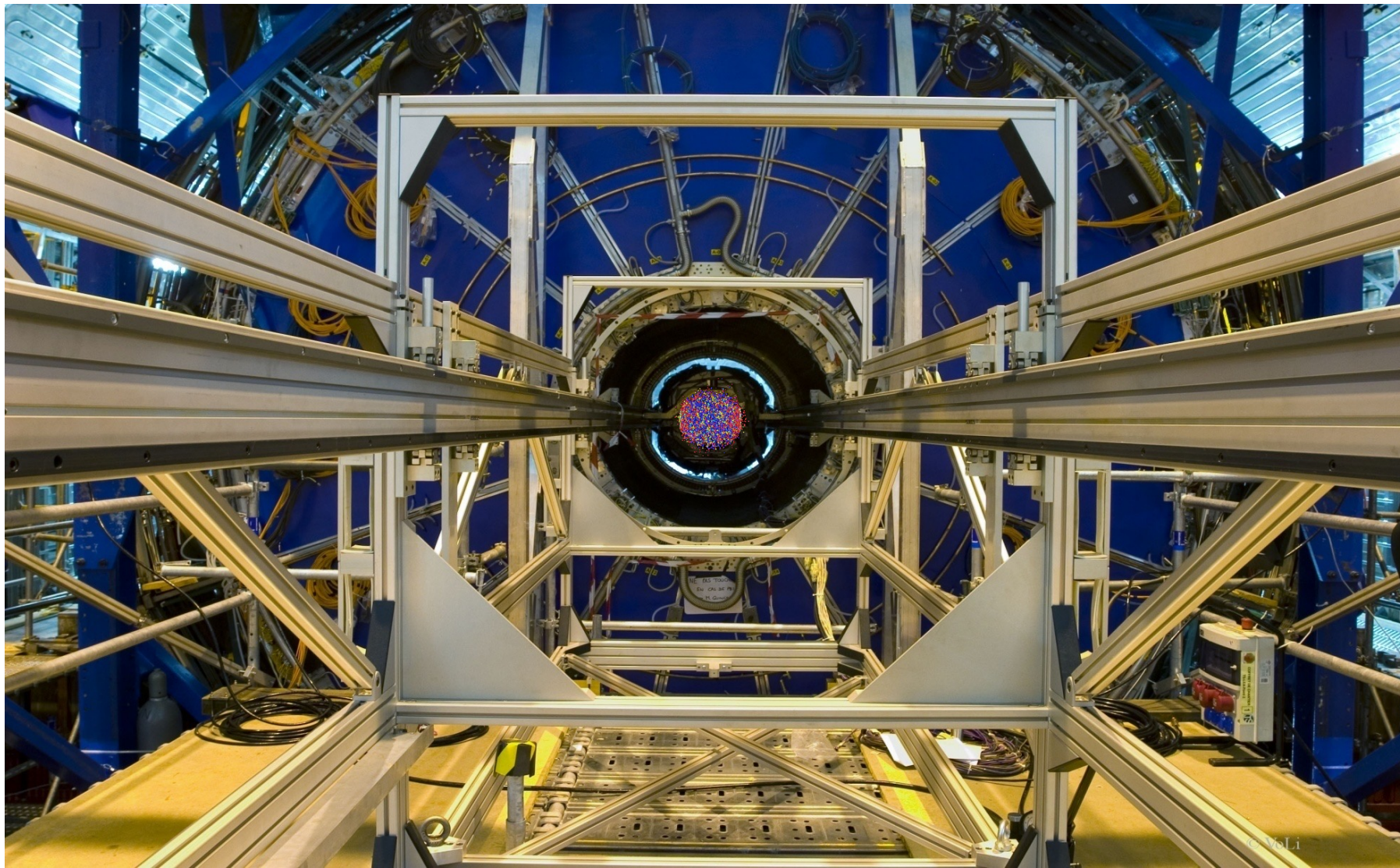
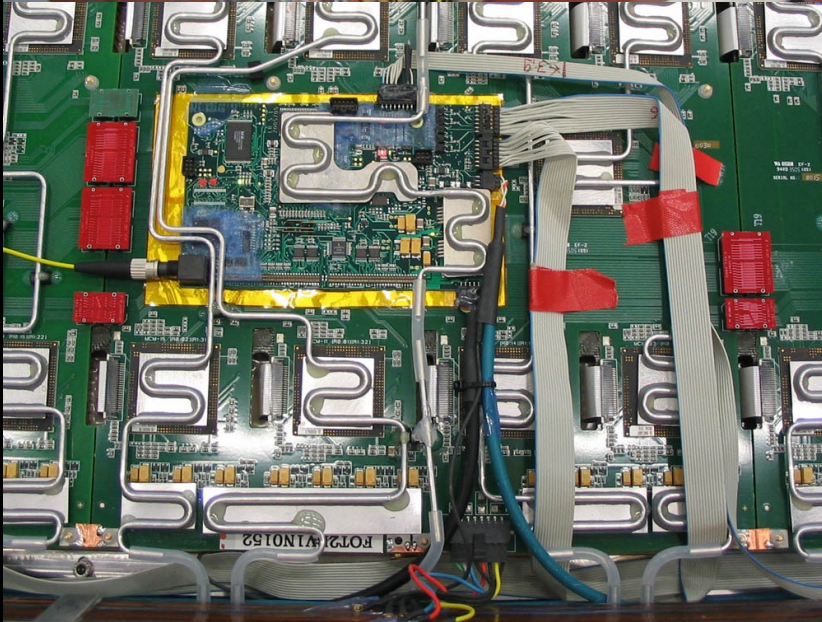
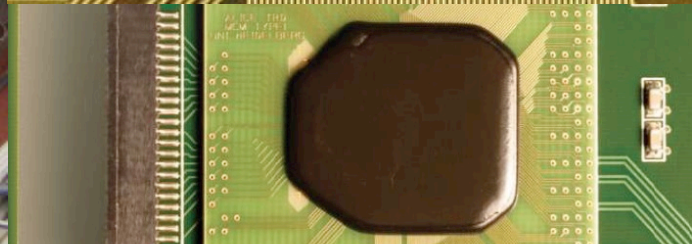
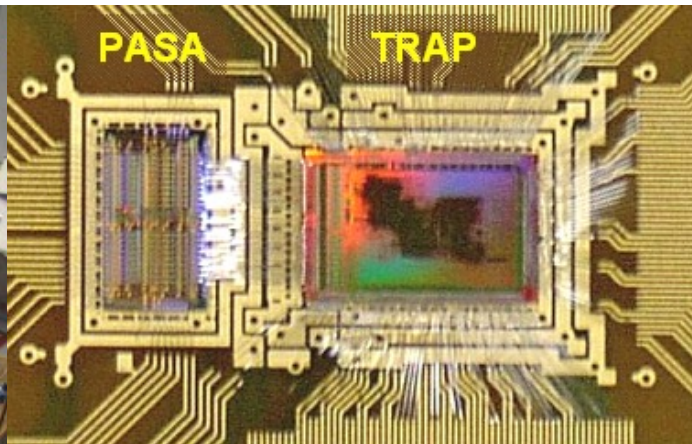


**On occasion of 80th birthday of
Peter Braun Munzinger**

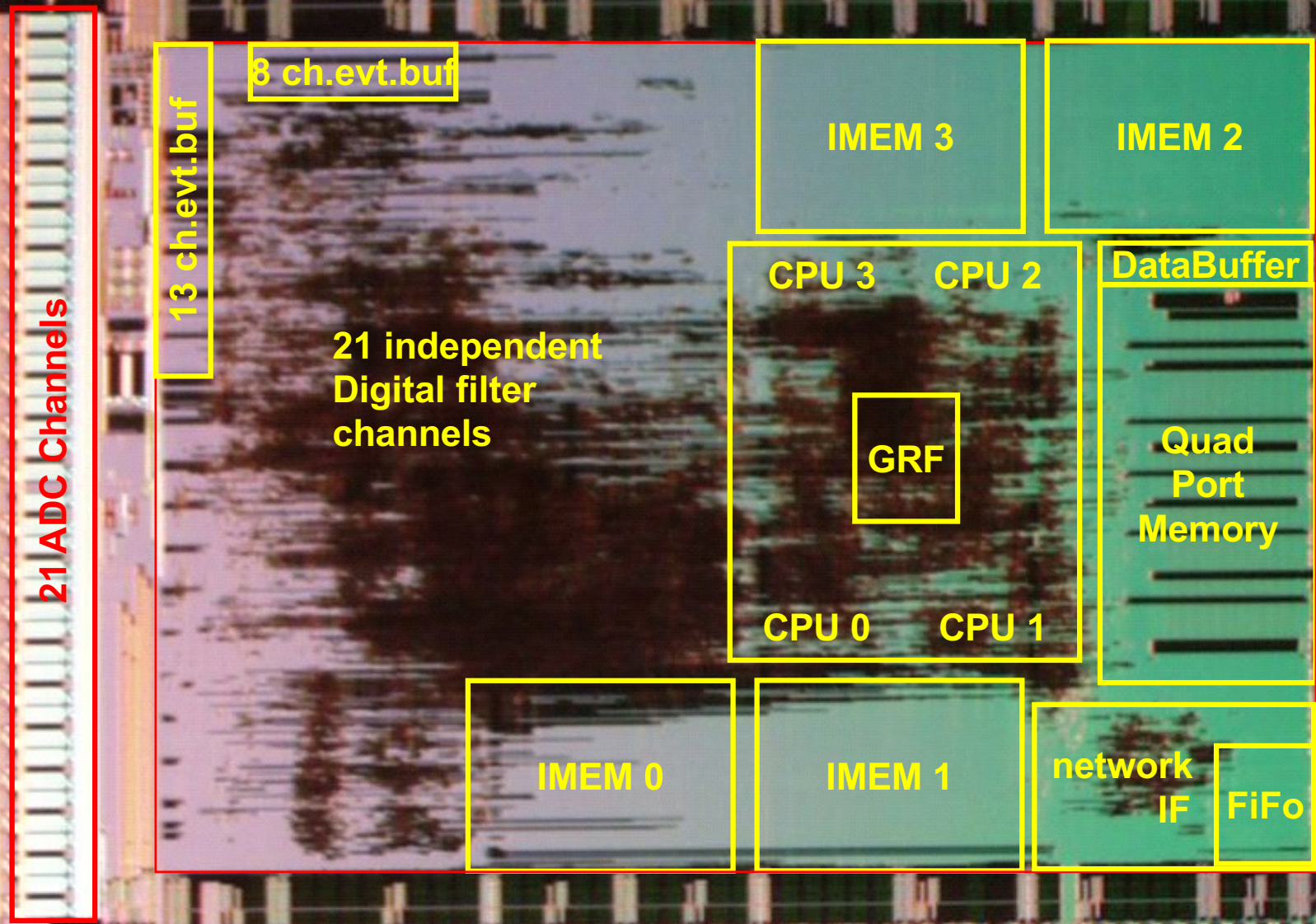


Online event processing in ALICE

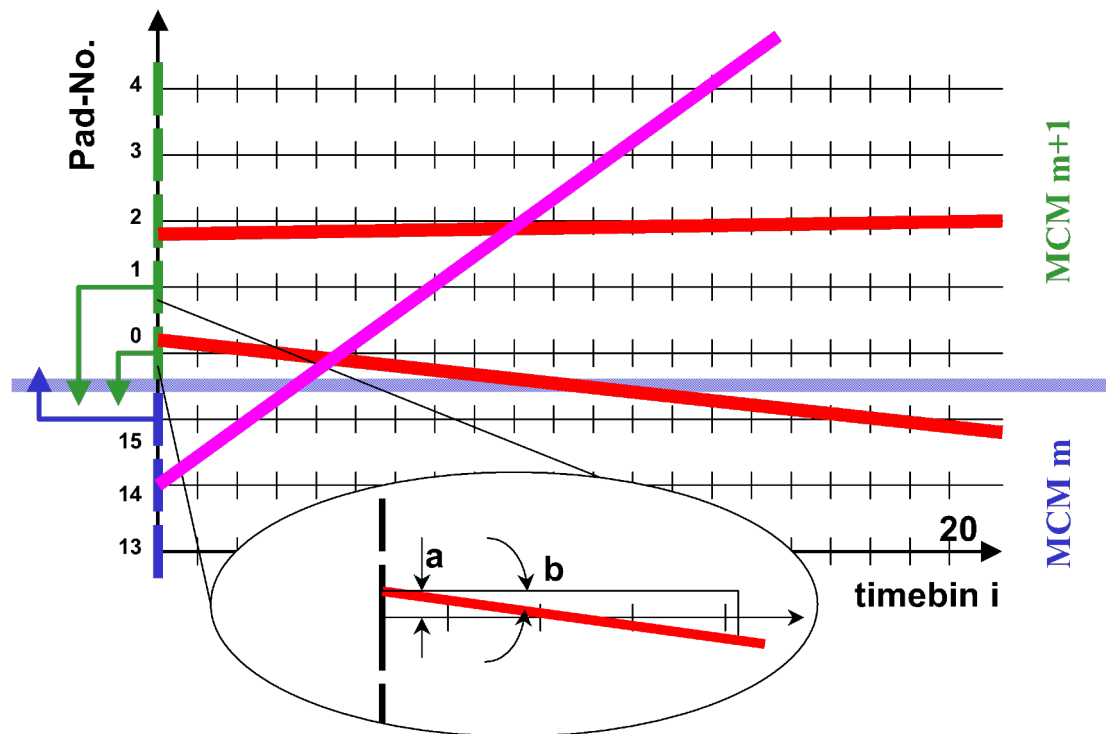
Prof. Dr. Volker Lindenstruth
FIAS, IfI, LOEWE Professor, CERN
Chair of HPC Architecture
University Frankfurt, Germany
GSI Helmholtzcenter
Phone: +49 69 798 44101
Fax: +49 69 798 44109
Email: voli@compeng.de
WWW: www.compeng.de



MIMD Processor



Tracklet Fit (Tracklet Preprocessor)



During Drift Time:

N = hit count
 $\sum x_i$ = time bin sum
 $\sum x_i y_i$ = time bin*position sum
 $\sum y_i^2$ = position² sum
 y_i = position
 $\sum y_i$ = position sum

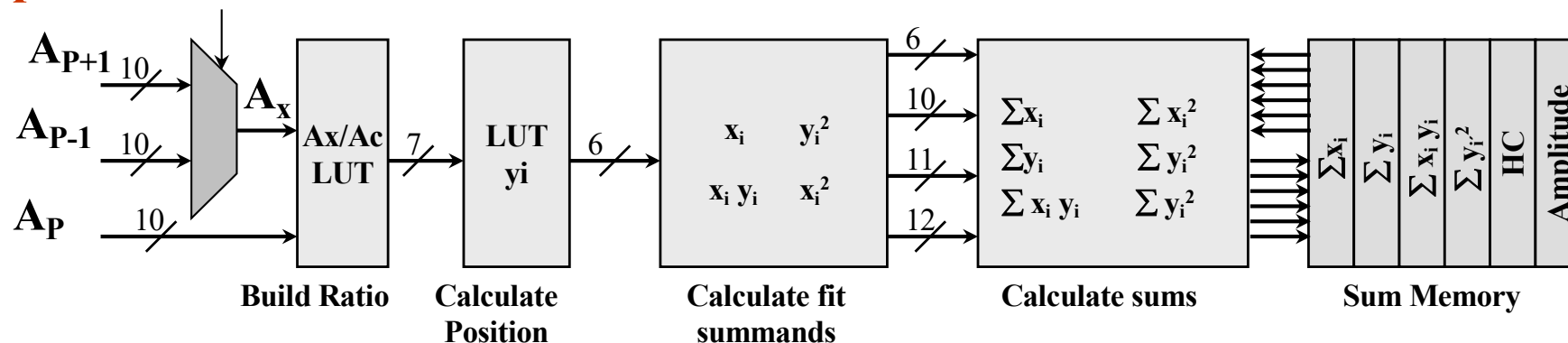
After Drift Time:

a = intercept
 b = slope
 χ^2 = track quality
 merge track segments in pad row

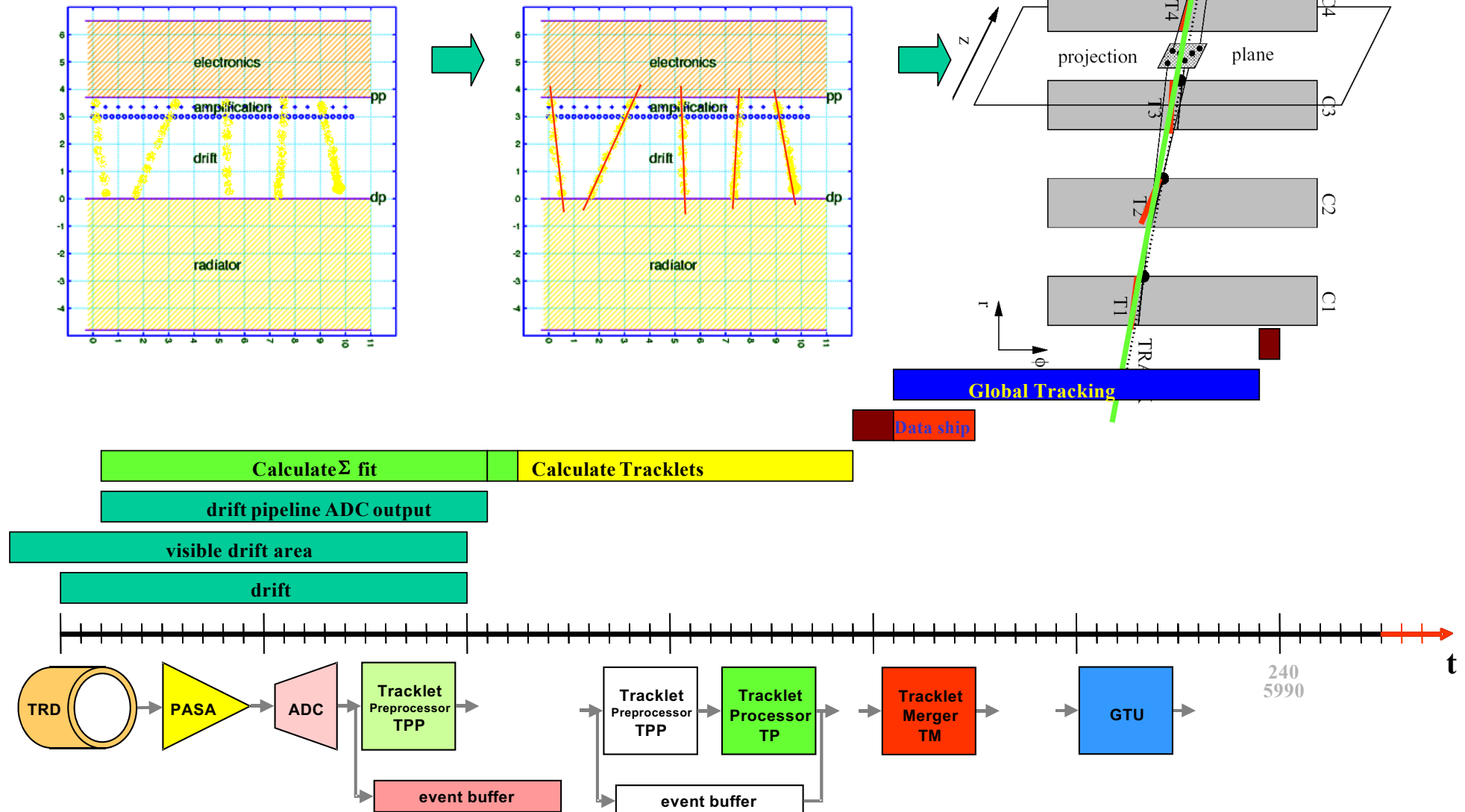
$$a = \frac{\sum x_i^2 \sum y_i - \sum x_i \sum x_i y_i}{N \sum x_i^2 - (\sum x_i)^2}$$

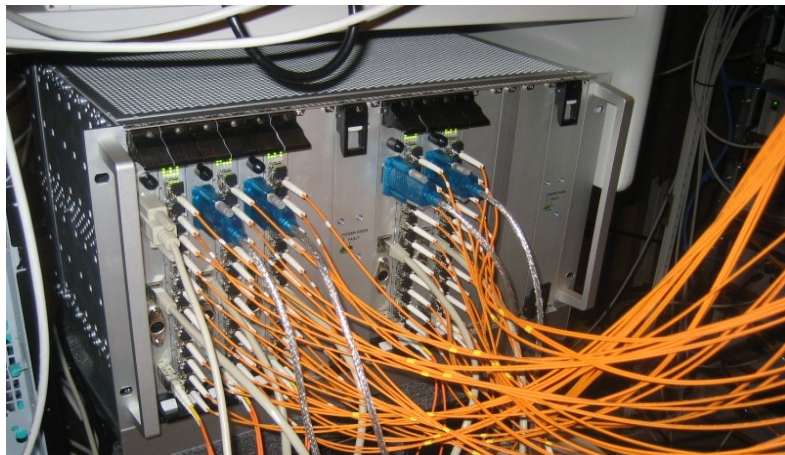
$$b = \frac{N \sum x_i y_i - \sum x_i \sum y_i}{N \sum x_i^2 - (\sum x_i)^2}$$

Pipelined Calculation :

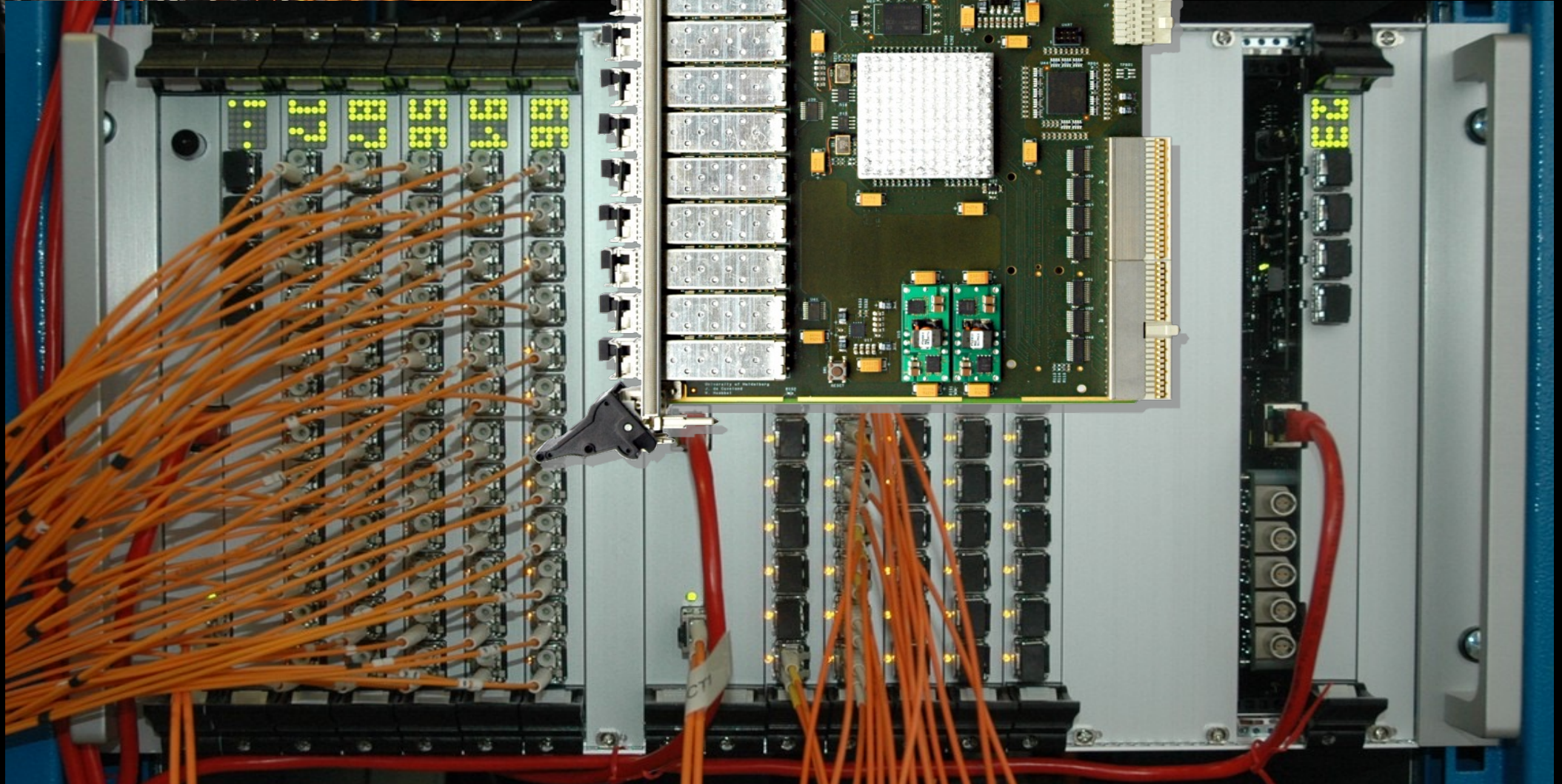


ALICE TRD Trigger Timing





GTU
2,5TBits/sec tracker
110 TMUs



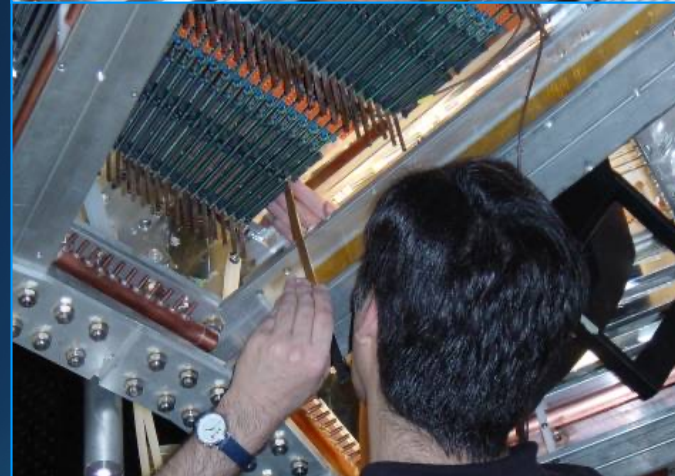
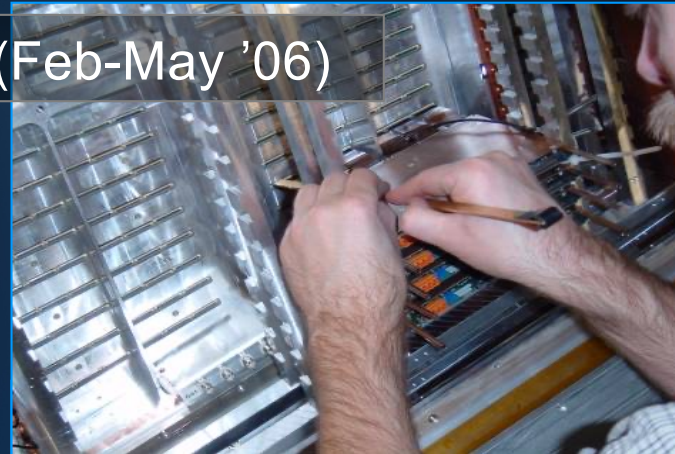
ALICE Time Projection Chamber

Installation of last Readout Chamber (Summer '05)

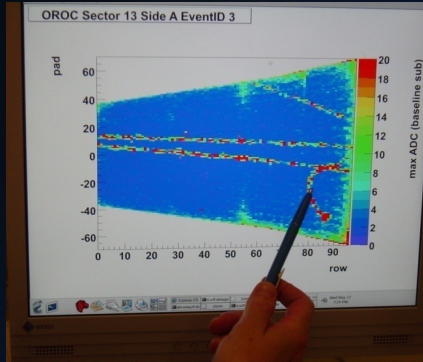


ALICE Time Projection Chamber

Installation of Front End Electronics (Feb-May '06)



ALICE Time Projection Chamber



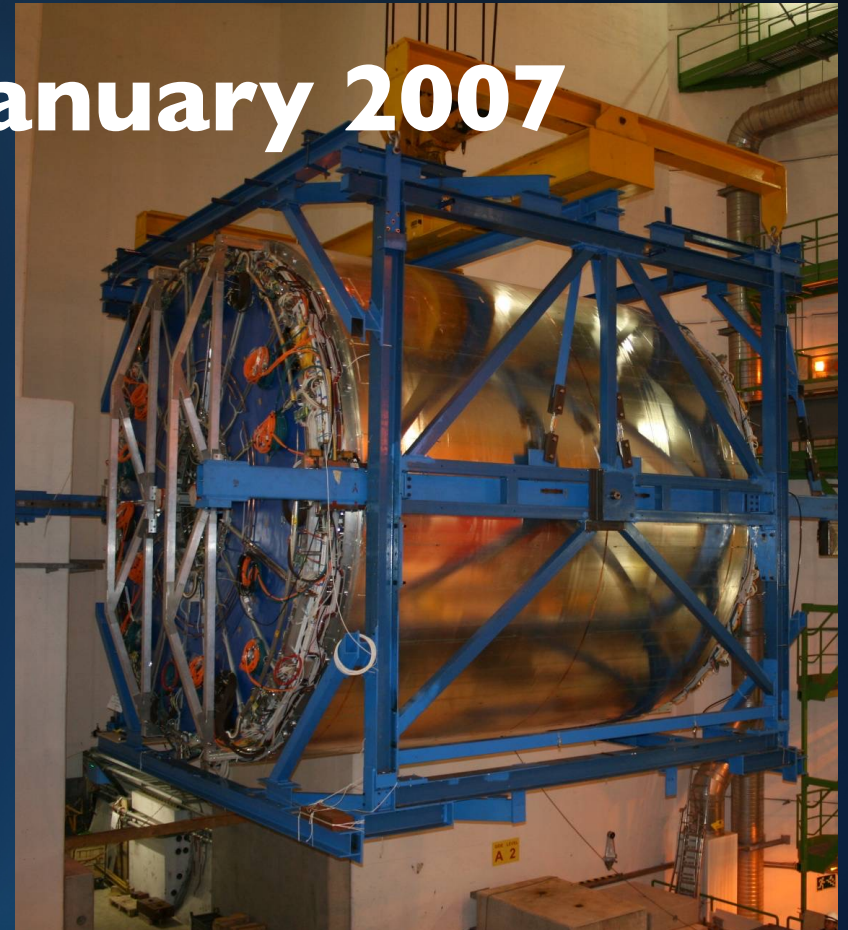
First cosmic tracks, June 2006



ALICE Time Projection Chamber

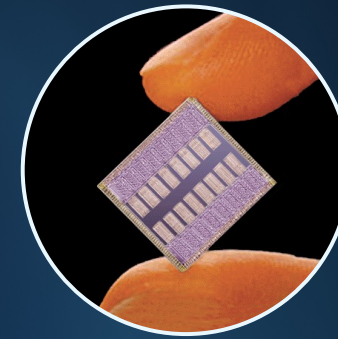
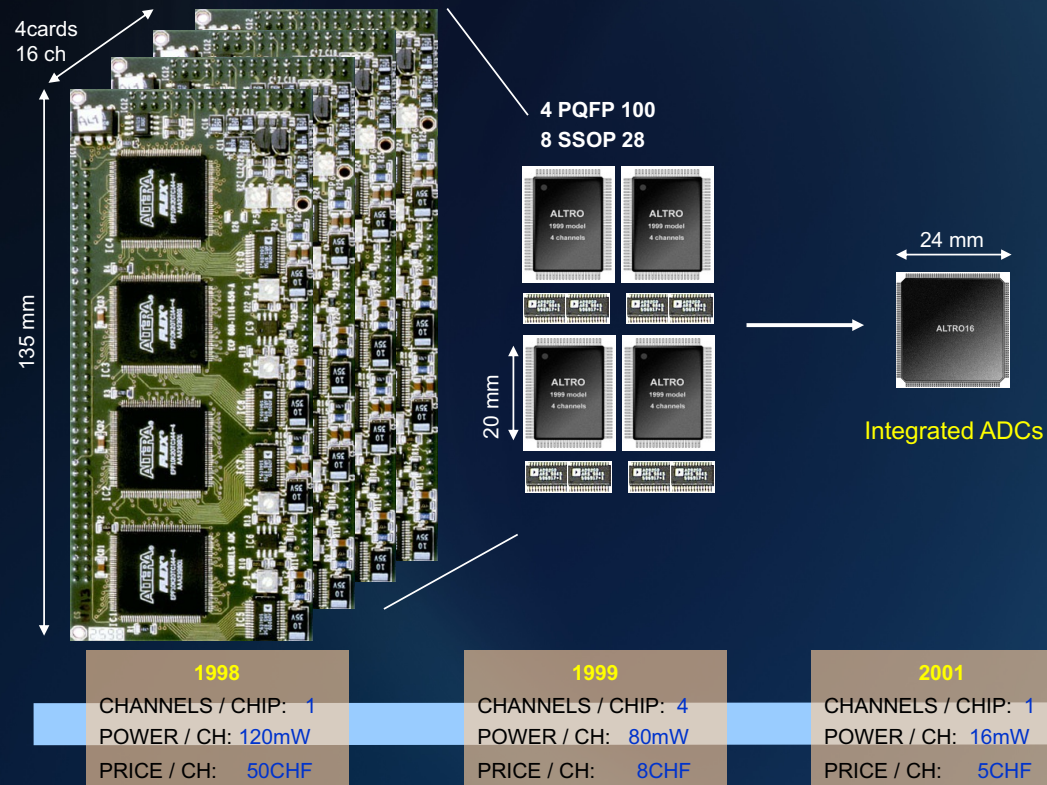


8 January 2007



Advancing TPC Readout Electronics

First use in the CERES TPC



The end of analogue memories
+ multiplexed digitization
fast digital sampling + sparse
readout ⇒ FAST TPCs

Innovative Readout



200

Extreme Tech:
“Most Complex SoC Device Ever”

PASA + ALTRO Chip Set

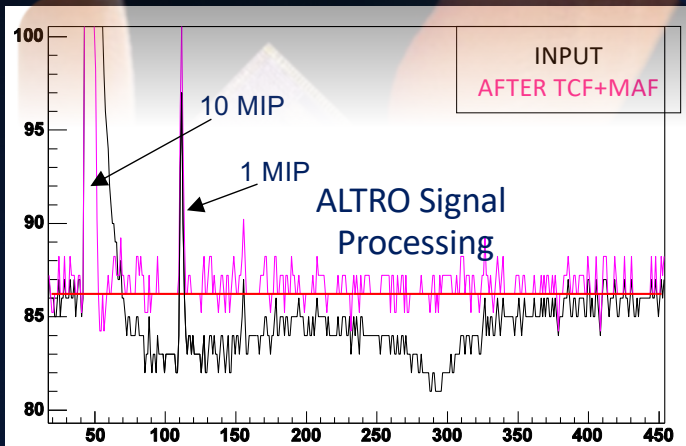
Very High Integration !!

16 low-power fast ADCs
16 DSP and 800K-bits Memory

4 nJ/bit



Electronic News:
“SoC Device in Atomic Particle Experiment” Electronic News

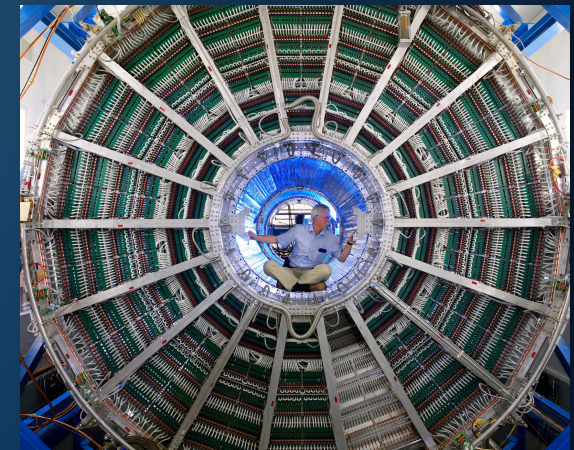


ALTRO electronics used also for other ALICE detectors:

- EMCAL, PHOS, FMD

ALICE TPC Electronics adopted

- NA45, HARP, CAST
- STAR Upgrade, MIPP, BONUS





Experiment

1 kHz, 30 GB/sec

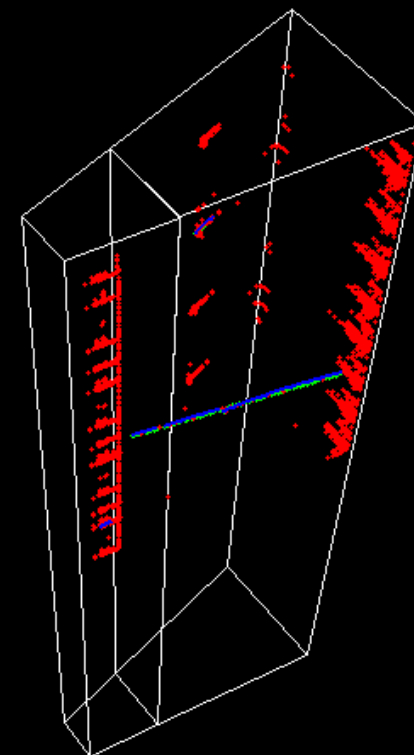
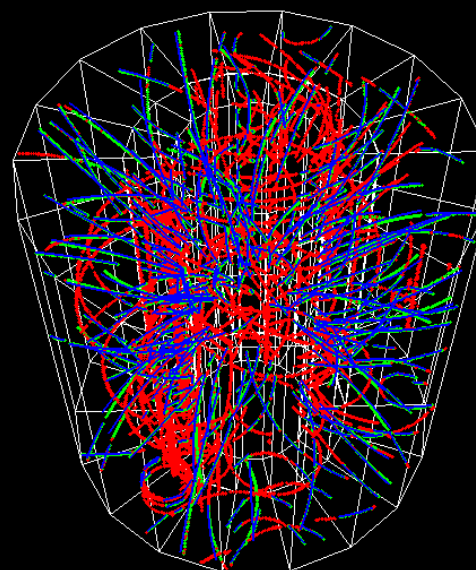
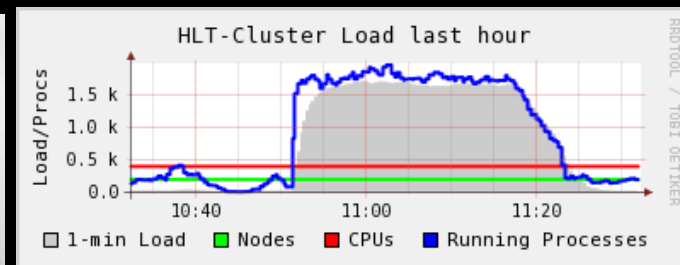
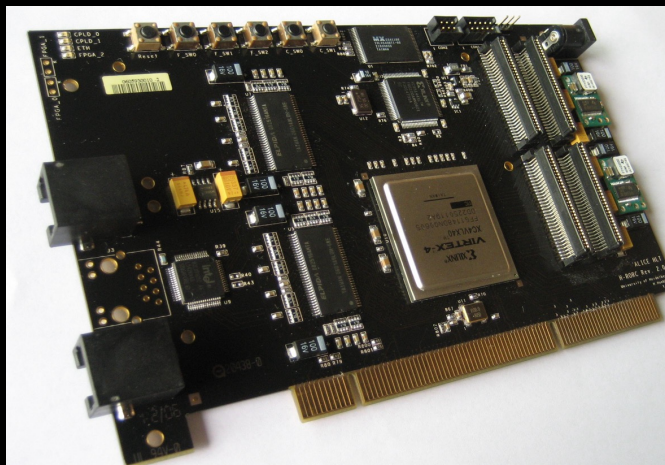


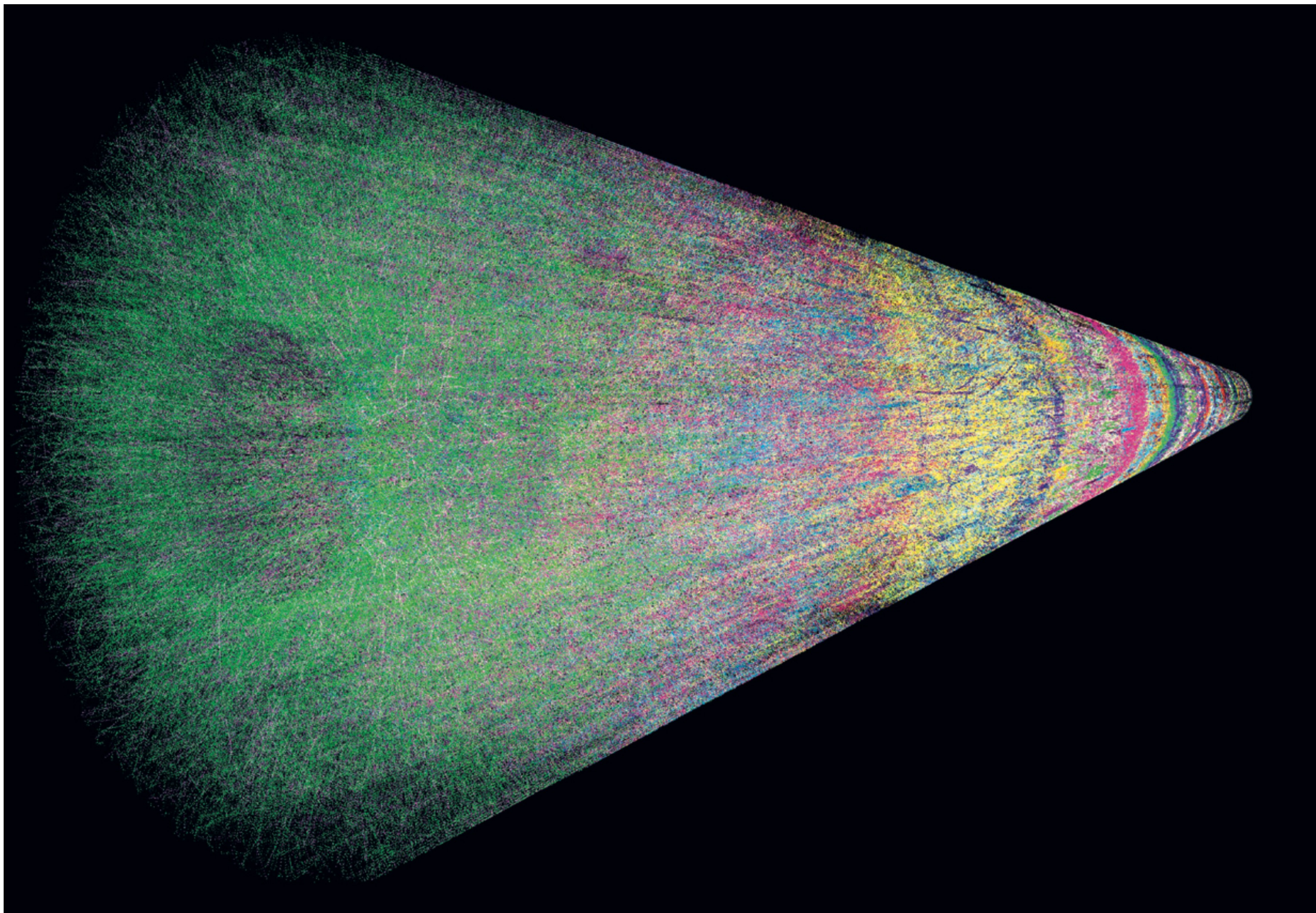
HLT

1.3 GB/sec

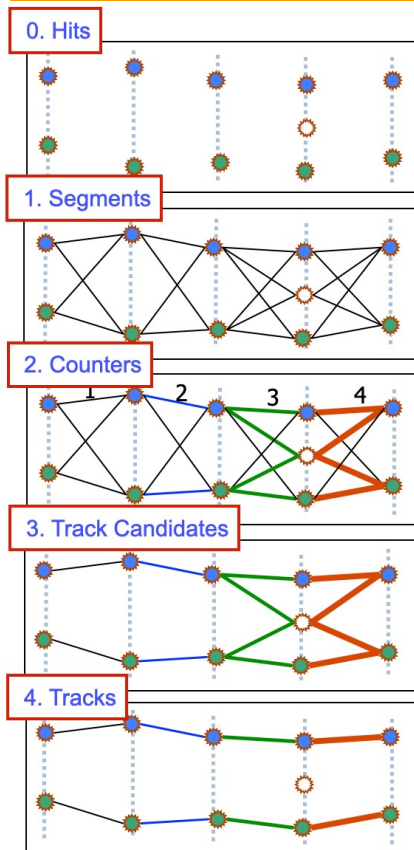


DAQ



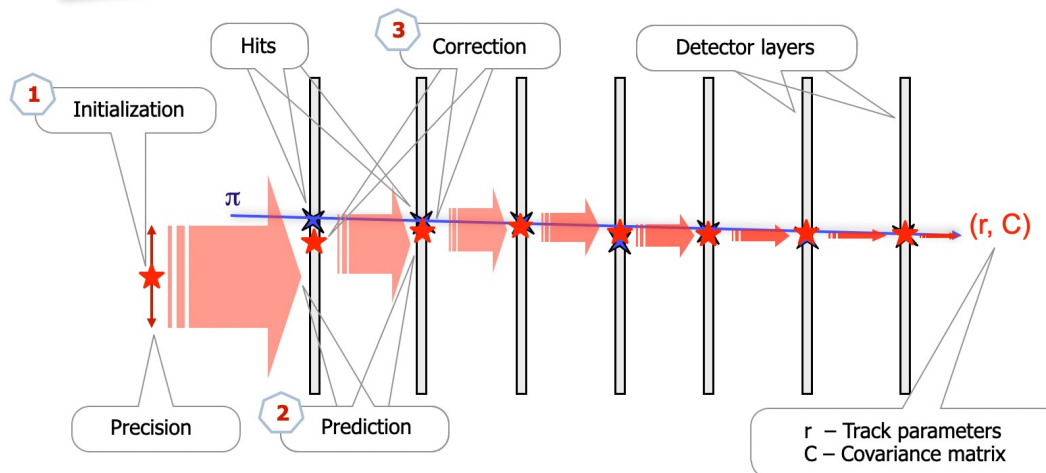


HLT ALICE TPC Track Reconstruction (CA+KF)



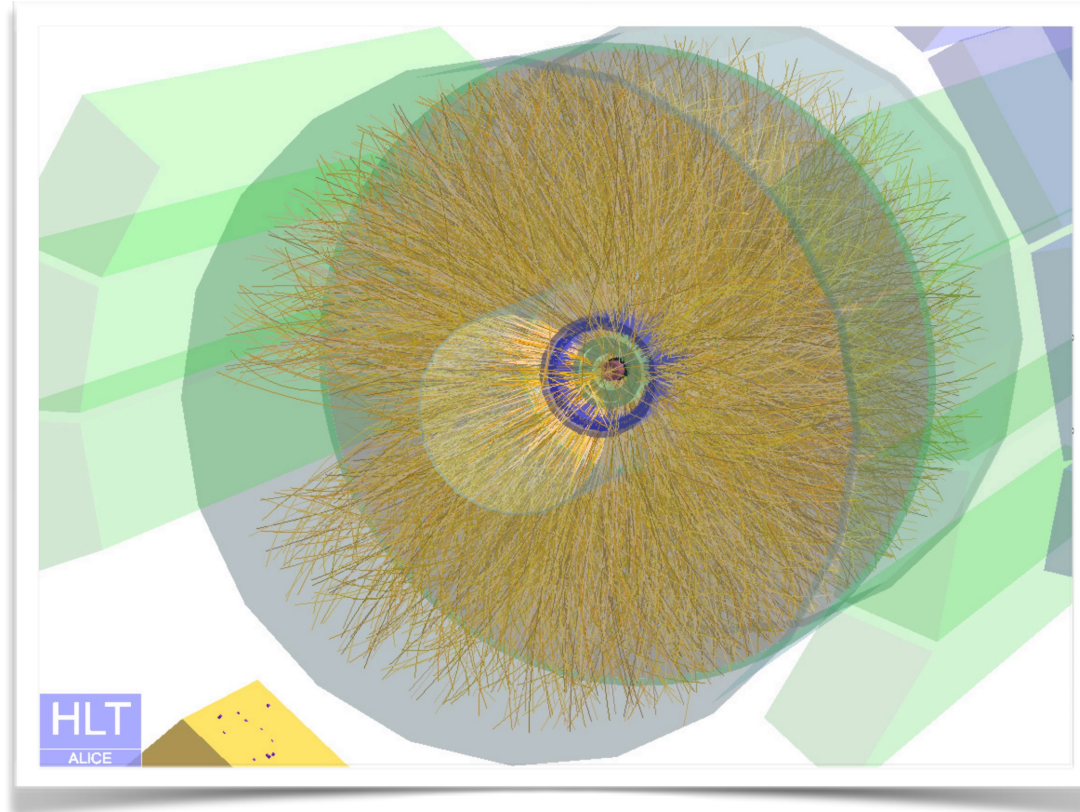
Cellular Automaton (CA) Track Finder:

- (1) Build short track segments.
- (2) Connect them according to the track model; estimate their possible position on a track.
- (3) Tree structures appear, collect segments into track candidates.
- (4) Select the best track candidates.



Kalman Filter (KF) Track Fit:

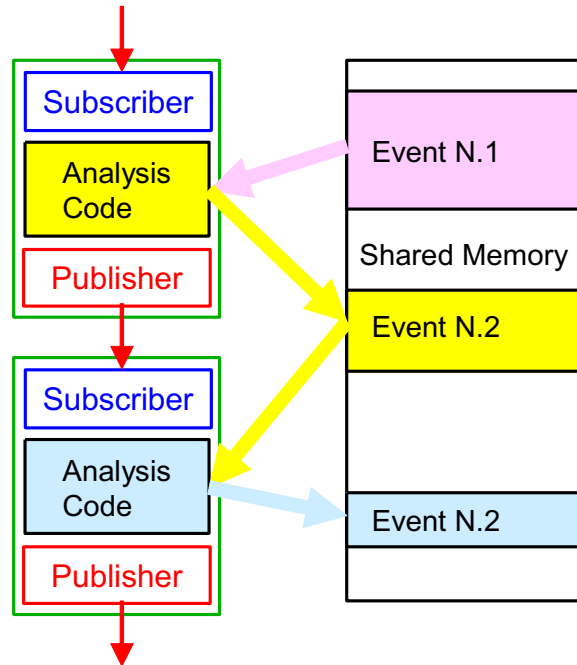
- (1) Start with an arbitrary initialization.
- (2) Add one hit after another.
- (3) Improve the state vector.
- (4) Get the optimal parameters after the last hit.



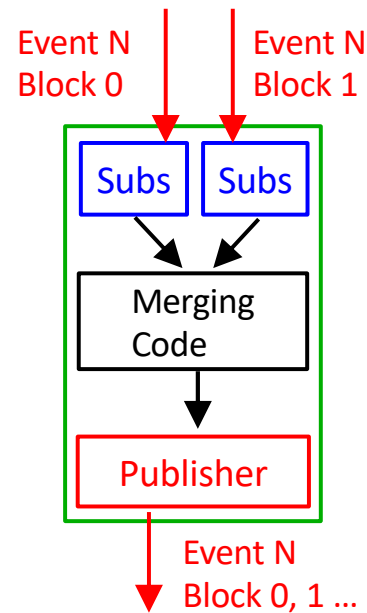
- highly vectorized
- very efficient on GPUs
- significant cost saving w.r.t. CPUs

Event Chain Building Blocks

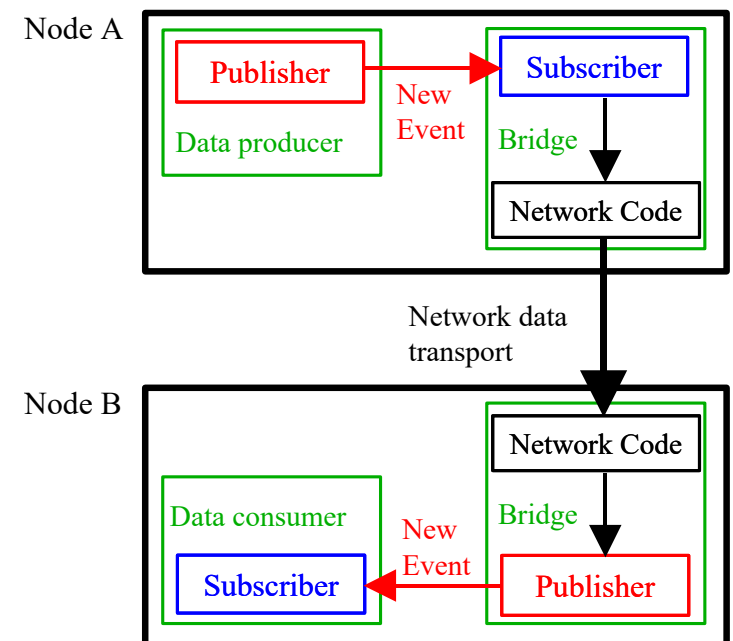
Hierarchical Event Analysis



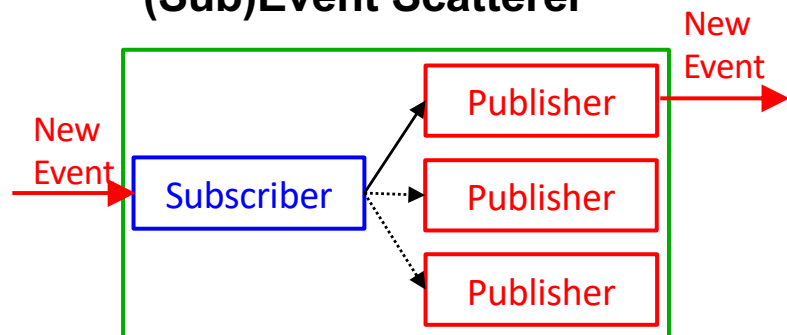
(Sub)Event Merger



Bridging between Nodes

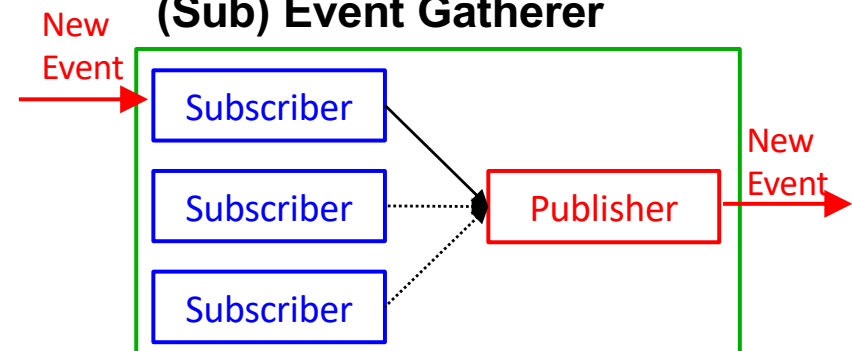


(Sub)Event Scatterer

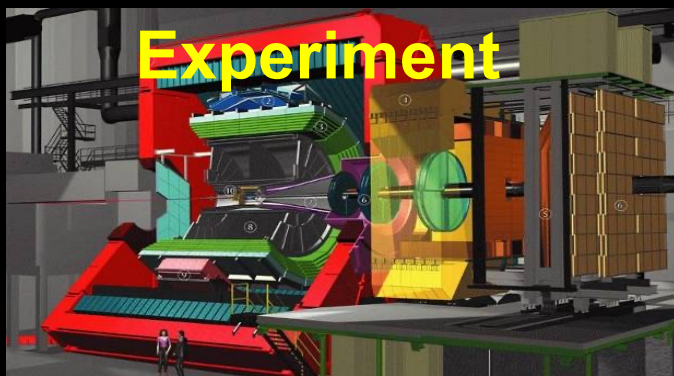


Load balancing
Fan-out

(Sub) Event Gatherer



Experiment



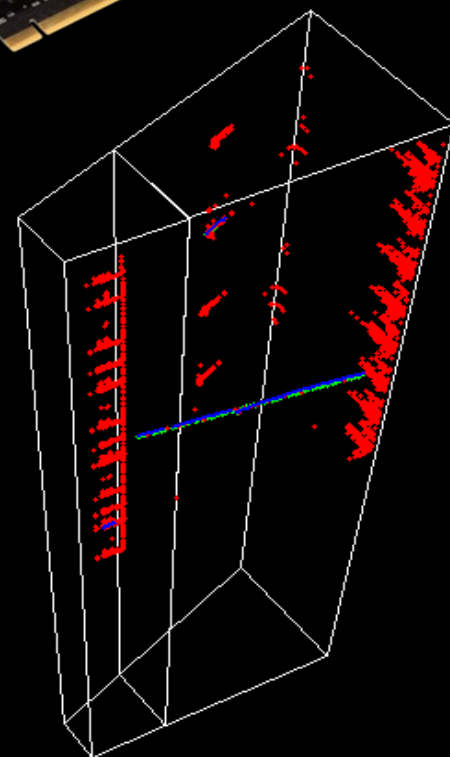
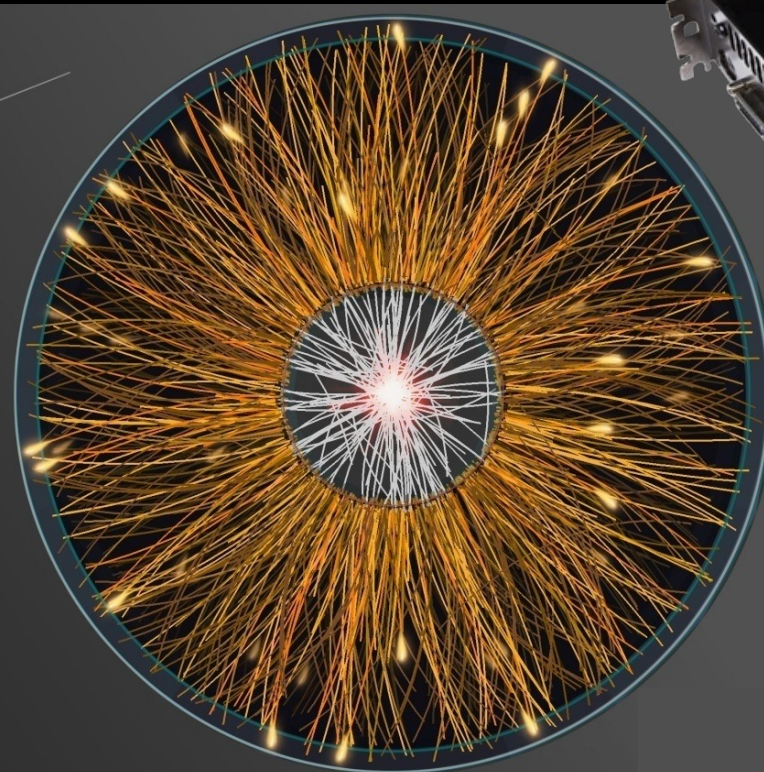
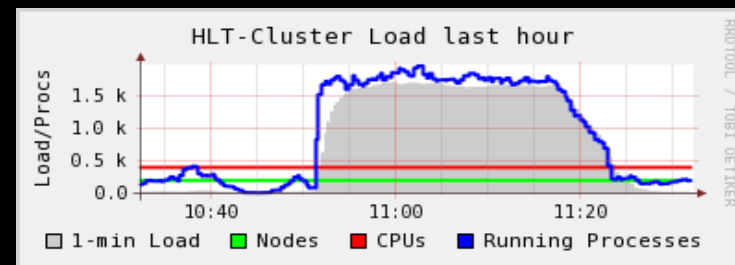
1300 GB/sec

EPN



200 GB/sec

DAQ



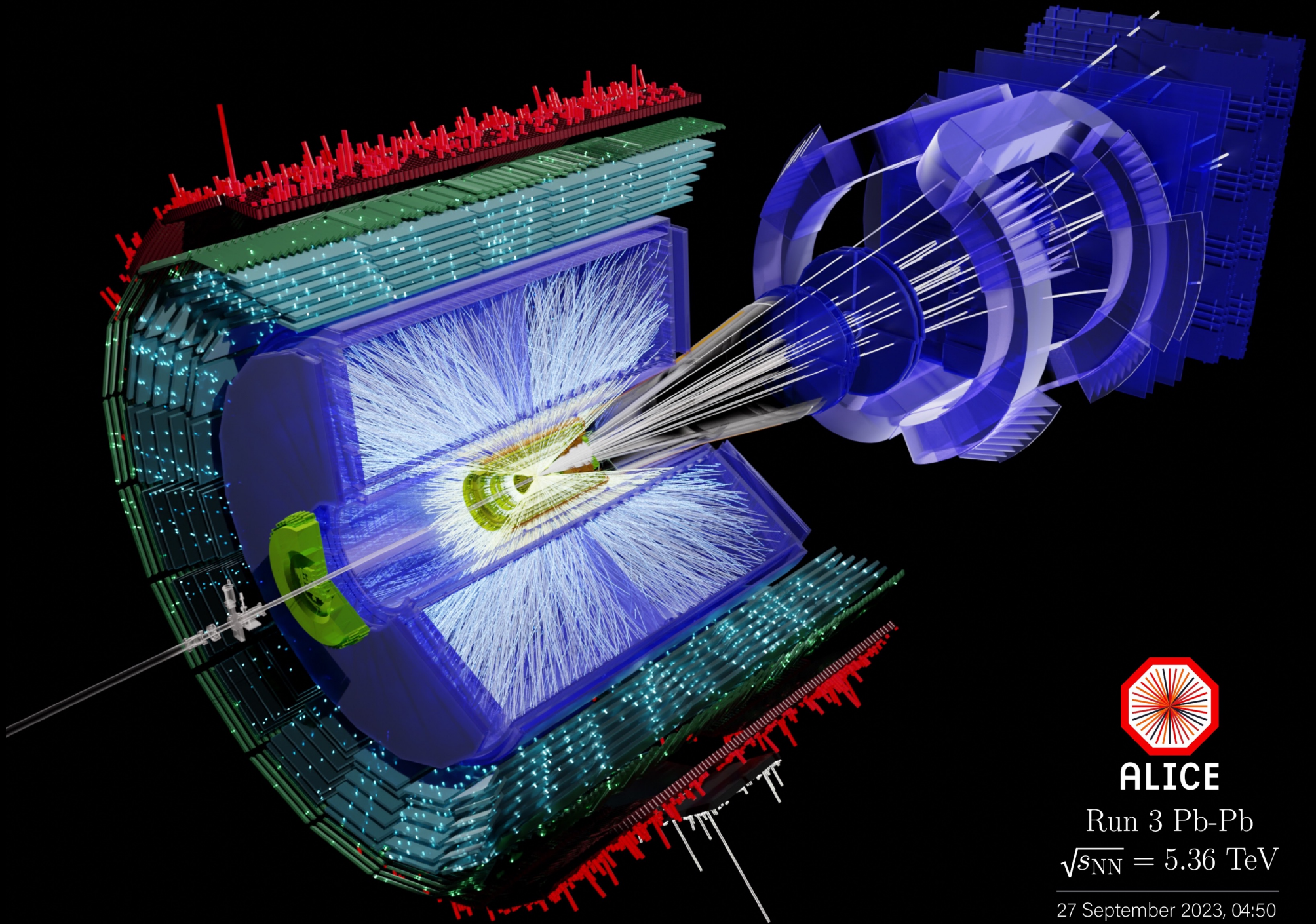
- 2800 GPUs, 32 GB each
 - 24640 CPU cores
 - 200 TB main memory
 - 200 PB mass storage
 - Up to 1.3 TB/s ingres
 - Up to 200 GB/s egres
 - 95% of processing on GPU
-
- Data distribution framework developed at FIAS



New nodes The event processing node racks in the ALICE computing farm, part of a completely new computing model for Run 3 and beyond.

ALICE UPS ITS GAME FOR SUSTAINABLE COMPUTING

The design and deployment of a completely new computing model – the O² project – allows the ALICE collaboration to merge online and offline data processing into a single software framework to cope with the demands of Run 3 and beyond. Volker Lindenstruth goes behind the scenes.



ALICE

Run 3 Pb-Pb

$\sqrt{s_{NN}} = 5.36 \text{ TeV}$

27 September 2023, 04:50

Zum
80.
Geburtstag

für Gesundheit, Freude
und viele erfüllende Momente.

Alles Gute!