DT Operations and Plans

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on behalf of the DT group
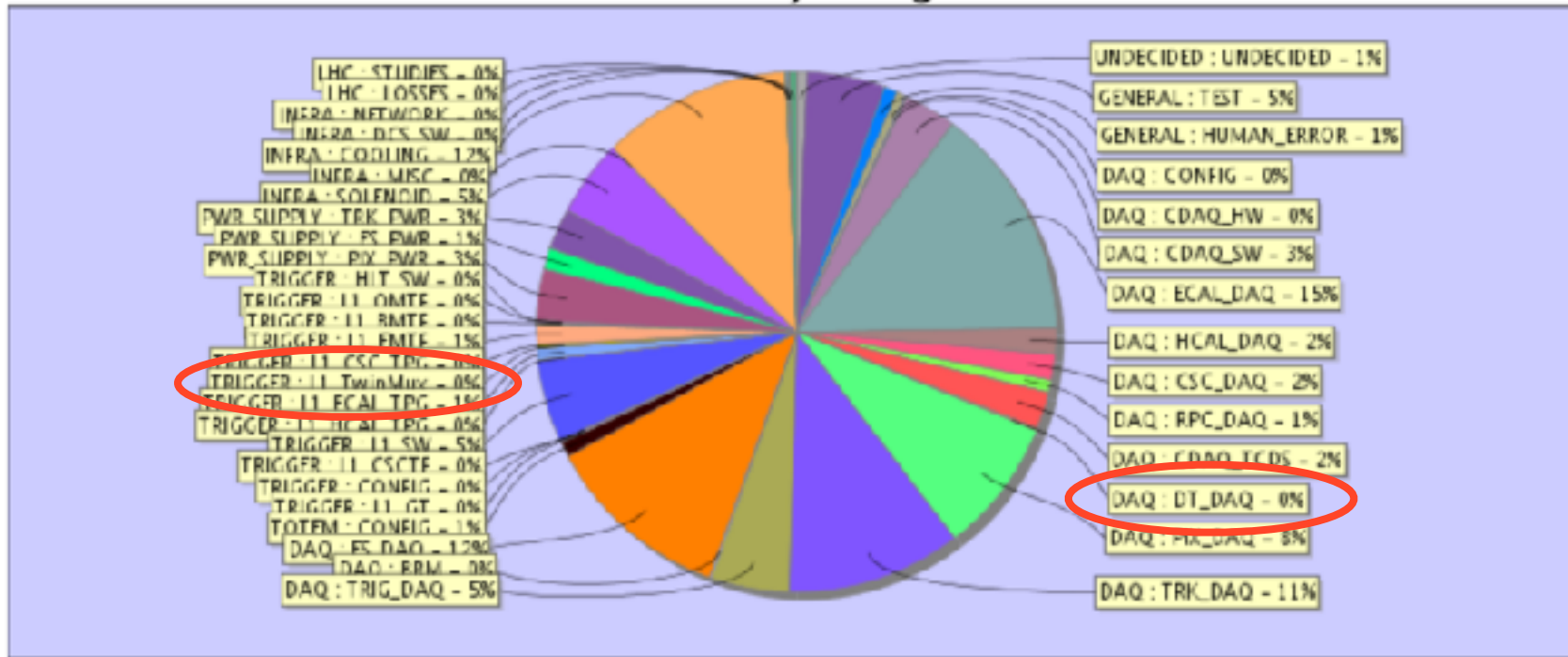
CMS Run and DPG Commissioning Workshop
Torino - 25/01/2017

Review the 2016 operational experience
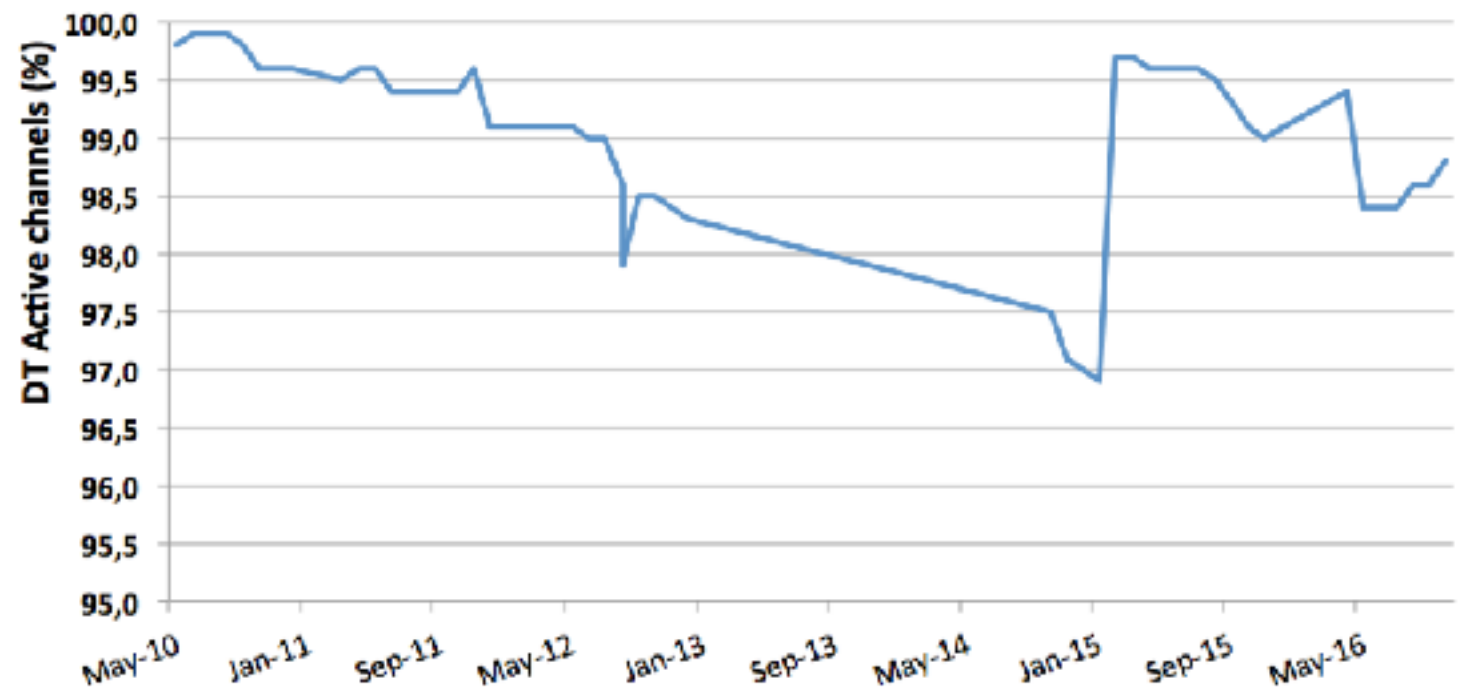
DT Operation

Lumi lost by categories

Very low contribution to CMS downtime from DT and Twinmux FEDs:

0.15% (~10 minutes)

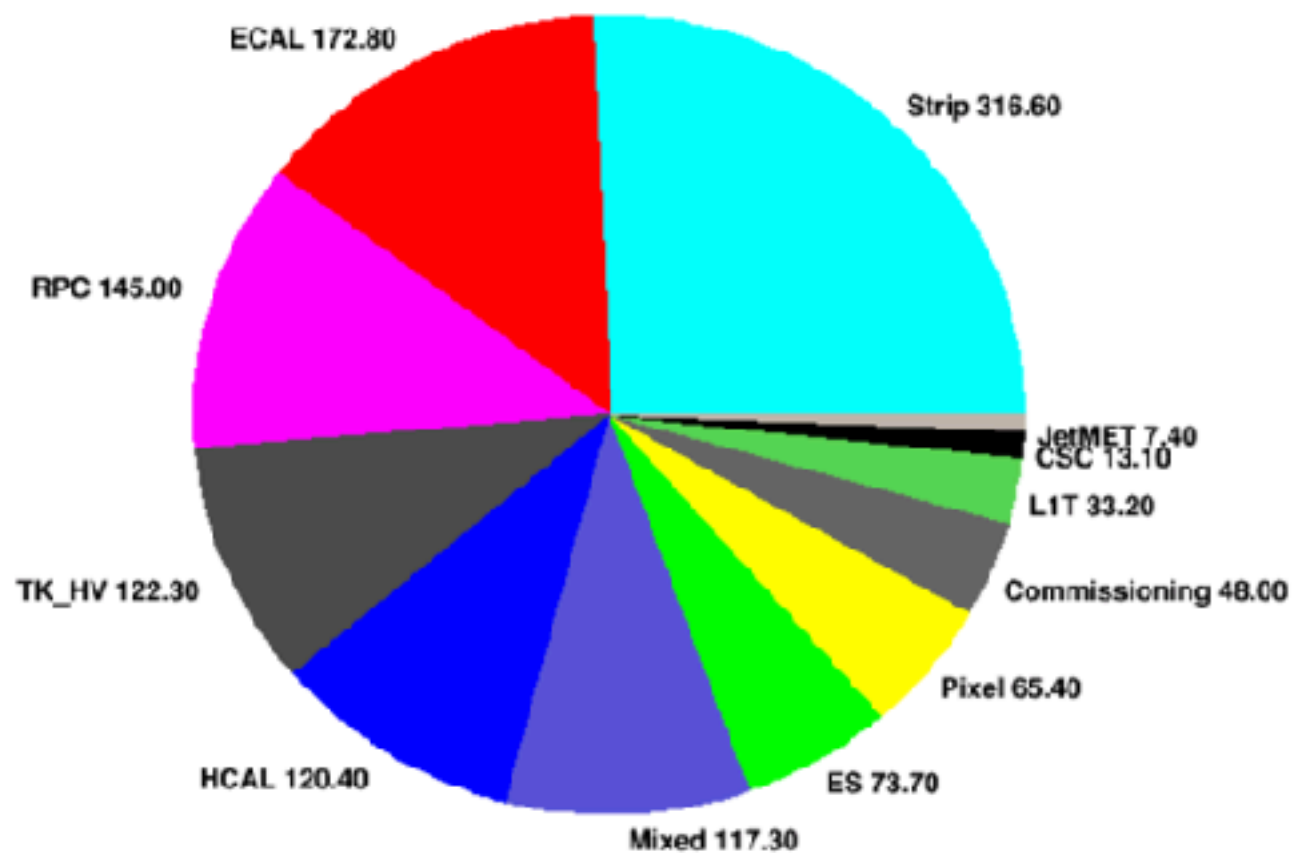Main incident was a transmission error between FED and DAQ

Fraction of active channels: ~98.8%

Plan to recover ~0.5% during EYETS

# Data Certification

Exclusive Luminosity Losses in /pb

Data certification:
less then 2 pb^{-1} of bad quality data.

Very good achievement, considering that the full trigger chain was replaced during 2015/2016 YETS

Twinmux Operation

- Final production: 60 boards
    - Installed in 5 crates at the beginning of 2016
    - 2720+720 optical fibers
    - Fully operational during 2016

- Firmware capabilities
    - Rx of DT, RPC, HO, Tx to BMTF and OMTF
    - RPC clustering, DT+RPC synchronisation
    - DT-RPC SuperPrimitives: BX-assignment via phi-matching
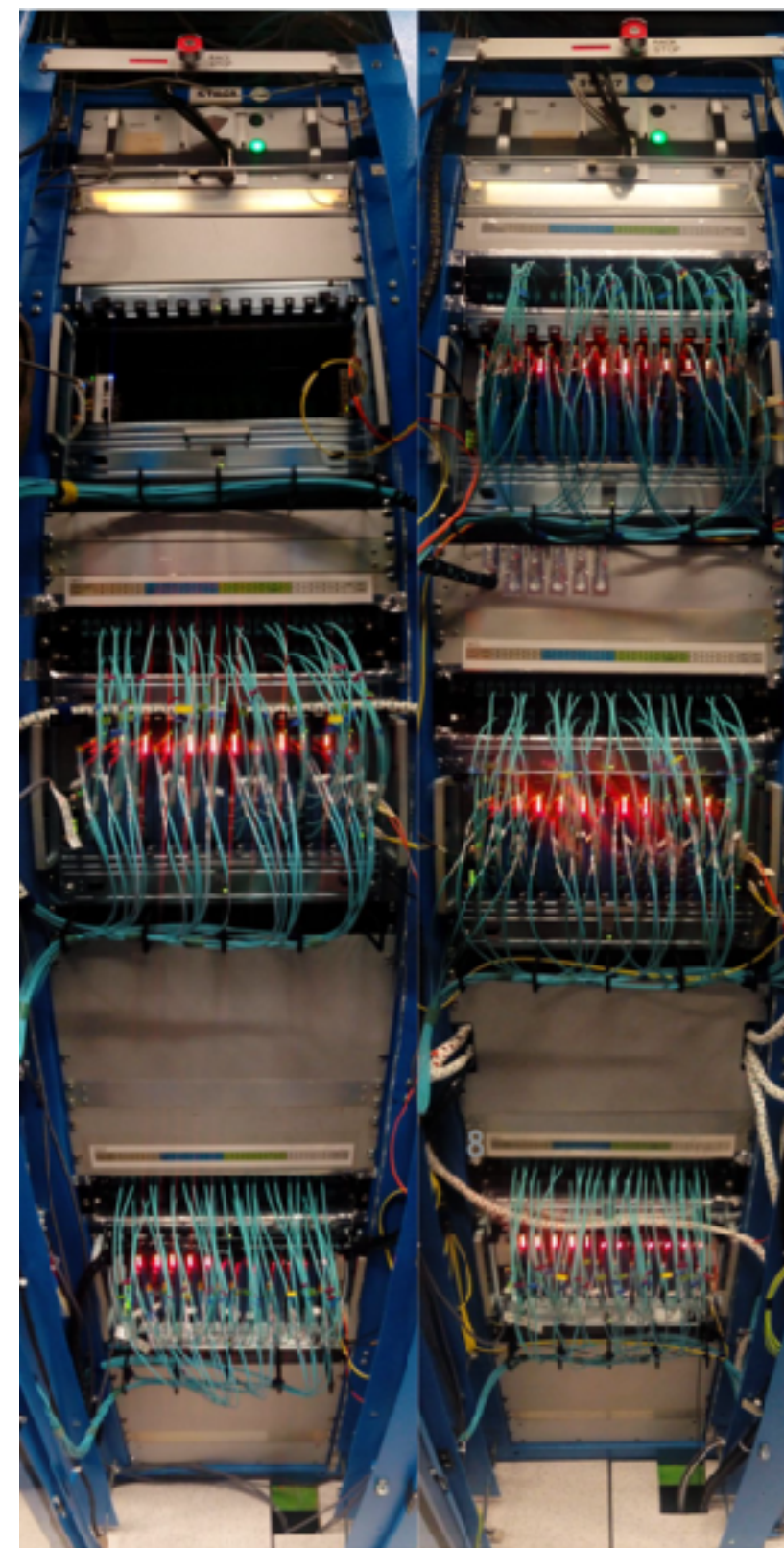
Twinmux Operation

- Most of 2016 data taking (both proton and ion runs) was taken with DT only primitives sent to the BMTF, while the DT+RPC super-primitives were commissioned.

- At the end of 2016 proton physics, the best algorithm was selected:

  - RPC clusters close in φ to DT Trigger Segments from the same chamber are searched for, in a ± 1BX time window centred around the DT Trigger Segment BX.
  - The closest RPC cluster is selected; if Δφ≤15 mrad, RPC and DT are considered matched.
  - If the DT Trigger Segment was built with less than 8 DT φ layers, the Trigger Segment BX is shifted to match the RPC cluster BX.
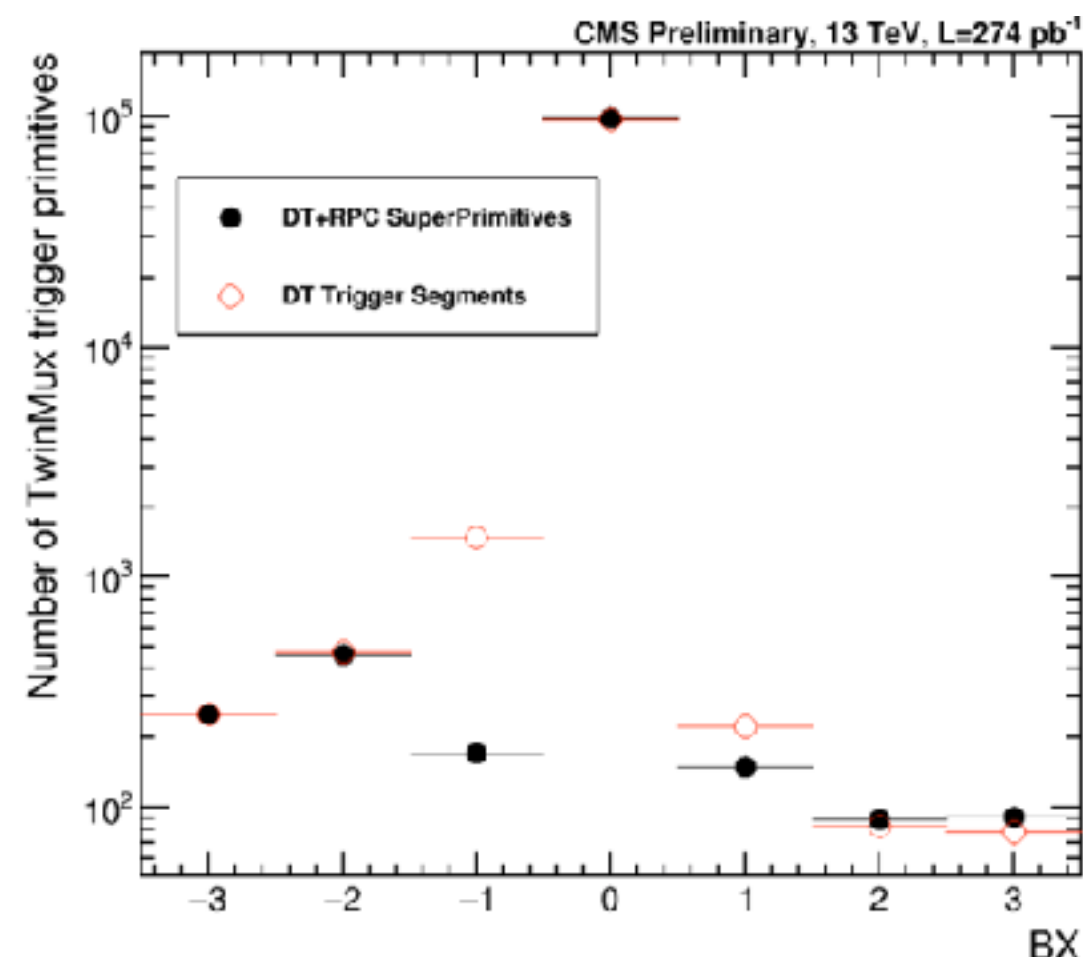
Obtained average increase of trigger primitive efficiency by 1.3%, less OOT
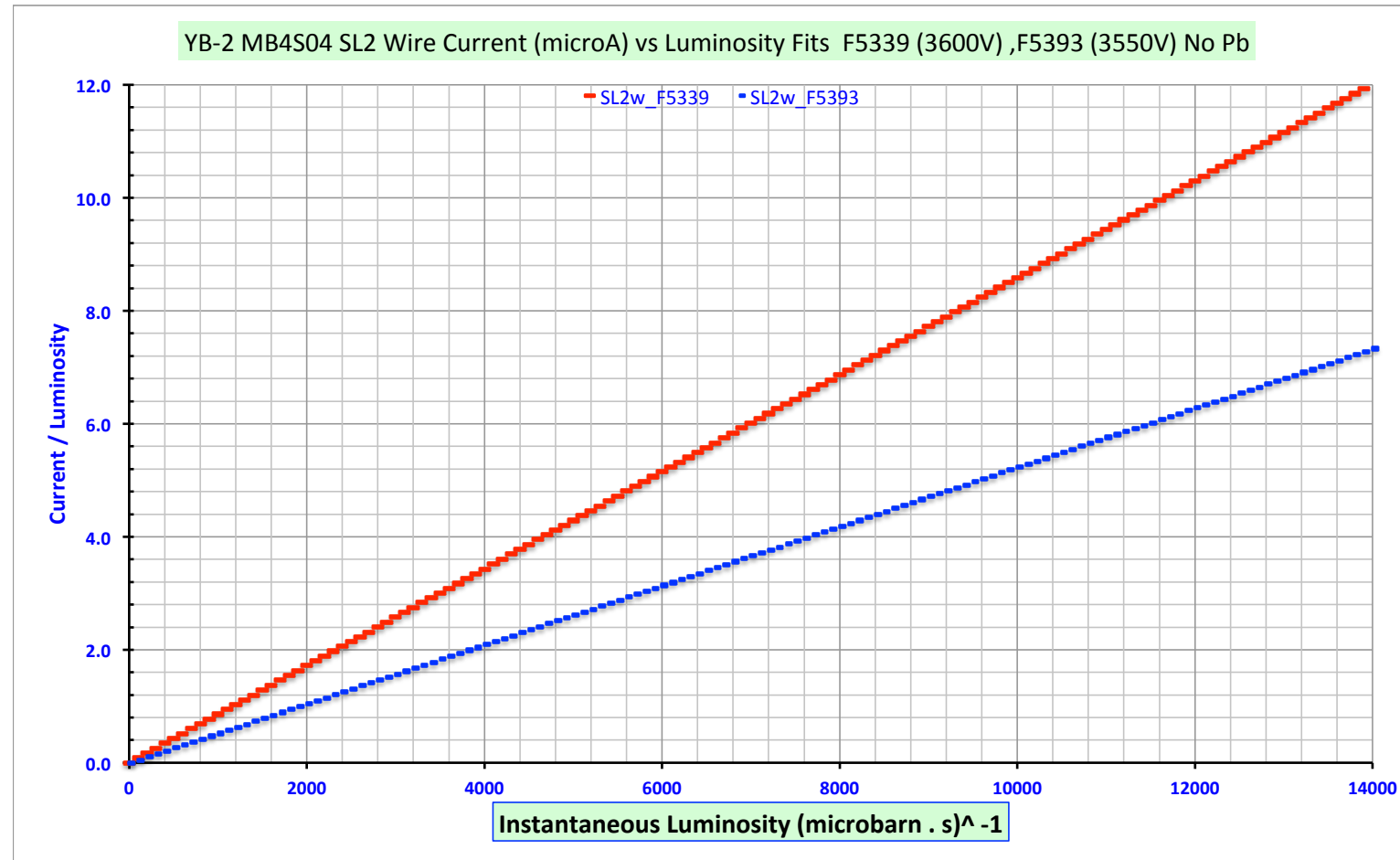
TwinMux SW 2016 evolution

- **Start**: replace old Trigger Supervisor with all-new L1 Trigger online SW architecture based on Swatch Framework

- **2016 commissioning**: development and validation of the TwinMux Swatch cell

- Physics start with a functional SW but some features missing in framework need to complete using command-line scripts

- Twinmux swatch cell continuously evolving during 2016:

  - Strong Swatch framework development

  - Inclusion of readout of RPC links

  - Strong TwinMux FW development (trigger algorithm)

- SW and system performed satisfactorily

Plans for 2017

DT EYETS activities

- Replace HV mainframe:

  - The old one was more then 10 year old
  - Easier maintenance of the new system
  - HW intervention done on December 2016. SW integration still ongoing

- Take the opportunity that the detector is open to repair few minicrates accessible in the external wheels.

- Extract in situ DT/RPC chambers for RPC repairs: 8 or 9 chambers. Uncabling starts this week.

- Improve neutron shielding for the external station of top sector (for external wheel only).

  - Test during LHC operation shown that a layer of borated polyethylene + a layer of lead can reduce the single-hit background of a factor 2.

  - We will instal the shielding to more chambers during LS2

25/01/2017

DT: HV reduction

YB-2 MB4S04 SL2 Wire Current (microA) vs Luminosity Fits F5339 (3600V) ,F5393 (3550V) No Pb

- Lower the DT anode HV by 50V in the stations most affected by background:

  - test done during 2016 data taking shown a current reduction of 1.6 at a cost of 1% of hit efficiency (negligible for the system)

Twinmux: plans for 2017

- DT+RPC super-primitives are validated. We are planning to start physics data taking with super-primitives enabled.

  - DT synchronisation was optimised in August 2016. It should be ok for 2017 too, but of course it will be verified at the beginning of data taking.

  - RPC synchronisation needs to be optimised.

- DT Low quality trigger (when confirmed by RPC cluster):

  - Tested during ion physics. The efficiency increase with small increase of primitives rate.

  - Still to verify the effect of these primitives in the BMTF (the RPC information can improve the timing information, but the poor spatial resolution of the segments can have effect on the trigger muon reconstruction)

  - We will probably ask to take one fill with DT Low quality trigger enabled

- RPC only trigger was tested at the end of 2016. The plan is to measure the efficiency in proton physics and then, eventually, enable it

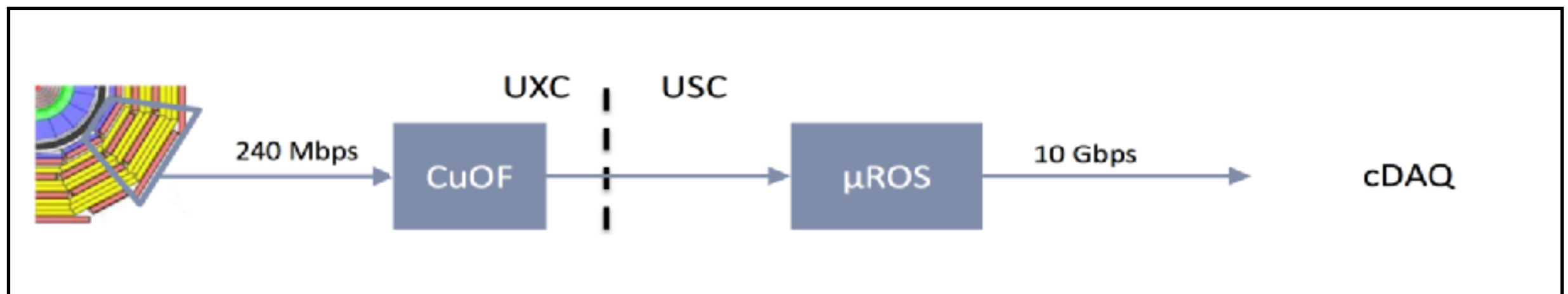- Study the effect of HO in the super-primitives algorithm

DT: uROS
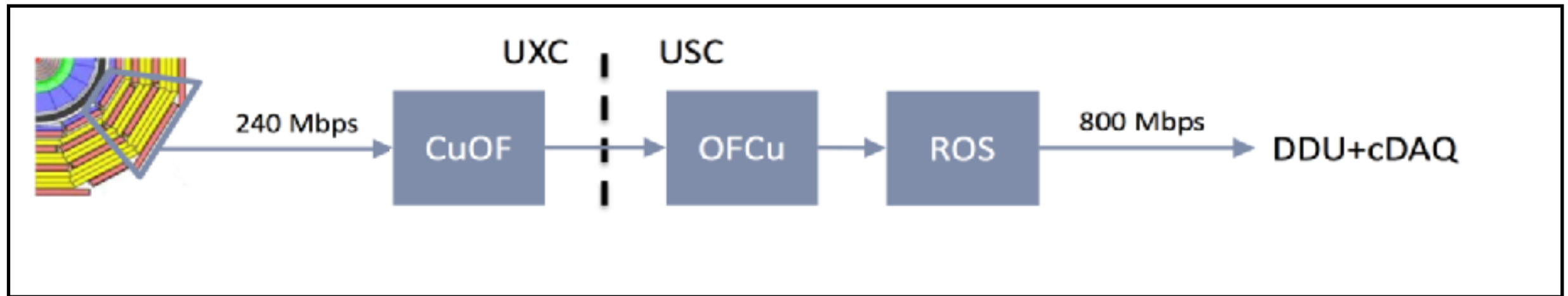
end of 2017
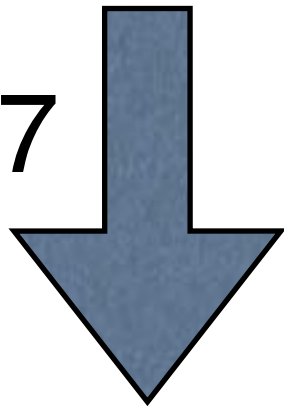
- More robust and powerful electronic based on µTCA (same board used for the DT trigger chain)
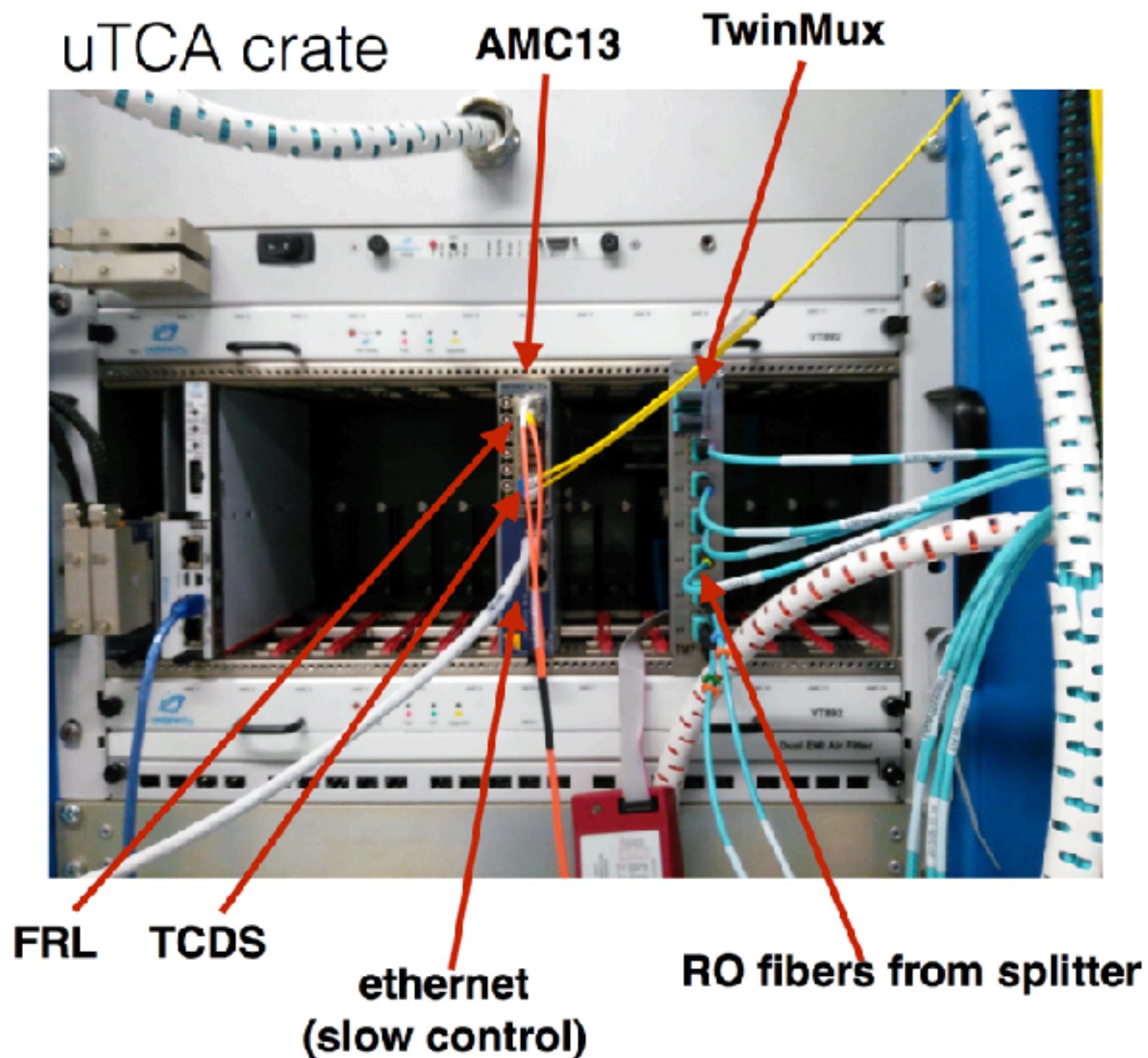- More bandwidth to DAQ

Test crate already installed

uROS test setup

Optical splitter

uTCA crate — AMC13, TwinMux, FRL, TCDS, ethernet (slow control), RO fibers from splitter

- TwinMux board receiving (through Optical Splitter) from 3 DT sectors

- Firmware dev. and commissioning in 2017

- Installation of final system: end of 2017

Some comments

- The DT payload should be below the DAQ limits in 2017.

  - Anyway, we will prepare an emergency TDC configuration that can reduce of ~30% the payload with minimal effect for background monitor and out-of-time muon reconstruction

- We would like to perform a gain scan during the CRAFT/CRUZET (to check difference with respect to last year scan)

  - it can be done during the Pixel commissioning data taking (the trigger efficiency will be good)

- In order to re-commissioning the extracted chambers, to test the minicrates intervention and to develop the new uROS FW and SW, we need to use extensively the minidaq in the next months. Is it possible to have it available more then 2 days per week?

Conclusions

- Good behaviour of the system during 2016 data taking.

- Fraction of dead channels stable during 2016. The main problem is due to RO links in the CMS balcony and in the counting room.

  - The problem should improve when the new uROS board will be installed (end of 2017)

- Despite the trigger system was almost completely replaced at the beginning of 2016, the operation of the detector and the quality of the data was not affected:

  - in 2017 we can fully exploit the potentiality of the Twinmux

25/01/2017