






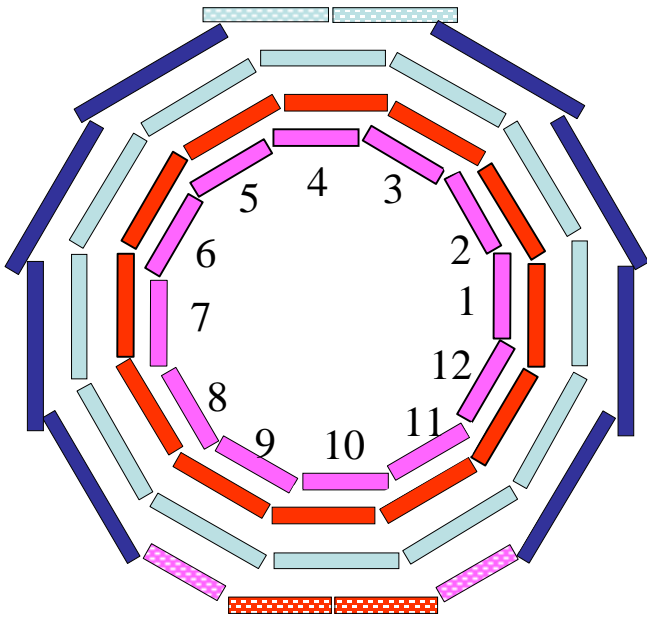


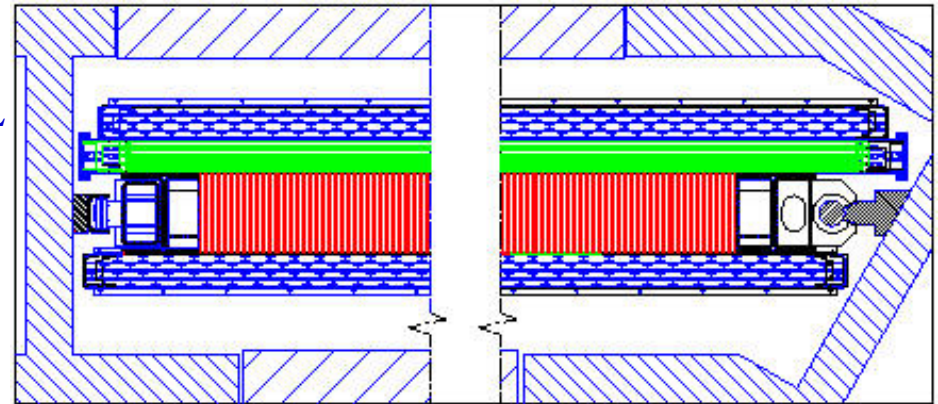
# The Installation Task

The Barrel Muon system comprises 250 chambers in 7 flavors:

	60 MB1	3SL	2 RPC
	60 MB2	3SL	2 RPC
	60 MB3	3SL	1 RPC
	40 MB4	2SL	1 RPC
	10 MB1	2SL	1 RPC
	10 MB2	2SL	1 RPC
	10 MB3	2SL	1 RPC



$\Phi$  SL  
 Z SL  
 Honeycomb  
 $\Phi$  SL

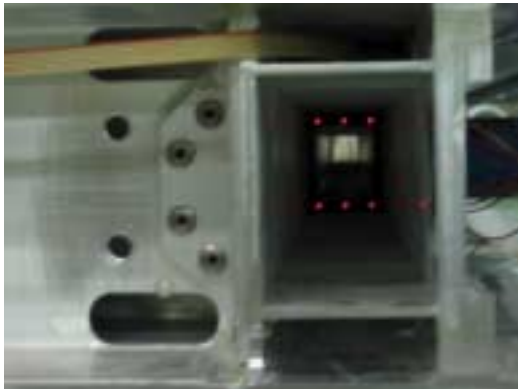


10 Sectors will be installed in SX5 => 210 Chambers.

Sectors 1 and 7 are used for the lowering fixture and will be installed in UX5

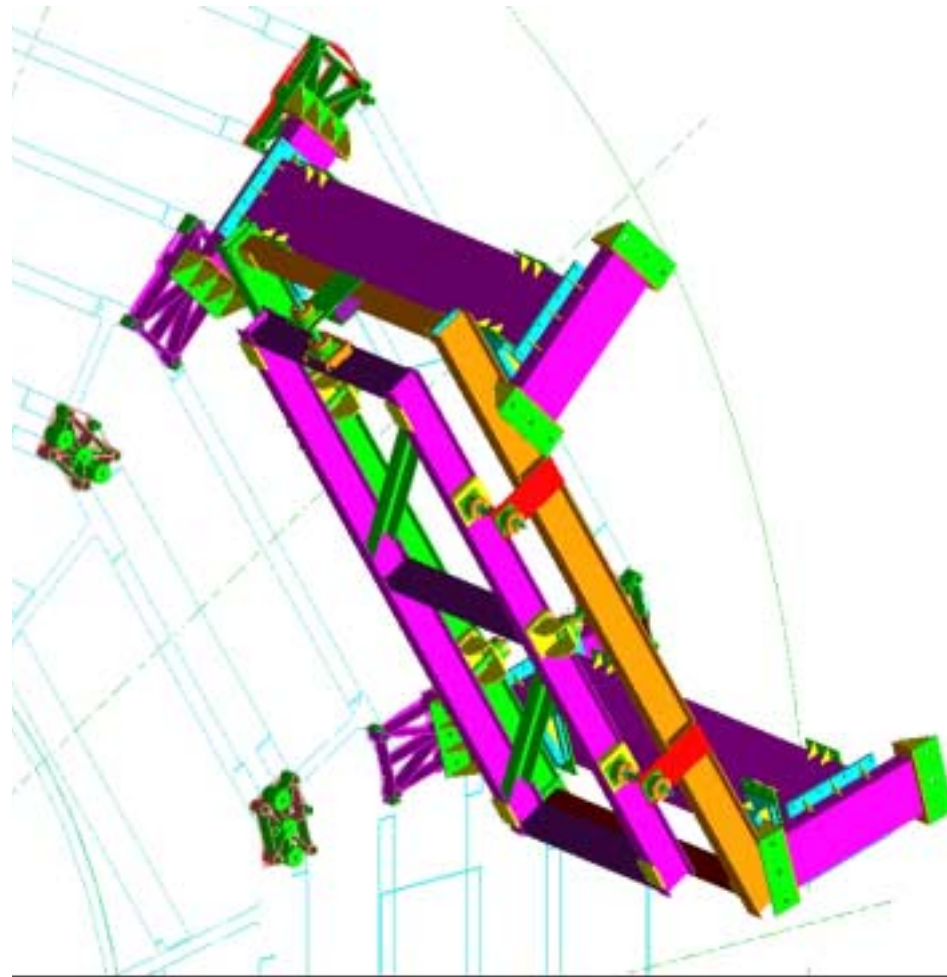
# Chamber Preparation

- DT and RPC chambers are sent to the ISR from the assembly centers fully tested
- Acceptance tests: HV, Leak-rate, noise, cosmics
- DT alignment calibration
- DT cabling+services
- DT assembly with RPCs
- Storage in transport fixture

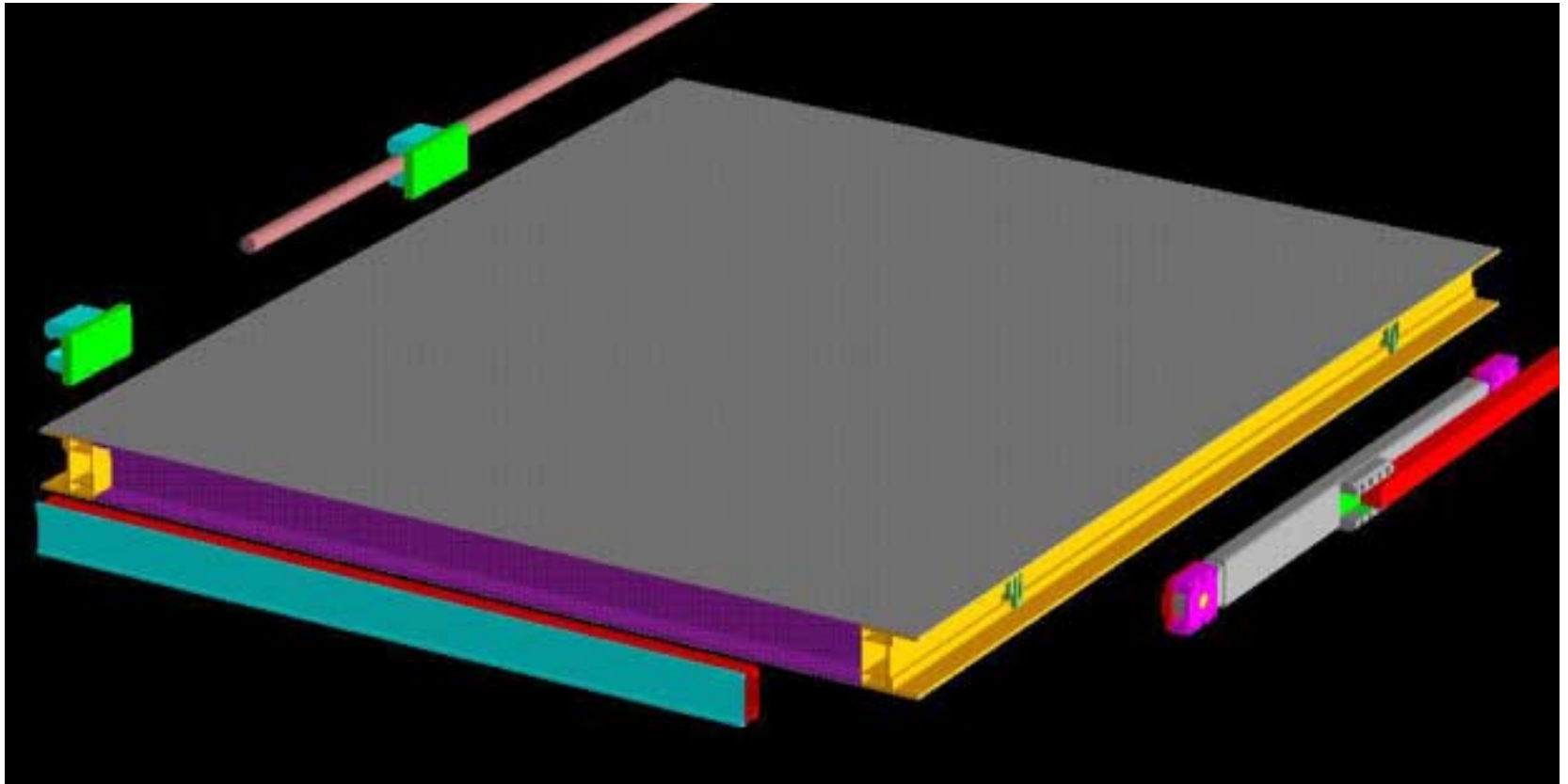


# Installation Sequence

- Transport 4-5 DT + RPC chambers from ISR to SX5.
- Acceptance tests:  
HV, Leak test, Noise rates.
- Attach support pieces to wheel.
- Configure cradle to chamber type/position.
- Insert chamber on cradle
- Attach cradle to wheel.
- Align rails cradle to iron.
- Transfer chamber to iron pocket.
- Dismount cradle.



# Chamber Support



# Installation Tests

The cradle is a crucial tool needed for installation both in SX5 and in UX5.



Functionality fully tested:

- Insertion of one MB2 Chamber
- Orientation for MB3, MB1
- Configuration for MB4/10

==> No bad surprises

==> Congratulations to

Massimo Benettoni



The cradle is aligned to the support pads (blue) with conical pins.

The support pads are cantilevered from the wheel to allow insertion with services (gas, cooling, DCS) in place



Attachment to push the chamber. →

The Cradle is bolted to the support pads. ↙





← Chamber insertion begins

Support rails on wheels measured with photogrammetry

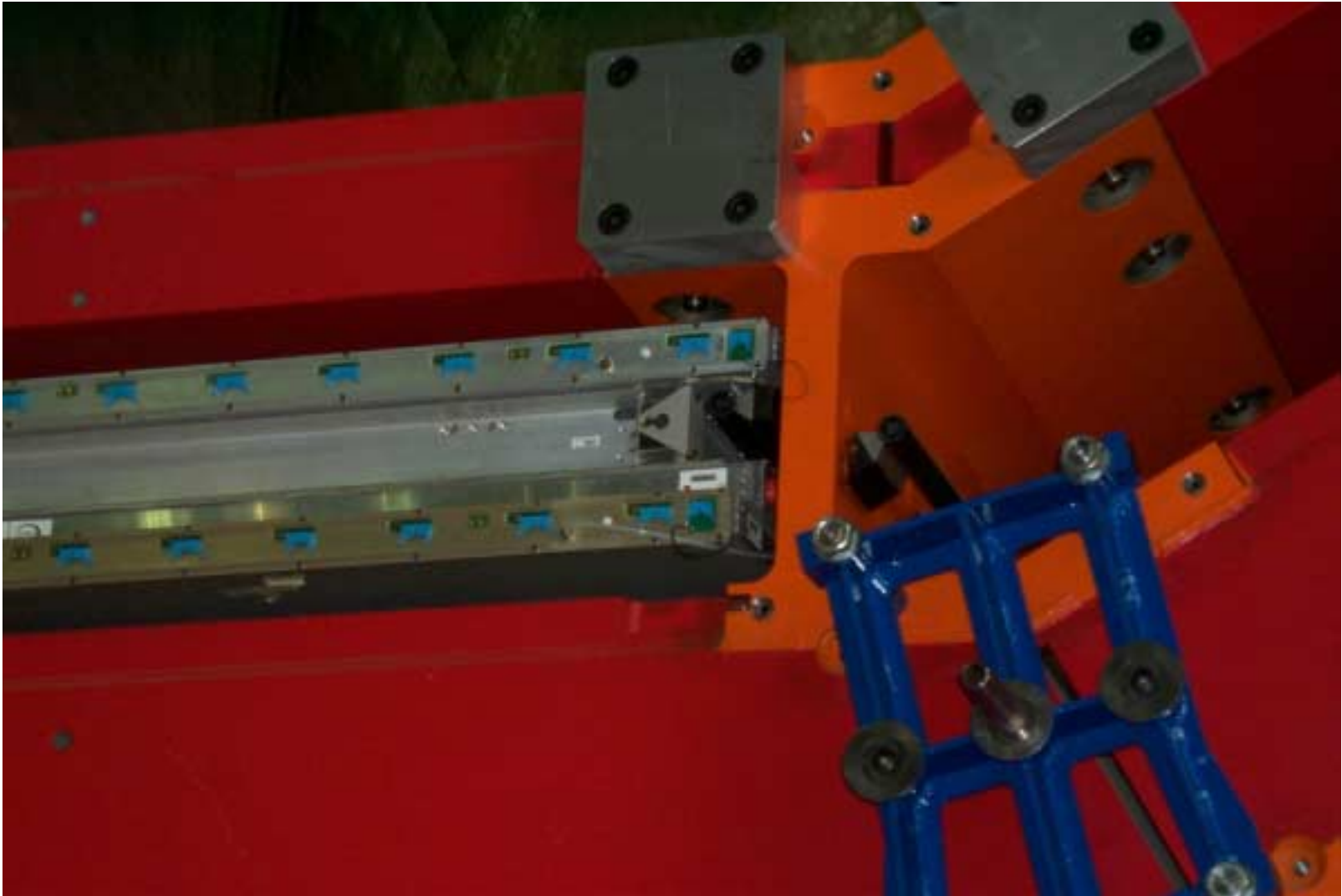
→ precise geometry

Chamber insertion completed. →





# MB2 installed in YB+2



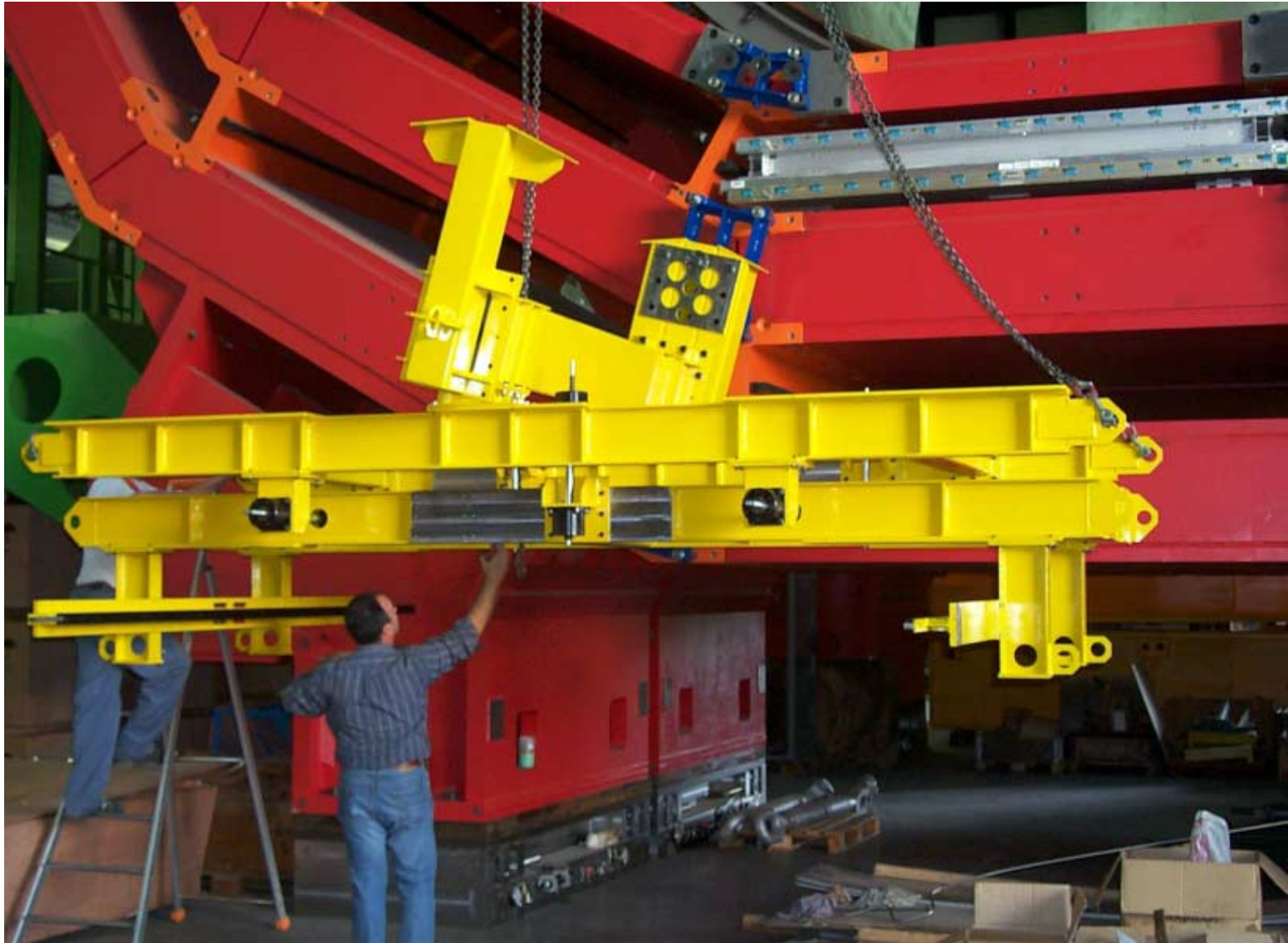
## Cradle rotation in MB3 configuration



## Cradle Mounted for MB3 Insertion



Cradle Mounted for MB4-10 Insertion (Two MB2 size chambers)



## Future Installation tests

- **Sector Test:** Install MB1, MB2, MB3 complete with cables and services.
- Installation of a minirate ( trigger, readout and control electronics) on a chamber already installed.



MB2 minirate prototype with readout electronics under test in CIEMAT



## Installation Tools

Some tooling is still needed for full scale installation:

- Transport frames for DT+RPC (CIEMAT).
- Ancillary tools for cradle rotation (Padova).
- Construction of a larger cradle for MB4.

In addition we will rely on existing SX5 equipment:

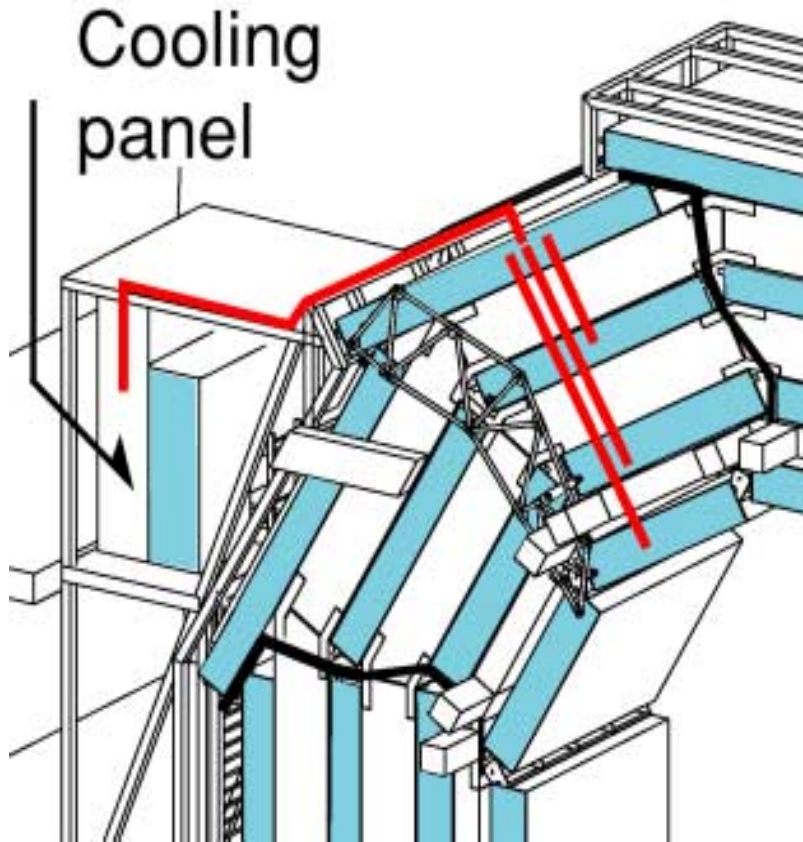
- Cherry pickers, movable platforms ...
- Refurbished L3 scissor lift.

Tooling costs are within cost book estimates.

# Chamber Installation Scenario

- Installation crew of 4 technicians from home Institutions plus crane operators
- Installation rate of one chamber/day at start-up plateau at 8 chambers/week
- One wheel (10 Sectors) = 42 Chambers in 5 weeks
- YB 0 YB-1, Sectors 8-9 September-December 2003
- YB+2 January-February 2004
- YB-2 Sectors 8-9 March 2004 Alignment/Magnet Test
- YB+1 September 2004 YB-1 November 2004
- YB -1 YB -2 April-June 2005
- 10 Sectors (40 Chambers) are installed in UX5 in 5 weeks starting November 2005

## Cabling and Services



- Gas and cooling pipes installed between 2 sectors by commercial firm.
- Connections to chambers done with flexible tubing at installation.
- HV, LV racks on balconies. Cables to PP (DT) or direct (RPC) ~ 34/sector
- RPC signal cables to link-boards ~80/s, DT trigger readout to sector collector ~16/s
- DCS ~7/s
- ➔ ~140 Cables/Sector
- ➔ ~ 12 fibers

- Cabling on gangways to racks will be done by a professional team independently of chamber installation.



# Cabling Scenario

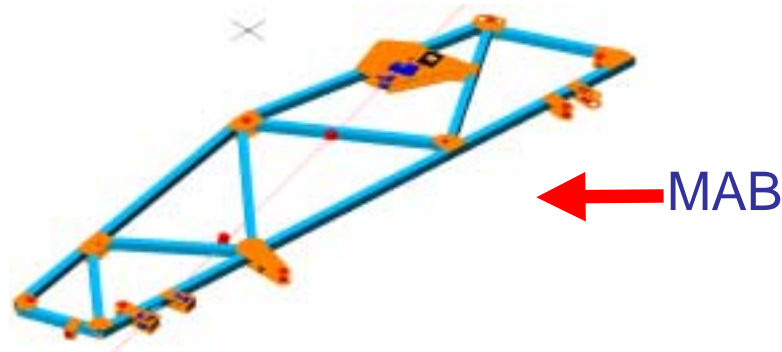
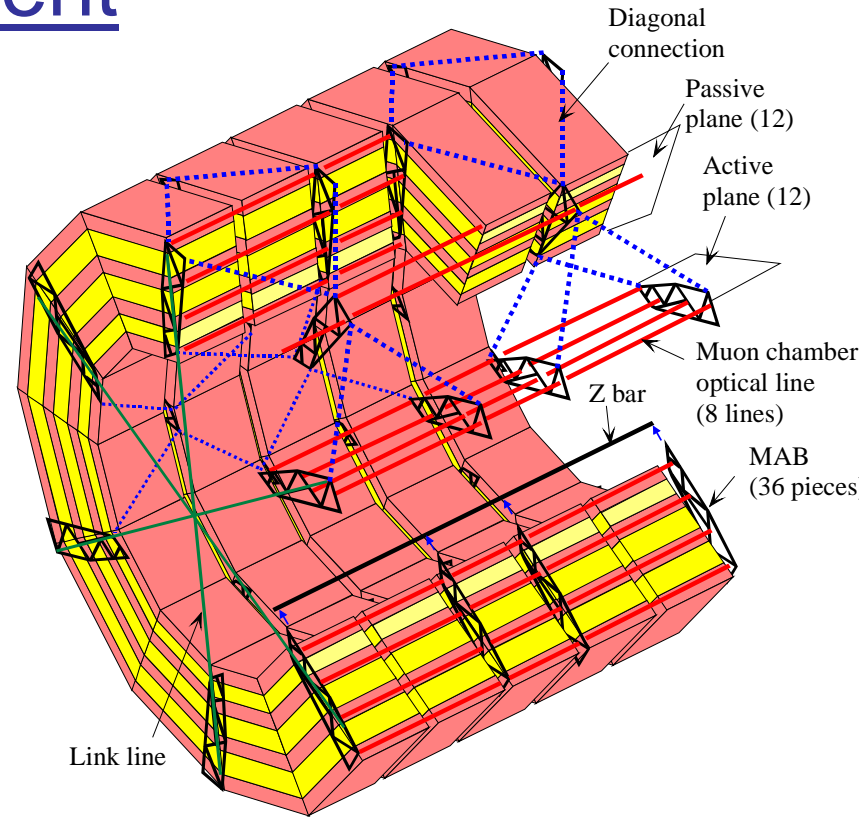
- DT chambers are installed with HV cables and minicrates. The HV cables are connected to patch panels mounted on the iron.
- Gas and cooling connections will be done as chambers are installed.
- Cabling on a sector can start once it is fully installed compatibly with safety. Connection to chambers will be done with 2 technicians from home Institutions.
  - YB 0 May 04      YB+2 July 04
  - YB+1 October 04
  - YB-1 June 05      YB-2 July 05
- In a conservative scenario a fraction of the early installation could be done without minicrates and then completed in parallel with other activities:
  - YB 0 April 04      YB+2 May 04

Chamber to Racks

# Alignment

Monitor position of DT chambers with respect to Tracker with  $\sim 150\mu\text{m}$  accuracy in  $R\Phi$  using:

- 36 rigid structures(MABs) with  $\sim 10$  cameras, and sensors (tilt,proximity,temperature..)
- 4 forks (40 LEDs)/DT chamber measured on an alignment bench
- **Link system**



# Alignment Installation and Cabling

- The MAB supports will be surveyed with photogrammetry  
~ 2.5 days/ Wheel.
- The MABs will be installed in UX5, ~ 1.5 days/ MAB including electronics and cabling: September 05 -April06.
- 18 MABs will be installed for the Magnet test and removed:  
YB 0 Sectors 7/8, 9/10    YB±1 Sectors 8/9  
YB±2, Sectors 1/2 , 3/4 .. 11/12  
~ 1.5 days/ MAB after chamber installation is completed.

The installation and cabling will be done with 2-3 technicians from home Institutions.

## Summary

- The main installation tool, the cradle, has been tested successfully.
- Apart for the cradles no other heavy tooling is required but we will rely on the existing SX5 infrastructure (cherry-pickers, moving platforms, scissor lifts..).
- The tooling cost is within the cost book estimate.
- The installation team will come from home Institutions apart for crane operators and logistic support at SX5.
- The overall installation schedule is consistent with CMS planning.