LHCb RRB-Tr 2001-32

Status of the LHCb Experiment

RRB meeting, CERN, 23 April 2001

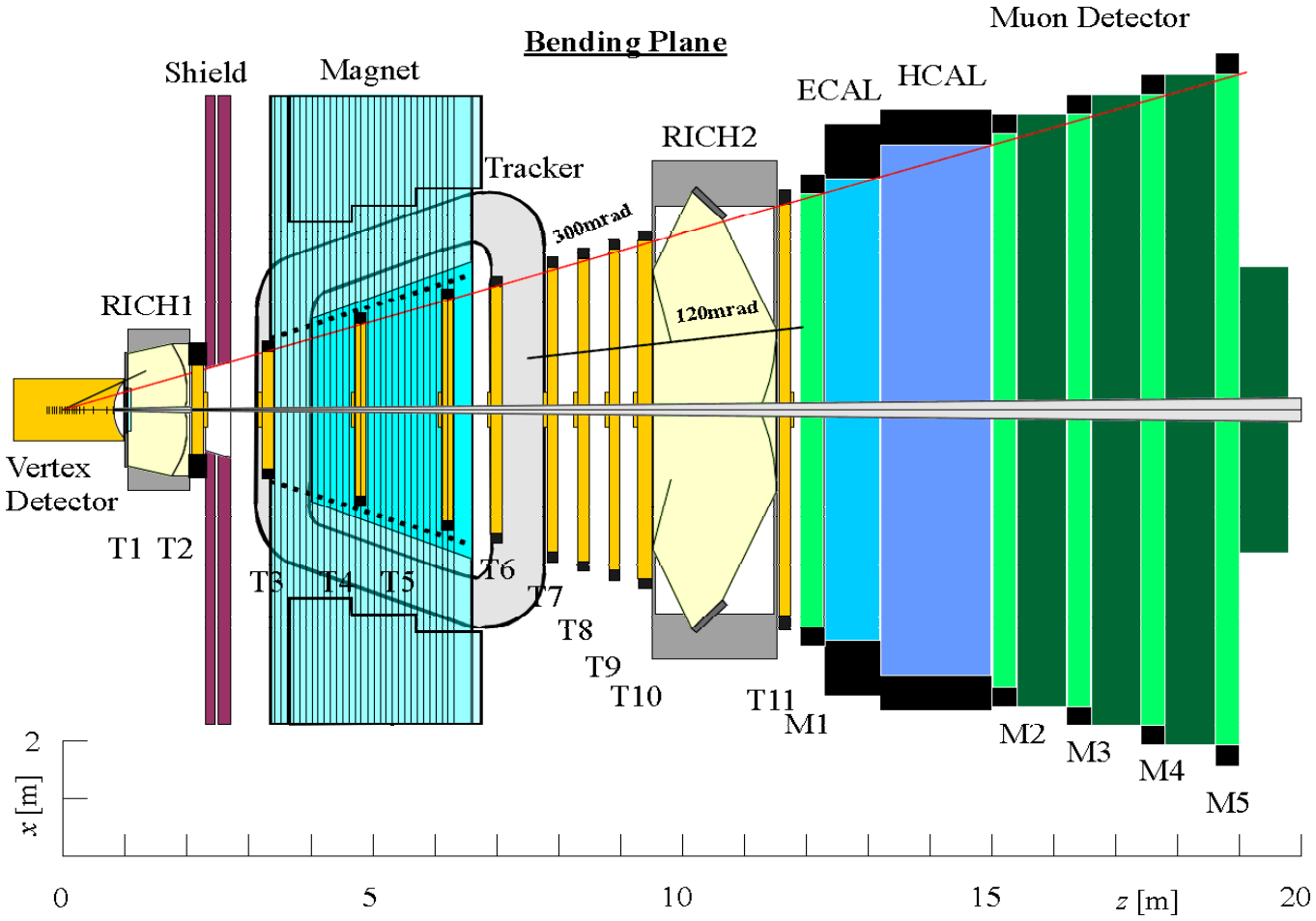
On behalf of the LHCb collaboration

Tatsuya Nakada

CERN and Lausanne Univ.

Contents of the talk

1) Magnet
2) Vertex Locator
3) Outer Tracker
4) Inner Tracker
5) RICH
6) Calorimeter
7) Muon
8) Trigger
9) Computing
10) Collaboration issues
11) Summary


Bending Plane
Muon Detector
Shield
Magnet
ECAL
HCAL
RICH2
Tracker
300mrad
120mrad
RICH1
Vertex
Detector
T1 T2
T3 T4 T5
T6
T7
T8
T9
T10
T11
M1
M2
M3
M4
M5
x [m]
2
0
5
10
15
z [m]
20

1) Magnet

Three contracts
- Al conductor:
  - Holton Machinery LTD, UK
- Coil construction:
  - SigmaPhi, France
- Iron for yoke:
  - Jebens, Germany

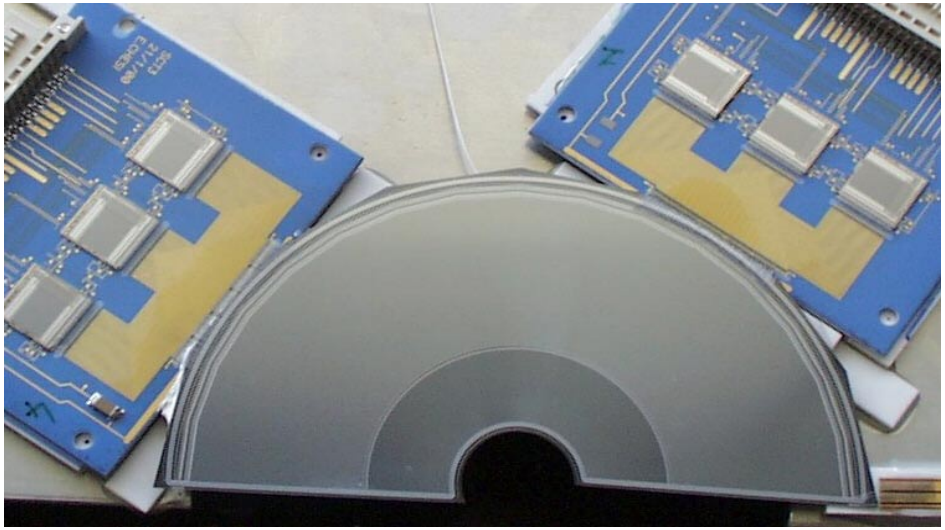
were placed and signed.

Extrusion trial of the Al conductor

2) Vertex Locator (TDR May 2001)

Baseline sensor technology defined

300μm n-on-n single sided Si with double metal layer



Radiation hard readout chip

Two options:

SCTA-VELO based on DMILL technology

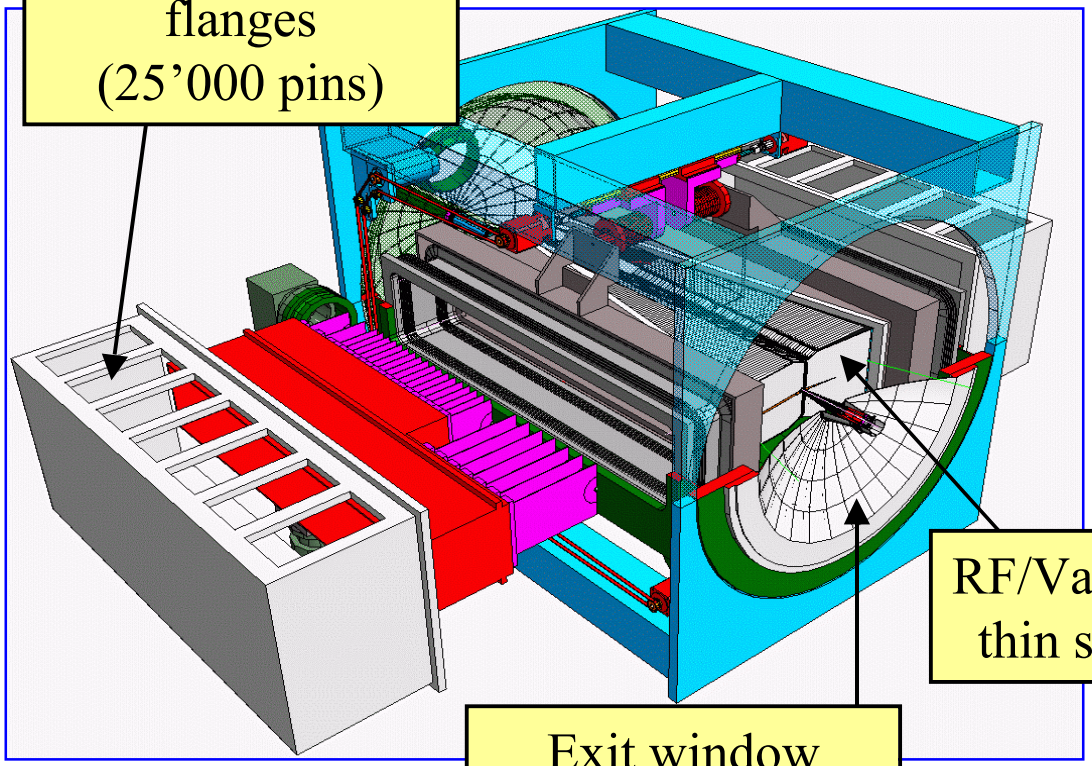
design fulfilling all the requirements submitted in November 2000

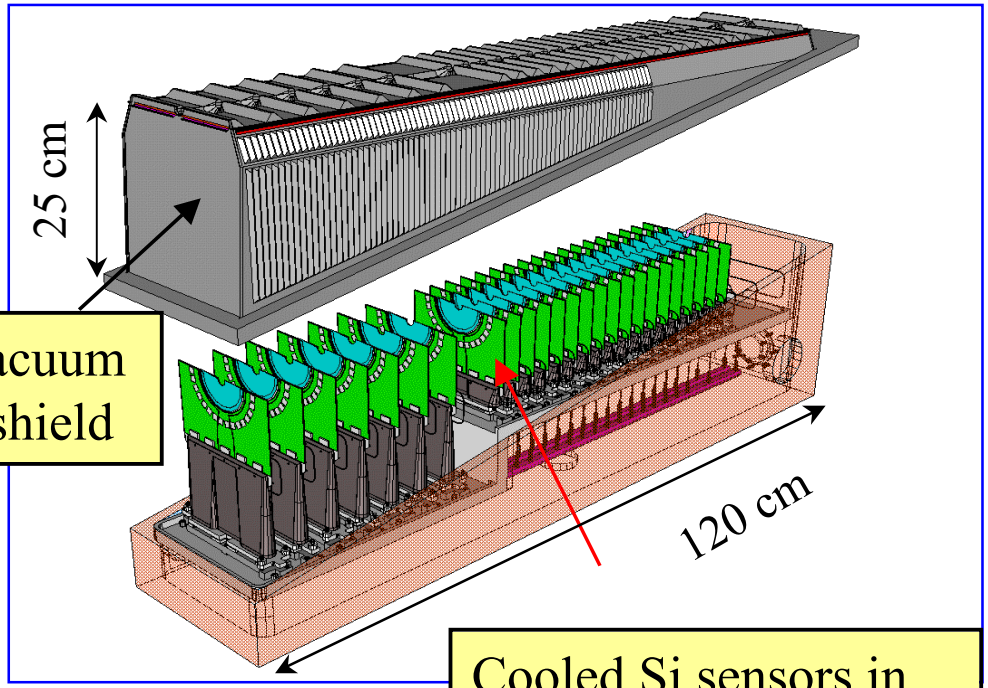
or:

BEETLE based on 0.25μm technology

development in progress

VELO mechanics ⇒ closely linked to the machine





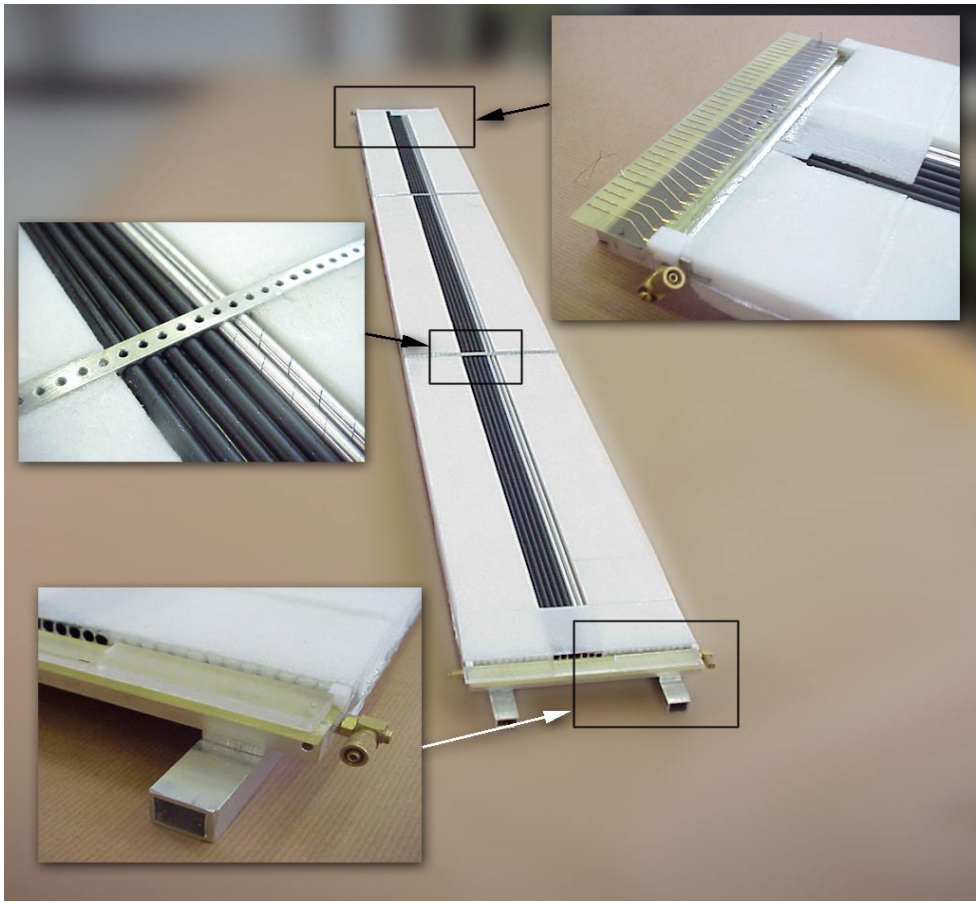
Regular reviews by the LHC machine group:

1st review: 3-4 April 2001 (very positive and constructive)

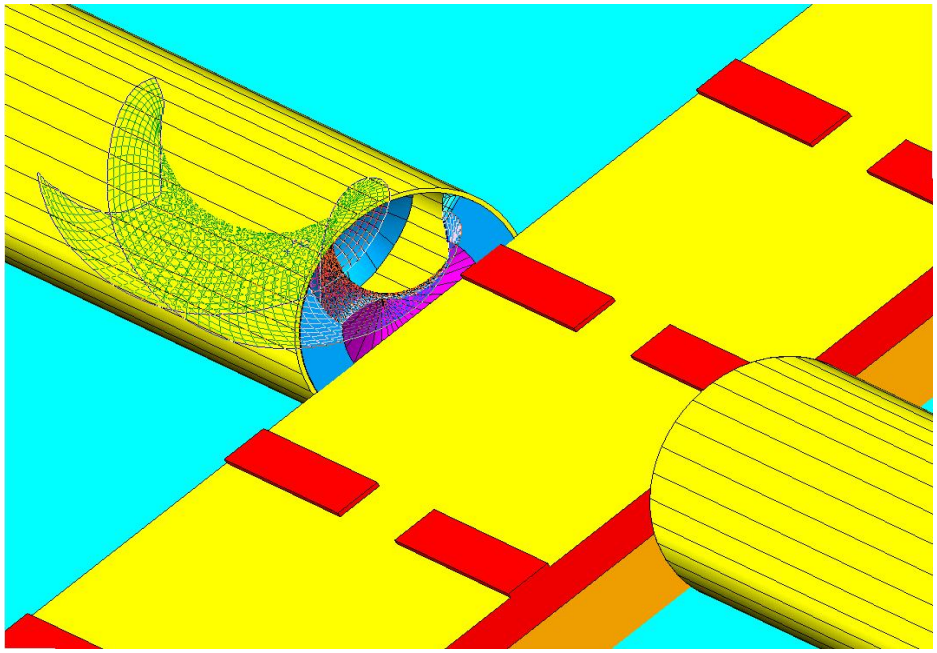
2nd review foreseen in February 2002

3) Outer Tracker (TDR September 2001)

Design studies for the modules



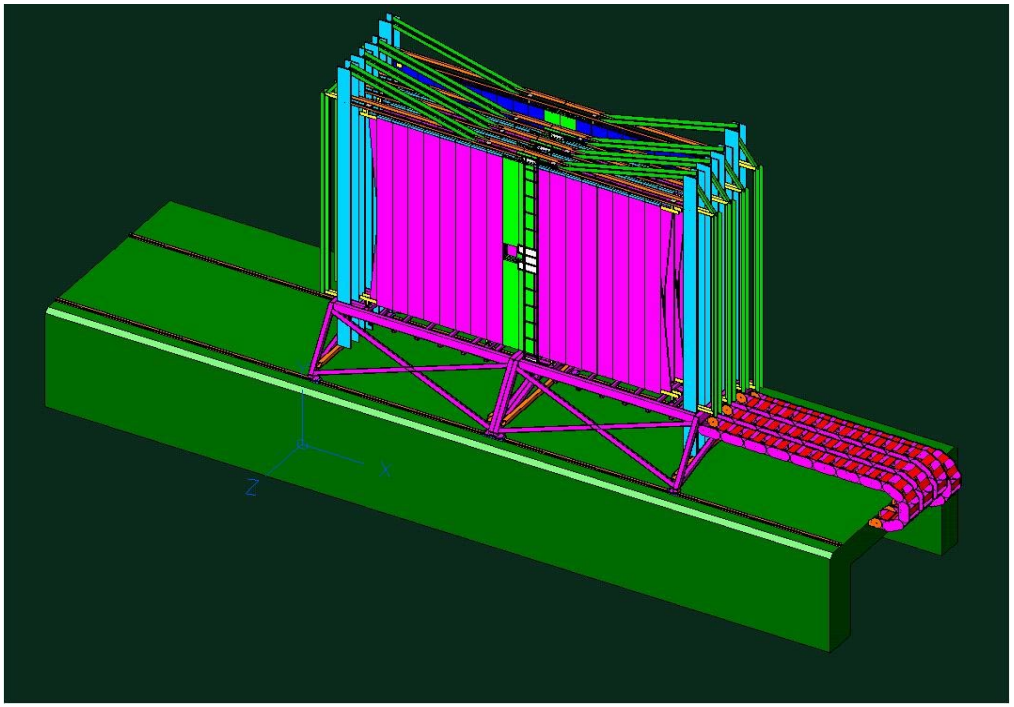
straw chambers

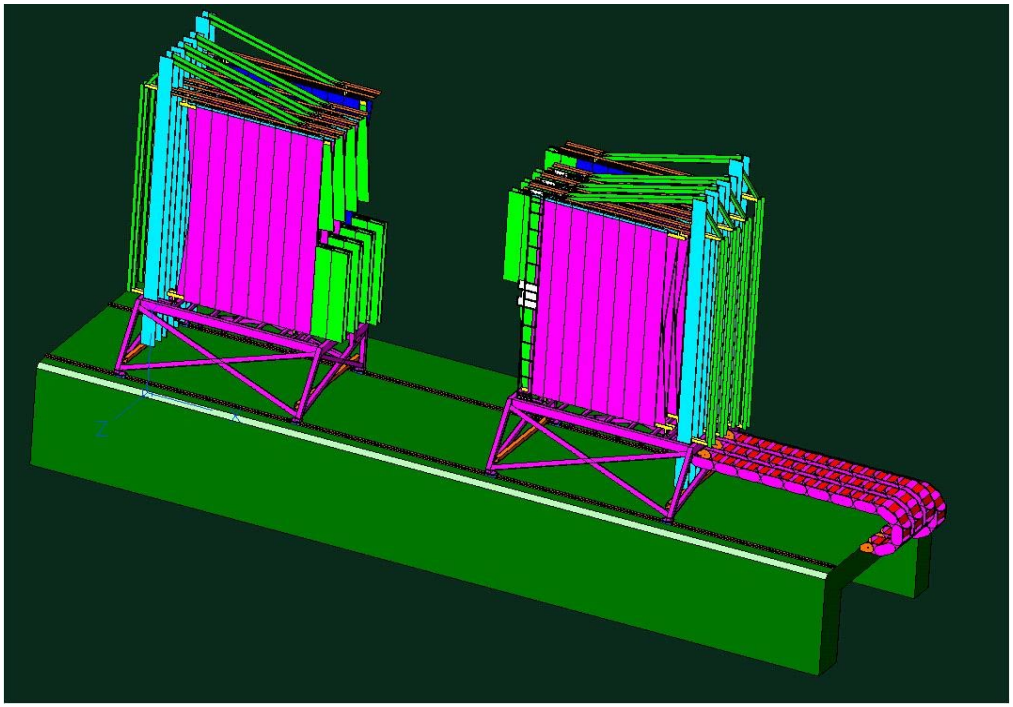


split anode and
wire spacer

and

station design studies





are all well advanced.

However, the TDR has been delayed to September 2001.

⇐Due to the tracking system optimisation.

(no delay for the installation plan)

…

Evolution of the beam pipe design

Al pipe

+ Stainless steel flanges and bellows

↓

Al pipe

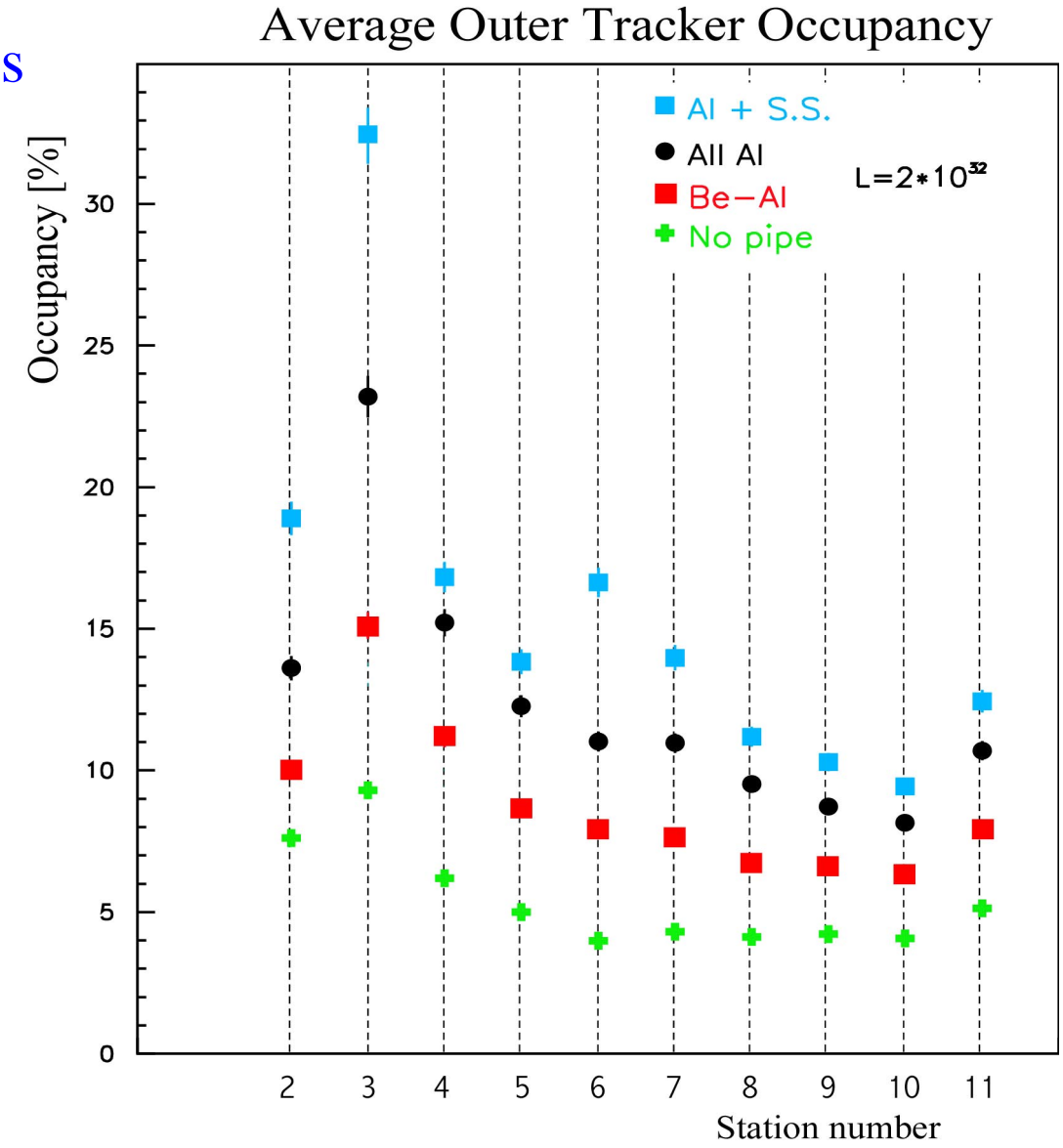
+ Al flanges and bellows

↓

Al-Be alloy pipe

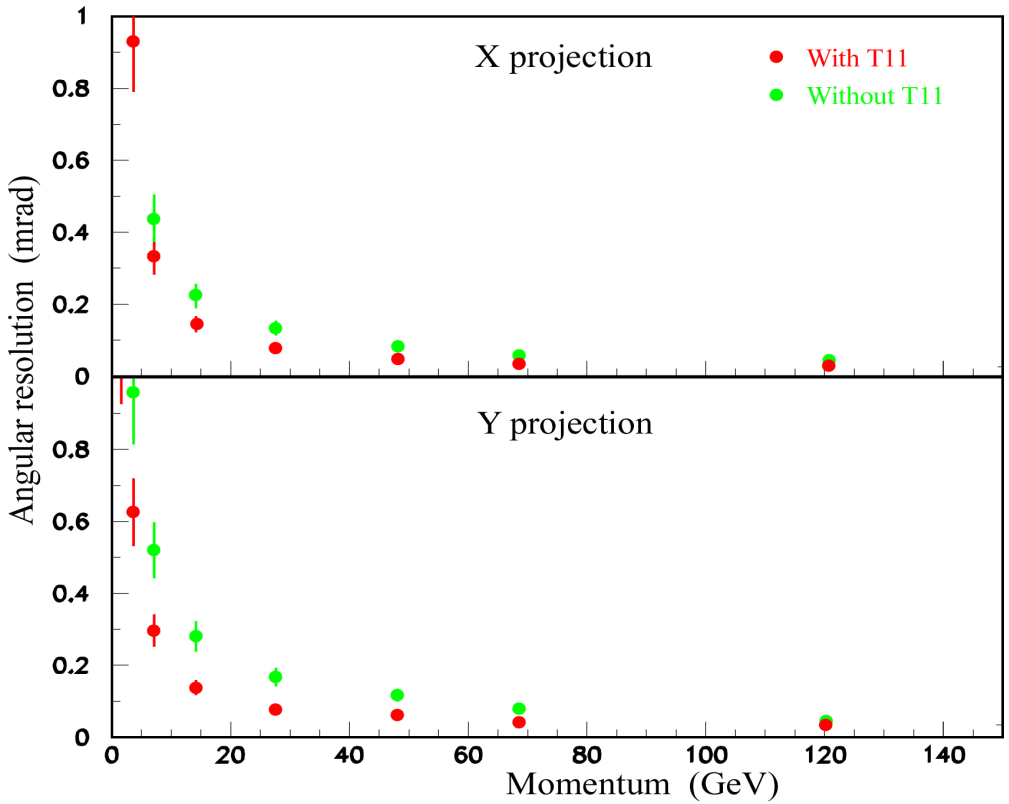
+ Al flanges and bellows

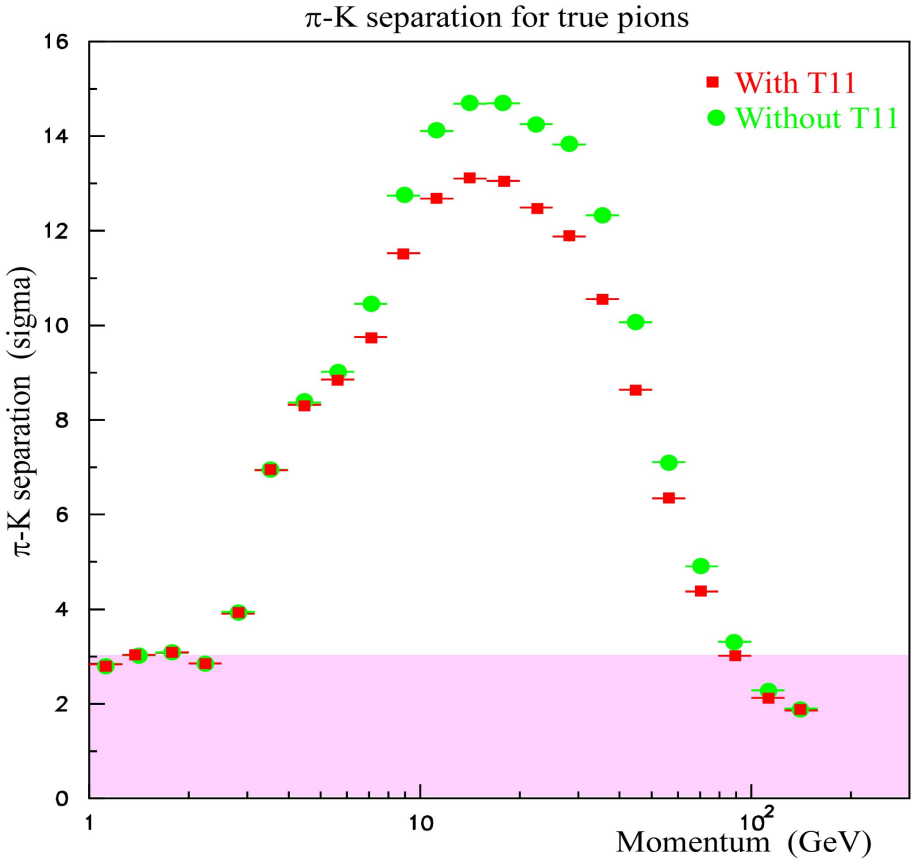
(LHCb favoured solution)



Re-examination of the stations.

An example: Station 11 is designed for RICH-2





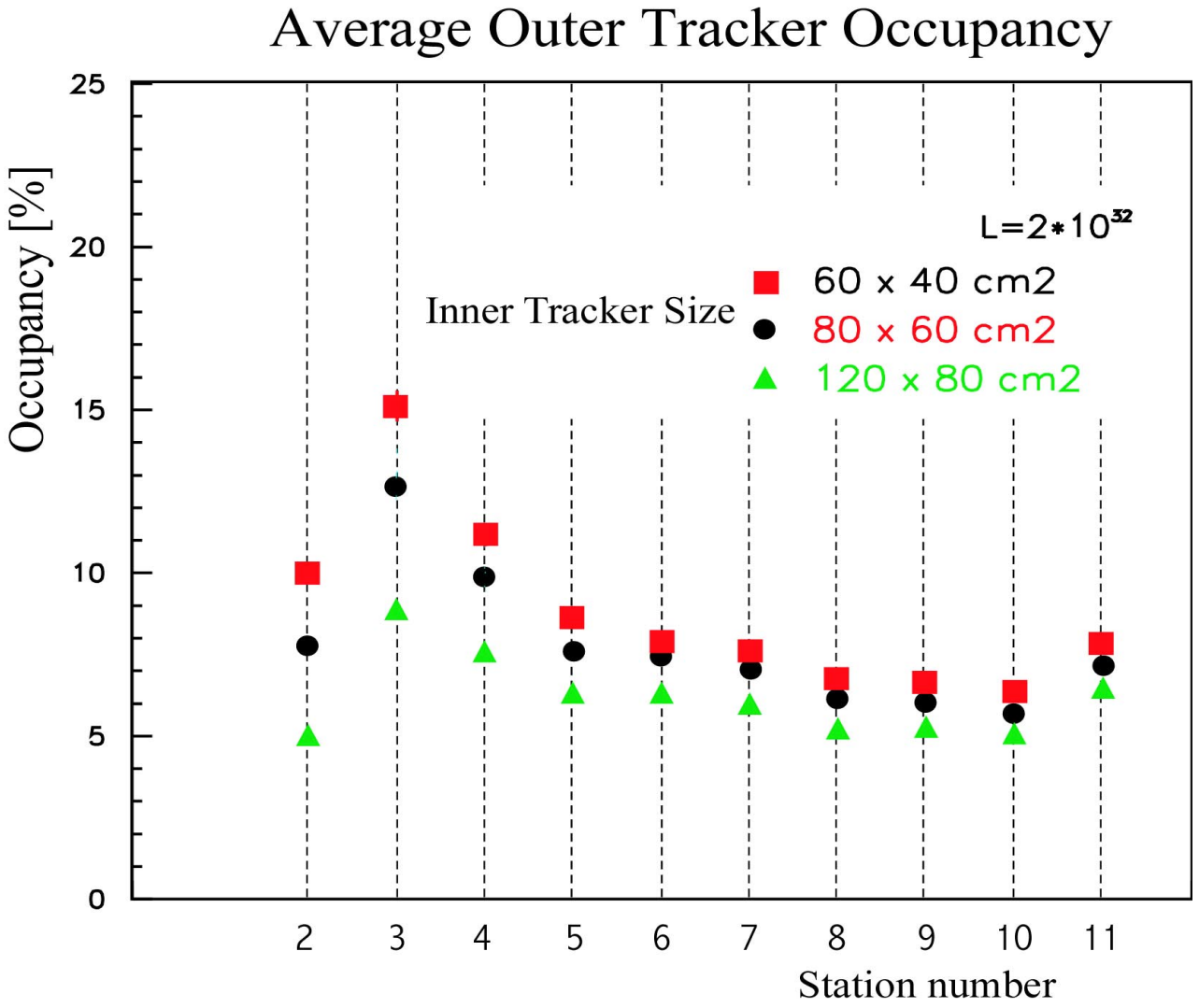
With: a better resolution for the track angle measurements at low ***p***.

→ not too important for RICH-2

Without: RICH-2 can be extended → more Cherenkov photons

- Necessity of ST11 is being discussed. -

Optimisation of the Inner Tracker size



Delay the OT **and IT** TDR's so that they will match the optimised LHCb tracking system.

4) Inner Tracker (TDR December 2001)

All Si solution is preferred if we can afford it.

This depends on

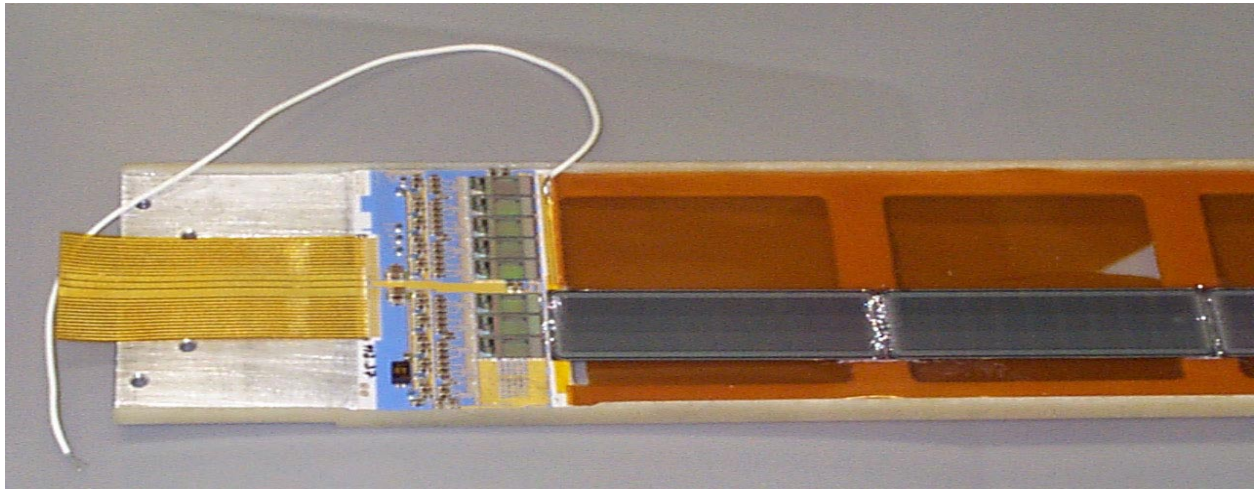
size of the inner tracker (Si surface)

S/N versus Si strip length (No. of read-out channels)

S/N and resolution versus Si pitch (No. of read-out channels)

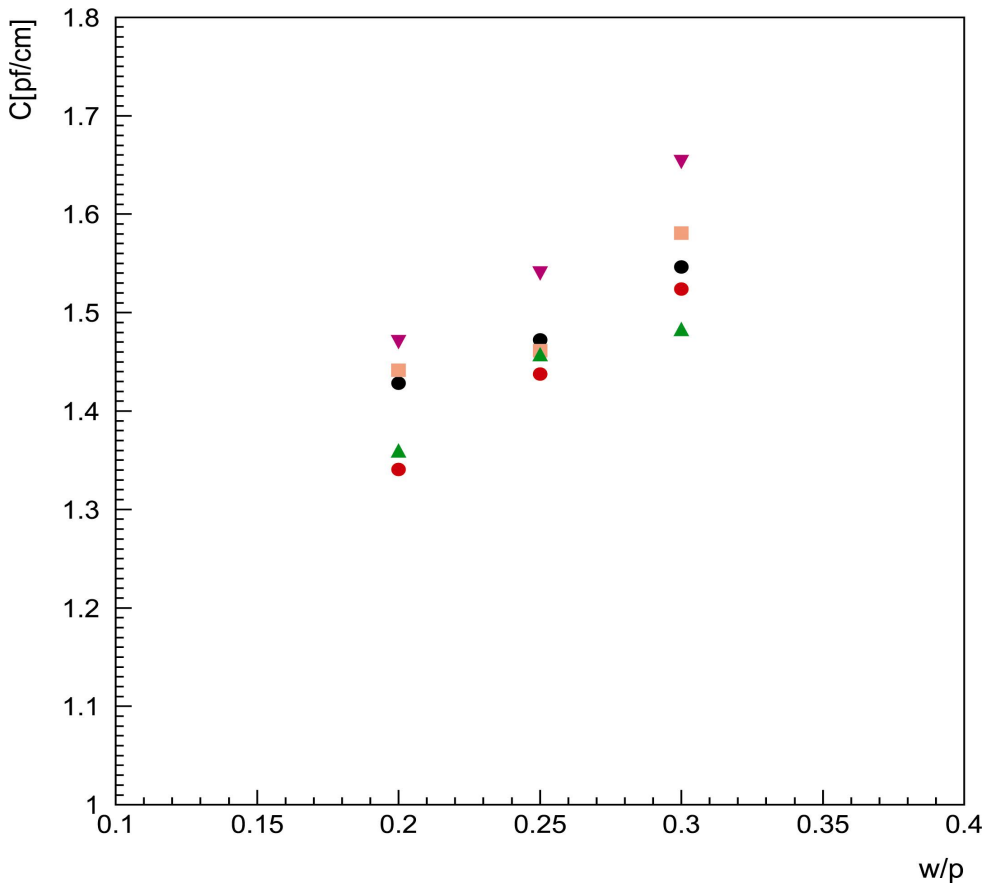
etc.

Overall tracking station optimisation and Si prototype test:



Si strip detector to test the effect of the strip length before and after the irradiation

Measured strip capacitance vs. (strip width)/(strip pitch)
for various Si sensors



If we have to cover a large surface with fine granularity,

Si + Triple GEM solution…

↓

Decision will be made very soon.

5) RICH

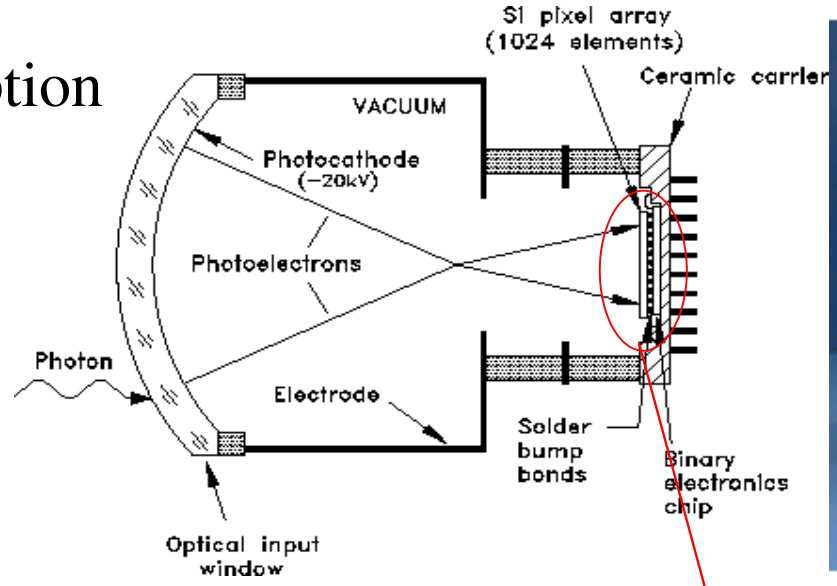
February 2001: Technical Design Report has been approved by the Research Board

Major concern now is:

final choice of the photon detector

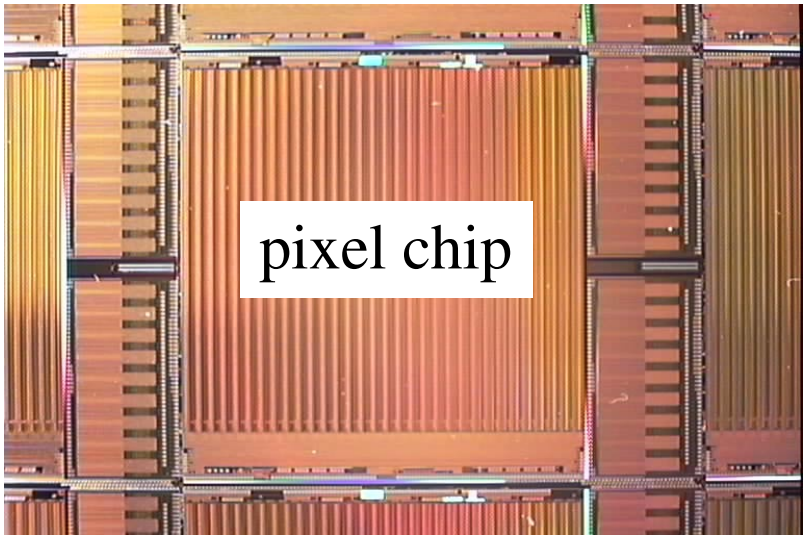
Baseline option

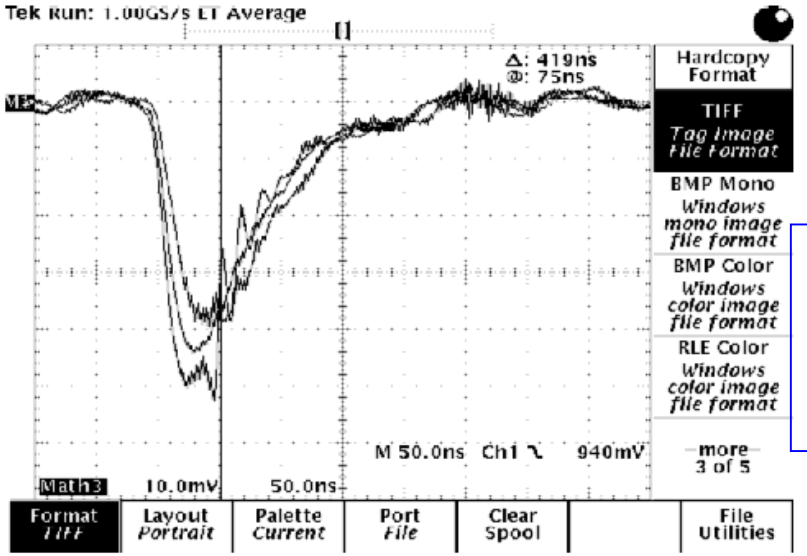
Pixel HPD



1024 pixel (500μm×500μm) detector and bump bonded pixel readout electronics.

Photocathode deposition and anode encapsulation at DEP.





1mV = 50 e
1pe = 5000e

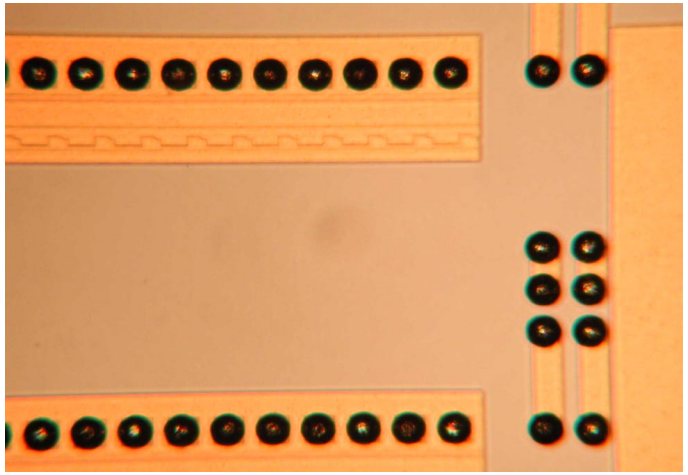
S/N = 50
☺ Good!

Chip does not run above 20 MHz: ☹ not good!

However functional and will be encapsulated by August.

Revised submission in June.

Structure for bump bonding test.



Situation will be reviewed in October 2001.

6) Calorimeter System

Technical Design Report:

approved by the Research Board, February 2001

Reviews:

- Engineering Design Reviews
  - H-cal module: 5 March 2001
  - E-cal module: 15 March 2001
- Front-end electronics Review
  - SPD, Preshower, E-cal, H-cal: 29-30 March 2001

Module-0 for E-cal and H-cal under production:

- To prepare tooling
- To learn and optimise the production process

E-cal

Production readiness of the E-cal and H-cal modules will be examined by the Technical Board early summer 2001.

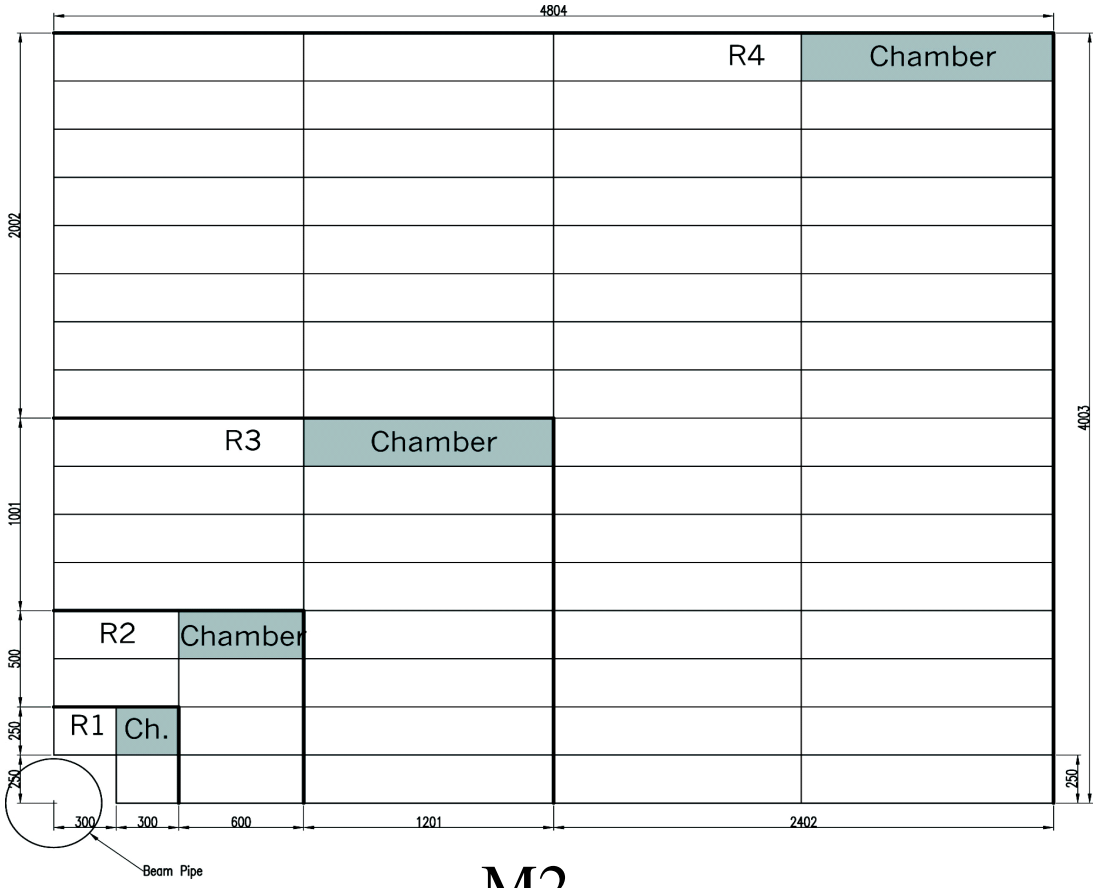
H-cal

7) Muon System (TDR May 2001)

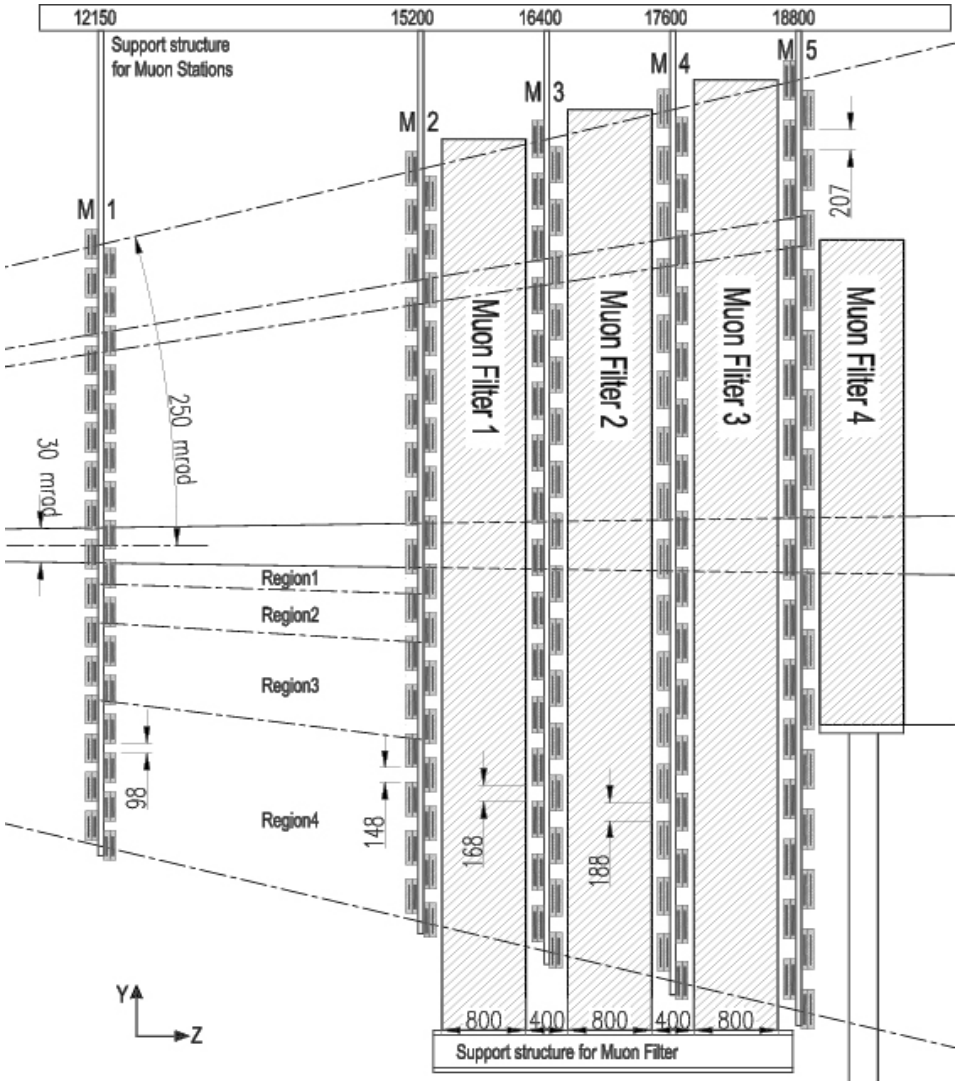
System layout defined

26k logical channels

(44% reduction from TP)



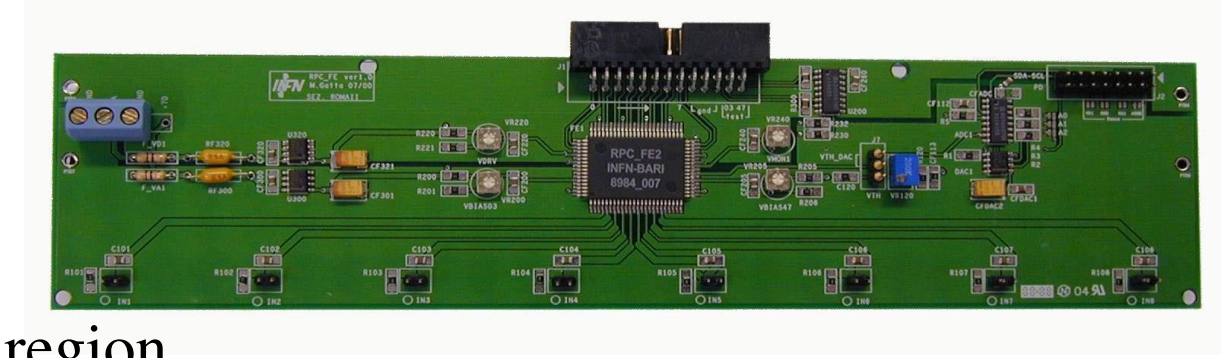
M2



Low rate region (< 1 kHz)

Resistive Plate Chambers with pad readout

+ CMS BiCMOS front-end chip



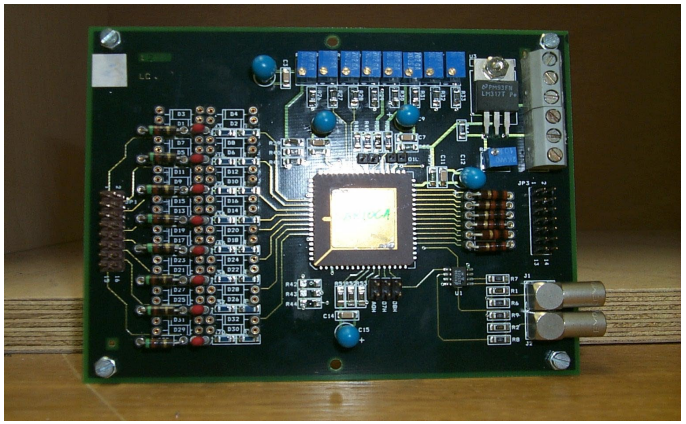
High rate region

Multi Wire Proportional Chambers with

wire and cathode pad/strip readout.

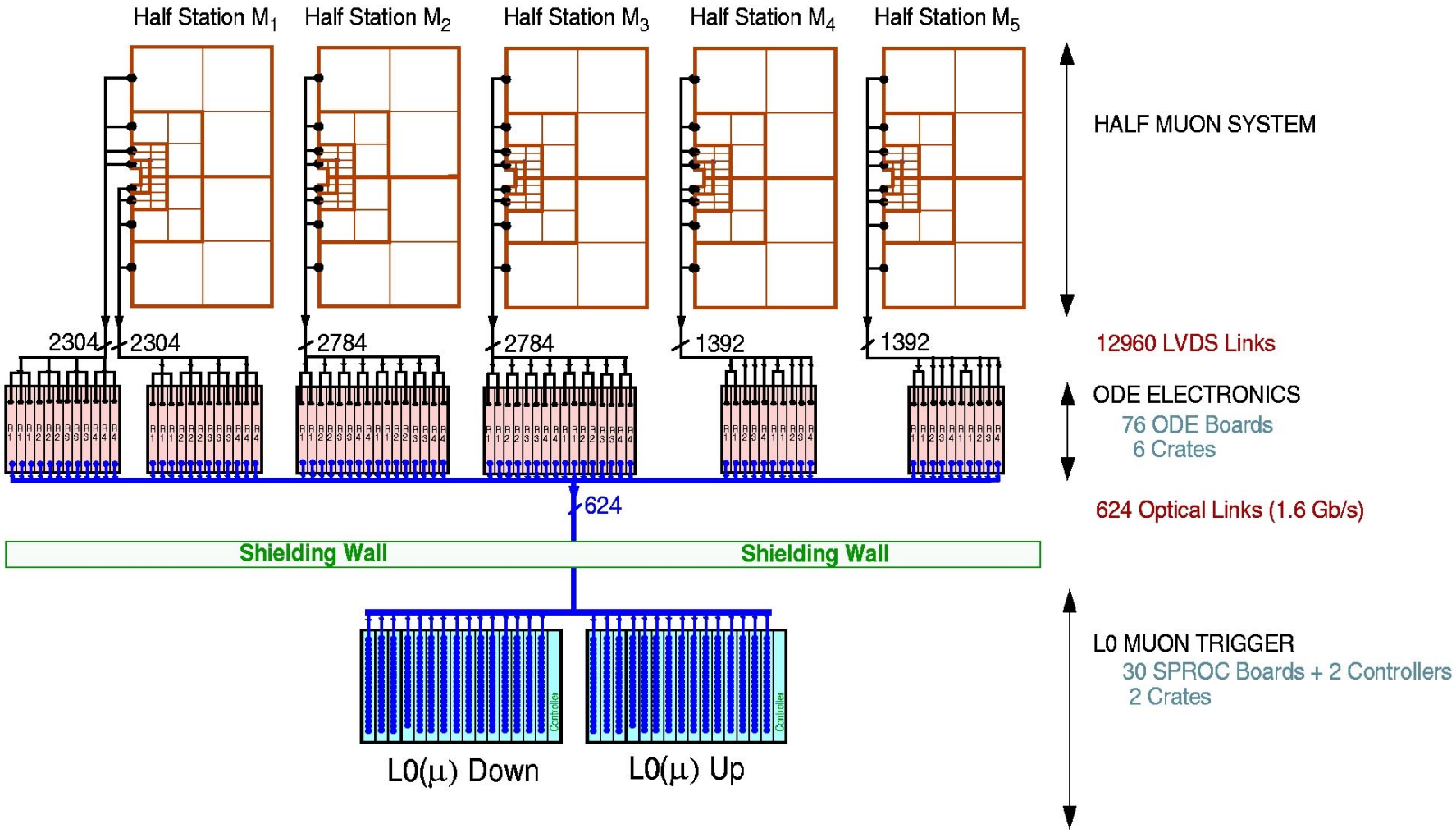
+ Custom made front-end chip in 0.25 μm CMOS technology

(CARIOCA) (backup: a modified ASDQ chip)



8) Trigger (TDR January 2002)

Level-0 muon trigger: design is changed to be fully synchronous



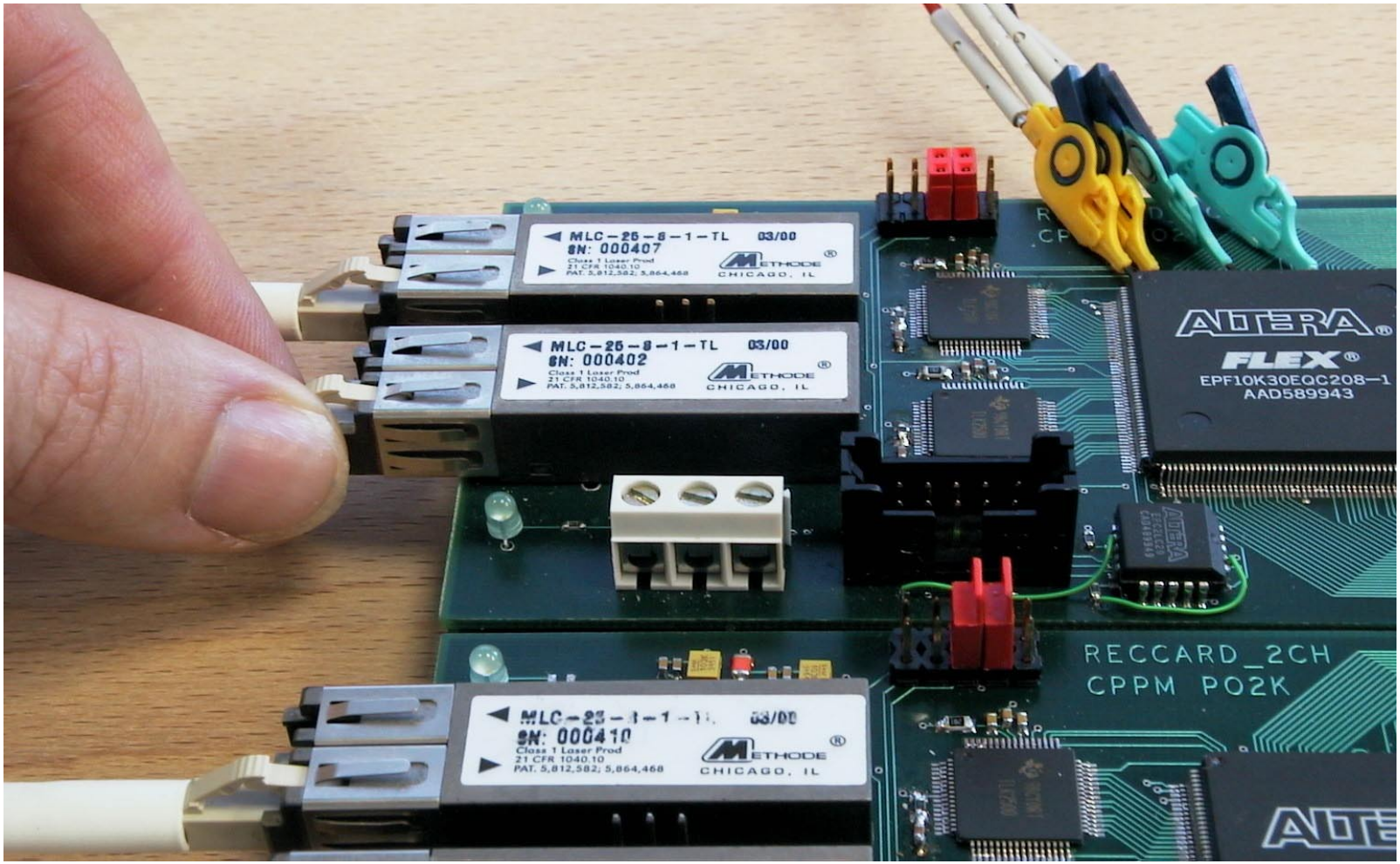
All the information is sent to the processor units at once

+ Simple and robust system

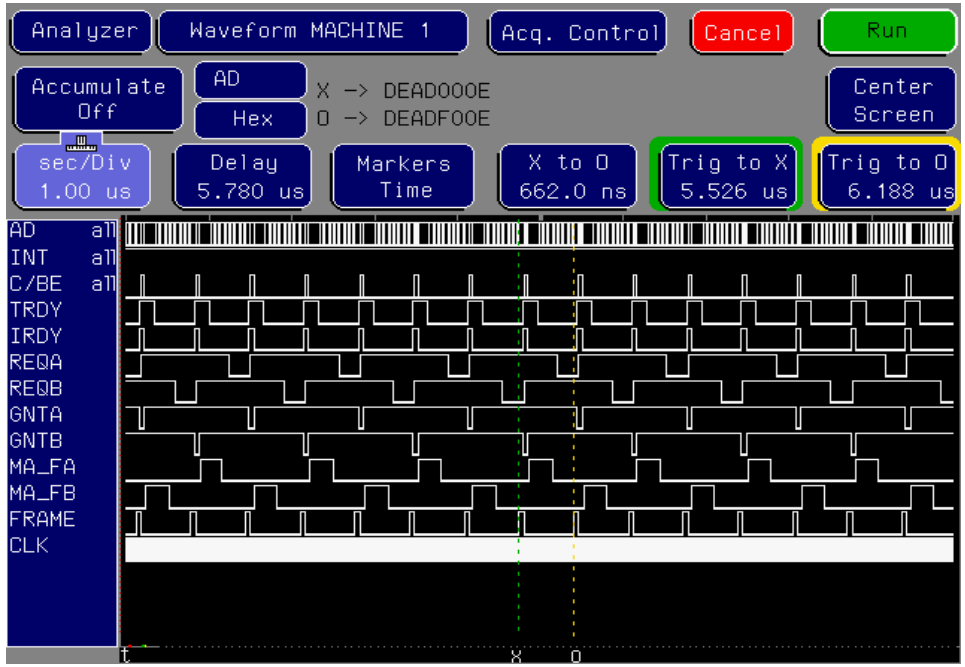
– Large amount of data to be transferred by optical links

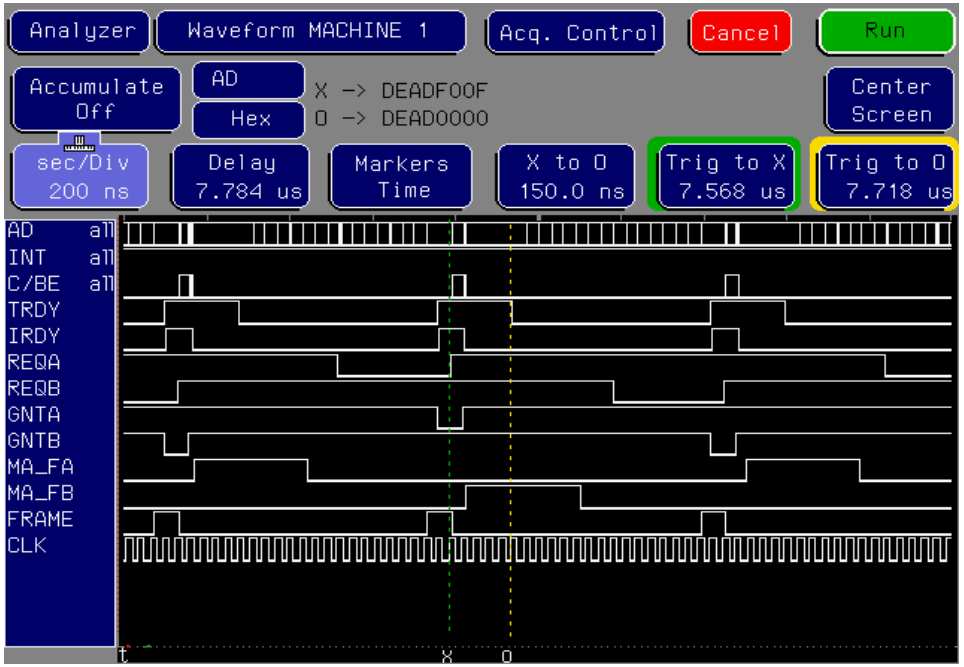
→ reduced number of logical channels(→muon system)

→ cost effective way with ribbon (12 in one)



Level-1 event building network: first prototype test
64 Bytes data over SCI





1.51 MHz transfer rate can be achieved

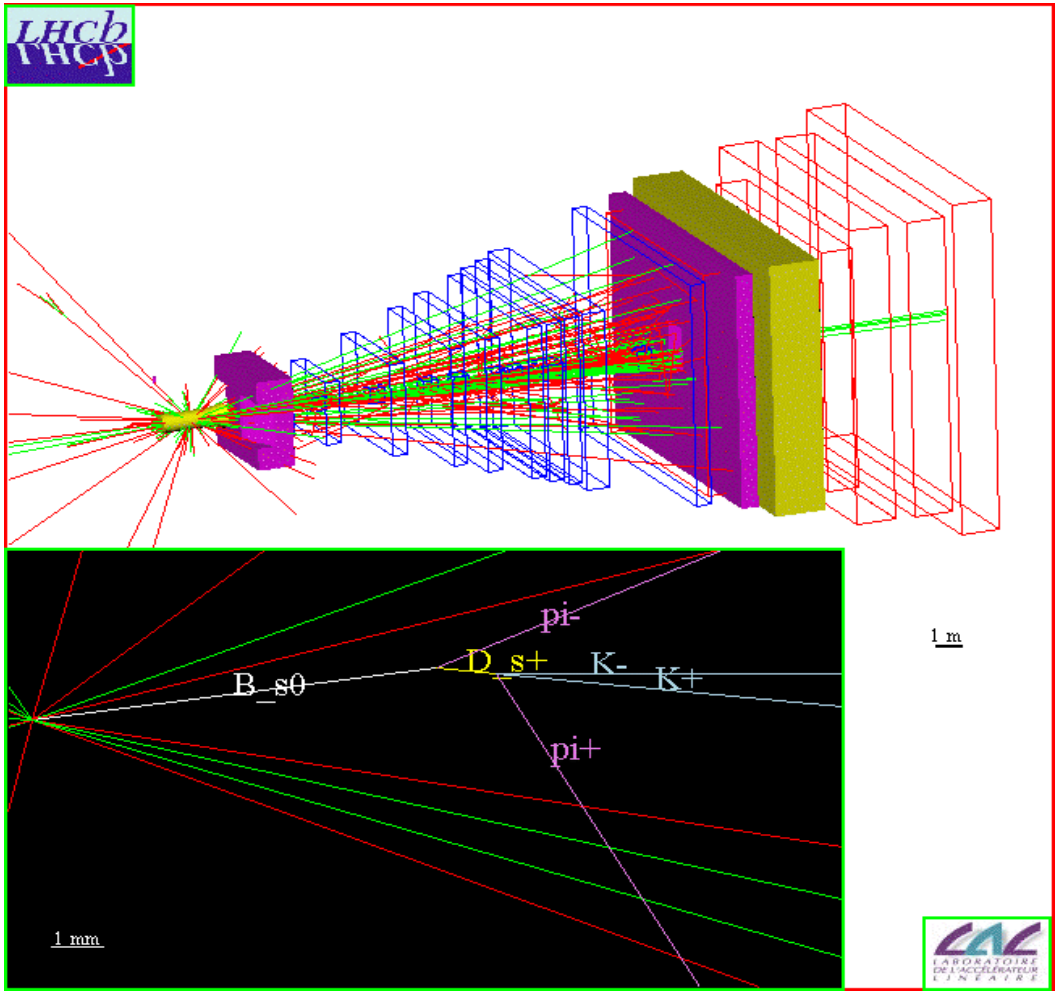
(1 MHz needed)

9) Computing

Offline effort

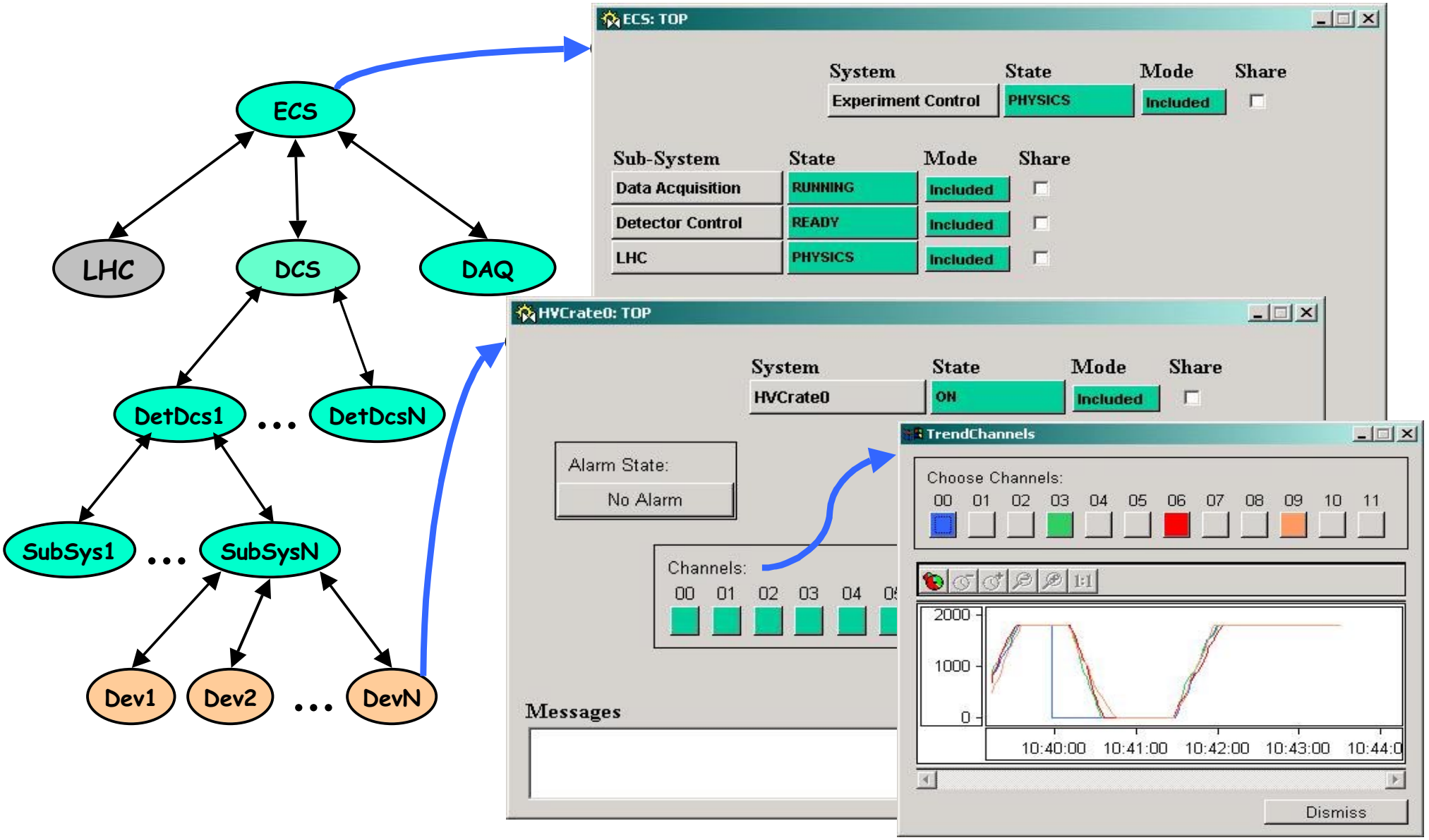
Framework (GAUDI) and Reconstruction (BRUNEL) in place.
Simulation (GEANT4) effort has started.

Event Display integrated in GAUDI + GEANT4
(an example of the core software contribution by an external institute)



Experimental Control System

User interface panels to build up the system



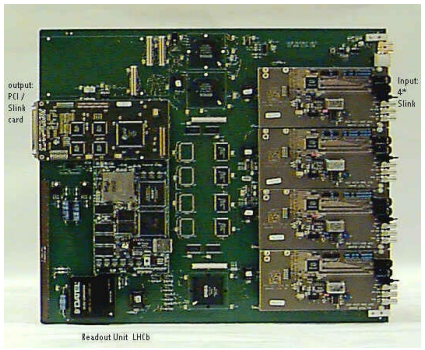
An alternative option for the Readout Unit

Network Processor

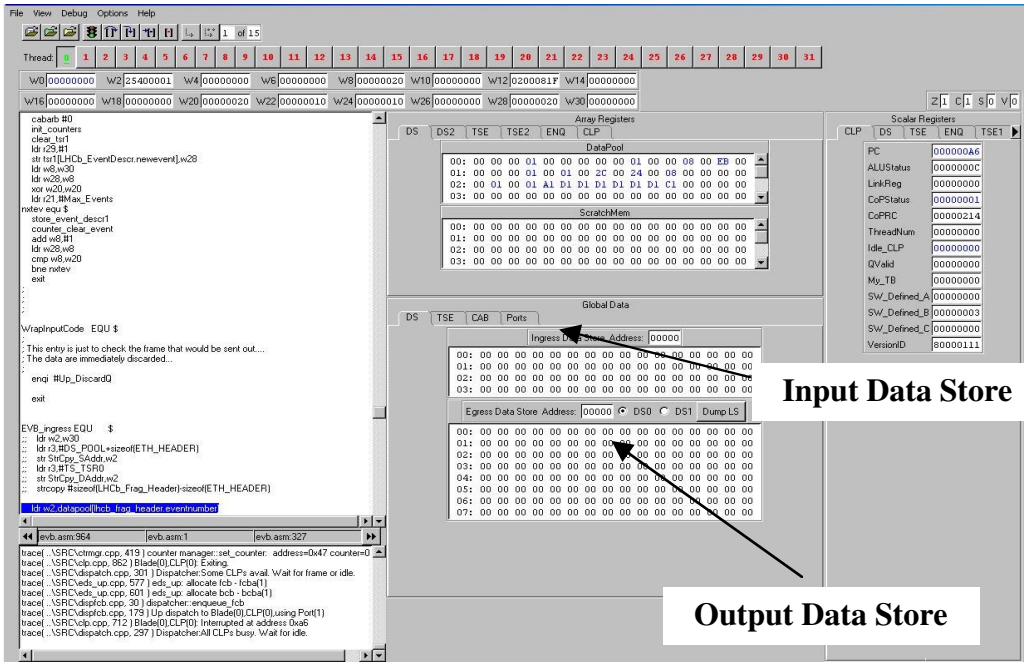
Network Processors:
New technology for assembling data fragments:
Programmable and fast.

Performance (simulated) ~250 kHz
Required <100 kHz

FPGA-based custom board



Network Processor Simulator Panel



10) Collaboration Issues

Withdrawal of in-active members

Russia: Lebedev Institute

Germany: Humboldt University, Freiburg University

(Expressed interests to rejoin later)

New Collaborators from Brazil

Full member: CBPF

Technical Associate: CEFET RJ (host UFRJ)

Currently the LHCb collaboration consists of

47 member institutes + 3 technical associates

500 people from 14 countries.

Organization:

Calorimeter Project established:

Project Leader:

J. Lefrancois (LAL)

Deputy Project Leader and coordinator for the detector construction:

A. Schopper (CERN)

Muon Subsystem deputy coordinator appointed:

G. Carboni (Rome II)

11) Summary

-Good progress in all the areas

-TDR's approved for

Magnet: major components have been ordered

Calorimeter: preparation for the production started

RICH: photon detector is the crucial item

(Commercial backup solution available)

-Three TDR's will be submitted before the next RRB

VELO and Muon: May

Outer Tracker: September

MoU signed by (see HJH's presentation)

France, Germany (MPI), Italy, The Netherlands, Romania, Russia

Switzerland (Lausanne, Zurich), UK

Still to be signed by

Brazil, China, Germany (BMBF), Poland, Spain, Ukraine