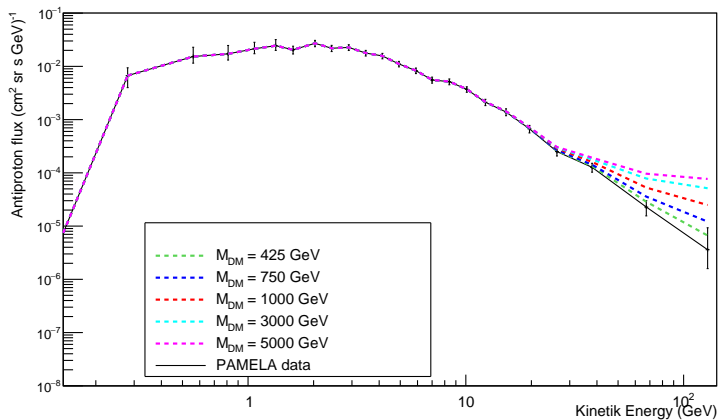


## Upper limits on annihilation cross section for leptophilic models





## Background + predictions for antiproton flux



## Summary

- **Improved background function  $\Rightarrow$  reliable/consistent upper limits on DM annihilation cross-section;**
- **Checked impact of propagation parameters and DM halo models;**
- **Checked impact of inclusion of energy scale uncertainties;**
- **Provide predictions for antiprotons;**

## Future work

- **Further constraints on leptophilic models from AMS-02 antiproton flux measurement.**

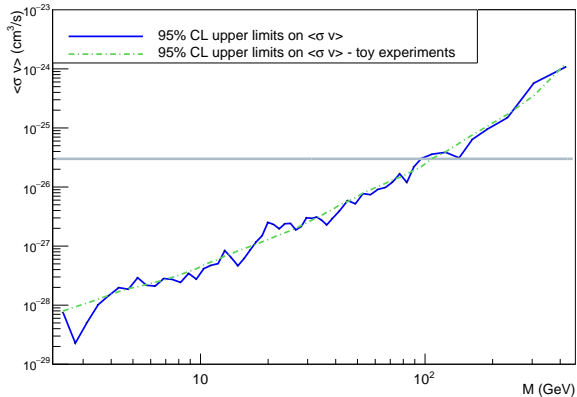


**Thank you!**

# Backup

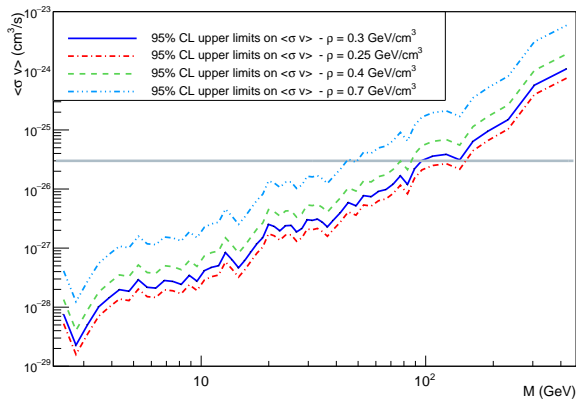
## Upper limits on annihilation cross section for leptophilic models

### Toy experiments



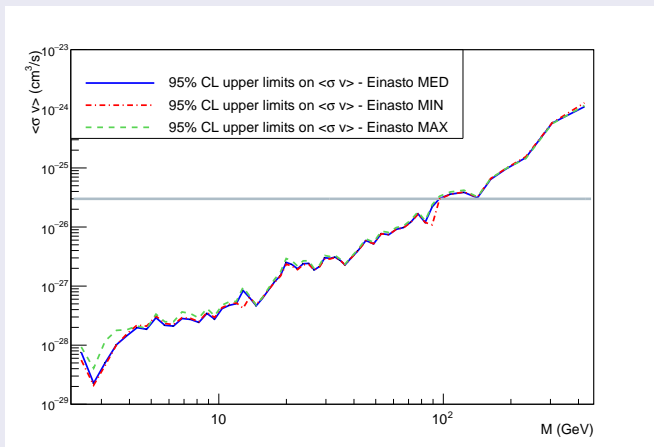
## Upper limits on annihilation cross section for leptophilic models

Value of DM density at Earth



## Upper limits on annihilation cross section for leptophilic models

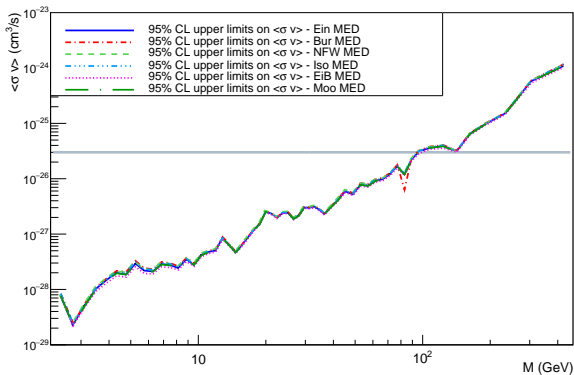
### Propagation parameters





## Upper limits on annihilation cross section for leptophilic models

### DM halo model



## Upper limits on annihilation cross section for leptophilic models

### Inclusion of EW radiation

