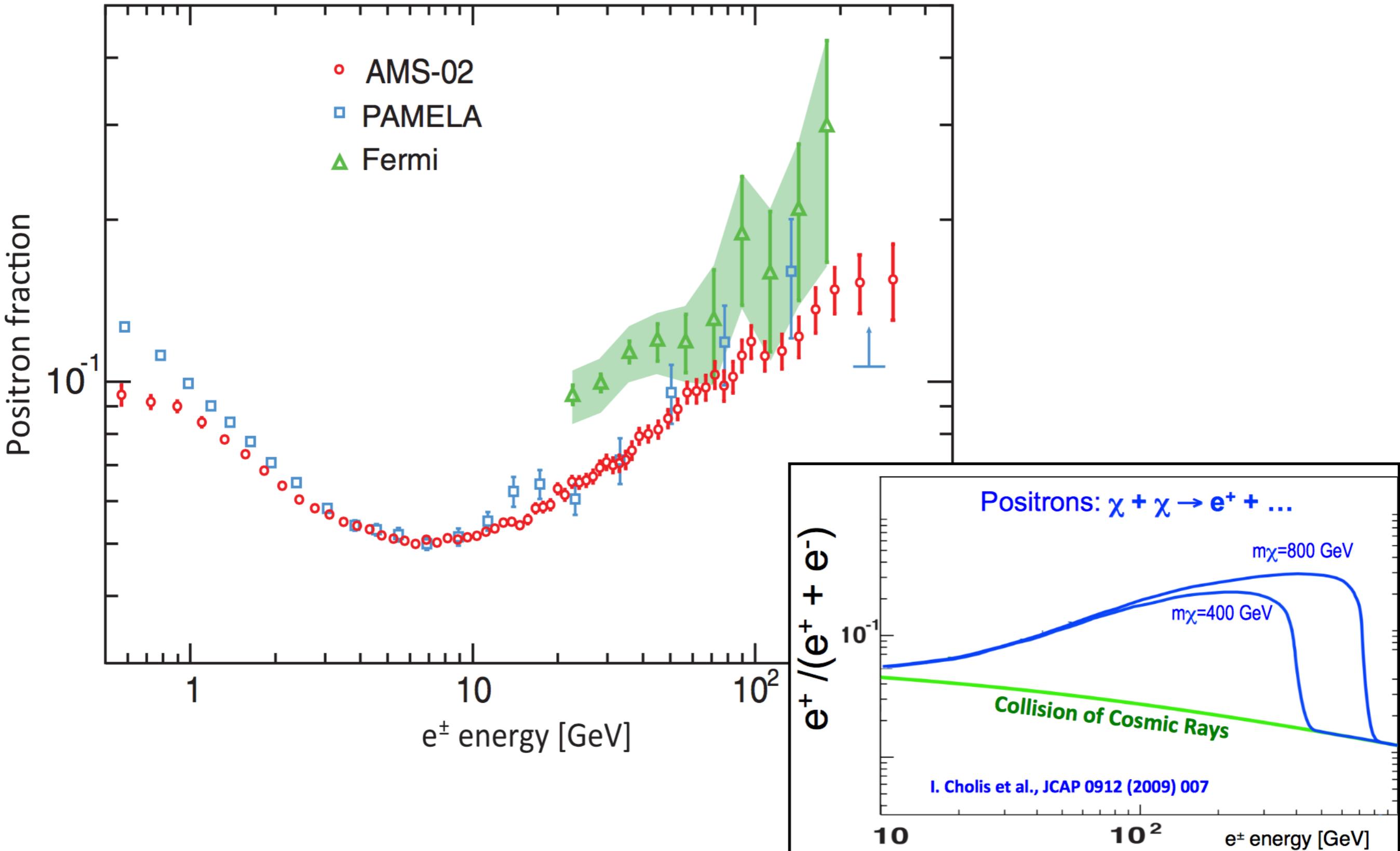


Measuring the e^+ / e^- fluxes with AMS-02 on the ISS

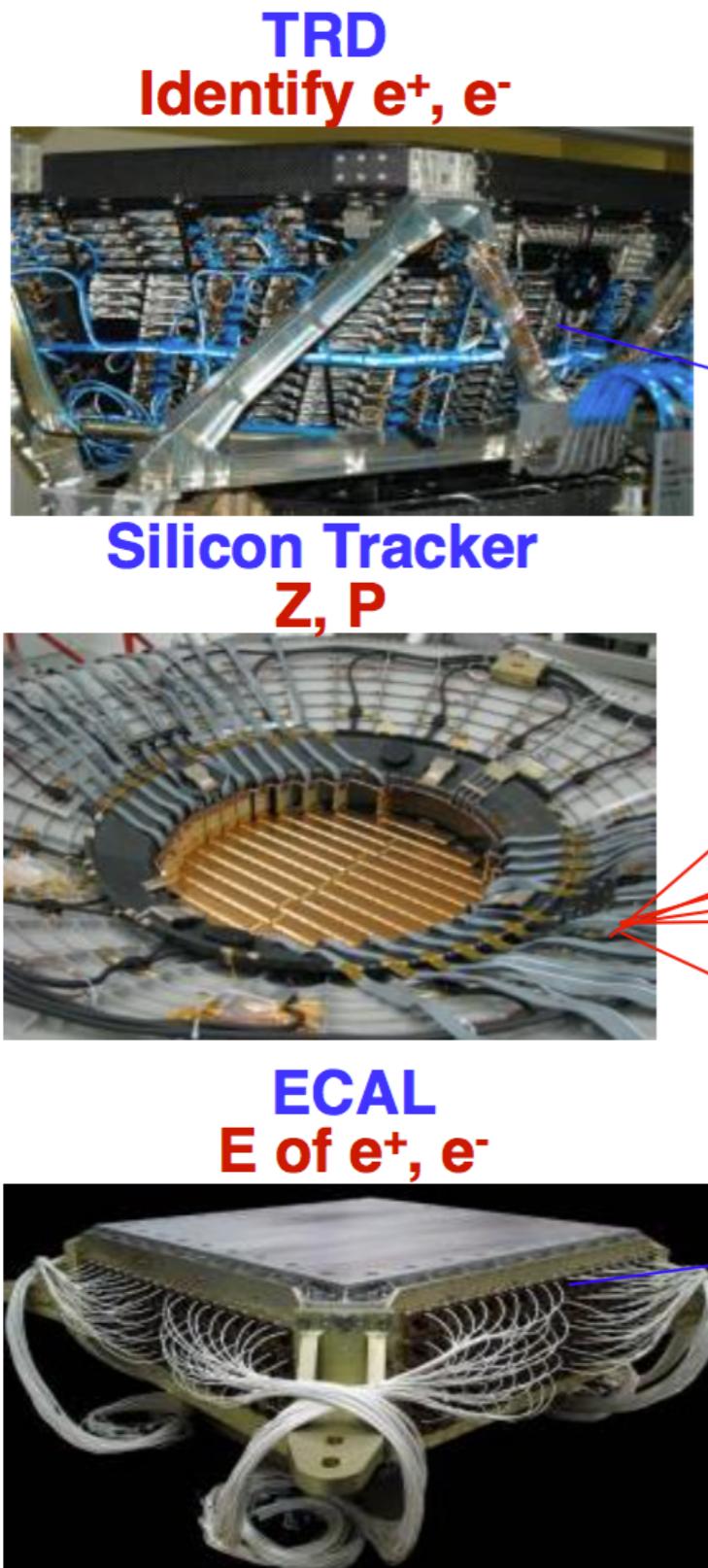


Nikolas Zimmermann - RWTH Aachen University
24.07.2015 - EPS Vienna

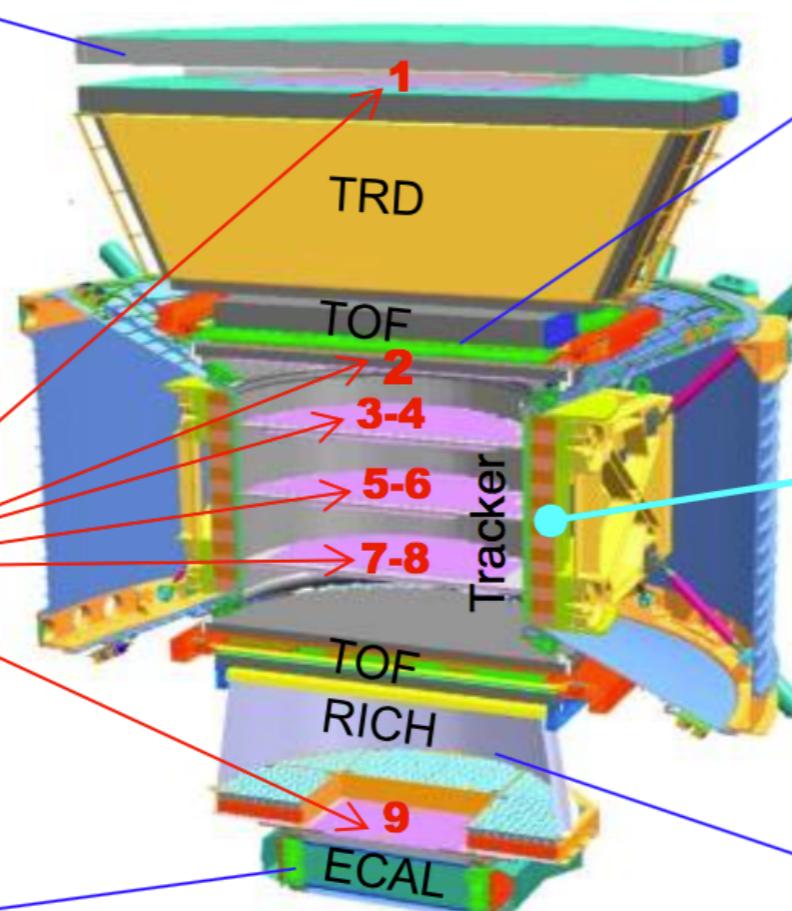
Motivation



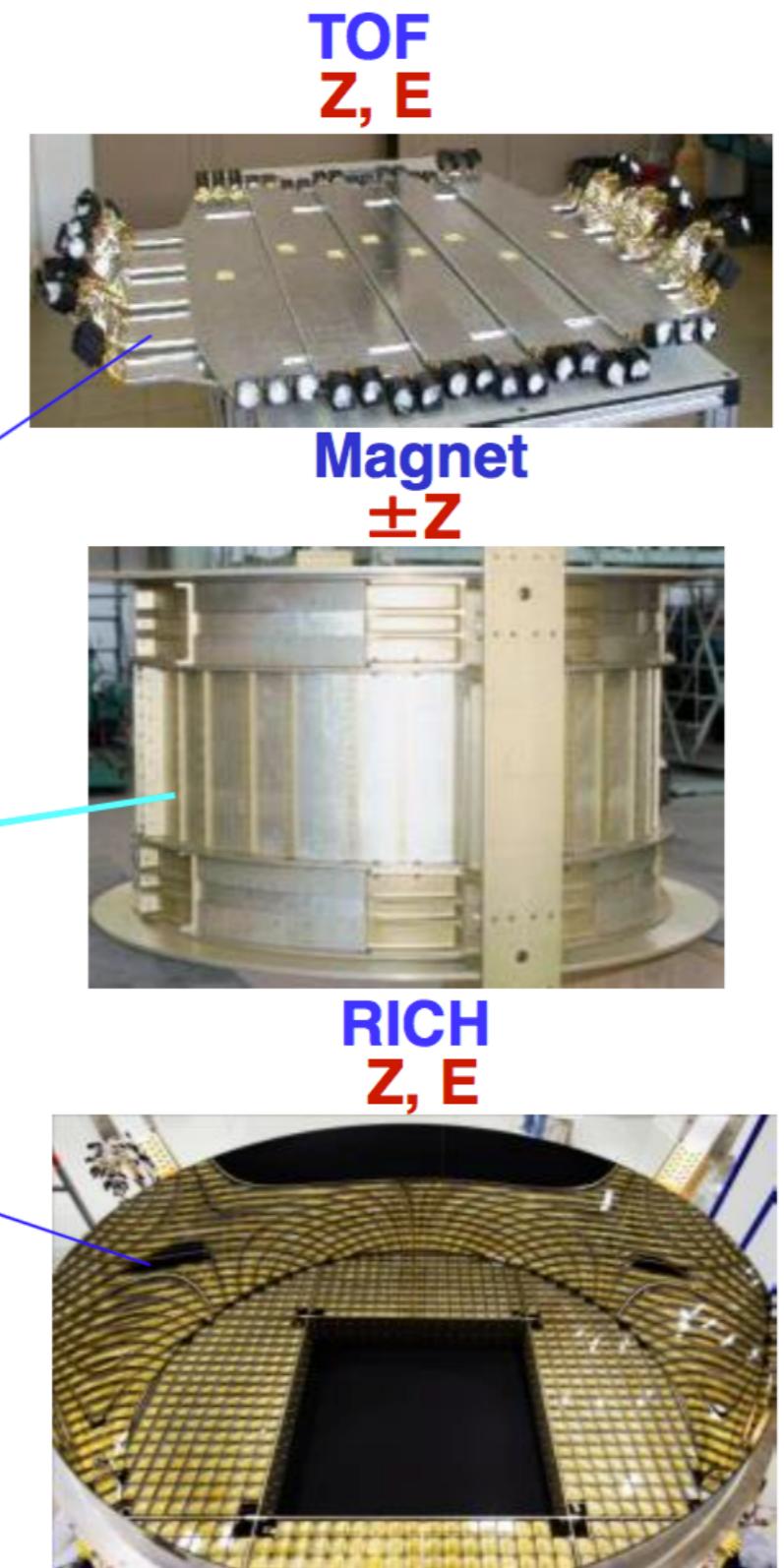
AMS-02: A TeV precision multipurpose spectrometer



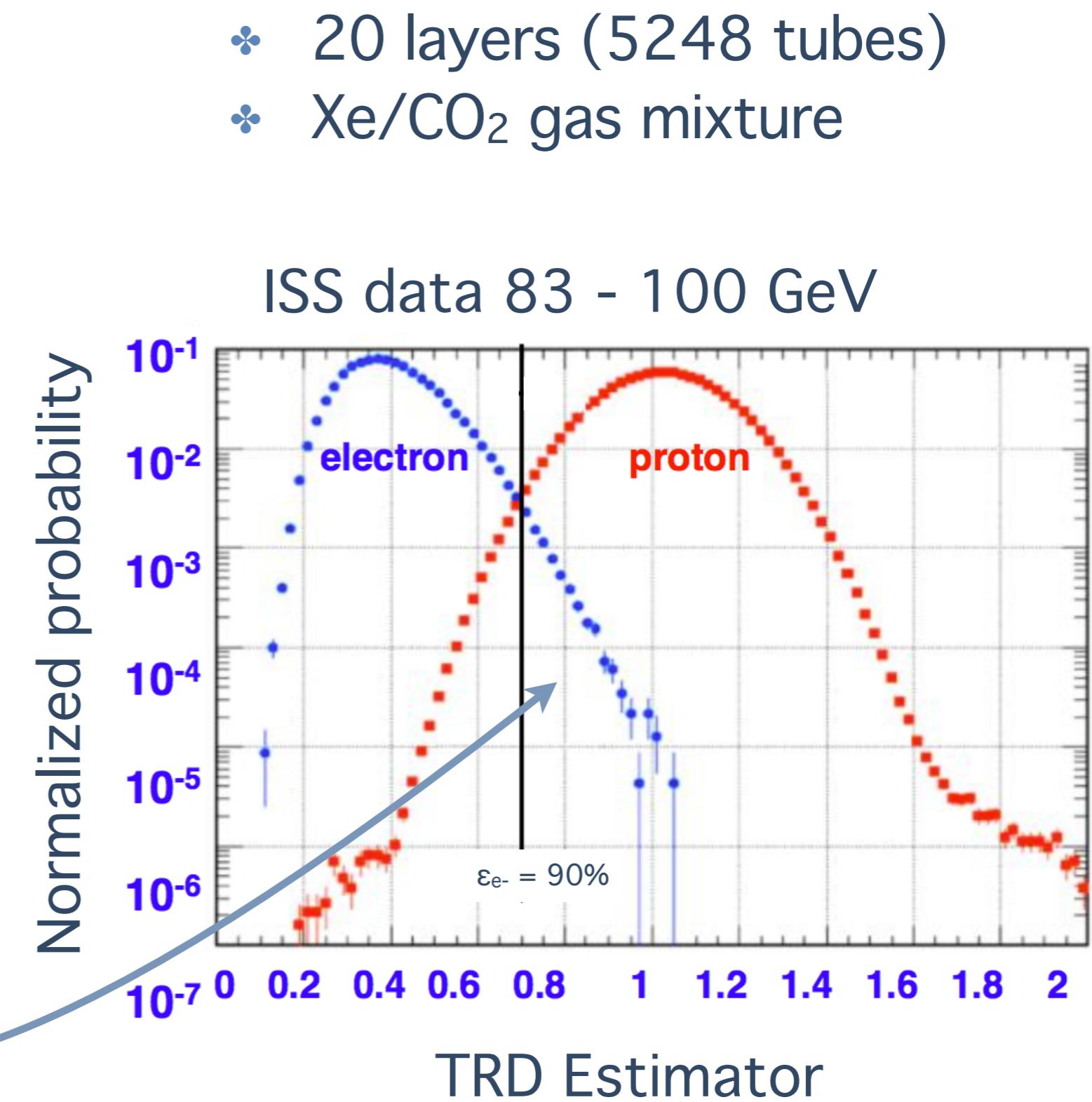
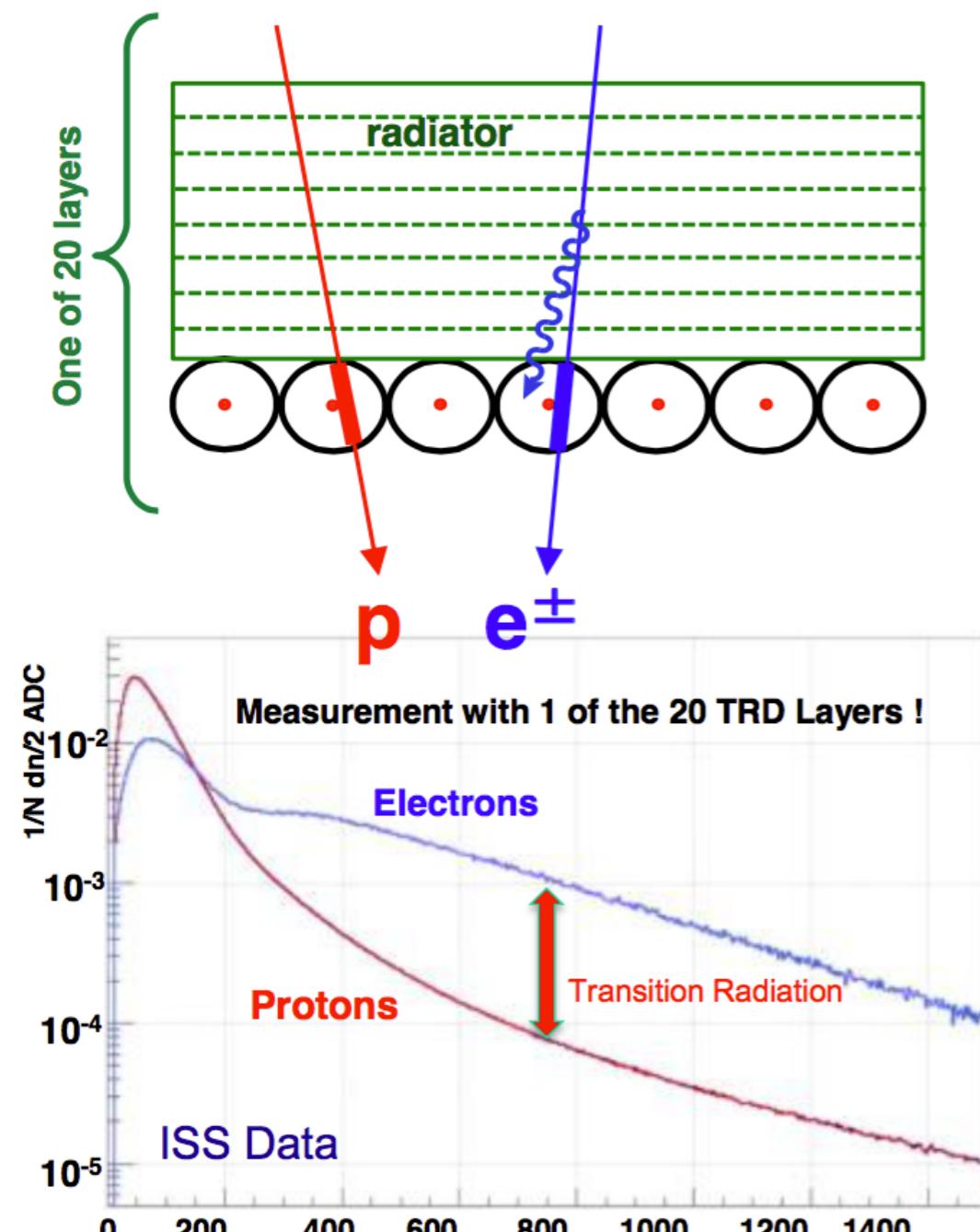
**Particles and nuclei
are defined
by their charge (Z)
and energy ($E \sim P$)**



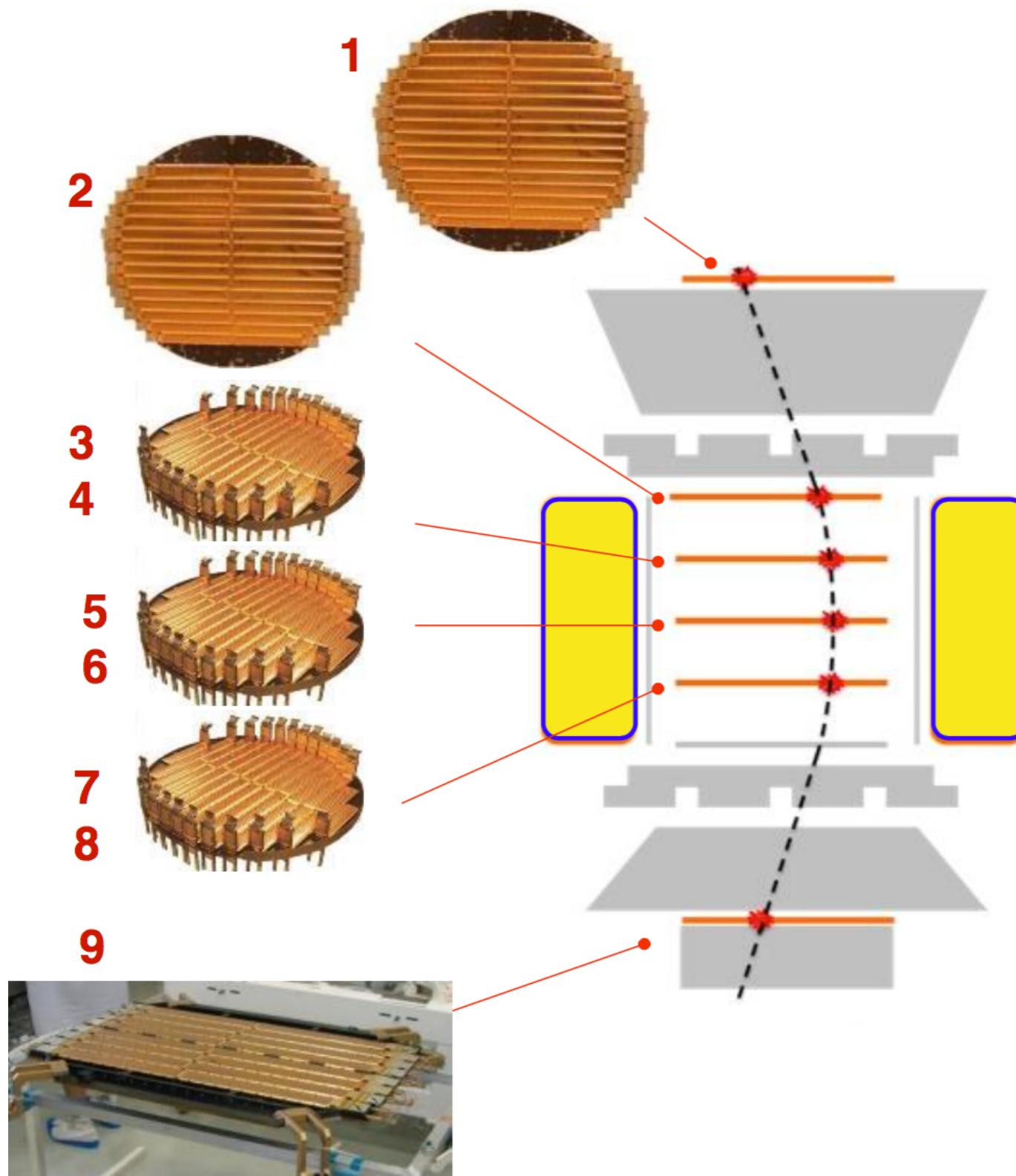
**Z and P
are measured independently by the
Tracker, RICH, TOF and ECAL**



AMS-02 Transition Radiation Detector

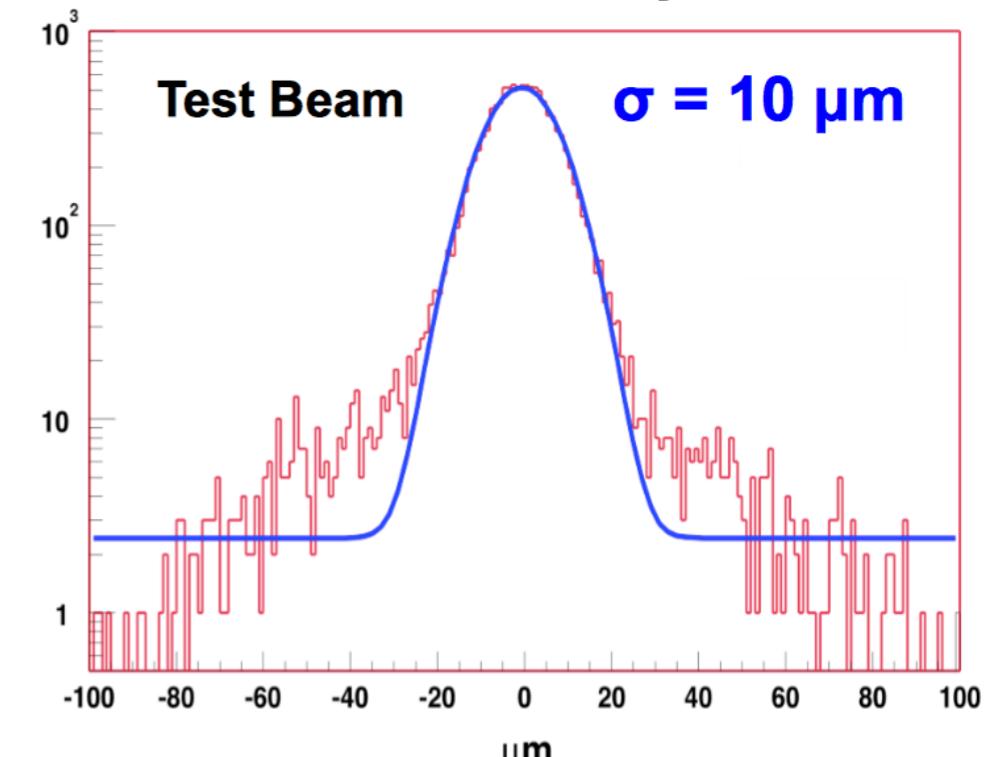


AMS-02 Silicon Tracker



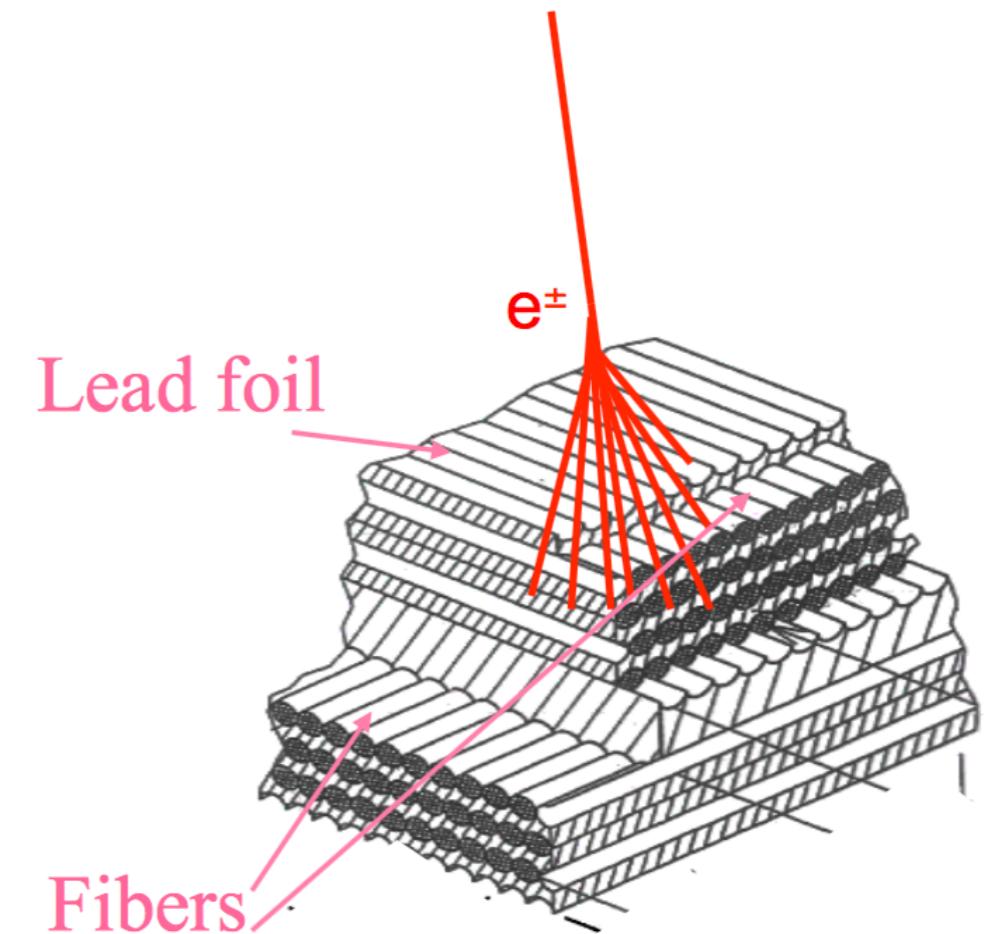
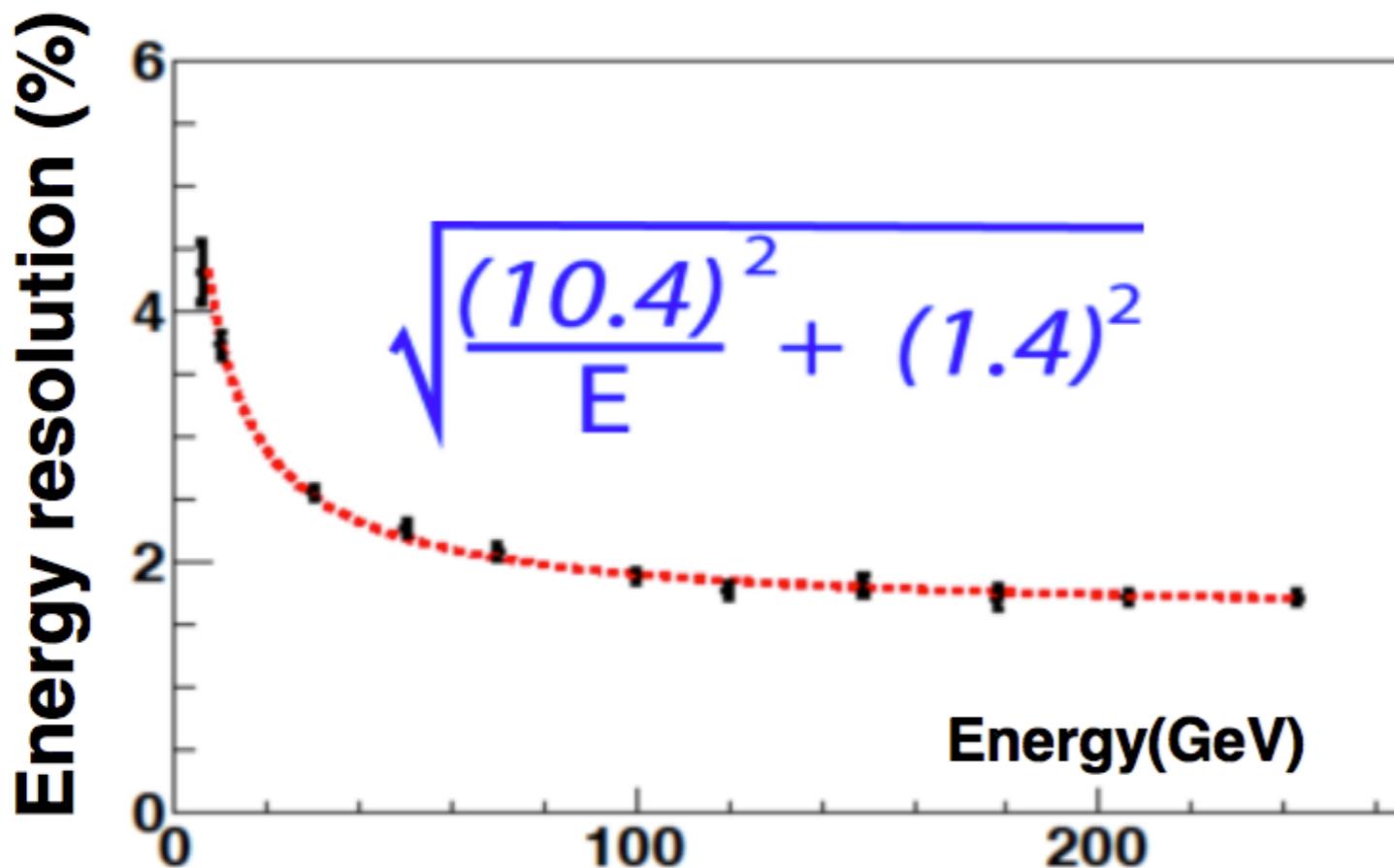
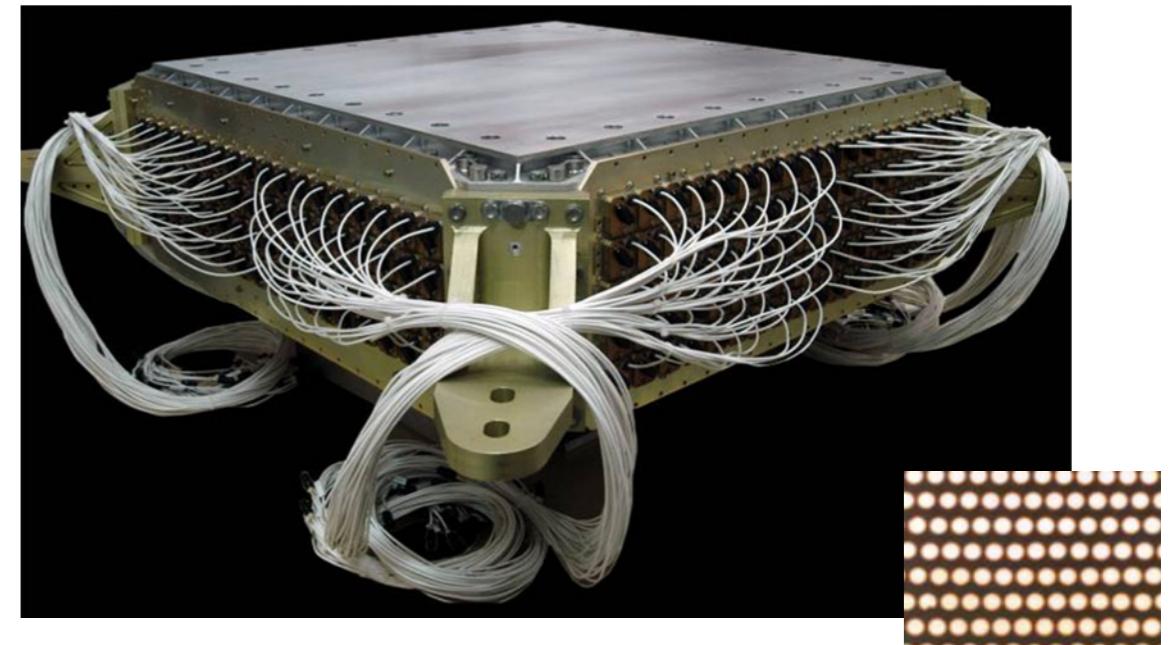
- 9 tracker planes
- Coordinate resolution $10 \mu\text{m}$
- Inner tracker alignment stability monitored using IR laser beam
- Outer tracker planes (1 / 9) aligned using cosmic-rays in 2 minute window
- MDR ~ 2 TV for electrons

Residual in layer 1



AMS-02 Electromagnetic Calorimeter

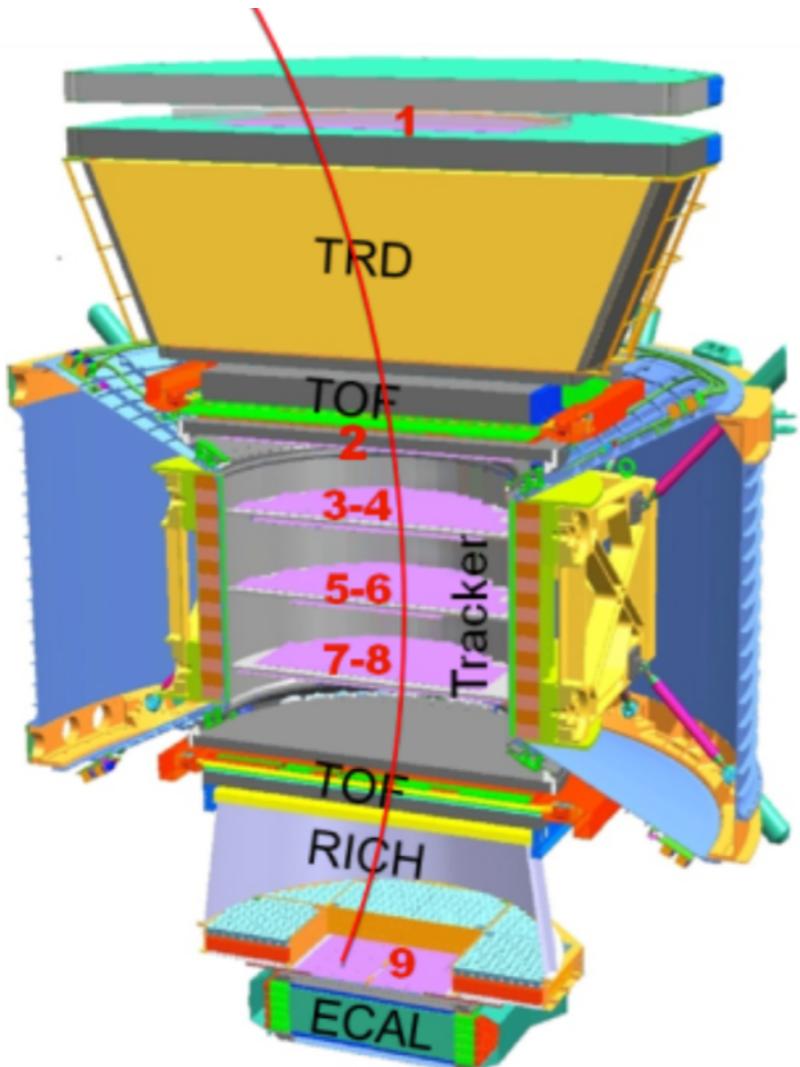
- 50.000 fibers, diameter of 1mm distributed uniformly inside 600 kg of lead
- 17 X_0 measurement of $e^{+/-}$ energies up to TeV
- Calibration in CERN testbeam



Analysis flow: Prepare e^+ / e^- sample

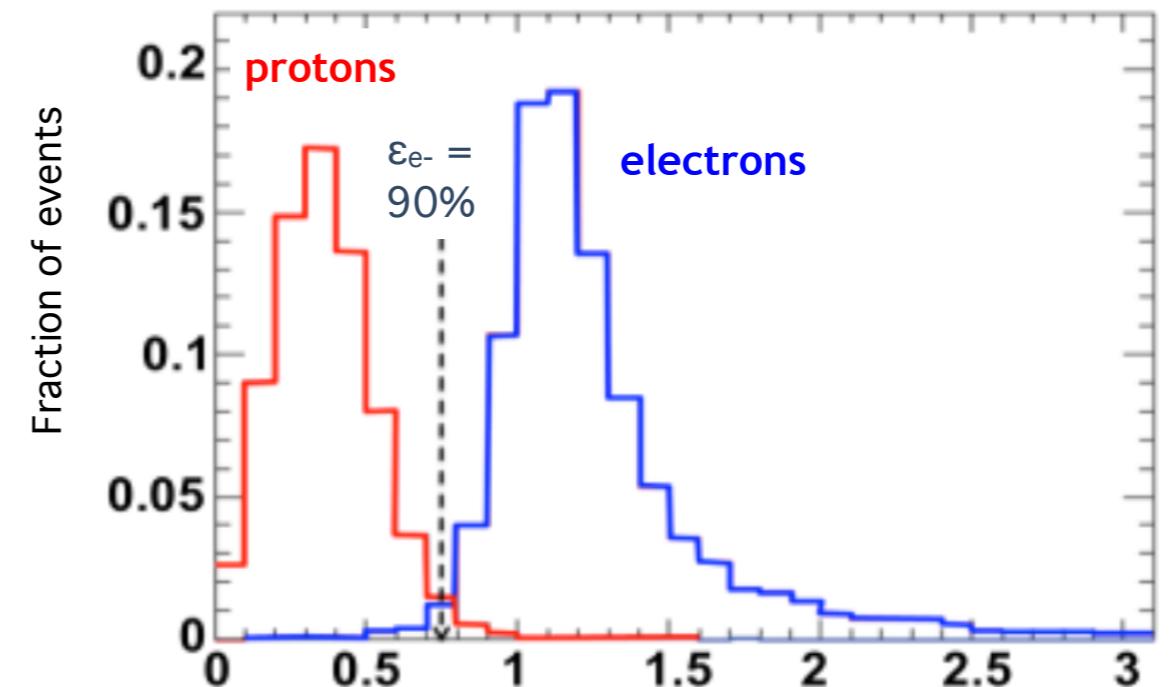
Geometric acceptance

$\sim 550 \text{ cm}^2 \text{ sr}$

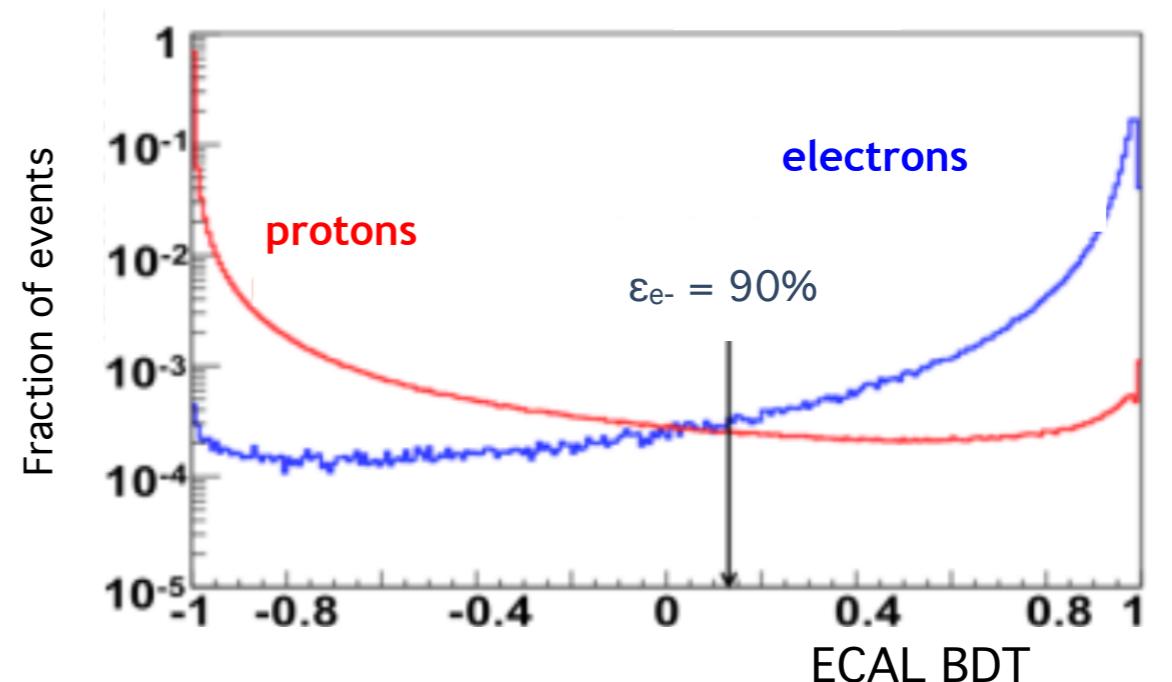


ECAL + Tracker provide
 p^+ rejection $\sim 10^4$

- ✿ ECAL / Tracker (E / P matching)

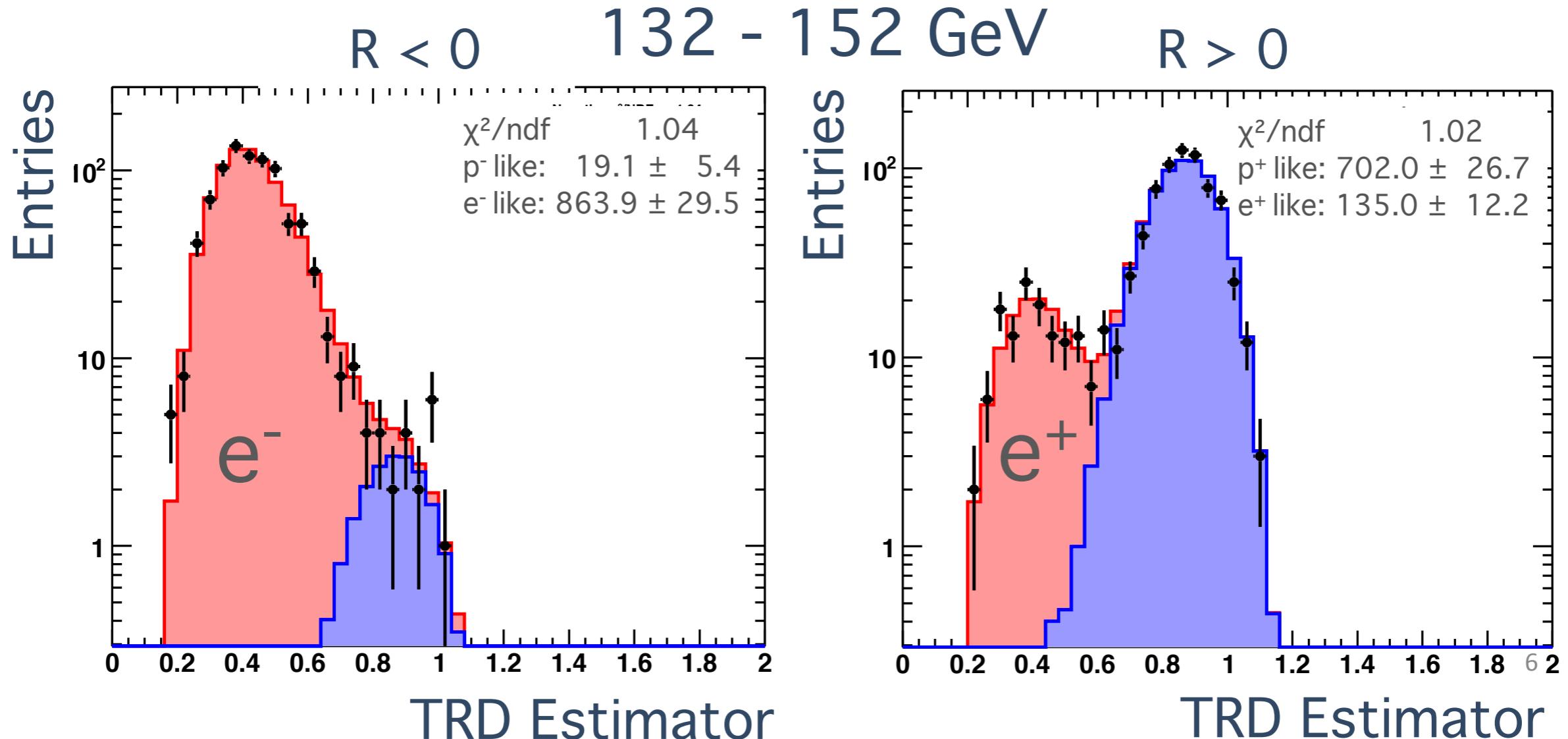


- ✿ ECAL shower shape



Flux calculation

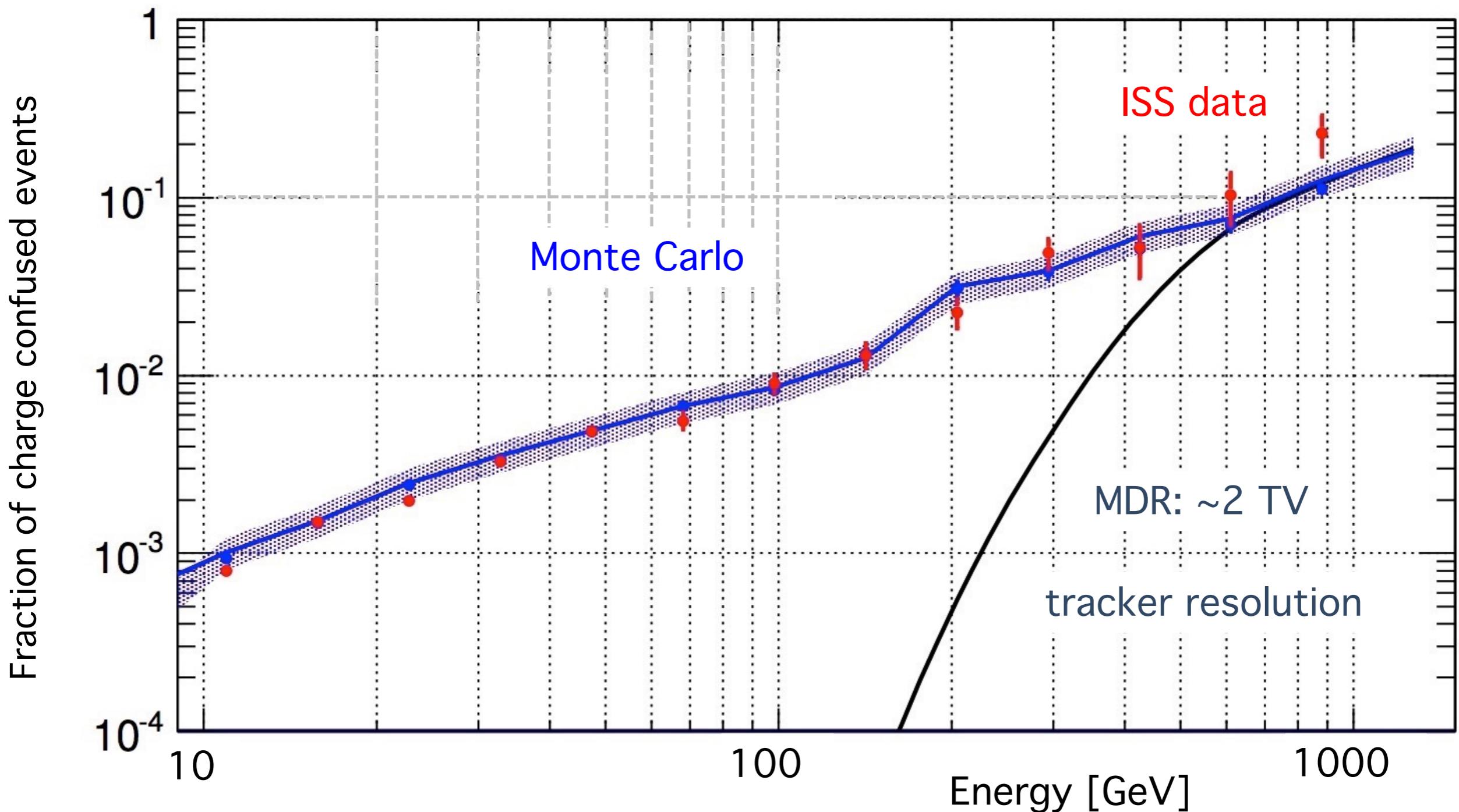
- ❖ Prepare pure proton/electron templates from ISS data using tight cuts



- ❖ Determine acceptance, efficiencies, measuring time → calculate flux

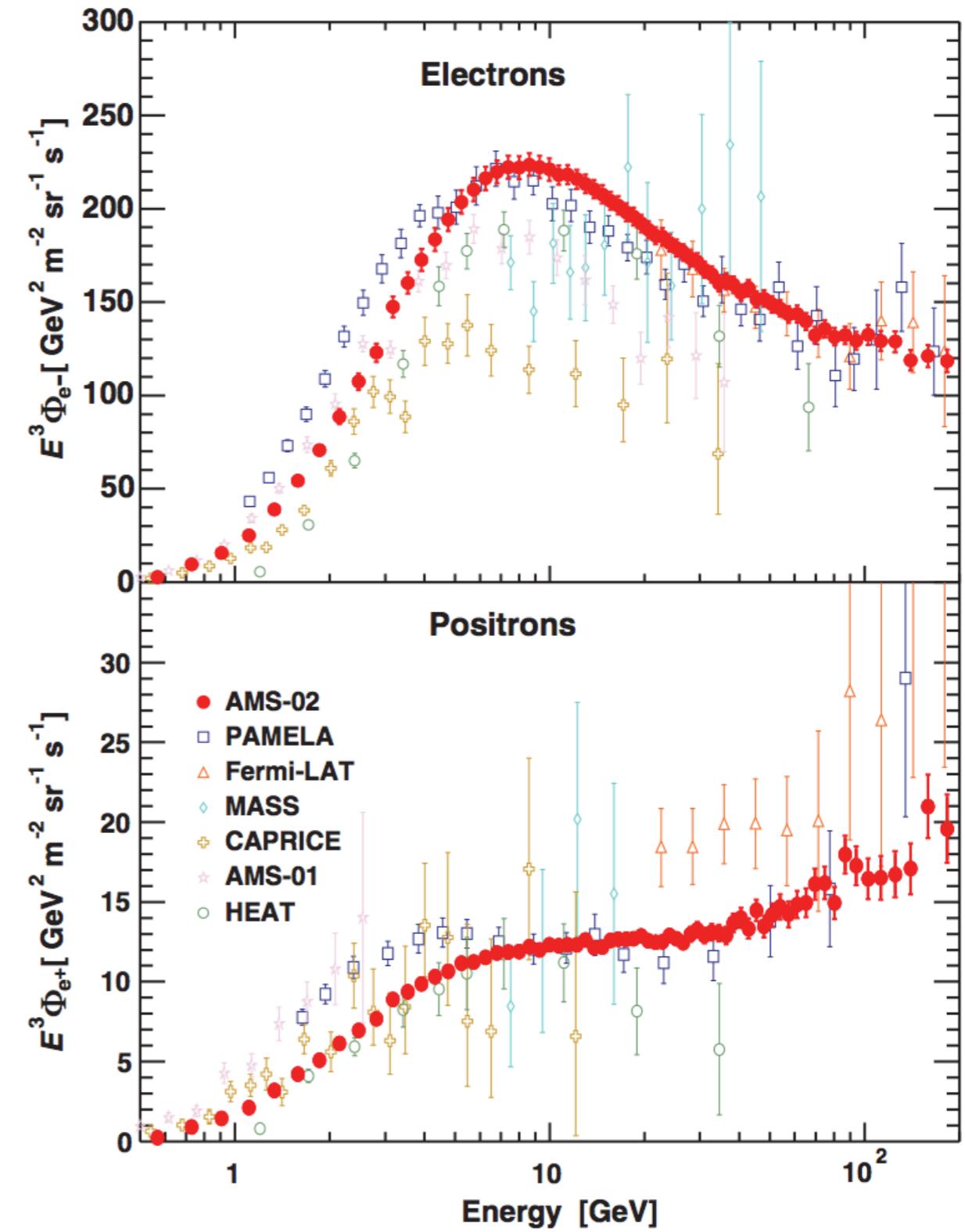
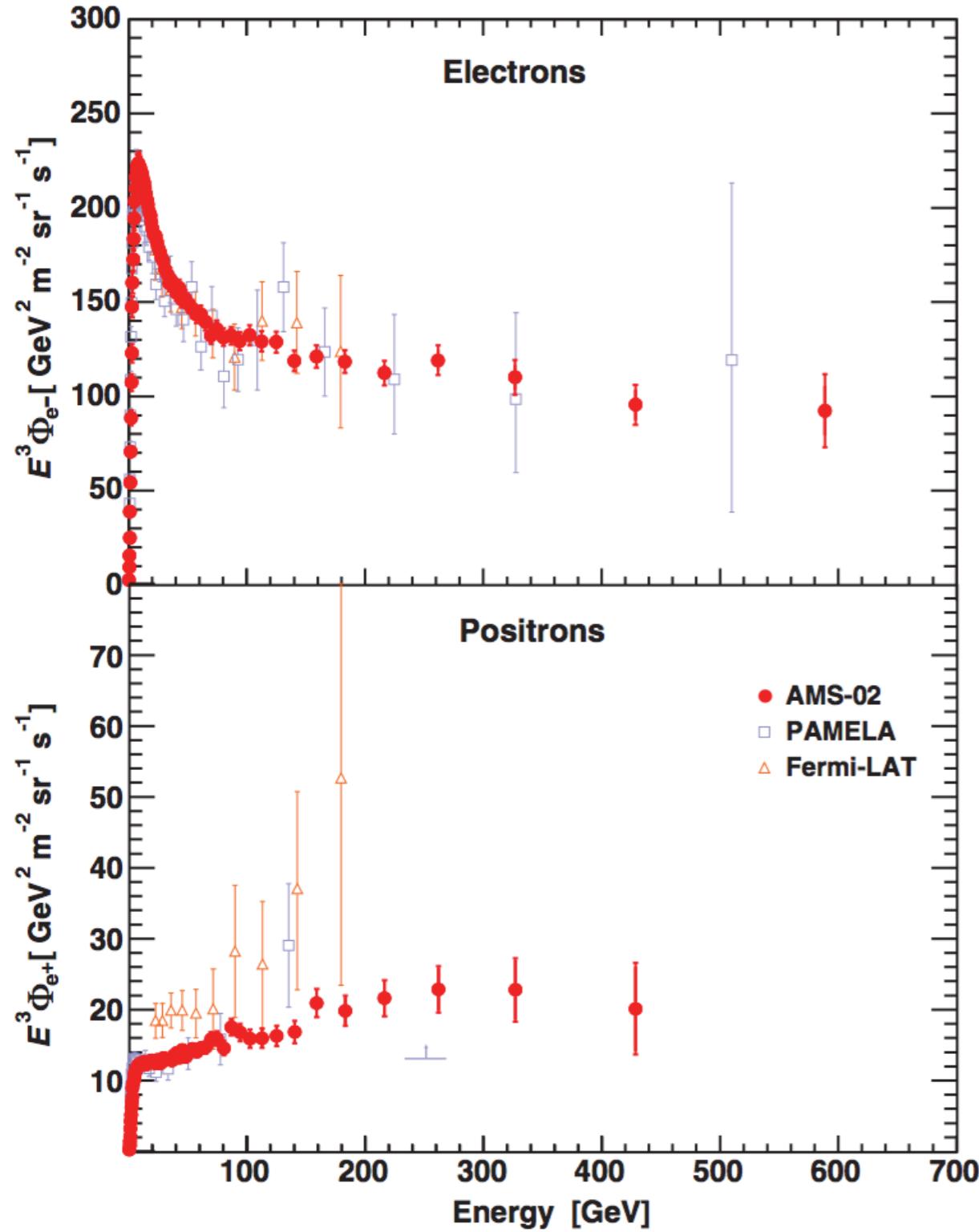
$$\Phi(E) = \frac{N_{\text{particle}}(E)}{dE \times A(E) \times \epsilon(E) \times T(E)}$$

Correcting wrong measurements of the charge sign



- Full Geant4 detector simulation agrees with „charge-confusion“ obtained directly from ISS data using template fit in BDT using c.c-sensitive variables

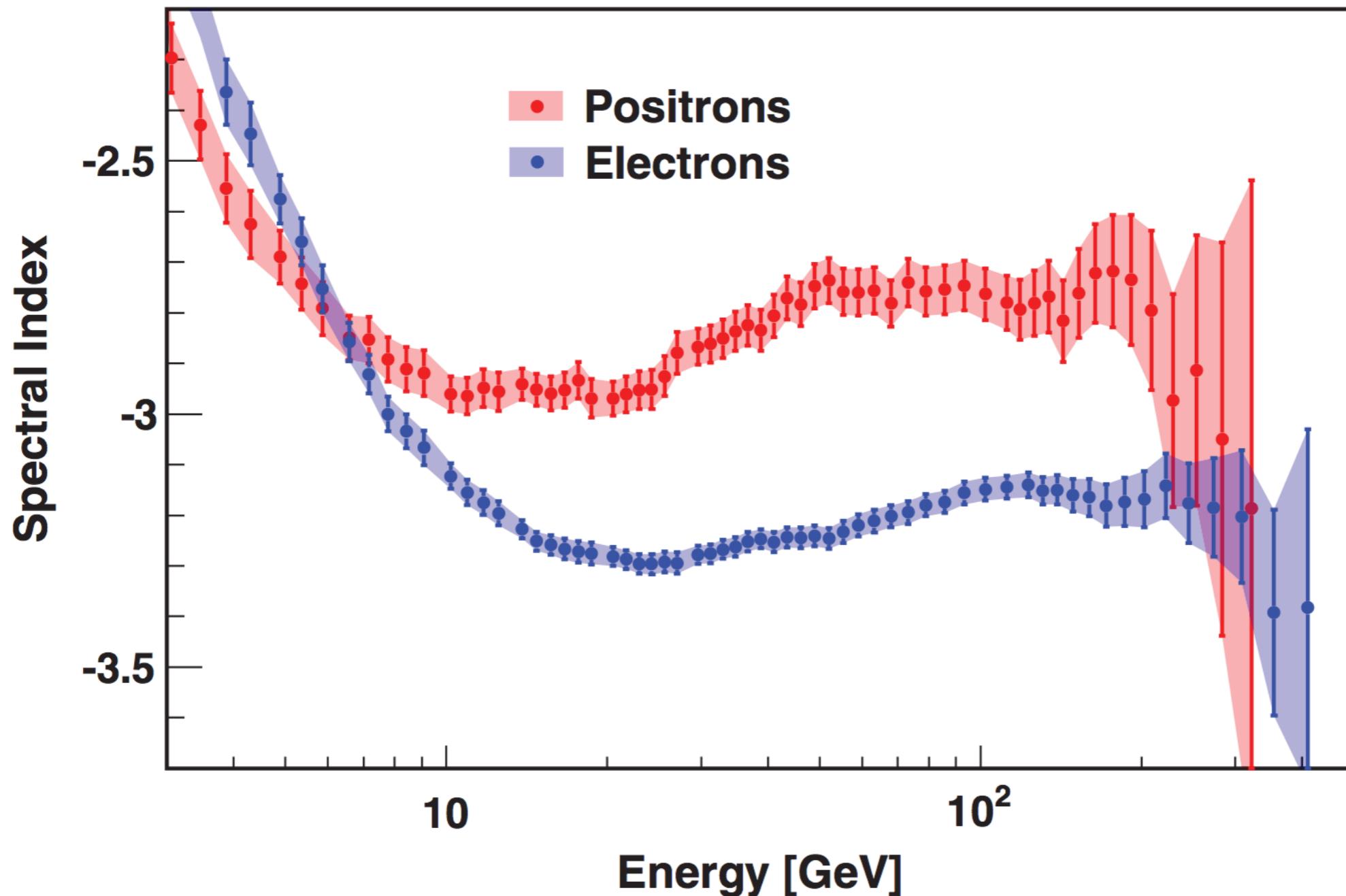
Electron / Positron flux



- ❖ Both the electron flux and the positron flux change their behavior at ~ 30 GeV but the fluxes are significantly different in their magnitude and energy dependence

Electron / Positron flux - spectral indices

$$\Phi_{e^\pm}(E) = C_{e^\pm} E^{\gamma_{e^\pm}} \quad \text{or} \quad \gamma_{e^\pm} = d[\log(\Phi_{e^\pm})]/d[\log(E)]$$



- Between 20 and 200 GeV the positron spectral index is significantly harder than the electron spectral index and this causes the rise in the positron fraction

Summary

- ⌘ Precision measurement of the e^- flux from 0.5 - 700 GeV
- ⌘ Precision measurement of the e^+ flux from 0.5 - 500 GeV
- ⌘ e^- / e^+ flux are significantly different in magnitude and energy dependance
- ⌘ The differing behavior of the spectral indices versus energy is a new observation and provides important information on the origins of cosmic-ray electrons and positrons

Stay tuned for upcoming
precise results from AMS-02!