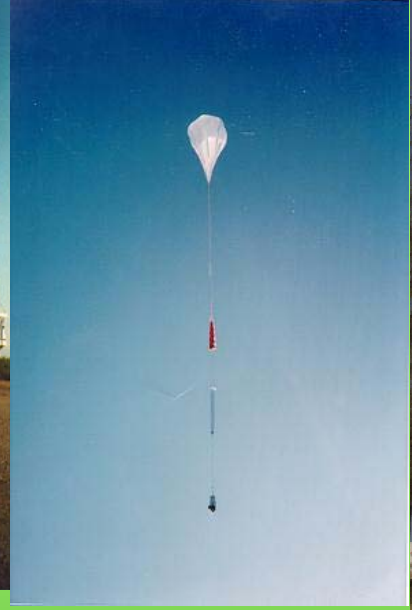



Silicon-Tungsten Calorimeters of the WiZard Collaboration

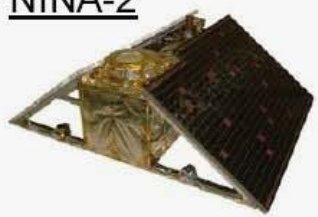
OUTLINE

- Brief History
- Calorimeters Description
- Simulation and Comparison with Experimental Data
- Identification Capabilities
- Front-End Electronics (Gigi's talk)
- Future developments (Gigi's talk)

The WiZard Collaboration experiments

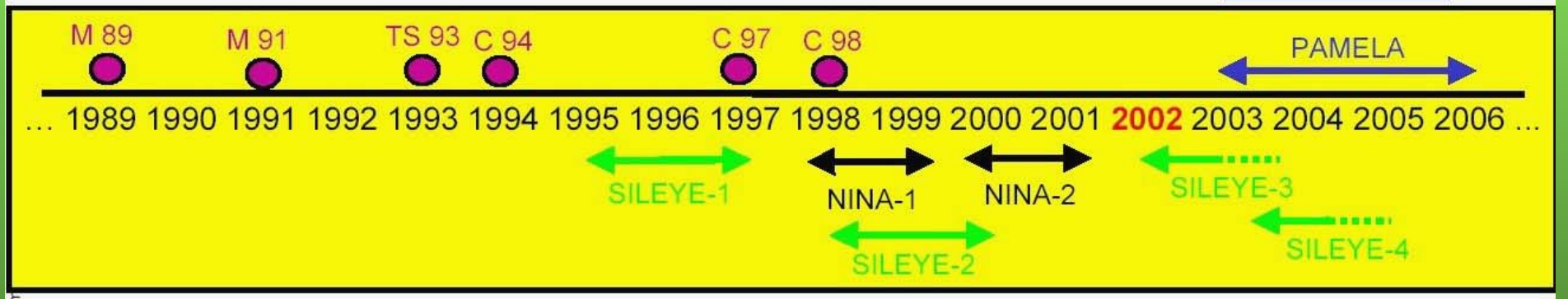
MASS-89, 91, TS-93,
CAPRICE 94-97-98

NINA-2



NINA-1

PAMELA



SILEYE-1

SILEYE-2

ALTEINO: SILEYE-3

ALTEA:
SILEYE-4

Italy:

Bari Florence Frascati Naples Rome Trieste CNR, Florence

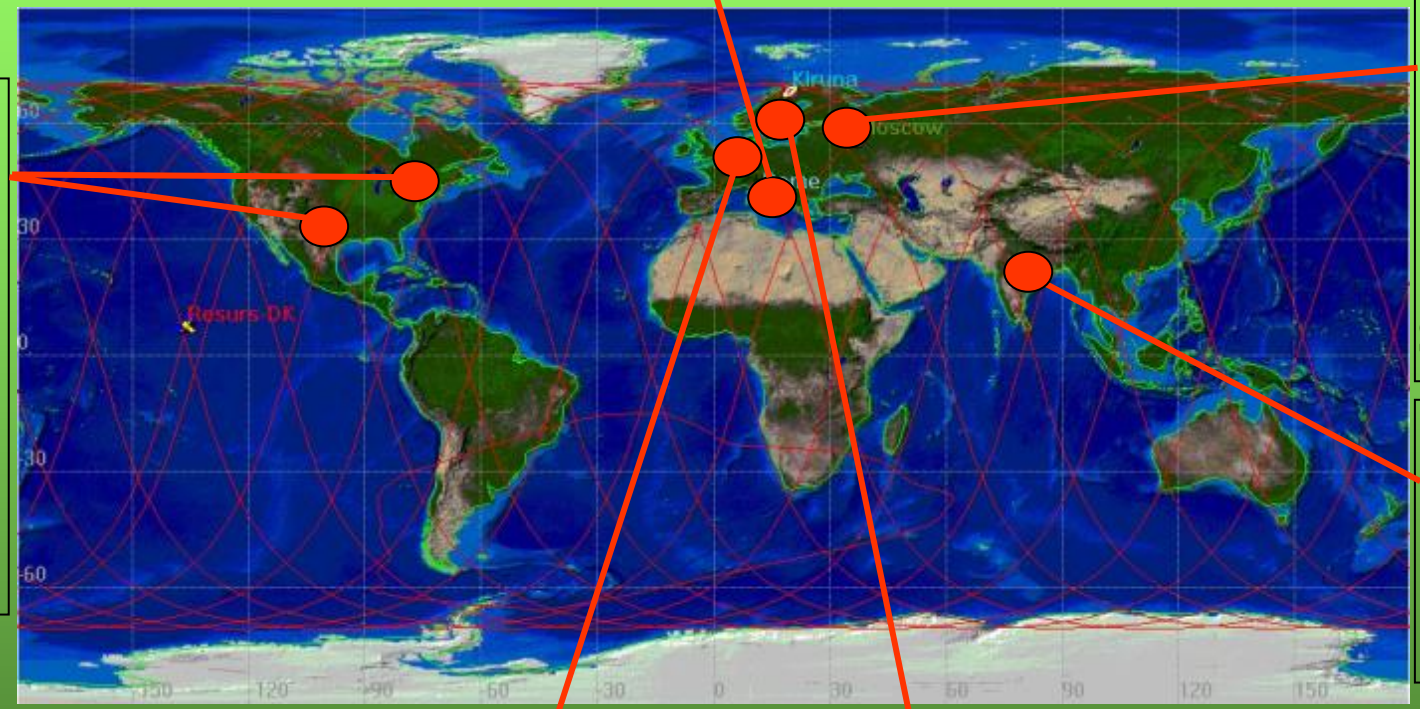
Russia:

Moscow
St. Petersburg

USA:

GSFC

NMSU



India:

Bombay

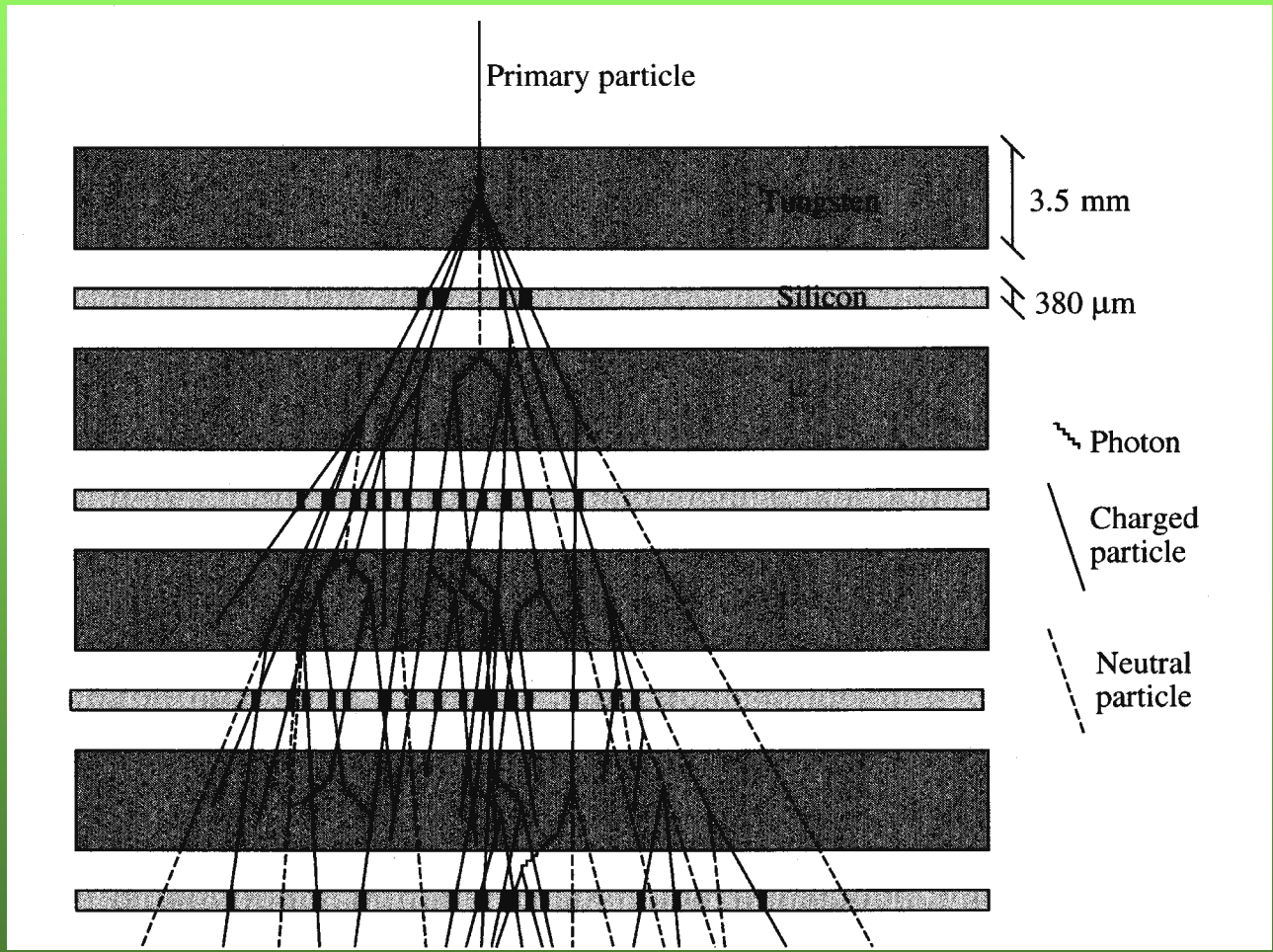
Germany:

Siegen

Sweden:

KTH, Stockholm

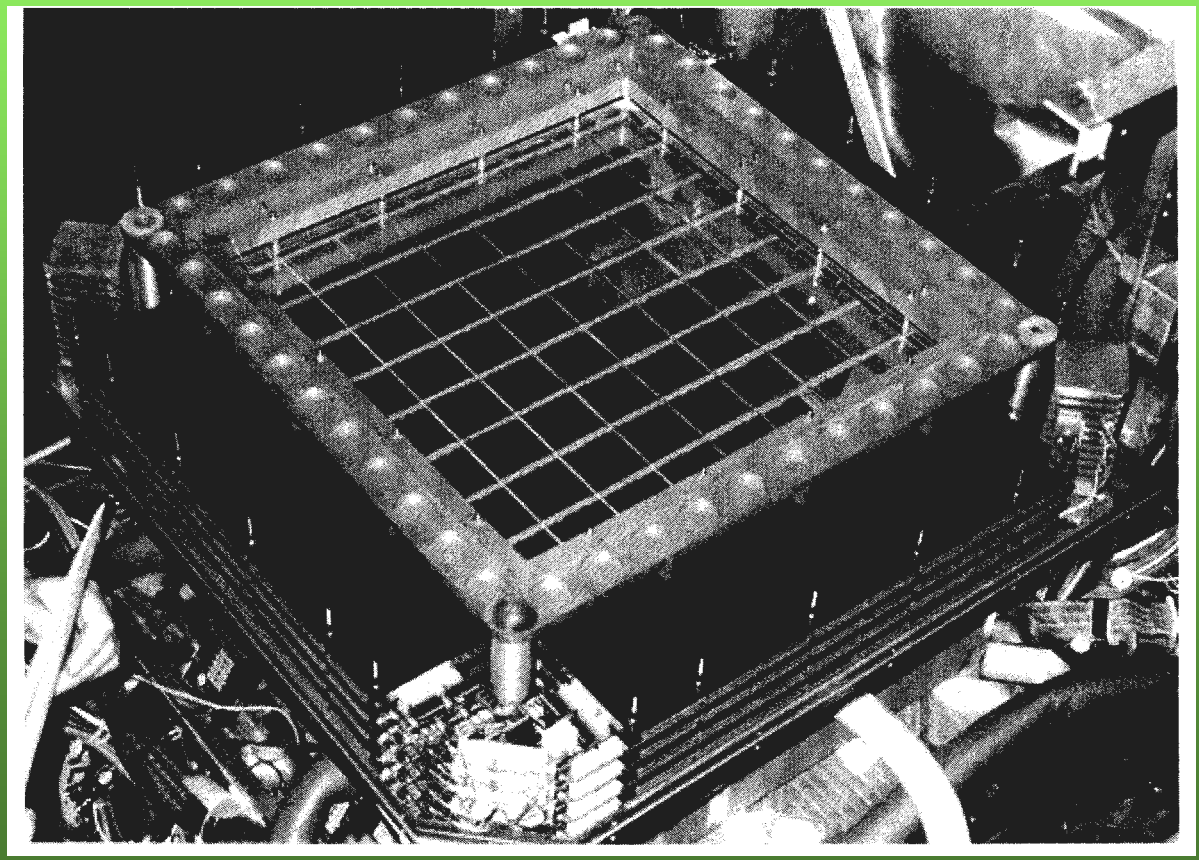
Calorimeter Principle



First Calorimeter Prototype

20x2 (X and Y views) 60x60 cm^2 Si detectors interleaved by 19 W layers of 0.5 X_0.
Test beams 1991-1992.

CAPRICE Calorimeter

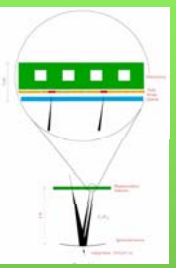


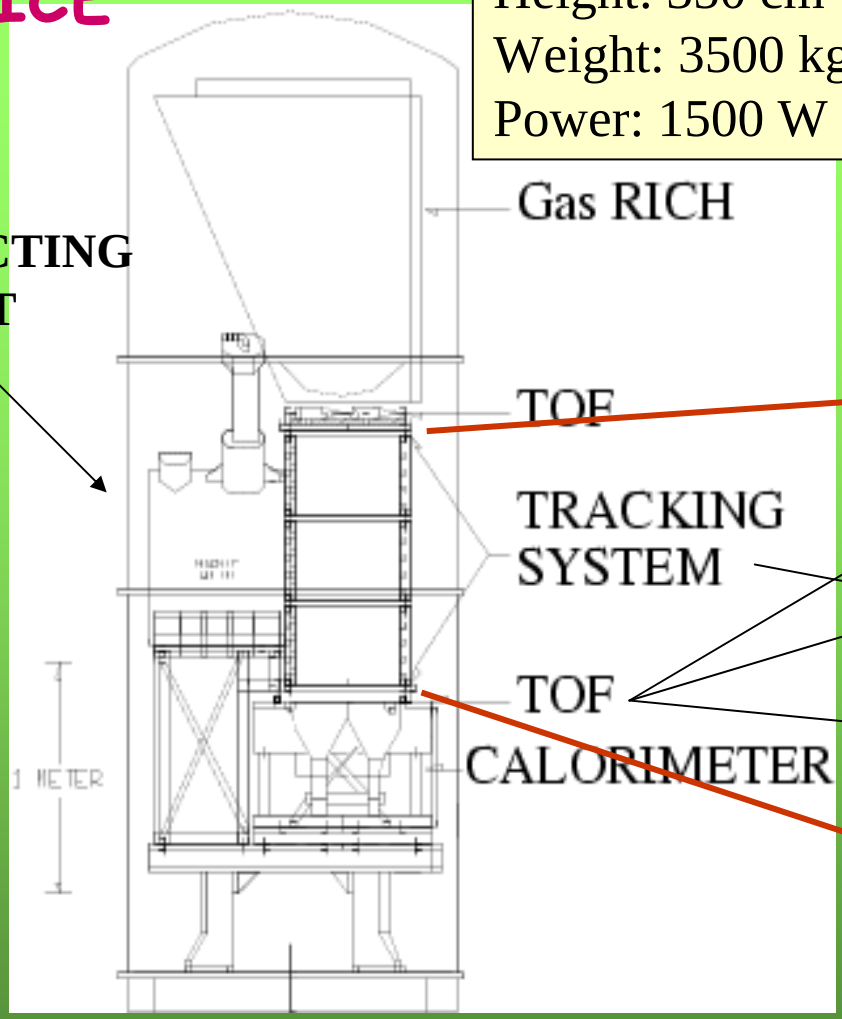
8 planes made by
64x2 (X and Y views)
60x60 cm^2 Si detectors
interleaved by W layers
of 1 X_0.
It flew on 1993, 1997
and 1998

CAPRICE

Height: 350 cm
Weight: 3500 kg
Power: 1500 W

SUPER CONDUCTING MAGNET

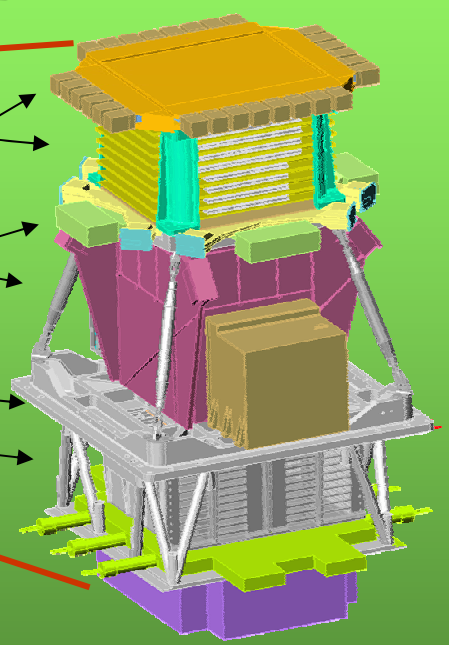




PAMELA

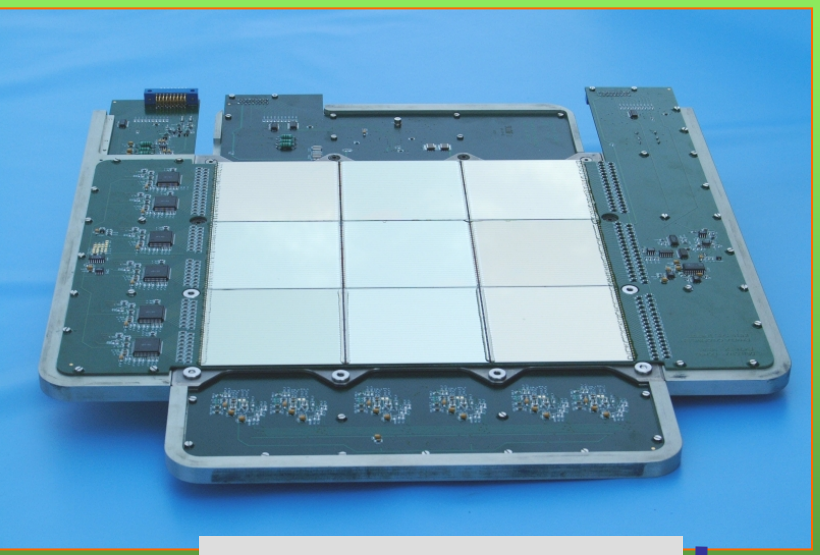
Height: 120 cm
Weight: 450 kg
Power: 360 W

TRD

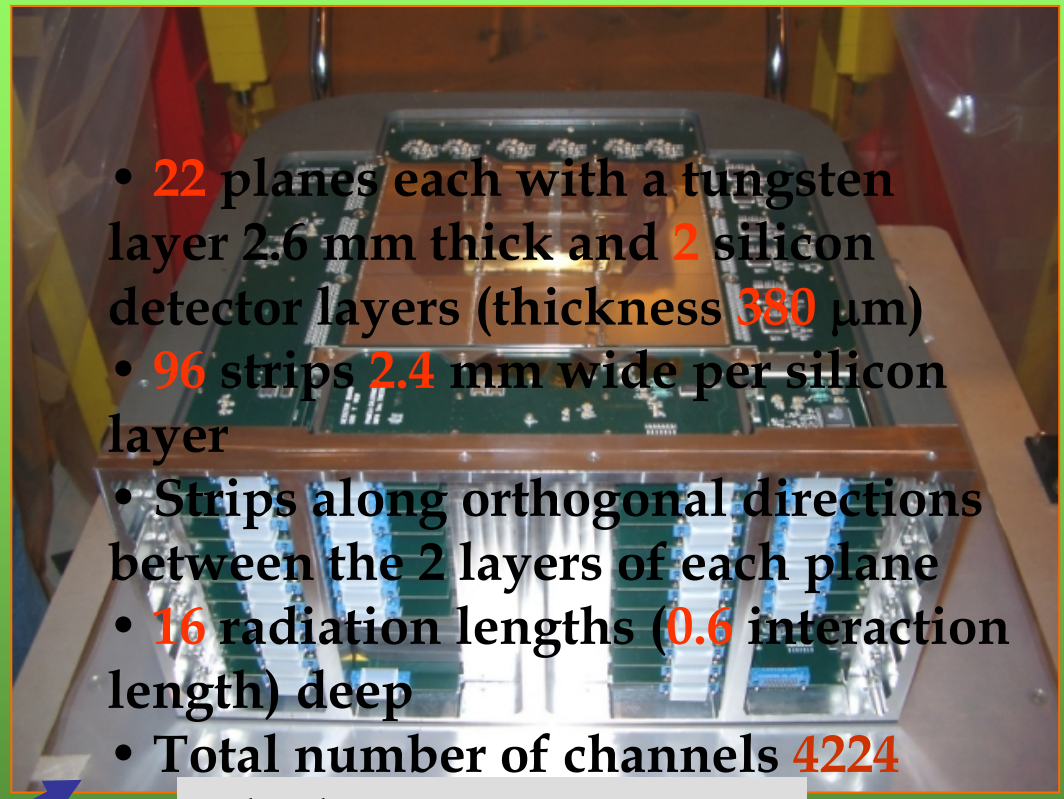


from balloon-borne detectors to satellite experiments

The imaging calorimeter



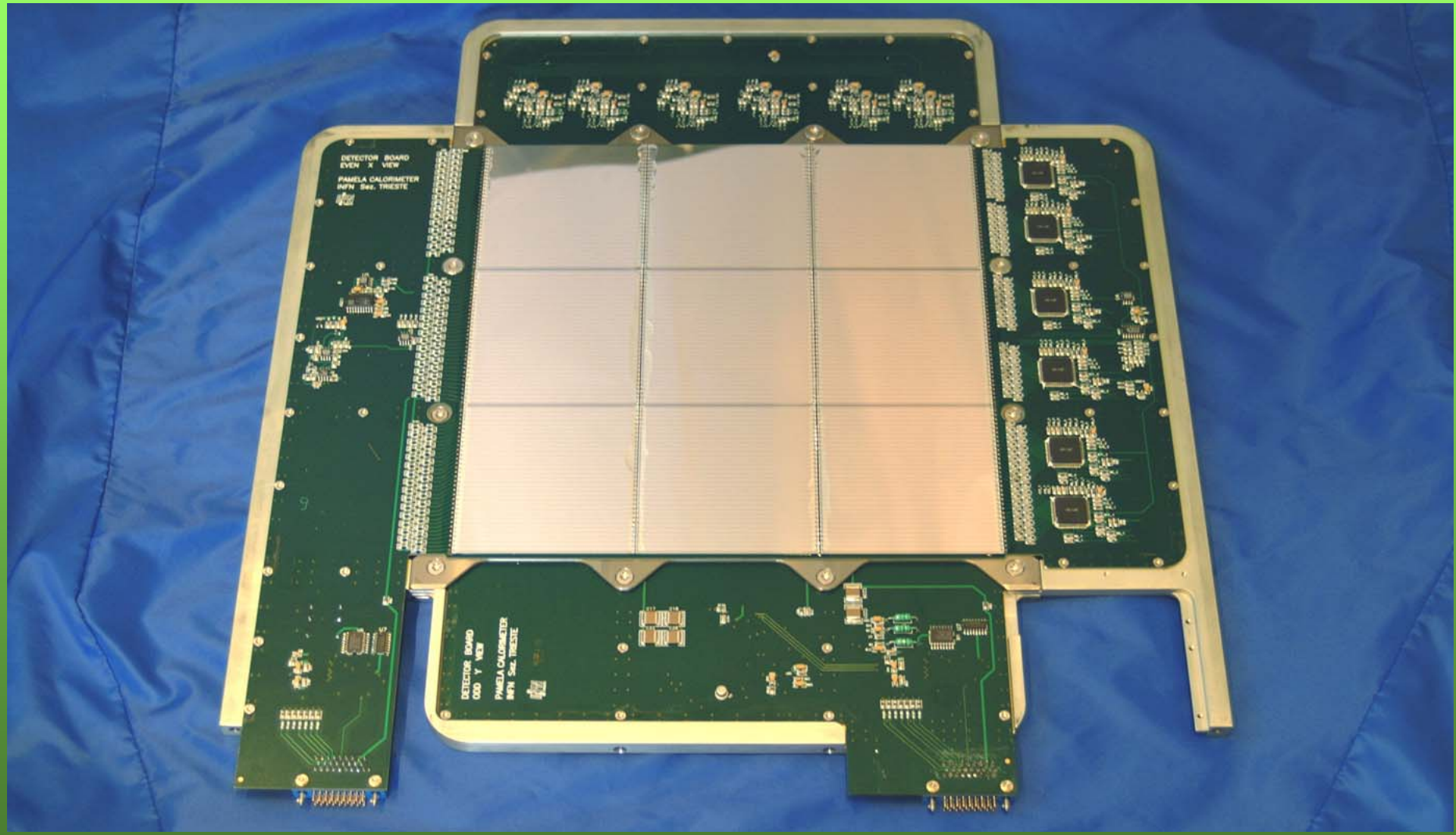
calorimeter plane



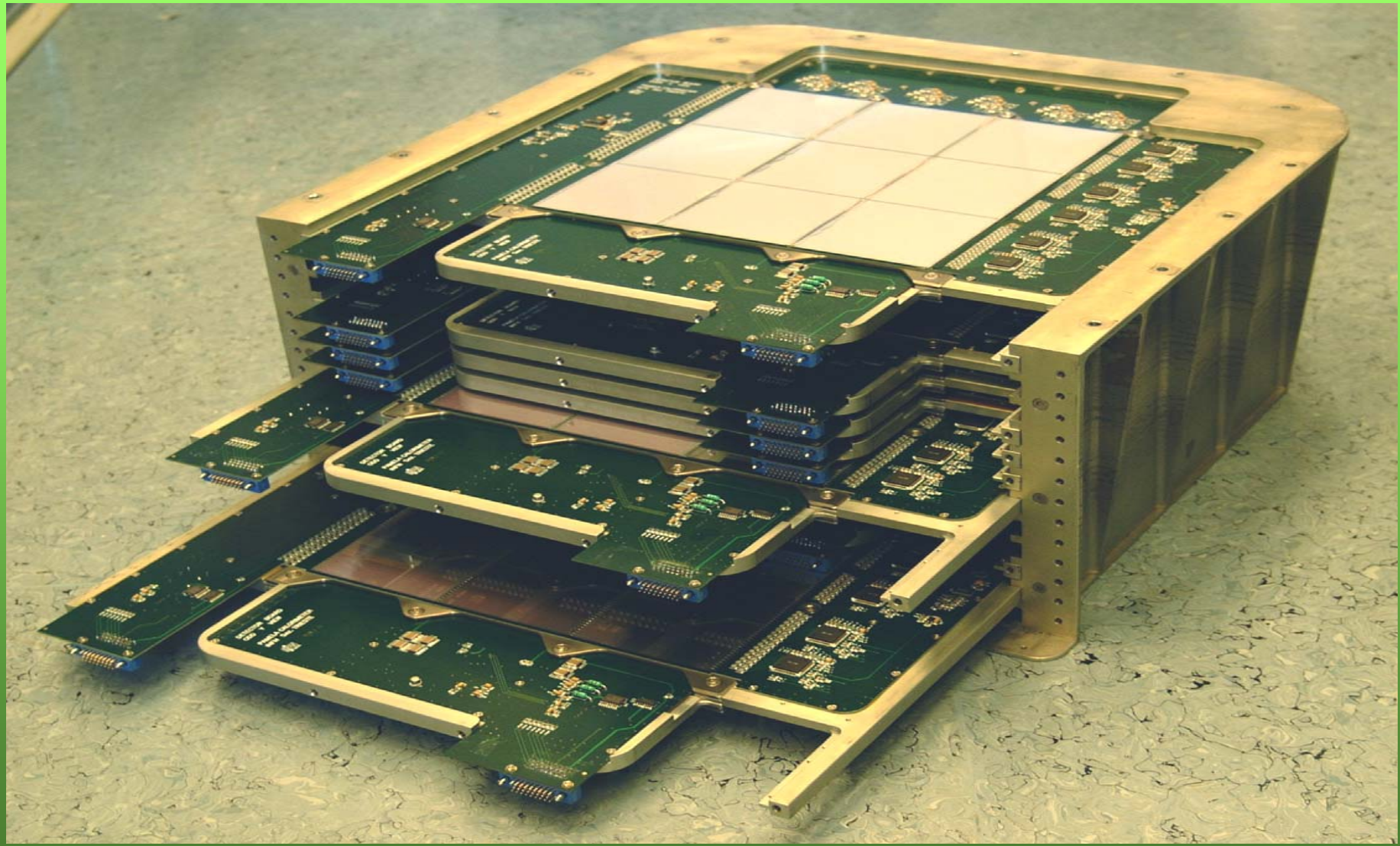
- 22 planes each with a tungsten layer 2.6 mm thick and 2 silicon detector layers (thickness 380 μm)
- 96 strips 2.4 mm wide per silicon layer
- Strips along orthogonal directions between the 2 layers of each plane
- 16 radiation lengths (0.6 interaction length) deep
- Total number of channels 4224
- Wide dinamic range ≈ 1 ÷ 1000 mip

Assembled calorimeter

A calorimeter plane



The imaging calorimeter



NINA: a Si Space Instrument

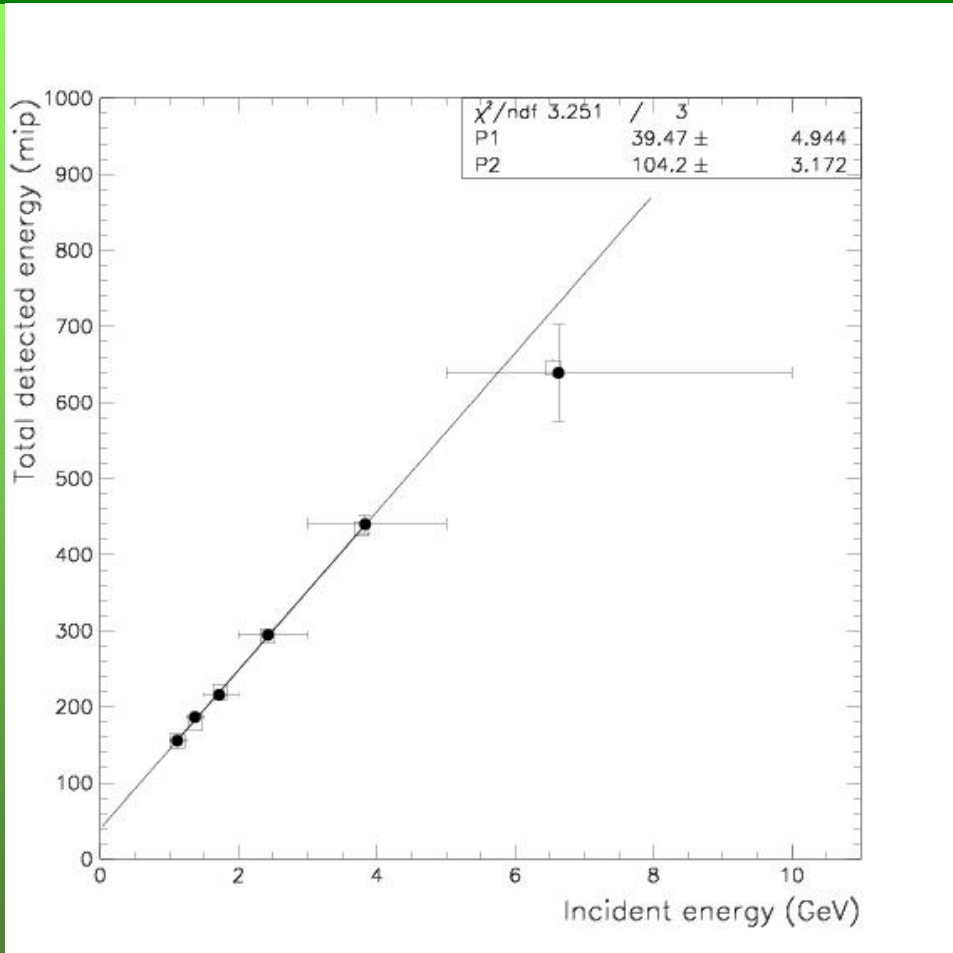
16 Si detectors 60x60 Cm^2 to detect low energy particles via their energy losses. One version was launched with a satellite in 1998 and one in 1999.

Simulation Package

- Package used GEANT both for the description of the geometry and physics.
- Hadronic packages: GHEISHA & FLUKA (old version)
- Comparison performed both with test beam data and cosmic-ray data

Simulation - Cosmic-Ray Data

Caprice Calorimeter

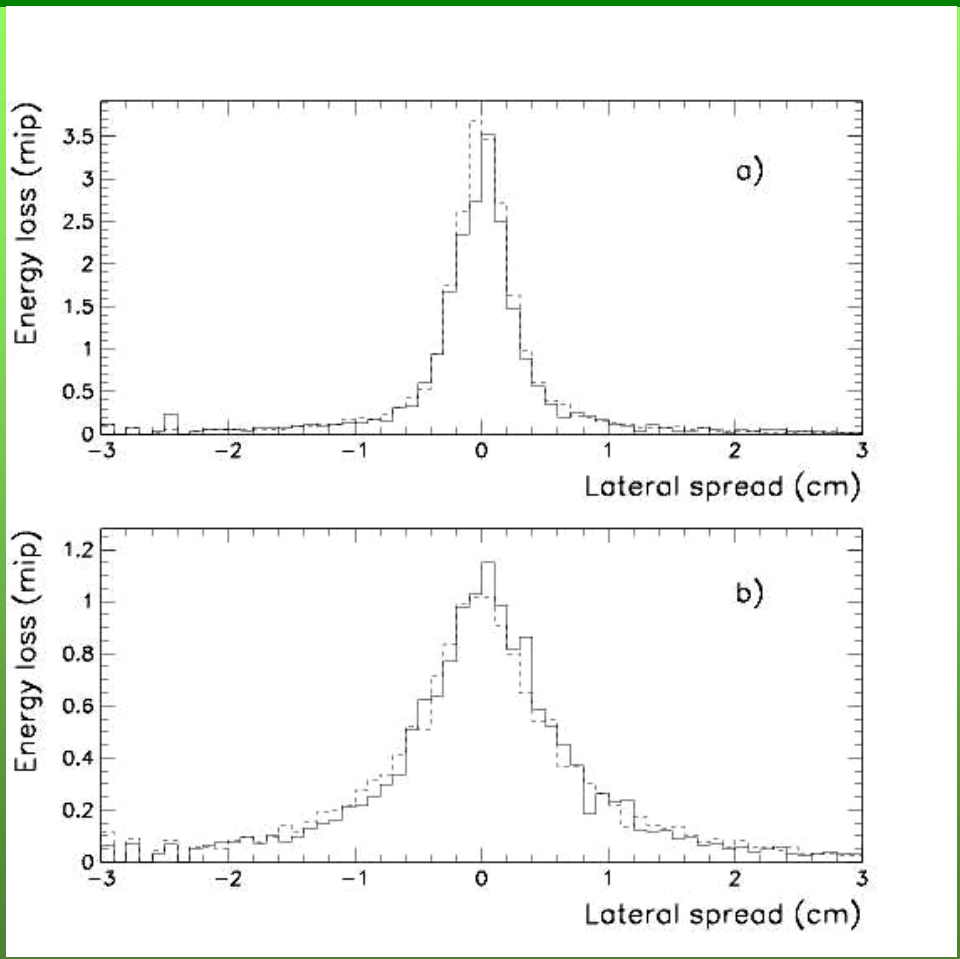


Energy Measurement

- Flight data
- Simulation

Simulation – Cosmic-Ray Data

Caprice Calorimeter

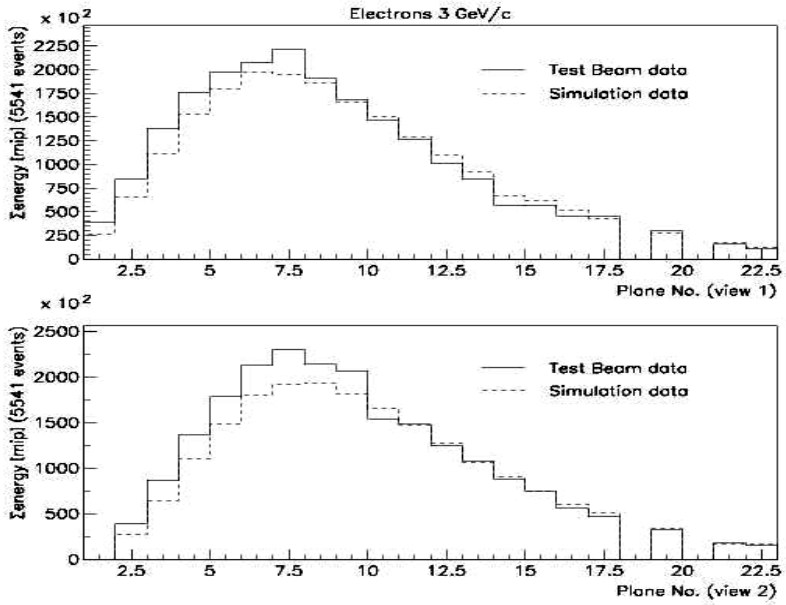


Lateral Profile

- Solid line: Flight data
- Dashed line: Simulation data

Simulation – Cosmic-Ray Data

Pamela Calorimeter

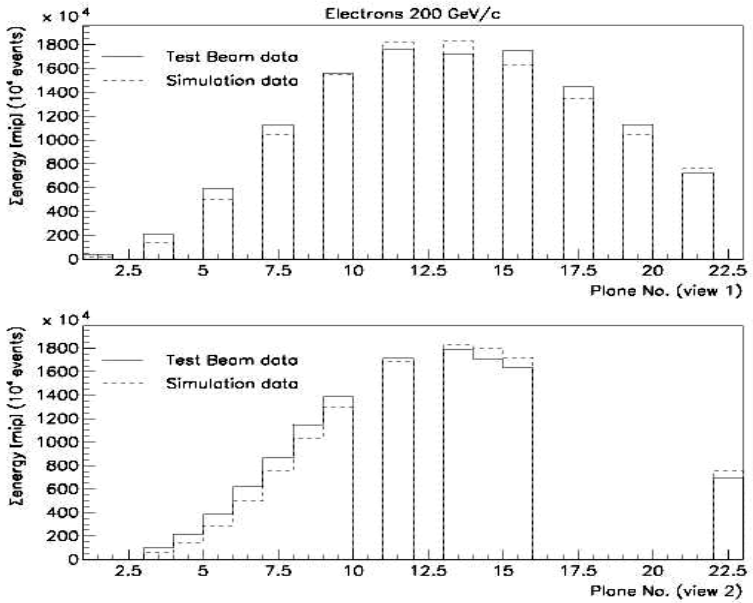


Longitudinal Profile (3 GeV/c e^-)

- Solid line: Test beam data
- Dashed line: Simulation data

Simulation – Cosmic-Ray Data

Pamela Calorimeter

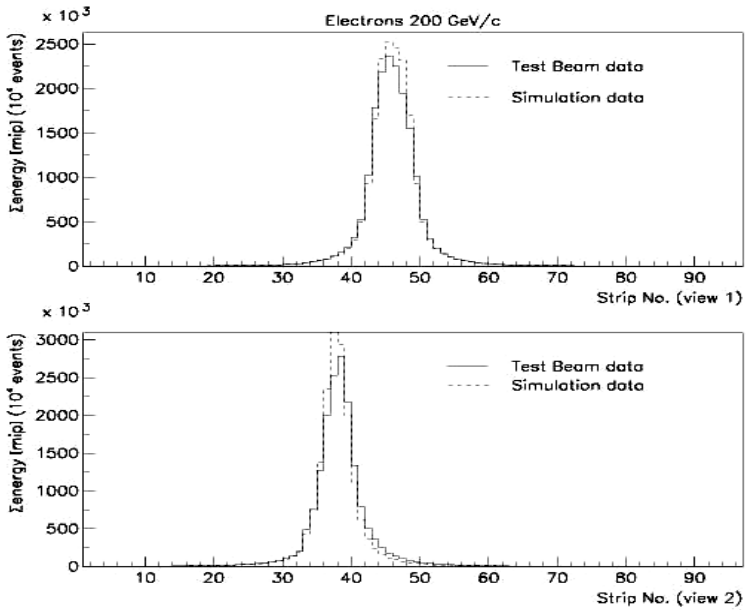


Longitudinal Profile (200 GeV/c e^-)

- Solid line: Test beam data
- Dashed line: Simulation data

Simulation – Cosmic-Ray Data

Pamela Calorimeter

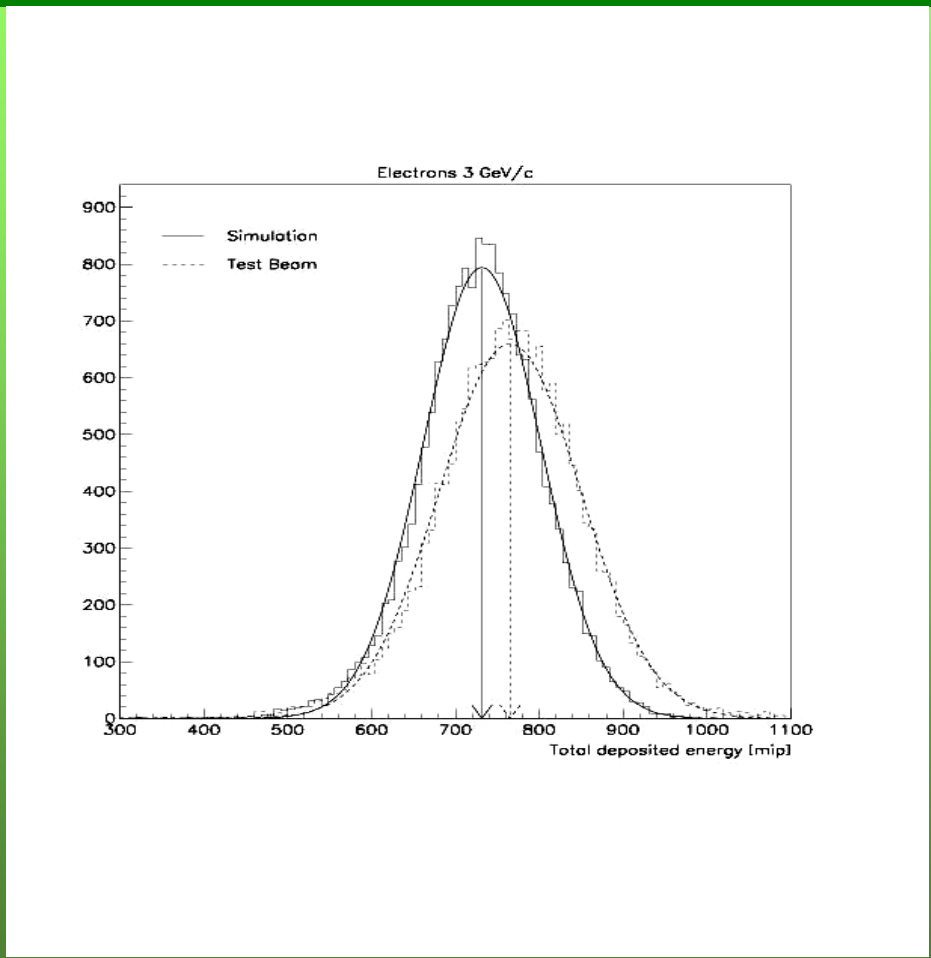


Lateral Profile (200 GeV/c e^-)

- Solid line: Test beam data
- Dashed line: Simulation data

Simulation – Cosmic-Ray Data

Pamela Calorimeter

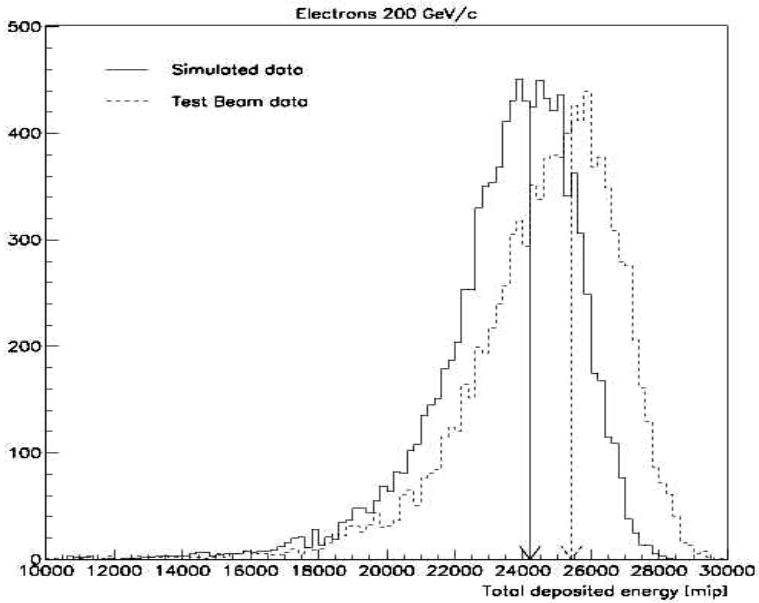


Energy Measurement

- Solid line: Test beam data
- Dashed line: Simulation data

Simulation – Cosmic-Ray Data

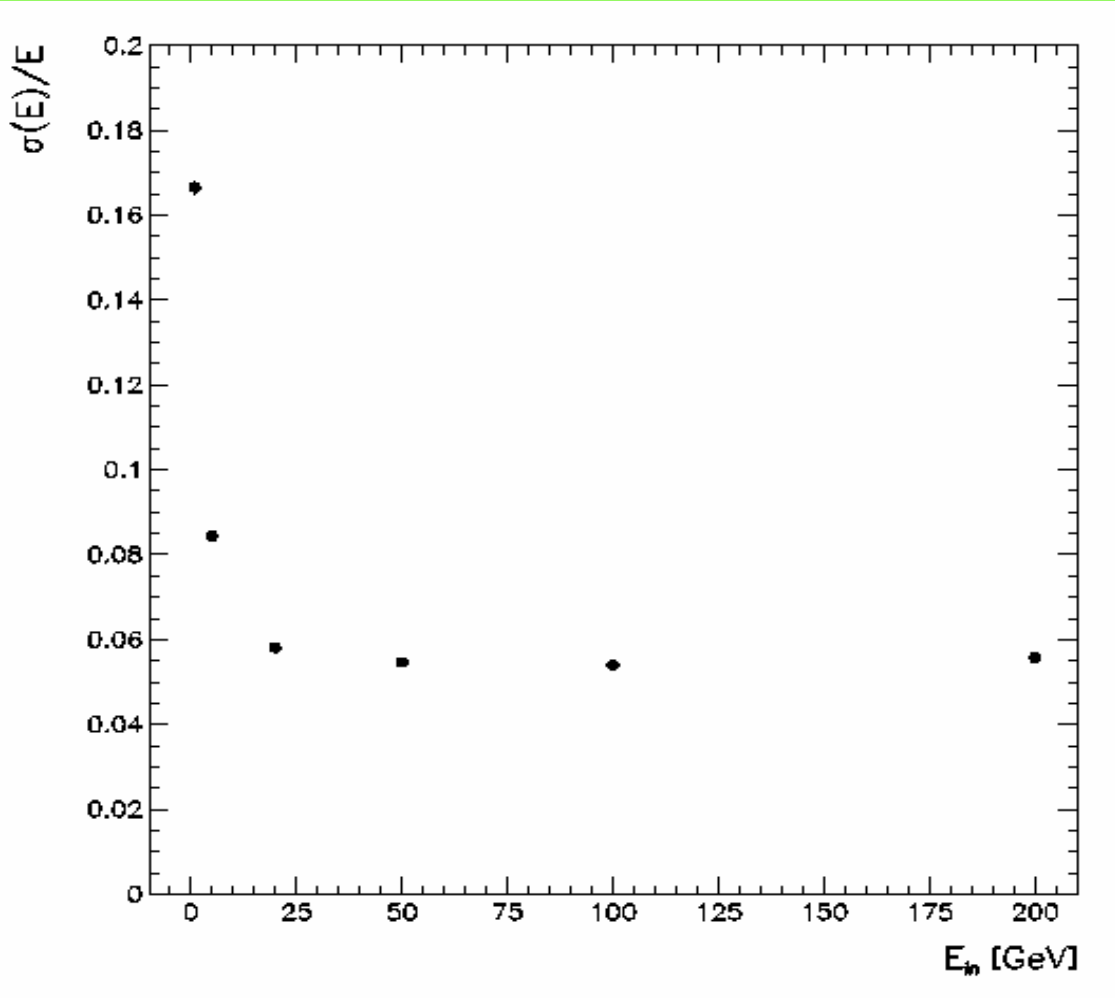
Pamela Calorimeter



Energy Measurement

- Solid line: Flight data
- Dashed line: Simulation data

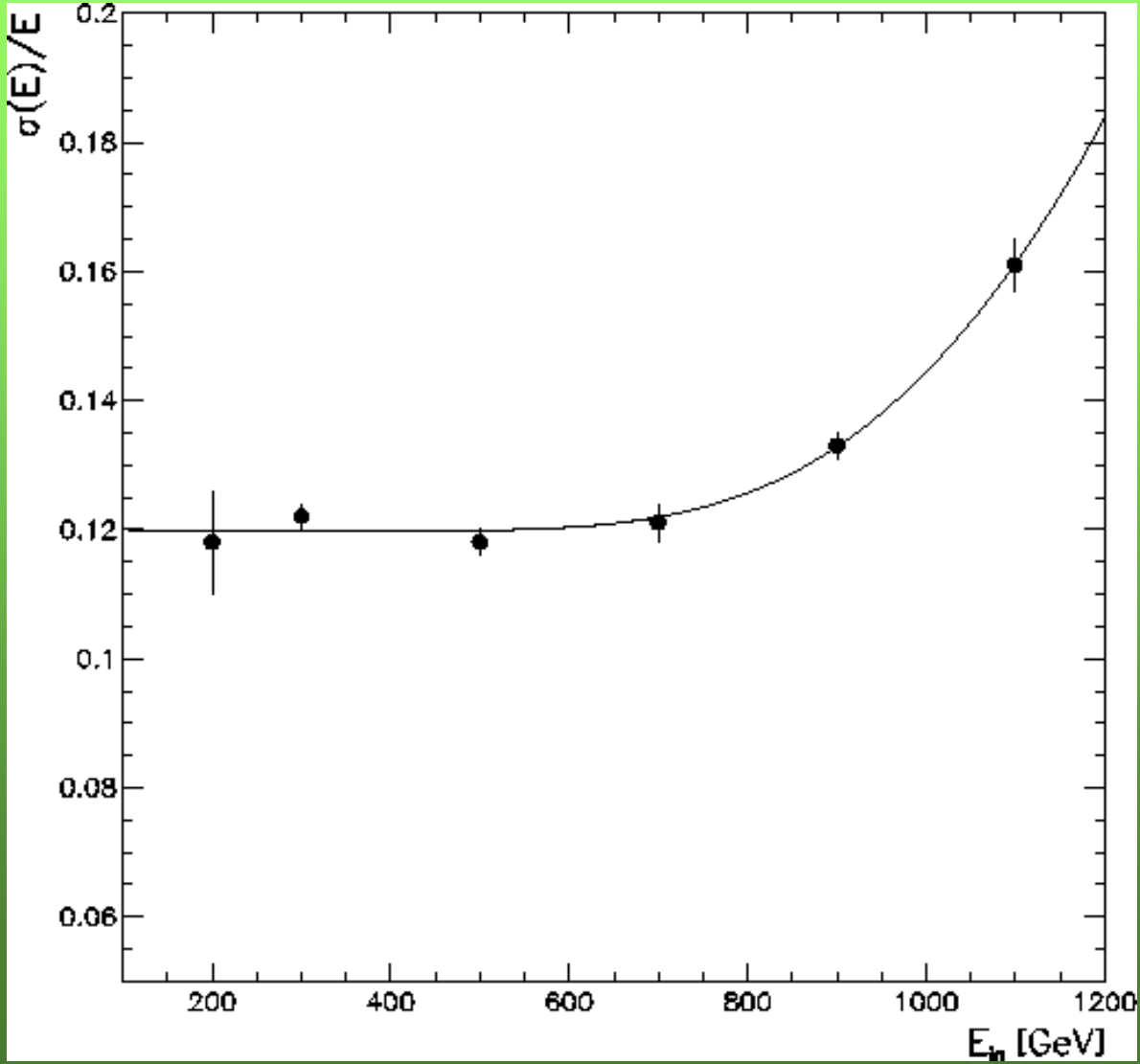
Calorimeter response (simulation)



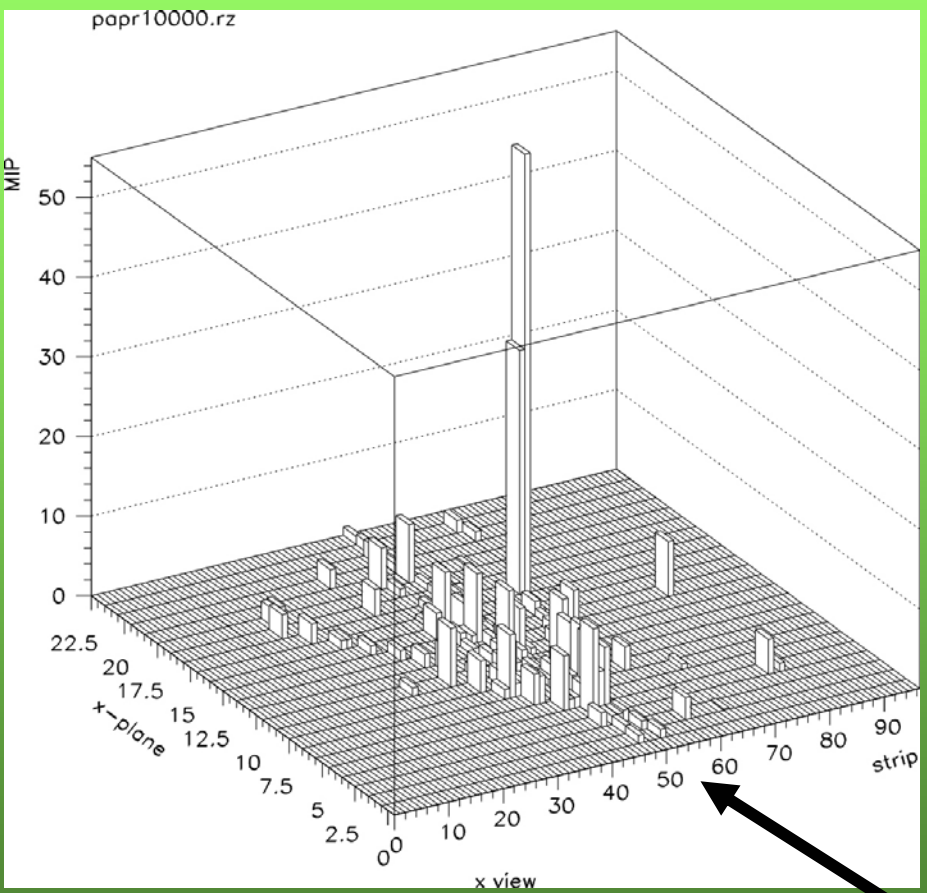
Expected energy resolution in the actual PAMELA configuration for cosmic-ray electrons

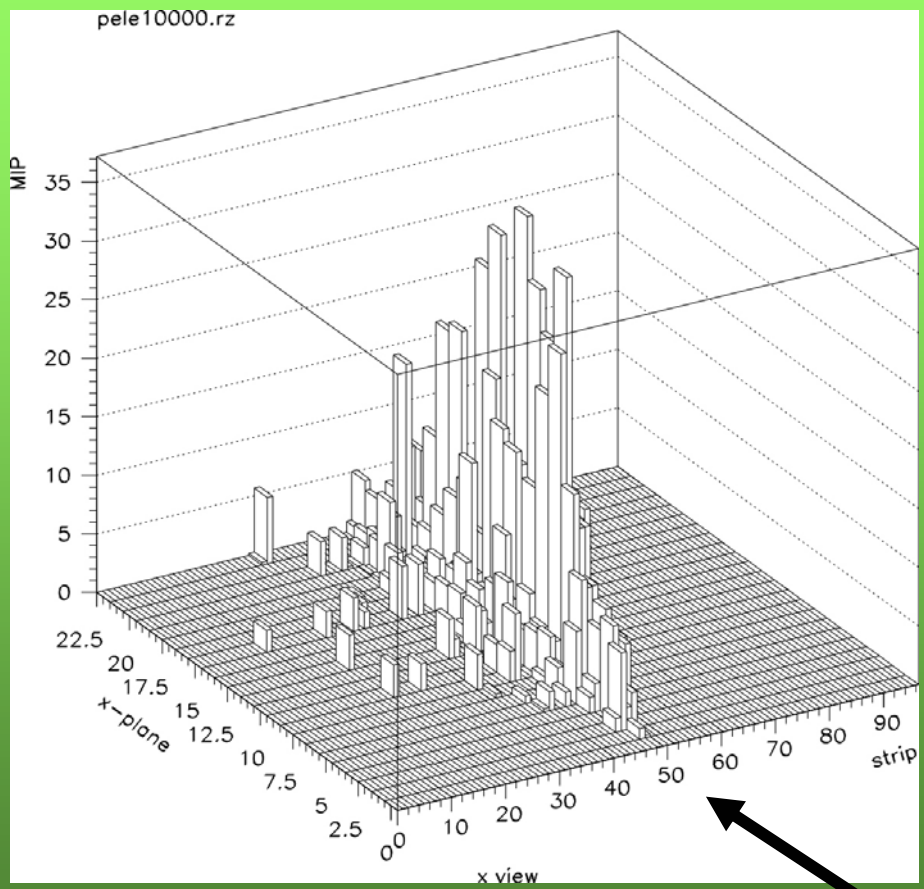
Calorimeter response

Simulated energy resolution in self-triggering mode



Calorimeter response (simulation)





10GeV $\bar{p}$

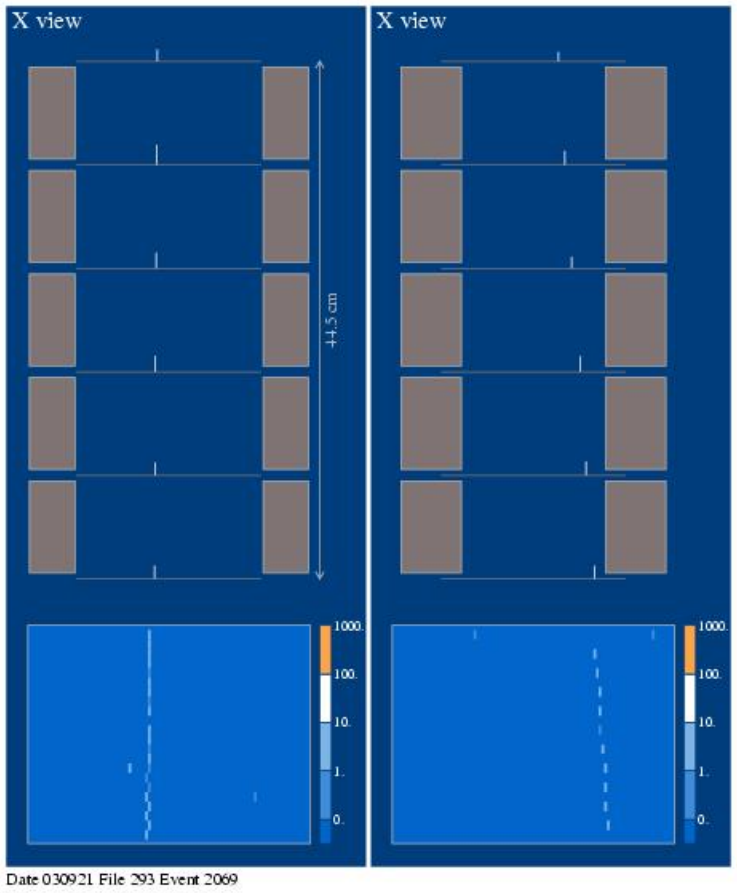
10GeV e^-

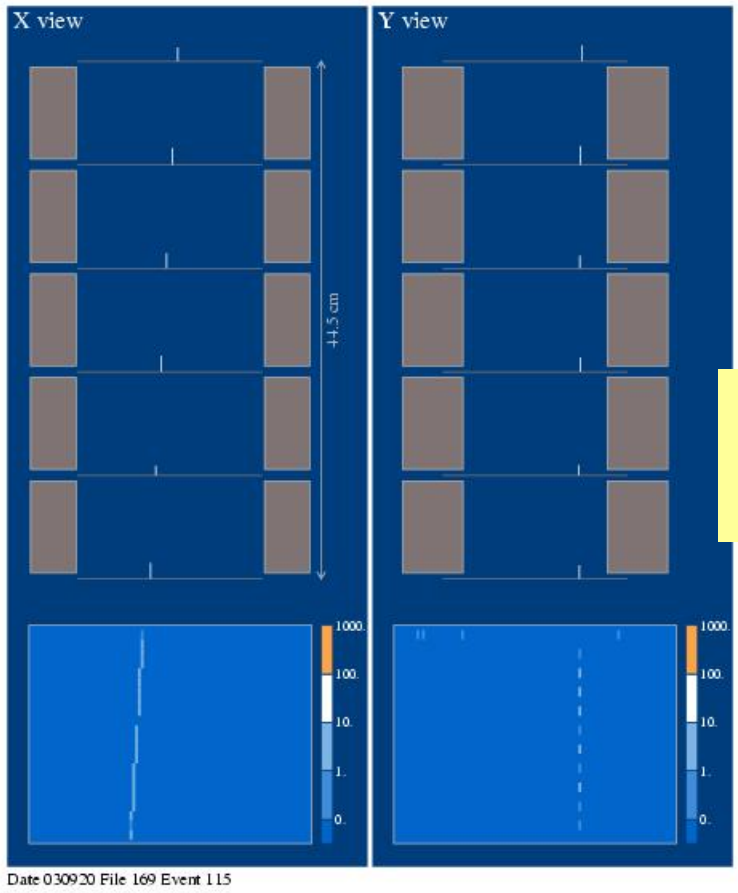
Conclusions about simulation

- A good agreement is found comparing simulation and experimental data for electromagnetic showers from 1 GeV up to 200 GeV and more. The simulation reproduces relatively well (differences of the order of few percent and less) the energy loss and its topological distribution.
- The simulation of hadronic showers does not give the same level of agreement obtained for the electromagnetic showers. However, differences are not large, of the order of 10-20%.

Real Events in the Calorimeter

SPS Test Beam Data: p 50 GeV/c

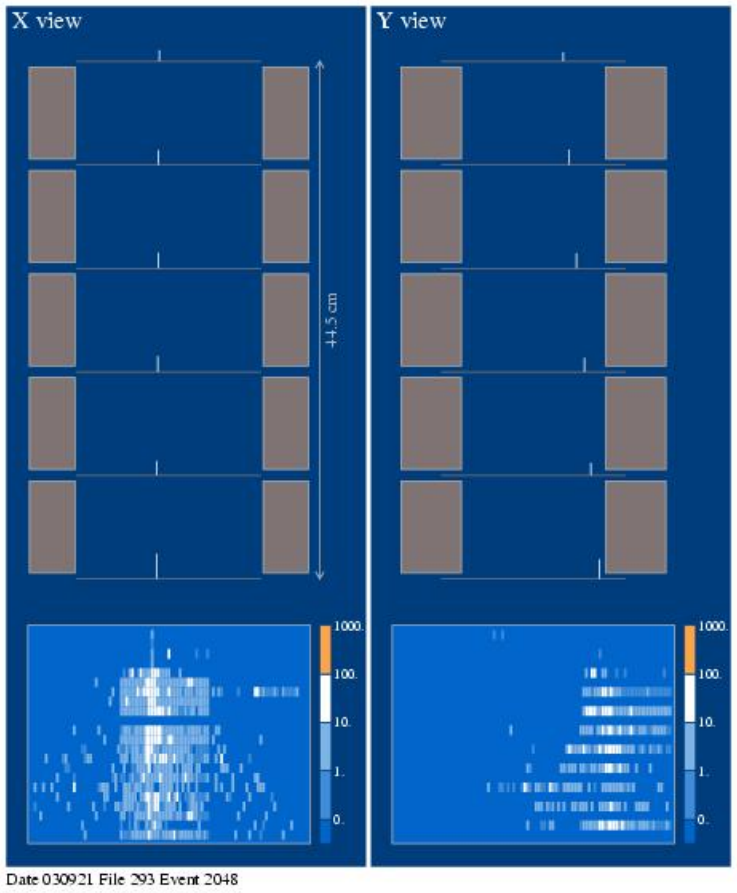


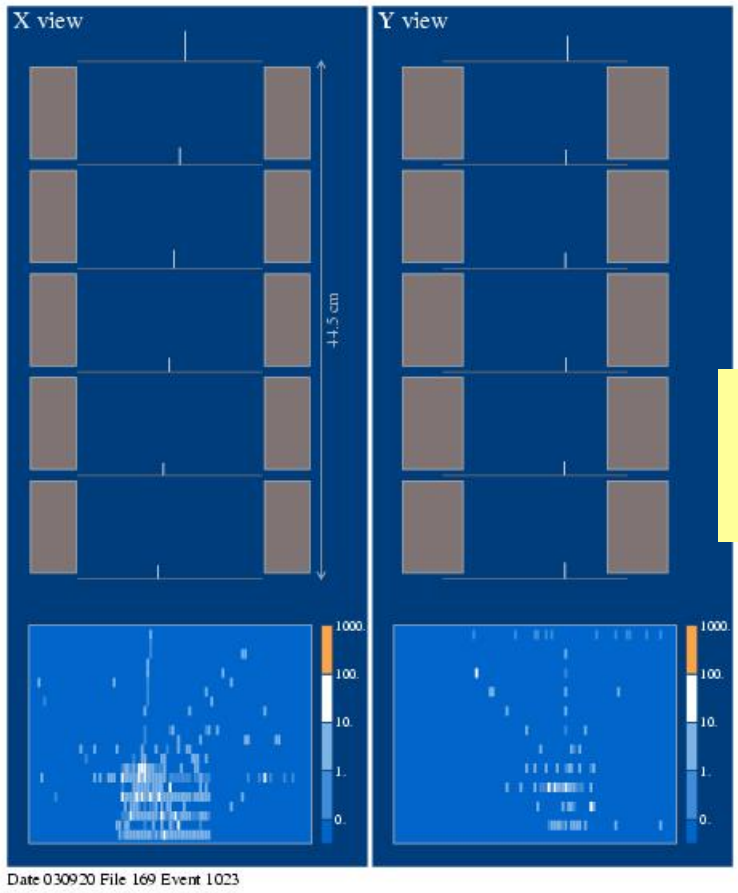


SPS Test Beam Data: p 100 GeV/c

Real Events in the Calorimeter

SPS Test Beam Data: p 50 GeV/c

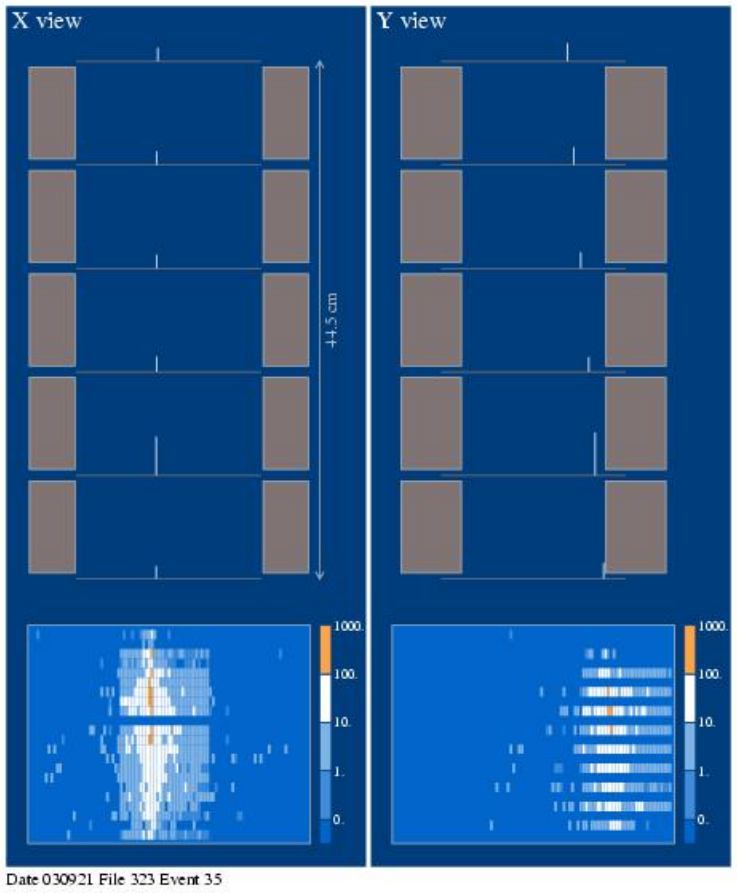


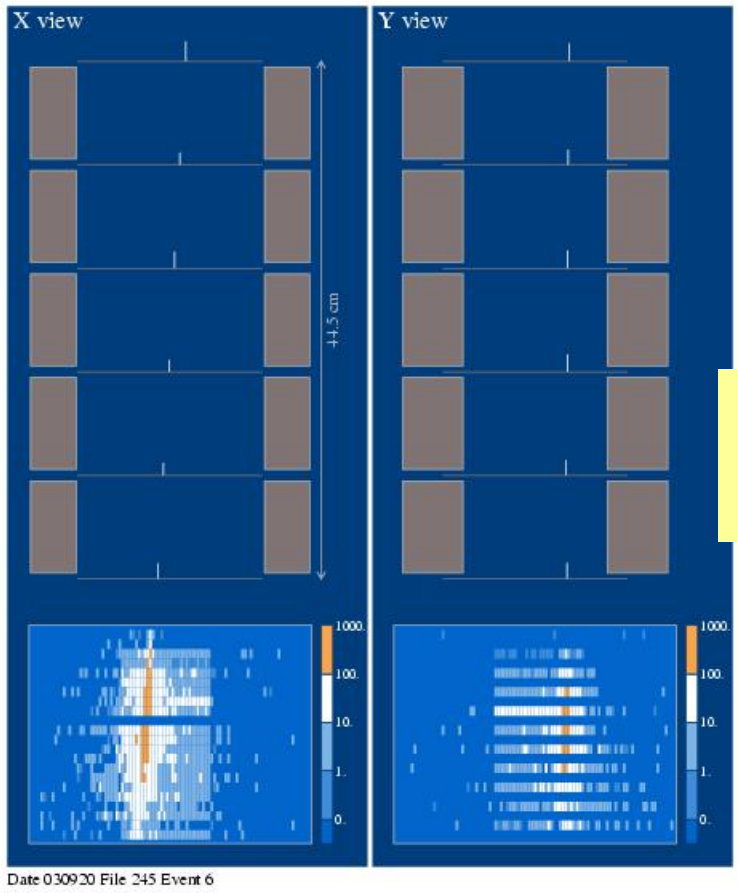


SPS Test Beam Data: p 100 GeV/c

Real Events in the Calorimeter

SPS Test Beam Data: e^- 50 GeV/c

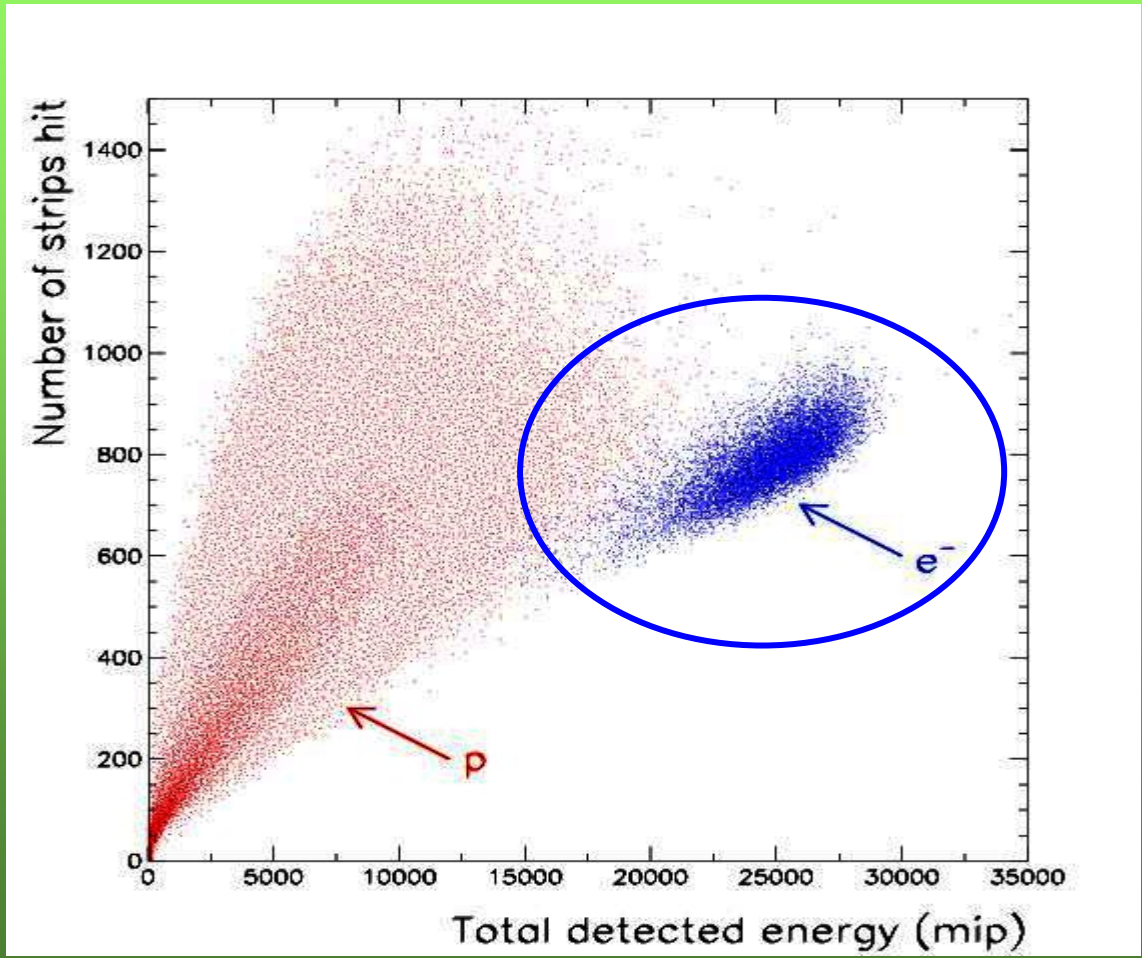




SPS Test Beam Data: e^- 100 GeV/c

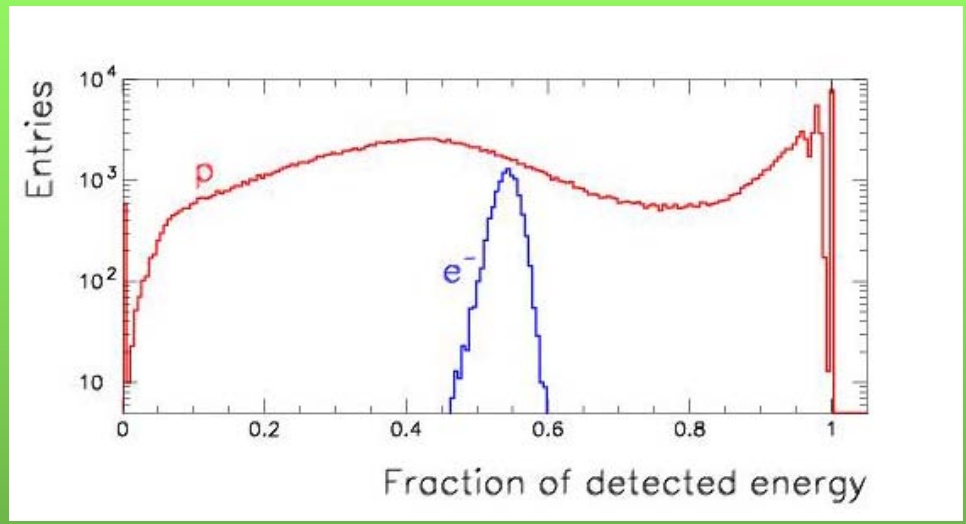
Electron-Proton separation (Calorimeter)

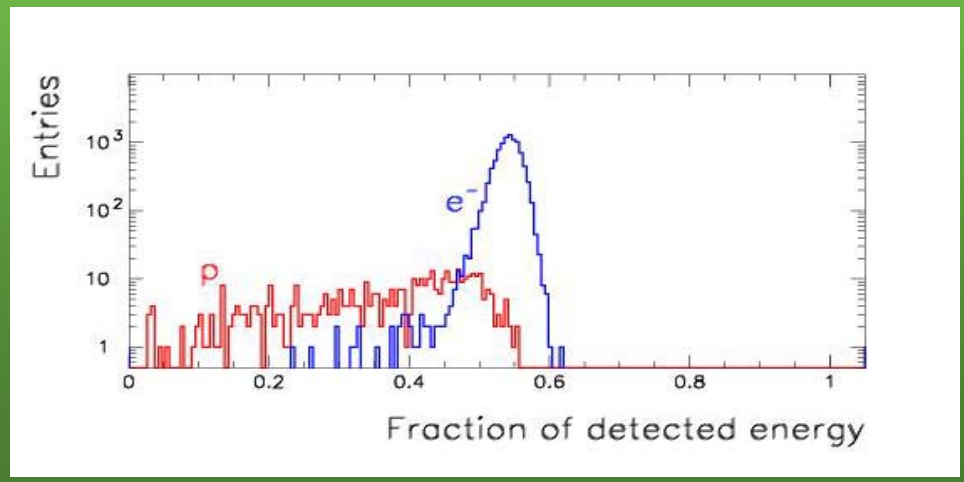
SPS Test Beam Data:
p & e^-
200 GeV/c



Electron-Proton separation (Calorimeter)

SPS Test Beam Data:
p & e^-
200 GeV





Proton rejection factor $\cong 3 \cdot 10^{-4}$
Electron selection efficiency $\cong 95\%$