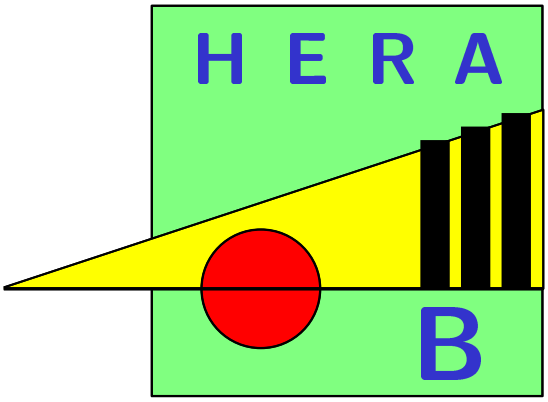
The First Level Trigger of HERA-B in 1999

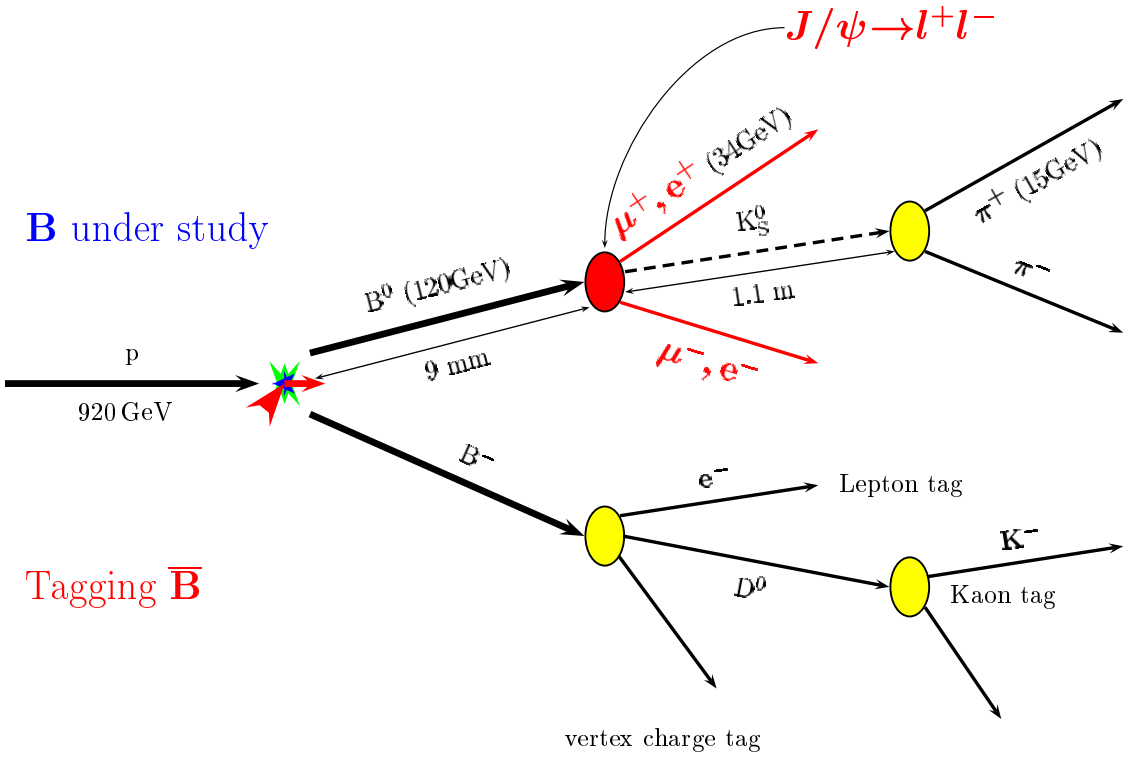


Ekkehard K Gerndt

24 June 1999

DESY, Germany

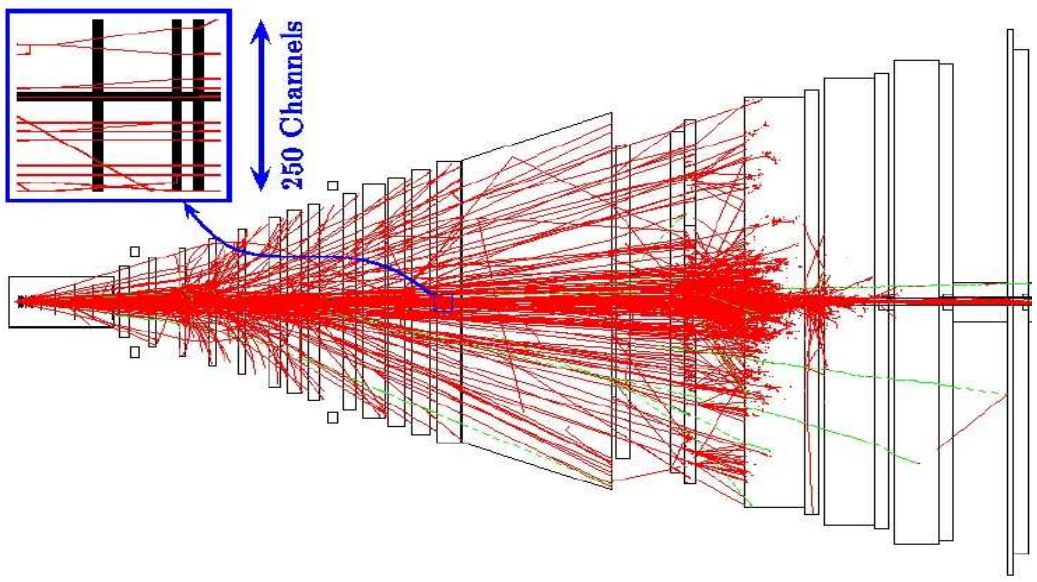
Initial Goal:
CP Violation Study of the Golden Decay
$B^0 \rightarrow J/\psi\, K^0_S$



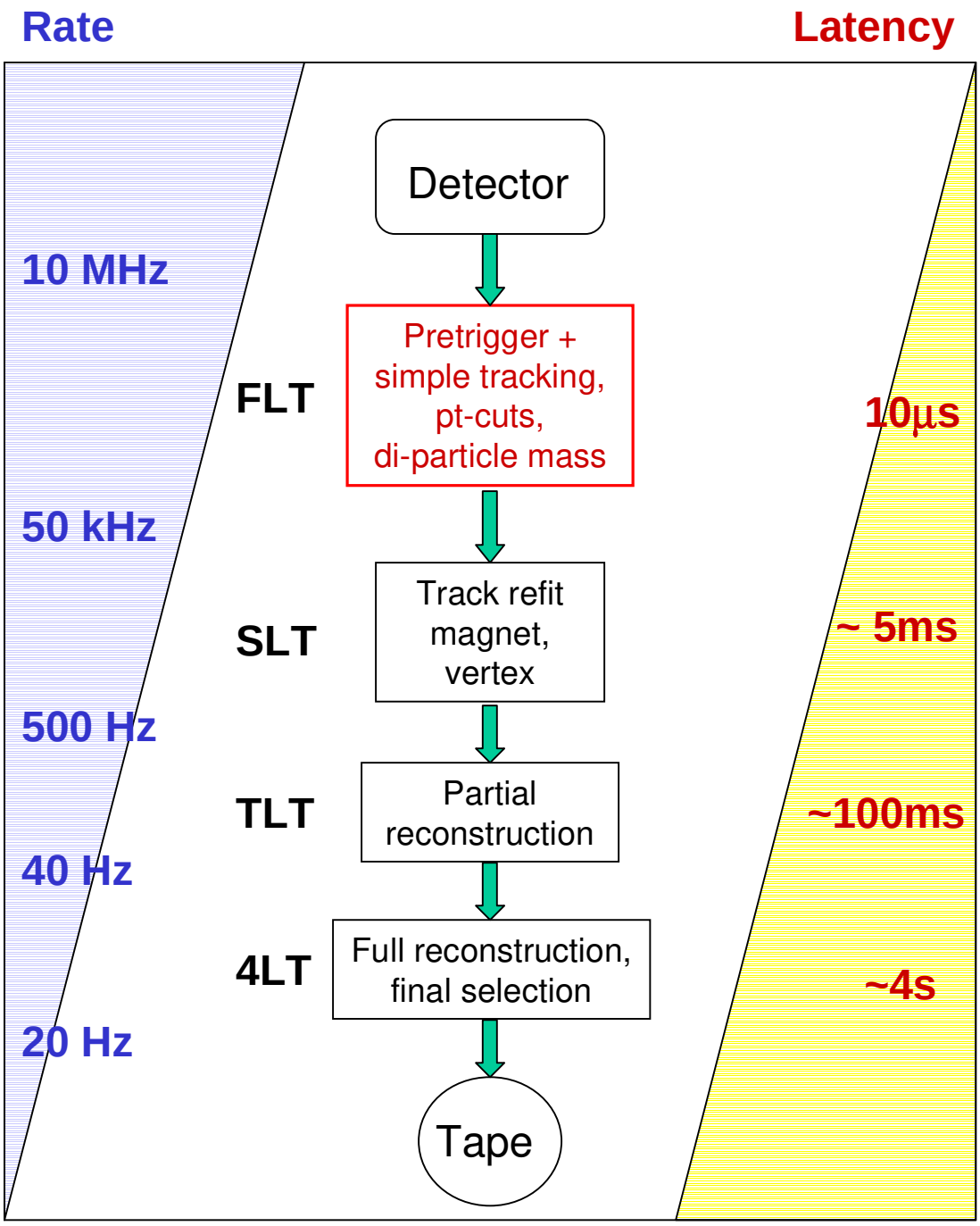
Operating Environment

- Rate of interesting signal **several Hz**
- Bunch crossing rate **10.4 MHz**
- < interactions/BX> := event **4..5**
- < tracks/event> **≈ 100**
- Signal/ Background in the range of **≈ 10^{-11}**
- occupancy up to **≈ 20%**

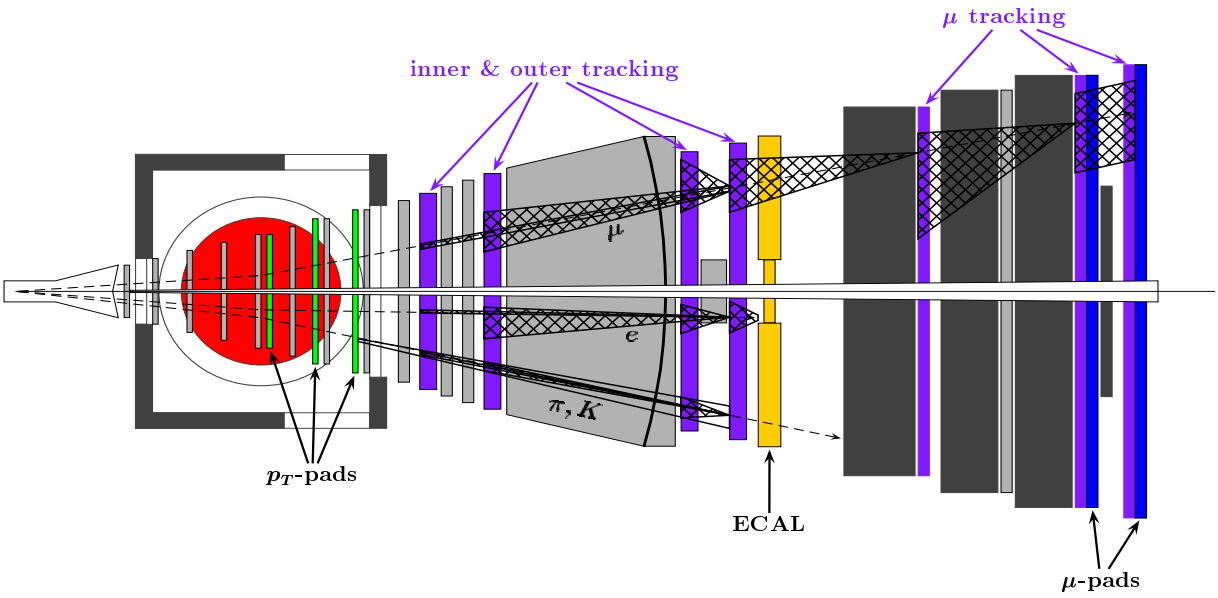
Typical simulated event (GEANT):



Pipelined Trigger:
Rates & Latencies



Pretrigger & First Level Trigger



Pretrigger: Initiate track search with defined particle ID: electrons, muons (and particles with high p_T).

<trigger seeds> ~ 10/BX

FLT: Reconstruct tracks opposite to beam direction in field free region.
→ Apply two particle mass cut
→ Initiate Trigger

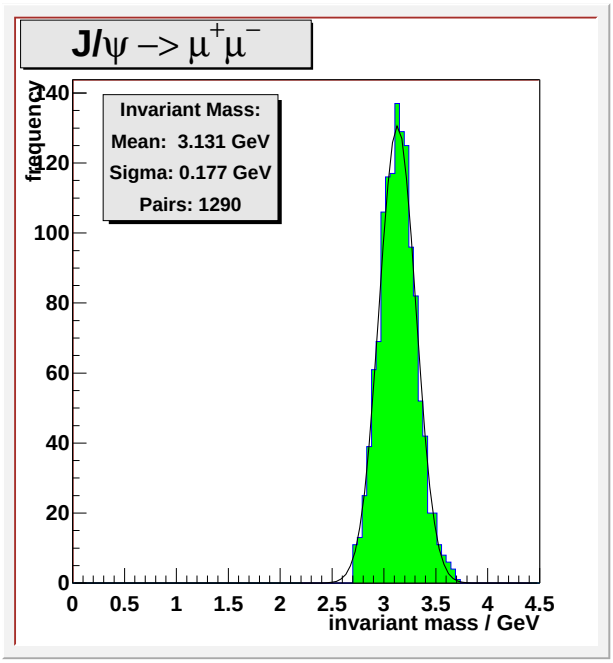
Input rate = 10 MHz
Output rate = 50 kHz
} **suppression = 200**

Latency (Pretrigger + FLT) = **10 μs**

Expected performance

(simulation results)

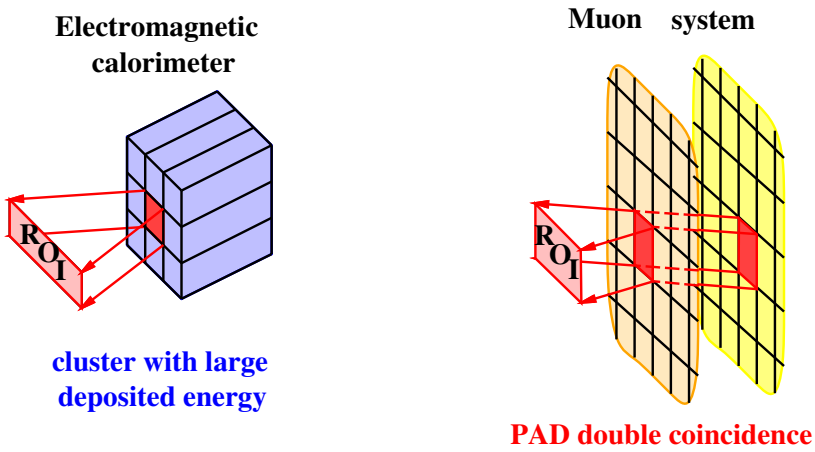
Mass resolution ~180 MeV ($\mu^+\mu^-$)



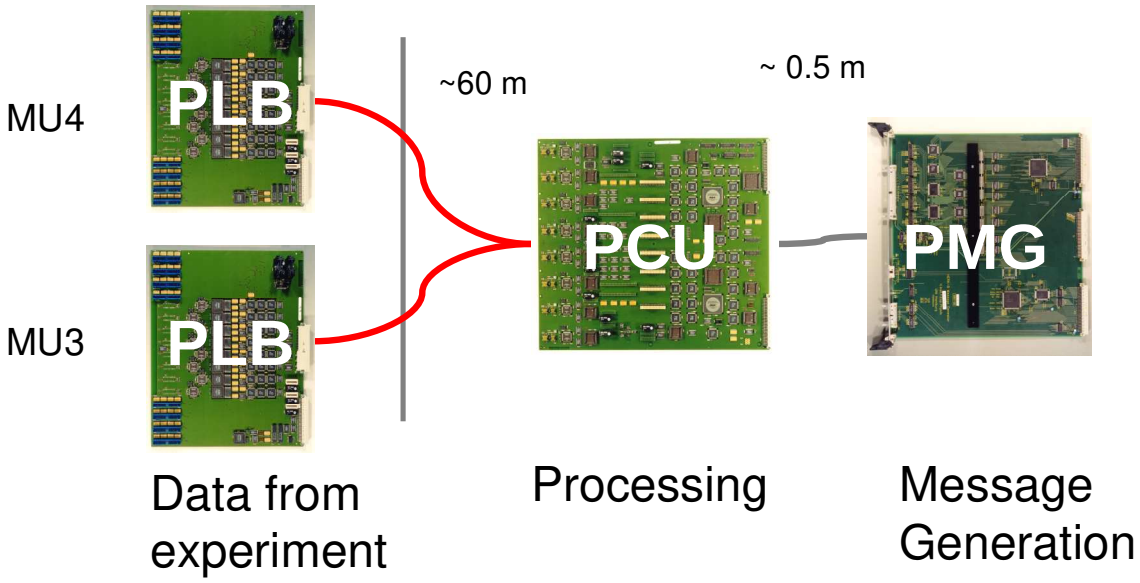
Efficiency by pretrigger ID

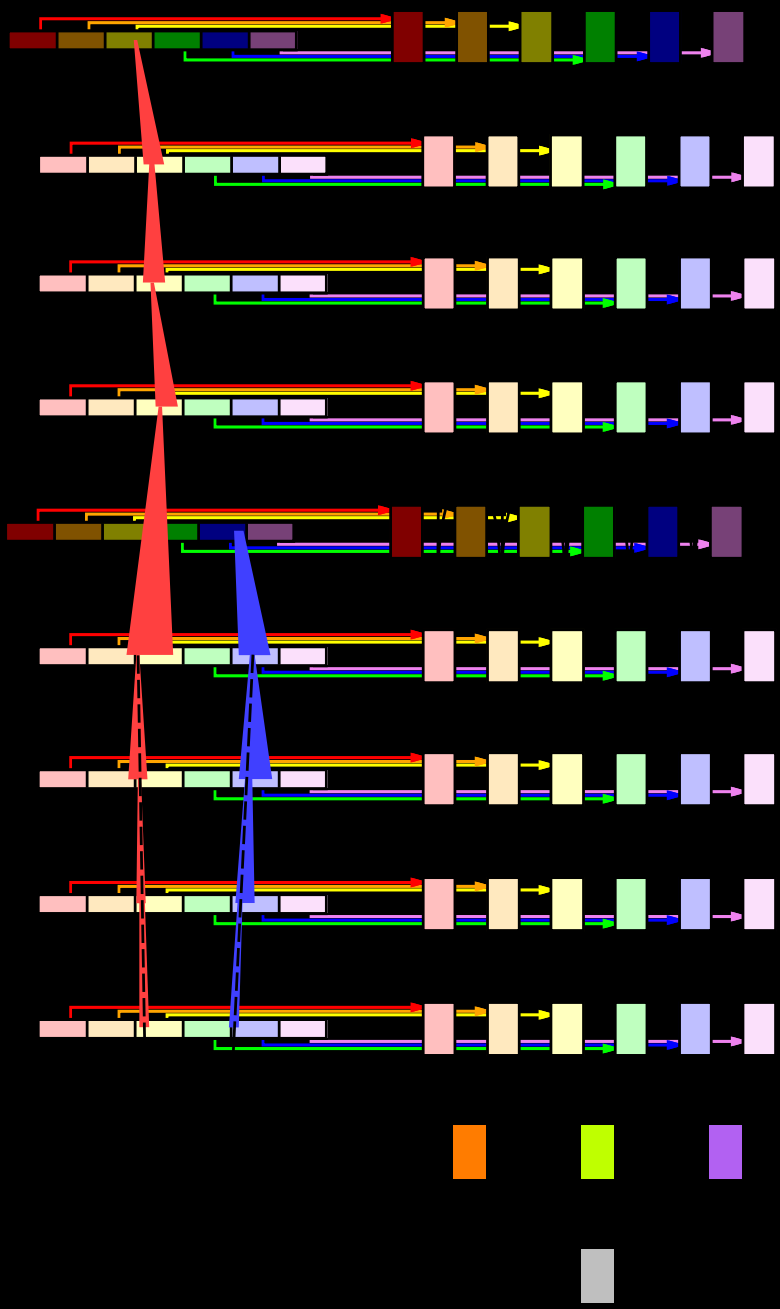
electrons:	**35%**	$J/\psi \rightarrow l^+l^-$
muons:	**55%**	
high pT:	**28%**	$B^0 \rightarrow \pi^+\pi^-$

Pretrigger Systems

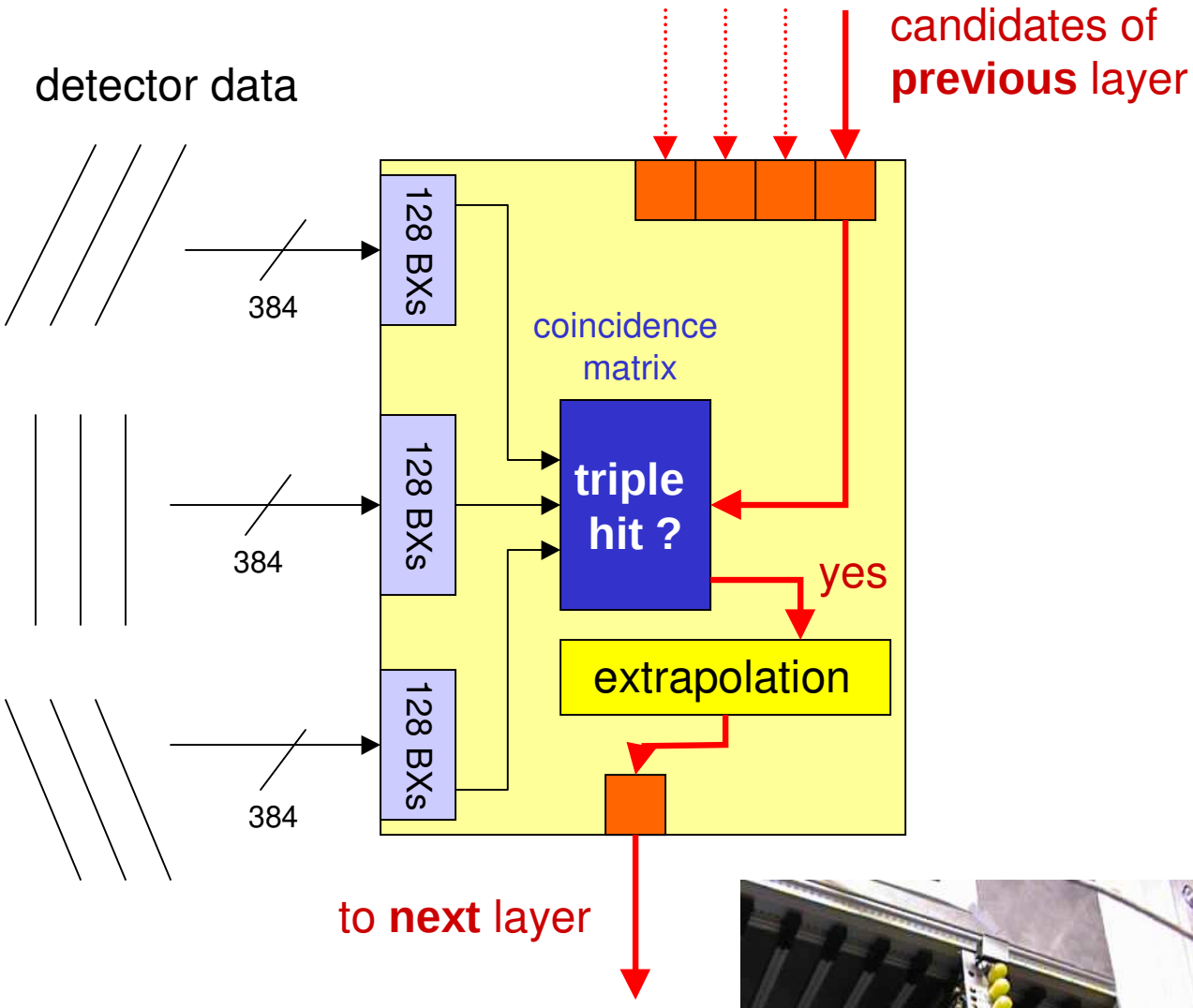


Muon Pretrigger electronics:



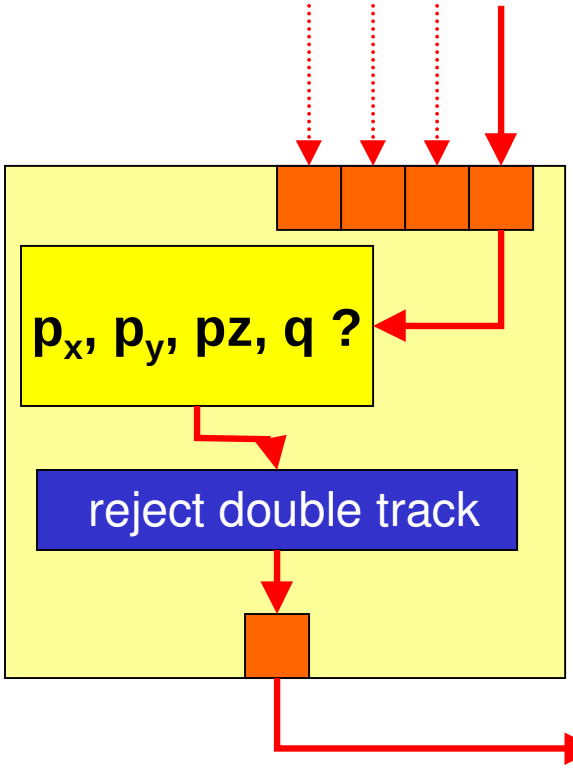


Track Finding Unit



- ~ 70 needed for full FLT
- 25 % available

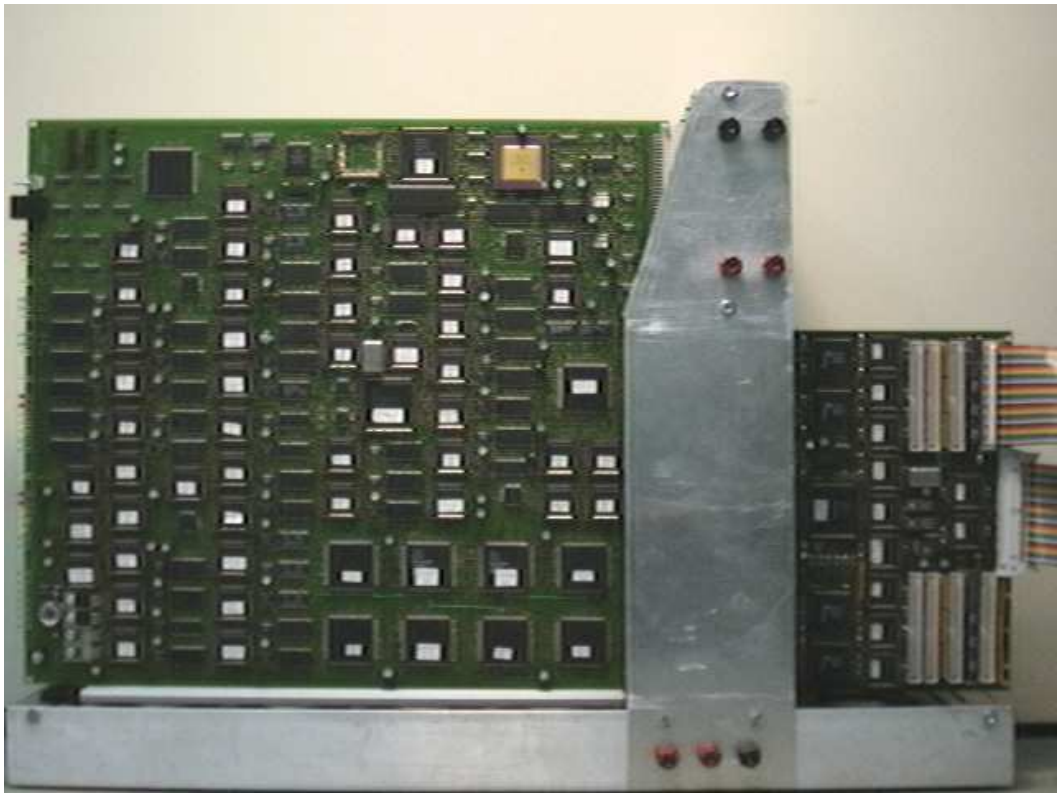
Track Parameter Unit



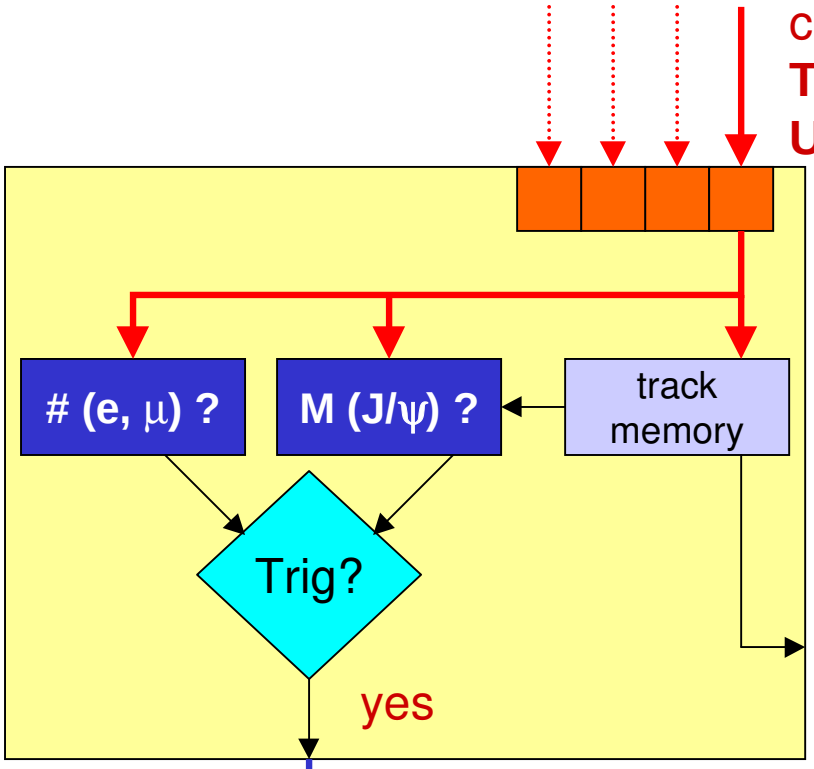
track candidates
from final
Track Finding Unit

- 4 needed for full FLT
- 50 % available

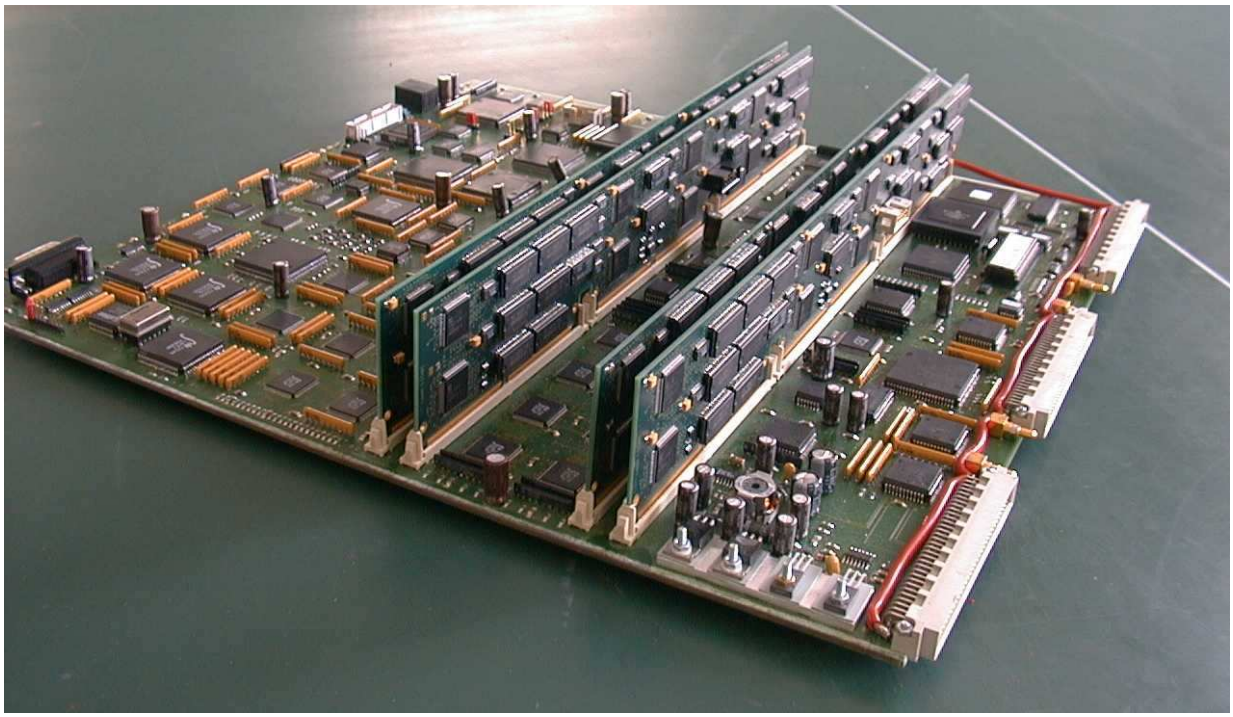
to **Trigger Decision Unit**



Trigger Decision Unit



- 1 needed
- commissioning at DESY

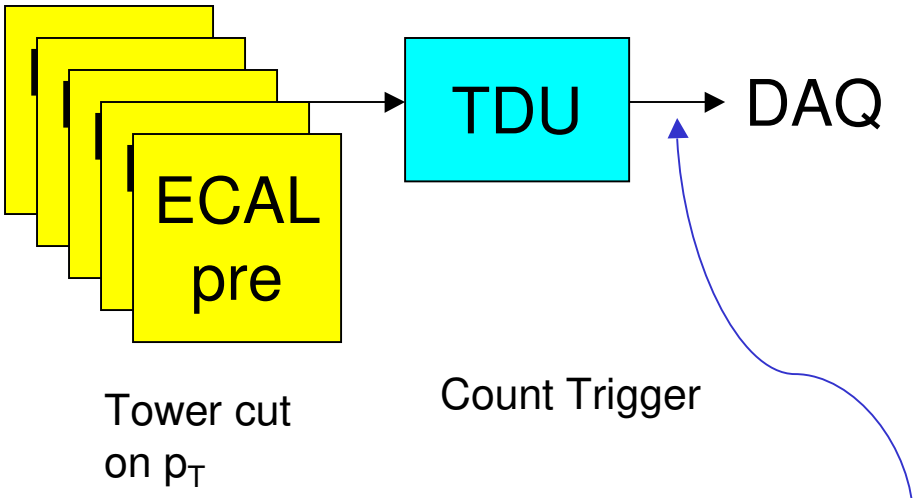


Status System Commissioning

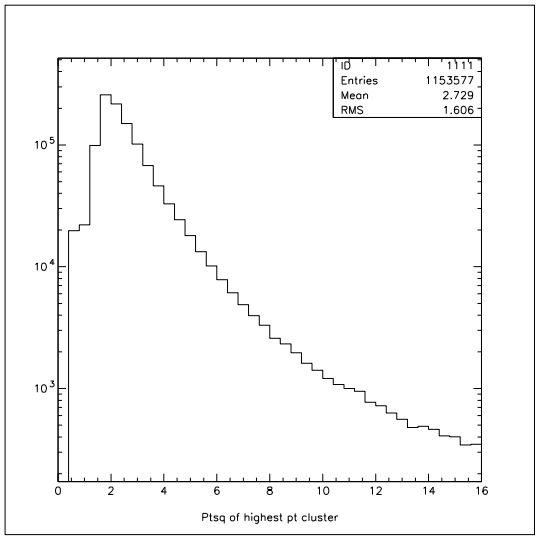
- Run period until May 99
- Board tests

Provide physics trigger

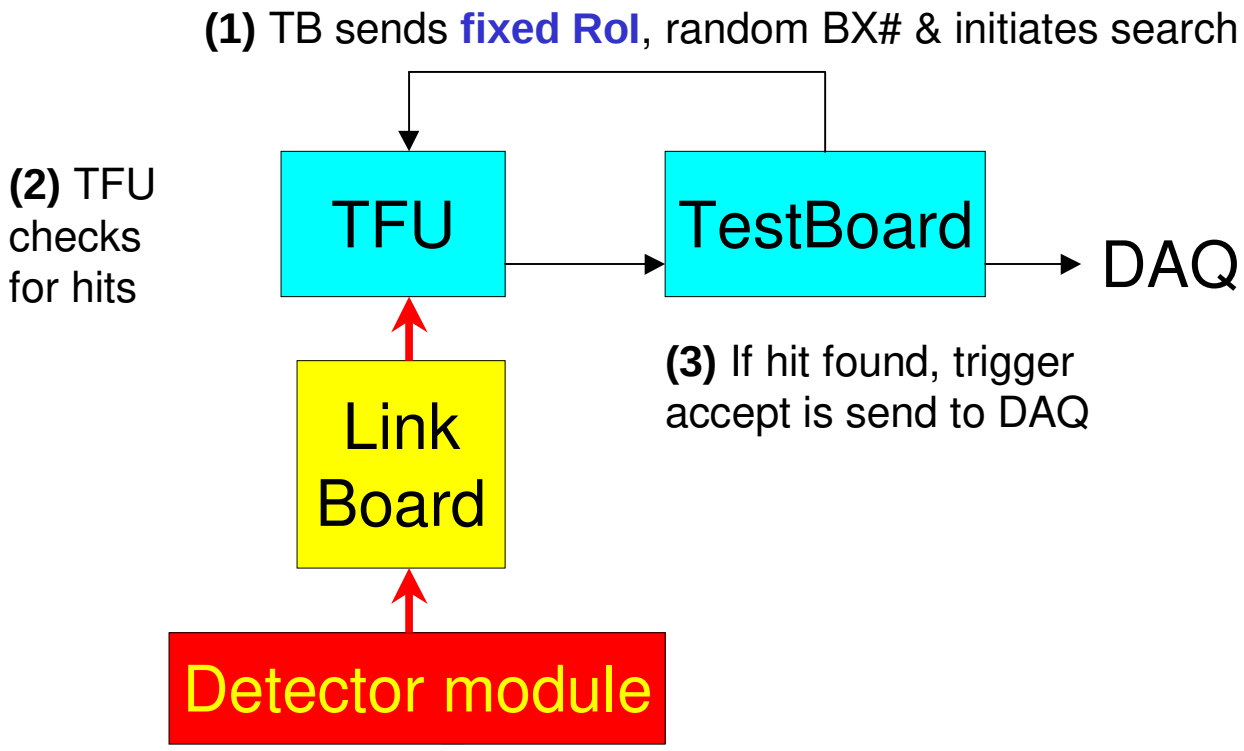
Trigger decision is based on energy measurements of **electronic calorimeter**

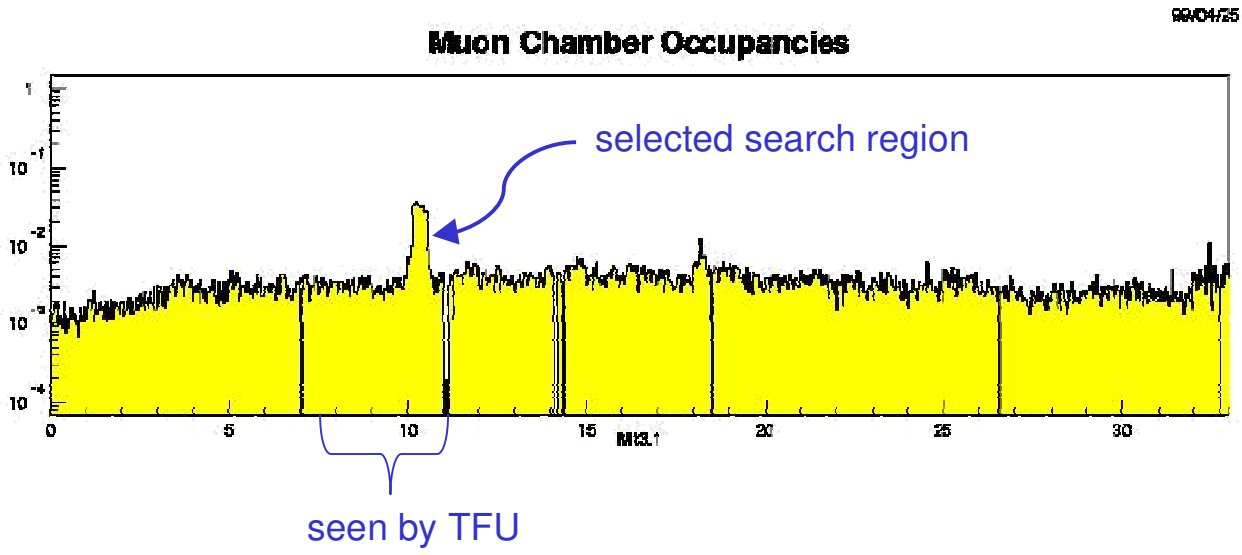


Number of tracks vs. (p_T^2)



FLT hit finding: MUON

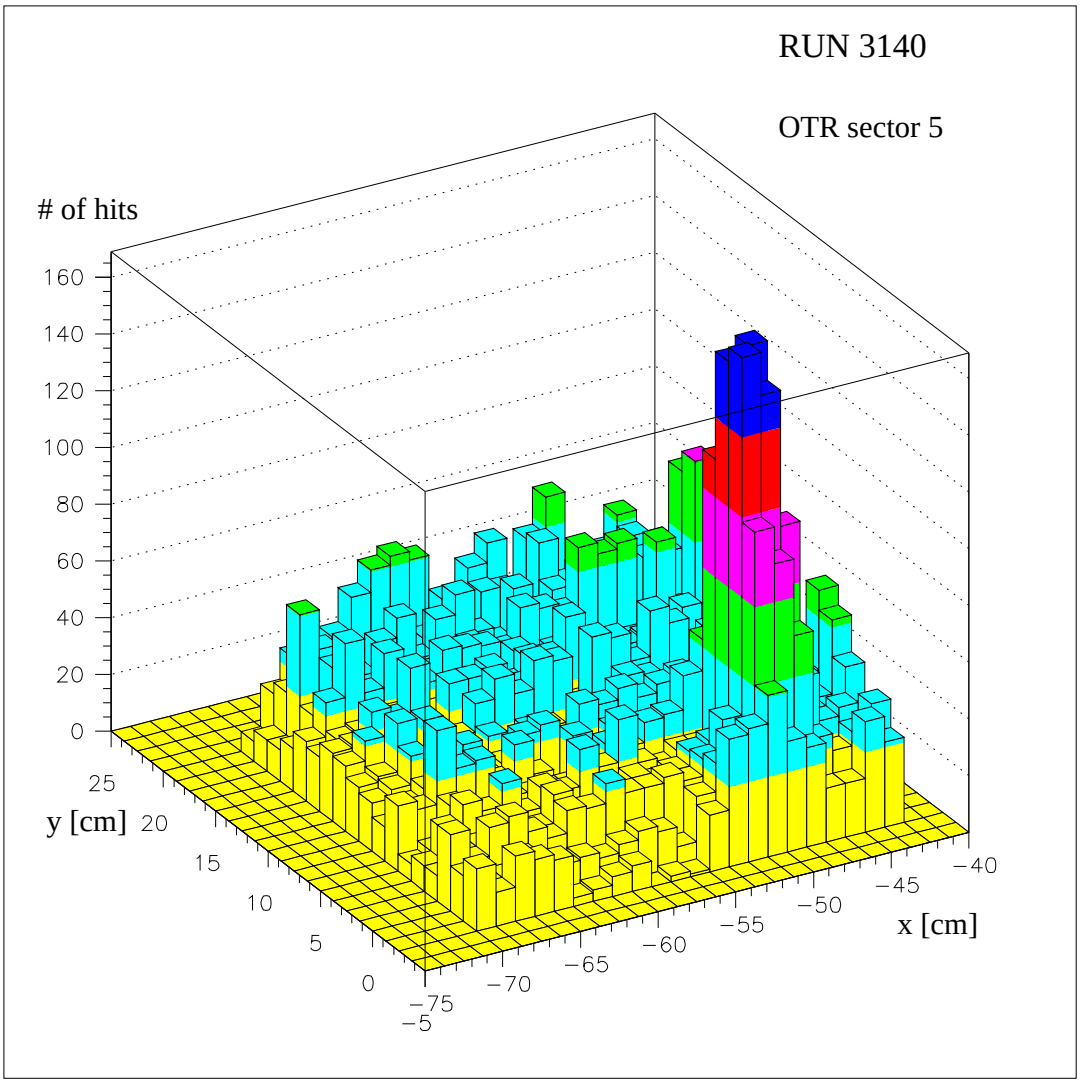




Reconstructed Hits

(in offline data)

Track Finding Unit triggers on hit in search region.
Detector data from **outer tracker**.



Summary & Outlook

- Very complex boards designed and built
- Series production of electronics on going
- Installation of electronics at DESY has started

- Important commissioning milestones reached

- Extend tests to track finding
- Start commissioning of second pretrigger in July

Looking forward to a complete First Level Trigger by the end of 1999