

CMS Annual Review Muon Alignment

June 13th, 2006

(T.R. for the Muon Alignment group)

Outline

- Installation Status & Tests done
- Next steps up to the MT & MTCC Goals vs schedule
- Plans for final installation in UX5
- Summary

Backup (LV, DAQ, Data format, COCOA reco, Align-DBs, and Cosmics-based align)

Installation Status: YE+3, YE+2

- ME+4 axial lasers installed in at 3 boundary positions (and some sensors on inner CSCs)

- ME+3 and ME+2 layers completed

- Partial readout test of ME+2 SLM lines (Still needs SLM laser adjustment/checks, revision of sensor shimming following the iron deformation)

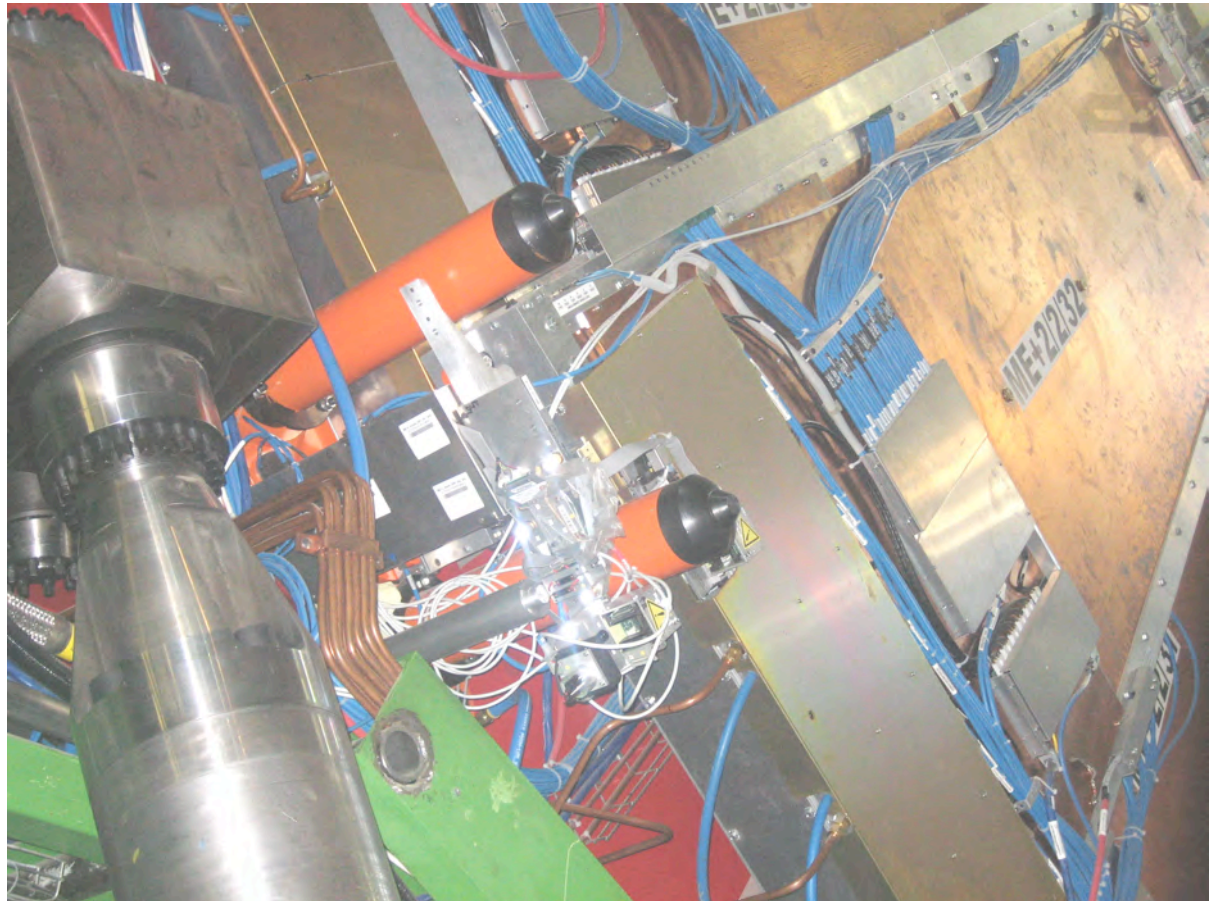


Installation Status: YE+3, YE+2

→ Serious problem of interference for the closing of the YE+ discs.

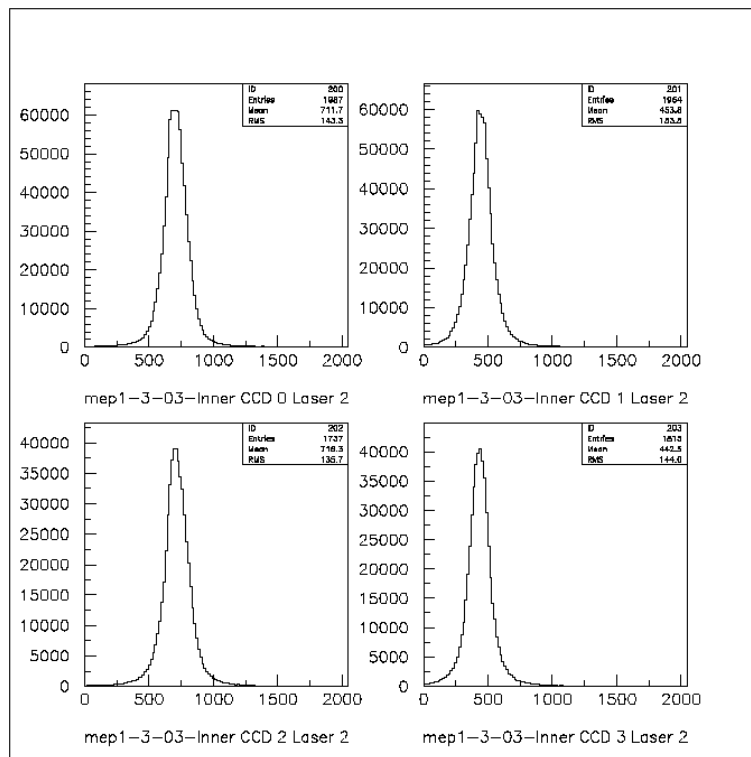
→ Dismount almost all lasers in TP to close YE+2 against YE+1 and try to re-install them after discs are in their final position.

→ Re-do hardware (and calibrations / CMM meas) for the final system



Installation Status: YE+1

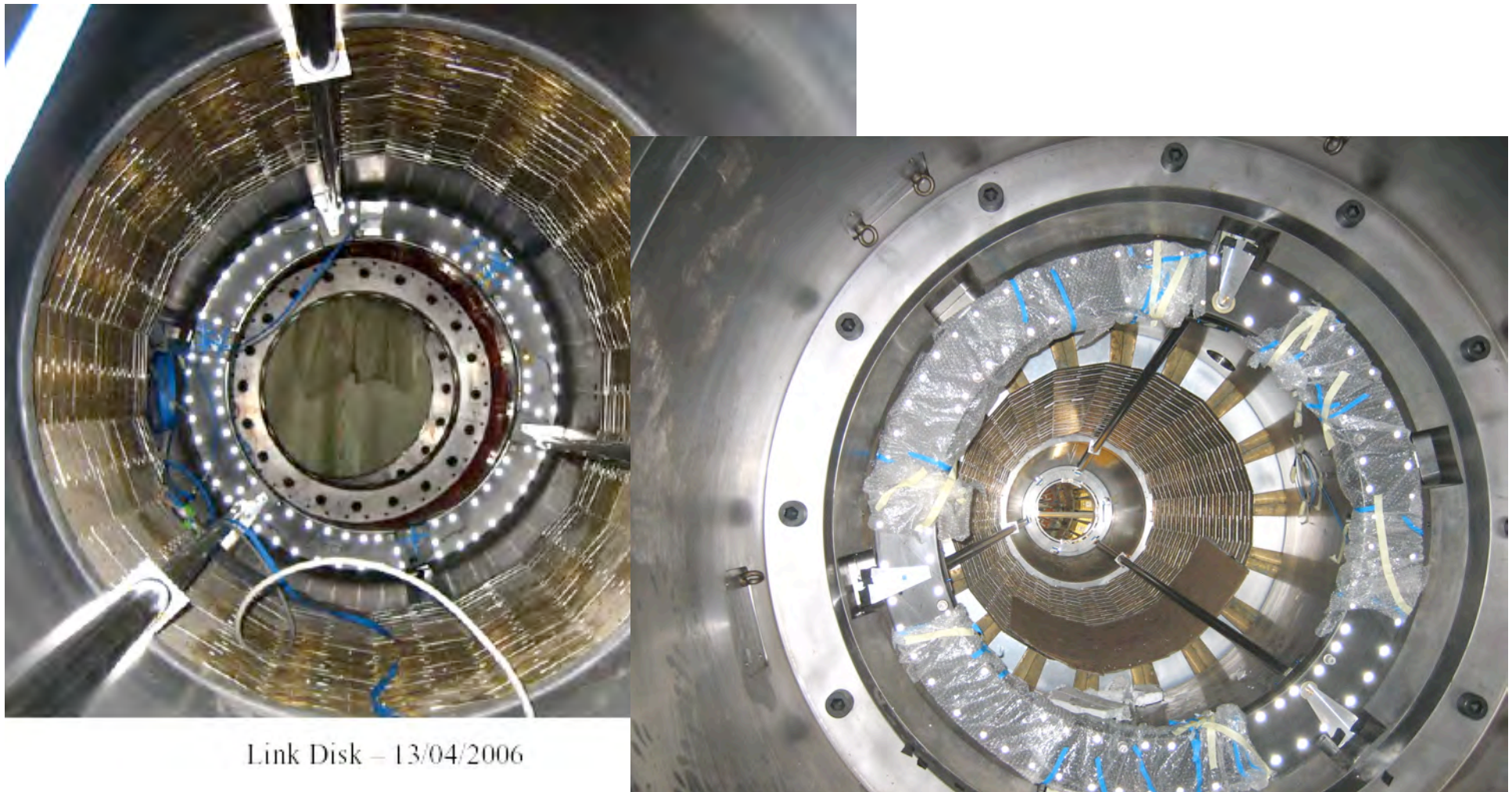
- ME+1 layer completed (1/2 SLMs for ME1/3 CSCs, R,T, Transfer plates, LD and ASPDs sensors on ME1/2 and ME1/1 CSCs , and DAQ)



- _ SLM lasers adjusted and readout test of ME+1/3 SLM lines done
- Separate readout of Analog sensors (ELMB boards) not yet integrated

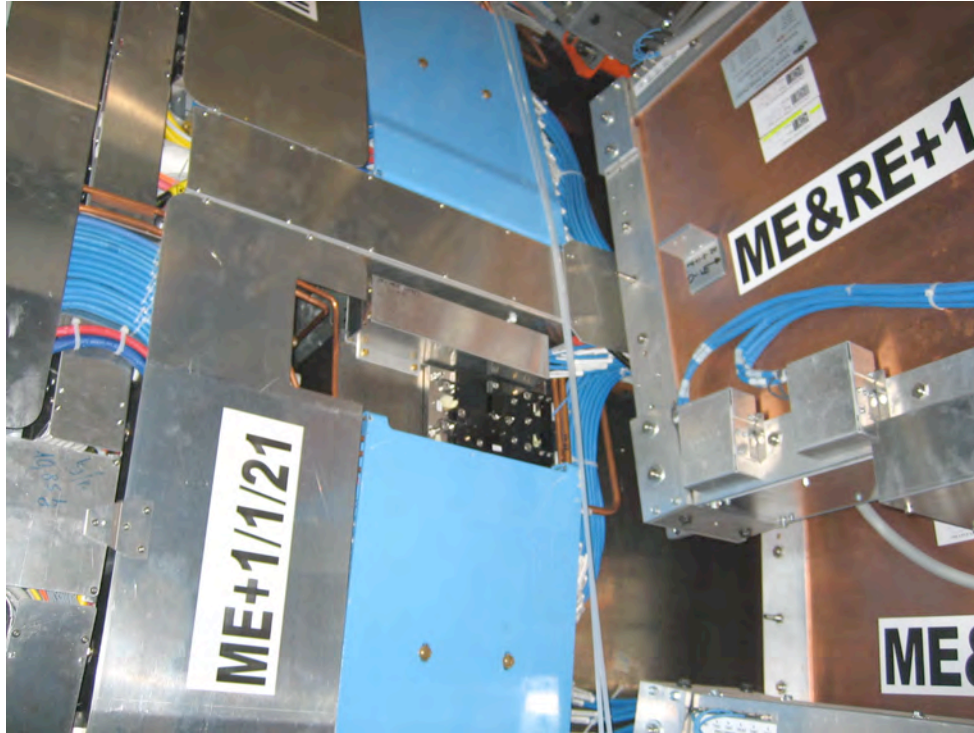
Installation Status: YE+1

- Link Disc (LD) and Radial/Longitudinal profiles adjusted. Measured by SU and laser readings: few mm in position ~ 1 mrad in orientation wrt to YE+1 iron



Link Disk – 13/04/2006

Installation Status: YE+1



→ Kinematic mounts, adjusted by three points from the top of YN1 (~ 2 m from LD fixations).

Far from easy! . Need to rethink installation/alignment tooling



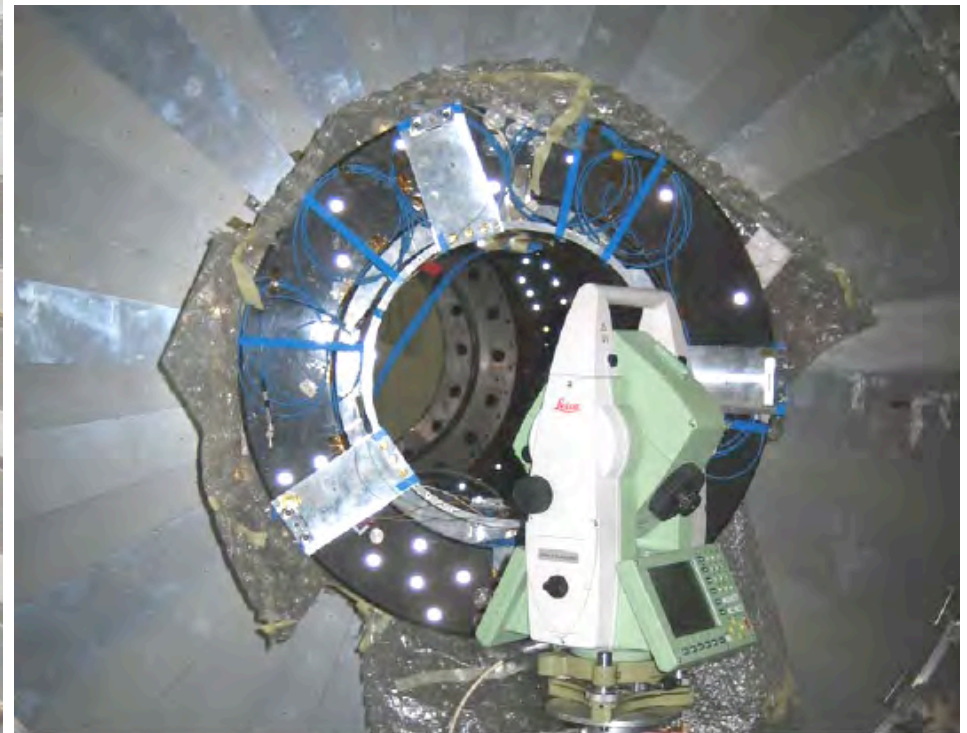
→ LD problem: No full recovery after movements (friction)
→ Quenches ??

Test of Link w/ Tracker on YE+1



- Mimic Detector closed AR+
positioning wrt LD+

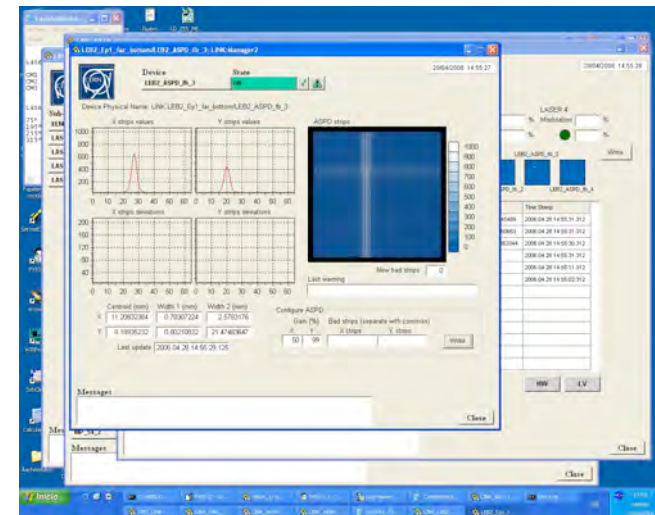
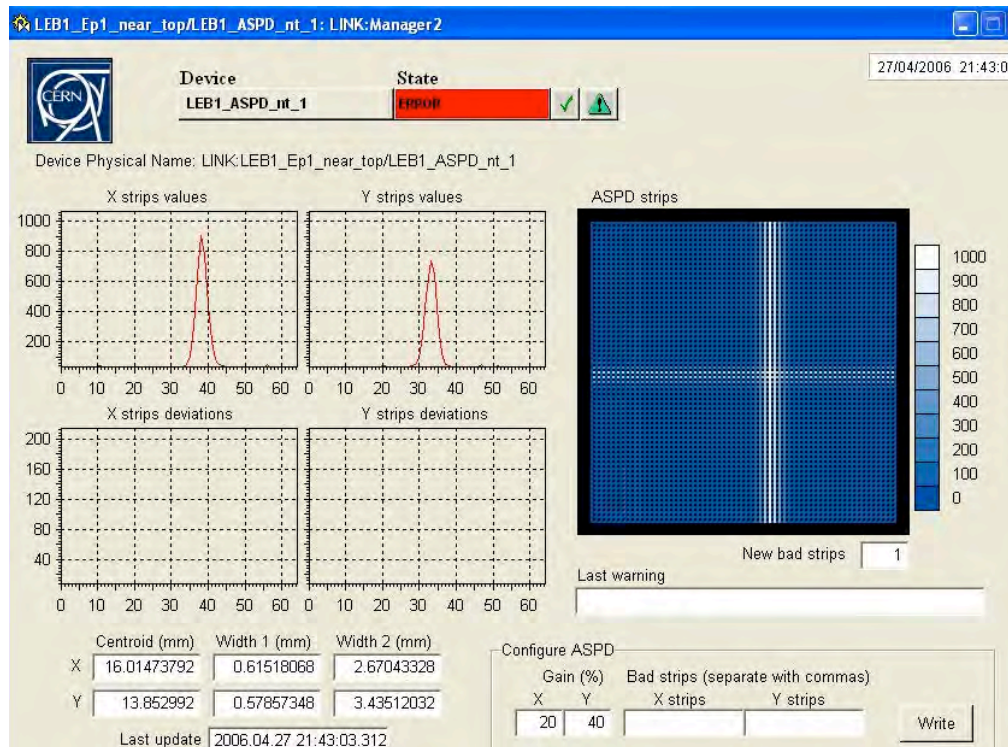
- No need of re-adjustment of AR
(just 3mm SE cone displacement in Y)



Alignment Ring – 13/04/2006

Installation Status: YE+1

- Readout tests of ME1/2 and ME1/1 ASPD sensors
- All electronics boards, LV and Laser power tested

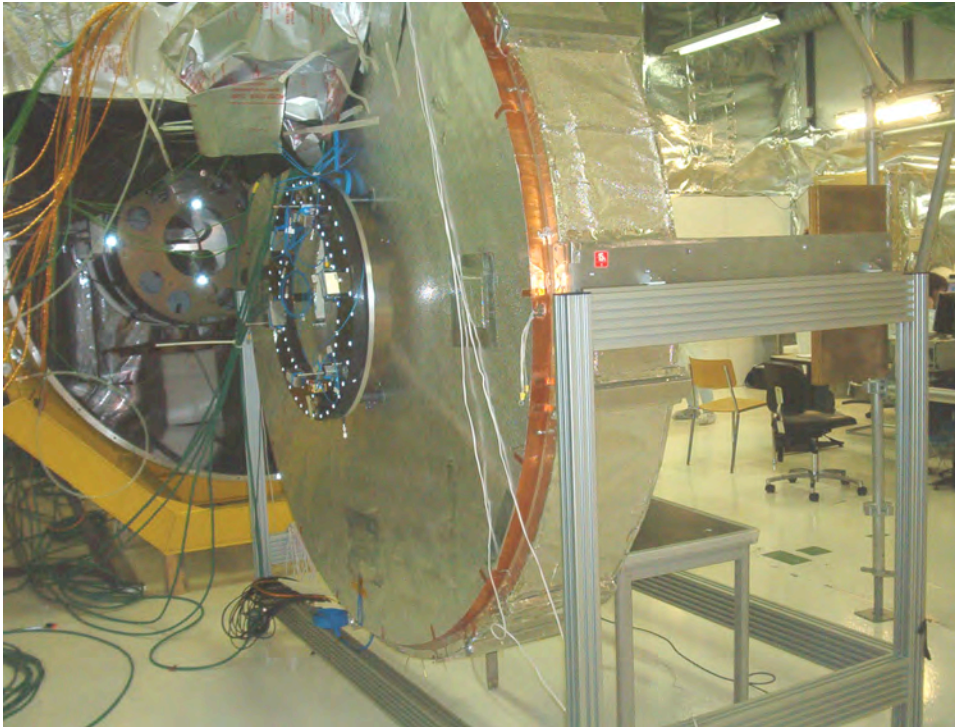


LD laser as seen in ME1/1 sensor
(~ 2,5 m light path)

AR laser as seen in ME1/2 sensor (~ 6m light path)

→ Conclusion: The system works (as in calibration conditions)
if structures are at its "nominal" position values

Installation Status: Tracker



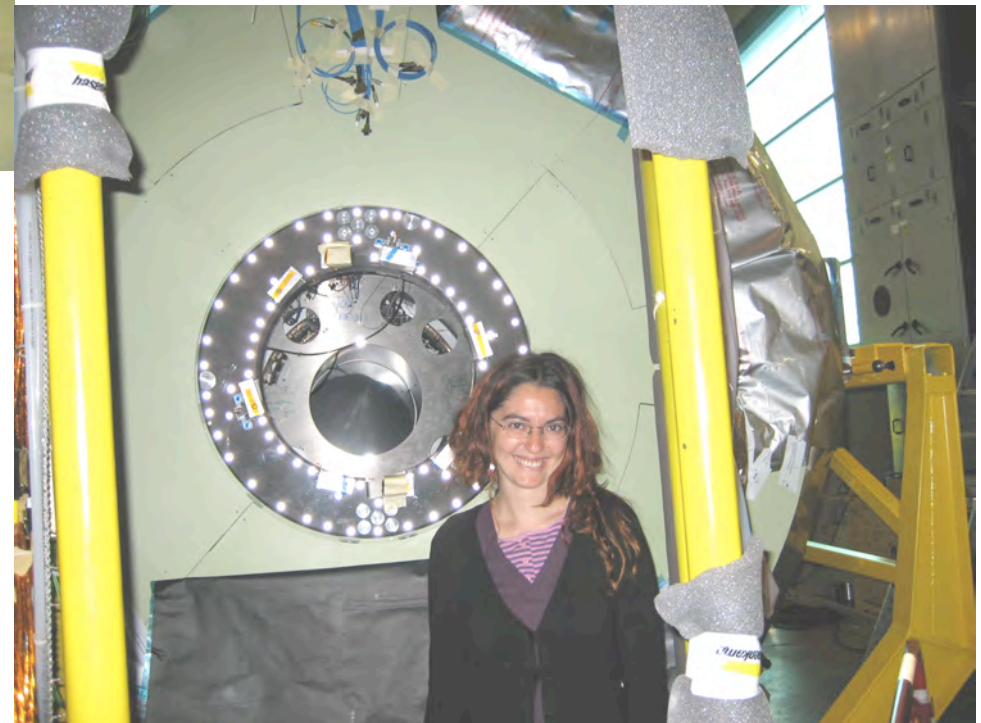
At B186:

- Test of AR+ Insertion on the BD
 - Conectorization and readout tests of sensors installed in BD
- (No time for SU measurements)

At P5:

- Mounting of AR on the BD/BH
- Waiting for SU measurements of TK & AR actual positioning & Understand if AR+ adjustments are needed and feasible

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Installation Status: YB0-, YB-1, YB-2

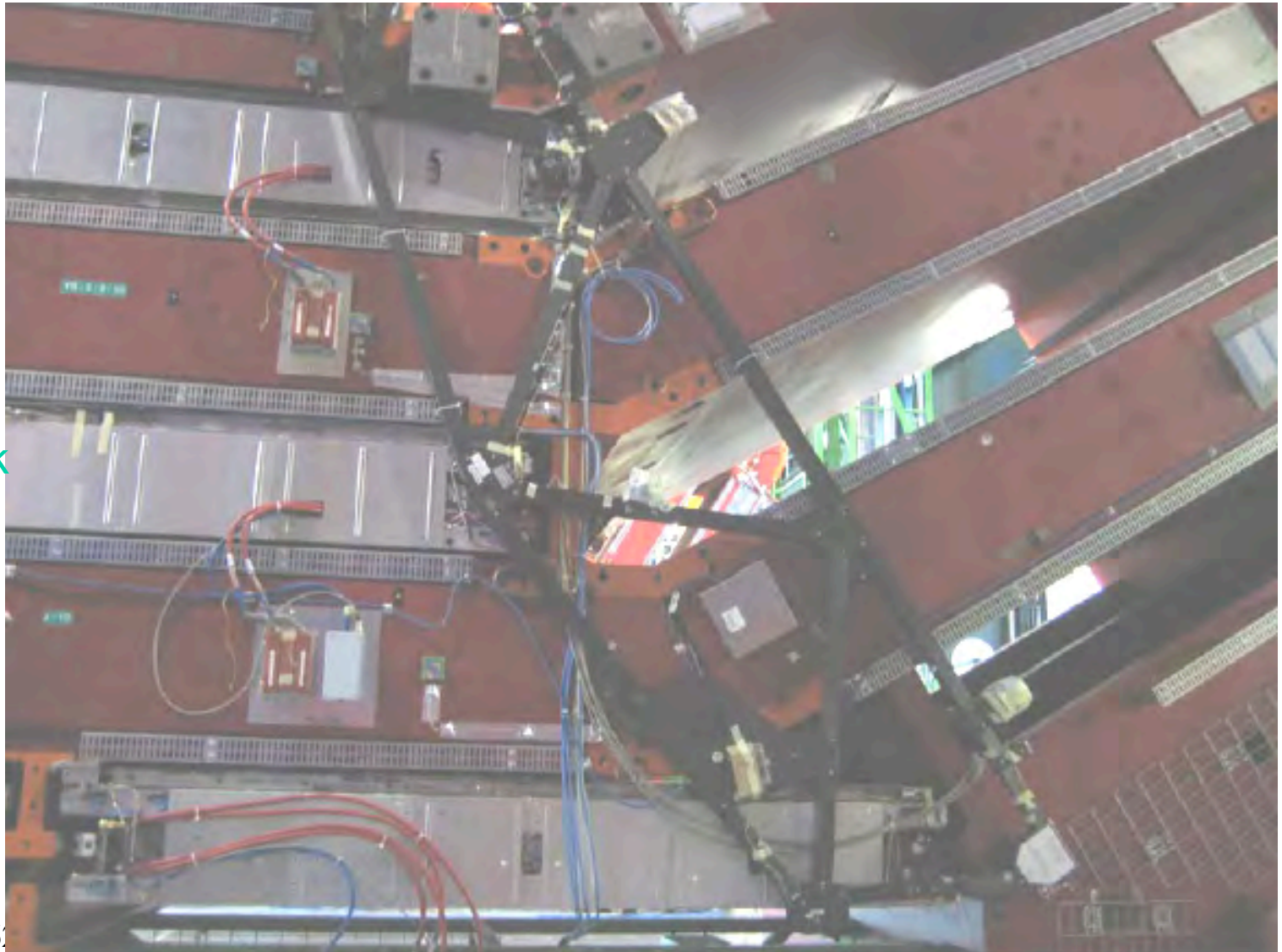
- 5 MABs + PC Readout boards // PiConNet units for all DTs in YB-

- Provisional cabling on YB- for the MT

- MABs on YB+ wheels are being installed during this week

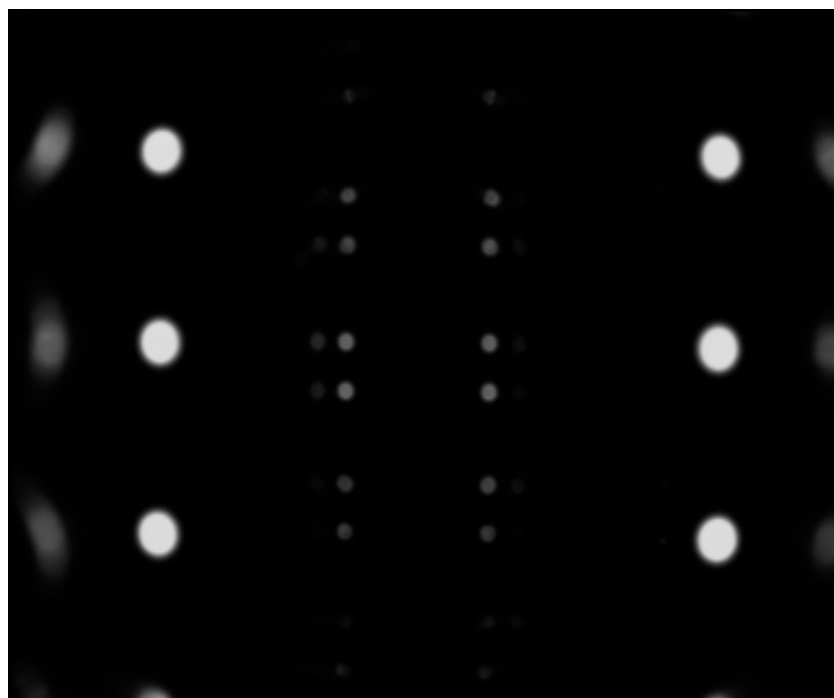
- Zbars in YB0: Found and repaired some mechanical failures.

Bars installed w/o calibration



- MAB on YB -

Installation Status: YB0-, YB-1, YB-2

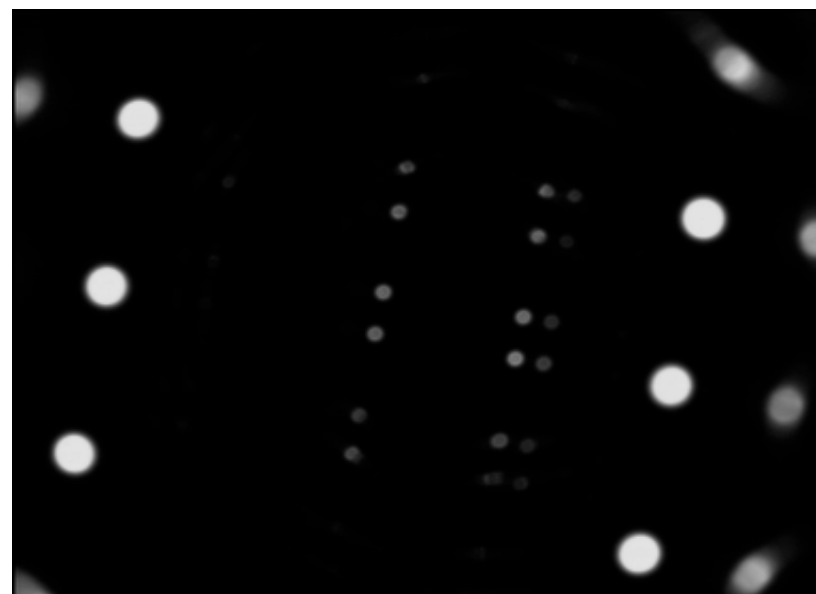


- Readout tests of all installed MABs
All within acceptance in the “Per Wheel” tests
- High level of redundancy in the system
- First PG measurement shows that not optimal MAB installation has been achieved

**POSITION OF THE MAB 2_10- (N°229)
W.R.T. THE YB-1**

SX5 – CERN – June 2006

NAME	X [m]	Y [m]	Z [m]
2297001	1.5399	-4.2715	-0.1190
2297002	1.9325	-5.2855	-0.1144
2297003	1.2053	-5.3879	-0.1118
2297004	2.5229	-6.5973	-0.1079
2297005	1.4855	-6.7956	-0.1044



Next Steps up to the MTCC & MTCC Goals vs schedule

- Test closing tolerances vs range for Barrel - side wheels
- Complete installation and readout tests on YB+
- Complete Tracker / AR+ SU measurements (& adjustment if possible)
- Complete adjustment of ME+2,+3 layers.

- Complete cabling up to Green Barrack and full readout configuration
- **!! Actions to be taken for the closing of YE+ discs (next week)**

- From June 28th on:
 - Readout of barrel wheels from Green Barrack
 - Certify data storage and quality
 - ... and cosmics at B=0 with DTs (1 weeks before full detector closing)

Next Steps up to the MTCC & MTCC Goals vs schedule

At B=0

- Check closing tolerance vs system dynamic range
- Validity/consistency of data vs survey measurements and cosmics analyses

With B field

- Check magnetic effects vs system dynamic range (quenches during the Magnet training period !!)

Setup whole project: many parts still missing from data format to geometry reconstruction
→ NO on-line analysis / results can be expected

Plans for final installation in UX5

In parallel to the MTCC (as much as resources allow!):

- Continue calibrations at the ISR
 - Link Zone: AR- and LD- . Starting to work to resume calibrations by July/August
 - MAB Zone: Still 26 MABs to be instrumented, PG measurements, and calibrations. Rate achieved for calibration: 1-2 MABs / day. Most probably re-start after MTCC is completed
- Engineering: Repair/re-design mechanics and improve installation tooling

After MTCC (mid October ?):

- Dismount most of the components: very fragile objects / reparations needed

In UX5:

- Redo installation and survey of alignment structures / components
- How much survey of DTs and CSCs can be avoided??

Summary

- We are ready for data taking
- Many lessons already extracted from installation to be implemented in the final system
- Improve coordination for common task (cabling, installation windows, integration issues)
- Very full work program to complete the hardware (in parallel with the MTCC)
- Most of the installation / adjustment work must be redone at UX5
- Still many missing parts to complete software chain: from DAQ-DCS integration to CMSSW reconstruction

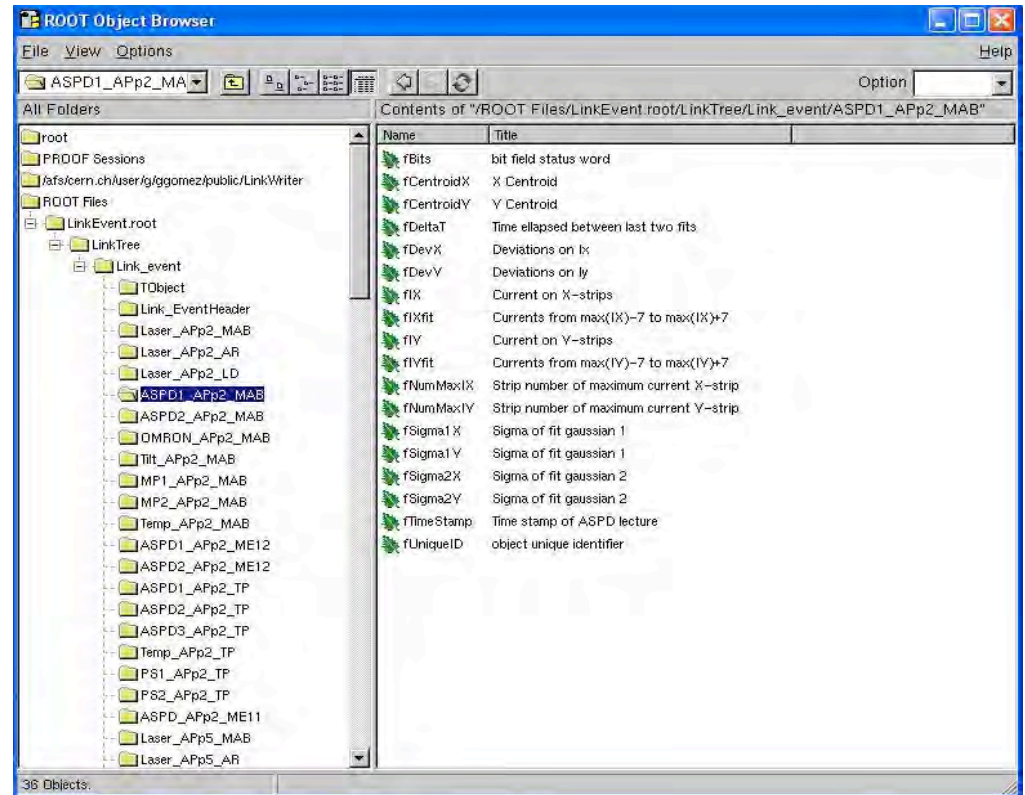
Backup

LV power, DAQ and Data-Quality

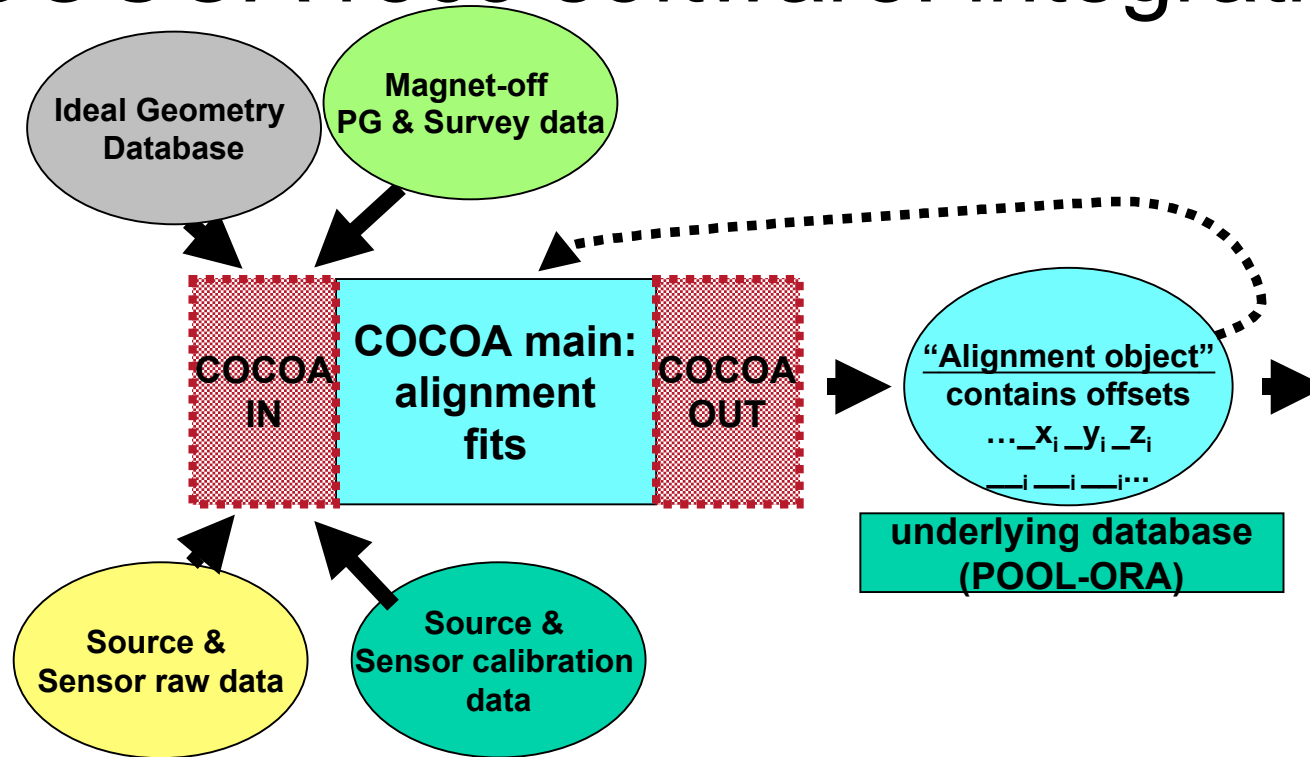
- (As for others) no CAEN A3006 boards available for MT. We have implemented a standalone conventional supply.
 - We manage to get from CAEN a pre-series module. It has been tested at 904 and Electronics-pool
 - CAEN promise to deliver the 5 first modules by October 2006. Testing of the system
 - Final order still to be placed.
- DAQ integration in PVSS.
 - Barrel hardware and Endcap DCOPS are readout by standalone Java and/or C++ code underneath →needs interface with PVSS
 - Link boards fully integrated in FSM structure
 - MA-node can be done after all subparts have implemented PVSS interface.
- Data quality control during data taking: just from PVSS (trends, displays...)

Data Format and DBs

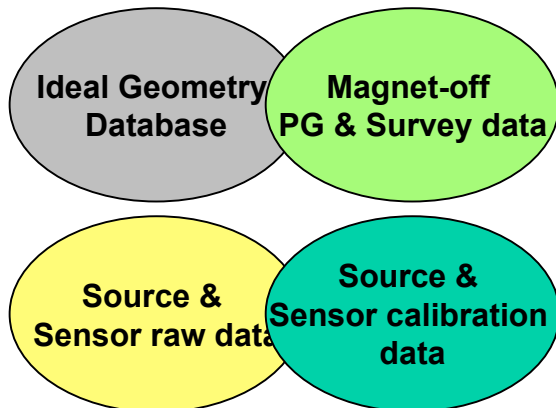
- Data flow
 - PVSS writes in Oracle DB (all data-points are stored)
 - A Root-Tree is build by a query to Oracle
- Root-Tree structure:
 - Endcap, Barrel, and Link branches for debug purpose (all available information in DB)
 - Common Alignment-Event with ad-hoc synchronization among the systems (w/ only needed input for reconstruction)



COCOA reco software: integration



COCOA main code: tested under different conditions/simulations → Robust



Barrel: Examples only (Zoltan/ Noemi)
 Link: Completed for MTCC geometry (Celsio M.R.)
 Endcap: ME+2 layer in work. Missing or obsolete drawings. ()

Alignment-Even Root structure defined (Gervasio G.)
 Implemented partially for the 3 subsystems. 20
 -> Calibration data introduced via Root or DBs. Starting in //

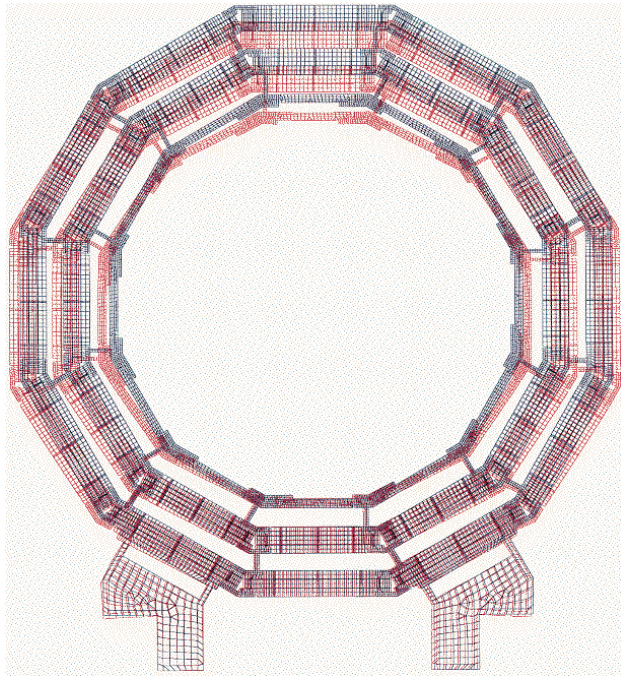
slow progress ...

Alignment_Geometry DB (DTs only): At “chamber level”

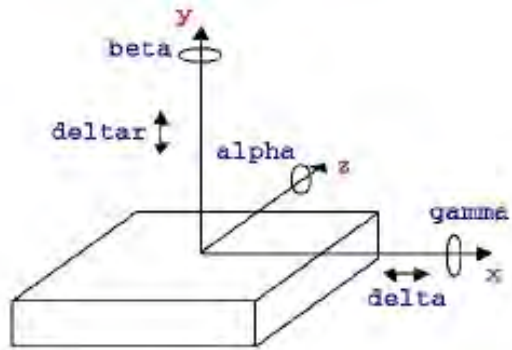
- We have been requesting SU measurements of chambers after installation... We got it for the barrel wheels:
 - Complete YB+2 and YB+1 → analyzed
 - YB-1, YB-2 (sectors 10/11) → to be analyzed
 - YB0 and all Endcap discs measurements no yet done
- Results match quite well the FEA for gravity deformations.. (and it seems to agree with cosmics results) →

On work:

- Complete the analyses for all available data
- Build a first Alignment-Geometry DB at chamber level (this is the level of granularity the laser based alignment can give.). Software needed not yet available in CMSSW

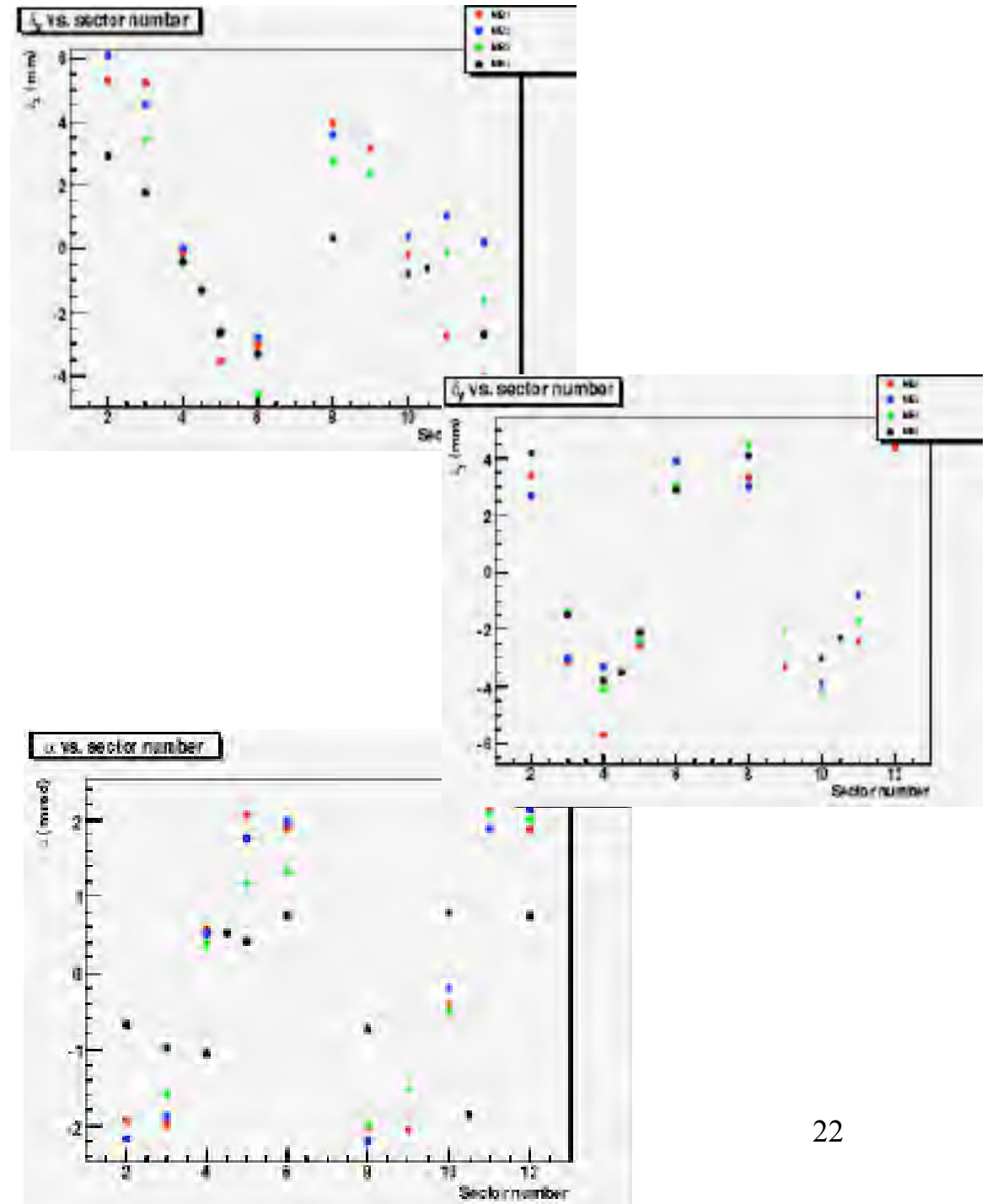


External barrel: Deformed shape



$$\chi^2 = \sum_i \frac{1}{\sigma_i^2} (\bar{x}_i - R\bar{x}_i^T - \bar{\delta})^2$$

T. Rodrigo 060620



Alignment_Geometry DB (DTs only): At “Layer” level

- Internal alignment of the chambers is being performed
 - Three different sources of information
 - Quality Control Measurements at construction sites (X position of the layers inside a SuperLayer, errors of about 50 μm)
 - Survey Measurements (Displacements and rotations between SuperLayers, errors of about 10 μm)
 - Alignment with Tracks using commissioning data (Partial information about the displacements and rotations of each layer in the chamber, errors of about 5 μm)
 - Crosscheck performed successfully
 - Starting the combination of the three sets of measurements to achieve displacements and rotations for each layer

Quality Control + Survey Measurements vs. Alignment with Tracks (projection over Alignment with Tracks measurable degrees of freedom)

