Study of the performances of the ALICE muon spectrometer

Blanc Aurélien, December 2008

PhD description

- “Study of the performances of the ALICE muon spectrometer”
  - instrumentation/detection.
- Master “Physique Pour l'Instrumentation”, UJF Grenoble
- Bourse BDI
  - Cofinancing CNRS(IN2P3)/”Région Auvergne”
  - PhD defense in 2010

⇨ Detector commissioning with cosmic events.

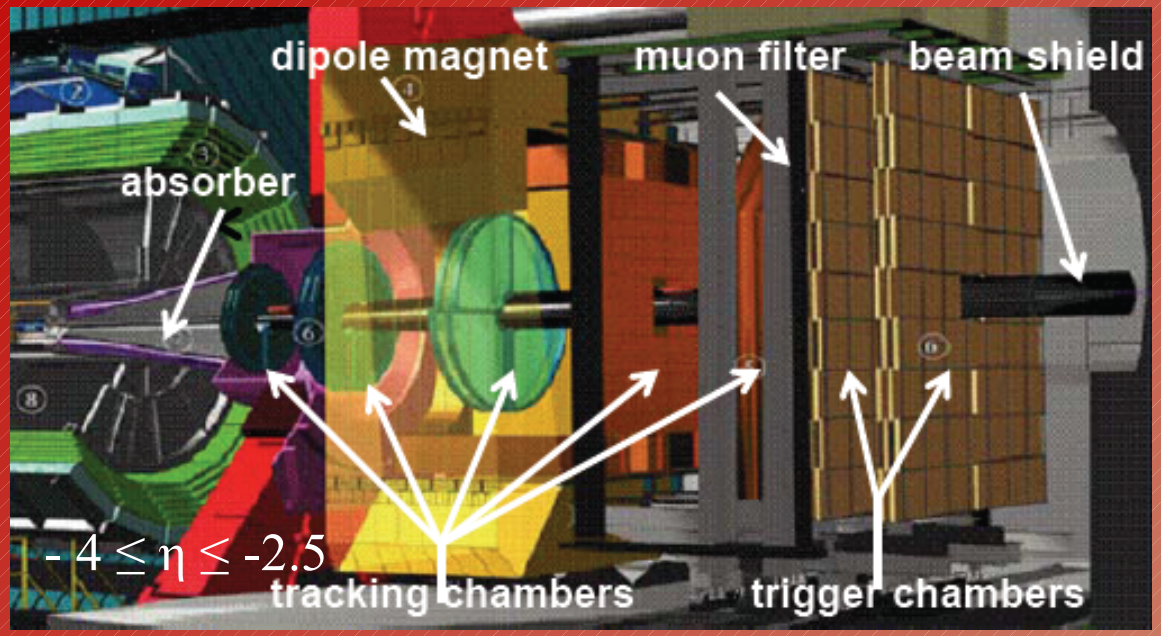
⇨ Timing optimization with “beam-gas”:

⇨ Validation of optimization criteria with simulations

⇨ Implementation in the monitoring software

⇨ First data analysis with p-p collisions at 14 TeV.

ALICE muon spectrometer



Tracking:

- Position resolution < 100 μm (bending plane)

  → ΔM < 100 MeV/c² @ 10 GeV/c²

- 1.1 M read-out channels

Trigger:

- See next slides

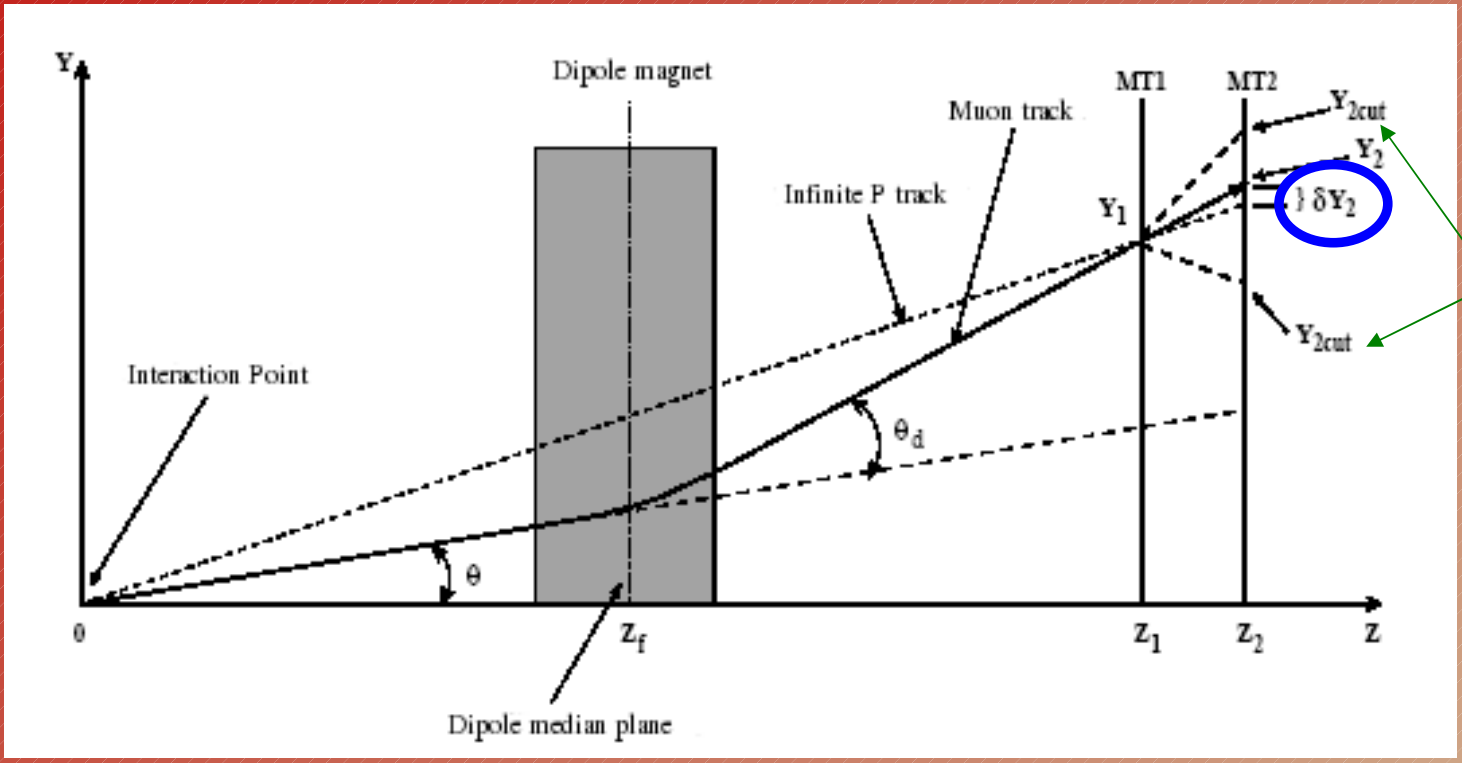
Muon trigger system (1)

The deviation δY2 between the 2 trigger stations is linked to the muon Pt.

The measurement of δY2 is used to perform 2 Pt cuts:

_low Pt cut: ~1GeV/c optimized for J/ψ physic.

_high Pt cut: ~2GeV/c optimized for ϒ physic.



Maximum of deviation given by the width of roads: ± 8 strips

Muon trigger system (2)

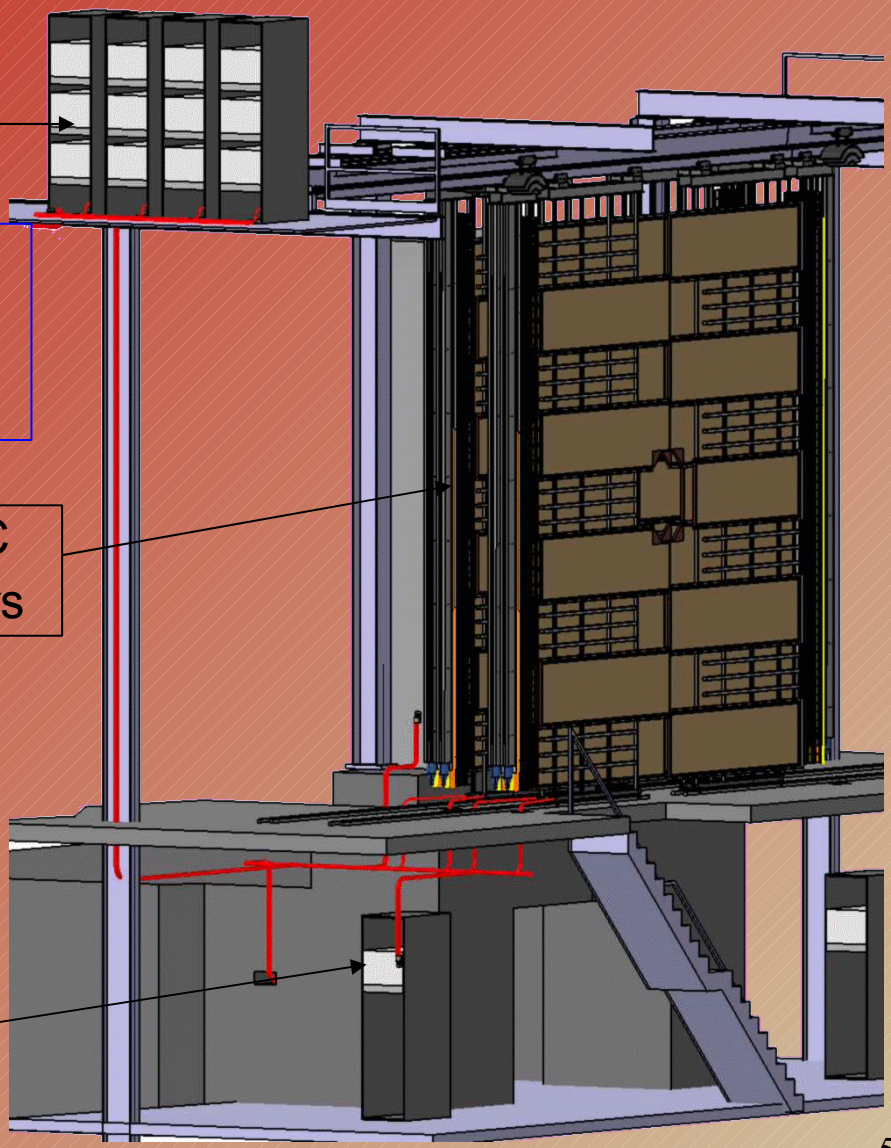
242 Local trigger boards
16 Regional trigger boards

~ 21000 strips and FEE channels

- Search for tracks in ~800 ns
- Deliver signal for single μ, like sign and unlike sign μ pairs, above 2 pt thresholds, each 25ns

72 RPC detectors

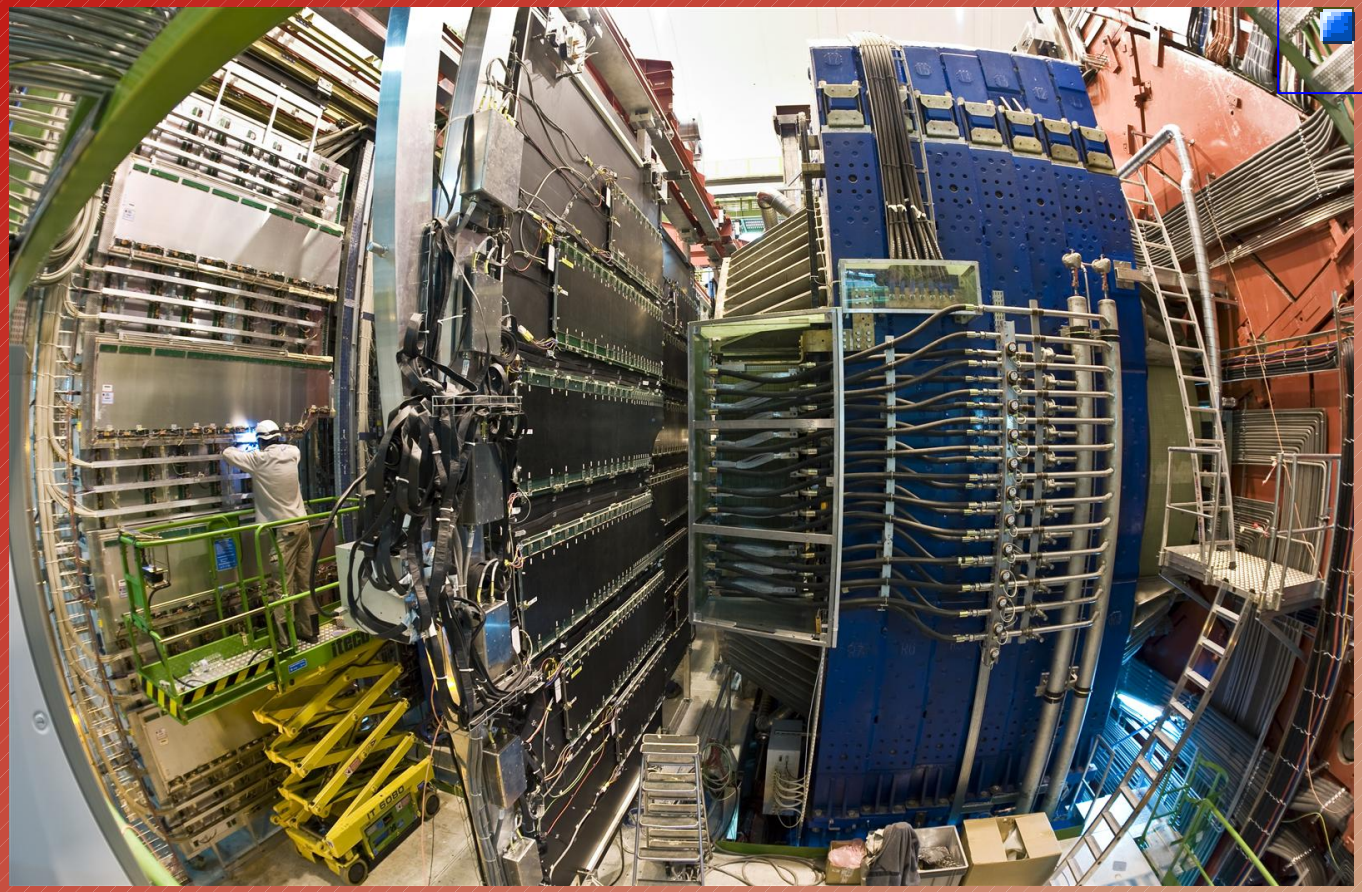
1 Global trigger board



Muon trigger system (3)

Collaboration between:

- INFN – Torino
- LPC – Clermont-Ferrand
- Subatech – Nantes



End of installation:
December 2007

Cosmic run: June 2008

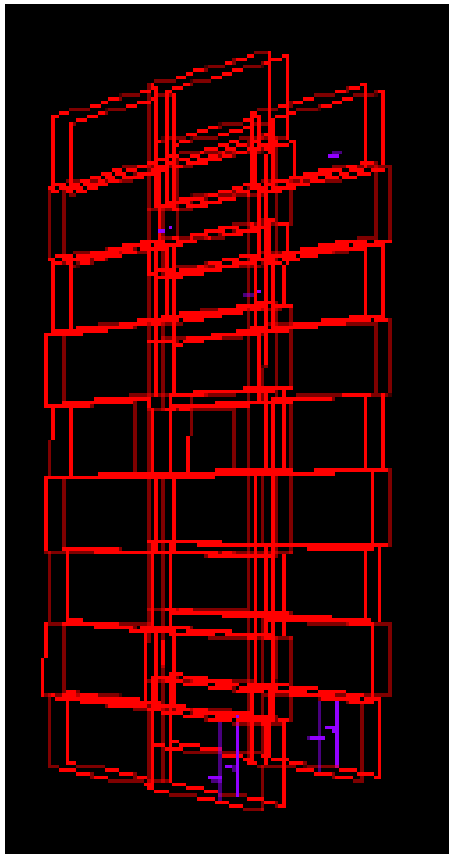
- Event display
- Trigger rate vs High Voltage
- Trigger rate vs Local board

Event display

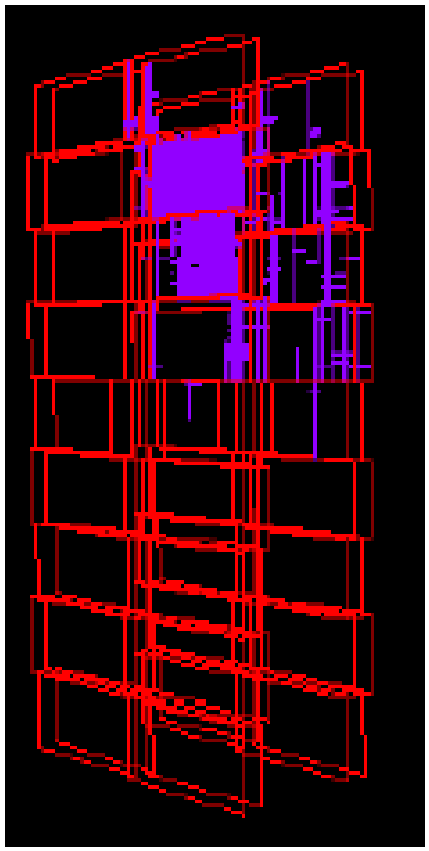
~170 hours of data

- Single muon rate: 0.07 Hz
- Shower rate: 0.1 Hz

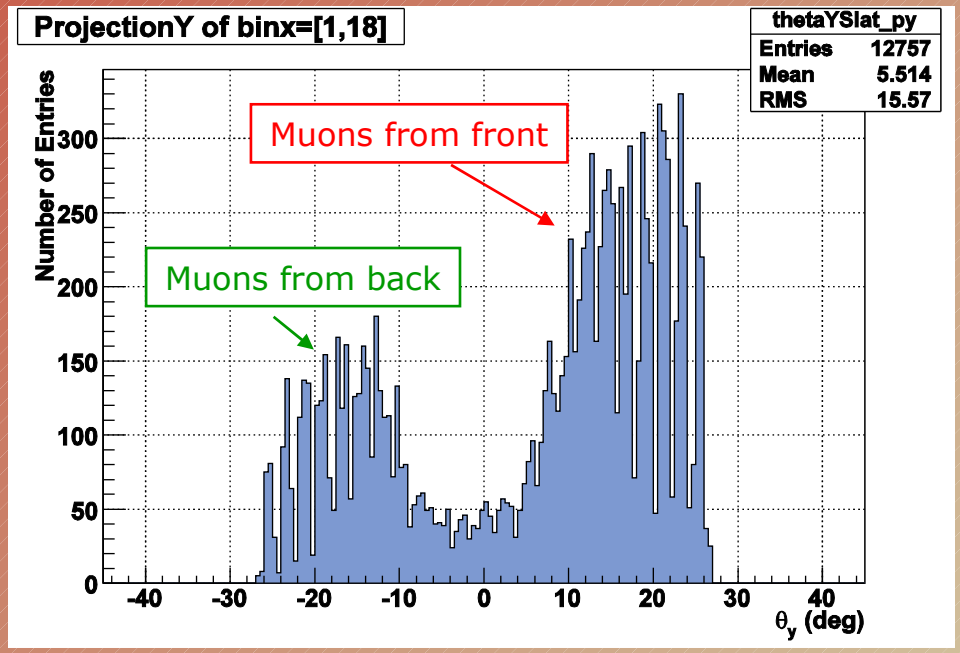
Cosmic muon



Cosmic shower



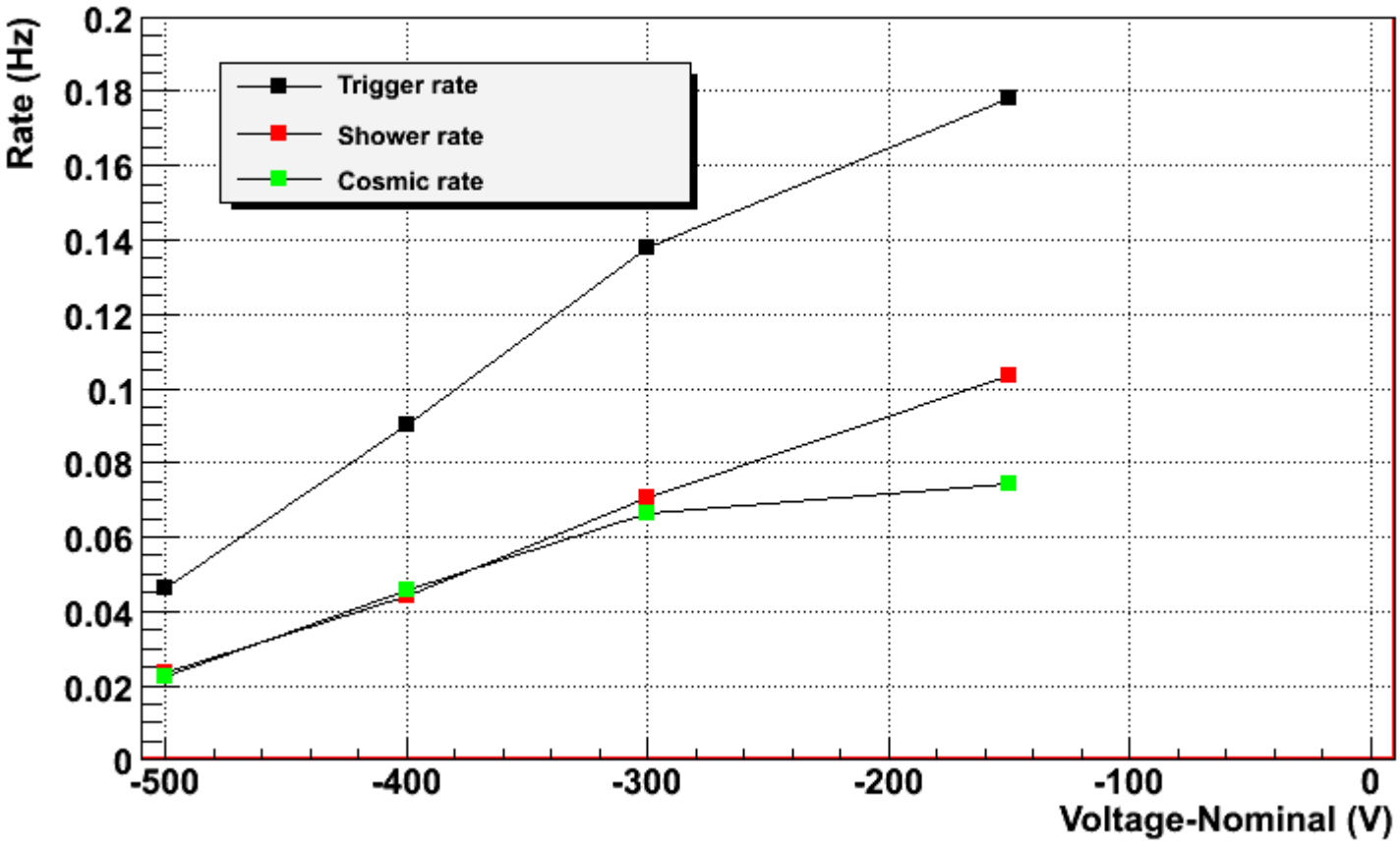
~ horizontal acceptance



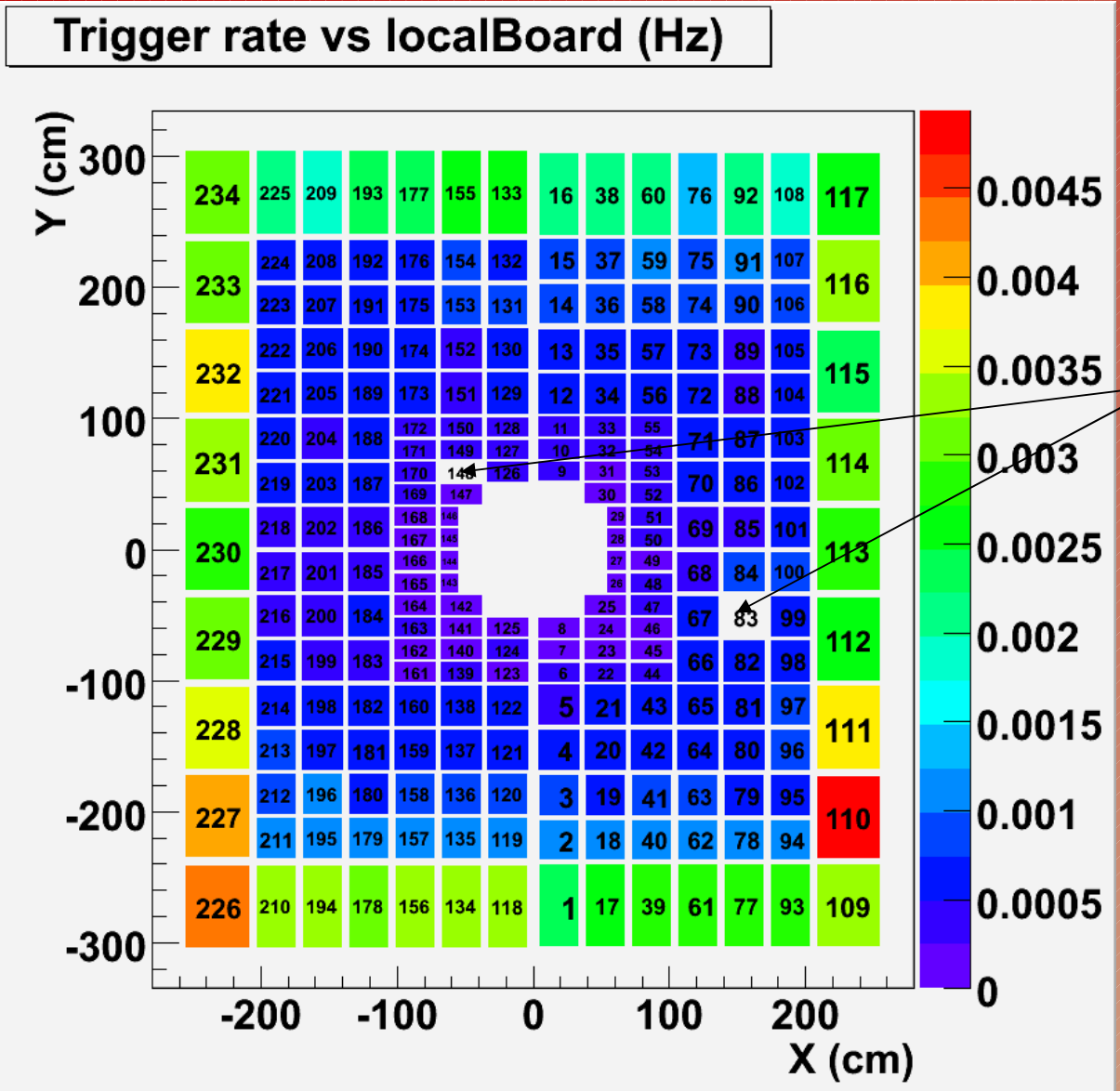
Trigger rate vs HV

RPC efficiency increases with High Voltage in this HV range

=> increase of the trigger rate



Trigger rate vs Local board



Trigger rate = muon + shower rate

Hardware problem: fixed

Not normalized to the strips dimensions.

First injection beam through ALICE, August 10th, 2008

- August 10th, 2008, injection test
- Local trigger level
- Global trigger level

August 10th, 2008, injection test

- 1 bunch of a few ns each 48s with 1/20 of the LHC nominal luminosity (about 5.10^10 p/bunch)
- Run in standalone mode

~2 hours of data

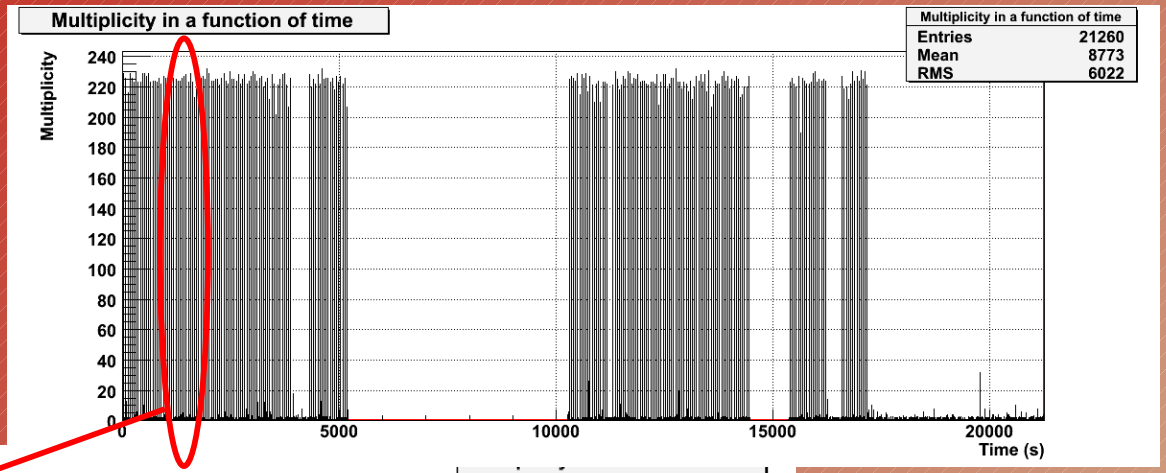
Recording frequency : 1 event/s

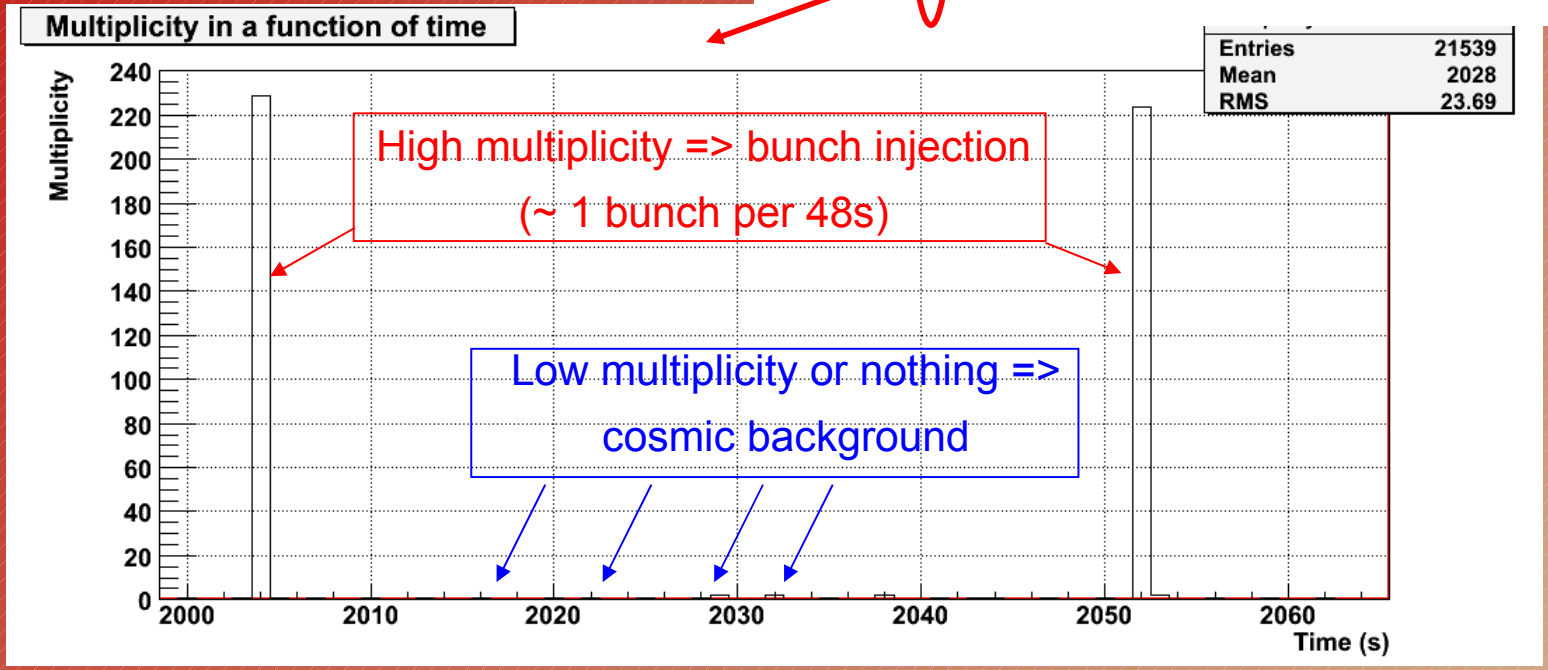
Software sequences for scaler read-out

Number of Global and Local positive trigger decisions during 1 second.

Local trigger level (1)

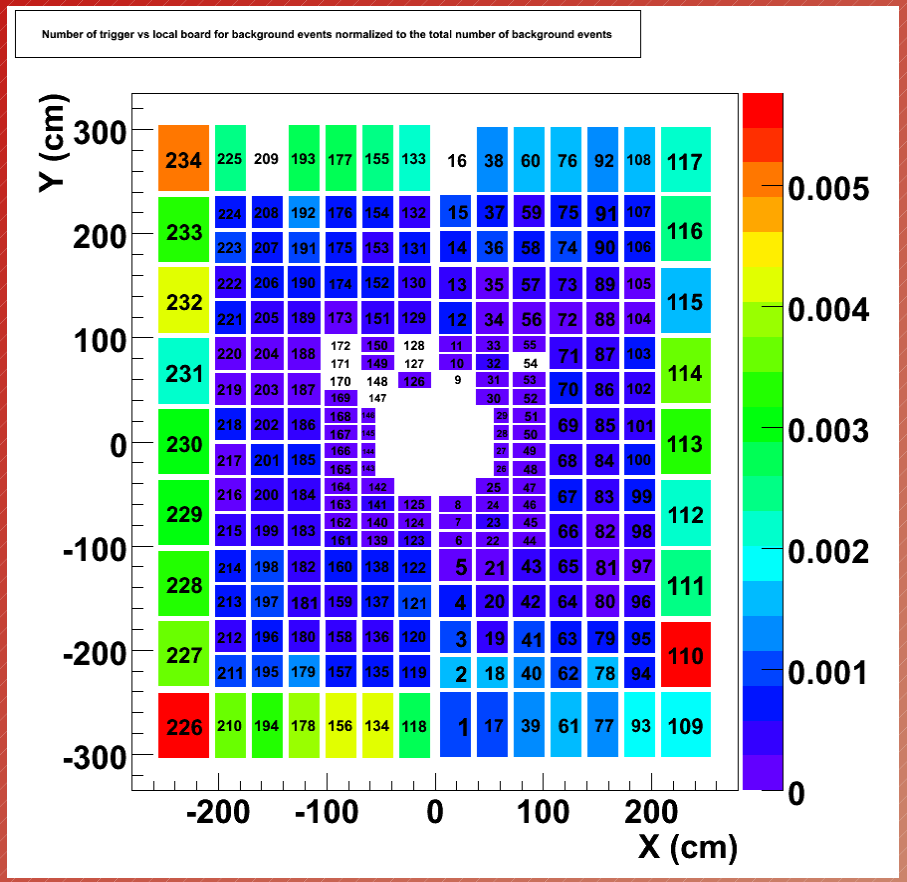
Multiplicity per event of Local boards giving a positive trigger decision, versus time.



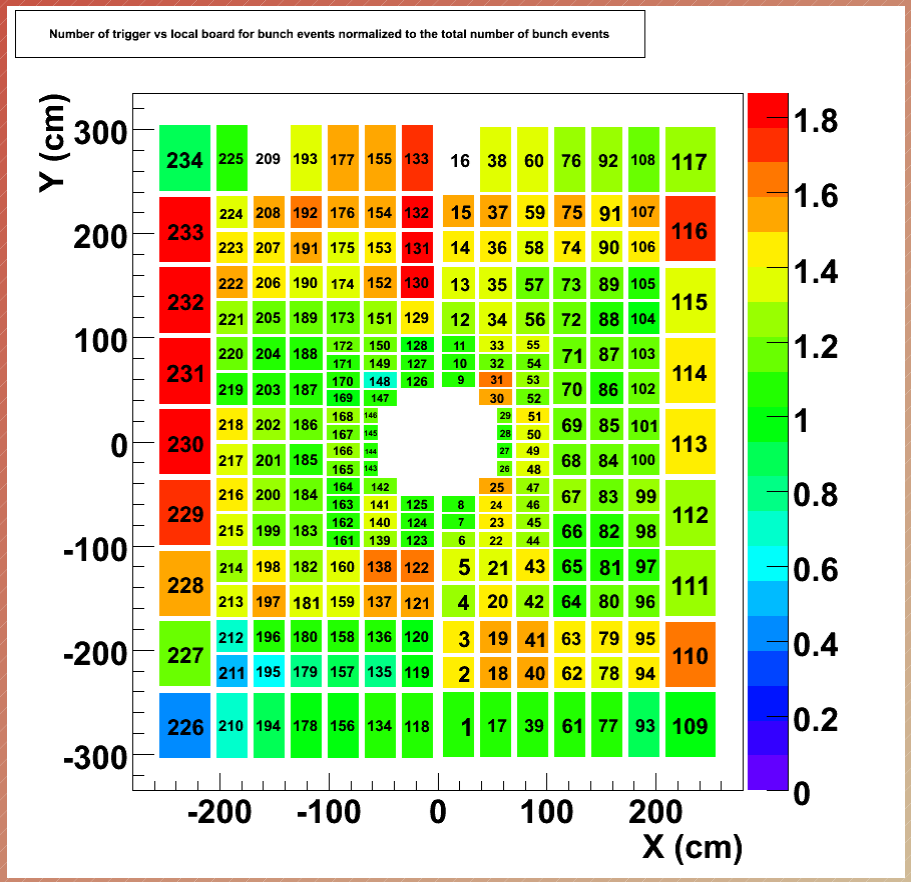


Local trigger level (2)

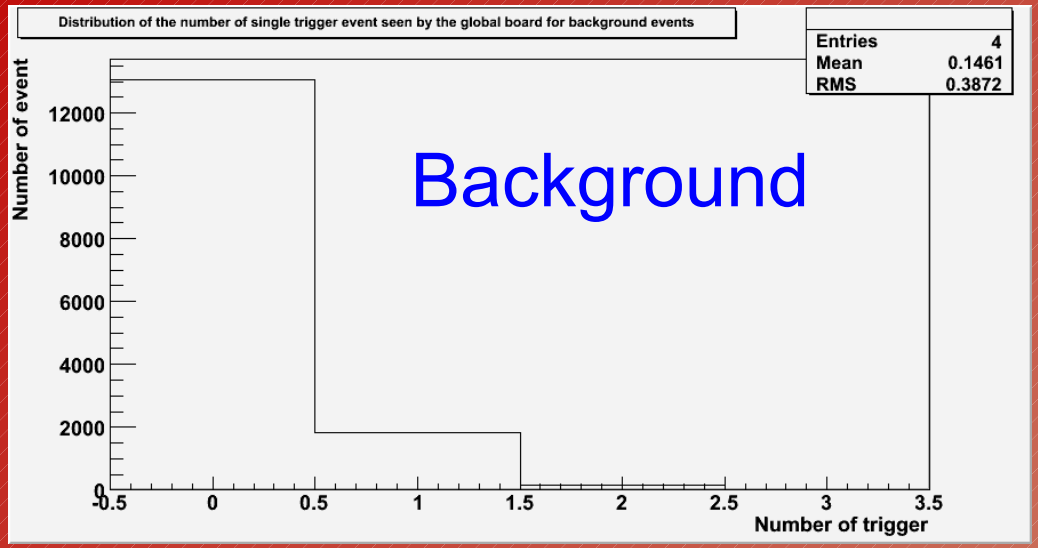
Percentage of positive Local trigger decisions per Local board for BACKGROUND events



Percentage of positive Local trigger decisions per Local board for BUNCH events

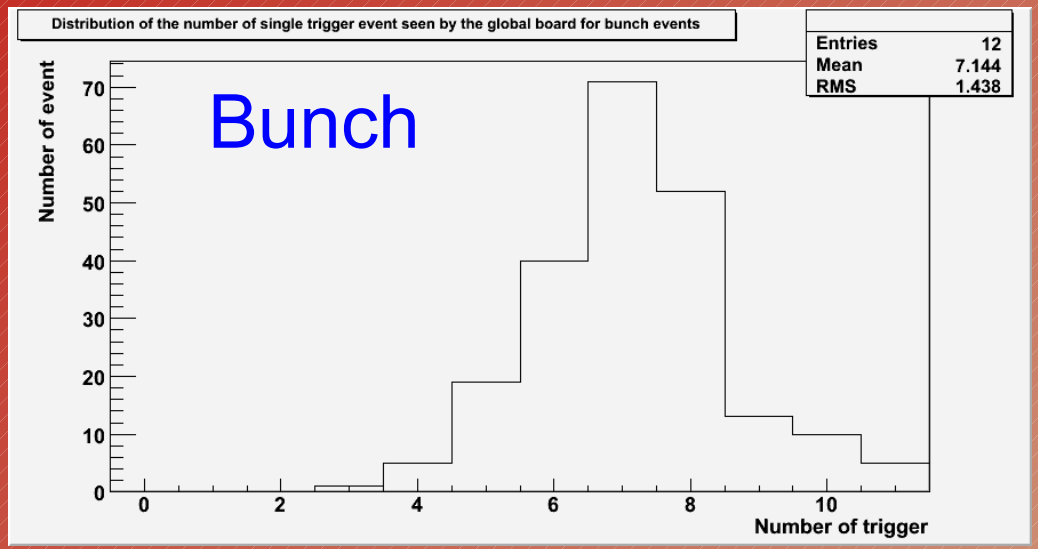


Global trigger multiplicity



In most cases, negative Global trigger decision per background event

Not more than 3 Global positive trigger decisions per background event



Average multiplicity = 7

Corresponds most probably to positive Global trigger decisions in the injection BC cycle and in few adjacent BC cycles

High multiplicity background

- All detector strips fired during injection (not shown) -> thousands (probably more) of particles.
- Spread on a few BC cycles.

→ Hadronic showers

→ 9 “beam screens”, Ti 15µm, that take “pictures” of the beam to verify steering in the Ti2 injection line.

→ 1-2 particle/cm^2 in ALICE

Conclusion

- During the last cosmic run, Muon Trigger was running almost perfectly and was very stable, concerning:
  - Detection functions
  - Trigger functions
  - Readout functions
- Muon Trigger was also operated during the first injection beam through ALICE
  - a very large background of thousands (probably more) of particles was measured at each injection bunch !
- Ready for physics
  - Timing optimization with “beam-gas” events
  - Wait for first 900 GeV p-p collisions