



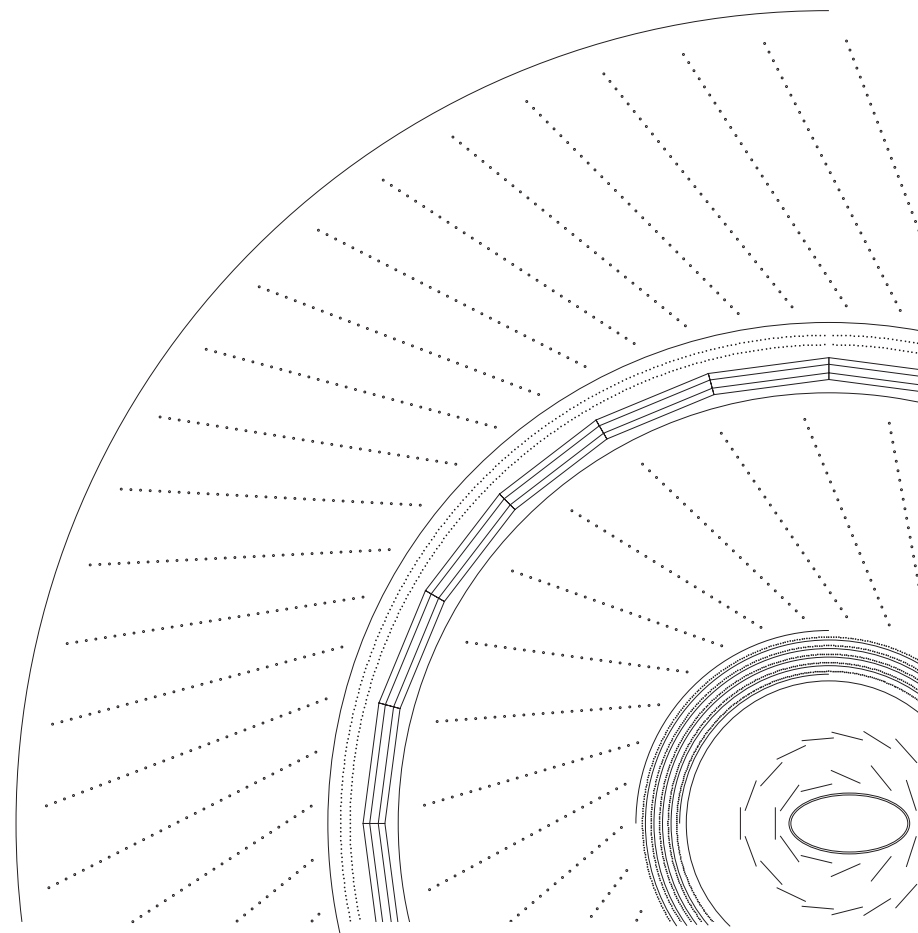
Commissioning of the Fast Track Trigger at H1



Universität Dortmund

Content:

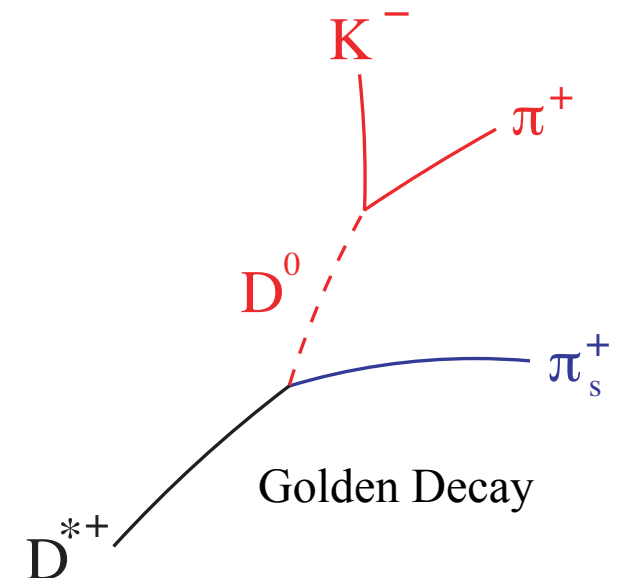
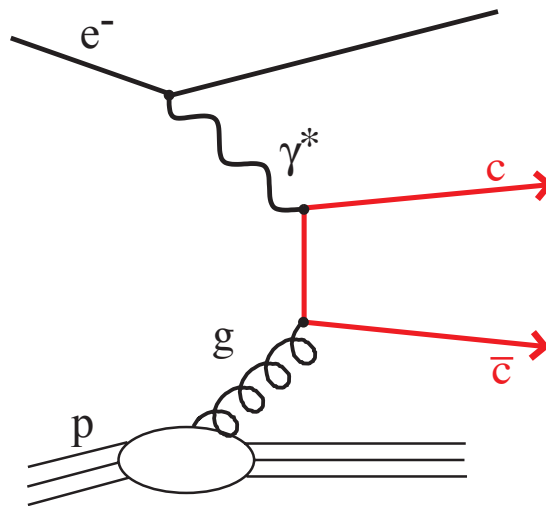
2. Motivation for the FTT
3. General Concept
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Motivation for the FTT

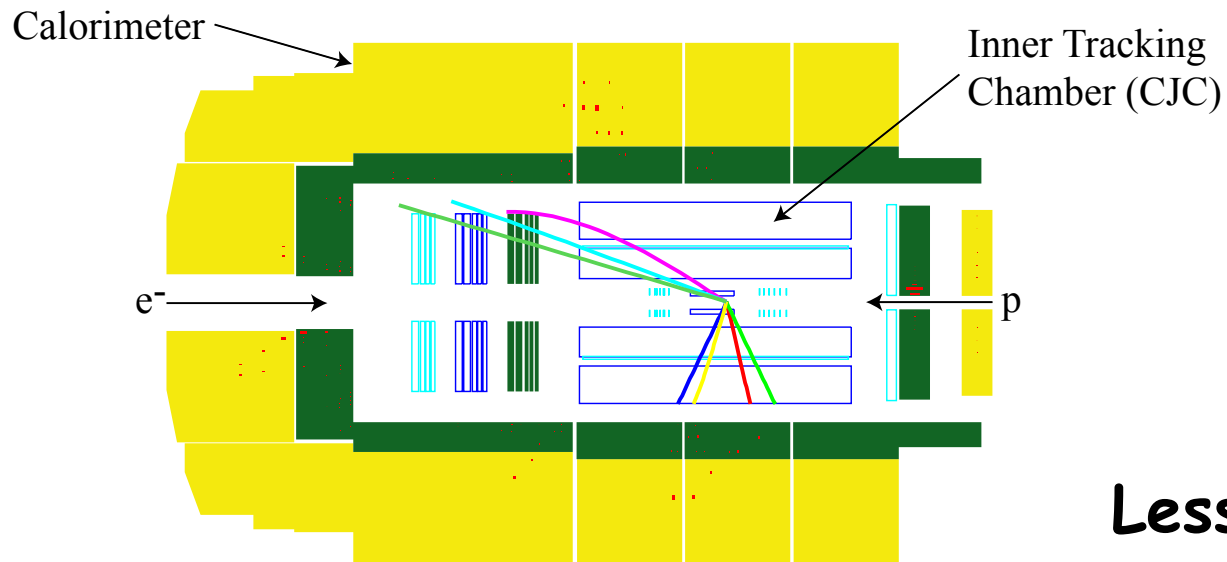
- HERA-Upgrade:
- 5-times **higher** Luminosity
⇒ Trigger selects from real ep-Events
 - Higher **Background**
- ep-Interactions with high p_t :
Current trigger still **fine**
 - Selection of exclusive final states
⇒ Need for the Fast Track Trigger

open charm
(e.g. D^*):



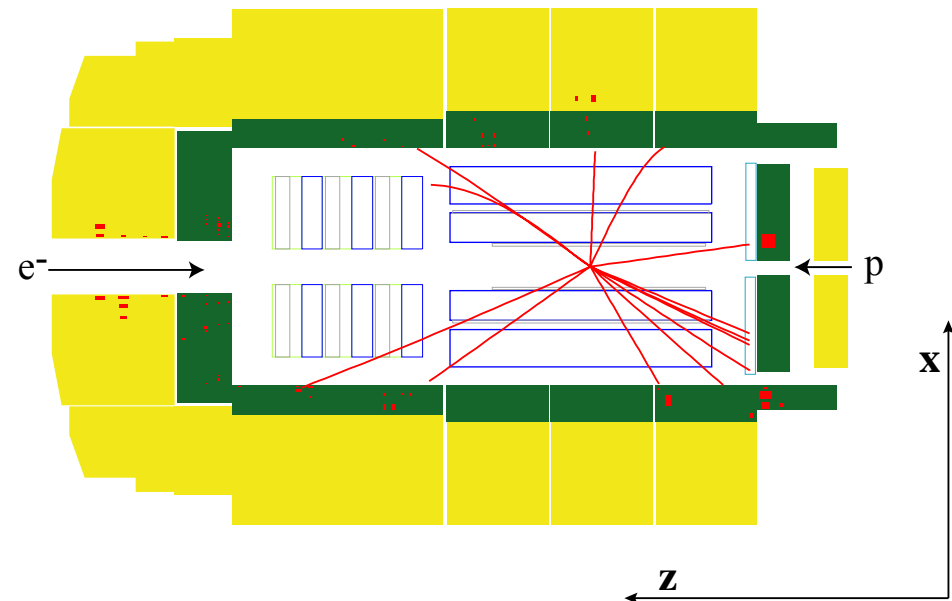
D*-Selection

D*-Decay

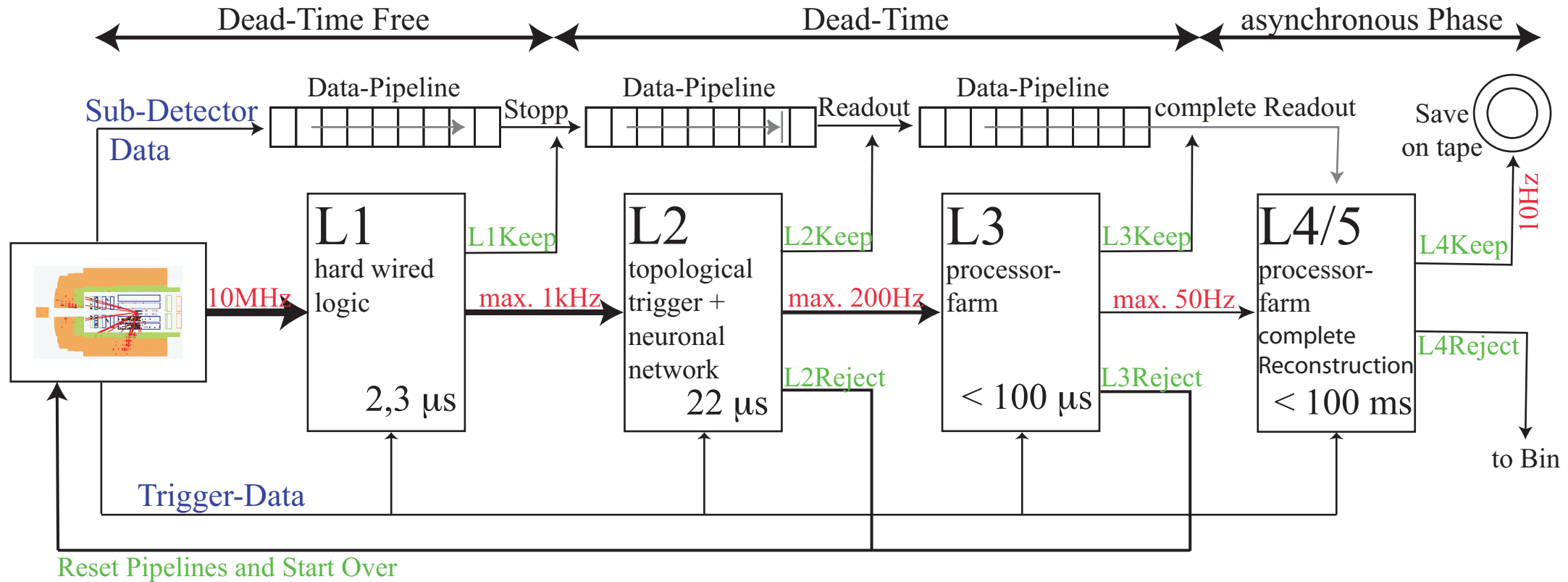


⇒ Track Reconstruction
on Trigger Level needed

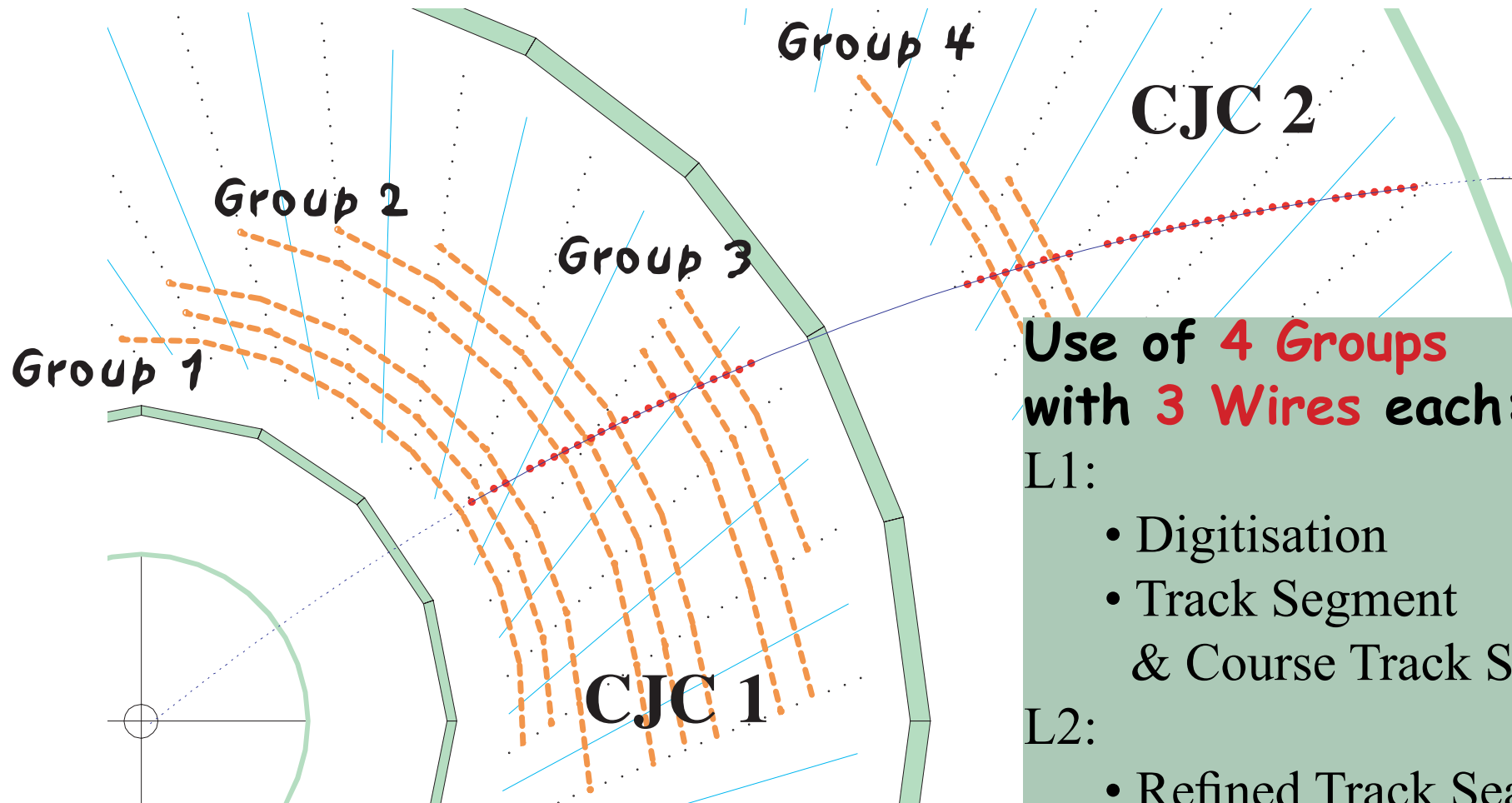
Less interesting Event



The Trigger System of H1



General Concept



Use of 4 Groups
with 3 Wires each:

L1:

- Digitisation
- Track Segment
& Course Track Search

L2:

- Refined Track Search
- 3-dim Track Fit

L3:

- Invariant Mass Calculations

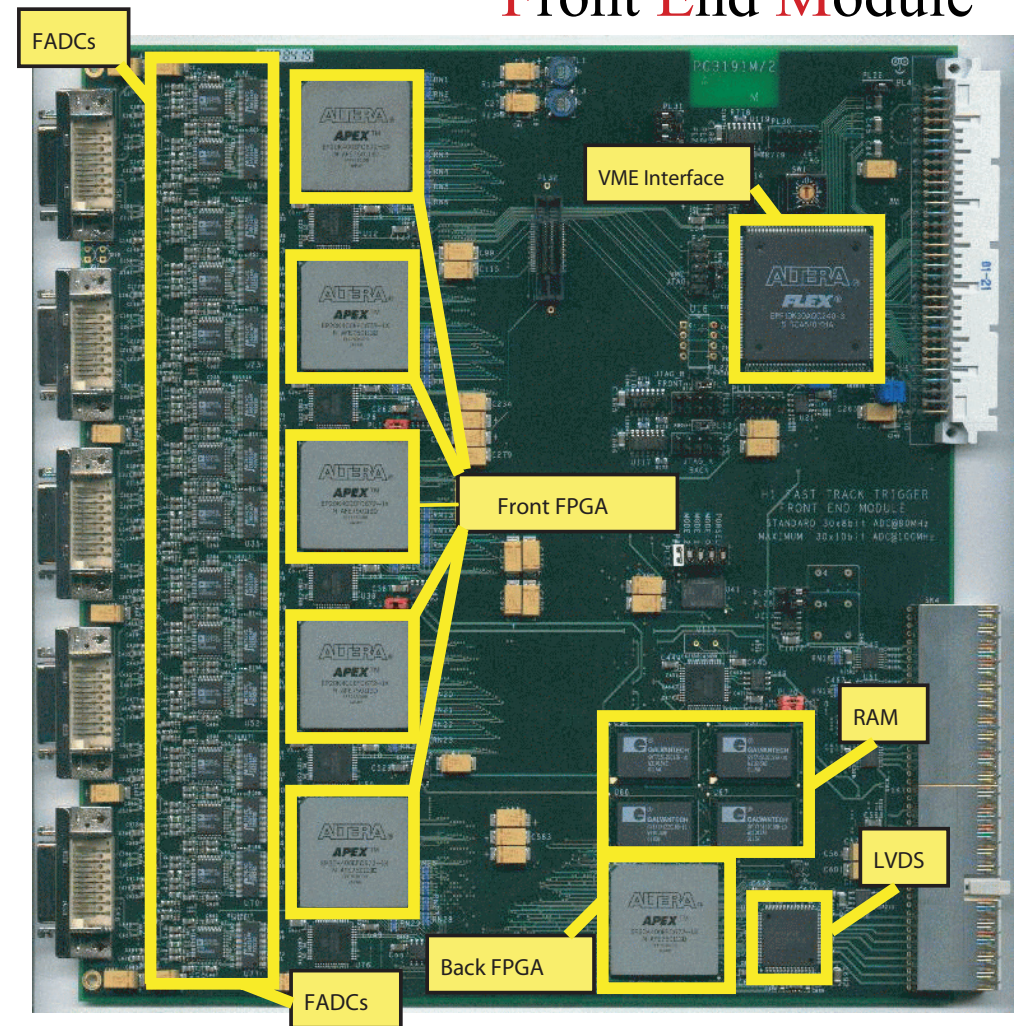
First Level ($2.3\mu\text{s}$)

- Digitalisation with 10bit at 80MHz
- Online hit detection (input bandwidth 90 Gbit/s)
- Track segment finding:
460.800 masks &
 5×10^{12} mask comparisons per second
- Coarse linking of segments to tracks in transverse plane (60×16)

L1 Trigger decision based on:

- transverse momenta
- multiplicity and topology of tracks
- z-Vertex

Front End Module



Second Level (22 μ s)

On ,L1-Hardware':

- Track-Segments search at higher resolution
- Fine granularity track search (histogram: 60x640 Bins)
- Data-Transmission to MP-Board via
5 GB/s LVDS-Links

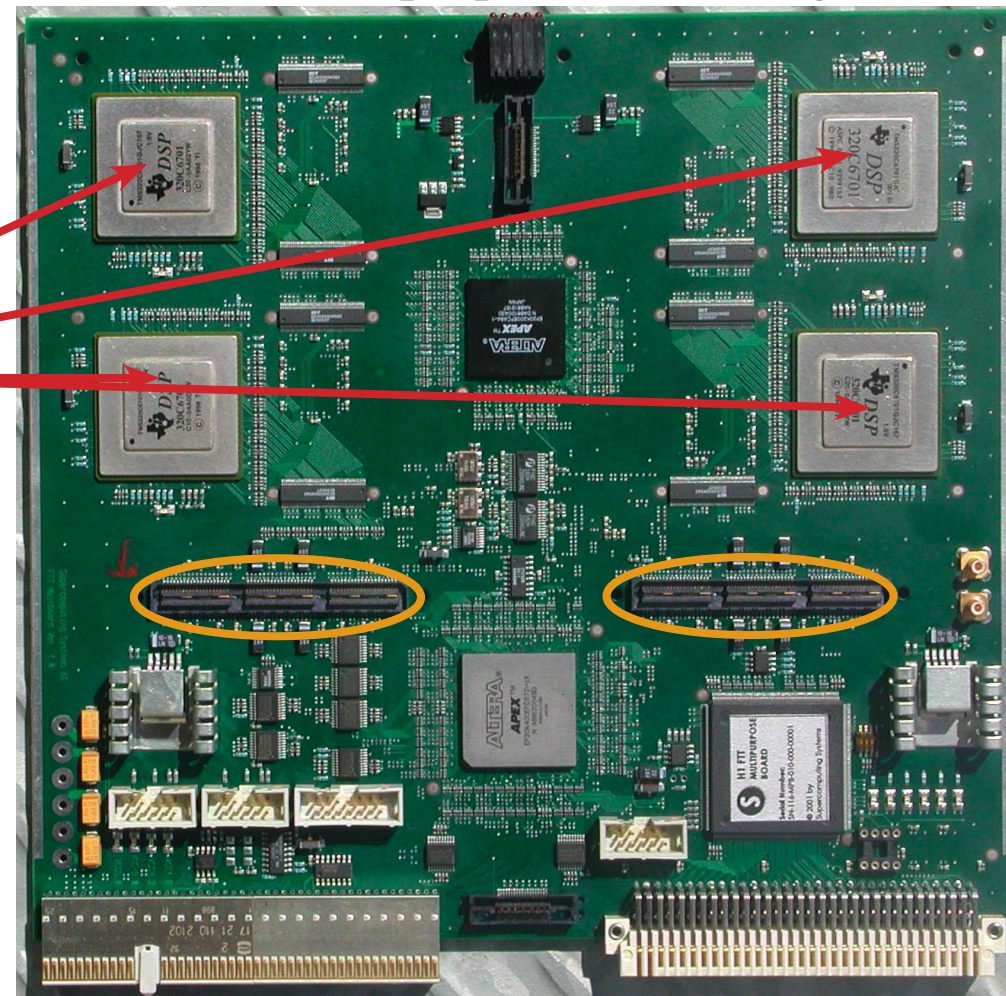
On ,L2-Hardware':

- Custom made
- Use of 6 MP-Bords with 4 DSP's each
- Each DSP: 2 Fit in 3 Dim.
- Altogether 48Fits

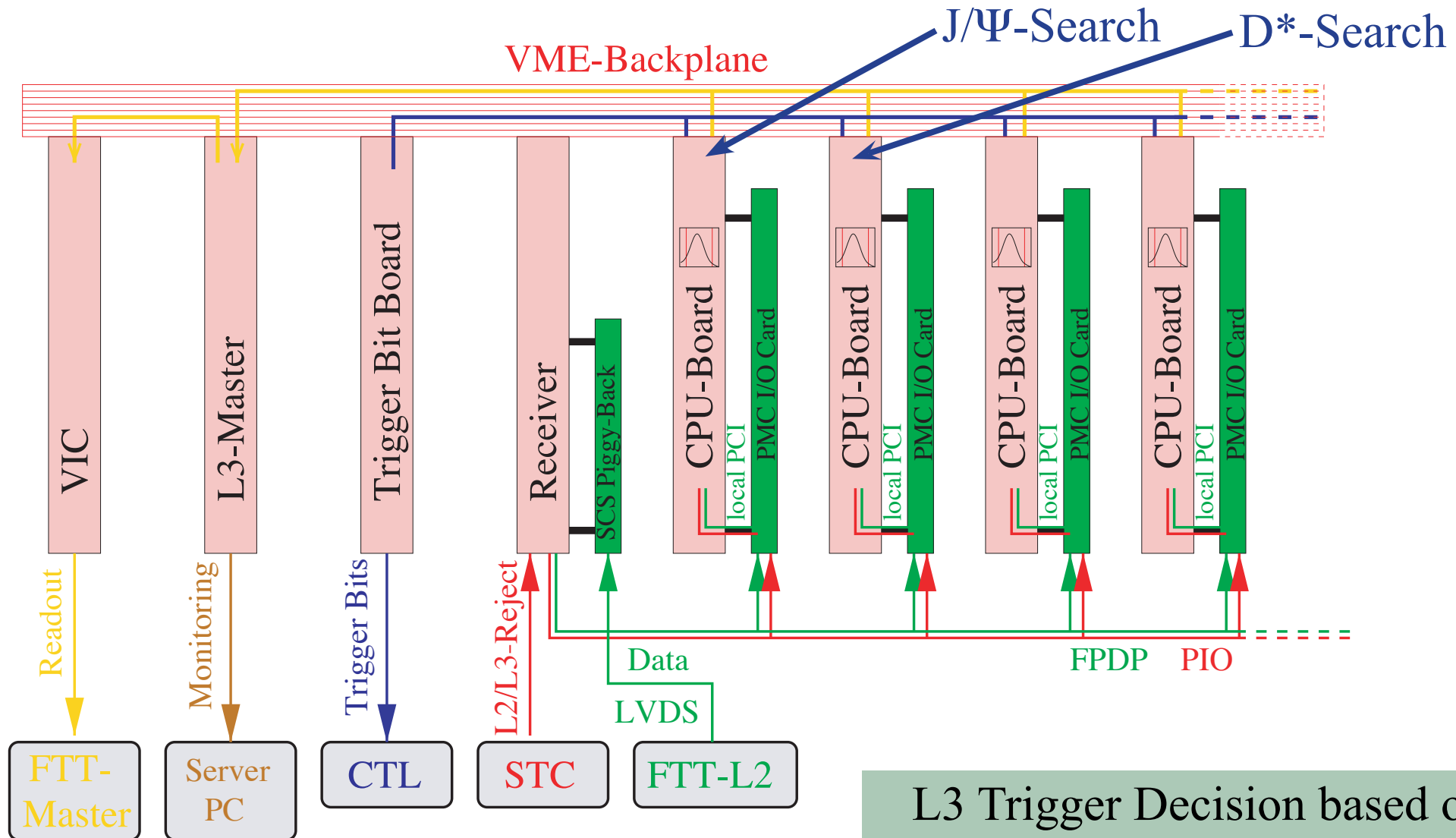
L2 Trigger Decision based on:

- High resolution 3d track-parameter
- Precise topologies

Multipurpose Processing Board



Third Level (100 μ s)



L3 Trigger Decision based on
Track Topologies and inv. Mass

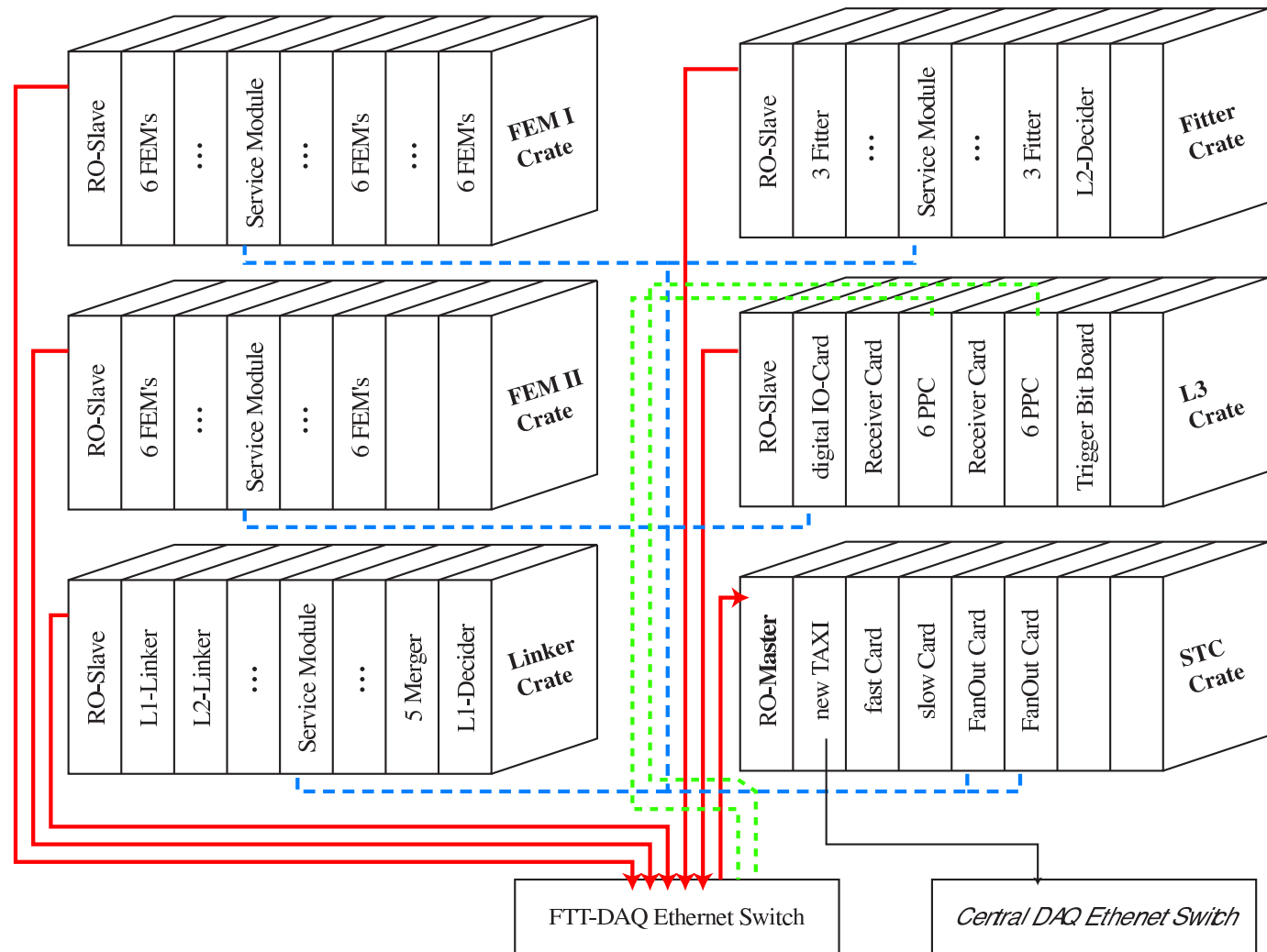
Readout System

- Timing: Deadtime of H1 must be below 10%
=> Readout Time: less than ~1.3ms

- Readout of 6 VME-Crates
=> Overall ~ 80 VME-Cards
- Fast signal transmission via differential TTL
- Data transmission via Ethernet (TCP/IP)

Main idea: split readout:

-) sync-Part: data collection within each crate
-) async-Part: data transmission via RoMaster to Central Data Acquisition



Synchronous Readout

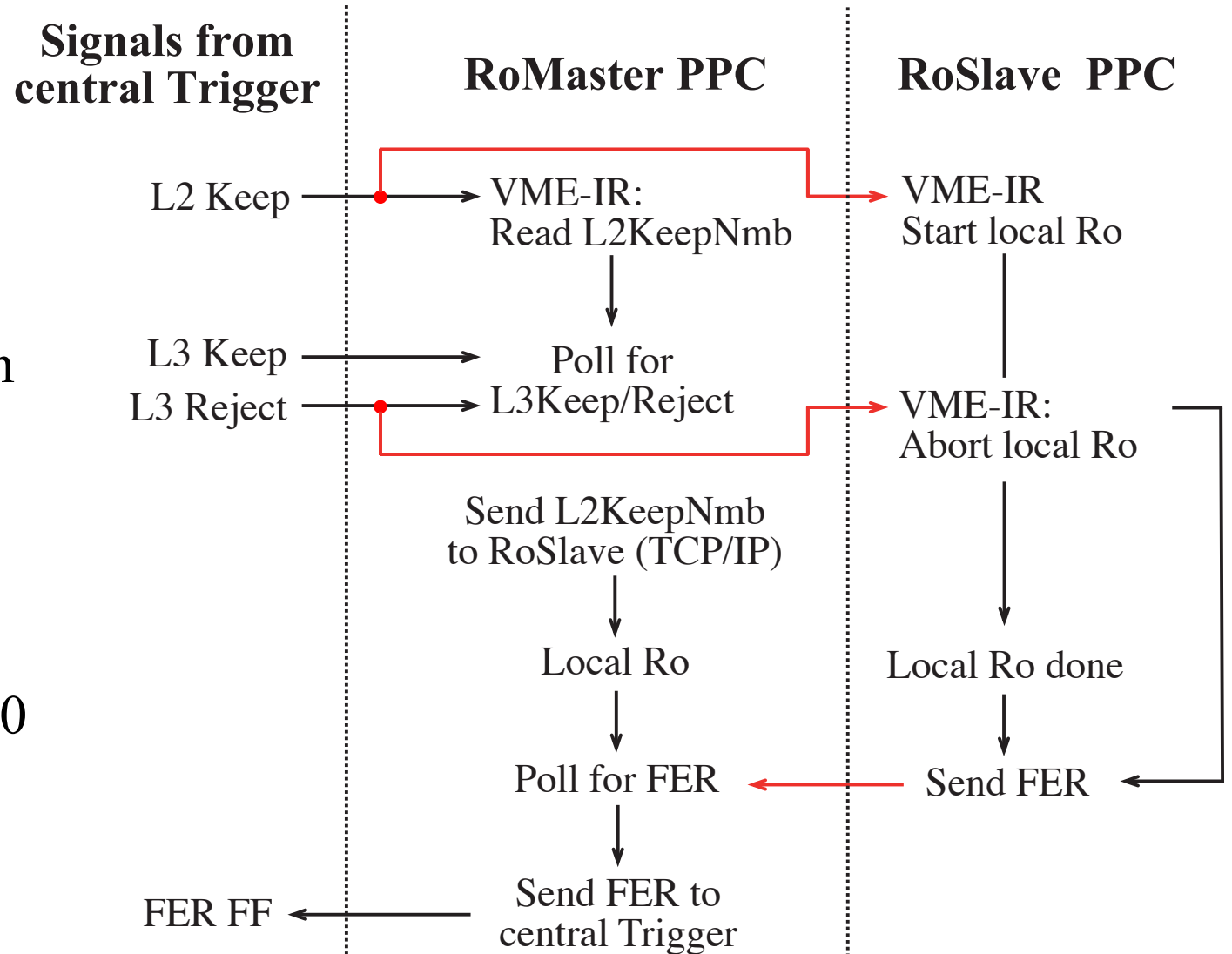
Problem for Design:

- 2 Lines to RoSlaves PPC
- 1 Lines from RoSlaves

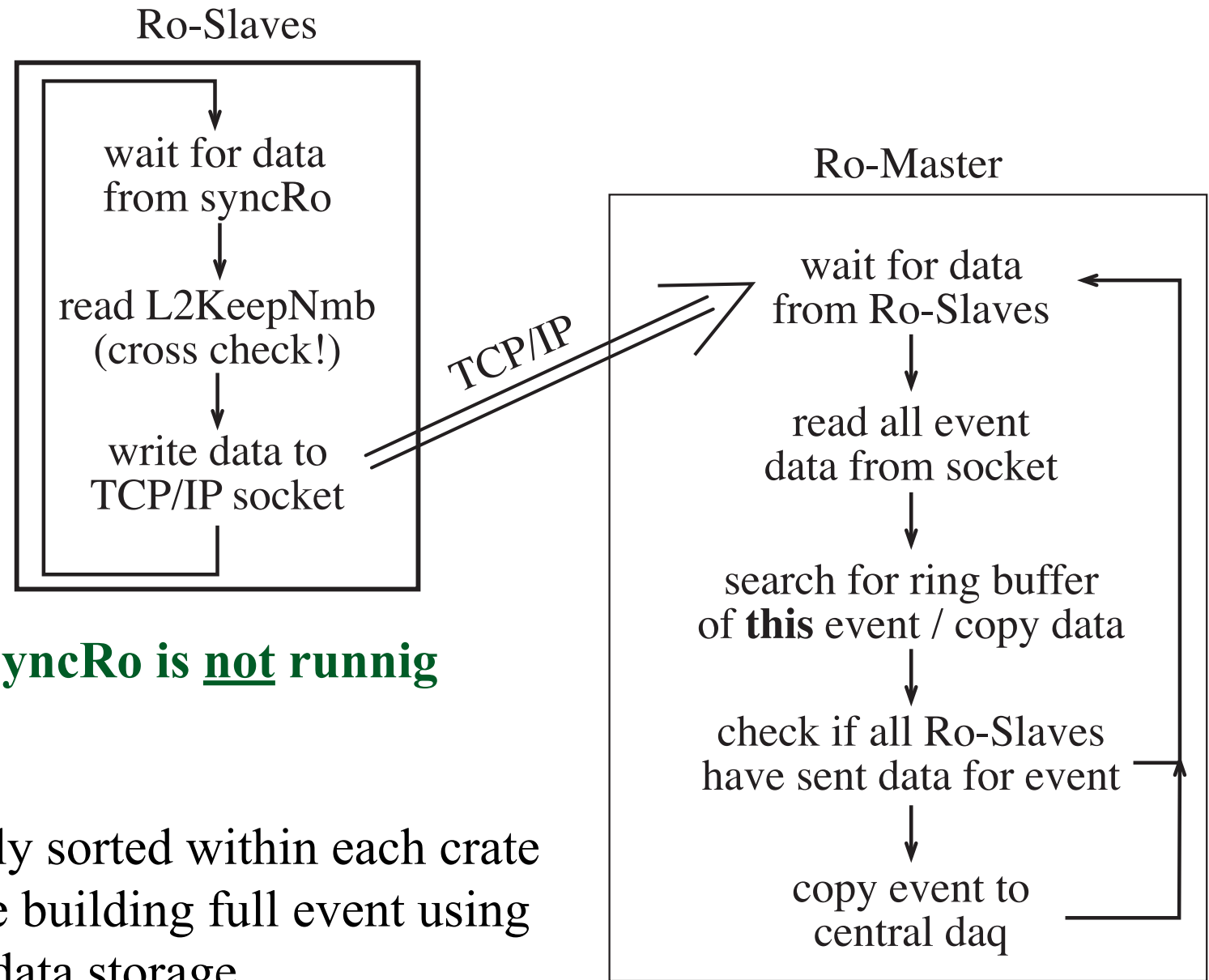
=> nearly no communication between RoSlaves and RoMaster

PowerPc:

- Motorola: mvme2400
- G3 with 350MHz
- 32 MBytes Ram
- OS: vxWorks 5.5
- <10 μ s interrupt latency



Asynchronous Readout



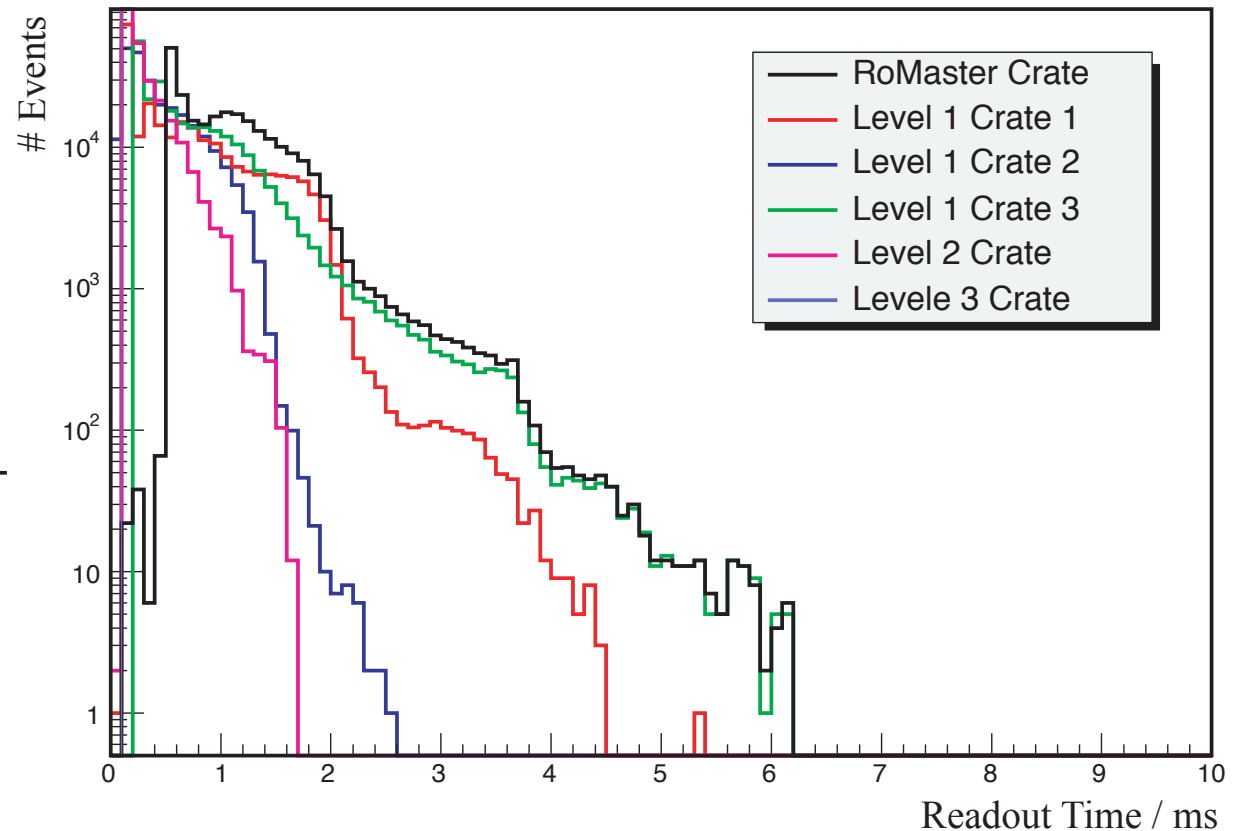
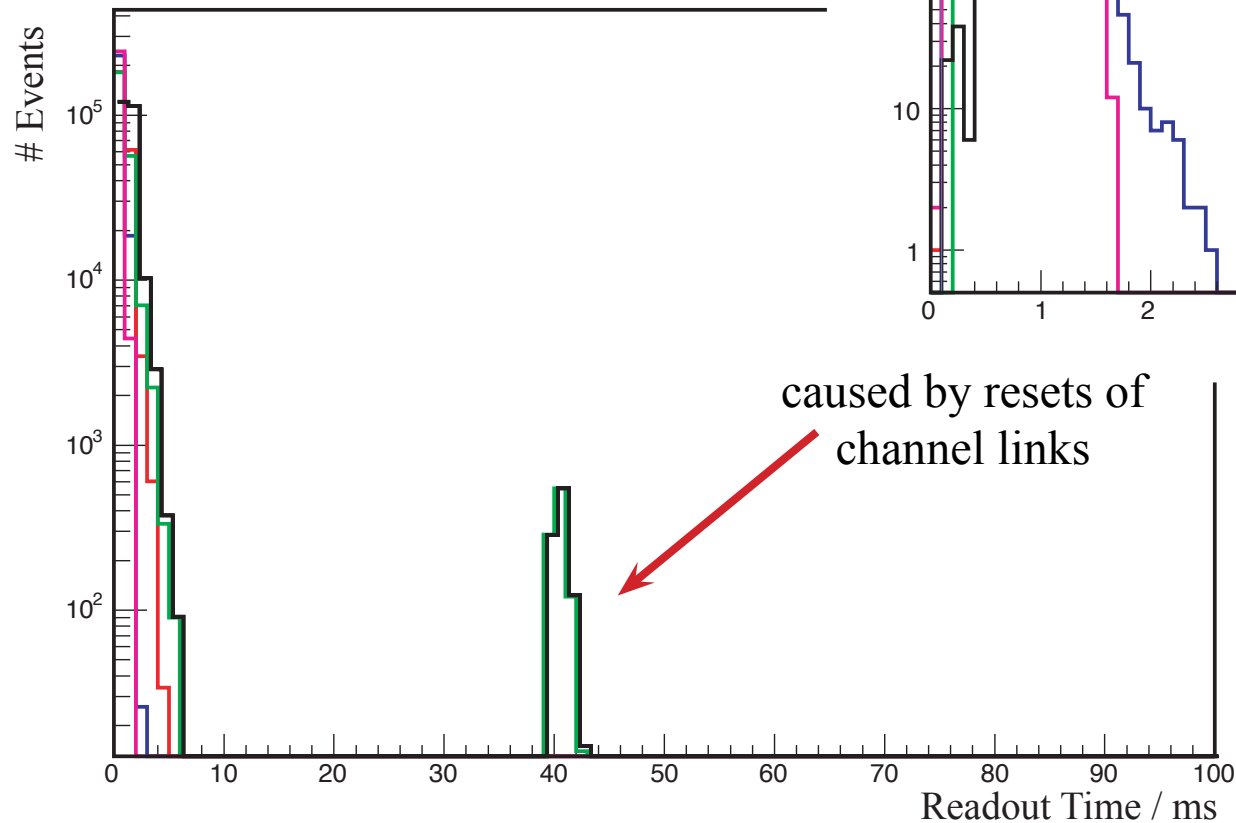
- runs only if the syncRo is not running

RoMaster:

- incoming data only sorted within each crate
=> sort data before building full event using ringbuffer for data storage
- consistency check of data

Readout Response Time

- average time $\sim 1.2\text{ms}$
- tails caused by two crates
- reduce data volume (only needed during commissioning)



Status of the FTT: L1

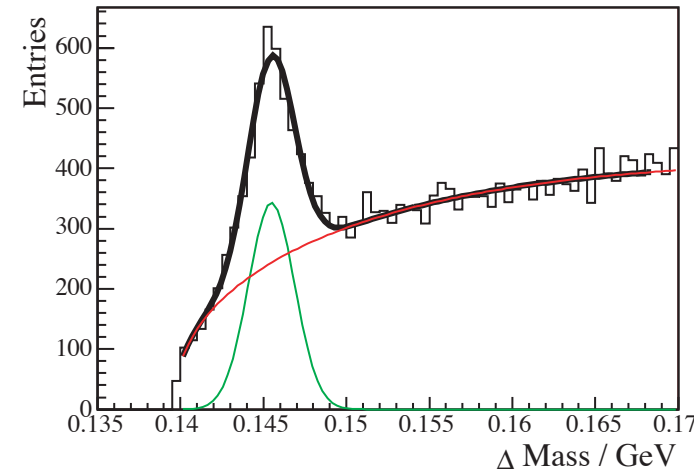
FTT-L1 fully operational:

- since beginning of year
- replaced old track trigger
- $\sim 50\%$ of all triggers based on FTT
- high efficiency and rate reduction

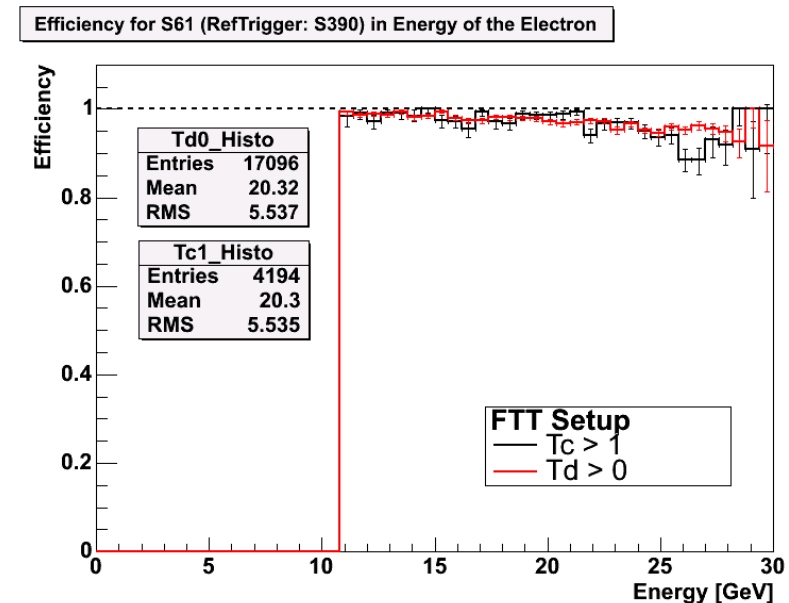
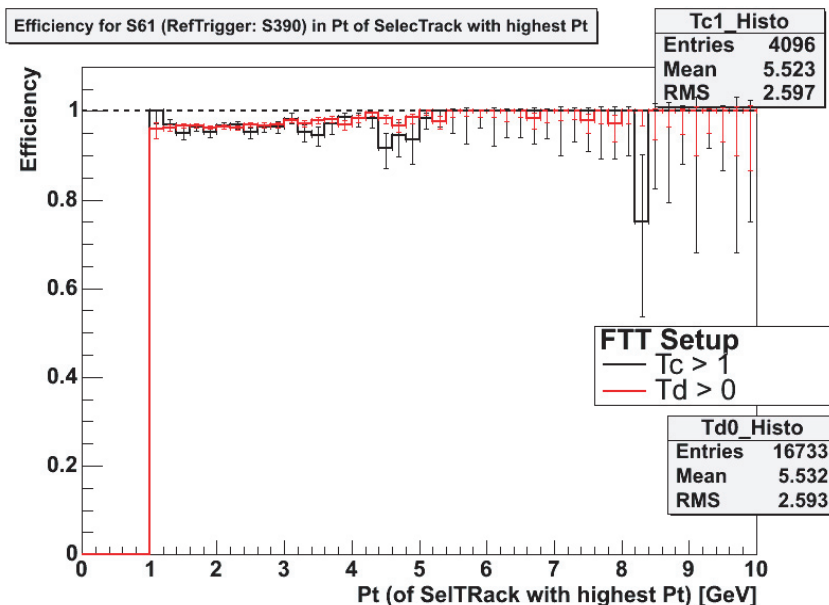
e.g. D^* -Decay: $D^* \longrightarrow D^0 \pi_{\text{slow}}$

A diagram showing a horizontal line representing a particle. A vertical line drops from the center of this horizontal line, and a diagonal line goes down and to the right from the same point. The diagonal line is labeled '60%'.

$\searrow \text{K} \pi$



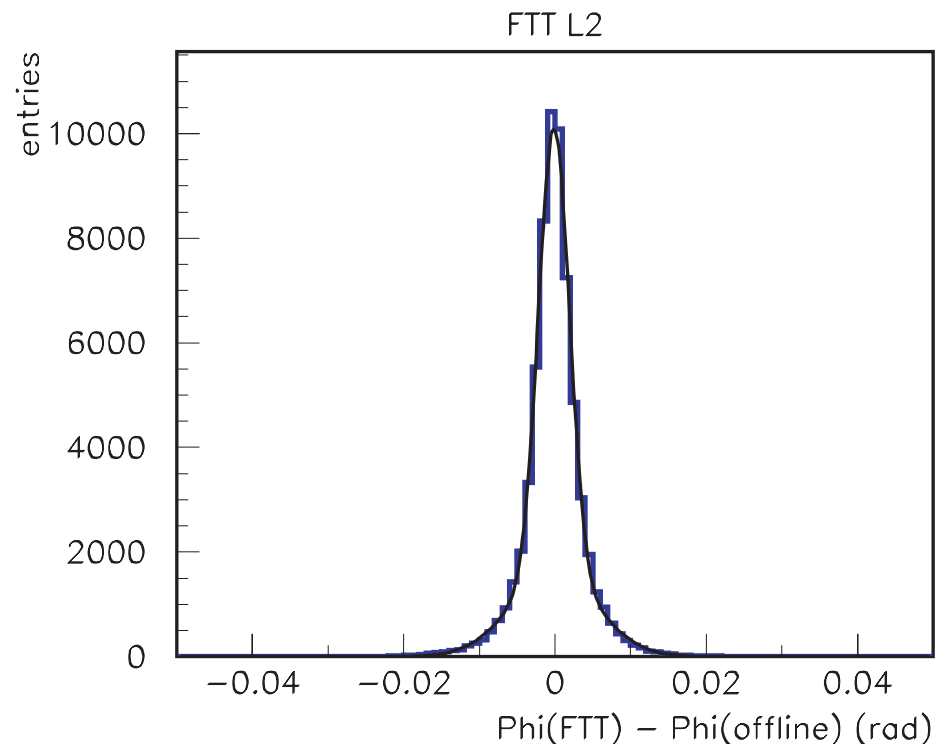
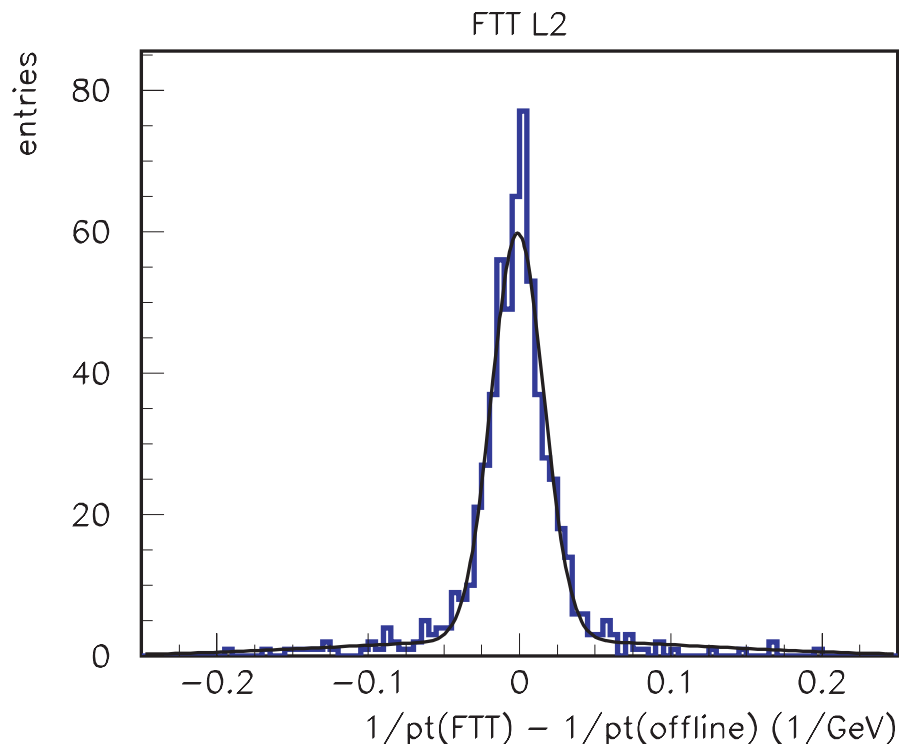
Selection via: $\Delta M = M(K \pi \pi_{slow}) - M(K \pi)$



Status of the FTT: L2

FTT-L2:

- commissioning nearly finished
- reached design resolution in
 - $1/p_t = 2\%$
 - $\phi = 2\text{mrad}$
- θ resolution not quite there
- connection to central trigger set up
- first test triggers active
- ready before end of this year

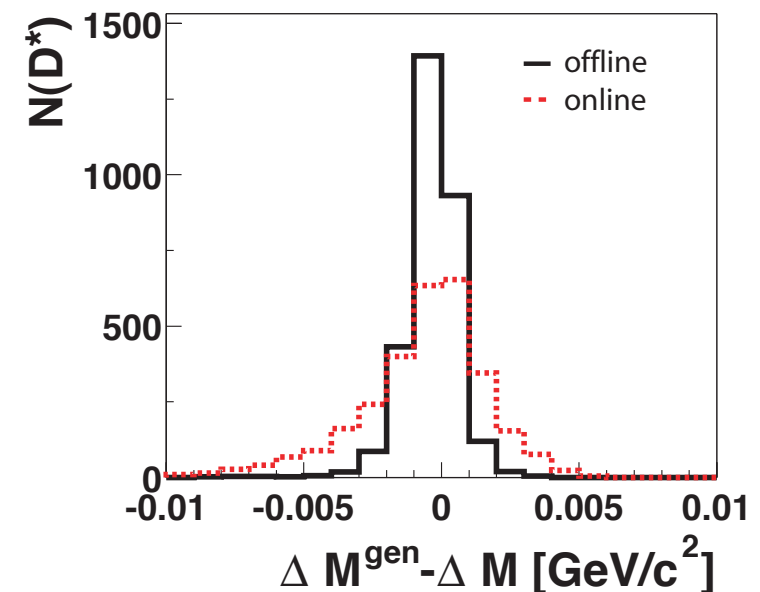
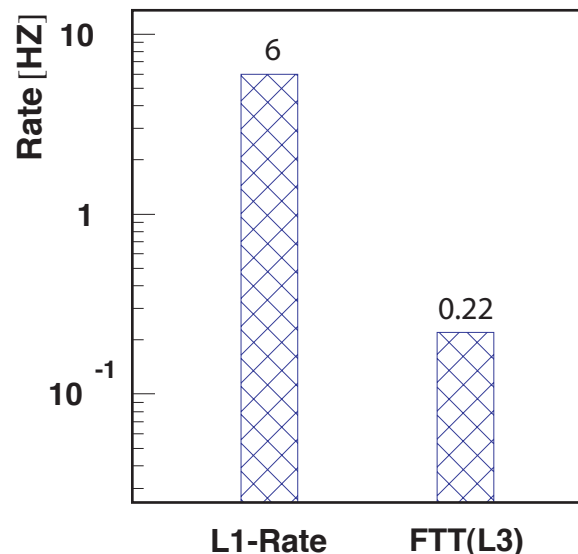


Status of the FTT: L3

- hardware installed
- data transmission within L3 tested
- test-data transmission from L2->L3 works fine
- event selection for two exclusive channels exists and is tested
- some readout code missing
- transmission of real data needs to be established

Aim:

- Setup L1, L2 & L3 to trigger exclusive D^* -Events



Summary

three Level FTT-Concept:

- 1st Level: 2dim tracks
- 2nd Level: High resolution 3dim. tracks
- 3rd Level: Track based topologies & inv. masses

actual Status:

- readout system is stable and fast enough
- 1st Level is working efficiently and stably
- D*-data is coming in and looks very promising!
- commissioning of L2 & L3 until end of this year

future Plans:

- setup D* using all 3 FTT layers
- analyse this data