

September 2010



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Contin A.,
Giovacchini F.,
Guandalini C.,
Laurenti G., Levi G.,
Lolli M., Masi N.,
Quadrani L.,
Palmonari F., Sbarra C.

The Time Of Flight of the AMS-02

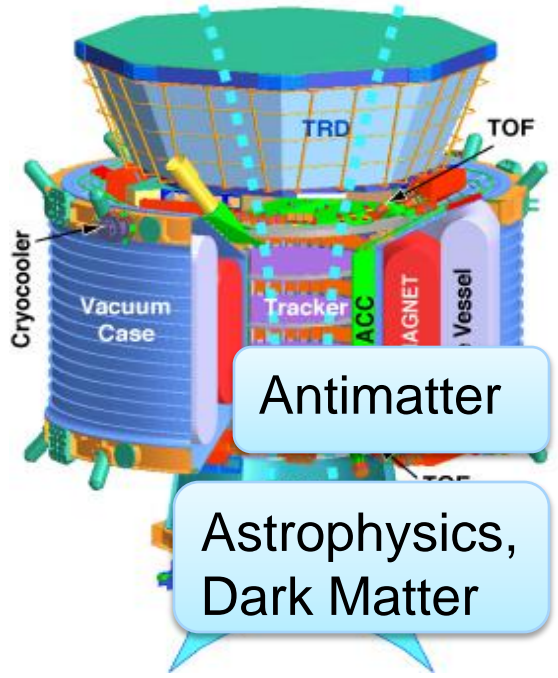
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Bologna University and INFN



Matter Anti-Matter

Main tasks



An Improved Version of AMS-01

Value	AMS-01	AMS-02
Mission length	10 days	10 years
MDR	150 GV	1 TV
He Statistics	2.86×10^6	$> 10^9$
$E_{max} (e^-)$	~ 30 GeV	1.4 TeV
$E_{max} (e^+)$	~ 3 GeV	350 GeV
$E_{max} (\bar{p})$	~ 3 GeV	450 GeV

The TOF system provides:

- the **fast trigger** to the whole AMS;
- the measurement of the time of flight (Δt – better than 180 ps), for the determination of the particle velocity (β), with a resolution of few %;
- the **distinction** from upward and downward going particles at a level of 10^{-9} necessary to distinguish between **matter and antimatter**;
- the measurement of the **absolute particle charge** up to $Z = 15$.

$$\frac{\overline{He}}{He} < 1.1 \times 10^{-6}$$

Strangelets



Expected Goal for Antinuclei Search



Expected number of detected cosmic ray particles above a given energy threshold in three years of data

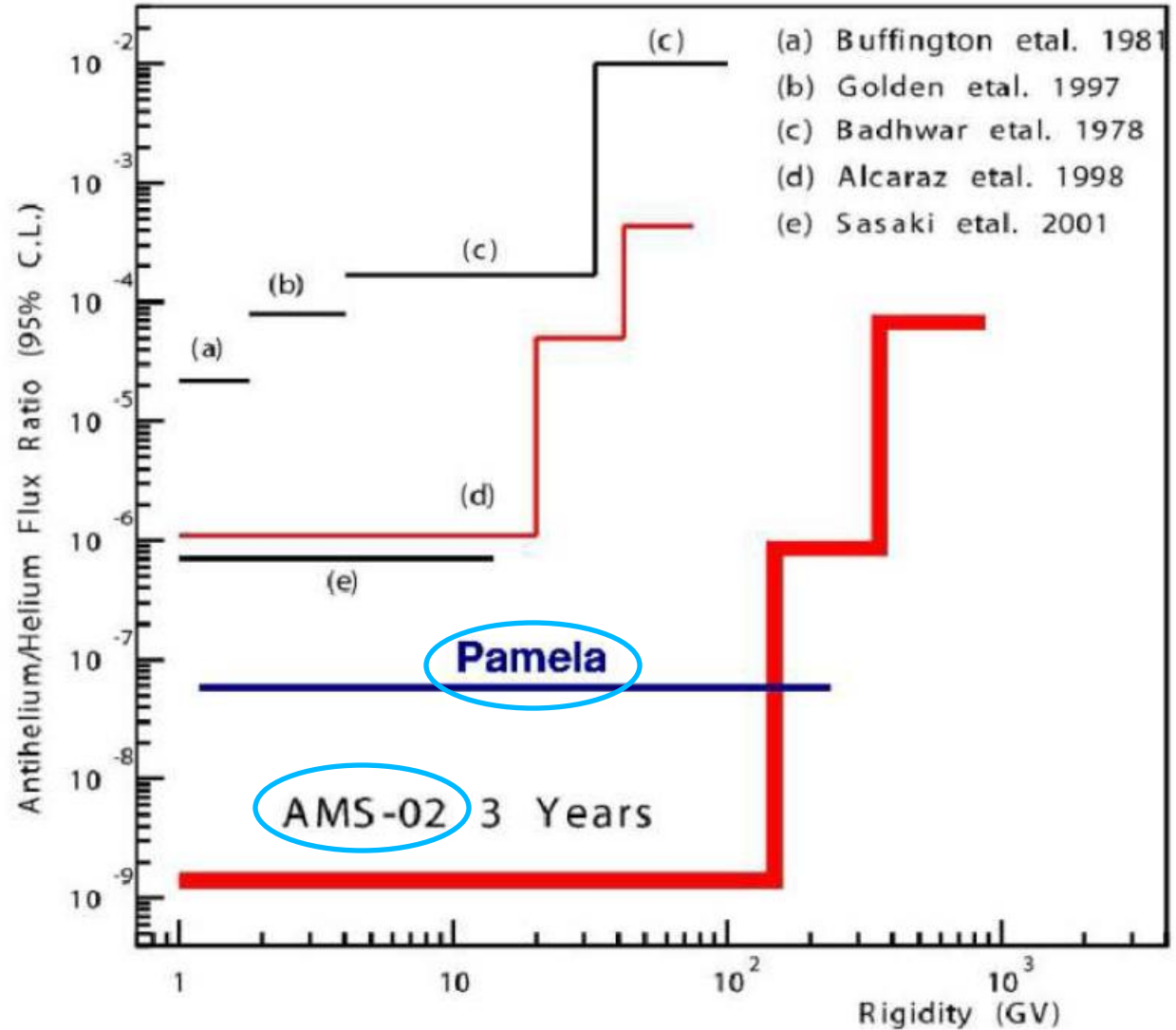
	$> 1 \text{ GeV}/c$	$> 10 \text{ GeV}/c$	$> 10^2 \text{ GeV}/c$	$> 1 \text{ TeV}/c$
p		6.1×10^9	1.5×10^8	2.5×10^6
e^-	1.4×10^8	6.8×10^6	7.2×10^4	4.4×10^2
e^+	9×10^6	3×10^5	1.6×10^3	6
\bar{p}	1.4×10^8	6.8×10^6	7.2×10^4	4.4×10^2
He	6.4×10^8	2.1×10^8	7.3×10^6	1.7×10^5



Expected Goal for Antinuclei Search

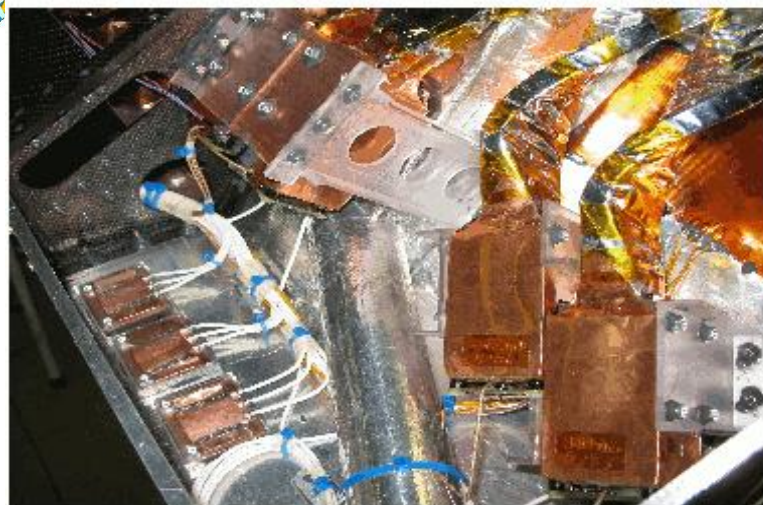


Antihelium/Helium Flux





The AMS-02 TOF





MAIN CHARACTERISTICS OF TOF SYSTEM

- ✓ **High redundancy of electronic components for unmanned operation of 10 years in the space station;**
- ✓ **Capability to operate in the space environment (in vacuum, large temperature variations) on the ISS.**
- ✓ **Large sensitive area: 6.4 m²**
- ✓ **Low weight (264 kg) and low power consumption (150 W)**



AMS-02/TOF Chronology

- TOF: INFN Laboratories (Bologna) 2001 - 2006
- TOF: Thermal vacuum and vibration test in Terni 2006 - 2007
- **CERN**: Test beam 2008 - 2010
- **ESA** (Estec): CR Muons February 2010
- **CERN**: Permanent Magnet, new test beam and calibration May 2010
- **NASA** (Cape Kennedy) - Final Step – CR Muons (unreleased) August 2010

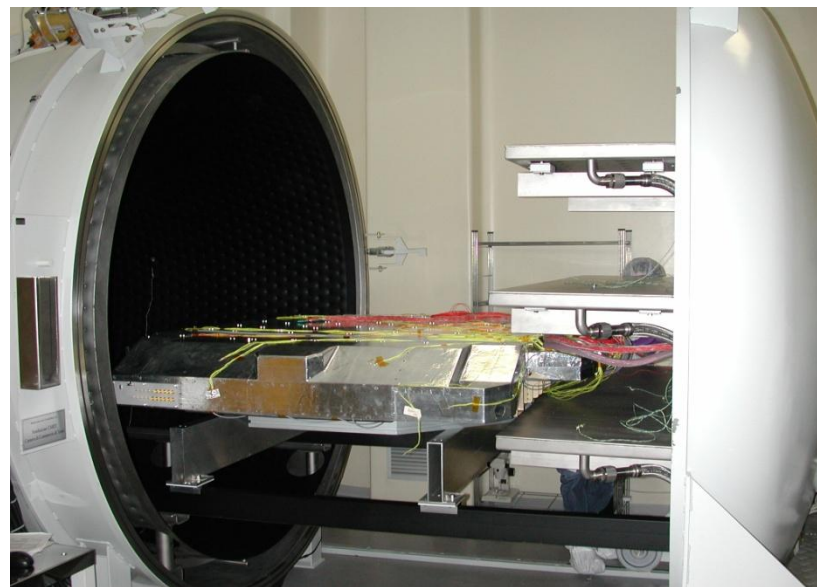
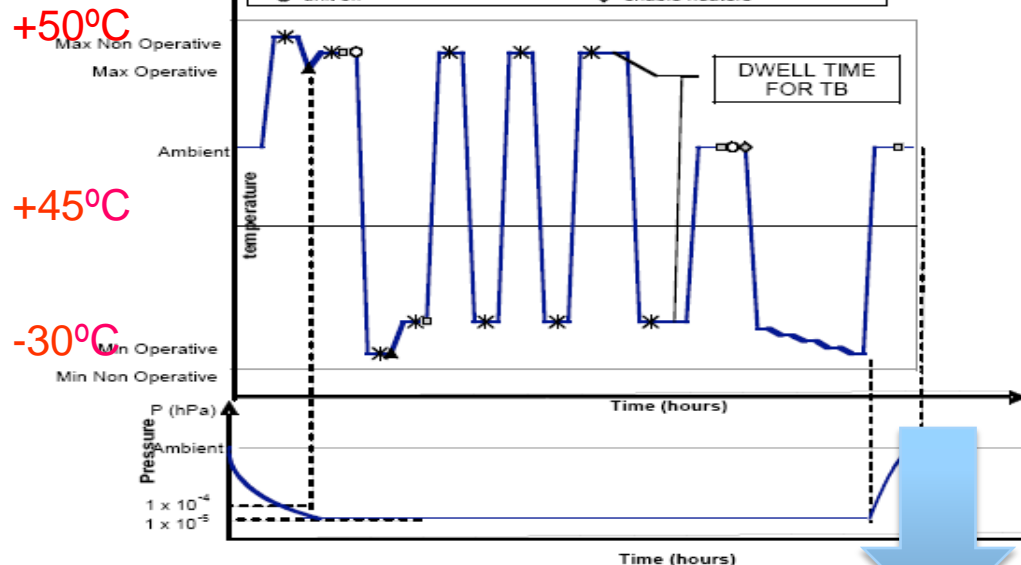


TOF THERMAL VACUUM TEST

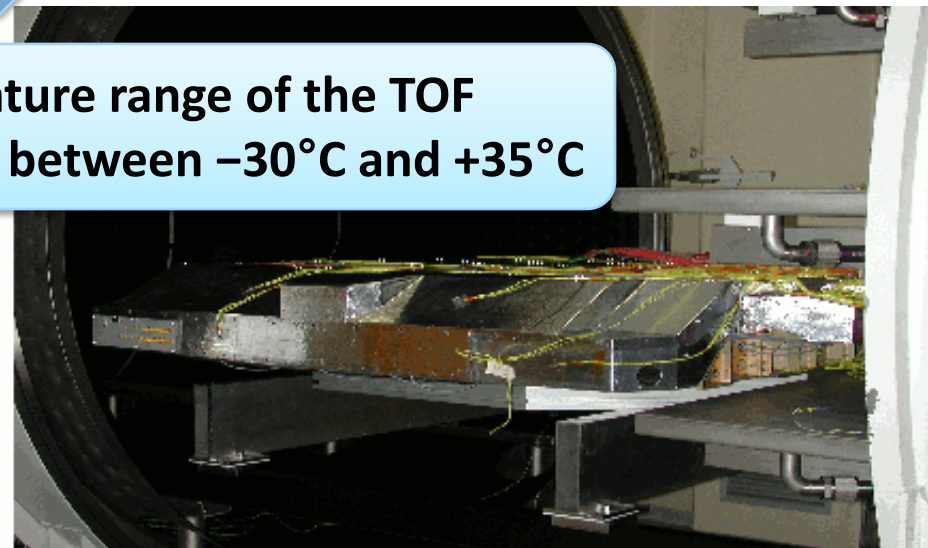
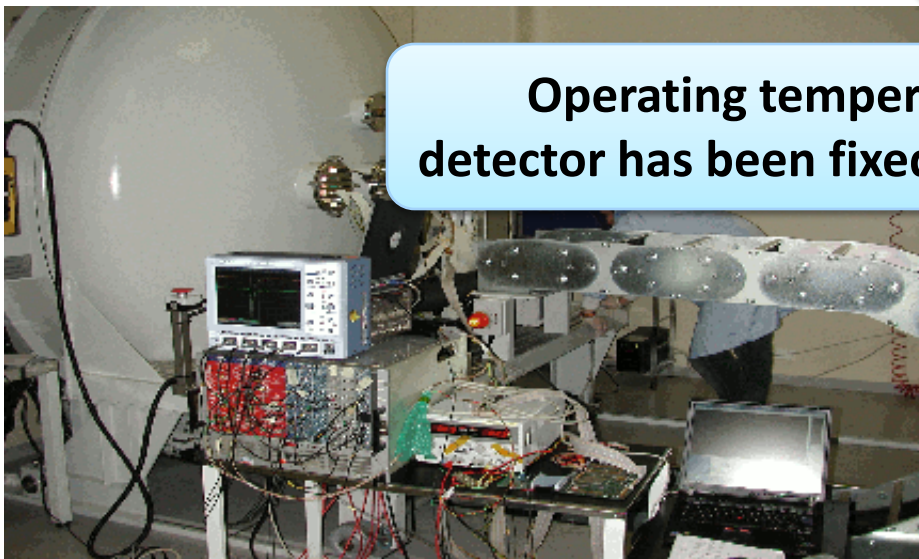


Vacuum Pressure $\approx 10^{-6}$ mbar

SERMS - Terni



Operating temperature range of the TOF detector has been fixed between -30°C and $+35^{\circ}\text{C}$





TOF VIBRATION TEST



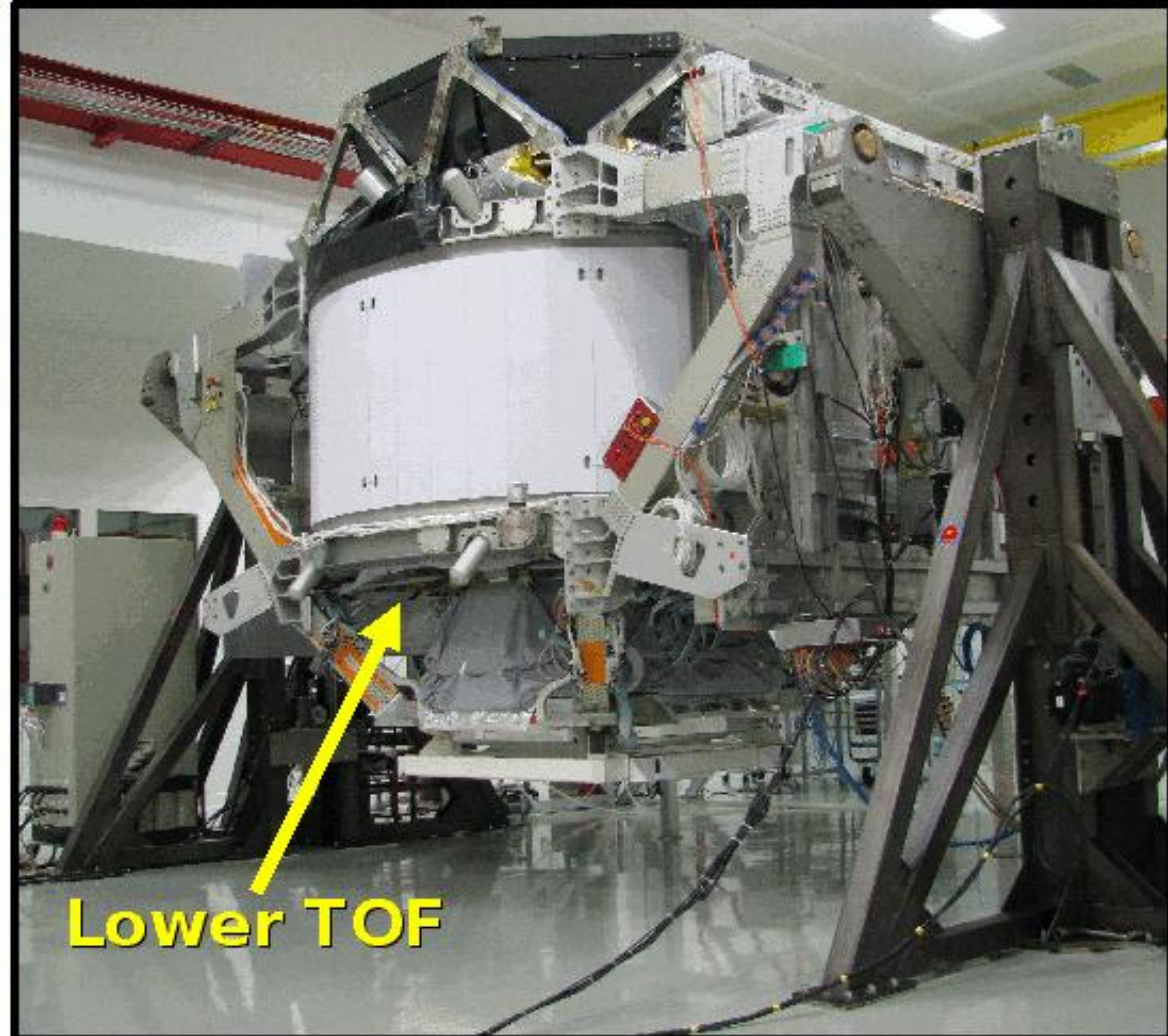
TOF performances were not degraded by the Maximum Expected Flight Level (MEFL) vibration environment

The VTs consist in dynamic mechanical tests on vibrating tables (x-y-z directions) simulating the Shuttle during take-off.





Lower TOF pre-integration (CERN, Geneva, Switzerland)

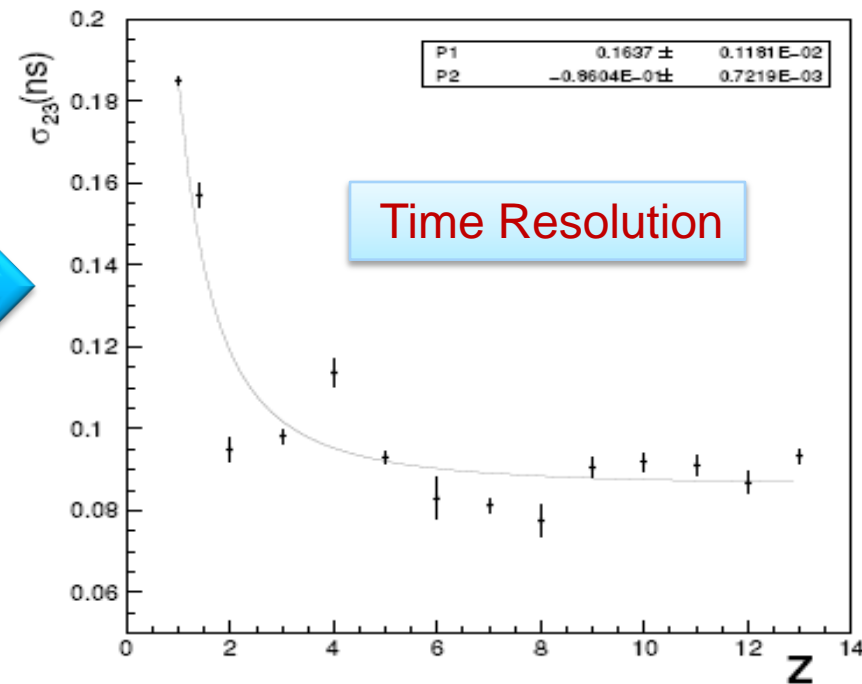
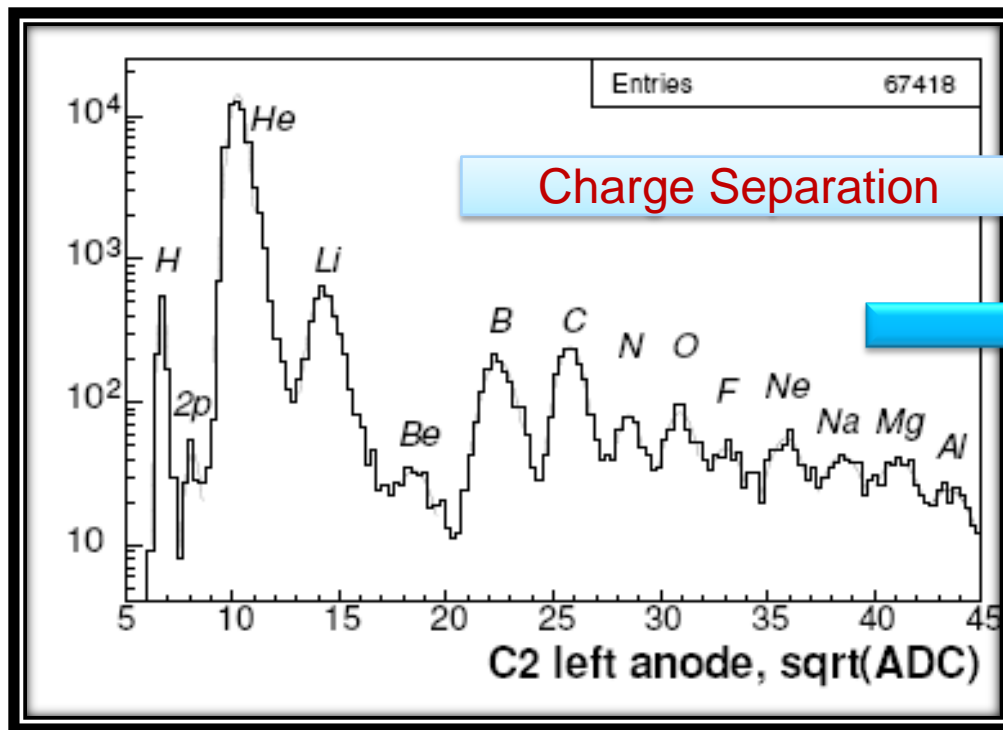


Lower TOF



Test Beam Results: TOF response to 400 GeV protons

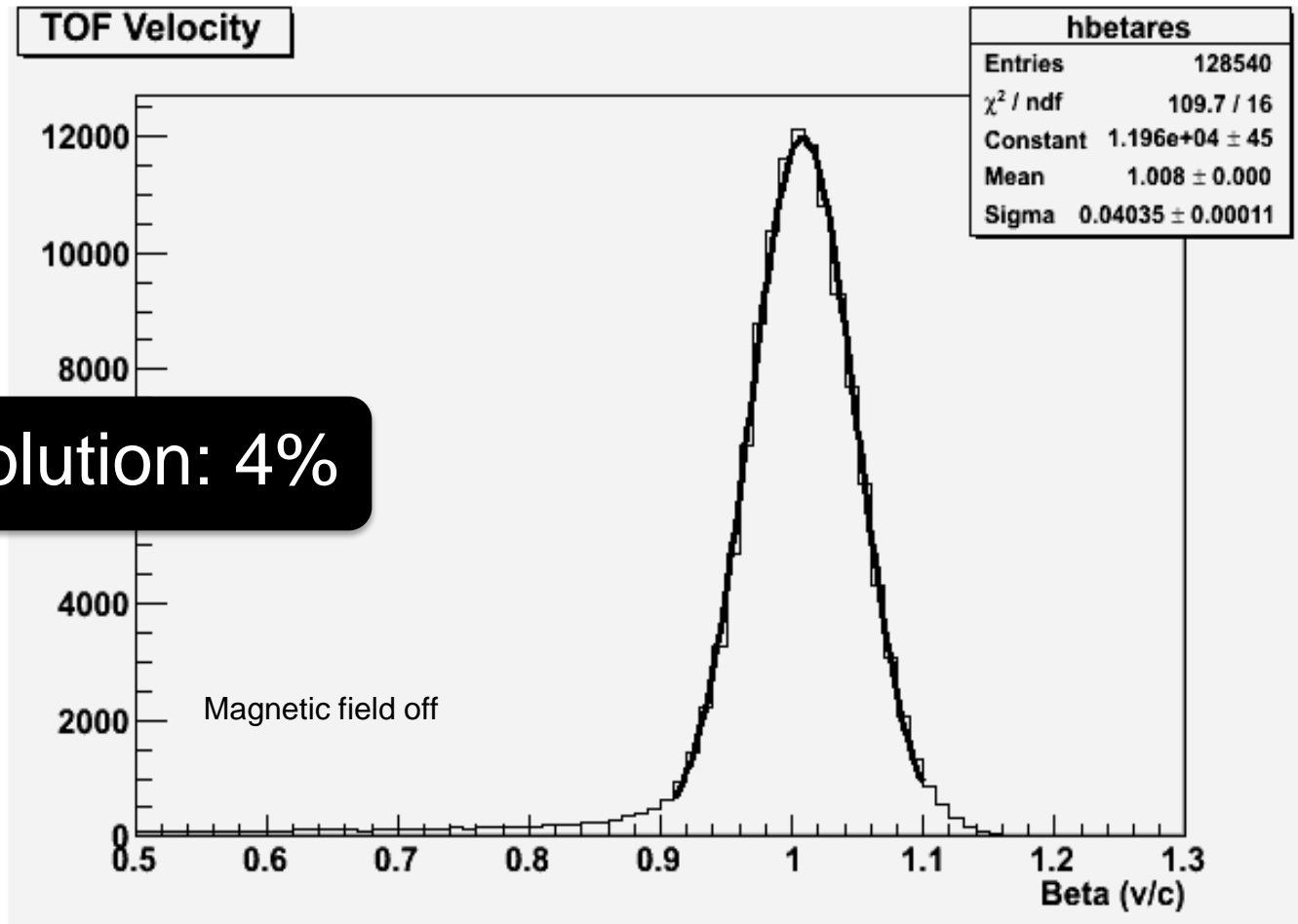
CERN test beam- February 2010





Test Beam Results: TOF response to 400 GeV protons

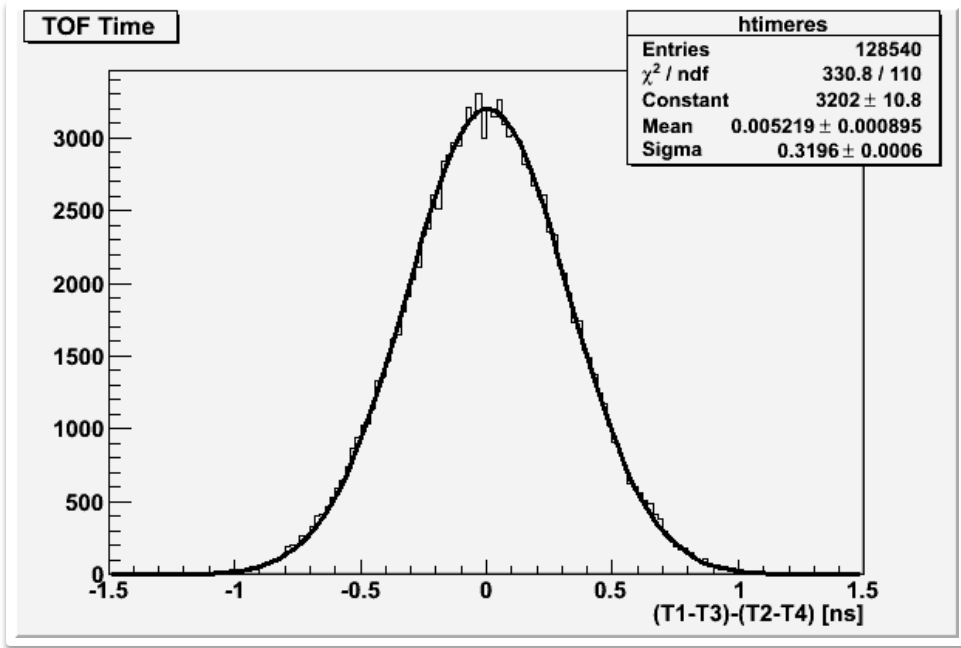
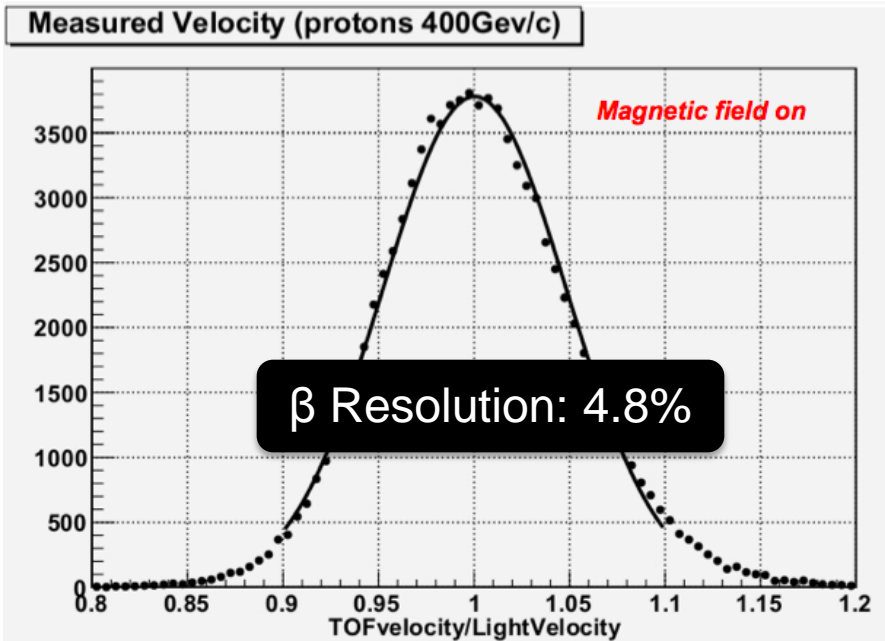
CERN test beam- February 2010





TOF response to 400 GeV protons

CERN test beam- February 2010



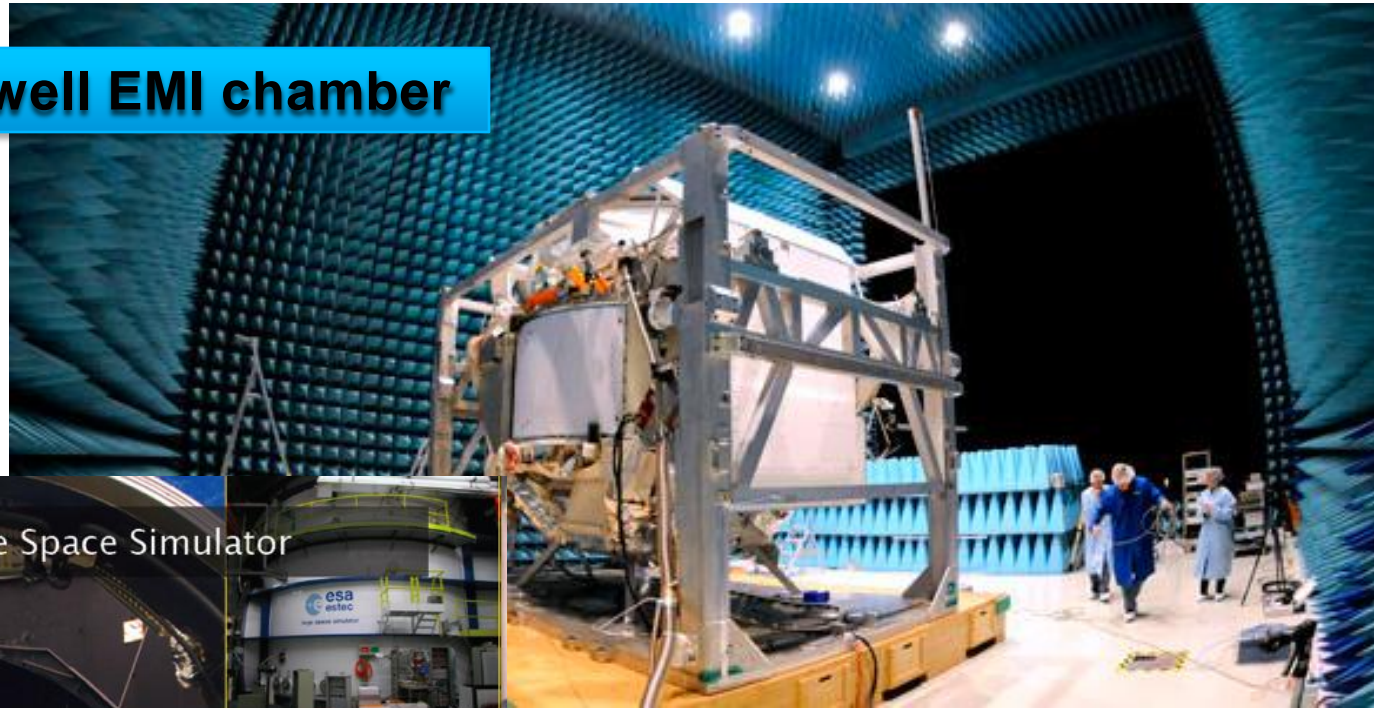
Time Resolution: 160 ps/pad



AMS-02 in ESTEC: New Tests



Maxwell EMI chamber



AMS-02 in the ESTEC Large Space Simulator

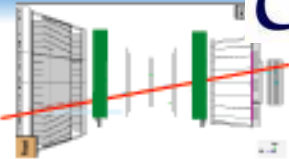




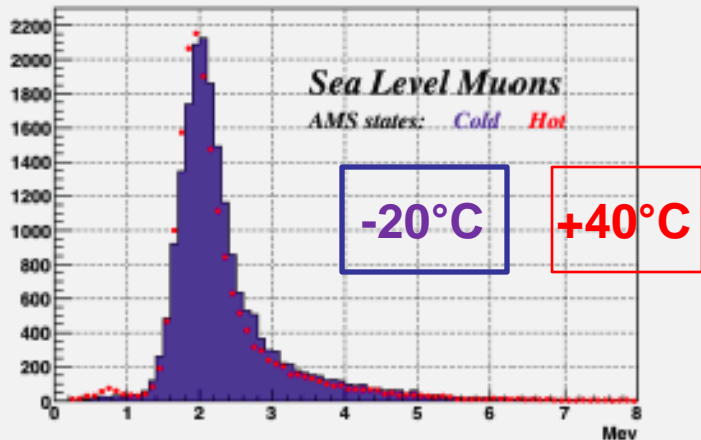
Muons Detections



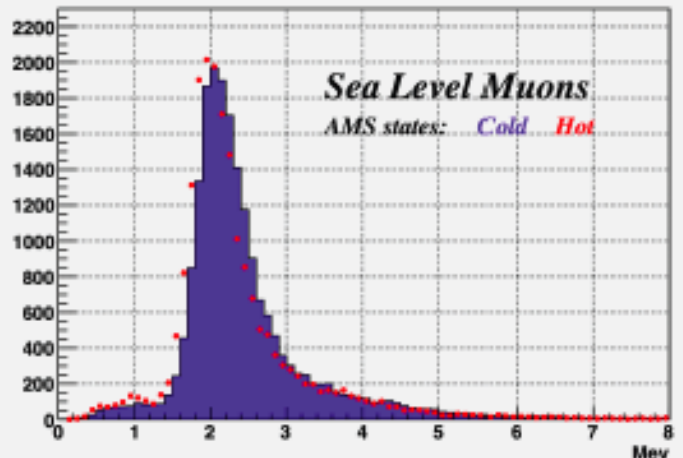
TOF PERFORMANCES



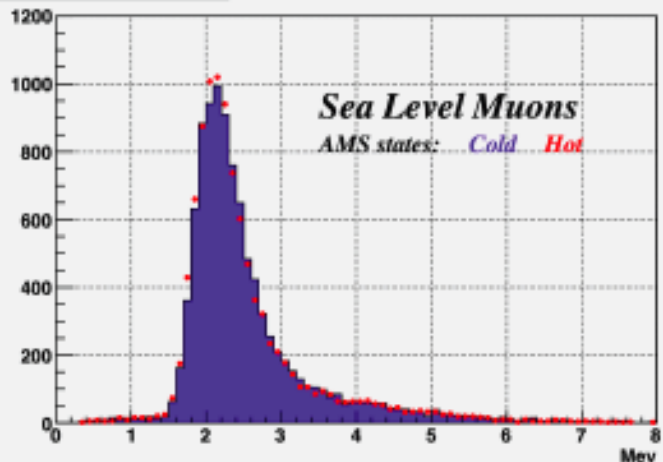
TofSignals(Layer-1)



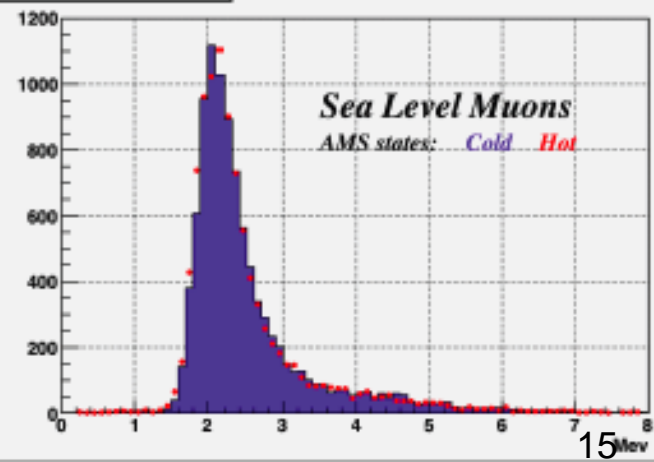
TofSignals(Layer-2)



TofSignals(Layer-3)

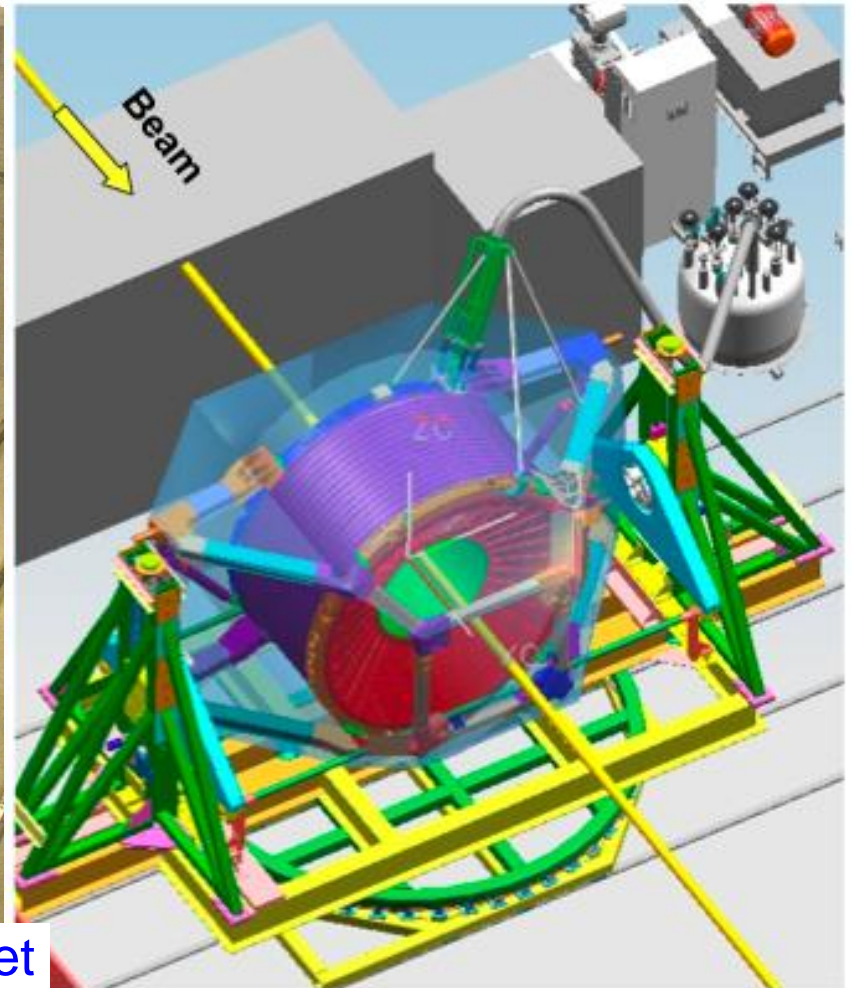
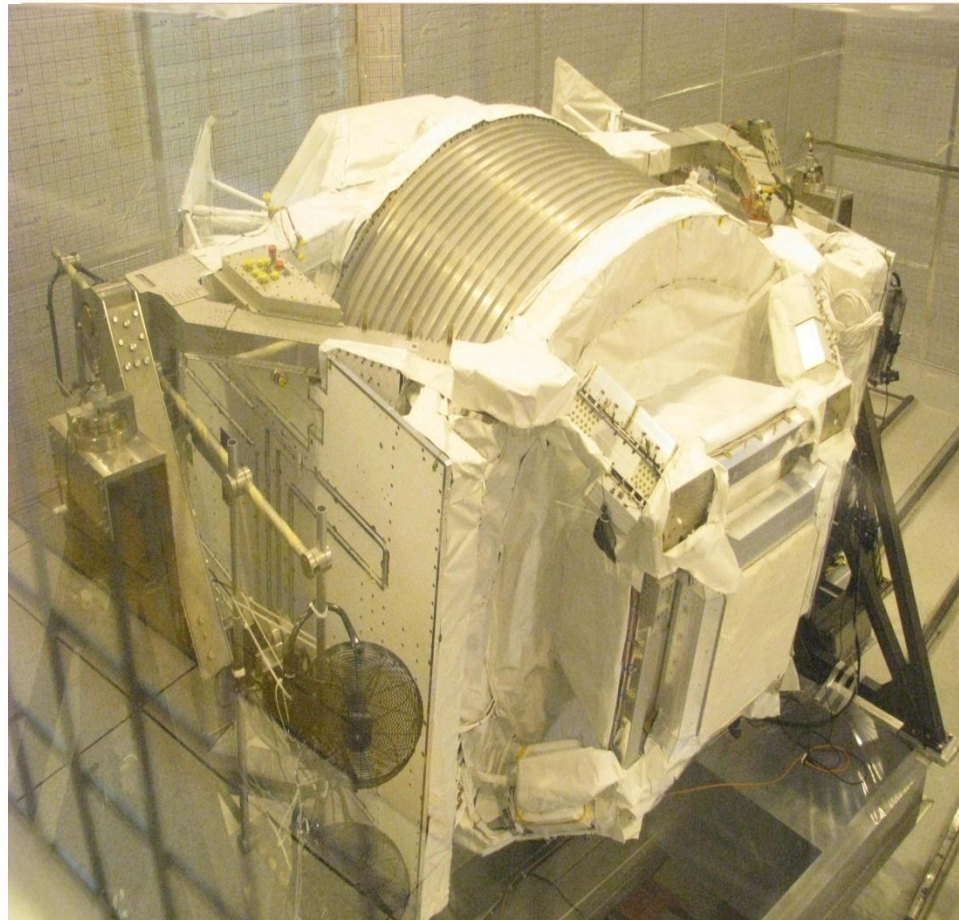


TofSignals(Layer-4)





AMS-02 in the CERN North Area



AMS in Test Beam with permanent magnet
8-20 Aug 2010



AMS at Cape Kennedy



2011 Launches

Date: Feb. 26

Mission: STS-134

Launch Vehicle: Space Shuttle Endeavour

Launch Site: Kennedy Space Center - Launch Pad 39[°]

Launch Time: 4:04 p.m. EST

STS-134 Description: Space shuttle Endeavour will deliver an EXPRESS Logistics Carrier-3 (ELC-3) and the Alpha Magnetic Spectrometer (AMS-02) to the ISS

ESA Astronaut:
Roberto Vittori





Lucio Quadrani Veronica Bindi

pOCC

AMS going through final tests at KSC – 28 Aug 2010

