# Precision measurement of the combined e<sup>+</sup> + e<sup>-</sup> flux with AMS-02



#### Manuela Vecchi

Instituto de Física de São Carlos, Universidade de São Paulo on behalf of the AMS-02 Collaboration





# The Alpha Magnetic Spectrometer

AMS-02 is a large acceptance particle detector operating aboard the ISS since 2011.

Scientific goals:

- Precise measurements of cosmic rays in the GeV to TeV region
- Study cosmic ray sources and propagation
- Search for primordial antimatter
- Indirect search for dark matter
- Study the effect of solar modulation in low energy region





#### **The AMS-02 Collaboration**

### Cosmic ray fluxes measured by AMS-02



# Why the combined e<sup>+</sup> + e<sup>-</sup> flux ?

Precise measurement of the combined e + and e<sup>-</sup> flux will improve our understanding of the CR sources



# Leptons identification

#### Keys of success :

- redundancy of sub-detectors
- ECAL energy resolution
- Large data <u>sample</u>

#### Main sources of background :

- Lepton/hadron mis-identification
  - (p identified as e+)
- Charge confusion

(independent on the charge sign)



## Lepton/hadron separation

ISS Data: 73-140 GeV, Z=1



### Energy measurement



# How do we measure the e<sup>+</sup> + e<sup>-</sup> flux ?

$$\Phi(\mathbf{E}, \mathbf{E} + \Delta \mathbf{E}) = \frac{N_{obs}(\mathbf{E}, \mathbf{E} + \Delta \mathbf{E})}{\Delta E \,\Delta T_{exp} \,A_{eff} \,\epsilon_{trig}}$$

 $\begin{array}{ll} \Phi & = \mbox{Absolute differential flux (m^{-2} \, sr^{-1} \, GeV^{-1})} \\ N_{obs} & = \mbox{Number of observed events} \\ \Delta T_{exp} & = \mbox{Exposure time (s)} \\ A_{eff} & = \mbox{Effective acceptance (m^2 sr)} \\ E_{trig} & = \mbox{Trigger efficiency} \end{array}$ 

### Events counting

Reference spectra for the signal and the background are fitted to data using the shape of the TRD classifier



Measurement is performed for the cut on the ECAL classifier that minimizes the overall statistical + systematic uncertainty

# Stability of the signal



- Acceptance
- Bin-to-bin migration

To assess the systematic error from the event selection: analysis repeated 2000 times in each energy bin varying the ECAL classifier cut and different values of selection cuts



### Detector acceptance

#### The detector acceptance has been obtained using a dedicated MC simulation



Example : TRD acceptance + quality cut

# Results: the combined $e^+ + e^-$ flux

PRL 113, 221102 (2014)



The (e<sup>+</sup>+e<sup>-</sup>) flux can be described by a single power-law above 30 GeV **No evidence of fine structures** 

### Spectral index



Fit to a single power law above 30 GeV yelds:  $\gamma = -3.170 \pm 0.008$  (stat + syst.)  $\pm 0.008$  (energy scale)

# Summary

- •The combined e<sup>+</sup>+e<sup>-</sup> flux has been measured up to I TeV based on 10.6 million events detected during the first 30 months of operation of the AMS-02 aboard the ISS.
- •The flux is smooth and (above 30 GeV) it can be described by a single power law.
- The data show very interesting features and will surely allow very deep phenomenological and theoretical studies.
- Next step is to extend the energy range and further reduce the systematics.