

Status of the LHCb Experiment

LHCb RRB at CERN

25 April 2007

on behalf of the LHCb Collaboration

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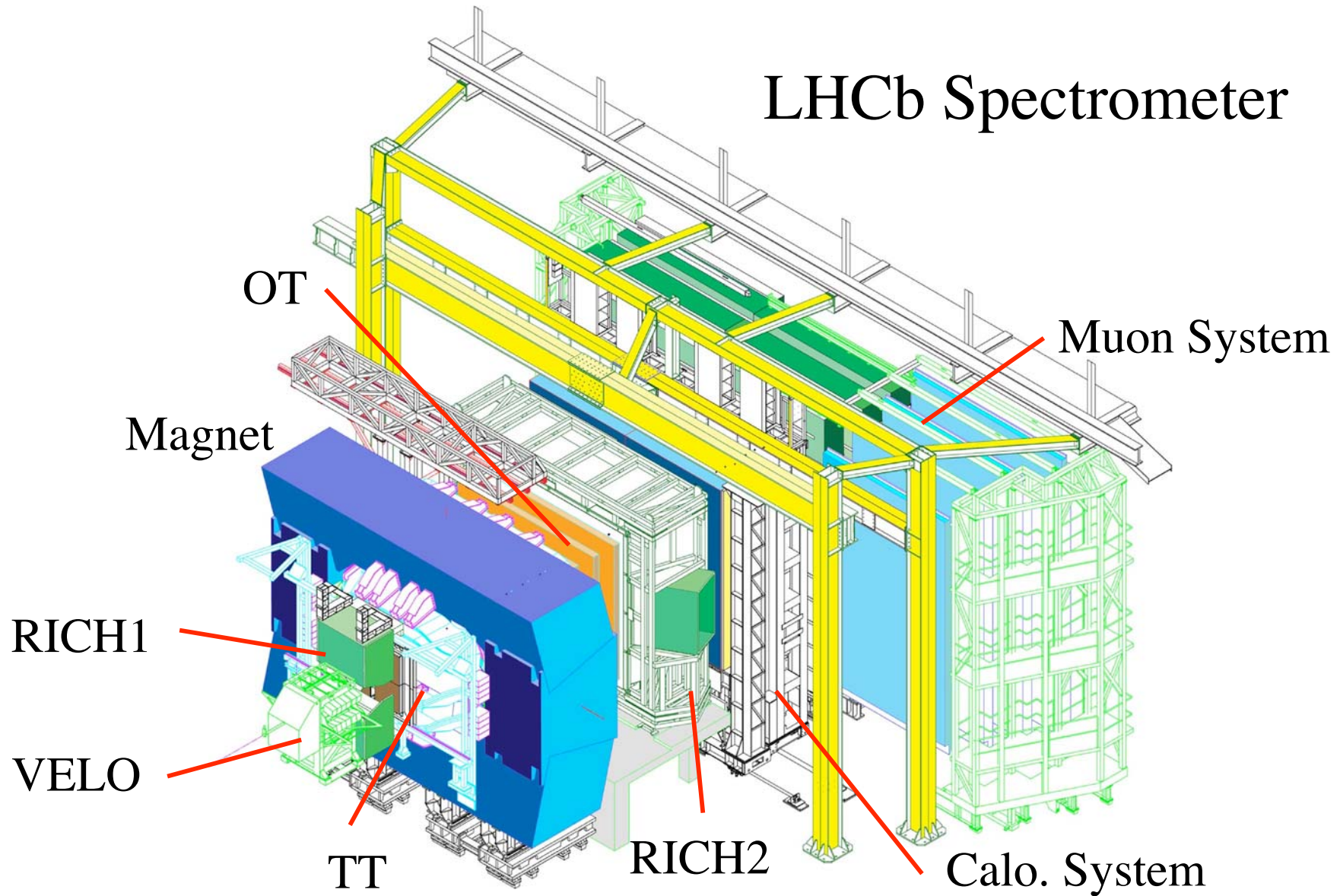
CERN
and
EPFL

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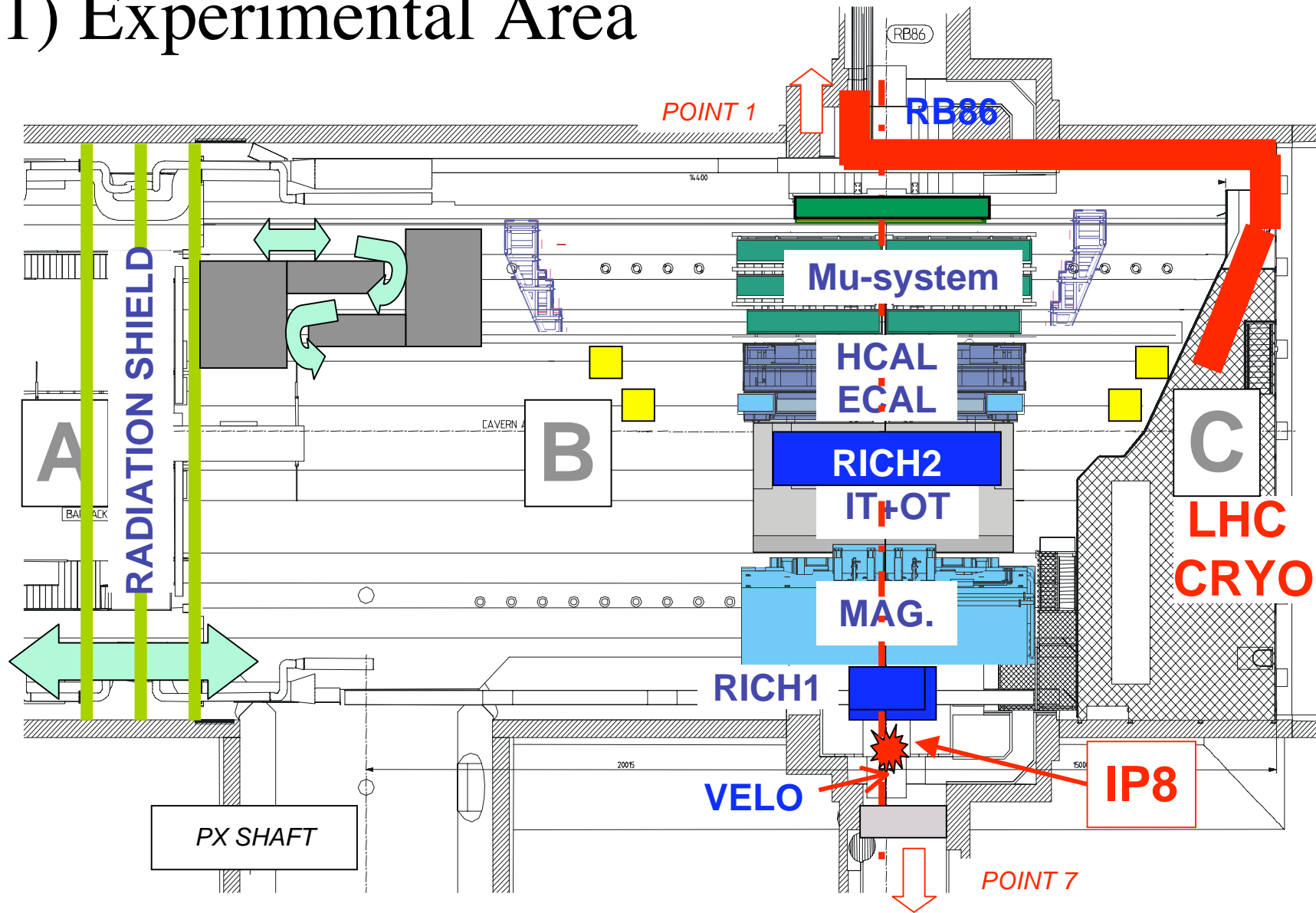
- I) Construction and Installation
- II) Cost and Funding
- III) Conclusions

I) Construction and Installation

LHCb Spectrometer



1) Experimental Area





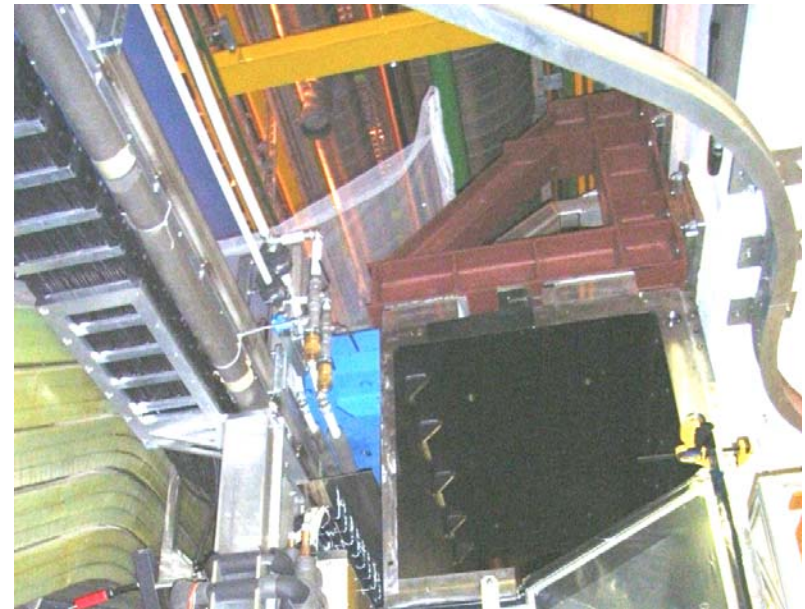
IP8 now

Gas and cooling pipes installed in the detector area
Most of the long distance cables installed

Remaining major work:
complete the shielding wall
gas pipe installation on the gantry

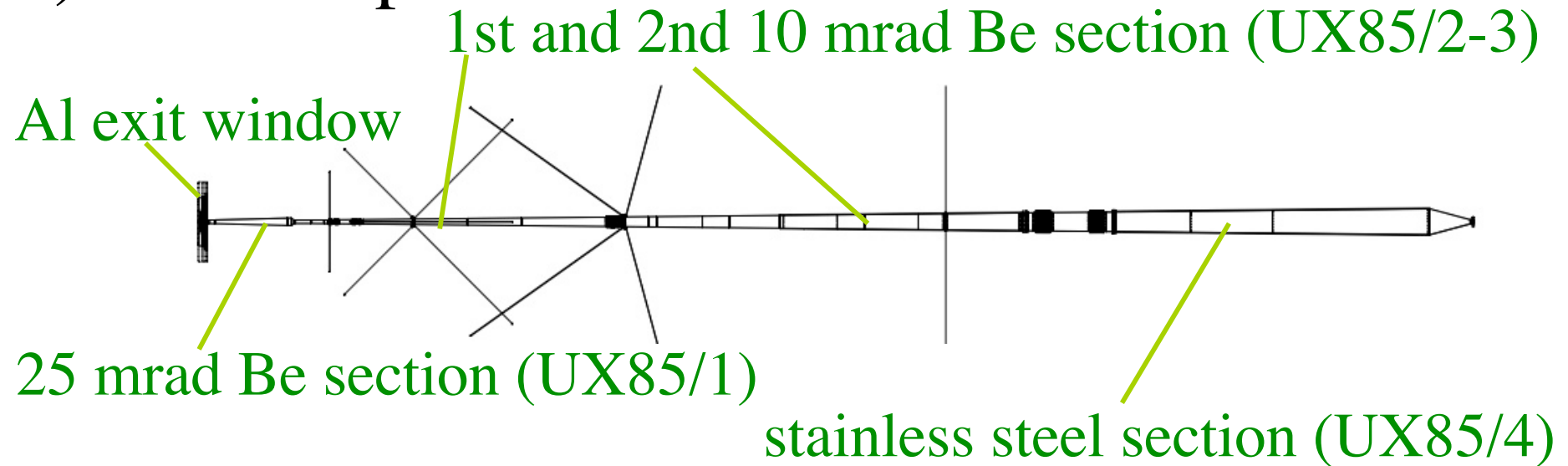


The upper part of the shielding wall



Cooling pipes for TT

2) Beam Pipe



Leaks in UX85/3 repaired by varnishing

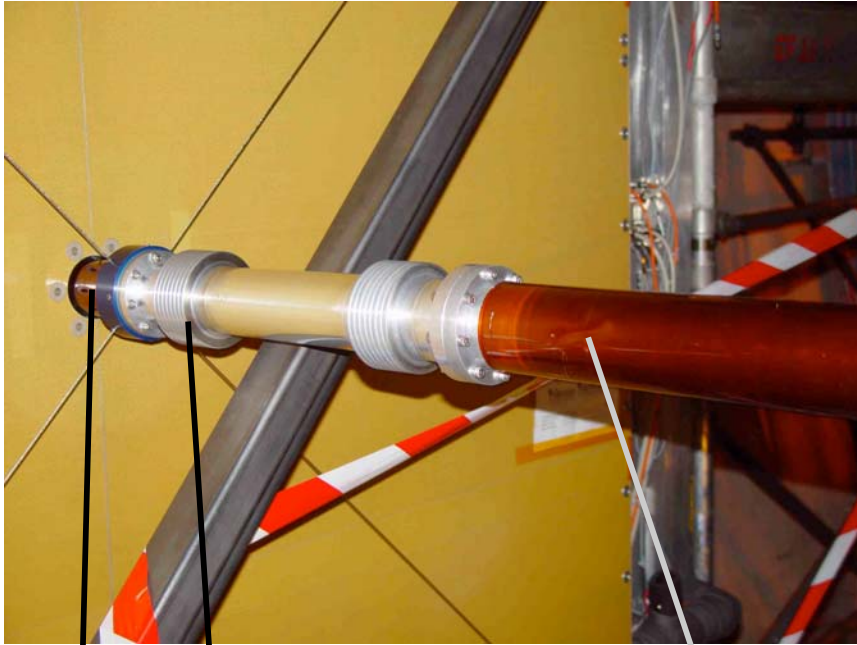
serious concern for long term stability due to radiation

LHC vacuum group (AT/VAC) requesting to prepare a replacement piece

Complete beam pipe installed and leak tested

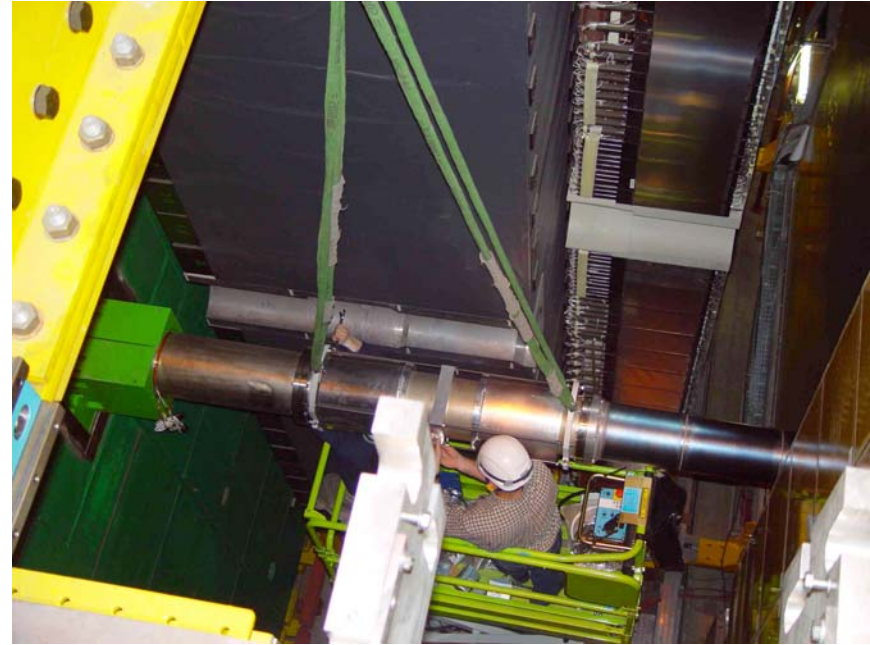
bake out in May

Al spare beam pipe now being made by CERN



behind TT

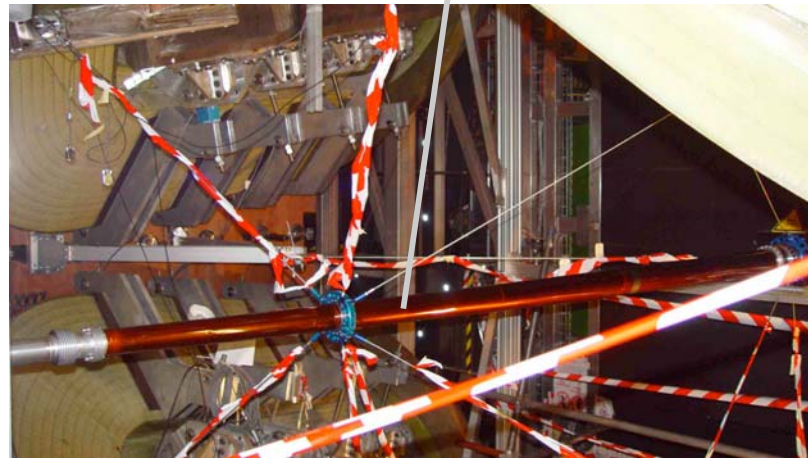
10 mrad section



in the calorimeters

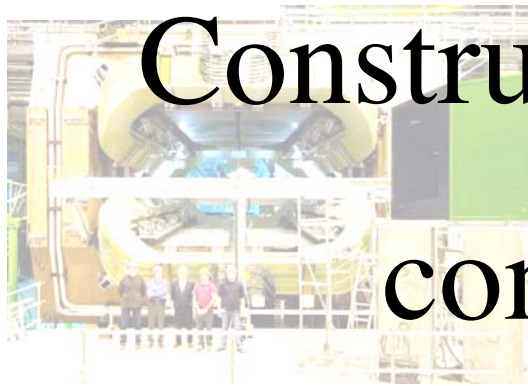
Al bellow

end of 25 mrad section

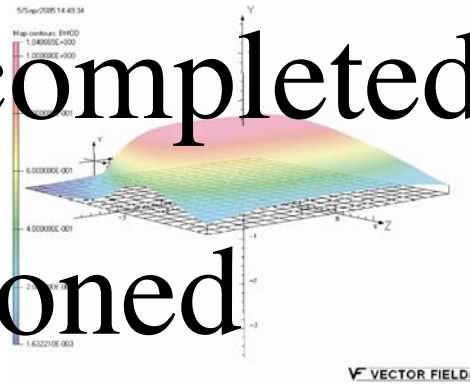


through the magnet

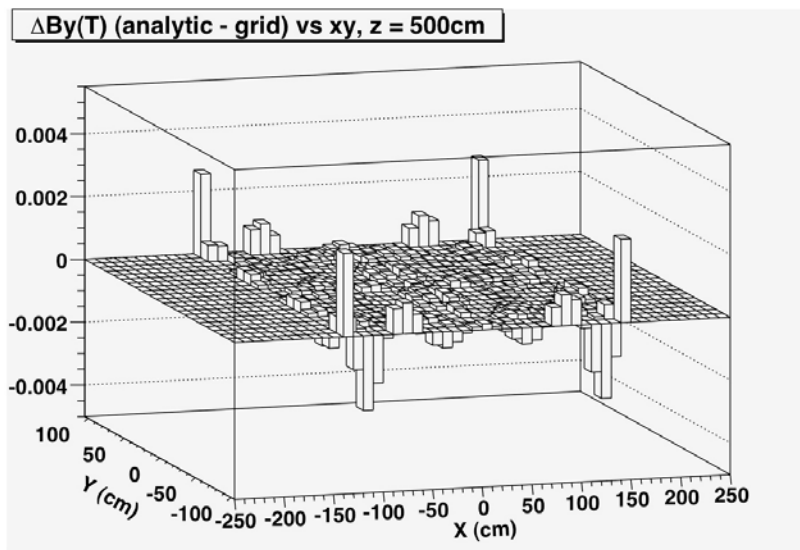
3) Magnet (funded by Common Fund)



Construction completed and commissioned



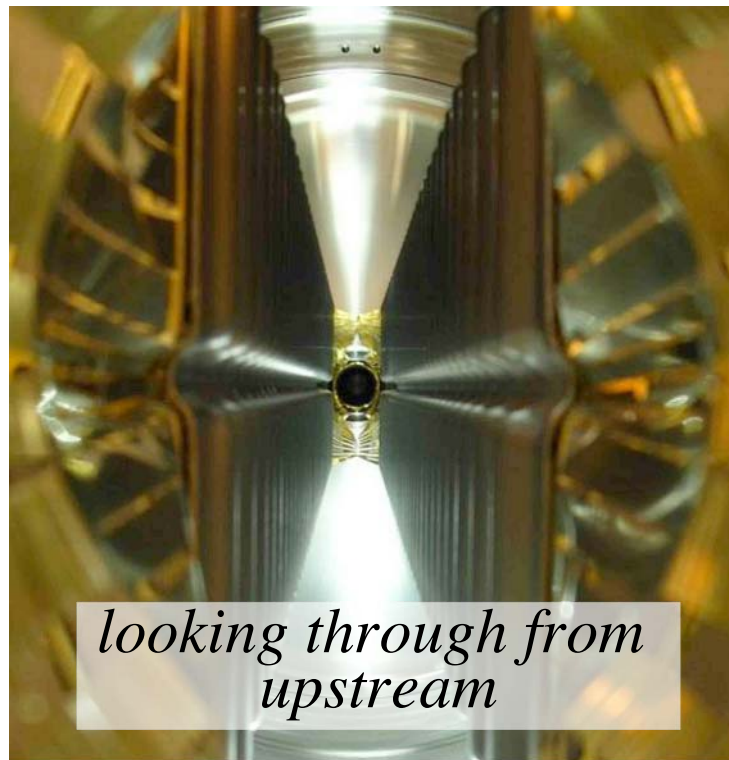
Work to incorporate the measured field map
in progress: method being tested by MC data



difference between
“true” and “parameterization”
 B_y (main component) in the
 $z = 5$ m (in the magnet) plane
→ very small difference

4) VErtex LOcator (funded by CH, DE, GB, NL)

VELO tank fully equipped with RF foils and NEG coated ready to receive the detector modules



RF boxes developed some leaks;

-between prim.-sec. vacuums → **no immediate concern**

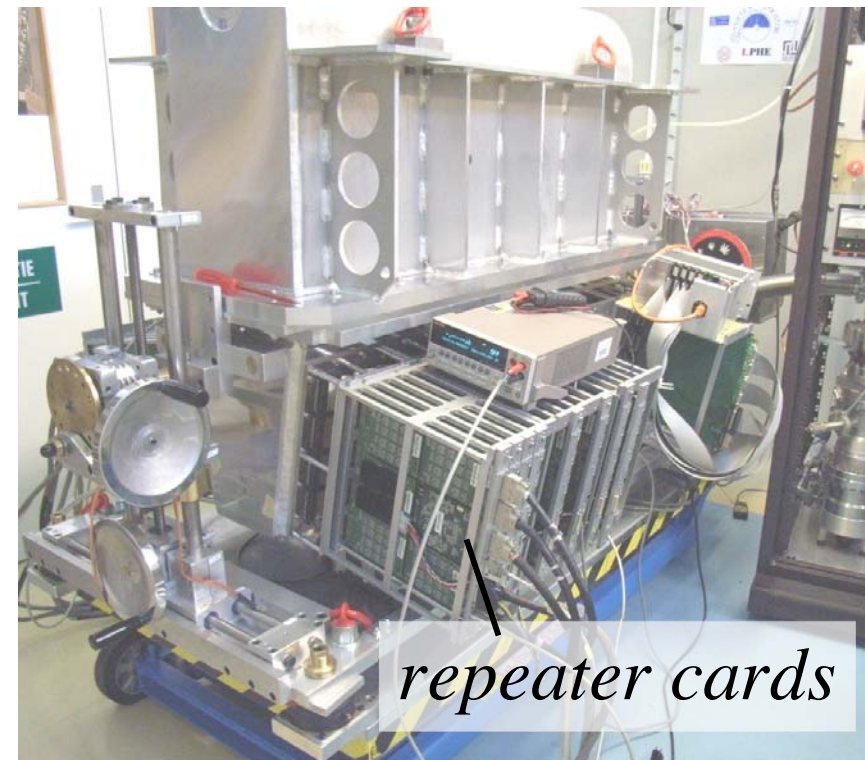
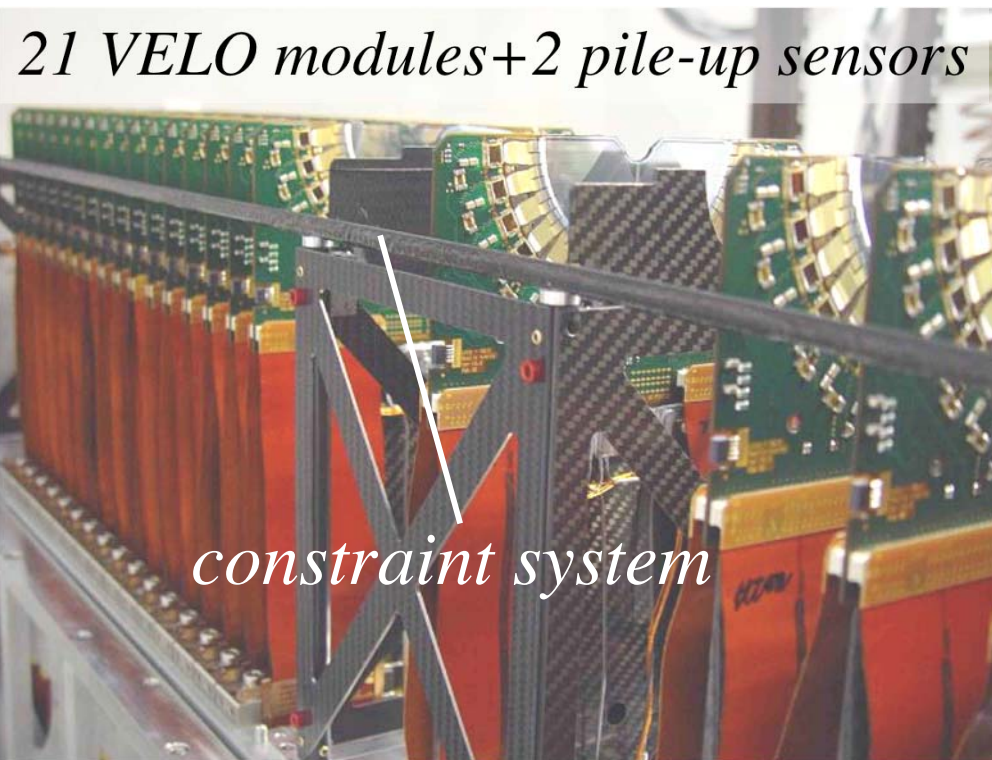
-NEG_{tank} saturate → **may become a problem with high I_{beam} ?**

Sensor module production **completed**

Right Detector Half **fully assembled**
undergoing full electrical tests

Left Detector Half assembly close to completion

Commissioning of the final electronics in progress



Right Detector Half

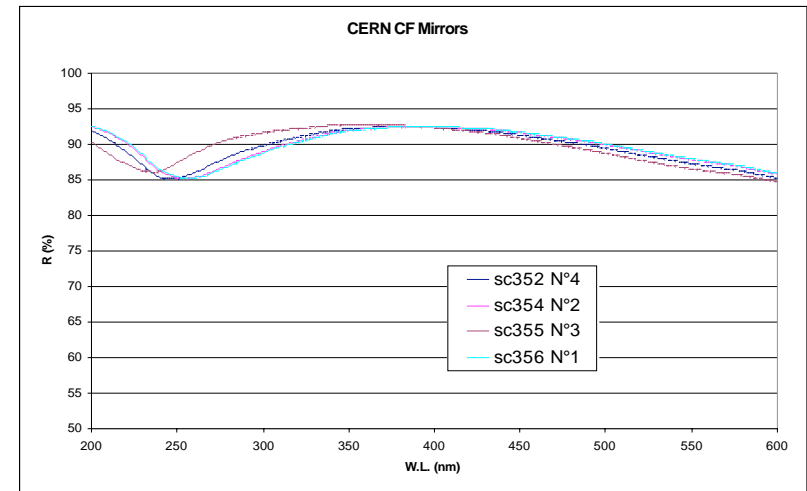
5) RICH (funded by CERN, CF, GB, IT)

RICH-2: In place and **Photon Detector installed**
In situ commissioning started

RICH-1: Gas enclosure completed and tested in situ
C-fibre mirror **produced and coated**
mirror system being assembled and aligned



RICH-2 HPD column installation *RICH-1 four uncoated spherical mirrors*

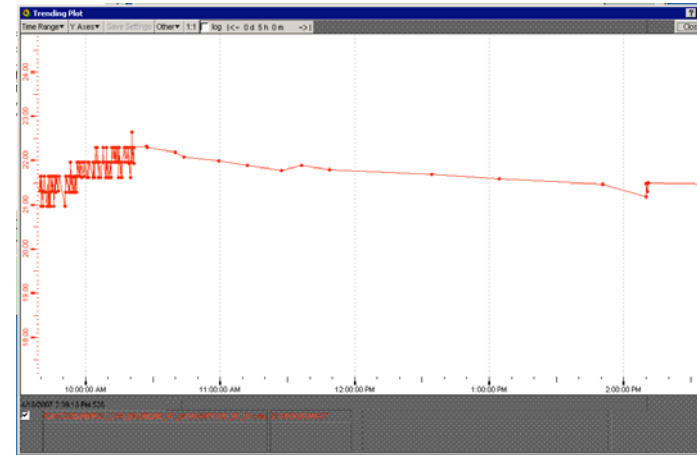
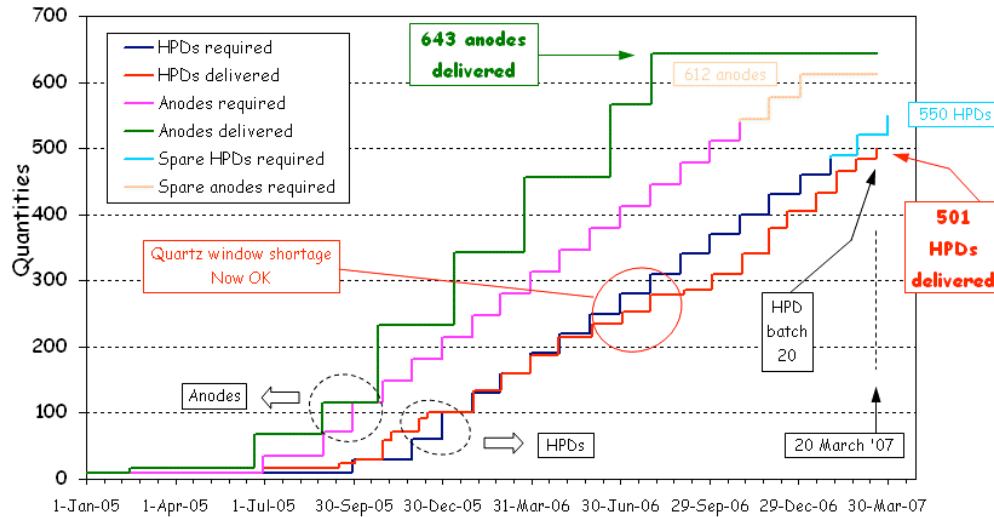


Reflectivity of MgF_2 coating

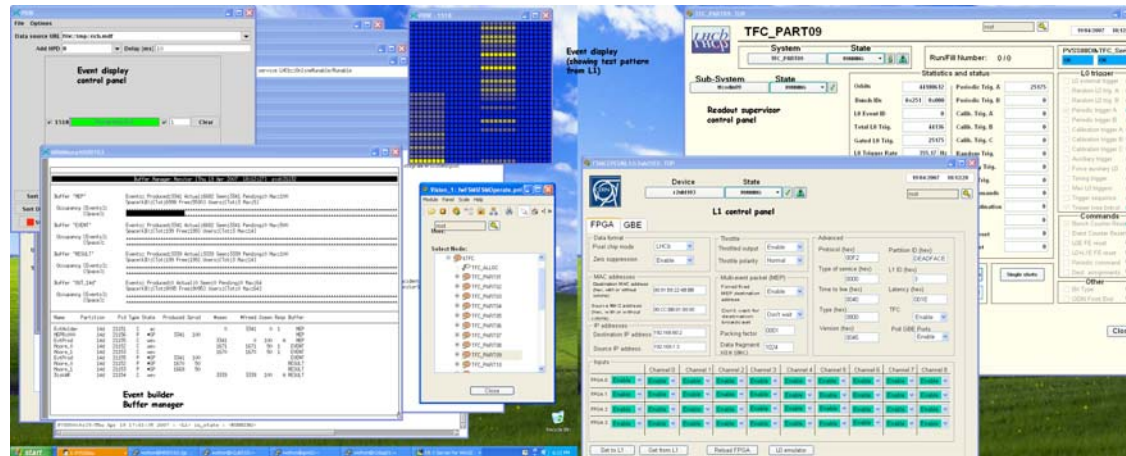
All the HPDs, except spares, produced

In situ readout and slow control commissioning started

HPD production status as of 20th March 2007



RICH-2 temperature reading



A screen shot of RICH DAQ testing

6) Outer Tracker (funded by CERN, CF, CN, DE, NL, PL)

Outer Tracker **installation completed**

Installation of services in progress

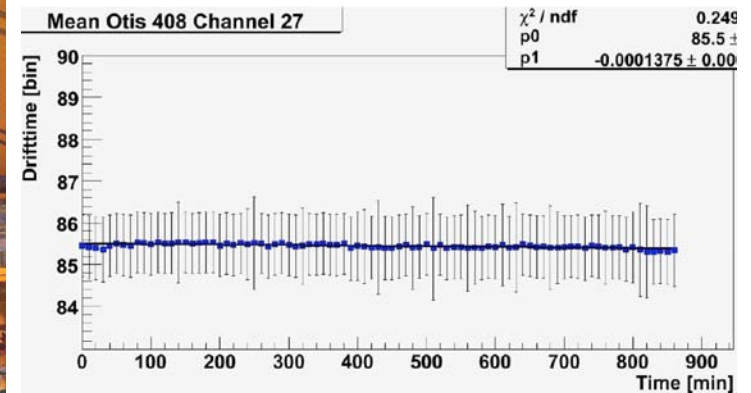
In situ commissioning started



cabling work



OT stations



*long term stability of
TDC count*

Progress on the “aging” issue:

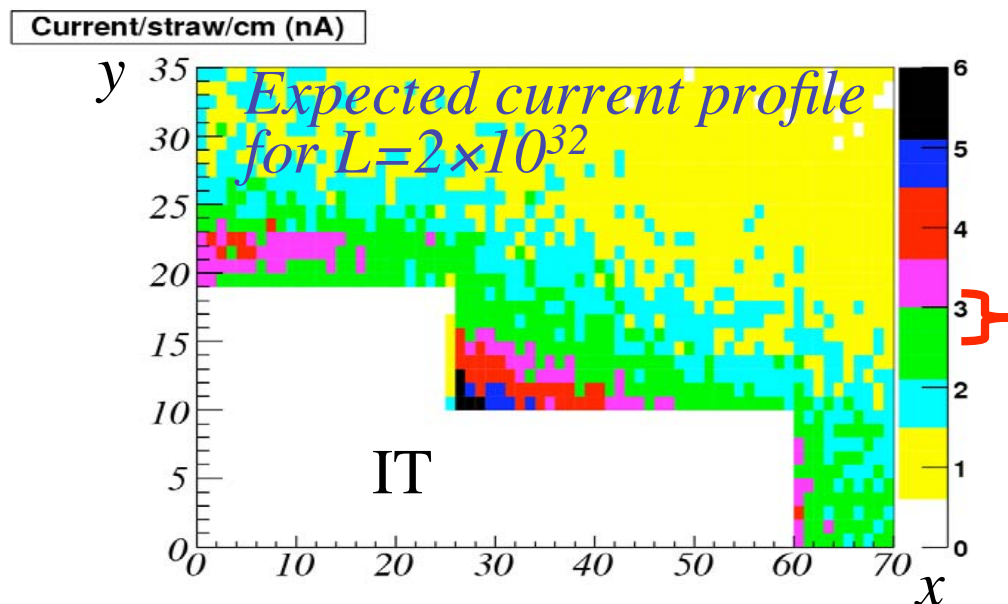
Problem is not due to the accumulated dose

Fast gain loss at a particular rate,

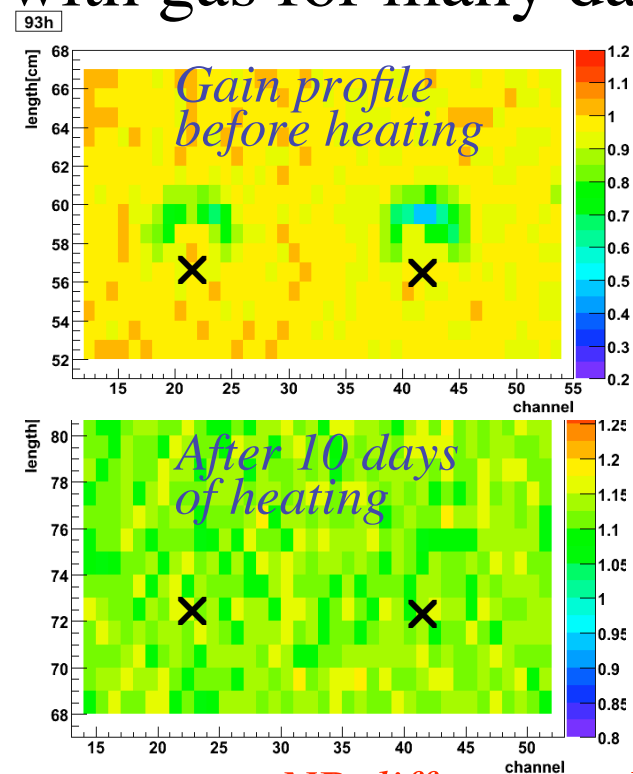
expected in the regions closest to the beam pipe

An effective prevention method now identified

warming up to $\sim 40^\circ\text{C}$ and flush with gas for many days



50 % gain loss
→ 15% efficiency loss/tube

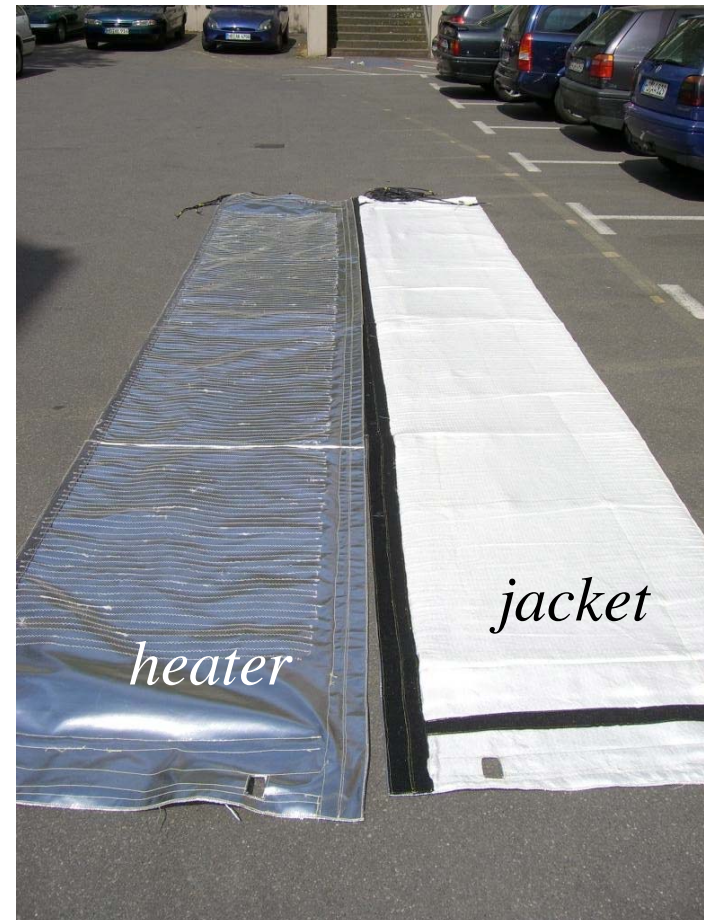


NB different scale

All the modules have been installed
→special heating tool needed for in situ treatment
prototype produced and to be tested in the vertical position

Warming up procedure needs to be
precisely defined for how long, at
which temperature, with which gas
flow, all the modules or only the
central ones

Recovery is possible with positive
and negative HV treatments



heating tool prototype

7) Silicon Tracker (funded by CERN, CH, DE, ES, UA)

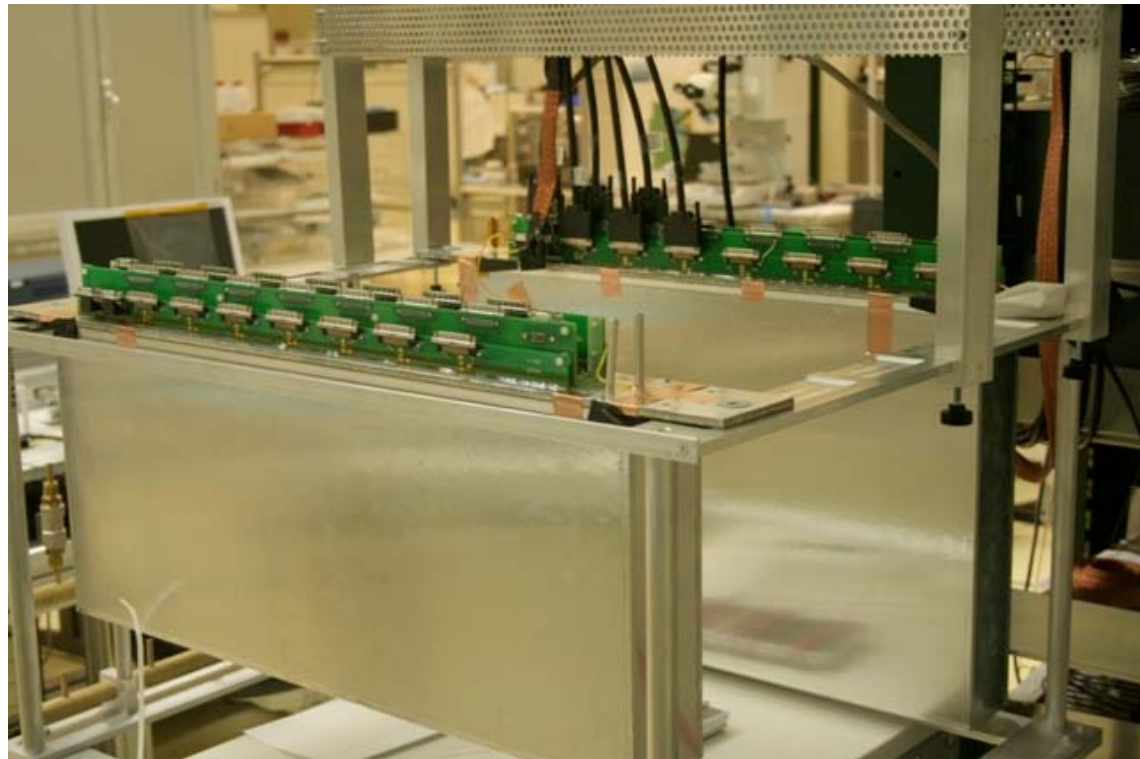
Ladder production almost completed

100% for TT and >70% for IT completed

IT detector boxes now finalised

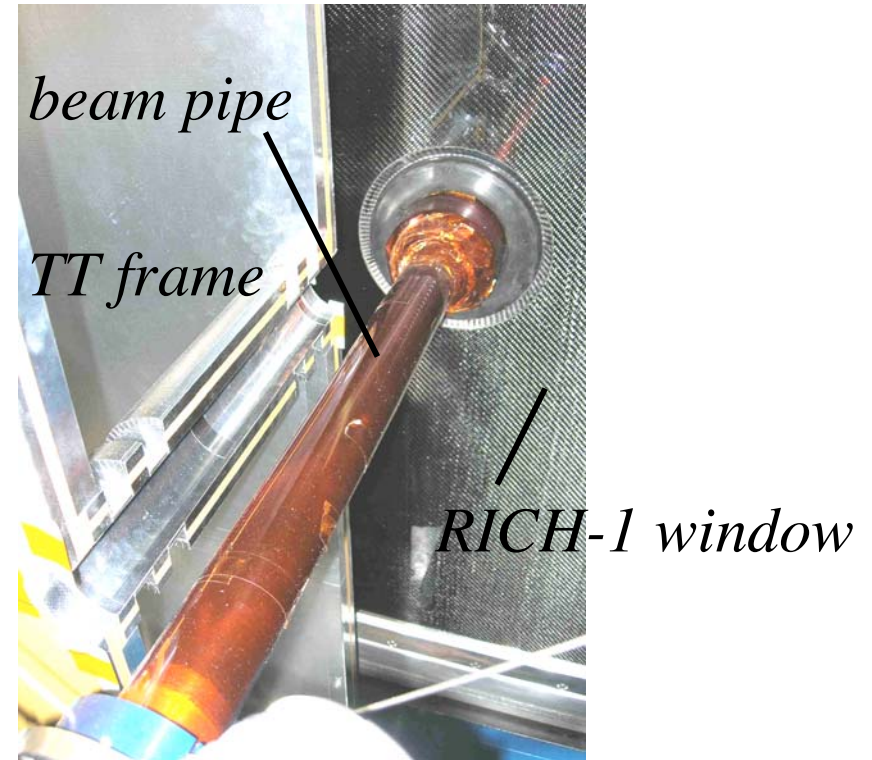
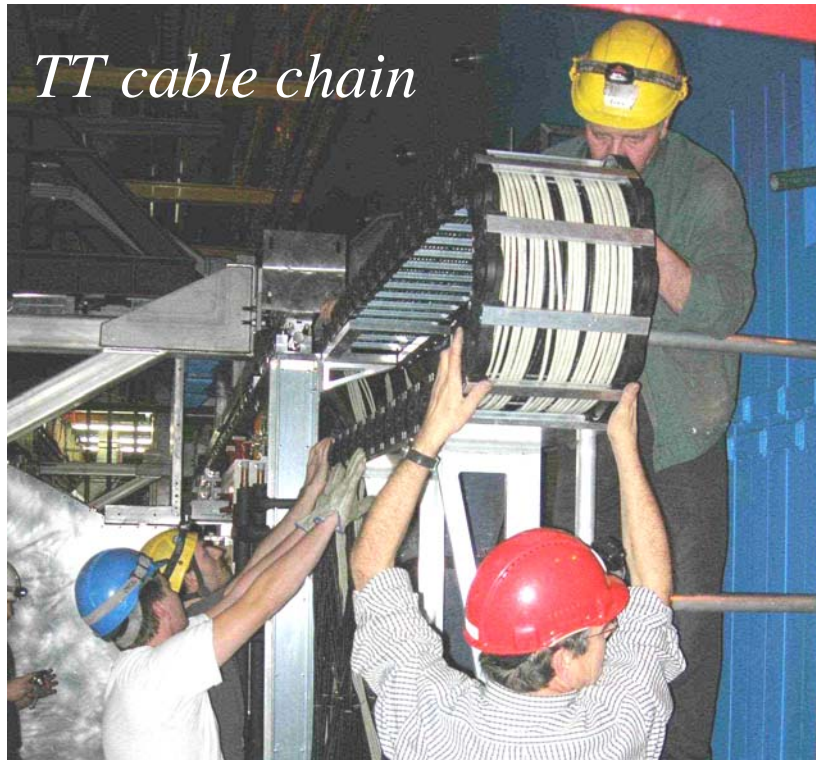


IT improved test system



one-sensor and two-sensor detector boxes

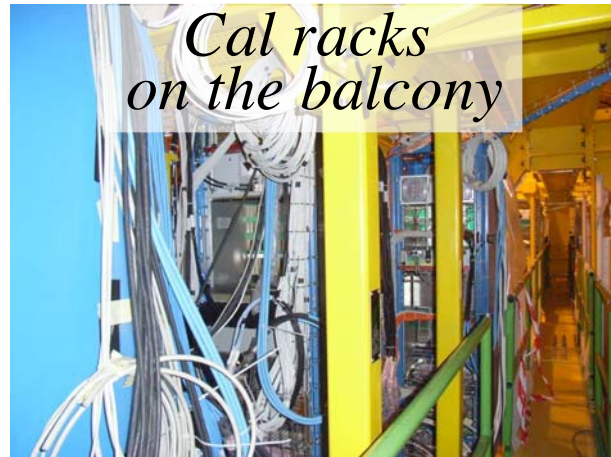
TT infrastructure installed and protection of the beam pipe against TT frame closing verified



Digitizer cards: all produced but set back due to delivered components not matching specifications → being repaired not critical, but inconvenient for commissioning

8) Calorimeter System (funded by CERN, CF, ES, FR, RO, RU, UA)

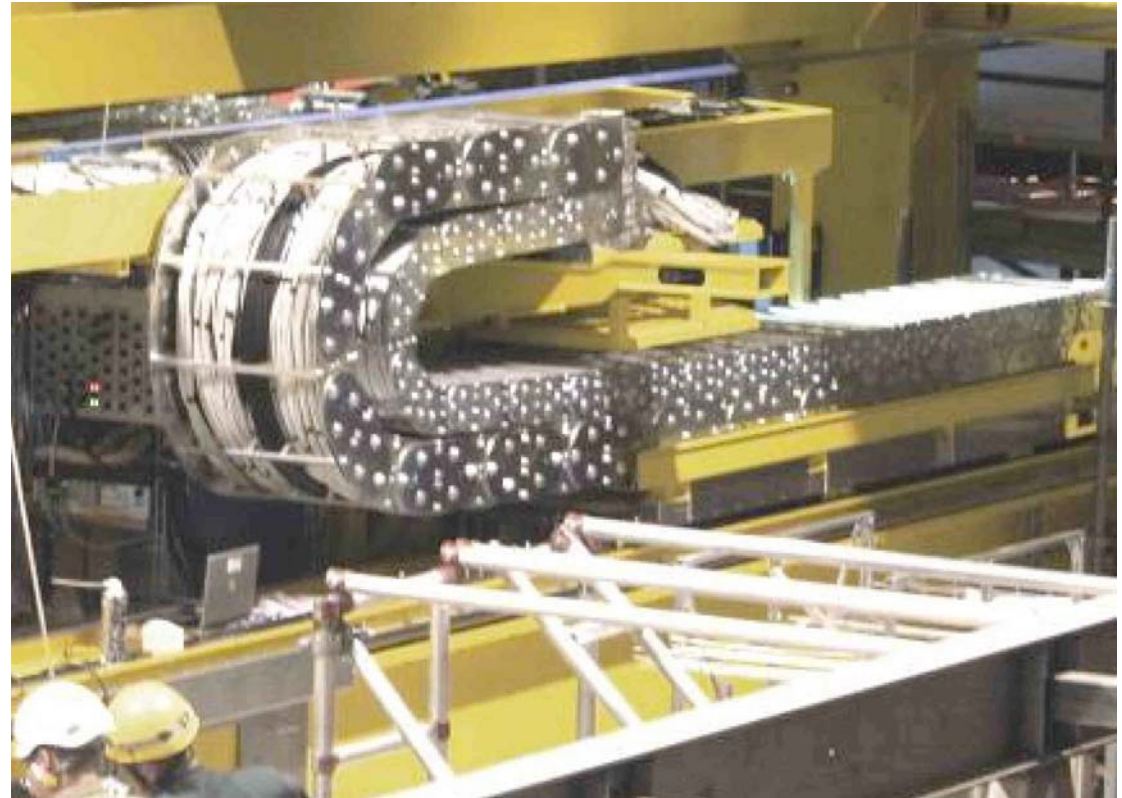
Cabling of Scintillator Pad Detector/Preshower in progress
Ecal/Hcal front-end all installed and commissioning advanced



*Cal racks
on the balcony*



Cal front-end cards



C-side 183 PS cables in the cable chain

9) Muon System (funded by CERN, CF, IT, RU)

All MWPCs and GEMs produced and tested, except spares

C-side M2-M5 fully installed and commissioning started

A-side M2-M5 installation of infrastructure being completed
chamber installation in progress

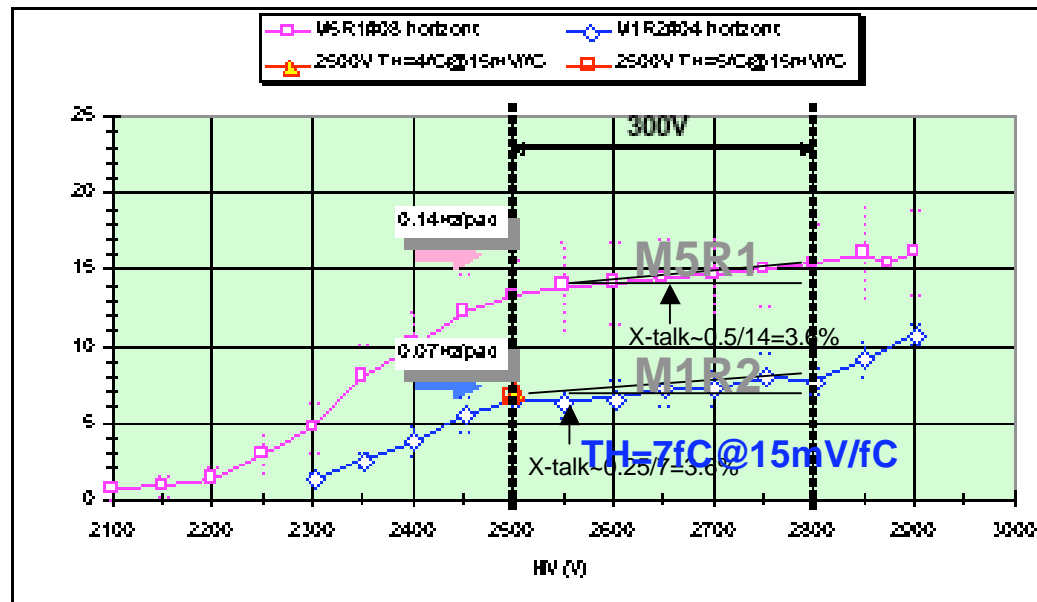


C-side M2 station completed



A-side M2 wall

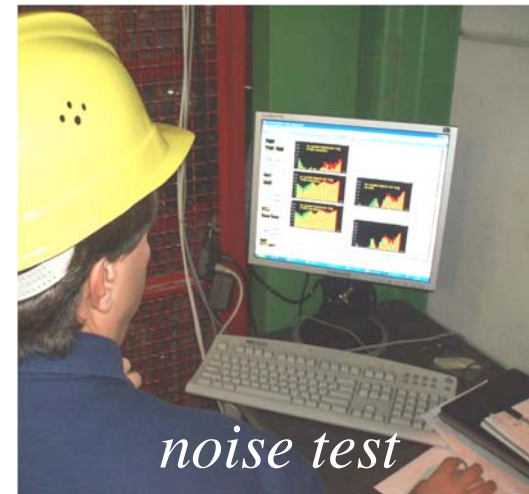
Chambers, tested before installation in the laboratory and at CERN. Tested again after the installation in situ



*plateau test with cosmics
before installation*



gas tightness test



noise test

Procurement for the M1 support components started:
some more details to be worked out: very tight schedule

10) Trigger and Online

(funded by CERN, CF, CH, DE, FR, ES, IT, NL)

Level-0 trigger consists of four components

Pile-up

L0
Calorimeters

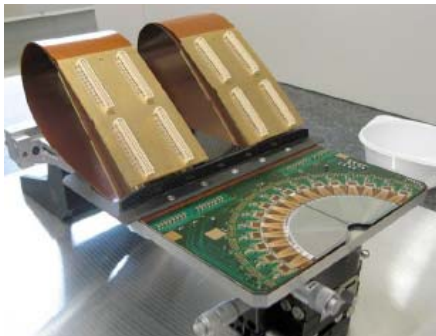
L0
Muon

L0
Decision
Unit

in production

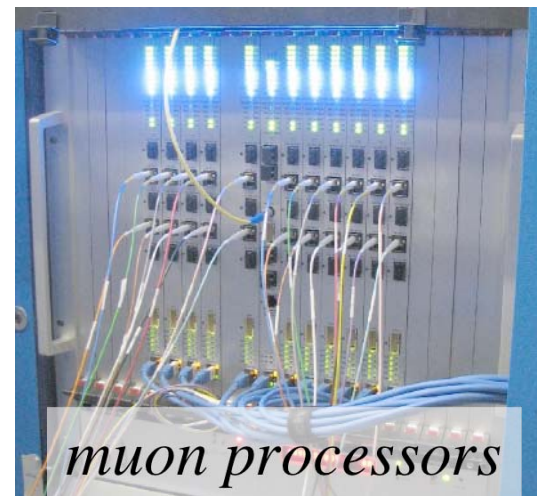
already enough produced for
commissioning quadrant

ready



four dedicated
detectors integrated
in VELO

They are
mostly a part of
the calorimeter
electronics



muon processors

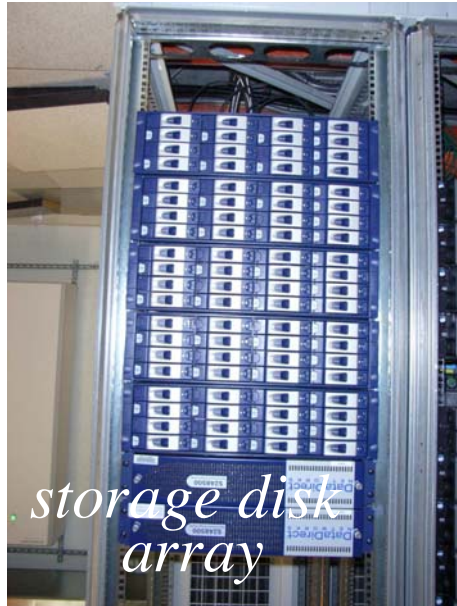


L0DU

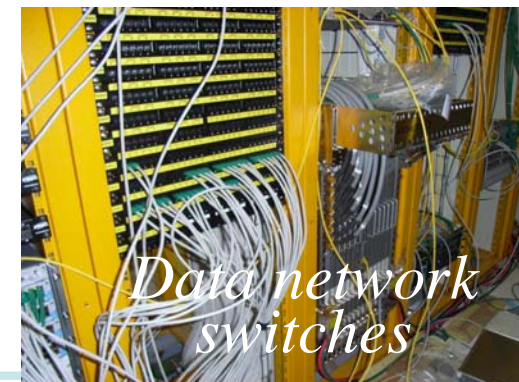
HLT is now optimized for 1 MHz readout data

Installation of the online equipment and necessary cabling progressing in the control room (surface) and in the barrack (accessible part of the underground area)

on the surface



underground barrack



11) Computing

Physics quality software in place

Reconstruction package released to be used for physics performance studies in preparation for data

Further tracking optimization for 900 GeV data, if needed

Global alignment challenge to be launched soon

Data Challenge 06 on going

LHCb GRID computing after MC production, i.e. reconstruction and stripping still encounters difficulty in data access. Closely working with the site, LCG project and middleware developers to overcome the problem

Full testing of analysis in a GRID environment is still pending.

III) Cost and Funding

Change from the last RRB in October 2006

Cost: No change 75.341 MCHF

Funding: New contributions
Spain (20 kCHF), UK (400 kCHF)
requests made for CPU's in 2006 approved
FR (300 kCHF)
in addition to already made extra contribution
BR (55 kCHF)
first contribution to the detector cost
US-NSF (30 kCHF)
2007 contribution to the CPU's
450 kCHF request for 2007-2009 not approved

Missing: **497 kCHF**
(Was 1302 kCHF at the time of the October 2006 RRB)

April 2007

Total Cost
75.341 MCHF

Total funding
74.844 MCHF

Still missing
497 kCHF

(in kCHF) Country	MoU signed	Extra for detector	Extra for CPU
Brazil	0	0	55
China	100	0	0
France	7500	0	800
Germany BMBF	3757	381	300
Germany MPG	2200	0	0
Italy	10000	847	0
Netherlands	6300	381	0
Poland	500	0	0
Romania	300	0	0
Russia	2500	0	0
Spain	2000	0	20
Switzerland	7900	0	0
UK	10300	44	400
Ukraine	200	0	0
US-NSF	0	0	560
CERN	16700	799	0

Total CPU needs: 3.420 MCHF

missing 497 kCHF not an immediate problem

possible further contribution from BR, and others

Additional cost on horizon:

-replacement Be beam pipe section: UX85/3

expected to be substantial; i.e. $O(\text{MCHF})$

needed only in a few years but long production time

→commitment required soon...

-VELO replacement RF boxes

cost expected to be not high

but expert manpower and R&D may be needed

III) Conclusions

- 1) Installation of the spectrometer is nearing completion, and commissioning has started for many subdetectors. Computing and physics preparation for data ongoing.
- 2) **Schedule is still tight**, in particular, for the production of IT, RICH-1 mechanics integration, and Muon system installation
- 3) Further additional contributions approved for the CPU farm 55 kCHF (Brazil), 300 kCHF (France), 20 kCHF (Spain), 400 kCHF (UK) and 30 kCHF (US-NSF)
→ **497 kCHF still missing** for the CPU farm.
Vacuum pipe replacement will require additional money. Continue to seek extra funding: pending request to Italy, further requests to Brazil, US-NSF, etc.

LHCb Milestones (April 2007)

