ALICE TRD trigger
algorithms and performance for Upsilon detection

(electron trigger in Pb-Pb @ LHC $\sqrt{s}$ = 5.5 TeV)

On-line tracking is high pt tracking

Electron efficiency

Upsilon efficiency

Trigger on signal and background

Electron separation with the Transition Radiation Detector

Rates?

Bogdan VULPESCU, University of Heidelberg, Germany

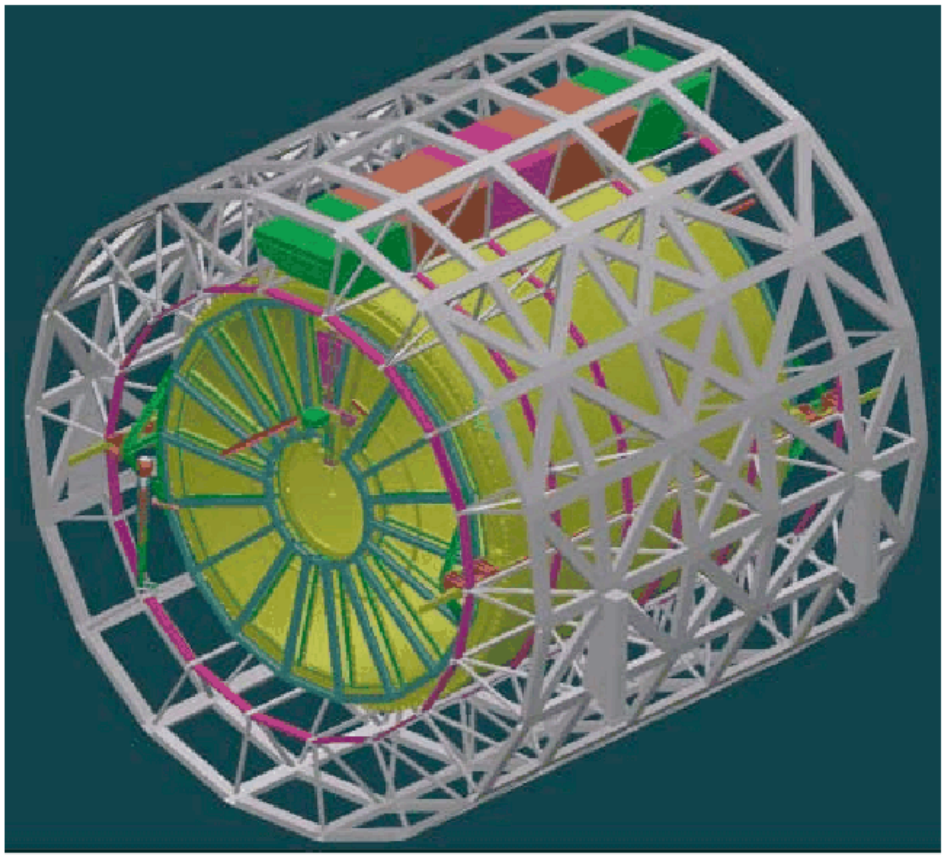
ALICE TRD

TPC: largest data volume to the DAQ
- tracking in 82 μs !

TRD: drift + MWPC
+ radiator
R > 300 cm
|η| < 0.9
Δ φ = 360 deg

18 φ–sectors x
5 Z-modules x
6 R-layers =
540 chambers.

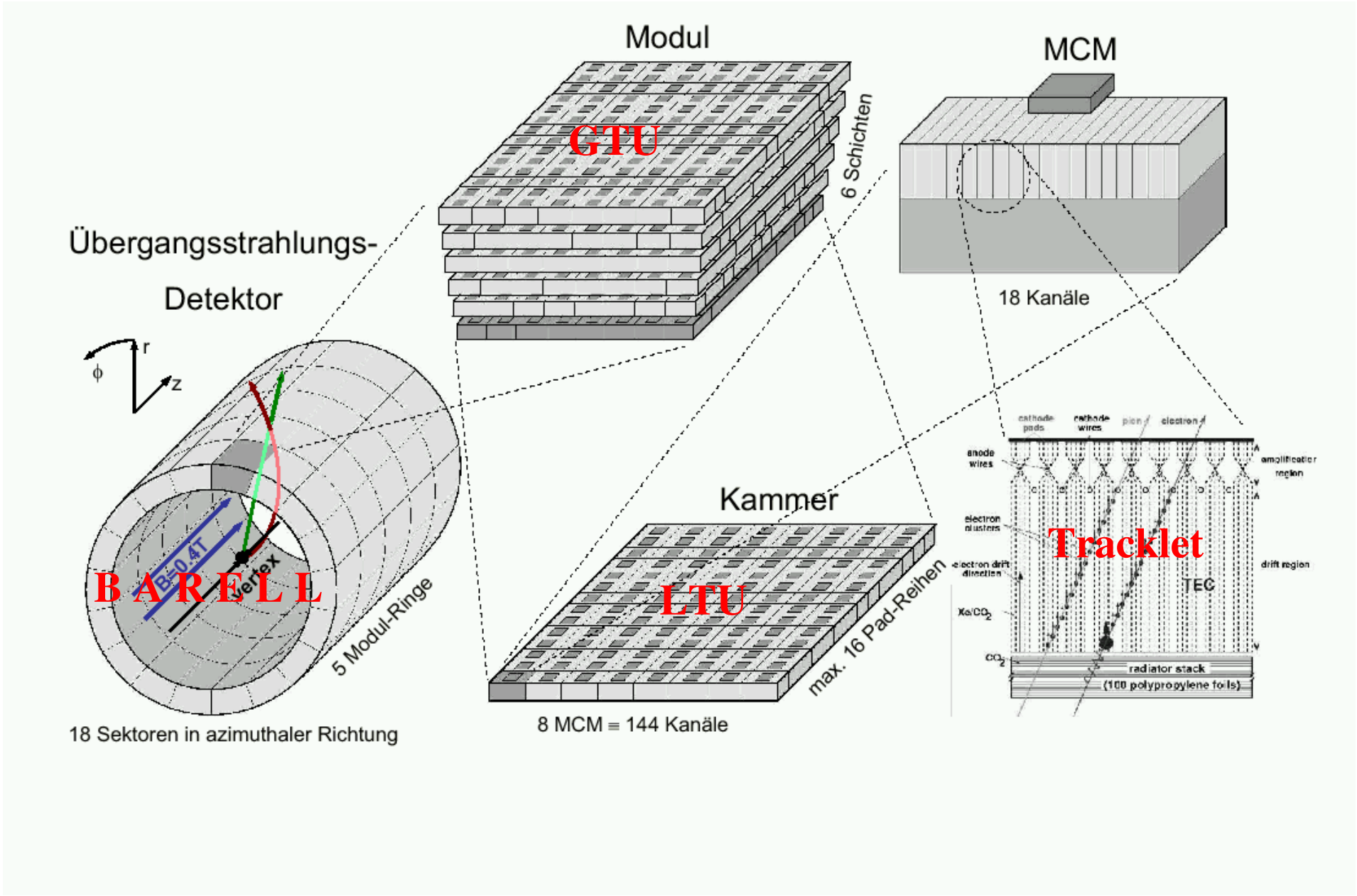
One TRD super module = 5 modules



Trigger:
6 x 3 cm gas chambers = 2 μs drift + (on-line tracking and PID) = 6.1 μs !!!

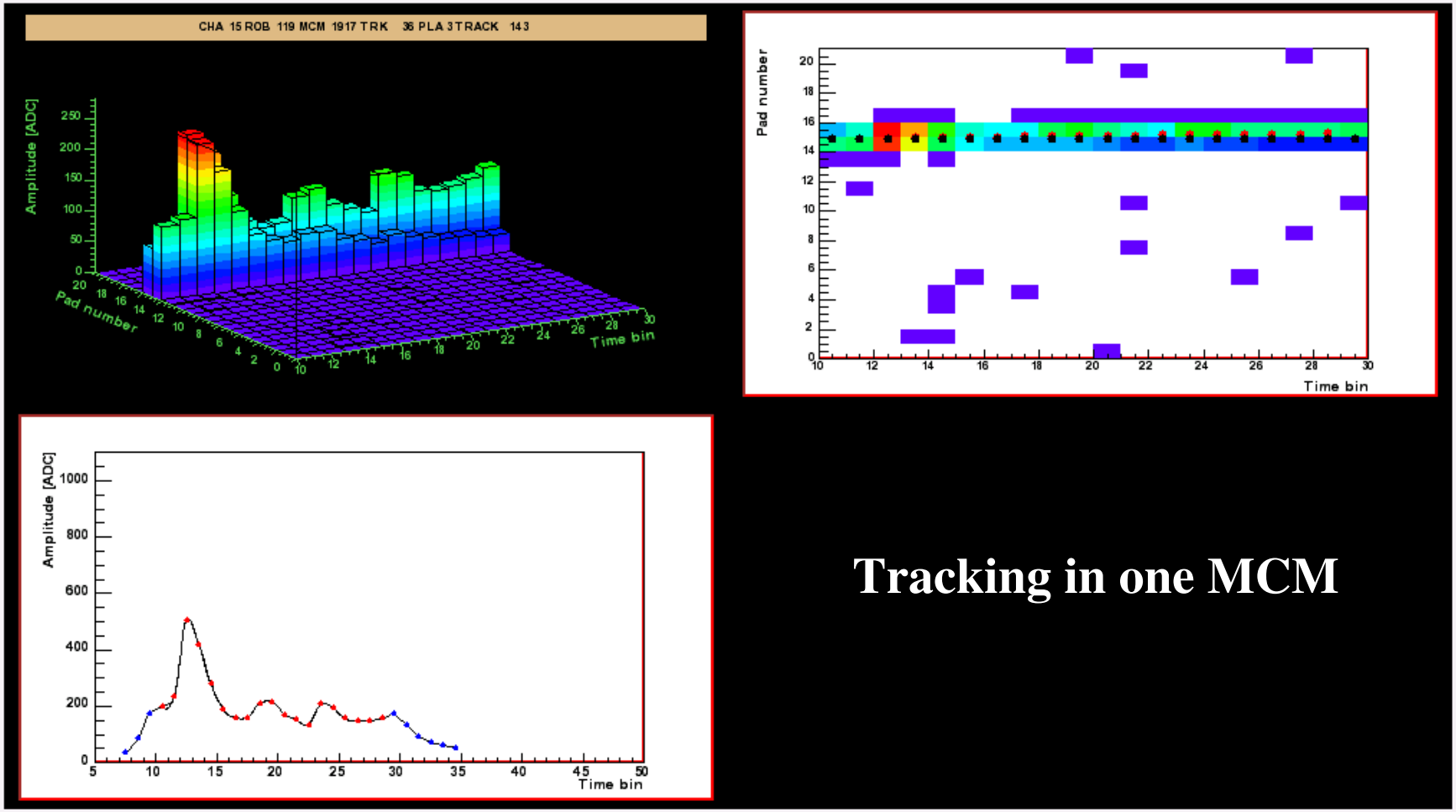
Bogdan VULPESCU, University of Heidelberg, Germany

Read-out structure



Bogdan VULPESCU, University of Heidelberg, Germany

Local Tracking Unit (single chamber tracking: tracklets)



Step | Analyze

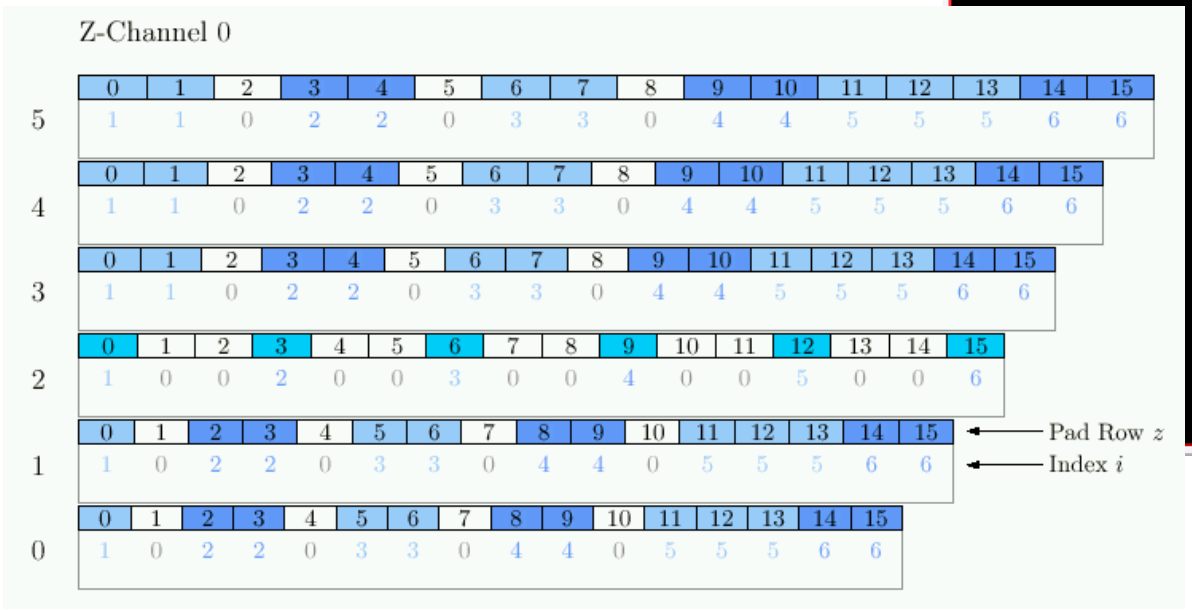
Bogdan VULPESCU, University of Heidelberg, Germany

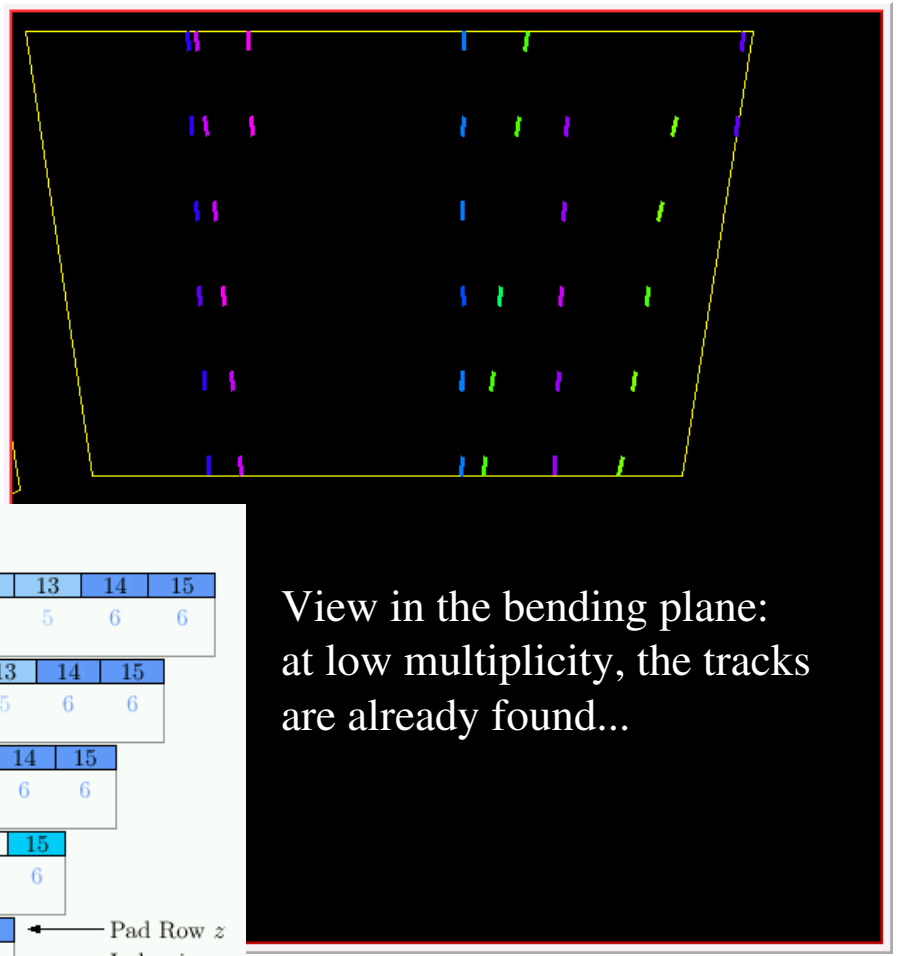
Global Tracking Unit (module tracks)

LTU: σ (Y) = 400 μm, σ (α) = 0.56 deg, σ (Z) = 6 cm

Group tracklets from different planes into tracks, according to matching in the Y coordinate and the deflection α, within the predefined Z classes.

Lower granularity in Z: sorting with tables from the Z int. diamond distribution and MULS.





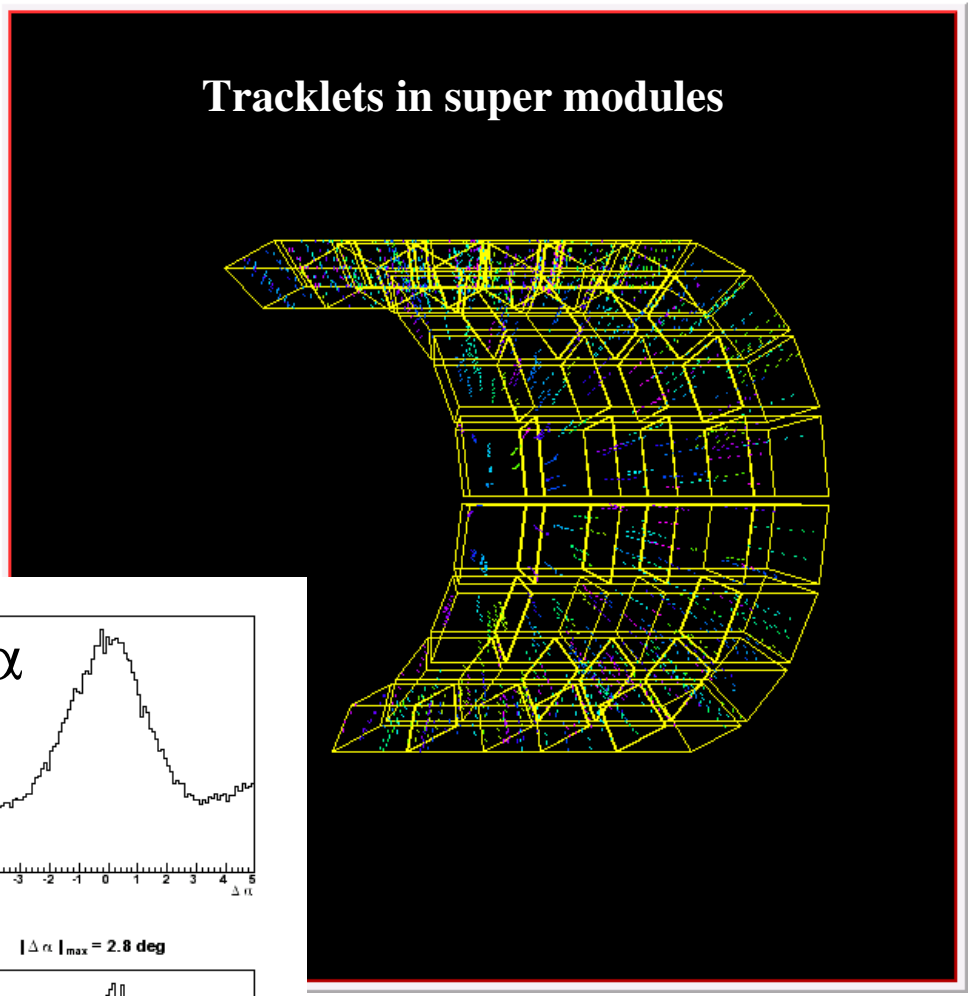
View in the bending plane: at low multiplicity, the tracks are already found...

Bogdan VULPESCU, University of Heidelberg, Germany

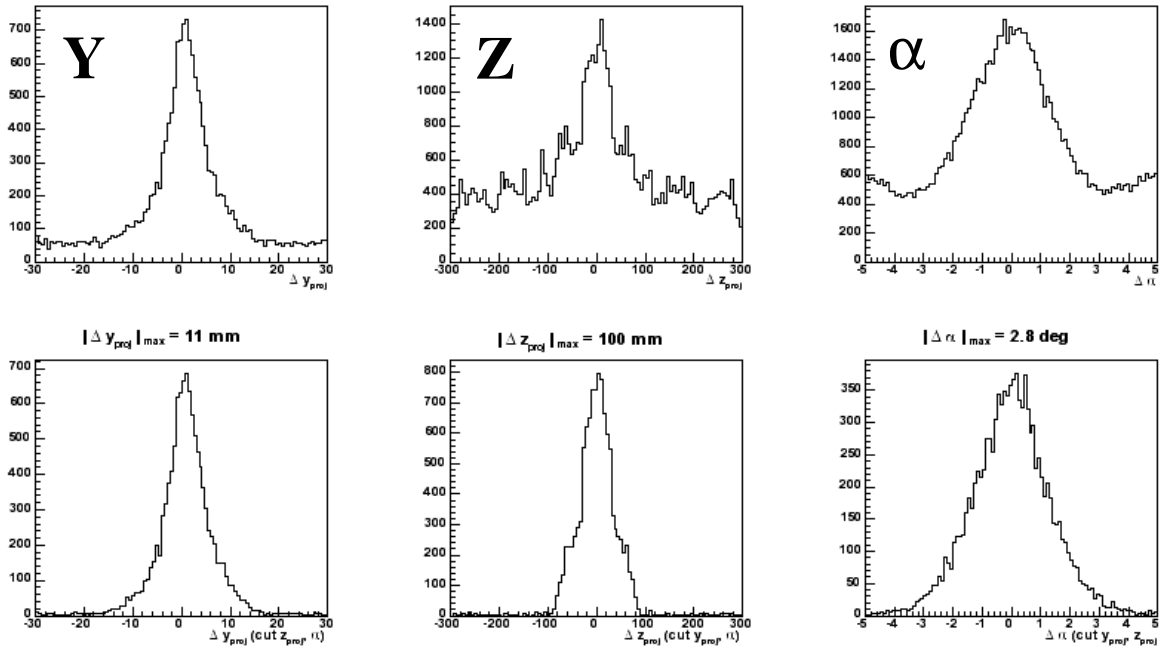
GTU tracking with sliding-window matching

Processor (FPGA) algorithms perform comparable with pure combinatorics!

Input data sorting, parallel channels matching and results uniquifier.



Tracklets pure combinatorics and cuts



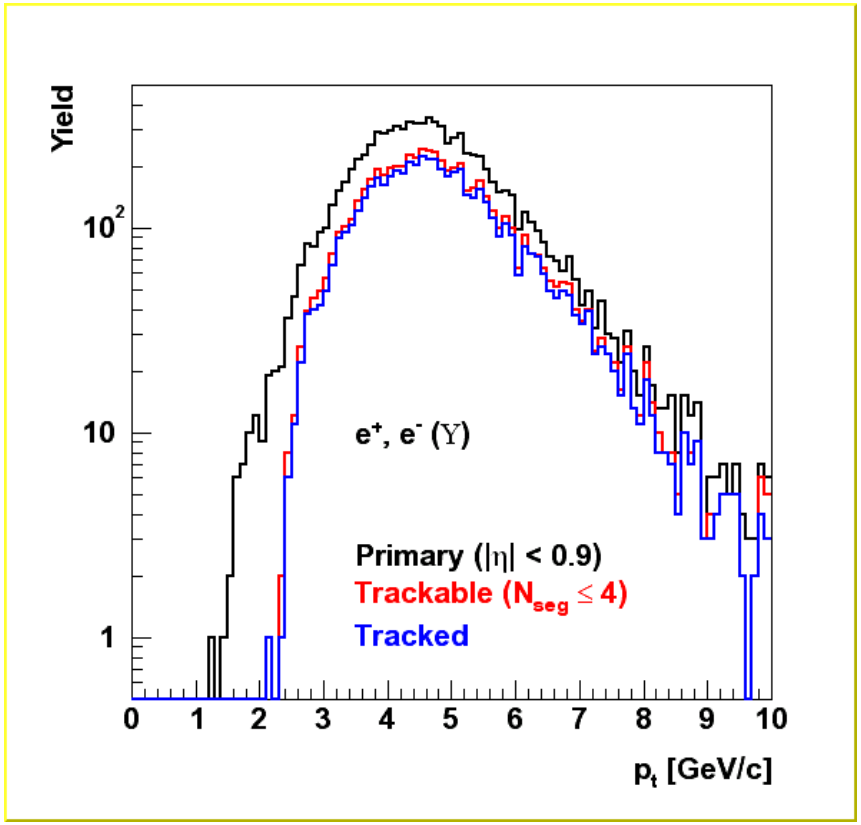
Bogdan VULPESCU, University of Heidelberg, Germany

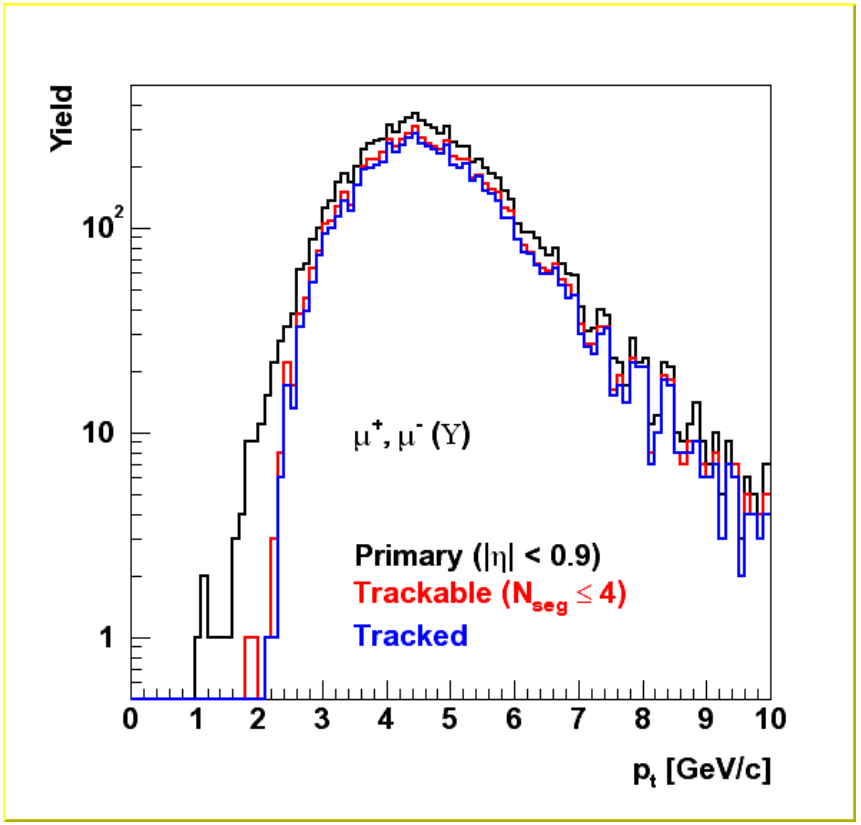
Searching for quarkonia signal in the di-electron channel

(the effect of BREMS by comparison with the di-muon channel)

LTU and GTU pt > 2.3 GeV/c

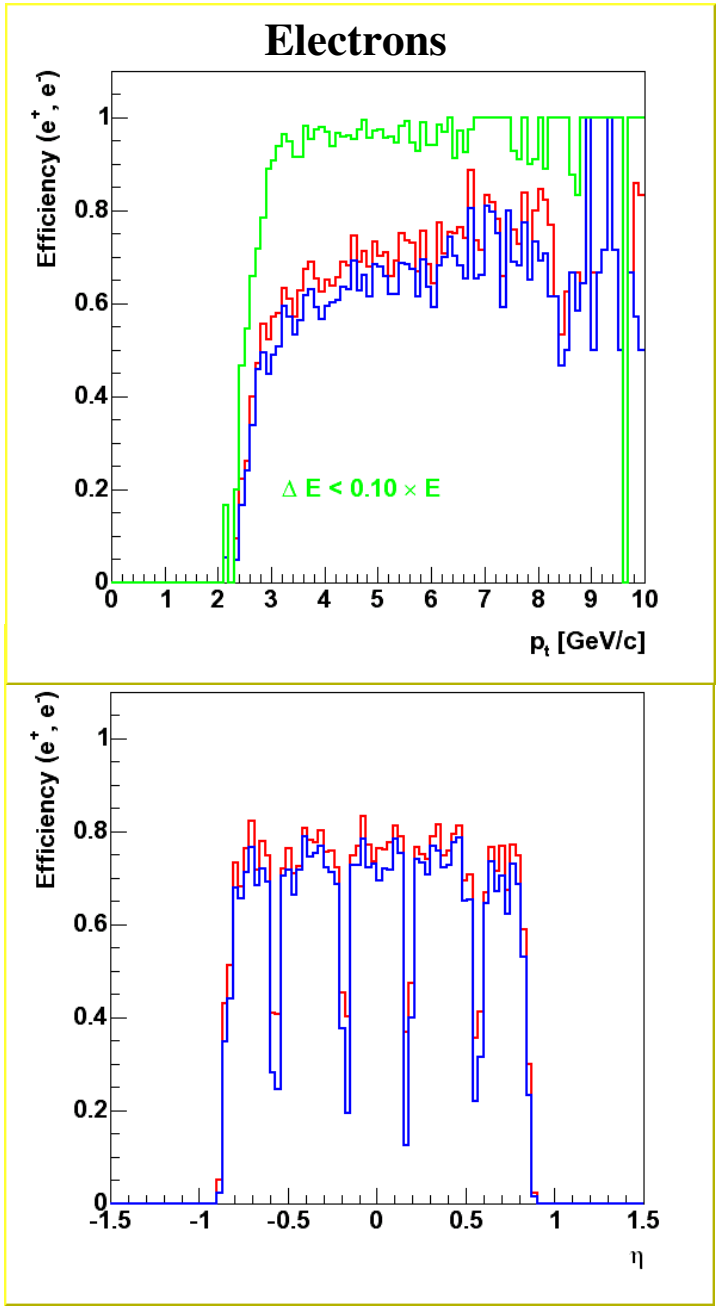
Tracking efficiency for primary particles

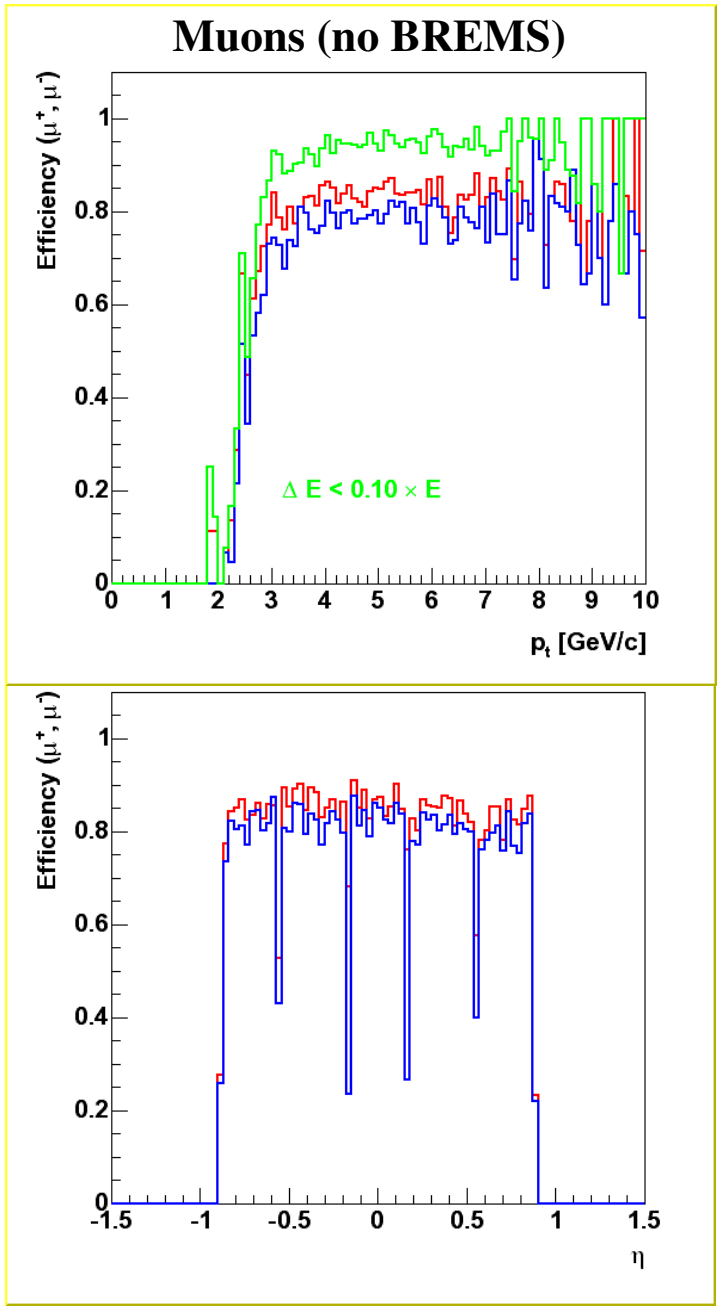




Bogdan VULPESCU, University of Heidelberg, Germany

Single particle efficiency





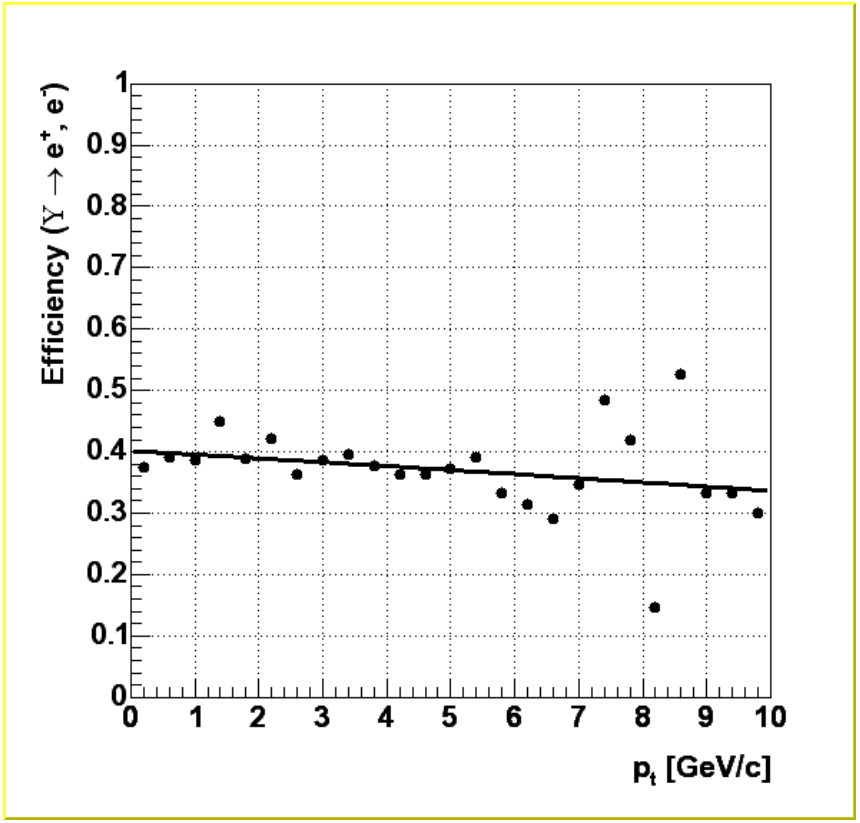
Bogdan VULPESCU, University of Heidelberg, Germany

Upsilon tracking efficiency in the di-electron channel

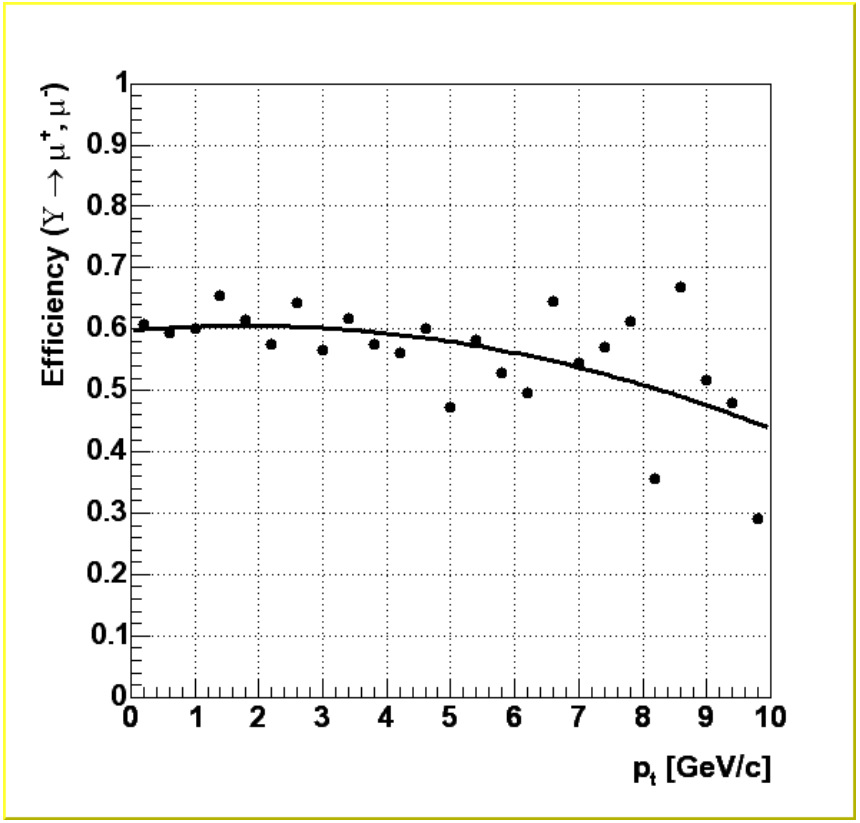
(in low multiplicity events)

Defined for the $\Upsilon \rightarrow e^+ e^-$ **within the TRD acceptance.**

$$\epsilon(\Upsilon) = \epsilon(e^+) \cdot \epsilon(e^-)$$



For comparison: di-muon channel



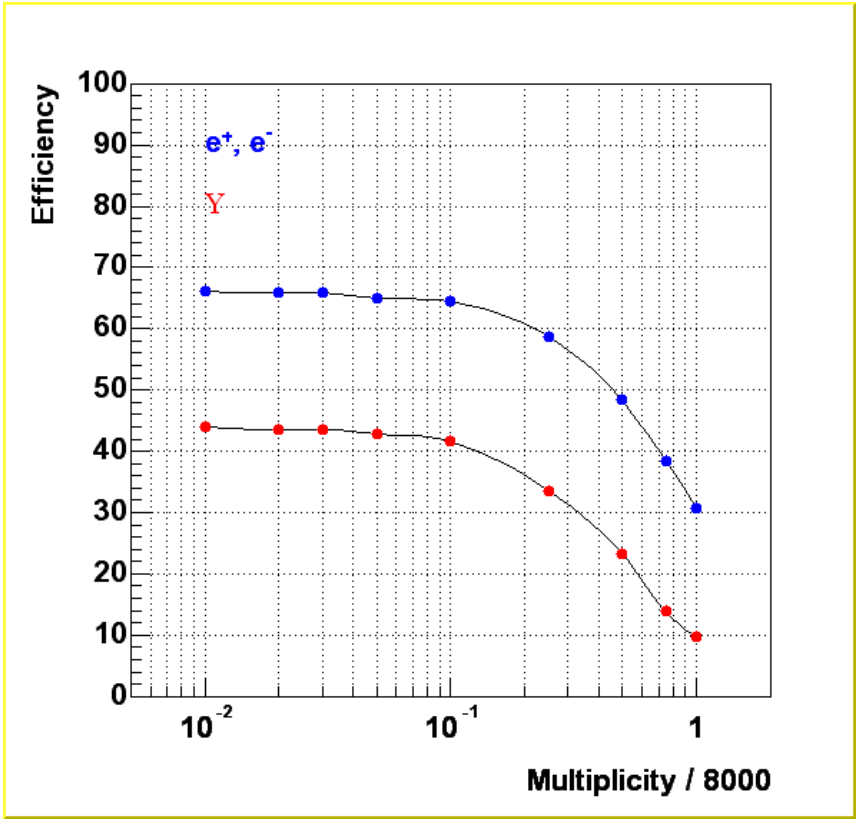
Bogdan VULPESCU, University of Heidelberg, Germany

Efficiency and momentum resolution at large particle multiplicity

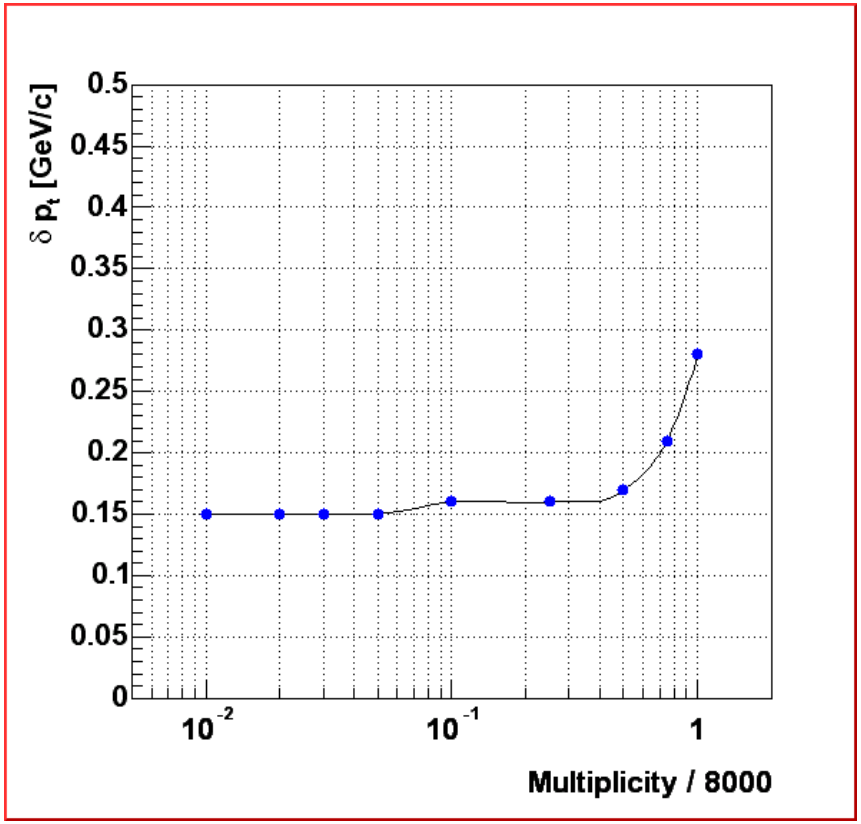
$$M = (dN_{ch} / dy)\,|\, y = 0$$

Simulations (HIJING) for: M = 1%, 2%, 3%, 5%, 10%, 25%, 50%, 75% and 100% of M = 8000
plus signal

Occupancy (detector granularity) limit



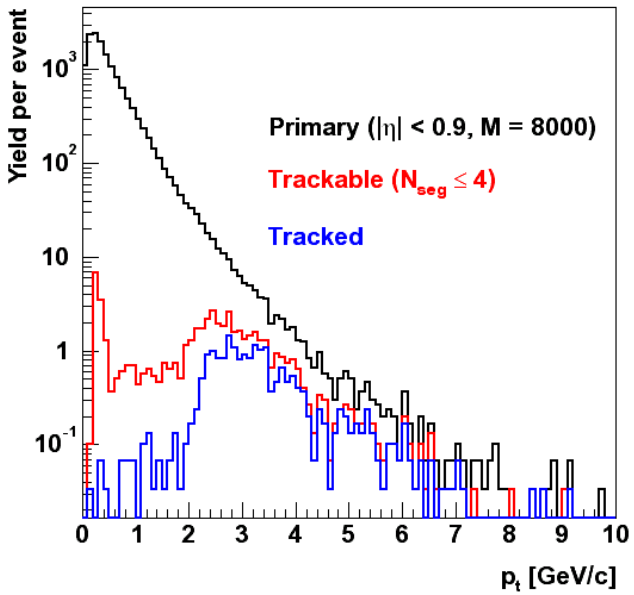
About 3 % bulk resolution at M = 0
(without BREMS tails...)



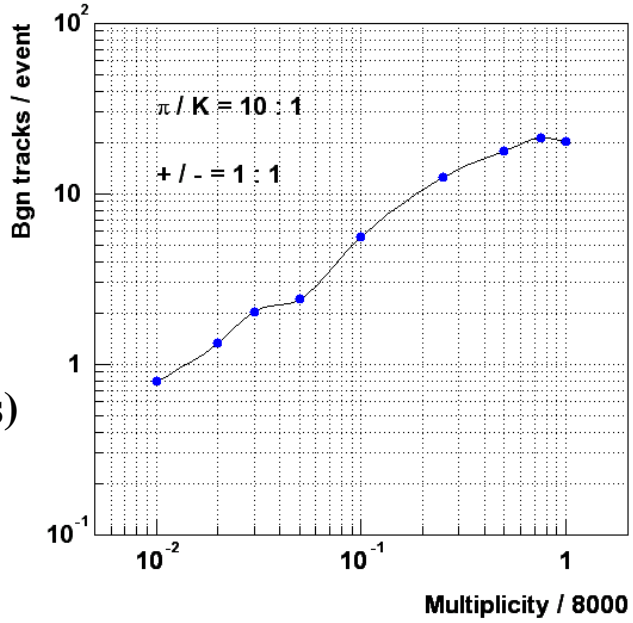
Bogdan VULPESCU, University of Heidelberg, Germany

Primary trigger background

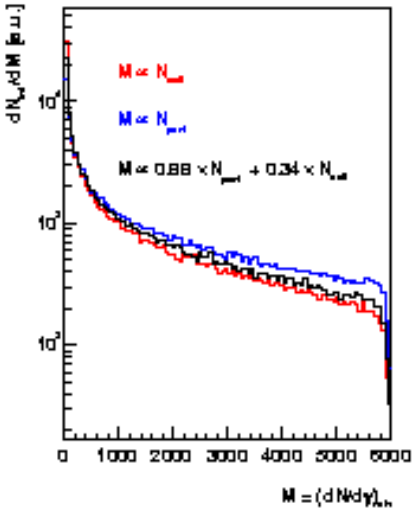
(the main trigger rate)

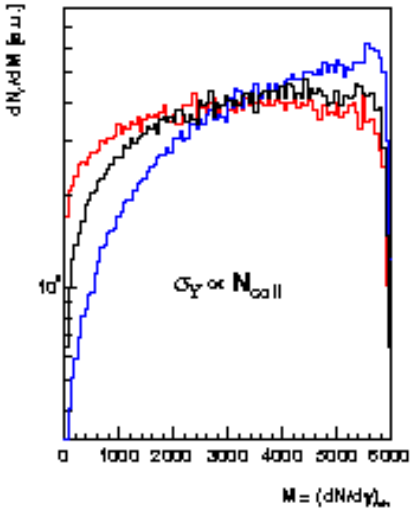


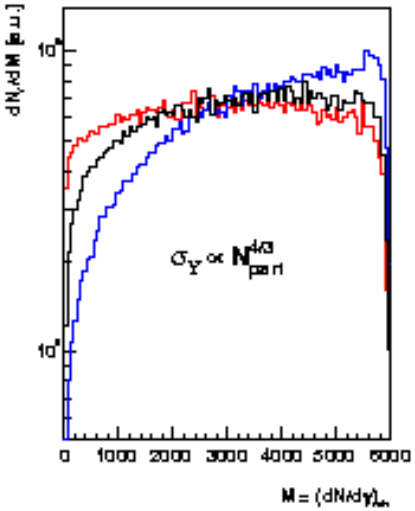
Model dependent
(spectrum hardness)



Glauber collision geometry







Bogdan VULPESCU, University of Heidelberg, Germany

Pion rejection performance

bulk value dependence on the event multiplicity

Depends on tracklets quality and number of reconstructed segments (TRD layers), etc.

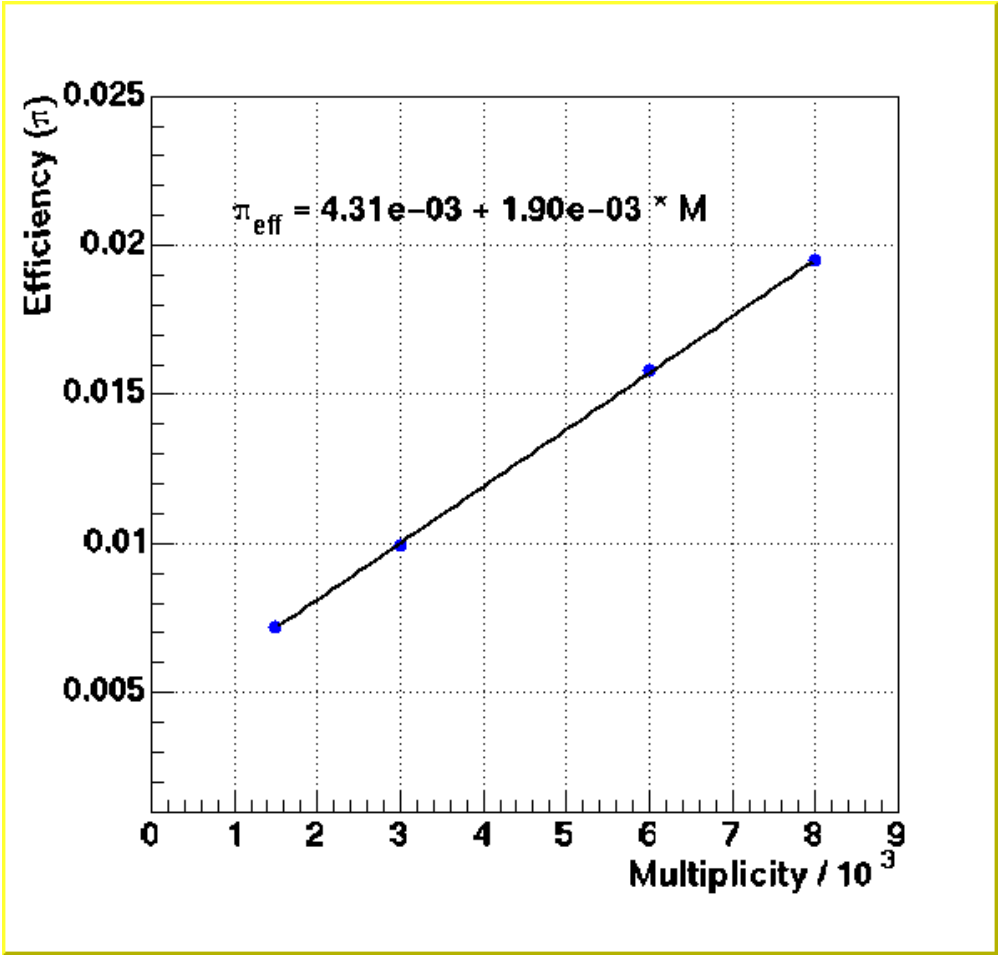
(simulation extrapolation from beam data at 2 GeV/c)

Methods:

- likelihood on integrated charge
- likelihood on integrated charge and position
- neural networks

Delicate subject of simulations...

Comparable with he improved PID in the TPC by dE/dx (but faster...).



Conclusions

At the level of the TRD TDR (Sept. 2001) there was most of the trigger functionality already implemented.

Progress of:
- signal electronics
- integrated clusterizer and tracking processor (LTU)

Changes in:
- detector geometry
- material budget

Prototypes of:
- Global Tracking Unit

The goals:
- define trigger rates and regions of interest to the High Level Trigger (TPC fast tracking)
- combine trigger with fast simulations of off-line tracking and look for S/N...