

# DT Commissioning at SX5

## Commissioning crew (so far):

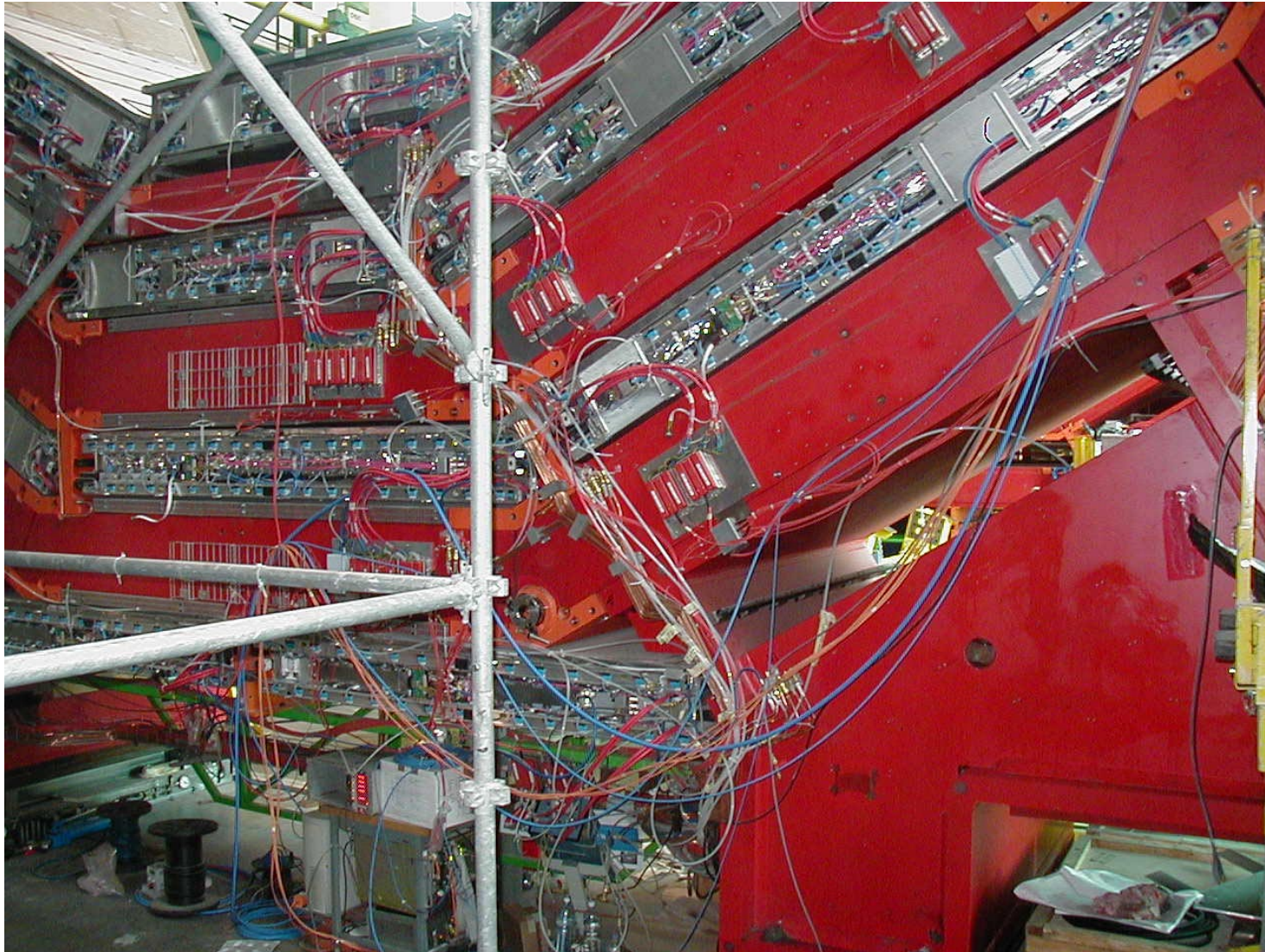
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Michael Sowa, [Marco Zanetti](#)

## Aims and goals

- (Re)Check MC Trigger/ReadOut functionalities
  - ✓ Subset of the tests done in Legnaro, Bologna and ISR for the Minicrate test, i.e. Boundary scan, TDC channels x-talk, TRB emulator and TRB TestPulses.
  - ✓ Only for the chambers in YB+2 also test of the TRB timing (problem concerned the BTI/TRACO sampling).
- Test of data taking and data quality
  - ✓ Runs with different trigger configurations (see later)
  - ✓ Perform diagnostic on basic quantities, i.e. occupancies and time-boxes to check possible pathologies channel by channel
  - ✓ Perform segments reconstruction for cell efficiency computation (and to check performances of the reco. algorithm)

**Main goal: verify if a chamber is ready to be cabled, i.e. no more interventions are needed**

# YB+2



## Operations timing (on average so far)

- Chamber temporary cabling and MC startup ~ 30 min (up to >1 h if extra grounds are needed)
- Minicrate test ~ 1 h
- Data taking ~ 8 h (one working day)  
DAQ rate from ~100 to ~400 Hz, depending on trigger configuration and on chamber dimension and position (sector, station)

Estimations done assuming **expert** commissioner not encountering **any problem** in the procedure

# Operations slowdowns

- ✓ Cabling: mistakes while connecting to MC, connectors worn out
- ✓ PU wrong configuration (due to oxidized chips connections)
- ✓ MC – pc communication interruption
- ✓ DAQ Run Control unstable after many configuration, sometime pc reboot needed
- ✓ Possible clash between DAQ and MC Test program (MC left in unknown state)
- ✓ Long list of operations, often causing problems if done in a wrong order
- ✓ ...

# Chambers commissioned so far

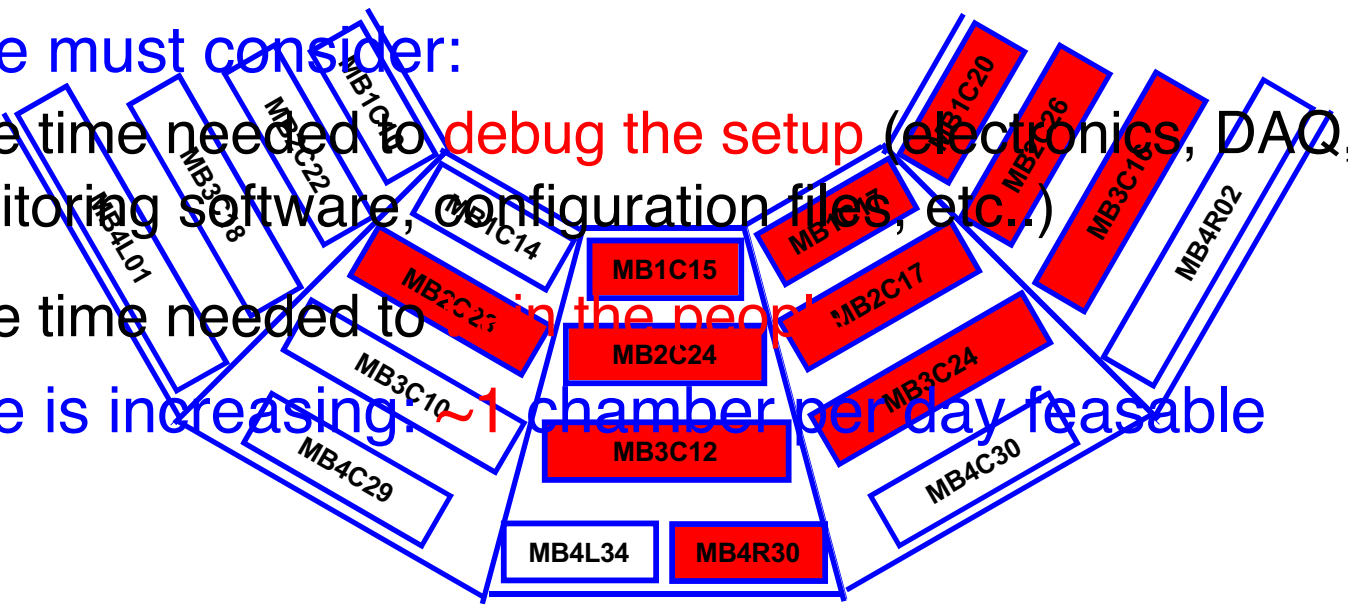
- DT commissioning startup on 1<sup>st</sup> week of May
- Sector 10 (but MB4 sx), 11 and 12 completed, sector 9 started. (MB4 sectors 11 and 12 not yet installed.)  
= 11 chambers commissioned
- Rate ~ 2.5 days per chamber.

- One must consider:

✓ the time needed to debug the setup (electronics, DAQ, monitoring software, configuration files, etc..)

✓ the time needed to in the next

- Rate is increasing. ~ 1 chamber per day feasible



# When a chamber is successfully commissioned?

- When the trigger functionalities are matched and the data are reasonable, i.e. no major interventions are needed
- But this is a great chance to study and understand the DT performances towards the real CMS working conditions:
  - ✓ Even if not bunched muons, the chambers are in the final position embedded in the iron, with all channels fired from all angles
  - ✓ Test for trigger and setup configurations
  - ✓ Analysis of data taken in auto-trigger mode
  - ✓ Test-bench for updates and plug-ins of **software** (DCS, DQM, reconstruction, calibration) and **hardware** for Cosmic Challenge

# Data taking: trigger configurations

- **Default.** SL high quality track (4 hits) trigger (HH+HL+H). **4M events**
- **H\_any\_theta\***. H trigger in one of the Phi SL confirmed by H or L in Theta SL. **1M**
- **Phi1only.** Like H\_any\_theta but with Phi2 BTI masked. **1M**
- **Phi2only.** Like H\_any\_theta but with Phi1 BTI masked. **1M**
- **Thetaonly.** Only H triggers form Theta SL. **1M**
- **HH+HL.** Like H\_any\_theta but with Theta BTI are masked. **1M**
- **Verticalonly.** Like default but with the minimal angular acceptance (practically only vertical tracks). **100 K**
- **Test Pulses.**

\* Not done for MB4 chambers (HH+HL instead)



# Monitoring and Analysis

- During data taking, “Test Beam” monitor used to have a first look at the data
- ORCA application runs on flat files to produce occupancies and time-boxes histograms (stored in ROOT files and pdf)
- ROOT application reads these files and perform the diagnostic (list of dead/inefficient/noisy channels, time-box pathologies written in txt file)
- ORCA application reconstructs segments and compute cells efficiency and resolution (stored in root files and pdf)
- For every chamber, results are posted in:

• <http://cms.pd.infn.it/commissioning/Results>

- Porting on official DQM ongoing

ONLINE

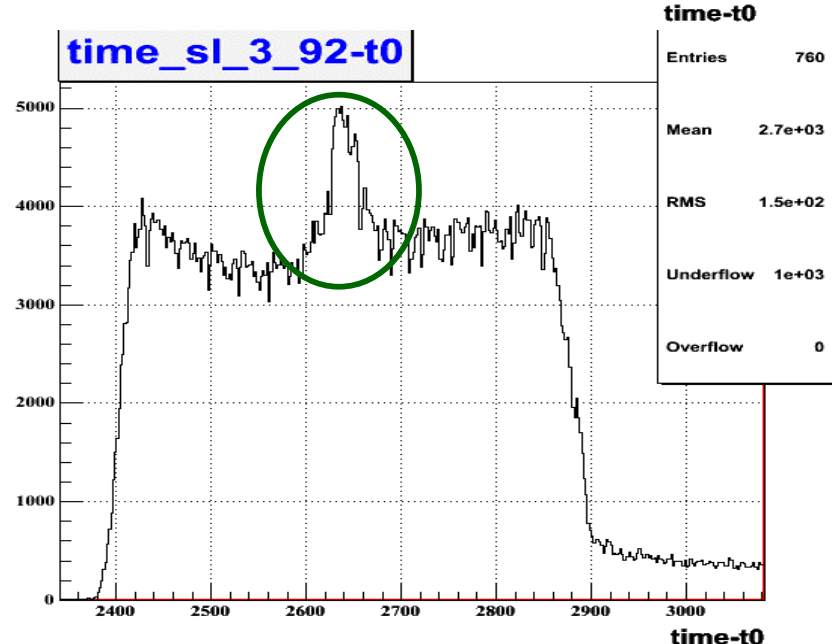
# Unexpected “features”

- 40 MHz pattern in time boxes. Partially cured with higher threshold

**Under study**

- Coherent noise at the center of the time box. Cured asking trigger coincidence between 2 SLs

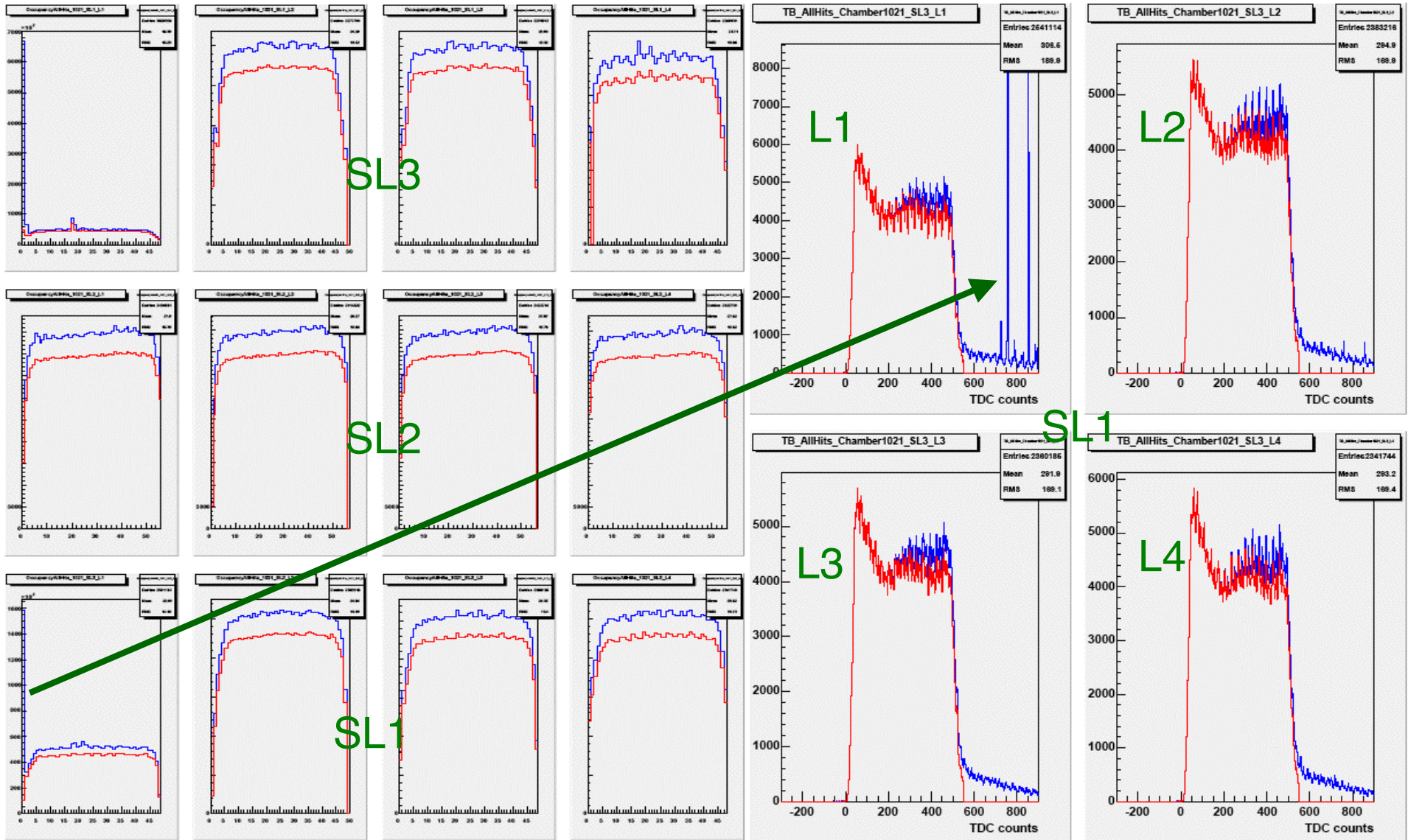
- In time noise of 1<sup>st</sup> channel of 1<sup>st</sup> layer. Cured with ground on DCS FEB cables



# Results

Occupancy

Time Boxes



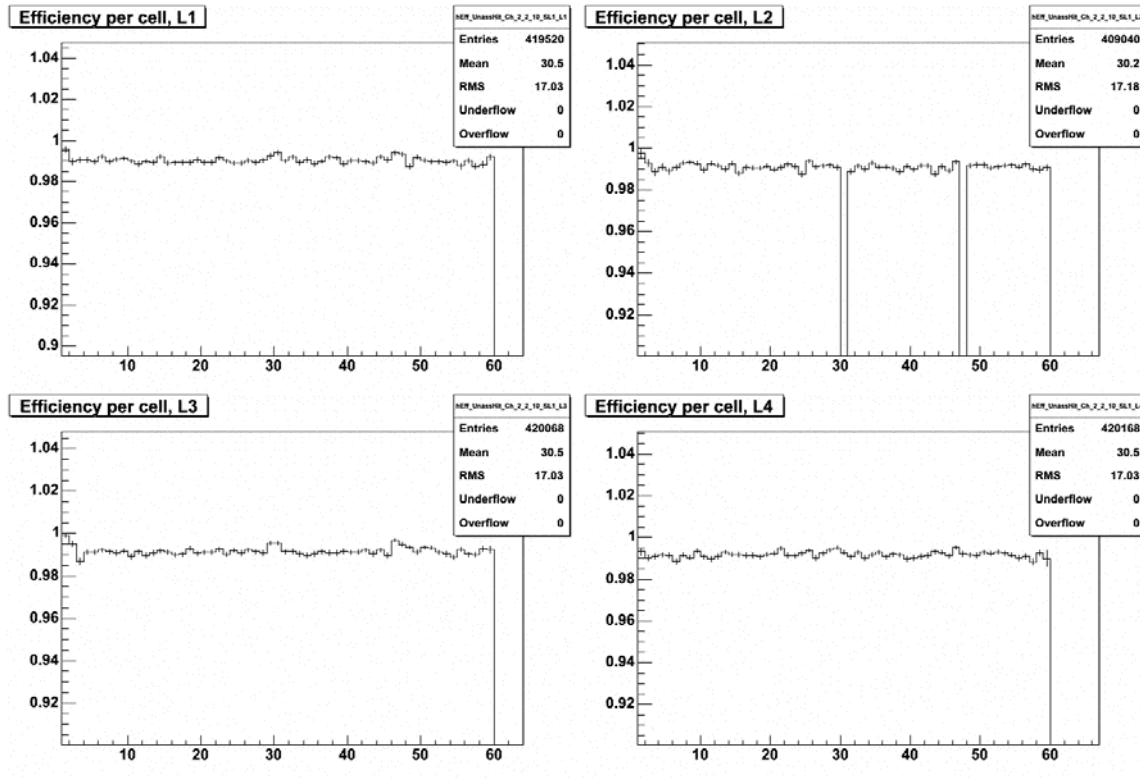
# Diagnostic

- **Dead channel** if less counts than the average noise level are there. ~2 per Ch.
- **Inefficient channel** if number of counts  $10\sigma$  away from the average num. of counts per layer (but for first and last channels). ~3 per Ch.
- **Noisy channel**. Noise rate is calculated from the number of events before time box begin, the tTrig and the number of triggers. A channel is defined noisy if its rate is  $> 1000$ . ~3 per Ch, but with no grounds added in every chamber
- **After Pulses check**. A warning is raised if the ratio (# 1<sup>st</sup> hit/# After Pulses)  $> 0.5$ . >3 per Ch, but with no grounds added in every Ch
- **Time boxes check**. The shape of the time box is checked, i.e. “tail-belly” and “head-belly” ratios should be inside specific ranges (~3%). Look for disconnected cathodes/strips. ~2 per Ch

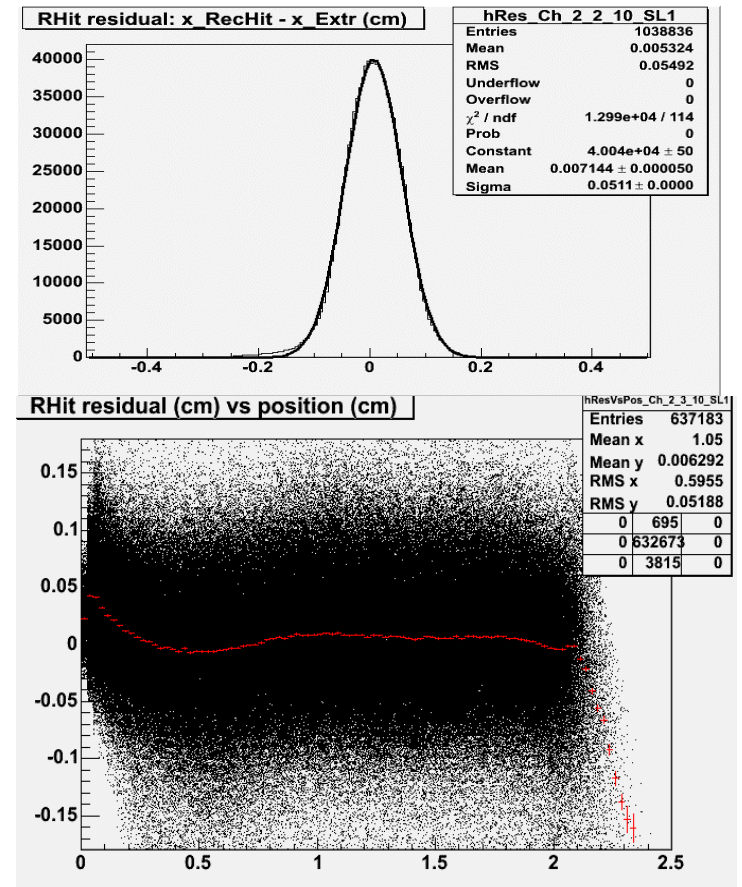
•Preliminary estimations! Detailed study needed

# Results

## Efficiency



## Resolution

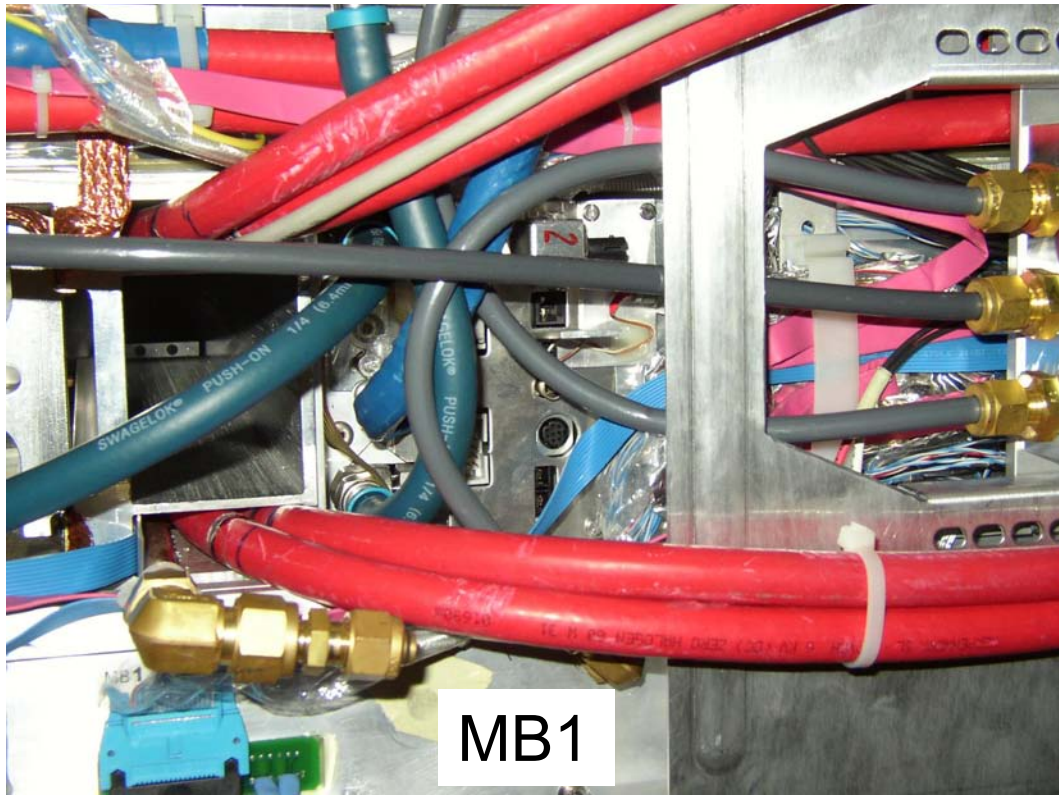


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MZ

# Conclusions

- Commissioning of DT chambers in YB+2 started and (slowly) proceeding. 11 chambers commissioned so far
- People acquiring confidence with the hardware and software setup, commissioning rate is increasing
- No major interventions needed so far (but adding grounds to reduce noisy channels). Only 1 problem not foreseen during MC complete test (8 dead ch. due to FEB fast mask on Theta SL). Still to decide the action to be taken
- Data analysis is going on. Diagnostic is now robust, segment reconstruction well advanced. Porting on CMS DQM framework is the next item

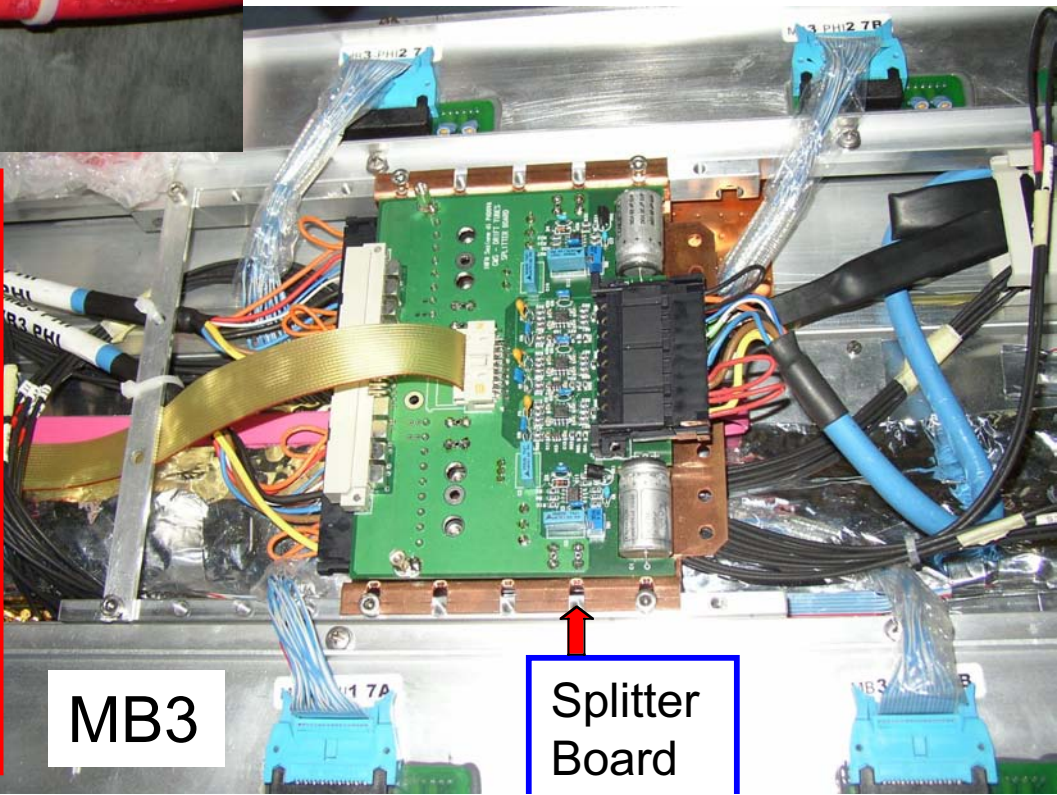
**BAKUPS**



MB1



MB2



MB3

Splitter Board

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 the rack with final cables