

First results from AMS-02 on the ISS



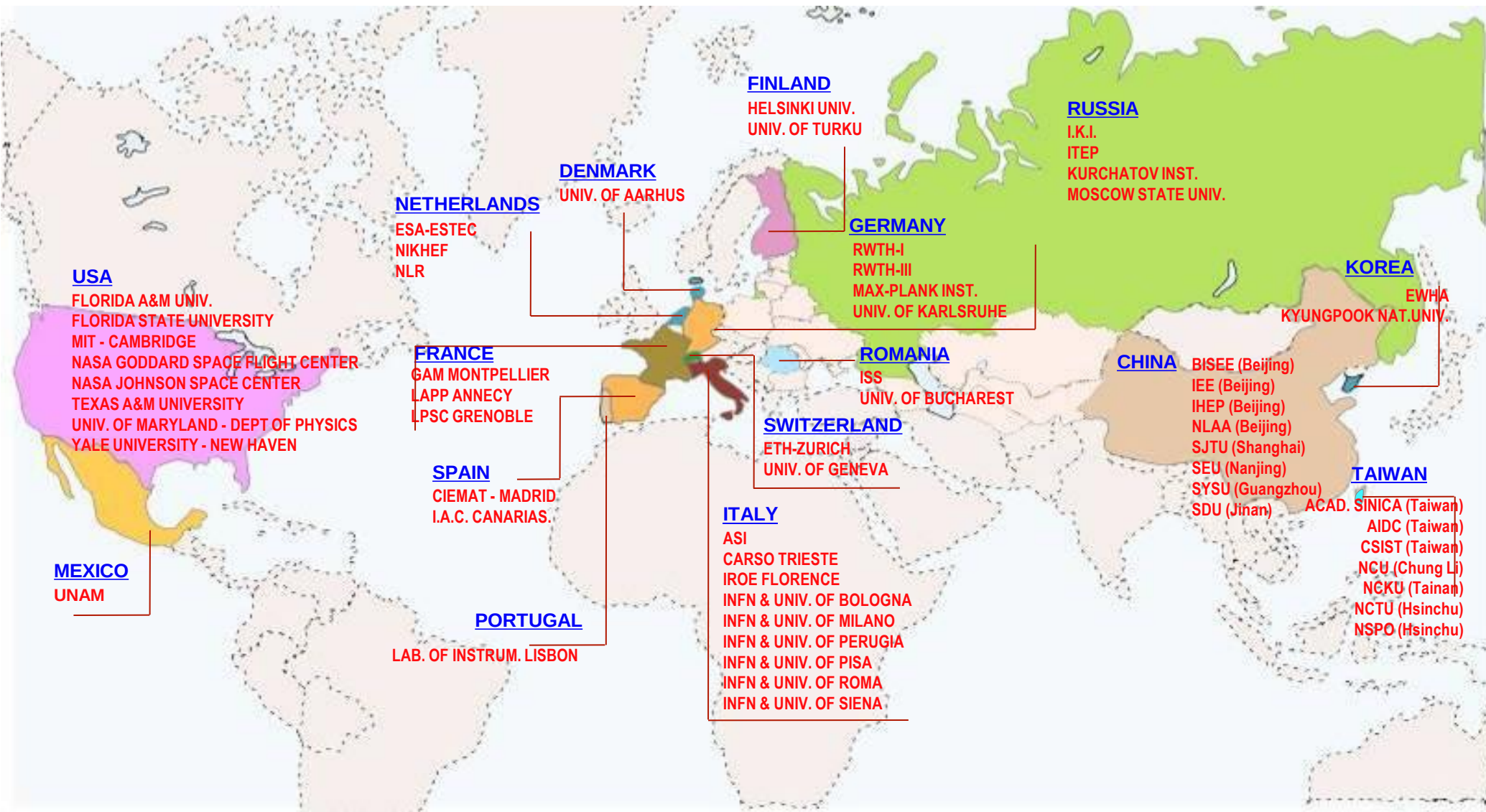
Stefano Di Falco

INFN Pisa

AMS- Commissione 2
September 23th 2013

AMS is an International Collaboration

16 Countries, 60 Institutes and 600 Physicists



Parte della collaborazione AMS-Italia



Cape Canaveral 2011

2014	Fis.+tec. +tecnol.+ senior	FTE (fis.+ tecnol.)
BO	6	3.9
MI B.	13	9.7
PG	23	11.0
PI	8	6.5
RM 1	4	0.8
TN	6	3.6
Totale	60	34.5
(2013)	65	34.7



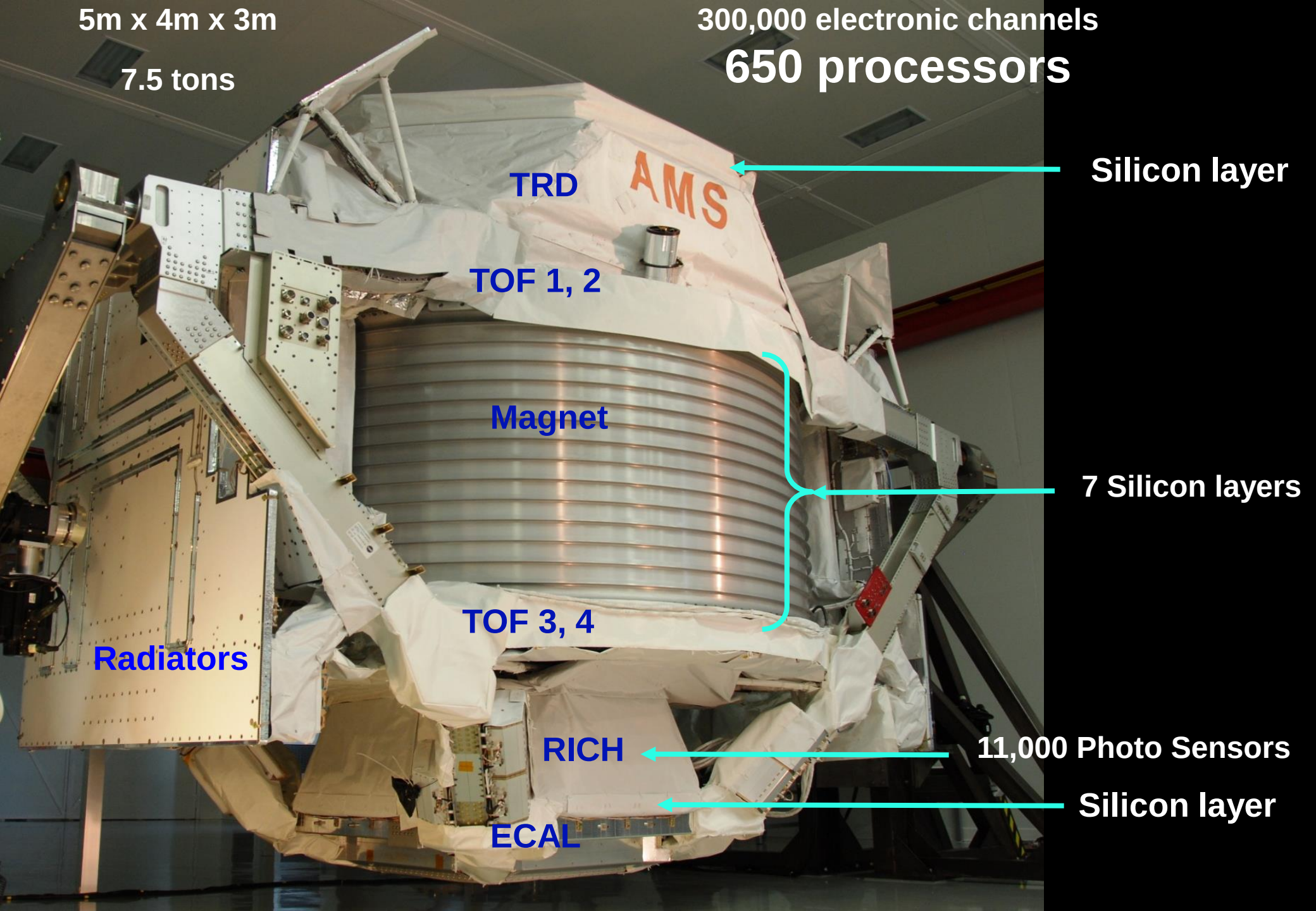
Nell'ultimo altri 2 valenti giovani hanno trovato posizioni all'estero
(Hawaii, Grenoble)

5m x 4m x 3m

7.5 tons

300,000 electronic channels

650 processors



TRD

AMS

TOF 1, 2

Magnet

TOF 3, 4

Radiators

RICH

ECAL

Silicon layer

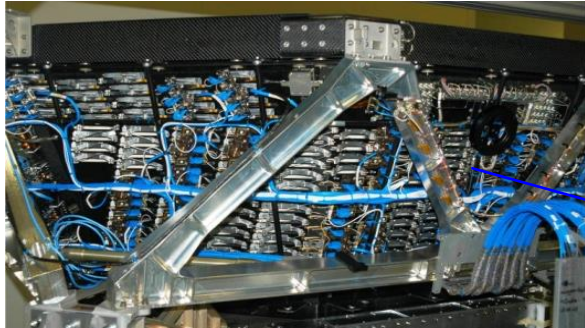
7 Silicon layers

11,000 Photo Sensors

Silicon layer

AMS: A TeV precision, multipurpose spectrometer

TRD (Roma)
Identify e^+ , e^-



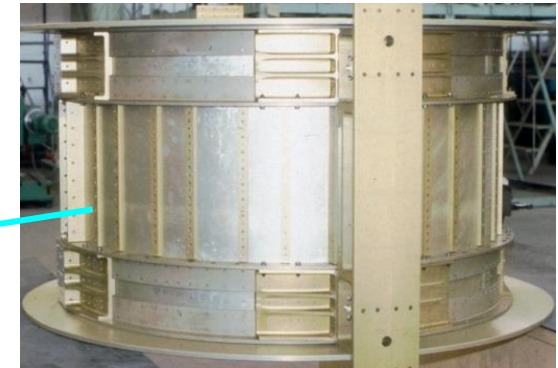
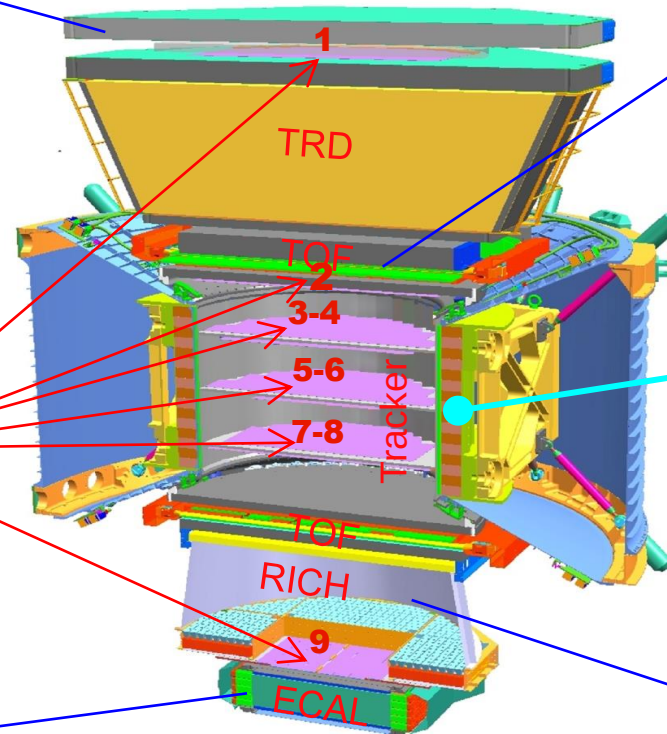
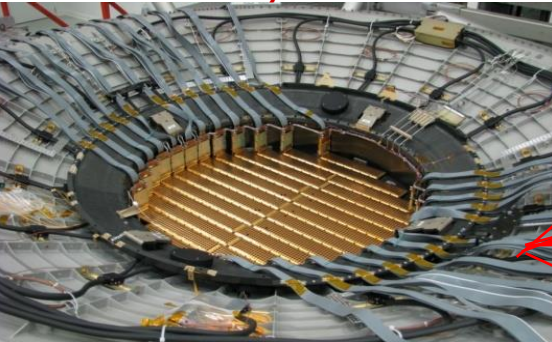
Particles and nuclei are defined by their charge (Z) and energy ($E \sim P$)

TOF (Bologna)
 Z , E



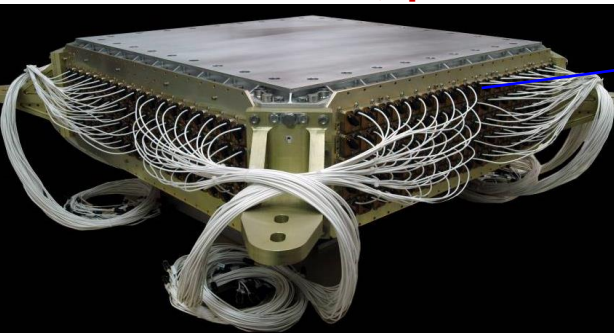
Magnet (1.5 kGauss)
 $\pm Z$

Silicon Tracker (Perugia)
 Z , P

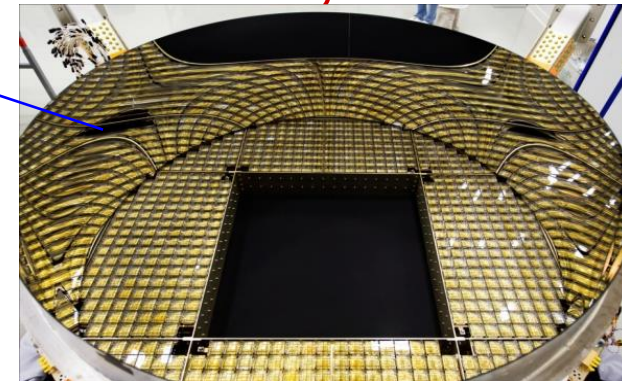


RICH (Bologna)
 Z , E

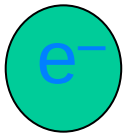
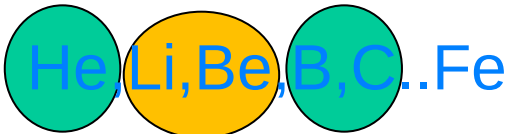
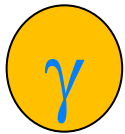
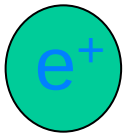
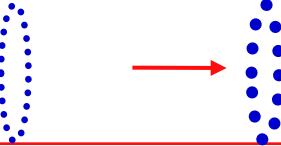
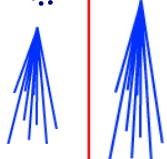
ECAL (Pisa)
 E of e^+ , e^- , γ



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

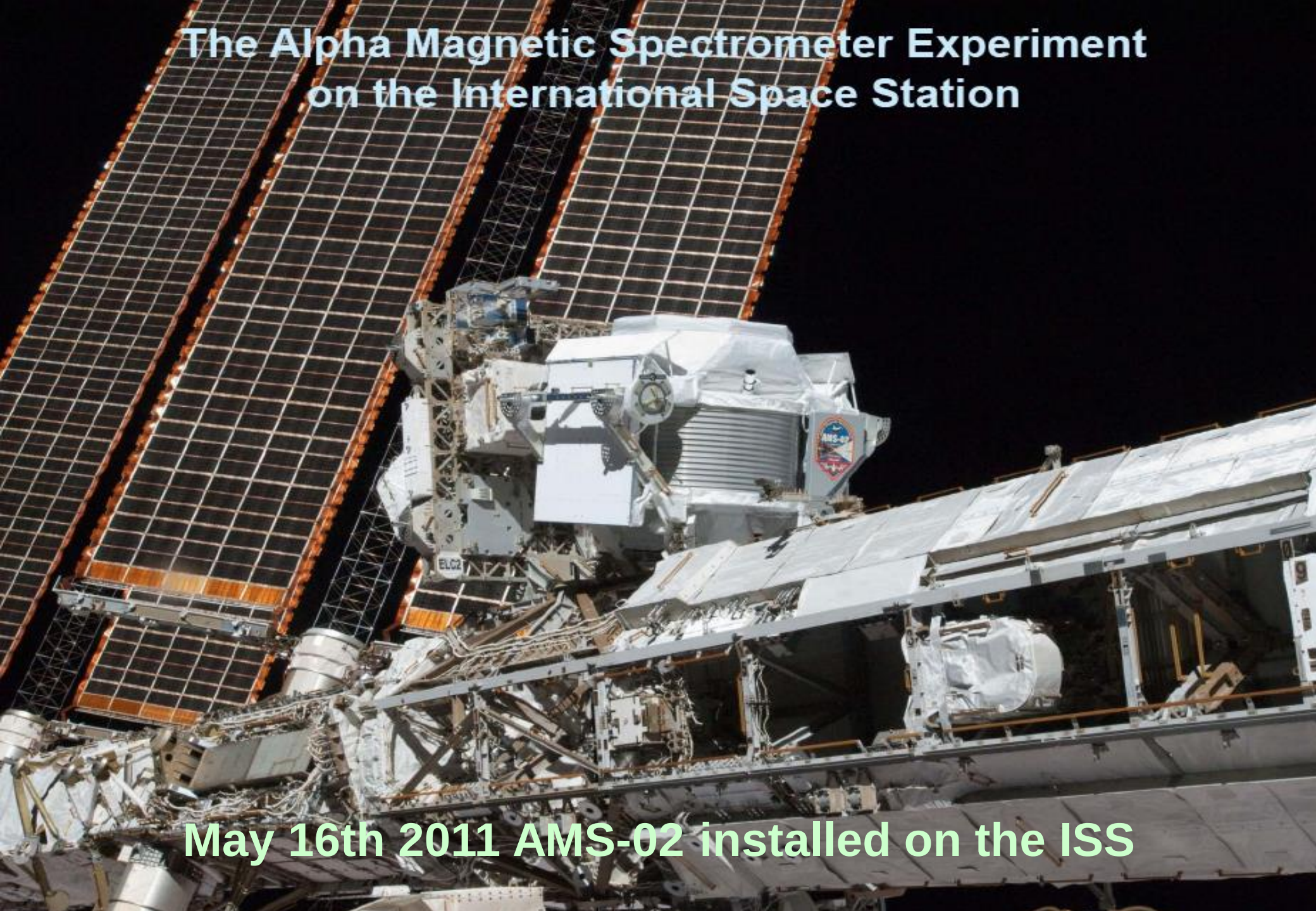


Identificazione delle particelle con AMS-02

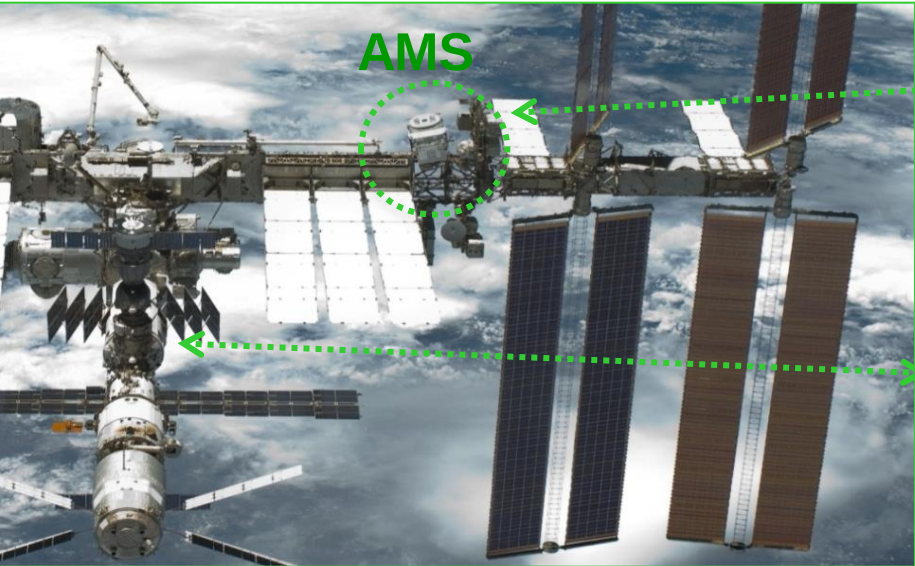
							
TRD							
TOF							
Tracker							
RICH							
ECAL							
Campi di studio	Spettroscopia dei raggi cosmici				Materia oscura		Antimateria

The Alpha Magnetic Spectrometer Experiment on the International Space Station

May 16th 2011 AMS-02 installed on the ISS



AMS Operations



AMS



Astronaut at ISS AMS Laptop



TDRS Satellites

Ku-Band
High Rate (down):
Events <10Mbit/s>

Flight Operations
Ground Operations

S-Band
Low Rate (up & down):
Commanding: 1 Kbit/s
Monitoring: 30 Kbit/s



**AMS Payload Operations Control and
Science Operations Centers
(POCC, SOC) at CERN**



**AMS Computers
at MSFC, AL**



White Sands Ground Terminal, NM

**Large part of the Data monitoring and
operations (laptop up/downlink) is
under responsibility of Milano group**

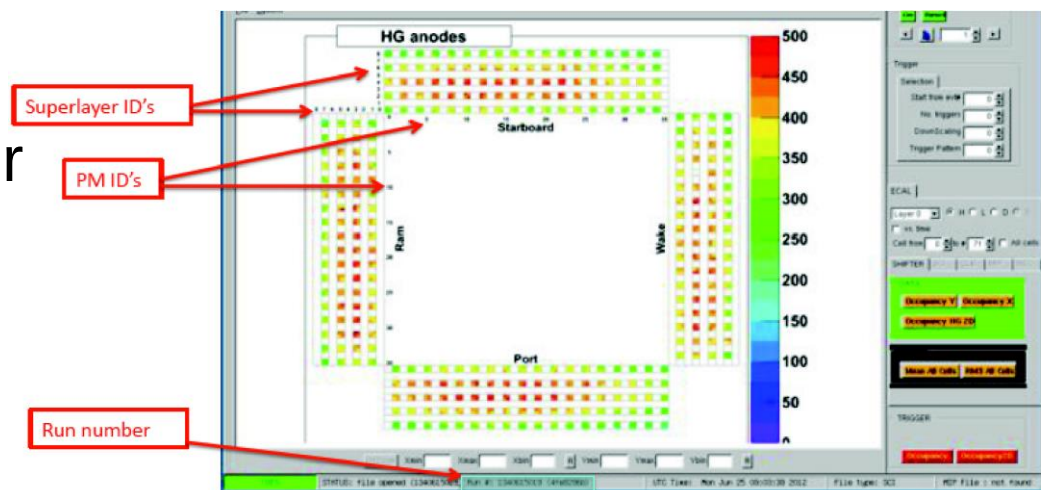


Al POCC sono attive 24hr/24 le postazioni di:

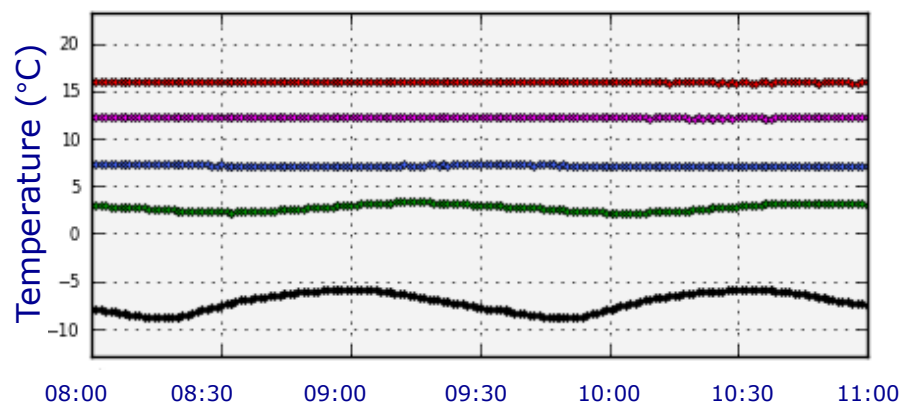
↗ LEAD	↗ (Perugia, Pisa)		
↗ DATA	↗ (Milano)	+ SOCC	+ Detector expert (reperibile al Cern)
↗ Thermal			ToF: Bologna
↗ Tracker+Trd (TT)	↗ (Perugia, Roma, Trento)		Tracker: Perugia
↗ TOF+ECAL+RICH (PM)	↗ (Bologna, Pisa)		ECAL: Pisa

ATTIVITA' AL POCC: Detector monitoring

- Occupancy
- Piedistalli
- Temperatura
- Low Voltage
- High Voltage
- Board status
- Soglie di Trigger
- Trigger rate
- Event size

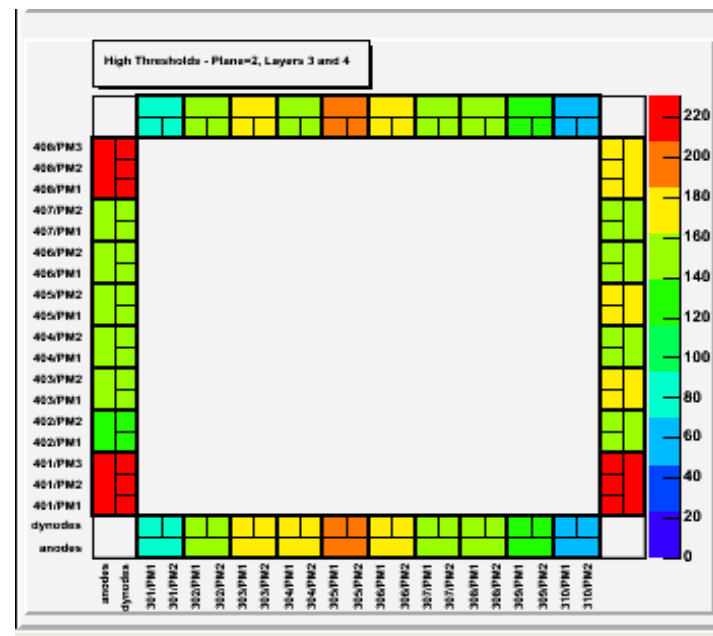


ECAL anode occupancy



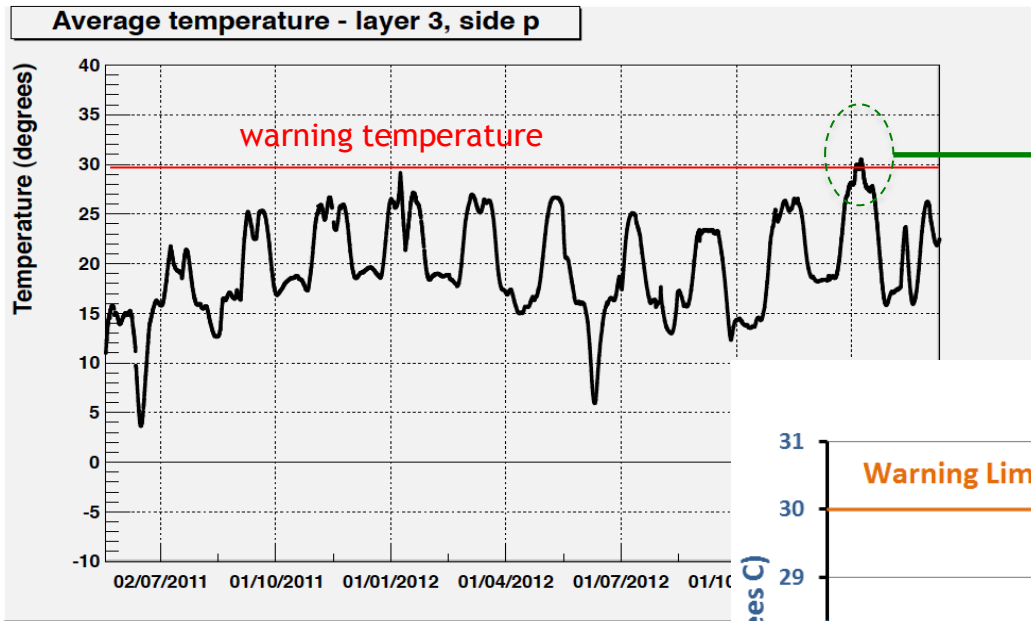
TRACKER layer 1 temperature

I programmi di monitoring online di Tracker, ToF e ECAL sono stati sviluppati e sono mantenuti dai gruppi italiani



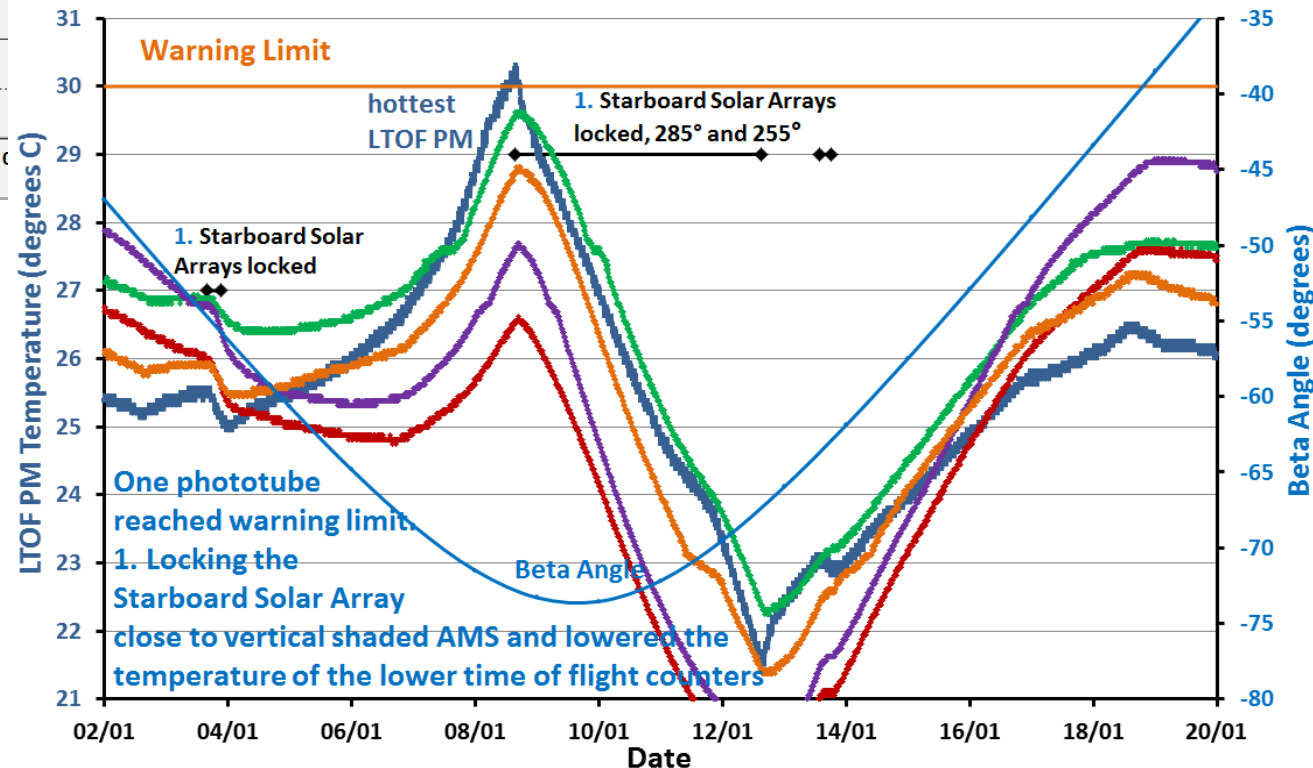
TOF trigger thresholds

Reazione agli allarmi di temperatura



Le condizioni termiche sulla ISS variano continuamente a causa di:

- Angolo beta rispetto al sole
- Posizione dei radiatori e dei pannelli solari
- Orientamento della ISS



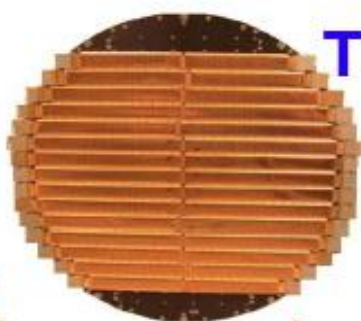
Oltre 1100 sensori di temperatura e 298 riscaldatori sono monitorati costantemente per assicurarsi che tutti i componenti non superino i loro limiti termici ed evitare così danni permanenti



1

Tracker: coordinate resolution $10\ \mu$
alignment: $3\ \mu$ with 20 UV lasers
dE/dX: identify nuclei

2



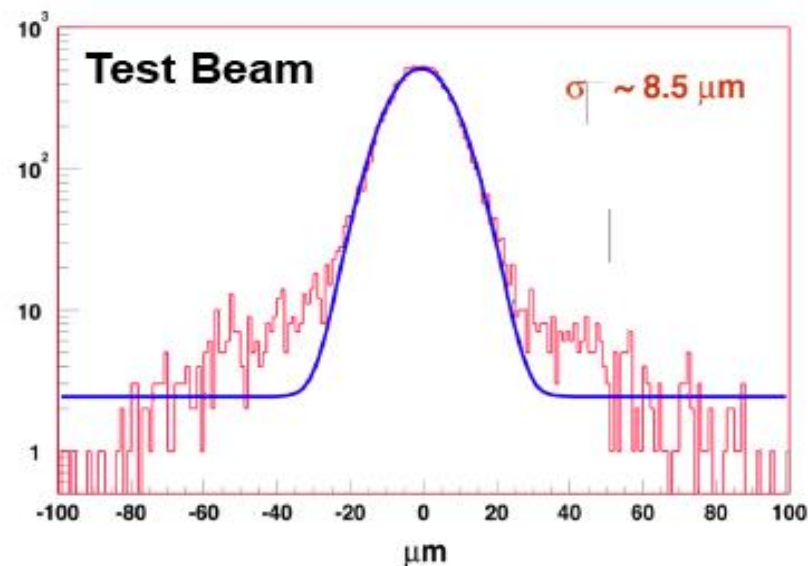
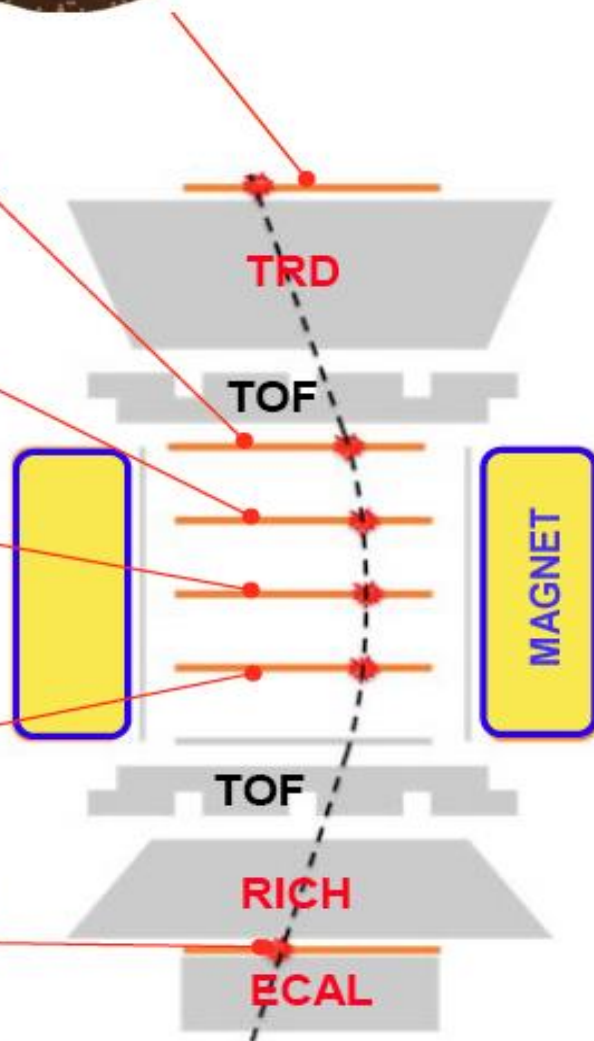
3
4



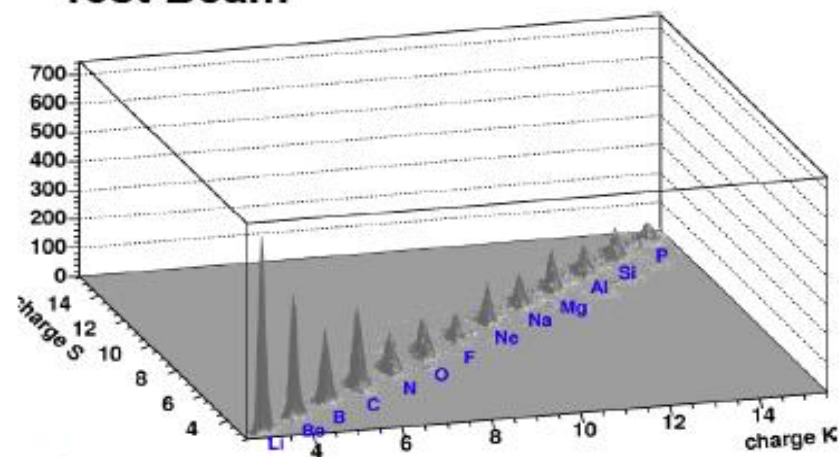
5
6



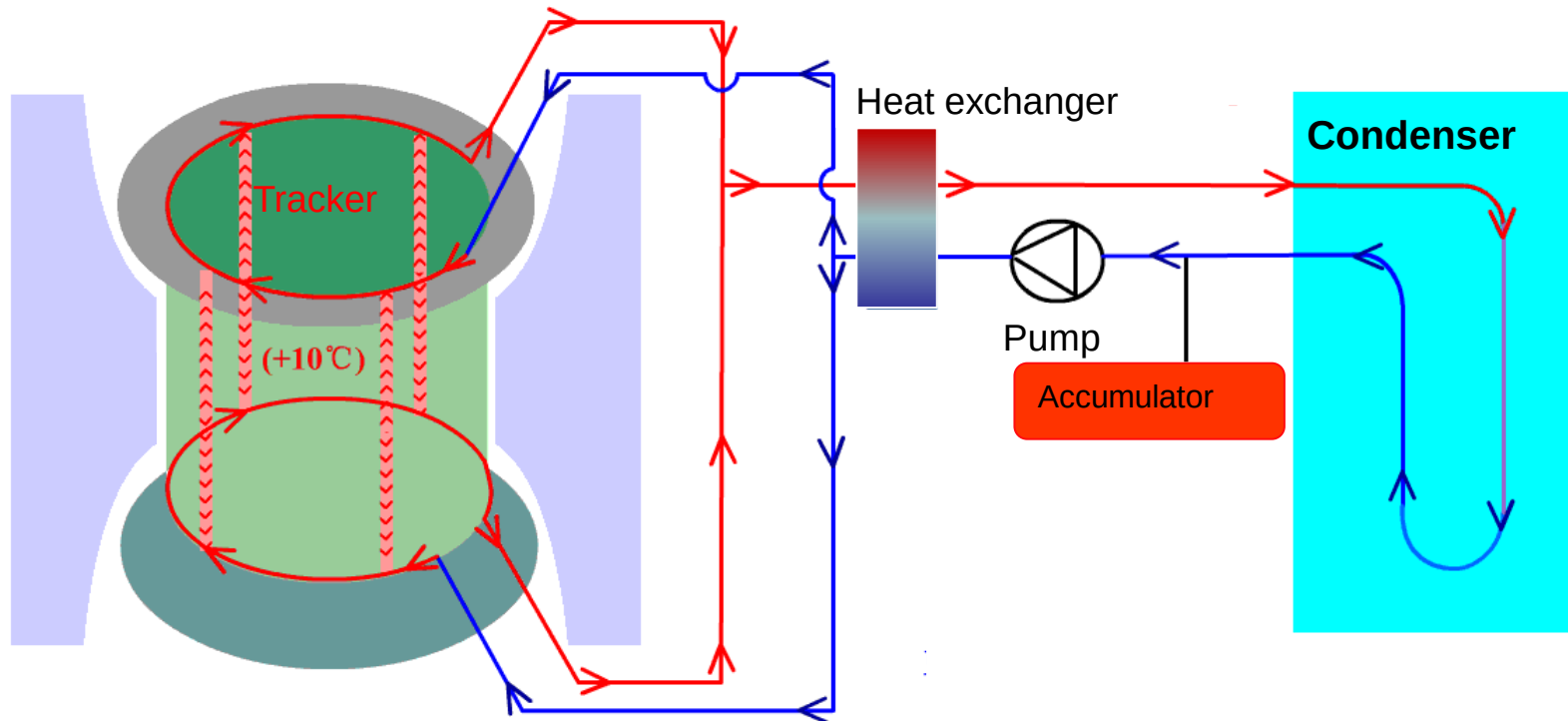
7
8
9



Test Beam



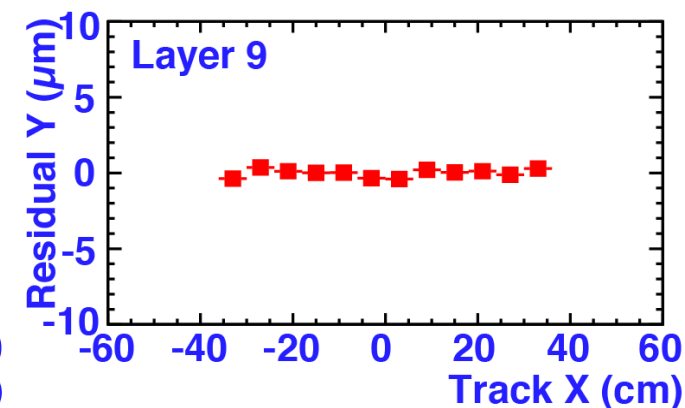
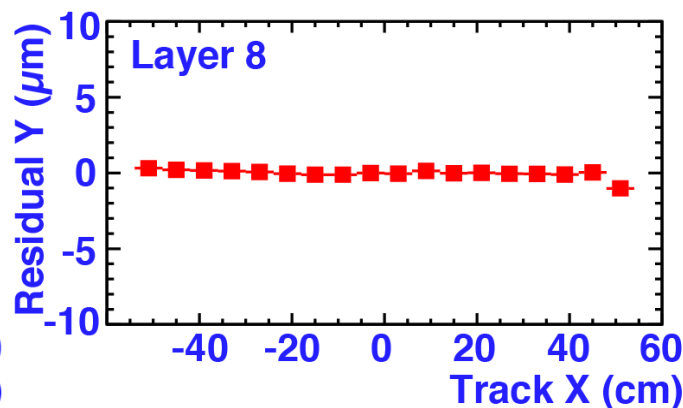
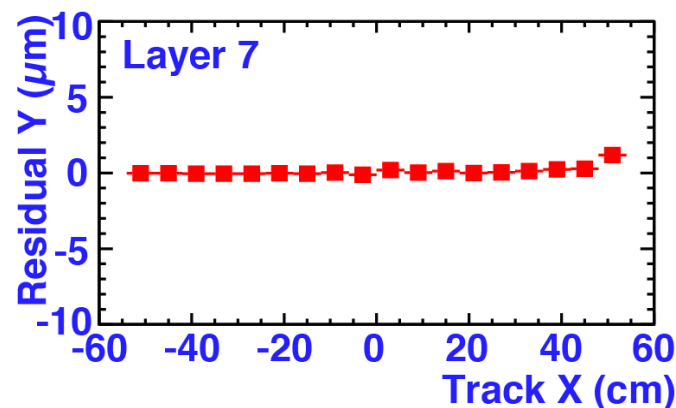
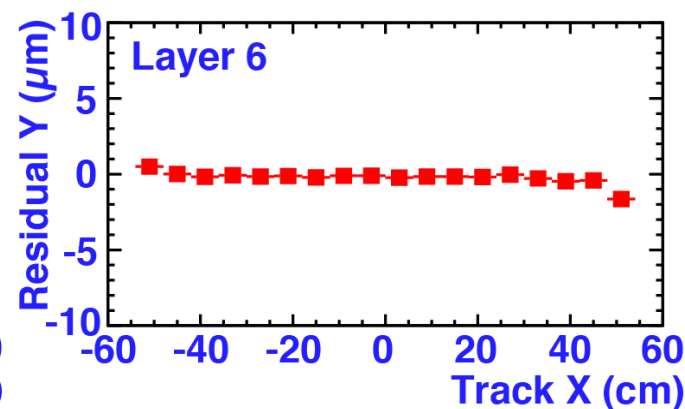
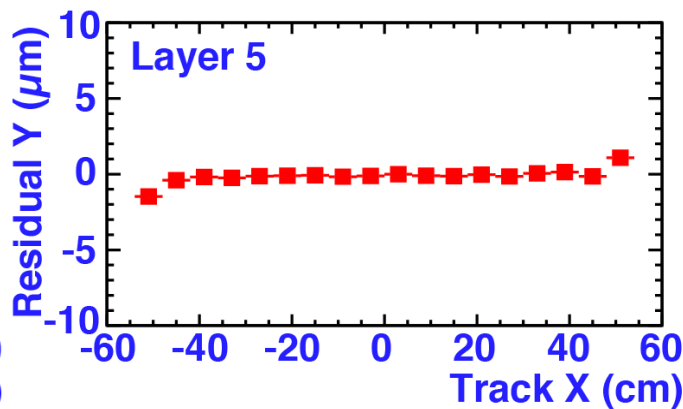
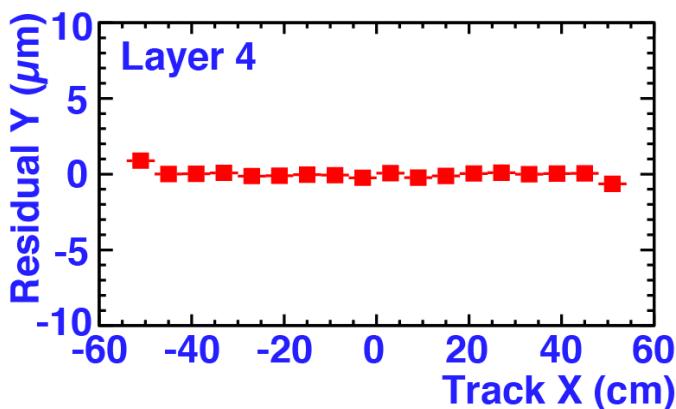
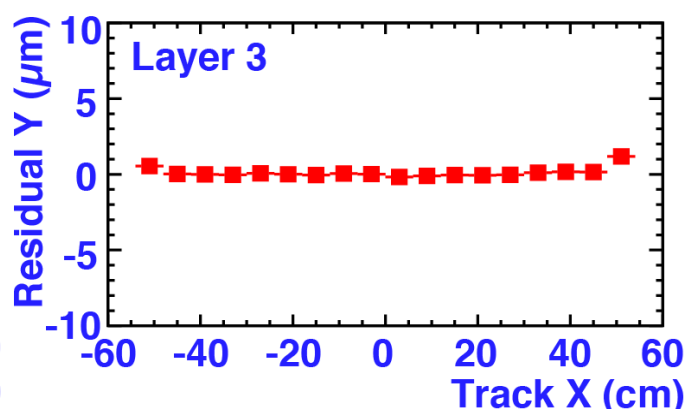
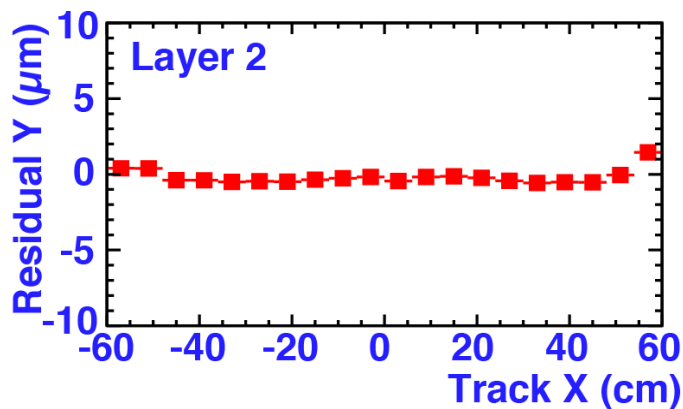
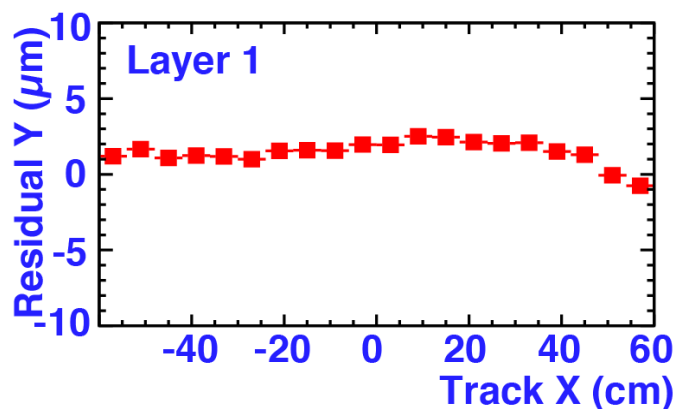
Tracker Thermal Control System in Space



Red line: CO₂ gas/liquid two phase

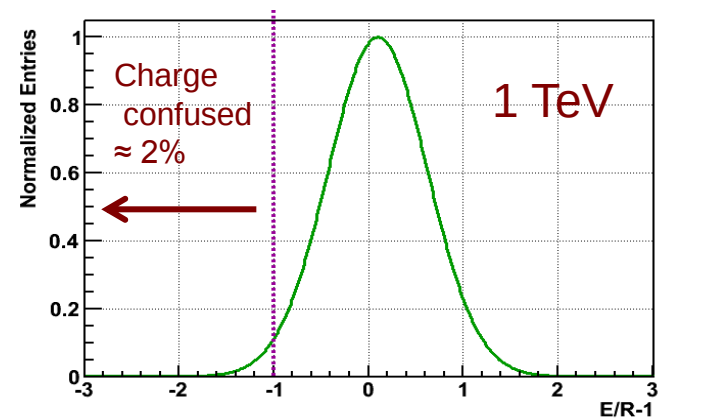
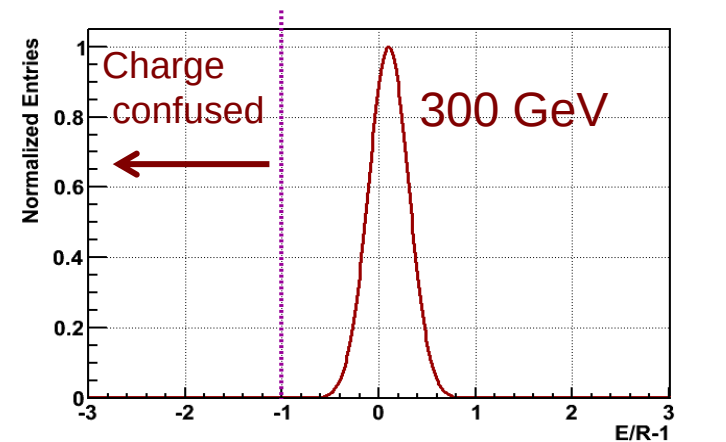
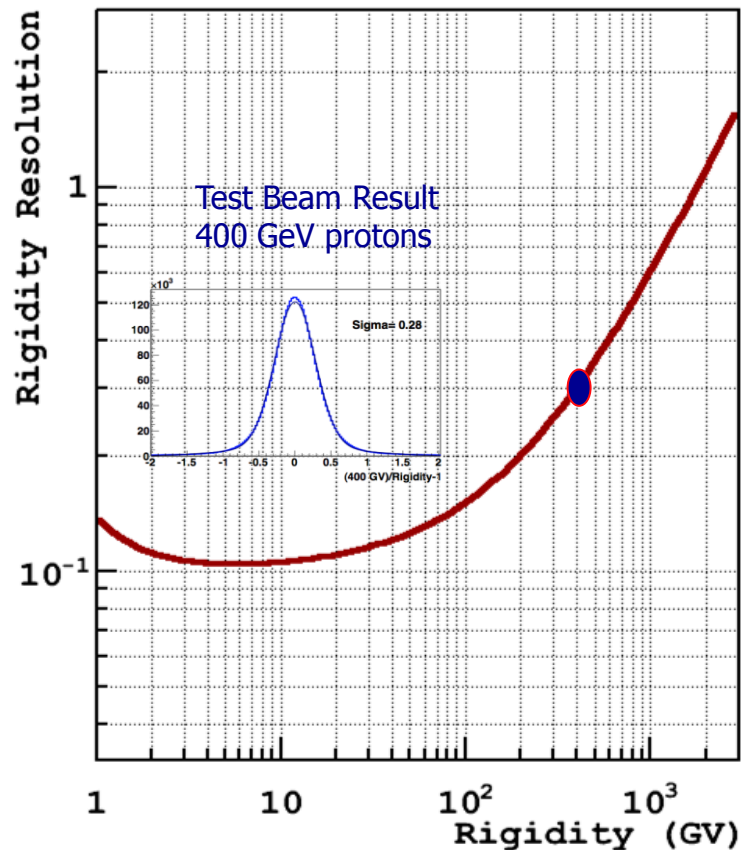
Blue line: CO₂ liquid phase

Alignment accuracy of the 9 Tracker layers over 18 months

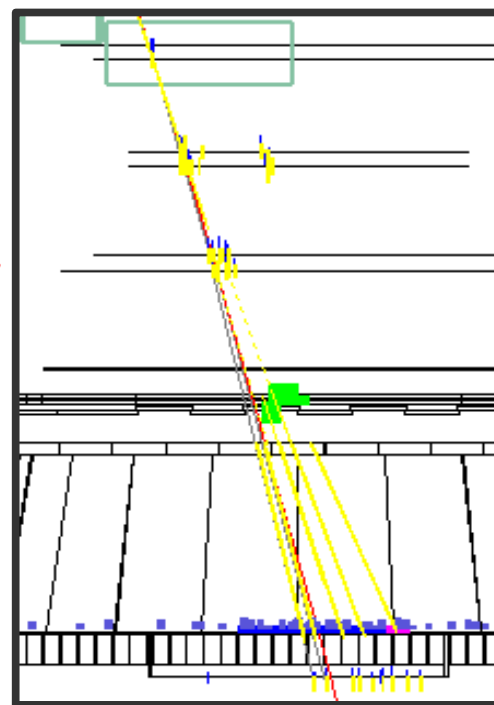
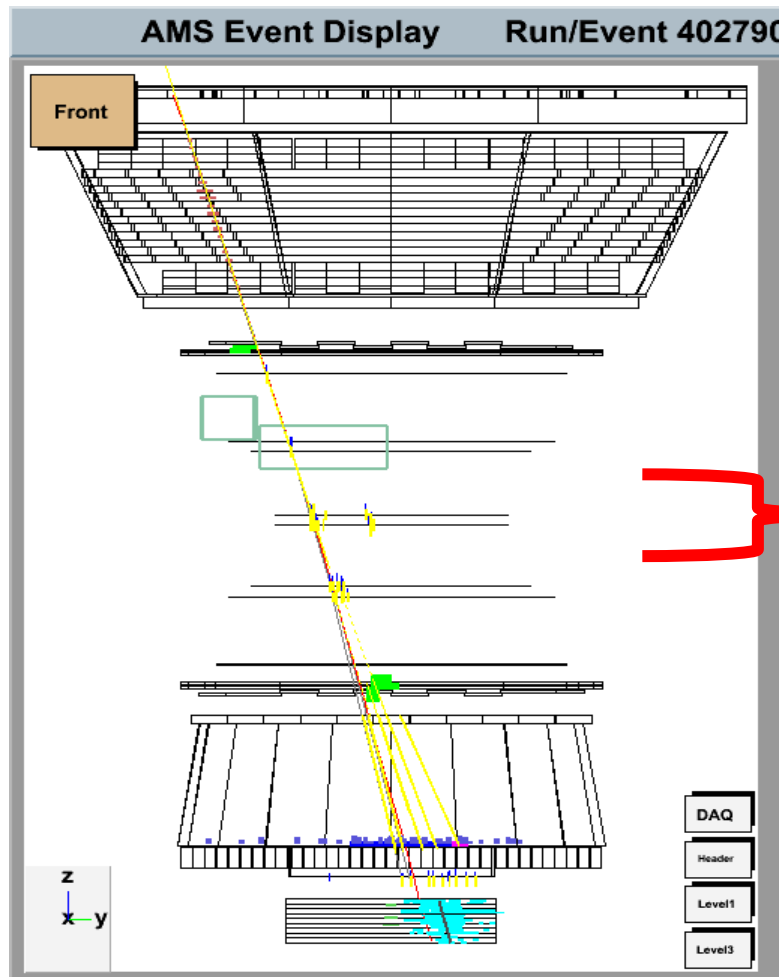


Risoluzione in impulso: matching E/p e confusione di carica e⁺/e⁻

La risoluzione in impulso contribuisce al livello del % alla confusione di carica alle energie del TeV



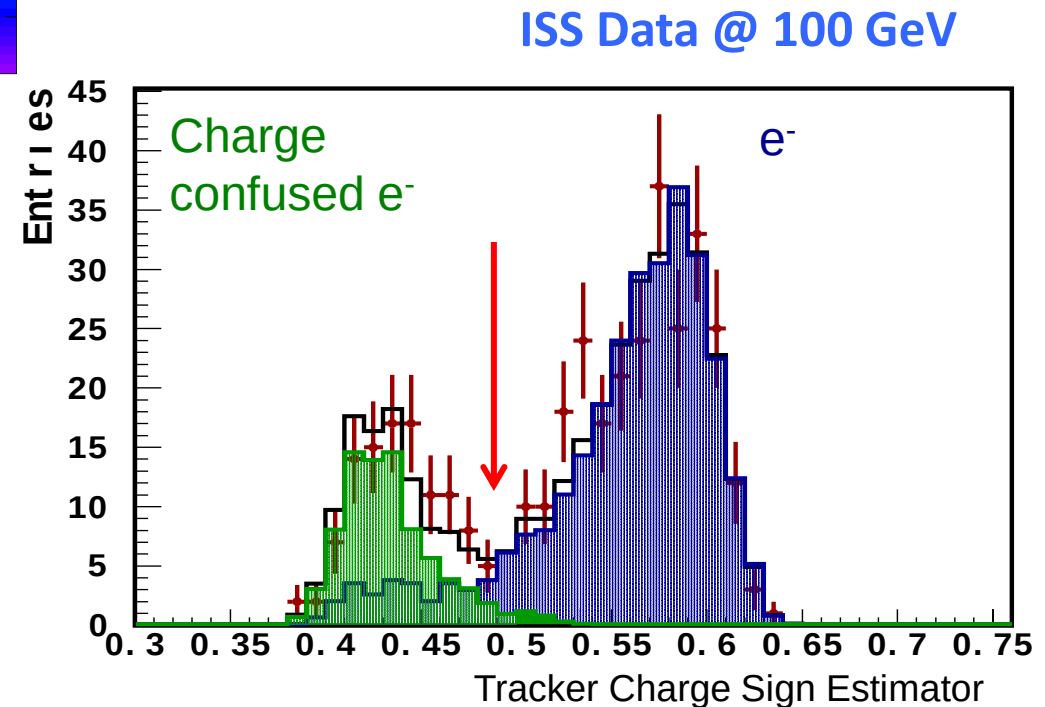
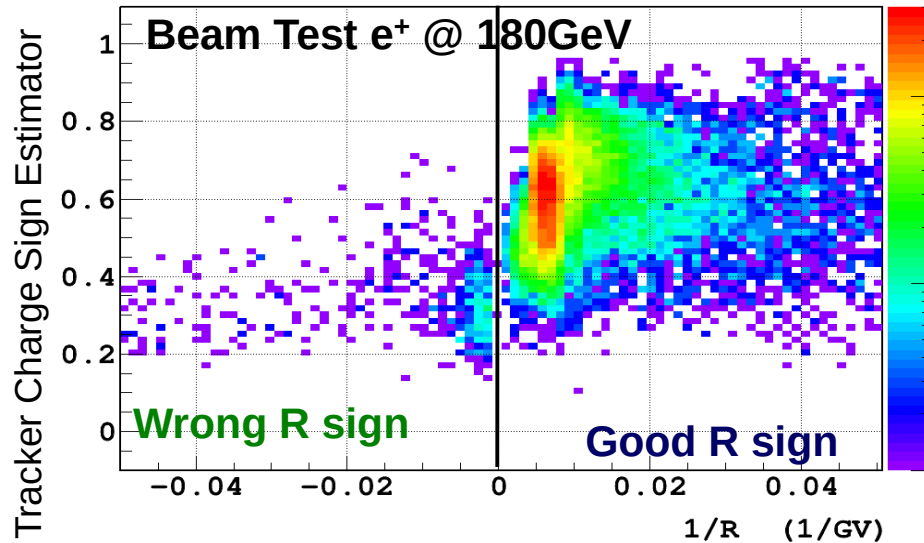
Confusione di carica e^+ / e^- dovuta ad interazioni nel rivelatore



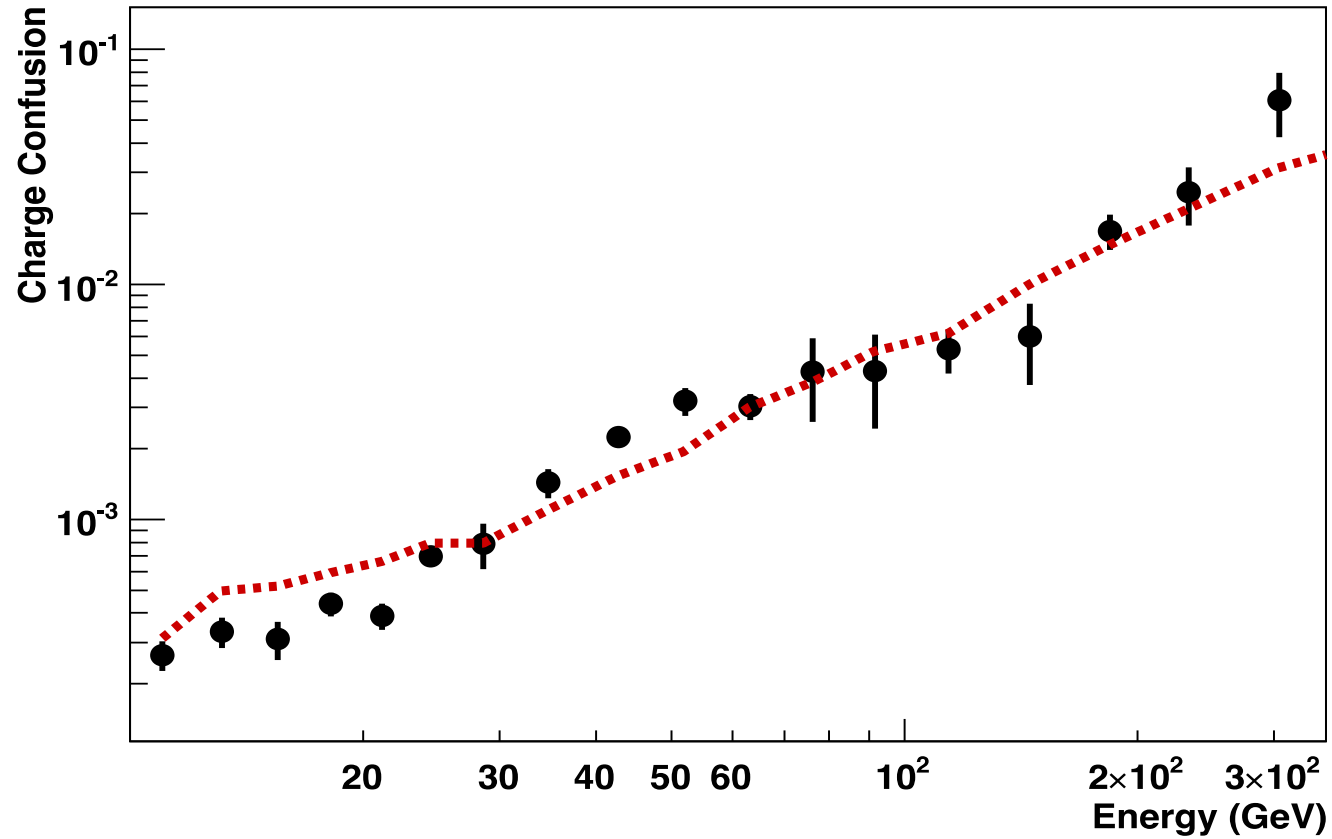
Bremsstrahlung and delta rays provide many nearby tracks with high probability for association of a wrong hit to the main track.

8 GeV electron reconstructed as 1 GeV positron

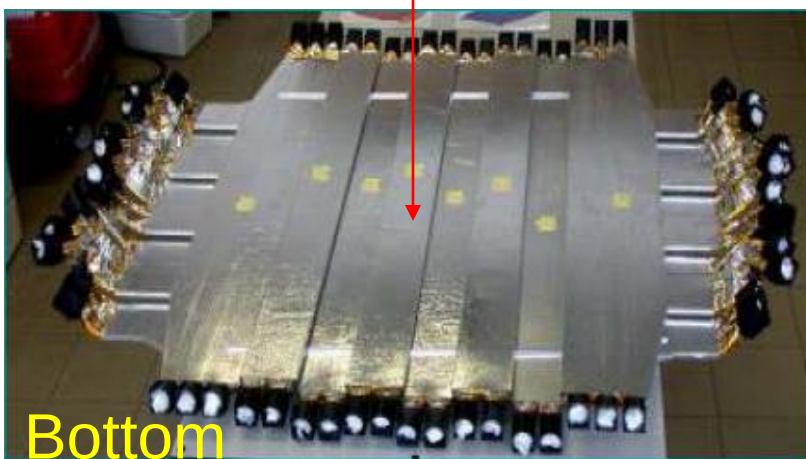
Tracker charge sign estimator (by Perugia group)



Charge Confusion from interaction



The Time Of Flight

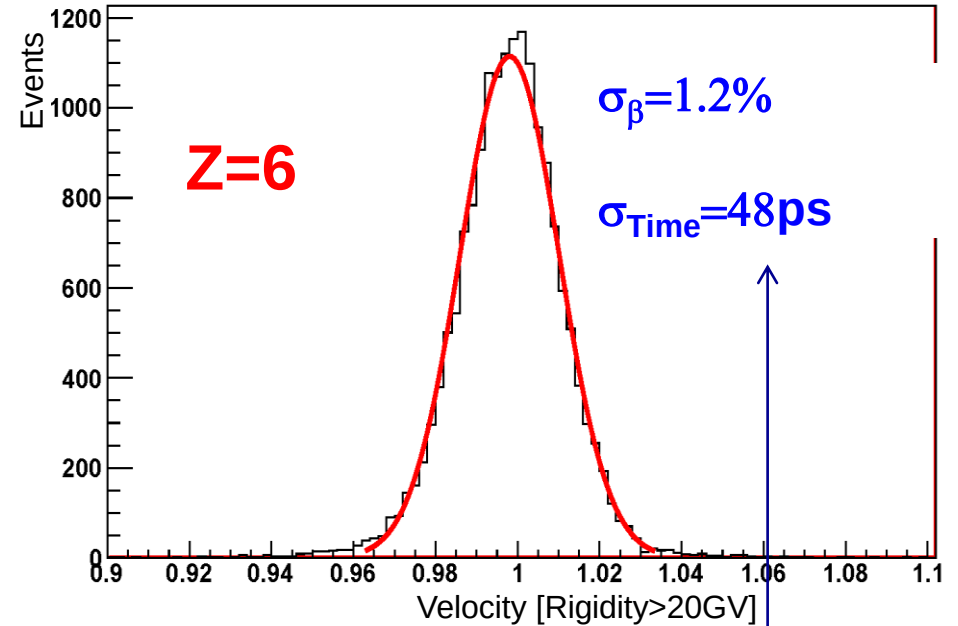
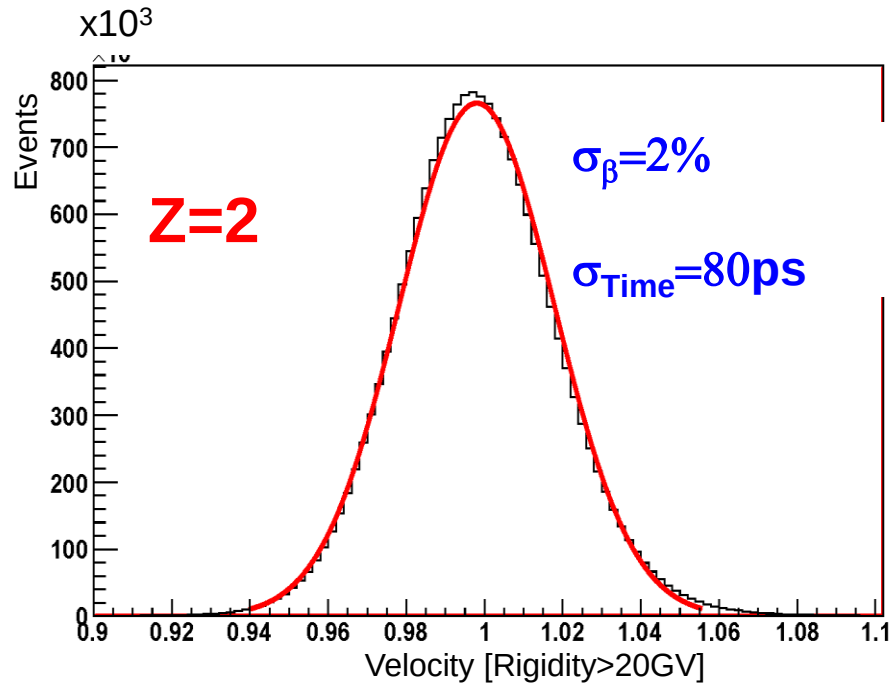


2x2 strati di pale di scintillatore

- ✓ Risoluzione in tempo 60 ps
- ✓ Direzione temporale
- ✓ Misura della velocità
- ✓ Misura della carica Z (dE/dx)

- Trigger di Particelle Cariche:
- ✓ Protoni: 3 strati & NO Veto
 - ✓ Elettroni: 3 strati & ECAL
 - ✓ Nuclei: 3 strati con $Z > 1$

ISS Data: Beta measurement



*Electronics
resolution*

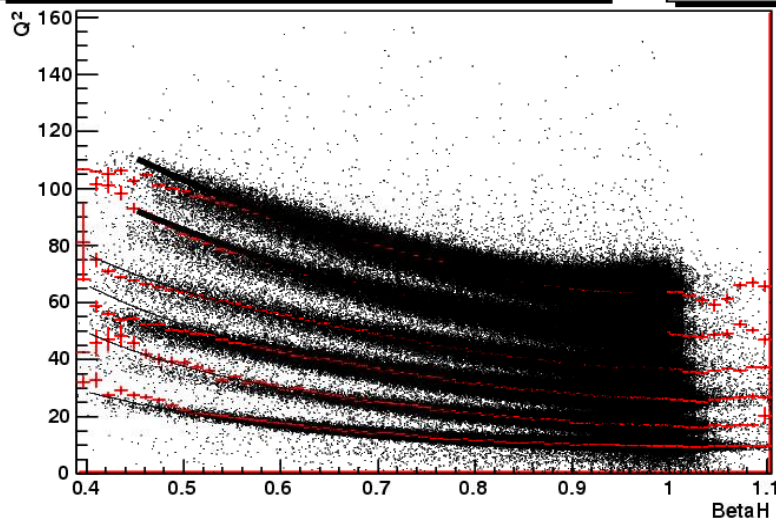
ISS Data: Charge Calibration - low beta

Different function for each counter and each charge

$$\frac{dE}{dx} \propto f_{Z,i}(\beta) Z^2$$

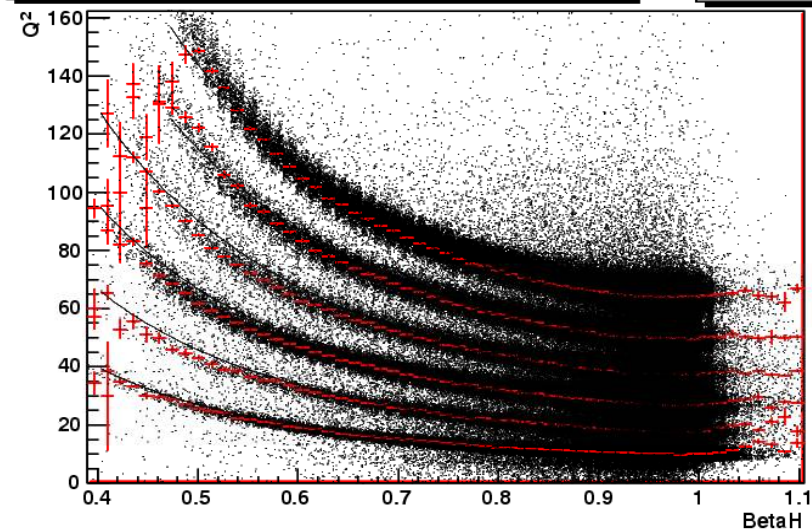
TOF Lay0Bar5 Different Velocity $Q^2[De/Dx]$ for $Z=3\sim 8$

anbeta_l0_b5_c3_p
Entries 16



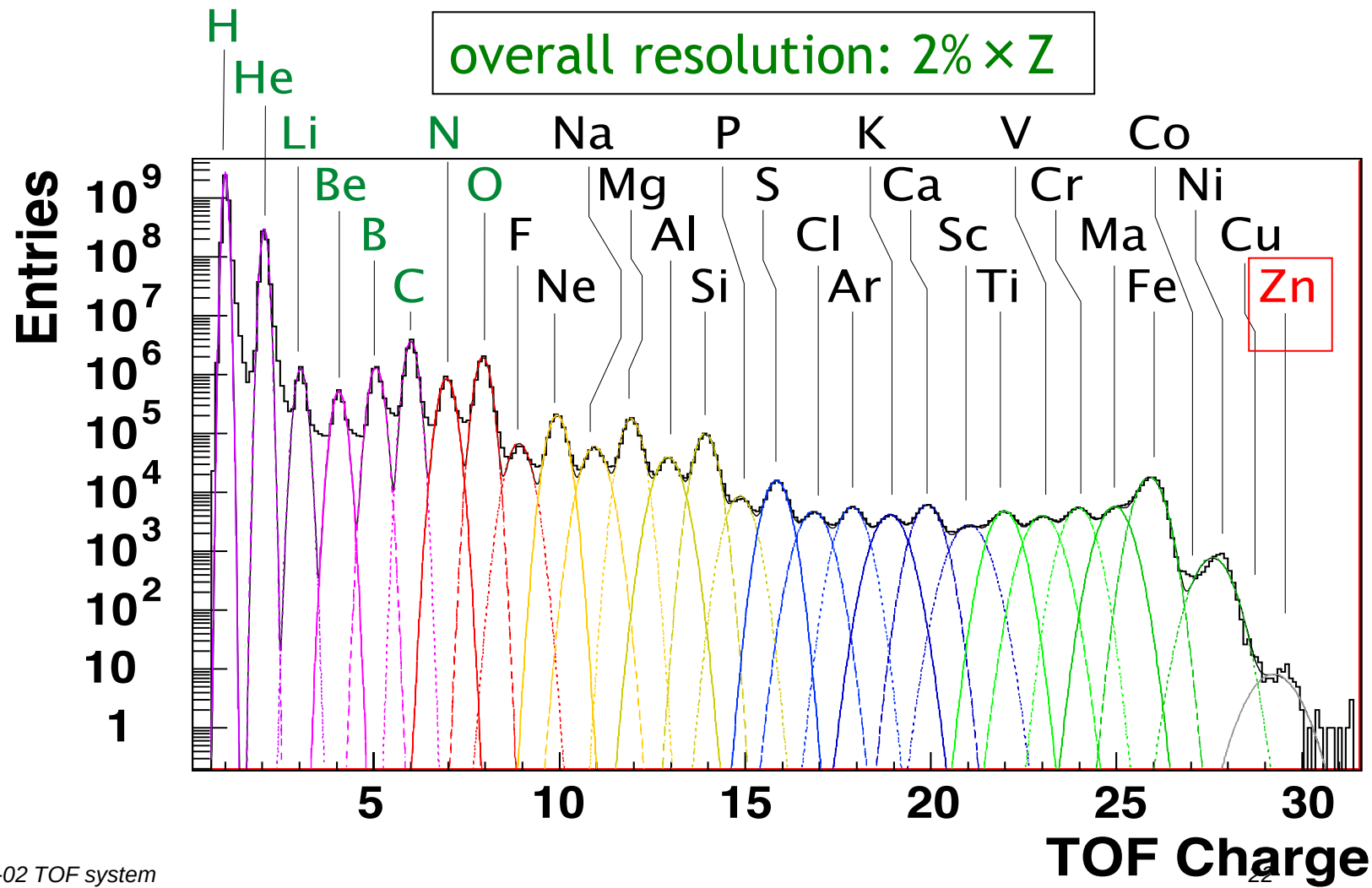
TOF Lay2Bar5 Different Velocity $Q^2[De/Dx]$ for $Z=3\sim 8$

anbeta_l2_b5_c3_p
Entries 16



ISS Data: Charge measurement

After careful calibration with space data using the redundancy of the AMS-02 apparatus





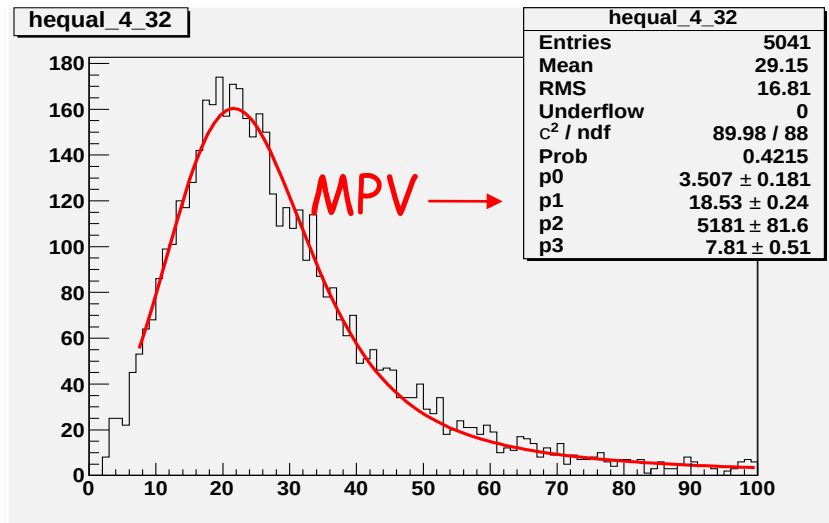
Calorimeter (ECAL)



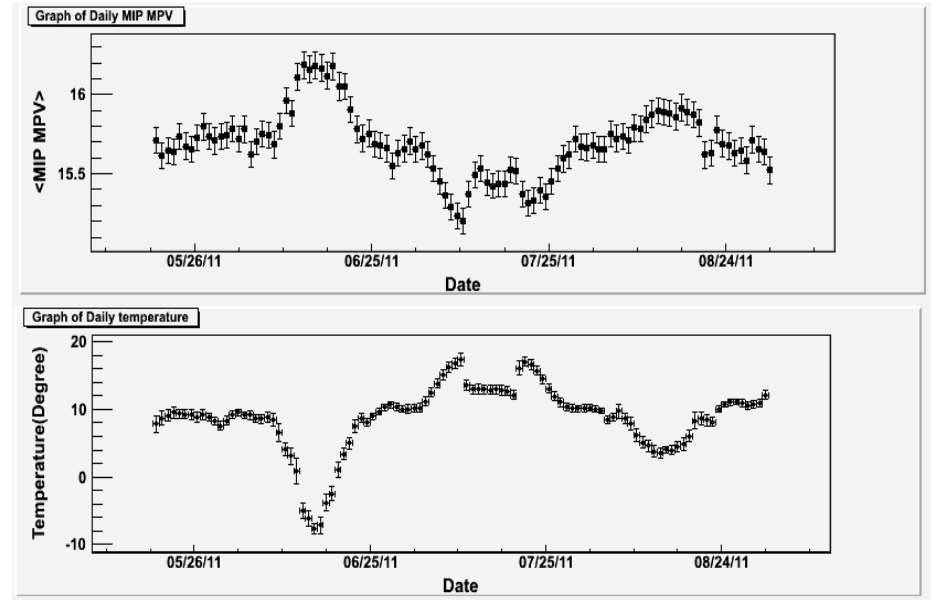
50,000 optical fibers, $\lambda = 1\text{mm}$, distributed uniformly inside 1,200 lb of lead
to measure energy (3% resolution) of electrons and gamma rays up to 1 TeV
Provides a standalone photon (and electron) trigger

NUOVA CALIBRAZIONE TIME-DEPENDENT

IL SEGNALE DI MIP DI PROTONE
VIENE USATO PER DETERMINARE
IL GUADAGNO DEL FOTOTUBO



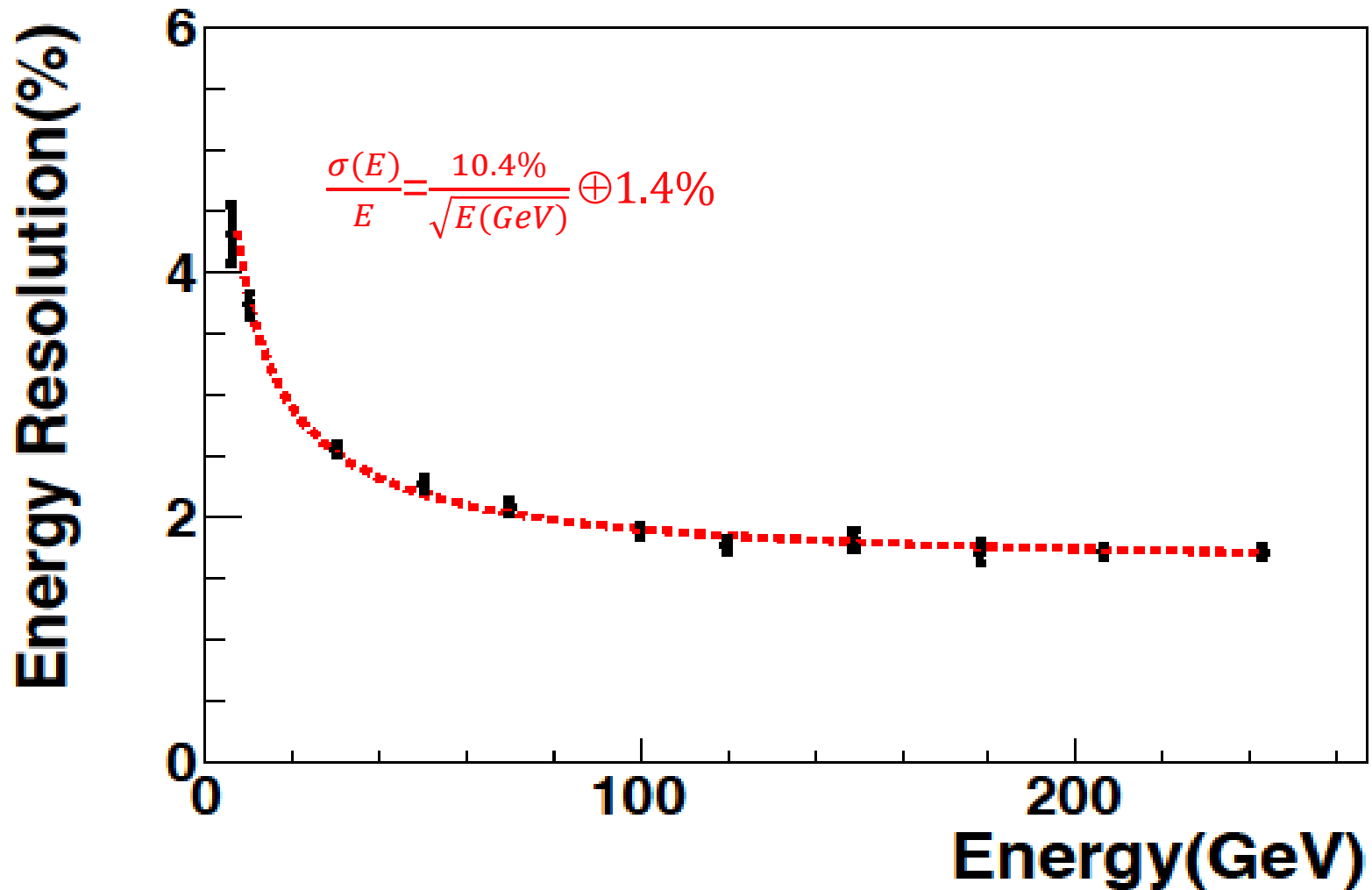
DIPENDENZA DEL GUADAGNO
DALLA TEMPERATURA: 1% ogni 4 gradi

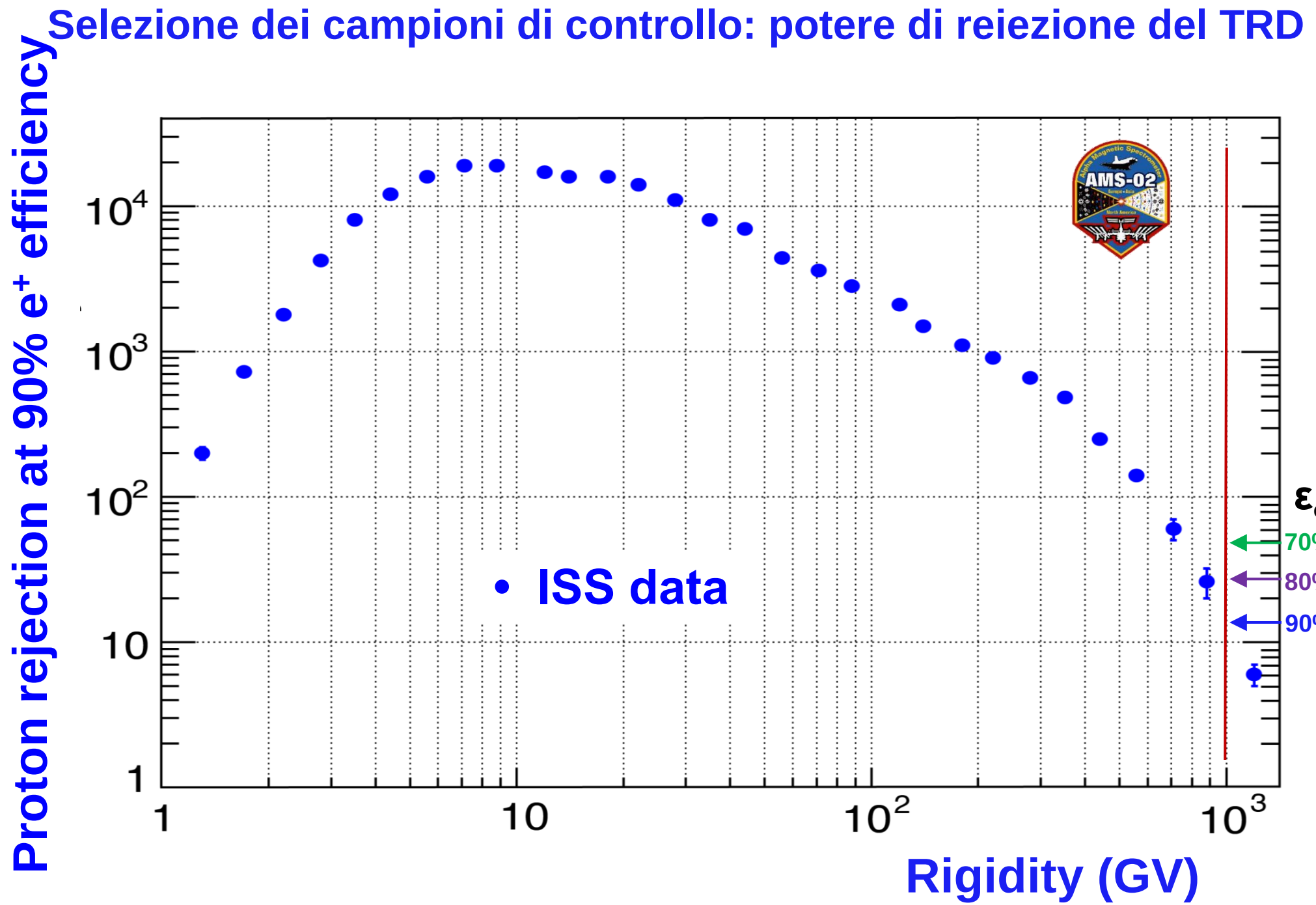


E' stato realizzato un **nuovo database** con i guadagni calcolati giornalmente e del relativo software per la ricostruzione dell'energia depositata nelle celle di ECAL

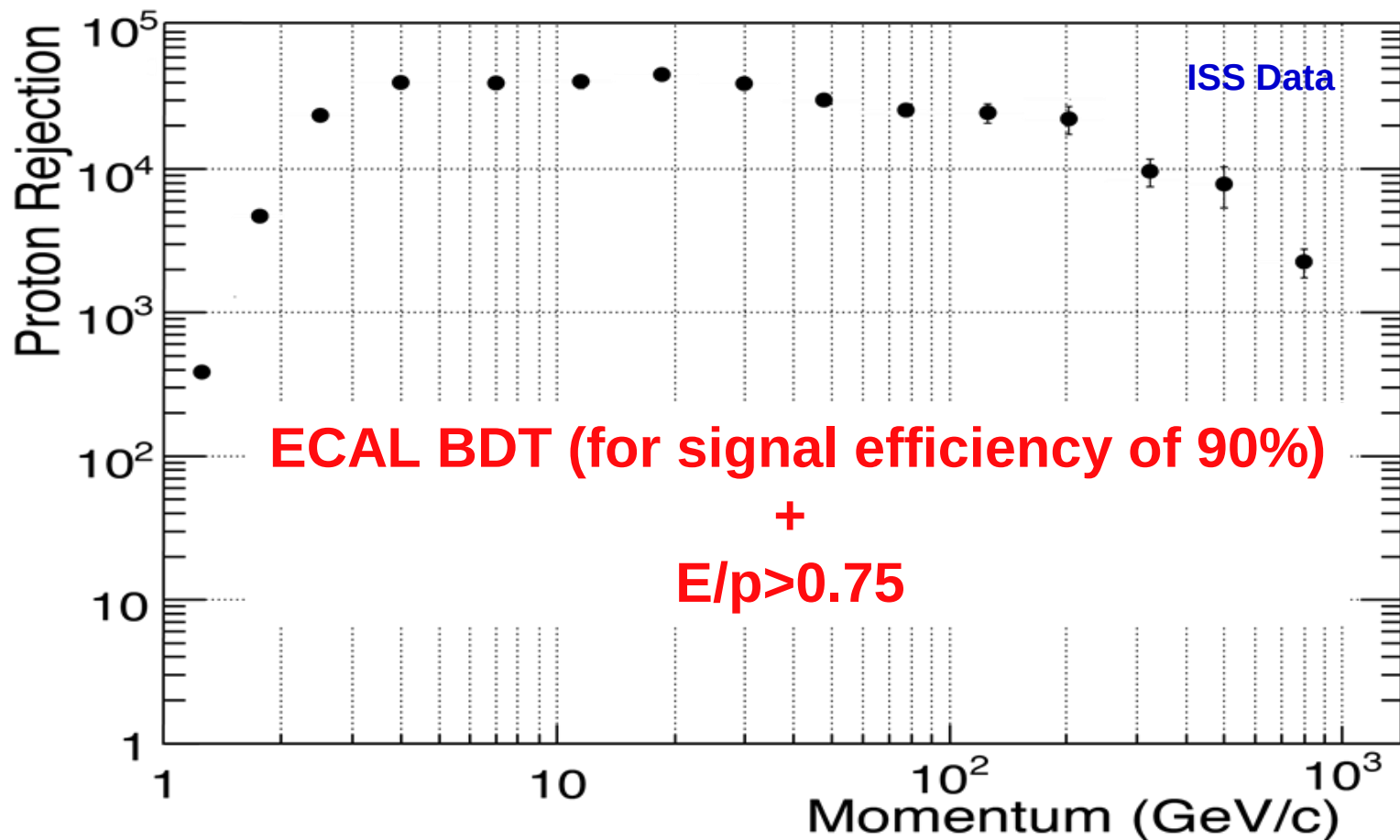
ECAL PERFORMANCES

Risoluzione in energia





IDENTIFICAZIONE DI ELETTRONI vs PROTONI con ECAL

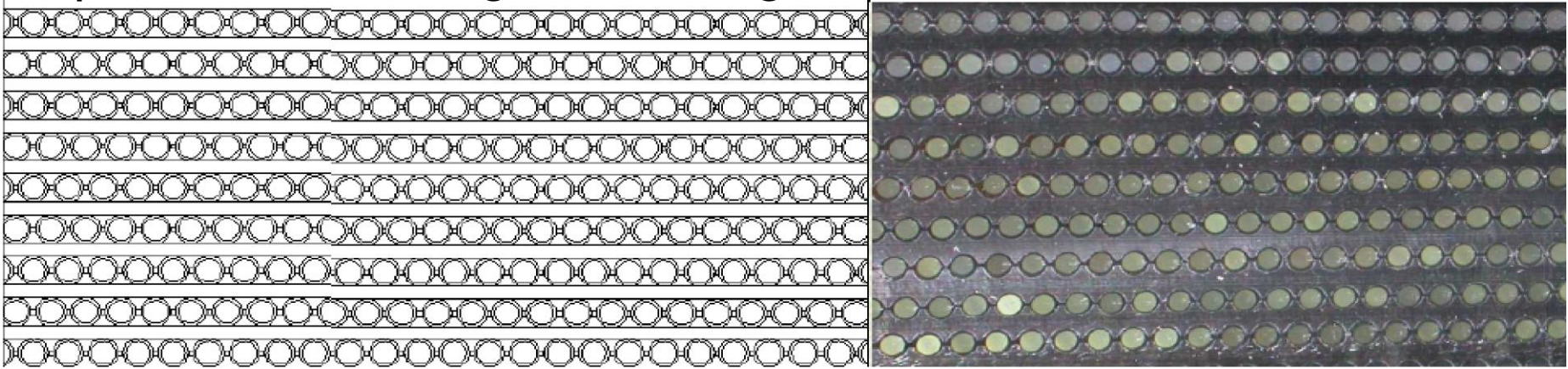


Il metodo, sviluppato a Pisa, è uno degli ingredienti principali della misura della frazione di positroni pubblicata

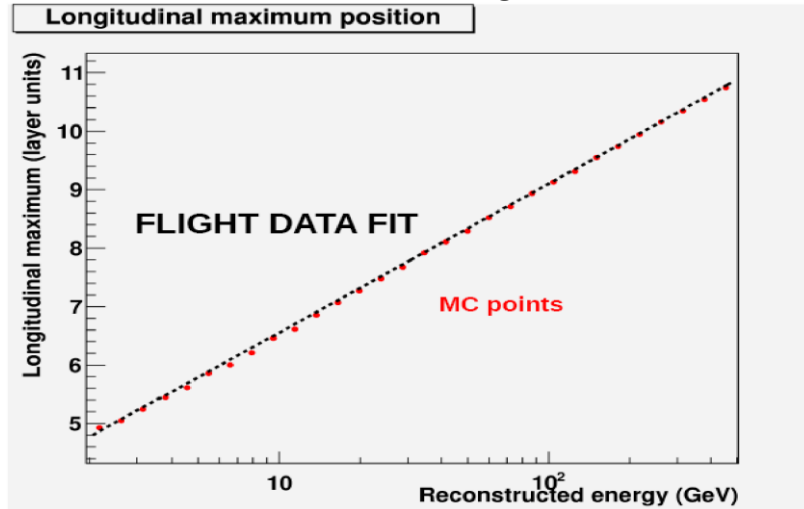
Una nuova versione basata sul Montecarlo è in preparazione per migliorare la reiezione sopra i 300 GeV

SIMULAZIONE DEL CALORIMETRO

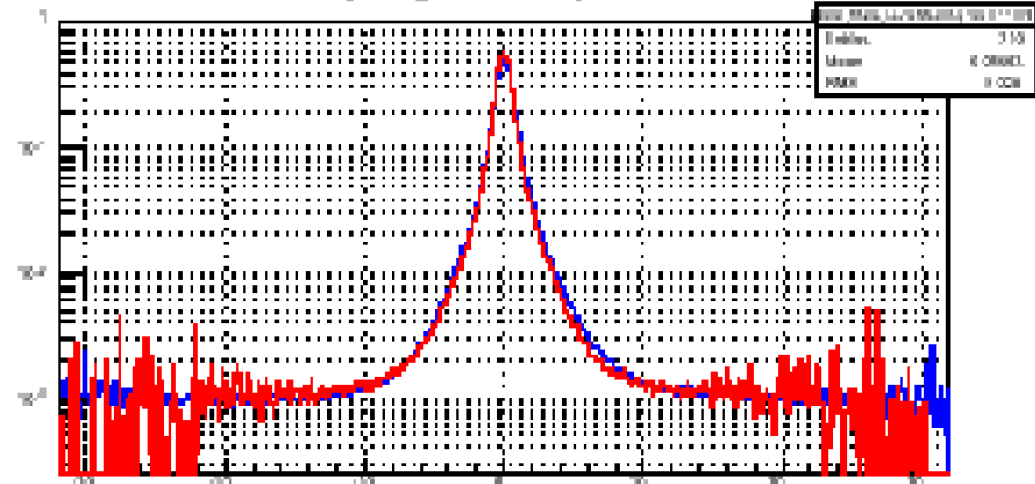
Riproduzione dettagliata della geometria e dei materiali



Posizione del massimo longitudinale



Distribuzione laterale di energia depositata



La simulazione diventerà sempre più rilevante con l'estendersi delle analisi alle alte energie dove la perdita di potere di reiezione del TRD e la bassa statistica non renderanno disponibili campioni di controllo estratti dagli stessi dati

AMS

Physics results

Data analysis in AMS (2 years of data)

AMS is a very precise particle physics detector.

Precision physics results require attention to detail and a large analysis effort.

The data are analysed by two independent AMS international teams.

Example: the positron fraction paper

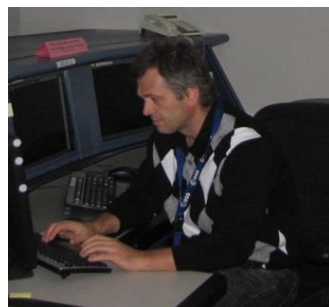
Group A



Group α



B. Bertucci



V. Choutko



A. Kounine



J. Berdugo



S. Schael



M. Incagli



S. Rosier-Lees



S. Haino, A. Oliva



J. Casaus, P. Zuccon



A. Contin

Physics results (ICRC 2013)

1. $e^+/(e^+ + e^-)$ ratio and anisotropy
2. Proton spectrum
3. Helium spectrum
4. Electron Spectrum
5. Positron Spectrum
6. All electron spectrum
6. Boron-to-Carbon ratio

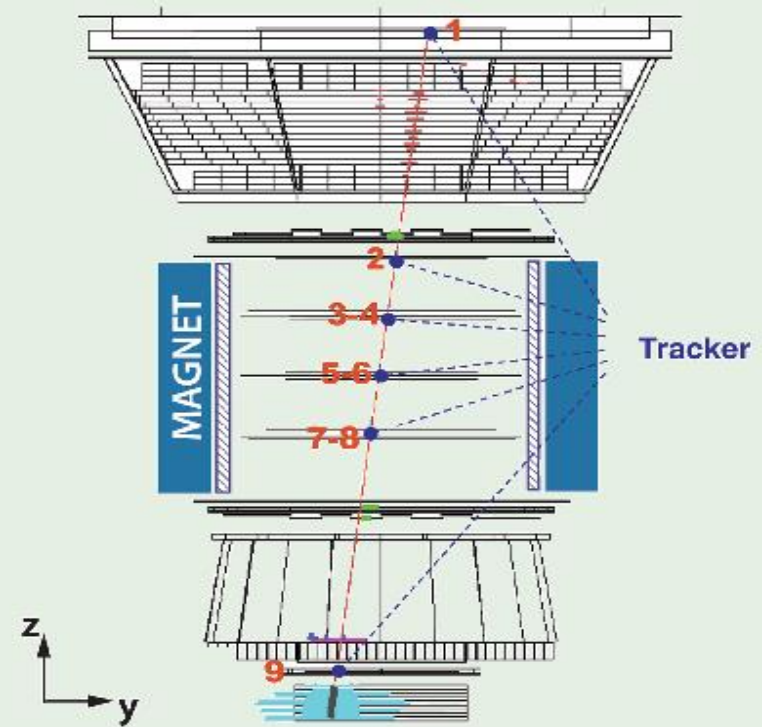
“First Result from the AMS on the ISS: Precision Measurement of the Positron Fraction in Primary Cosmic Rays of 0.5-350 GeV”

Selected for a
Viewpoint in Physics and
an Editors' Suggestion
[Aguilar, M. et al (AMS
Collaboration) Phys. Rev. Lett.
110, 1411xx (2013)]

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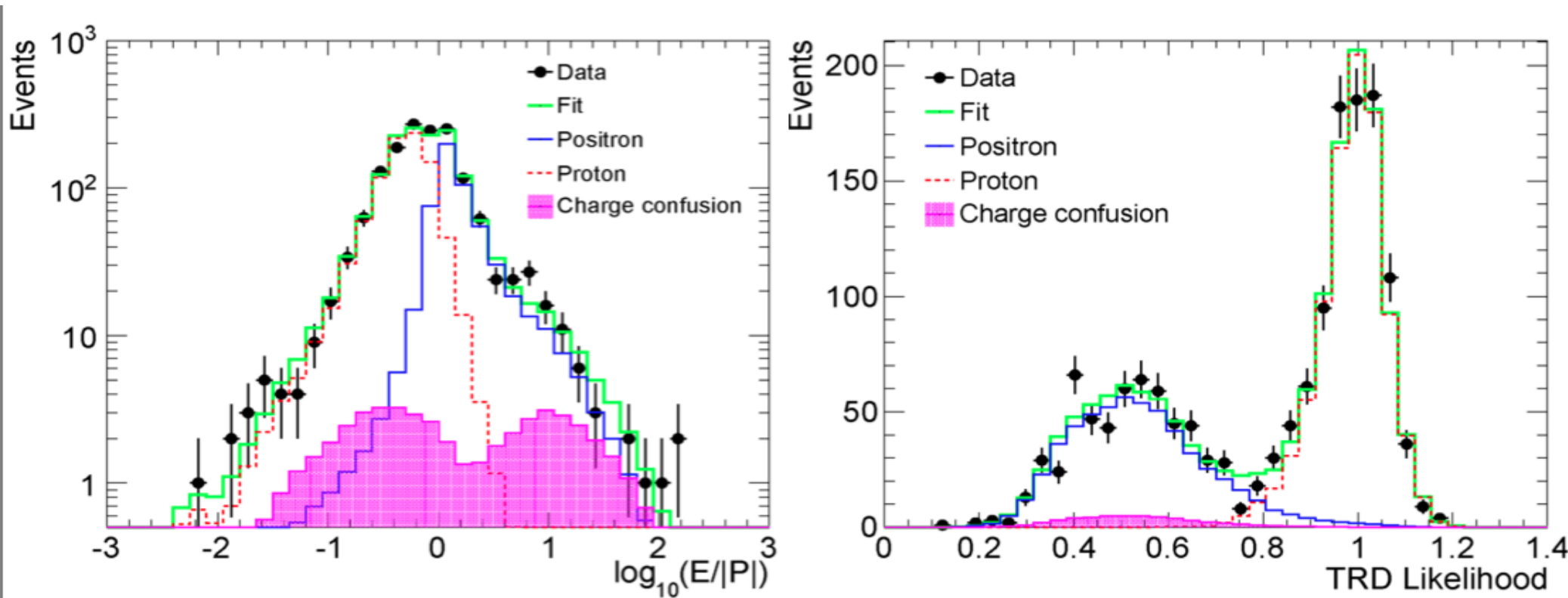
Published by
American Physical Society™



Volume 110, Number 14

Fit to data

$E = [83, 100] \text{ GeV}$



Projections on the two axis, but the global fit is 2D

- Fit is repeated at each energy bin
- After EcalBDT selection, no additional cut is applied



AMS-02 (6.8 million e^+ , e^- events)

The positron fraction is steadily increasing from 10 to ~250 GeV

From 20 to 250 GeV, the slope decreases by an order of magnitude

No structure in the spectrum

Positron fraction

10^{-1}

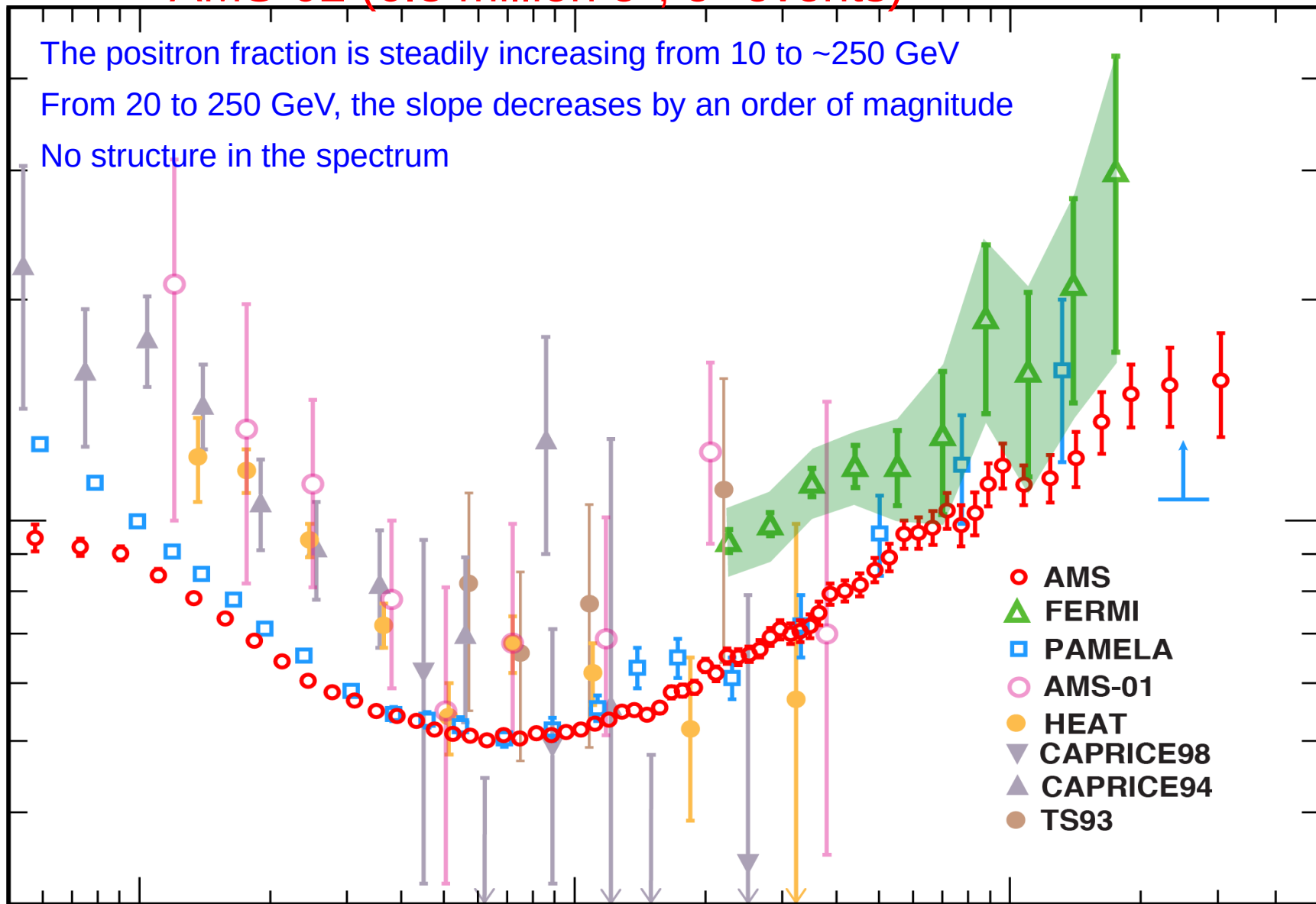
1

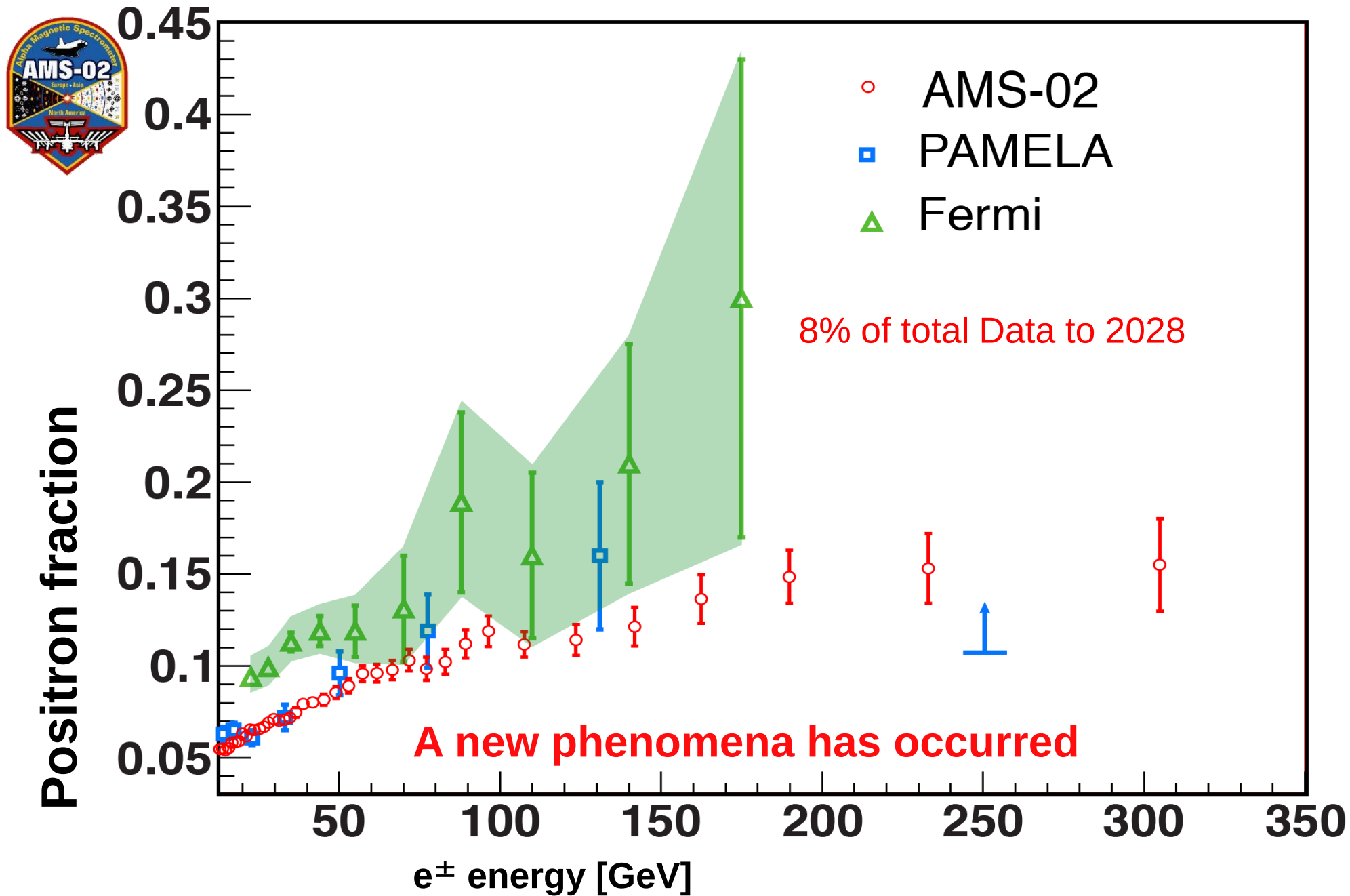
10

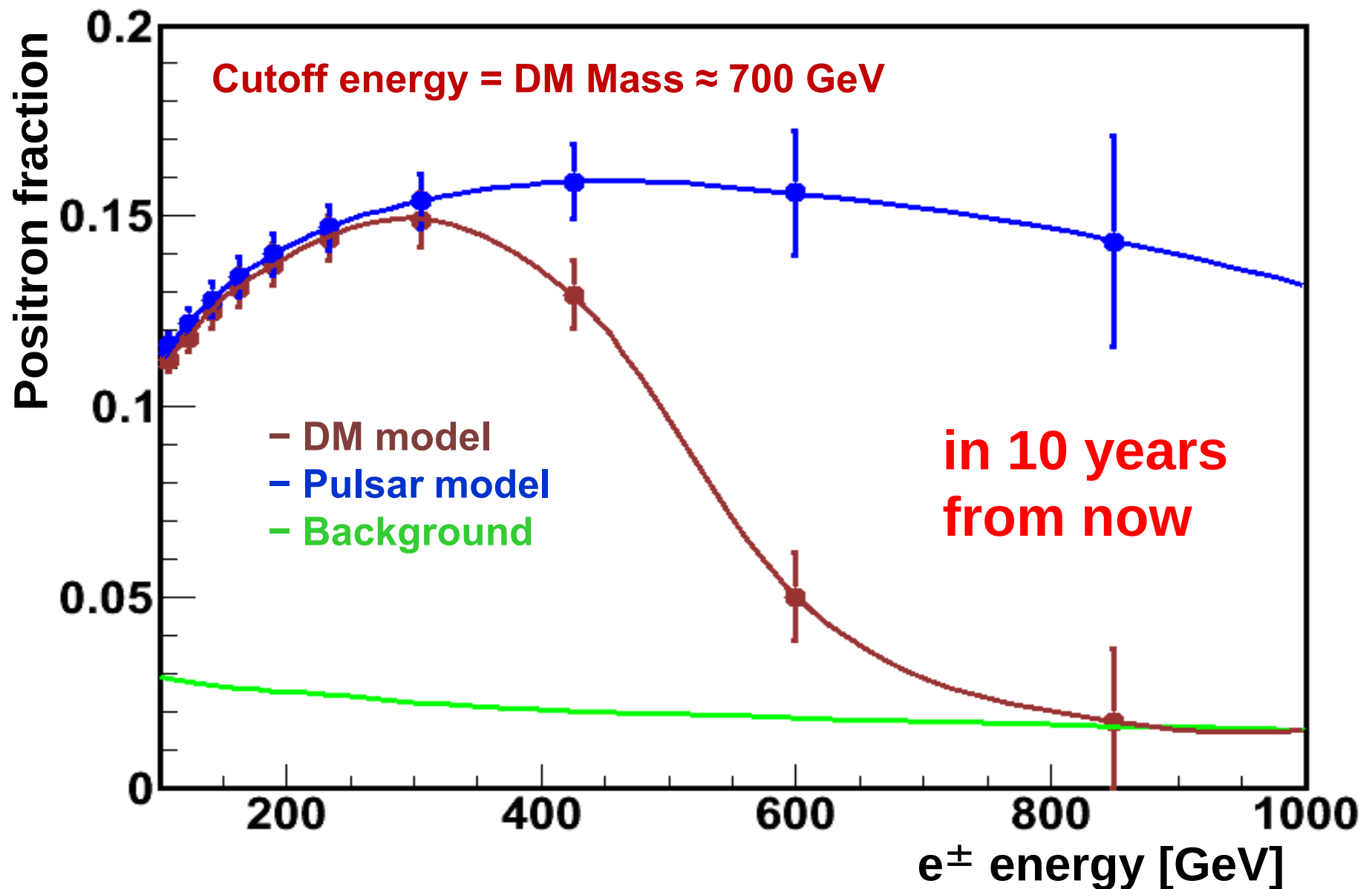
10^2

positron, electron energy [GeV]

- AMS
- △ FERMI
- PAMELA
- AMS-01
- HEAT
- ▼ CAPRICE98
- ▲ CAPRICE94
- TS93

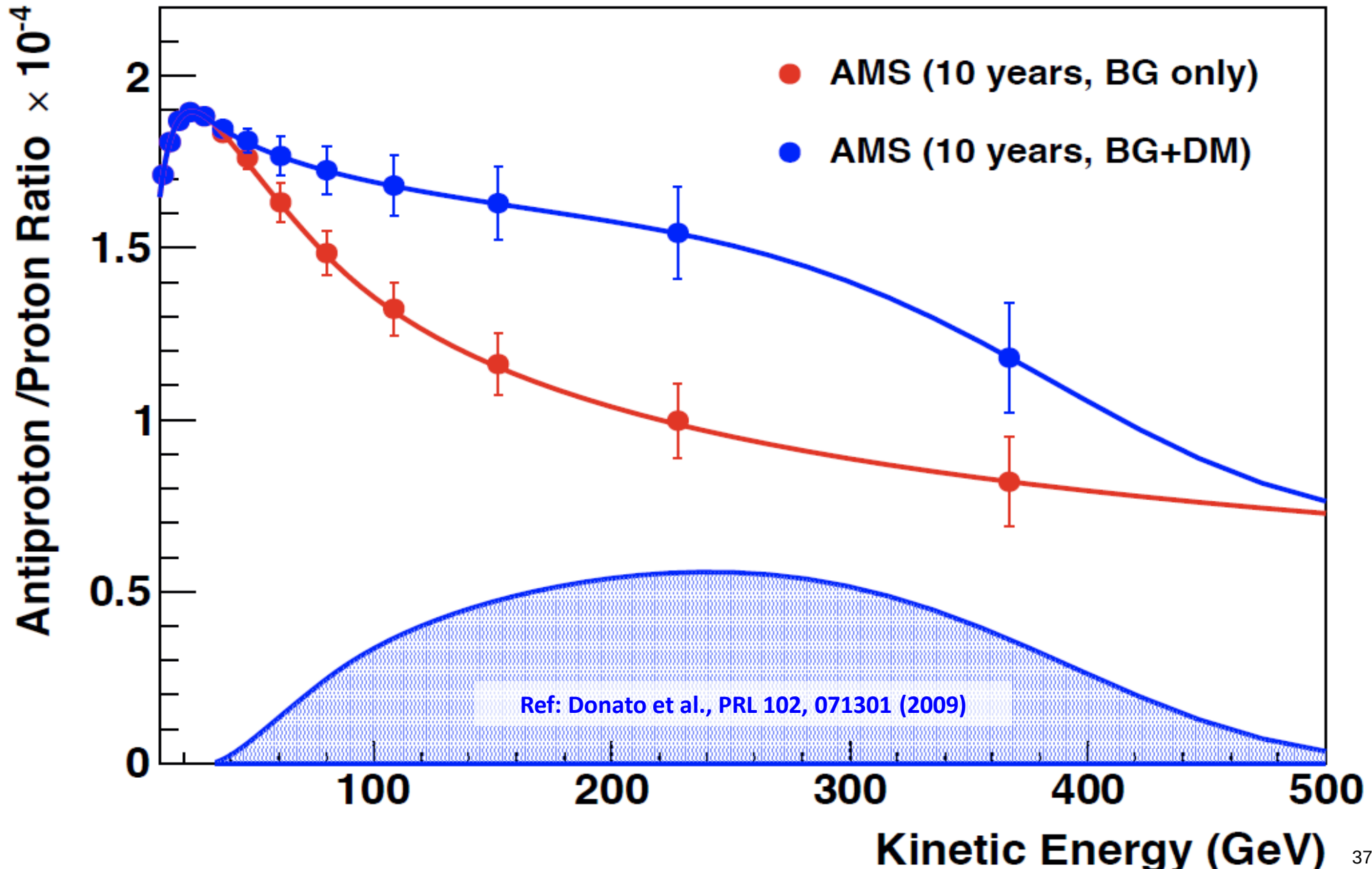






What will the Positron Fraction look like at high energy?

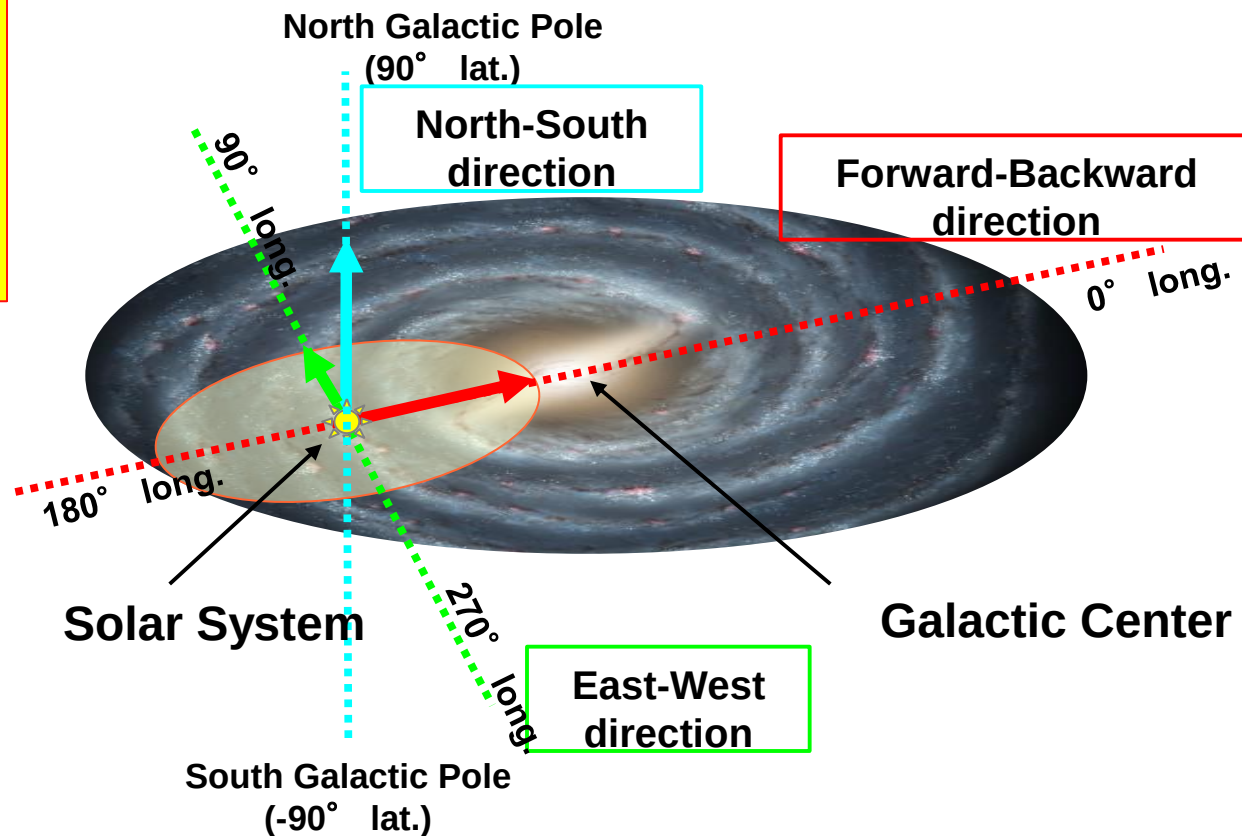
Comparison of p/p Results with Models in 10 more years



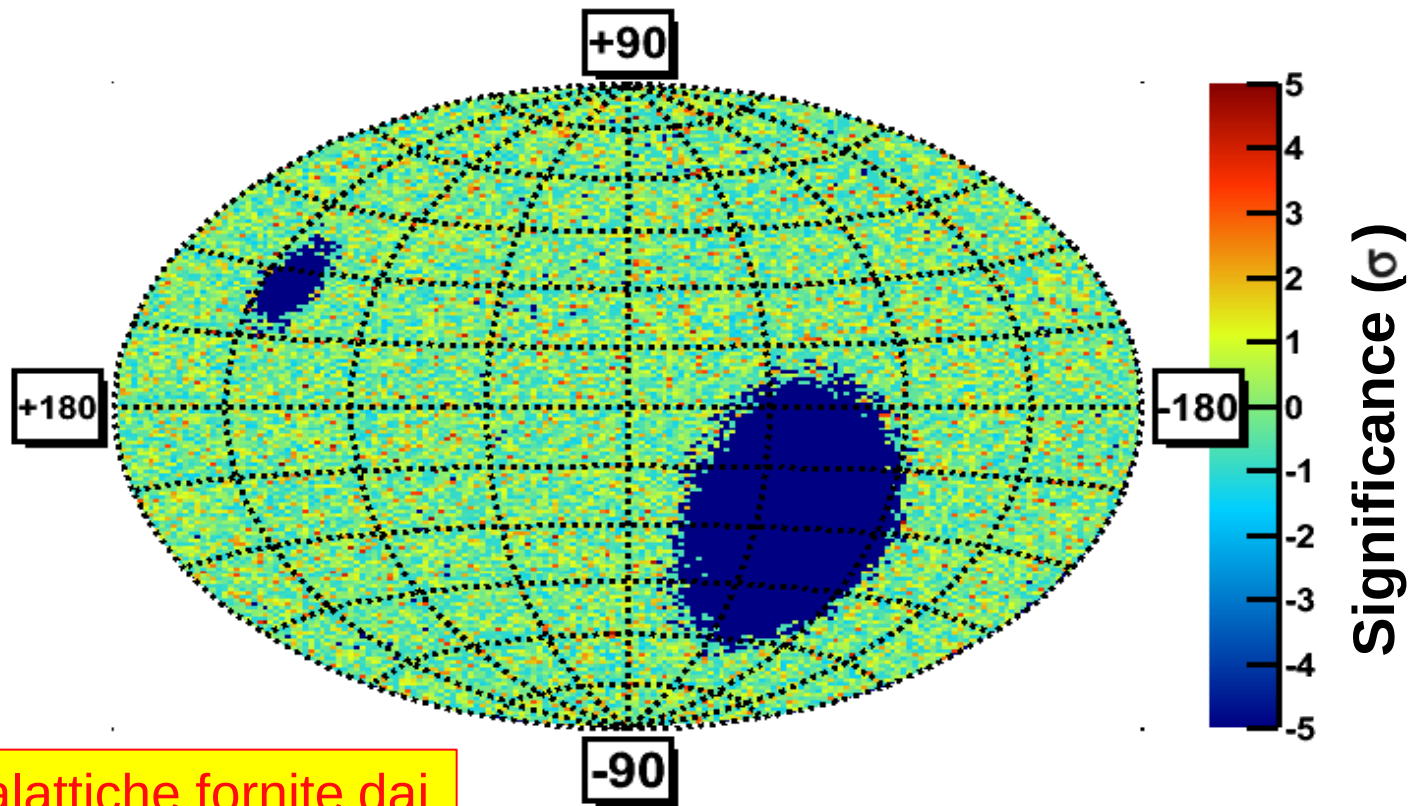
Studio dell'anisotropia in 5 bin di energia: 16-350, 25-350, 40-350, 65-350 e 100-350 GeV.

Back-tracing delle particelle al di fuori del campo magnetico terrestre per ricostruire la loro direzione originaria (gruppo di Milano)

Le direzioni originarie sono usate per costruire mappe del cielo in coordinate galattiche (b,l) con il numero di positroni ed elettroni

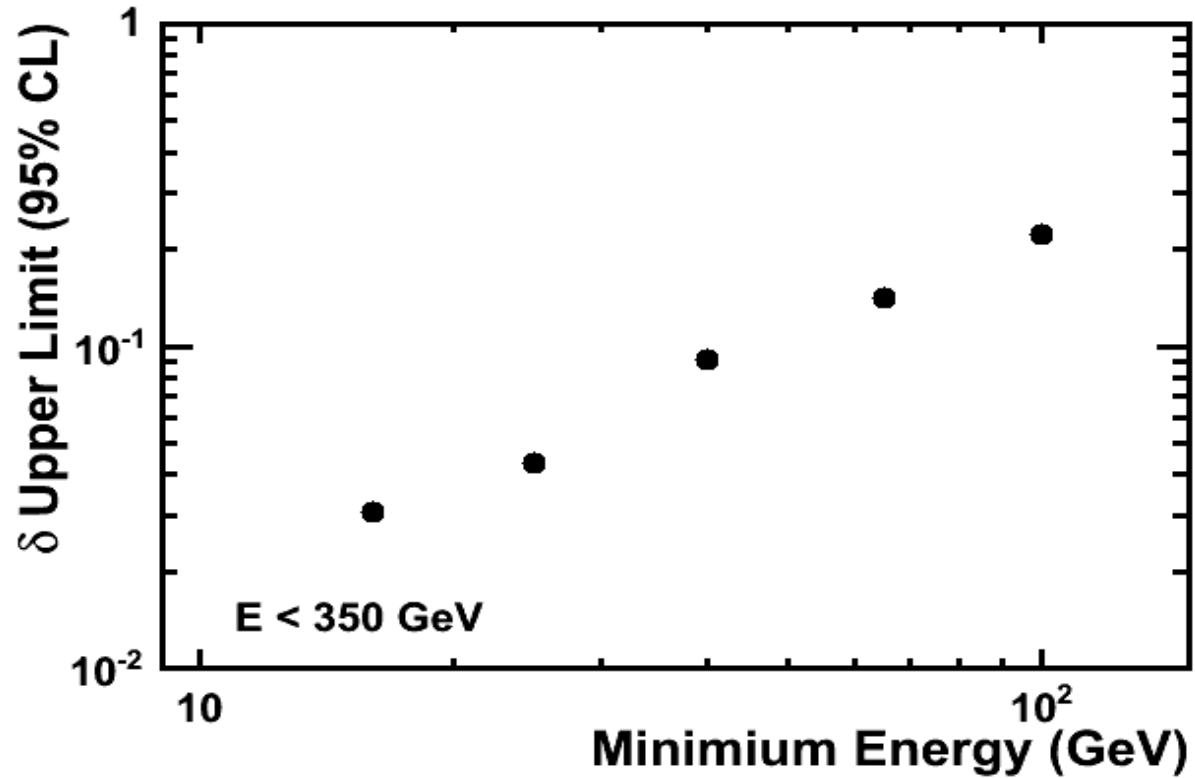


The relative fluctuations of the positron ratio, e^+/e^- , across the observed sky map show no evident pattern



Coordinate galattiche fornite dai gruppi di Milano e Roma

AMS upper limits on δ at the 95% CL

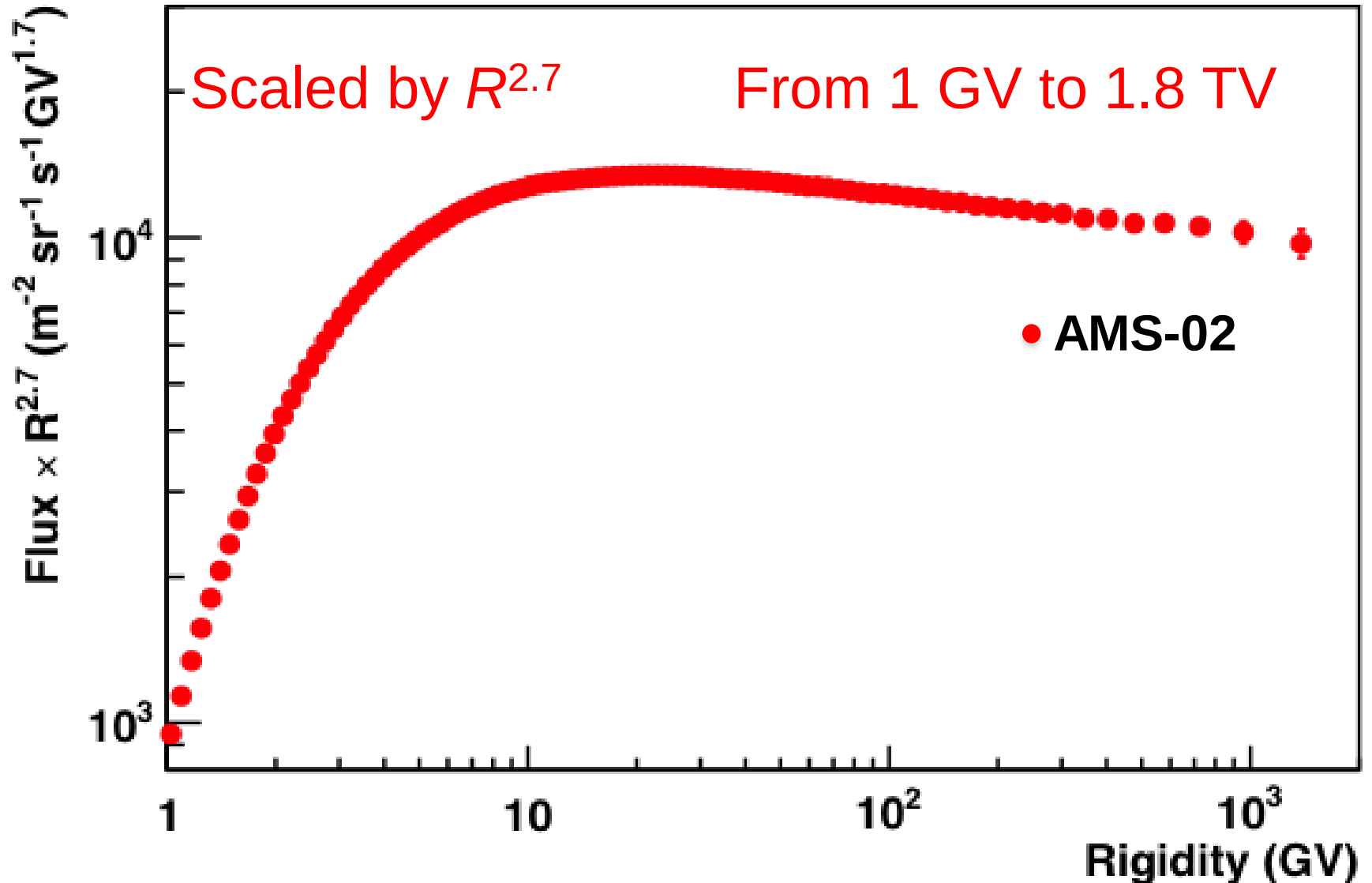


$\delta < 0.030$ for $16 < E < 350$ GeV



New results from AMS

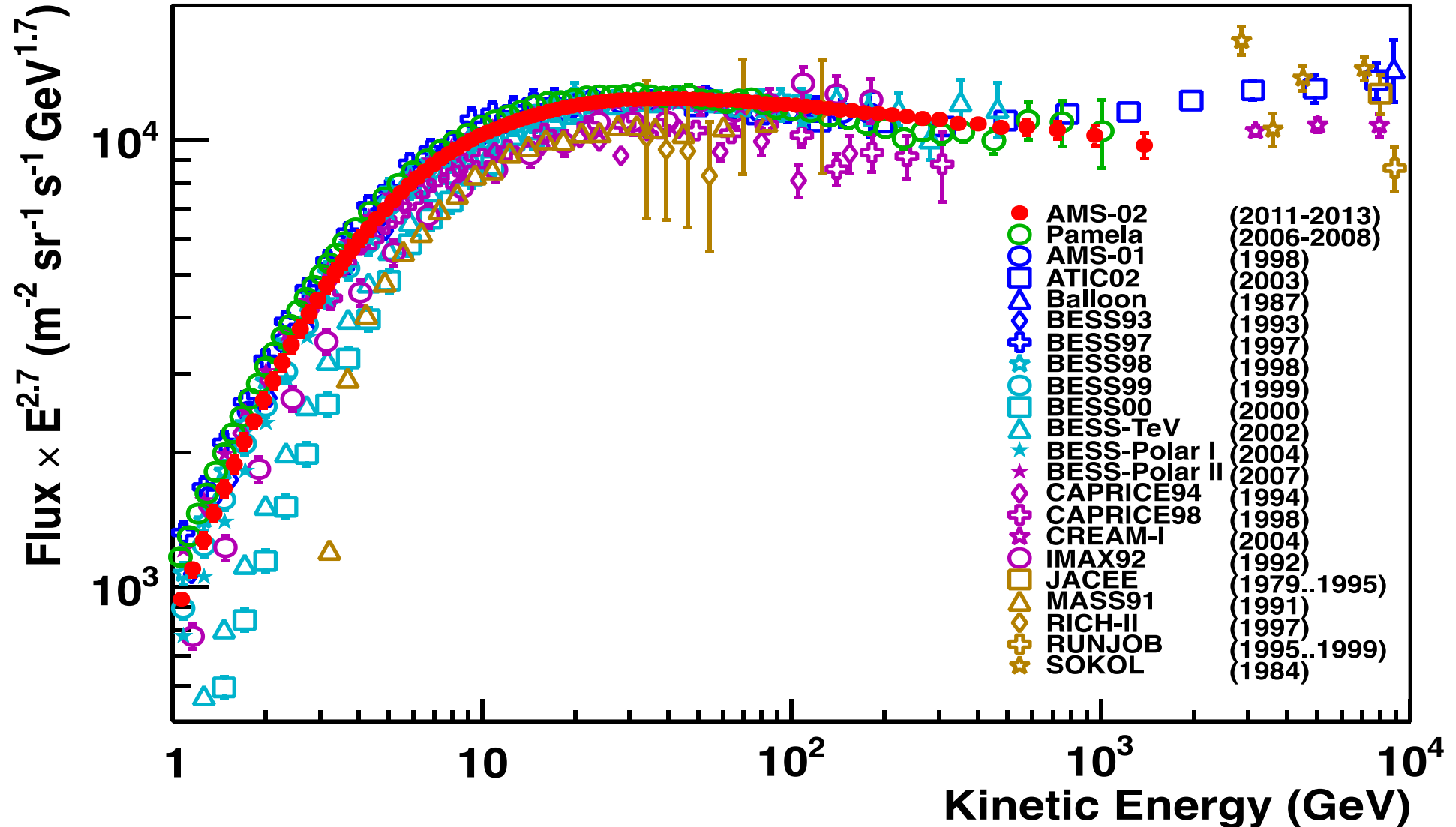
2) Proton flux





Proton flux

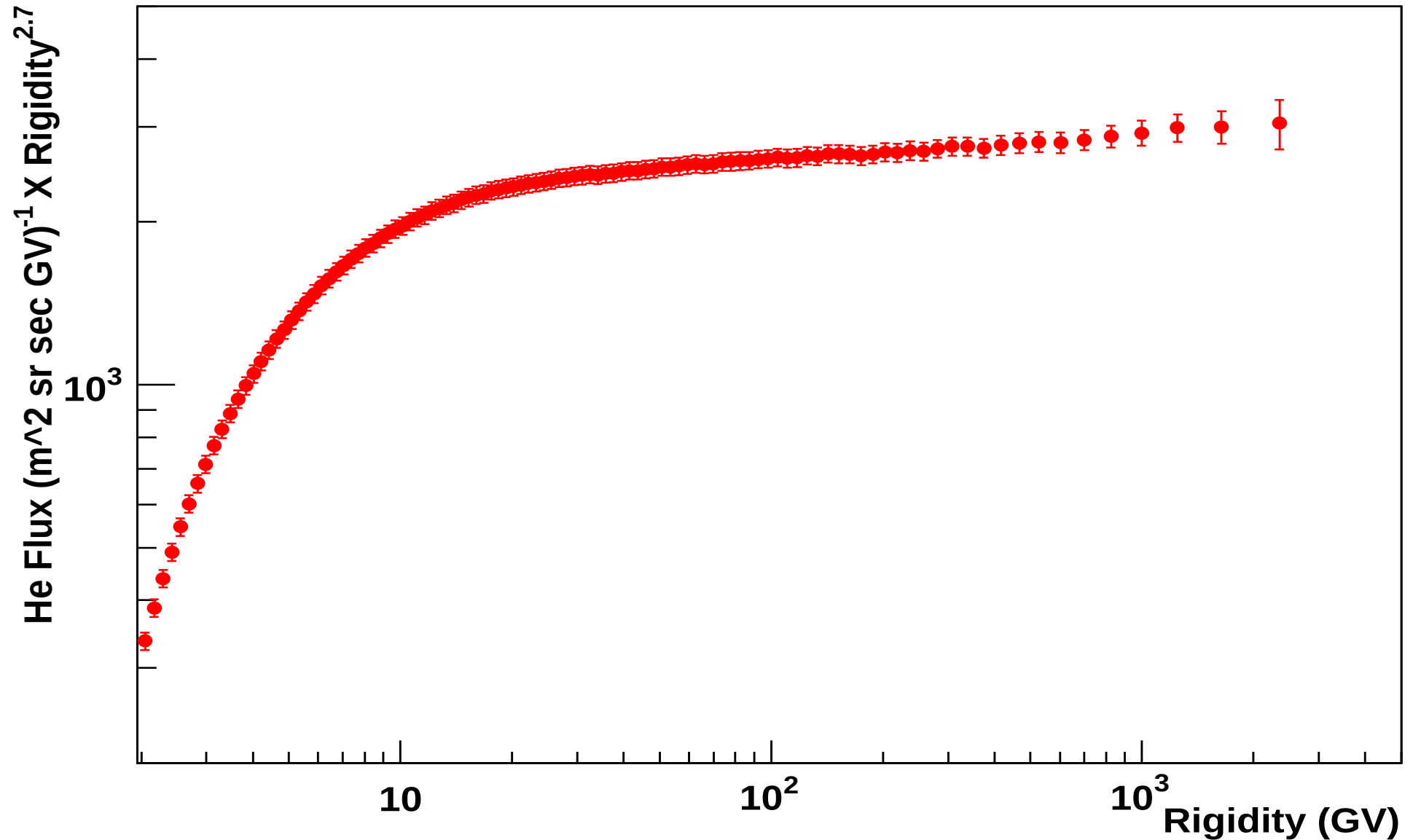
Comparison with past measurements





New Results from AMS

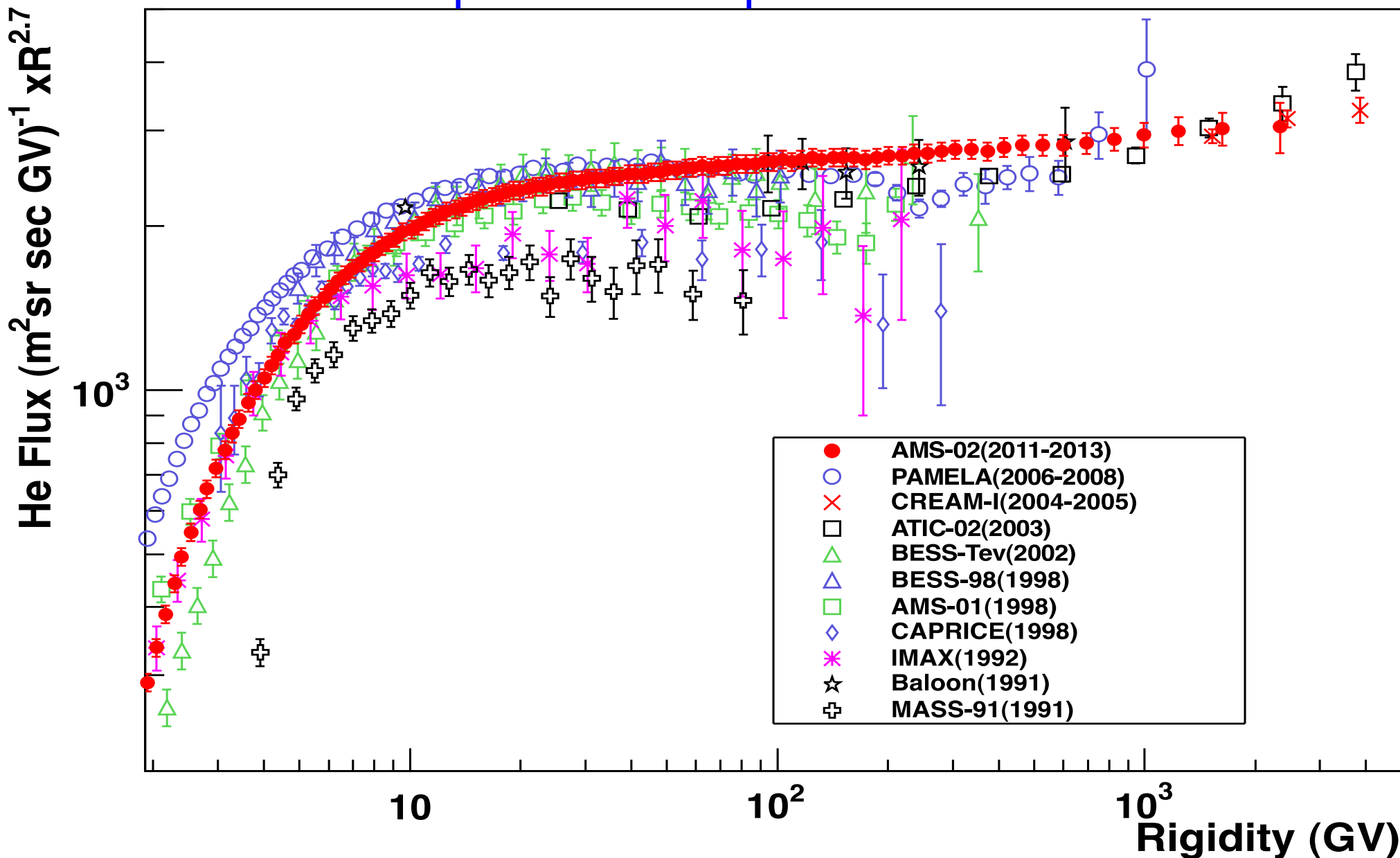
3) Helium flux





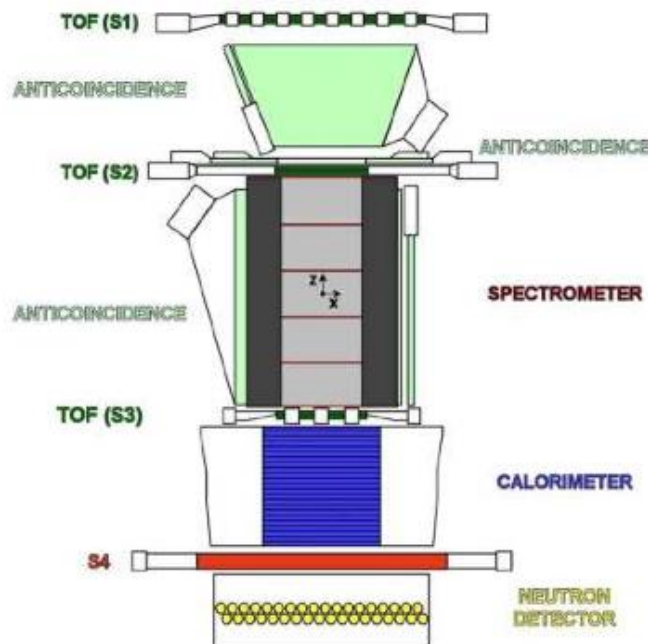
Helium flux

Comparison with past measurements

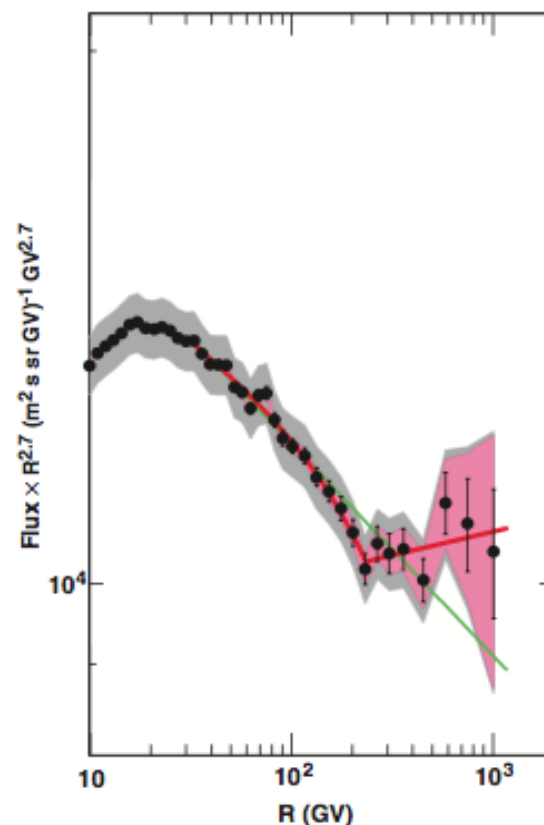


PAMELA Measurements of Cosmic-Ray Proton and Helium Spectra

O. Adriani,^{1,2} G. C. Barbarino,^{3,4} G. A. Bazilevskaya,⁵ R. Bellotti,^{6,7} M. Boezio,⁸
E. A. Bogomolov,⁹ L. Bonechi,^{1,2} M. Bongi,² V. Bonvicini,⁸ S. Borisov,^{10,11,12} S. Bottai,²
A. Bruno,^{6,7} F. Cafagna,⁷ D. Campana,⁴ R. Carbone,^{4,11} P. Carlson,¹³ M. Casolino,¹⁰
G. Castellini,¹⁴ L. Consiglio,⁴ M. P. De Pascale,^{10,11} C. De Santis,^{10,11} N. De Simone,^{10,11}
V. Di Felice,¹⁰ A. M. Galper,¹² W. Gillard,¹³ L. Grishantseva,¹² G. Jerse,^{8,15} A. V. Karelin,¹²
S. V. Koldashov,¹² S. Y. Krutkov,⁹ A. N. Kvashnin,⁵ A. Leonov,¹² V. Malakhov,¹² V. Malvezzi,¹⁰
L. Marcelli,¹⁰ A. G. Mayorov,¹² W. Menn,¹⁶ V. V. Mikhailov,¹² E. Mocchiutti,⁸ A. Monaco,^{6,7}
N. Mori,^{1,2} N. Nikonov,^{9,10,11} G. Osteria,⁴ F. Palma,^{10,11} P. Papini,² M. Pearce,¹³
P. Picozza,^{10,11*} C. Pizzolotto,⁸ M. Ricci,¹⁷ S. B. Ricciarini,² L. Rossetto,¹³ R. Sarkar,⁸
M. Simon,¹⁶ R. Sparvoli,^{10,11} P. Spillantini,^{1,2} Y. I. Stozhkov,⁵ A. Vacchi,⁸ E. Vannuccini,²
G. Vasilyev,⁹ S. A. Voronov,¹² Y. T. Yurkin,¹² J. Wu,^{13†} G. Zampa,⁸ N. Zampa,⁸ V. G. Zverev¹²



Proton



Helium

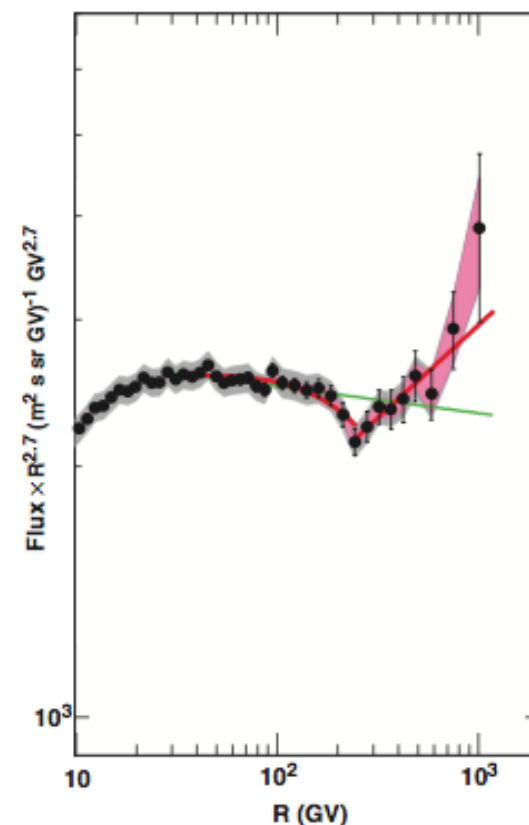
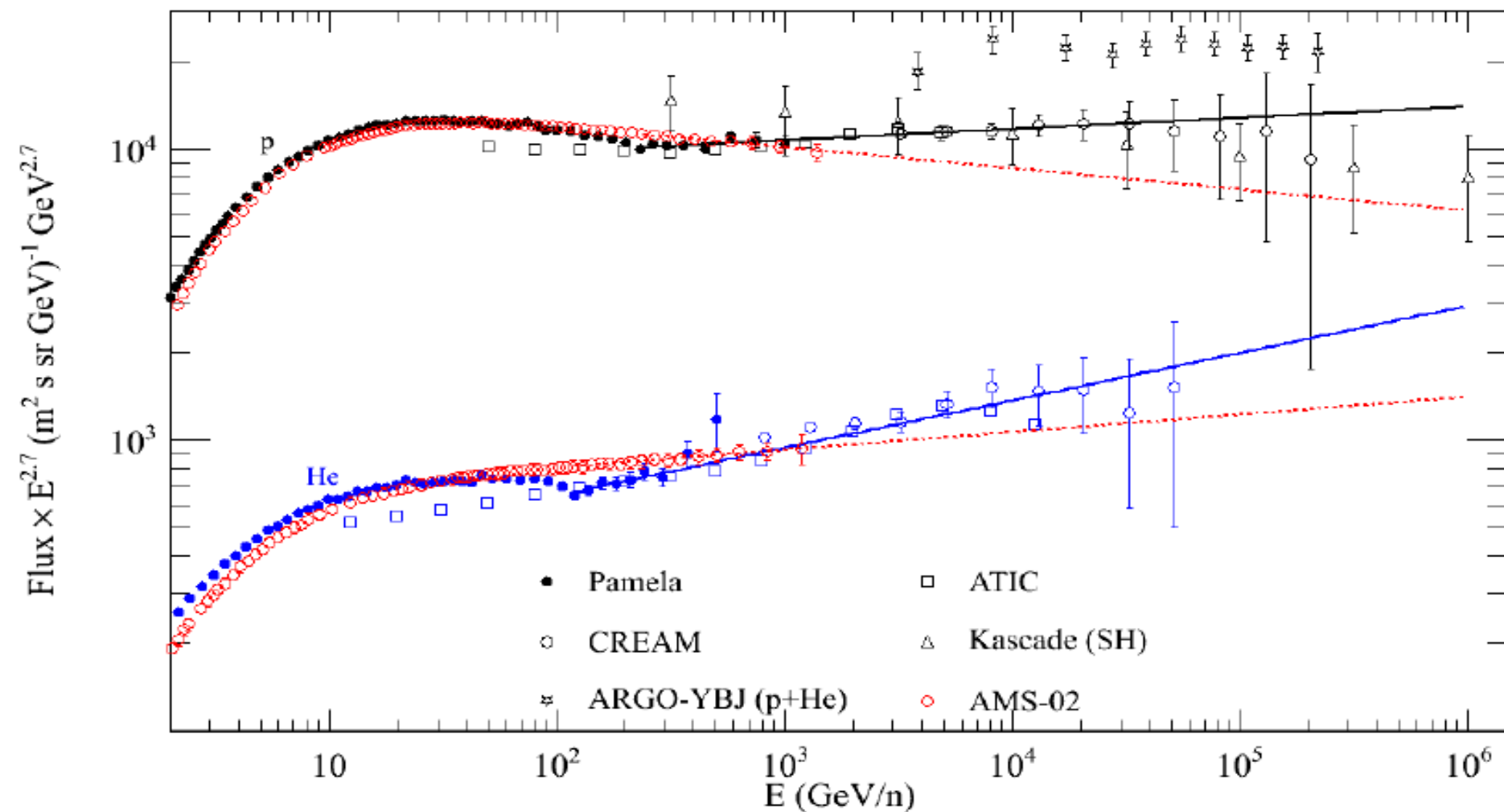


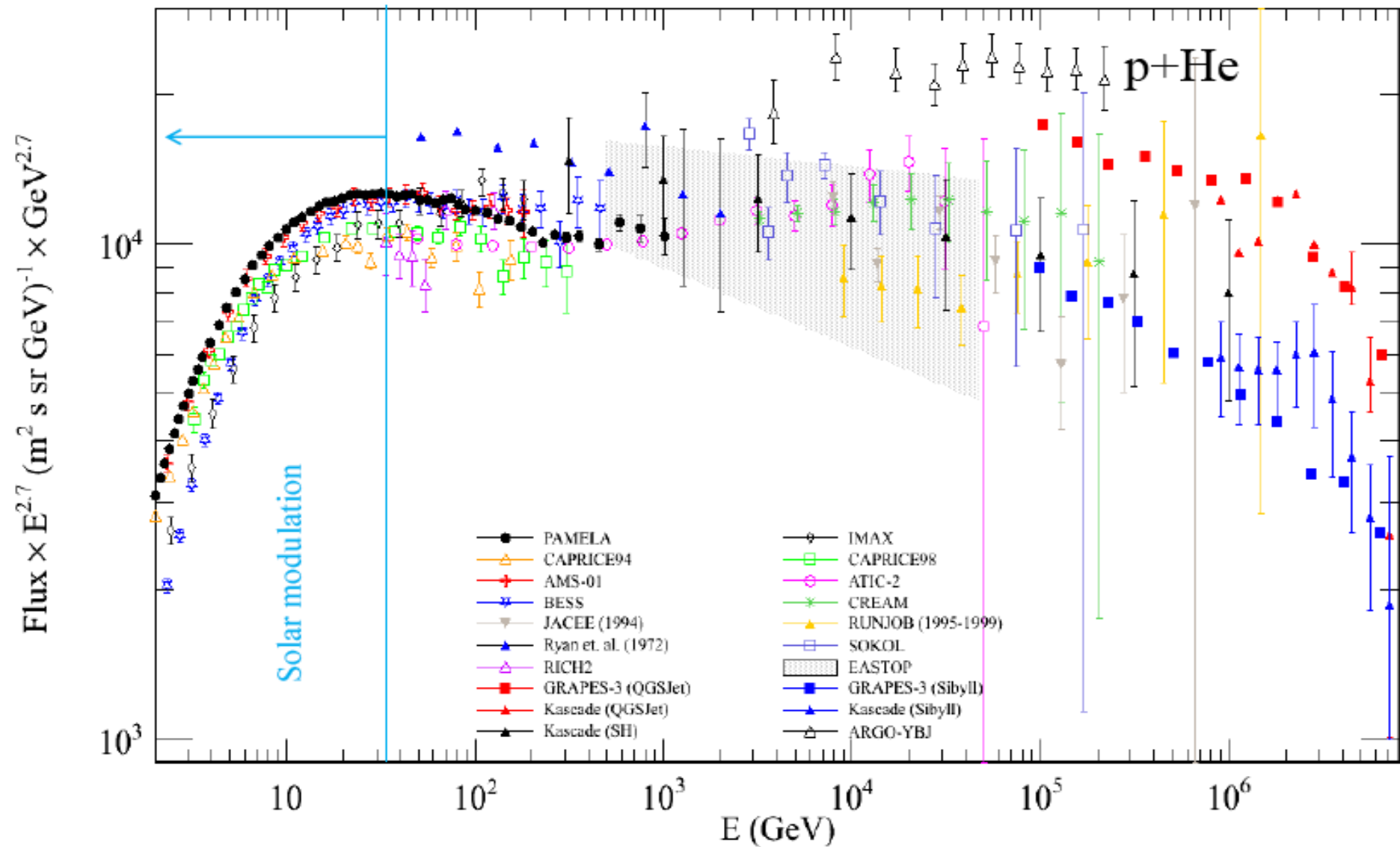
Fig. 4. Proton (left) and helium (right) spectra in the range 10 GV to 1.2 TV. The gray shaded area represents the estimated systematic uncertainty, and the pink shaded area represents the contribution due to tracker alignment. The green lines represent fits with a single power law in the rigidity range 30 to 240 GV. The red curves represent the fit with a rigidity-dependent power law (30 to 240 GV) and with a single power law above 240 GV.

Proton and Helium Nuclei Spectra



Proton (Hydrogen) Spectrum

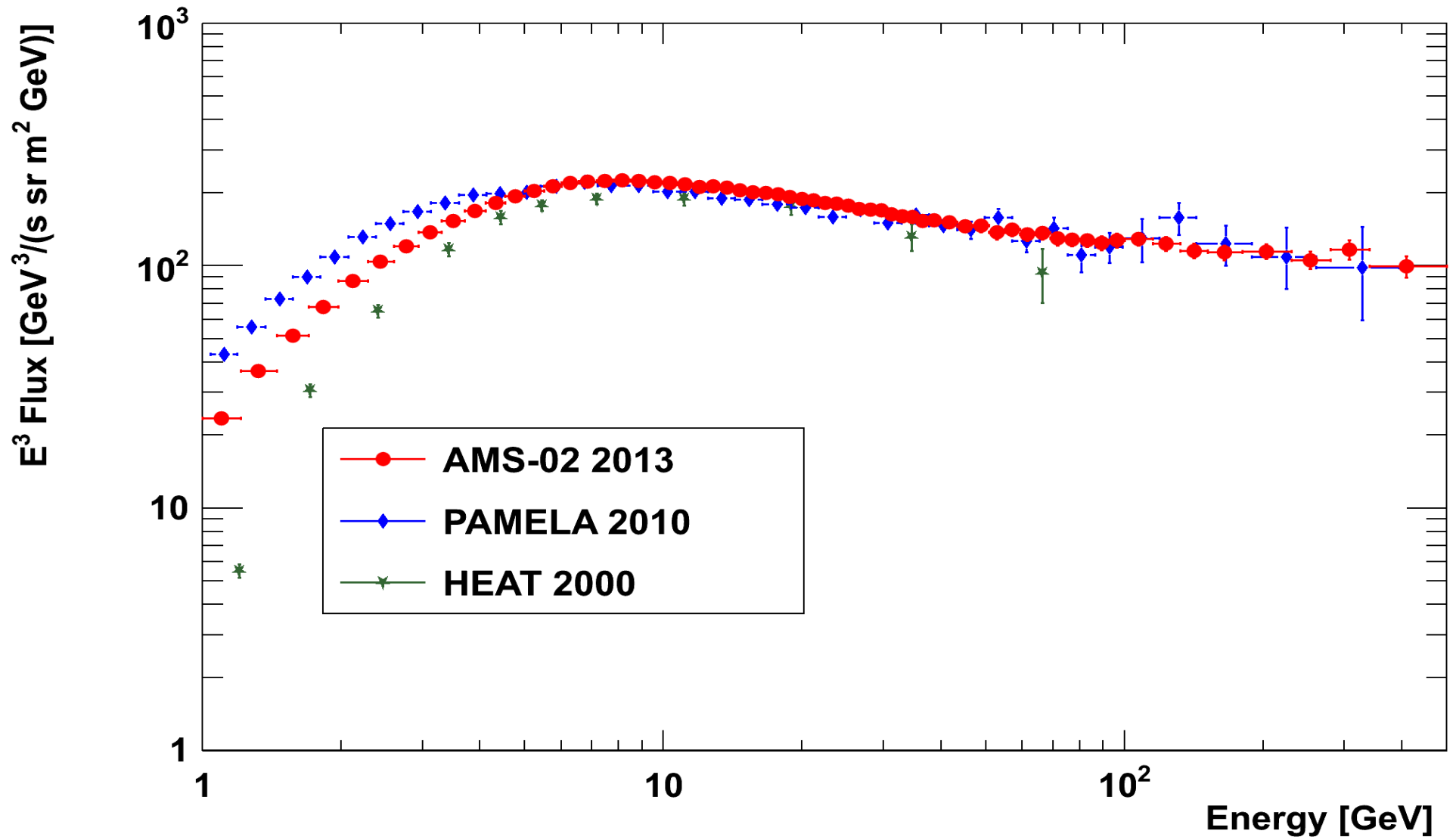
Studio degli effetti della modulazione solare (gruppo di Milano)





New results from AMS

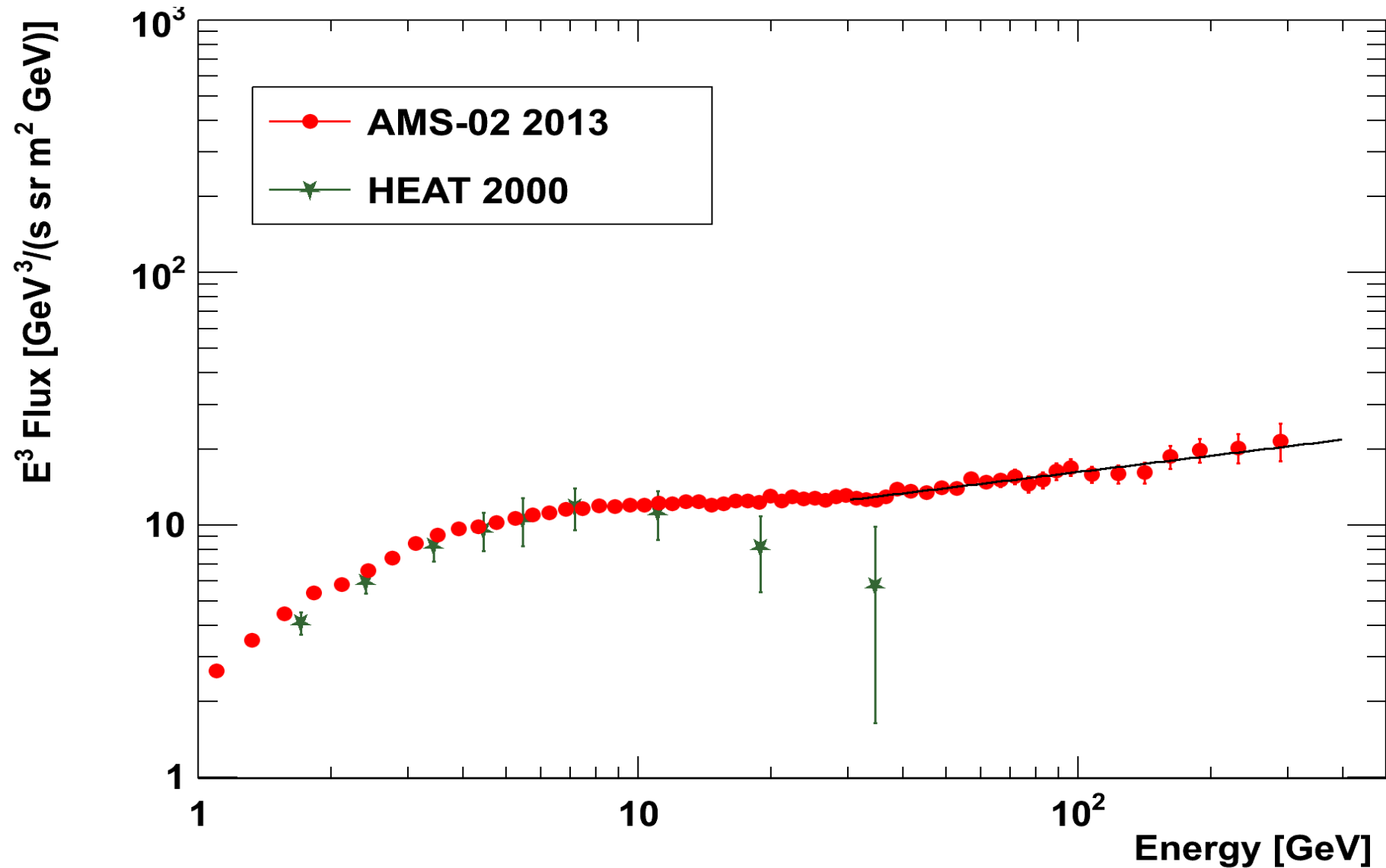
4) Electron Spectrum





New results from AMS

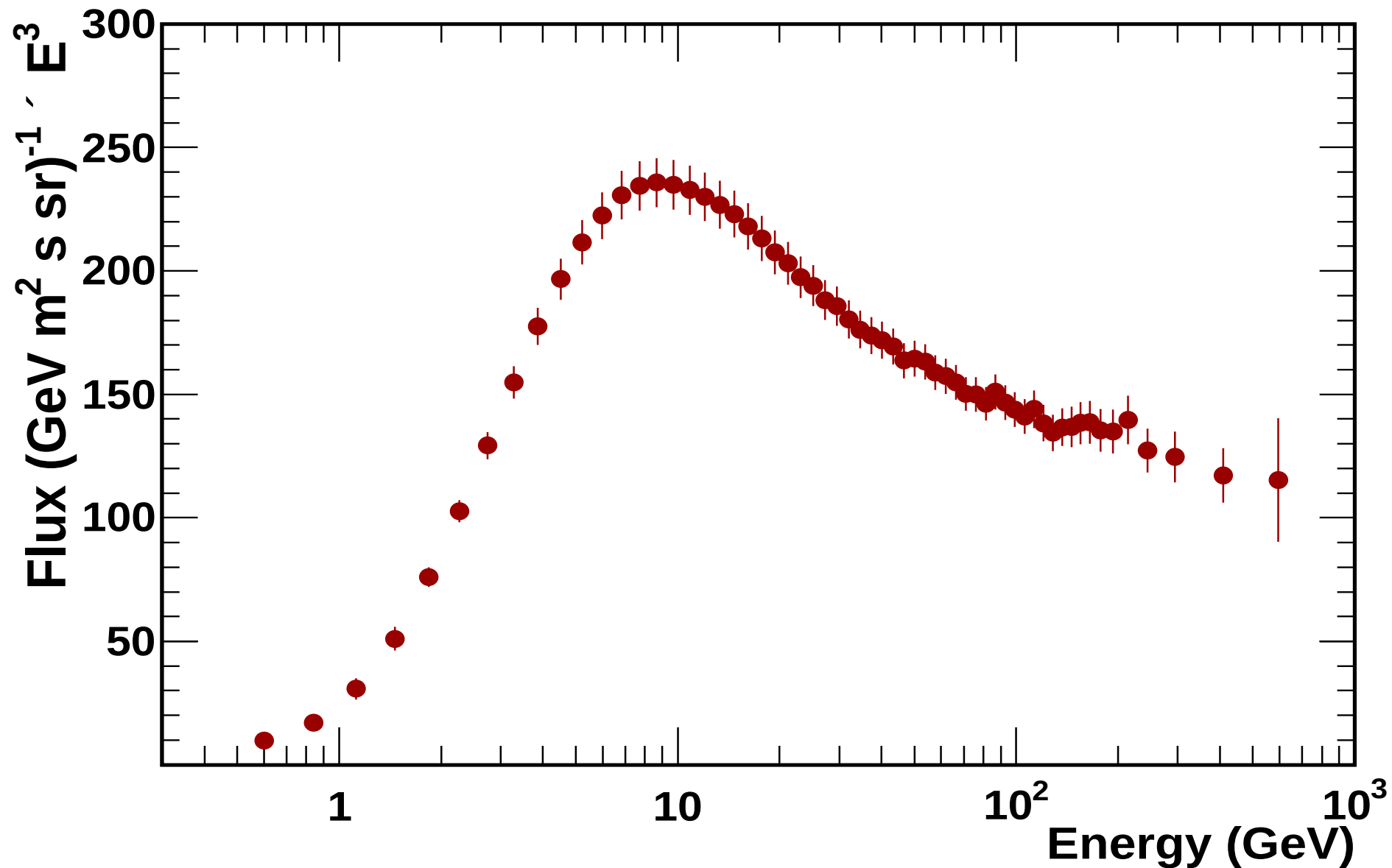
5) Positron Spectrum





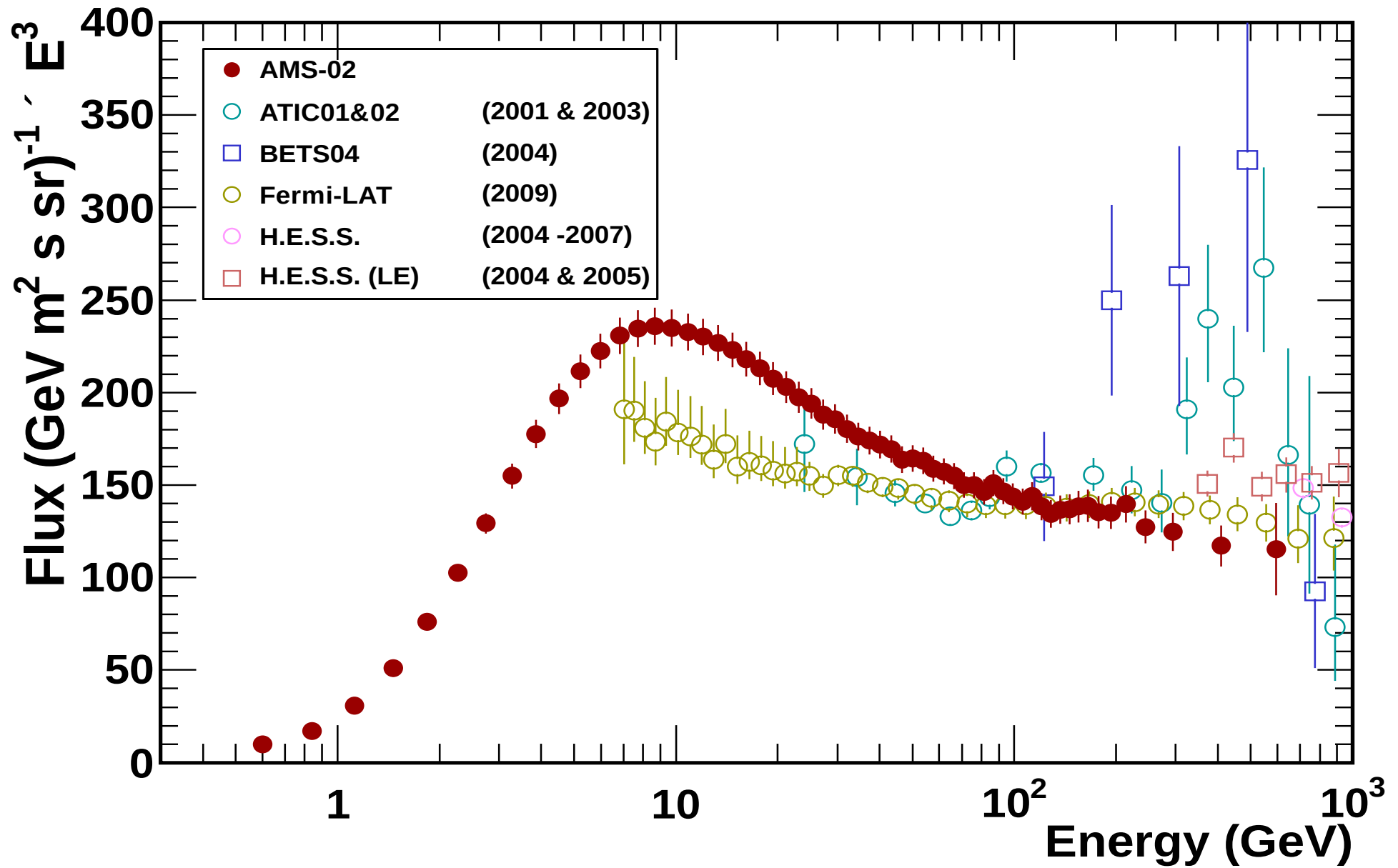
New results from AMS

6) (Electron plus Positron) Spectrum





(Electron plus Positron) Spectrum comparison with recent measurements



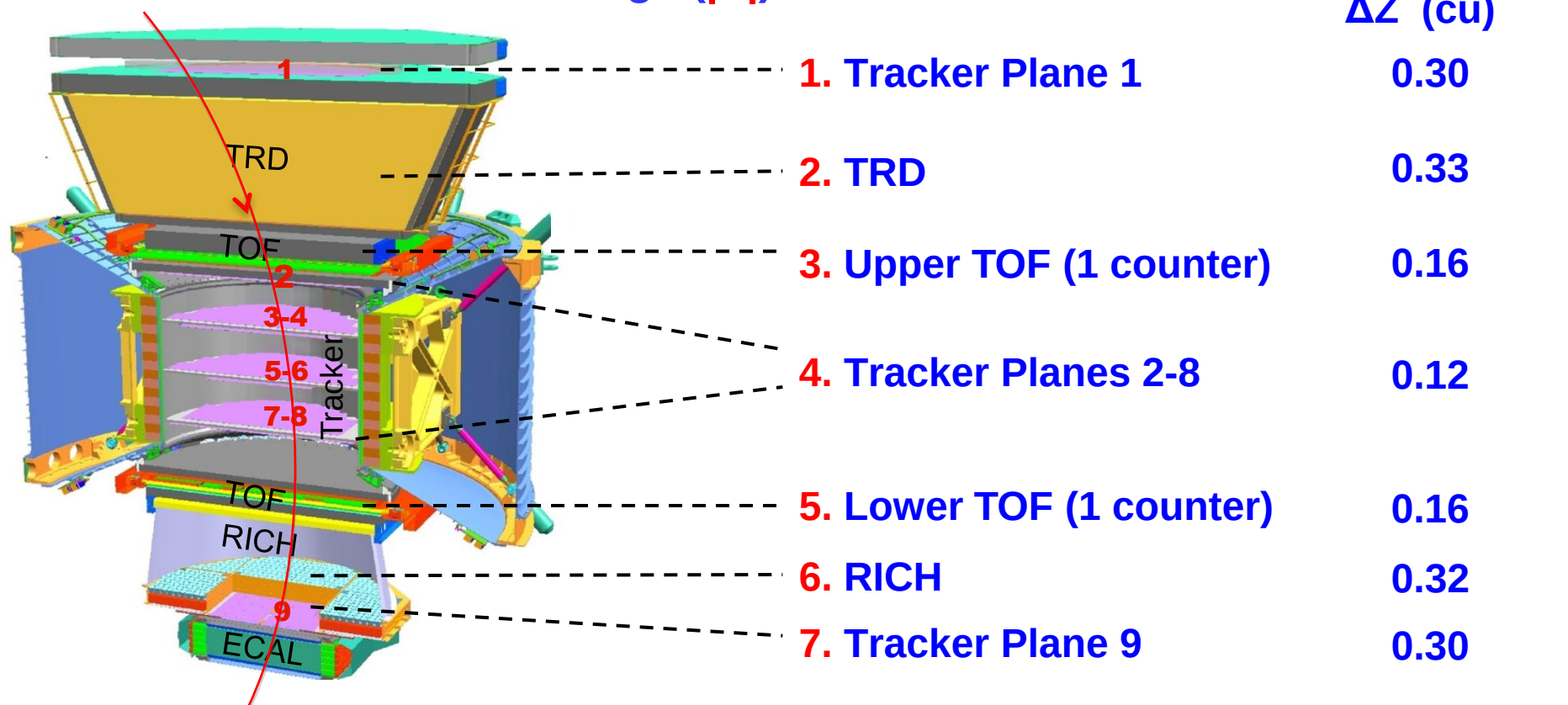


New results from AMS

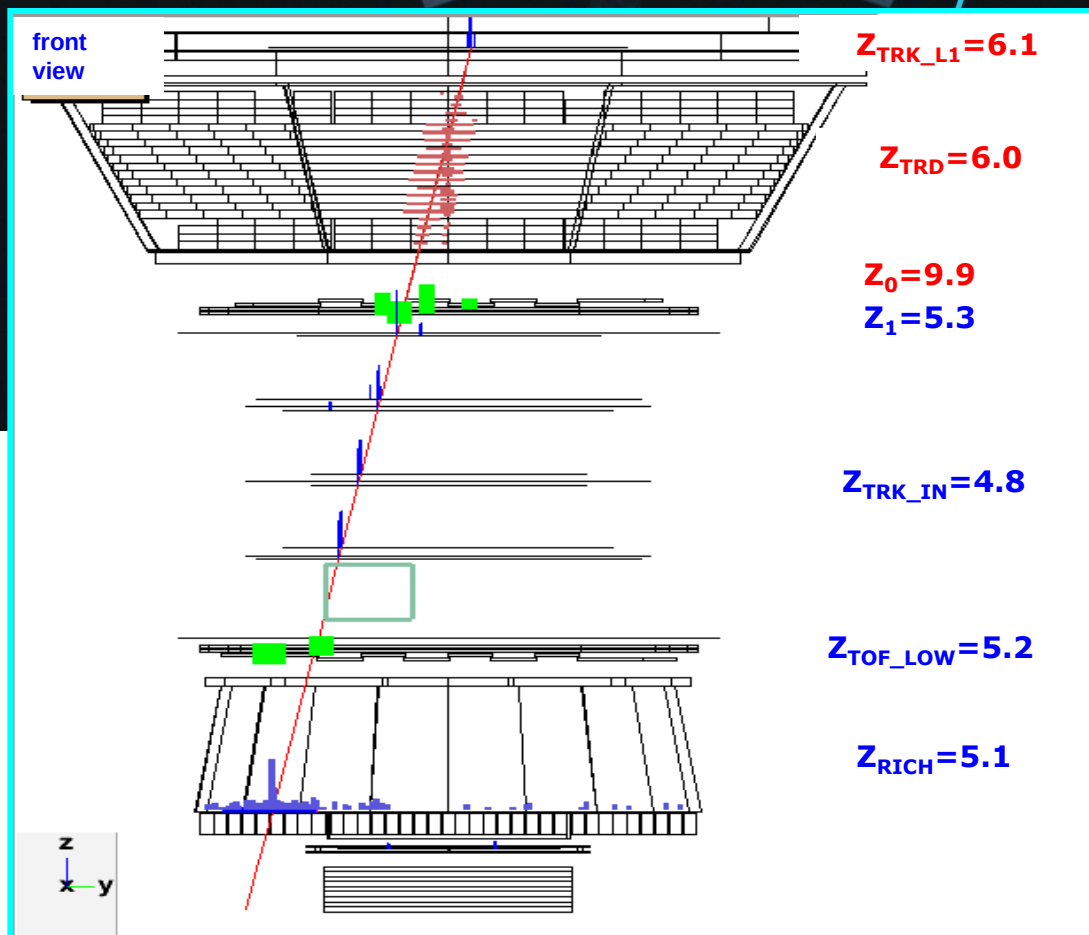
7) Boron-to-Carbon ratio

Precise measurement of the energy spectra of B/C provides information on Cosmic Ray Interactions and Propagation

AMS: Multiple Independent Measurements of the Charge ($|Z|$)



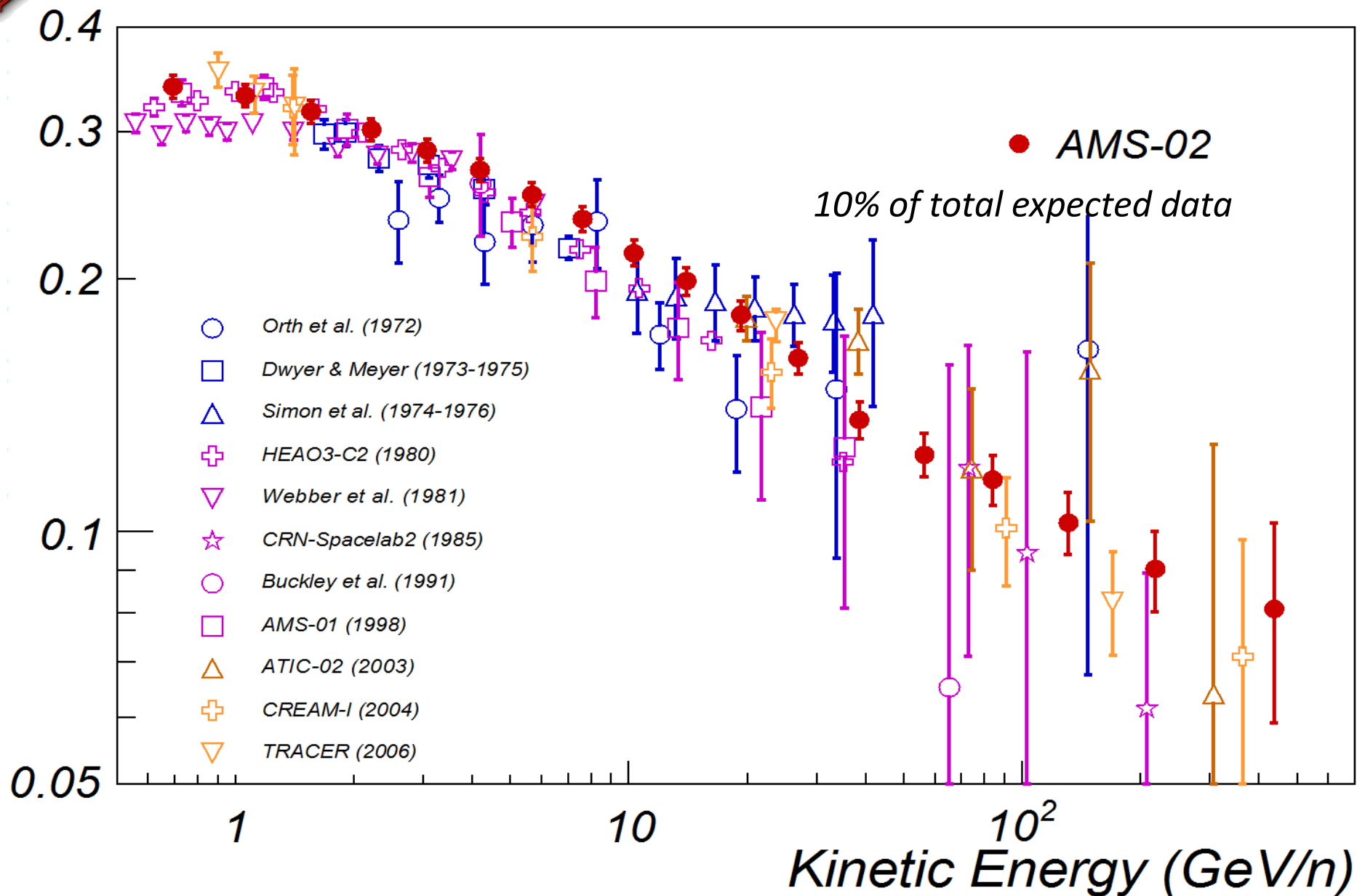
Carbon
Fragmentation
to Boron
 $R = 10.6 \text{ GV}$





Boron-to-Carbon ratio

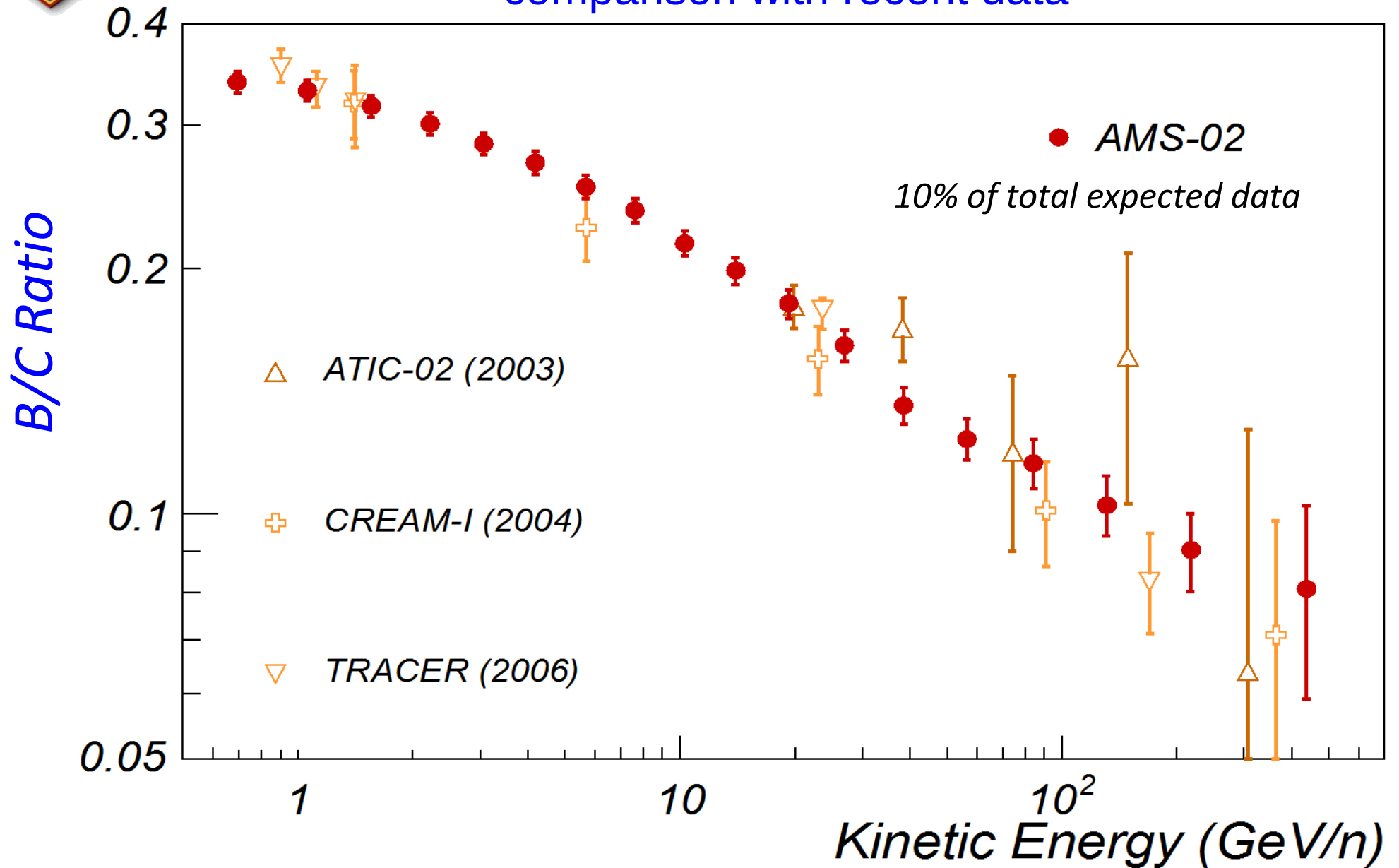
B/C Ratio





Boron-to-Carbon ratio

comparison with recent data



We now understand
the systematic errors to $\sim 1\%$.

Studies with 1% statistical error
will take time to collect the data.

Pubblicazioni e proceedings della Collaborazione AMS nel 2013

“First Result from the Alpha Magnetic Spectrometer on the International Space Station: Precision Measurement of the Positron Fraction in Primary Cosmic Rays of 0.5–350 GeV”

Phys.Rev.Lett. 110 (2013) 14, 141102.

DOI: 10.1103/PhysRevLett.110.141102

ICRC2013 proceedings:

- Precision measurement of the positron fraction in primary cosmic rays of 0.5-350 GeV
- Determination of the positron anisotropy with AMS
- Precision measurement of the positron spectrum and the electron spectrum with AMS
- Precision measurement of $e^+ + e^-$ spectrum with AMS
- Precision measurement of the proton flux with AMS
- Precision measurement of the helium flux with AMS
- Precision measurement of the Cosmic Ray Boron to Carbon ratio with AMS

Esempi di altre pubblicazioni e proceedings dei gruppi AMS-ITALIA nel 2013

Nuclear Instruments and Methods in Physics Research A 714 (2013) 147–154

Contents lists available at SciVerse ScienceDirect

Nuclear Instruments and Methods in
Physics Research A

journal homepage: www.elsevier.com/locate/nima



Technical Notes

The AMS-02 lead-scintillating fibres Electromagnetic Calorimeter

C. Adloff^a, L. Basara^a, G. Bigongiari^d, F. Bosi^c, P. Brun^a, F. Cadoux^a, F. Cervelli^c, V. Chambert^a, G. Chen^b, G.M. Chen^b, H.S. Chen^b, G. Coignet^a, G. Cougoulat^a, S. Di Falco^c, J.M. Dubois^a, S. Elles^a, E. Falchini^c, A. Fiasson^a, D. Fougeron^a, N. Fouque^a, S. Galeotti^c, G. Gallucci^c, F. Gherarducci^c, L. Girard^a, F. Giuseppe^c, C. Goy^a, R. Hermel^a, M. Incagli^{c*,1}, J. Jacquemier^a, L. Journet^a, R. Kossakowski^a, V. Lepareur^a, Z.H. Li^b, B. Lieunard^a, T. Lomtadze^c, Y.S. Lu^b, P. Maestro^d, C. Magazzù^c, M. Maire^a, A. Orsini^c, M. Paniccia^a, E. Pedreschi^c, F. Peltier^a, M. Piendibene^c, F. Pilo^c, J. Pochon^a, T. Rambure^a, S. Rosier-Lees^a, F. Spinella^c, X.W. Tang^b, J. Tassan-Viol^a, A. Tazzioli^c, C. Vannini^c, J.P. Vialle^a, H.L. Zhuang^b

Research Article

Latitudinal Dependence of Cosmic Rays Modulation at 1 AU and Interplanetary Magnetic Field Polar Correction

P. Bobik,¹ G. Boella,² M. J. Boschini,^{2,3} C. Consolandi,^{2,4} S. Della Torre,^{2,5} M. Gervasi,^{2,4} D. Grandi,² K. Kudela,¹ S. Pensotti,^{2,4} P. G. Rancoita,² D. Rozza,^{2,5} and M. Tacconi^{2,4}

33RD INTERNATIONAL COSMIC RAY CONFERENCE, RIO DE JANEIRO 2013
THE ASTROPARTICLE PHYSICS CONFERENCE

ICRC
2013

Cosmic Ray Modulation studied with HelMod Monte Carlo tool and comparison with Ulysses Fast Scan Data during consecutive Solar Minima

P. BOBIK¹, G. BOELLA^{2,5}, M. J. BOSCHINI^{2,4}, S. DELLA TORRE², M. GERVASI^{2,5}, D. GRANDI², G. LA VACCA^{2,5}, K. KUDELA¹, S. PENSOTTI^{2,5}, P. G. RANCOITA², D. ROZZA^{2,3} AND M. TACCONI^{2,5}.

33RD INTERNATIONAL COSMIC RAY CONFERENCE, RIO DE JANEIRO 2013
THE ASTROPARTICLE PHYSICS CONFERENCE

ICRC
2013

Geomagnetic Backtracing: A comparison of Tsyganenko 1996 and 2005 External Field models with AMS-02 data

M. J. BOSCHINI^{1,2}, C. CONSOLANDI^{1,3}, S. DELLA TORRE¹, M. GERVASI^{1,3}, D. GRANDI¹, S. HAINO⁴, G. LA VACCA^{1,3}, S. PENSOTTI^{1,3}, P.G. RANCOITA¹, D. ROZZA^{1,5,6}, M. TACCONI^{1,3}

¹ INFN Sezione di Milano Bicocca, I-20126 Milano, Italy

² CINECA, I-20090 Segrate (MI), Italy

³ Università di Milano Bicocca, I-20126 Milano, Italy

⁴ National Central University, NCU, Chung-Li, Tao Yuan 32054, Taiwan

⁵ Università dell'Insubria, I-22100 Como, Italy

⁶ European Organization for Nuclear Research, CERN, CH-1211 Geneva 23, Switzerland

[†] now at: University of Hawaii at Manoa, HI-96822 Honolulu, USA.

33RD INTERNATIONAL COSMIC RAY CONFERENCE, RIO DE JANEIRO 2013
THE ASTROPARTICLE PHYSICS CONFERENCE

ICRC
2013

GeoMag and HelMod webmodels version for magnetosphere and heliosphere transport of cosmic rays

P. BOBIK², M. J. BOSCHINI^{1,3}, C. CONSOLANDI¹, S. DELLA TORRE¹, M. GERVASI^{1,4}, D. GRANDI¹, K. KUDELA², G. LA VACCA^{1,4}, S. PENSOTTI^{1,4}, M. PUTIS², P.G. RANCOITA¹, D. ROZZA^{1,5,6} AND M. TACCONI^{1,4}

¹ INFN Milano Bicocca - Italy

² Institute of experimental Physics, Kosice - Slovakia

³ CINECA

⁴ University of Milano Bicocca

33RD INTERNATIONAL COSMIC RAY CONFERENCE, RIO DE JANEIRO 2013
THE ASTROPARTICLE PHYSICS CONFERENCE

ICRC
2013

On the Contribution of Pulsars to the Positron Fraction in Cosmic Rays

S. DELLA TORRE¹, M. GERVASI^{1,2}, P.G. RANCOITA¹, D. ROZZA^{1,3,4}, A. TREVES^{1,3}.

¹ INFN Sezione di Milano Bicocca, I-20126 Milano, Italy

33RD INTERNATIONAL COSMIC RAY CONFERENCE, RIO DE JANEIRO 2013
THE ASTROPARTICLE PHYSICS CONFERENCE

ICRC
2013

Suprathermal particle addition to solar wind pressure: possible influence on magnetospheric transmissivity of low energy cosmic rays?

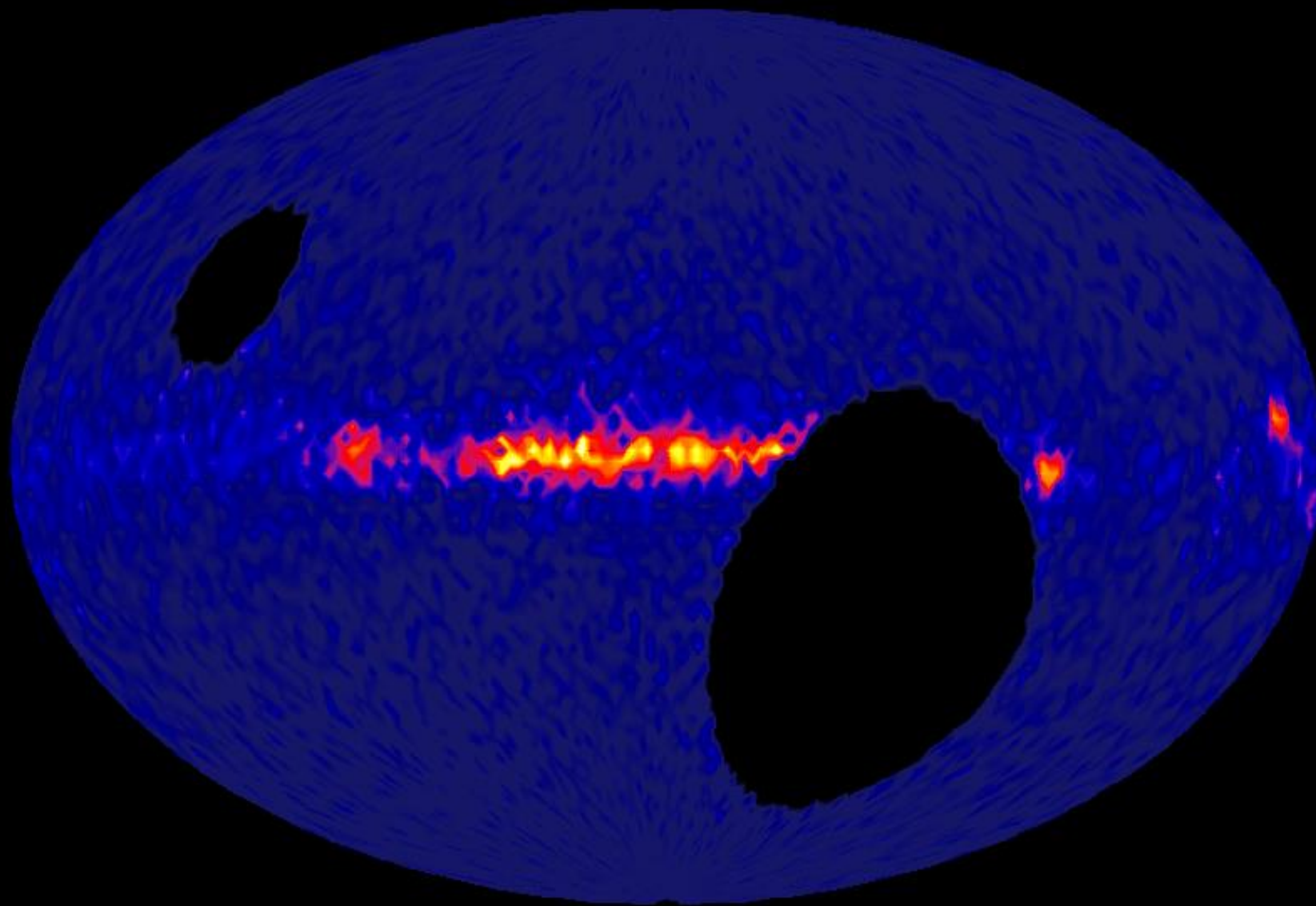
P. BOBIK⁵, M. J. BOSCHINI^{1,6}, C. CONSOLANDI¹, S. DELLA TORRE¹, M. GERVASI^{1,4}, D. GRANDI¹, K. KUDELA⁵, G. LA VACCA^{1,4}, M. MALLAMACI¹, S. PENSOTTI^{1,4}, P.G. RANCOITA¹, D. ROZZA^{1,2,3}, M. TACCONI^{1,4}.

Physics analysis nearing completion

1. Antiprotons (0.5-300 GeV)
2. Anti-He (@ few 10^8 events)
3. Solar physics
4. Ion fluxes
5. Photon analysis

AMS ECAL gamma sky ($E > 2$ GeV)

Flux from a $2^\circ \times 2^\circ$ pixel
(photon/cm²/s)



$\times 10^{-9}$

9

8

7

6

5

4

3

2

1

0

Cigno

Vela

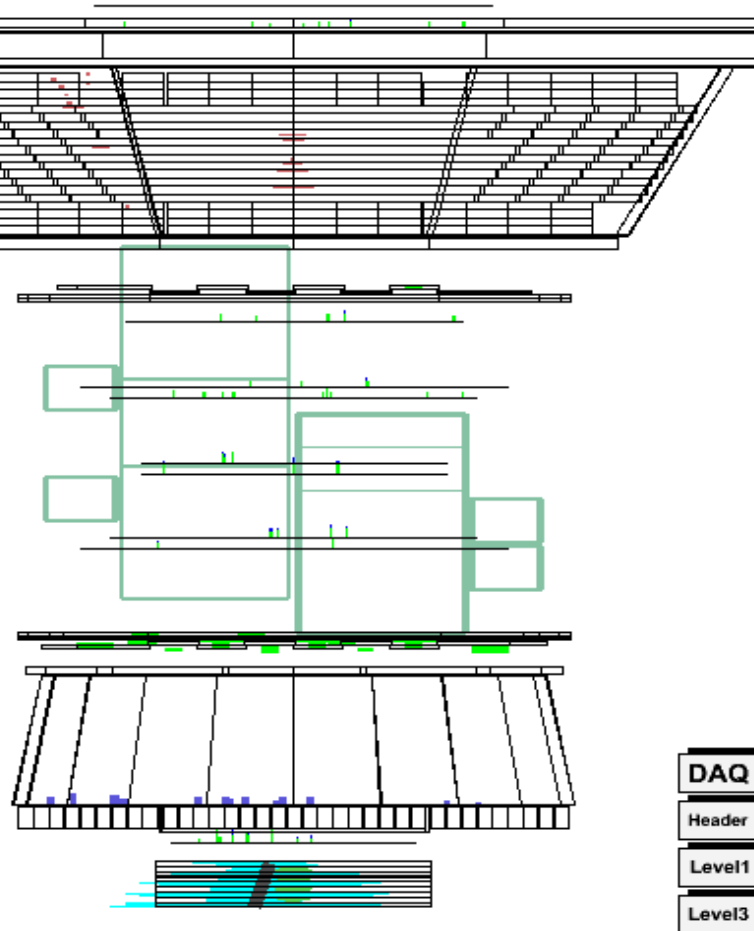
Geminga
Granchio

IL FOTONE DI PIU' ALTA ENERGIA

AMS Event Display

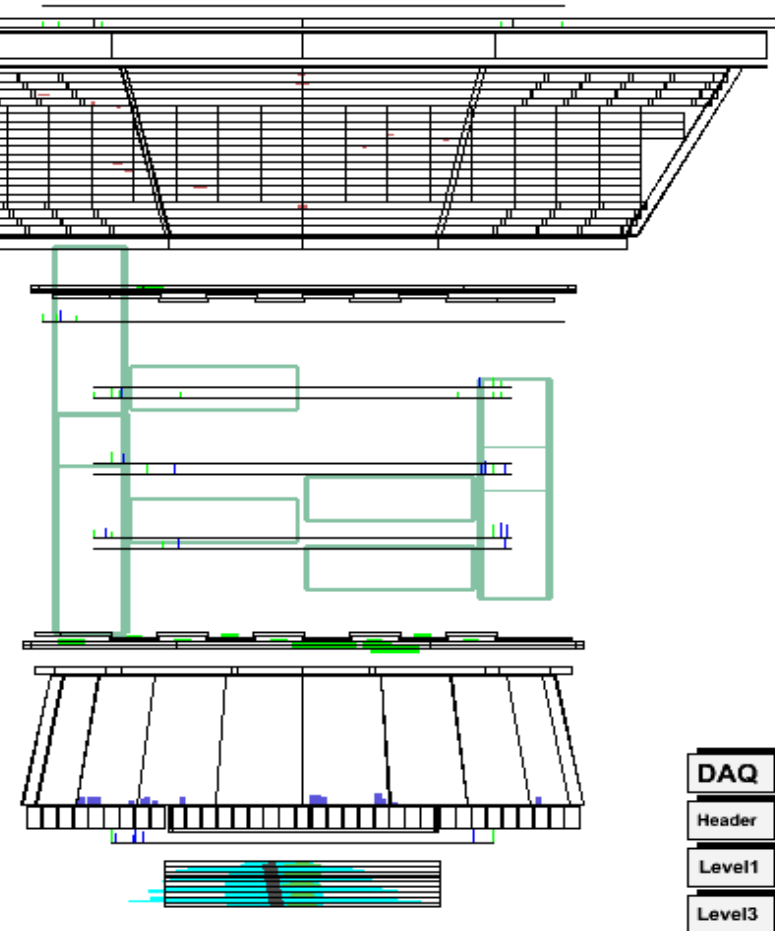
Run/Event 1355189231 / 484997 GMT Time 2012-346.01:34:10

Front



DAQ
Header
Level1
Level3

Side



DAQ
Header
Level1
Level3

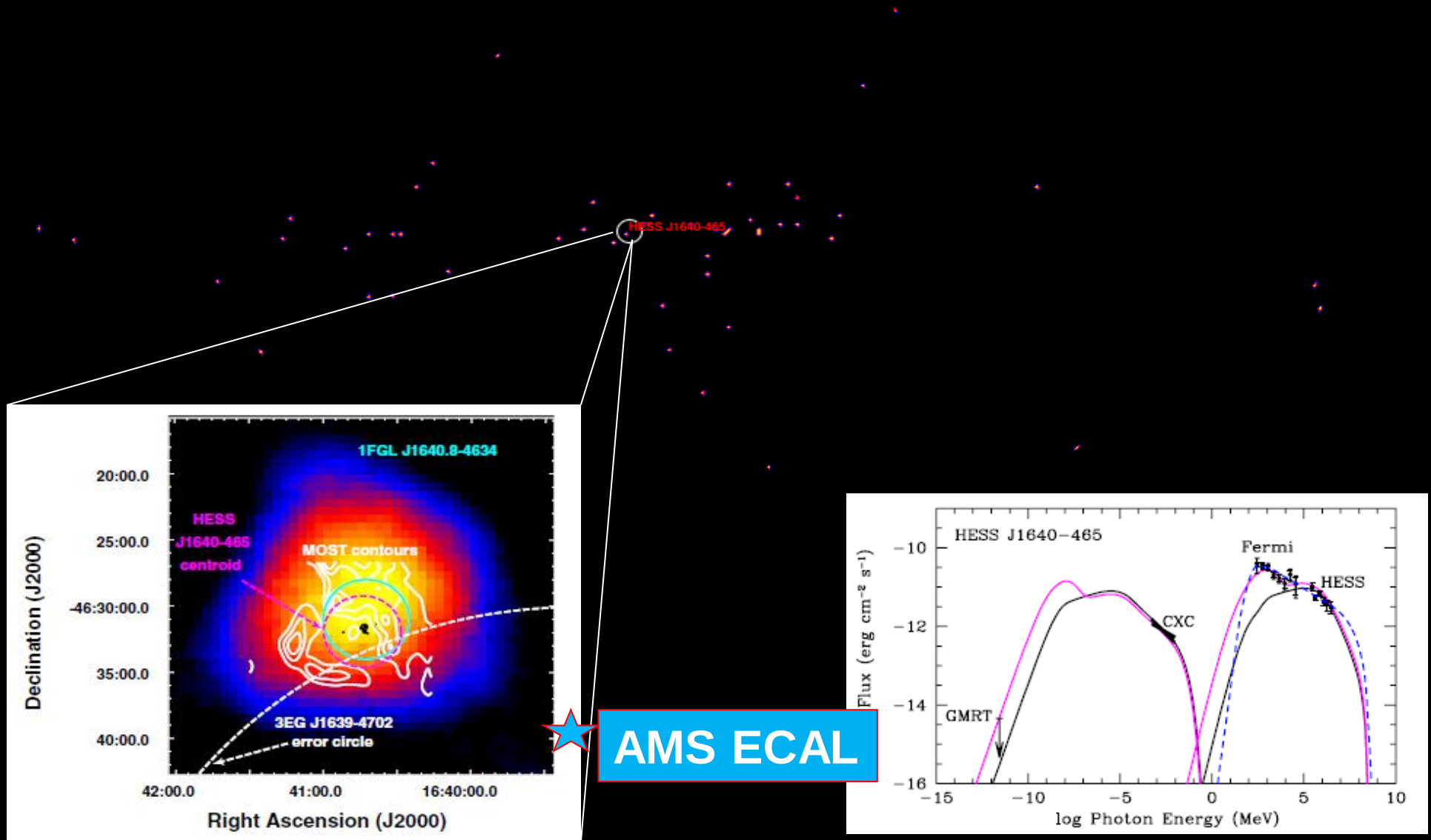
Particle ToFEcal No 0 Id=64 p= $-4e+07 \pm 4e+21$ M= $4.96e+07 \pm 5e+21$ $\theta=0.42$ $\phi=2.94$ Q= 4 $\beta=-0.628 \pm 0.017 / -0.63 / \beta_h=0.000 \pm 0.000$ $\theta_M=-53.7^\circ$ Coo=(50.33,11.02,-135.98) LT -1.00 $\theta_G=2.54$ $\phi_G=3.06$
EcalShower No 0 NHits 525 Energy= $1.62e+03 \pm 84$ $\theta=2.88$ $\phi=-1.15$ Coo=(-6.94,-8.64,-153.88) $\chi^2=2.28$ Asymm=-0.07 Leak=(0.00,0.26,0.00,-0.00,0.00,-0.00,0.00) Max=12.00
Side,Rear,Dead,Alt,NonLin,S13,Org

1.6 TeV!!

The highest energy AMS ECAL photon

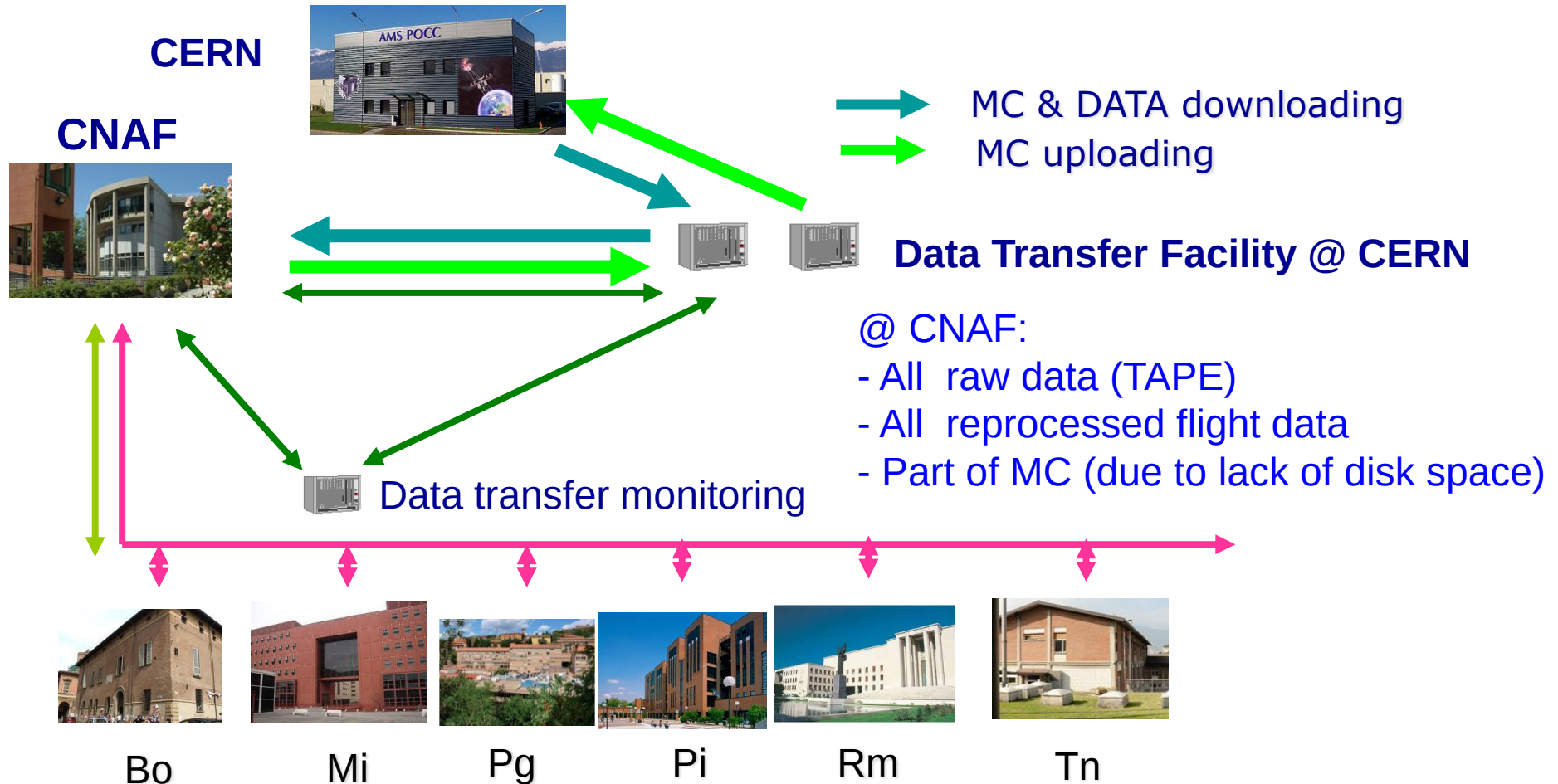
AMS: $l=338.4 \pm 0.5$ $b=0.05 \pm 0.5$ RA=16h 39m 27s Decl=-46° 40' 18"

HESS: $l=338.316 \pm 0.007$ $b=-0.021 \pm 0.007$ RA=16h 40m 48s Decl=-46° 34' 06"



Report Calcolo 2013 / Richieste 2014

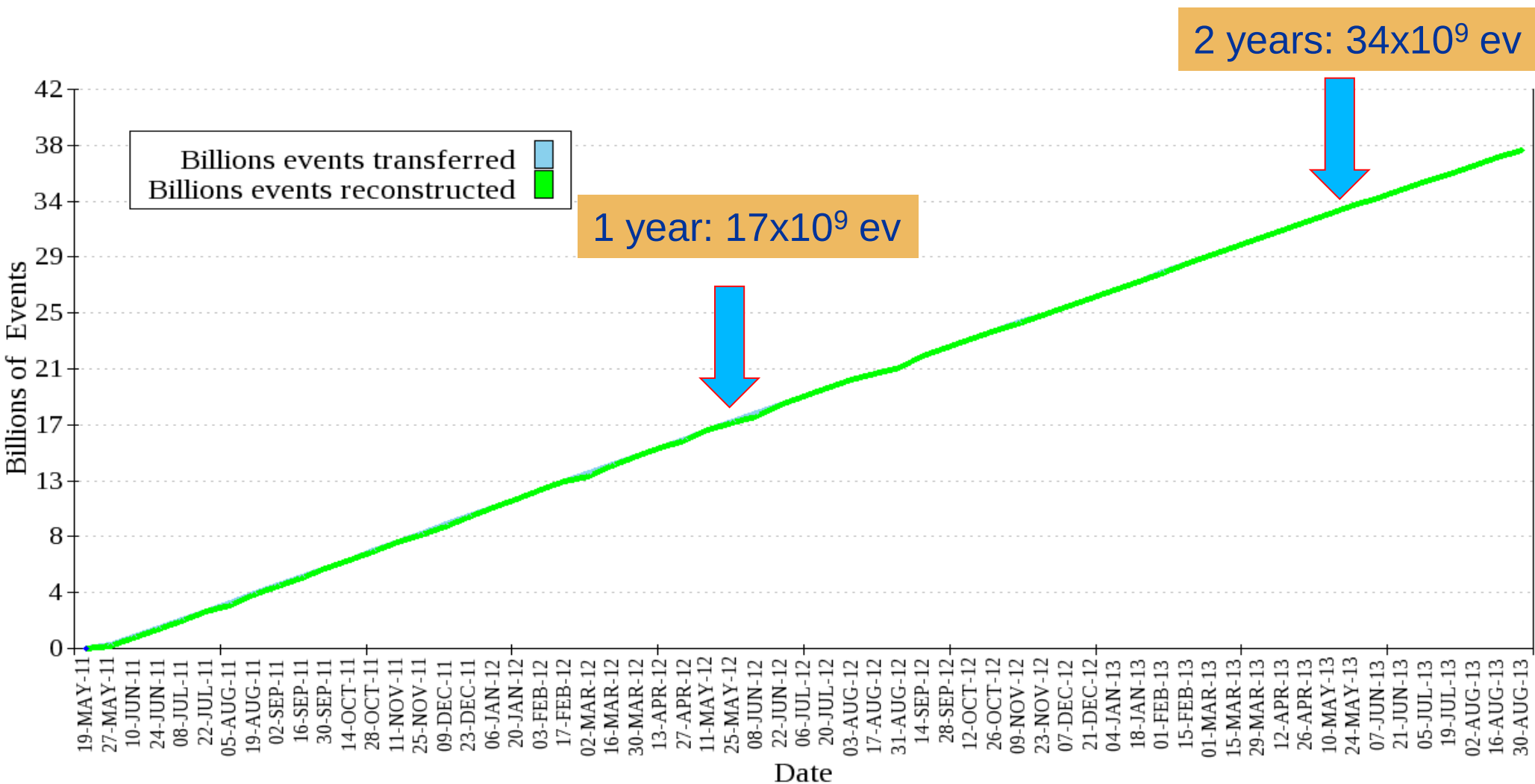
Computing resources for AMS data analysis are concentrated at CNAF



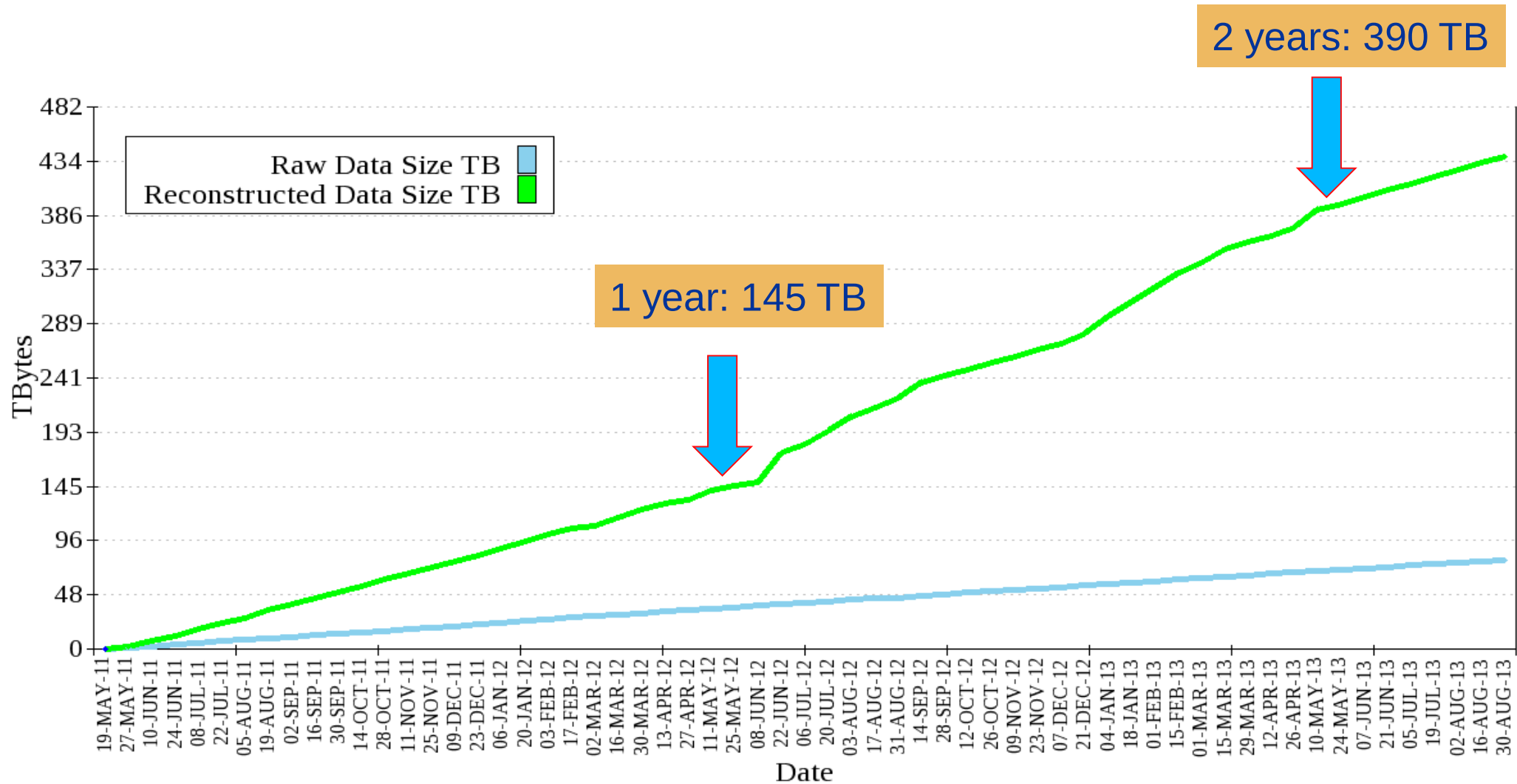
Data Size

- Raw data size : 1 year $\approx$ 30 TB
- Reconstructed Event size: 1 year of data $\sim$ 150 TB
- Single Simulated and Reconstructed MC Event : 10-150 kB depending on energy and primary
 - Samples of protons, He nuclei, light nuclei, e^- , e^+ , anti-protons, photons, current available MC samples at CNAF $\sim$ 60 TB (wrt 200 TB of the collaboration).

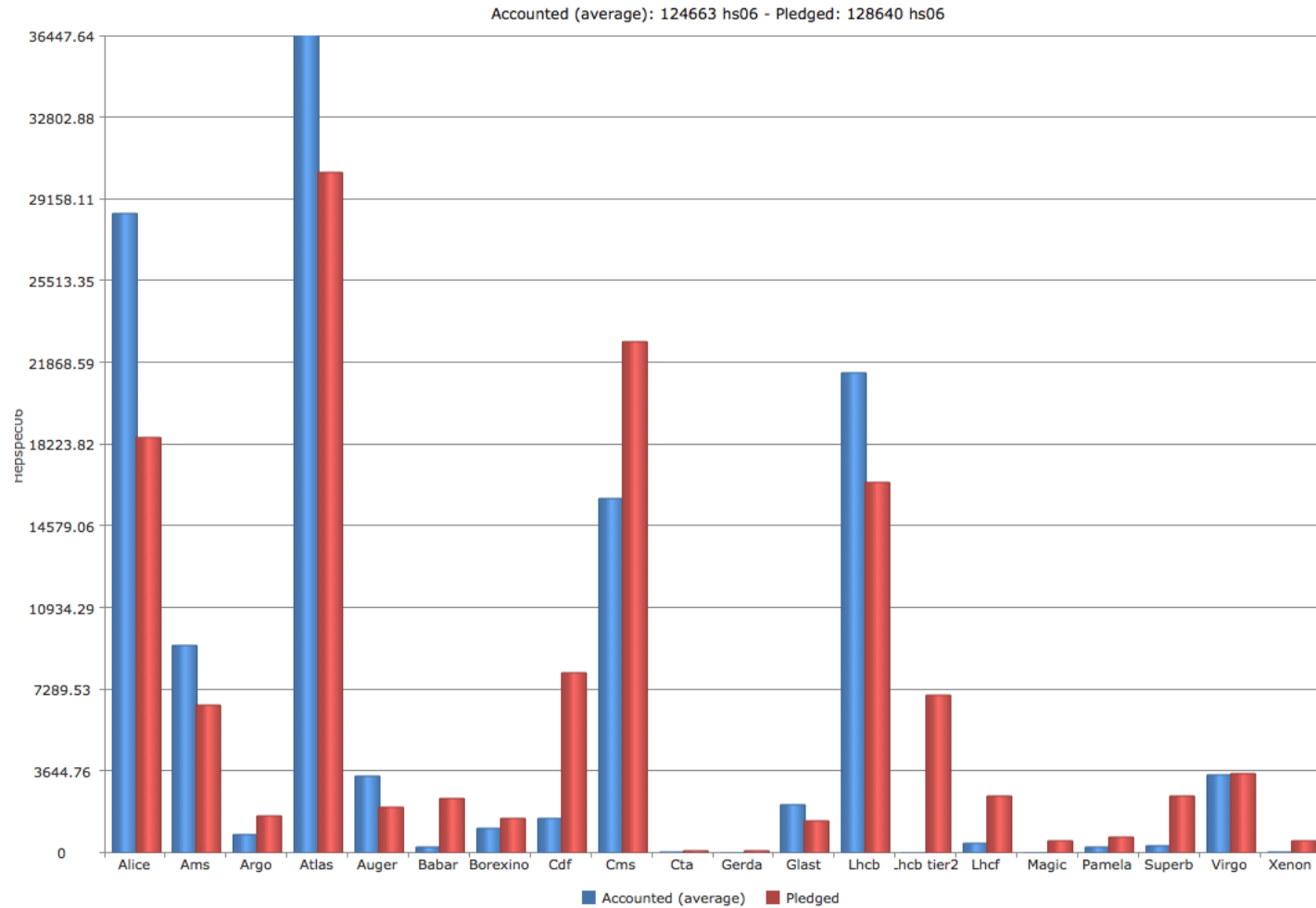
AMS Event Production



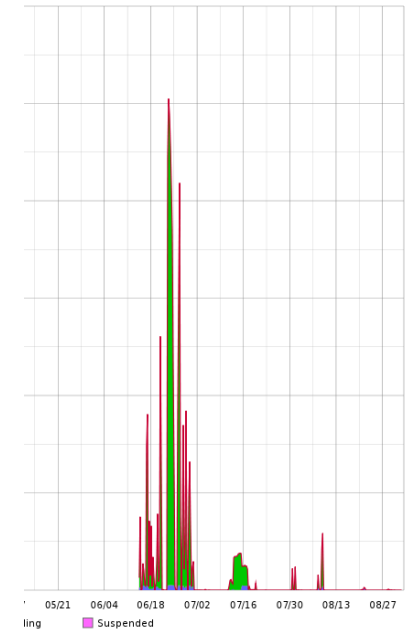
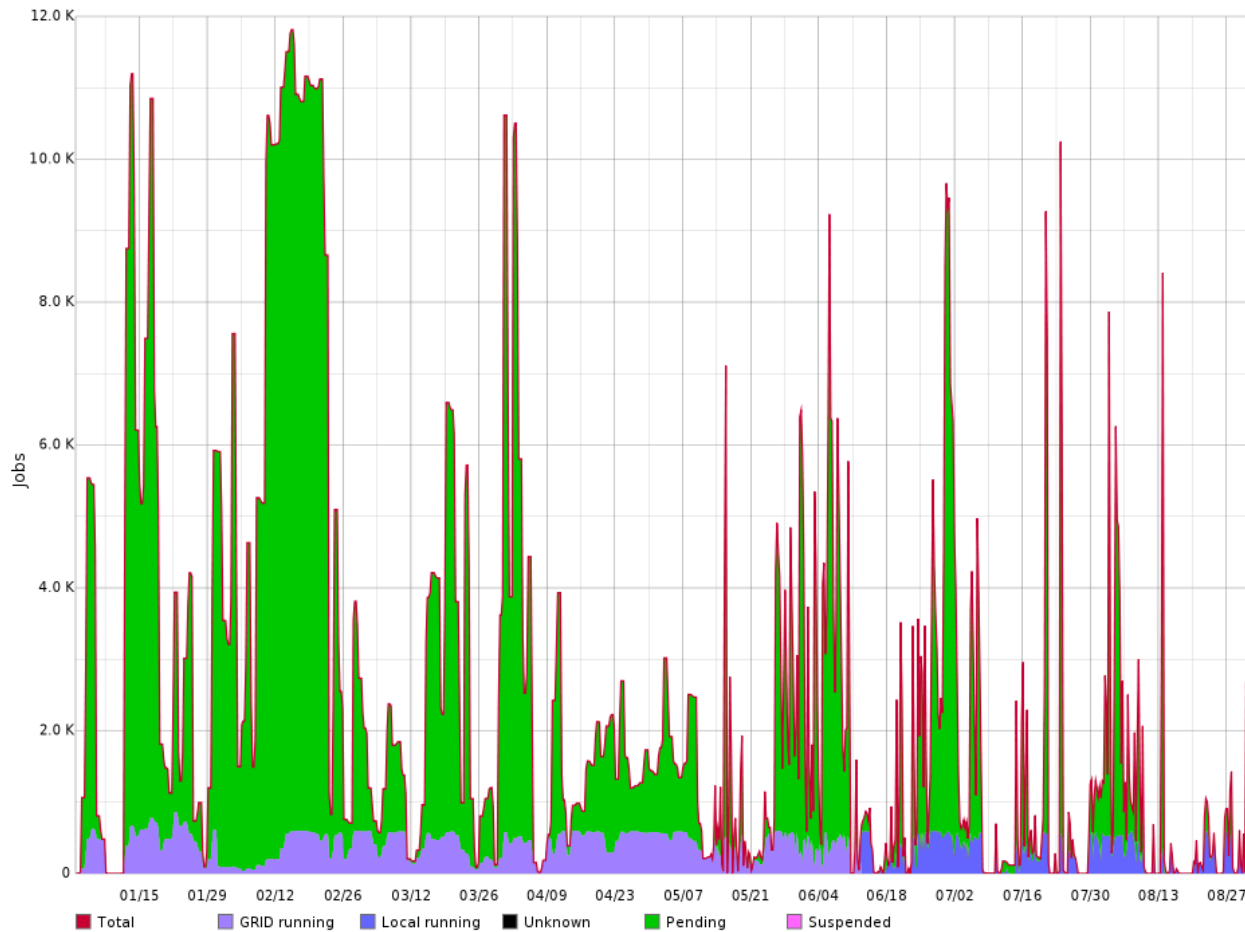
Data Size



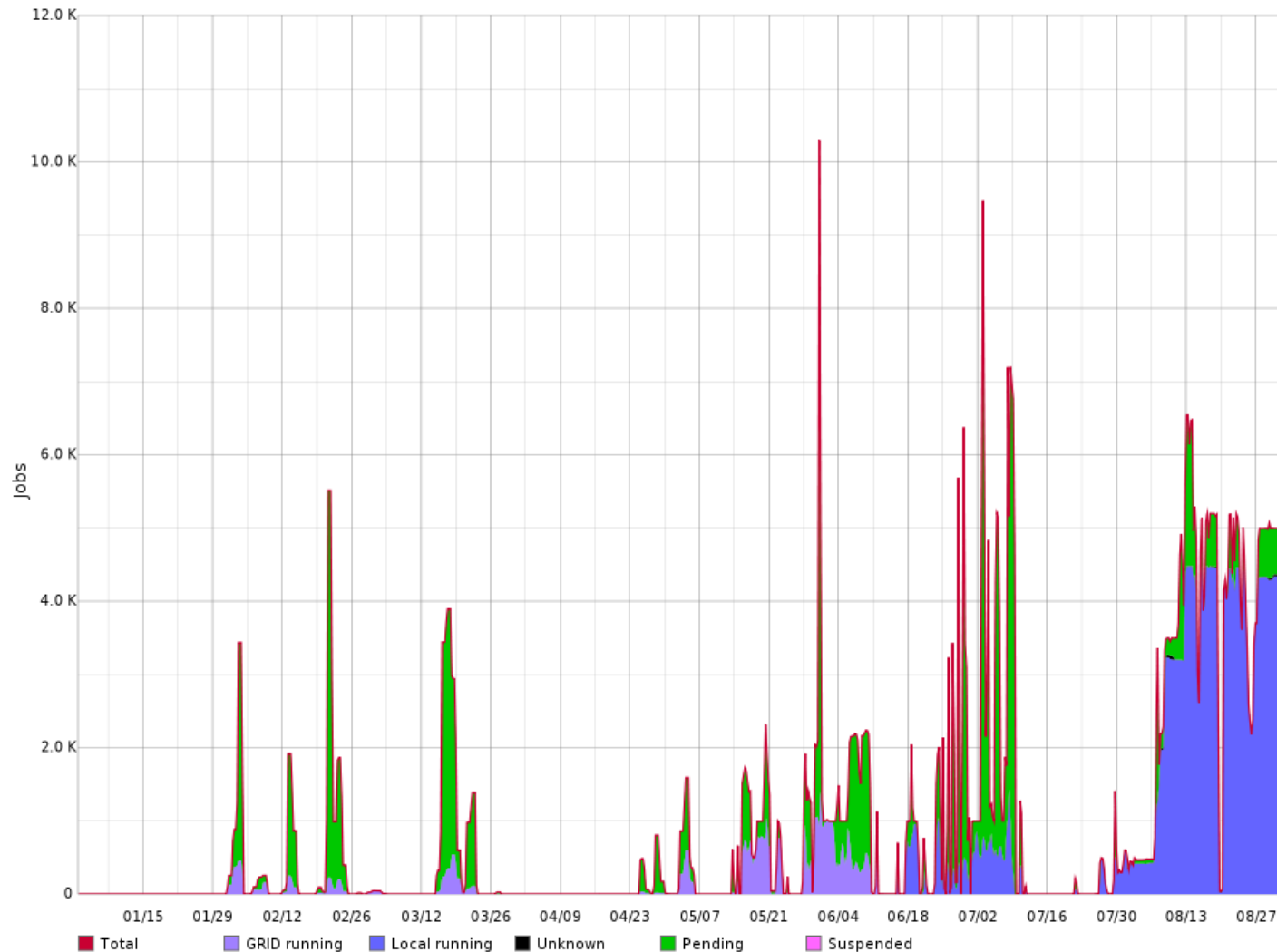
AMS processing at CNAF: 9921 / 6532



AMS analysis queue

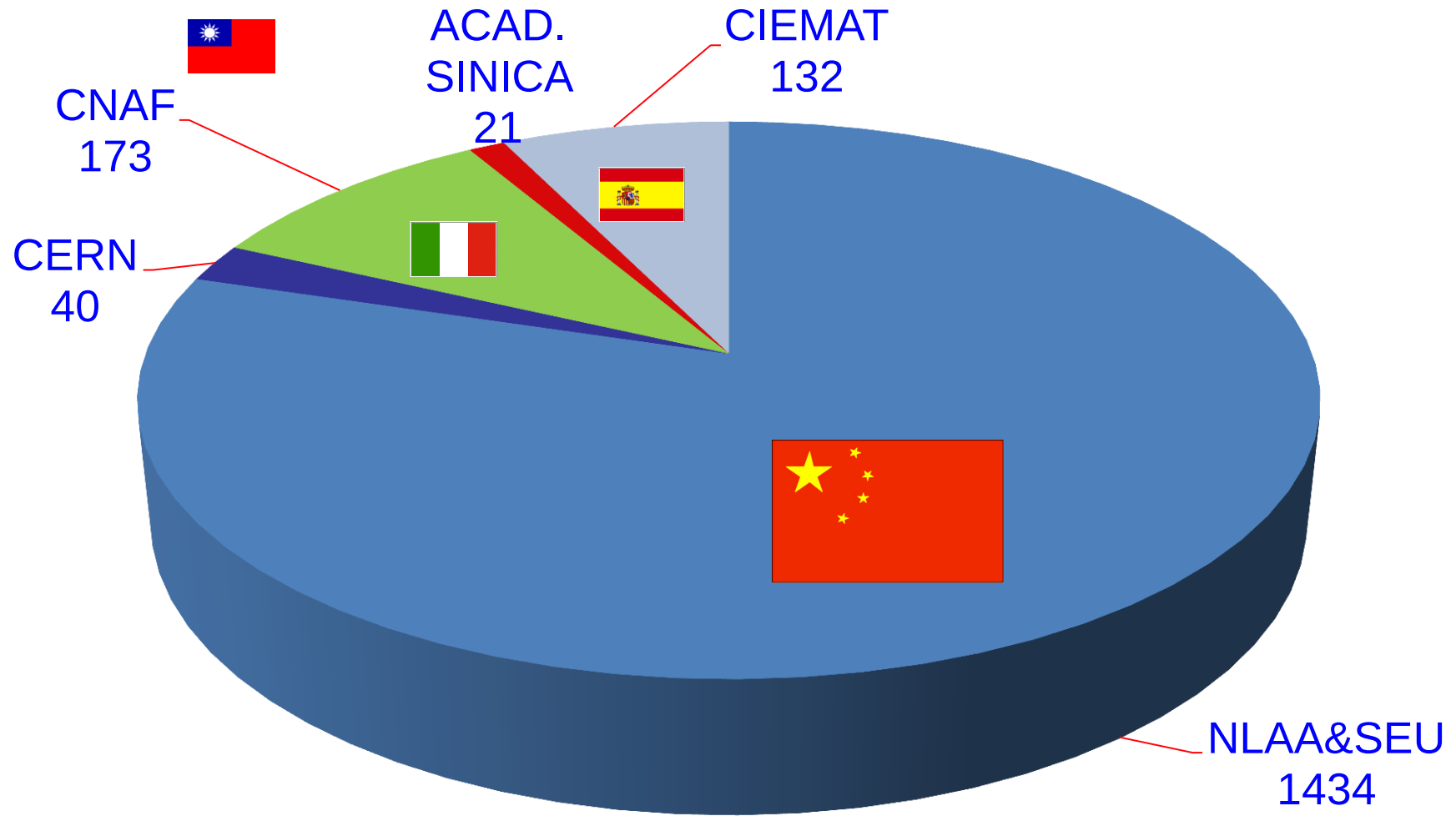


AMS MC production queue



MC CPU Distribution by MC Sites (2013)

Total of 1800 CPU Years Spent



RICHIESTE PER IL 2014

L'aumento di risorse disco/nastro riflette il volume dei dati / MC previsti annualmente e le attività di produzione MC ed analisi della collaborazione italiana

Aumento del 10% di CPU : 18 k€

Aumento di 400 TB dello spazio disco : 140 k€

Aumento di 120 TB delle TAPE (raw data x 2 + raw MC) : 6k€

I costi relativi sono quelli “presunti” dal CNAF secondo gli standard delle gare del centro ed applicati coerentemente agli esperimenti di tutte le CSN* tenendo conto dei rimpiazzii (11k€ inclusi nelle voci di cui sopra)

Partecipazione alle operazioni di AMS

- L'esperimento richiede il controllo degli esperti 24/24 - 7/7.
- Ormai le condizioni operative sono note: anche il POCC di Taiwan è in condizioni operative stabili
- La previsione delle necessità di permanenza al CERN è ben definita.
- La presenza di simulfellows al CERN è stata ed è di grande aiuto per le operazioni di AMS dal POCC CERN

Contributo ASI (2013-15)

- L' ASI ha attivato un'estensione triennale del contratto scientifico che però non includerà più
 - A) missioni
 - B) consumi

ma solo contratti per il personale TD

Considerazioni conclusive (I)

AMS è un esperimento di precisione, destinato a funzionare a lungo Sulla ISS.

I gruppi italiani, responsabili di quasi tutti i payload, sono sistematicamente coinvolti nelle operazioni del POCC

Grazie alla calibrazione continua di tutti i rivelatori è possibile ottenere prestazioni ottimali non raggiungibili neppure nel corso dei test da terra. E' grazie all'estrema precisione delle calibrazioni che è possibile ottenere risultati di fisica precisi al %.

La partecipazione dei gruppi Italiani all'analisi è di fondamentale importanza, buona parte del lavoro deve però essere fatta al CERN

I simulfellows sono molto utili per supportare l'analisi di AMS al CERN

Similfellow AMS al CERN

La presenza di giovani borsisti al CERN è essenziale per la partecipazione effettiva all'analisi dati e alle operazioni dell' esperimento

- 2012 3 simifellow operativi (1 anno) (fondi 2011)
- 2013 2 similfellow (fondi 2012)
- *2014 3 similfellow (fondi 2013)*
- *2015 3 similfellow (fondi 2014)*

Limitare oggi i fondi per le trasferte alla sola copertura dei turni di presa dati, non renderà possibile attivare similfellow per il 2015..

Considerazioni conclusive (II)

Le richieste di missioni per il 2014, includono le risorse necessarie per l'attivazione di tre similfellows.

Queste richieste non sono state scorporate, in quanto un similfellow puo' svolgere più funzioni

Ridurre le missioni renderebbe inefficace il lavoro della componente italiana di AMS e creerebbe dei problemi di gestione di AMS sulla ISS.

Grazie!

