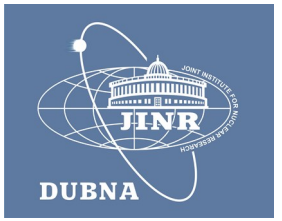

Time-of-Flight Walls for NA49/NA61

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JINR (Dubna)

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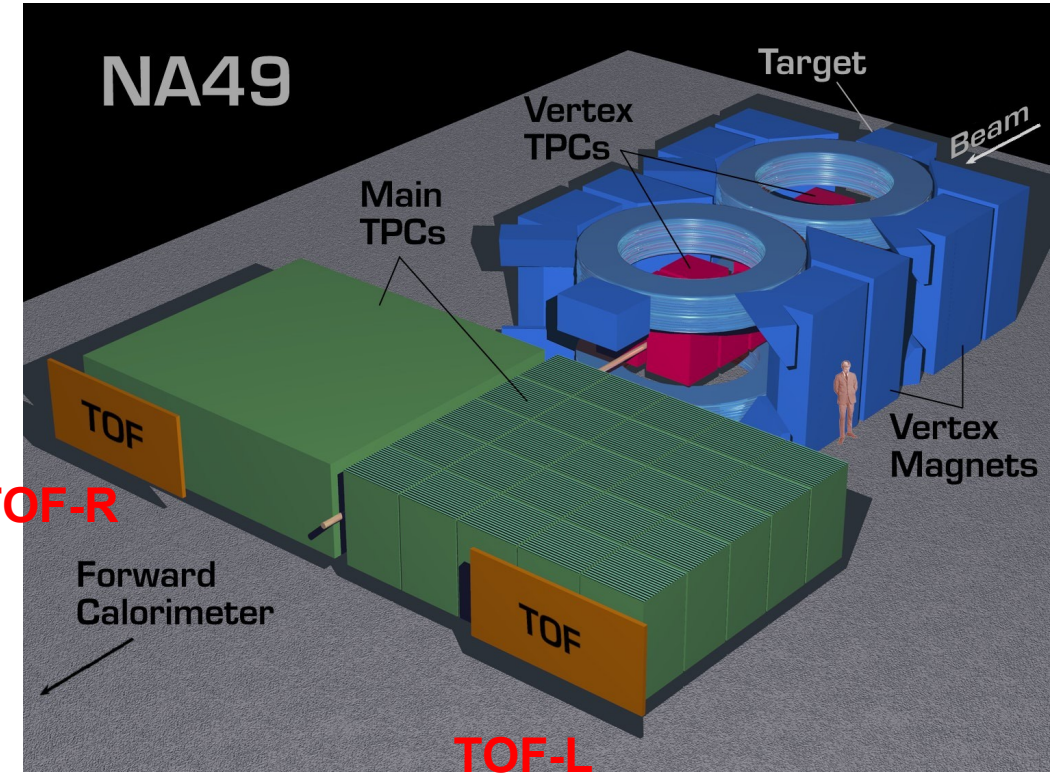
Requirements

- About 2 m^2 active area for one wall
- **Time resolution better than 80 ps**
- High efficiency for MIP =>
  Thickness and tight packing
- Low double-hit probability (<12%)=>
  High segmentation (20-25 cm^2)
- Similar flight paths => Detectors
  should be perpendicular to tracks
- Low material budget
- Construction simplicity and reliability
- Low heat production =>
  Low power consumption
- **Low price**



Walls of “pixels” made of scintillation detectors

Hi-Res Time Measurements

For precise time measurements we need
short and **stable** pulse

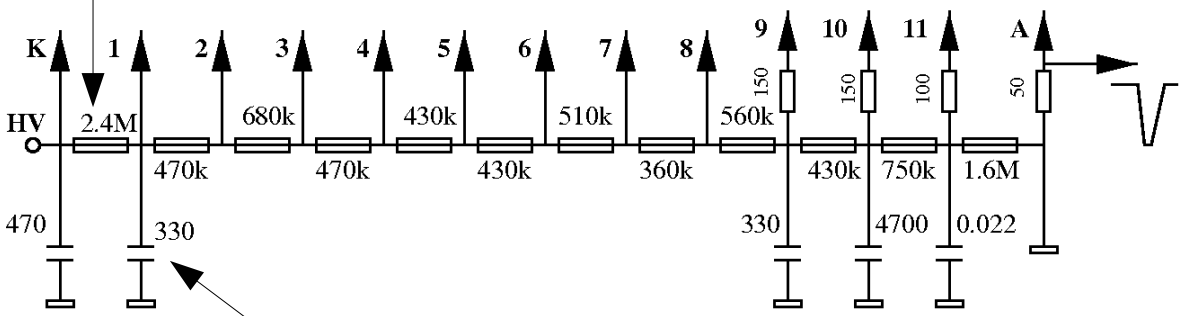
$\sigma t \sim \tau / \sqrt{N}$

A lot of light => photoelectrons
Reduce noise

Fast scintillators & PMTs
Fast light collection (no light guides)
Fast collection of photoelectrons (high voltage on photocathode)

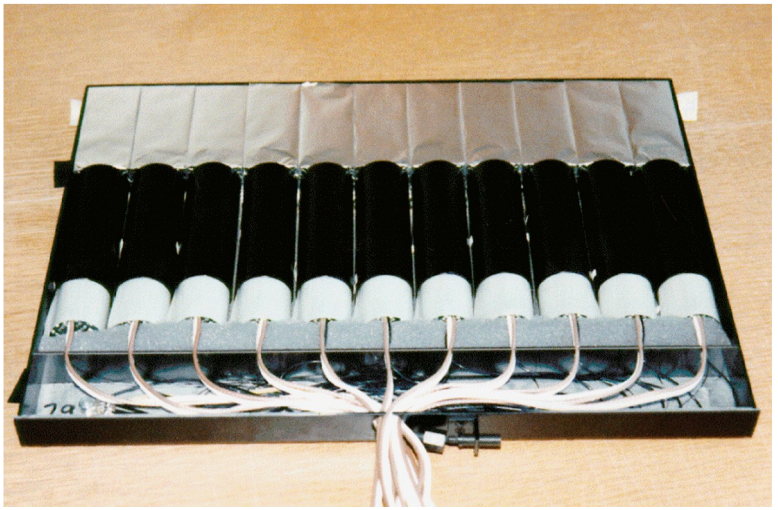
$U_1 > 500$ V

FEU-87 PMT
HV divider



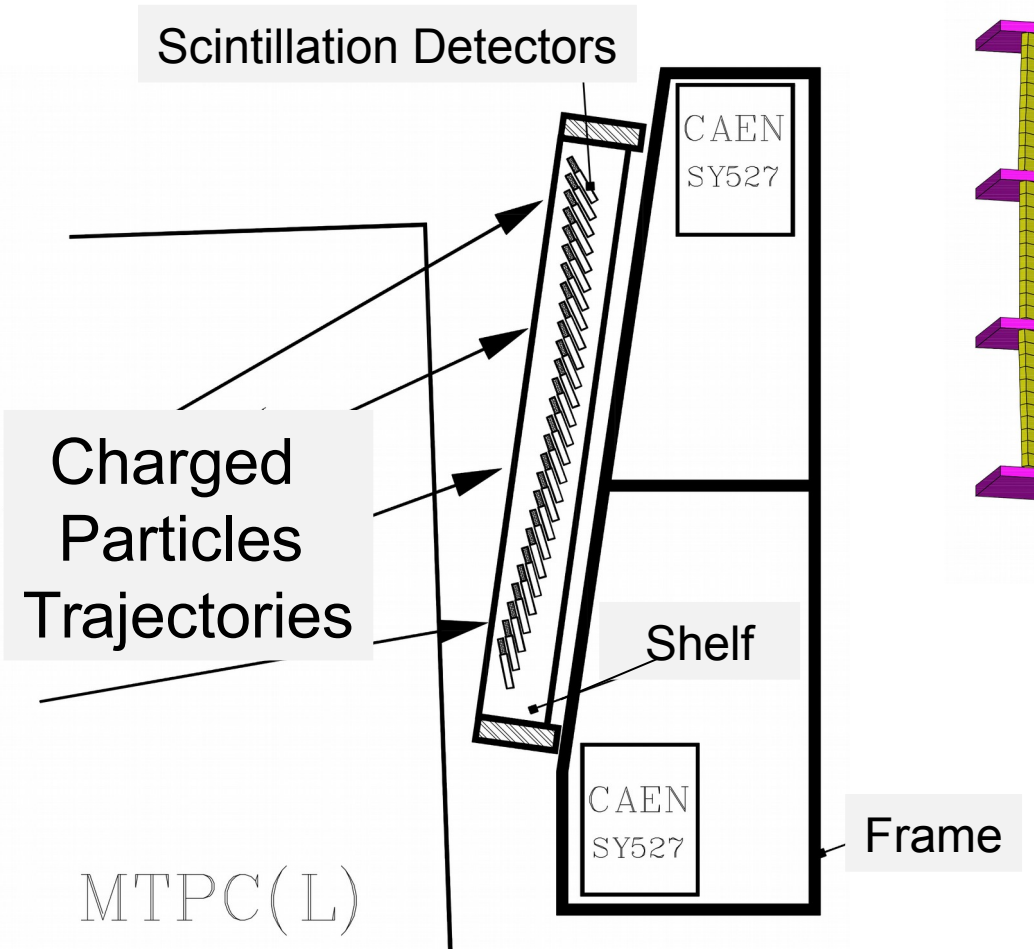
to filter noise out

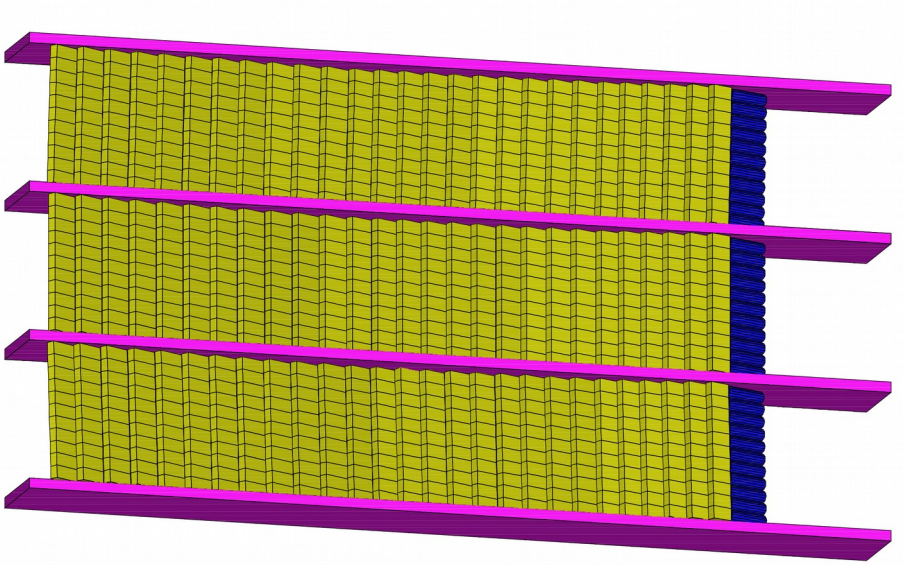
Detectors and Cassette



- 891 detectors per wall
- 23 mm (thick) x 34 mm (hight) x 60/70/80 mm (length)
- Scintillators: Bicron BC-418 (TOF-R)
  polysterene +4% p-terphenyl (TOF-L)
- Al foil wrap of scintillators
- No light guides
- One-side light collection
- PMTs: Philips XP-2972 (TOF-R)
  FEU-97 (TOF-L)
- Less than 0.2 mA per PMT current consumption
- 11 detectors per cassette

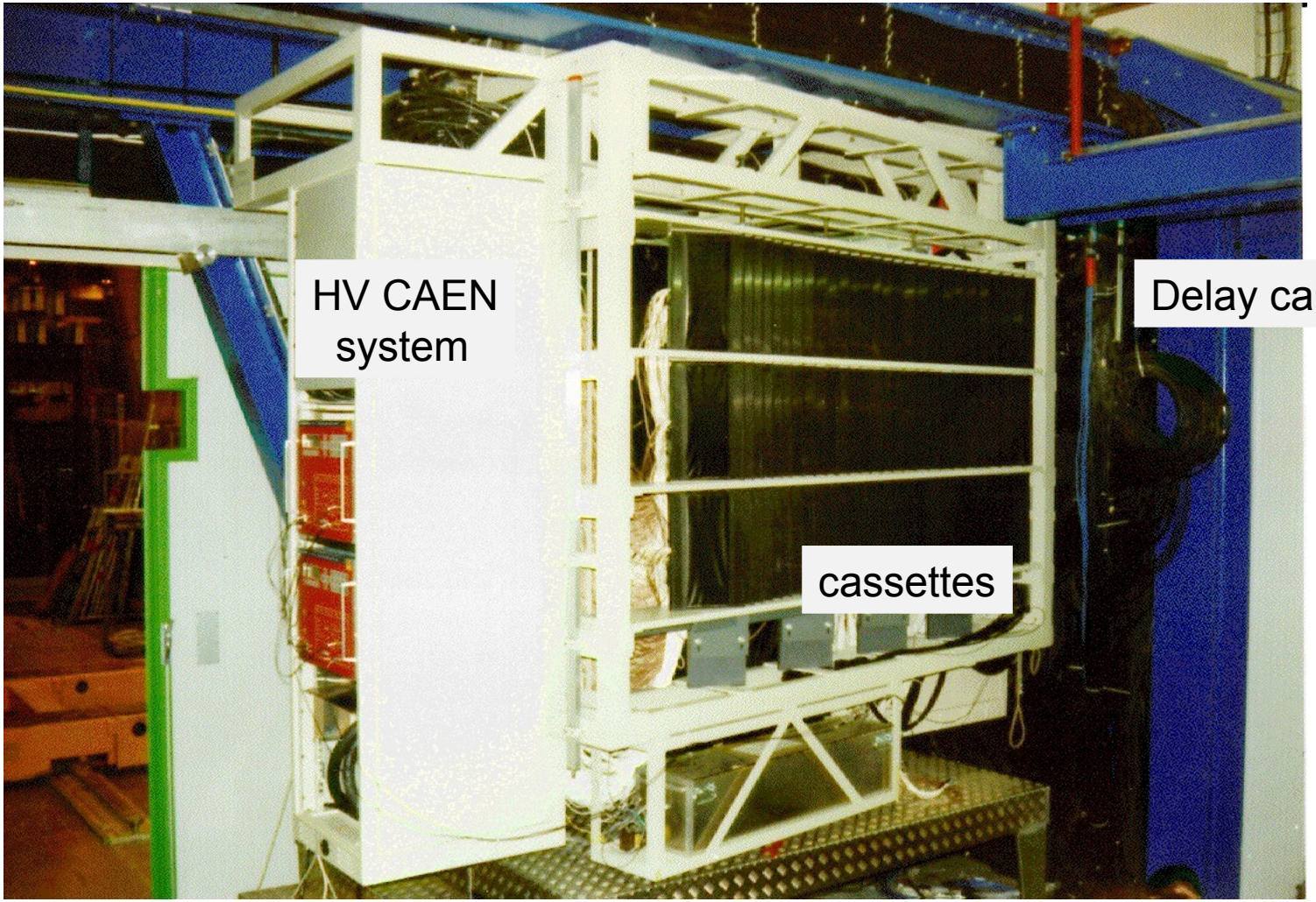
Detectors Layout



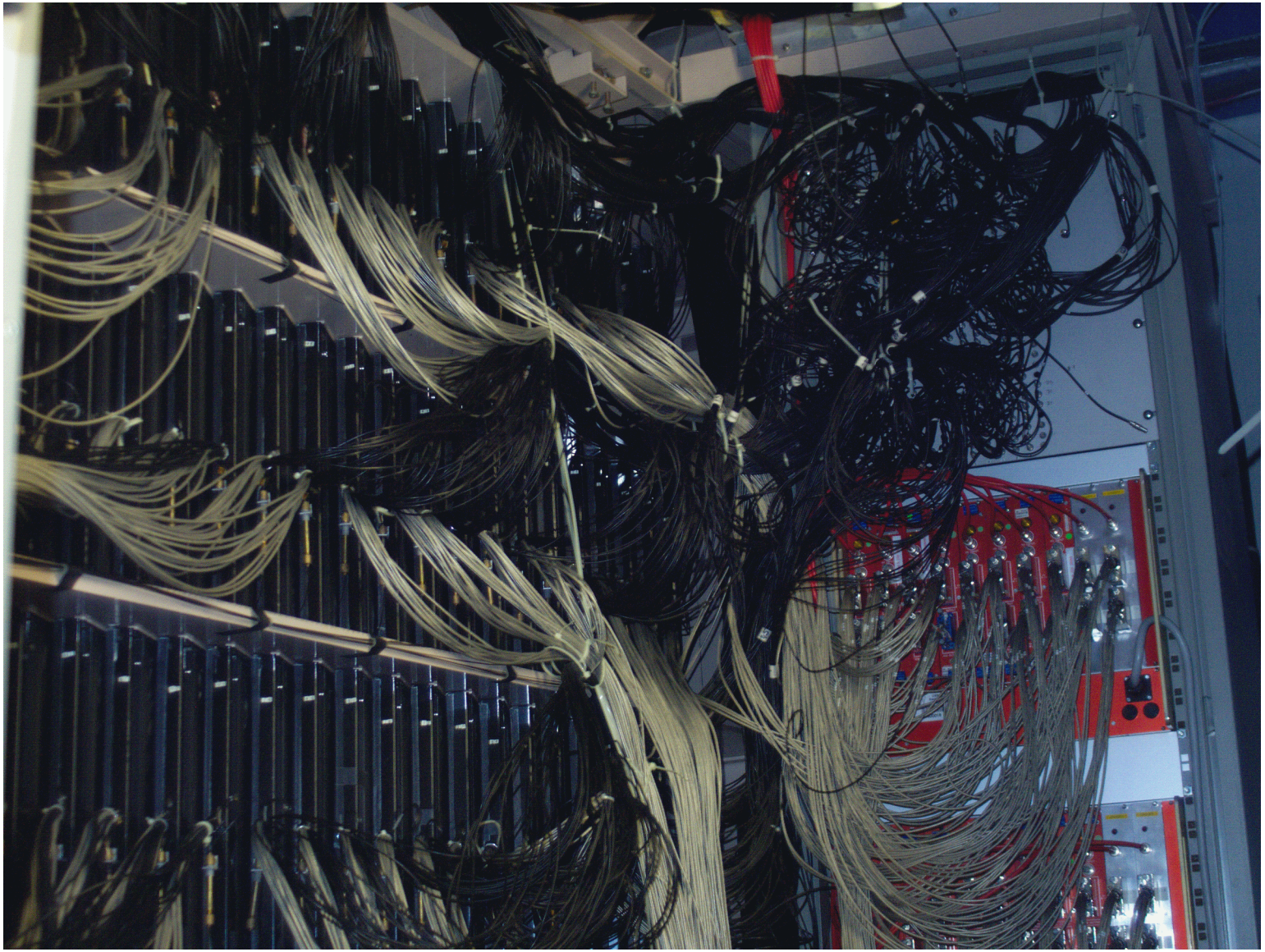


- 3 shelves per wall
- 27 cassettes per shelf
- PMTs were located behind the scintillators
- Detectors were located to have about the same path length from the target

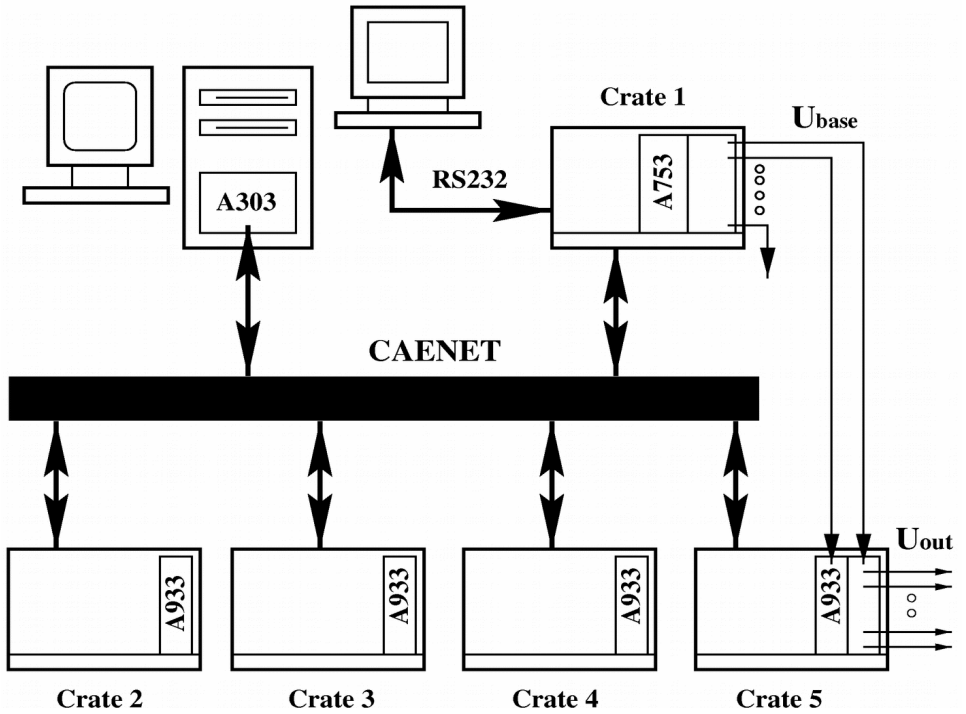
The Wall



Detectors on Shelves



HV Supply System (CAEN SY527)



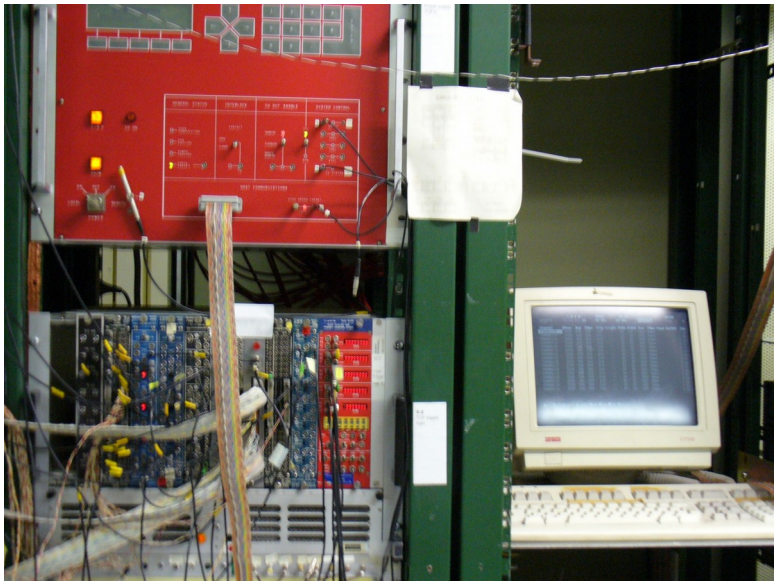
10 HV crates

10 (9-chan.) HV supply modules (counting house)

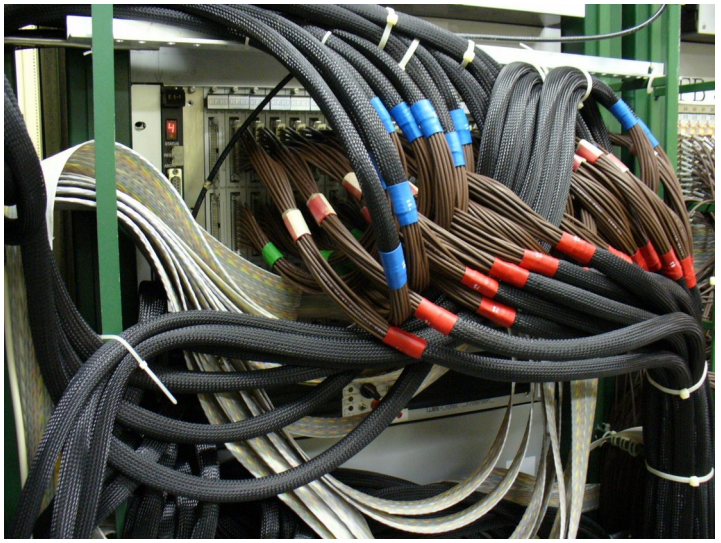
76 (24-chan.) HV distributors (experimental area)

Monitoring – 2 PCs (CAENNET) & RS232

HV settings were saved in the CAEN EEPROM and controlled by a monitor (RS232)

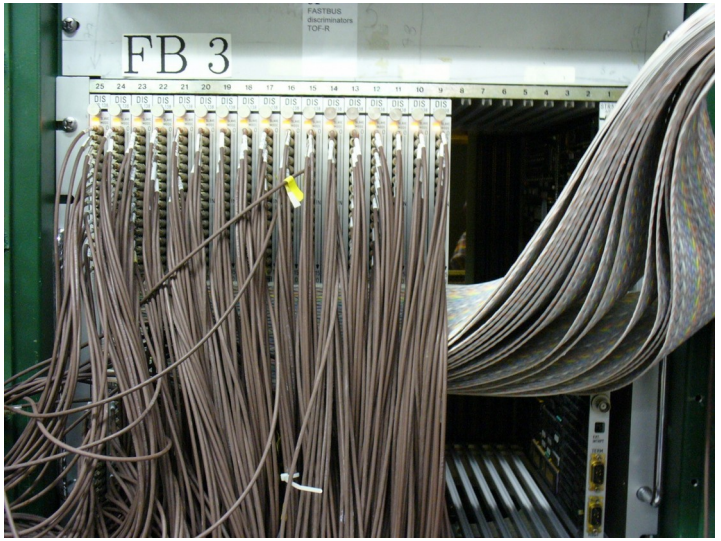


Front-End Electronics



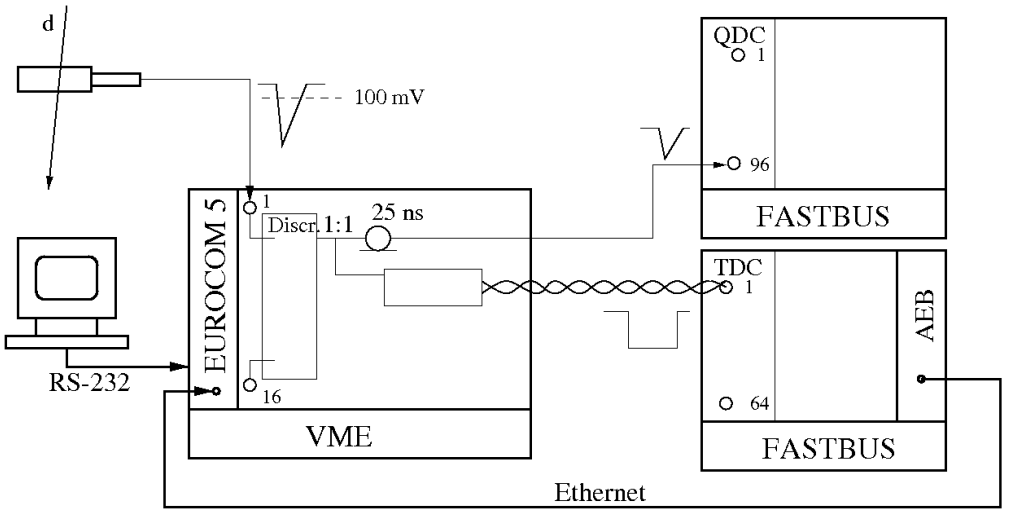
TOF-L CF discriminators (VME)

VME processor for threshold settings



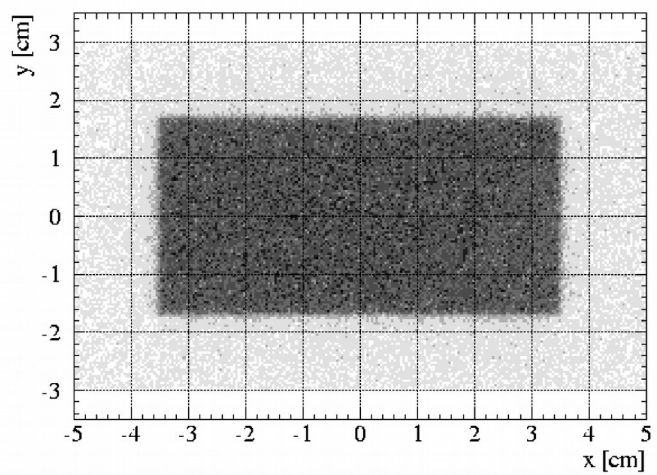
TOF-R CF discriminators (FASTBUS)

Crate controller (AEB) for threshold settings



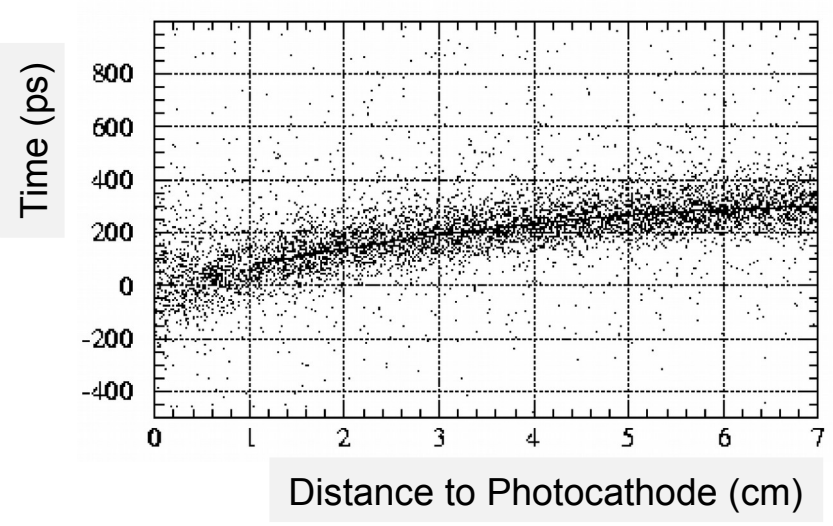
TOF-R TDC/ADC

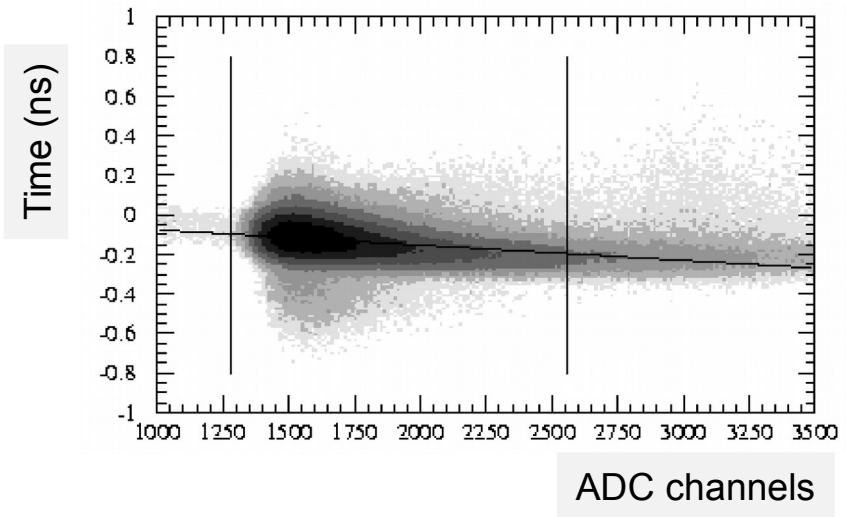
Calibrations



Location of each scintillator in TPC coordinate system

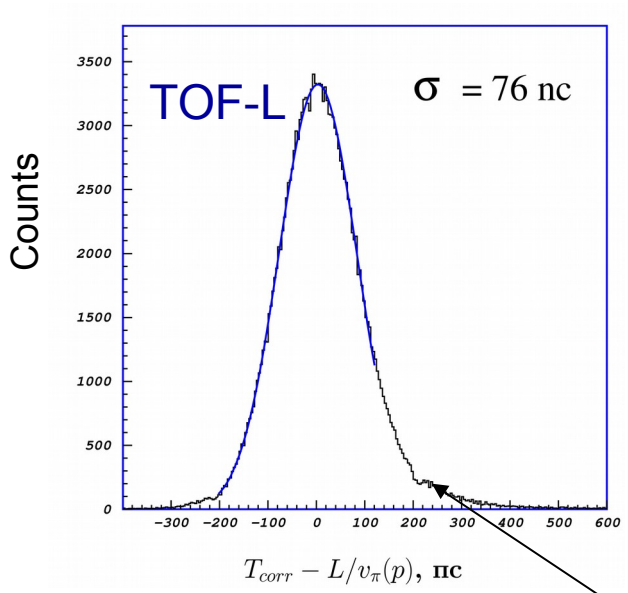
Delay in the scintillator

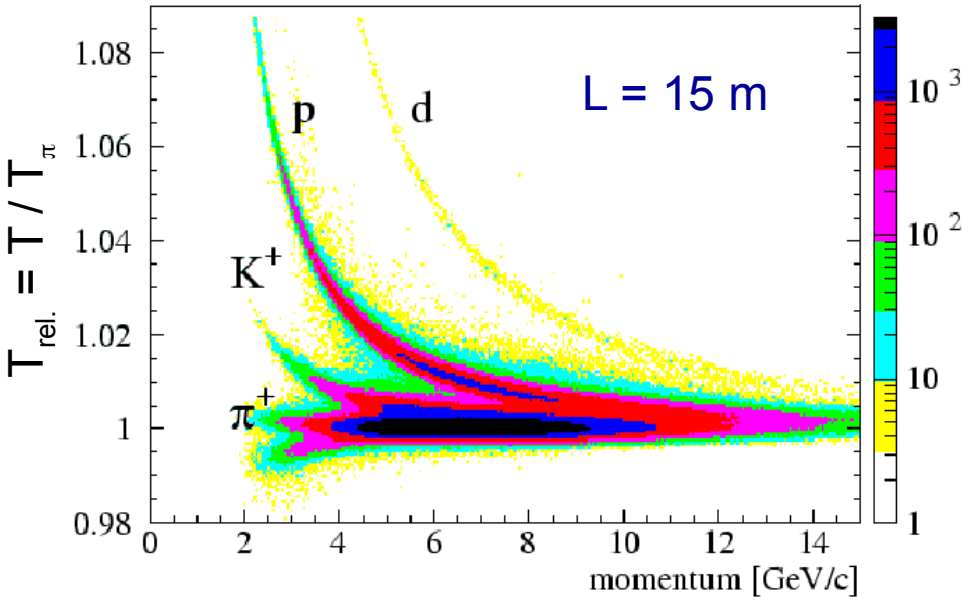


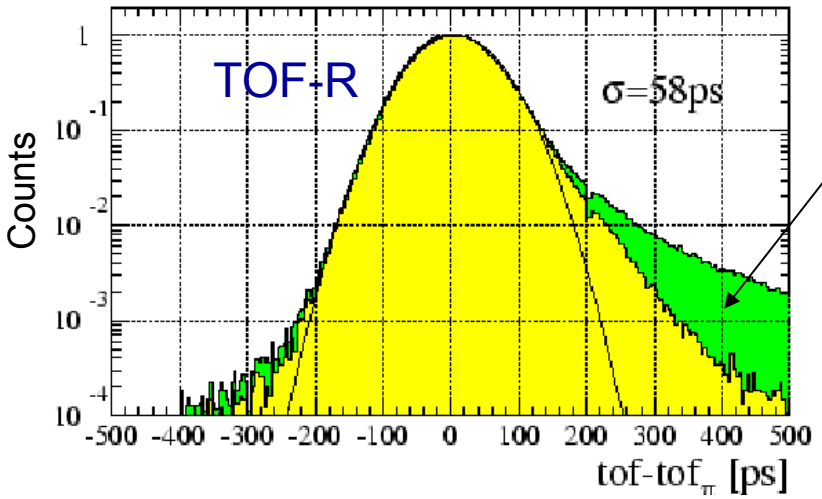


Residual time-walk correction

TOF Resolution and Efficiency





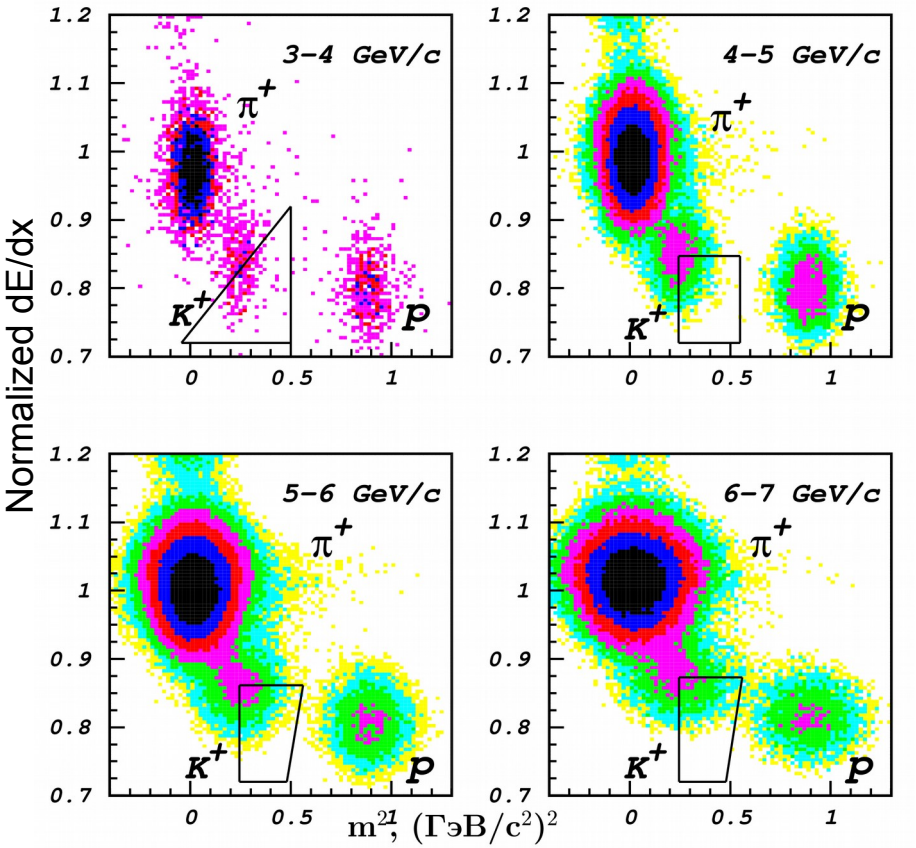


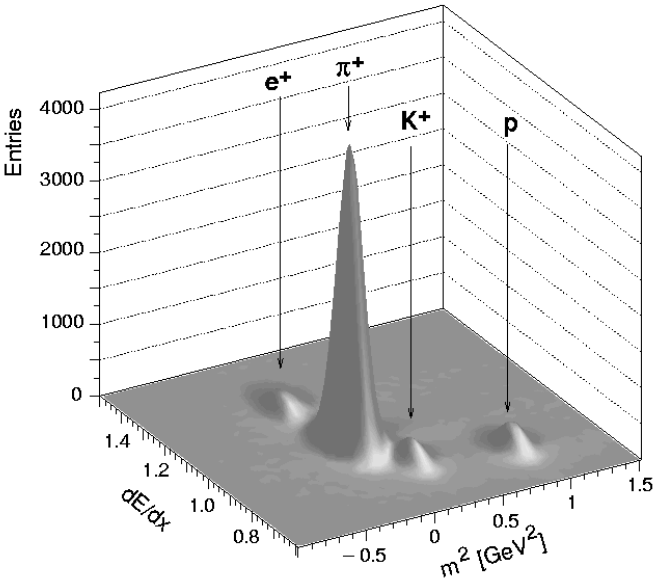
From γ conversion in scintillators

Double hits due to the finite granularity, edge effects and background from γ's are the main sources of efficiency reduction.

The sum of all losses, as determined experimentally by comparison with the TPC track data, amounts to 29% on average.

TOF + dE/dx

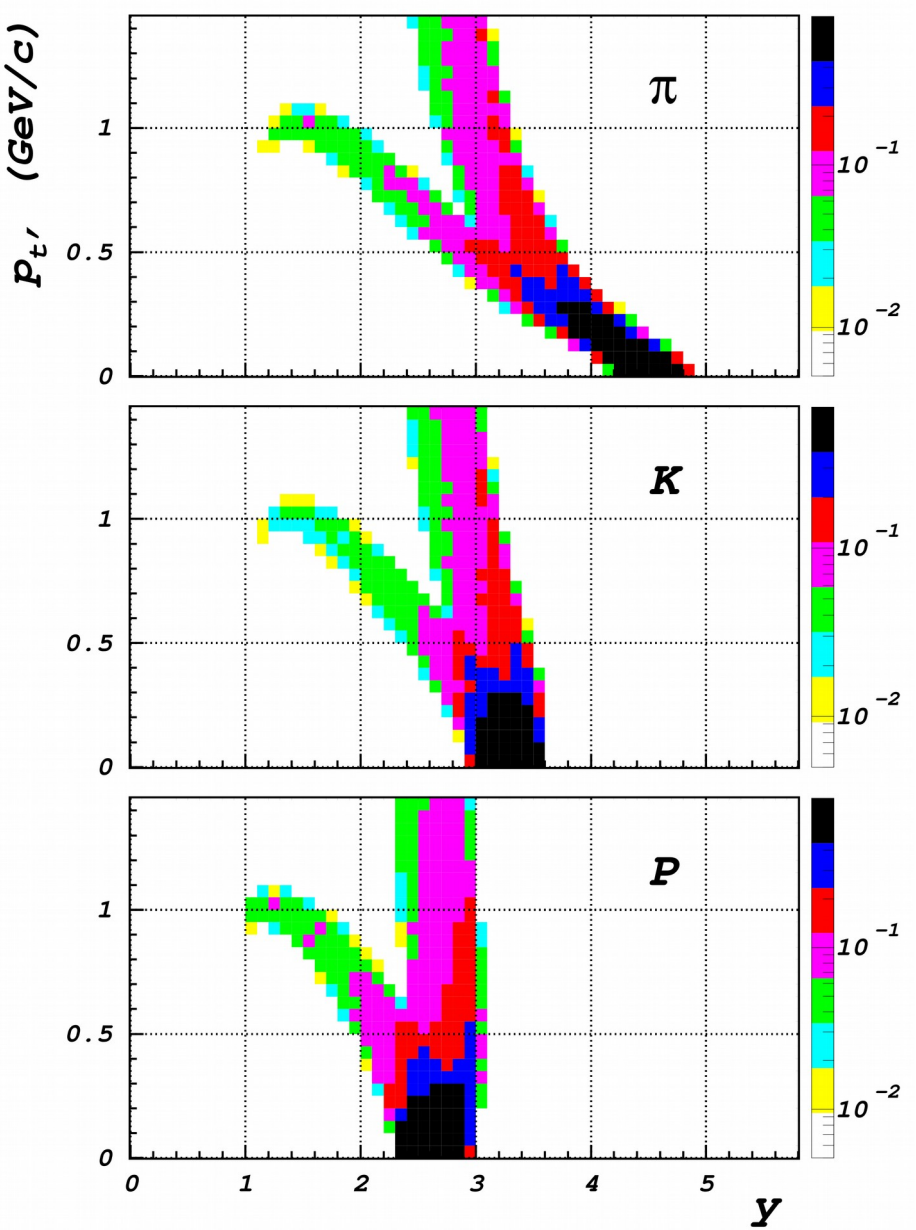


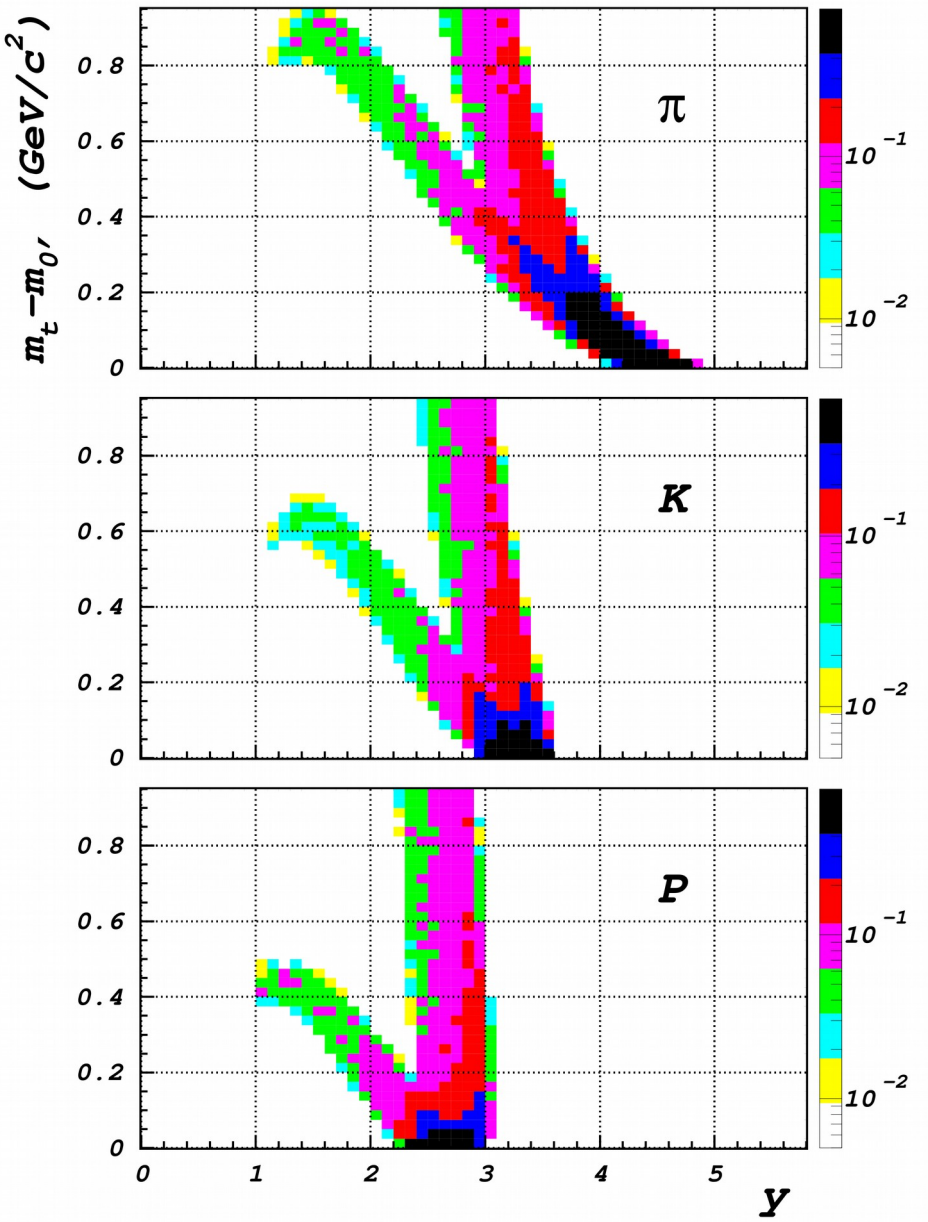


NA49 combined particle ID: TOF + dE/dx (TPC with 4.5% resolution)

At 6 GeV/c –a momentum typical for midrapidity kaons– one obtains a 4 σ separation of pions and kaons (3 σ of it by dE/dx alone) and a 6 σ separation of kaons and protons (nearly exclusively by TOF).

TOF Acceptance from Monte-Carlo





Conclusions

1. Two big time-of-flight walls made of pixel scintillation detectors were produced by Marburg University and Dubna groups.
2. The walls met all requirements of NA49/NA61 experiment.
3. The walls were successfully used in the experiment for the time period that was about 3 times longer than it was projected originally.
4. “After a long and happy life together”, the walls passed away a few years ago.