

Trigger shifter tutorial

Introduction, control, and configuration

Introduction

- This is the first shifter tutorial for 2018
 - Intended mostly for (new) 2018 shifters
- The **slides might be updated** in-between tutorials
 - Watch for updates to these slides (e-mail announcements)
 - They will be posted on the OnlineWBTrigger TWiki
- 2018 first semester call went out in October – **fully subscribed**
- A few important reminders
 - **You are responsible** for the Trigger
 - **Look, listen, and communicate** with the shift crew!
 - Remember your job is to **be on shift for 8 hours!**
 - Limit e-mail, social-networking, analysis work, and please **do not attend meetings by video or phone conference** – otherwise find a replacement shifter
- More information in the trigger Online Workbook TWiki:
<https://twiki.cern.ch/twiki/bin/viewauth/CMS/OnlineWBTrigger>

Your Job is to...

- Ensure **proper, stable, and efficient operation** of the trigger
 - Start-up the basic shifter tools in preparation for global data taking after computer crashes or after a power cut
 - **Monitor** the proper functioning of the Trigger
 - **Keep** yourself, the Shift Leader, and the L1 and HLT DOCs **informed**
 - **Answer operations-related questions** from other central shifters
 - **Choose prescale columns** following provided instructions
- **Troubleshoot** and fix problems
 - **Check alarms** and take the corresponding actions (call expert or perform action)
 - **Check** regularly the **control processes**
 - **Document problems** (in the Elog)
- At the end of the shift, **write a shift report** into the Trigger Elog
- **Help improve documentation** by giving suggestions in the Trigger Elog

Communication is essential!

- **Shift leader**
 - **Coordinator** on duty
 - **Must be informed about everything CMS**, make operational decisions, communicate to outside (CERN Control Center - CCC, Run Field Managers - RFMs)
 - Talk to shift leader about prescale factor changes, etc.
 - Please **tell shift leader if you are calling an expert** so they stay informed
- **L1 DOC (161958) and HLT DOC (165575)**
 - Need to be informed of any issues with the Trigger
 - In case of **any questions or problems** you cannot solve, **call** the L1 DOC
 - **Don't be shy about calling at 3 a.m. if needed**
- **Trigger subsystem experts**
 - Contact list in TWiki:
<https://twiki.cern.ch/twiki/bin/view/CMS/OnlineWBTriggerContacts>
- **Level-1 Trigger Technical Coordinators (Operations Managers)**
 - Dinyar (Rabady, 167806) and Alessandro (Thea, 161800)
 - Please **call the on-duty phone** at 64500

Before your first shift

- **Access to CMS CR requires the following courses**
 - **Safety at CERN**
 - **CMS** (Former *CMS - Level 4 C*)
 - Both are online via <http://sir.cern.ch>
- **Request access** via EDH (<http://edh.cern.ch>)
- **To check your accesses** go to <http://adams.web.cern.ch>

- **Shift shuttle:** <http://smb-dep.web.cern.ch/en/ShuttleService> (Circuit 3)

- It is a good idea to **subscribe to the CMS Commissioning hypernews** for announcements about shift cancellations, etc.!

- **Trainee Shifts** - 2-3 shifts shadowing another shifter, contact cms.trig.admin@cern.ch to sign up, they are created just for you!

Please stay informed!

- Attend this Tutorial and ask questions!
 - Questions to: cms-trigger-shifts-online@cern.ch
 - You can also use the egroup to swap/offer shifts
- Trigger Online Workbook
 - <https://twiki.cern.ch/twiki/bin/view/CMS/OnlineWBTrigger>
- Trigger Shifter Guide – **read top to bottom!**
 - <https://twiki.cern.ch/twiki/bin/view/CMS/TriggerShifterGuide>
- Trigger Online Issues
 - <https://twiki.cern.ch/twiki/bin/view/CMS/OnlineWBL1OnlineIssues>
- Read the instructions at the bottom of the L1 Page
 - <https://l1page.cms>
- Read the TWiki about the prescale columns
 - <https://twiki.cern.ch/twiki/bin/view/CMS/OnlineWBL1CollisionPrescales>
- If possible arrive 15 minutes early and talk to departing shifter
- Read the elogs from the last few shifts to get an idea of what is happening
eLogBook is part of <https://cmsonline.cern.ch>

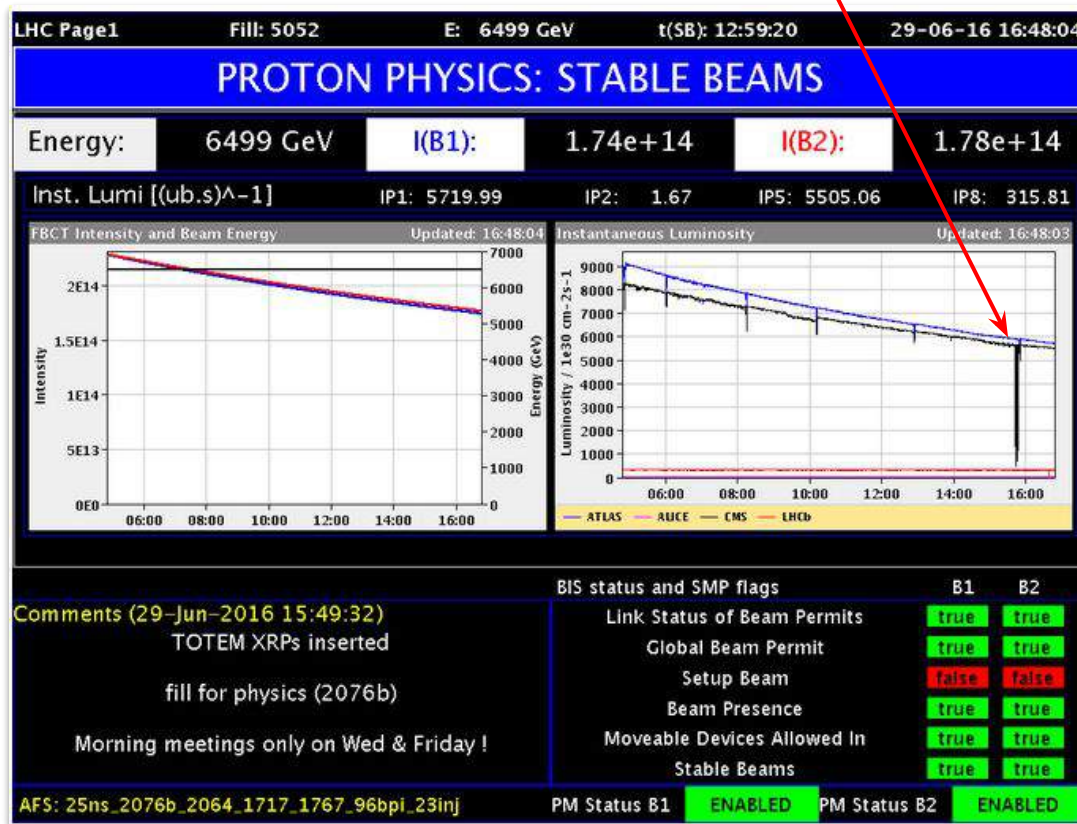
The LHC

The 2018 LHC Schedule (draft)



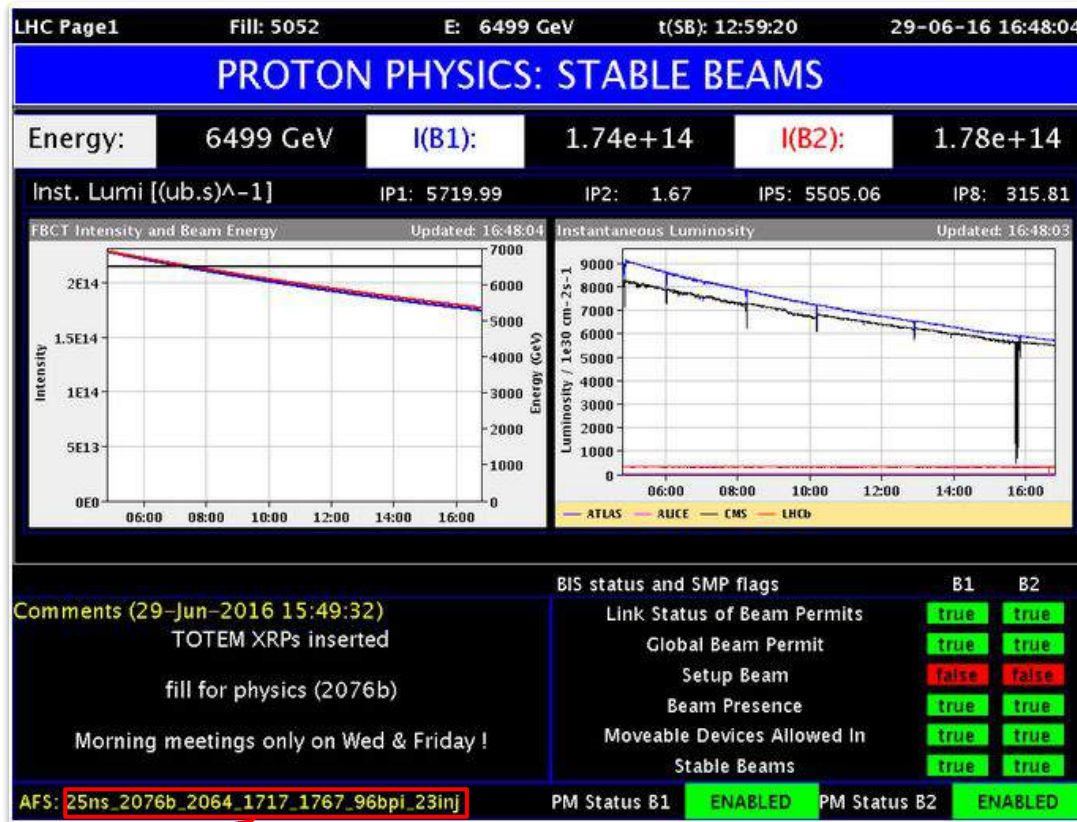
LHC Displays (Page 1)

Mini lumi-scan (rates will fluctuate)



<https://op-webtools.web.cern.ch/Vistar/vistars.php?usr=LHC1>

LHC Displays (Page 1)



LHC filling scheme: `<spacing>_<Nb>b_<IP1/5>_<IP2>_<IP8>_<code>`

e.g. here: 2064 colliding bunches in CMS/ATLAS

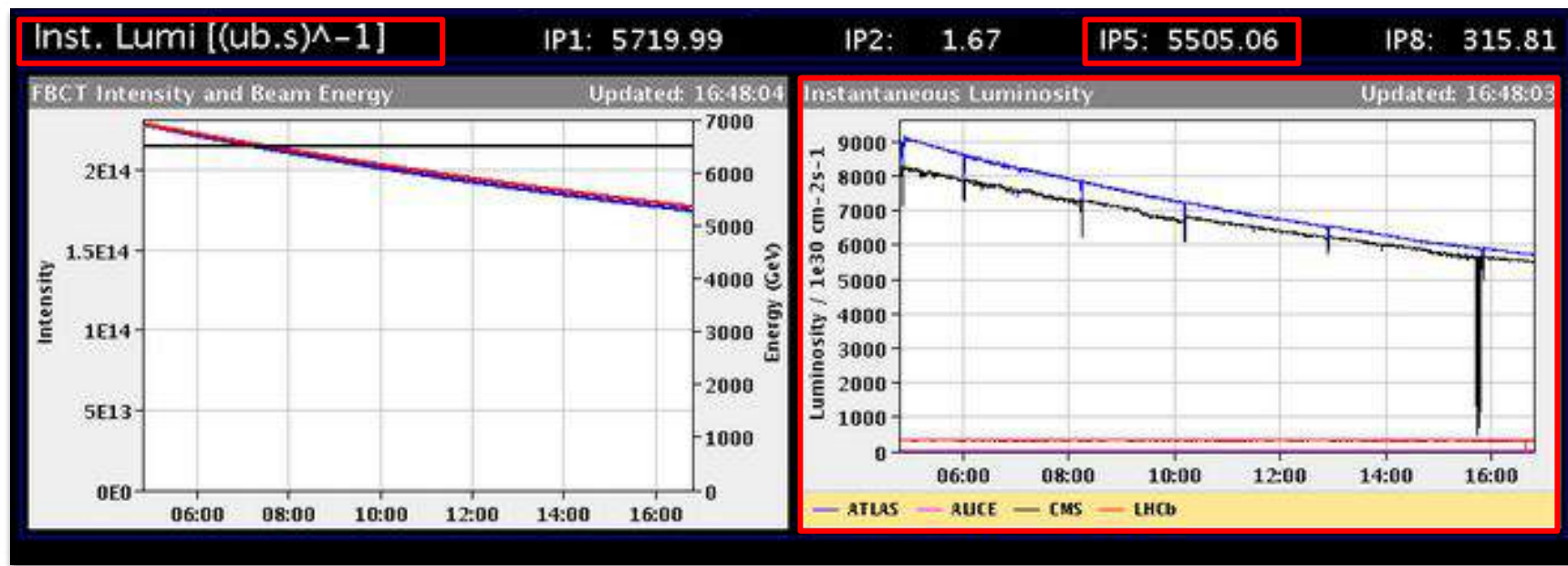
<https://lpc.web.cern.ch/lpc/fillingschemes.htm>

Instantaneous Luminosity

You need to **always** be aware of the **current instantaneous luminosity**.

Used to

- Determine when to change prescale column
- Diagnose potential source of high (or low) rates

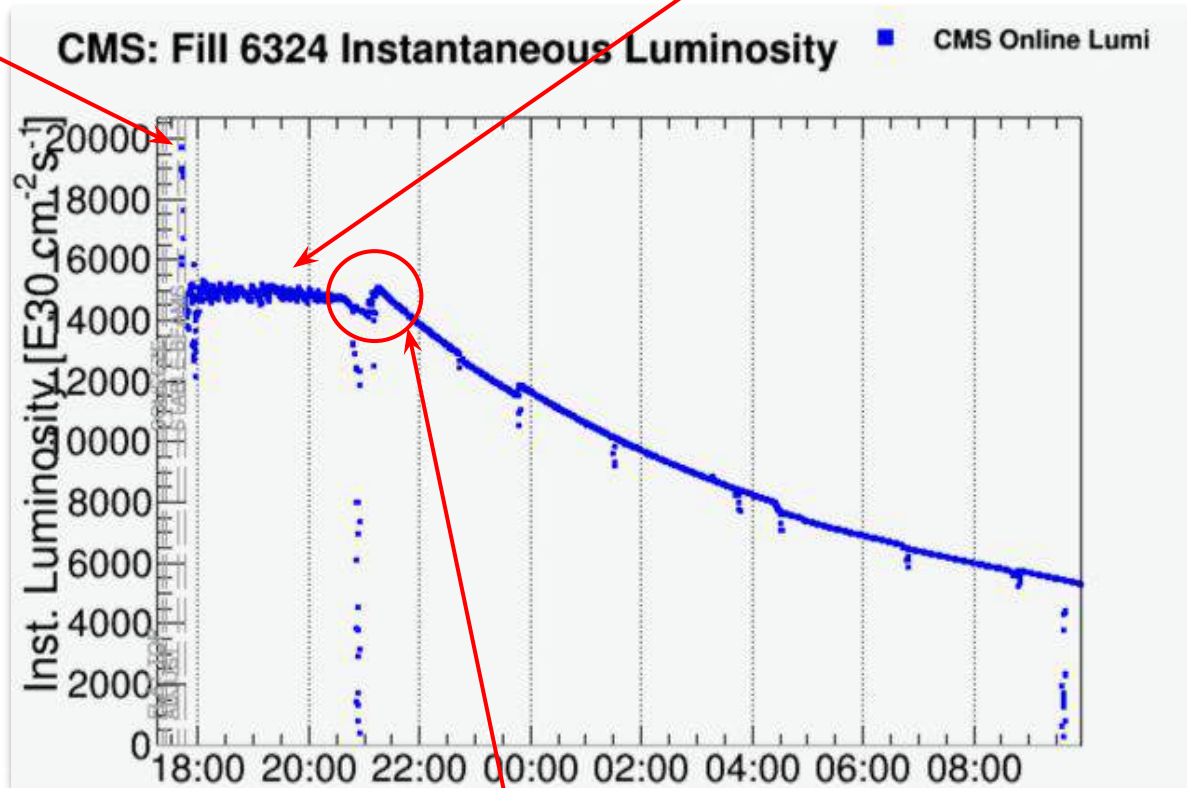


$$1 \text{ (ub.s)}^{-1} = 1\text{e}30 \text{ (cm}^{-2}\text{s}^{-1}) \Rightarrow \text{luminosity is } 5.5\text{e}33 \text{ (cm}^{-2}\text{s}^{-1})$$

Luminosity levelling

Initial high lumi

Luminosity levelling

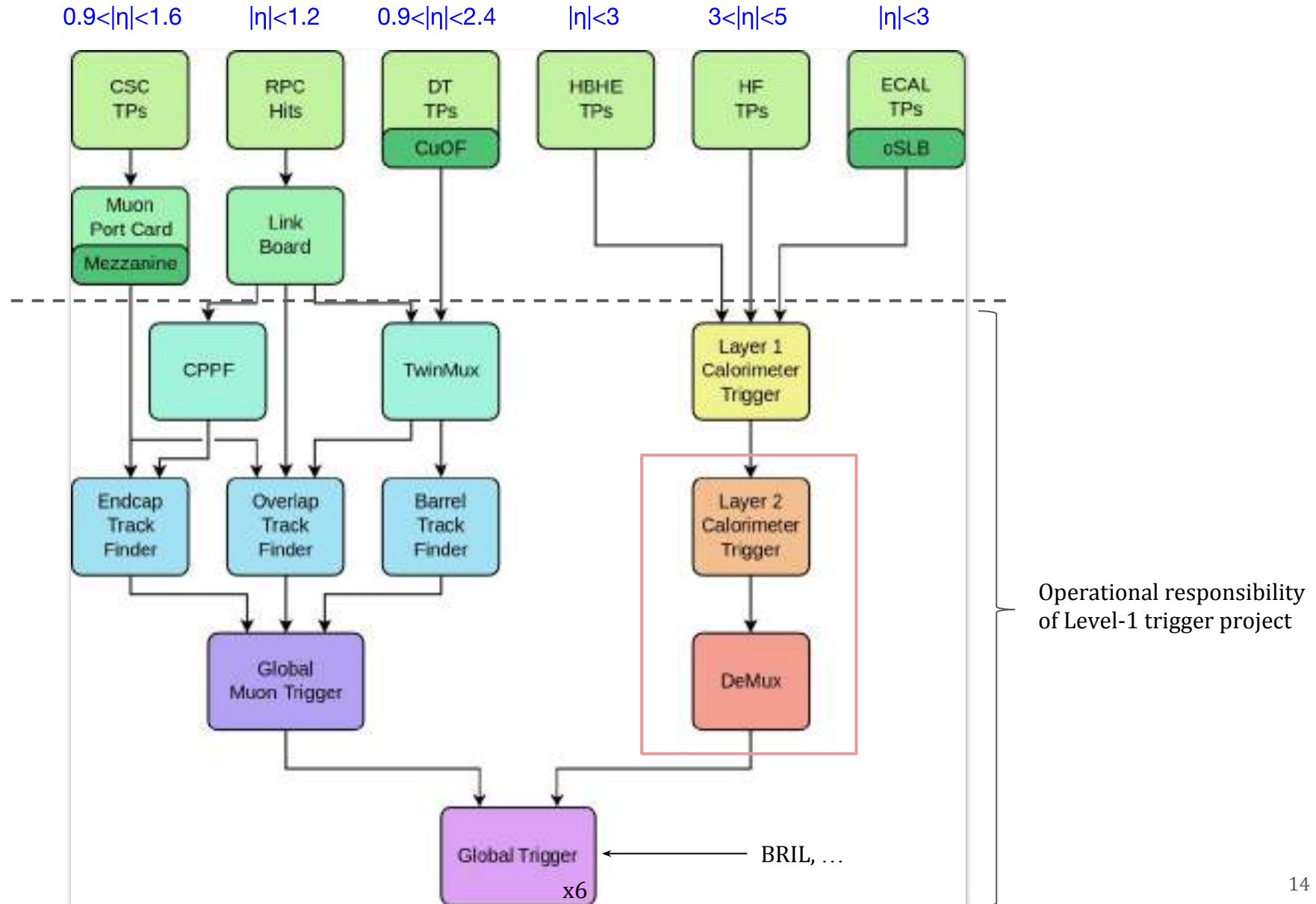


Crossing-angle optimisation will lead to increase in lumi at the end of the luminosity levelling

Very likely mode of operation in 2018.

The CMS Level-1 trigger

The L1 Trigger (simplified)



Global Trigger (μ GT)

- Represents the final stage of the Level-1 trigger
 - Receives **inputs** from muon trigger chain (μ GMT), calorimeter trigger chain (**Calo Layer-2**) and "external conditions" (e.g. **BPTX** to determine whether beams are colliding in a bunch crossing)
 - Programmable with up to 512 **trigger algorithms ("algos")**
 - e.g. "DoubleMu_4_4" (checks if two muons with $p_T > 4$ GeV are in an event)
 - Responsible for computing a "**final decision**" (**FINOR**) **signal** by combining the results of all trigger algorithms
- Many configurable parts
 - **Level-1 trigger menu**
 - Collection of trigger algorithms available in the firmware at a given time
 - **Prescale columns**
 - A given trigger algorithm can be throttled by a **prescale**.
 - e.g. prescale 2 means this trigger algorithm is throttled by a factor 2
 - **Prescale 0** means the trigger algorithm is entirely disabled
 - A **prescale column** is a collection of prescales for all algos in a menu
 - The prescale column **can be changed during the run** to adapt to changing beam conditions or requirements
 - ...

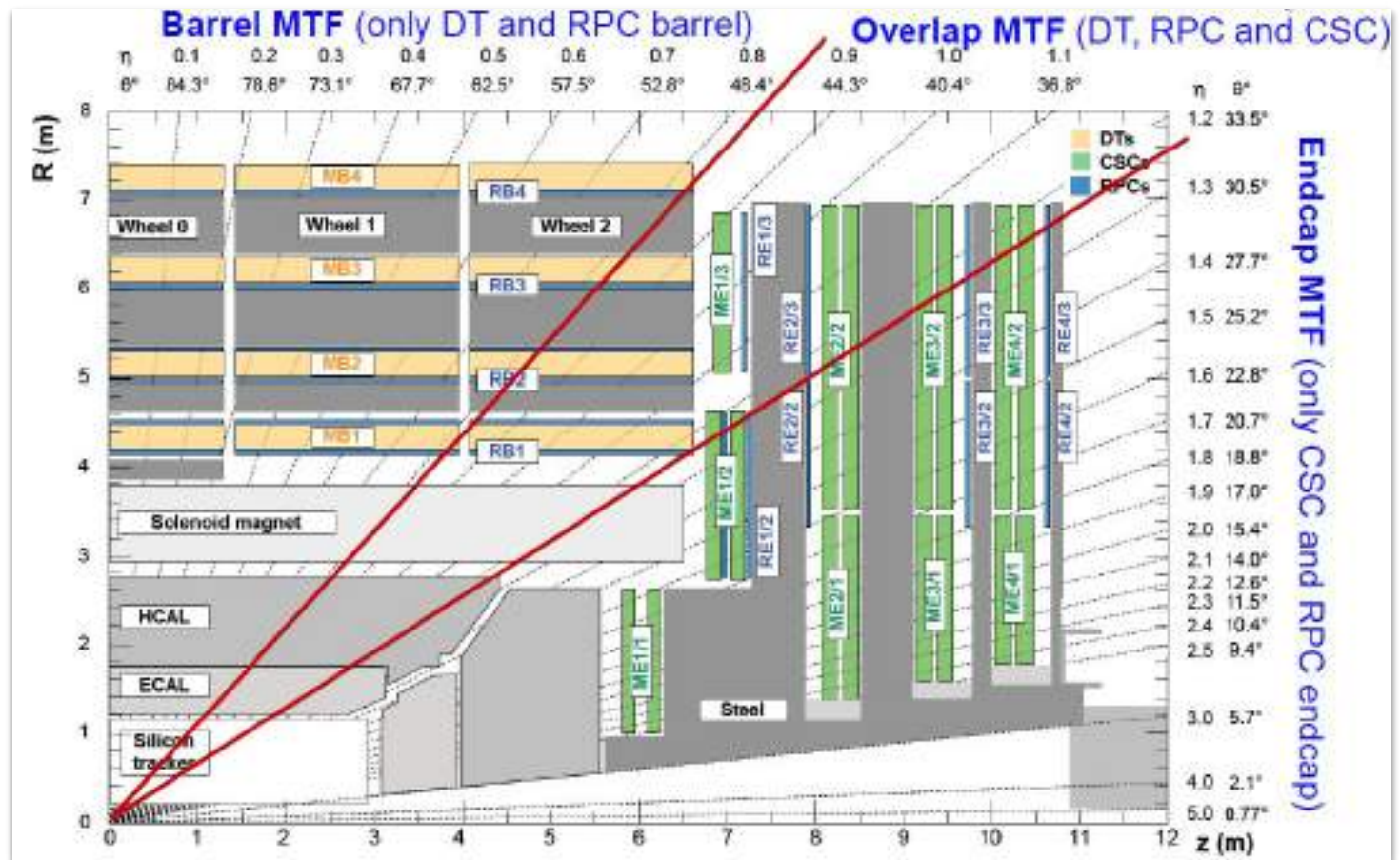
Trigger Control and Distribution System (TCDS)

- Not part of the Level-1 trigger project
 - Nonetheless important to understand basics
- Receives FINOR signal from μ GT and uses this (and other internally and externally generated signals) to determine whether to issue readout signal ("L1A") to subdetectors
 - Internally generated signals:
 - Random triggers
 - Used to collect unbiased data
 - Rate can be set by DAQ shifter
 - Calibration triggers
 - Issued at 100 Hz during standard operations in order to take calibration data for calorimeters
 - Trigger rules
 - TCDS blocks multiple L1A signals in a sliding time window (e.g. no two L1A signals within a 3 BX window)
 - ReTri protection system
 - Protection for Tracker system (possibility to physically damage modules at certain readout frequencies)
 - TCDS blocks trigger signals when running with periodic triggers at low L1A rates (e.g. one colliding bunch)
 - Externally generated signals:
 - "Busy" and "Warning" signals from Trigger Throttling System (TTS) indicate that a subdetector cannot cope with the current readout rate \Rightarrow TCDS blocks L1A signals

Some definitions

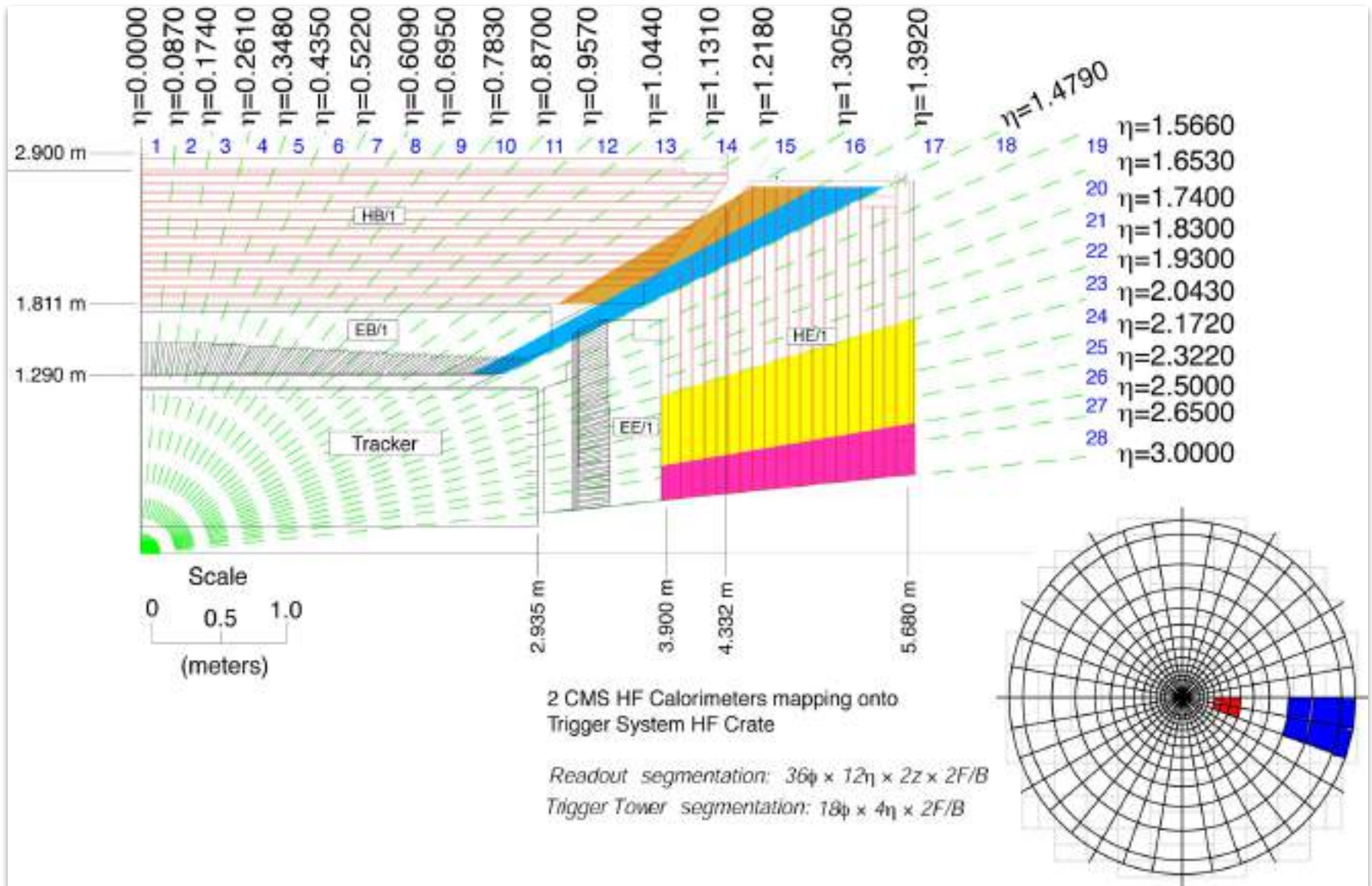
- $L1 \text{ Rate} = \text{FINOR} + \text{Random (600Hz)} + \text{Calibration (100 Hz)}$
 - Random may be something other than 600 Hz during tests
- $L1 \text{ Rate (Post-Deadtime)} = L1 \text{ Rate} - \text{Suppressed Triggers}$
 - This is the rate INTO the HLT
- Deadtime
 - Percentage of time when triggers could not be accepted:
 $\text{Number of BX where triggers could not be accepted} / \text{Number of BX}$
 - Triggers suppressed by
 - Trigger Rules – 1 trigger in 3 BX, etc.
 - Trigger Throttling – Subdetector is busy state, in error, etc.
 - This becomes the dominant cause of deadtime at very high (100 kHz) rate
 - Hard reset, resync sequences, calibration sequence
 - ReTri system
 - Mostly relevant when very few bunches colliding

Muon track finder coverage



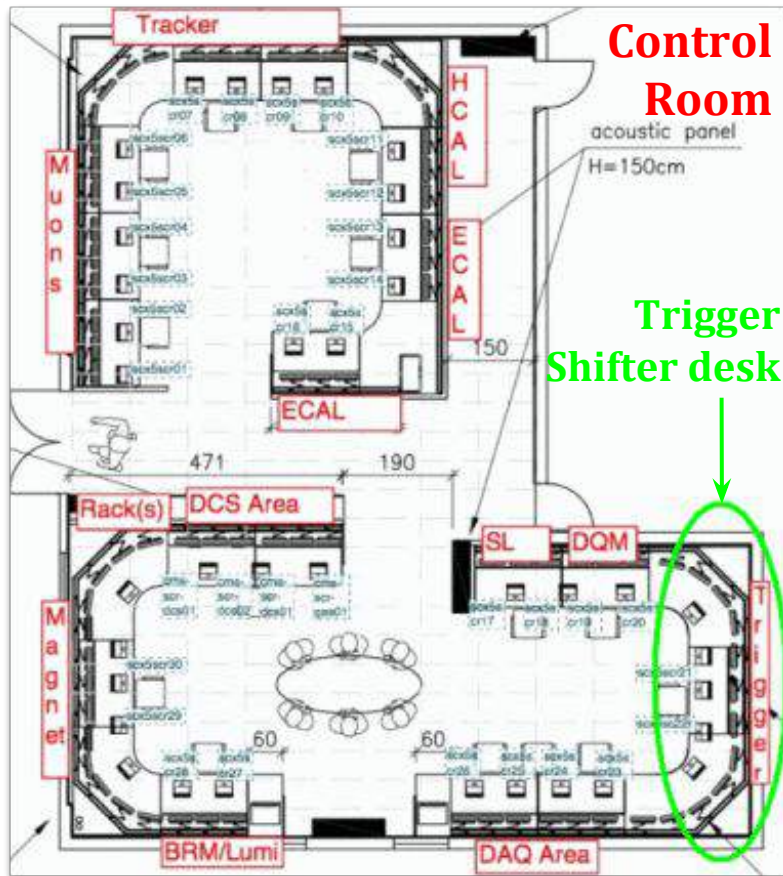
K. Bunkowski

Calorimeter Trigger Geometry



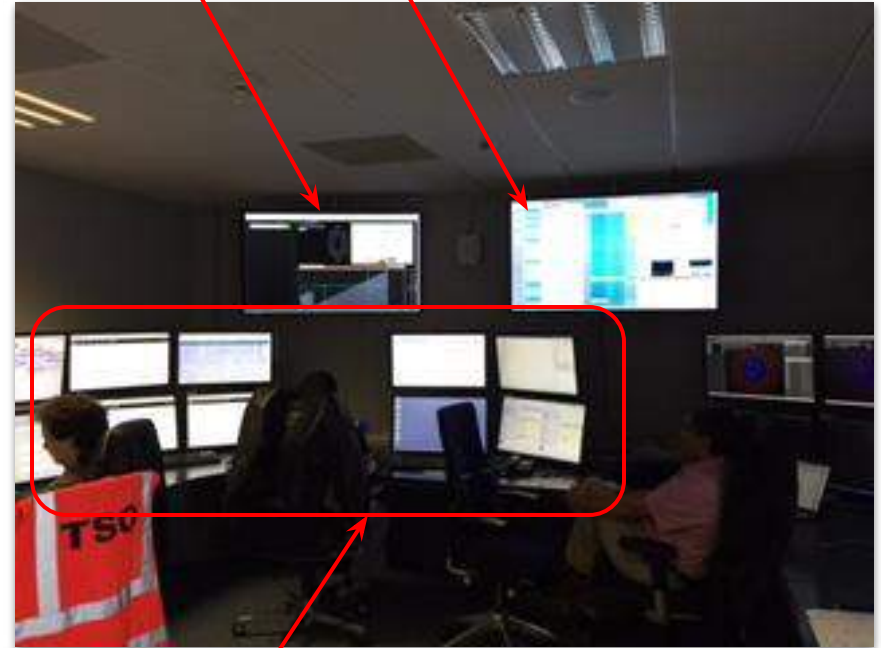
Shift essentials

The CMS control room



Trigger Shifter phone: 75257

CMS DAQ and DCS Information



Two PCs to be used by you:

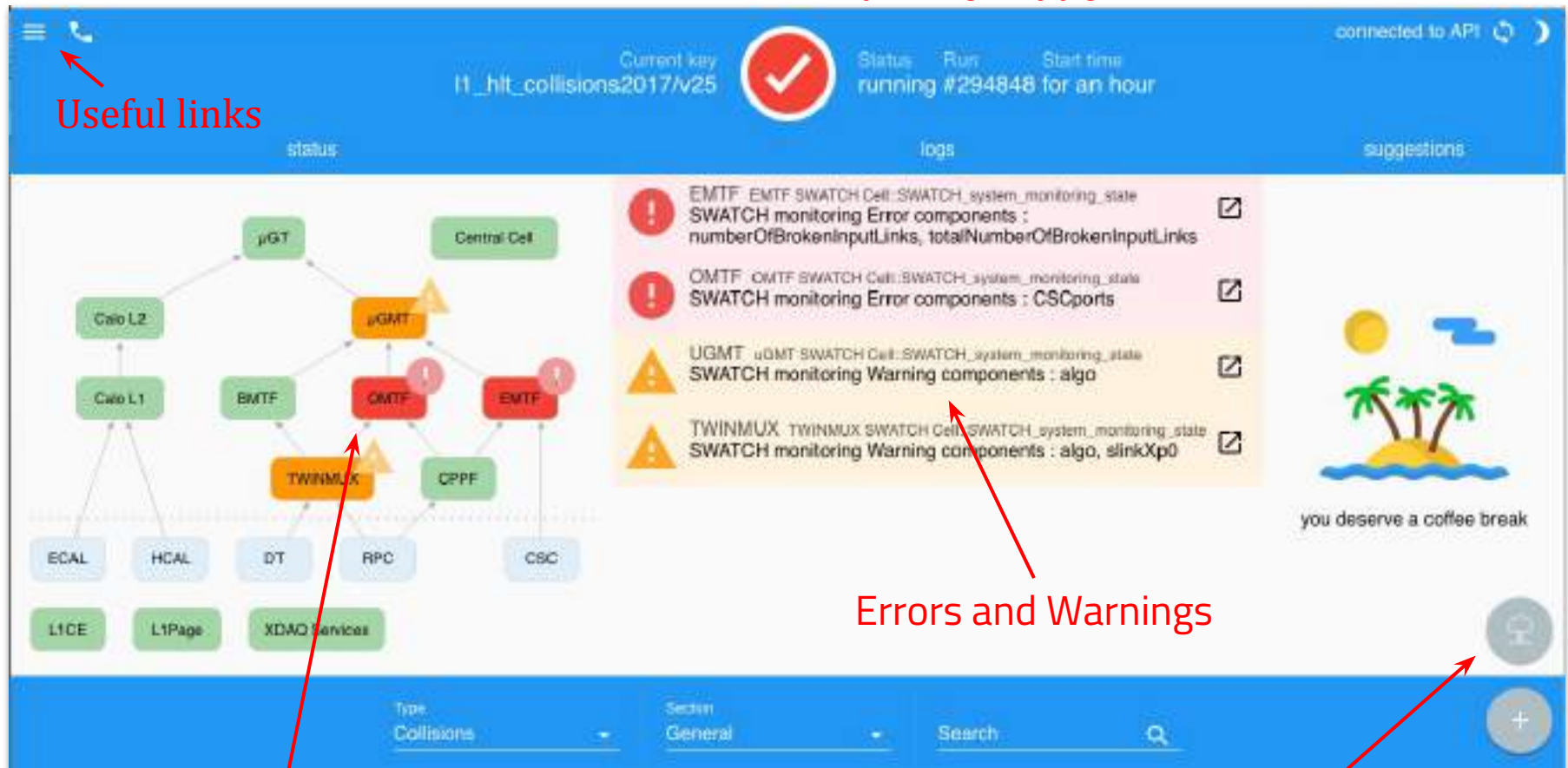
- 4 large high-res screens per PC
- Keep **operational windows on right PC**
- 2nd is for DQM and monitoring

Chromium icon on each desktop

The L1 Page

Run information

Useful links



Errors and Warnings

↓ Scroll down for short-term instructions ↓

Subsystem process
information

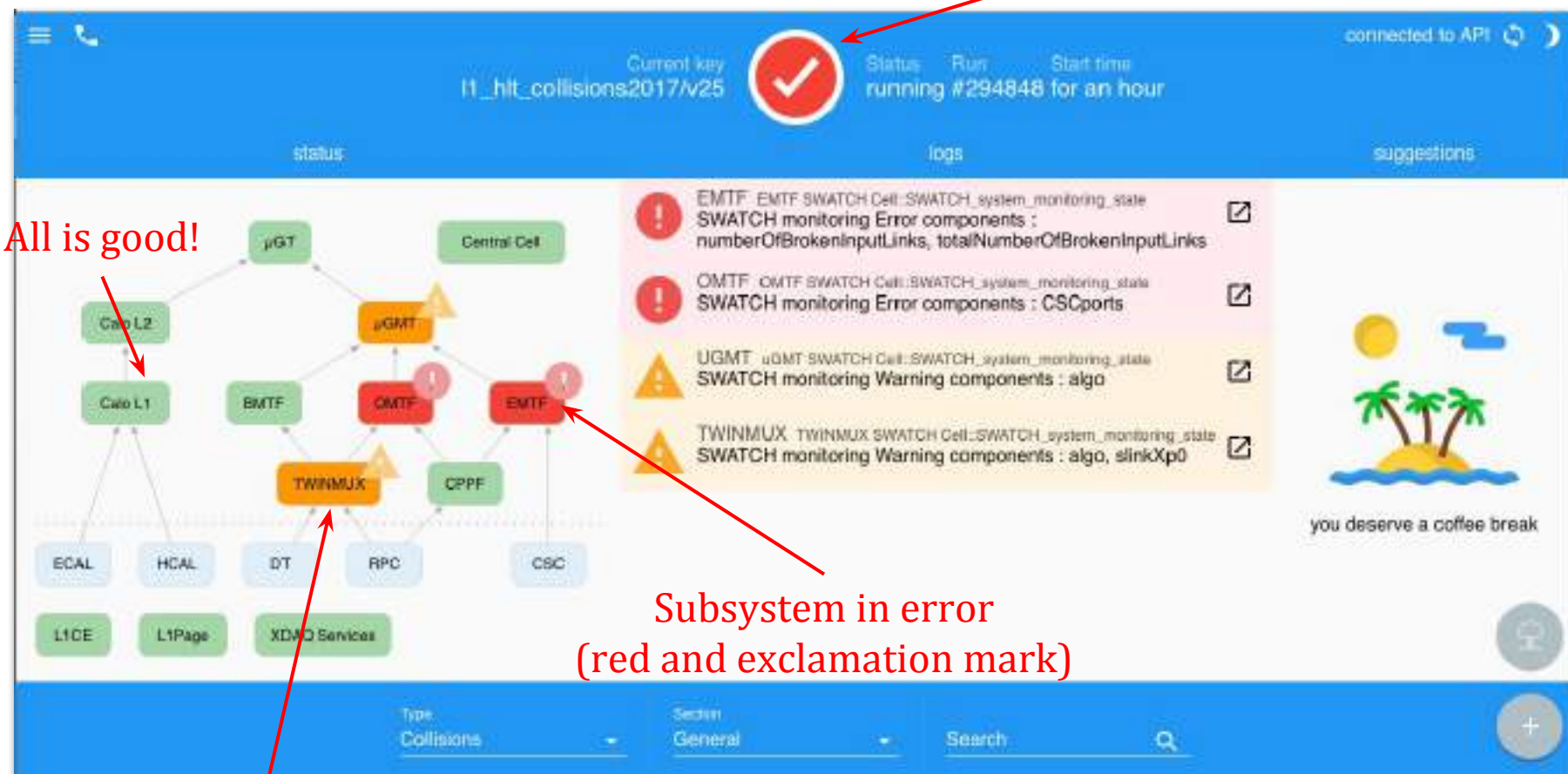


Process controller

The L1 Page

Overall trigger status

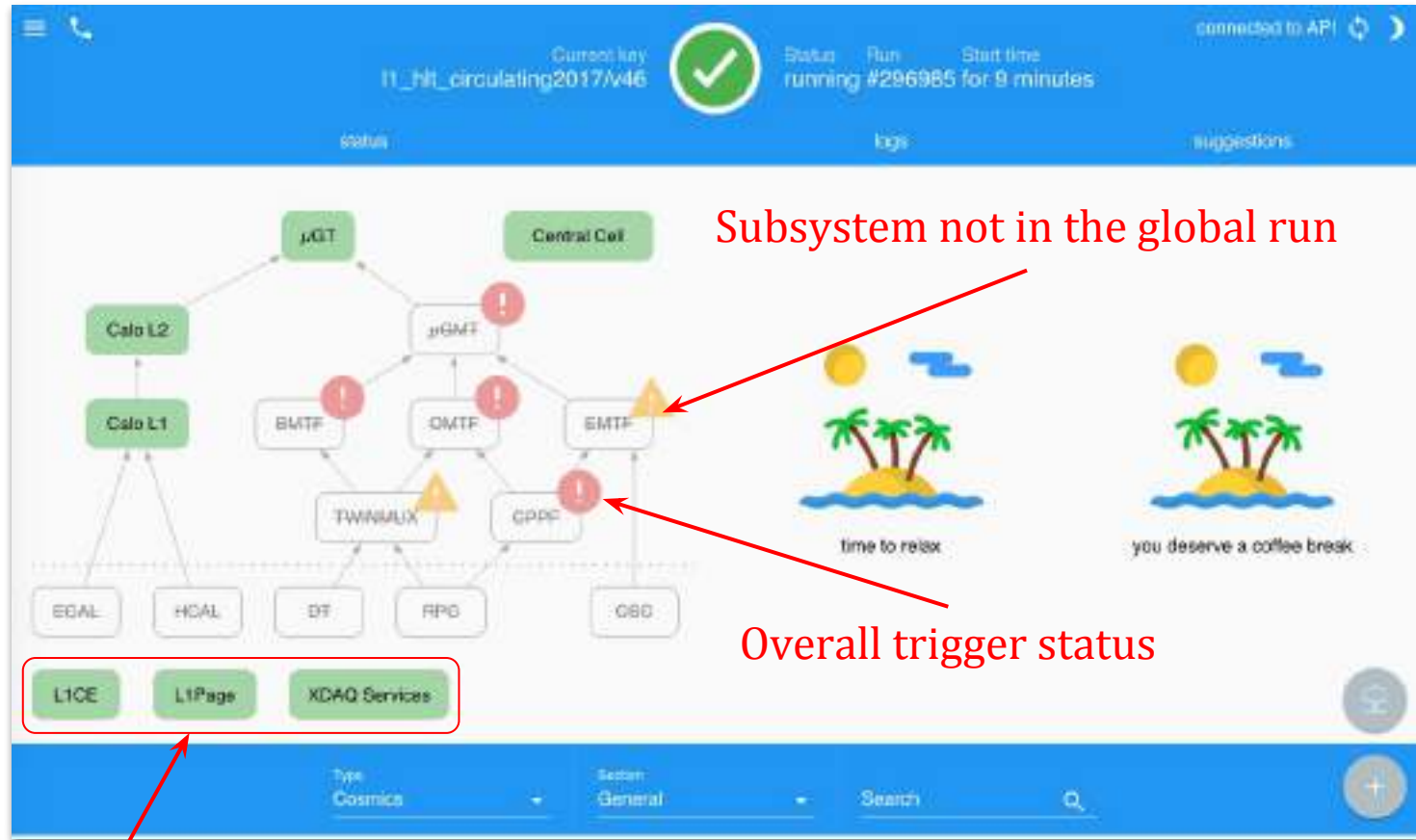
All is good!



Subsystem in error
(red and exclamation mark)

Subsystem in warning
(orange and warning sign)

The L1 Page



L1CE, L1Page, XDAQ Services
should always be green

The L1 Page



connected to API  

Current key
l1_hlt_collisions2017/v90

Status
running

Run
#296796

Start time
for 37 minutes

status

logs

suggestions

```
graph BT; ECAL --> Calo L1; HCAL --> Calo L1; Calo L1 --> Calo L2; Calo L2 --> muGT; DT --> TWINMUX; RPC --> TWINMUX; TWINMUX --> BMTF; TWINMUX --> OMTF; BMTF --> muGMT; OMTF --> muGMT; CPPF --> OMTF; CPPF --> EMTF; CSC --> EMTF; muGMT --> muGT; muGT --> Central Cell
```

The diagram illustrates the L1 detector components and data flow. At the bottom, there are three boxes: L1CE, L1Page, and XDAQ Services. Above them, a dashed line separates the detector components from the processing layers. The detector components include ECAL, HCAL, DT, RPC, and CSC. The processing layers include Calo L1, Calo L2, BMTF, OMTF, EMTF, TWINMUX, and CPPF. The data flow is as follows: ECAL and HCAL feed into Calo L1, which feeds into Calo L2. Calo L2 feeds into muGT. DT and RPC feed into TWINMUX, which feeds into BMTF and OMTF. BMTF and OMTF feed into muGMT. CPPF feeds into OMTF and EMTF. CSC feeds into EMTF. muGMT feeds into muGT. muGT feeds into Central Cell.



time to relax



you deserve a coffee break

Type
Collisions


Section
General

Search



Contacts Page

<https://twiki.cern.ch/twiki/bin/view/CMS/OnlineWBTriggerContact>



DinyarRabady
Log Out
CMS

[CMS Homepage](#)
[CMS Twiki](#)
[Changes](#)
[Index](#)

Online Workbook
L1 Home

L1 Page
(on private network)
Workbook
elog
Shifter Guide

Jump

Search

CMS All webs

Edit Attach PDF

Twiki > CMS Web > OnlineWB > OnlineWBTrigger > OnlineWBTriggerContacts (2017-12-01, NicholasCharlesSmith)

Trigger Expert Contacts (for online)

During operation, the first person to call (and the person who should be informed) is the current **L1 DOC** at **16-1968**. The L1 DOC will also help you to get in contact with the subsystem expert who should help with your problem. The L1 DOC schedule is on the [Shift List](#).

The current table should contain the most up-to-date contacts of subsystem experts. Wherever possible, mobile phone numbers are given. For calls from outside CERN, replace the leading 16-xxxx with +41-75-411-xxxx (for mobile phones).


For High Level Trigger or Trigger Studies Group related questions use contacts listed in [TriggerStudiesGroupContacts](#). For other contacts see also [OnlineWBContactList](#).

Contacts:

System/Task	Name	Email	Phone	Comments
L1 DOC	n.a.	n.a.	16-1968	(manager changes ~ weekly)
HLT DOC	n.a.	n.a.	16-5575	(manager changes ~ weekly)
L1TC On duty	n.a.	cms-l1t-technical-coordination@cern.ch	(+41 22 76) 64500	L1 Technical coordinator on-call
Control Room	Trigger Station	n.a.	75257	to reach the trigger shifter
	DAQ Station	n.a.	75200	
	Shift Leader	n.a.	77111	
	DCS Station	n.a.	75140	
Run Field Manager	n.a.	n.a.	75575	
Control Centre	Trigger Station	n.a.	73283	to reach the offline trigger shifter
Trigger Coordination	Alessandro Thea	Alessandro.Thea@cern.ch	16-1800	Trig. Tech. Coord.
	Dinyar Rabady	Dinyar.Rabady@cern.ch	16-7806	Trig. Tech. Coord.

The L1 Page

connected to API

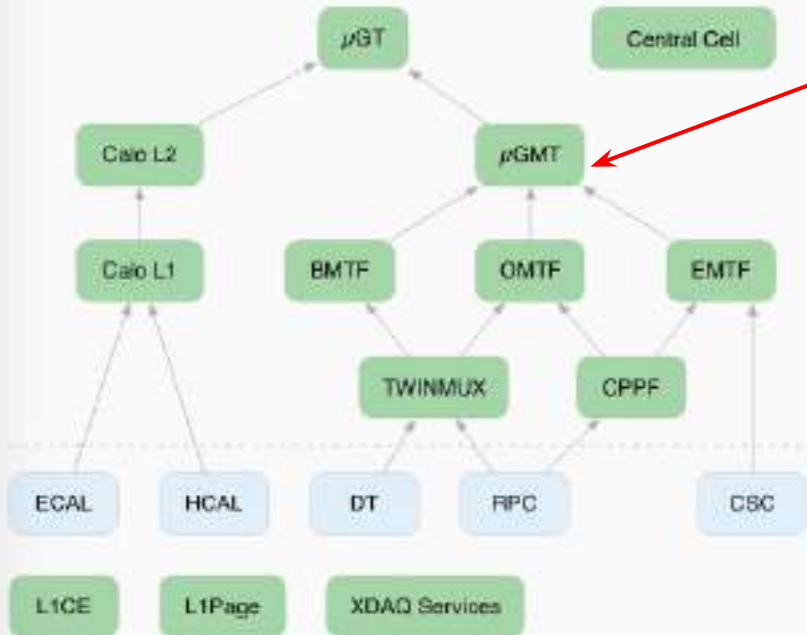
Current key **l1_hlt_collisions2017/v90** 

Status **running** Run #296796 for 37 minutes

Start time

status logs suggestions

Click on Subsystem box to open detail view



time to relax

you deserve a coffee break

Type **Collisions** Section **General** Search

The L1 Page --- Detailed subsystem view

The screenshot displays the L1 Page interface for a subsystem. At the top, a status bar shows 'Current key: 11_hlt_cosmics2017/v111' and 'Run: Run 291702 : running 4 minutes ago'. Below this, a blue header bar for the 'UGT' subsystem indicates 'in run', 'all applications online', '1 alarm', and '3 operations'. The main content area is divided into six panels, each representing a subsystem component:

- SUPERVISOR**: Status 'critical', 'healthy: system responds to HTTP GET'. An annotation 'Middle click opens in new tab' with a red arrow points to the external link icon.
- TCDS ICI**: Status 'critical', 'healthy: system responds to HTTP GET'. Includes an external link icon.
- TCDS PI**: Status 'critical', 'healthy: system responds to HTTP GET'. Includes an external link icon.
- TSTORE**: Status 'critical', 'healthy: System gives valid TStore response'. Includes an external link icon.
- GTUP TCDS ICI Cell**: Status 'healthy: unmonitored, assumed healthy'. Includes a 'Run Control' status box showing 'running' and 'Executed transition 'start''. Includes an external link icon.
- GTUP TCDS PI Cell**: Status 'healthy: unmonitored, assumed healthy'. Includes a 'Run Control' status box showing 'running' and 'Executed transition 'start''. Includes an external link icon.

Below these panels is the **uGT SWATCH Cell**, status 'healthy: unmonitored, assumed healthy', with a 'Run Control' status box showing 'Successfully completed system FSM transition 'start''. At the bottom, a blue 'Process Control' bar contains buttons for 'STATUS', 'START', 'STOP', and 'RESTART'. A red arrow points to a 'CLOSE' button in the bottom right corner with the annotation 'Click to close'.

Process control

Process Control

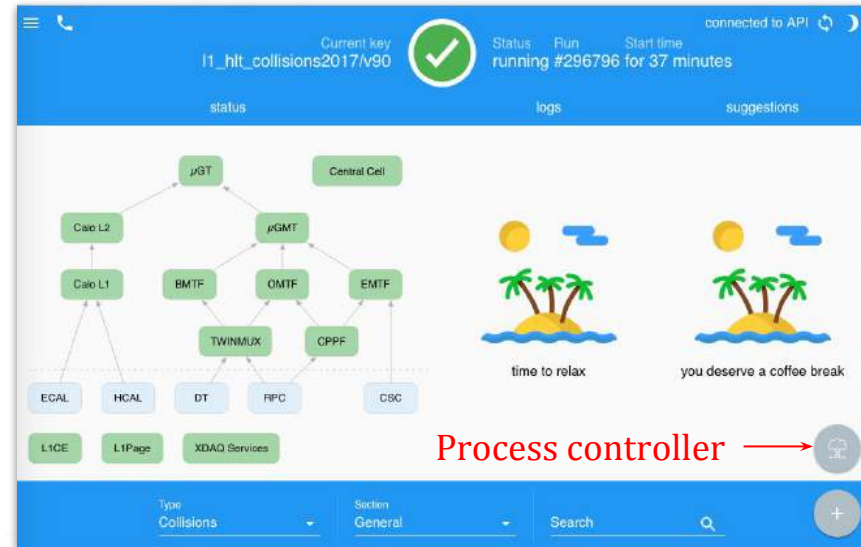
If you get a request from an expert, restart the processes (SWATCH software) for the subsystem with the process control

If a status box is red or yellow and there is a skull ☠️, check the TWiki below for the rules about restarting a subsystem's processes.

If a system is white (out) – **do not restart**, local work may be going on

Instructions and guidelines can be found at:

<https://twiki.cern.ch/twiki/bin/view/CMS/OnlineWBL1OnlineIssues>



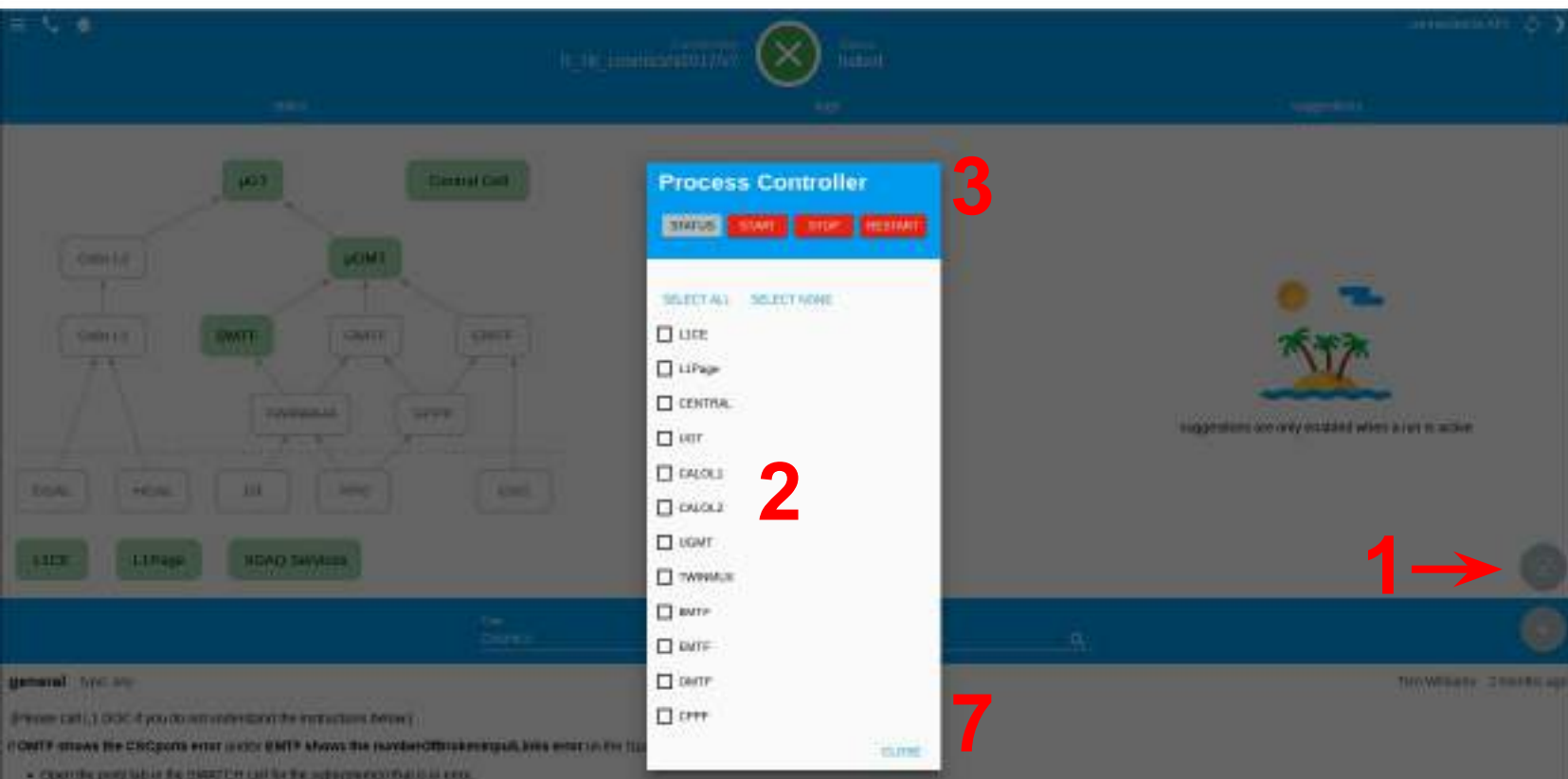
Process Control - how to

1. Click the icon
2. Select subsystem
3. Click RESTART (or stop/start)
4. Wait for result
5. If the process fails to restart, follow instructions to the right
6. Write an elog
7. Close the window

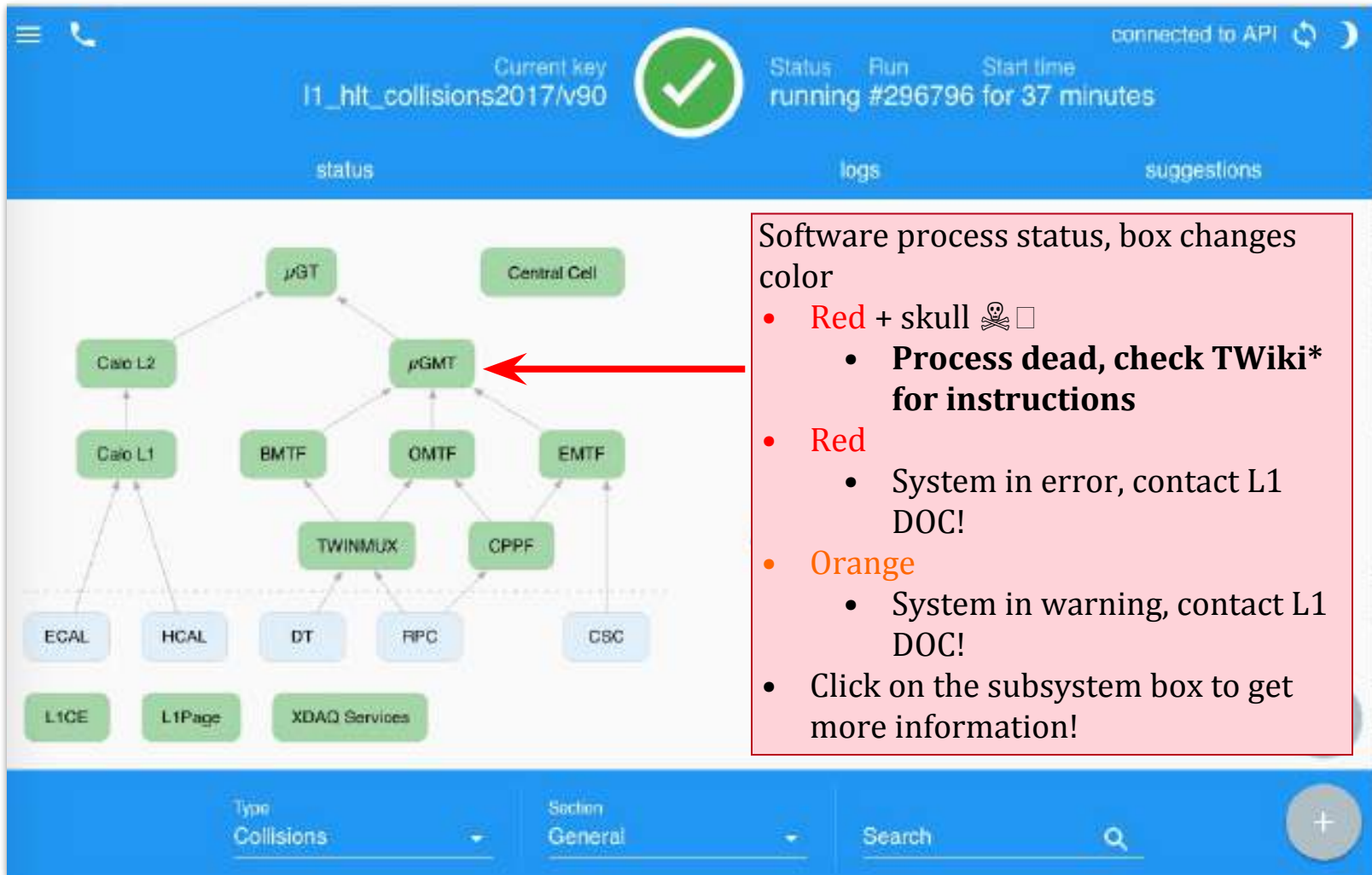
If a process fails to restart the PC may be down, so please call:

- The subsystem expert
- L1 DOC

If they cannot restart the PC the DAQ DOC must be called.



Software process status



Software process status, box changes color

- **Red** + skull ☠️ ☐
 - **Process dead, check TWiki* for instructions**
- **Red**
 - System in error, contact L1 DOC!
- **Orange**
 - System in warning, contact L1 DOC!
- Click on the subsystem box to get more information!

*[https://twiki.cern.ch/twiki/bin/view/CMS/OnlineWBL1OnlineIssues#Restarting a subsystem s process](https://twiki.cern.ch/twiki/bin/view/CMS/OnlineWBL1OnlineIssues#Restarting_a_subsystem_s_process)

Software process status

Service is required for correct trigger operation.

Service is up and running.

The screenshot displays the UGT (User Gateway Tool) interface, which is currently in the 'in run' state. The interface shows the status of various services and components:

- UGT**: in run, all applications online, 1 alarm, 3 operations.
- SUPERVISOR**: critical, healthy. system responds to HTTP GET.
- TCDS ICI**: critical, healthy. system responds to HTTP GET.
- TCDS PI**: critical, healthy. system responds to HTTP GET.
- TSTORE**: critical, healthy. System gives valid TStore response.
- GTUP TCDS ICI Cell**: healthy. unmonitored, assumed healthy. Run Control running. Executed transition 'start'.
- GTUP TCDS PI Cell**: healthy. unmonitored, assumed healthy. Run Control running. Executed transition 'start'.
- uGT SWATCH Cell**: healthy. unmonitored, assumed healthy. Run Control running. Successfully completed system FSM transition 'start'.

The **Process Control** section at the bottom includes buttons for **STATUS**, **START**, **STOP**, and **RESTART**. A **CLOSE** button is located in the bottom right corner.

*[https://twiki.cern.ch/twiki/bin/view/CMS/OnlineWBL1OnlineIssues#Restarting a subsystem s process](https://twiki.cern.ch/twiki/bin/view/CMS/OnlineWBL1OnlineIssues#Restarting_a_subsystem_s_process)


Configuration

Configuration Basics

In normal running, everything is configured from the Data Acquisition (DAQ) System based on a CMS Run Mode which determines the L1_HLT key

Trigger Shifter however should confirm that correct key has been chosen

The L1_HLT key contains three subkeys:

- **Configuration key**
 - Static configuration parameters for L1 trigger
 - **Run settings key**
 - Masks, prescale factors, enables trigger bits, etc.
 - **HLT key**
 - Sets HLT parameters, paths, and prescale factors
- 
- These keys have to match!**

These keys are made by the L1 DOC or HLT DOC

CMS usually has 3-4 types of keys available:

- **Collisions** – for normal data taking with stable beams
- **Circulating** – for circulating beam in the machine
- **Cosmics** – for taking cosmic-ray calibration/alignment data with no beam in the machine
- **Special keys** for high rate tests, van der Meer scans, etc.

Selecting prescale columns

During Collisions, prescale columns will need to be set according to the instantaneous luminosity or the number of colliding bunches (see LHC section) at CMS

Reminder: Prescales throttle or shut down rate of trigger bits (see L1 Trigger section)

Instructions on which columns to choose:

<https://twiki.cern.ch/twiki/bin/view/CMS/OnlineWBL1CollisionPrescales> (maintained by HLT DOC)

Example: You should see the following type of list for collisions:

Column Index	Column Name	Lumi Range
column 0	emergency	> 1.28e34
column 1	1.25e34	1.15e34 to 1.28e34
column 2	1.15e34	1.06e34 to 1.15e34
column 3	1.06e34	9.5e33 to 1.06e34
column 4	9.5e33	8.8e33 to 9.5e33
column 5	8.5e33	7.9E33 to 8.8e33
column 6	7.5e33	6.0E33 to 7.9E33
column 7	5e33	4.4E33 to 6.0E33
column 8	3.5e33	2.7E33 to 4.4E33
column 9	2e33	1.5E33 to 2.7E33
column 10	1e33	9E32 to 1.5E33
column 11	7e32	5E32 to 9E32
column 12	5e32	4E32 to 5E32
column 13	3.5e32	2.5E32 to 4E32

LHC Page1	Fill: 5052	E: 6499 GeV	t(SB): 12:59:20	29-06-16 16:48:04
PROTON PHYSICS: STABLE BEAMS				
Energy:	6499 GeV	I(B1):	1.74e+14	I(B2): 1.78e+14
Inst. Lumi [(ub.s)^-1]		IP1: 5719.99	IP2: 1.67	IP5: 5505.06 IP8: 315.81

(Top of LHC Page 1, should always be visible on your workstation)

$1 \text{ (ub.s)}^{-1} = 1\text{e}30 \text{ (cm}^{-2}\text{s}^{-1}) \Rightarrow \text{use column 7 (named "5e33")}$

Please inform the shift leader if you want to change the prescale!

Prescales -- cheat sheet

As luminosity decreases, the prescale column should be changed according to the luminosity using the table linked to the L1 Page.

- Expect 0.8 to 1.3 kHz for HLT (Stream Physics) rates
 - Average over the fill of ~ 1 kHz
 - Prescale columns are tuned to do this
 - For studies occasionally there is extra or only ZeroBias rate

Always monitor the deadtime (see section on monitoring):

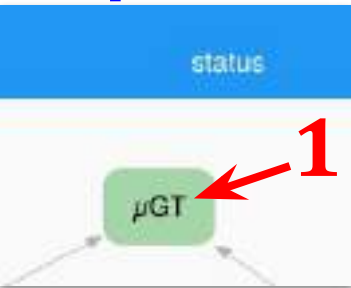
- Rates of 95 kHz or more are okay if
 - **Deadtime is below 10%**
 - Rule of thumb: $\sim < 5\%$ is normal, $\sim > 5\%$ above normal, $> 10\%$ is a problem

Possible problems:

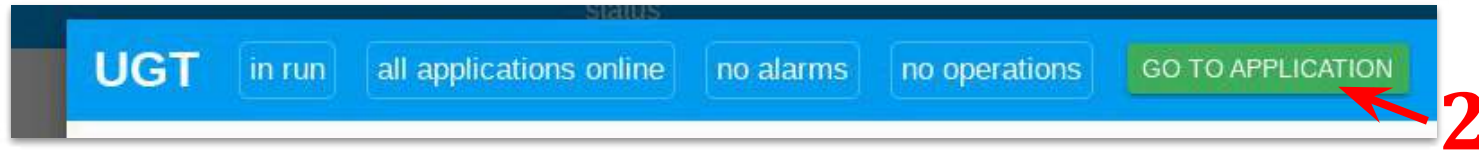
- High deadtime and pre-deadtime L1 Rate < 90 kHz
 - Problem most likely not trigger, but confirm this!
 - Talk to the the shift crew, e.g. DAQ, Shift Leader
- High deadtime and pre-deadtime rate > 100 kHz
 - May have a hot trigger detector, check DQM and indiv. L1 Triggers

How to change the prescale column

Open the uGT Swatch Cell



Note: After (re-)configuration the uGT goes to its default prescale column!
Please check that it is correct before starting a new run.



Choose uGT Prescales 3

4 Refresh table and check Index

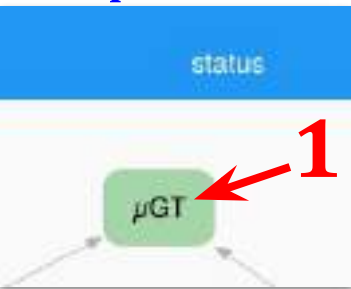
5 Select the correct column from the drop-down menu

6 Click to change prescale Updates after 23 s (one Lumi Section)

App/Prescale-Index	Cosmics (0)	Cosmics + High Random (1)	Cosmics + Medium Random (2)	High BG (3)	High Jets (4)	HighBPTX (5)
0 L1_SingleMuCosmics	1	1	1	1	1	1
1 L1_SingleMuOpen	1	1	1	1	1	1
2 L1_SingleMuCosmics EMTP	1	1	1	1	1	1
3 L1_SingleMuCosmics EMTP	1	1	1	1	1	1
4 L1_SingleMuCosmics EMTP	1	1	1	1	1	1
5 L1_SingleMuCosmics EMTP	1	1	1	1	1	1
6 L1_SingleMuCosmics EMTP	1	1	1	1	1	1
7 L1_SingleMuCosmics EMTP	1	1	1	1	1	1
8 L1_SingleMuCosmics EMTP	1	1	1	1	1	1
9 L1_SingleMuCosmics EMTP	1	1	1	1	1	1
10 L1_SingleMuCosmics EMTP	1	1	1	1	1	1
11 L1_SingleMuCosmics EMTP	1	1	1	1	1	1
12 L1_SingleMuCosmics EMTP	1	1	1	1	1	1
13 L1_SingleMuCosmics EMTP	1	1	1	1	1	1
14 L1_SingleMuCosmics EMTP	1	1	1	1	1	1
15 L1_SingleMuCosmics EMTP	1	1	1	1	1	1
16 L1_SingleMuCosmics EMTP	1	1	1	1	1	1
17 L1_SingleMuCosmics EMTP	1	1	1	1	1	1
18 L1_SingleMuCosmics EMTP	1	1	1	1	1	1
19 L1_SingleMuCosmics EMTP	1	1	1	1	1	1

Preview effect of different prescale column

Open the uGT Swatch Cell



Choose uGT
Preview
Rates 3

A screenshot of the 'uGT SWITCH Cell | Control Panels | uGT Preview Rates' page. The page shows a 'Preview Rates' section with a 'Current Preview Prescale' of 3.2612_grow (1). Below this is a drop-down menu for 'Prescale Prescale Column' with 'Growth_rate' selected. A 'CHANGE PREVIEWPRESCALE' button is also visible. At the bottom is a table with columns: 'name', 'Algorithm', 'Min', 'Prescale (1)', 'Max', 'Current algorithm', and 'Rate (mg/L/h)'. Red arrows and numbered boxes point to specific elements: '4 Check current column' points to the 'Current Preview Prescale' field; '5 Select the correct column from the drop-down menu' points to the 'Prescale Prescale Column' drop-down menu; '6 Click to change prescale Updates after 23 s (one Lumi Section)' points to the 'CHANGE PREVIEWPRESCALE' button.

name	Algorithm	Min	Prescale (1)	Max	Current algorithm	Rate (mg/L/h)
3.2612_grow (1)	3.2612_grow (1)	1.2612	1.2612	1.2612	3.2612	1.2612
3.2612_grow (2)	3.2612_grow (2)	1.2612	1.2612	1.2612	3.2612	1.2612
3.2612_grow (3)	3.2612_grow (3)	1.2612	1.2612	1.2612	3.2612	1.2612
3.2612_grow (4)	3.2612_grow (4)	1.2612	1.2612	1.2612	3.2612	1.2612
3.2612_grow (5)	3.2612_grow (5)	1.2612	1.2612	1.2612	3.2612	1.2612
3.2612_grow (6)	3.2612_grow (6)	1.2612	1.2612	1.2612	3.2612	1.2612
3.2612_grow (7)	3.2612_grow (7)	1.2612	1.2612	1.2612	3.2612	1.2612
3.2612_grow (8)	3.2612_grow (8)	1.2612	1.2612	1.2612	3.2612	1.2612
3.2612_grow (9)	3.2612_grow (9)	1.2612	1.2612	1.2612	3.2612	1.2612
3.2612_grow (10)	3.2612_grow (10)	1.2612	1.2612	1.2612	3.2612	1.2612
3.2612_grow (11)	3.2612_grow (11)	1.2612	1.2612	1.2612	3.2612	1.2612
3.2612_grow (12)	3.2612_grow (12)	1.2612	1.2612	1.2612	3.2612	1.2612
3.2612_grow (13)	3.2612_grow (13)	1.2612	1.2612	1.2612	3.2612	1.2612
3.2612_grow (14)	3.2612_grow (14)	1.2612	1.2612	1.2612	3.2612	1.2612
3.2612_grow (15)	3.2612_grow (15)	1.2612	1.2612	1.2612	3.2612	1.2612
3.2612_grow (16)	3.2612_grow (16)	1.2612	1.2612	1.2612	3.2612	1.2612
3.2612_grow (17)	3.2612_grow (17)	1.2612	1.2612	1.2612	3.2612	1.2612
3.2612_grow (18)	3.2612_grow (18)	1.2612	1.2612	1.2612	3.2612	1.2612
3.2612_grow (19)	3.2612_grow (19)	1.2612	1.2612	1.2612	3.2612	1.2612
3.2612_grow (20)	3.2612_grow (20)	1.2612	1.2612	1.2612	3.2612	1.2612
3.2612_grow (21)	3.2612_grow (21)	1.2612	1.2612	1.2612	3.2612	1.2612
3.2612_grow (22)	3.2612_grow (22)	1.2612	1.2612	1.2612	3.2612	1.2612
3.2612_grow (23)	3.2612_grow (23)	1.2612	1.2612	1.2612	3.2612	1.2612
3.2612_grow (24)	3.2612_grow (24)	1.2612	1.2612	1.2612	3.2612	1.2612
3.2612_grow (25)	3.2612_grow (25)	1.2612	1.2612	1.2612	3.2612	1.2612
3.2612_grow (26)	3.2612_grow (26)	1.2612	1.2612	1.2612	3.2612	1.2612
3.2612_grow (27)	3.2612_grow (27)	1.2612	1.2612	1.2612	3.2612	1.2612
3.2612_grow (28)	3.2612_grow (28)	1.2612	1.2612	1.2612	3.2612	1.2612
3.2612_grow (29)	3.2612_grow (29)	1.2612	1.2612	1.2612	3.2612	1.2612
3.2612_grow (30)	3.2612_grow (30)	1.2612	1.2612	1.2612	3.2612	1.2612
3.2612_grow (31)	3.2612_grow (31)	1.2612	1.2612	1.2612	3.2612	1.2612
3.2612_grow (32)	3.2612_grow (32)	1.2612	1.2612	1.2612	3.2612	1.2612
3.2612_grow (33)	3.2612_grow (33)	1.2612	1.2612	1.2612	3.2612	1.2612
3.2612_grow (34)	3.2612_grow (34)	1.2612	1.2612	1.2612	3.2612	1.2612
3.2612_grow (35)	3.2612_grow (35)	1.2612	1.2612	1.2612	3.2612	1.2612
3.2612_grow (36)	3.2612_grow (36)	1.2612	1.2612	1.2612	3.2612	1.2612
3.2612_grow (37)	3.2612_grow (37)	1.2612	1.2612	1.2612	3.2612	1.2612
3.2612_grow (38)	3.2612_grow (38)	1.2612	1.2612	1.2612	3.2612	1.2612
3.2612_grow (39)	3.2612_grow (39)	1.2612	1.2612	1.2612	3.2612	1.2612
3.2612_grow (40)	3.2612_grow (40)	1.2612	1.2612	1.2612	3.2612	1.2612
3.2612_grow (41)	3.2612_grow (41)	1.2612	1.2612	1.2612	3.2612	1.2612
3.2612_grow (42)	3.2612_grow (42)	1.2612	1.2612	1.2612	3.2612	1.2612
3.2612_grow (43)	3.2612_grow (43)	1.2612	1.2612	1.2612	3.2612	1.2612
3.2612_grow (44)	3.2612_grow (44)	1.2612	1.2612	1.2612	3.2612	1.2612
3.2612_grow (45)	3.2612_grow (45)	1.2612	1.2612	1.2612	3.2612	1.2612
3.2612_grow (46)	3.2612_grow (46)	1.2612	1.2612	1.2612	3.2612	1.2612
3.2612_grow (47)	3.2612_grow (47)	1.2612	1.2612	1.2612	3.2612	1.2612
3.2612_grow (48)	3.2612_grow (48)	1.2612	1.2612	1.2612	3.2612	1.2612
3.2612_grow (49)	3.2612_grow (49)	1.2612	1.2612	1.2612	3.2612	1.2612
3.2612_grow (50)	3.2612_grow (50)	1.2612	1.2612	1.2612	3.2612	1.2612