The PAMELA electromagnetic calorimeter: performances

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Presentation outline

- The PAMELA experiment
- The electromagnetic calorimeter
- Particle identification
- Results
- Conclusions

The PAMELA collaboration

Italy: Bari, Florence, Frascati, Naples, Rome, Trieste, CNR, Florence

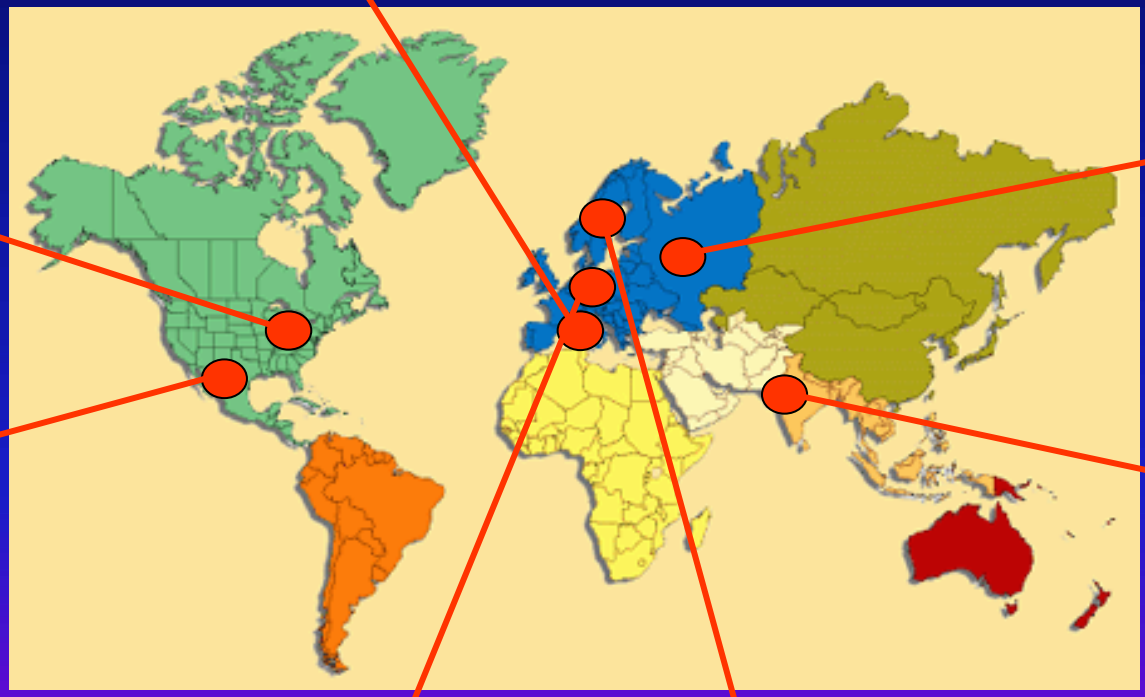
Russia: Moscow, St. Petersburg

USA: GSFC, NMSU

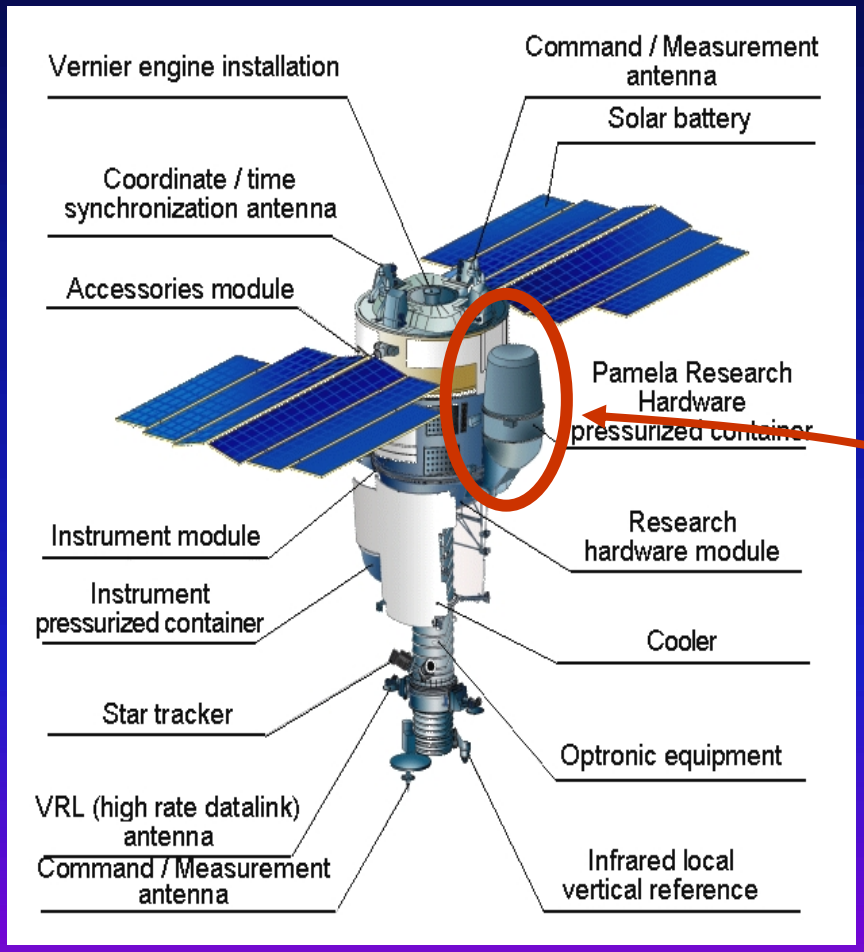
India: Mumbai

Germany: Siegen

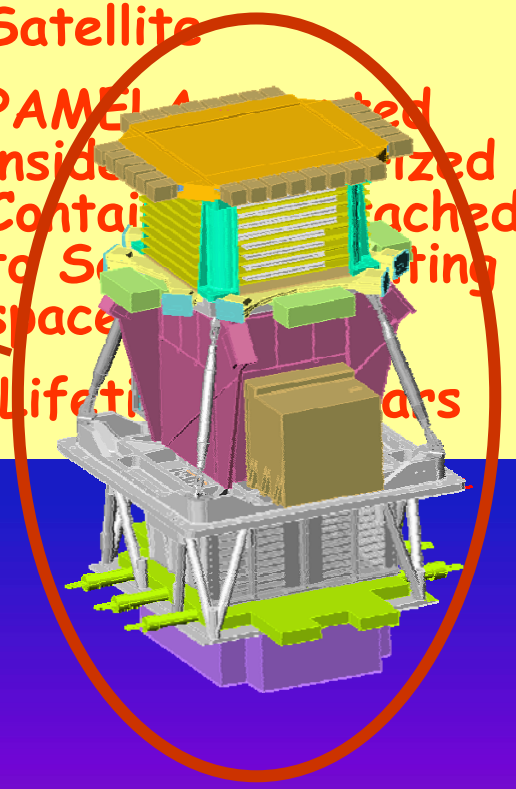
Sweden: KTH, Stockholm



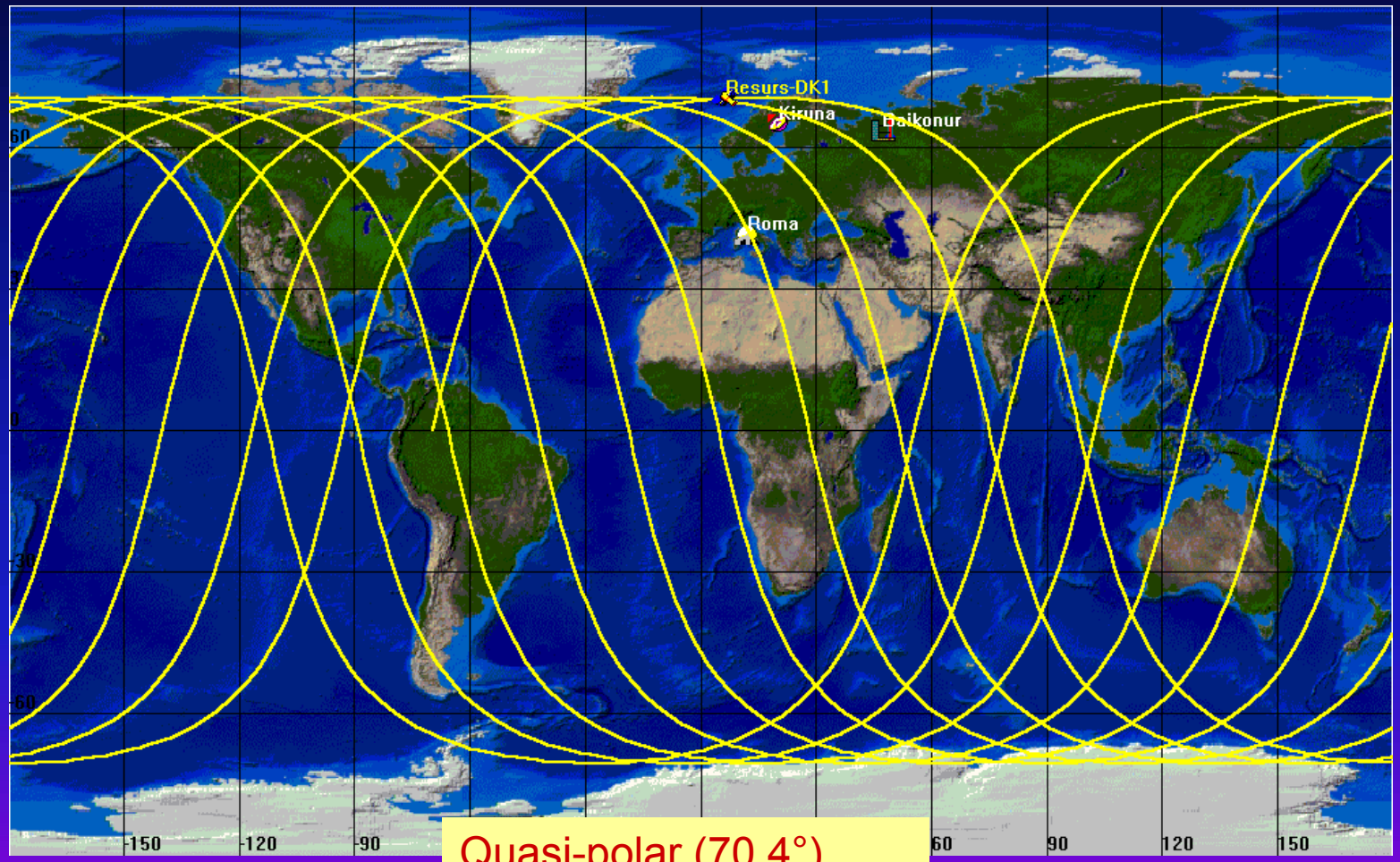
The PAMELA experiment



- Soyuz-TM Launcher from Baikonur
- Earth-Observation-Satellite
- PAMELA mounted inside pressurized Container attached to Service Module ring to spacecraft
- Lifetime > 3 years

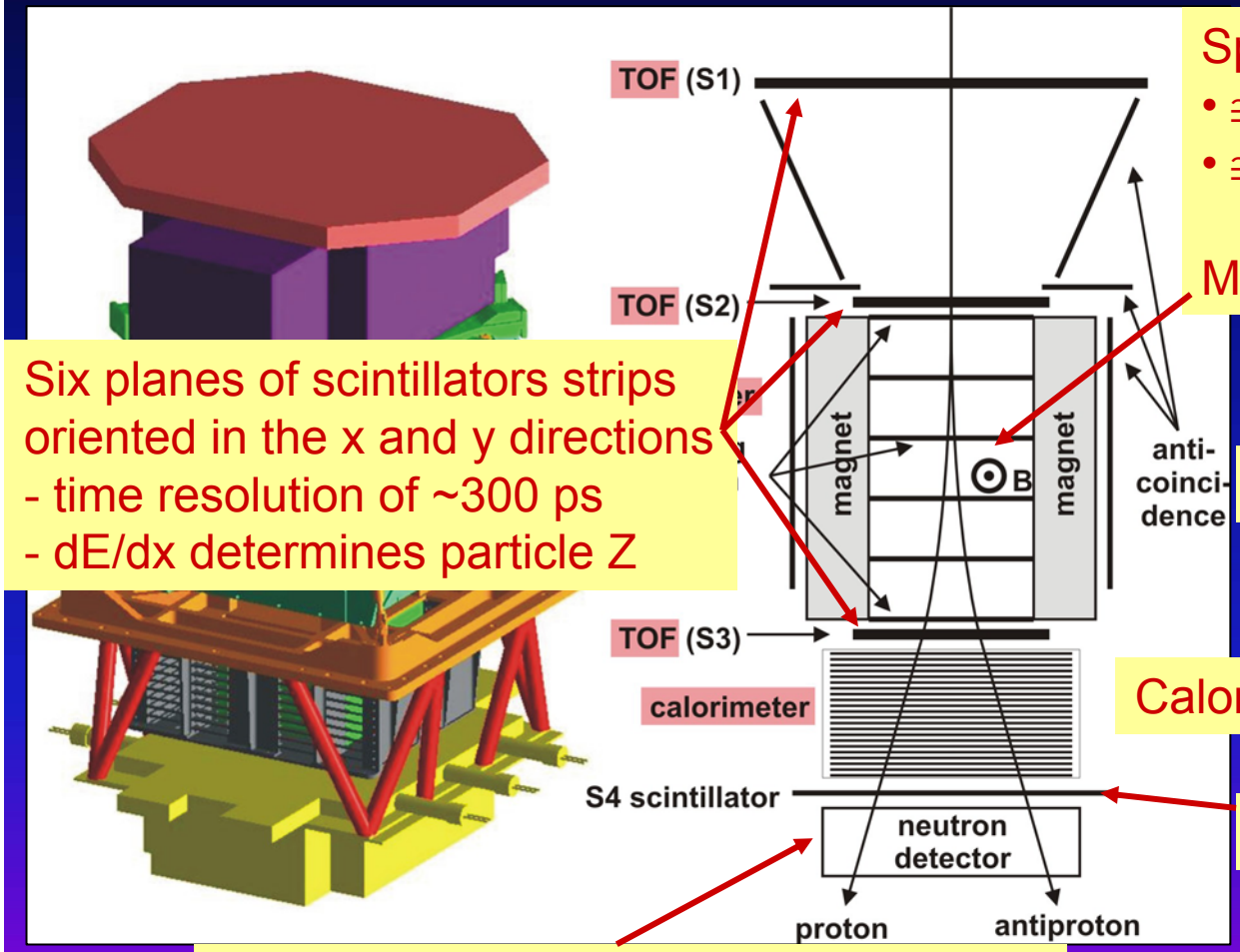


The PAMELA experiment



Quasi-polar (70.4°)
Elliptical (300÷600 km)

The PAMELA experiment



Spatial Resolution
- ≅3.1 μm bending view
- ≅13.1 μm non-bending view

MDR from test beam data ≅ 1 TV

Six planes of scintillators strips oriented in the x and y directions
- time resolution of ~300 ps
- dE/dx determines particle Z

Anti-coincidence shield

Calorimeter

Shower tail catcher scintillator

ND p/e separation capabilities >10 above 10 GeV/c increasing with energy

The PAMELA experiment

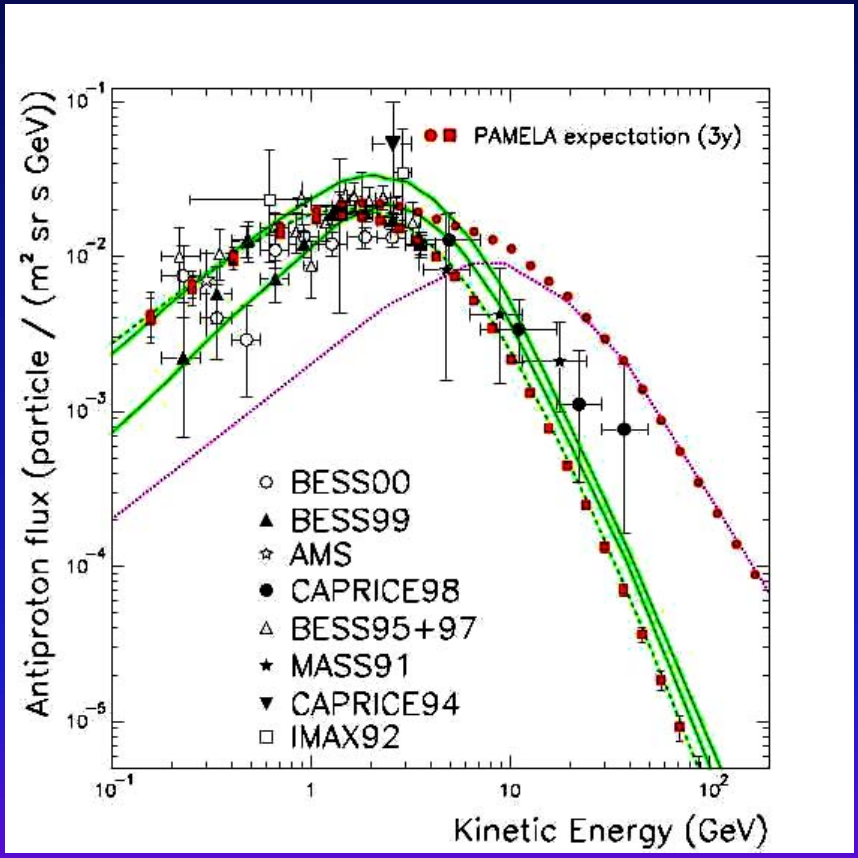
PAMELA will explore:

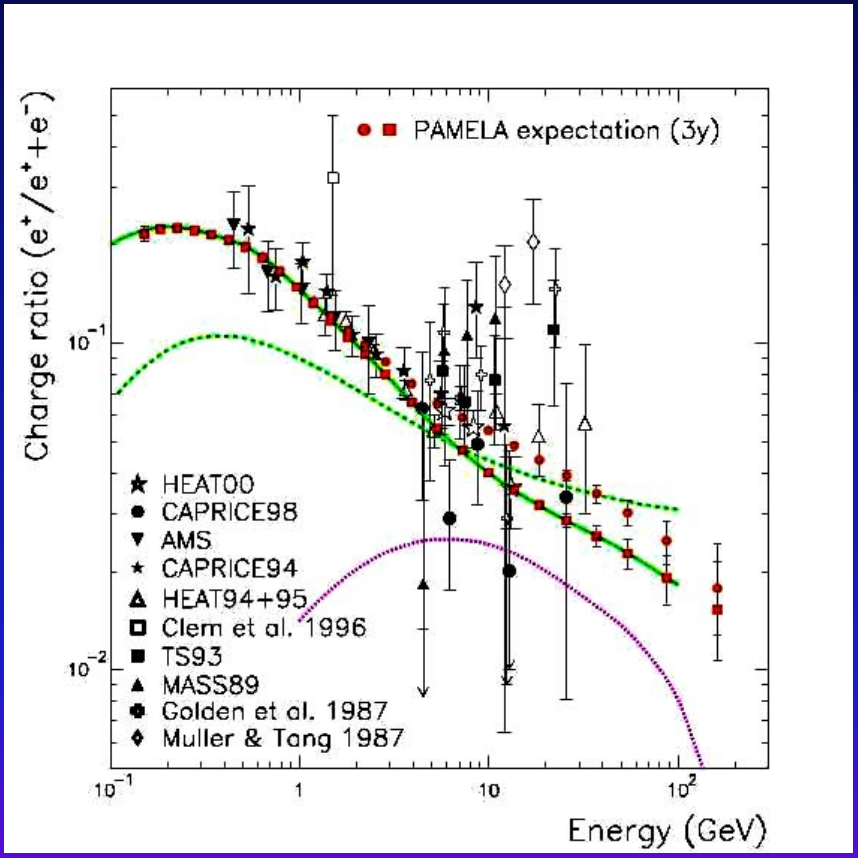
❑ Antiproton flux	80 MeV - 190 GeV
❑ Positron flux	50 MeV – 270 GeV
❑ Electron flux	up to 400 GeV
❑ Proton flux	up to 700 GeV
❑ Electron/positron flux	up to 2 TeV
❑ Light nuclei (up to Z=6)	up to 200 GeV/n
❑ Light isotopes (D, ^{3}He)	up to 1 GeV/n
❑ Antinuclei search	(sensitivity better than 10^{-7} in He/He)

+

- ❑ Long-term monitoring of the solar modulation of cosmic rays
- ❑ Energetic particles from the Sun (e^+)
- ❑ High-energy particles in the Earth magnetosphere

The PAMELA experiment



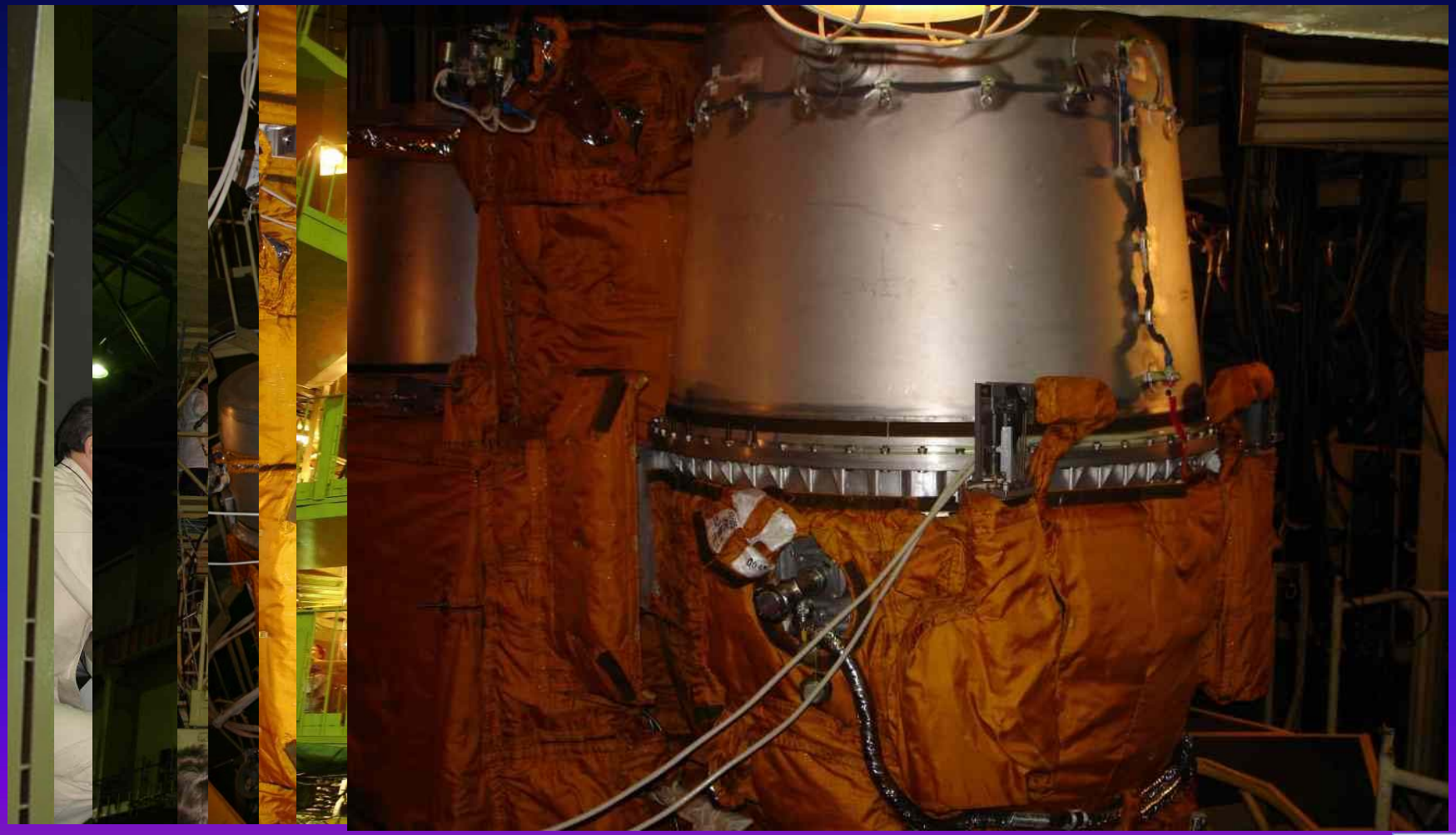


Anti-protons

Positrons

The PAMELA experiment

The PAMELA experiment



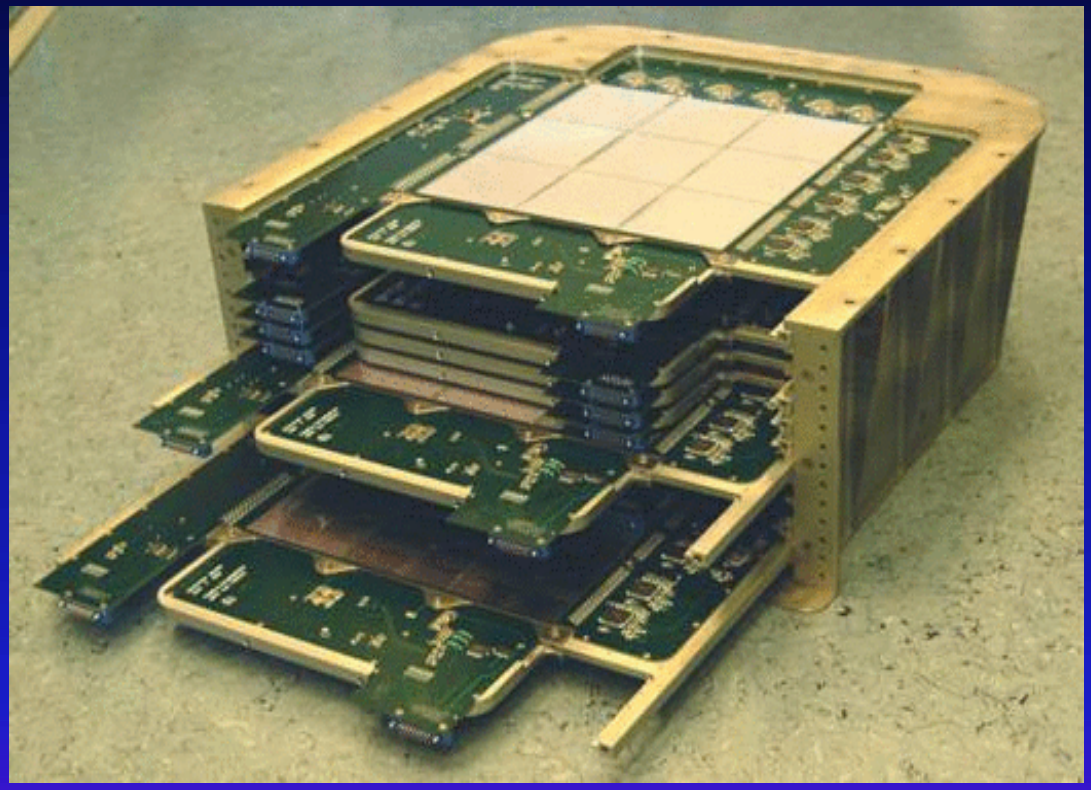
The PAMELA experiment

Confirmed launch date:

15th June 2006

next thursday!

The electromagnetic calorimeter



- 22 W absorbers 0.26 cm/0.74 X_0
- 44 Si planes (380μm thick)
- 8x8 cm^2 detectors in 3x3 matrix
- 96 strips of 0.24 cm per plane
- Total depth: 16.3 X_0 / ~0.6 int. len.

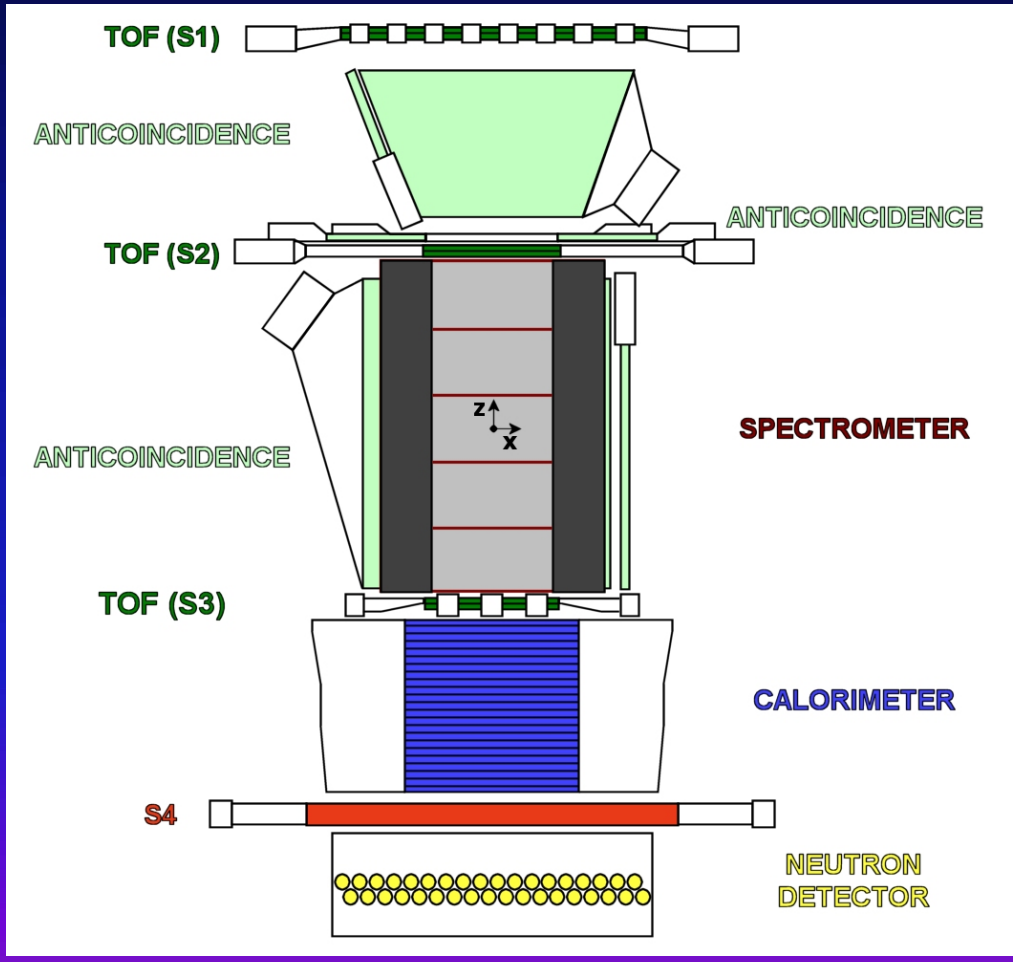
- Mass 110 kg
- Power consumption 48 W

Particle identification

PAMELA will need to detect:

- Anti-protons, electrons background
- Positrons, protons background

Rejection power needed: 10^5-10^6

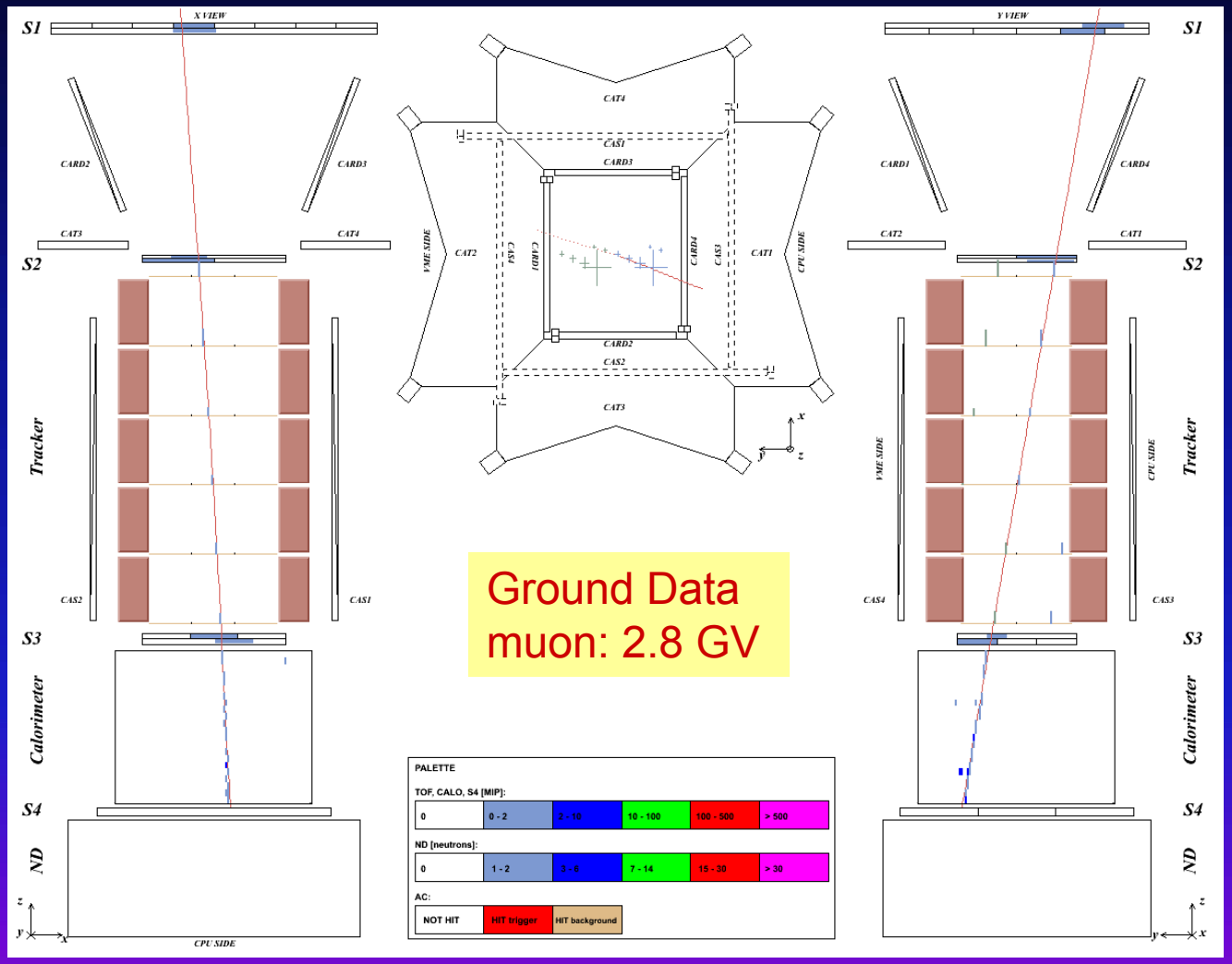


Particle identification

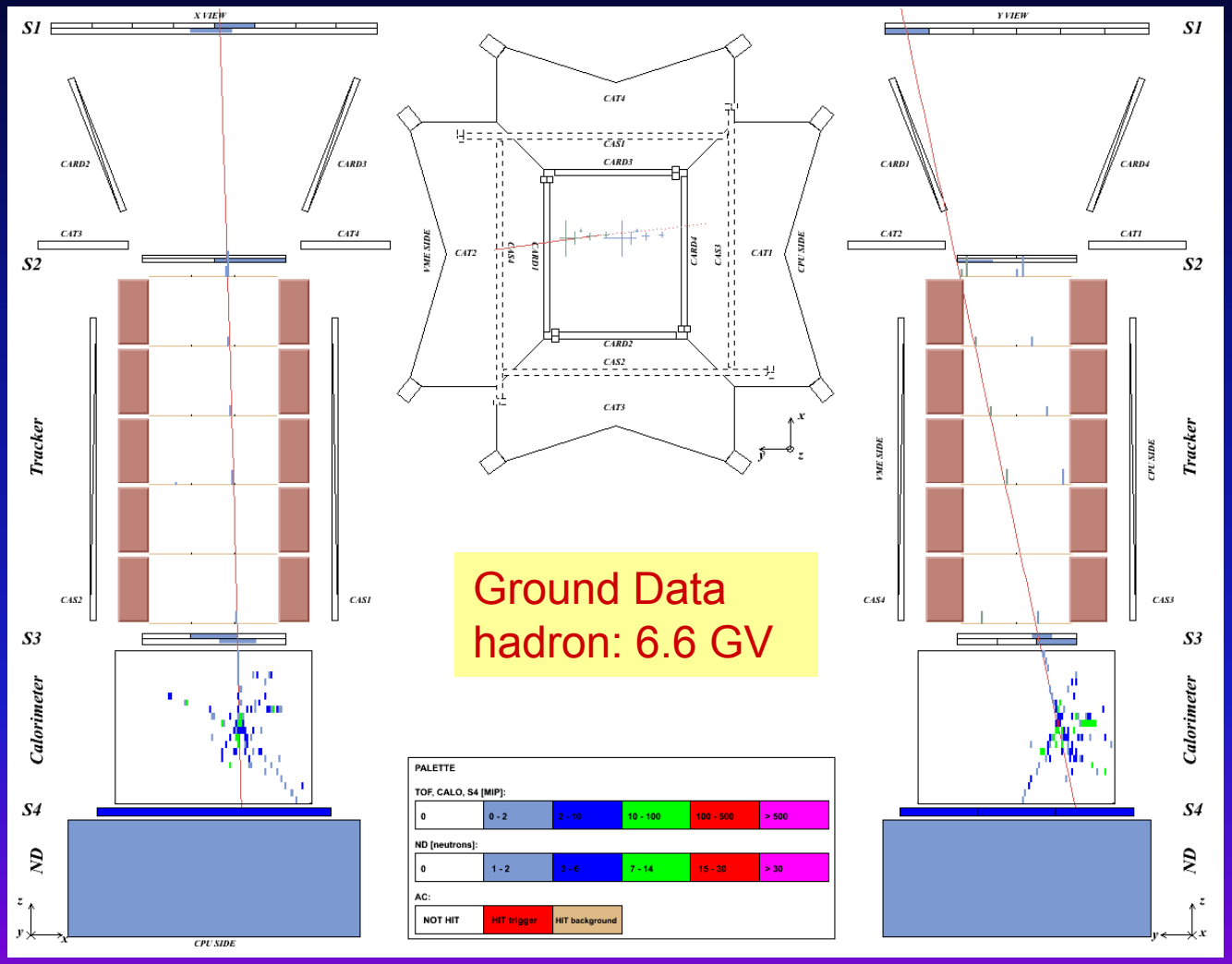
Shower identification main variables:

- Total energy deposit
- Starting point of the shower
- Longitudinal shower profile
- Transverse shower profile
- Topological development of the shower

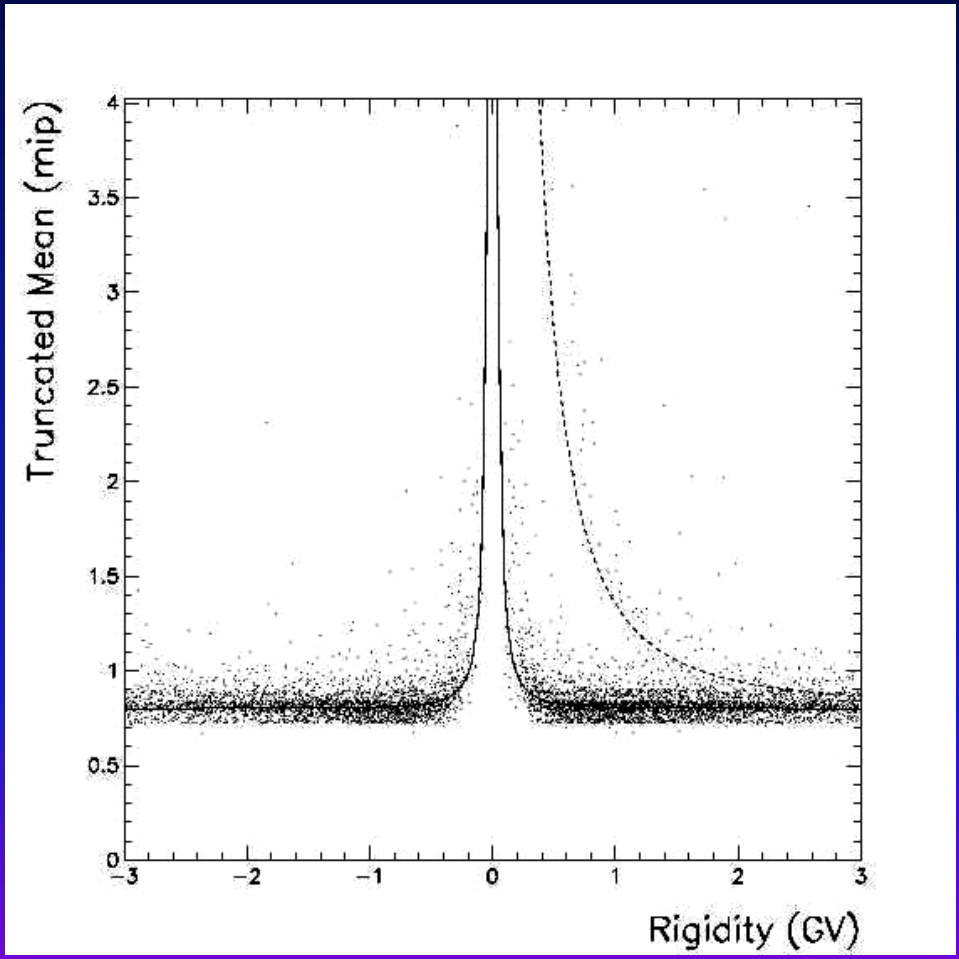
PAMELA event



PAMELA event



Particle identification

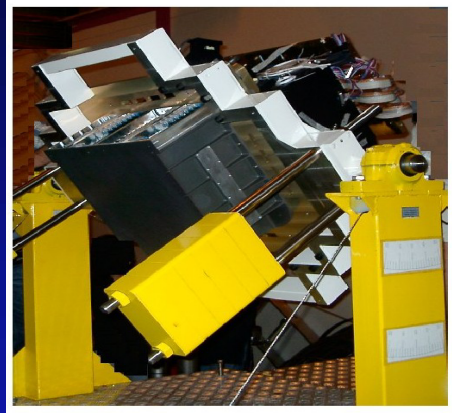


- Ground data (Rome 2005)

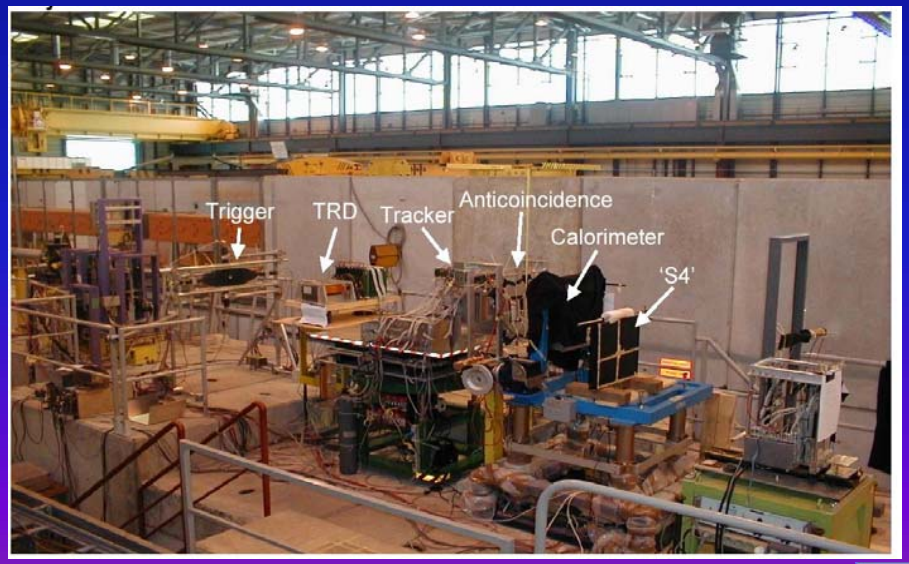
Particle identification

FM SPS, September 2003

Magnet/Tracker,
Calorimeter
SPS, July 2002



Detectors tested at PS / SPS
Test facilities as Prototypes
and in FM configuration

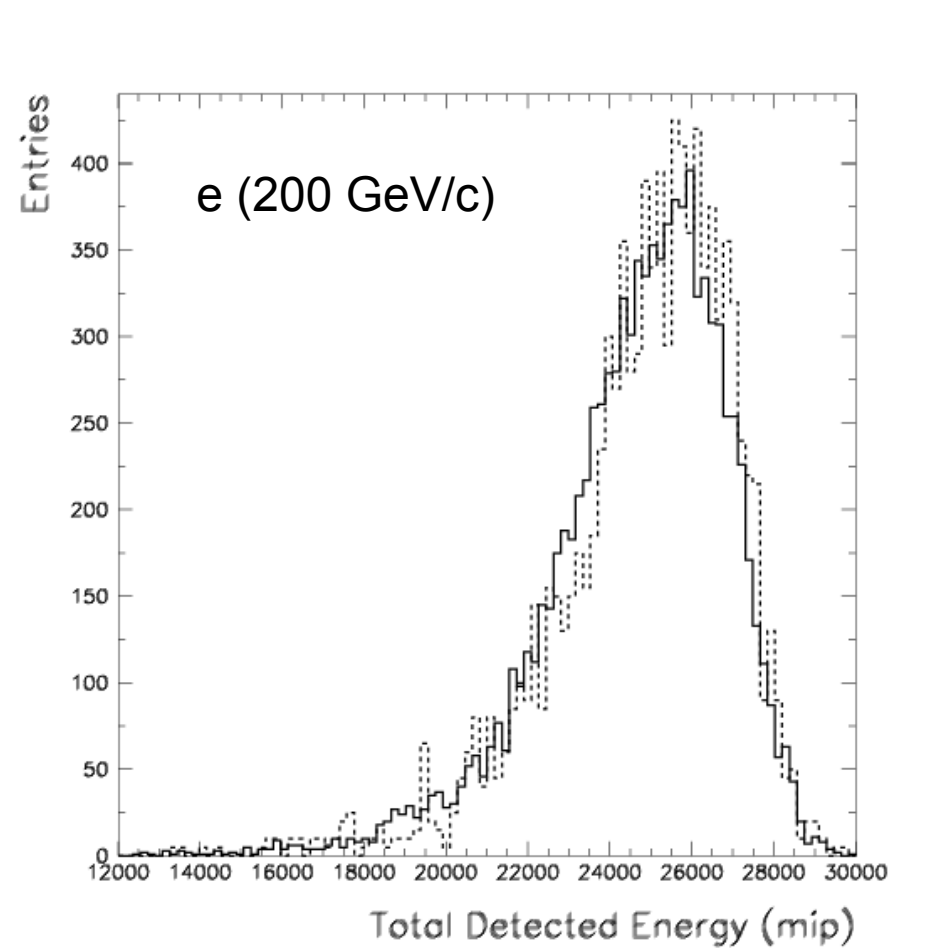


SPS, July 2000

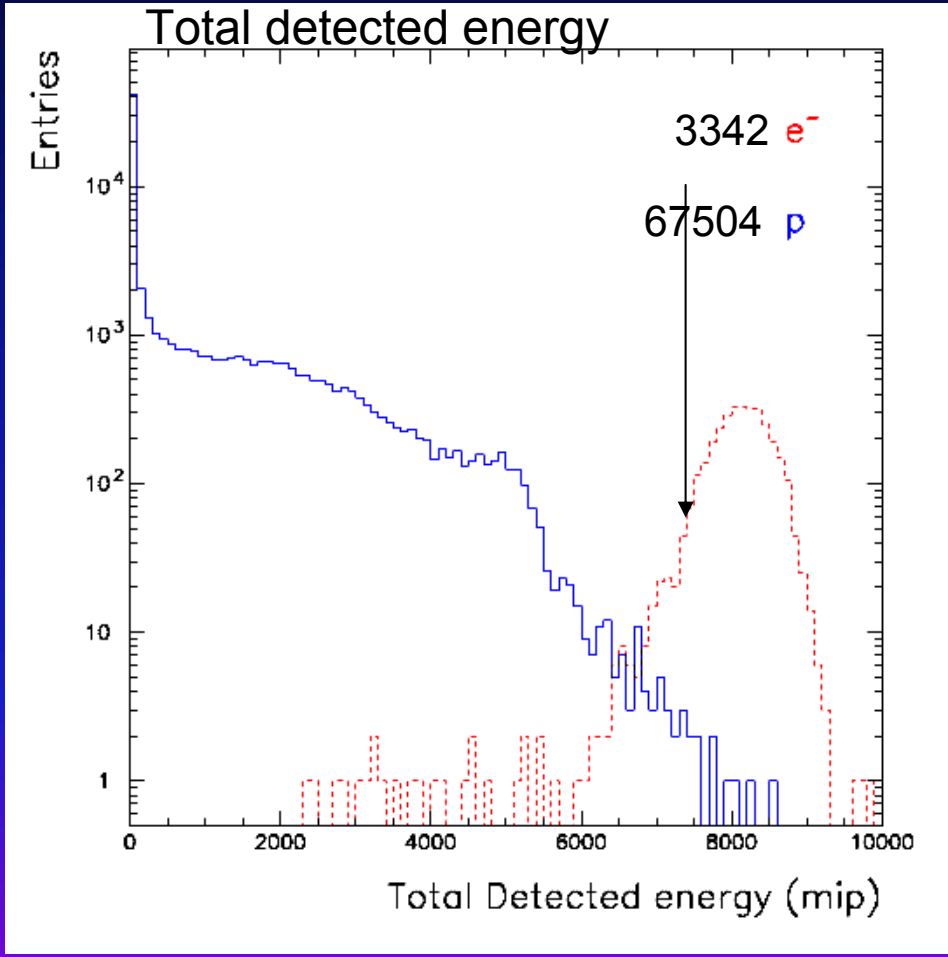
Particle identification

"gpamela" simulation:

- PAMELA apparatus
- Monte Carlo - GEANT 3.21
- Default GHEISHA hadron shower package



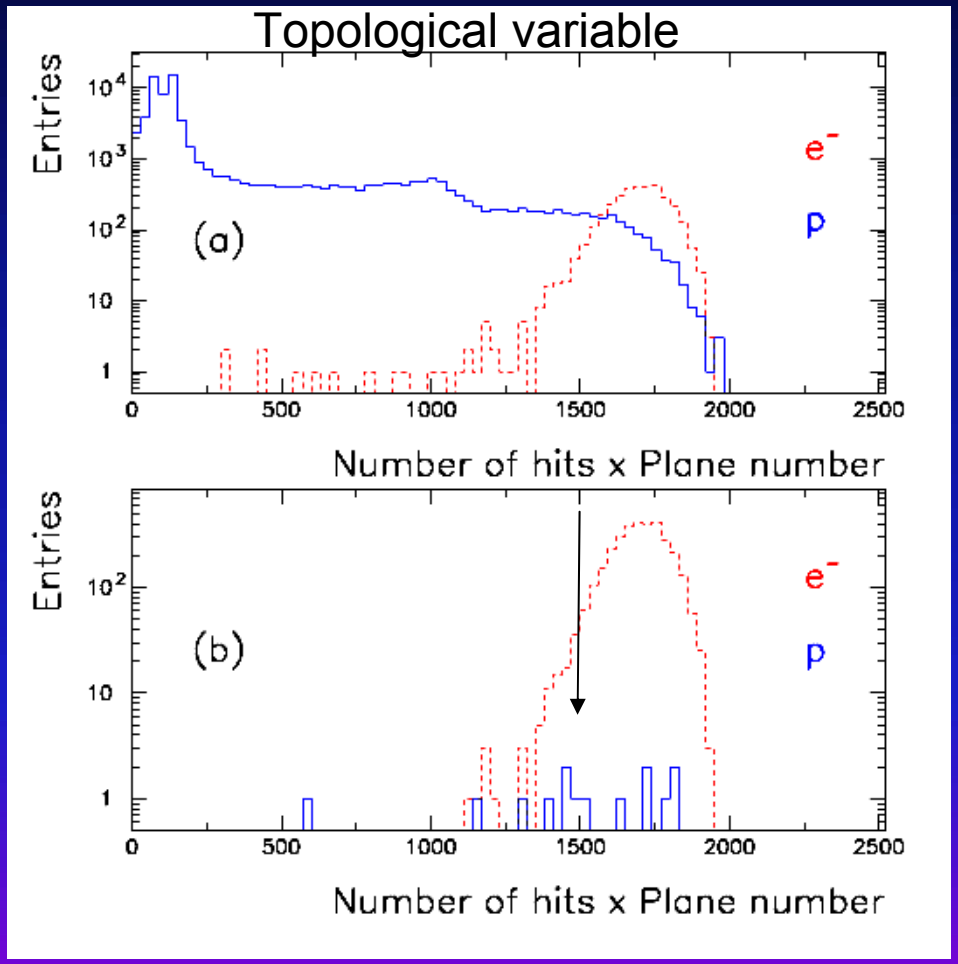
Particle identification



- Test-beam data
- Particle momentum 50 GeV/c

- Cut at 7300 mip
- 99.98% proton reduction
- 4.3% electron reduction

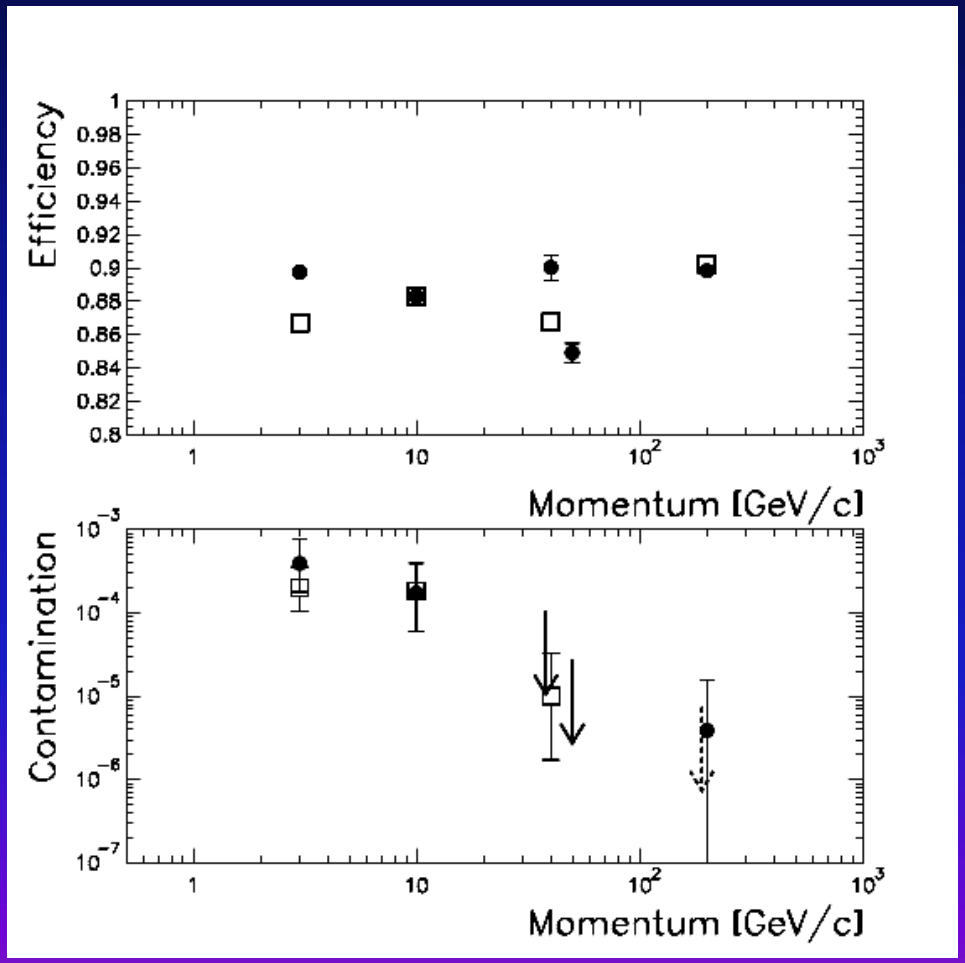
Particle identification



- Test-beam data
- Particle momentum 50 GeV/c

- Cut at 1500
- 50% proton reduction
- 2.5% electron reduction

Results



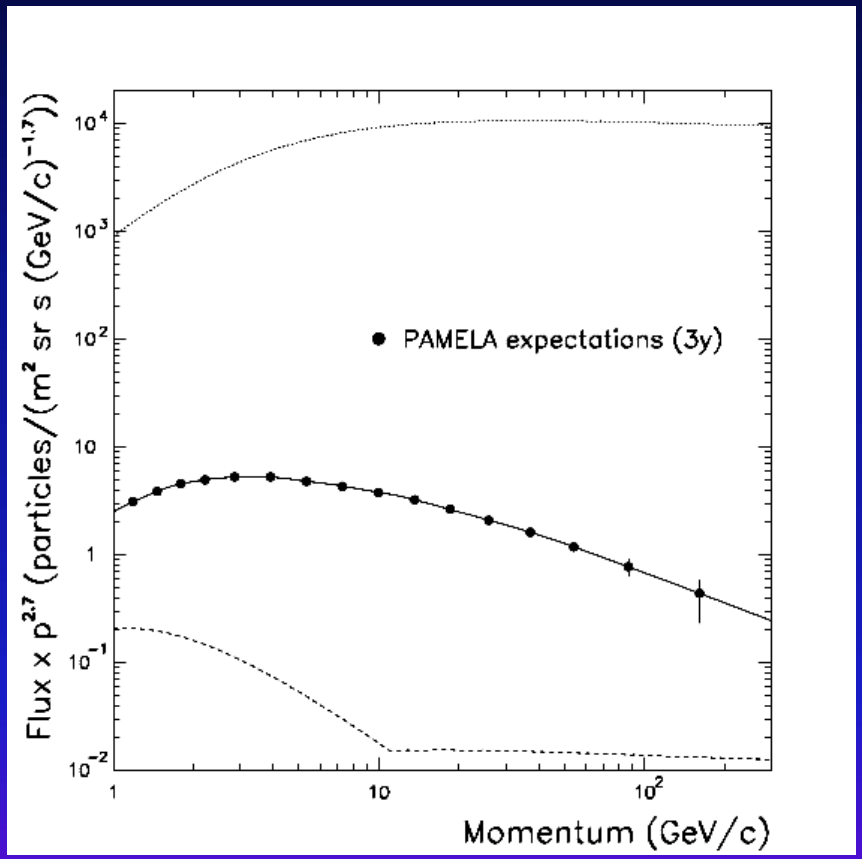
- Closed symbols: test beam data
- Open symbols: simulations

- Solid arrows: test beam data
- Dashed arrow: simulations

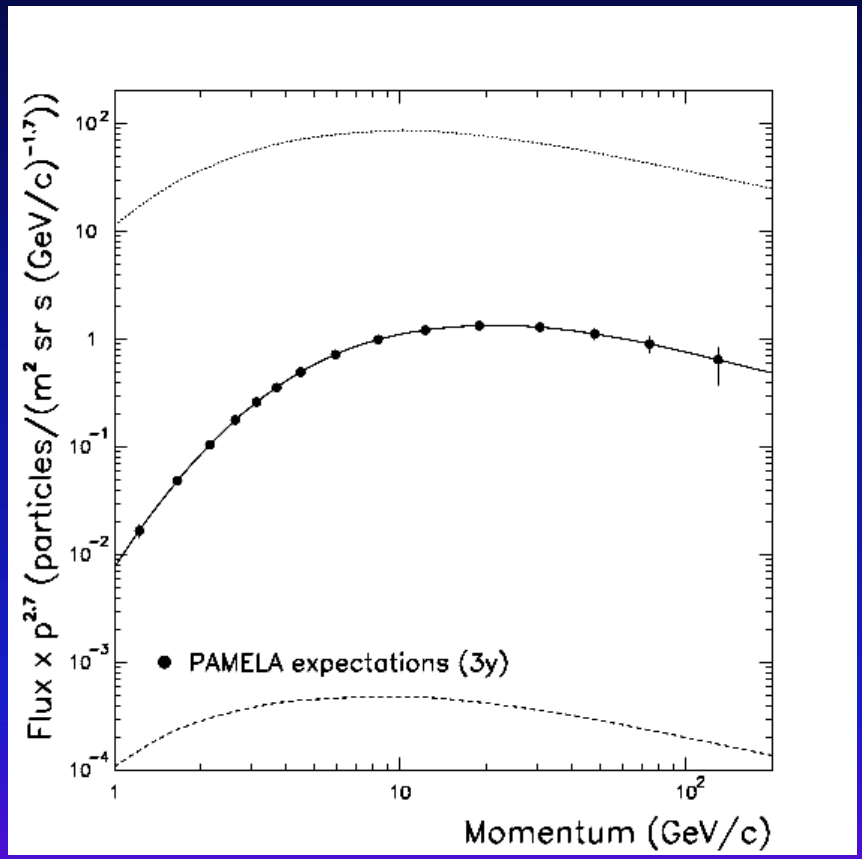
Conclusions

- The PAMELA calorimeter has been tested and studied
- Electron/hadron separation has been determined
- Possibility to identify rare antiproton and positron components with small background

Results

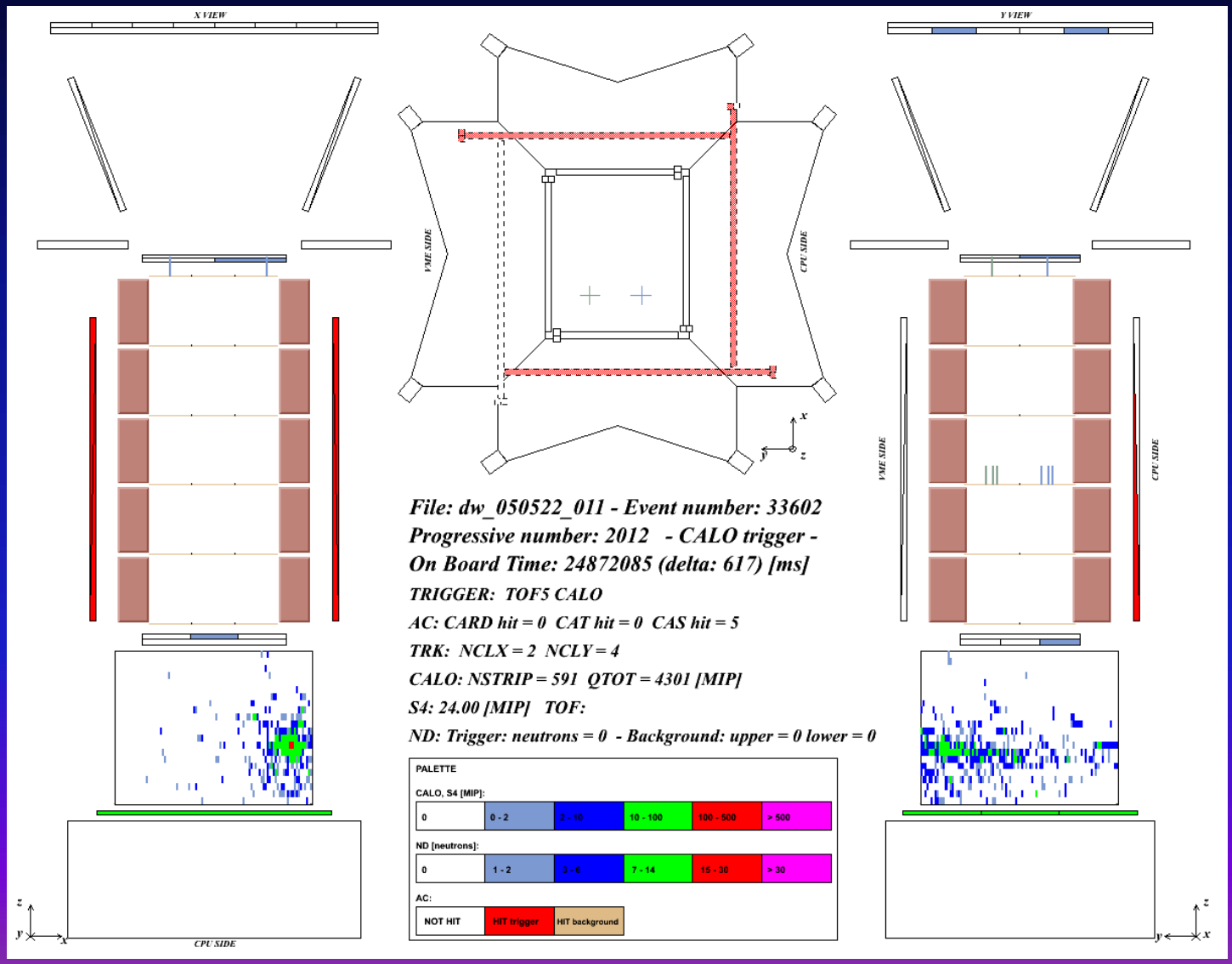


Positron identification

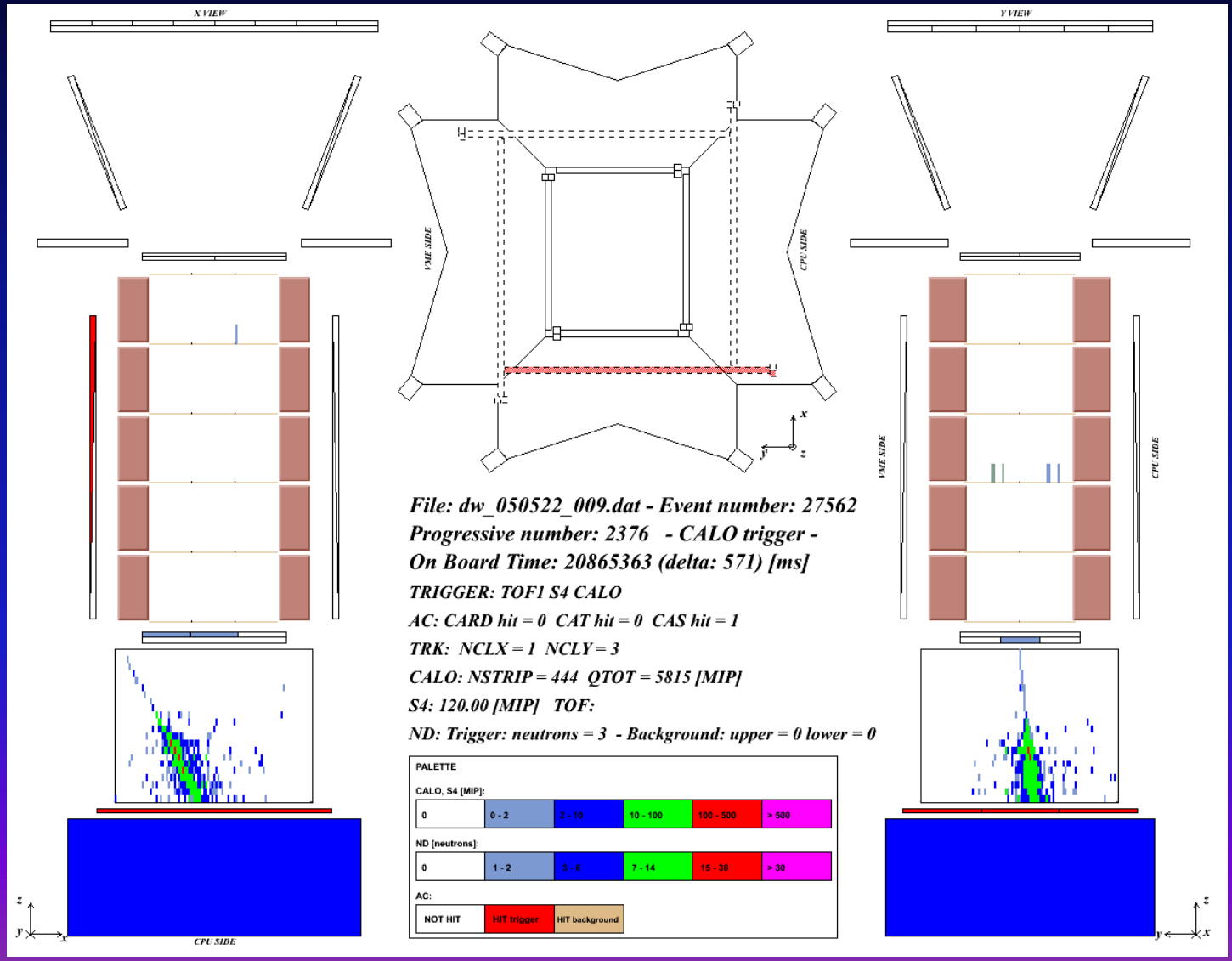


Antiproton identification

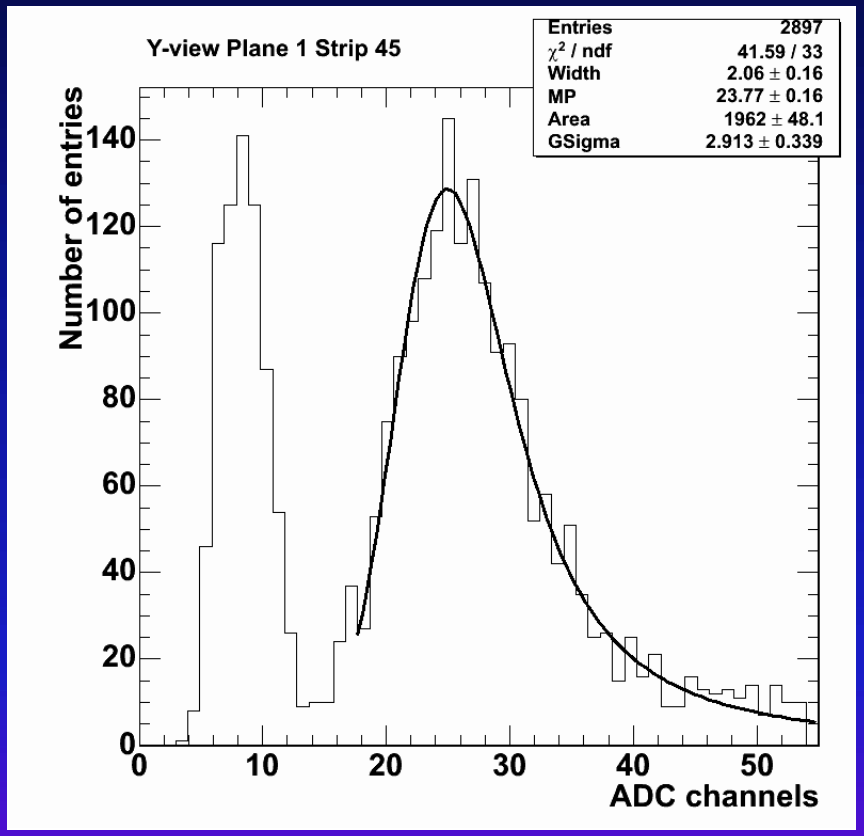
Self-trigger event



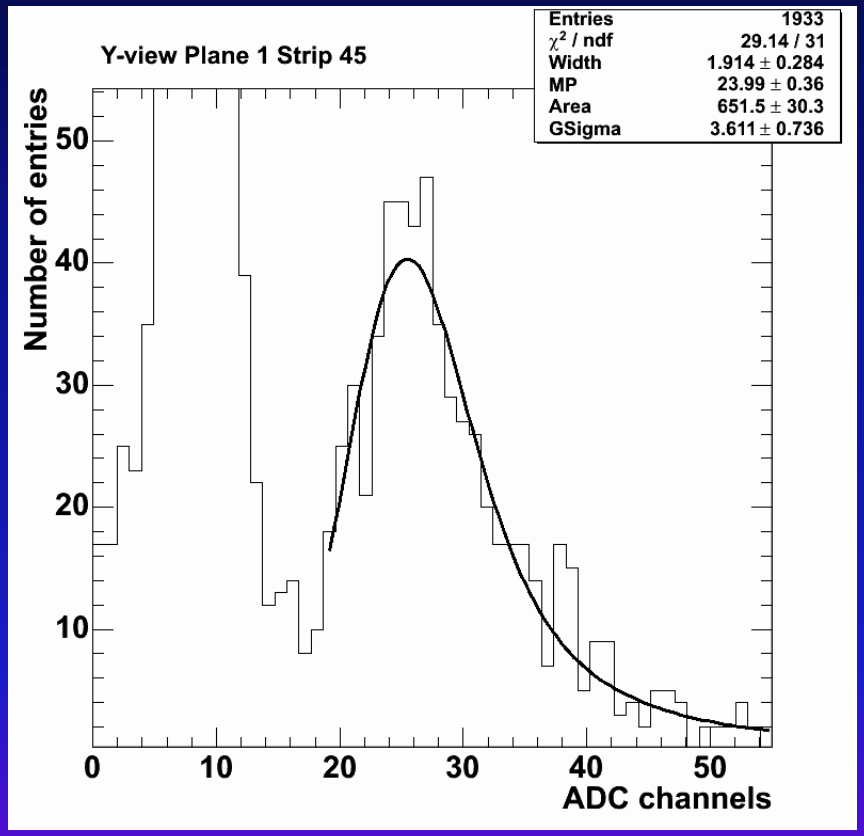
Self-trigger event



The electromagnetic calorimeter



Rome 2005



Samara 2005