Overview of Detector Commissioning and Startup Operations

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A.Benvenuti

INFN Bologna

Outline

- Commissioning Task
- Hardware requirements
- Goals for the magnet test (personal view)
- UX5 commissioning

Pre Commissioning (ISR)

➢ The chambers (RPC and DT) arrive at the ISR already certified at the assembly sites with a series of tests:

- gas leakage
- behavior under HV
- response to cosmic rays and test-pulse

➢ These tests are repeated at the ISR for DTs and RPCs to find eventual damage or deterioration during transportation

➢ Before the DT chambers are certified fit for installation they go through a series of operations:

- Insertion of the alignment forks and calibration of the on chamber alignment system

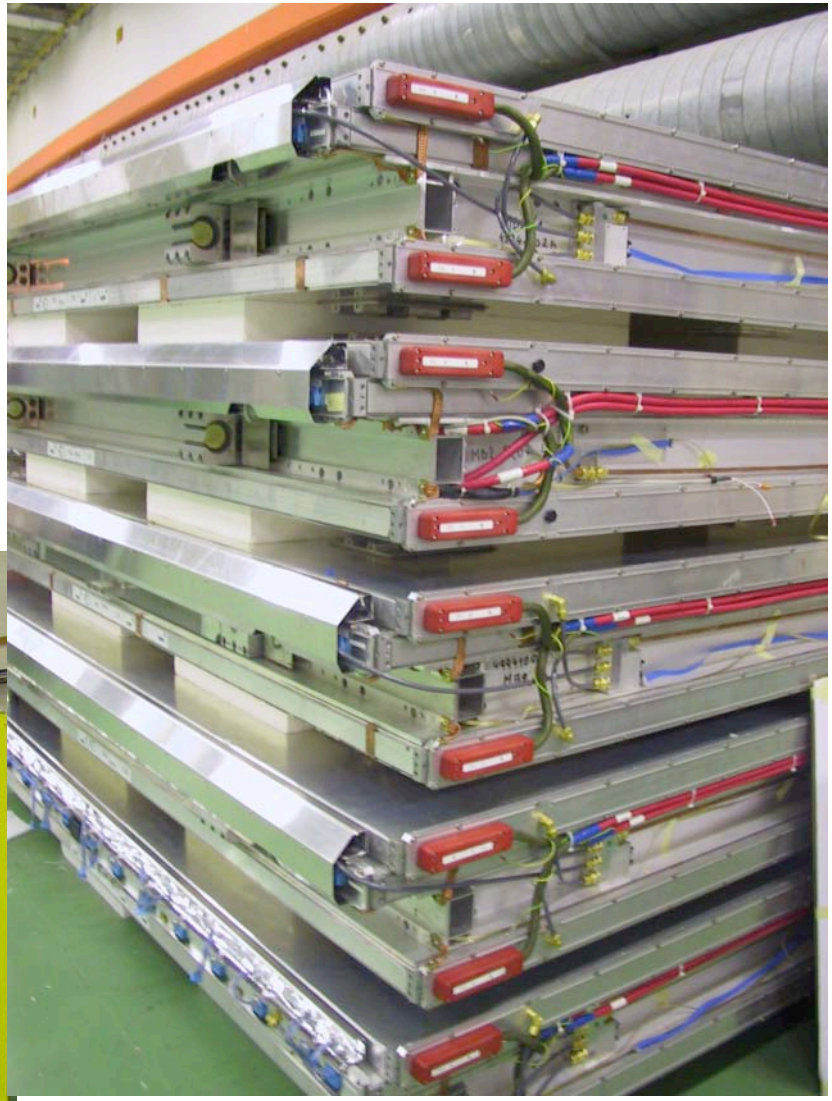
Pre Commissioning (ISR)

- Dressing: HV cabling; Theta SL F-end, LV, DCS and test pulse; gas manifolds and PADC; cooling circuit,…
- Replacement of HV boards and certification tests

➢ The DTs are then equipped with minicrates and the trigger and readout functionality is checked

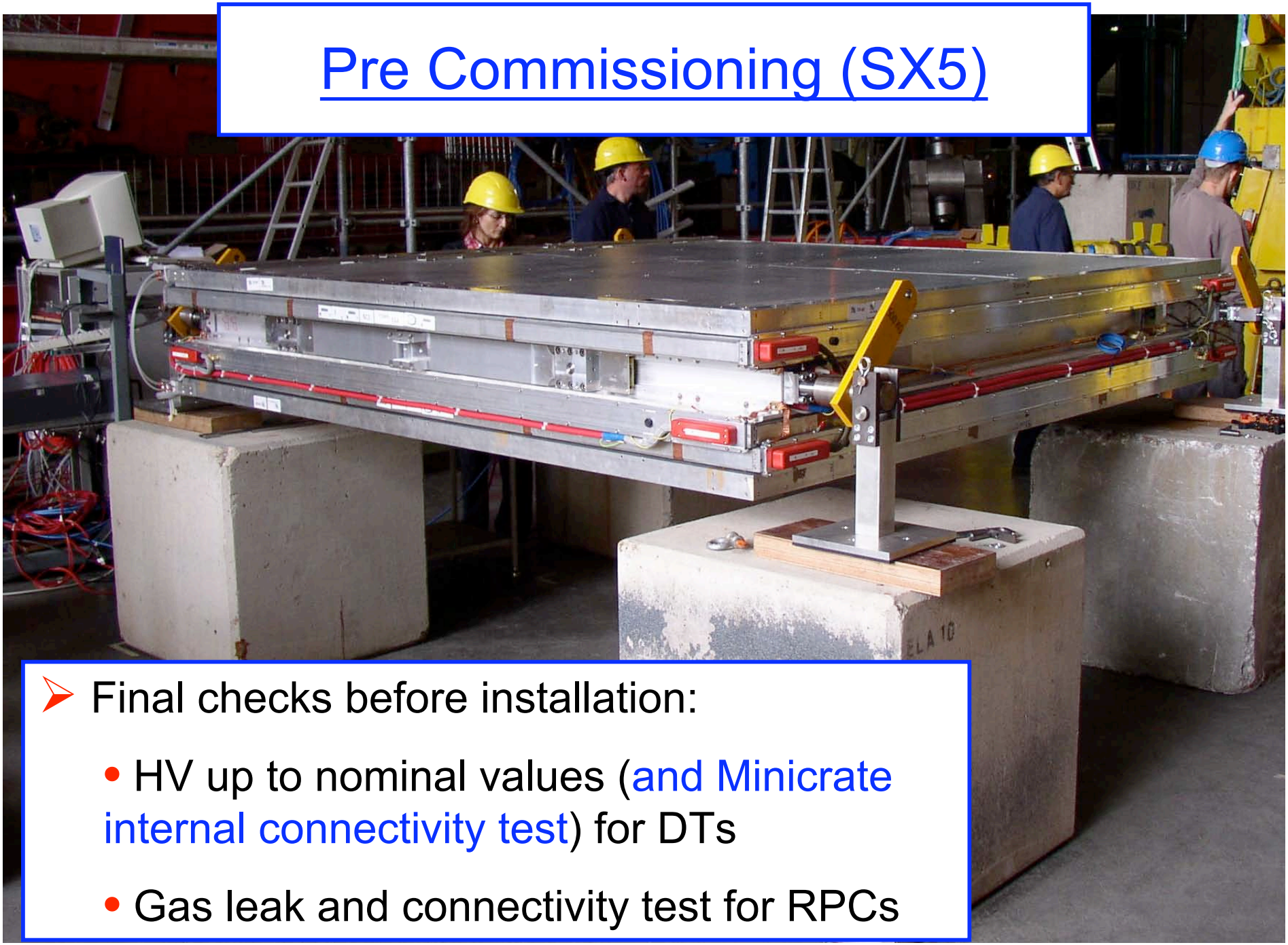
➢ RPCs are attached to the DTs and are tested again for gas leakage and signal connectivity.

➢ The cooling circuit (RPC+DT) is tested with overpressure up to 20bars and the chamber packet is loaded on the transport frame

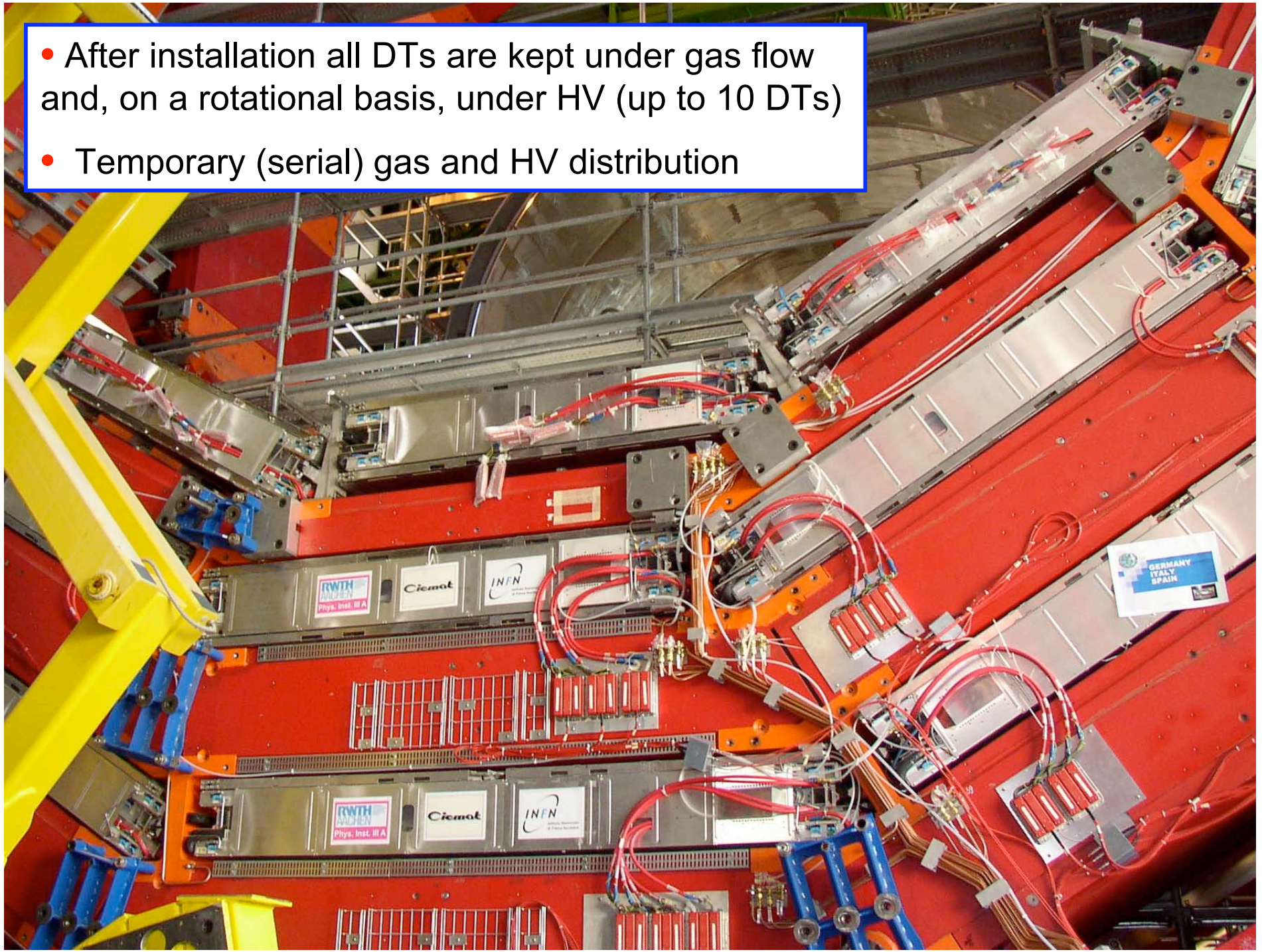


From bare to installable chambers (± MC)

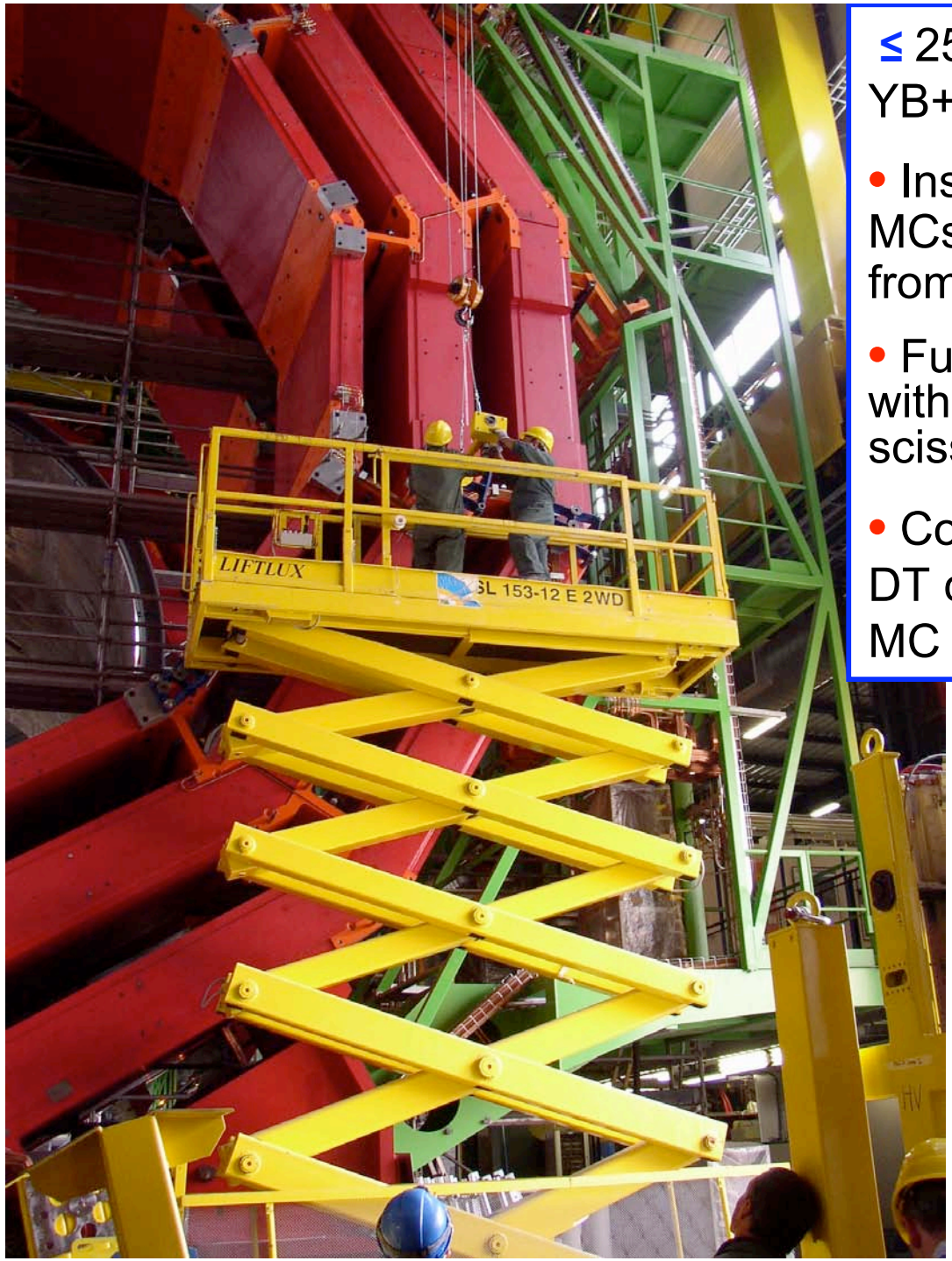
Pre Commissioning (SX5)



- Final checks before installation:
  - HV up to nominal values (and Minicrate internal connectivity test) for DTs
  - Gas leak and connectivity test for RPCs

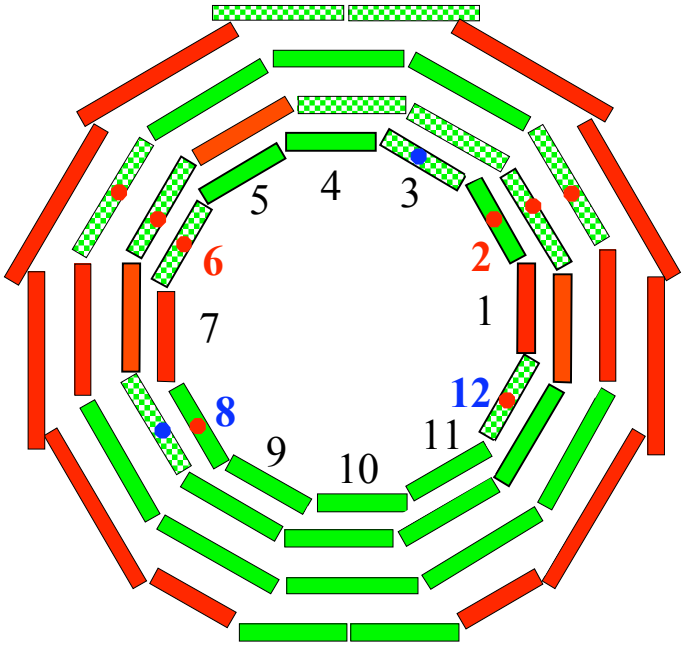


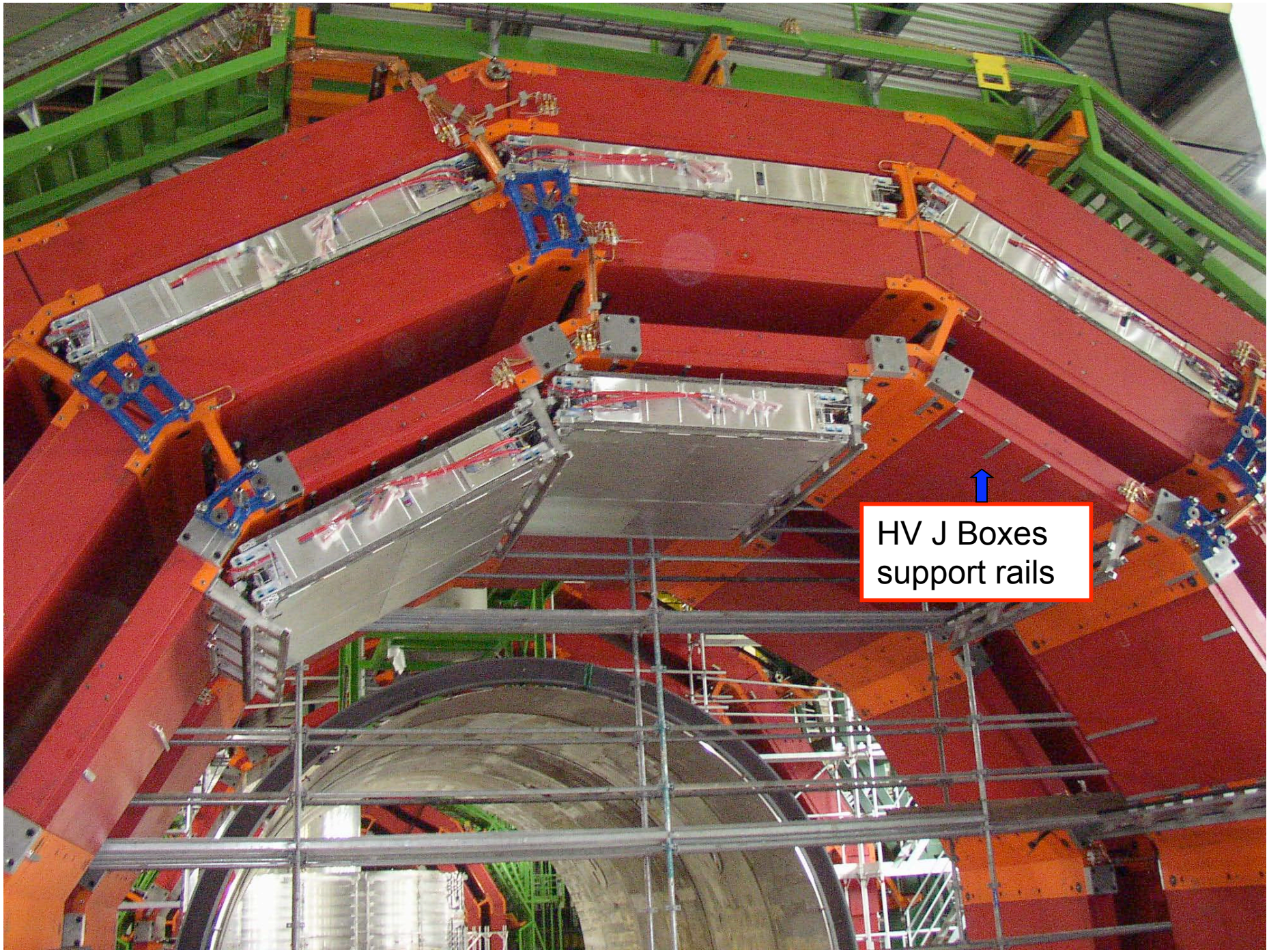
- After installation all DTs are kept under gas flow and, on a rotational basis, under HV (up to 10 DTs)
- Temporary (serial) gas and HV distribution



≤ 25 DT chambers will be installed in YB+2 without MiniCrates

- Insertion cabling and testing of MCs in installed chambers is done from a scissor lift
- Full MC functionality test is done with a stand-alone system from the scissor lift
- Completion and test of the RPC-DT cooling circuit to be done after MC insertion




HV J Boxes
support rails

Commissioning

Commissioning progresses through several stages dictated by logistics (the chambers functionality should be checked before it is blocked by cables) and by the availability of hardware and infrastructure:

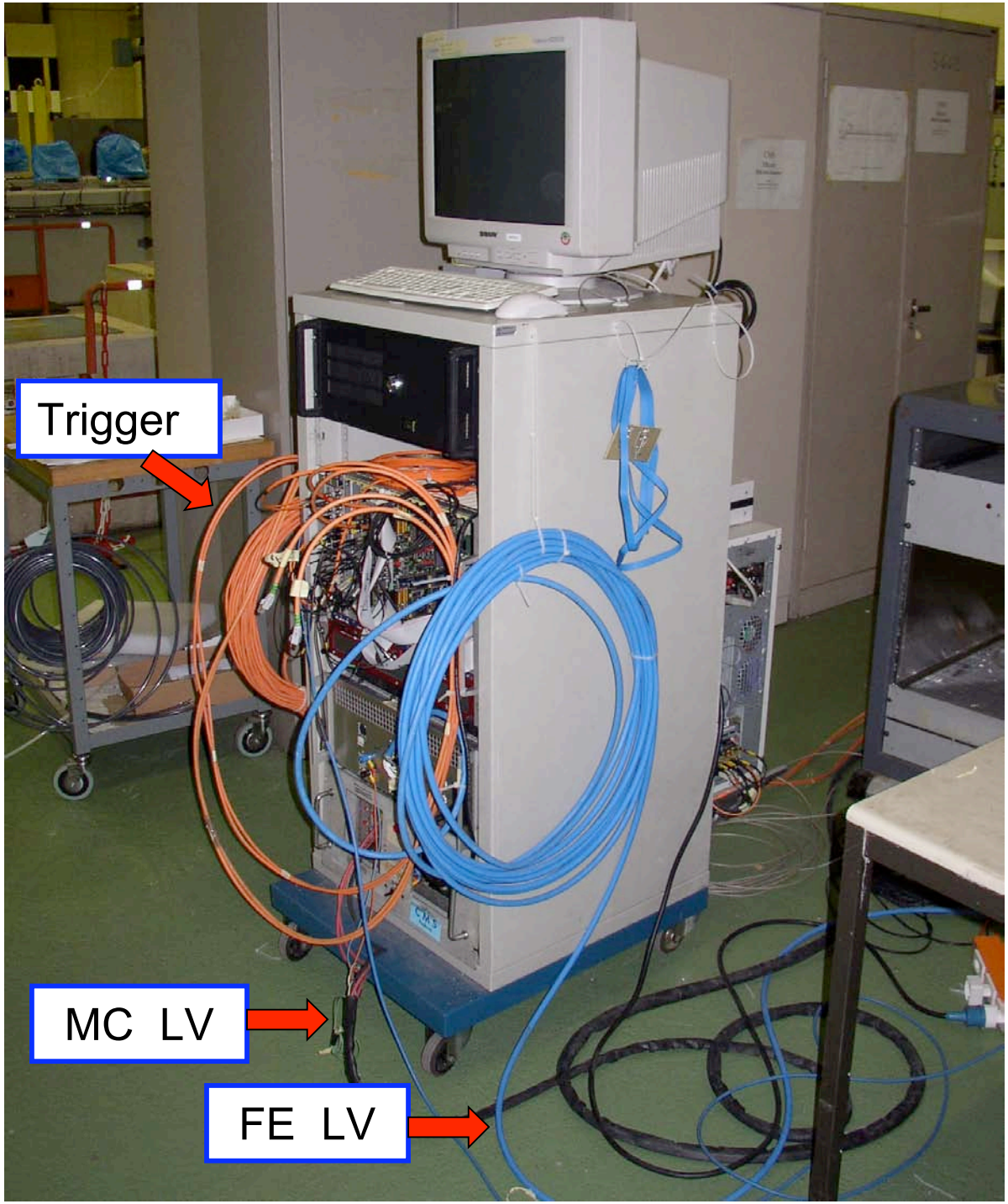
➢ Standalone:

single chamber with portable system (LV, HV, cables, cooling?, DCS/DSS, DAQ and monitor).

Check:

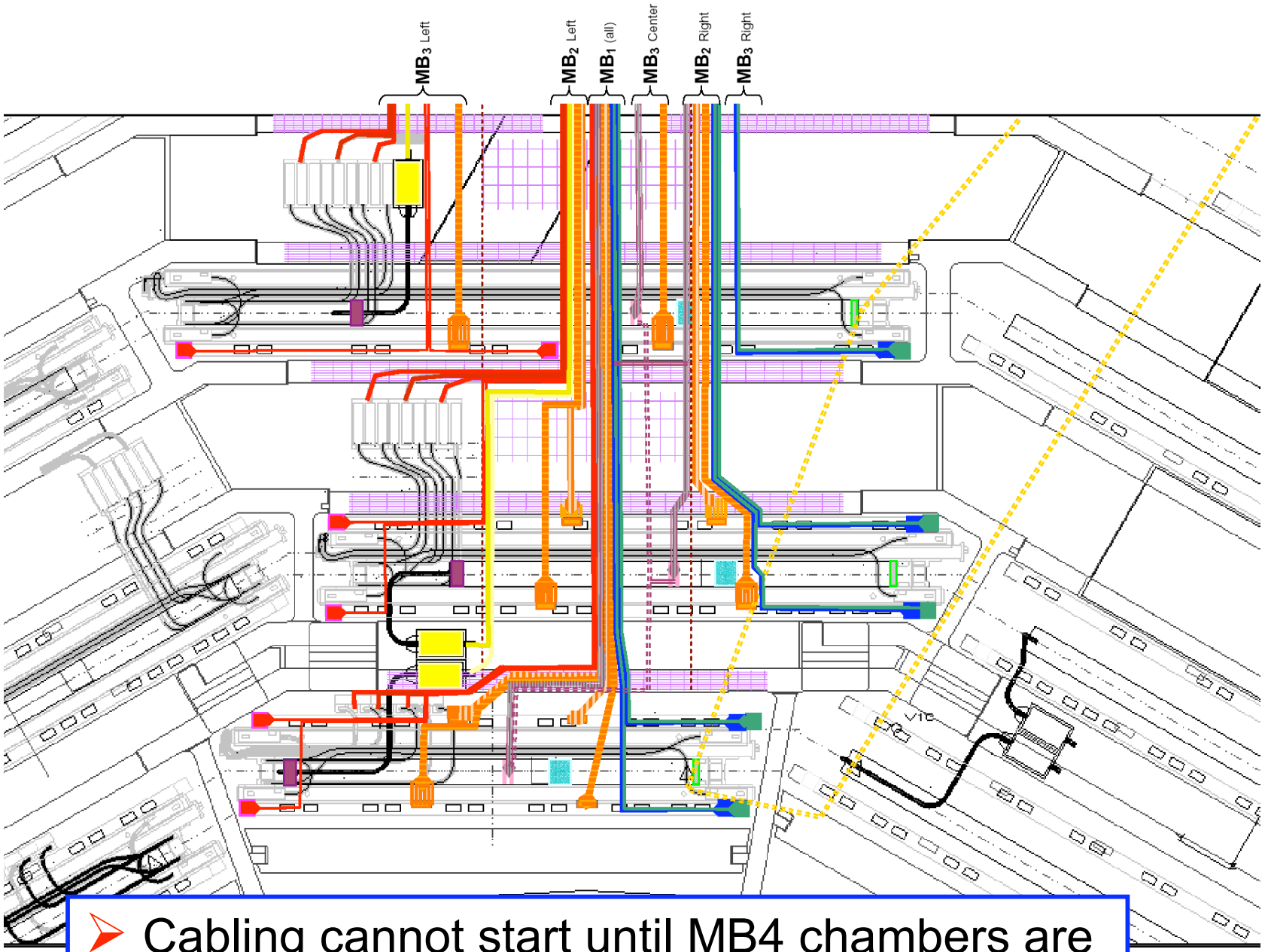
- Minicrate functionality
- DCS connections to PADC and alignment,
- chamber functionality with cosmic ray data taking in self-trigger mode (list of dead/noisy channels, efficiency..

➡ Certifies that the chamber is operational and sector cabling can proceed.



MiniCrate Test stand as used at the ISR

More compact version for SX5 (one portable in place of 2PCs) under way

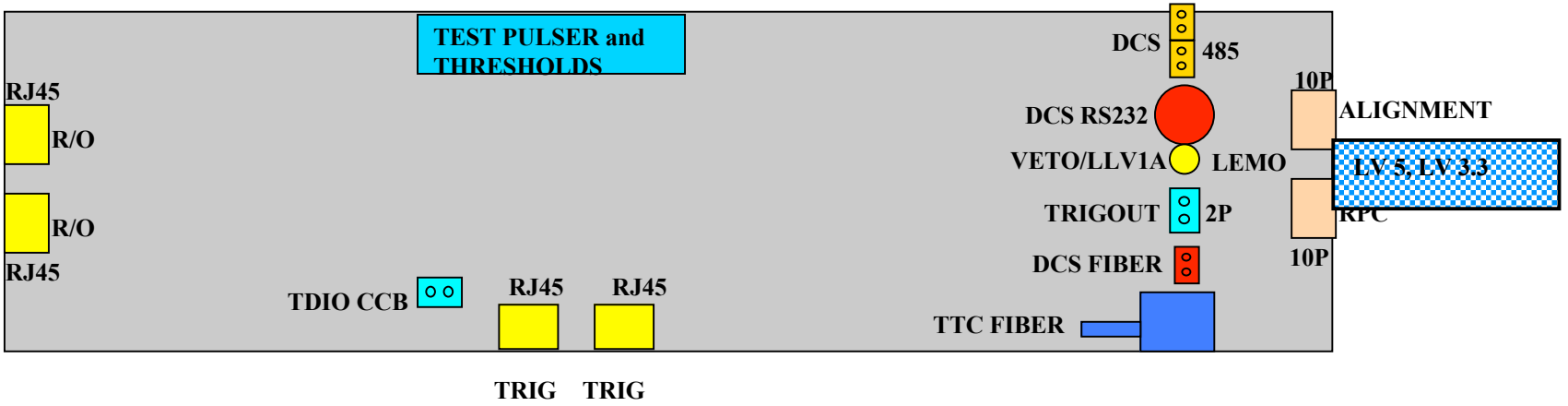


- Cabling cannot start until MB4 chambers are installed and commissioned

Commissioning

Sector

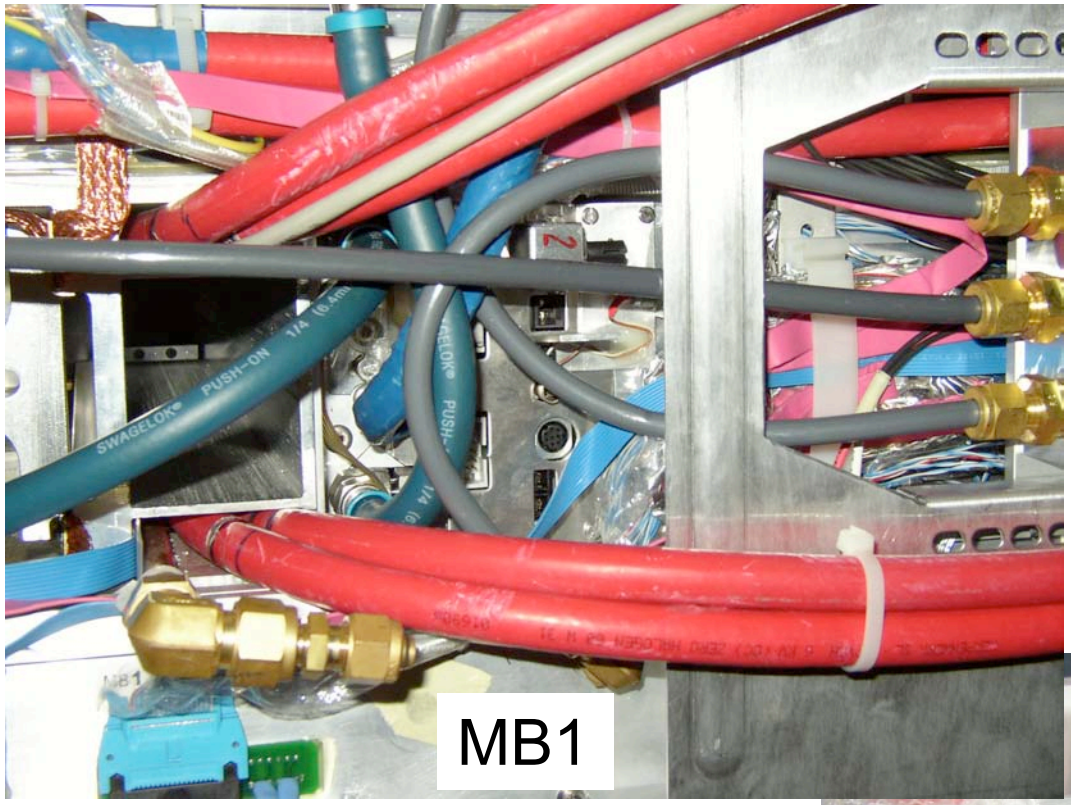
The chamber cabling is completed for DTs (and RPCs) up to the balcony.
All connections to the minicrate are final (Mandatory)

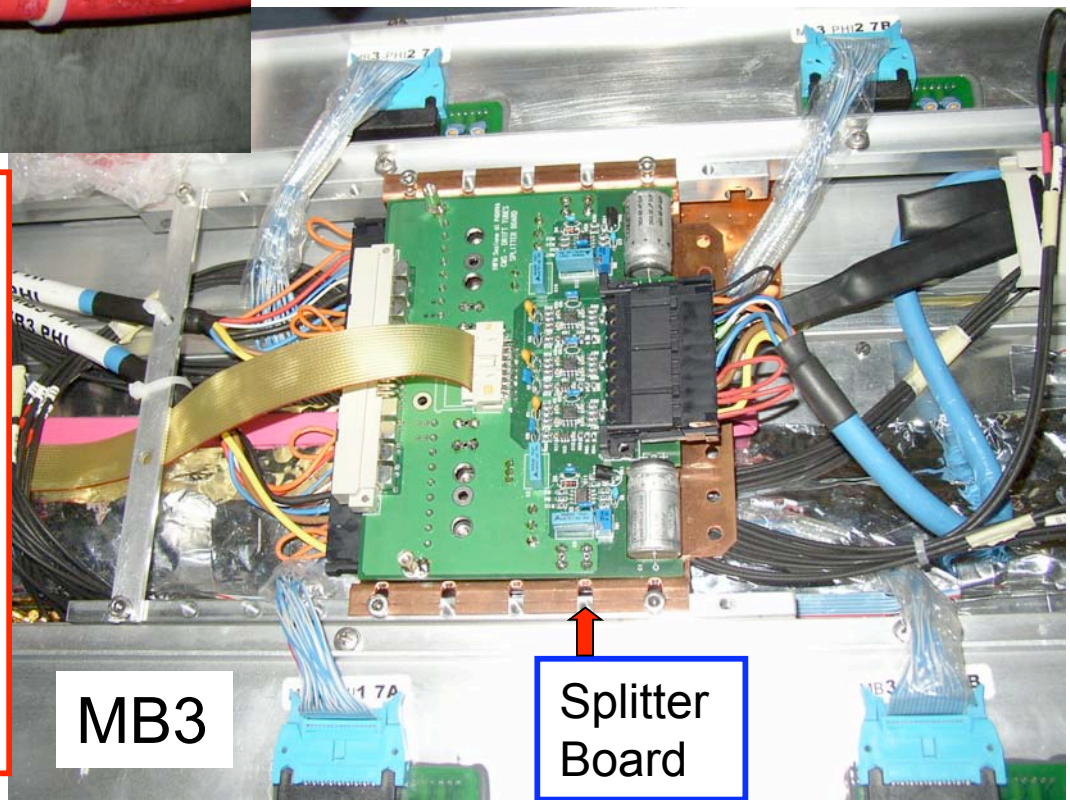


Individual chamber commissioning proceeds as for the standalone mode.
It certifies the integrity of the connections up to the balcony.

Sector commissioning proceeds through data acquisition of all chambers with a self trigger from one chamber or multiple chambers combination.
This step certifies the chambers functionality at the system level.

Hardware requirements: TTCrx, SC, ROS + ancillary trigger electronics, local DAQ or links to CR + DDU..



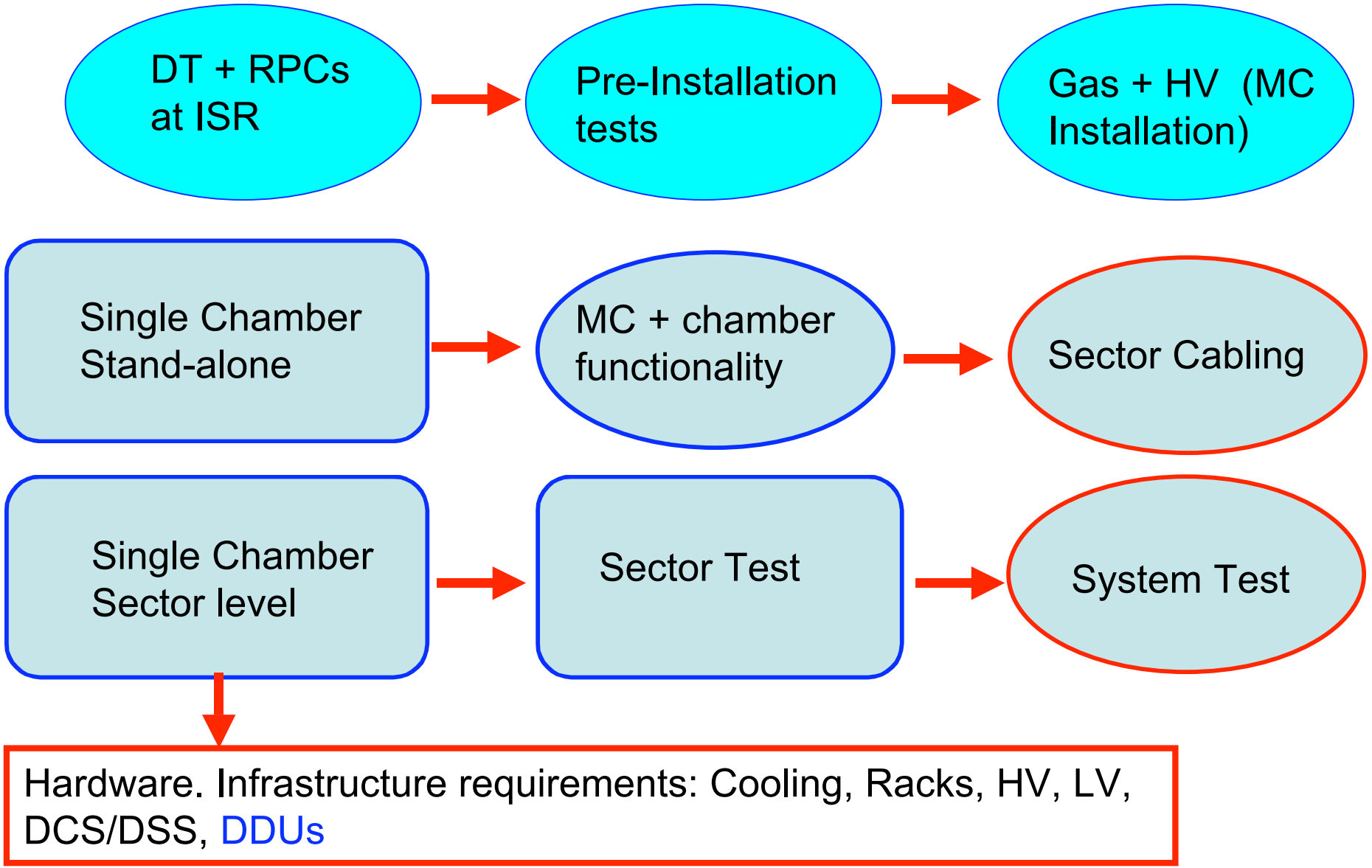


Cramped environment is dangerous for cables and connections integrity.

LV connection to SB requires to remove carter, cover and DCS

Commissioning completed when MC tested from balcony with final cables

Commissioning Summary



Magnet Test

➢ Alignment (Barrel)

- Alignment system functionality test
- Monitor detector movements under magnetic field

2 adjacent sectors (10,11) fully equipped with chambers in each wheel (aligned with photogrammetry?):

- 45 DT chambers (but MB4/11 installation conditional to cabling completion across foot)
- Only LED forks must be operational in all DT
- Plan for standalone LED forks control (it is not feasible to keep 45 minicrates operational)
- Aim for ≥ 2 sectors fully operational

Magnet Test

➢ DT Functionality

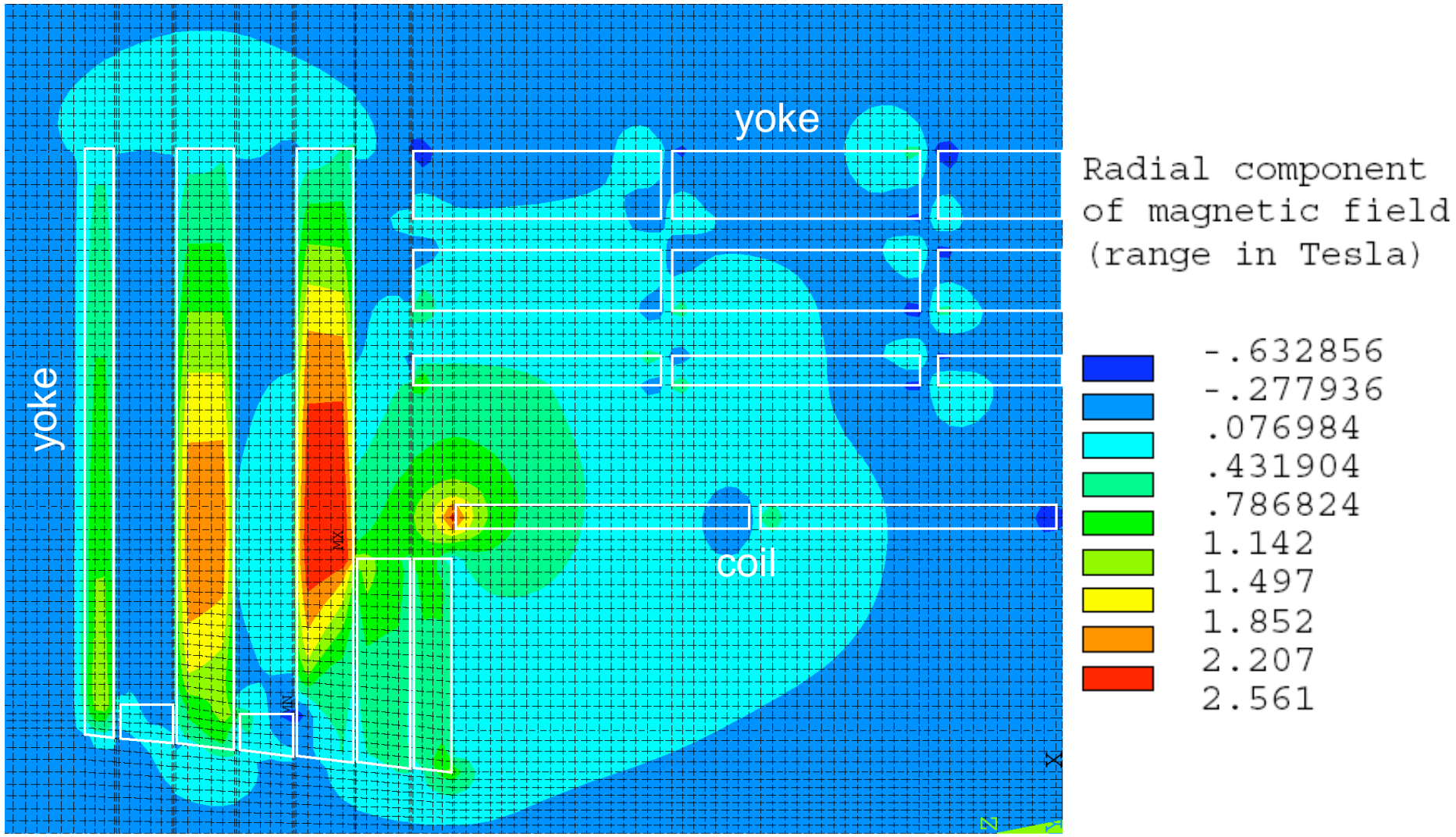
- Check effect of fringe field on chamber performance:
  - HV behavior
  - Vdrift
  - Resolution

- Check effects of fast/slow discharges on power supplies and electronics

Data taking from counting room in stand alone mode with self trigger and/or RPC trigger.

Choose fully operational sectors as 10 in YB+2 and YB0 (or YB+1 if YB0 is not ready)

Requirements: Links to Counting Room, Run control, DCS/DSS, …



Fringe field most prominent for MB1. It induces longer trajectories (apparent Vdrift is slower) and might affect bunch crossing identification efficiency

Magnet Test

- Slice test

Data acquisition from counting room under self trigger and/or external trigger: RPC, HCAL, CSC

Sub detectors rough synchronization needed.

- Magnet Test specific software and/or hardware should be discouraged and limited to the indispensable.

- DCS,DSS, Run Control should be developed as Version 0.x for data taking in UX5.

Commissioning in UX5

Time for commissioning YB-1 and YB-2 in SX5 is very limited in any foreseeable schedule since most of the installation will be done after the magnet test.

All efforts should be done to commission as much as possible in SX5 (duplicate test stations?) since it will be much harder in the cavern.

At least 10 sectors (the horizontal ones) must be installed in UX5. Commissioning and cabling will interfere with other activities notably MAB installation.

Commissioning in UX5

Commissioning (and cabling) in SX5 requires basic infrastructure and hardware to be available on the wheels: Power, Gas, Cooling, HV, LV, VME crates

Full MC commissioning with cosmics data taking before cabling is unrealistic for horizontal sectors and (probably) for any leftover sector.

Commissioning at the sector level is the best strategy and should start as soon as possible with RPC trigger and/or DT combined triggers to ensure a reasonable illumination

The grounding scheme can be checked and optimized for the first time in a realistic environment.

The experience with the magnet test will be a great asset for this task.

Startup Operations

Cosmic ray data taking (in self trigger or RPC trigger) with the BMU fully cabled and operational is the best way to ensure a detector ready at day zero:

- Exercise MiniCrates and chambers
- Provide the map of Dead/Noisy Channels
- Make a rough synchronization (timing)
- Check chamber alignment

The procedure will start in stand-alone mode with DCS/DSS fully operational and will progress through the self-checking of the individual chambers (test-pulse,MC internal tests..), local data taking and onward to Global DAQ.

Startup Operations

Single beam LHC operation (day -2) will provide some useful information on the effect of halo muons and possibly some tracks from beam gas interactions

First collisions at low luminosity (day -1) will help to refine the detector control/monitoring software, the run configuration constants and synchronization procedures.

First stable Luminosity (day 0, might be a long day..) will provide better synchronization constants and average drift velocity for each chamber.

Summary

It is a long process from components (too many to mention) to SuperLayers, installed chambers and cabled (easy chair) detectors.

We are now on the verge of the commissioning phase that is a challenge but also a reward.

This is the period when you make a detector your own, you learn its vagaries and make it work.

This will be a precious experience for the (hopefully) soon to come LHC data taking days.

In the meantime you can have the first dry run with the Magnet Test.