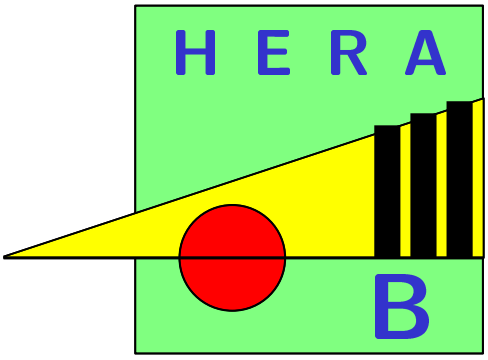
November 15-19, 1999
Hamamatsu, Japan

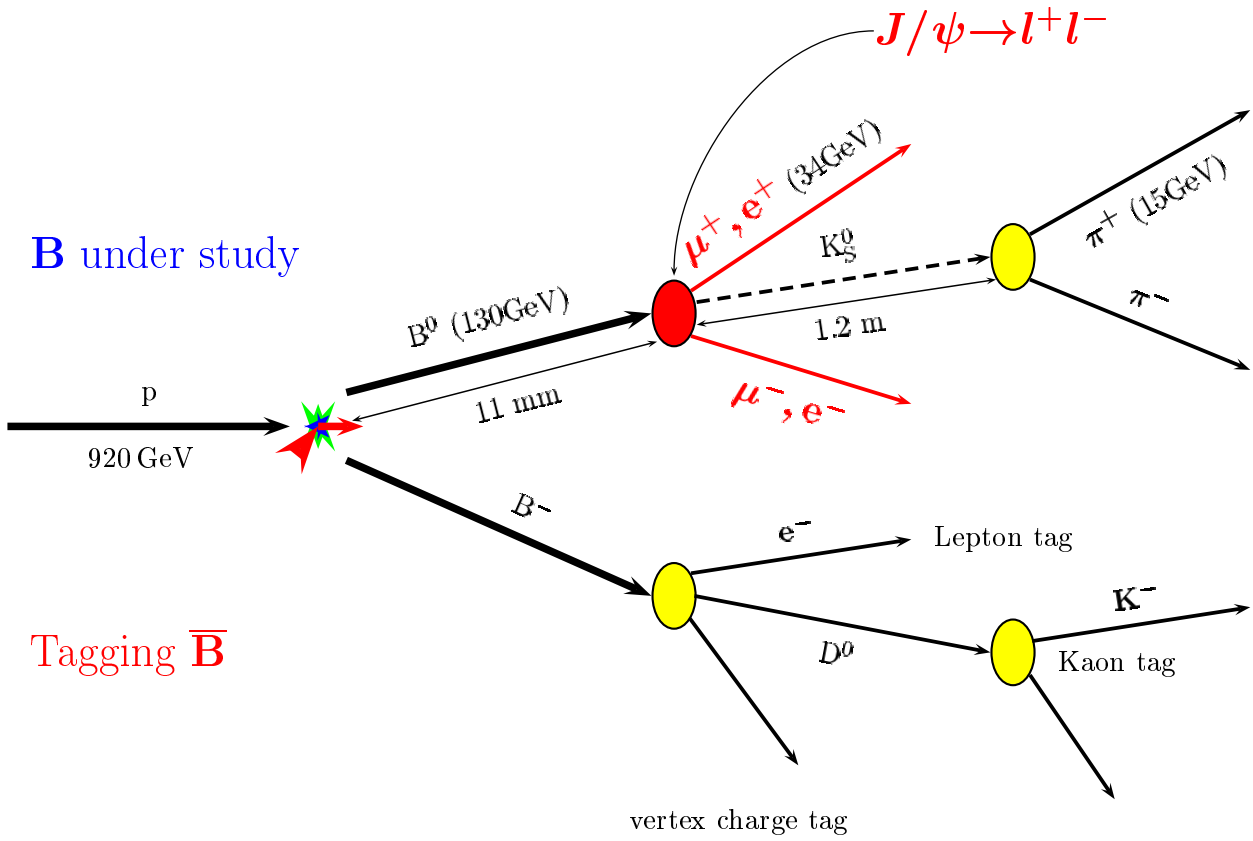
The HERA-B First Level Trigger in 1999



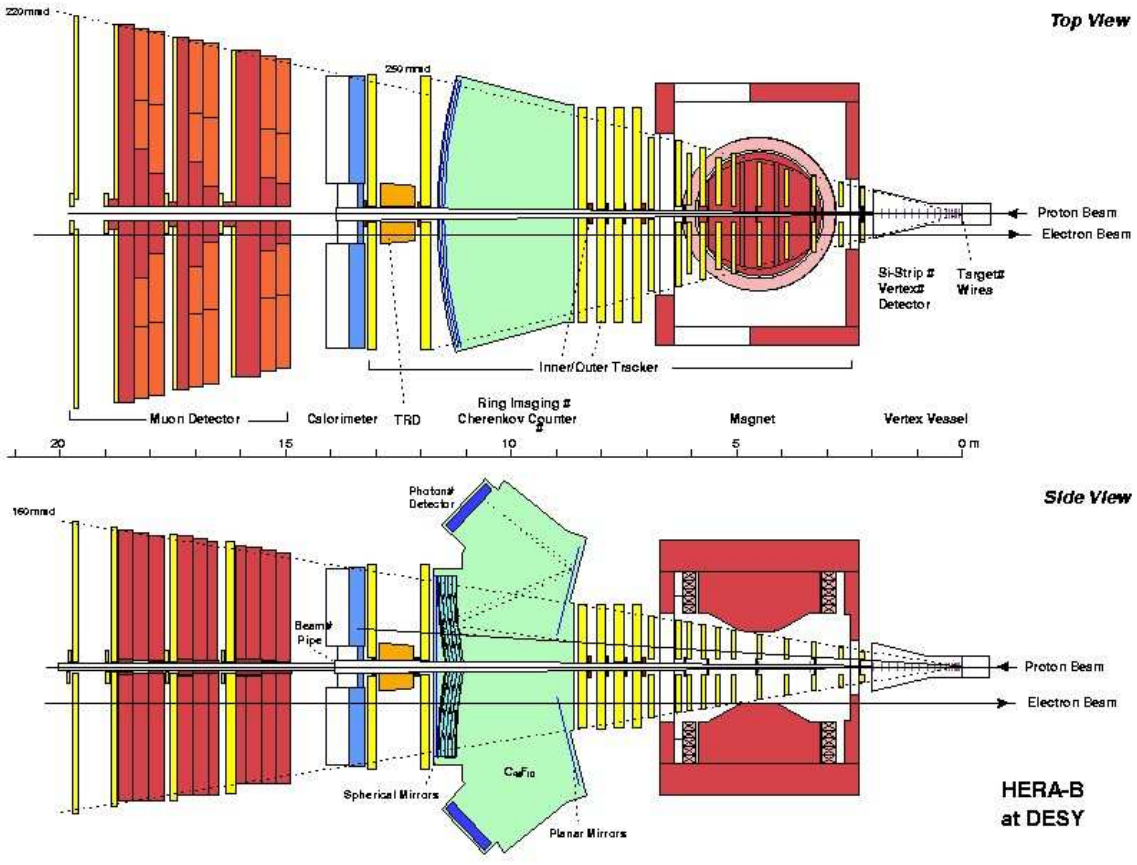
Ekkehard K Gerndt
17 November 1999
DESY, Germany

Introduction

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



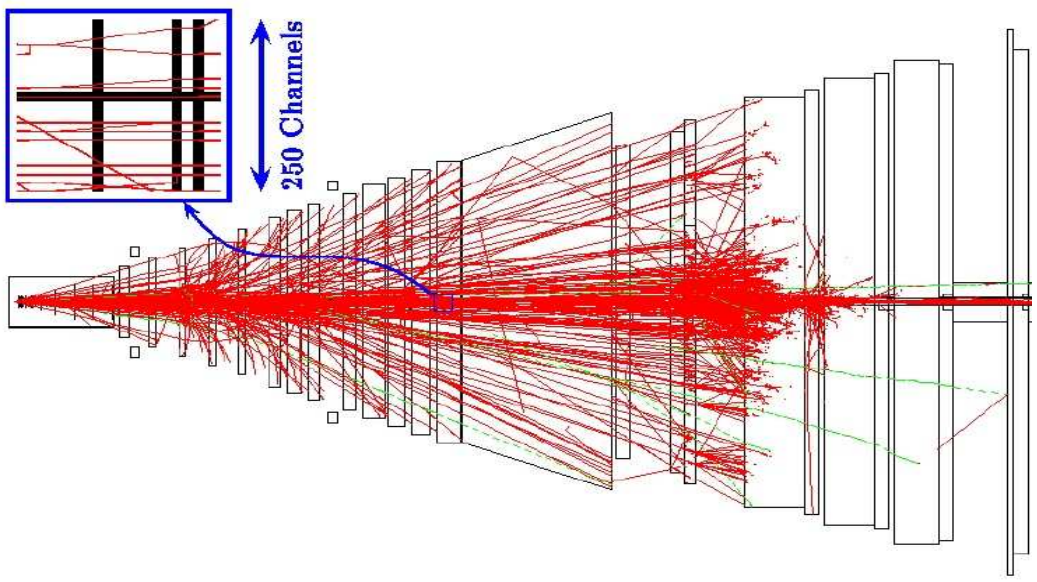
The HERA-B Detector



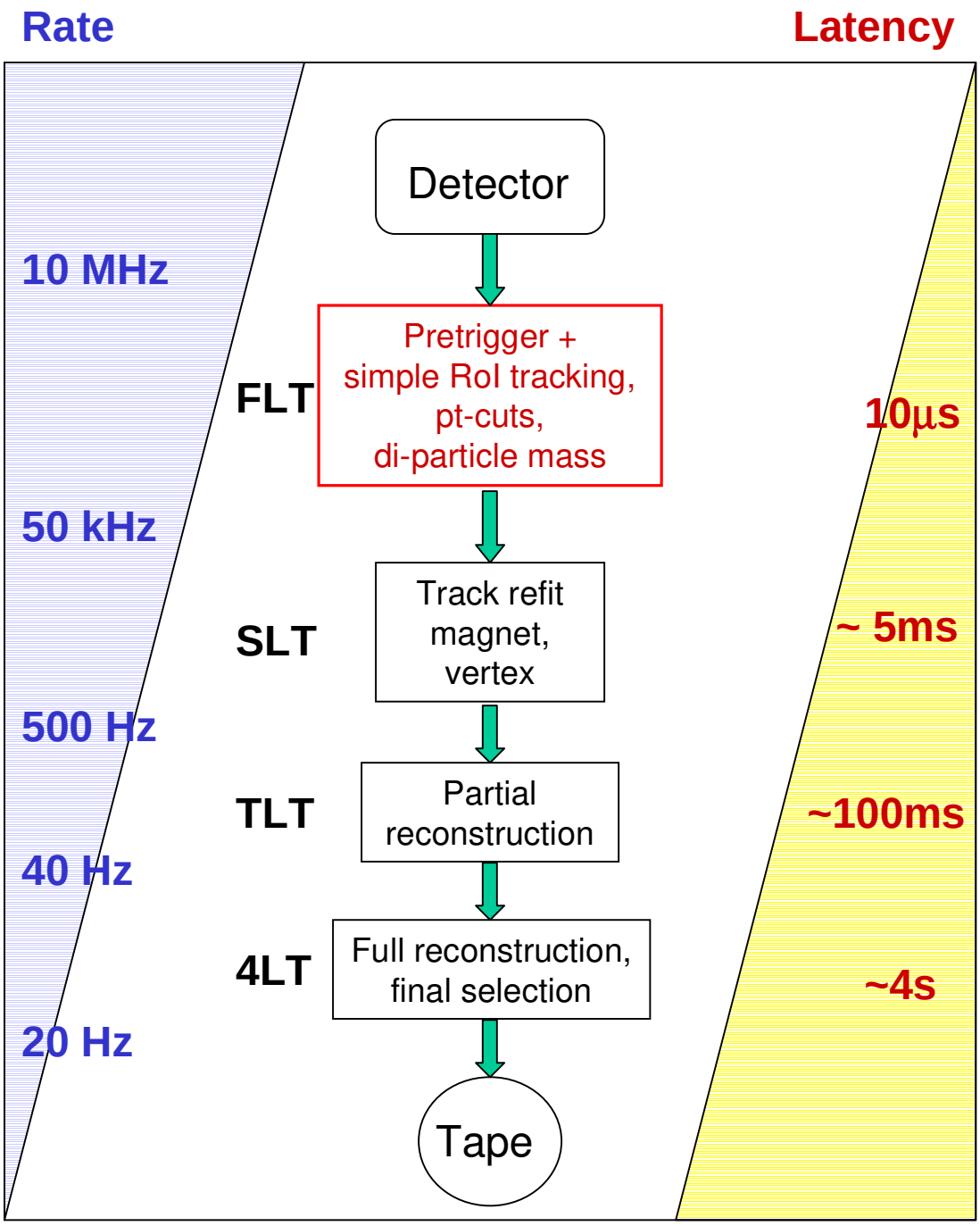
Operating Environment

- 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%**

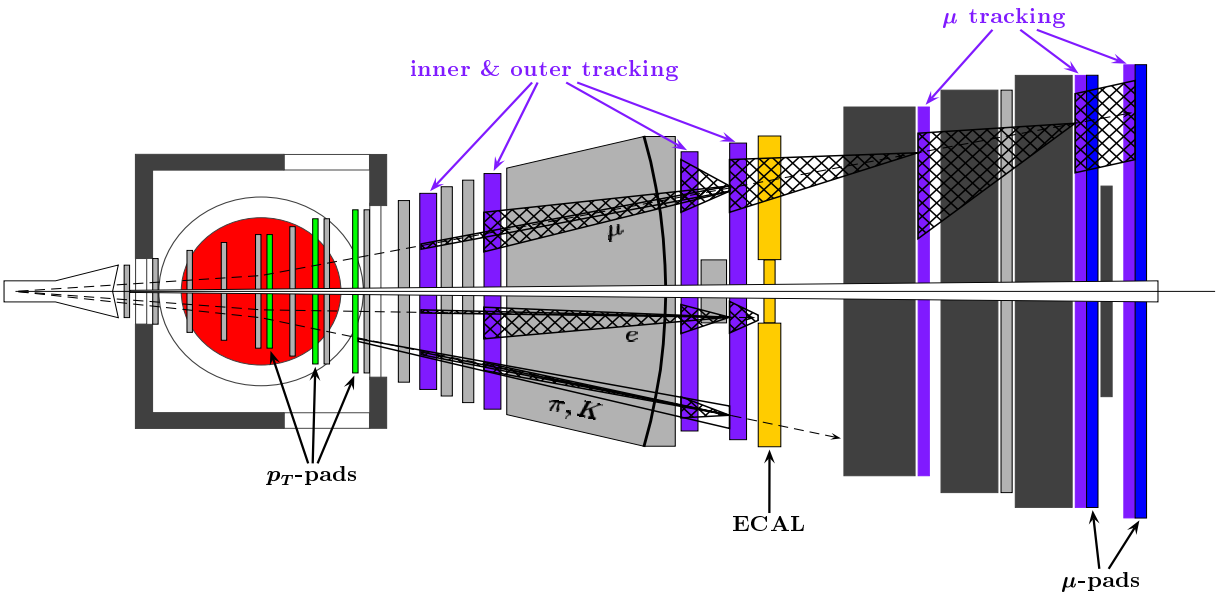
Typical simulated event (GEANT):



Pipelined Trigger:
Rates & Latencies



Pretrigger & First Level Trigger



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

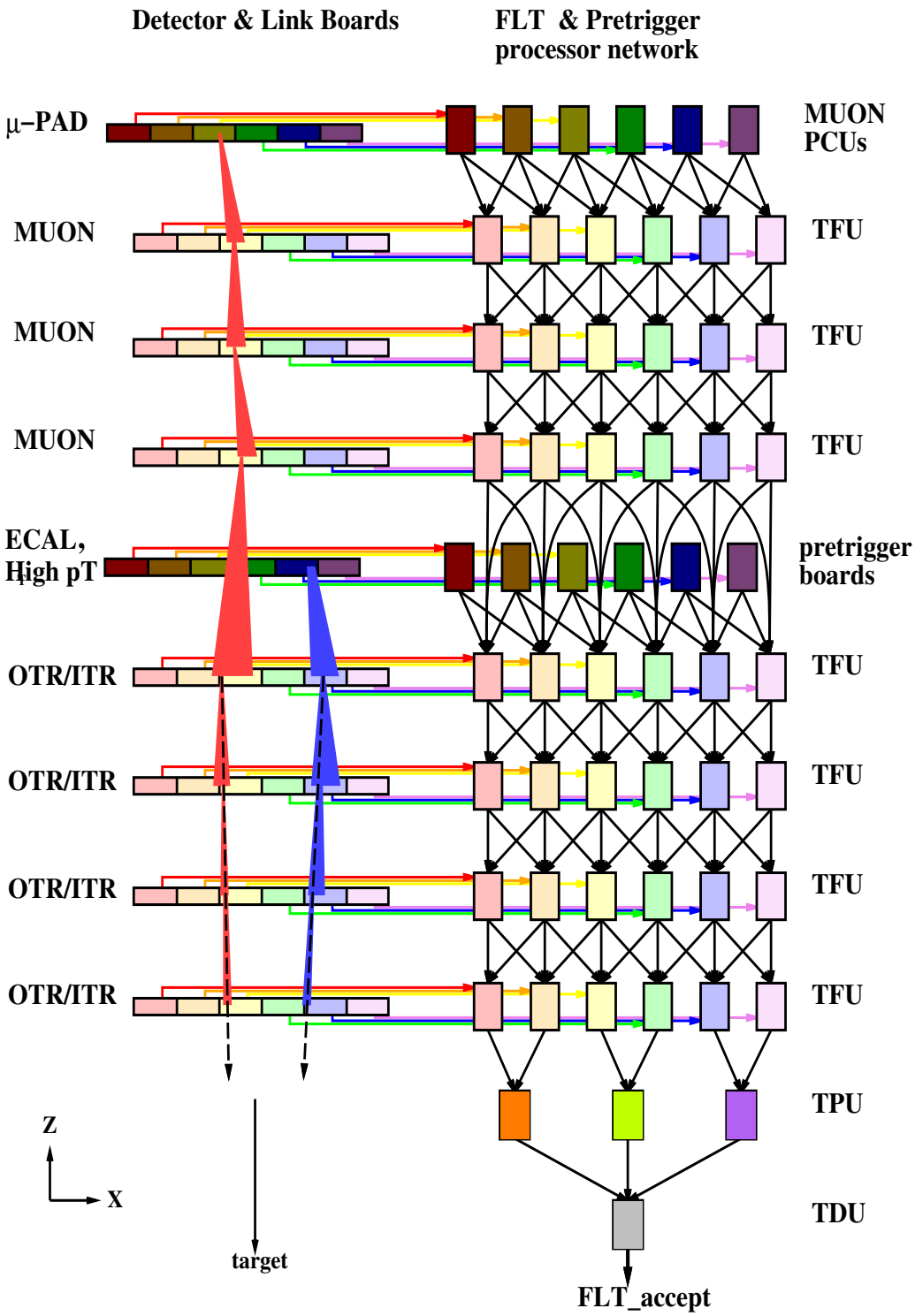
<trigger seeds> ~ O (10/BX)

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**

FLT & Pretrigger Network

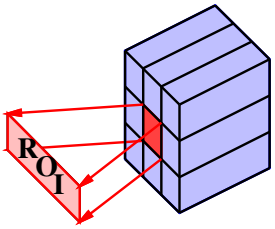


Hardware Overview and Status

Pretrigger Systems

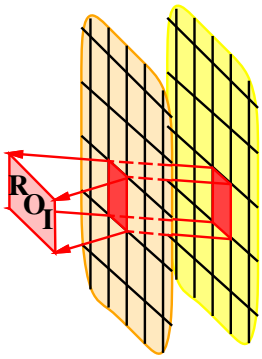
Status:
80 % J/ψ acceptance installed

Electromagnetic calorimeter



cluster with large deposited energy

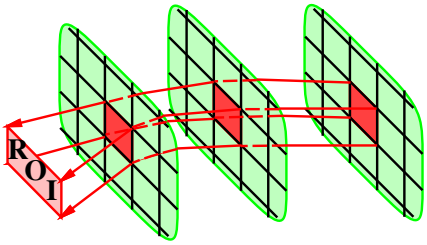
Muon system



PAD double coincidence

Status:
50 % installed, system tests

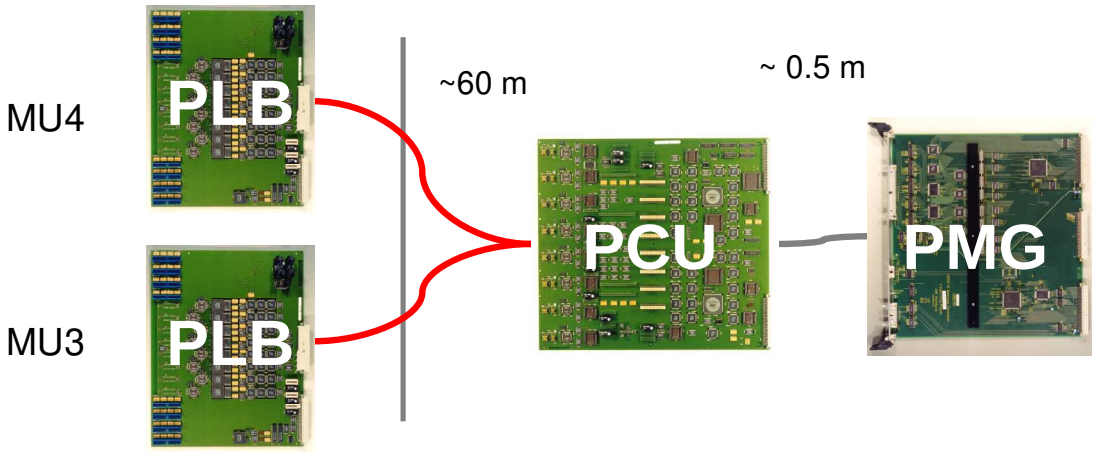
High P_T system



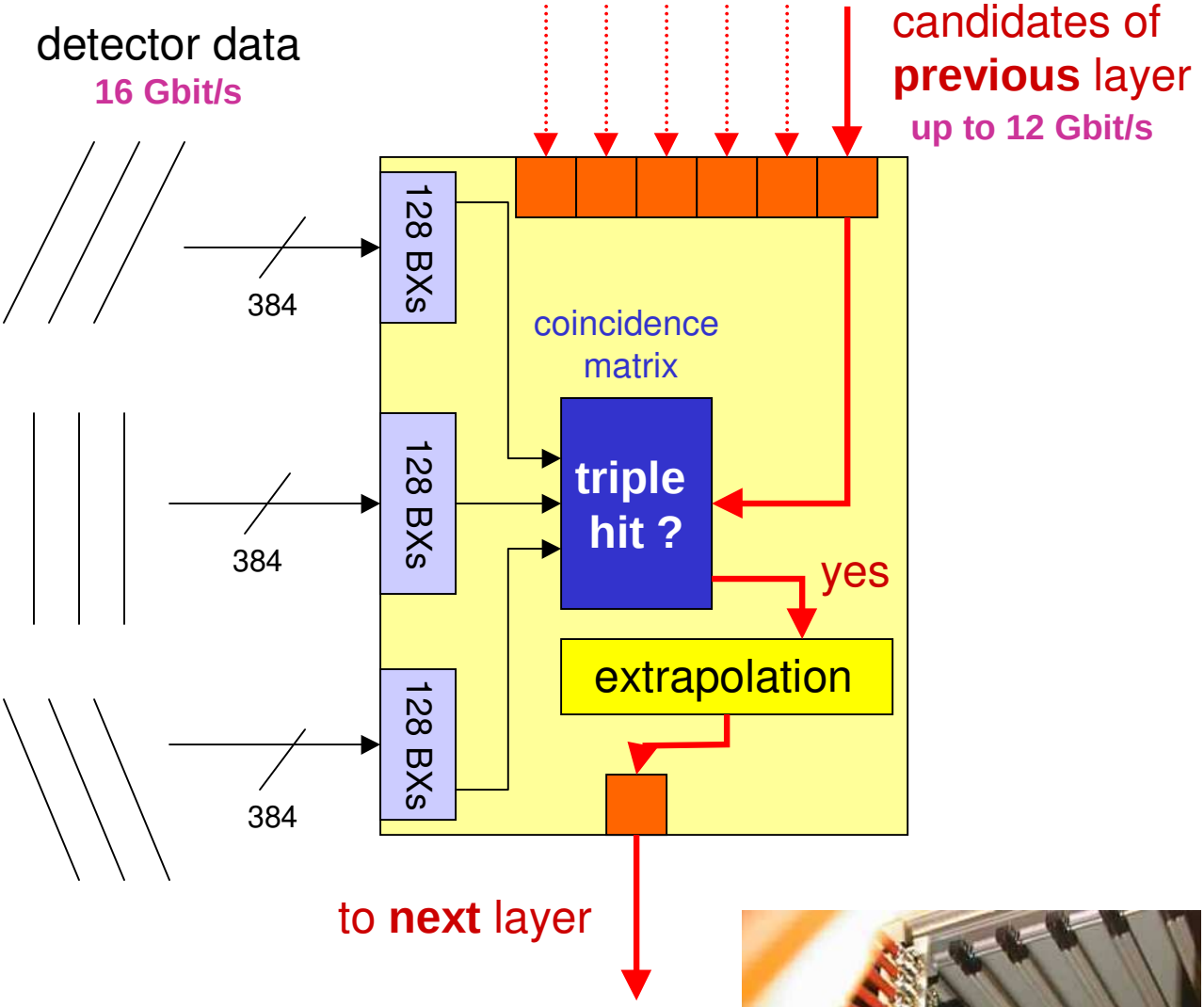
PAD triple coincidence

Plan:
installation Dec.99/Jan.00

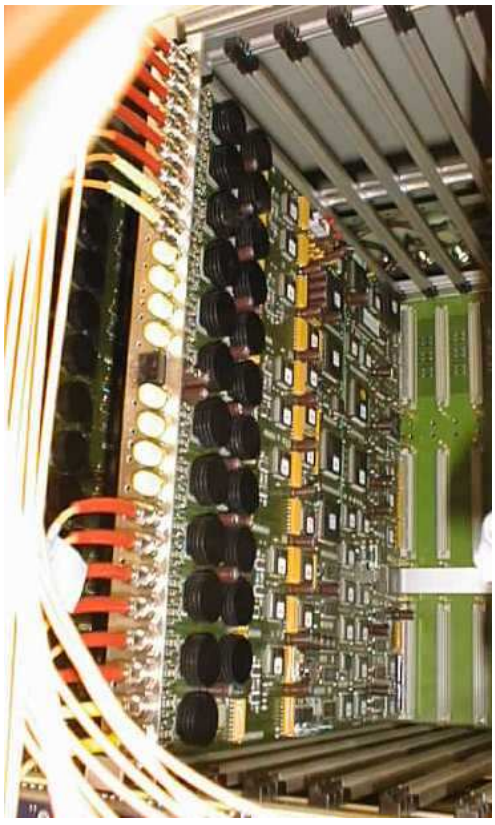
Muon Pretrigger electronics:



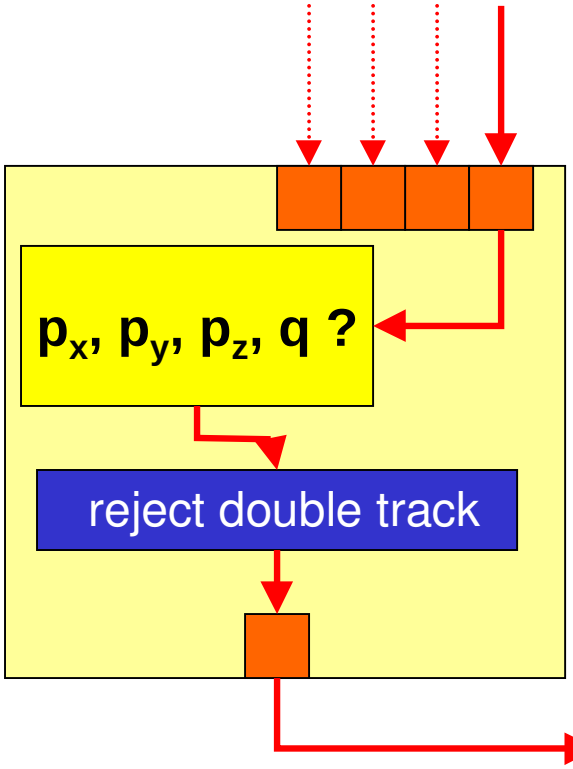
Track Finding Unit



- ~ 70 needed for full FLT
- 90 % available



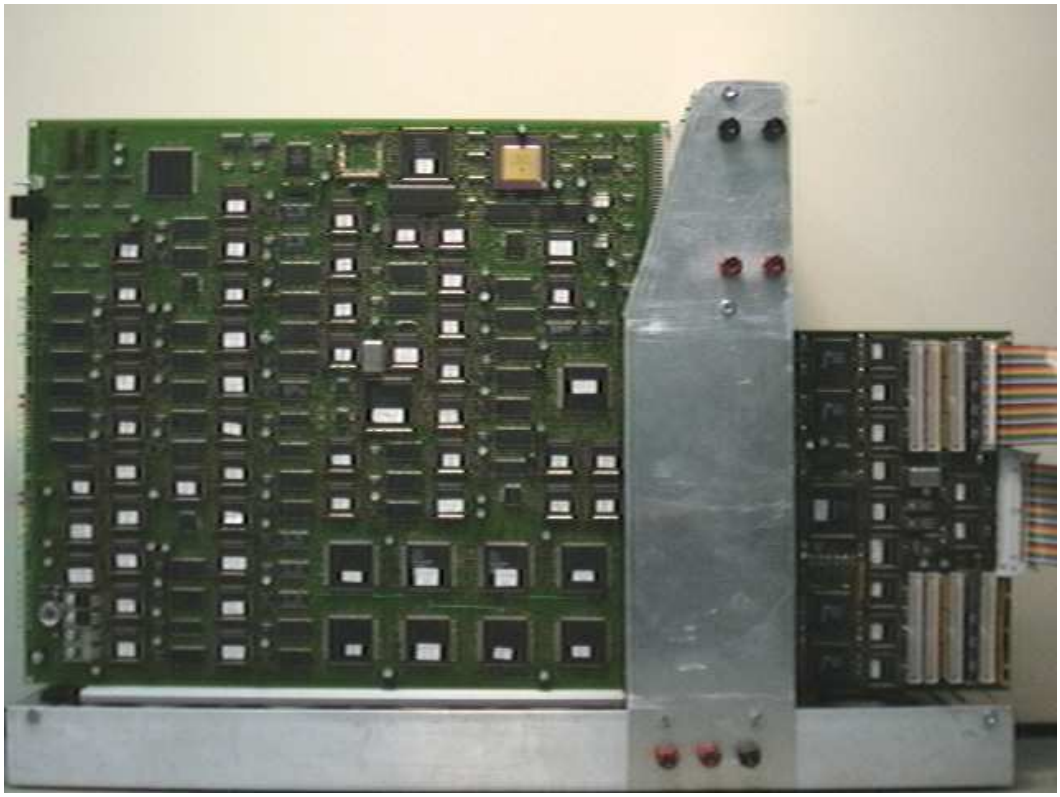
Track Parameter Unit



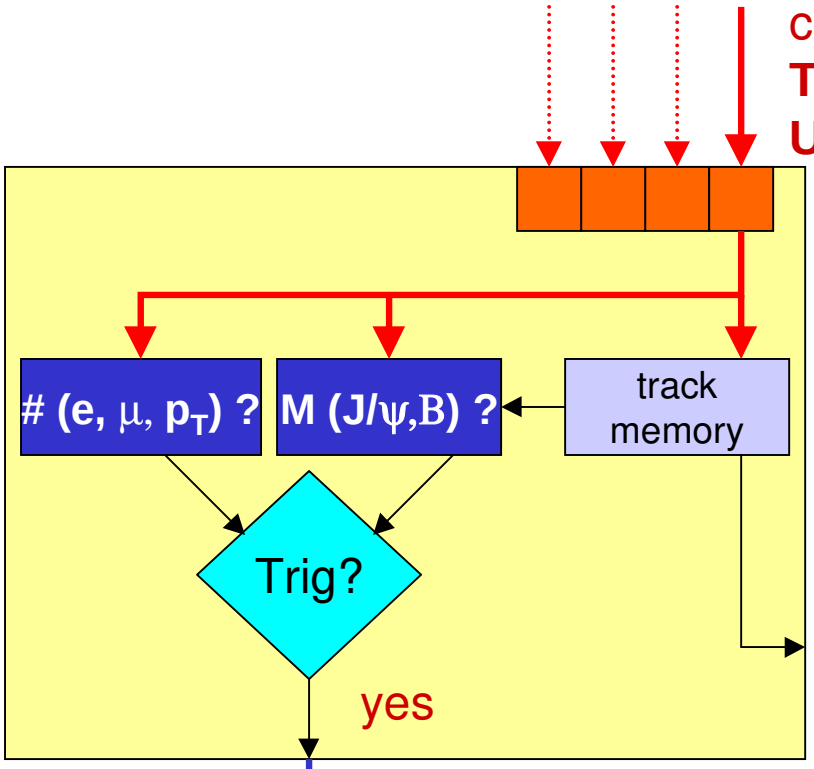
track candidates
from final
Track Finding Unit

- 4 needed for full FLT
- 100 % ready

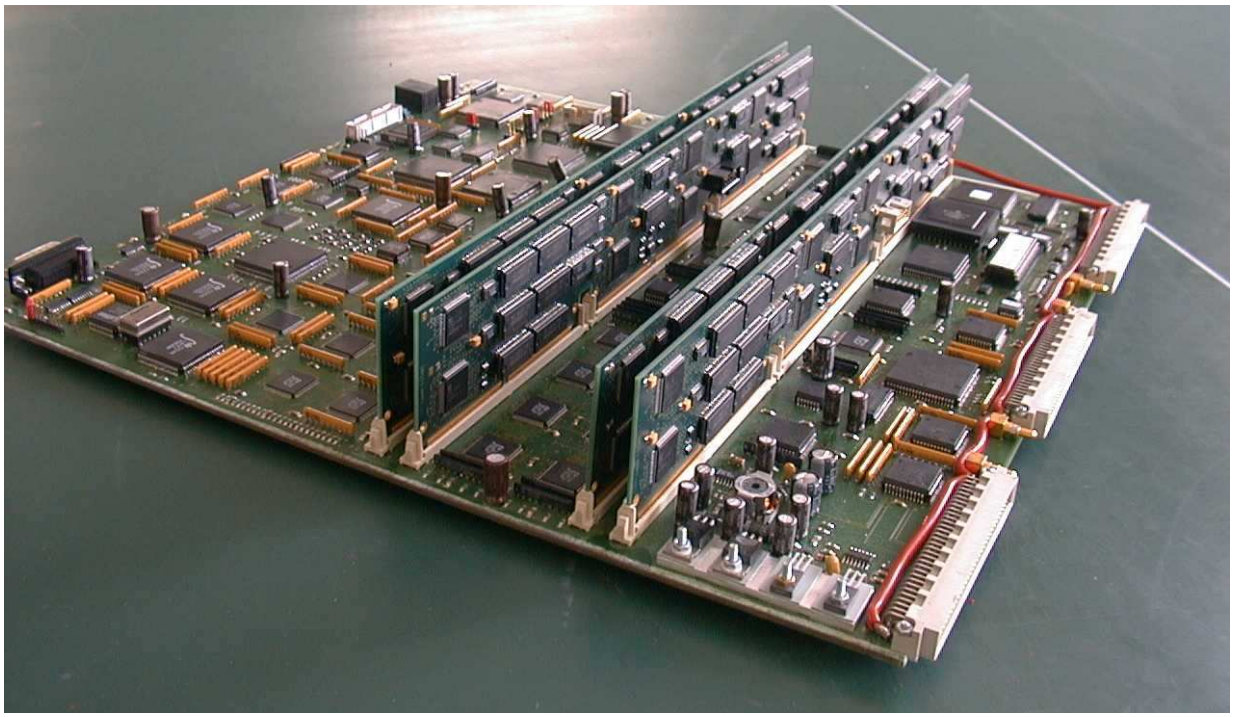
to **Trigger Decision Unit**



Trigger Decision Unit

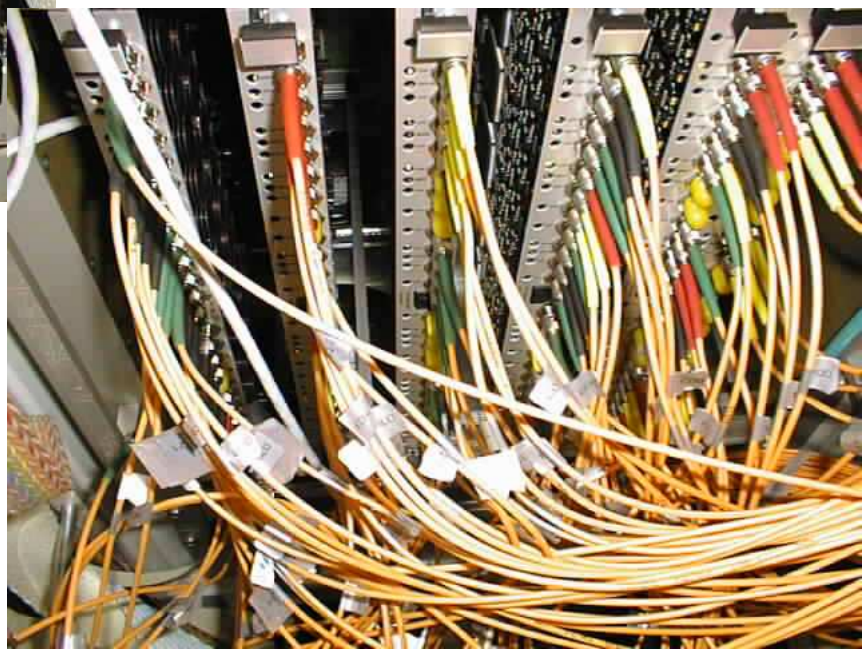


- 1 needed
- 2 ready



Hardware Summary

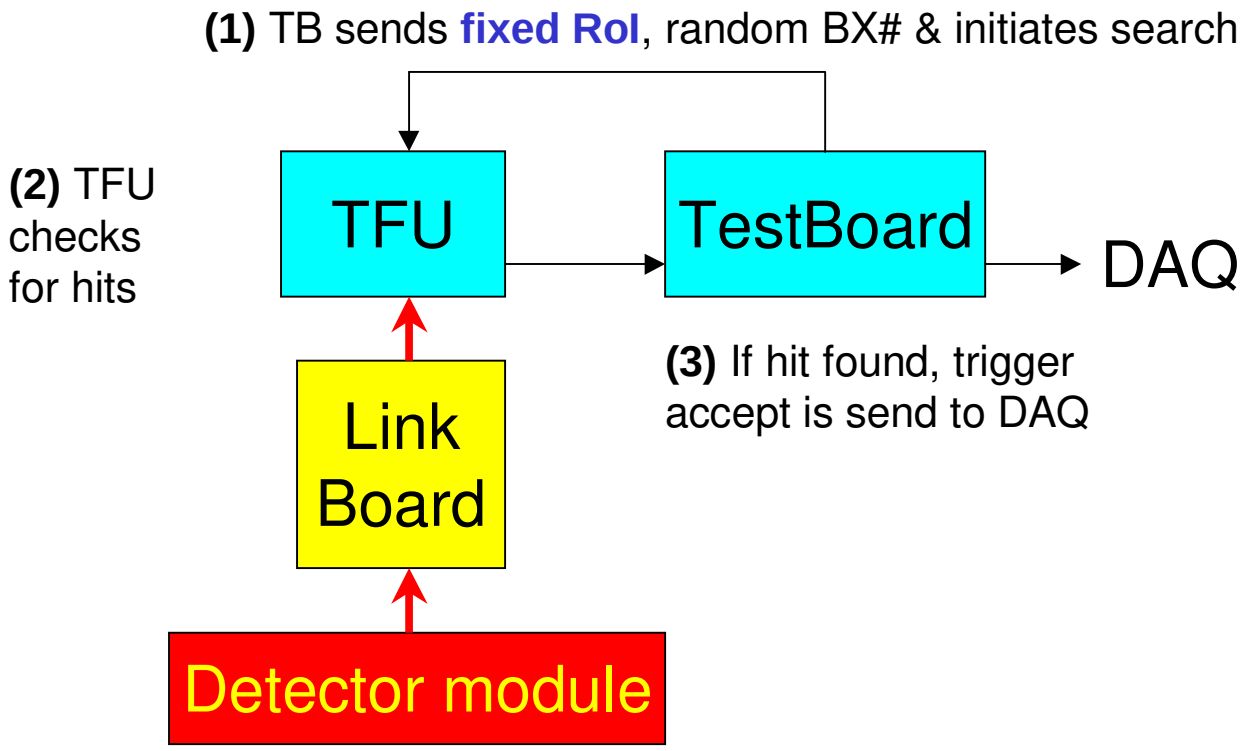
- **50% data link boards installed** (not shown)
- substantial part of the pretrigger & FLT hardware at DESY
- part of installation in electronics hut **see below**

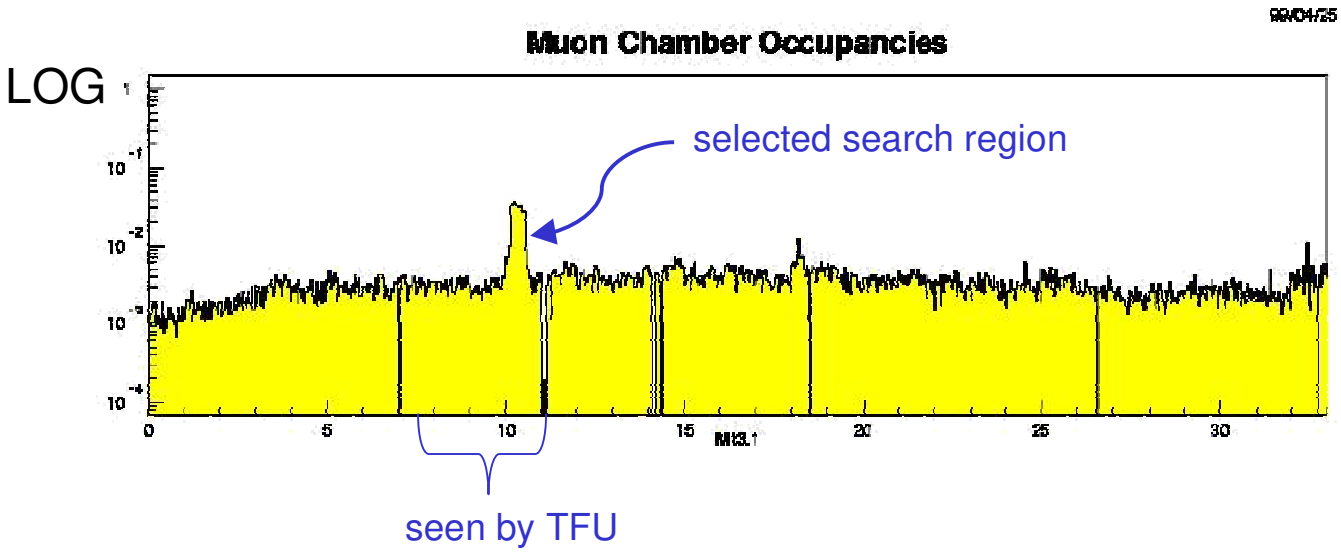


Status
System Commissioning

- Board tests
- System operation

FLT hit finding: MUON

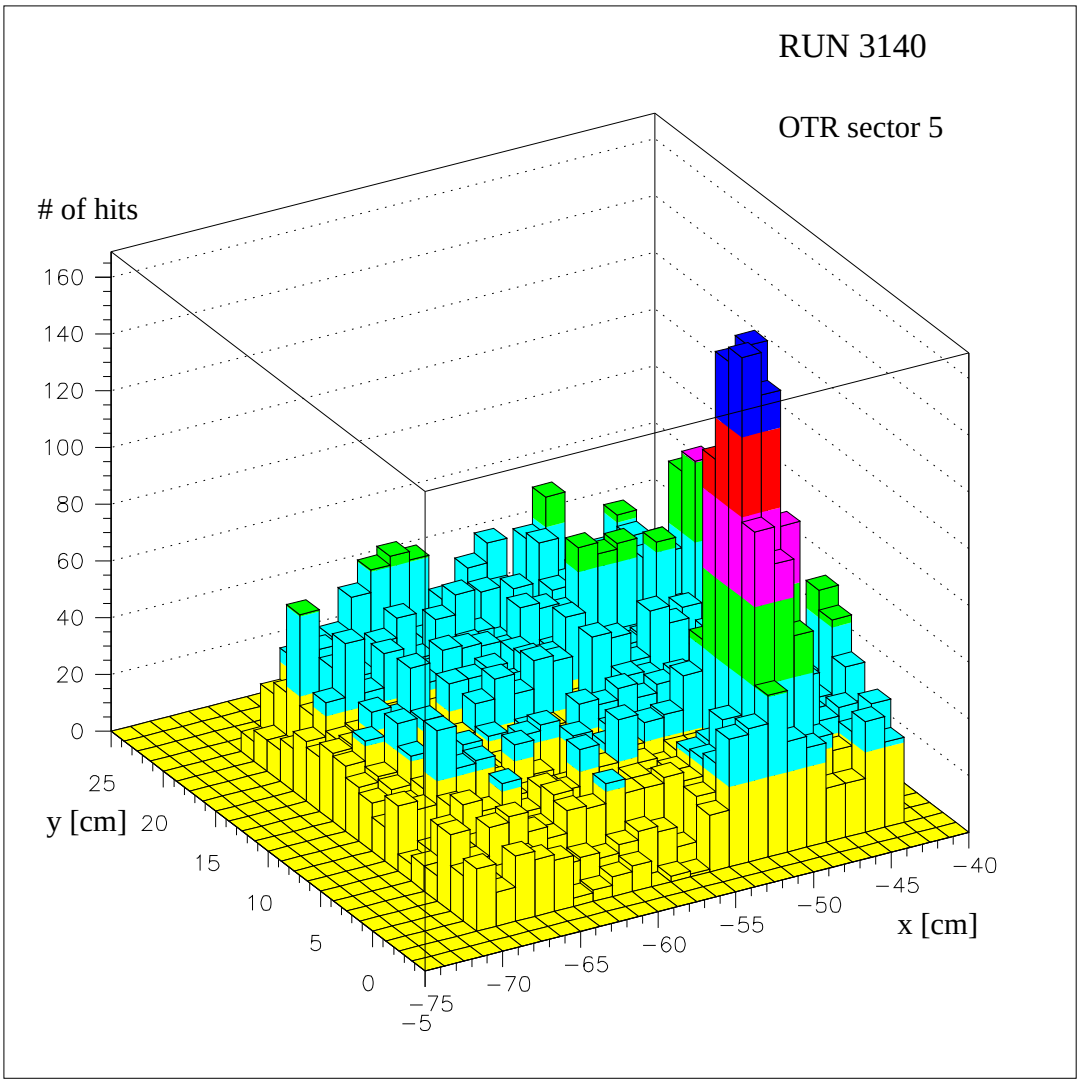




Reconstructed Hits

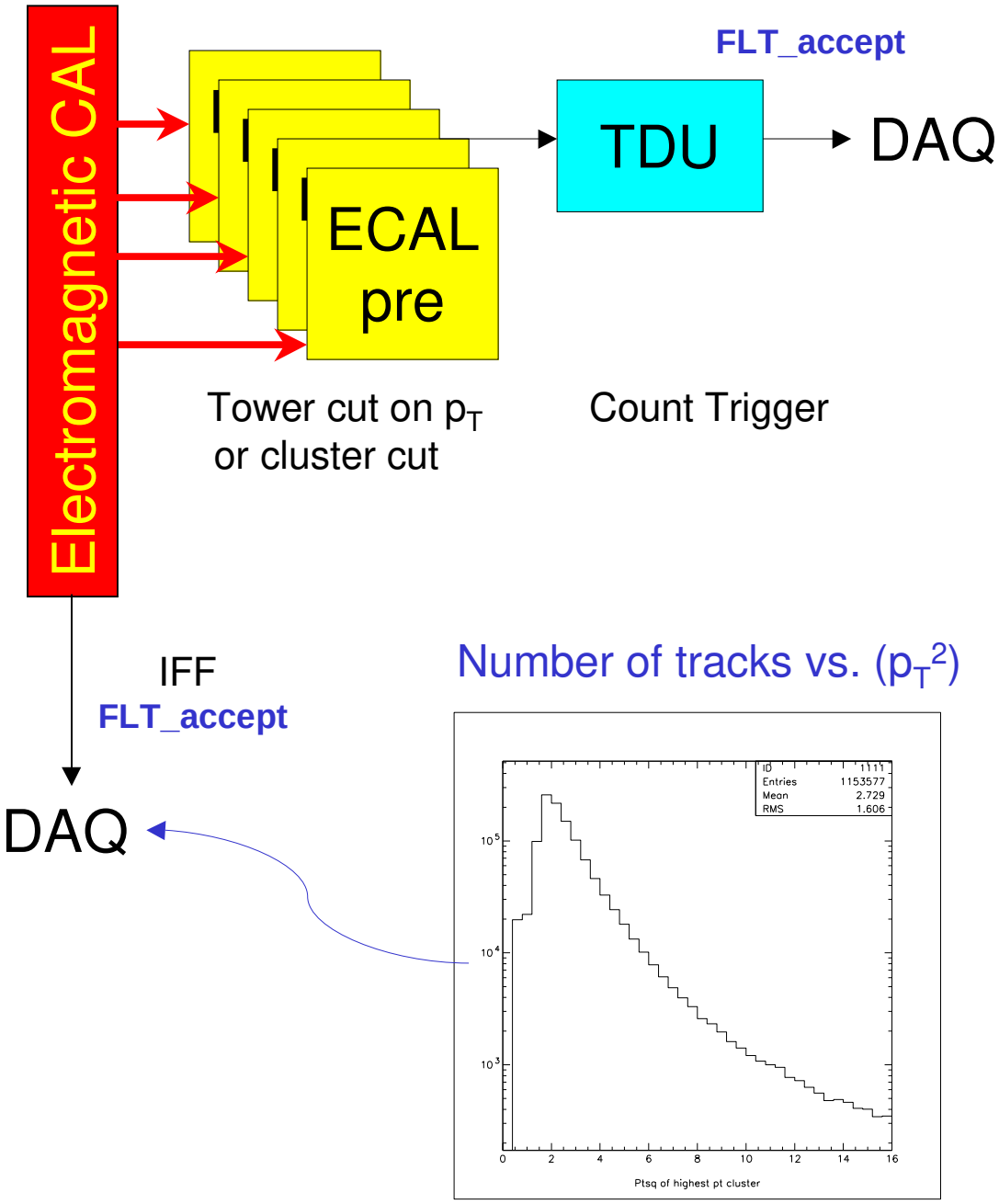
(in offline data)

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



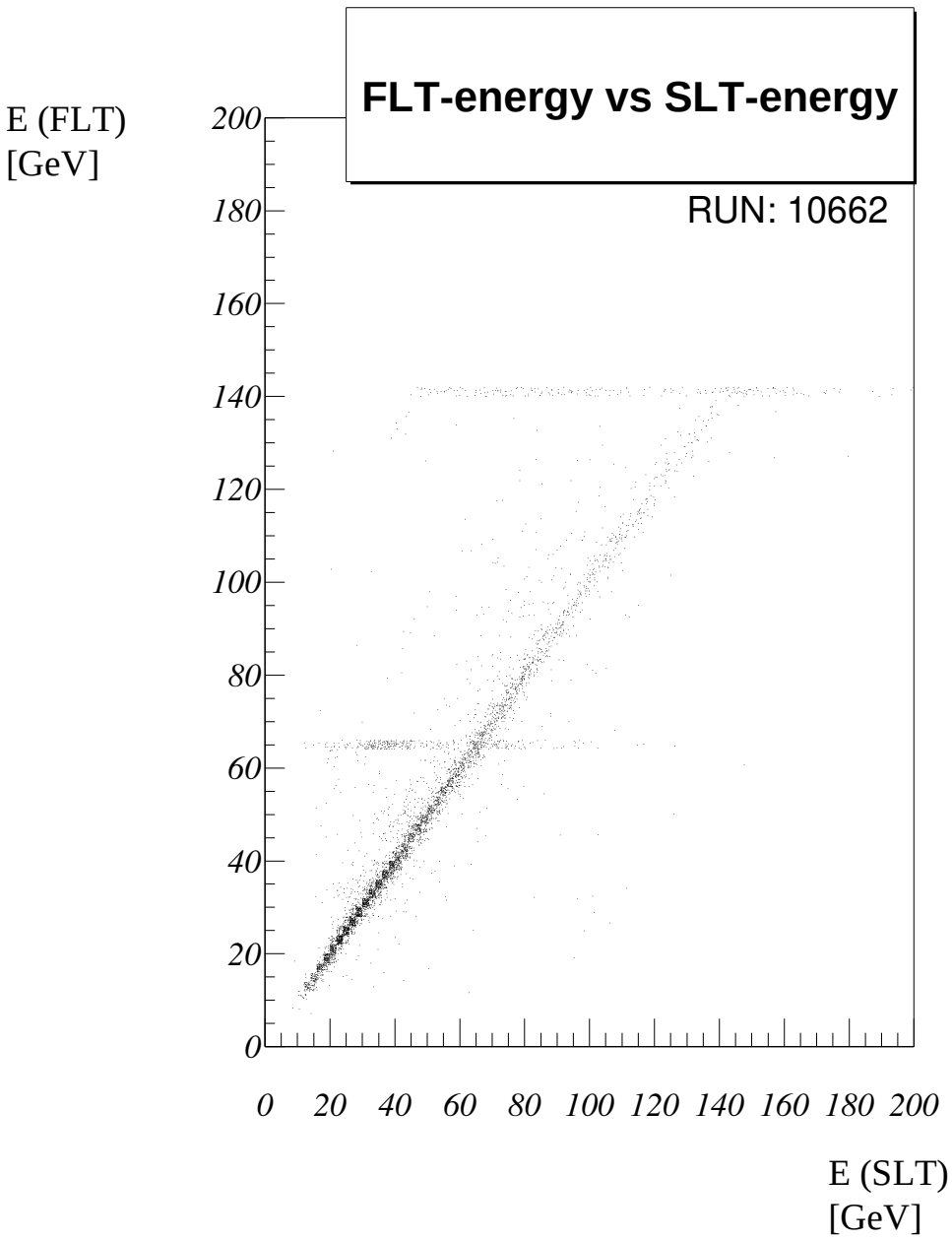
Provide physics trigger

Trigger decision is based on energy measurements of the **electromagnetic calorimeter**



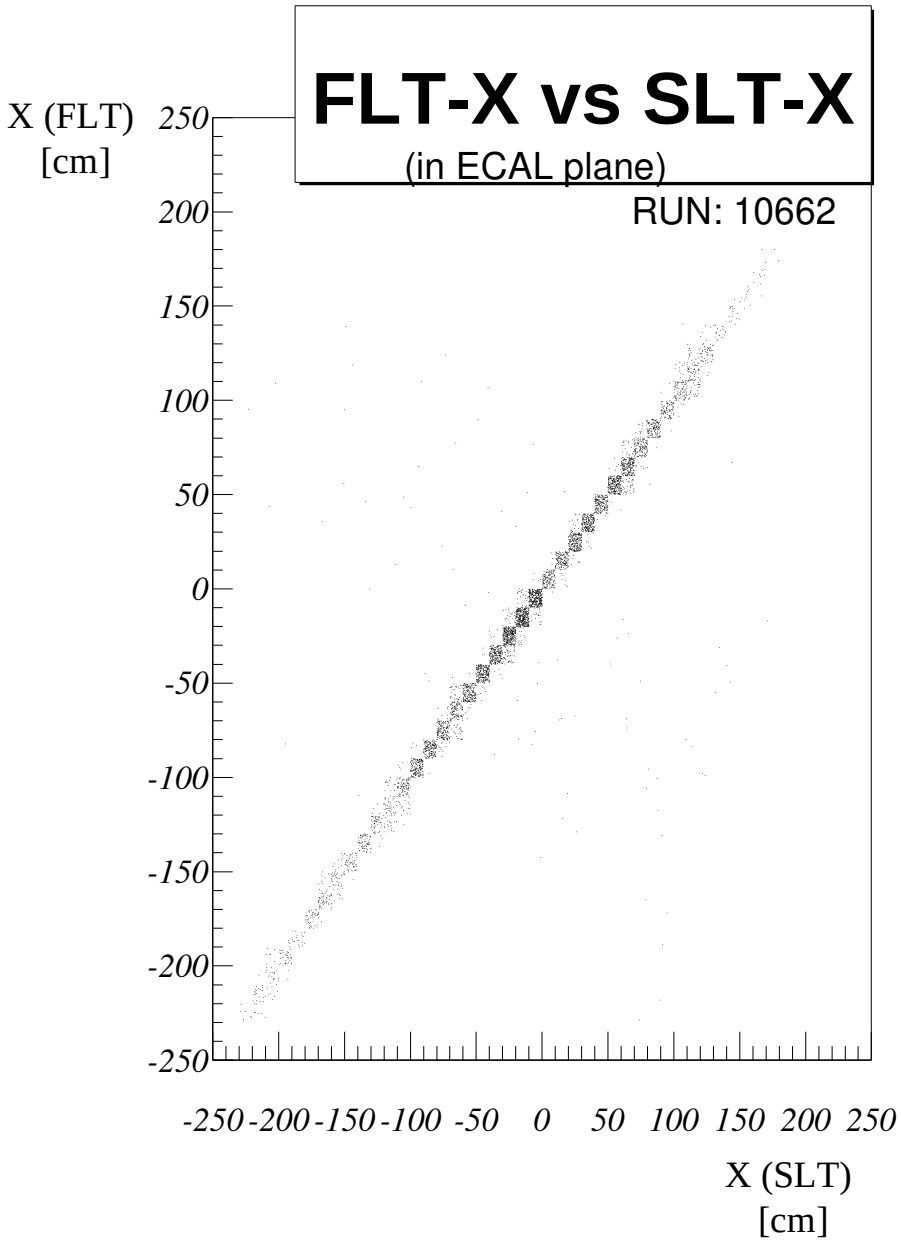
FLT data vs. DAQ data

Highest ECAL Energies

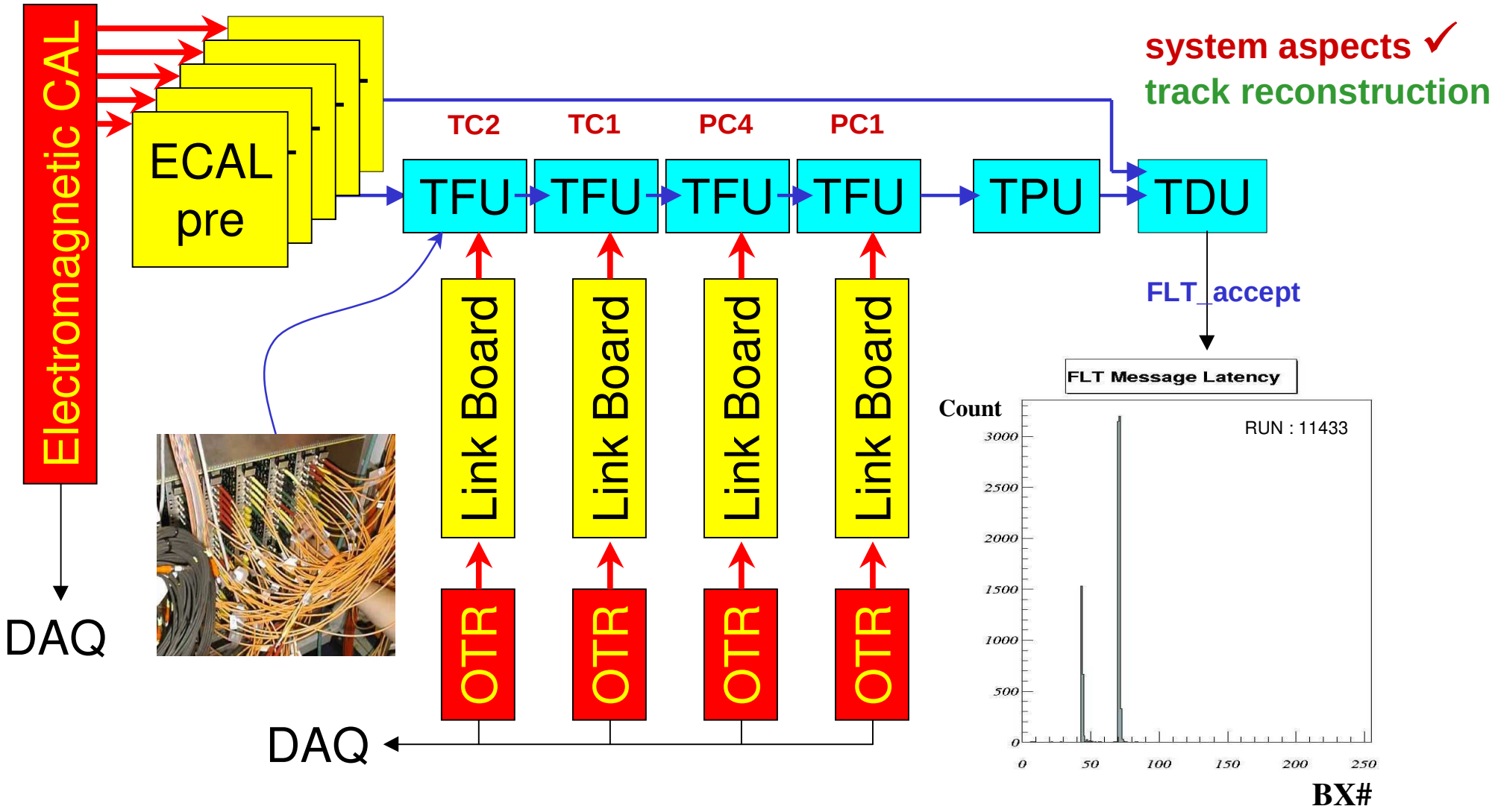


FLT data vs. DAQ data

ECAL Position



Next: Four in a Row



Summary & Outlook

- **Series production** of electronics almost **finished**
- **Installation** of electronics at DESY **well advanced**
- **System** commissioning **under way**