La missione AMS

Alpha Magnetic Spectrometer

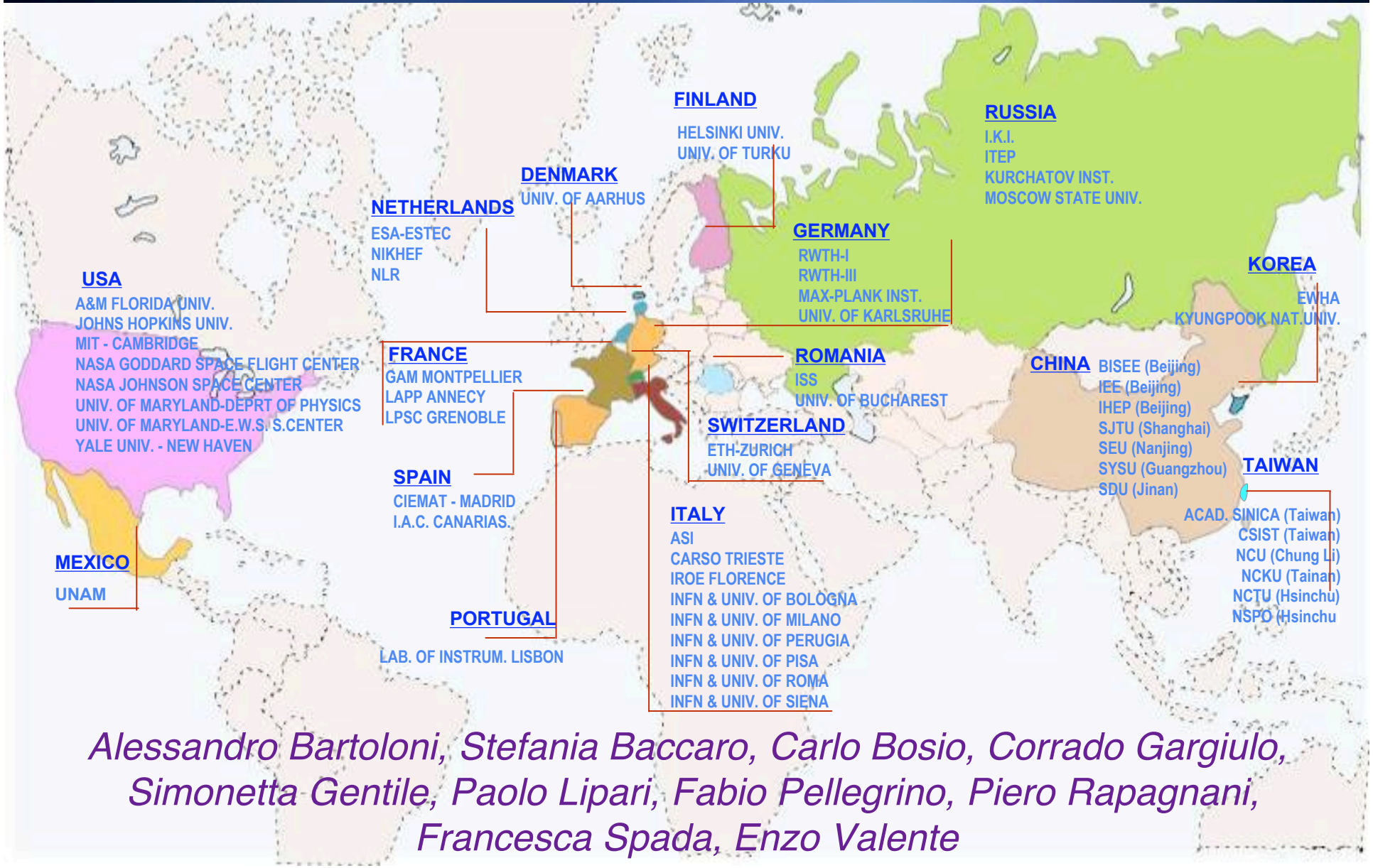
Bruno Borgia
24 Maggio 2011

Outline

- Fatti figure e numeri
- Criteri di progetto
- Prestazioni dei rivelatori

Paolo Lipari: Prospettive scientifiche

16 Paesi 60 Istituti 600 ingegneri ricercatori e tecnici



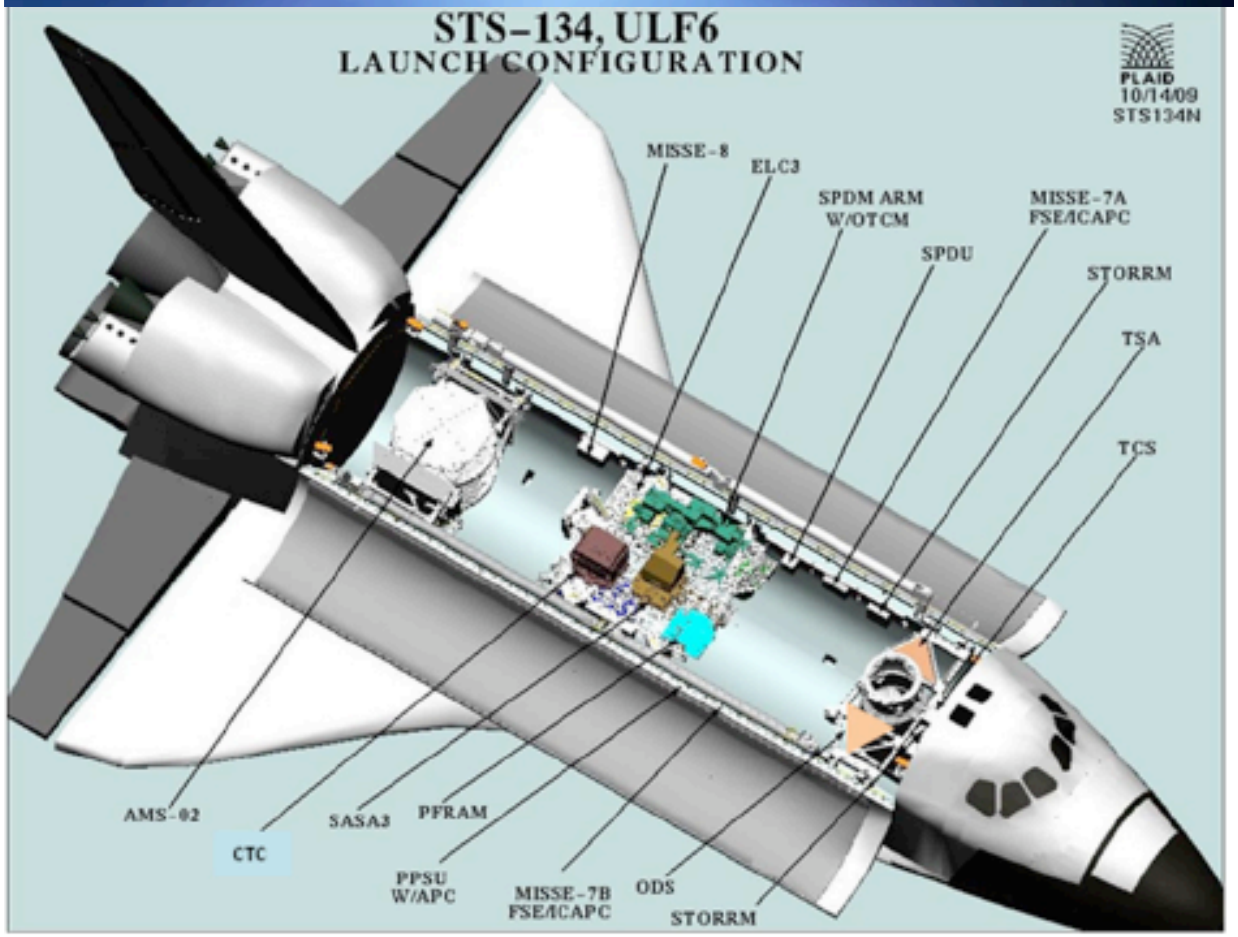
Alessandro Bartoloni, Stefania Baccaro, Carlo Bosio, Corrado Gargiulo, Simonetta Gentile, Paolo Lipari, Fabio Pellegrino, Piero Rapagnani, Francesca Spada, Enzo Valente

- March 10: Space shuttle Endeavour begins its slow move from High Bay 3 in the Vehicle Assembly Building to Launch Pad 39A at NASA's Kennedy Space Center in Florida at 7:56 p.m. EST. The 3.4-mile trek, known as "rollout," will take about seven hours to complete.

10 Marzo AMS nel Canister

Parametri principali

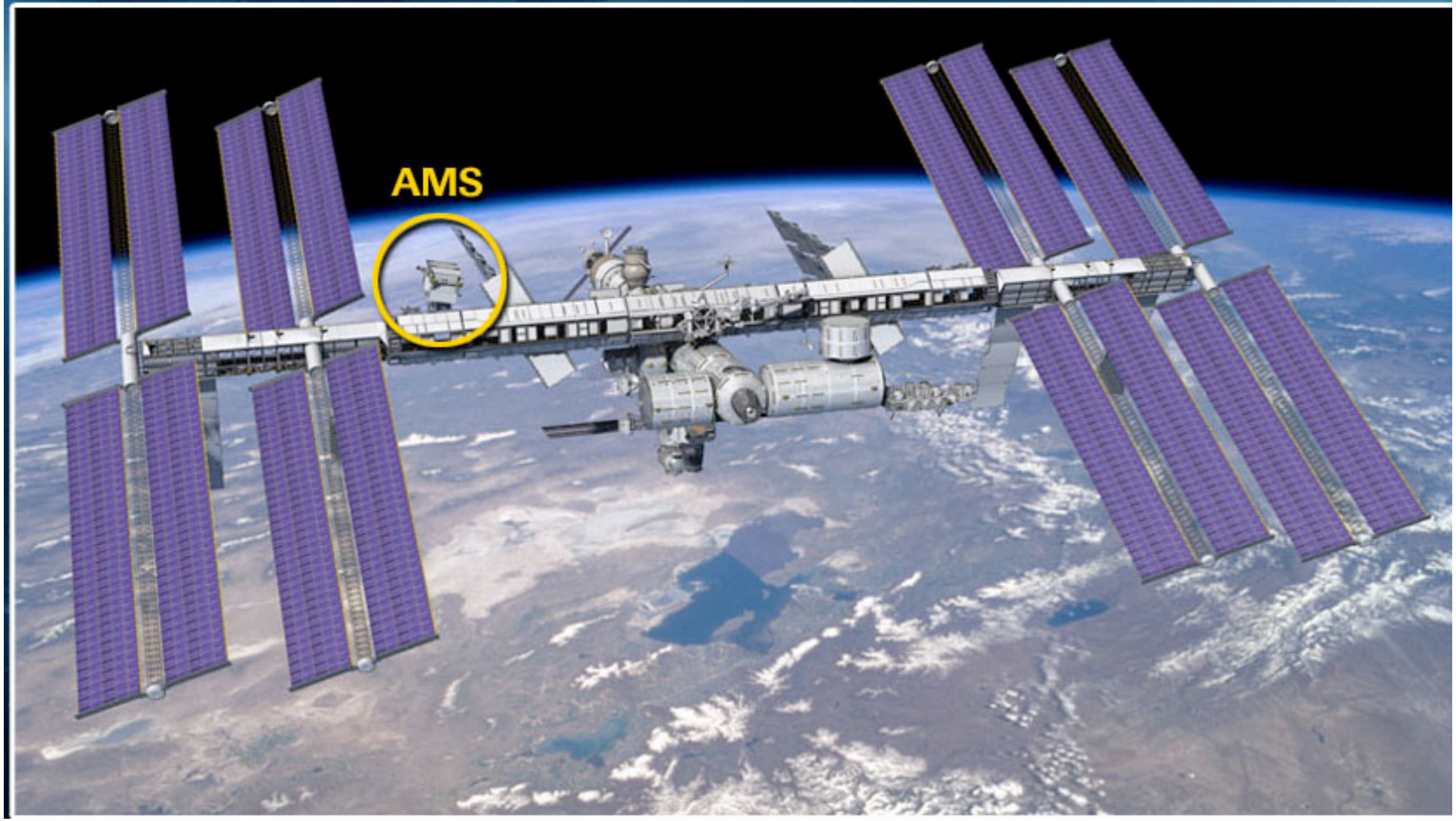
	Endeavour	AMS
peso	70 ton	7 ton
dimens	37x24 m	3x3x4.5 m
orbita	350 km	
velocità	28 mila km/h	
velocità r ISS	3 cm/s	
potenza		2.4 kW
data downlink		6 Mb/s
durata	14 giorni	> 2020
flusso RC		25 000 p/s




NASA
Airstream

16 Maggio ore 14.56 GMT+2

Un esperimento per lo studio delle particelle “elementari” sulla Stazione Spaziale Internazionale



AMS sulla ISS

Stato di AMS

- *18 Maggio 12.15 CET*: attracco Endeavour alla ISS
- *19 Maggio 8.30 CET:* inizio trasferimento AMS
- " *12.00 CET:* fine trasferimento AMS
- " *16.33 CET:* AMS operativo
- " *17.01 CET: trasferiti 2 Gbyte dati al CERN*
- *21 Maggio:* comportamento termico nella norma
  - radiatore RAM <t> = 0 °C +/- 5 °C
  - radiatore WAKE <t> = +10 °C +/- 3 °C

Motivazioni

Bariogenesi

Il Modello Standard

non spiega l'asimmetria materia-antimateria

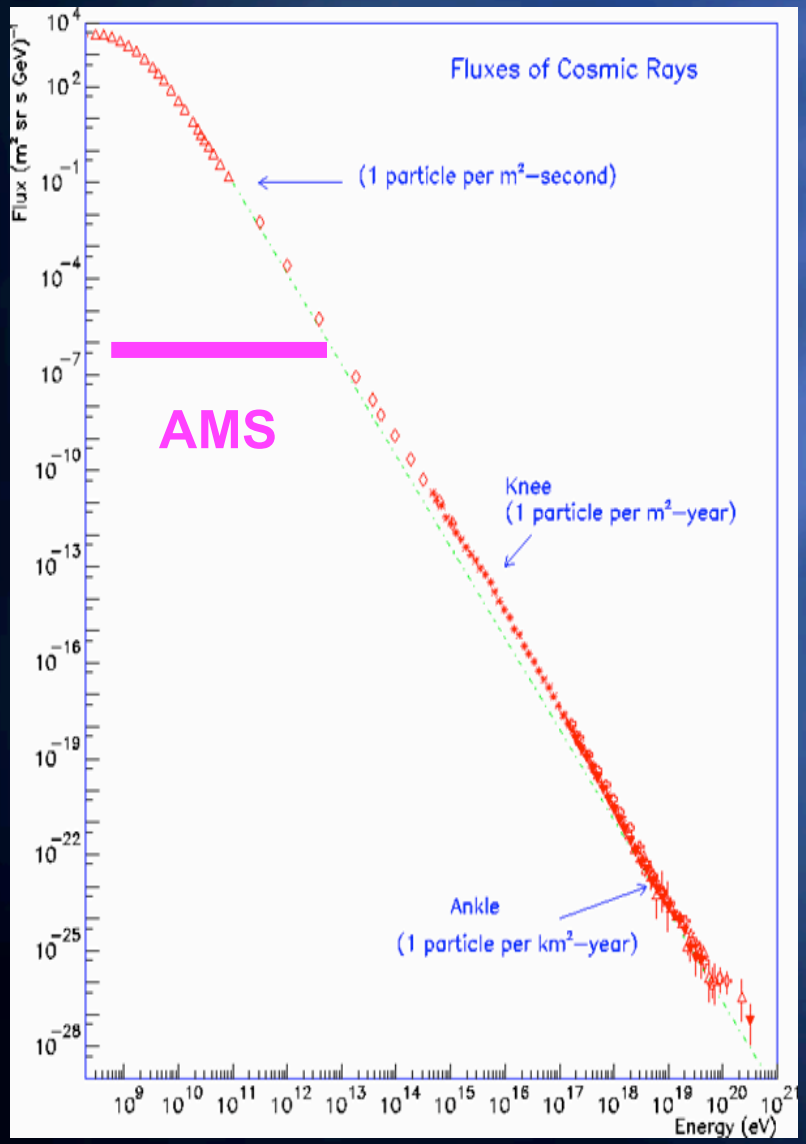
Materia oscura

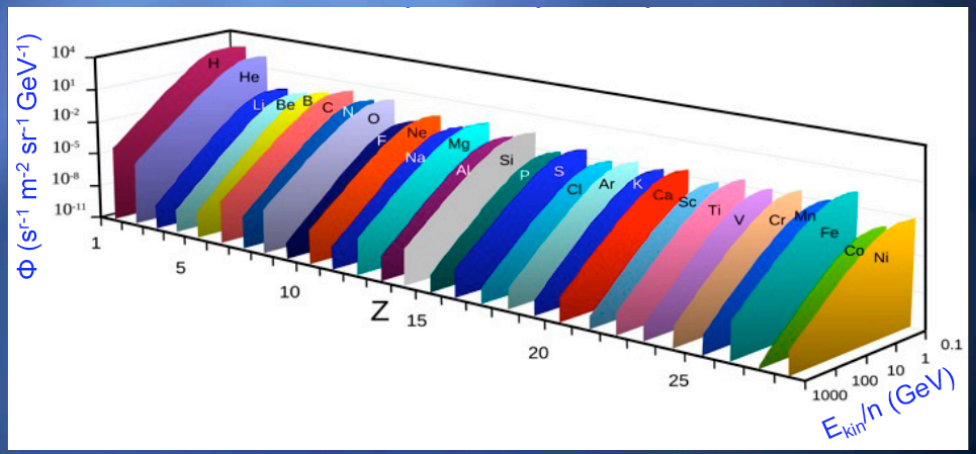
La Supersimmetria potrebbe fornire la soluzione

Flussi dei Raggi Cosmici

alta statistica, grande precisione

Spettri e composizione chimica RC





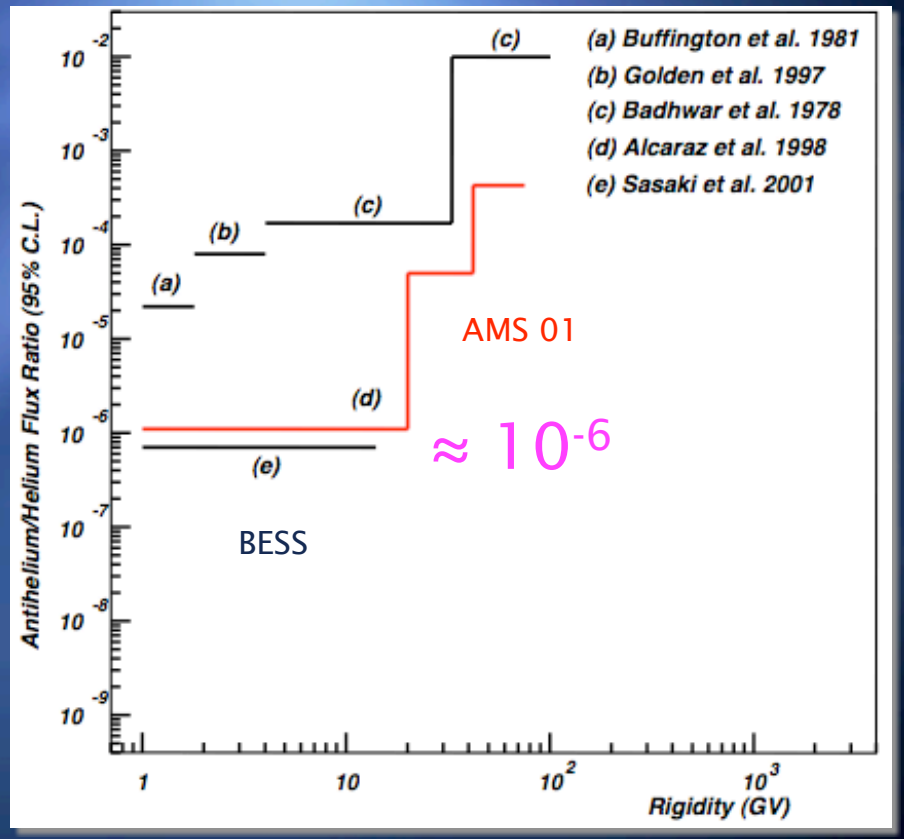
Antimateria primordiale

Il Big Bang presuppone
la formazione di materia ed
antimateria in eguali quantità

La scomparsa dell'antimateria
richiede tre condizioni
(Sakharov)

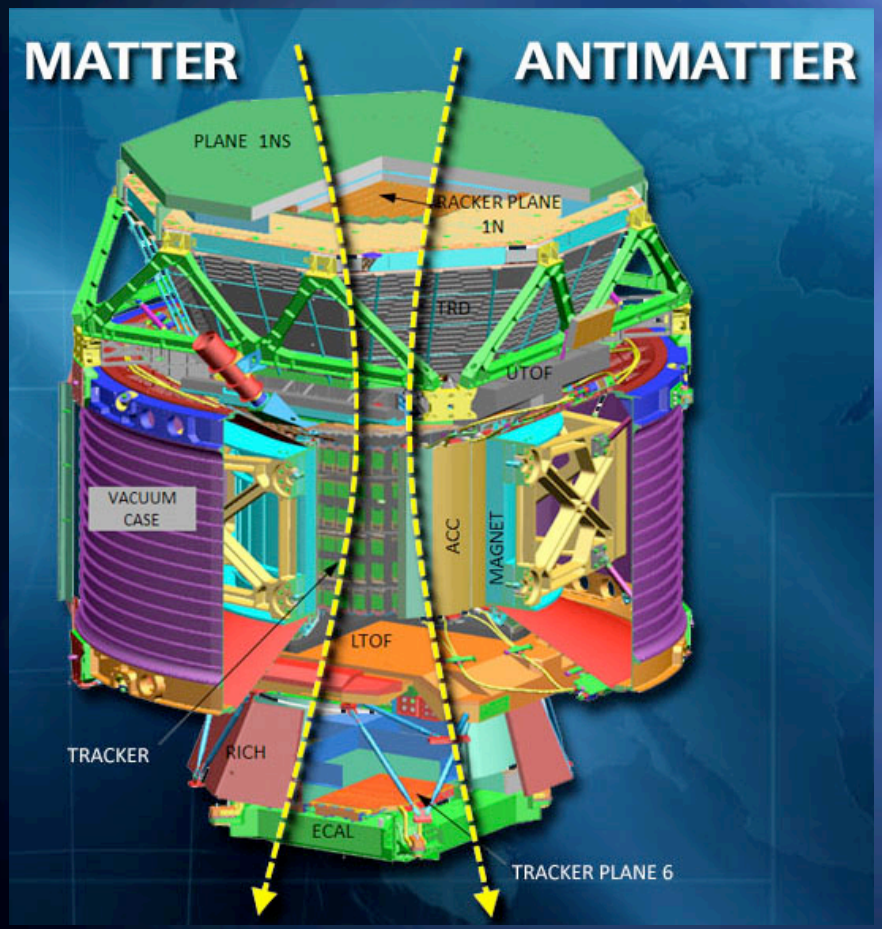
1. violazione del numero barionico
2. violazione di C e CP
3. condizioni di non equilibrio

$\overline{He}$ / He



limiti attuali

Anti He



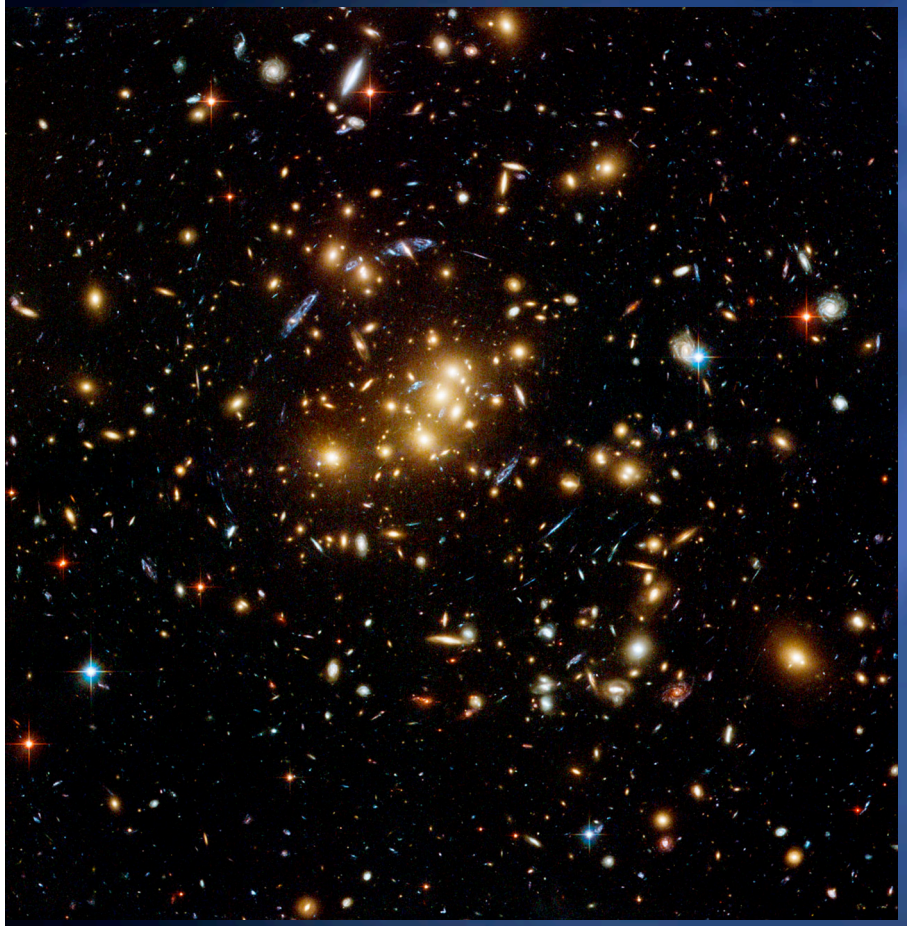
Sakharov (2001) :

$n(\overline{He})/n(He) \approx 10^{-6} - 10^{-8}$

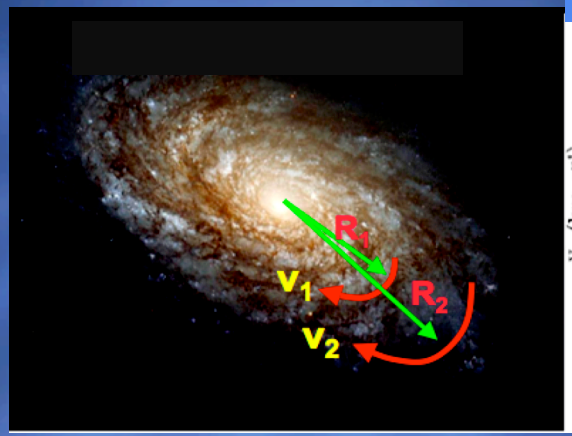
$\Rightarrow \quad \pm Q \qquad m$

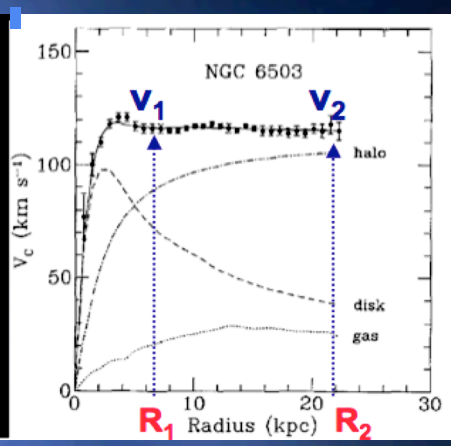
- grande BL^2
- direzione alto-basso
- spessori minimi

Materia oscura: effetti gravitazionali

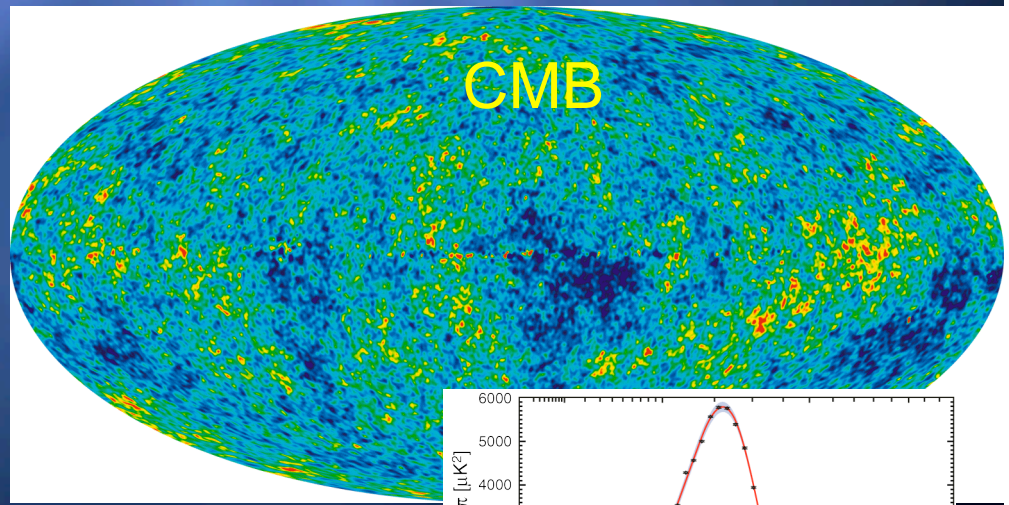


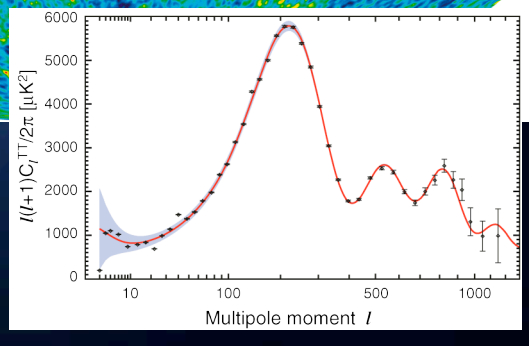
Lensing gravitazionale





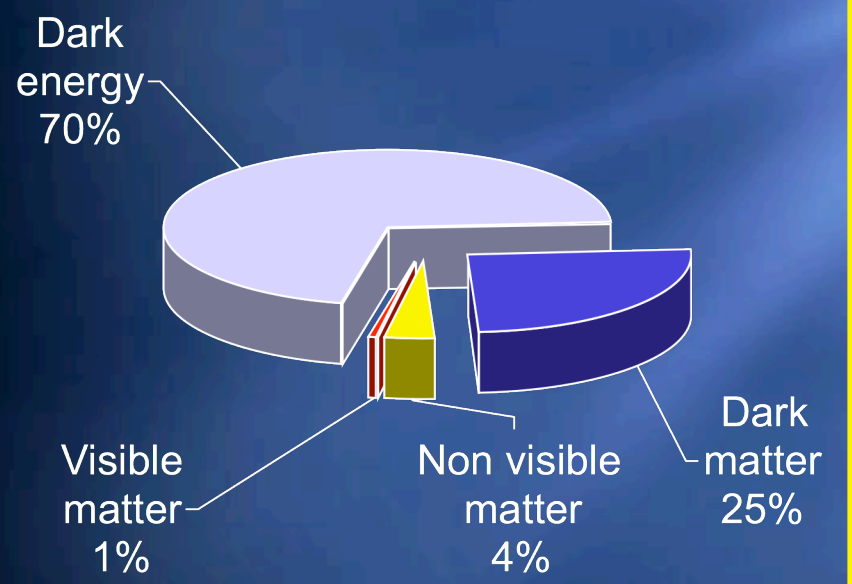
V. Rubin 1975





Boomerang
WMAP

Materia oscura



Supersimmetria?

fermioni $\rightarrow$ bosoni super
bosoni $\rightarrow$ fermioni super

neutralino χ

partner supersimmetrico di Z e higgs

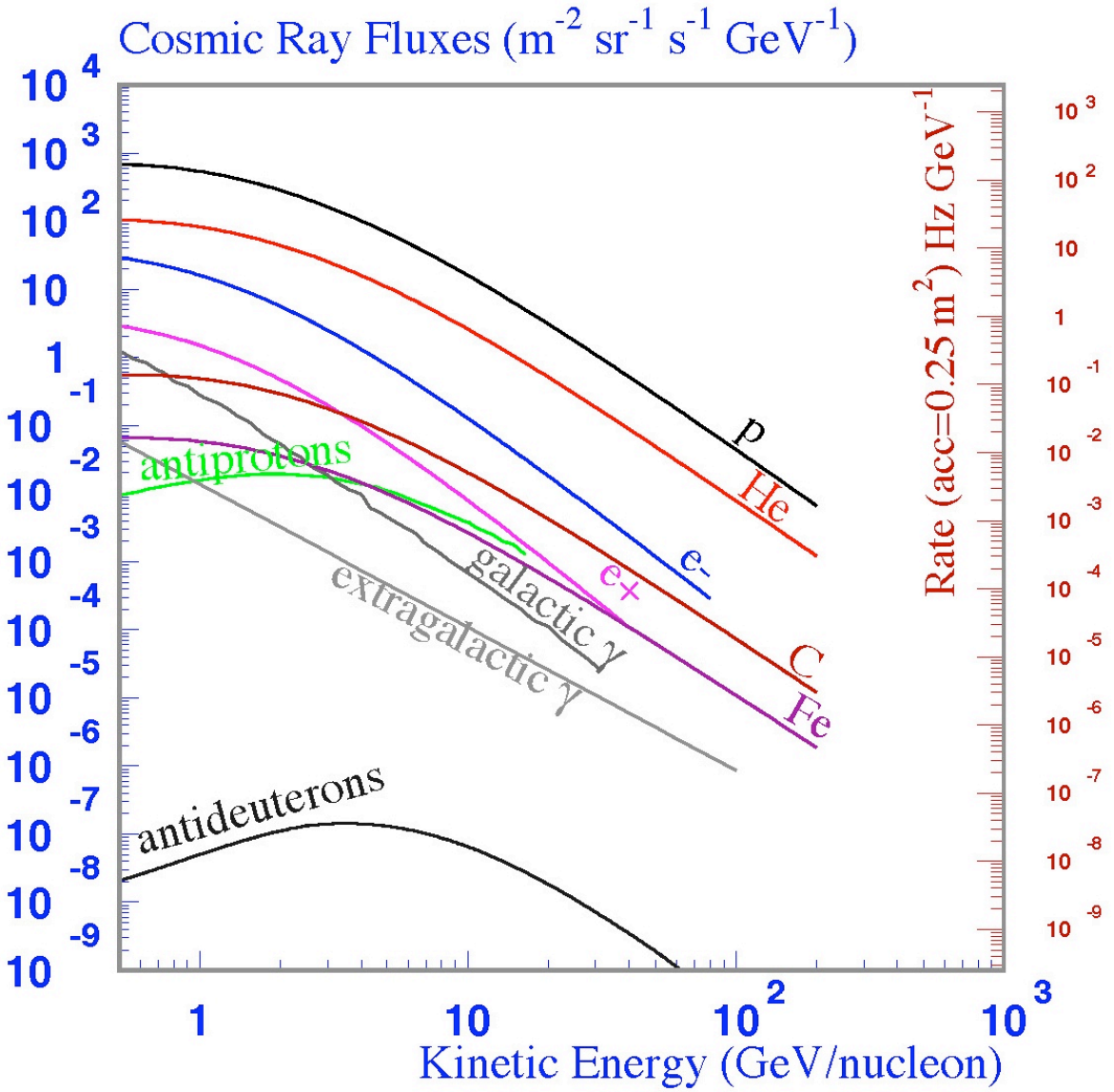
canali candidati per AMS

$\chi + \chi \rightarrow e^+ \quad X$

$\rightarrow \bar{p} \quad X$

$\rightarrow \gamma \quad X$

$\chi + \chi \rightarrow e^+$.....

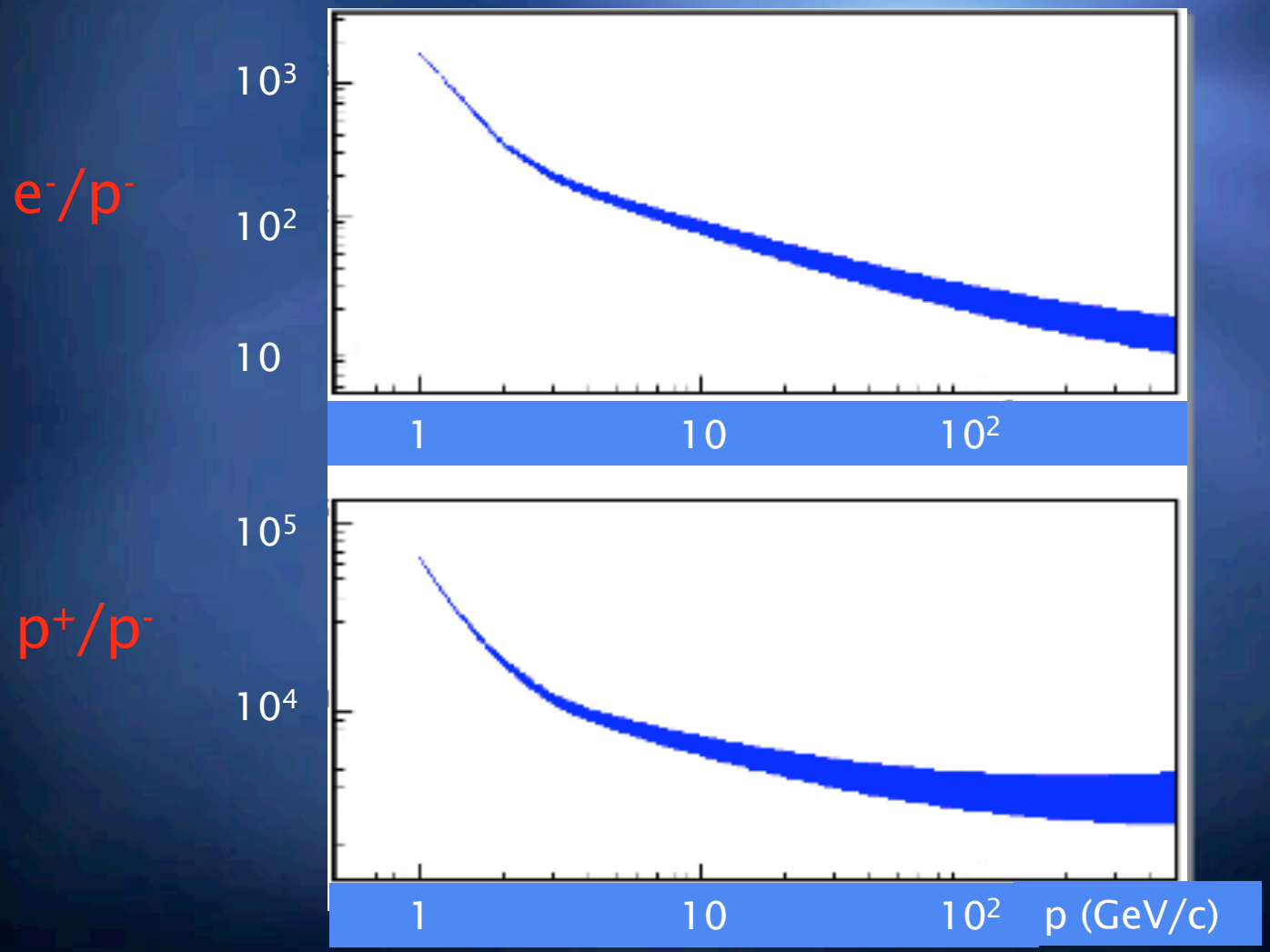


$p/e^+ \approx 10^3 - 10^4$

$\Rightarrow$ discriminazione $p \approx 10^5$

Antiprotoni

A.Malinin/UMD

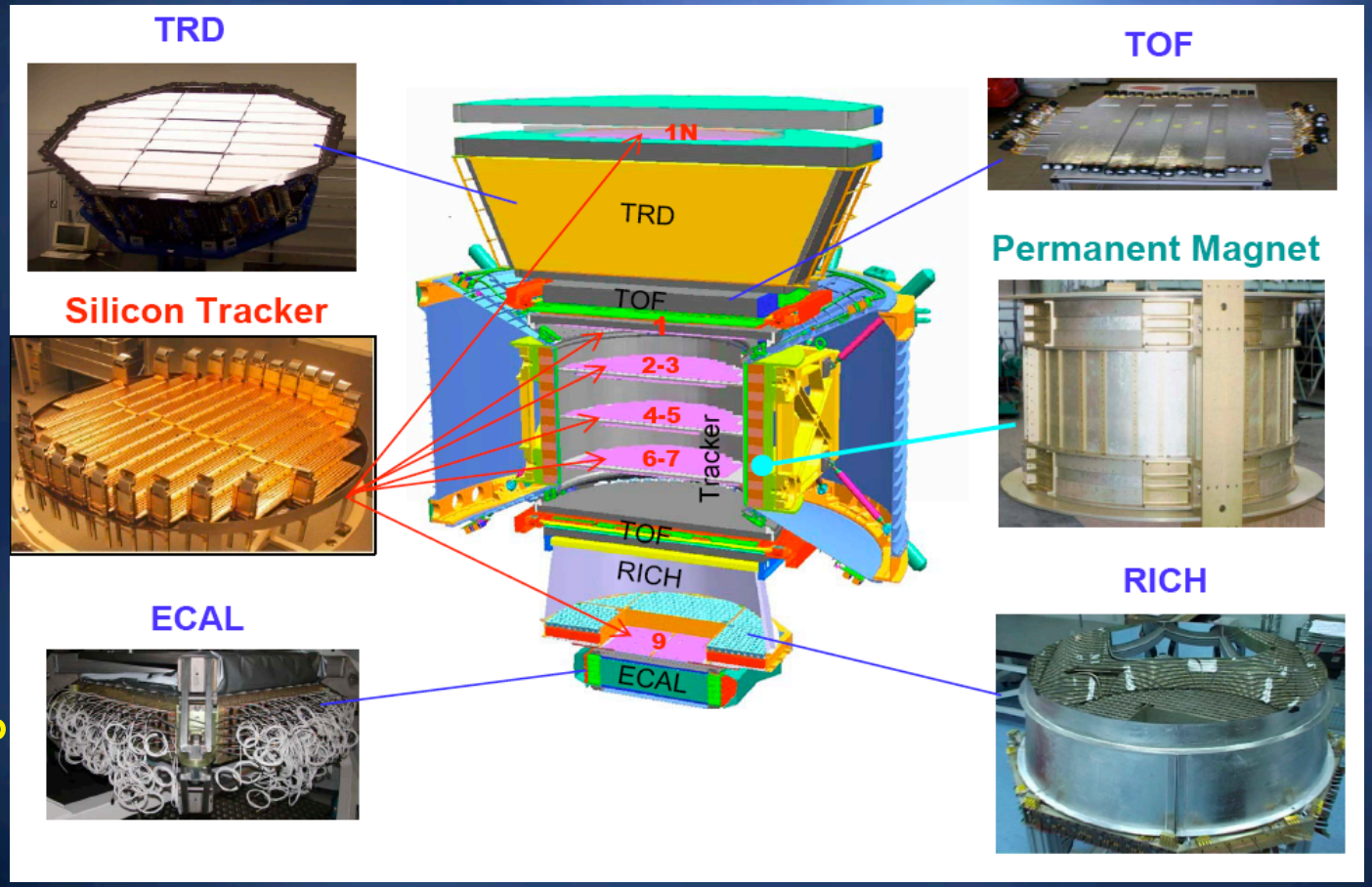


AMS

e/P

p, ±Q, Z

E(e,γ), e/P



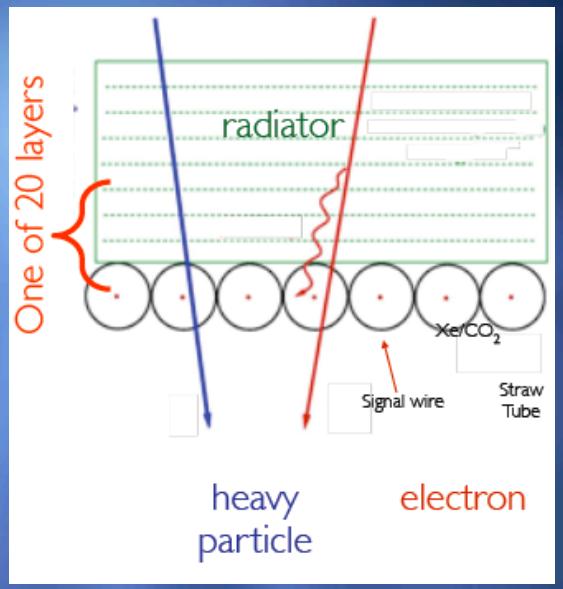
v, Z

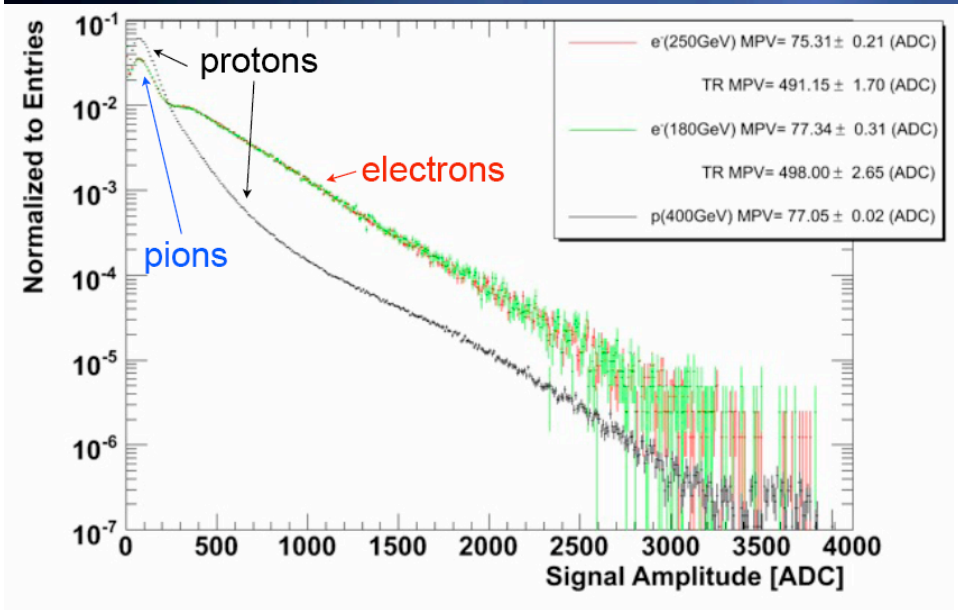
p, ±Q

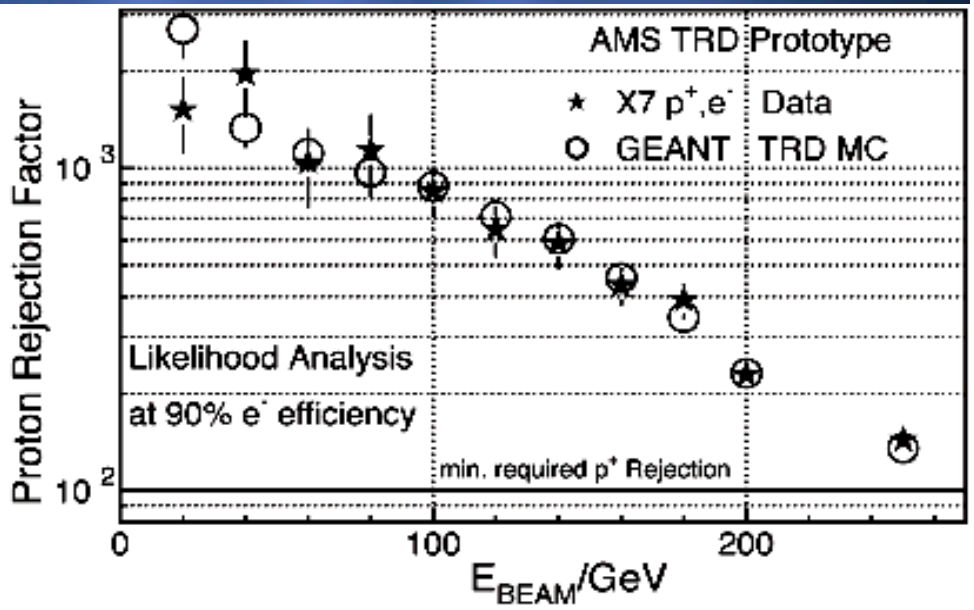
v, Z

$$m = p\,[(1/\beta^2) - 1]^{1/2}$$

Transition Radiation Detector

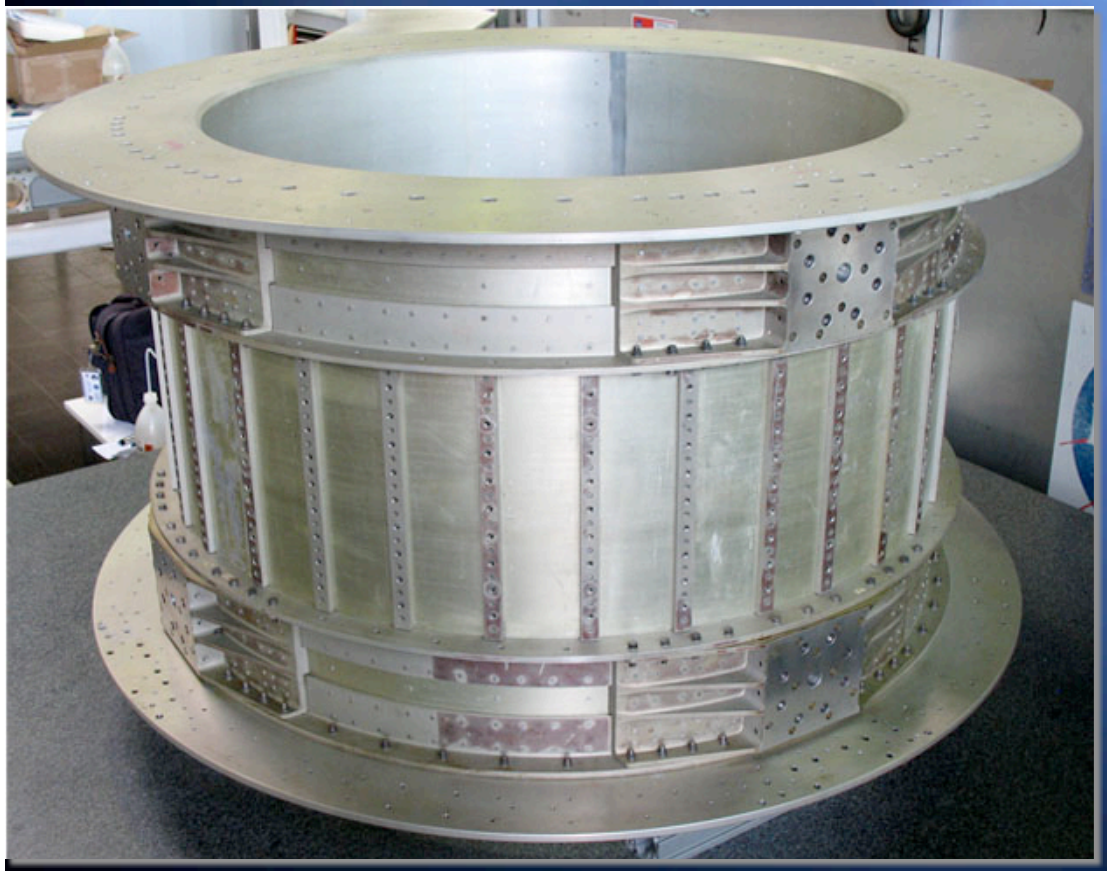




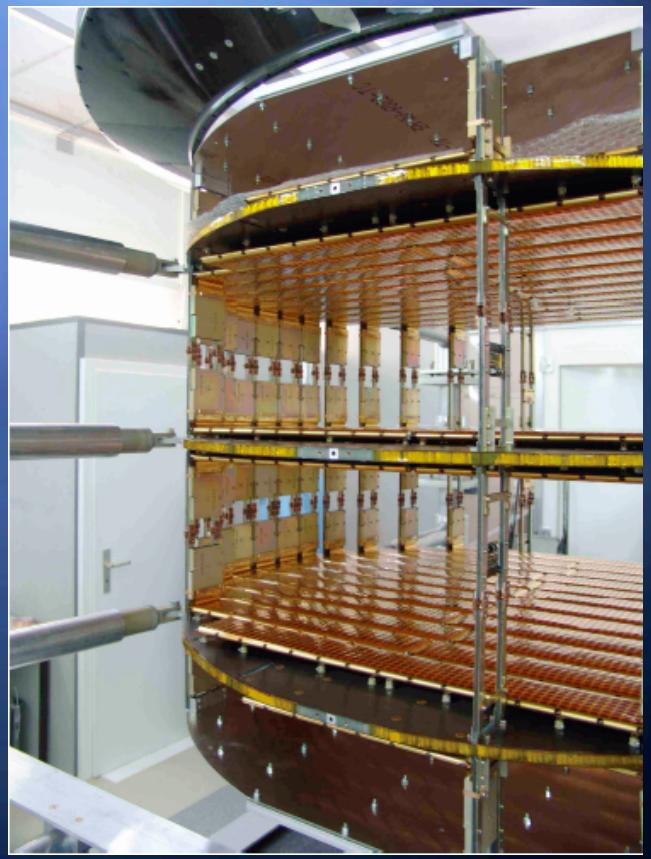


Magnete e Tracker

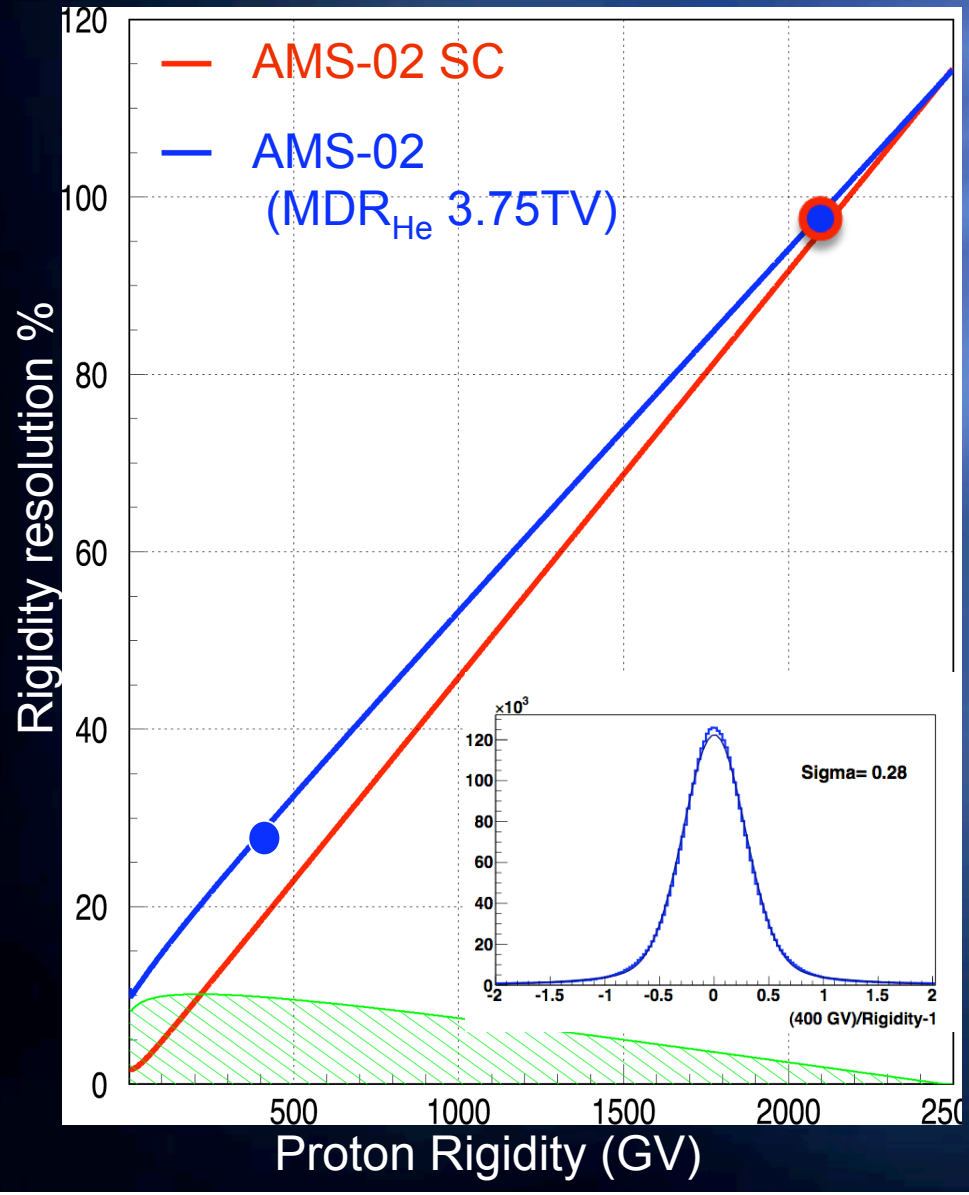
Magnete permanente ≈1500 gauss

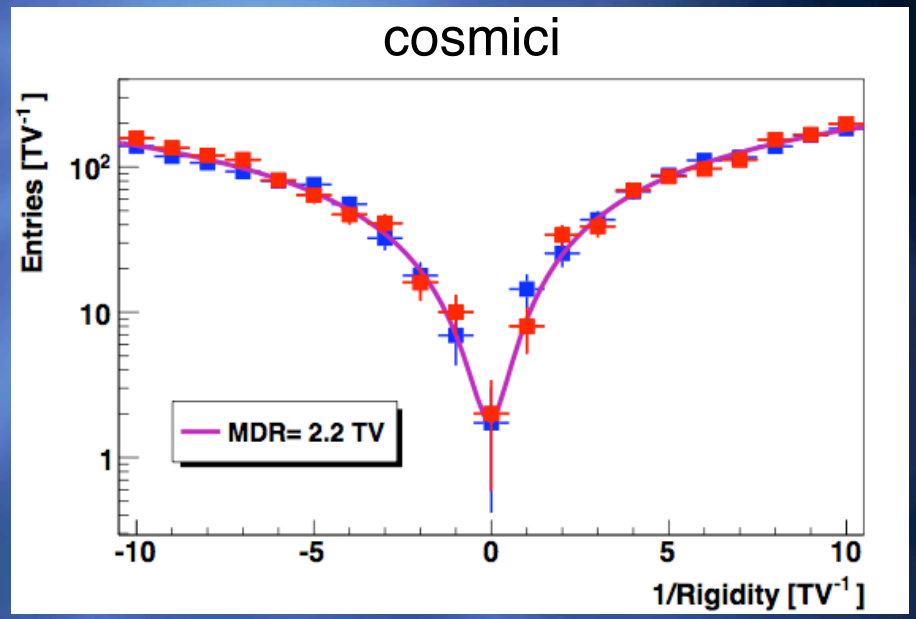


Tracker



Risoluzione Tracker

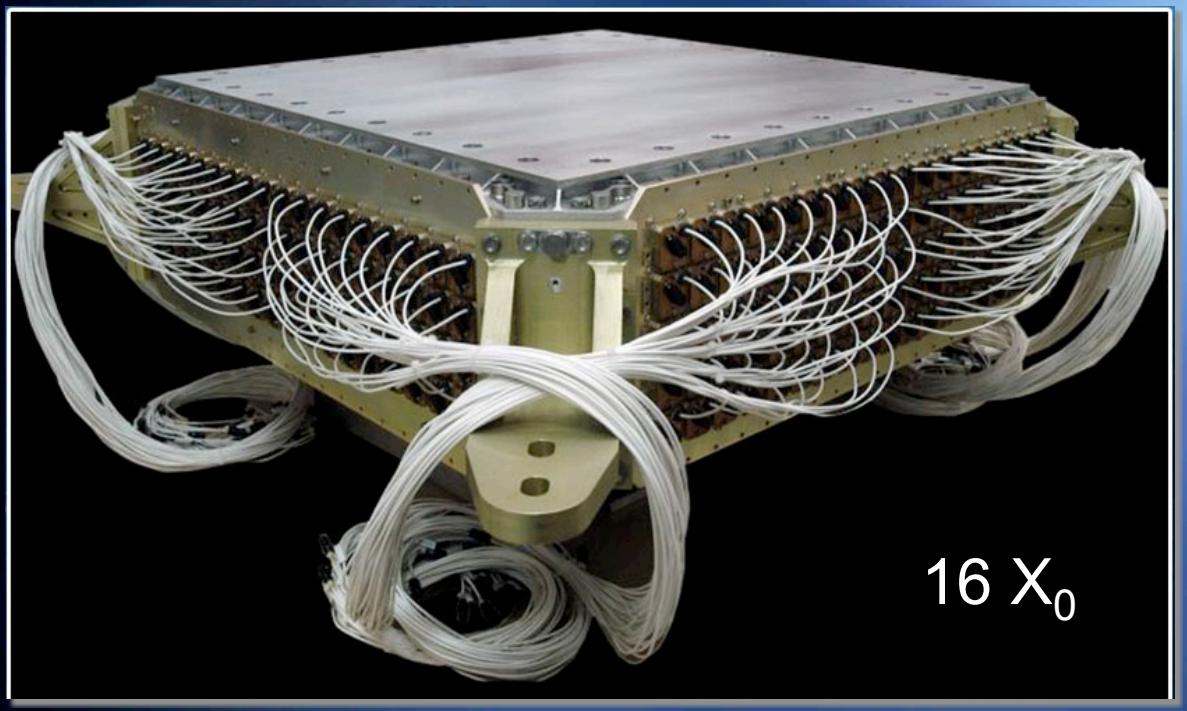


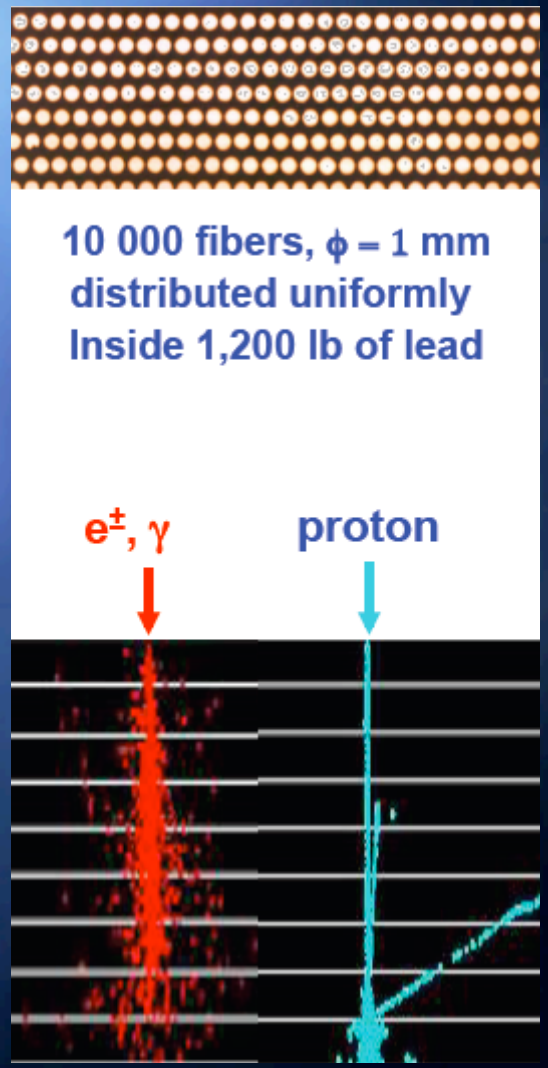


Rigidità R = p/Ze

Test Beam Result
400 GeV protons

Calorimetro Elettromagnetico



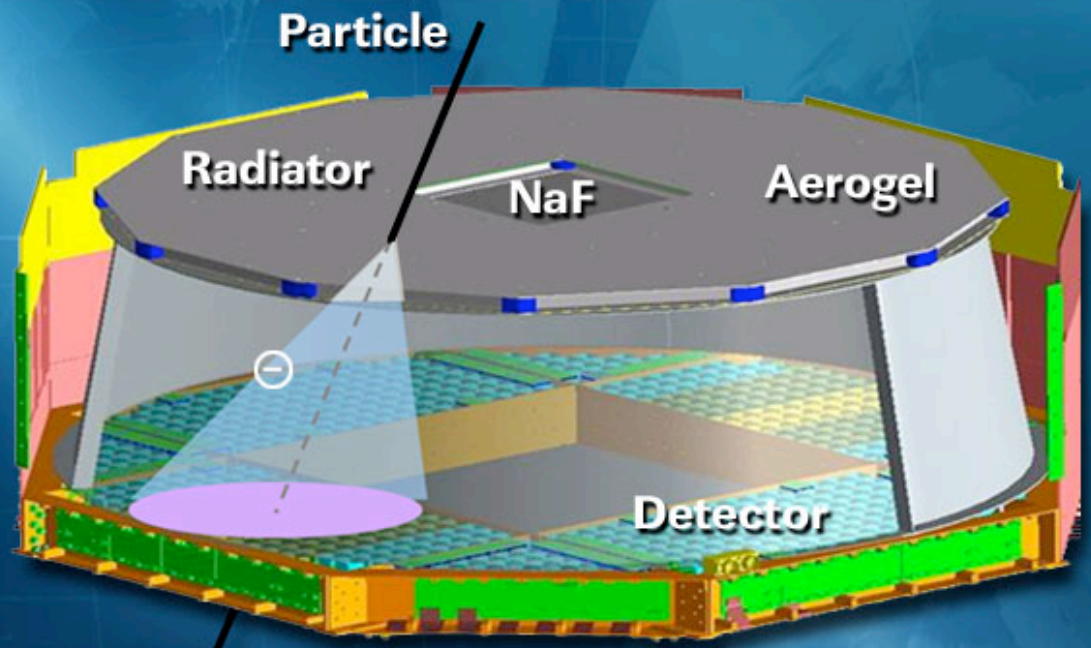


Discriminazione e/p:

➔ sviluppo dello sciame

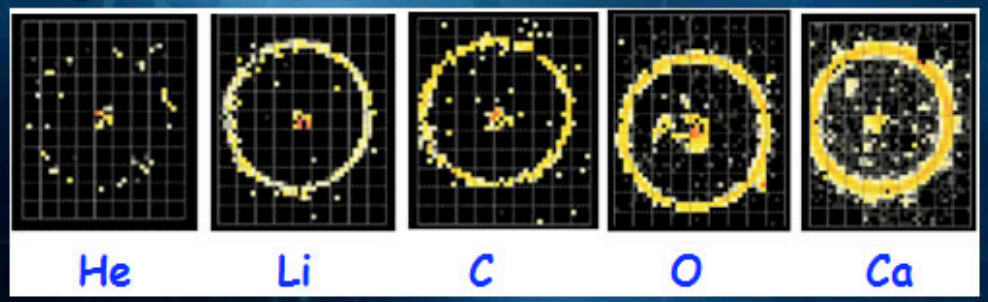
➔ confronto $E_{calorimetro}$ vs p_{track}

Ring Imaging CHerenkov

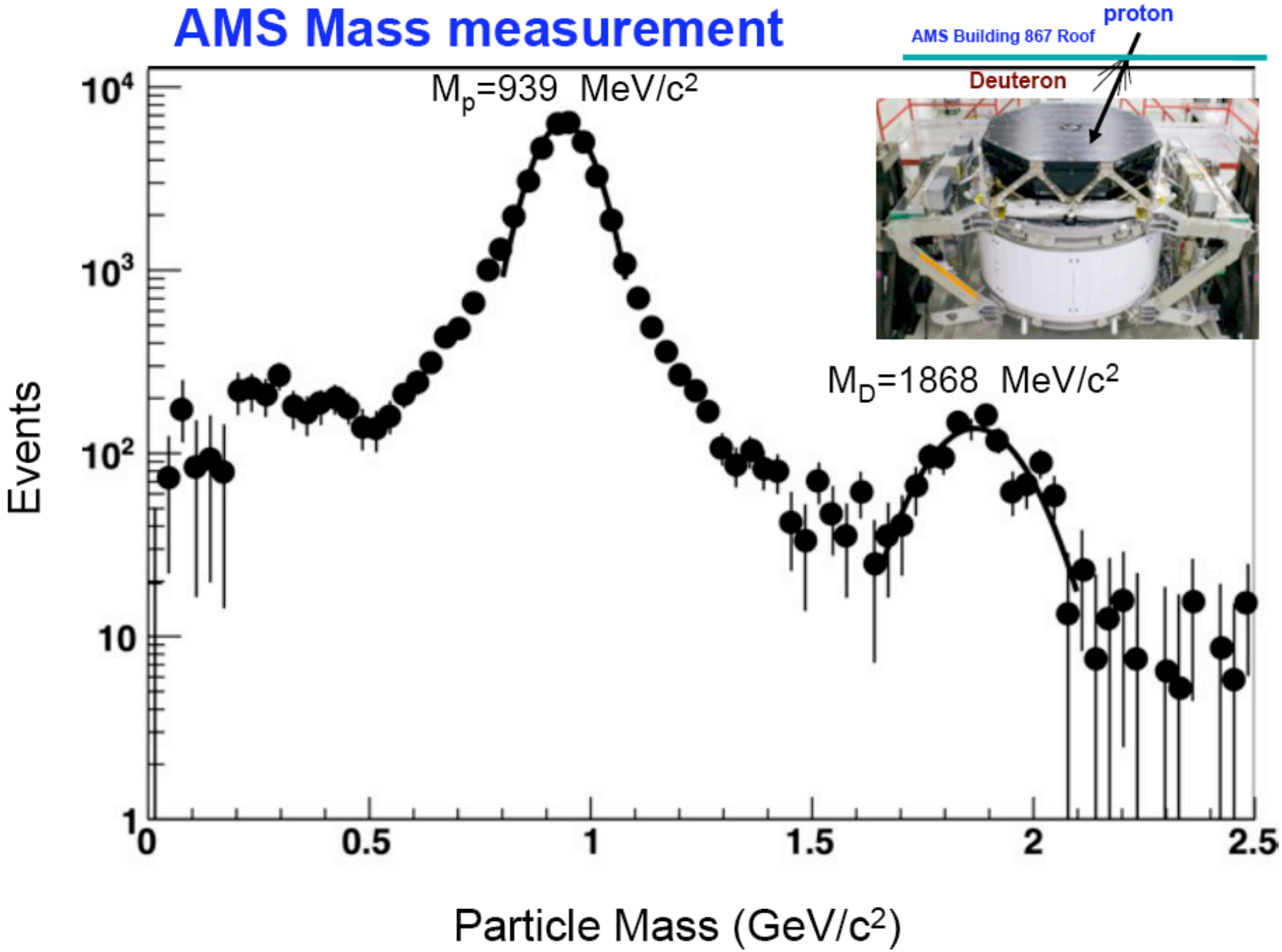


Intensità $\propto Z^2$
$\cos\theta \propto 1/\beta$

Single Event displays from the Test beam E=158 GeV/n

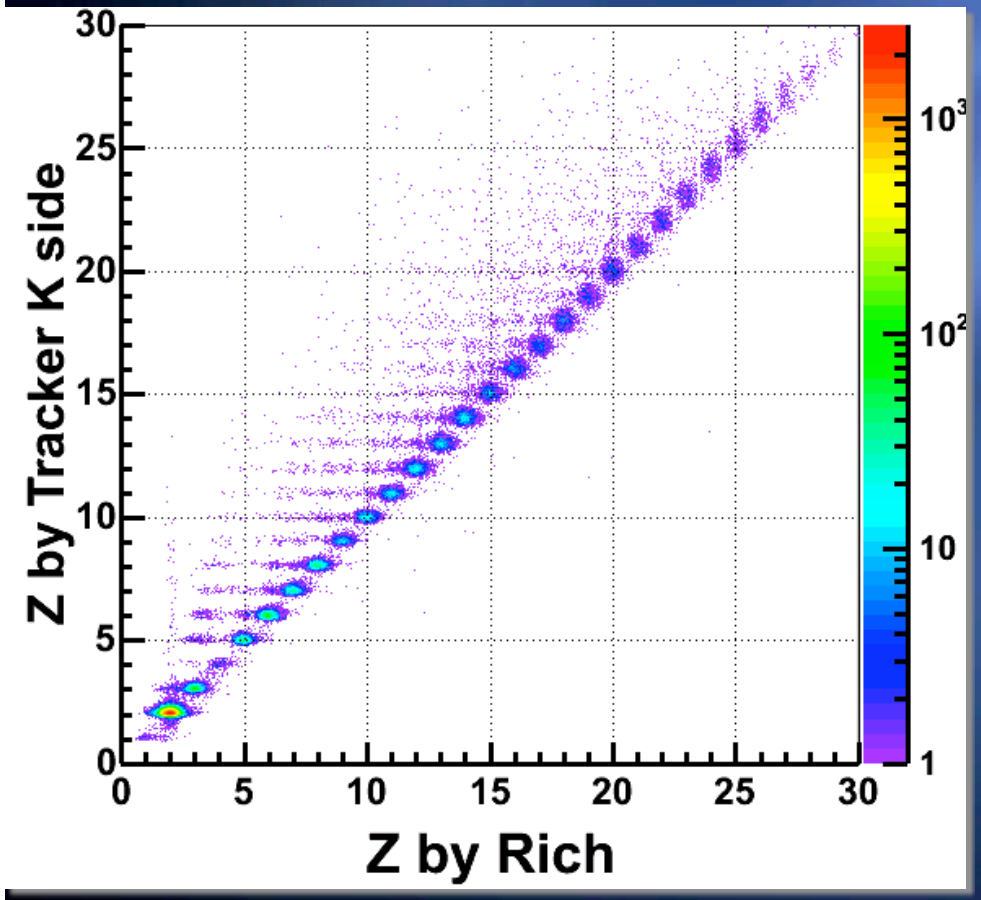


AMS Mass measurement

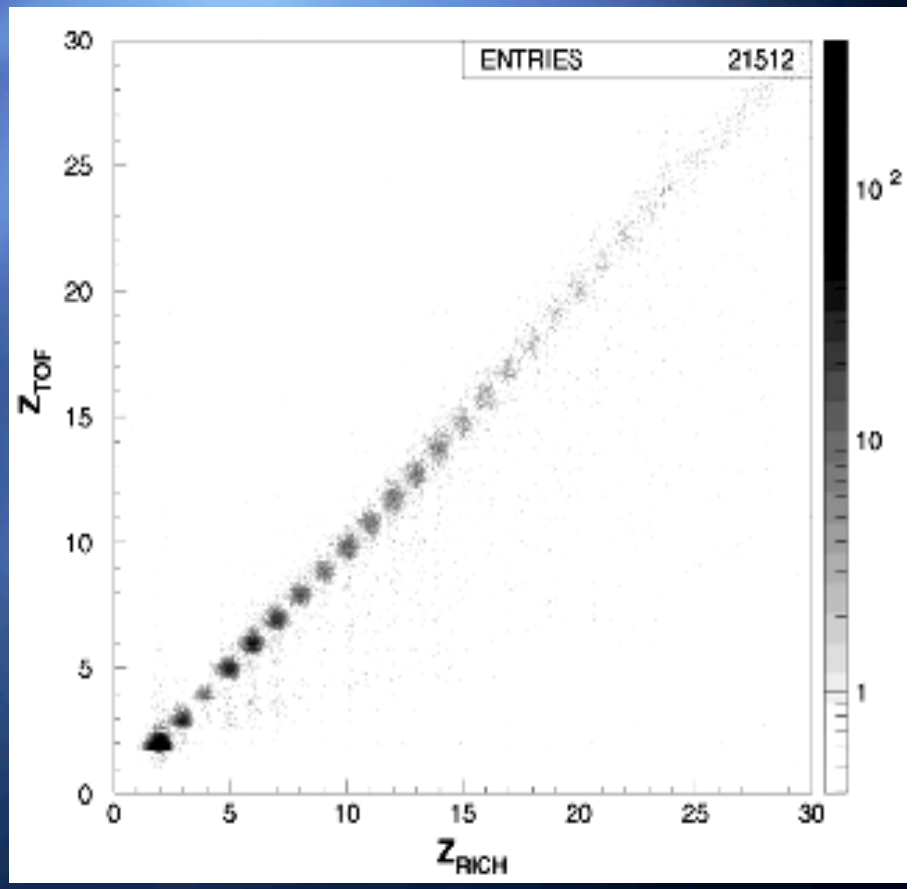


Identificazione Z

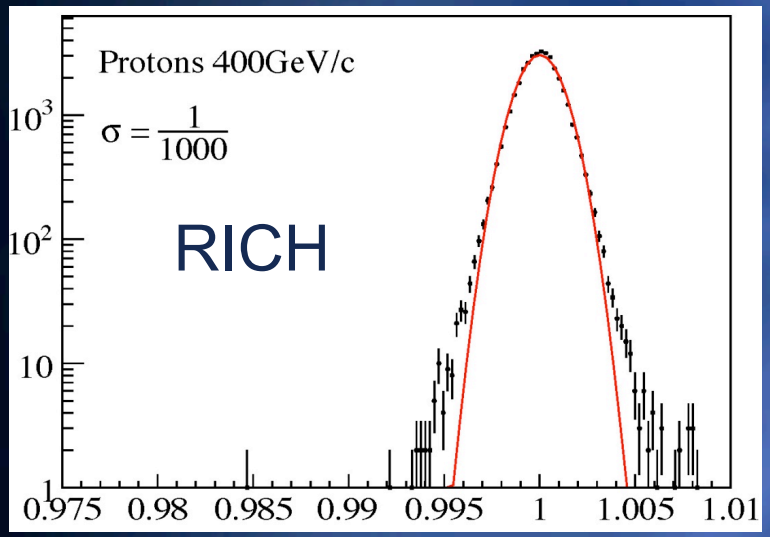
TRK vs RICH

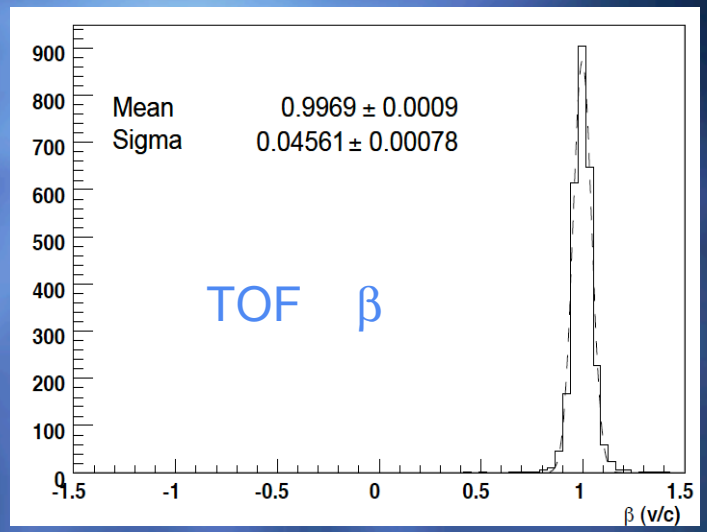


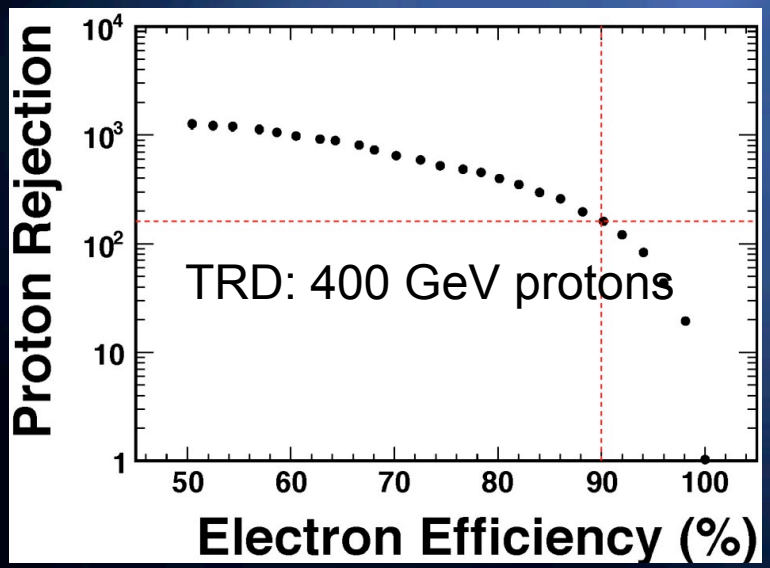
TOF vs RICH

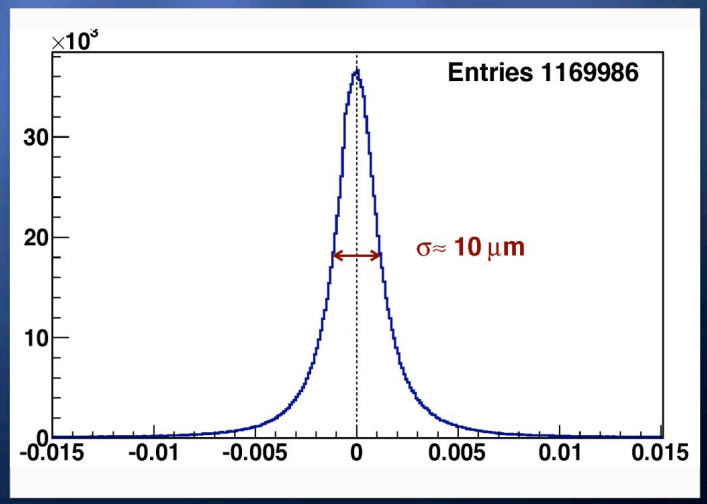


Test beam al CERN



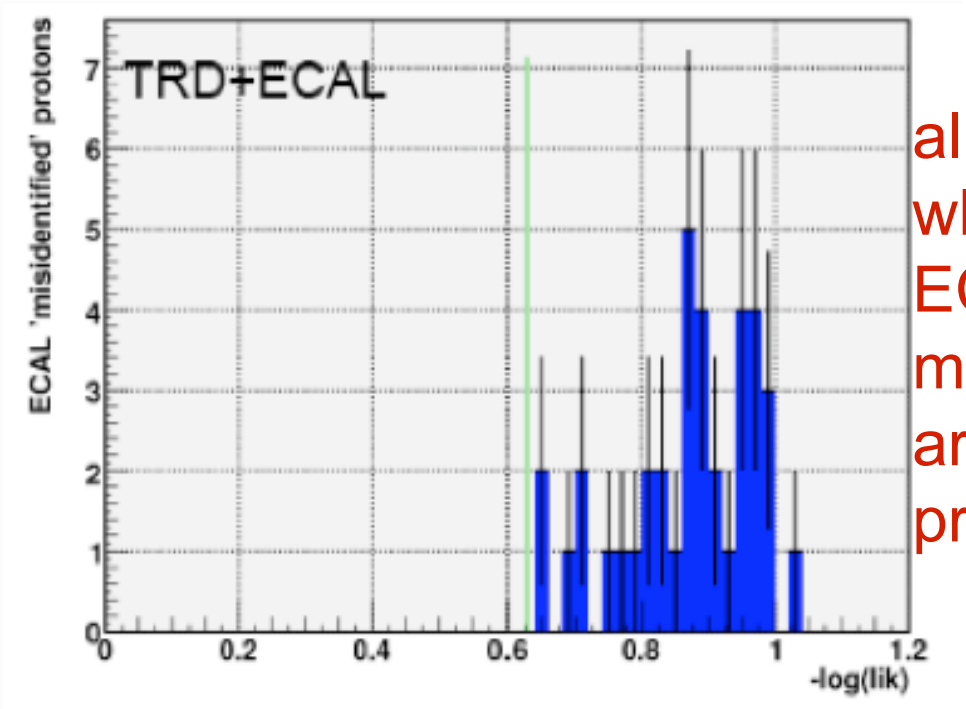






Bending Plane Residual (cm)

Preliminary AMS rejection

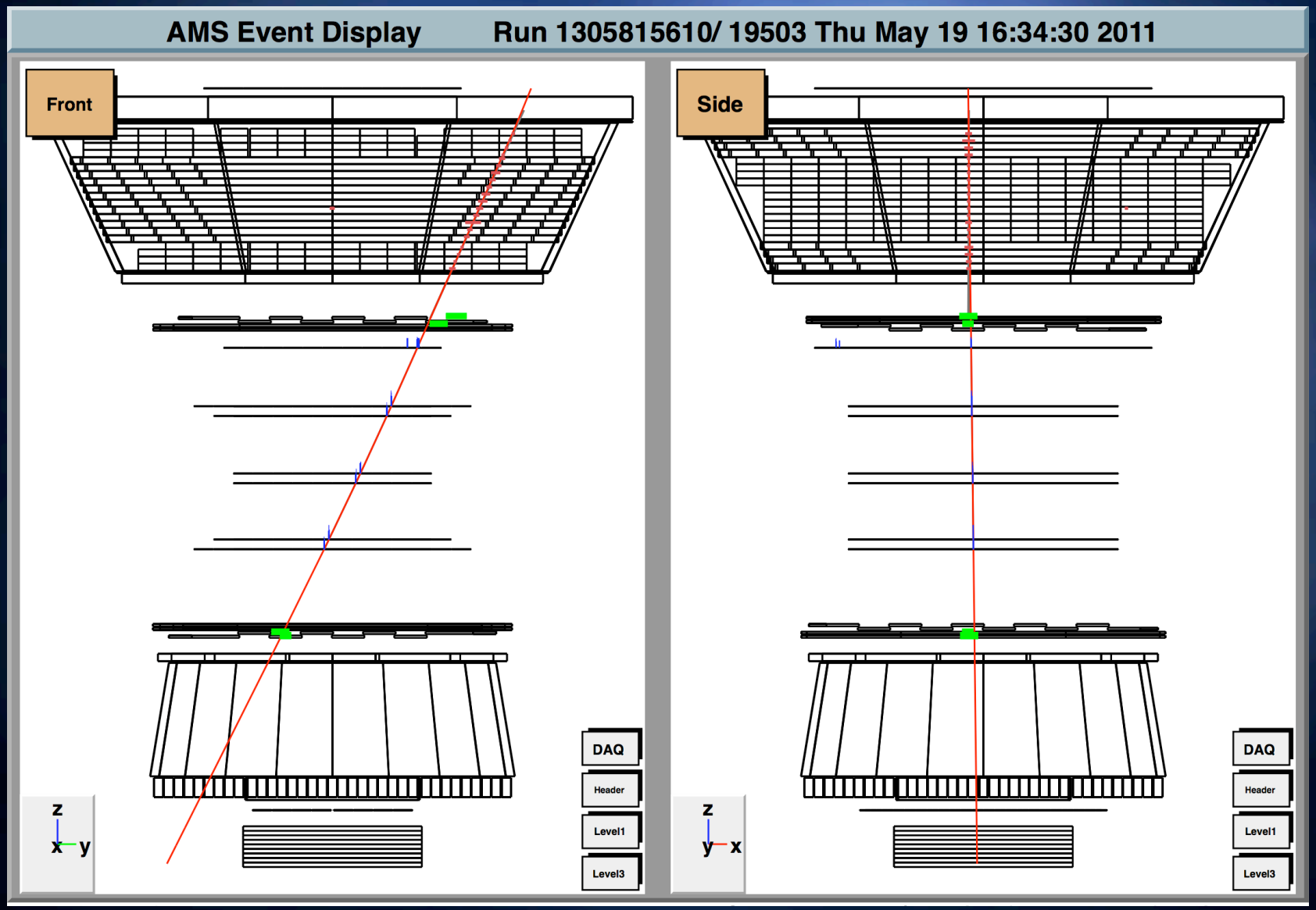


all 36 events which survive ECAL and E/p matching cuts are tagged as protons by TRD

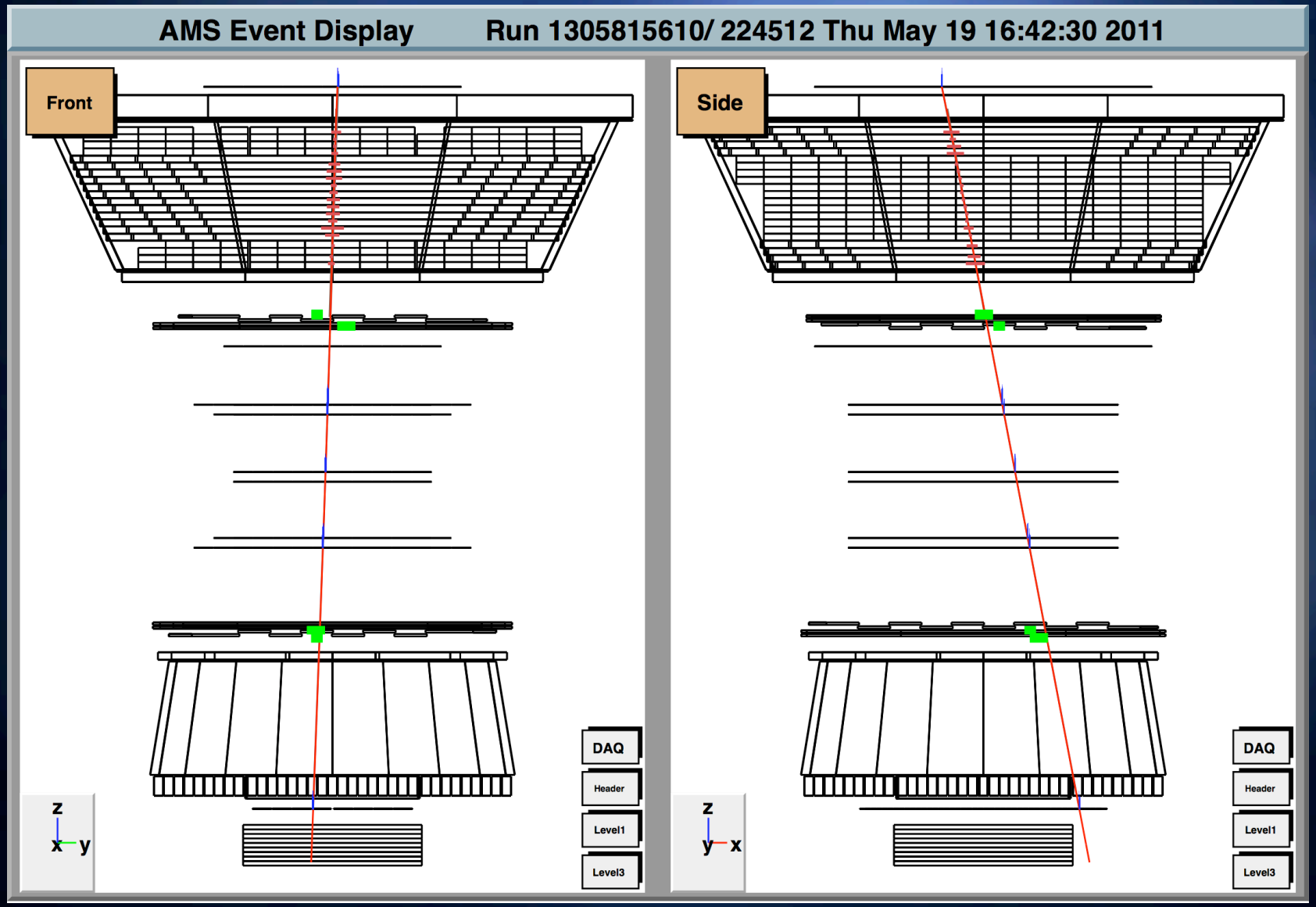
- 400GeV protons:
- ECAL+TRACKER+TRD rejection:
  - $R_p < 1.2 \cdot 10^{-6}$ (0 out of 1.96e6)

I primi eventi dallo spazio

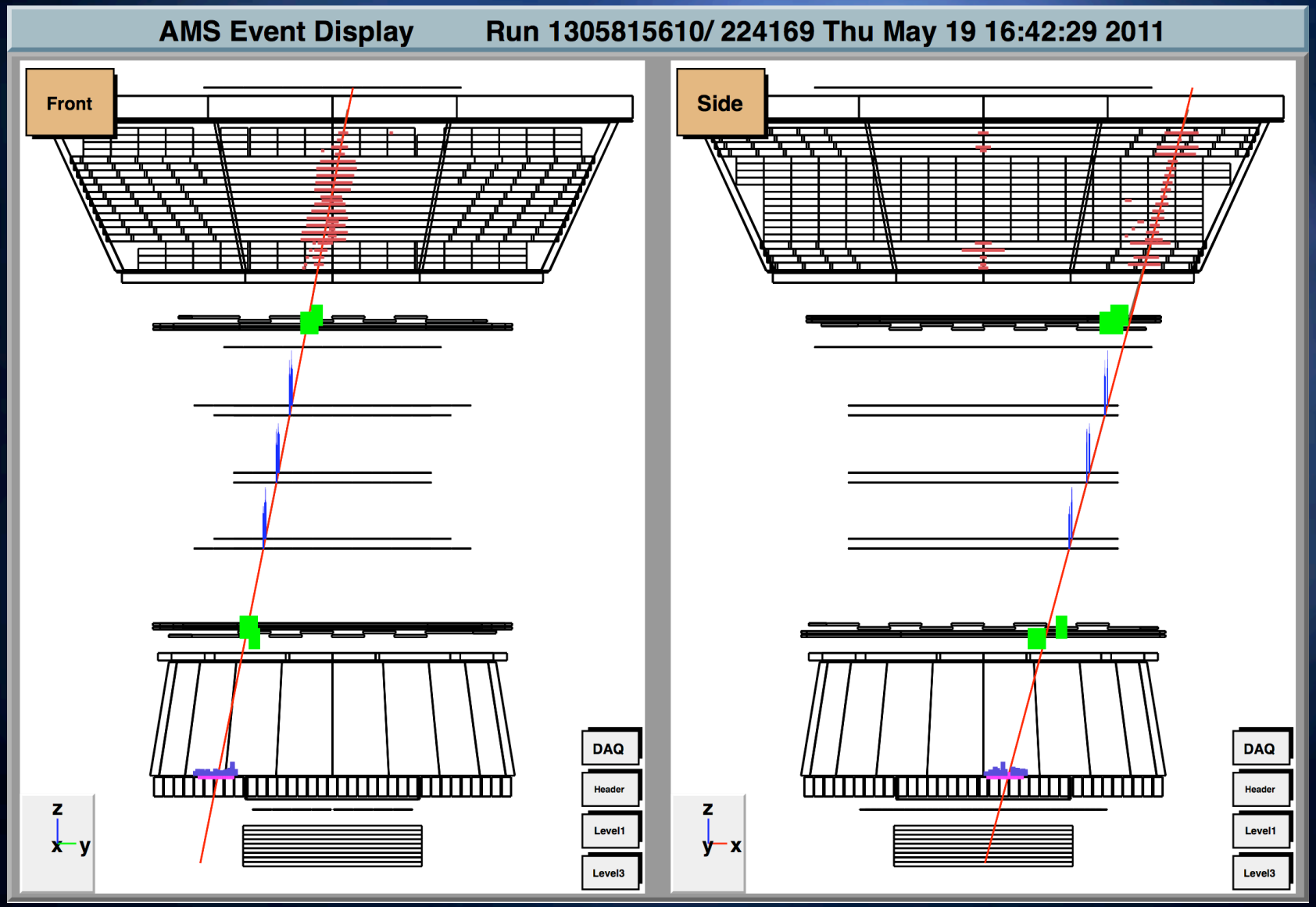
Protone


AMS Event Display
Run 1305815610/ 19503 Thu May 19 16:34:30 2011
Front
Side
DAQ
Header
Level1
Level3
z
x
y

He


AMS Event Display
Run 1305815610/ 224512 Thu May 19 16:42:30 2011
Front
Side
DAQ
Header
Level1
Level3
z
x
y

Carbonio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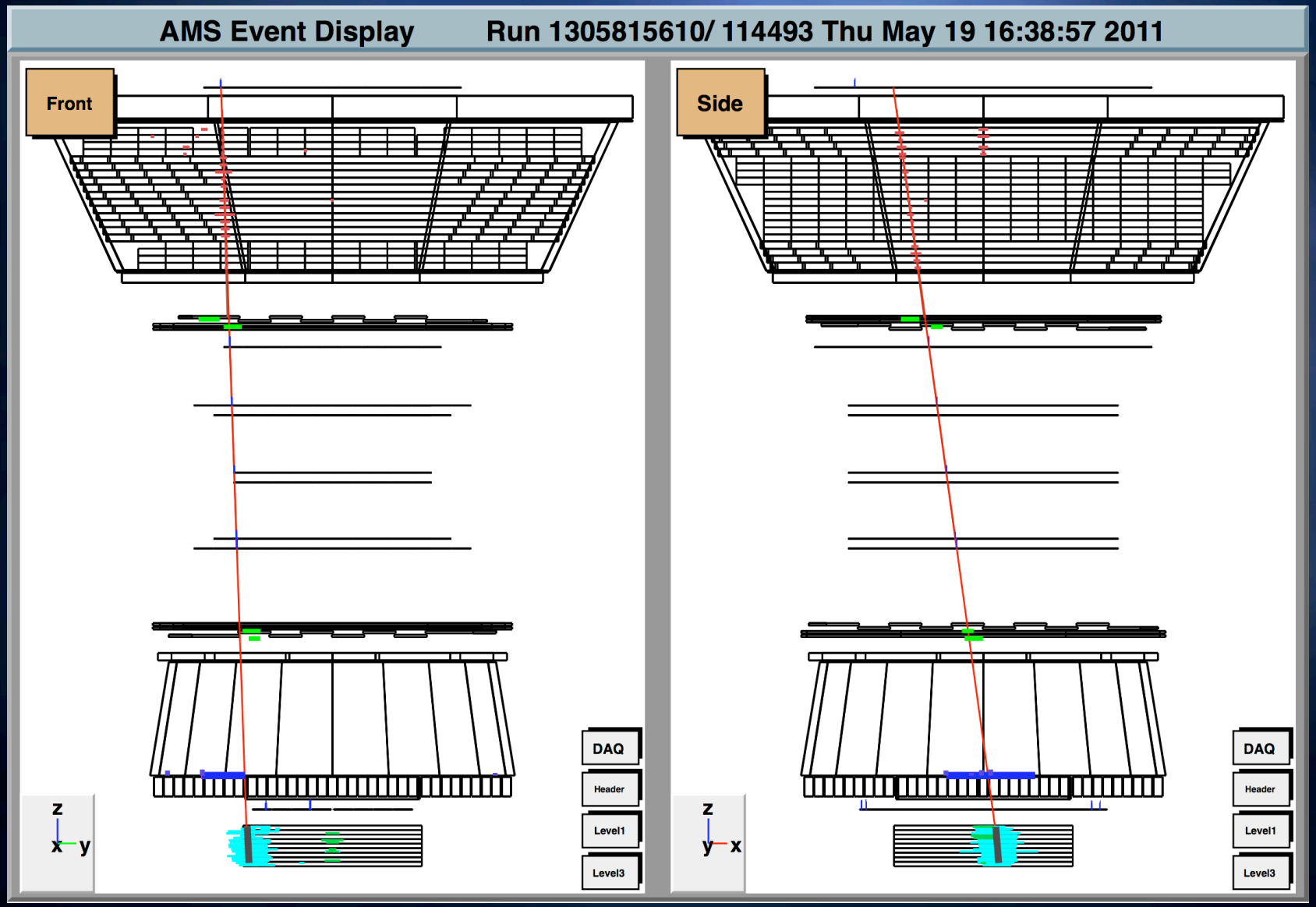
Front
Side
DAQ
Header
Level1
Level3
z
x
y

Elettrone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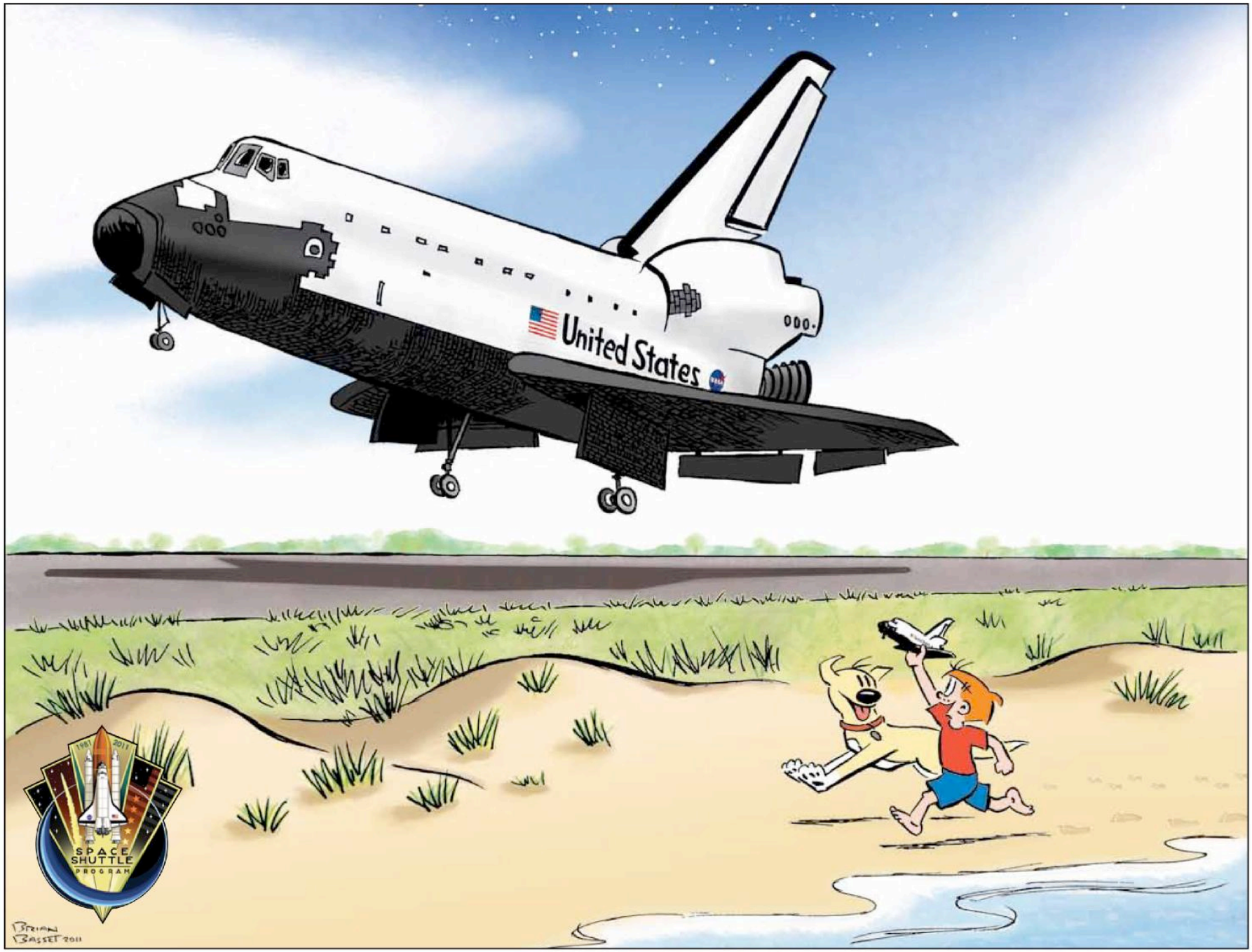
Front
Side
DAQ
Header
Level1
Level3
z
x
y



What a Ride it's Been!

by Brian Basset