



CERN-RRB-2002-136

Status of the LHCb Experiment

RRB meeting 23 October 2002

CERN, Geneva

on behalf of the LHCb Collaboration

Tatsuya Nakada

CERN and University of Lausanne

Contents

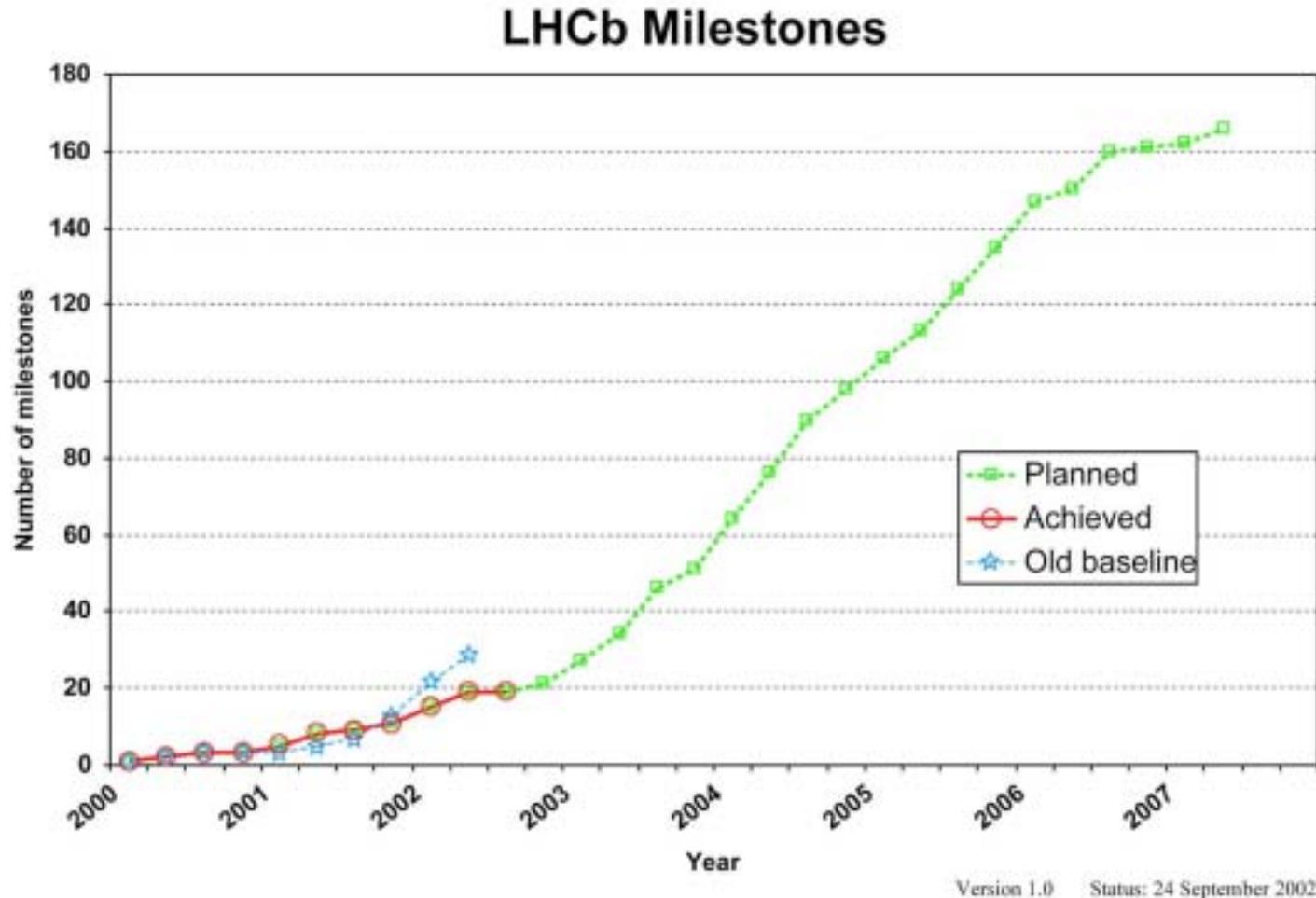
- 1) General Issues
 - milestone status
 - LHCb organization
 - MoU status
- 2) LHCb-light Status
- 3) Subsystem Status
- 4) Summary

1) General Issues

Milestone status

All the milestones have been updated for
first beam in April 2007

(Original milestones assumed beam in July 2005)



LHCb organisation; (new appointment)

CALOrimeter (SPD, Preshower, Ecal, Hcal)

Project Leader

A. Schopper (CERN)

Deputy

J. Lefrancois (LAL)

Magnet

Project Leader

W. Flegel (CERN)

Muon

Project Leader

G. Carboni (Rome II)

Deputy

P. Campana (Frascati)

Deputy

B. Schmidt (CERN)

Outer Tracker

Project Leader

A. Pellegrino (NIKHEF)

RICH (RICH-1, RICH-2)

Project Leader

D. Websdale (ICL)

Deputy

O. Ullaland (CERN)

Silicon Tracker (TT, IT)

Coordinator

U. Straumann (Zurich)

Deputy

O. Steinkamp (Zurich)

Trigger (Level-0, Level-1, HTL)	
Coordinator	H. Dijkstra (CERN)
Vertex Locator	
Project Leader	T. Ruf (CERN)
Computing (Online, Offline)	
Coordinator	J. Harvey (CERN)
Experimental Coordination	
Electronics	J. Christiansen (CERN)
Experimental area	D. Lacarrere (CERN)
Test beam	R. Lindner (CERN)
Task force coordination	
Particle identification	R. Forty (CERN)
Physics	O. Schneider (Lausanne)
Tracking	M. Merk (NIKHEF)
Technical Coordinator	W. Witzeling (CERN)
Resource Coordinator	A. Smith (CERN)
Coll. Board Chair	C. Matteuzzi (Milano)
Spokesperson	T. Nakada (CERN/Lausanne)

Construction MoU signature status

New signature:

China Vice President of Tsinghua University, Beijing has signed MoU for their contribution to the common project and OT.

Still to be signed:

Brazil

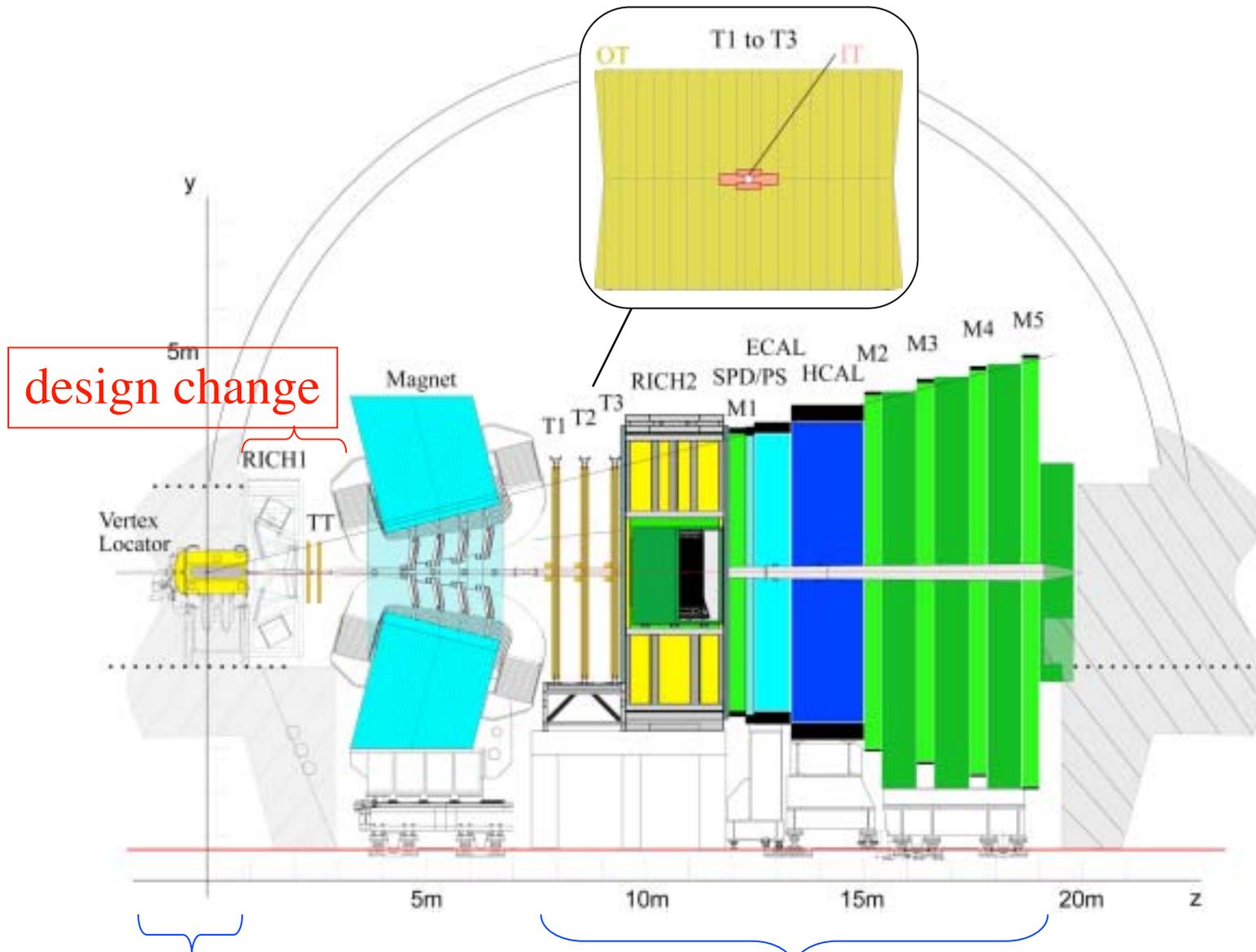
Germany, BMBF Discussion is in progress so that the participating institutes will sign

Poland

Already signed:

France, Germany (MPI), Great Britain, Italy, The Netherlands, Romania, Russia, Spain, Switzerland, Ukraine

2) Status of LHCb-light



designs not affected by the switch to LHCb-light

Design not affected

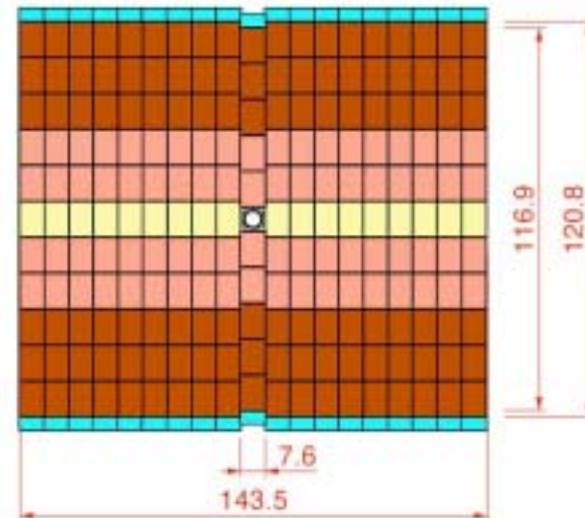
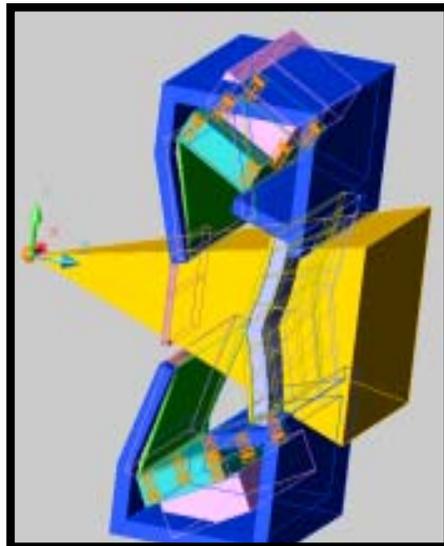
VELO, T1 to T3 (OT and IT), RICH-2, CALO and Muon
proceed toward the construction

Re-design needed

RICH-1: modify mechanics and optics to shield photon detectors

TT: change from straw/Si combination to all silicon detector to be used in the L-1 trigger.

Will be presented to LHCC in due time



Validate the tracking system with reduced number of tracking stations.

NB: reduced from 11 (TP) to 9 (OT TDR) to 4 (now LHCb-light)

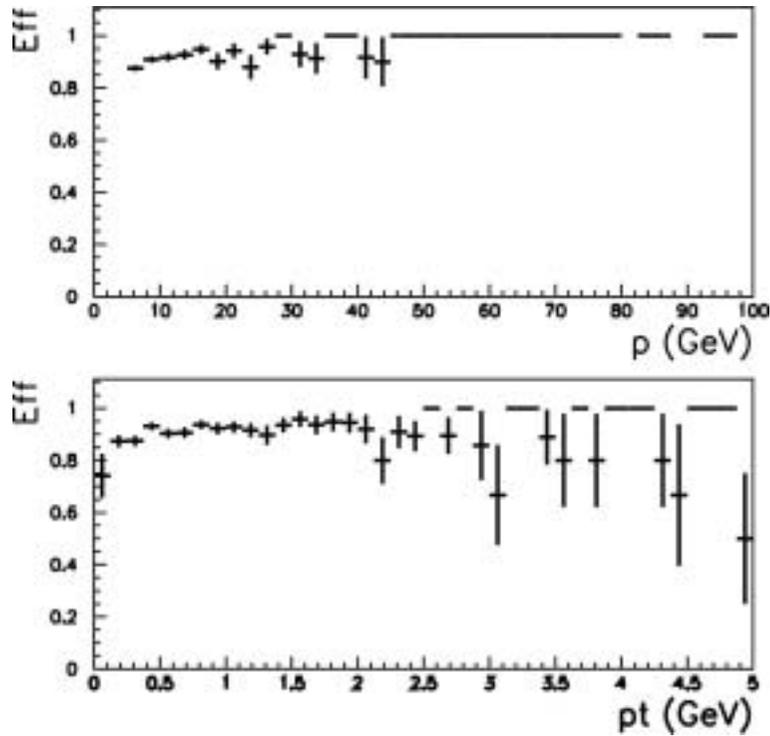
First round of high statistics (>1M events) performance study with new software environment (discussed later).

Despite of usual “running-in” problems in the new software , e.g.

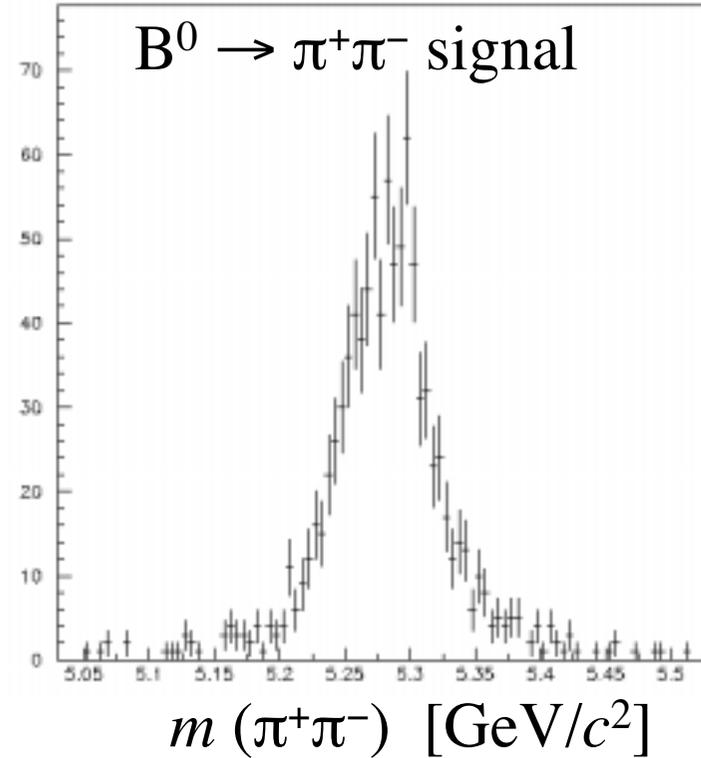
- detection efficiency of some detectors smaller than it should have been,
- fully optimized track finding strategy not yet in place
- track fit not fully tuned
- vertex resolution not well understood (nothing to do with light set-up)

etc.,

initial results are very encouraging.



track finding efficiency
 $> 90\%$ for $p > 5 \text{ GeV}/c$
ghost rate $\approx 30\%$



From 0.6M $b\bar{b}$ inclusive events
no background remains.
Event yield close to TP.

LHCb-light TDR submission

Originally planned toward the end of 2002

→ postponed to September 2003

Need to complete

a) physics performance study with

-improved reconstruction and analysis software

-much higher bb statistics for the background study

and

b) the designs for RICH-1 and TT.

This delay does not compromise the overall LHCb plan.

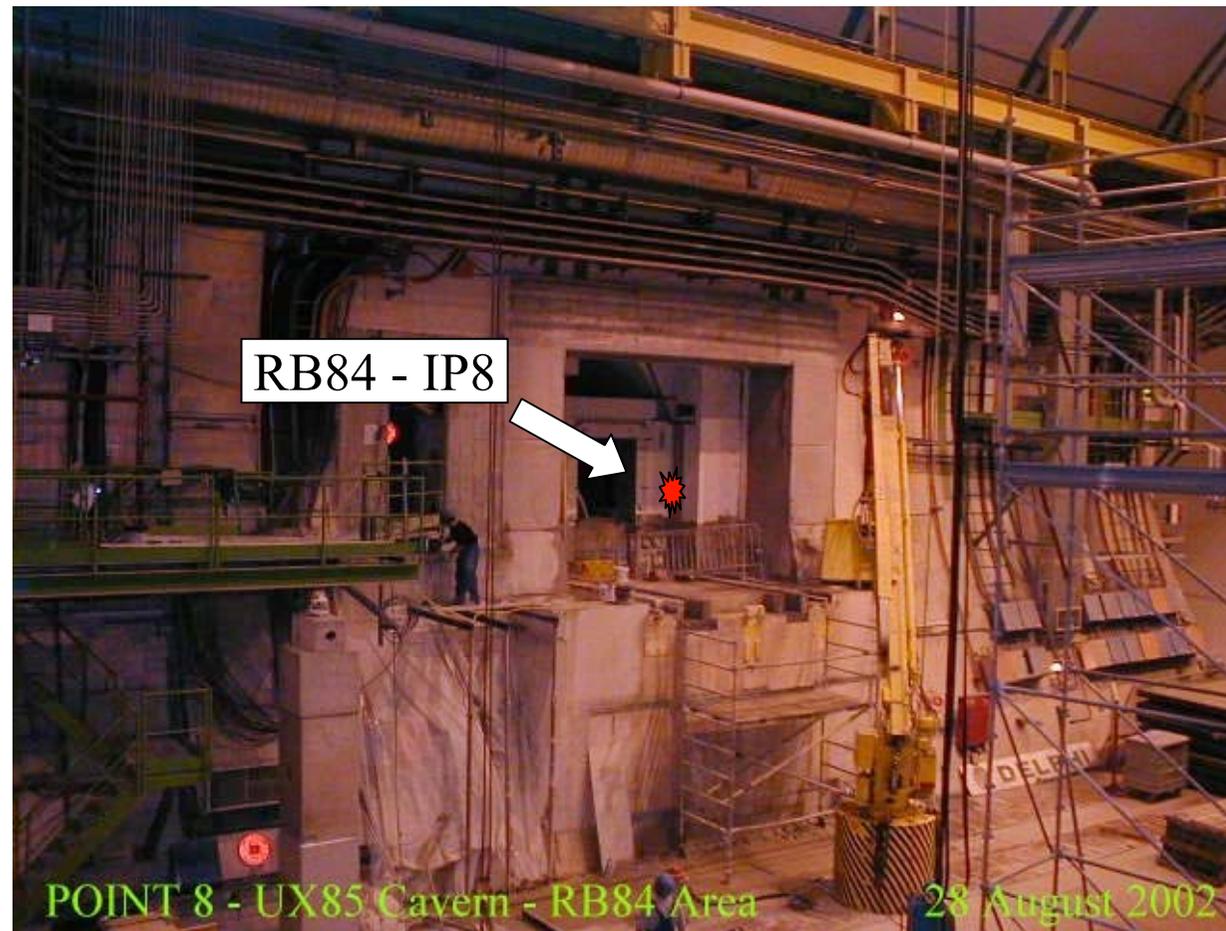
3) Subsystem status

Experimental area

Completed:

Concrete reinforcement of the head-wall

Cutting of the ex-DELPHI concrete shield in the RB84 Area

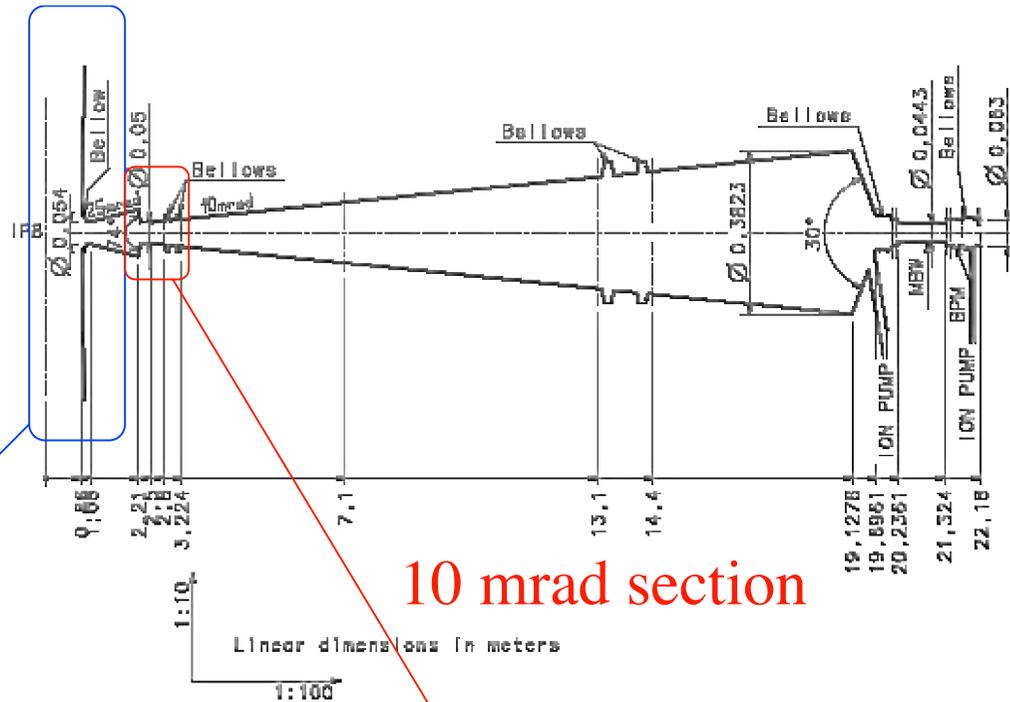


Installation of the magnet support beginning of 2003.

Re-installation of the General Services in the UX85 Cavern to be completed by Spring 2003

Beam Pipe

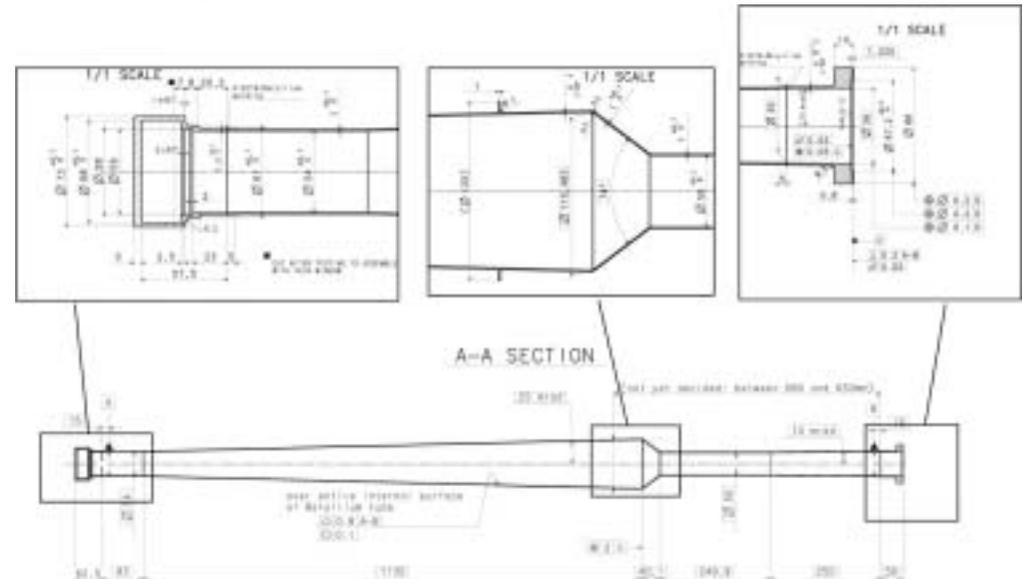
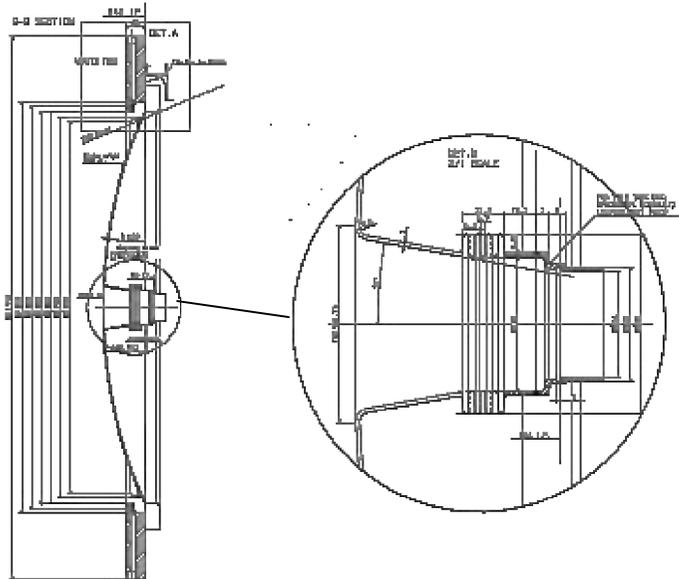
VELO tank exit window



10 mrad section

Al prototypes under construction at CERN

Be prototype being ordered to Komposit, Russia



Magnet

[funding from Common Fund (CF)]

Al conductor from
Holton Machinery LTD, UK
delivered to



SigmaPhi, France
for the coil construction



4 triplets potted
(a total 10)

24 pancakes wound
(a total 30)

Iron (600 t) for yoke is ready to be cut at Jebens, Germany

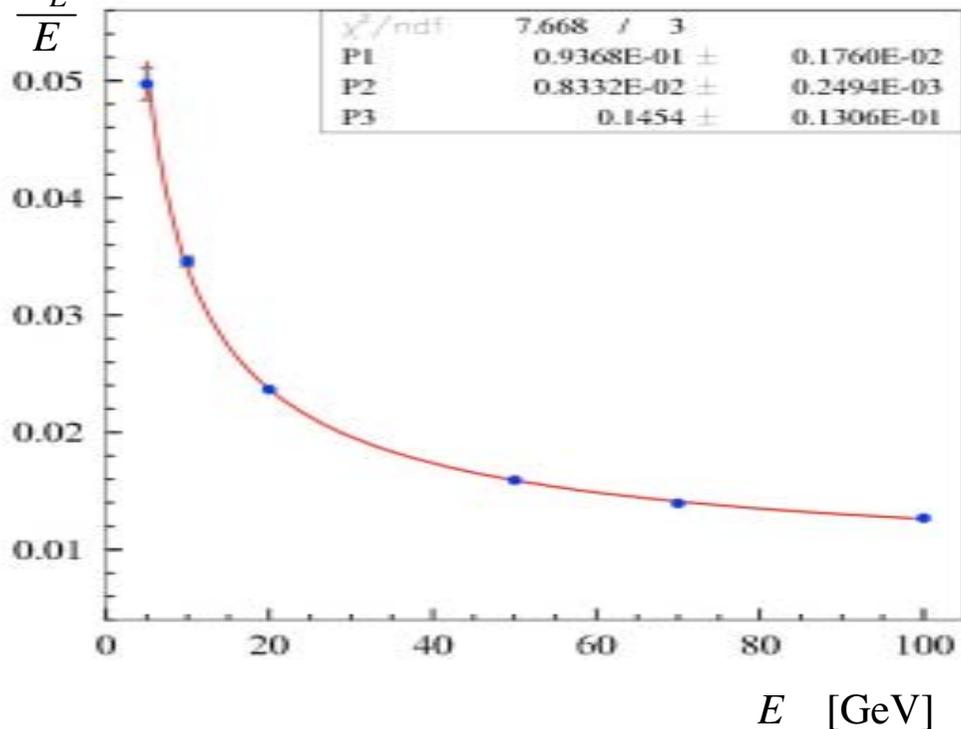
Magnet planned to be installed by the end of 2003 in IP8

Calorimeters (ES, FR, RO, RU, UA, CERN, CF)

ECAL series production
well advancing at ITEP Moscow
1200 modules arrived at CERN
(out of a total 3300)

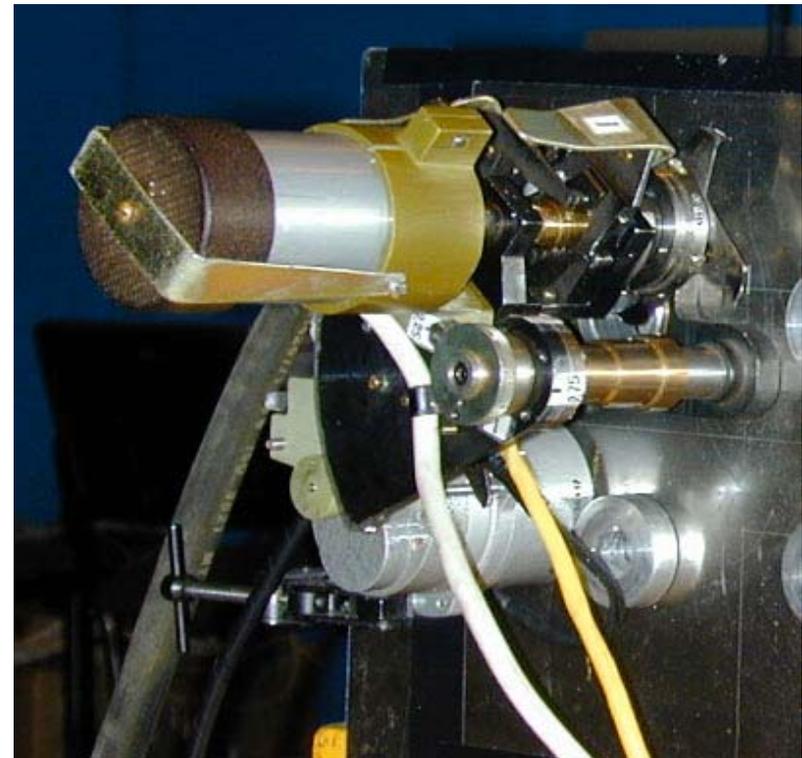
energy resolution measured in test beam

$$\frac{\sigma_E}{E} = \frac{9.4\%}{\sqrt{E}} \oplus (0.83 \pm 0.02)\% \oplus (0.145 \text{ GeV})/E$$



HCAL series production
started at IHEP Protvino
2 modules arrived at CERN
(out of a total 52)

fibre cutting machine
developed by Novosibirsk

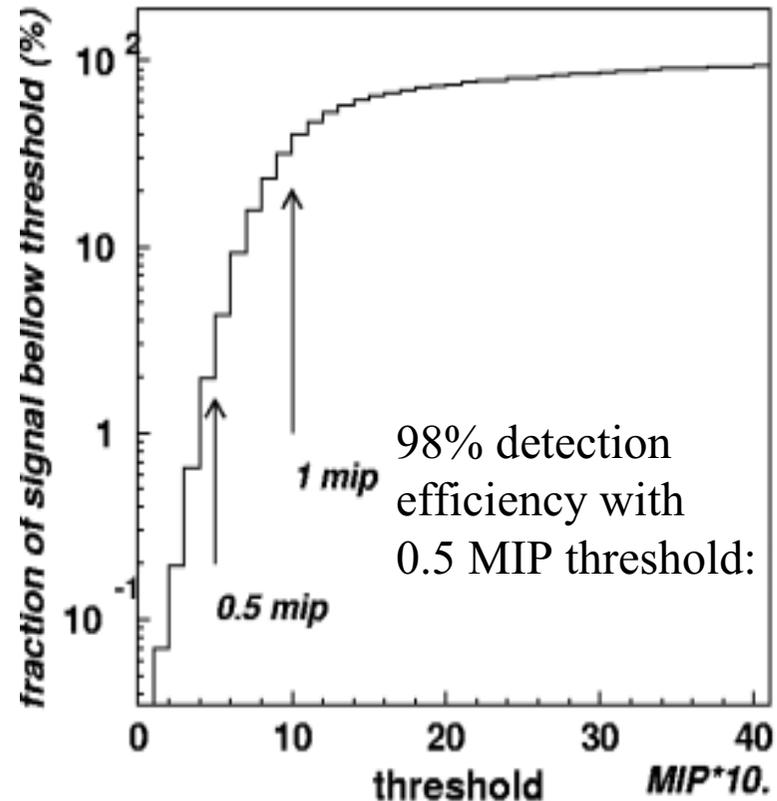
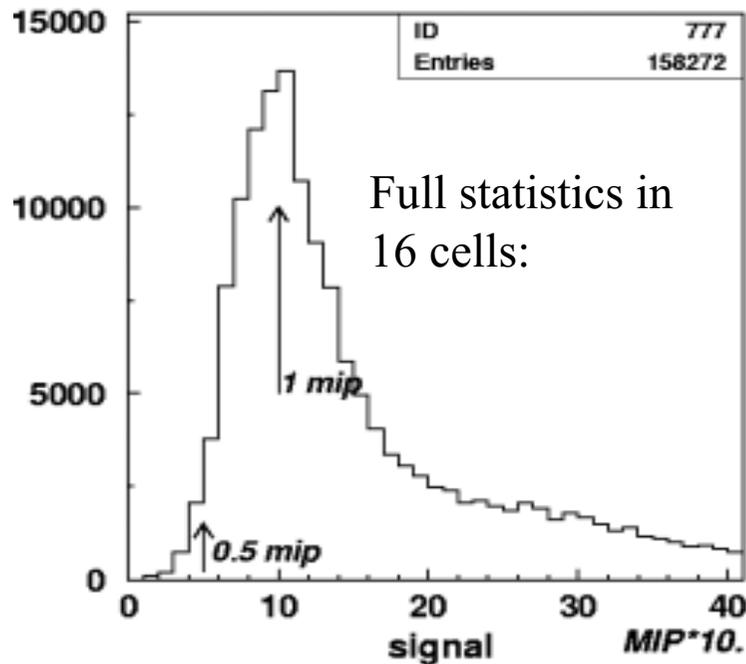


1200 ECAL and 2 HCAL modules in Hall 156



SPD and Preshower: preparation for series production at INR Moscow

Two modules of outer section geometry manufactured in May-June 2002 using technology to be applied for mass production.



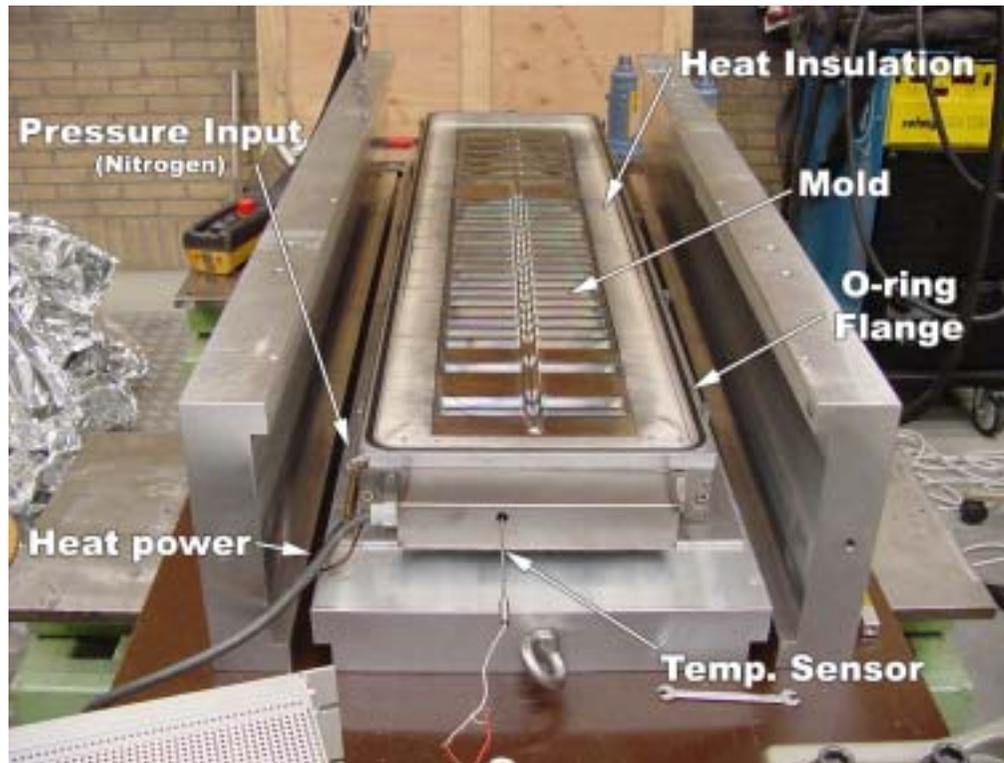
10% of SPD/Preshower
50% of E-cal modules
10% of H cal modules

November 2003
July 2003
February 2003

VELO

(CH, DE, GB, NL)

Prototyping of the critical items for the vacuum tank



Al RF shield

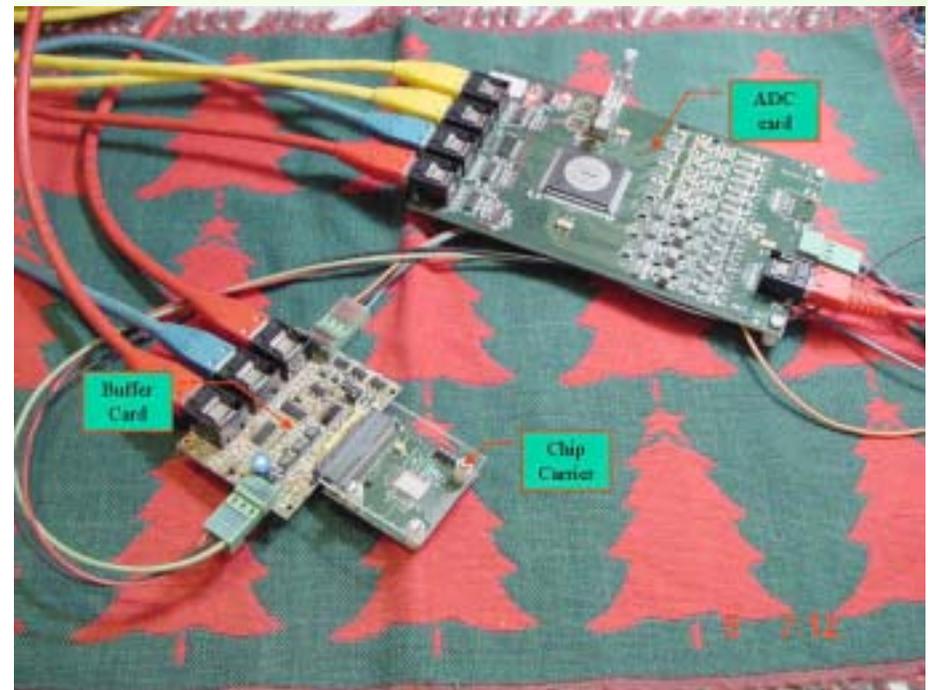
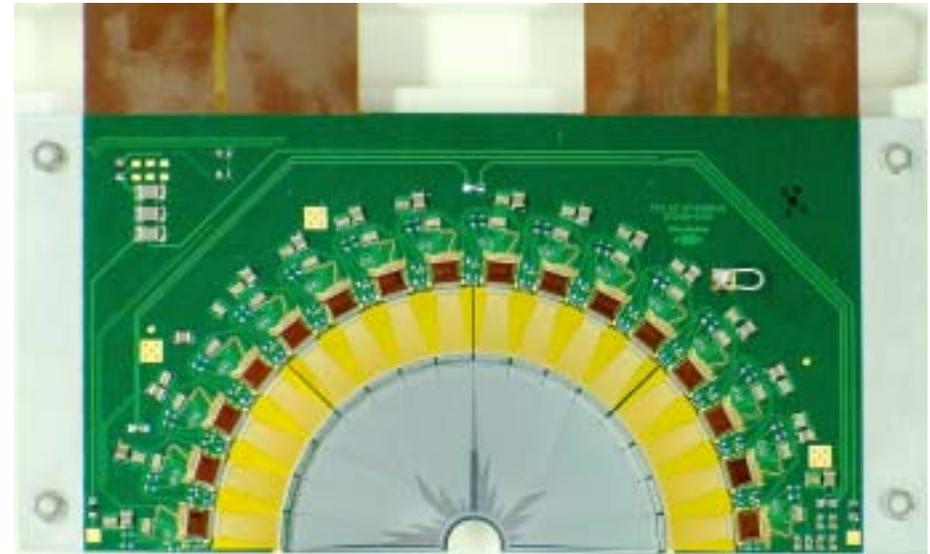


rectangular bellow

Decision of the front-end chip: SCTA-VELO (Dmill) vs Beetle (0.25 μ m)
beginning of 2003

Beetle 1.1 + Hybrid
for test beam

SCTA-VELO lab test set-up



2003
50% of Si sensors to be ordered
hybrid production to be started

Muon

(BR, IT, RU, CERN)

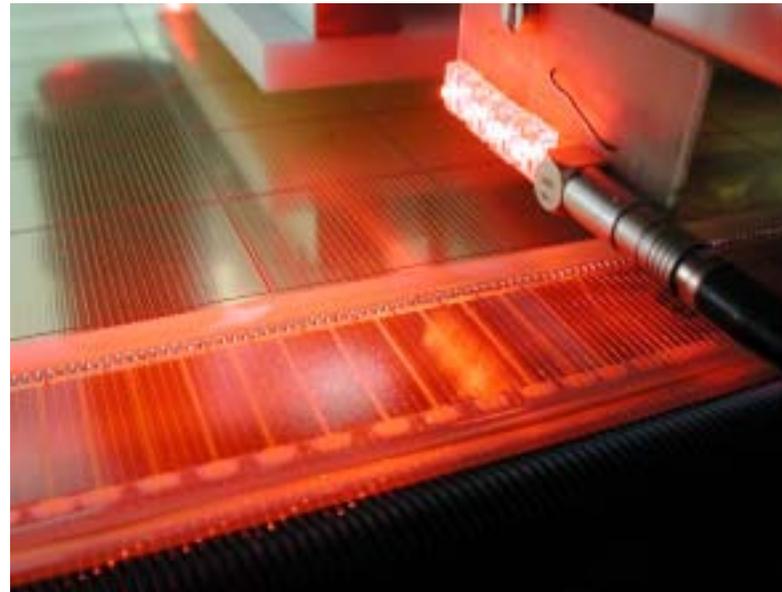
After careful aging study, RPC's were abandoned.

Continuous increase of resistivity of the plates
resulting in loss of rate capability.

Number of MWPC's increased: 864 \rightarrow 1344

Construction plan being worked out; extra site or more chambers/site?

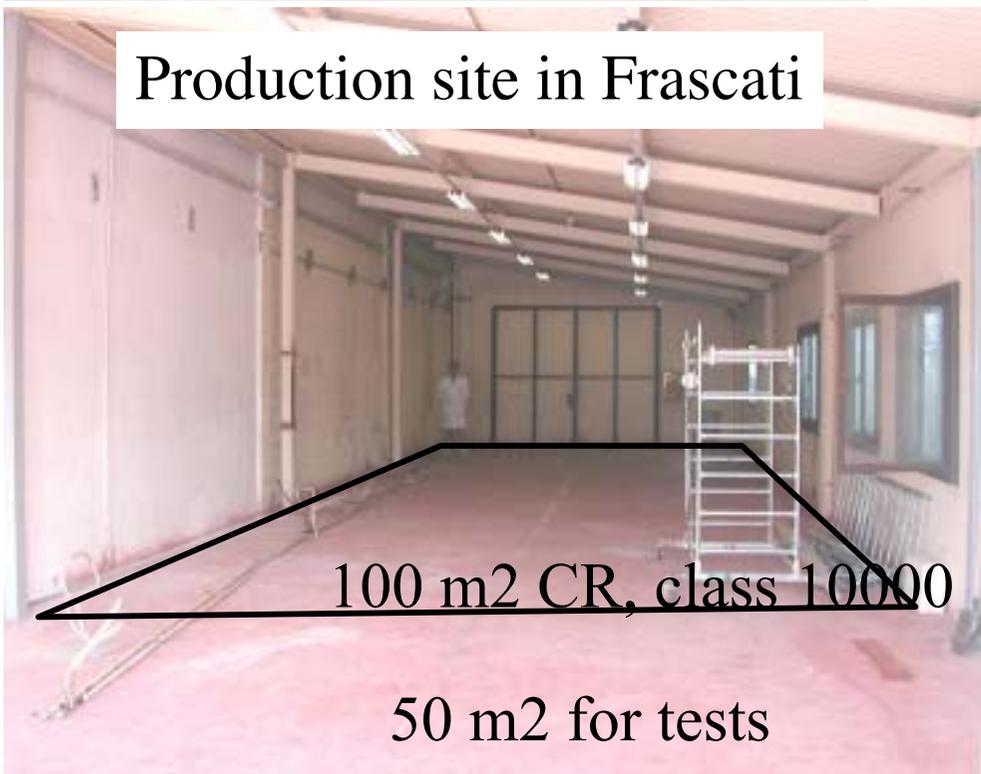
Preparation for series production in progress: tools and site
wire pitch measurement device at CERN and PNPI



wiring machine in Ferrara



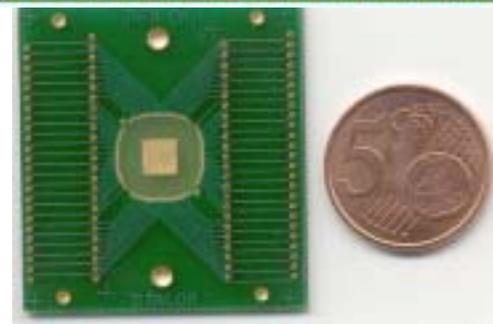
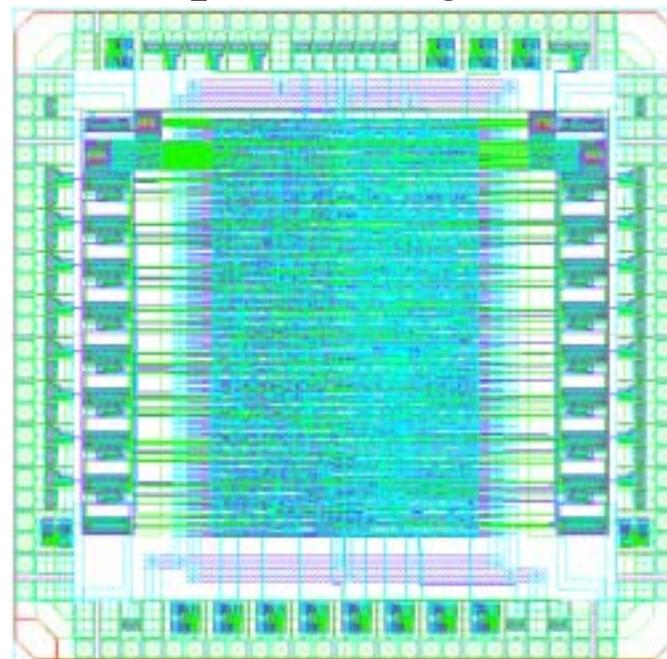
Production site in Frascati



100 m² CR, class 10000

50 m² for tests

DIALOG
(digital chip after discriminator)
developed in Cagliari



2003

MWPC production sites ready

RICH (GB, IT, CERN)

RICH-2 passed the Engineering Design Report.
Construction will start soon.

mirror support prototype

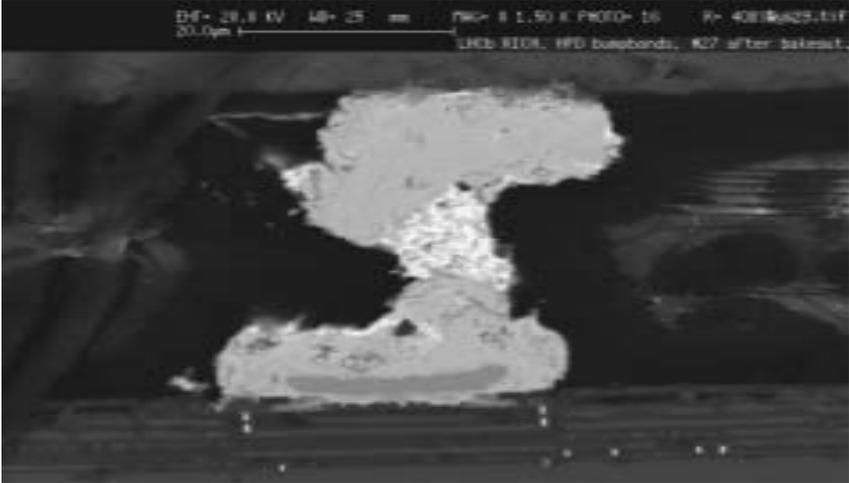


composite window prototype

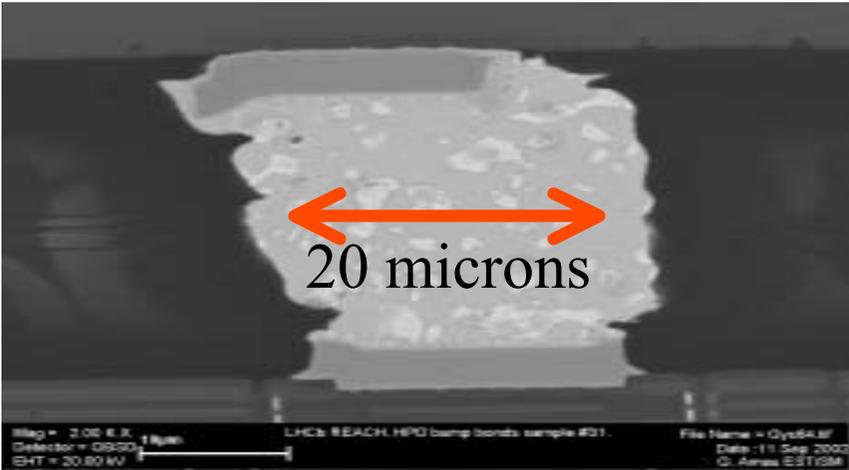


Photon detector remains the critical item: HPD development

positive progress in bump-bonding

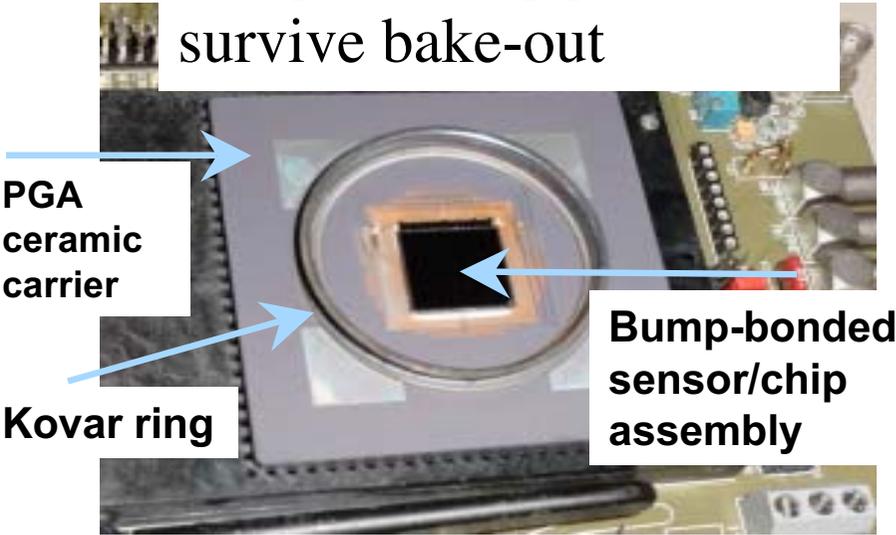


old "Stretched" bump bond



new "Relaxed" bump bond

Assemblies with the new bump bonding procedure survive bake-out

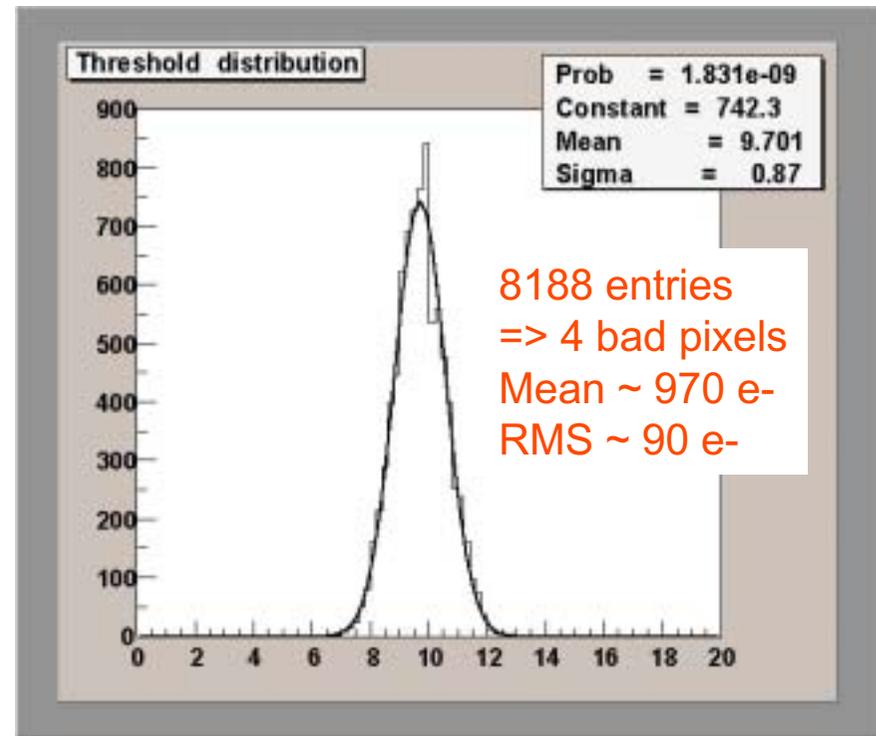
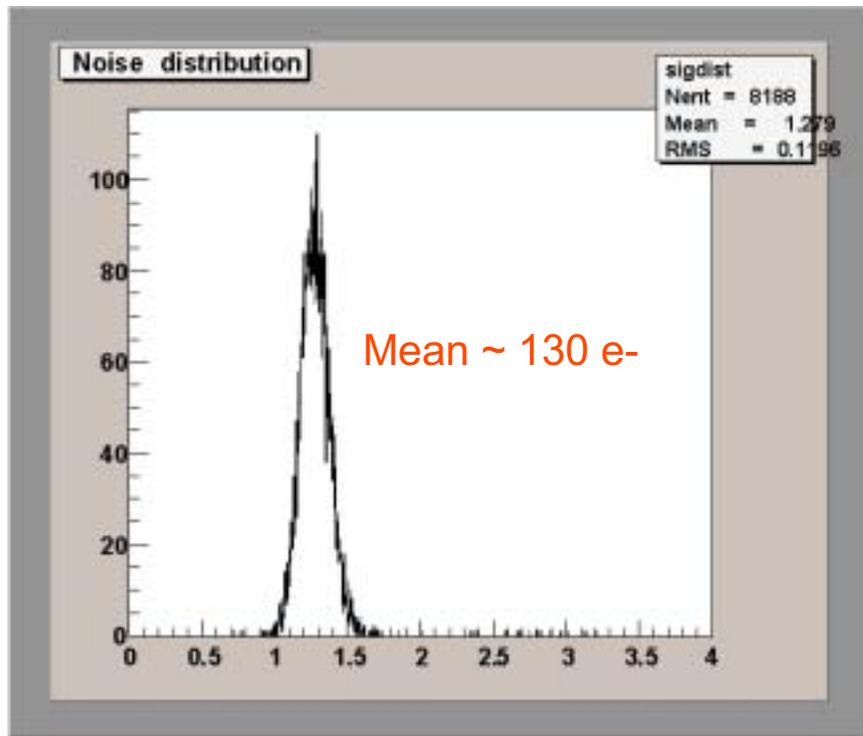


fraction of working pixels

Before	After
99.93 %	99.60 %
99.83 %	99.84 %
99.99 %	99.99 %

New prototype HPD by the end of 2002

LHCb pixel chip works at 40 MHz



Noise and threshold characteristics satisfy LHCb RICH requirements

Threshold < 2000e

Noise < 300e

MAPMT remains as backup solution: front-end chip prototype being produced (Beetle adjusted for the PMT input signal)

Orders for RICH-2 mirrors and superstructure in 2003

Outer Tracker (CN, DE, NL, PL, CERN, CF)

Tidying-up details of the chamber design: e.g.

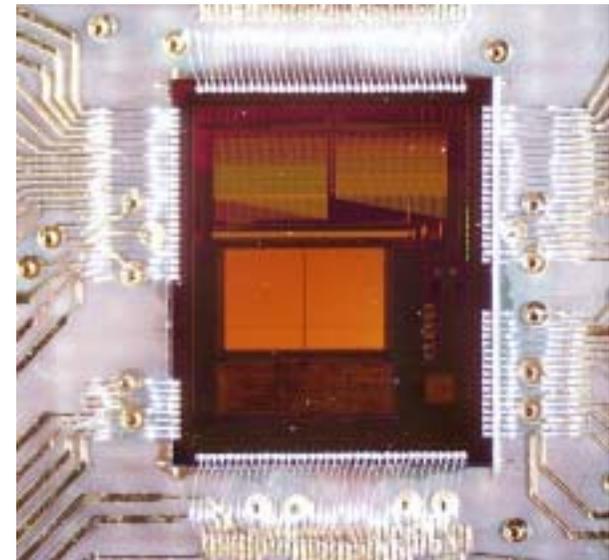
improving the wire locator design for noise reduction



gas tightness and mechanical stability test



TDC (OTIS 1.0)



Construction of the panel is ready



produced at Cracow

Preparation of the clean rooms in the three production sites:

- NIKHEF being assembled
- Heidelberg being extended
- Warsaw ready



Acquisition of chamber material in 2003.

Inner Tracker

(CH, DE, ES, UA)

test beam set-up

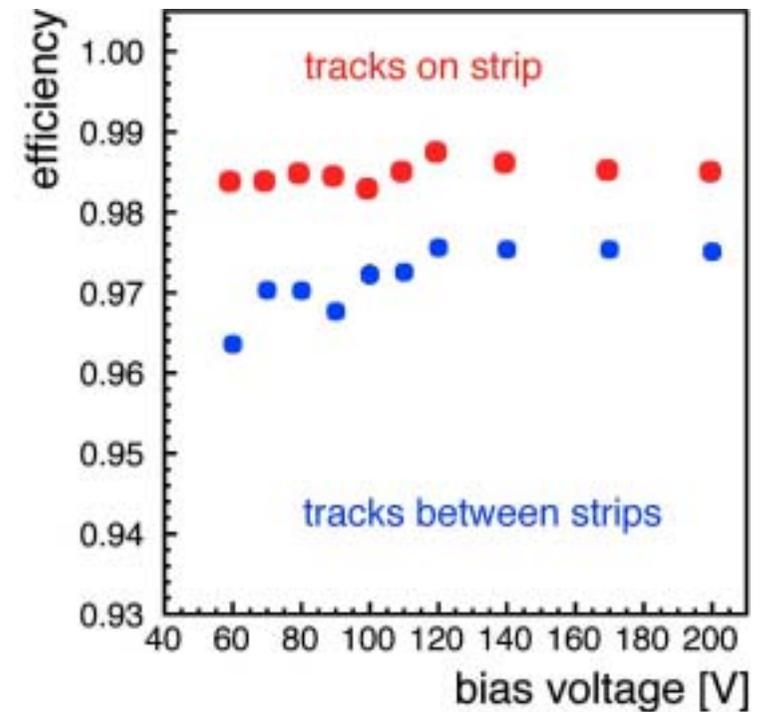


Si sensor parameters

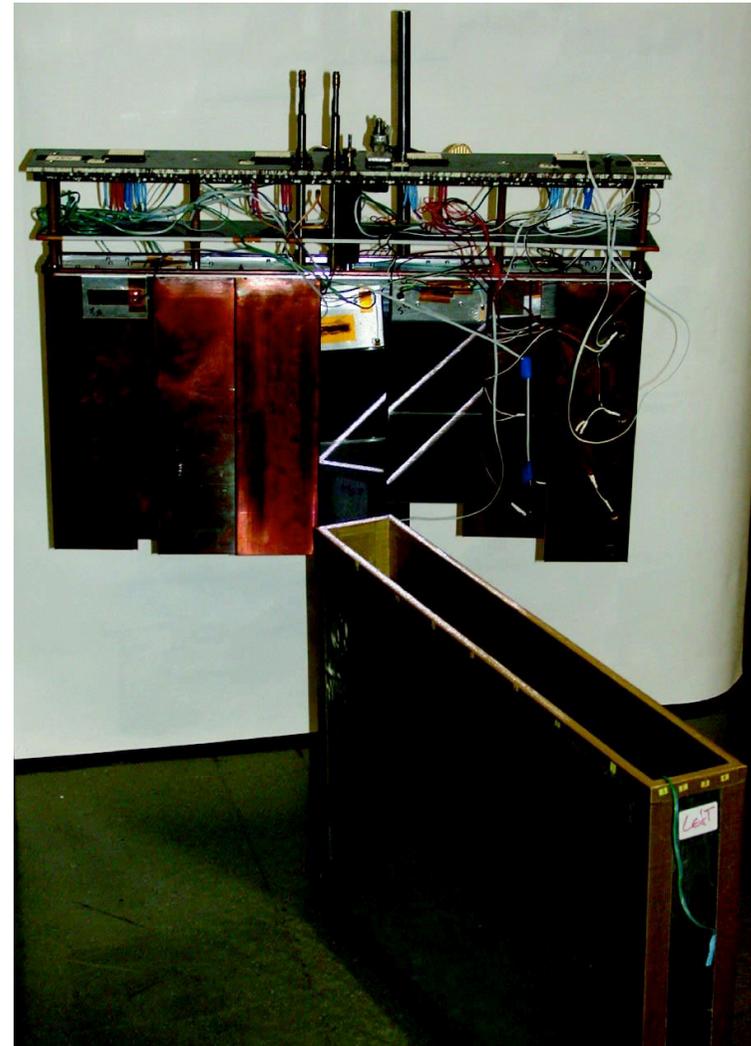
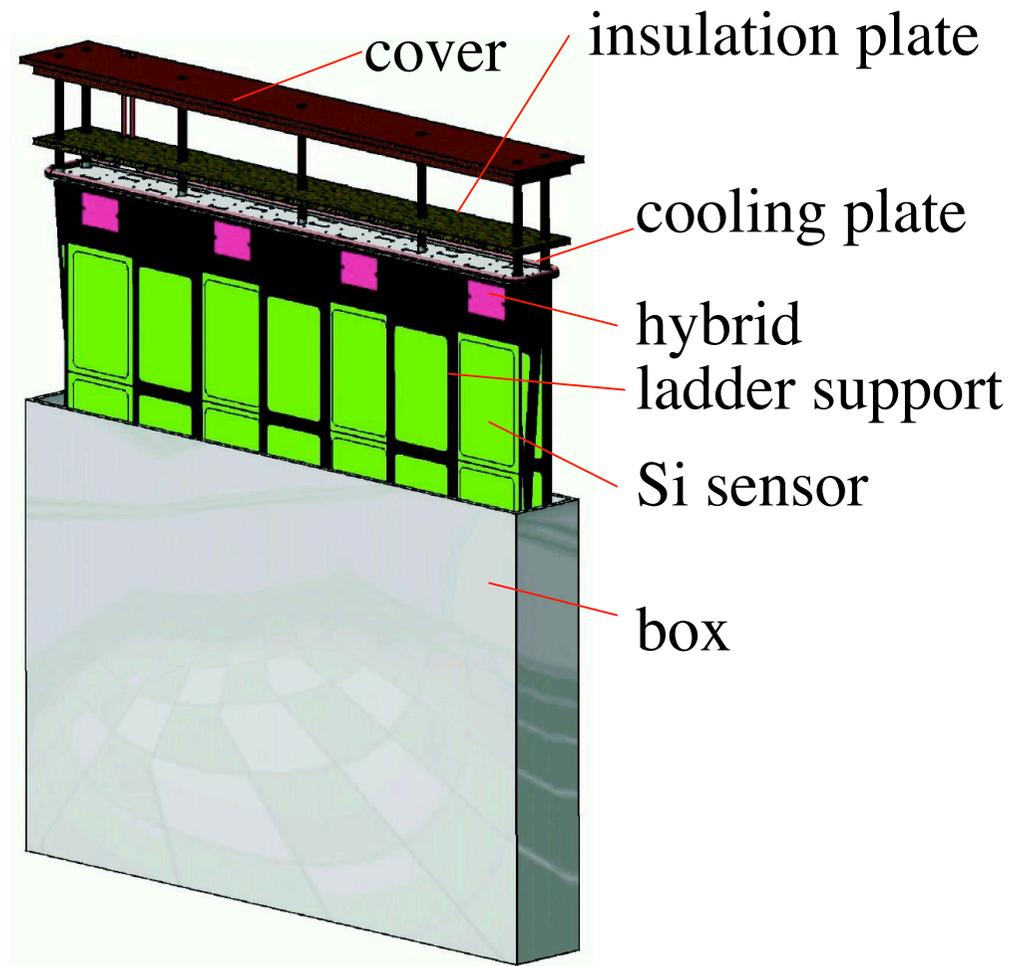
320 μm thick

198 μm strip pitch

2 \times 11 cm strip length

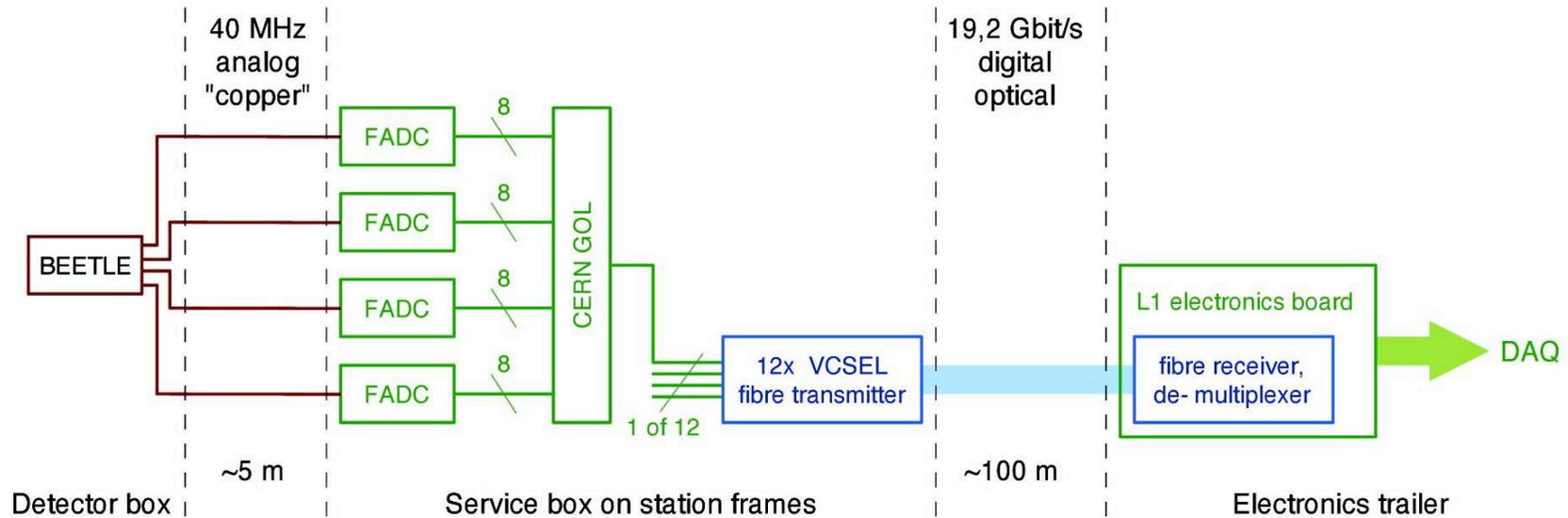


TDR mechanical design completed

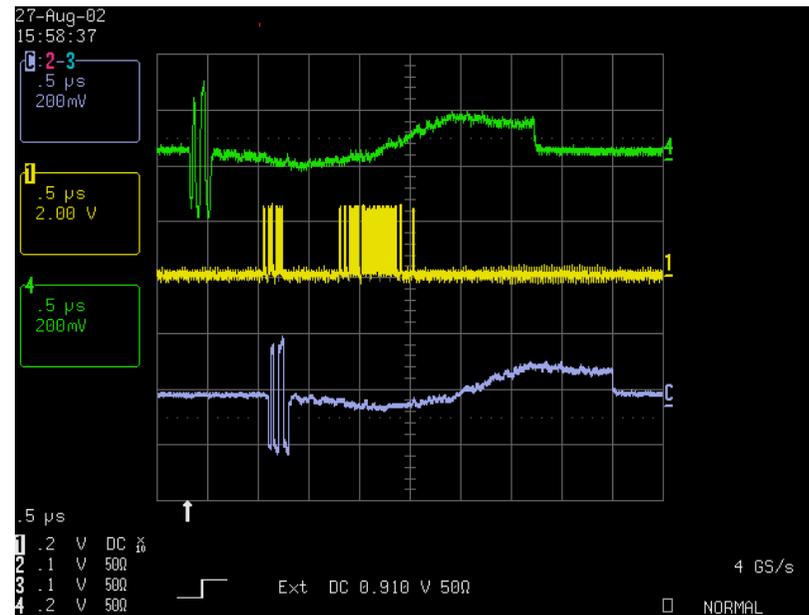


full scale model to test mechanical and cooling properties

Electronics layout



100 m optical link transmission test

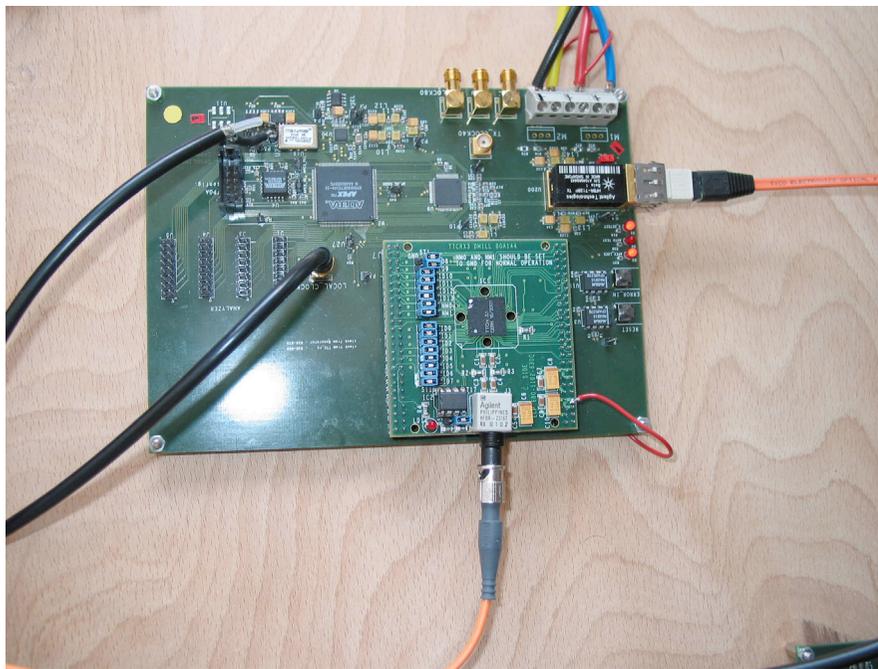


TDR will be submitted in November 2002 as planned.

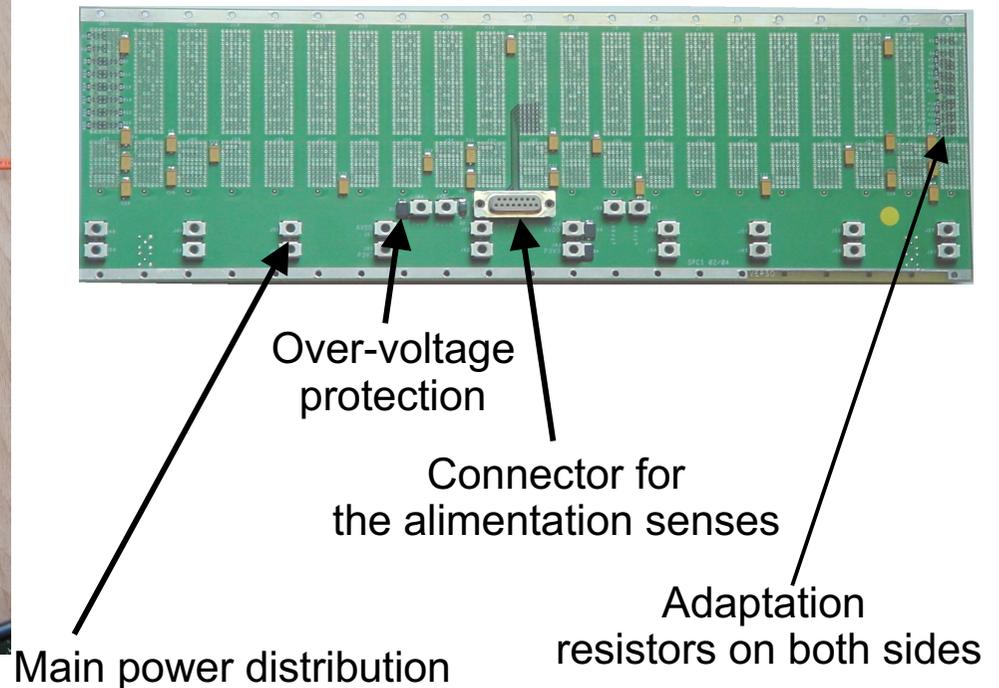
Trigger (CH, DE, FR, IT, NL, CF)

Basic designs of Level-0 trigger components have been completed and prototype works are in progress.

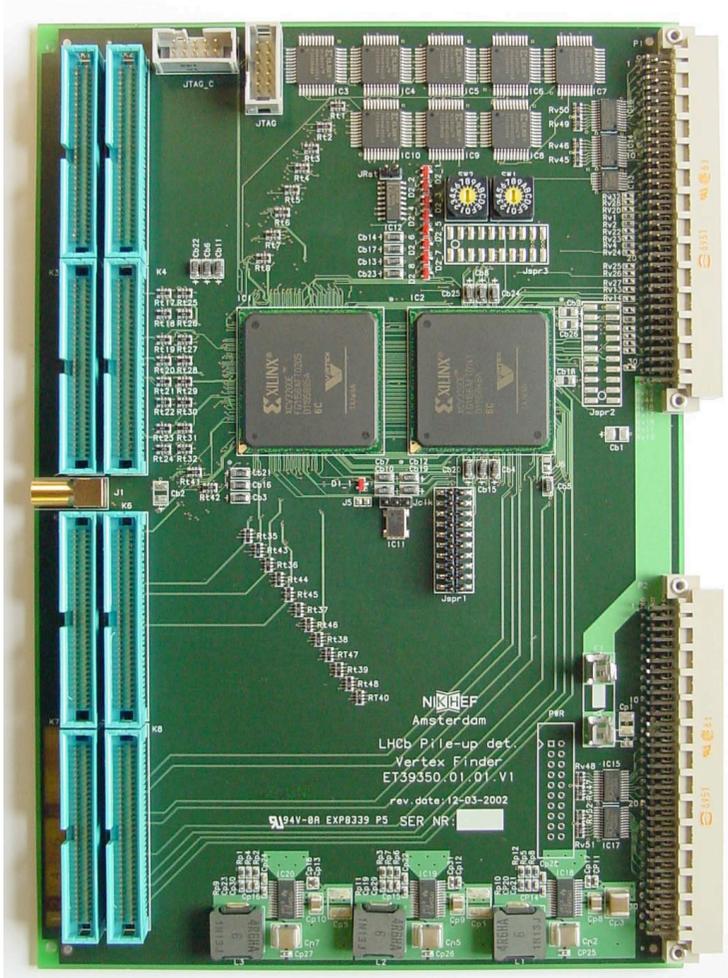
Level-0 muon trigger optical link test set-up



Calorimeter trigger crate back plane



Level-0 pile-up veto prototype



Level-0 decision unit prototype test set-up



- Level-0: designs reviewed by a panel including external referees.
- Level-1: re-evaluation of requirements due to the small data size expected from LHCb-light → a significant efficiency improvement.

Computing (CF)

New LHCb off-line environment is in place

Event generation and detector material simulation SICBMC
(Pythia, QQ, GEANT3)

Detector digitization and event reconstruction BRUNEL
(GAUDI)

Analysis of the reconstructed events DaVinci
(GAUDI)

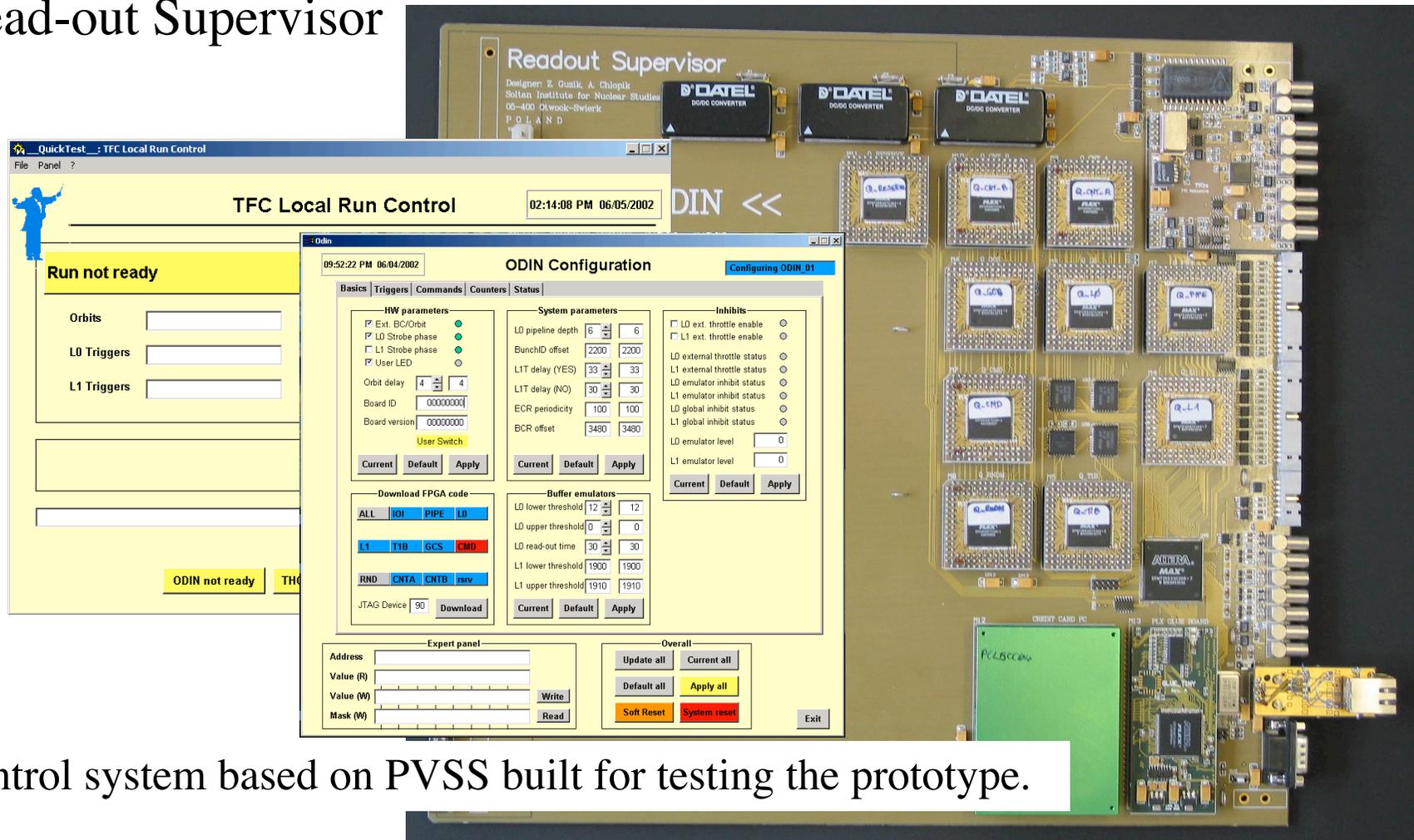
Large data samples (3.3 M events) produced in August by
Amsterdam (25k), Bologna (1009k), Cambridge (37k), CERN (1452k)
Lyon (595k), Moscow (27k), Oxford (24k), RAL(130k), Rio (24k)

All the OO-DST at CERN:
used for physics performance studies of LHCb-light ₃₂

Online activities

Some prototype building in Timing and Fast Control (TFC)

Read-out Supervisor



Run control system based on PVSS built for testing the prototype.

TTCrx chips for all subdetectors have been ordered for delivery in 2003

4) Summary

- i Magnet, Ecal and Hcal are well into the construction as planned.
- ii Several other subsystems will start spending CORE money in 2003 for acquiring material and preparation of the production sites.
- iii LHCb-light re-optimization work, affecting the RICH-1 and TT designs, will be completed by September 2003. This delay does not compromise the overall LHCb schedule.
Preliminary results show that large reduction of the tracking stations does not damage the physics performance.
- iv Much work to do but the experiment is well on its way to be ready for physics in 2007.