

# CMS

## Overview

M. Della Negra  
LHC days in Split  
October 2004

Compact Muon Solenoid



# Schedule and Initial detector

**Pilot Run** Collisions in Summer 2007

**Shutdown** Winter of 2007/2008

**Physics Run** Early Spring 2008

## **CMS Initial Detector for Pilot Run in 2007**

Without staged items AND without endcap ECAL, pixel detector (though latter will be ready)

Install ECAL endcap + Preshower (EE/ES) and Pixels during the 2007/2008 winter shutdown

## **CMS Initial Detector for Physics Run in 2008**

### **Staged items:**

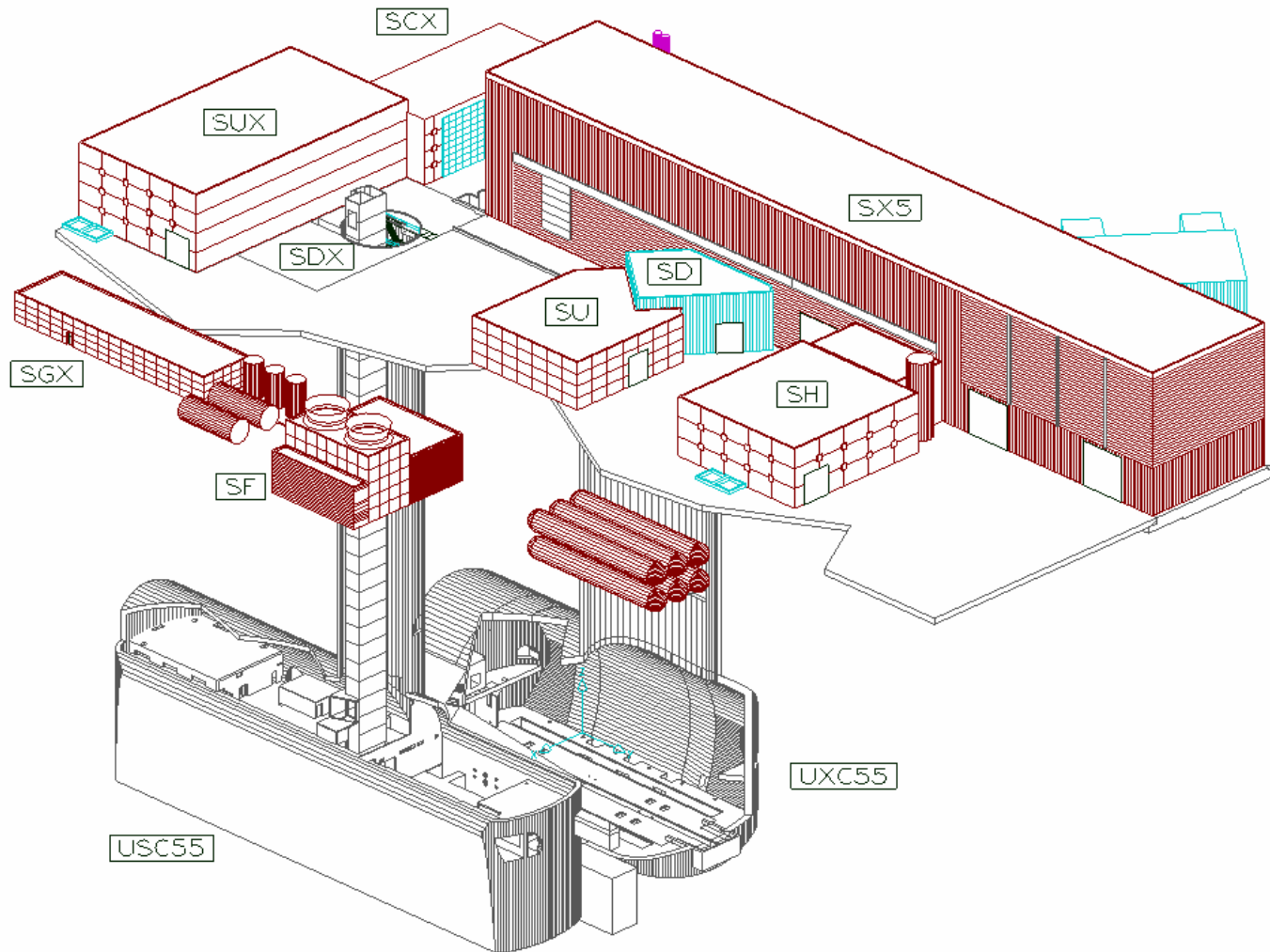
Muons: ME4/2, RE4, REs at small radius (RE1/1, RE2/1, RE3/1)

Tracker: 3rd forward pixel disks

50% DAQ (4 DAQ slices → 2 DAQ slices?)



# Civil Engineering and Magnet





# Civil Engineering

**SX5 Second phase**  
Metallic structure completed

**SX5 2000 ton plug**  
Has been closed in August





# Civil Engineering

**UXC55 will be delivered end of 2004**

**UXC55 wall toward Point 4**  
Completed with part of vault



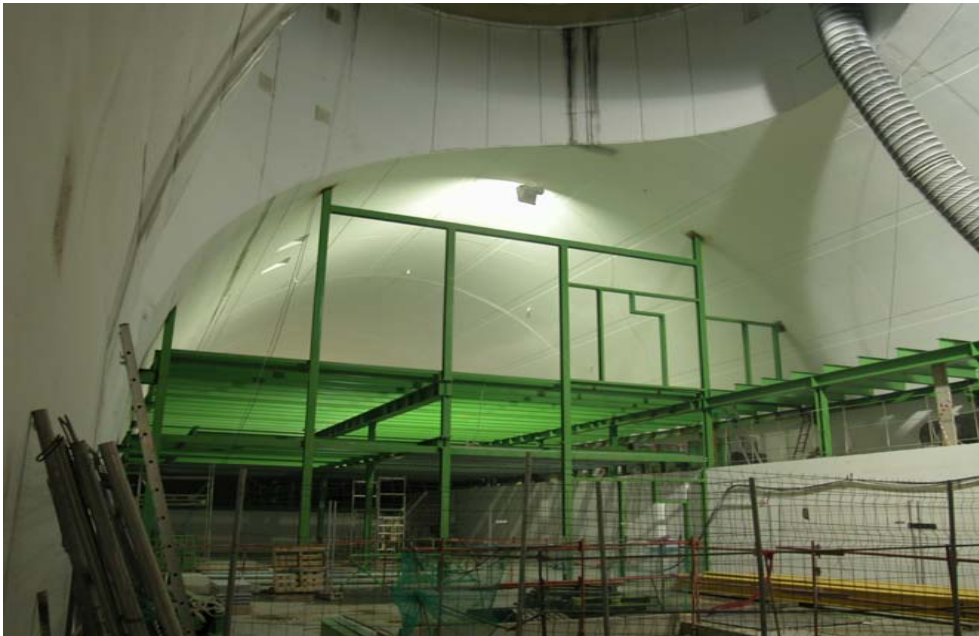
**UXC55 wall towards Point 6**  
Penultimate lift of concrete





# Infrastructure

**USC 55 Cavern accessed 4 Aug.**  
Metallic structures on Control side

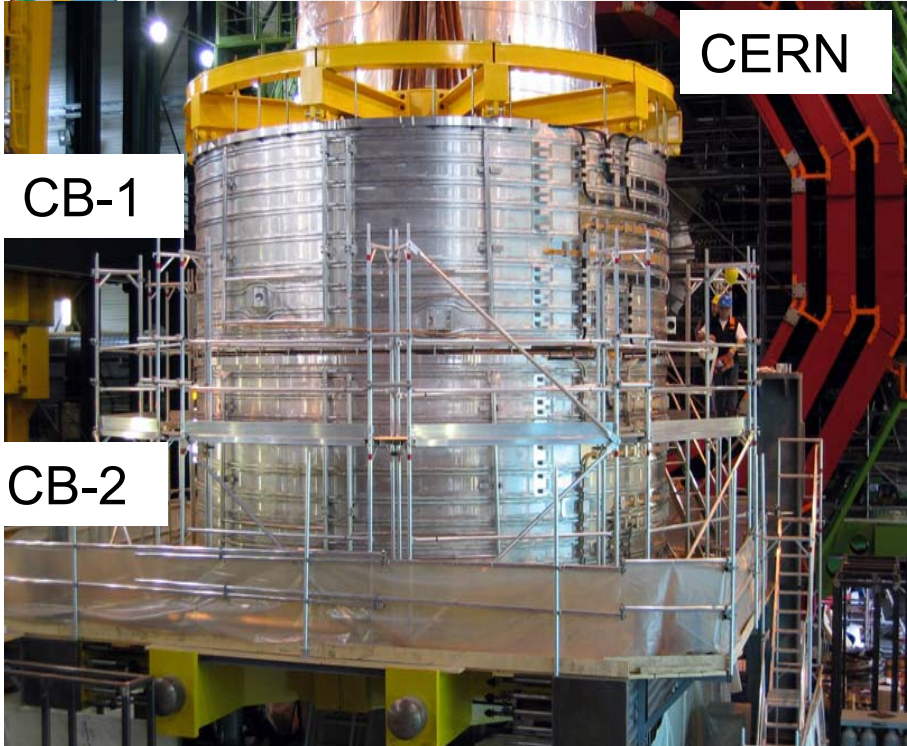


**USC 55 Cavern**  
Crane rail on Service side





# Status of Coil



CERN

CB-1



CB-2



Genova  
Ansaldo

CB+1

CB0



CB+2 winding complete

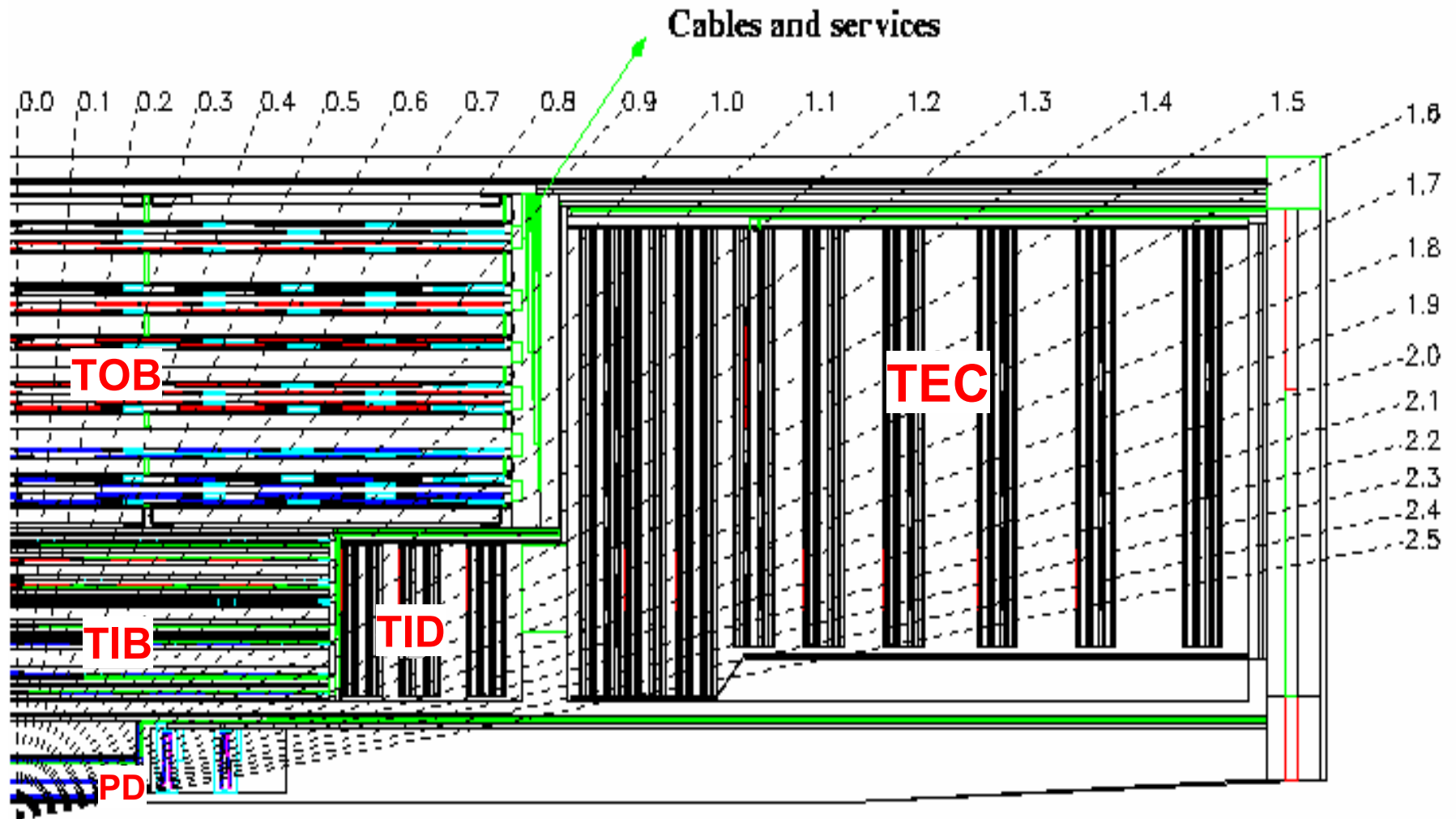
Module	Status	Delivered at CERN
CB-2	100%	yes
CB-1	100%	yes
CB0	100%	30 Sept
CB+1	95%	Nov 04
CB+2	63%	Dec 04

Micr

**Magnet Test on the surface (SX5) starts 1st Oct 2005**



# Inner Tracker

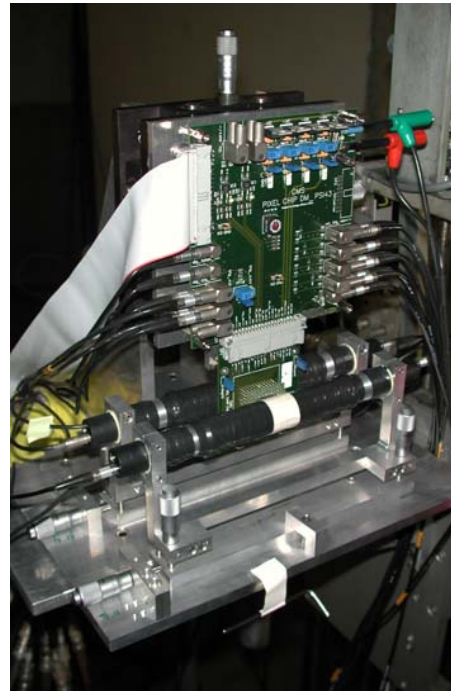
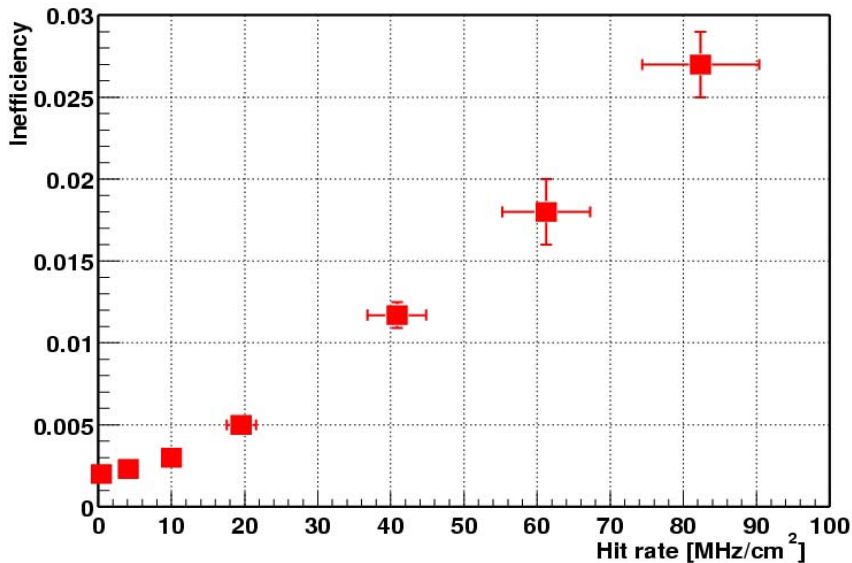
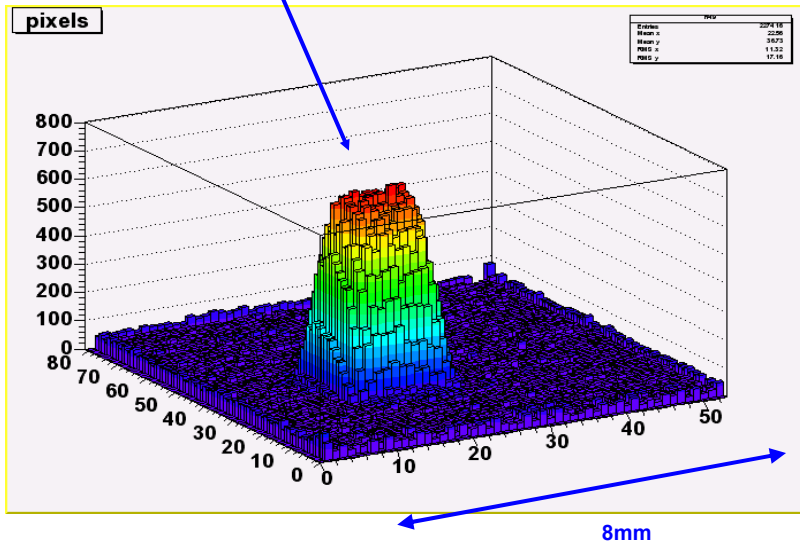






# Pixels: LHC Rate Beam Test at PSI

Hits triggered by scintillator telescope ! (2mmx2mm)



- PSI46 chip bump bonded with CMS sensor
- 350 MeV/c p-beam up to 80MHz/cm<sup>2</sup> rate
- Beamspot 10mm x 20mm FWHM
- Pixel hit inefficiency measured with scintillator telescope.

Track rate of 25MHz/cm<sup>2</sup> (LHC @ r = 4cm)

**Data Loss ~ 0.8%**

DMILL chip was 5% (2002)



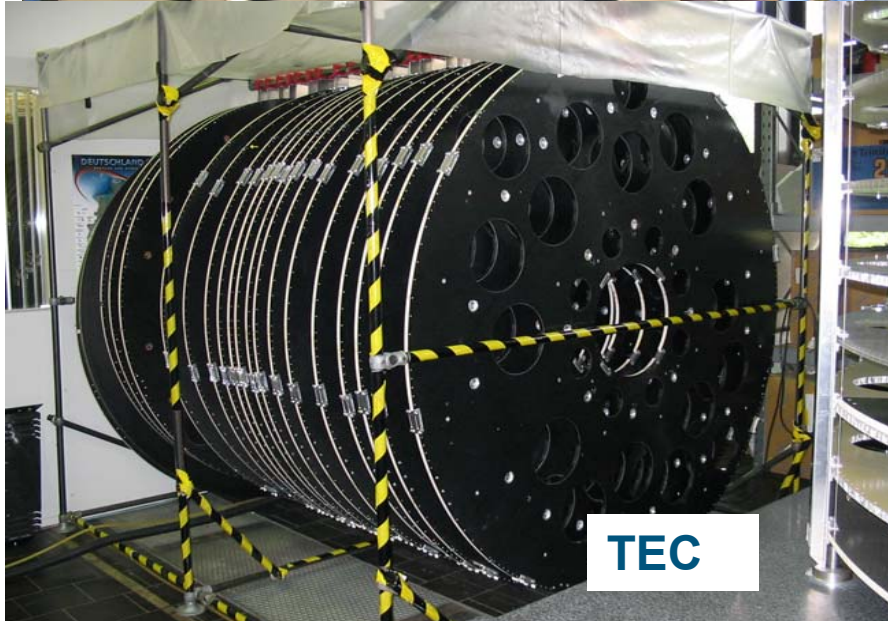
# Silicon Tracker: All CF structures delivered



Support Tube



TOB



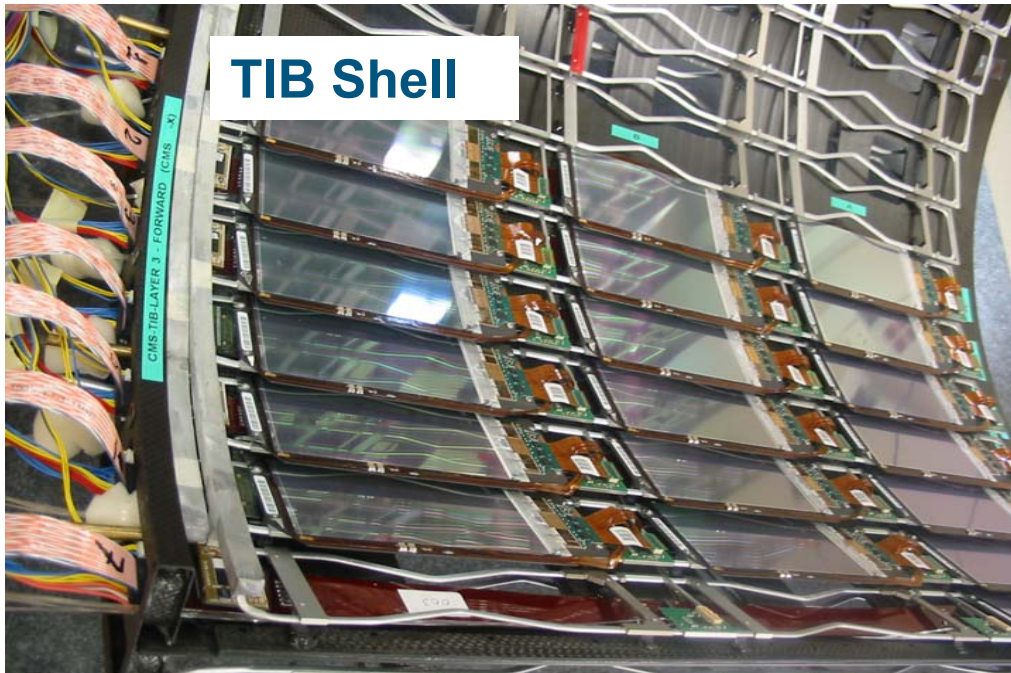
TEC



TIB



# Silicon Tracker Integration



**TIB Shell**



**TOB: RODs**



**TEC Petal**



**TOB: ROD insertion**



# Tracker: Overview

## Sensors

Thin sensors: total needed 7000, 98% complete (HPK).

Thick sensors: total needed 18000. New qualification lot from ST have marginal quality.

Under negotiation: the number of ST sensors to go in CMS and the cost to CMS. The rest of the production will go to HPK.

Today 11,500/18,000 (65%) shifted to HPK: 2350 HPK sensors delivered (excellent quality). HPK ramping up from 700/mo to 1500 sensors/mo (2 mo delay).

## Hybrids and Module Assembly

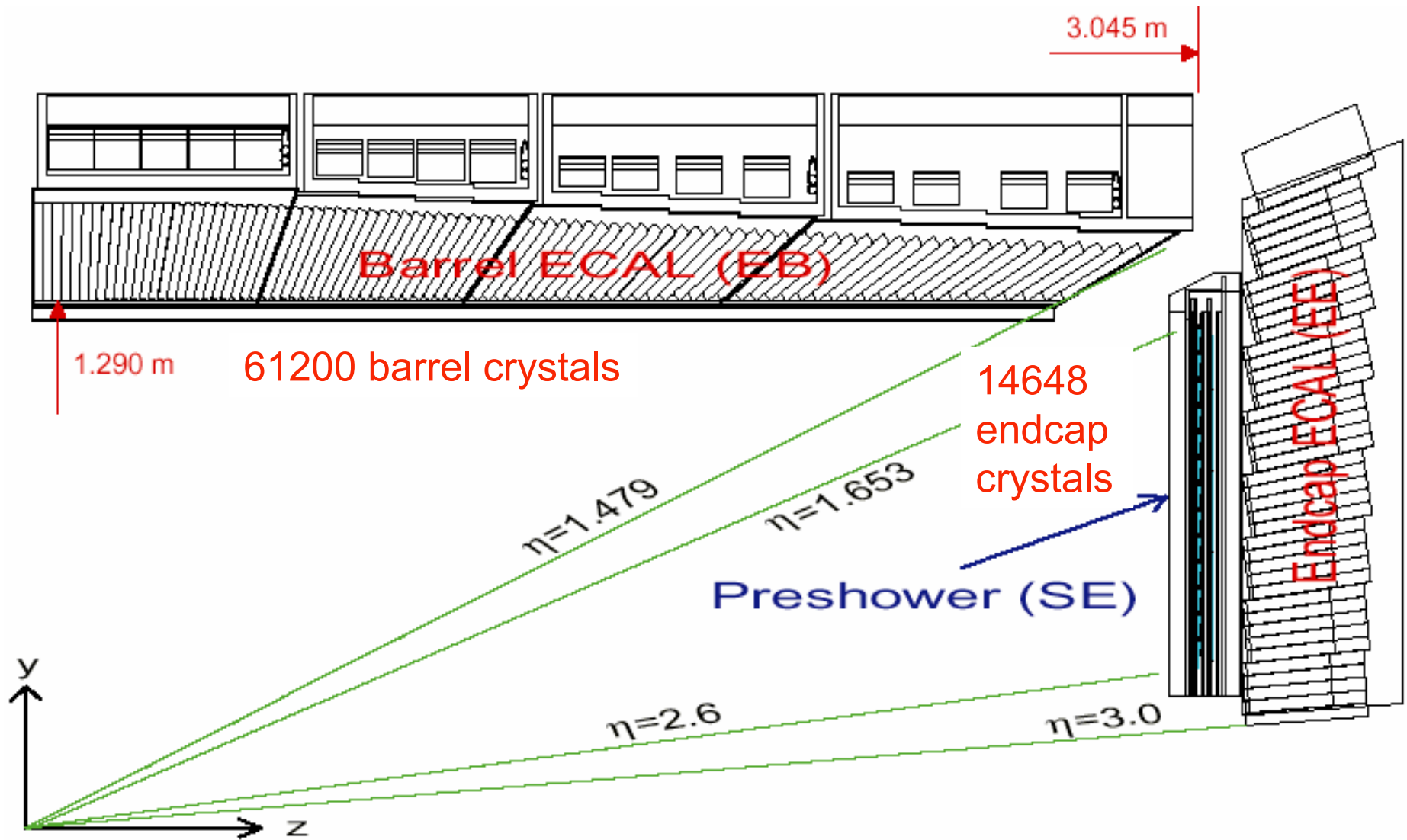
Production stopped last May. Serious problems with the metallization process and with the QC at the company. Change of management at the company. Re-optimization of the process. Re-starting the production soon. New hybrids to the module assembly centers expected in January 05. All module assembly centers operational. Each of them has assembled at least 100 modules.

## Schedule SST:

SST installation: 1 Apr 06 (v33.2/ CR03)→1 Nov 06 (v34.1/CR04) +7 mo delay with no float.

Very tight schedule: Assume last TOB module delivered Dec 05 and 10 months of final TK integration in Bat 186 at CERN.

# ECAL





# ECAL Crystals

## Current Production

Present agreement with BTCP will end up in June 2005 for a total of ~40K crystals. The full Barrel needs ~63K crystals (including 1700 crystals for a spare Sub-module).

## Rest of the Production

New contracts have to be negotiated for the rest of the production (~23K Barrel crystals + ~15K Endcaps). Tender has been done and opened on August 17<sup>th</sup>. All potential producers have replied and made conforming offers, following their production capacity and the proposed CMS Schedule v34.

The evaluation of the offers is in progress.

## Evaluation of crystals from other producers than BCTP

The evaluation of the crystals from new producers (**SIC, Apatity**) has continued during the Summer both in the CMS institutes and at the H4 test beam.

Results are promising.



# ECAL SM Assembly

**13 'bare' Supermodules assembled (out of 36).** The 18th 'bare' Supermodule (completion of the first half Barrel) is planned for early January





# First SM Integration started mid-August



SM1 ready to go in Test beam in October 2004





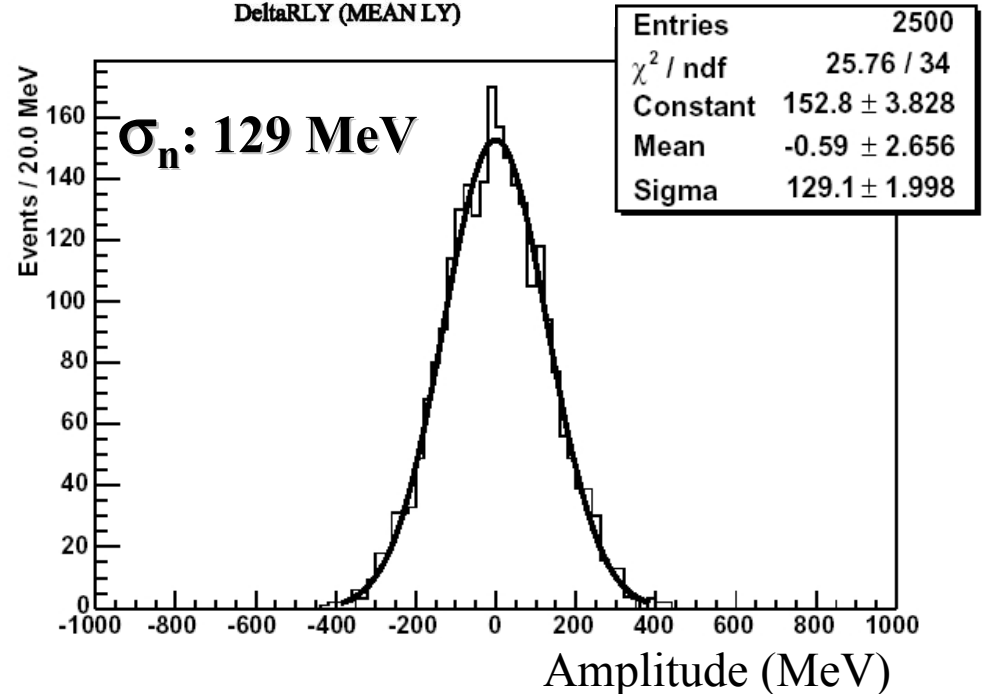
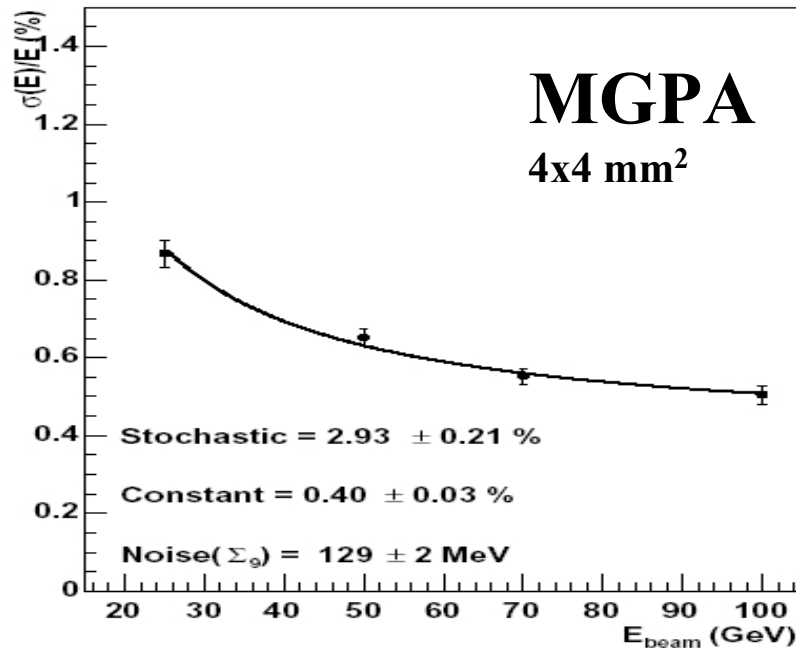
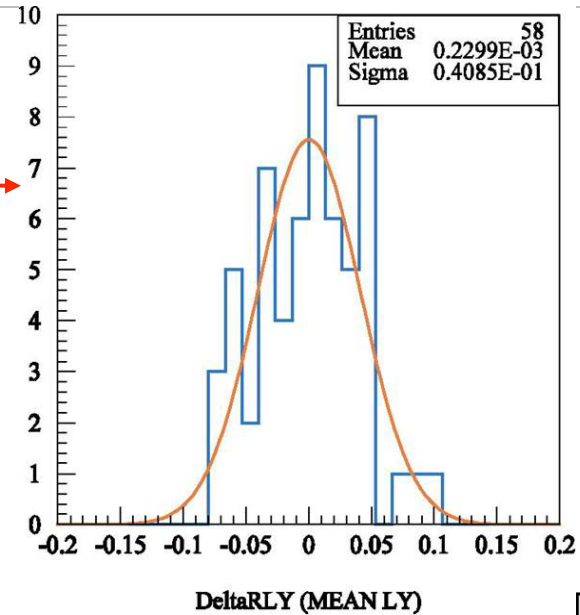
# Test beam: final results 2003

Precalibration from laboratory data:

$$\sigma = 4.1\%$$

Reached target E resolution with MGPA (3 X 3):

$$\frac{\sigma_E}{E} = \frac{(2.9 \pm 0.2)\%}{\sqrt{E / \text{GeV}}} \oplus \frac{(129 \pm 2) \text{ MeV}}{E} \oplus (0.4 \pm 0.03)\%$$







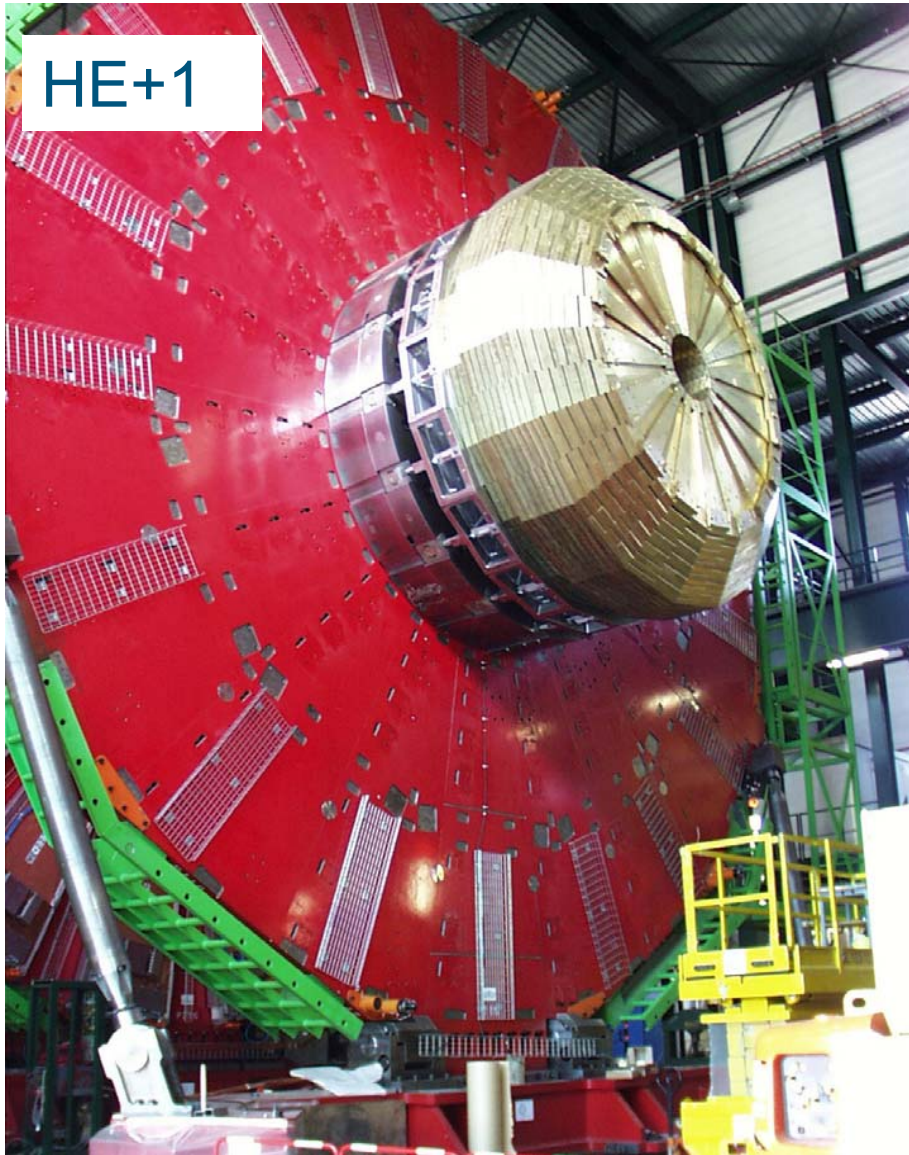
# HCAL: The two HBs have been completed



Installation of readout boxes started  
source calibration in 2005.  
Insertion in vacuum tank: Summer 2005.



# HCAL: The two HEs have been completed



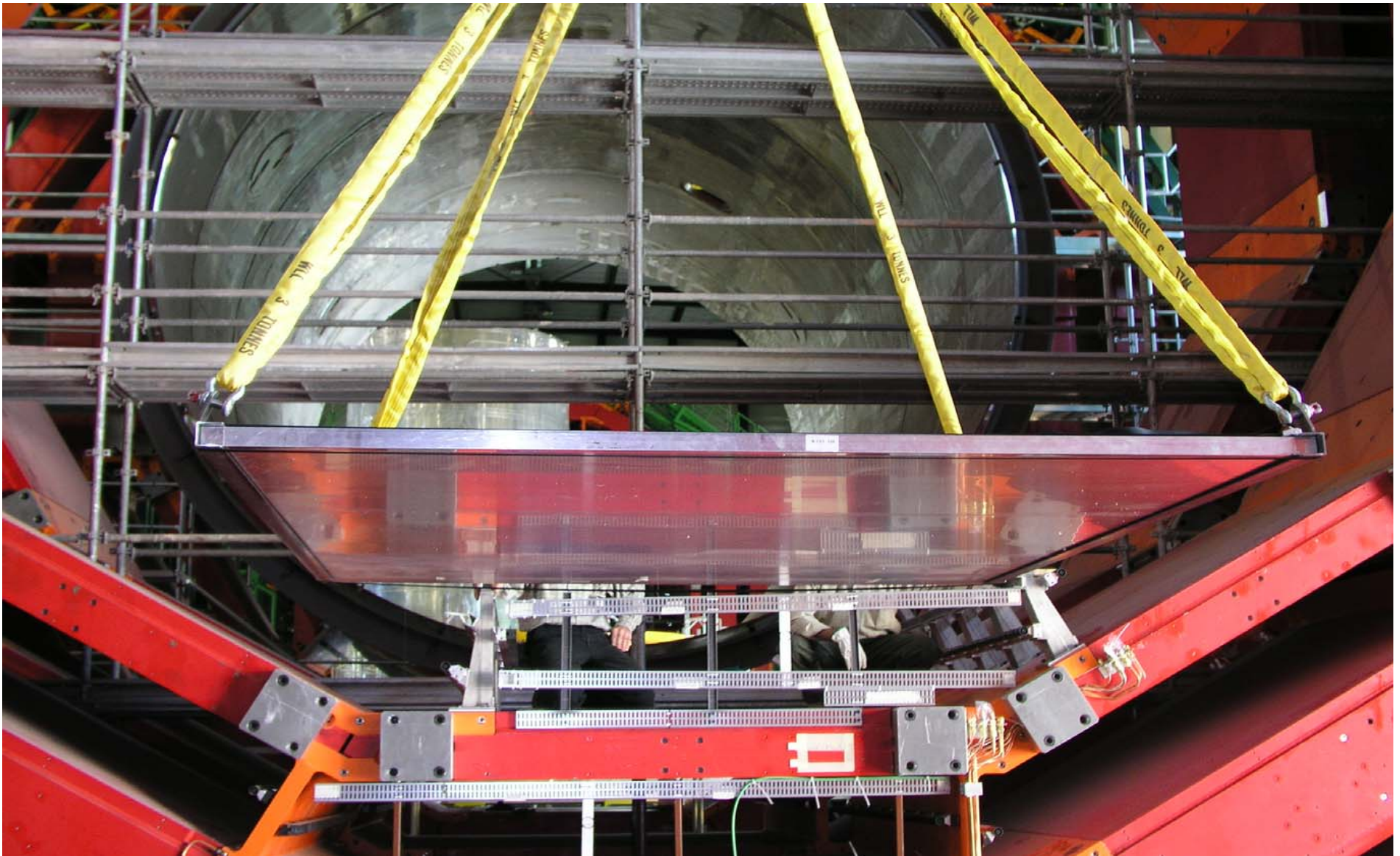


# The First HF is Assembled, Bat 186



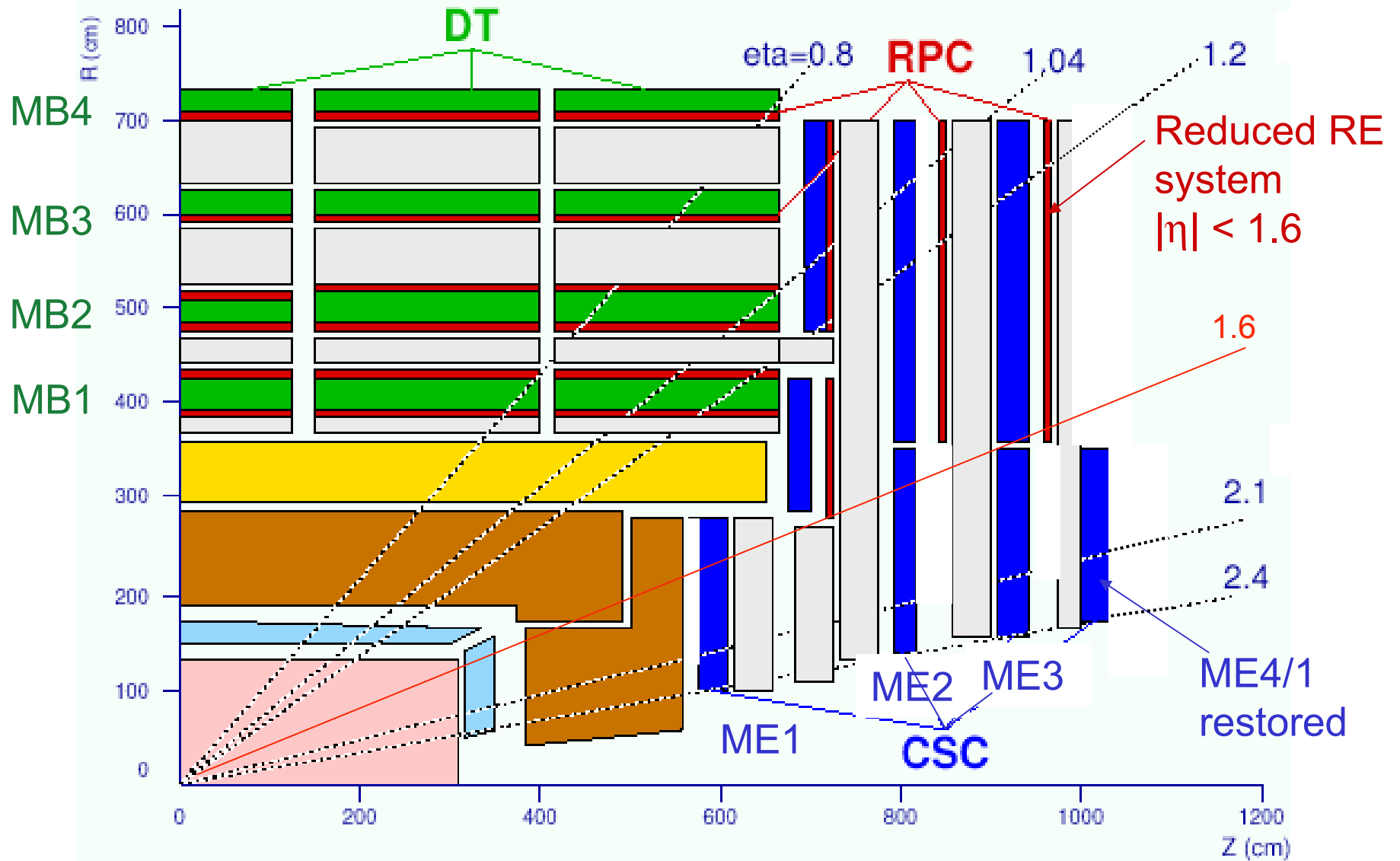


# HO Trial Assembly





# Muon System





# ISR Tunnel Sept 04

DTs 149/250 (60%)



CSCs 496/468 (105%)



RPCs 200/480 (40%)

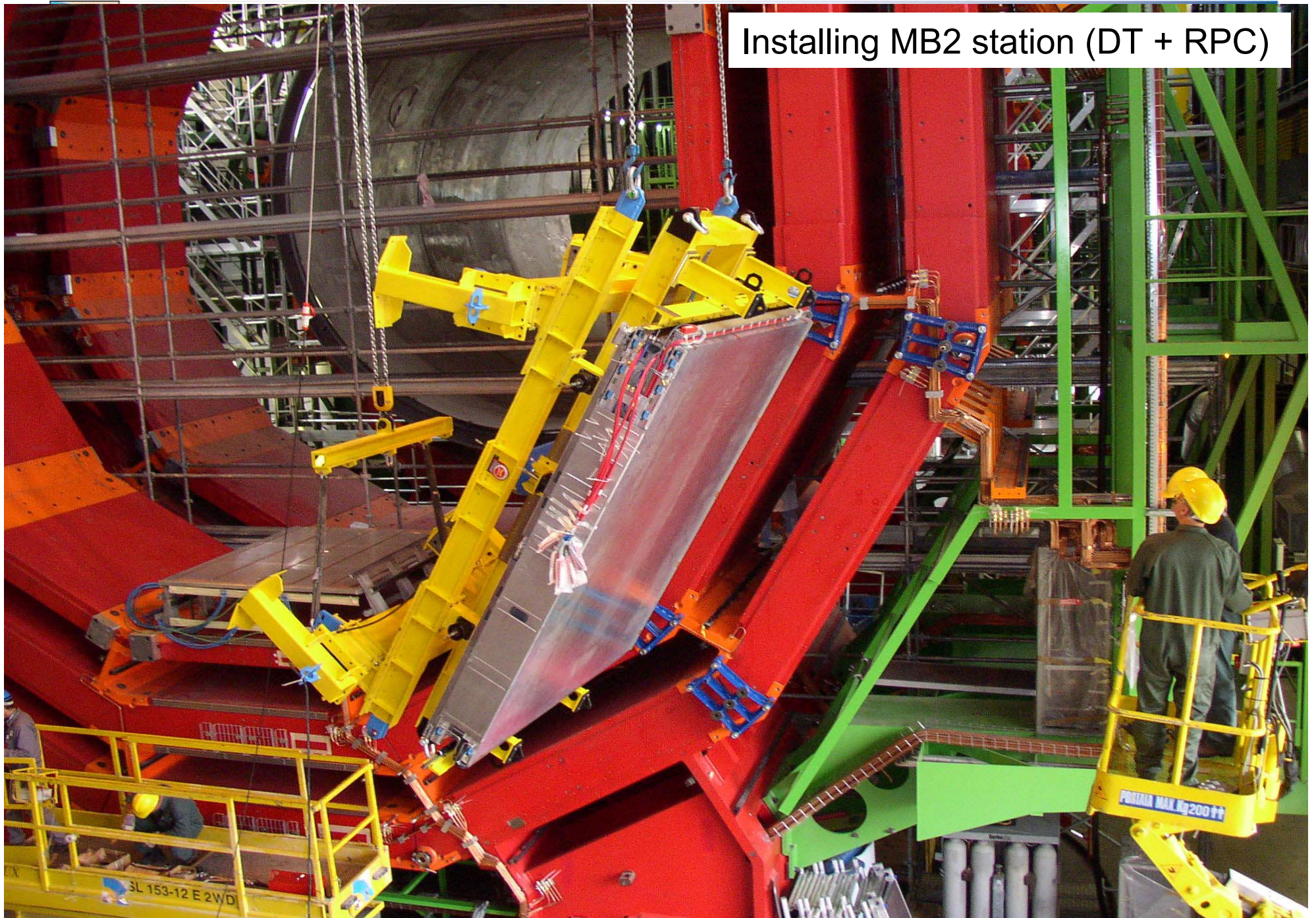


Testing Chambers





Installing MB2 station (DT + RPC)

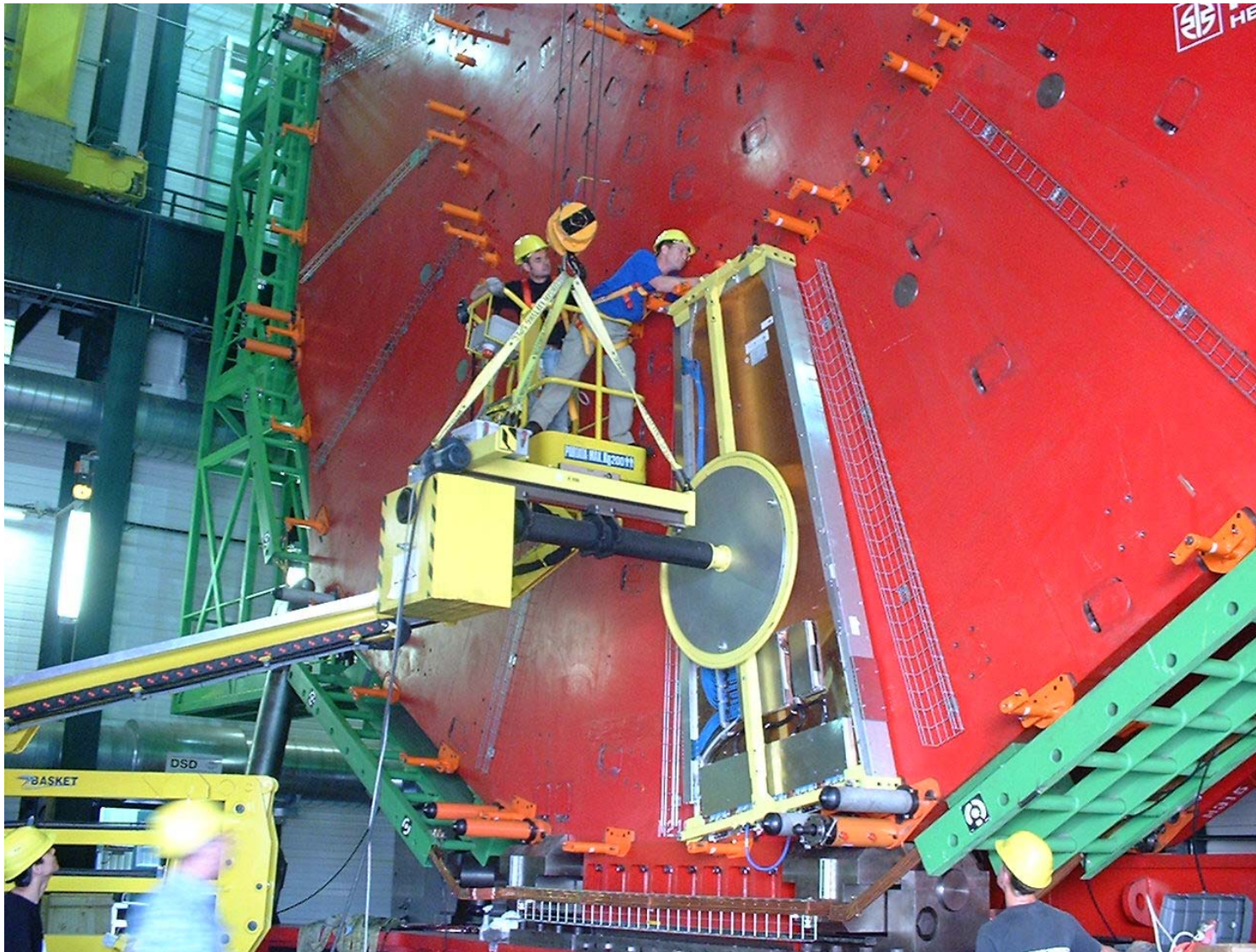


11 MB stations installed in YB+2



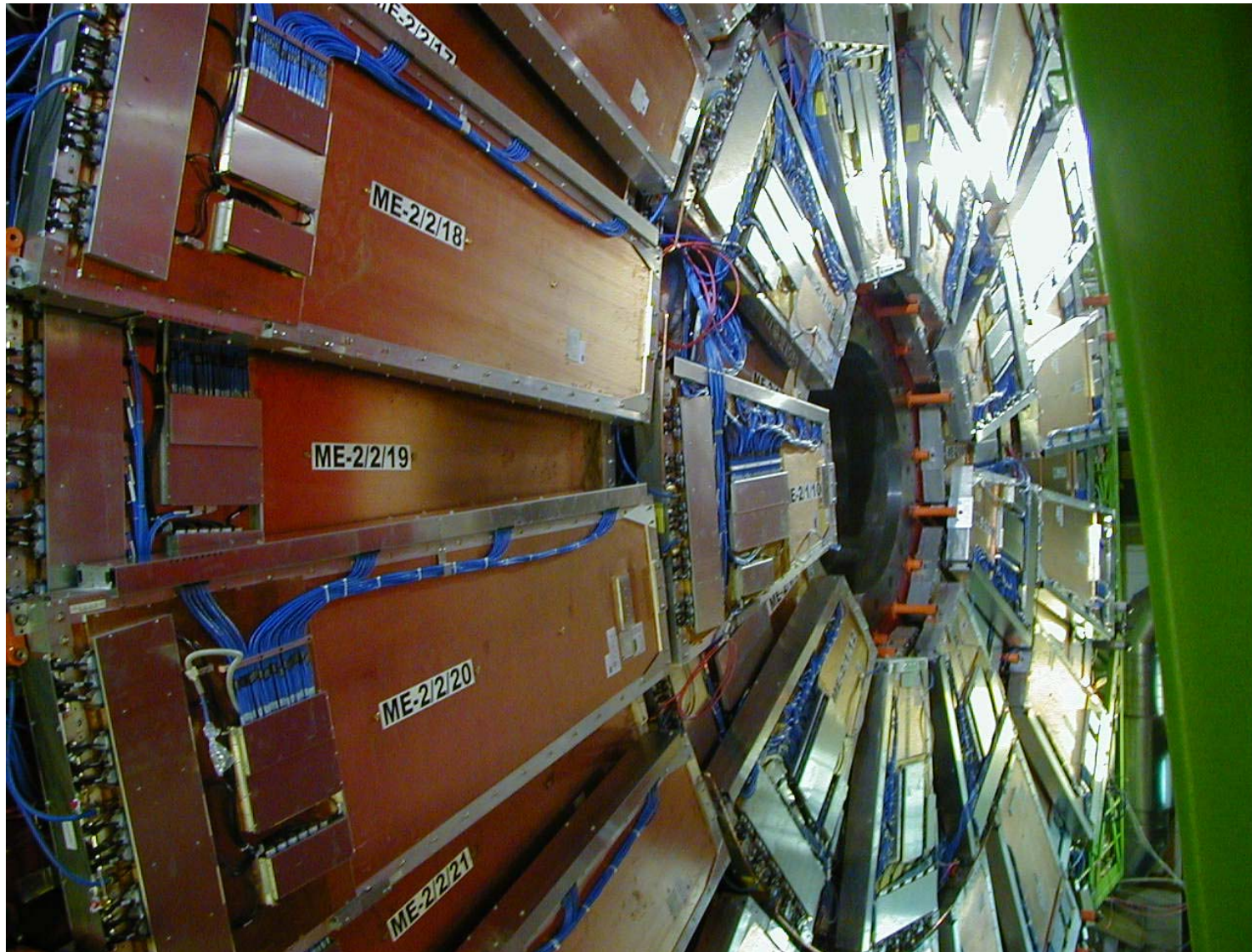


# Mounting 1st CSC chamber





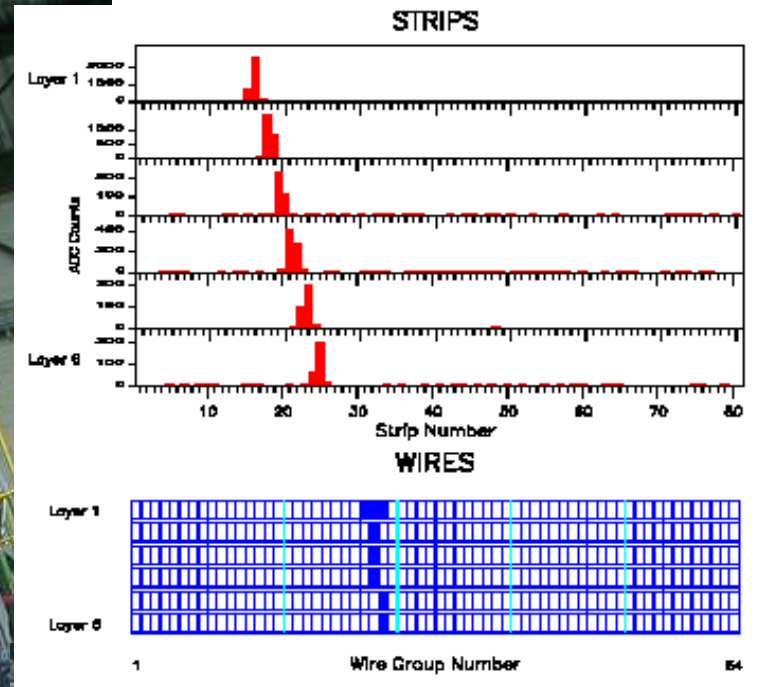
# 162/468 CSCs installed (35%)



Completed ME-2 station



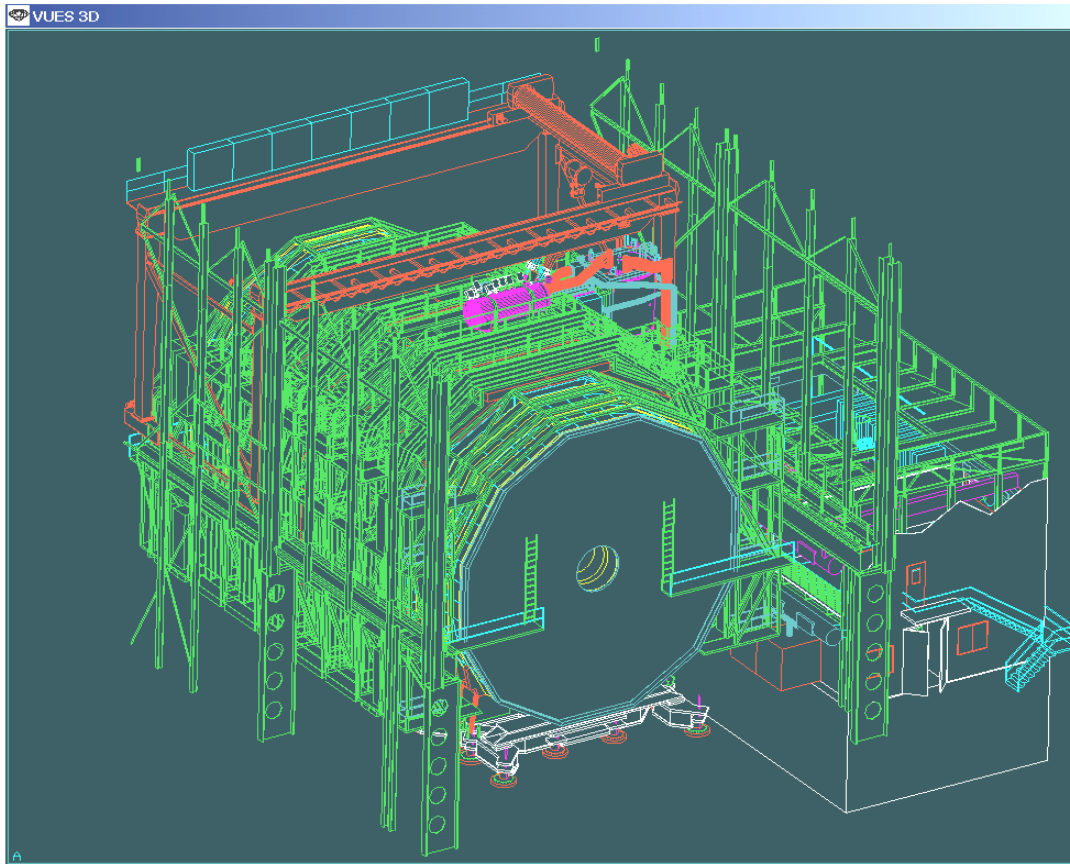
# 117/468 CSCs commissioned (25%)





# Magnet Test in SX5

CMS closed for magnet test in SX5 surface building: autumn 05

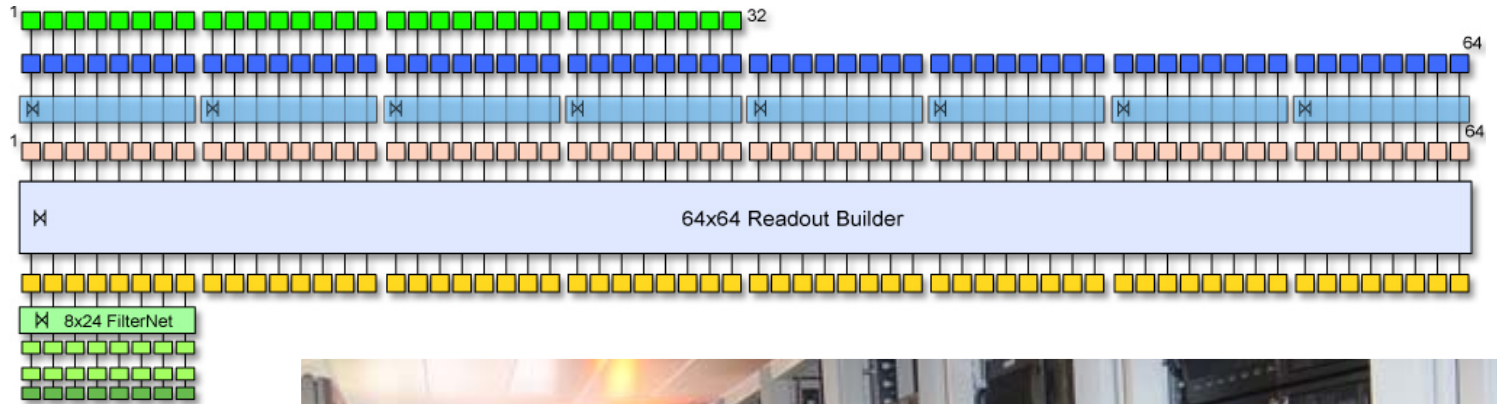


- Check functionality of magnet, including cooling, power supply and control system.
- Map the magnetic field.
- Check closure tolerances, movement under field and muon alignment system (endcap + barrel + link to Tracker).
- Check field tolerance of yoke mounted components.
- Check installation & cabling of ECAL/HCAL/Tracker[dummy] inside coil, including cabling test.
- Test combined subdetectors in 20 degree slice(s) of CMS with magnet. Try out operation procedures for CMS. (24/7 running).



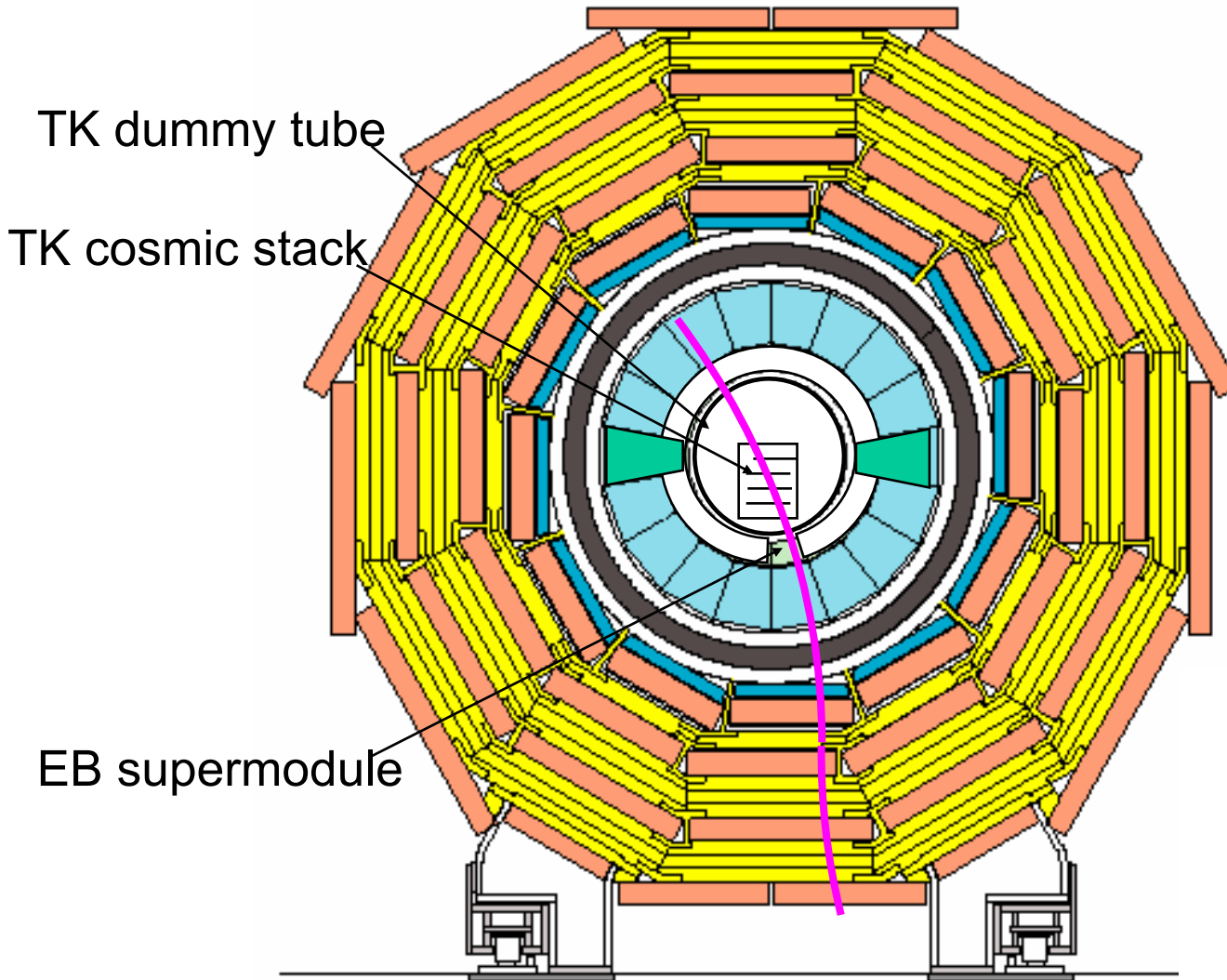
# Pre-series computer room: P5 green barrack

1/8<sup>th</sup> of the DAQ  
Event Builder  
+ Filter Farm of  
16 PCs  
installed in Cessy





# Magnet test: “cosmic challenge”



## Ambitious Integration Test (end 2005) :

- cabling & services (esp LV)
- controls and safety
- trigger
- off-det electronics (FEDs)
- build and record events with 1/8th DAQ Builder.
- Analyse events online
- Event Display
- databases
- data-structure/storage
- analysis software etc etc





# Conclusion

**Civil Engineering:** Irrecoverable delays in USC and UXC.

**Magnet:** Project 93% complete. 3 coil modules finished, 2 at CERN. All at CERN by end-04. Finish magnet test by end 05.

**HCAL, Muons (Barrel DTs, RPCs and CSCs) :** construction on schedule and well advanced.

## To watch

**ECAL:** Crystals production, contracts need to be placed with multiple vendors, cost of crystals. Very tight schedule.

**Tracker:** Re-start of mass assembly of Si modules, Very tight schedule.

## CMS now tracking wrt to v34.1 Schedule

Postpone ECAL Endcap and Pixel installation after pilot run

No float in ECAL Barrel and Tracker installation

**A low luminosity detector (minus the ECAL endcaps and pixels) will be ready for the pilot run in 2007.**