



GOBIERNO
DE ESPAÑA

MINISTERIO
DE ECONOMIA
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Ciemat

Centro de Investigaciones
Energéticas, Medioambientales
y Tecnológicas



Taller de Altas Energías
Benasque
25 Septiembre 2013

AMS-02 Operation and Performances on the International Space Station and first results

Isabel Rodríguez Herranz

Centro de Investigaciones Energéticas Medioambientales y Tecnológicas

Dark Matter Indirect Search

-Antiprotons, positrons and γ -ray spectra

Primordial Antimatter Search

-Detection of anti-nuclei, $|Z| \geq 2$

Cosmic-Ray Propagation Models

-Composition and Flux

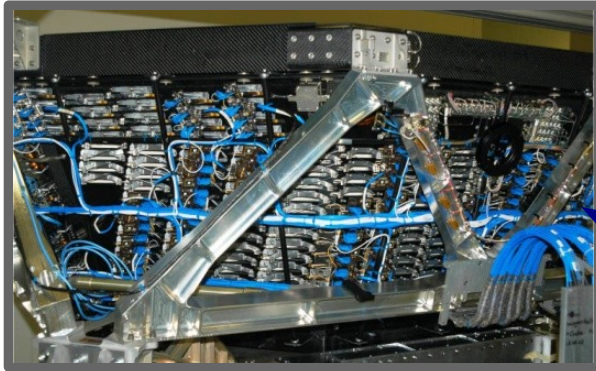
Exotic Searches (e.g. strangelets)



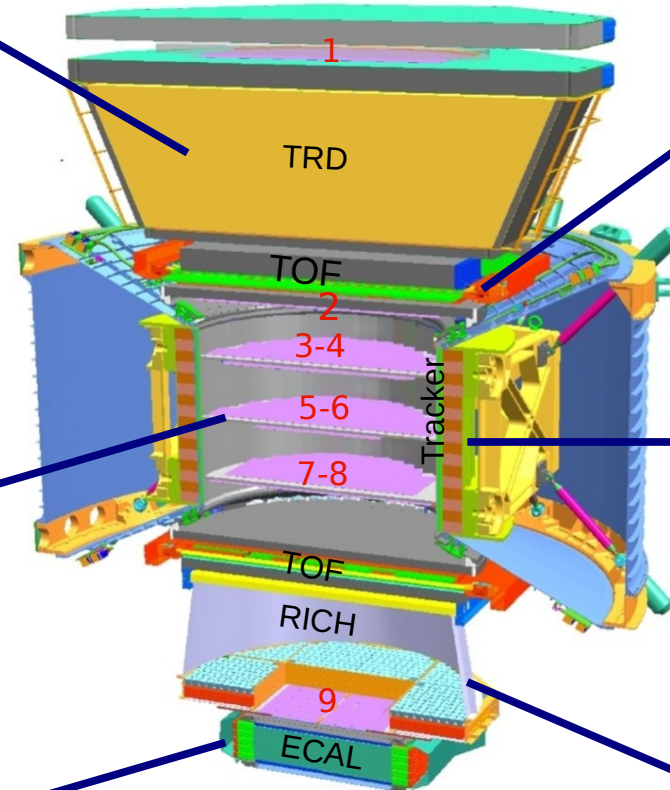
AMS-02: The instrument



TRD: Identify e^+ , e^-



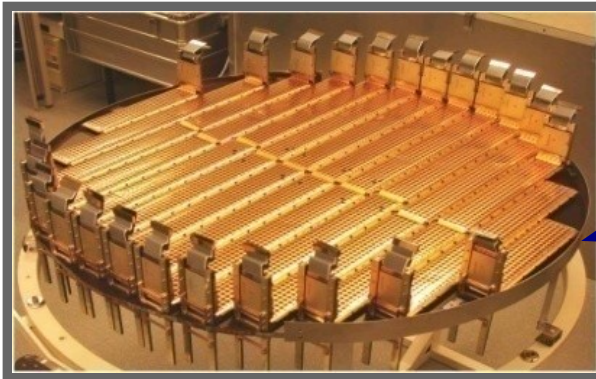
*Z , P measured independently
by the Tracker, RICH, TOF and ECAL*



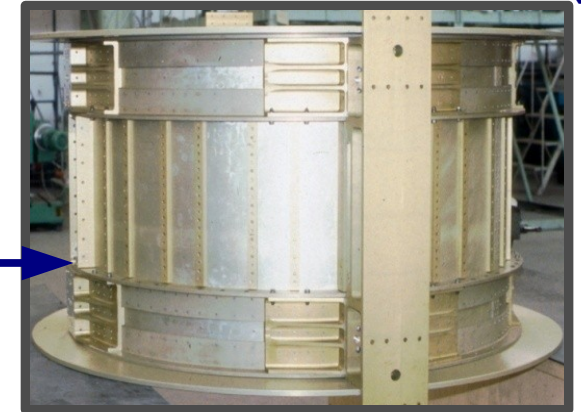
TOF: Z , β



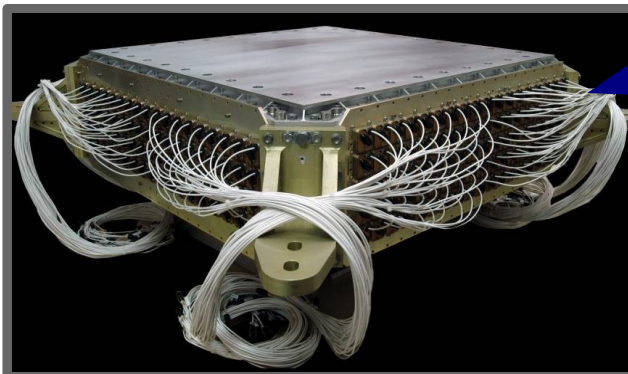
Silicon Tracker: Z , P



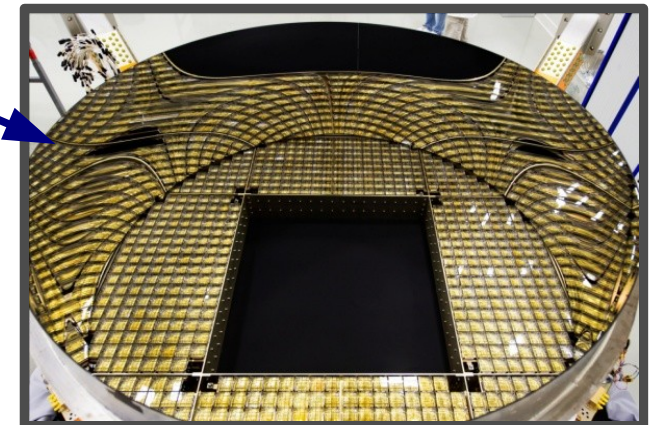
PERMANENT MAGNET: $\pm(Z)$



ECAL: E of e^+ , e^- , γ



RICH: Z , β



*Particles and nuclei
are identified by their
charge (Z) and energy ($E \sim P$)*

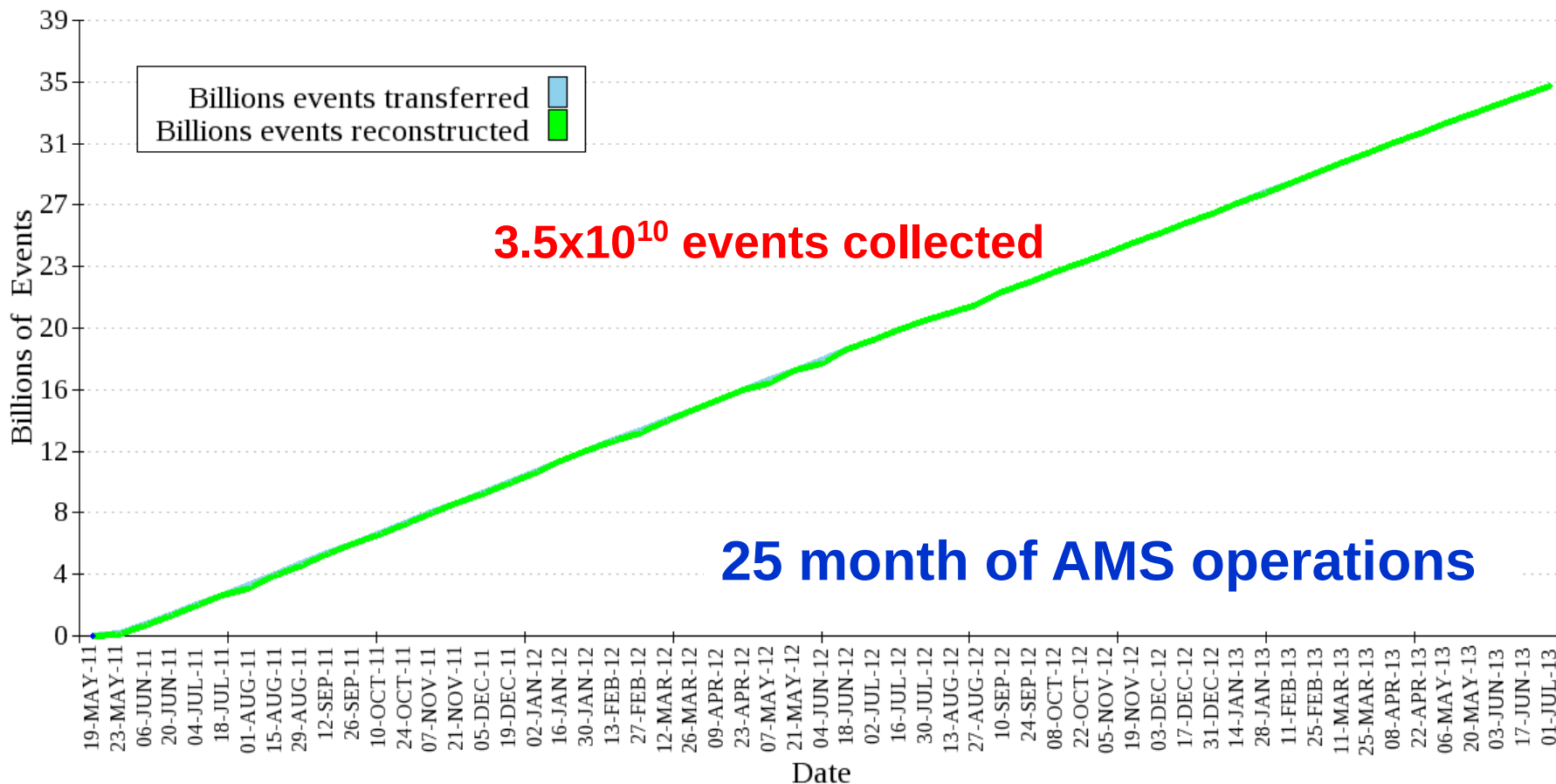
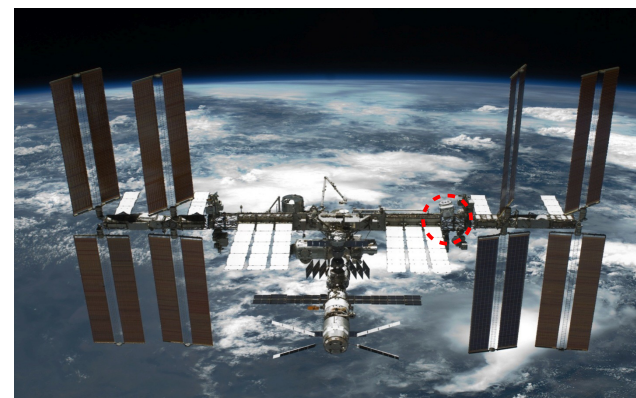
AMS-02: Operation



Launch 16th May 2011

Operating from 19th May 2011 at ISS

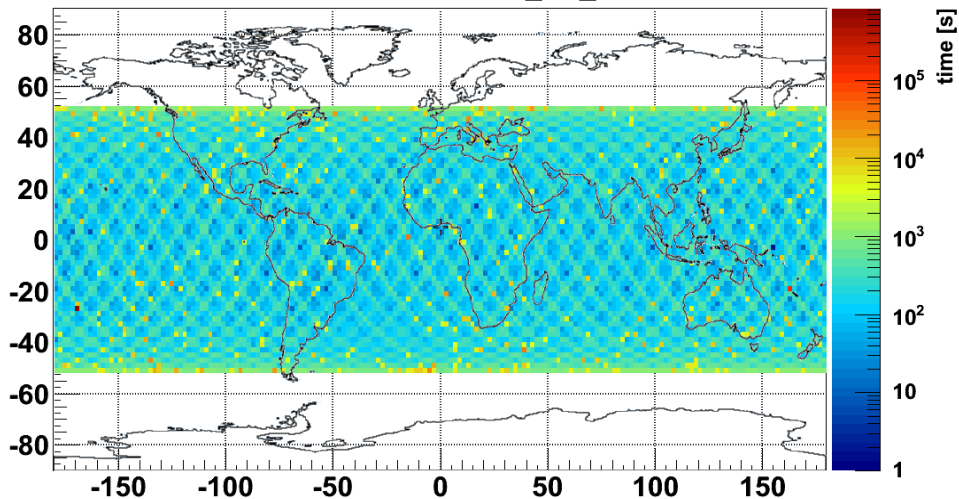
1.6×10^{10} events/year



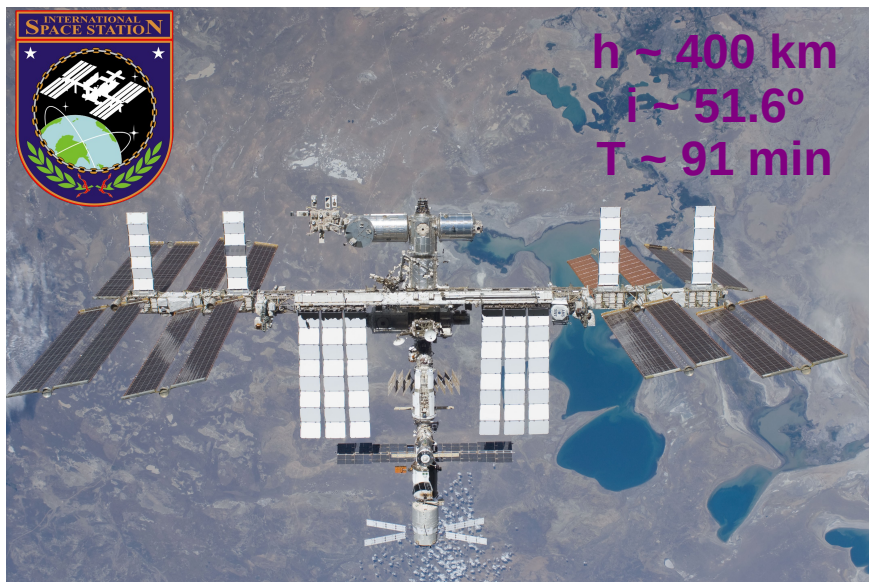
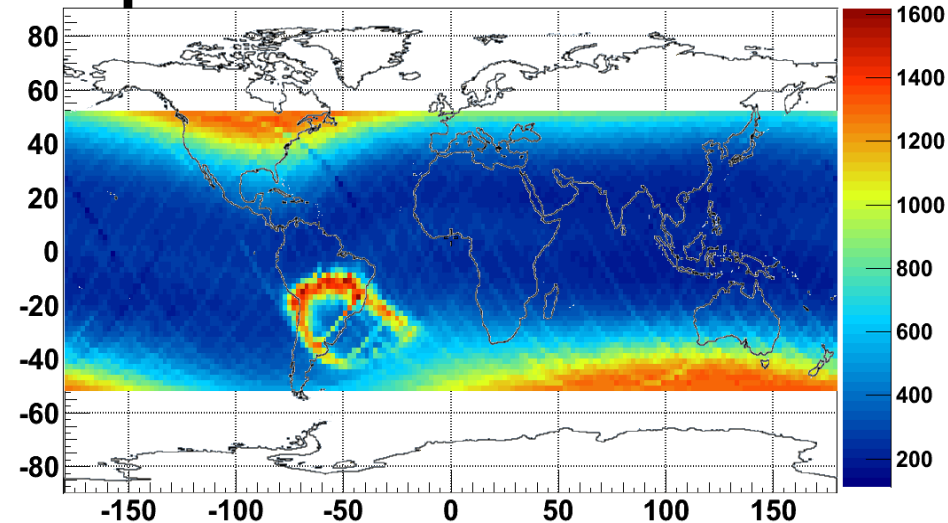
AMS-02: Operation



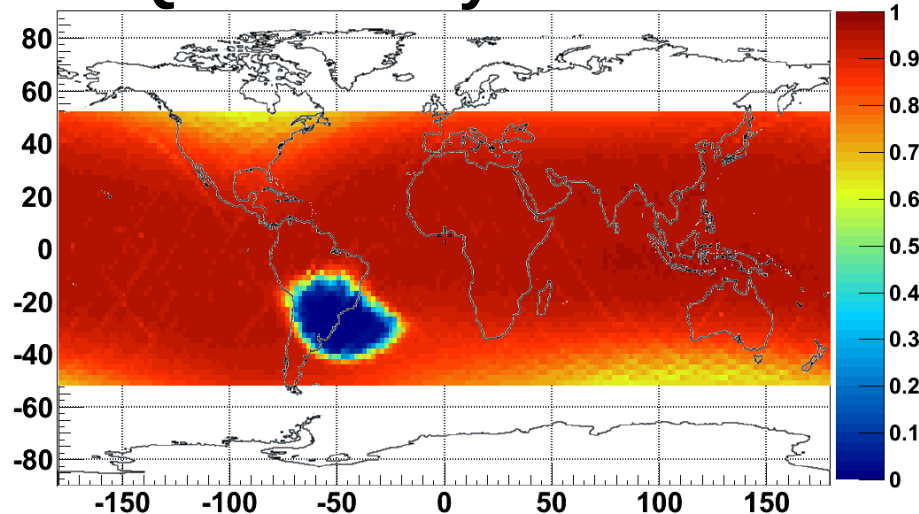
Time at location [s]



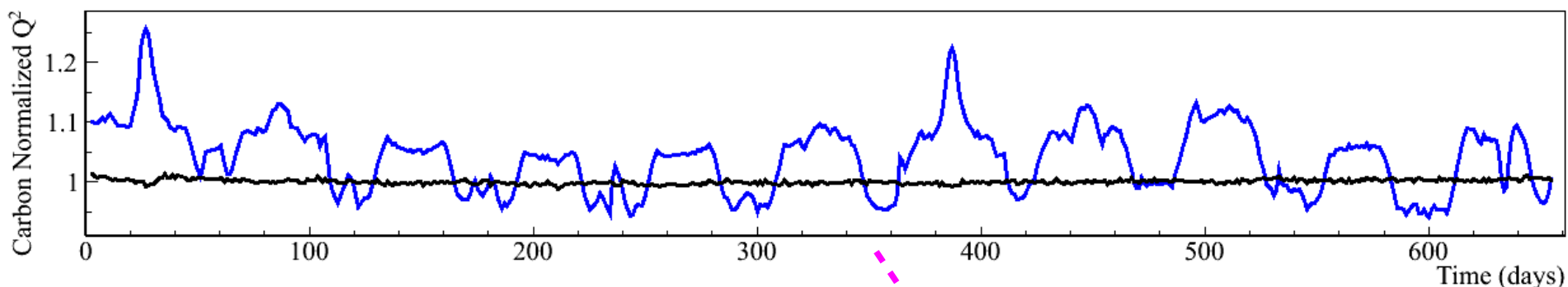
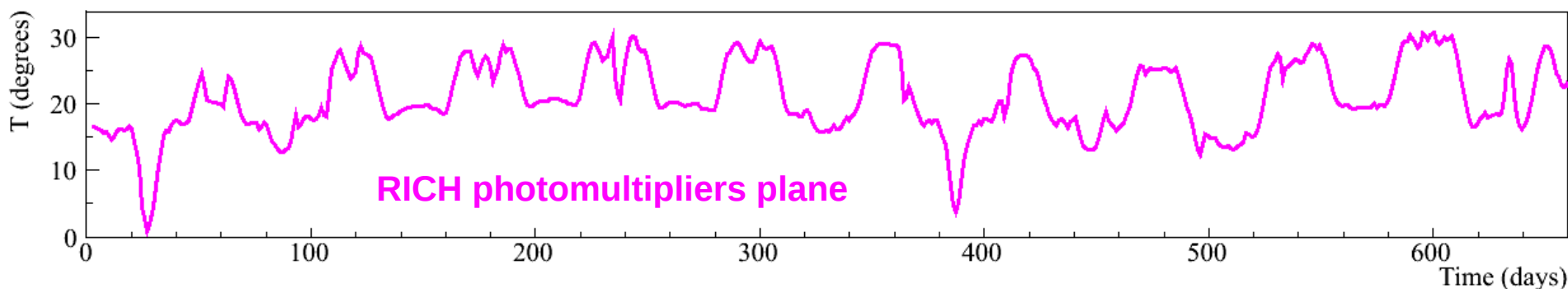
Acquisition rate 200-2000 Hz



DAQ efficiency 85%



AMS-02: Operation



POCC @ CERN

Critical conditions in space

**Temperature changes in a wide range
1118 T sensors + 298 heaters**

Monitoring and corrections required

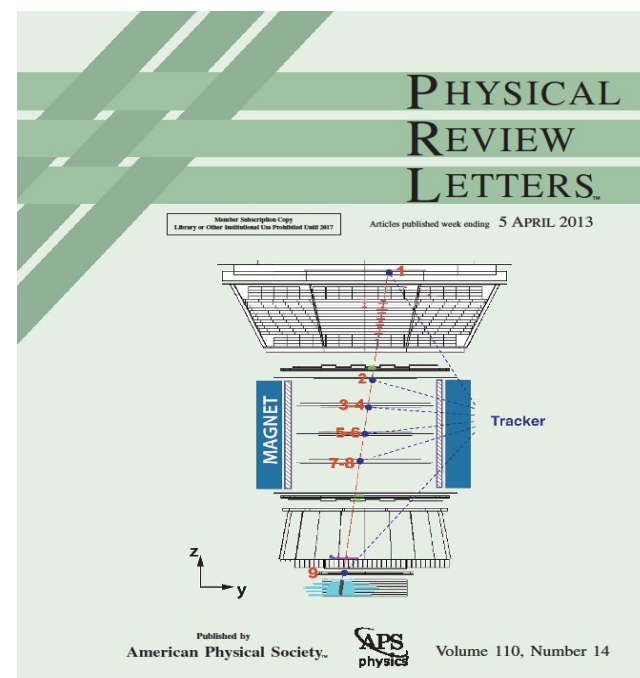


Publications:

**“First Result from the AMS on the ISS:
Precision Measurement
of the Positron Fraction in Primary Cosmic Rays
of 0.5-350 GeV”**

M. Aguilar et al. (AMS Collaboration)

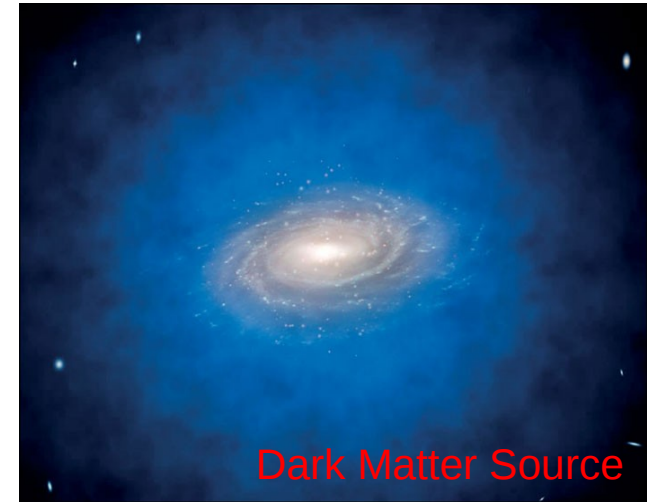
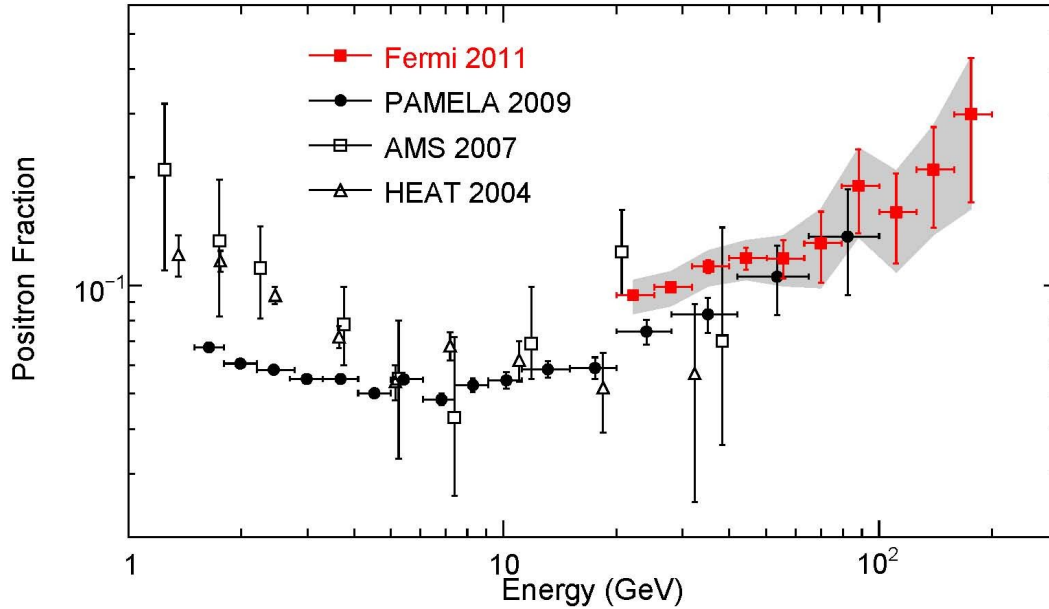
Phys. Rev. Lett. 110, 41102. 2013



25 CONTRIBUTIONS:

- 7 physical results
- 18 performance of detectors

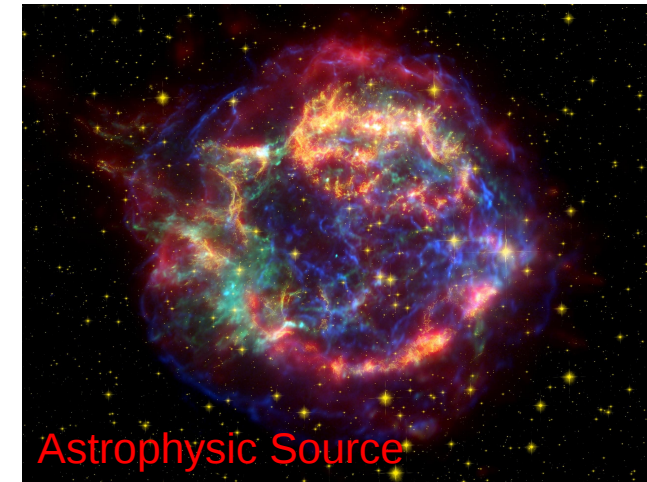
Positron Fraction: Motivation



Not expected excess at high energies

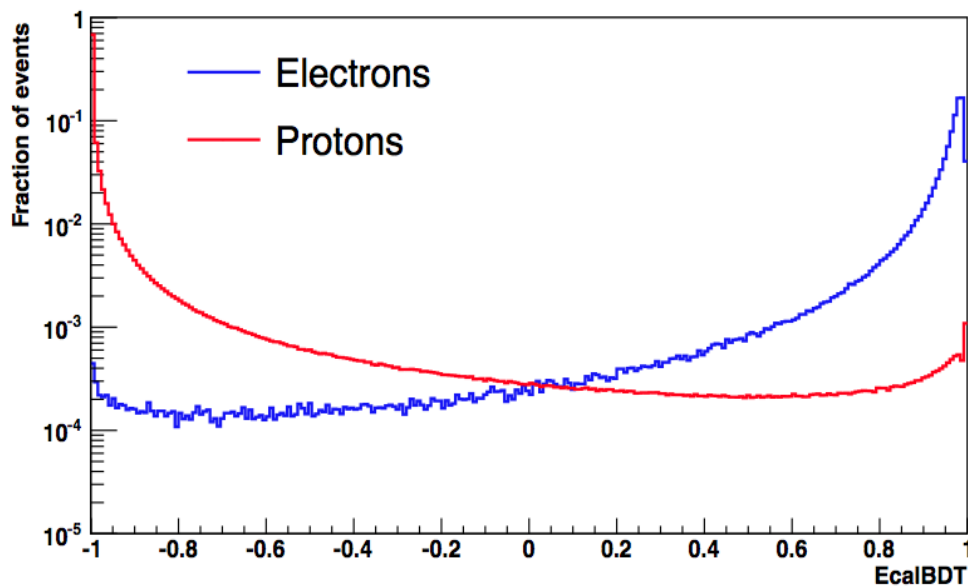
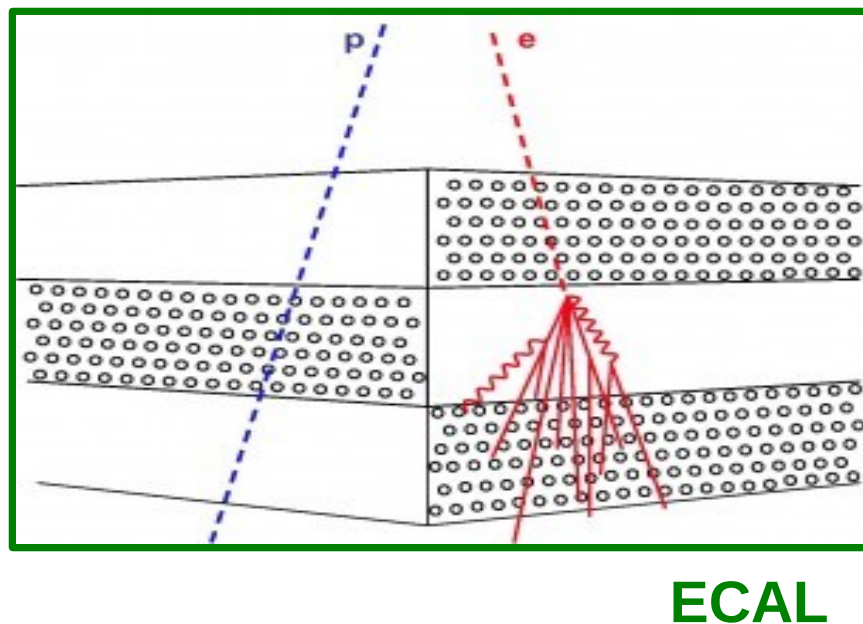
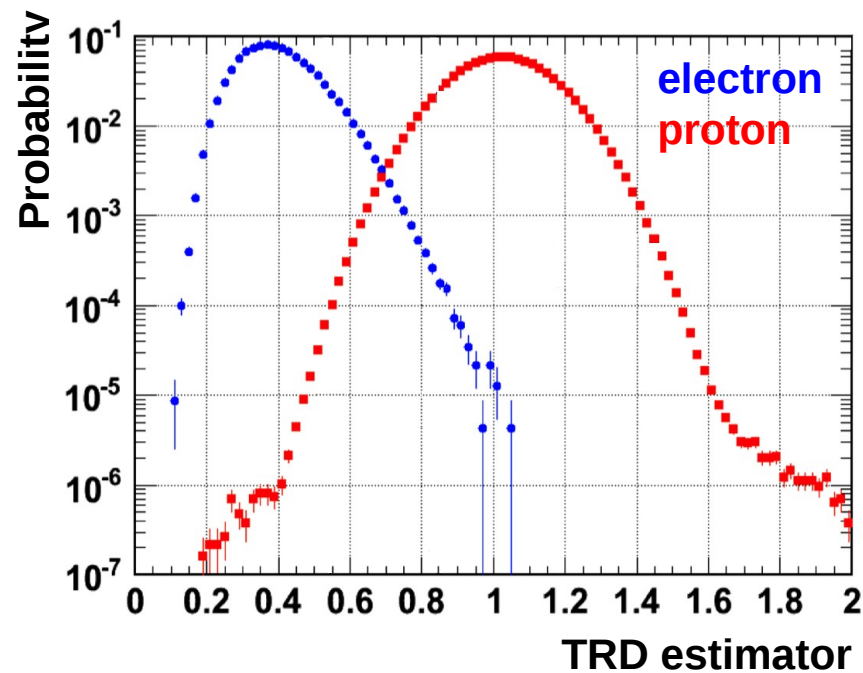
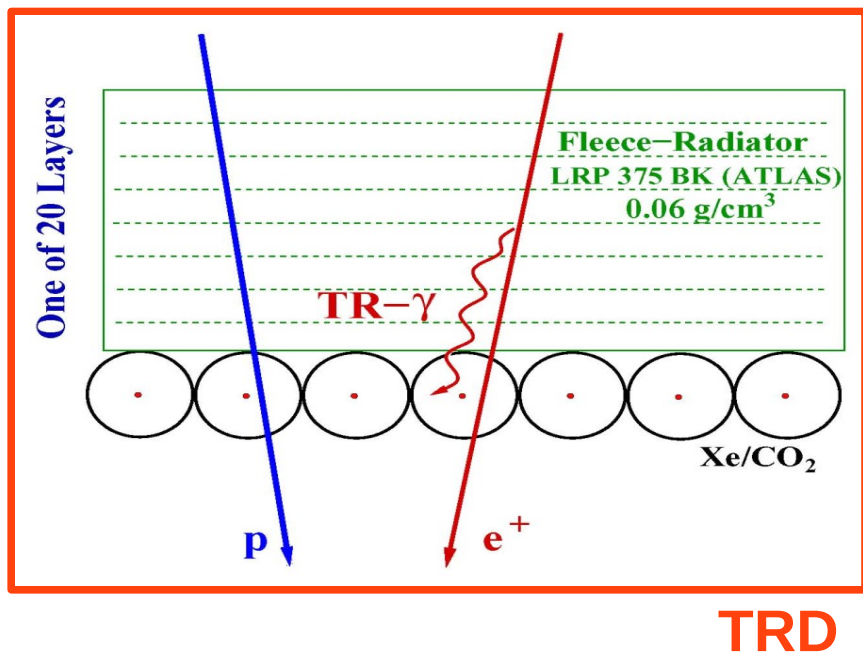
The clearest Cosmic Rays anomaly

$1 e^+ \leftrightarrow 10^4 p$

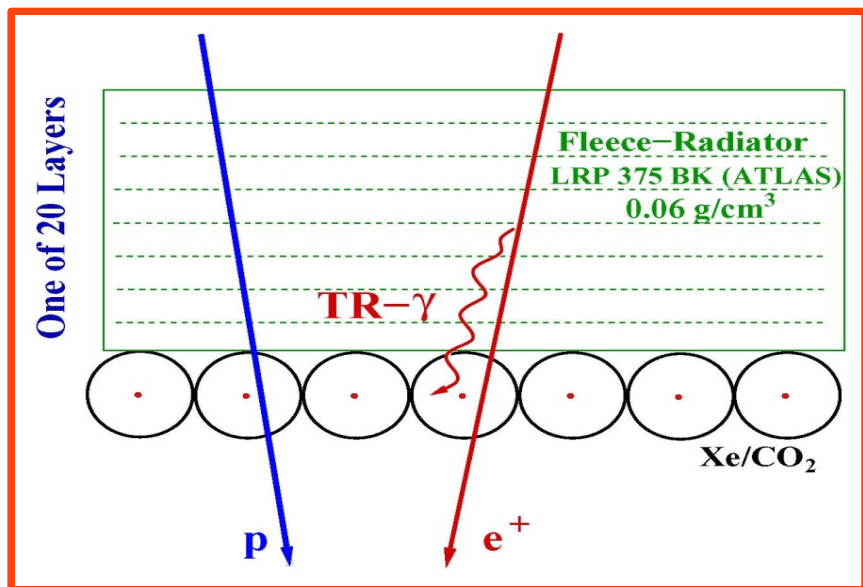


AMS-02: 18 months of data – 25 billion events - 6.8 millions e^+e^-

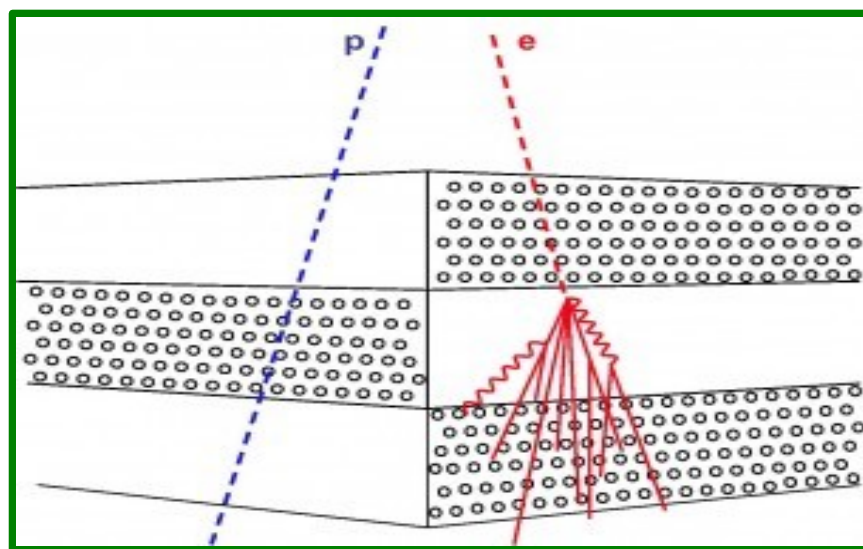
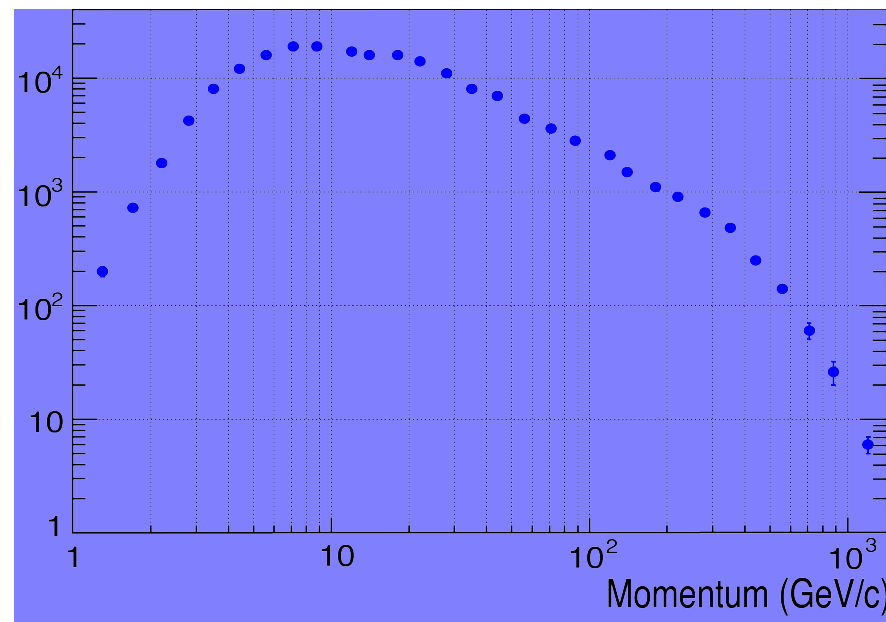
Positron Fraction: Proton Rejection



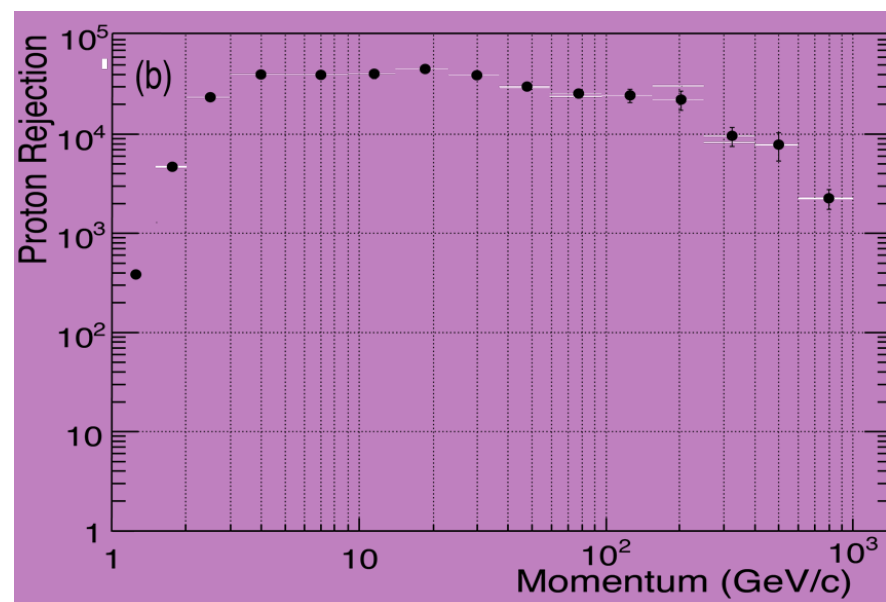
Positron Fraction: Proton Rejection



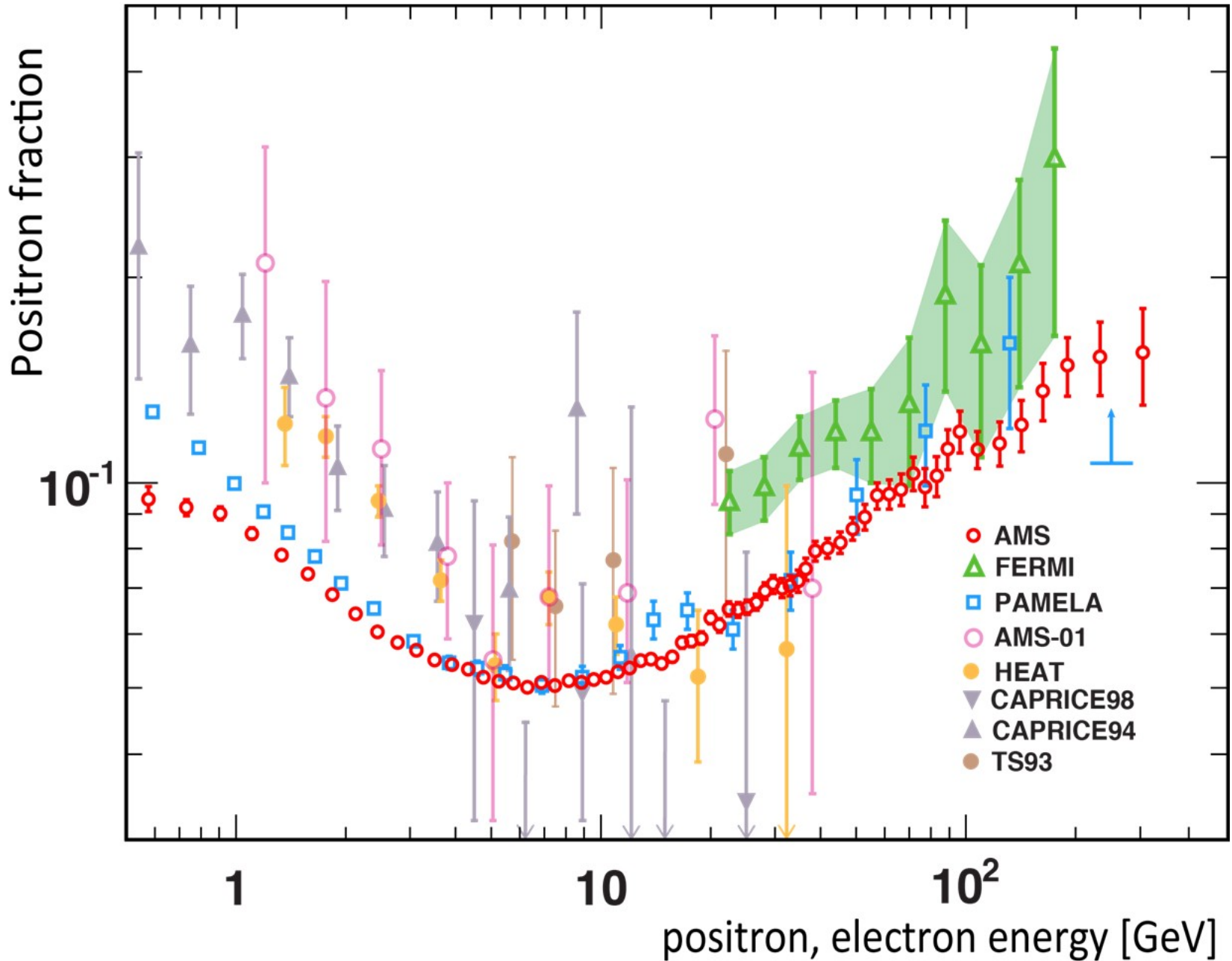
TRD



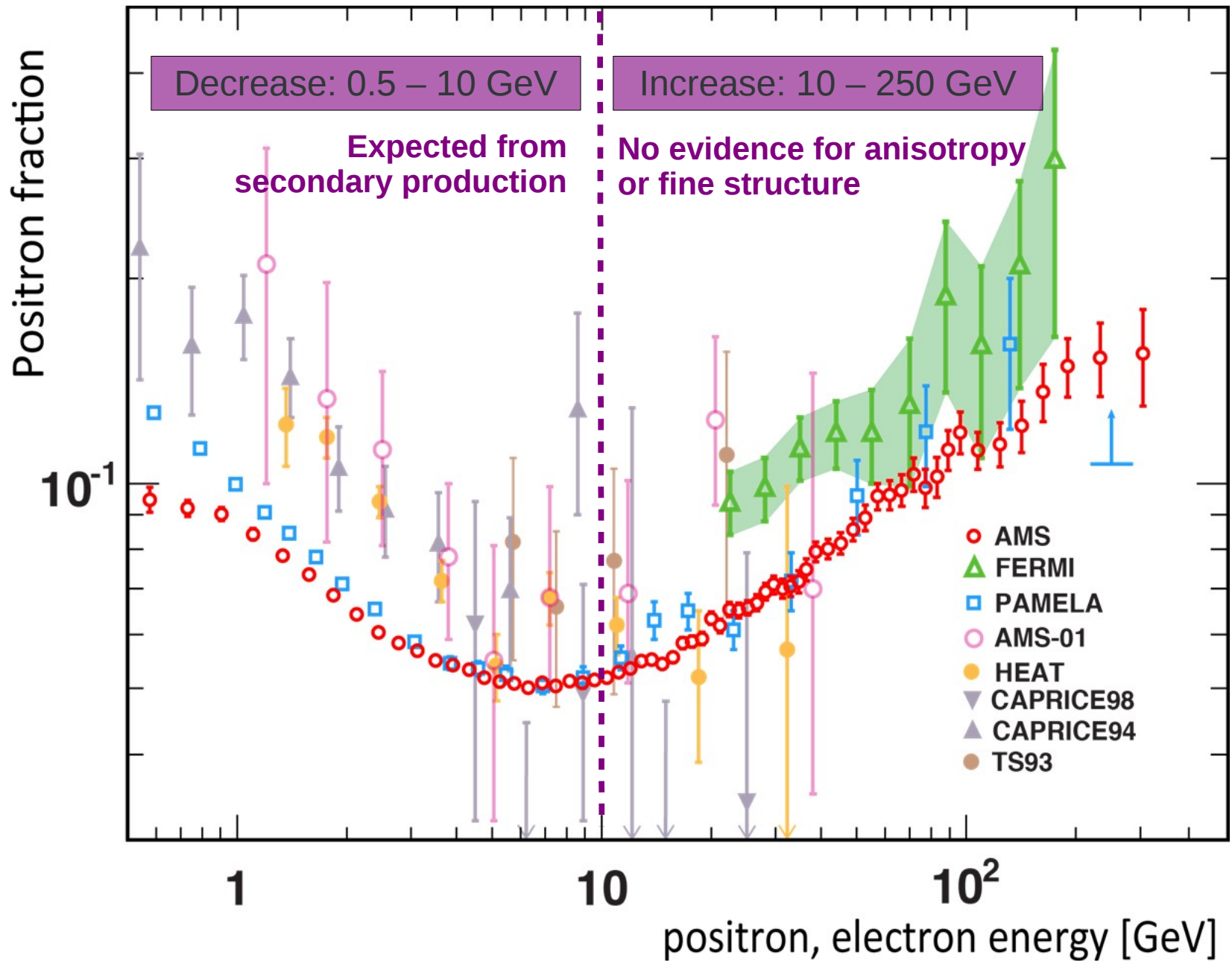
ECAL



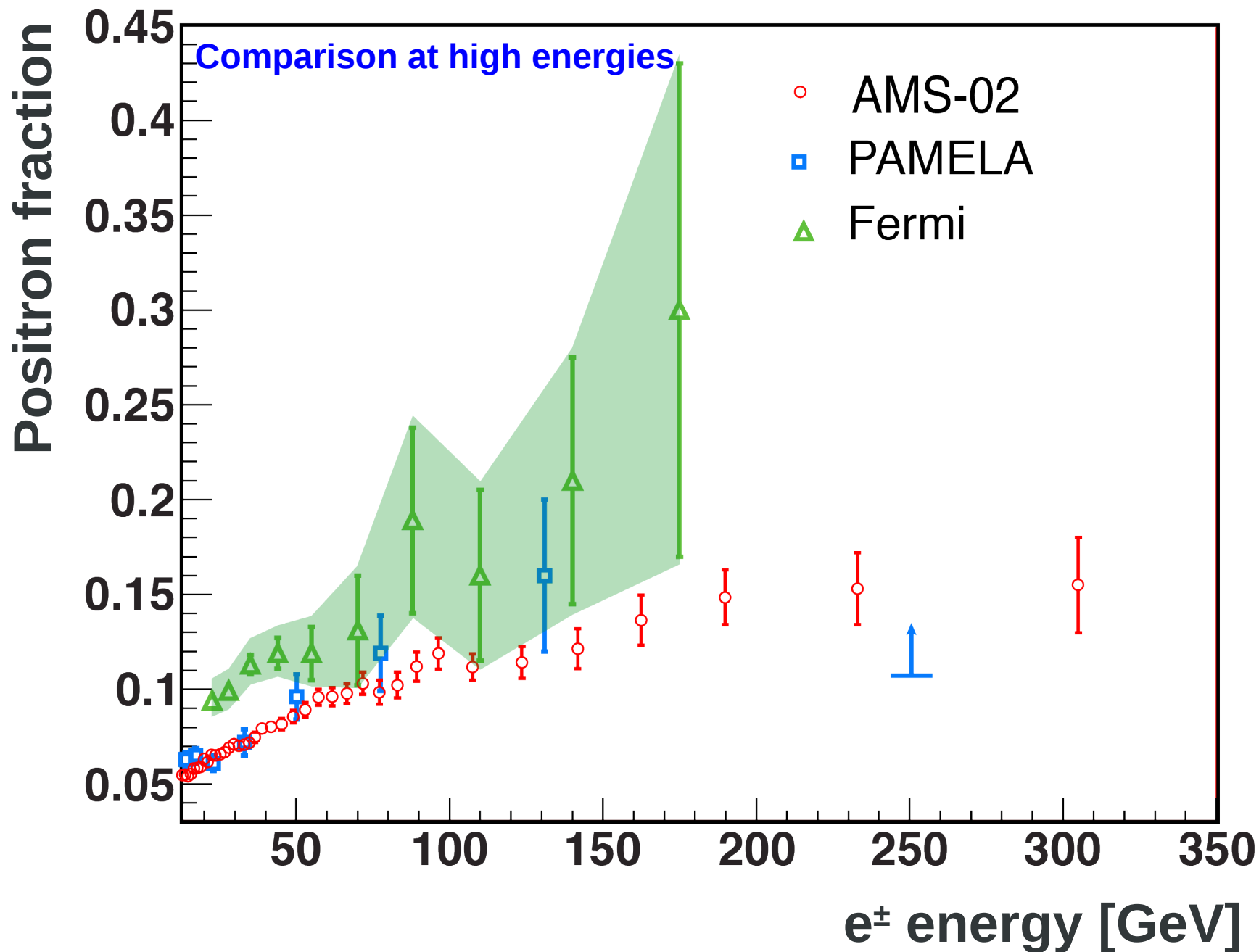
Positrons Fraction: Result



Positrons Fraction: Result



Positrons Fraction: Result



More statistics needed





AMS

- A very sensitive CR detector in the space
- Large statistics (until the end of the ISS)
- Special environmental conditions

Positron fraction

- High precision measurement (0.5-350 GeV)
- Excess at high energies ($E > 10 \text{ GeV}$)
- No evidence for anisotropy or fine structure
- Good fit to simple model for a common source

NEW RESULT @ ICRC 2013 on:

- e^- spectrum (1 – 500 GeV)
- e^+ spectrum (1 – 350 GeV)
- e^-+e^+ spectrum (0.5–700 GeV)
- p spectrum (1 GV – 1.8 TV)
- He spectrum (2 GV – 3 TV)
- B/C ratio (5 – 500 GV)

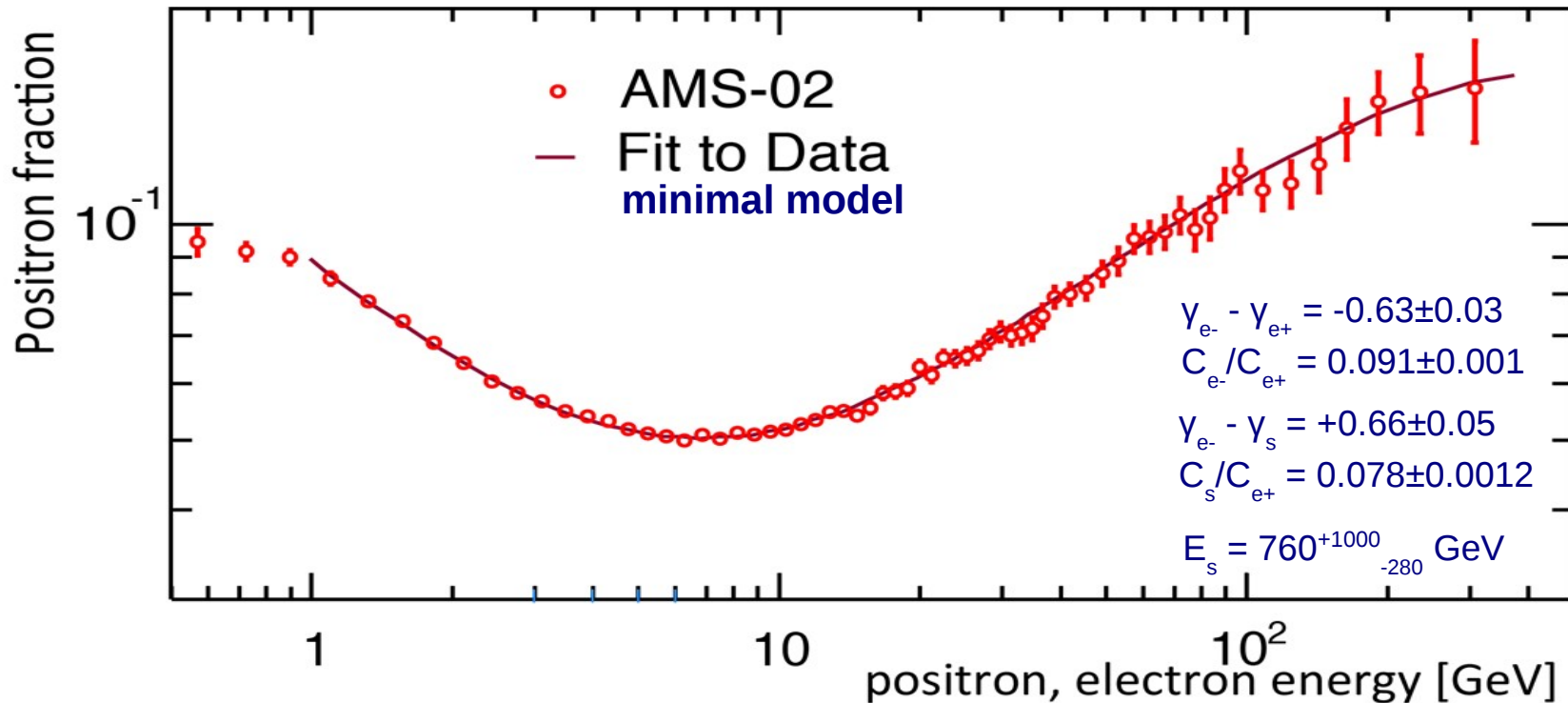
And much more on the way...

BACKUP

Positrons Fraction: Interpretation



The agreement between the data and the model shows that the positron fraction spectrum is consistent with e^\pm fluxes each of which is the sum of its **diffuse spectrum** and a single common **power law source**.



$$\Phi_{e^+} = C_{e^+} E^{-\gamma_{e^+}} + C_s E^{-\gamma_s} e^{-E/E_s}$$

$$\Phi_{e^-} = C_{e^-} E^{-\gamma_{e^-}} + C_s E^{-\gamma_s} e^{-E/E_s}$$

CRs collisions
 +
Single energetic common source

Systematic uncertainty sources

- Assymmetric acceptance of e^+ and e^-
- Selection e^+/e^-
- Bin-to-bin migration
- The reference spectra
- Charge confusion:
 - Finite resolution of the tracker and multiple scattering
 - Secondary tracks along the path of the primary e^+ in the tracker