The AMS-02 Experiment Status

Outline

> News from the past: AMS-01 Ions

> The major change happened in July

> New testing in August

> Present at KSC

> (Not-so) Far future

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Trieste, 8/9/2010, SciNeGHE 2010

The AMS Physics Goals

CR Hadronic Component

> Secondary-to-Primary Ratios: CR Propagation Models

> Long Period Observations: Solar Modulation

Indirect Dark Matter Research

> Anti-particle Spectrum (anti-p, e^+)

> γ-ray Flux

Direct Search for Anti-Nuclei

… and something unexpected

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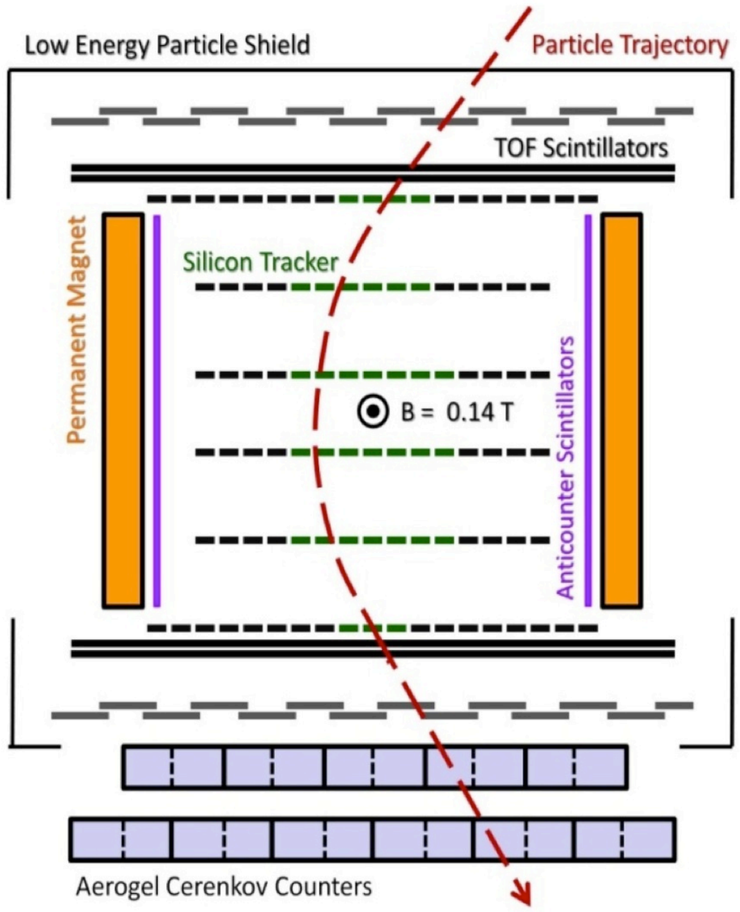
An AMS Brief Description

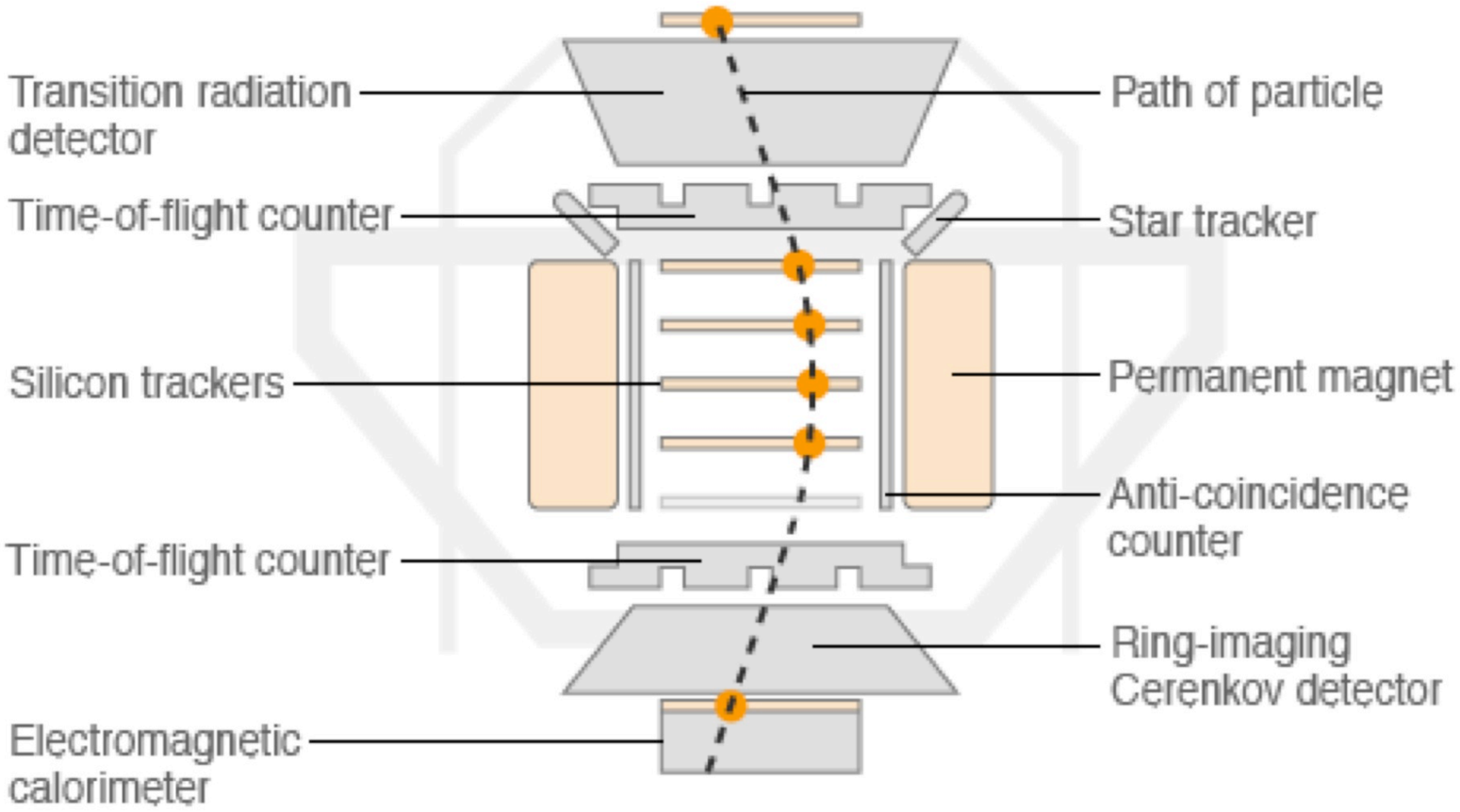
AMS-01 (1998)

10 Days Data-Taking (Shuttle Mission)
Permanent Magnet (B = 0.13 T)
Si Tracker (A = 3 m², L = 1.2 m) → p, Z
Time-of-Flight + Veto → trigger, β, Z
Aerogel Counters → e/p separation

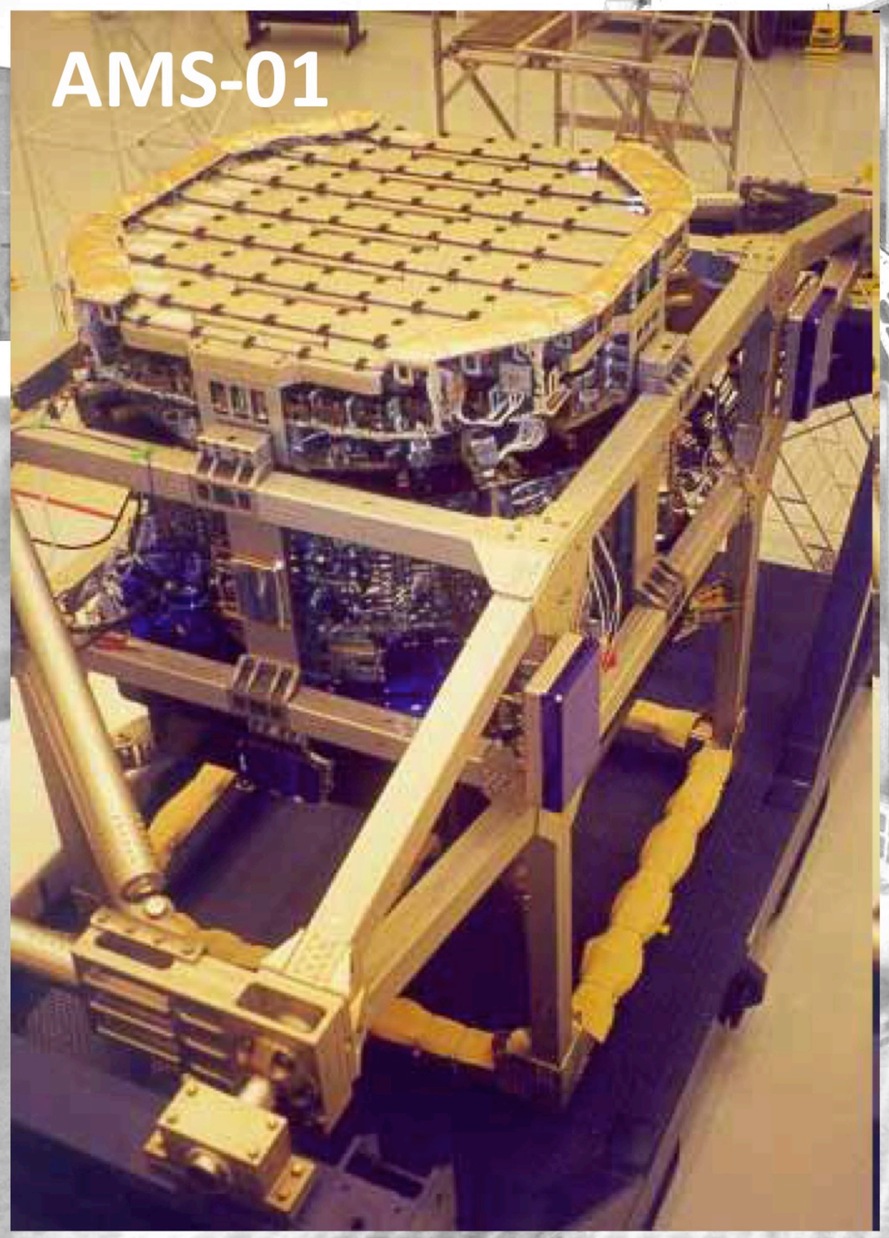
AMS-02 (2011 - …)

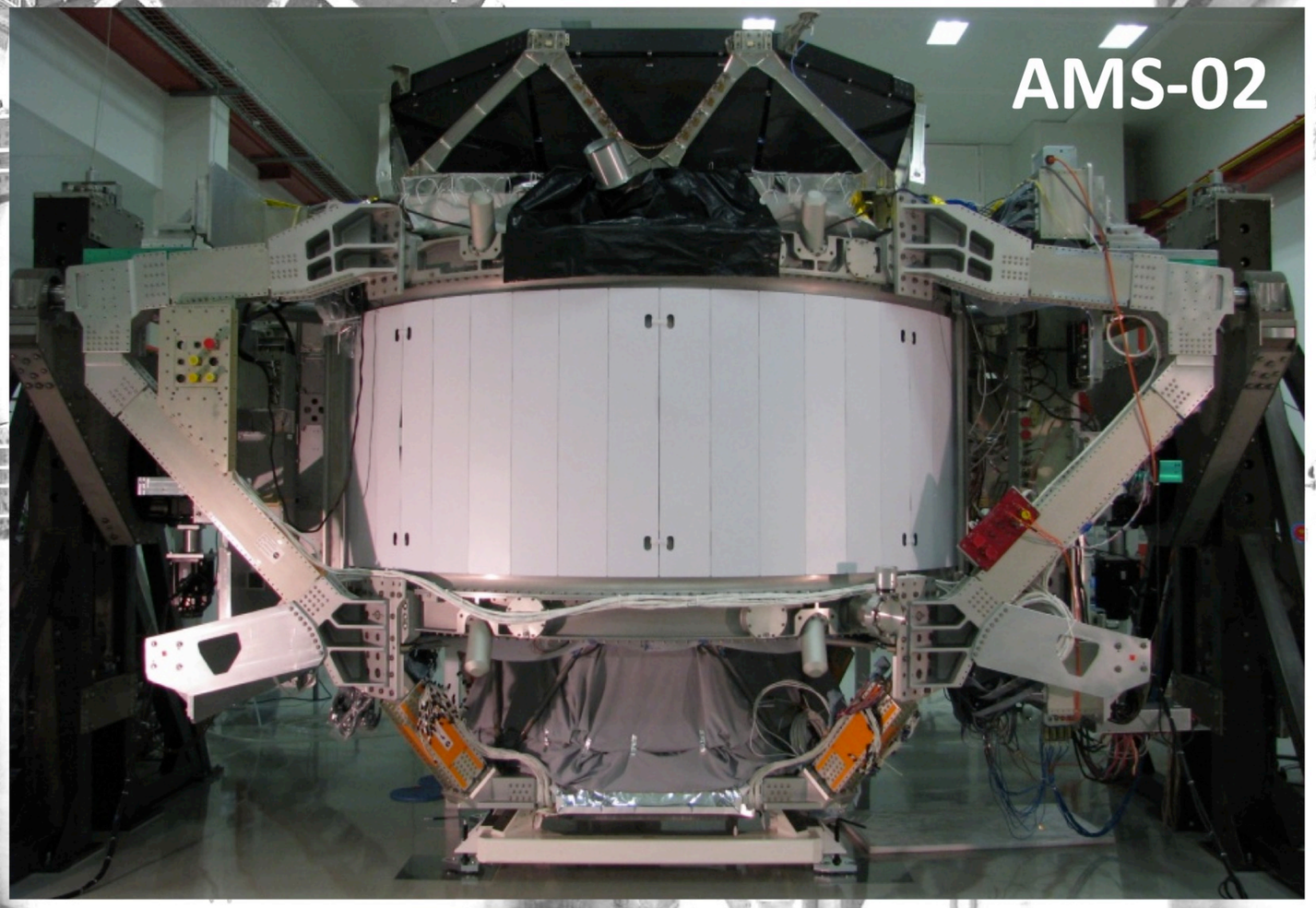
10 Years Data-Taking (ISS Life)
Permanent Magnet (B = 0.13 T)
Si Tracker (A = 6.2 m², L = 3 m) → p, Z
Time-of-Flight + Veto → trigger, β, Z
Ring Imaging Cherenkov → β, Z
Transition Radiation Detector → e/p sep.
Electromagnetic Calorimeter → e/p sep., E of e & γ





AMS-01 and AMS-02





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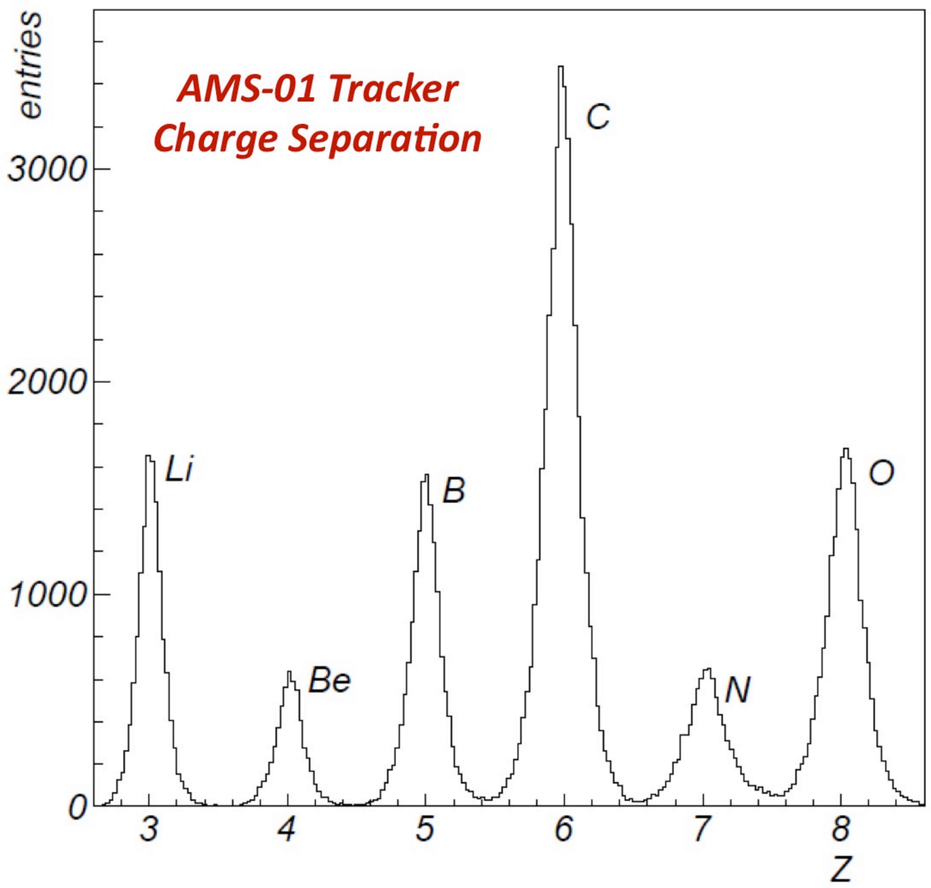
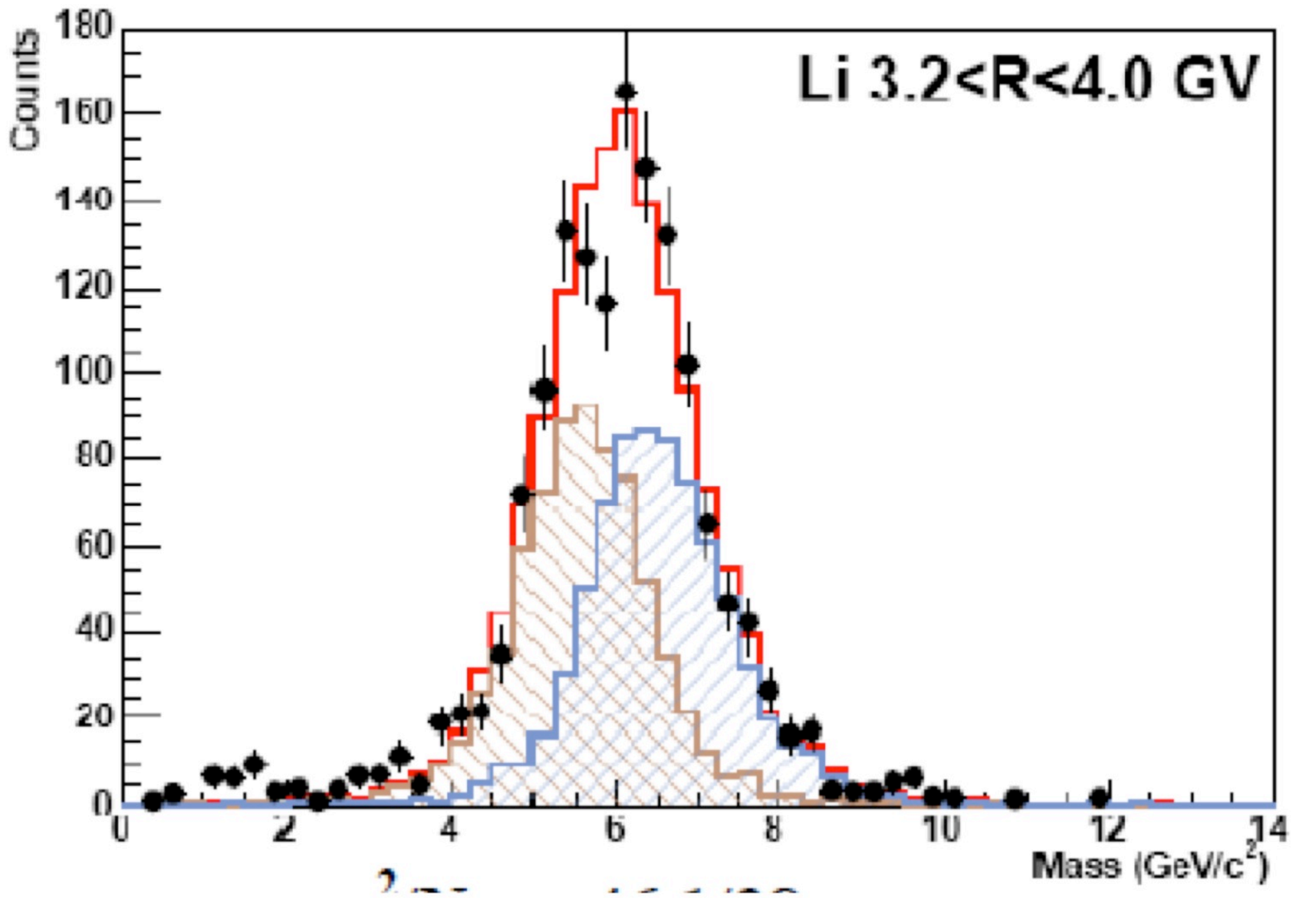
A New Result: The AMS-01 CRNs Analysis

Most of our knowledge of Cosmic Rays comes from Cosmic Rays Nuclei (CRN).
Propagation models depend from the secondary-to-primary ratios such as Li-Be-B/C .





Chemical Composition

Si Tracker Z Res. = 0.10 (Li) to 0.14 (C) c. u.
Identification Eff. ≈ 99%
Contamination on B/C = 2 ÷ 9%
He-Li separation from TB data (ToF + Tracker)

Isotopic Composition

Mass from Tracker + ToF (up to R < 6.3 GV)
Composition Fit Technique (use of MC)

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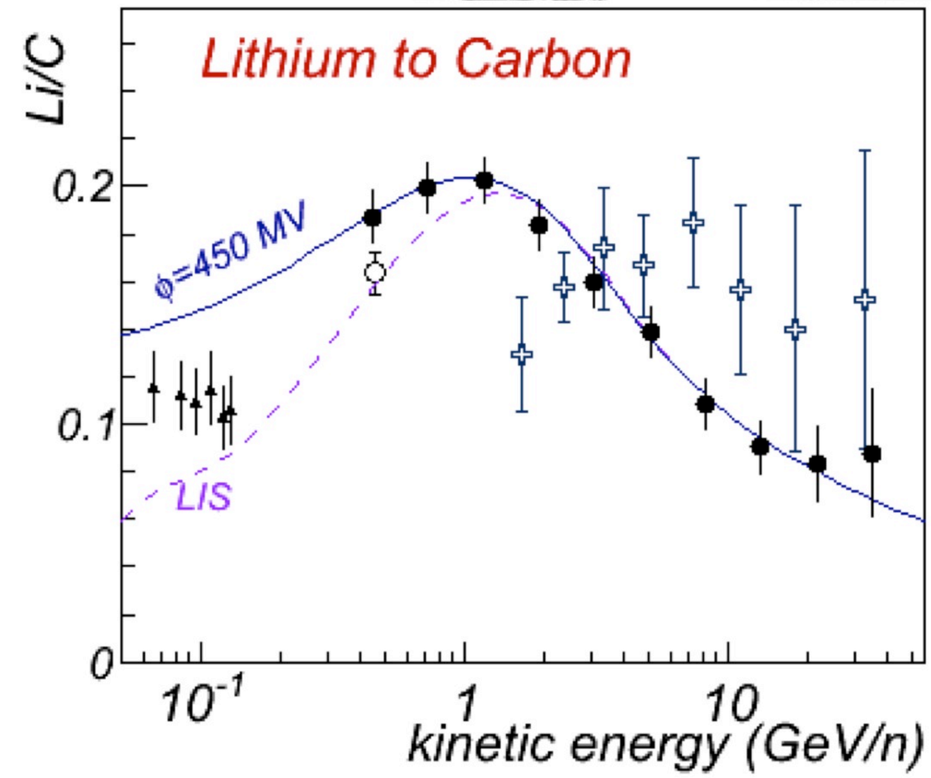
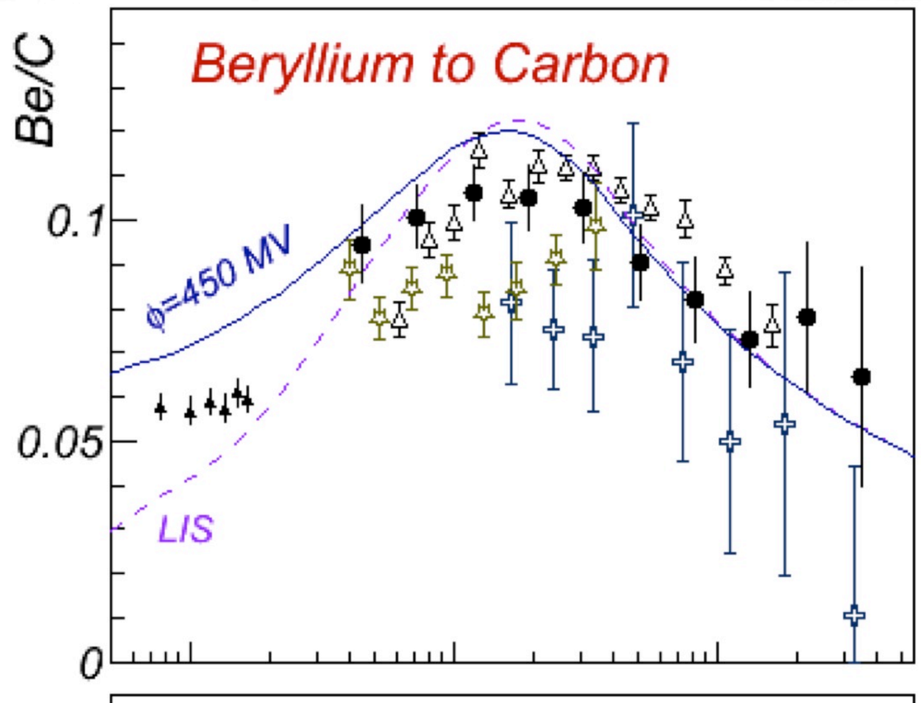
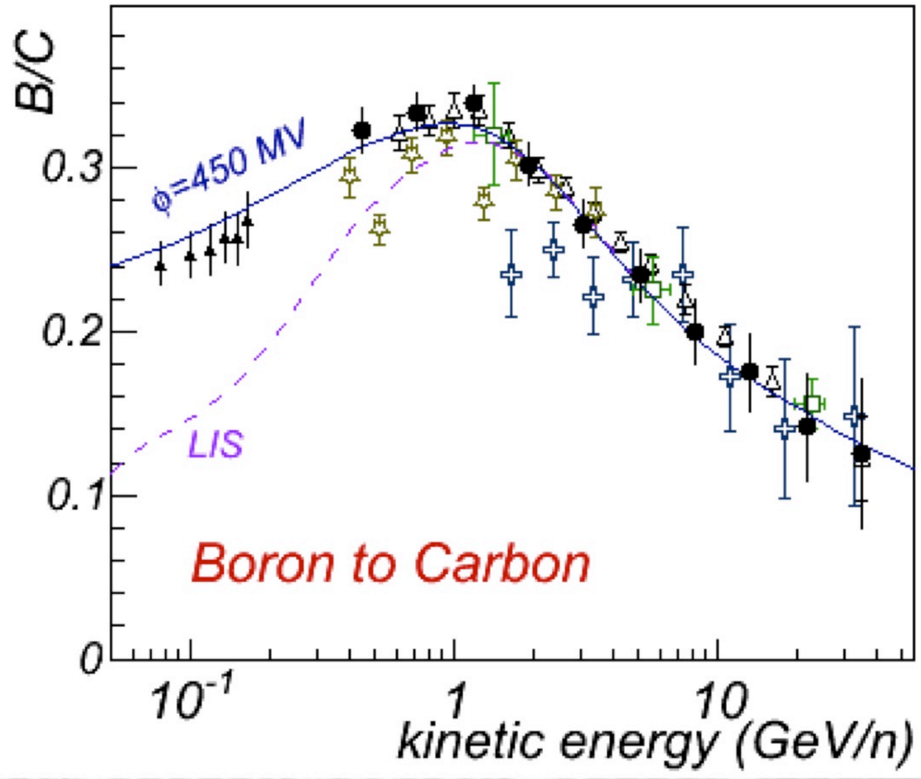
The AMS-01 CRNs Analysis: Secondary-to-Primary



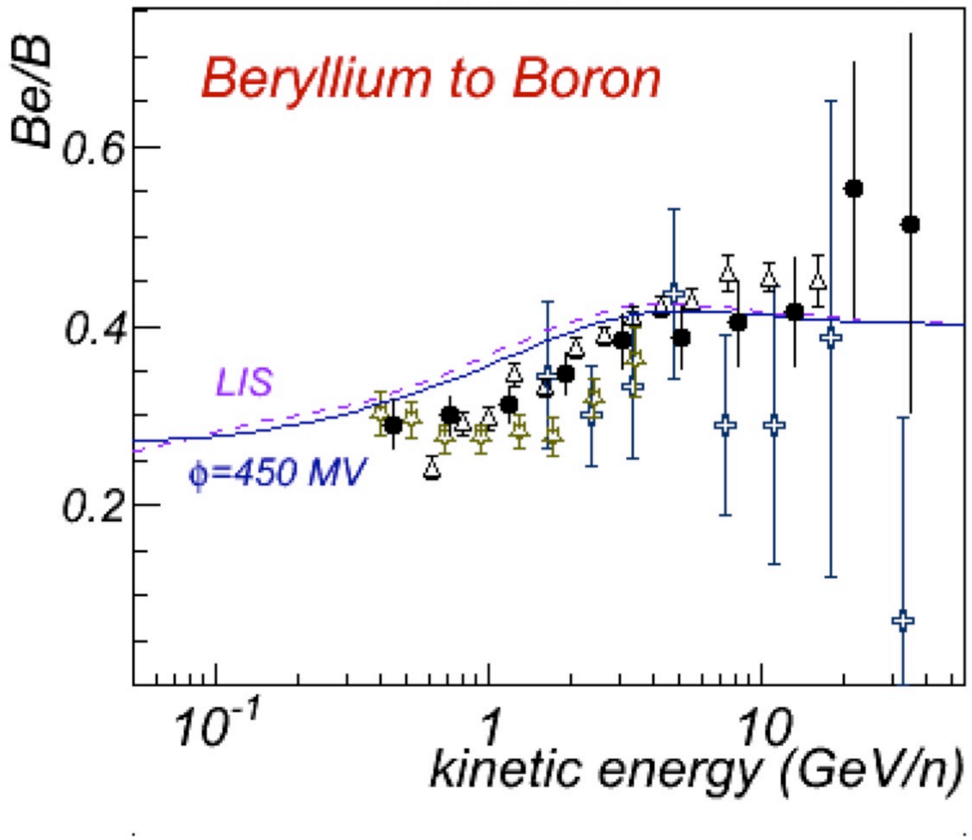


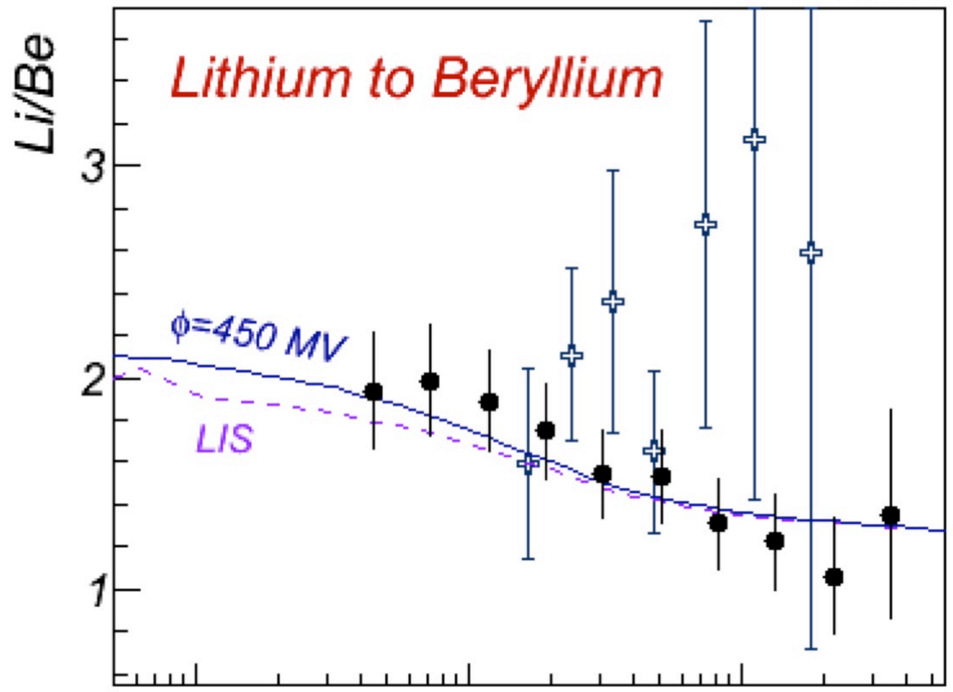


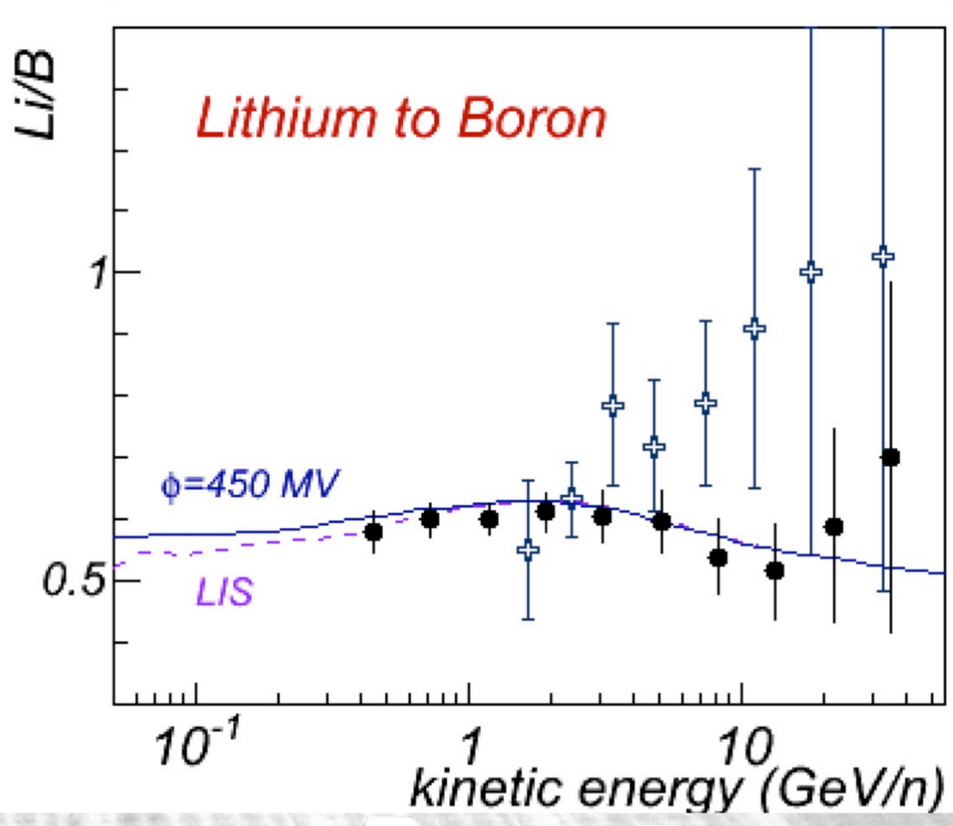
●	*AMS-01 this analysis*
○	*Webber et al. 1972*
✚	*Orth et al. 1978*
△	*HEAO3-C2 1990*
□	*CREAM 2008*
☆	*Lezniak & Webber 1978*
▲	*CRIS/ACE 2003*

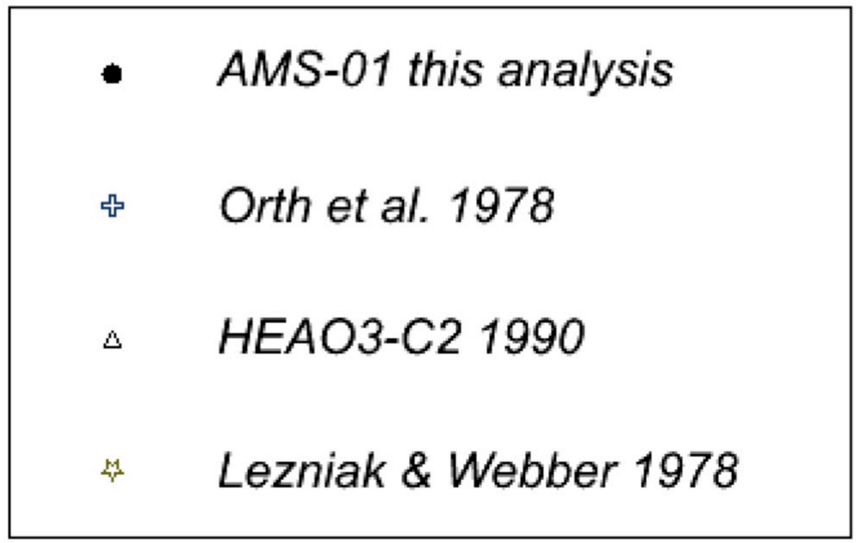
http://arxiv.org/abs/1008.5051 in press for ApJ

The AMS-01 CRNs Analysis: Secondary-to-Secondary



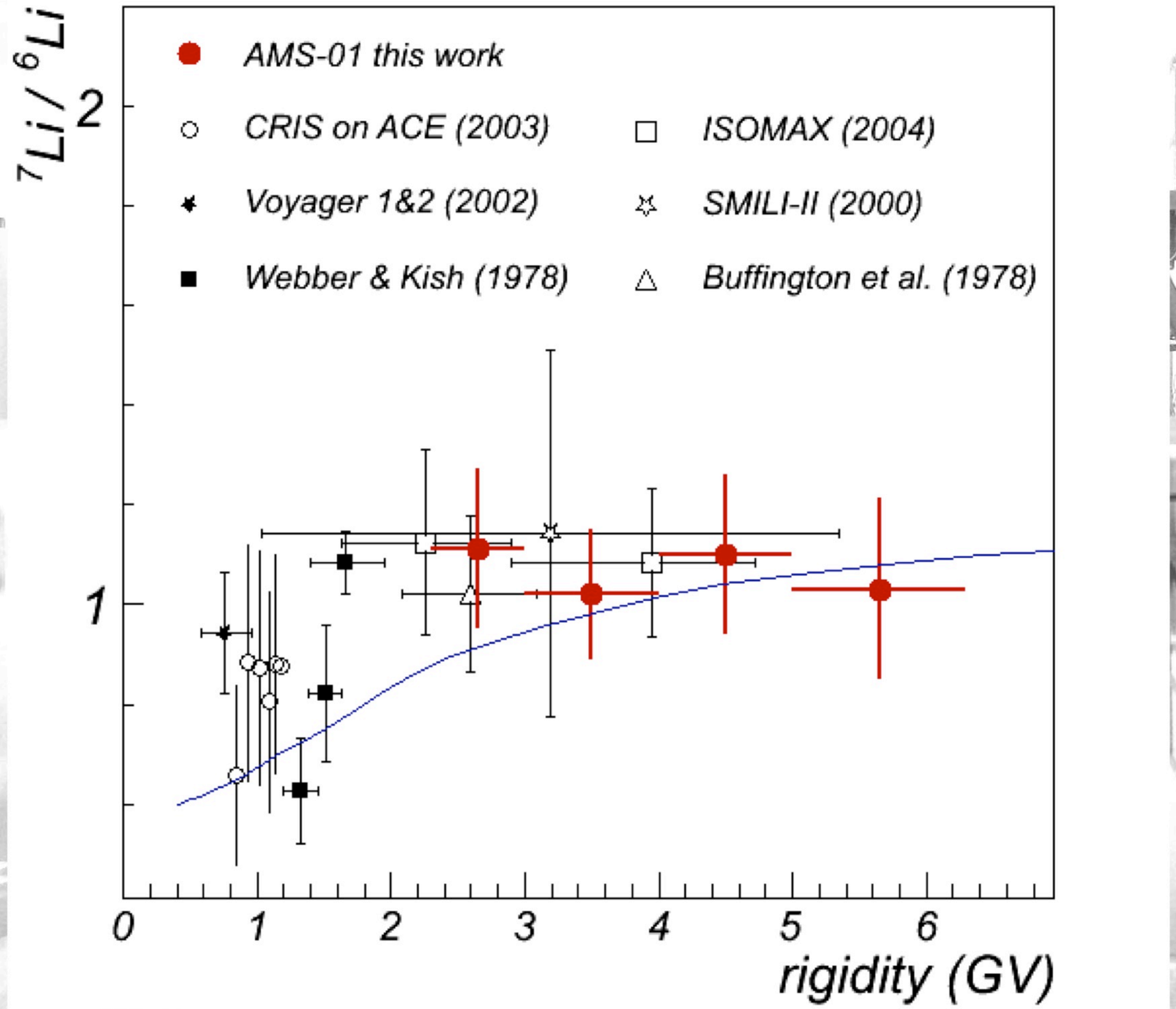






http://arxiv.org/abs/1008.5051 in press for ApJ

The AMS-01 CRNs Analysis: Isotopic Ratios



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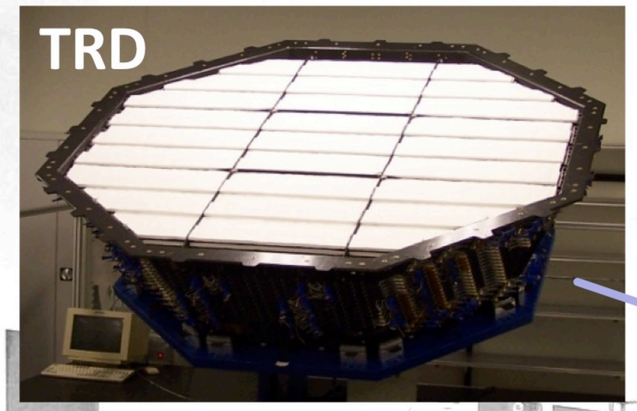
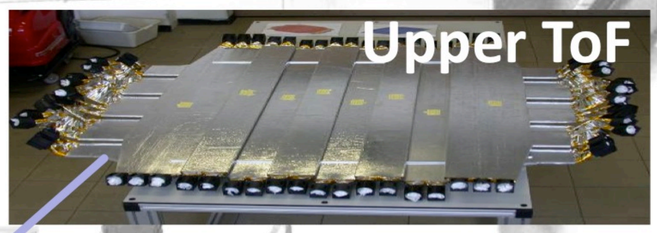
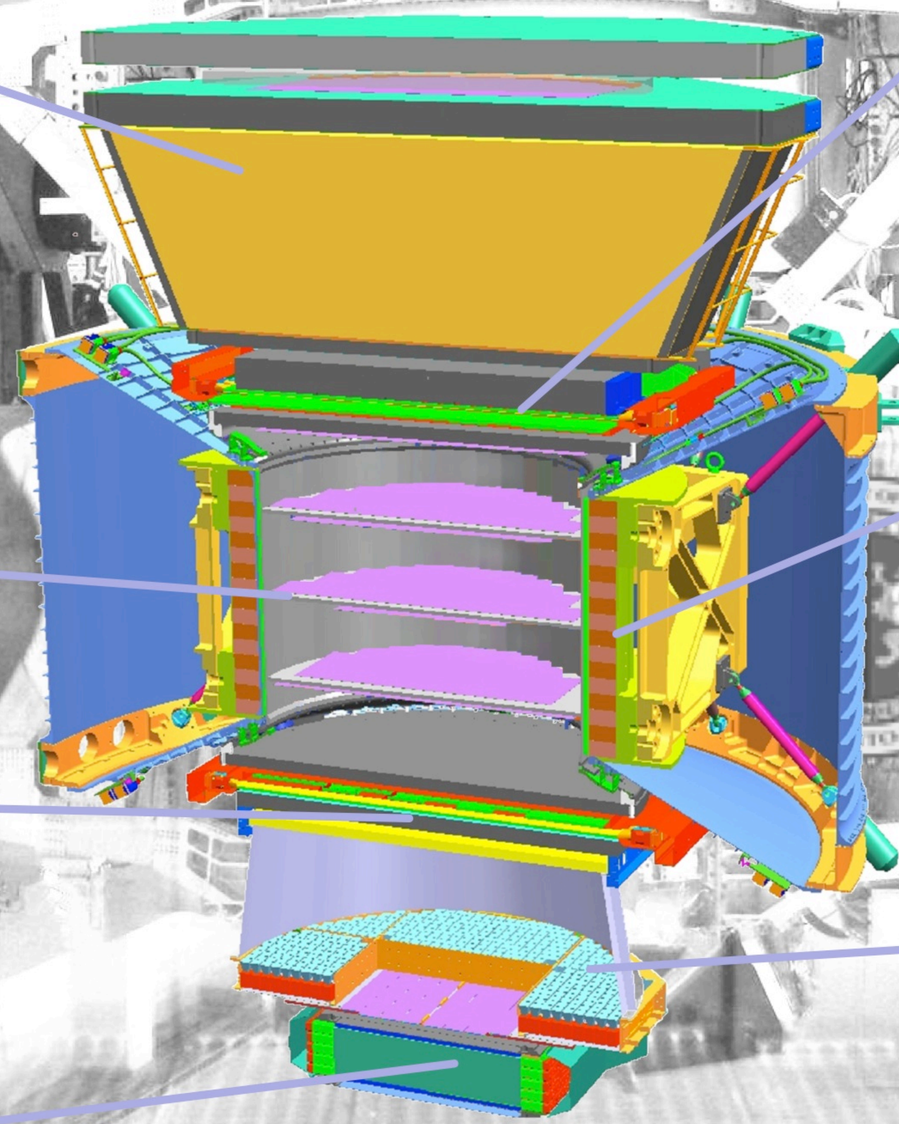
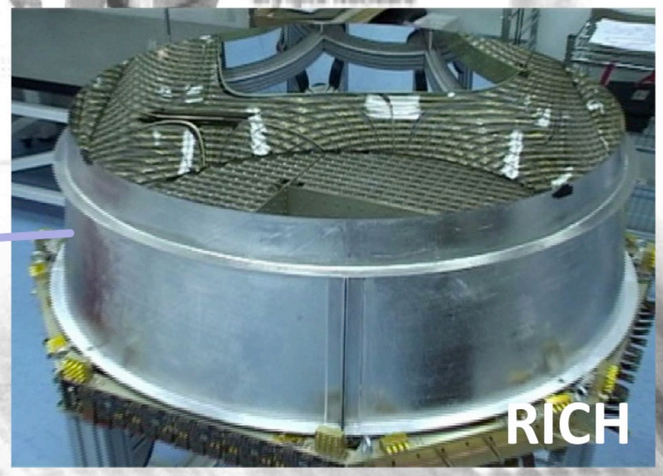
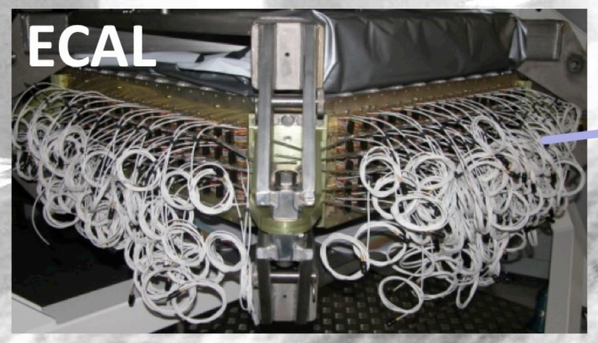
AMS-02 Subsystems











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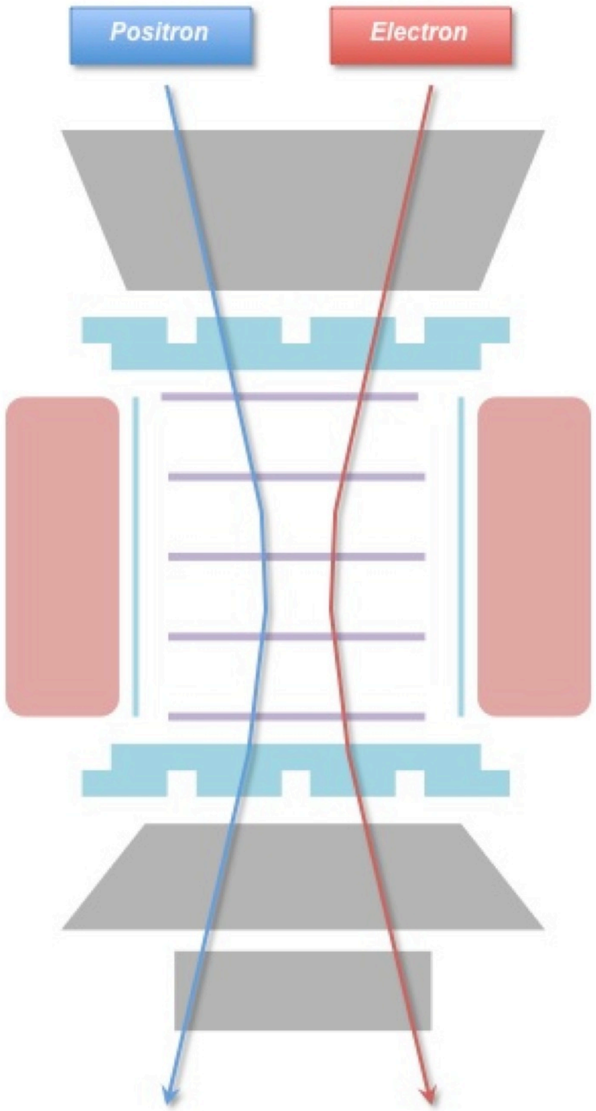
AMS-02 Measurements



	e^-	p	Fe	e^+	$\bar{p}$	$\overline{He}$	γ
TRD							
TOF							
Tracker + Magnet							
RICH							
ECAL							
	Cosmic Rays			Dark Matter		Antimatter	γ Sky

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AMS-02 Measurements

Particle Sign and Rigidity (±, R)

ToF: *up-going to down-going distinction (10^9 rej.)*

Magnet: *bending*

Tracker: *measures the deflection up to MDR (2 TeV)*

from orientation → charge sign

from curvature radius → momentum

Absolute Charge (Z)

ToF*: up to 4 dE/dx ($\propto Z^2$) independent meas.*

Tracker*: up to 9 dE/dx ($\propto Z^2$) independent meas.*

RICH*: N_γ ($\propto Z^2$) measurement*

Expected complete separation

Velocity

ToF*: $\Delta\beta/\beta \approx 3\%$ ($\Delta t \approx 160$ ps, L = 1.2 m)*

RICH*: $\Delta\beta/\beta \approx 0.05$ (0.01) % for p (ions)*

e/p Separation

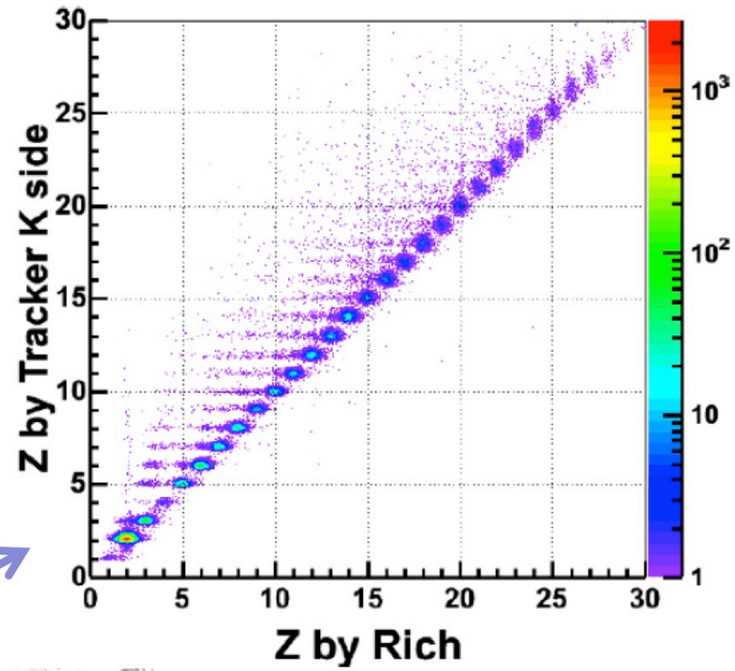
TRD*: 10^3 p rejection. up to E ≈ 300 GeV*

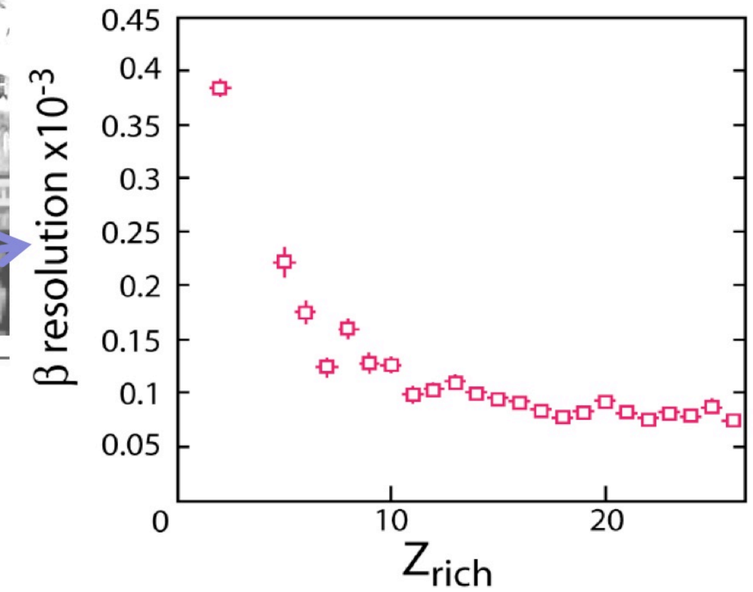
ECAL*: 10^4 p rejection*

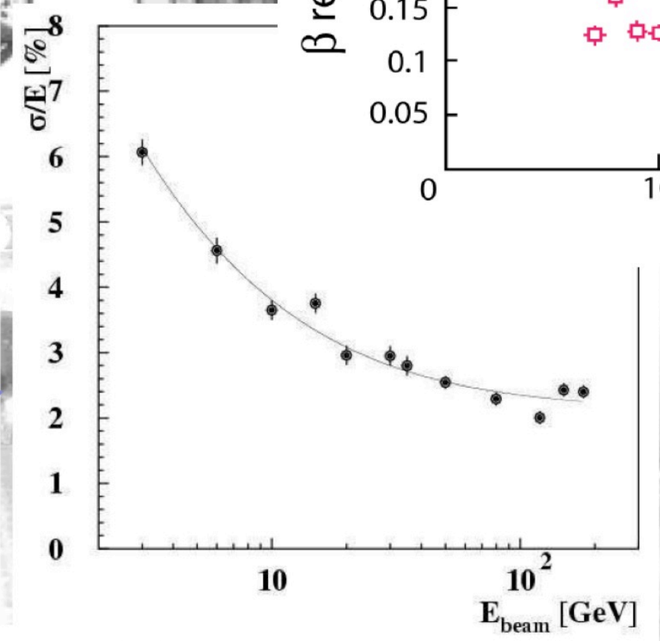
Energy and γ

ECAL*: $\Delta E/E \approx [10/(\sqrt{E}) \oplus 2]$ %*

γ: ECAL (photon mode) or Tracker (conversion mode)







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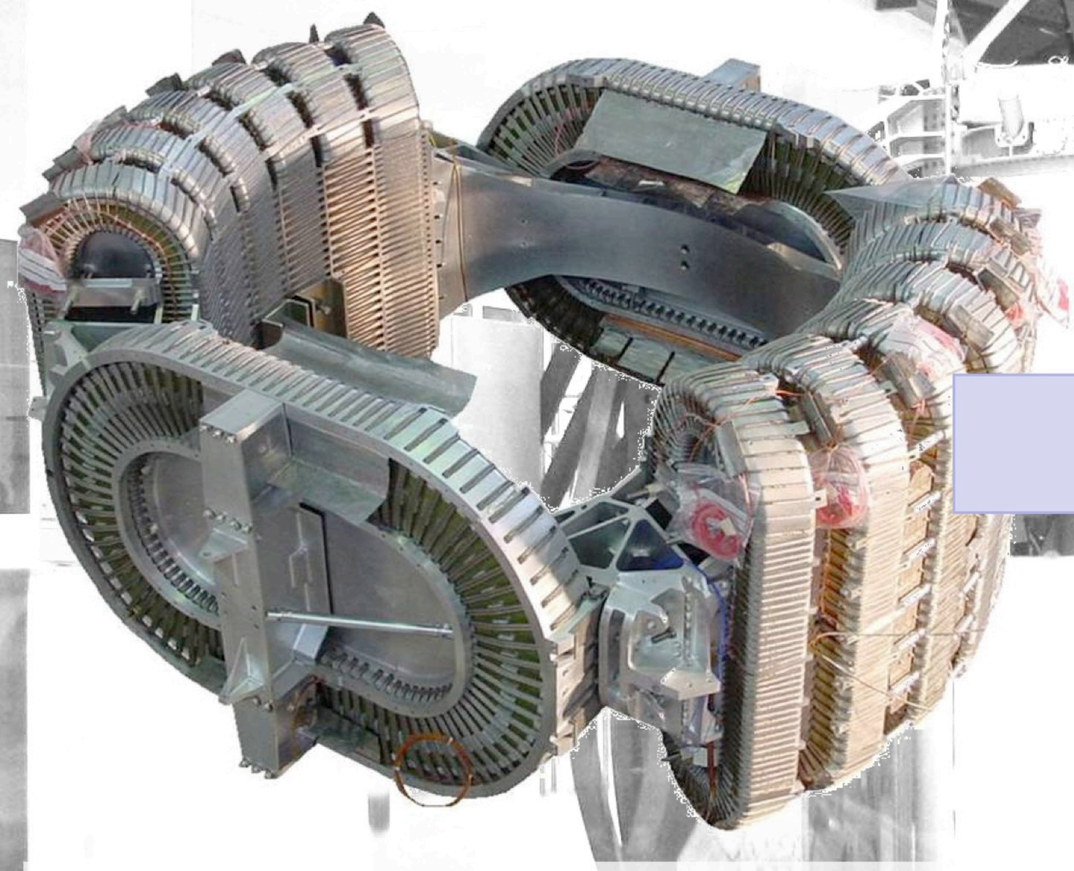
AMS-02 The July Major Change: from SCM to PM

A very good reason: extension of the ISS program to 2020 (Feb 2010)!

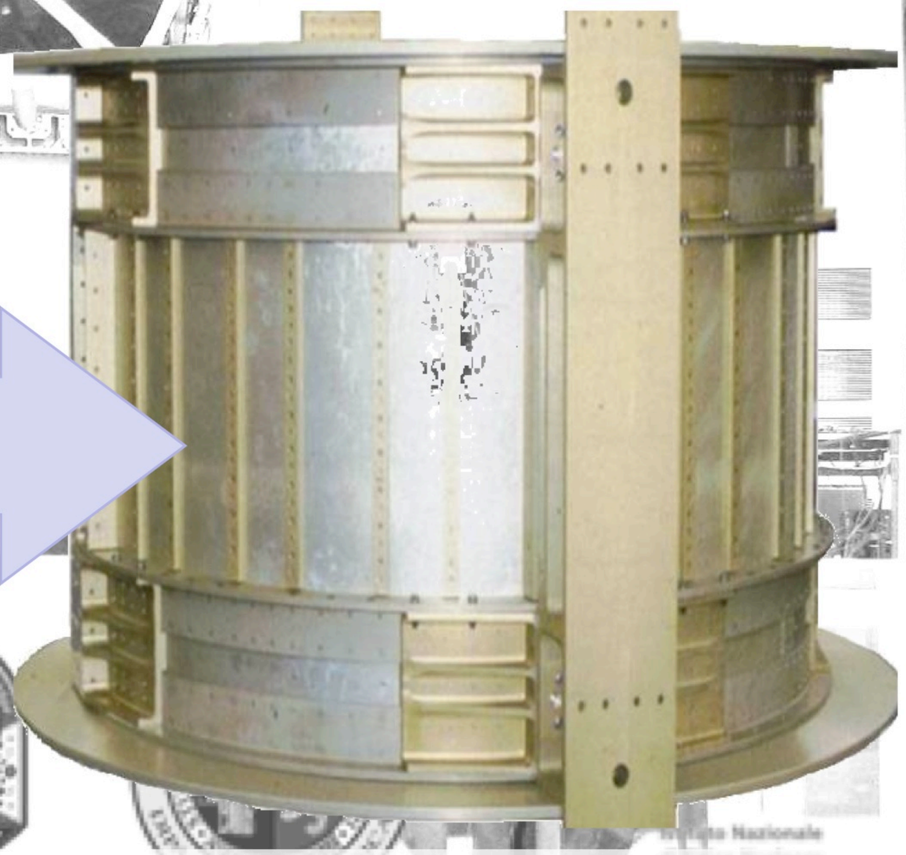


Superconducting Magnet

B = 0.87 T

Endurance = 3 years

Re-estimated as less than 3 years from ESTEC Thermo-Vacuum test (Apr 2010)



Permanent Magnet

B = 0.13 T

Endurance ≈ ∞

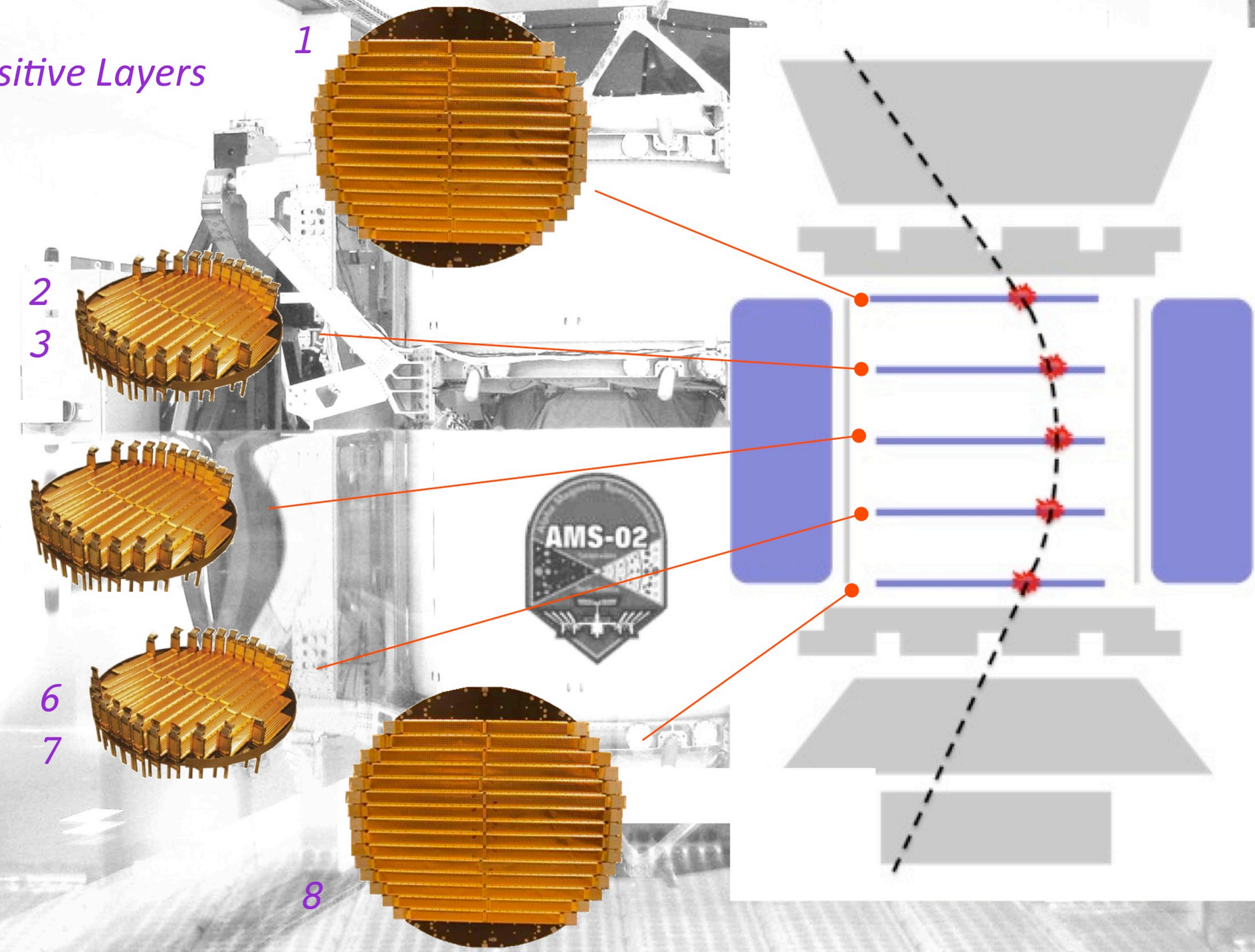
Easier to handle in space

Already space-qualified

But the designed momentum resolution would be affected → ***Adjust the Tracker***

The AMS-02 Superconducting Magnet Configuration

Tracker Sensitive Layers



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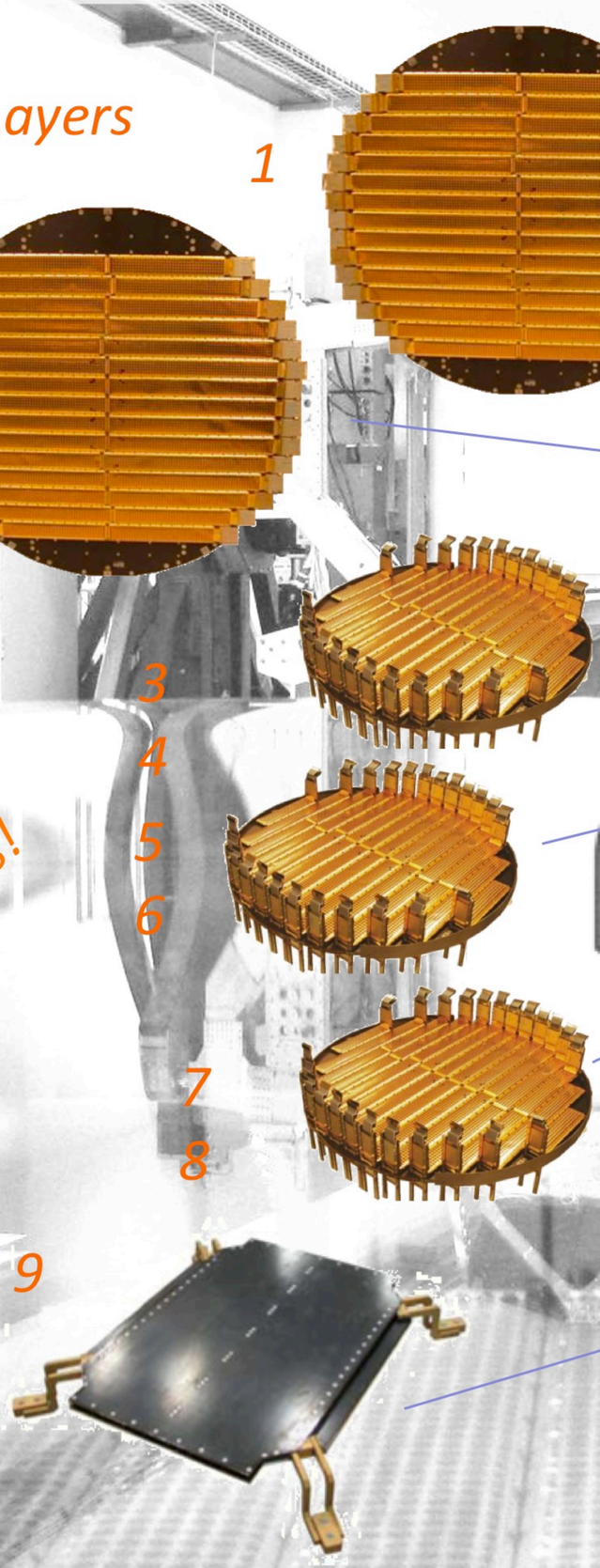
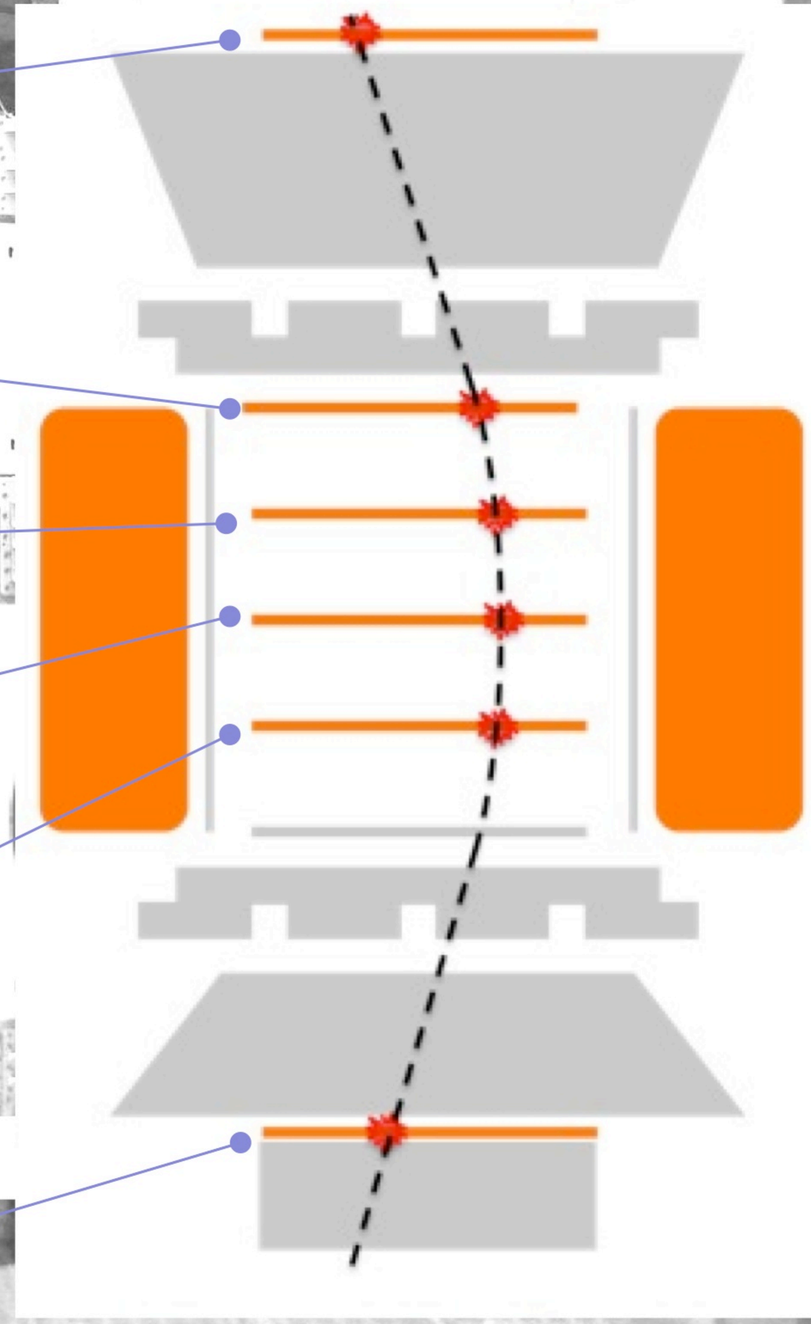
The AMS-02 Permanent Magnet Configuration

Tracker Sensitive Layers

1
2
3
4
5
6
7
8
9

Optimized for positrons!





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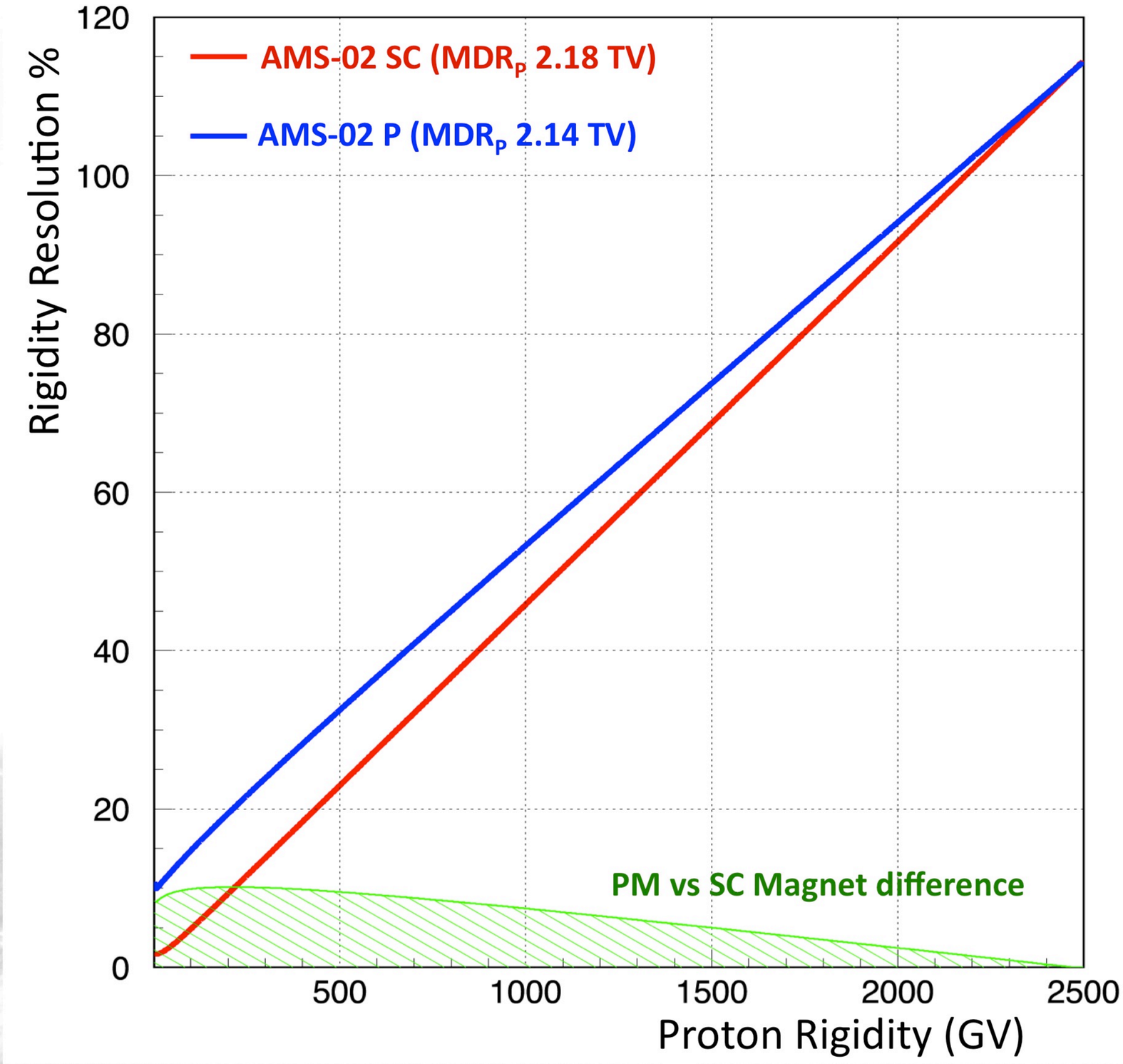
The Momentum Resolution: MonteCarlo



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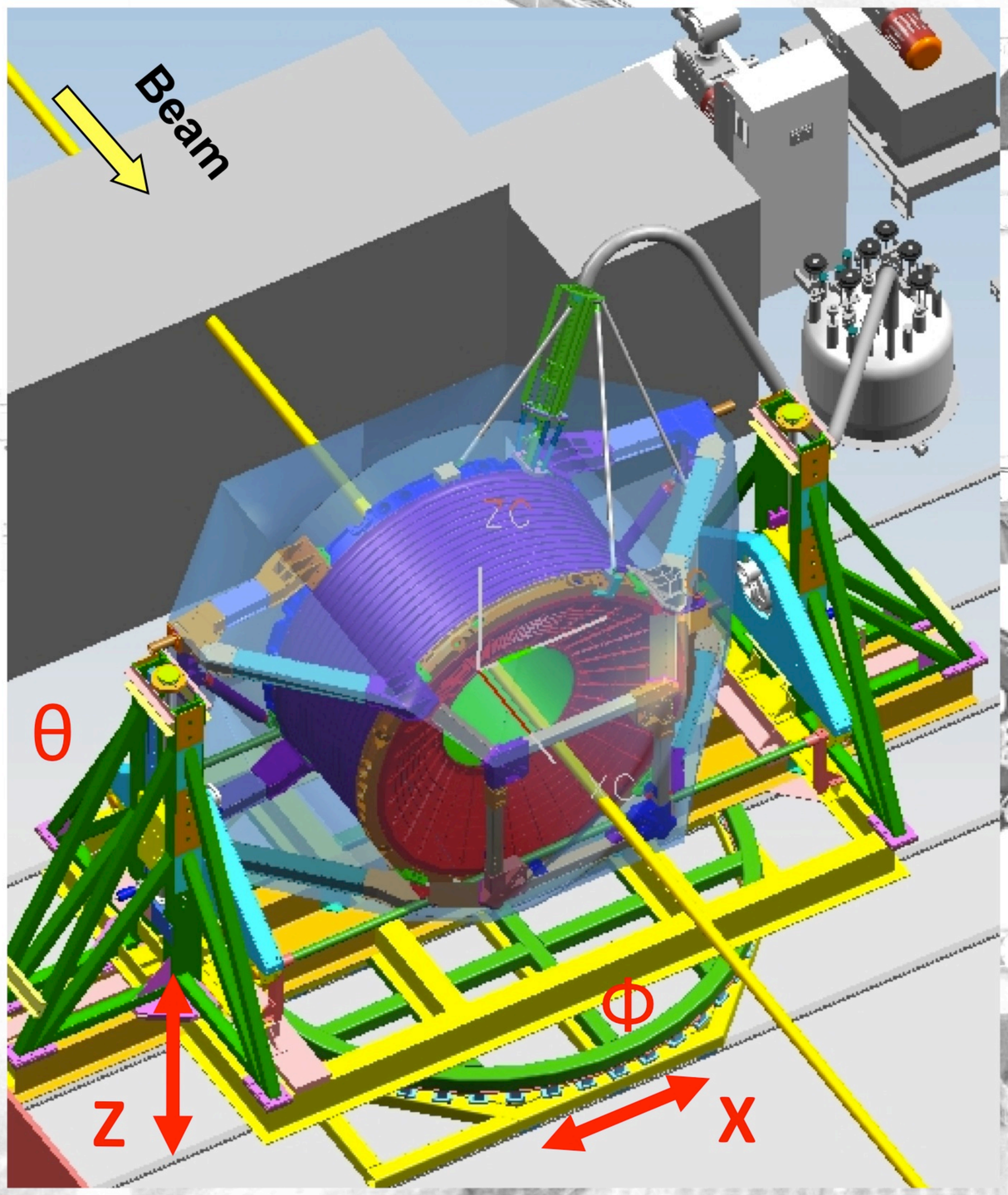
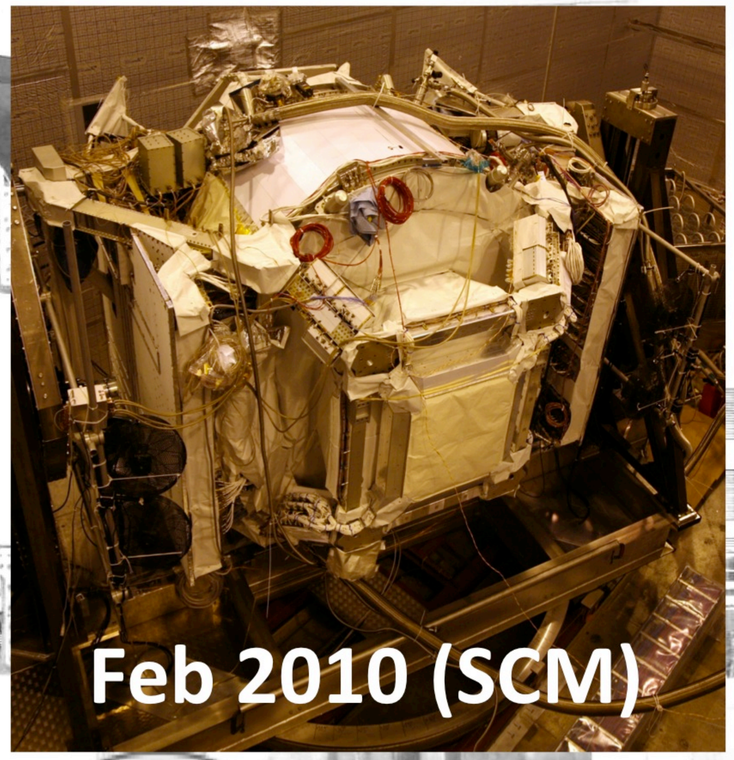
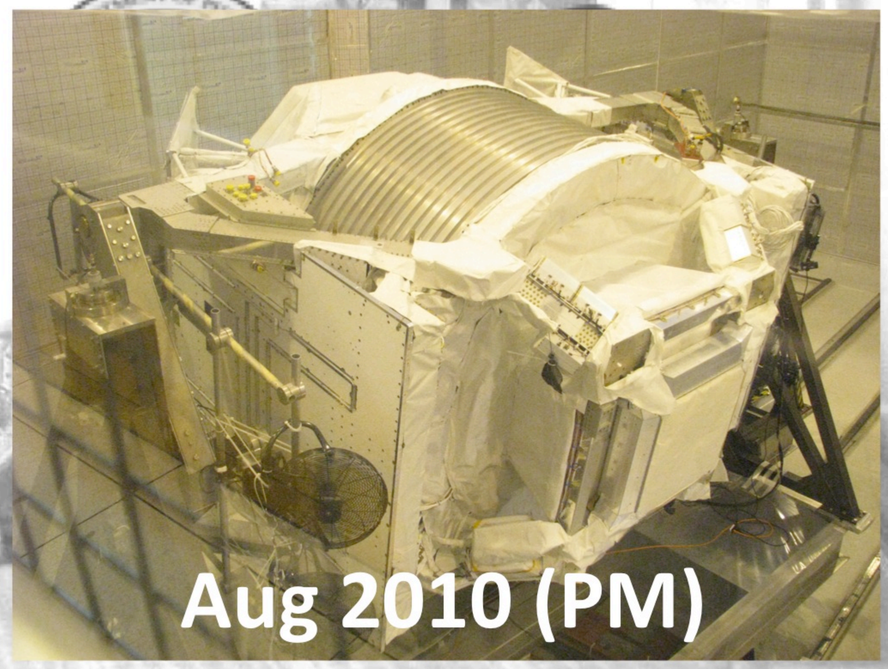
The AMS-02 Test Beams







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The AMS-02 Test Beam Purposes

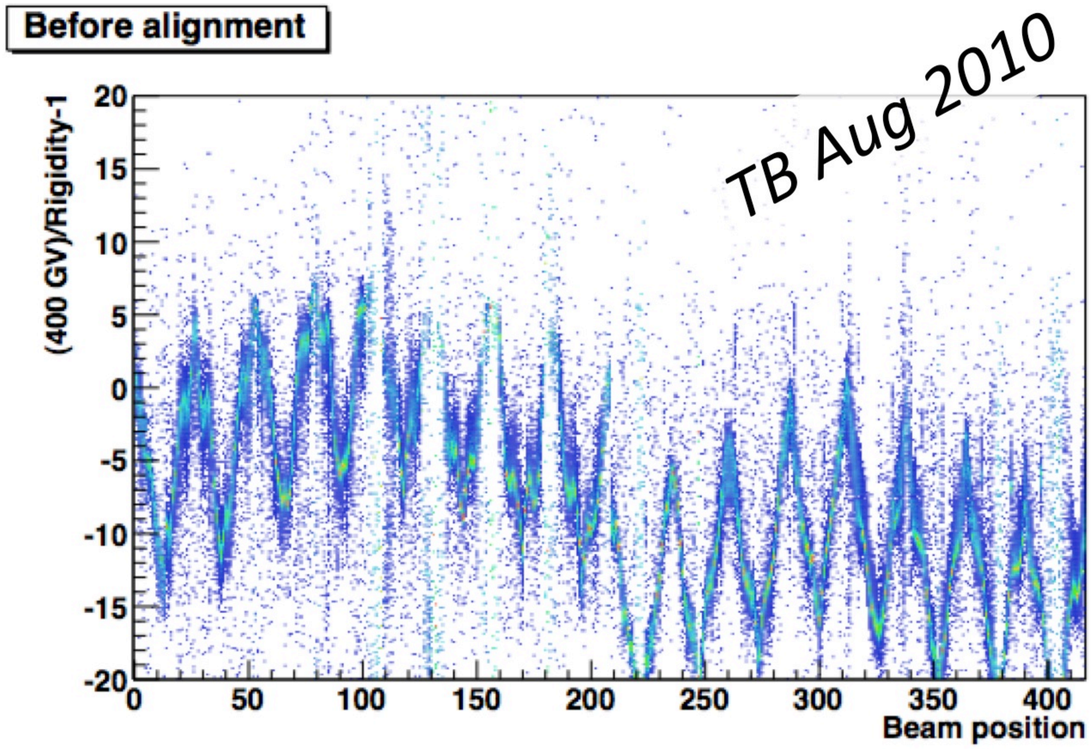
> Tracker Alignment at Fixed Rigidity (p at 400 GV/c)

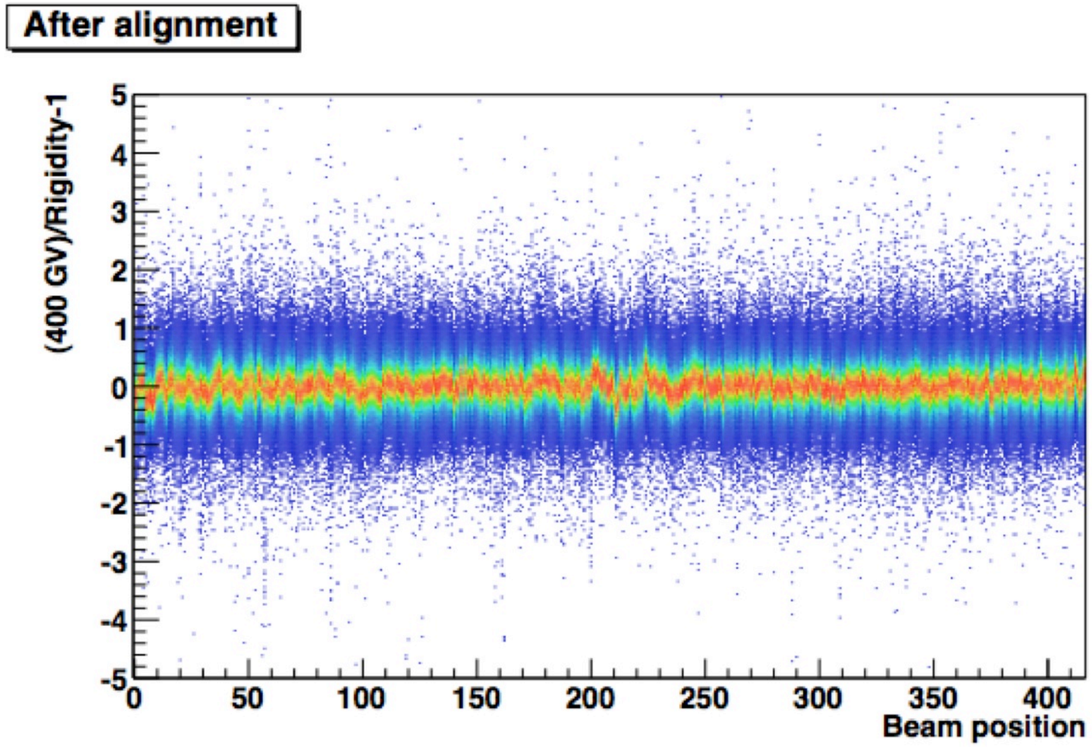
> Alignment Check with Positive and Negative Samples ($\pi^{\pm}$ and $e^{\pm}$ at 180, 290, … GV/c)

> Tracker Resolution and Charge Confusion

> e/p Separation Studies (ECAL, TRD)

> Sub-detectors Threshold and Uniformity Studies





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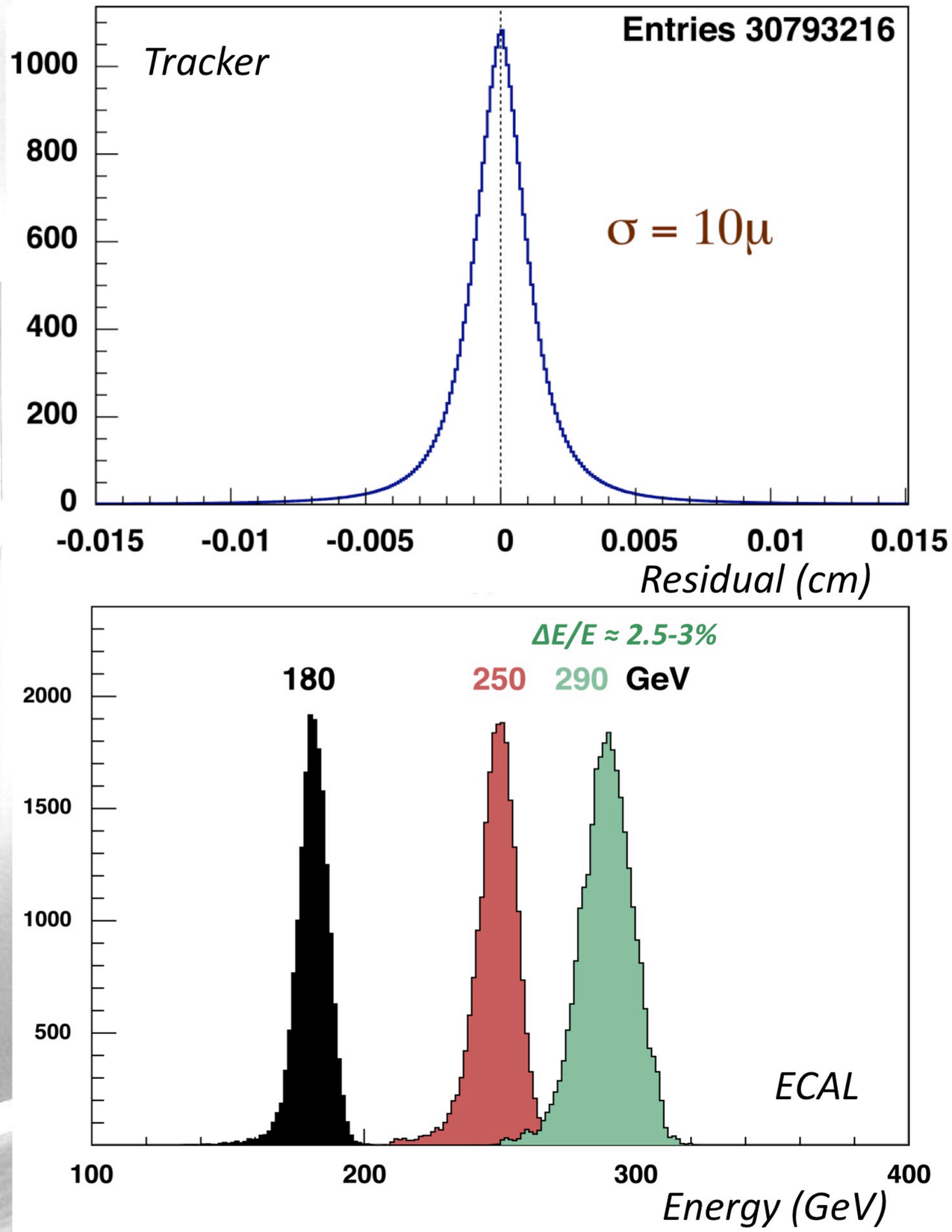
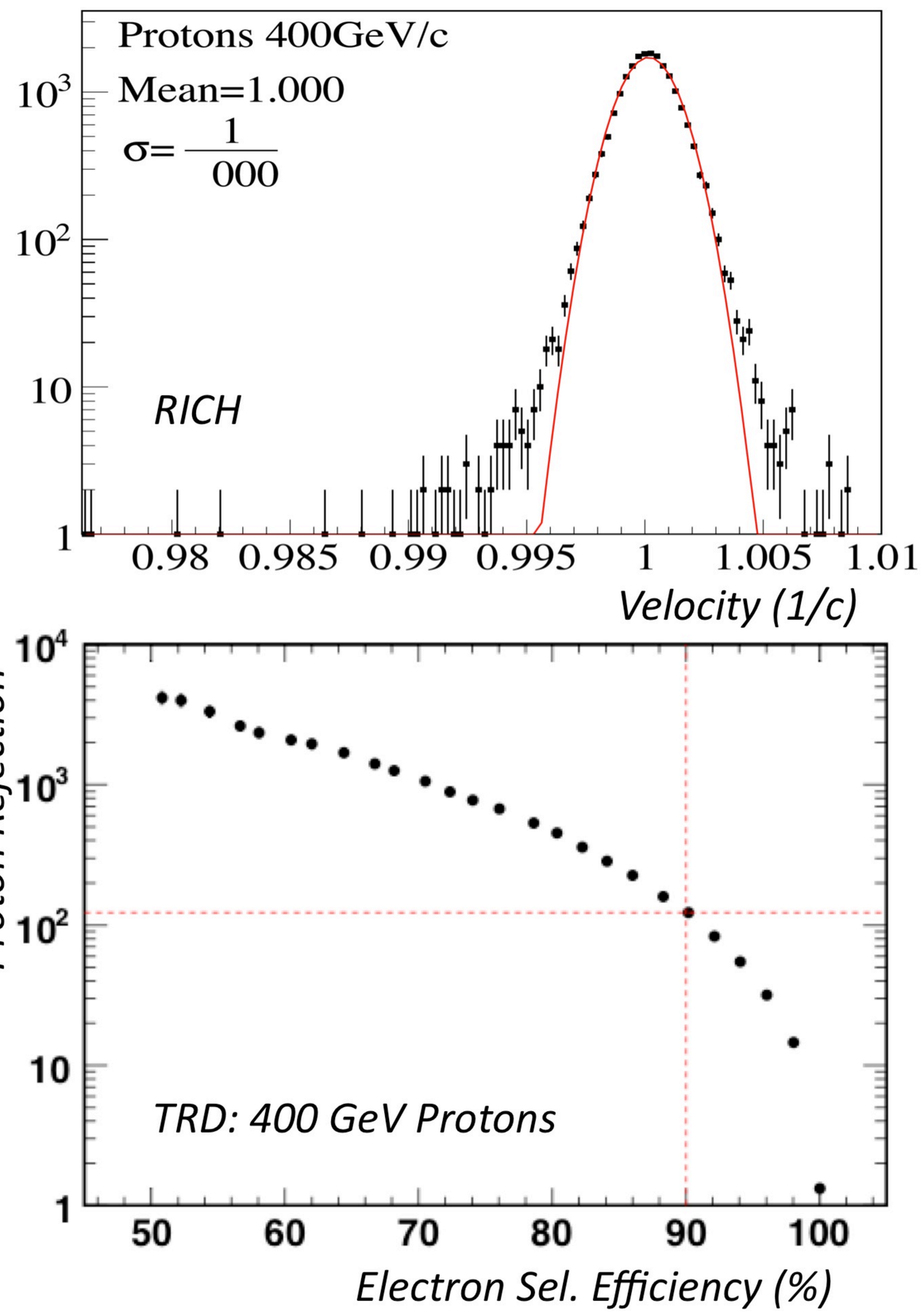
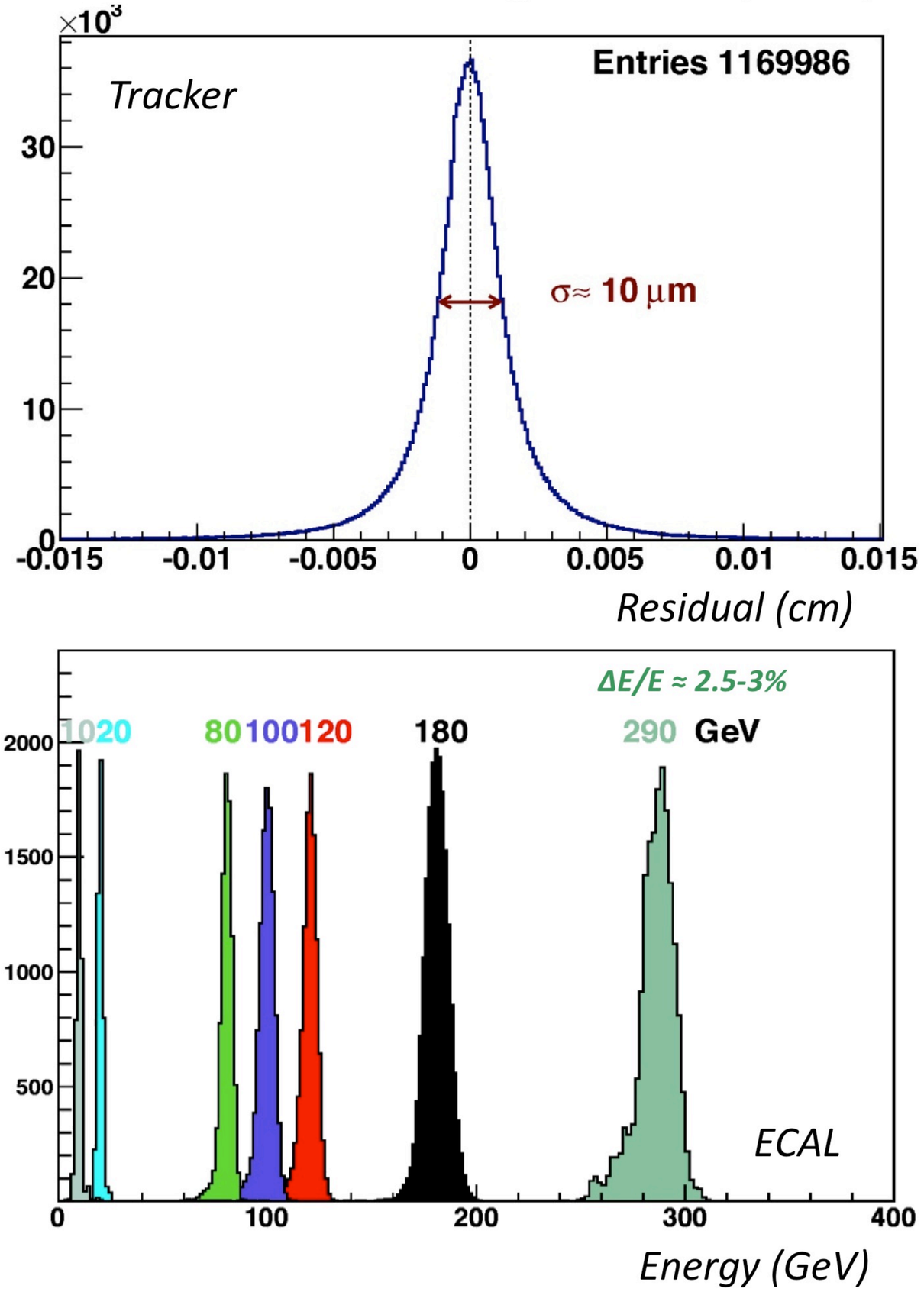
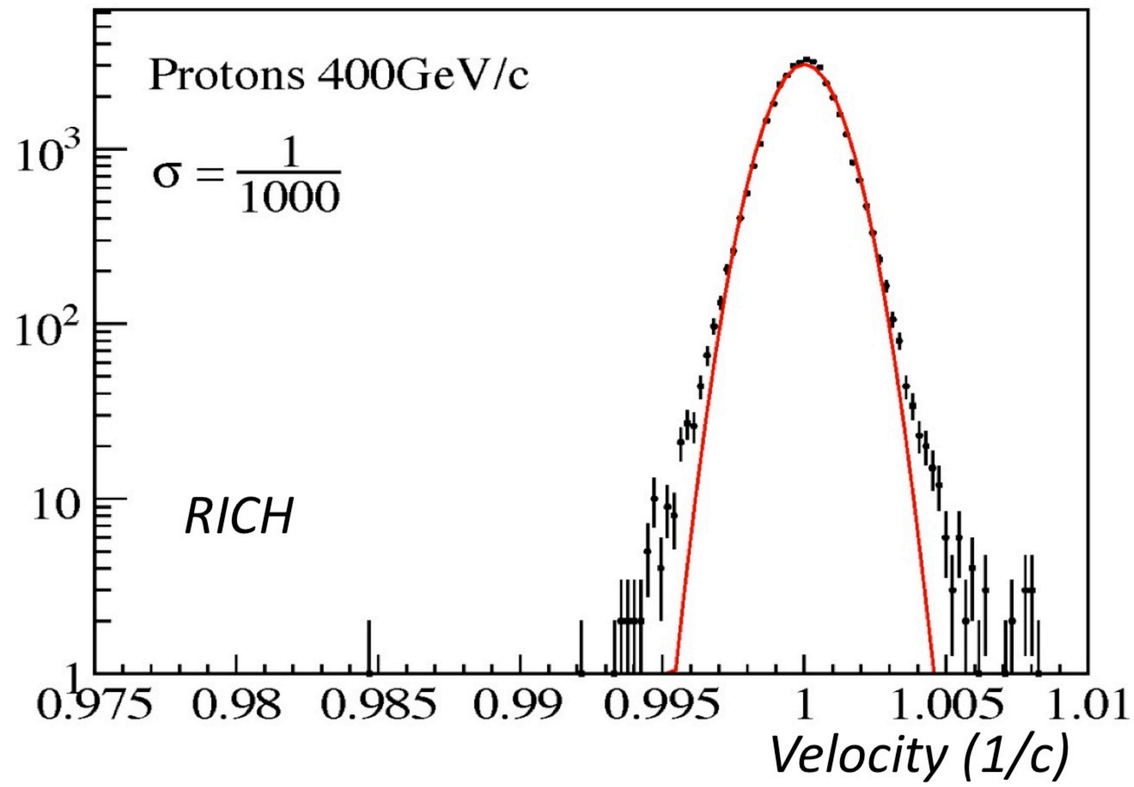
Test Beam Feb 2010 (SCM) Results

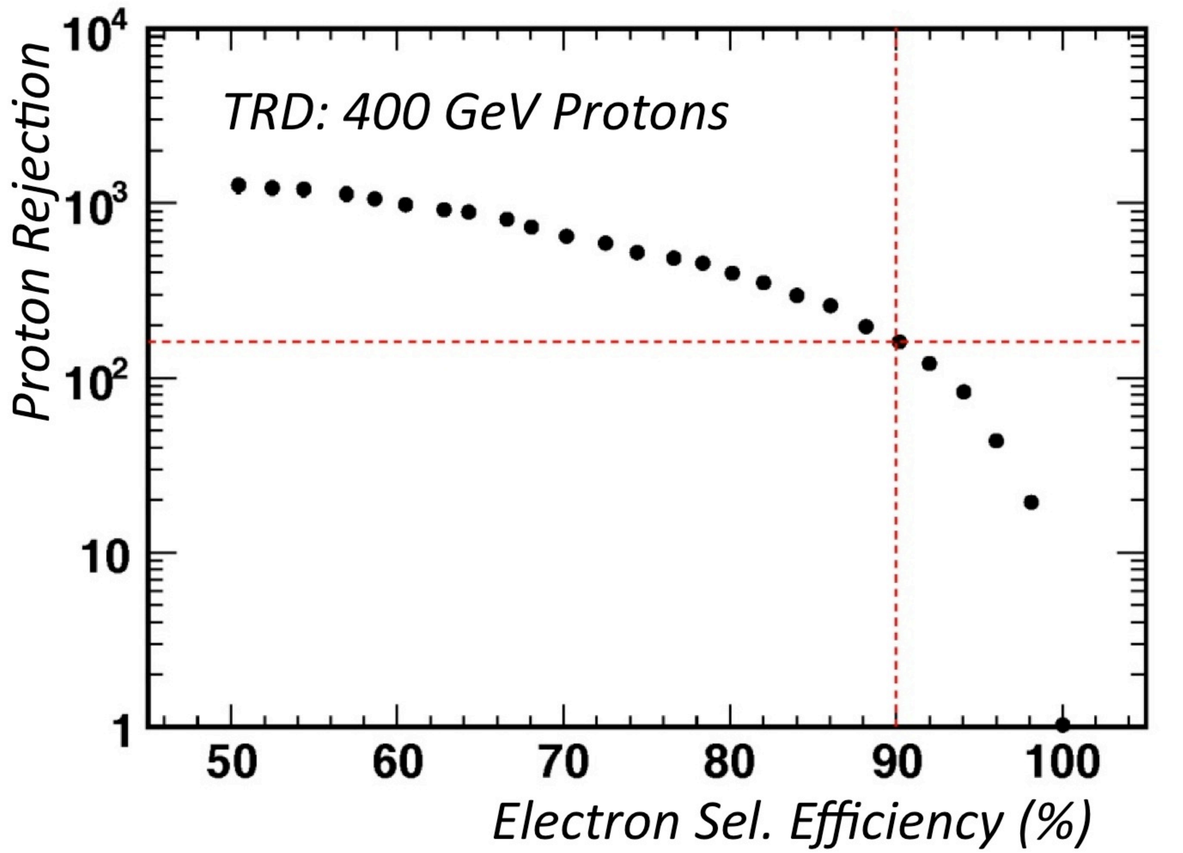




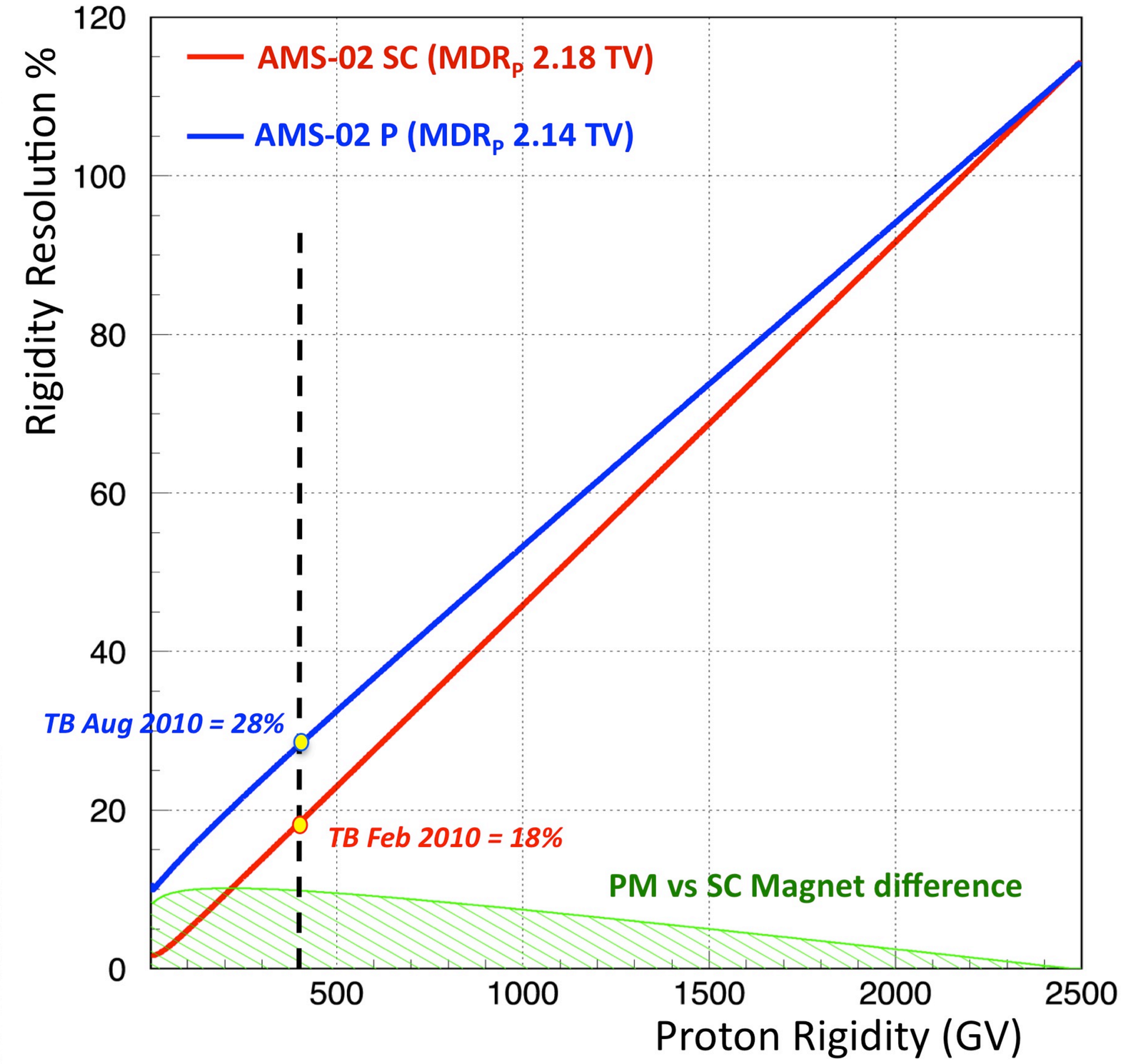
Test Beam Aug 2010 (PM) Results







The Momentum Resolution Estimation from TBs



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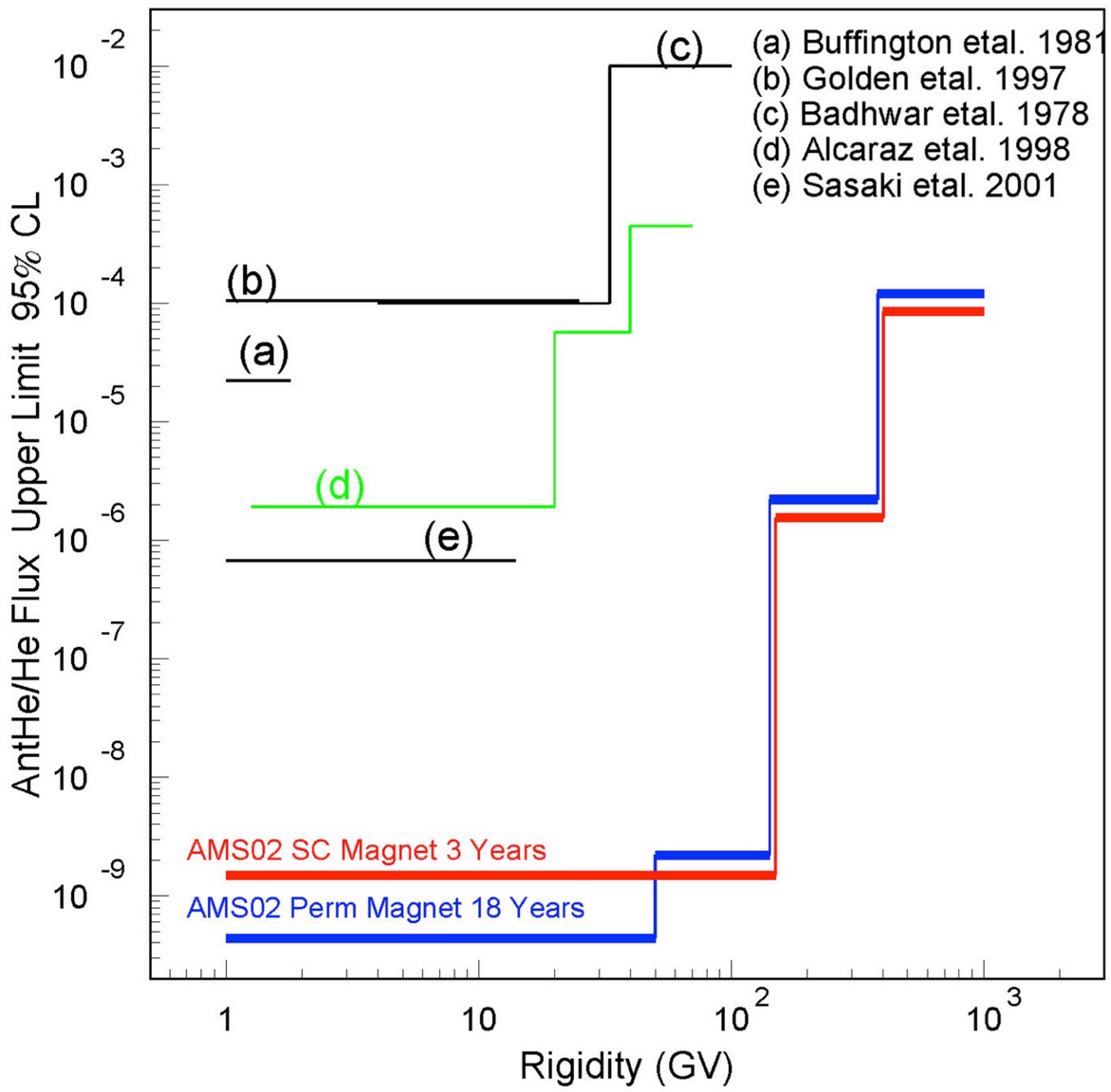
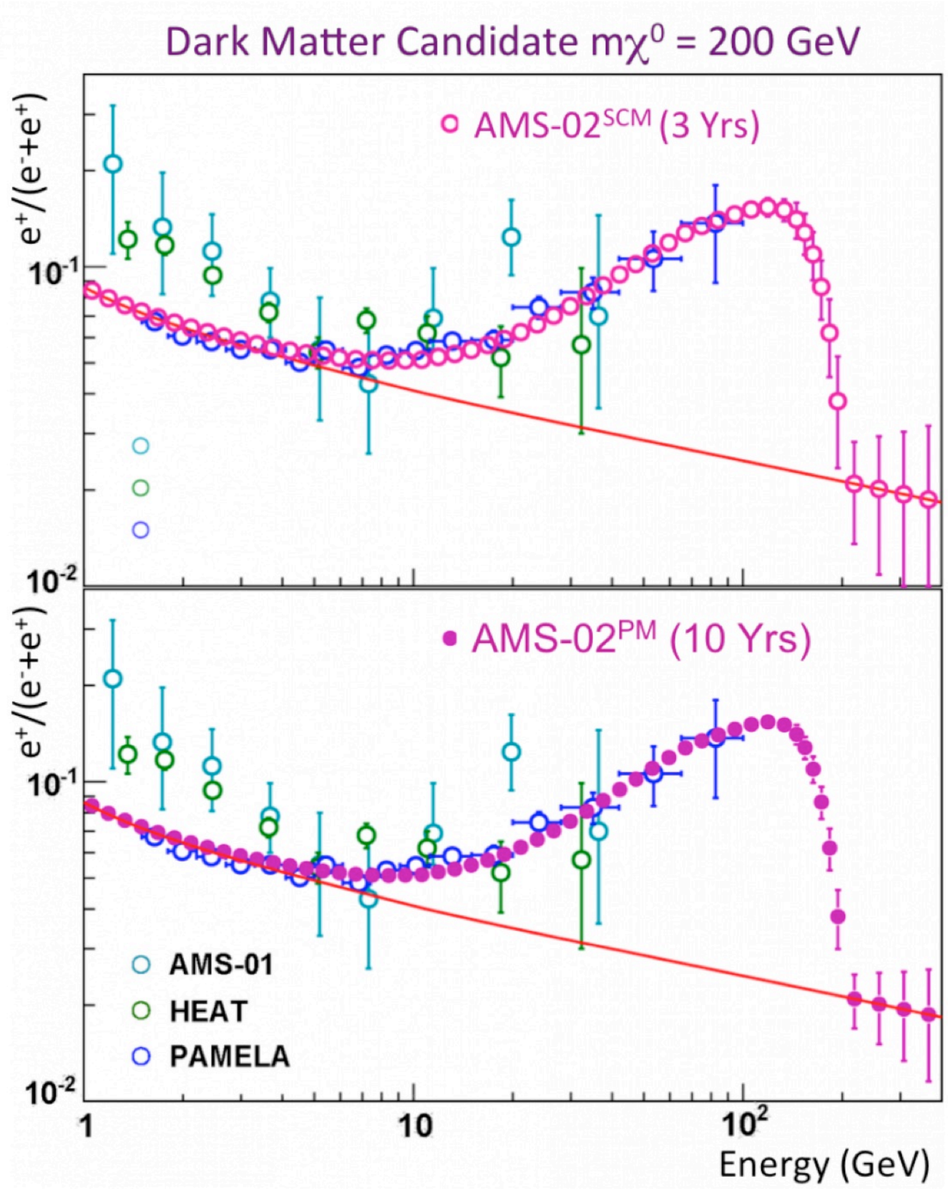
Expected Performances

Antimatter



Dark Matter "Best" Channel



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Conclusions

> AMS-02 PM is fully tested and validated

> AMS-02 PM is ready at KSC

> AMS-02 will be launched on Feb 2011

> Follow AMS-02 adventures on www.ams02.org

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