Calo Layer-1 Online Software

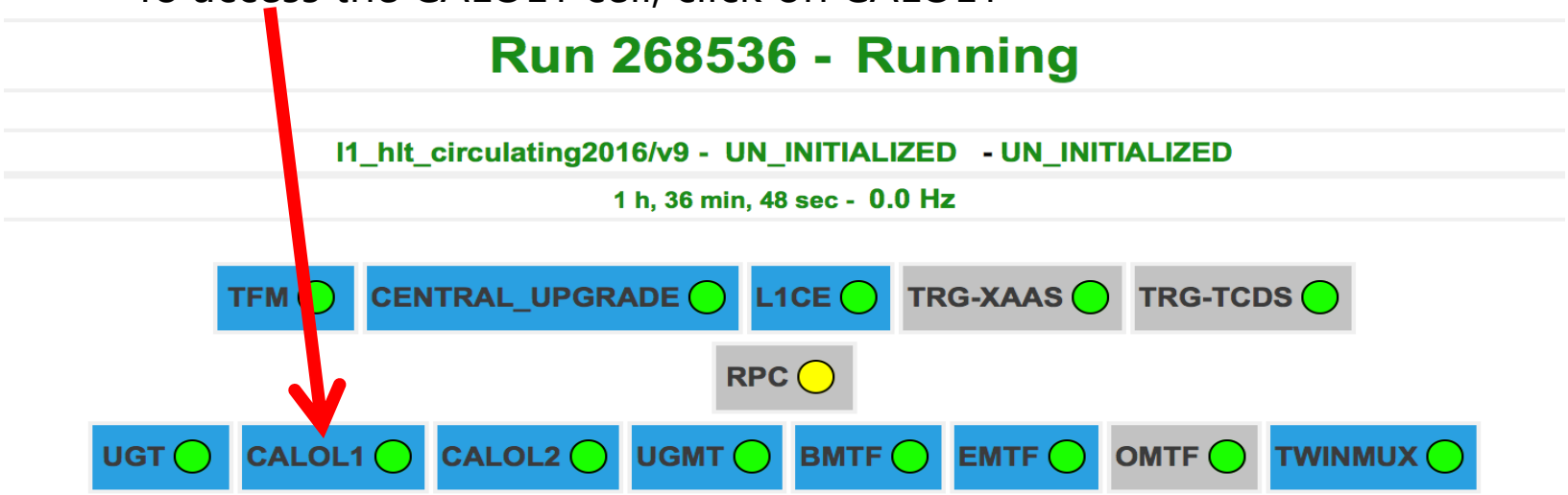
Nate Woods, Tyler Ruggles

University of Wisconsin—Madison

CaloL1 SWATCH Cell

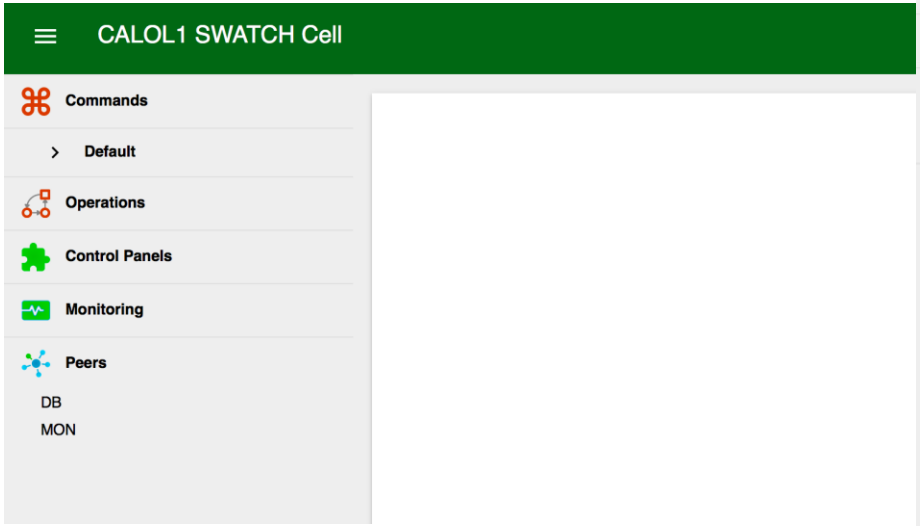
CaloL1 and Online SW

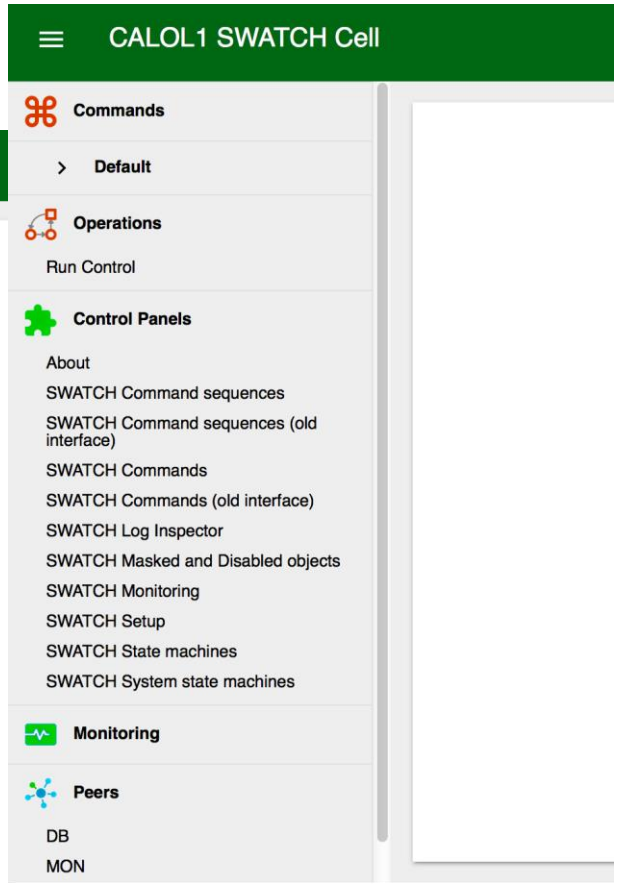
- Make sure you have a tunnel set up to access .cms pages
  - See RCT Twiki: https://twiki.cern.ch/twiki/bin/view/CMS/RCTOps#Accessing_Online_Cluster_Webpage
- The L1 Page (http://l1page.cms/main/FirstPage) shows an overview of the status of the CALOL1 swatch cell
  - Blue rectangle: in global, gray rectangle: in local
  - To access the CALOL1 cell, click on CALOL1



CaloL1 swatch cell

- When the swatch cell initially loads on your browser it will usually appear unhelpful

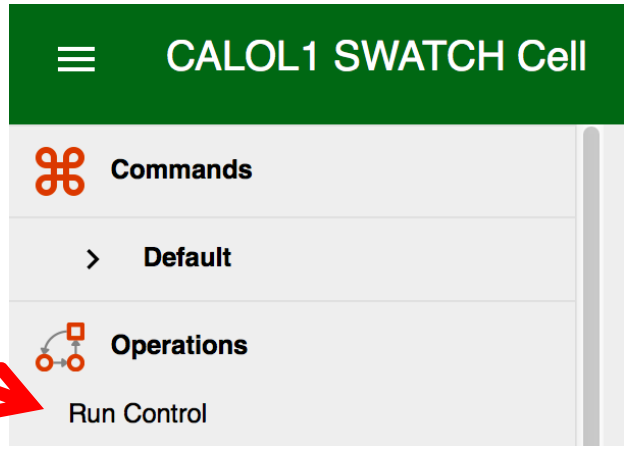


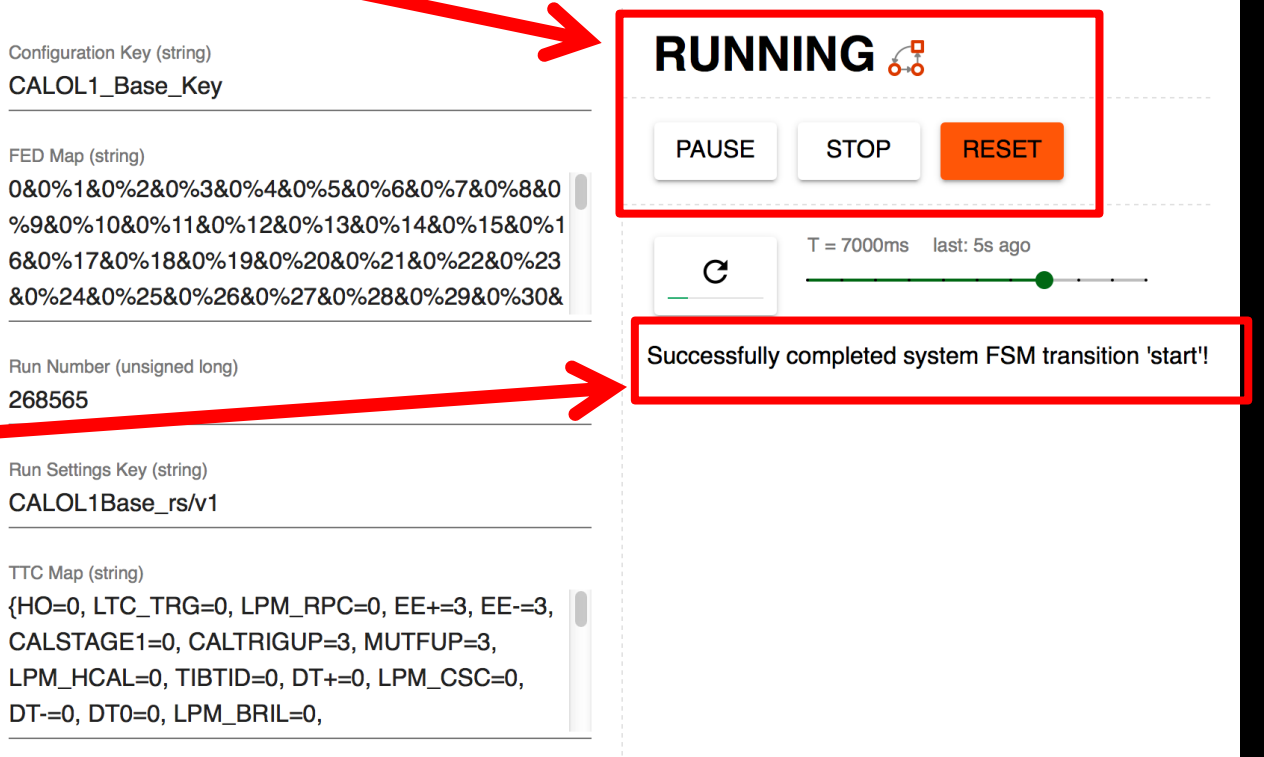


- By clicking the left bar, options will appear to monitor the stats of the cell or change configurations
  - Operations → Run Control
  - Control Panels → Host of selections

Operations/Run Control

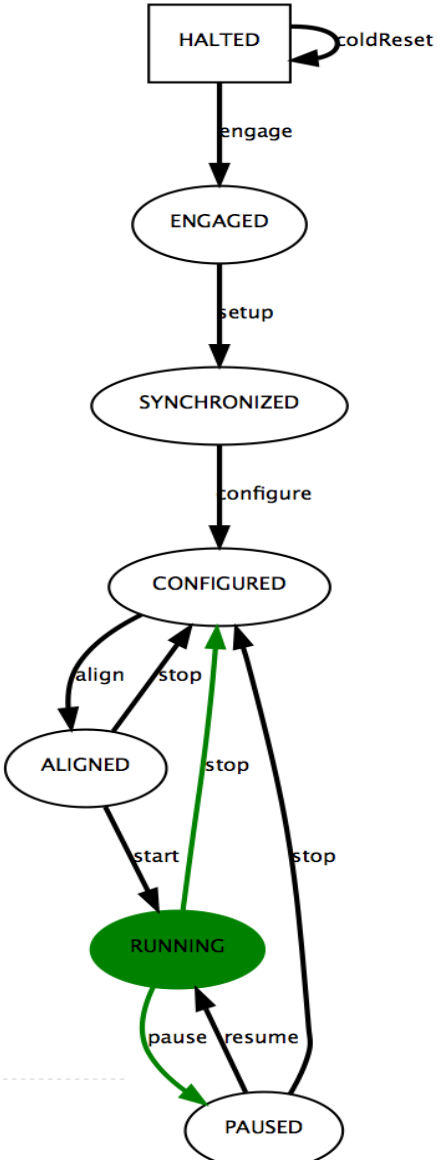
- **Click Operations → Run Control**
- **Run Control displays current config.**
  - **Bold** shows current State of the cell along with available Transitions that can be executed from that State
  - Any error messages (or success notifications) from the previous transition will be printed below

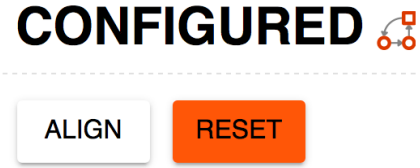




CaloL1 States / Transitions

- The CaloL1 swatch cell is always in a defined State or making a transitions from 1 defined State to another State
- See the schematic to the right for a diagram of:
  - States in ovals / rectangles
  - Transitions as arrows connecting various States
- Click flow chart button next to state to see this diagram

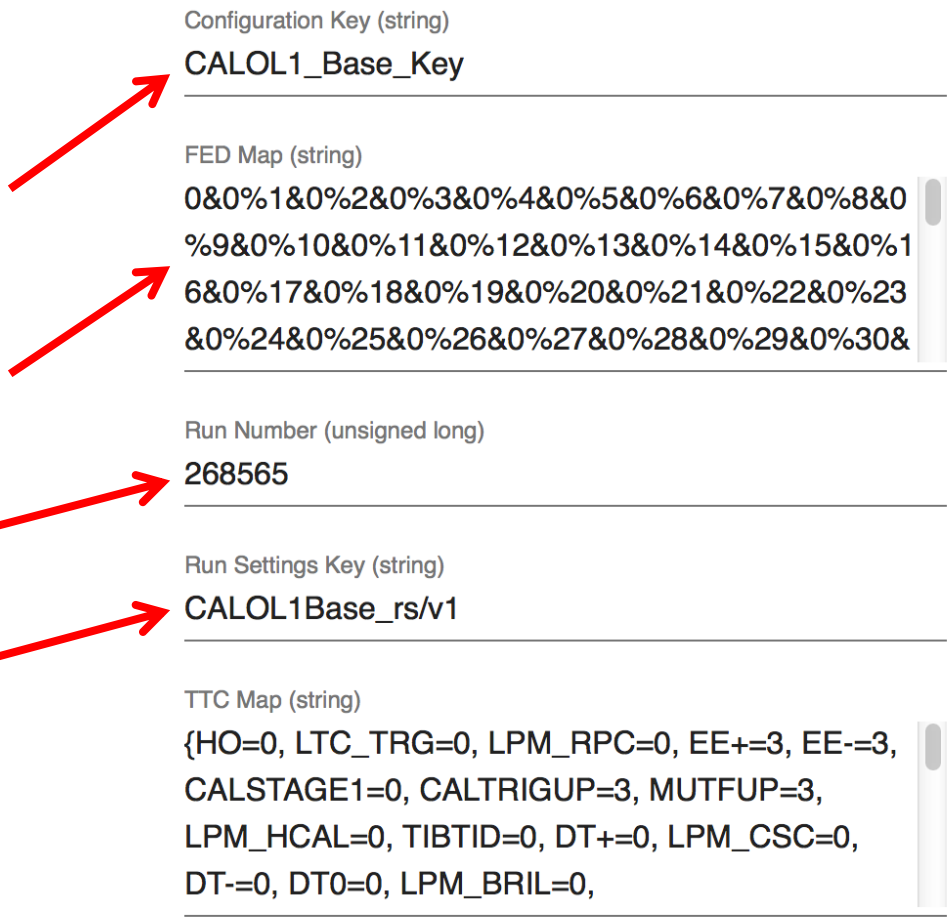




Operations/Run Control

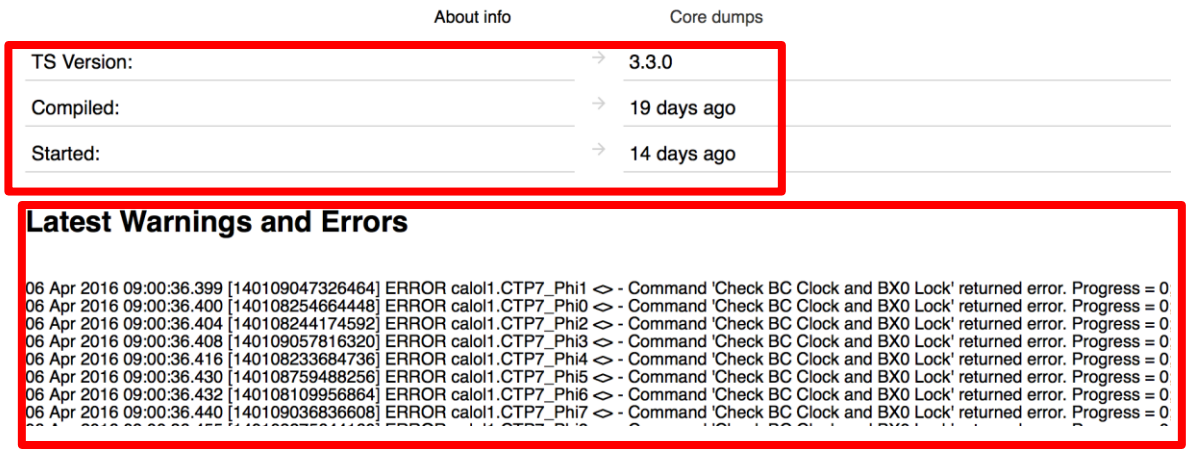
The settings use for the current run are displayed here:

- Configuration Key (more in DB section)
- The FED Map representing the included/excluded subsystems and their components
- Current run Number
- Run Settings Key (this is associated with link and tower masking, more later)



Control Panels: About

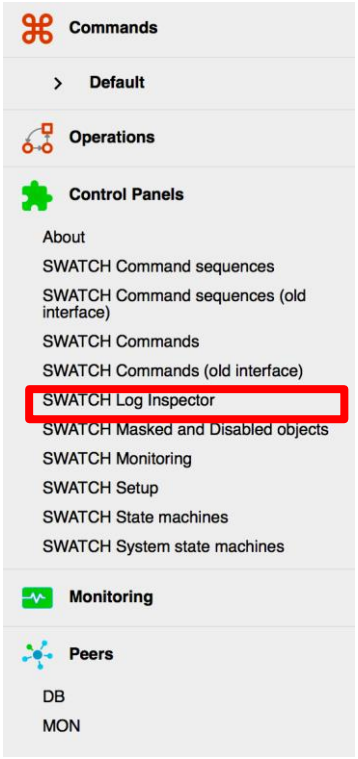
- **The most helpful areas for checking the status of our system and debugging potential issues are in the Control Panels left bar**
  - "About"
    - Displays version of Trigger Supervisor on upgrade PC
    - Shows date that CaloL1 code was compiled
    - Shows data the cell was most recently started

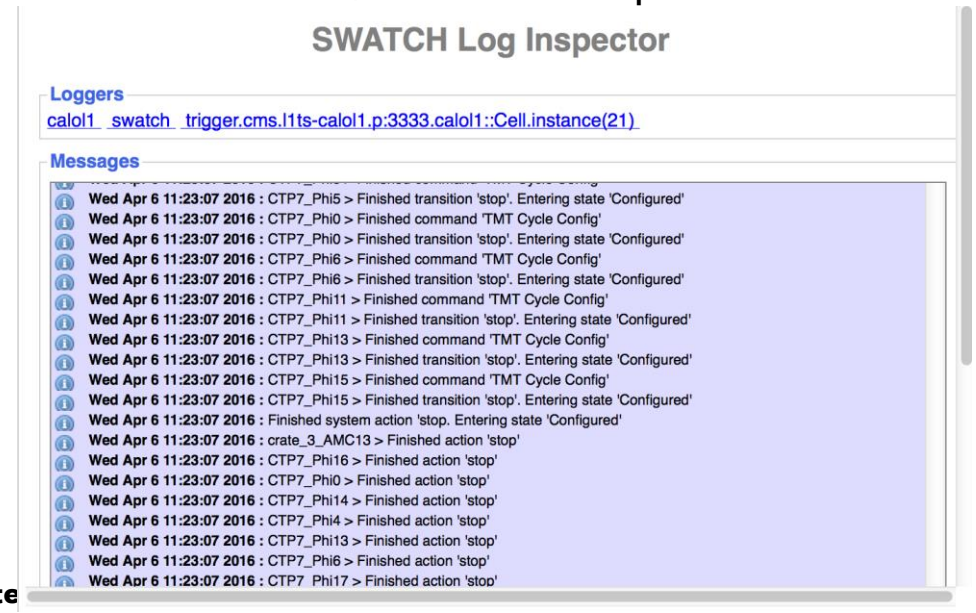


- Also displayed are the latest warnings / errors

Control Panels: Log Inspector

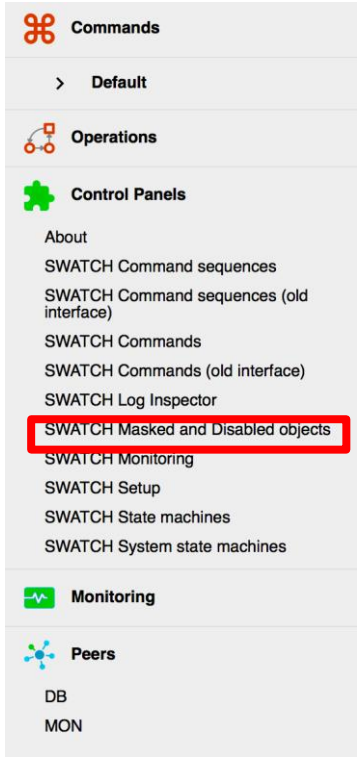
- **The most helpful areas for checking the status of our system and debugging potential issues are in the Control Panels left bar**
  - "Log Inspector"
    - Toggle between different Loggers: CaloL1, swatch, and webpage
    - Much more detailed information than the return statements in the Run Control area, details on a per command basis

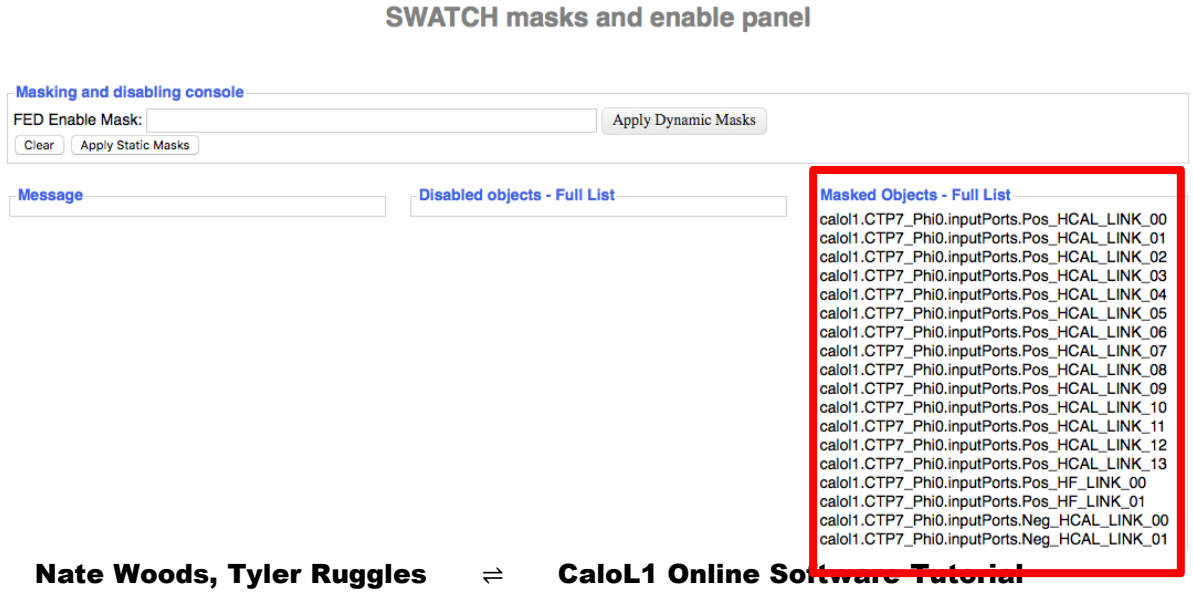




Control Panels: Masked and Disabled

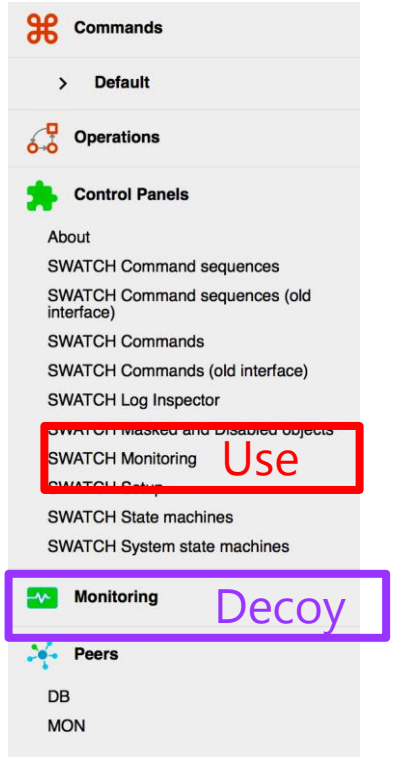
- **The most helpful areas for checking the status of our system and debugging potential issues are in the Control Panels left bar**
  - "Masked and Disabled Objects"
    - In this current run, HCAL and HF are all excluded, that could be seen by scrolling through the "Masked Objects – Full List"
    - **This is not where we do link or tower masking!**

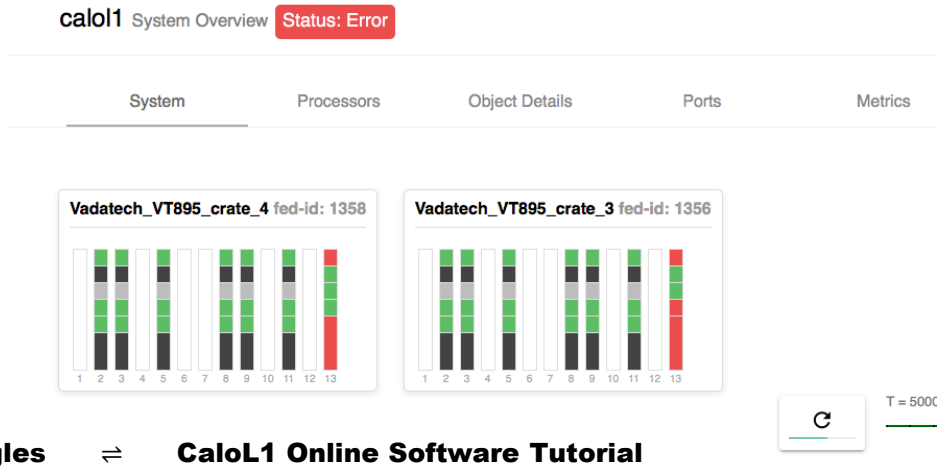




Control Panels: Monitoring

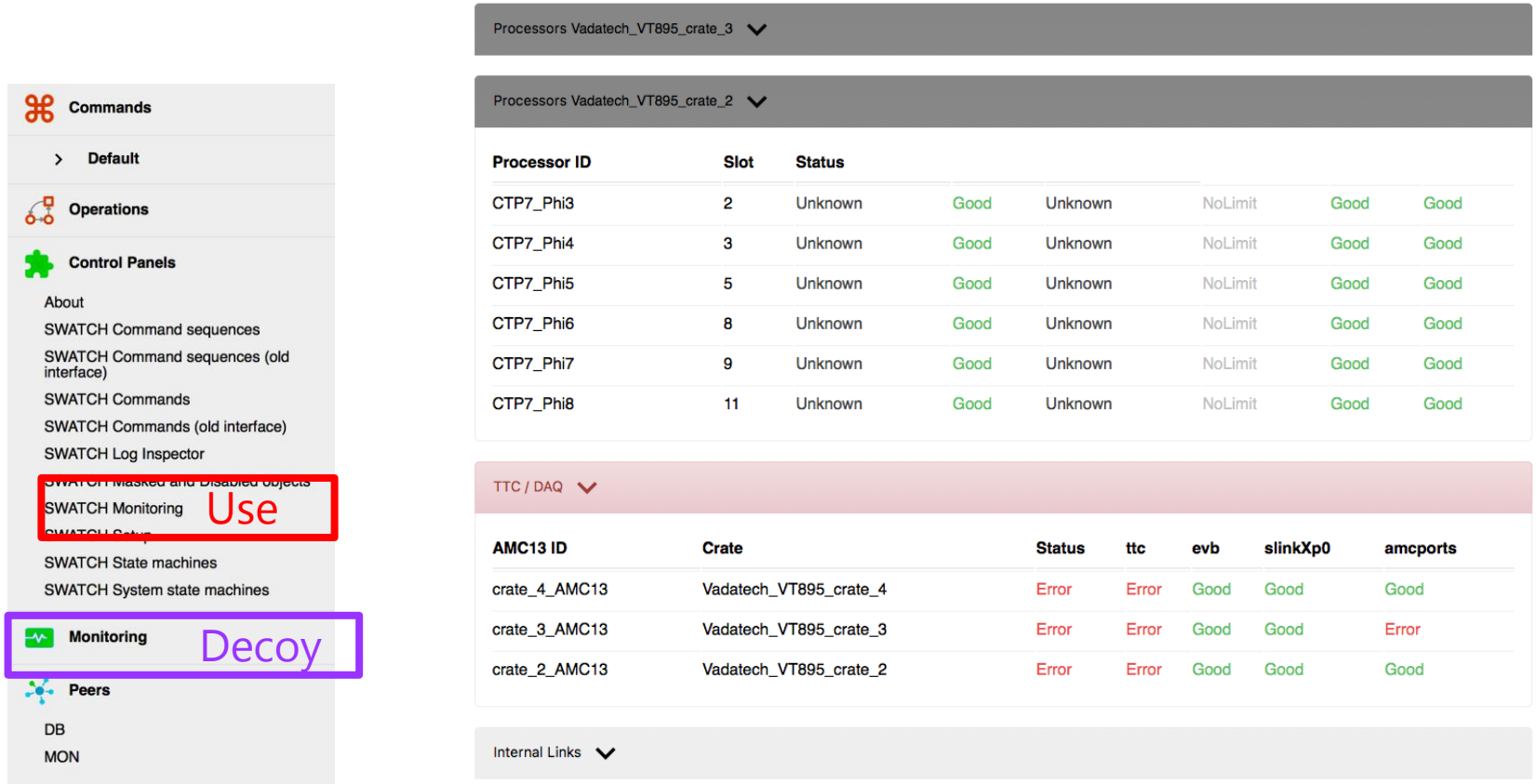
- **The most helpful areas for checking the status of our system and debugging potential issues are in the Control Panels left bar**
  - "Monitoring"
    - Monitoring provides a range of views of the system
    - Default view is broken down by crate showing 6 CTP7s per crate in their associated hardware slot along with the crate's AMC13
      - For detailed information on each and the associated color coding you can scroll down…





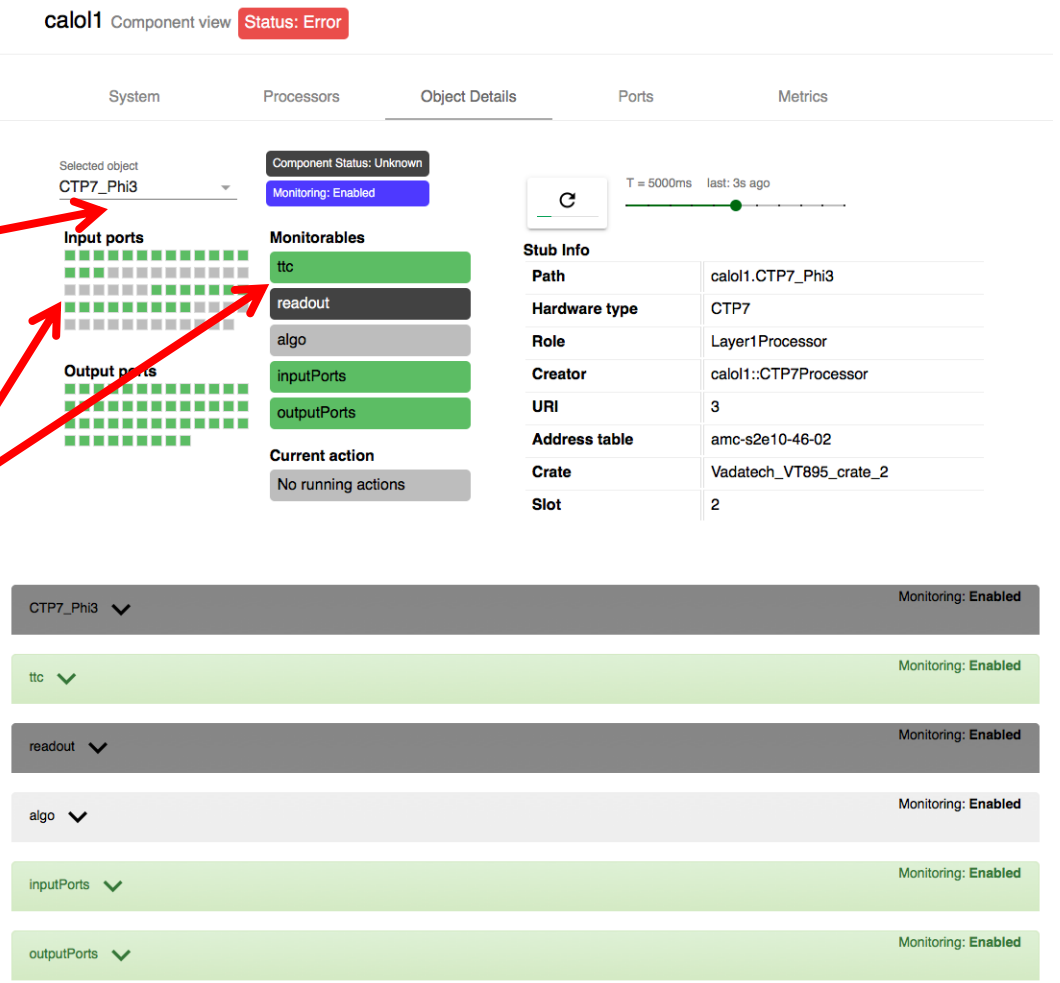
Control Panels: Monitoring

- Detailed Crate View and per-card summary seen by scrolling down from default view and expanding on of the "Processor Vadatech_VT895_crate_X" crates by clicking on it



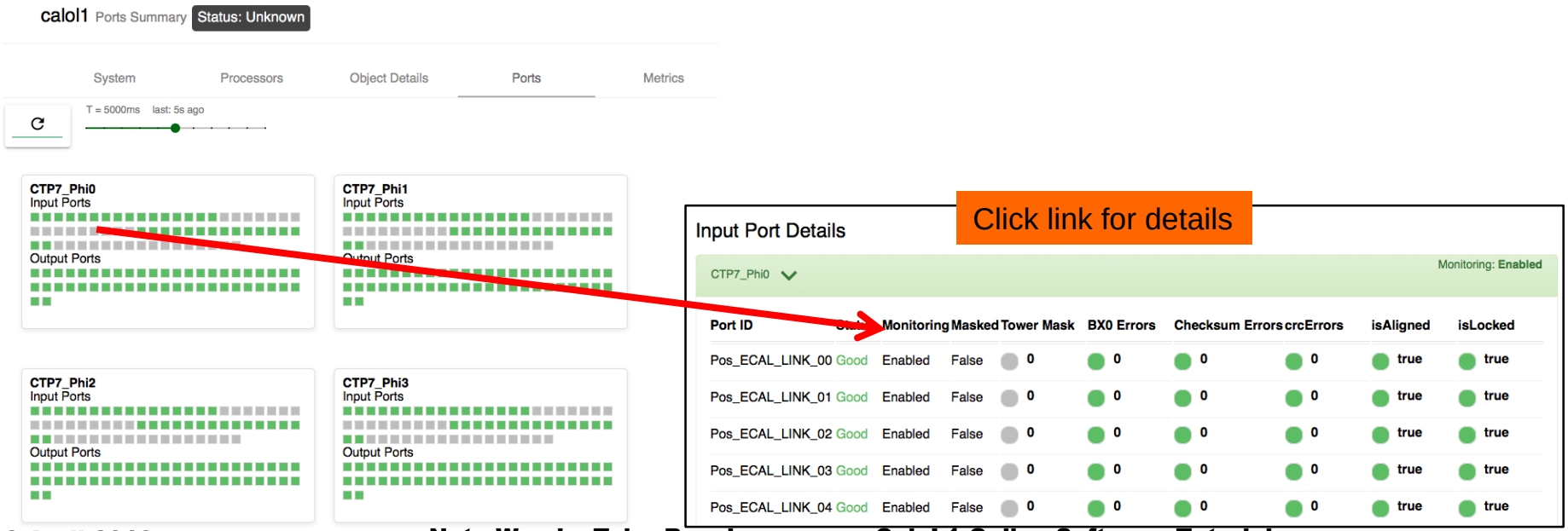
Control Panels: Monitoring

- For a detailed Processor view, click "Object Details" along the top, and select the processor of interest from the drop down
- Clicking any link (represented as a square under Input/Output Ports) or title under "Monitorables" will being you to a more detailed view of that object



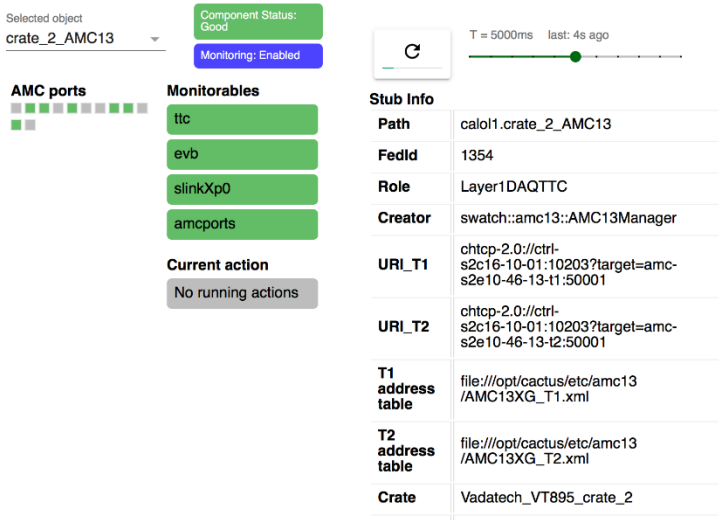
Control Panels: Monitoring

- "Ports"
  - A scrollable display of all of our input ports can be easily seen by click Ports
  - The view is broken down by CTP7 iPhi region
  - Again, clicking on any port (box) will take you to a detailed view of the associated metrics with that link



Control Panels: Monitoring

- **Object Details → AMC13 details**
- **Some important details can be found here:**
  - Is the CaloL1 system experiencing back pressure from other systems?
  - Error counters for TTC related metrics
    - Some error conditions are not well chosen for CaloL1. In particular, a handful of bc0Errors isn't worrying



ttc — Monitoring: **Enabled**

Metric ID	Value	Last updated (UTC)	Monitoring	Error Condition	Warning Condition
resyncCount	**1090519040**	2016-04-08 08:00:46	Enabled	N/A	N/A
ttcDoubleBitErrors	**0**	2016-04-08 08:00:46	Enabled	> 0	N/A
ttcSingleBitErrors	**0**	2016-04-08 08:00:46	Enabled	> 0	N/A
bc0Errors	**0**	2016-04-08 08:00:46	Enabled	> 0	N/A
bc0Counter	**61296**	2016-04-08 08:00:46	Enabled	N/A	N/A
clkFreq	**40079000**	2016-04-08 08:00:46	Enabled	< 3.99e+07 or > 4.01e+07	N/A

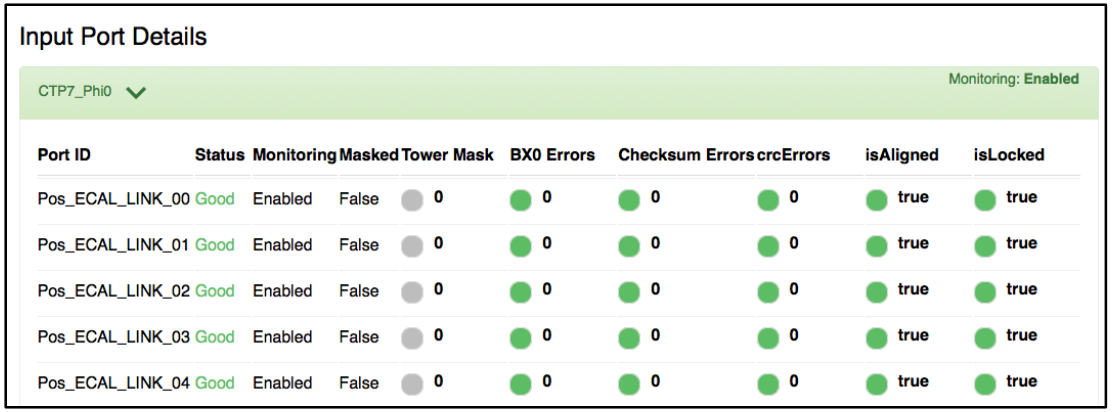
slinkXp0 — Monitoring: **Enabled**

Metric ID	Value	Last updated (UTC)	Monitoring	Error Condition	Warning Condition
packetsSent	**0**	2016-04-08 08:01:47	Enabled	N/A	N/A
words	**0**	2016-04-08 08:01:47	Enabled	N/A	N/A
eventsSent	**0**	2016-04-08 08:01:47	Enabled	N/A	N/A
wordsSent	**0**	2016-04-08 08:01:47	Enabled	N/A	N/A
events	**0**	2016-04-08 08:01:47	Enabled	N/A	N/A
backPressureTime	**0**	2016-04-08 08:01:47	Enabled	N/A	N/A
linkUp	**true**	2016-04-08 08:01:47	Enabled	N/A	== 0
packetsReceived	**1**	2016-04-08 08:01:47	Enabled	N/A	N/A
initialized	**true**	2016-04-08 08:01:47	Enabled	== 0	N/A
backPressure	**false**	2016-04-08 08:01:47	Enabled	N/A	== 1
revision	**1578106881**	2016-04-08 08:01:47	Enabled	N/A	N/A

Control Panels: Input Port Details

Input Port Details is where we will do the majority of our diagnosing

- Tower Mask: hex number specifying which towers are masked (more later)
- BX0 Errors: Number of mismatches between bunch crossing zero signal received on the link, and that propagated by TTC (40 MHz)
- Checksum Errors: number of times the link received the wrong information
- crc Errors: ignore for now
- isAligned: did the link align initially?
- isLocked: is the link currently locked and in sync?
- Everything should always be green.
- O(a few) Checksum/BX0 errors will not cause an alarm
  - "warning" at 1000
  - "error" at 5000



Run Settings and Masking

SWATCH Database

- **Configuration parameters, run settings, and masks are set in the online database**
- **Keys select one or more modules specifying parameters**
- **Modules are stored as xml files**
  - To change a parameter or mask, download the xml file, edit it, upload it as a new module, and make a new key
  - … and tell the L1DOC to use your new key
  - … and put it on this TWiki
- **Make changes via the Level 1 Configuration Editor (L1CE)**
  - From L1 Page, click DataBase→L1 Configuration Editor
- **Hardware is described in a JSON format (hopefully will never change)**

Tables (types of keys/modules)

- **CALOL1_RS**
  - Run settings, including masks
- **CALOL1_RS_KEYS**
  - Keys that specify which CALOL1_RS files to use
- **CALOL1_ALGO**
  - Not currently used. Will eventually contain LUTs
- **CALOL1_HW**
  - Hardware description (JSON)
- **CALOL1_INFRA**
  - Configuration parameters that should be transferred offline
- **CALOL1_KEYS**
  - Specify ALGO, HW, and INFRA files to use

Parameter XML Example

```
<infra id="calol1">
  <context id="processors">
       <param id="alignBX" type="uint">54</param>
       <param id="alignSubBX" type="uint">4</param>
       <param id="DAQDelayLineDepth" type="uint">435</param>
       <param id="tmtCycleConfig" type="uint">0</param>
       <param id="exampleVector" type="vector:uint">0, 1, 2</param>
  </context>
  <context id="daqttcs">
    <param id="bcnOffset" type="uint">3433</param>
    <param id="slinkMask" type="uint">1</param>
    <param id="localTTC" type="bool">false</param>
    <param id="ocrCmd" type="uint">8</param>
    <param id="resyncCmd" type="uint">4</param>
  </context>
</infra>
```

Parameter XML Example

```
<infra id="calol1">
  <context id="processors">
      <param id="alignBX" type="uint">54</param>
      <param id="alignSubBX" type="uint">4</param>
      <param id="DAQDelayLineDepth" type="uint">435</param>
      <param id="tmtCycleConfig" type="uint">0</param>
      <param id="exampleVector" type="vector:uint">0, 1, 2</param>
  </context>
  <context id="daqttcs">
    <param id="bcnOffset" type="uint">3433</param>
    <param id="slinkMask" type="uint">1</param>
    <param id="localTTC" type="bool">false</param>
    <param id="ocrCmd" type="uint">8</param>
    <param id="resyncCmd" type="uint">4</param>
  </context>
</infra>
```

Type of module: **infra**, **algo**, or **run-settings**

id: name of system ("**calol1**")

Parameter XML Example

```
<infra id="calol1">
  <context id="processors">
      <param id="runNumber" type="uint">999999</param>
      <param id="alignBX" type="uint">54</p
      <param id="alignSubBX" type="uint">4<
      <param id="DAQDelayLineDepth" type="u
      <param id="tmtCycleConfig" type="uint
  </context>
  <context id="daqttcs">
    <param id="bcnOffset" type="uint">3433</
    <param id="slinkMask" type="uint">1</par
    <param id="localTTC" type="bool">false</
    <param id="ocrCmd" type="uint">8</param>
    <param id="resyncCmd" type="uint">4</param>
  </context>
</infra>
```

Context id: which objects this applies to

- "**processors**" for all CTP7s
- "**daqttcs**" for all AMC13s
- Specify individual processors by name, e.g. "**CTP7_Phi2**" for the CTP7 at RCTPhi=2 or "**crate_3_AMC13**" for the AMC13 in crate 3

Parameter XML Example

```
<infra id="calol1">
  <context id="processors">
      <param id="alignBX" type="uint">54</param>
      <param id="alignSubBX" type="uint">4</param>
      <param id="eDepth" type="uint">435</param>
      <param id="fig" type="uint">0</param>
      <param id="exampleVector" type="vector:uint">0, 1, 2</param>
  </context>
  <context id="daqttcs">
    <param id="bcnOffset" type="uint">3433</param>
    <param id="slinkMask" type="uint">1</param>
    <param id="localTTC" type="bool">fals
    <param id="ocrCmd" type="uint">8</par
    <param id="resyncCmd" type="uint">4</
  </context>
</infra>
```

Parameter id: name of parameter

Type: may be "int", "uint", "bool", "float", or "string"

A vector of any other type is specified "vector:type", and its values are comma-separated

Parameter Miscellany

- LUTs use the table type, detailed here
- If multiple commands have parameters with the same name, they can be differentiated with the "cmd" subtag
  - <param id="varName" cmd="commandName" type=…>
- Each XML can only have one module, but can have multiple contexts
- Full XML file documentation here

Link Masking

- Link masks are specified in XML modules similar to the parameter files
- Specify which CTP7 via the context, and the individual link by name (example on next slide)
- If you forget the syntax, the base link mask module CALOL1_RS/StaticLinkMask has several examples as comments
- Masking a link zeros its TPs, disables its monitoring, and allows the trigger to configure even though it's bad
- The error message in the CaloL1 cell (also sent to DAQ) says exactly which link(s) failed

Link Mask XML Example

```
<run-settings id="calol1">
  <context id="CTP7_Phi0">
    <mask id="inputPorts.Pos_ECAL_LINK_10" />
  </context>
  <context id="CTP7_Phi7">
    <mask id="inputPorts.Neg_HCAL_LINK_11" />
    <mask id="inputPorts.Neg_HF_LINK_00" />
  </context>
</run-settings>
```

Link Mask XML Example

```
<run-settings id="calol1">
  <context id="CTP7_Phi0">
    <mask id="inputPorts.Pos_ECAL_LINK_10" />
  </context>
  <context id="CTP7_Phi7">
    <mask id="inputPorts.Neg_HCAL_LINK_11" />
    <mask id="inputPorts.Neg_HF_LINK_00" />
  </context>
</run-settings>
```

Masks are always **run-settings** modules

CTP7(s) specified as in parameter files

Link Mask XML Example

```
<run-settings id="calol1">
  <context id="CTP7_Phi0">
    <mask id="inputPorts.Pos_ECAL_LINK_10" />
  </context>
  <context id="CTP7_Phi7">
    <mask id="inputPorts.Neg_HCAL_LINK_11" />
    <mask id="inputPorts.Neg_HF_LINK_00" />
  </context>
</run-settings>
```

"inputPorts" specifies the type of object to mask (input link)

Positive or negative eta

Which calorimeter ("ECAL", "HCAL", or "HF")

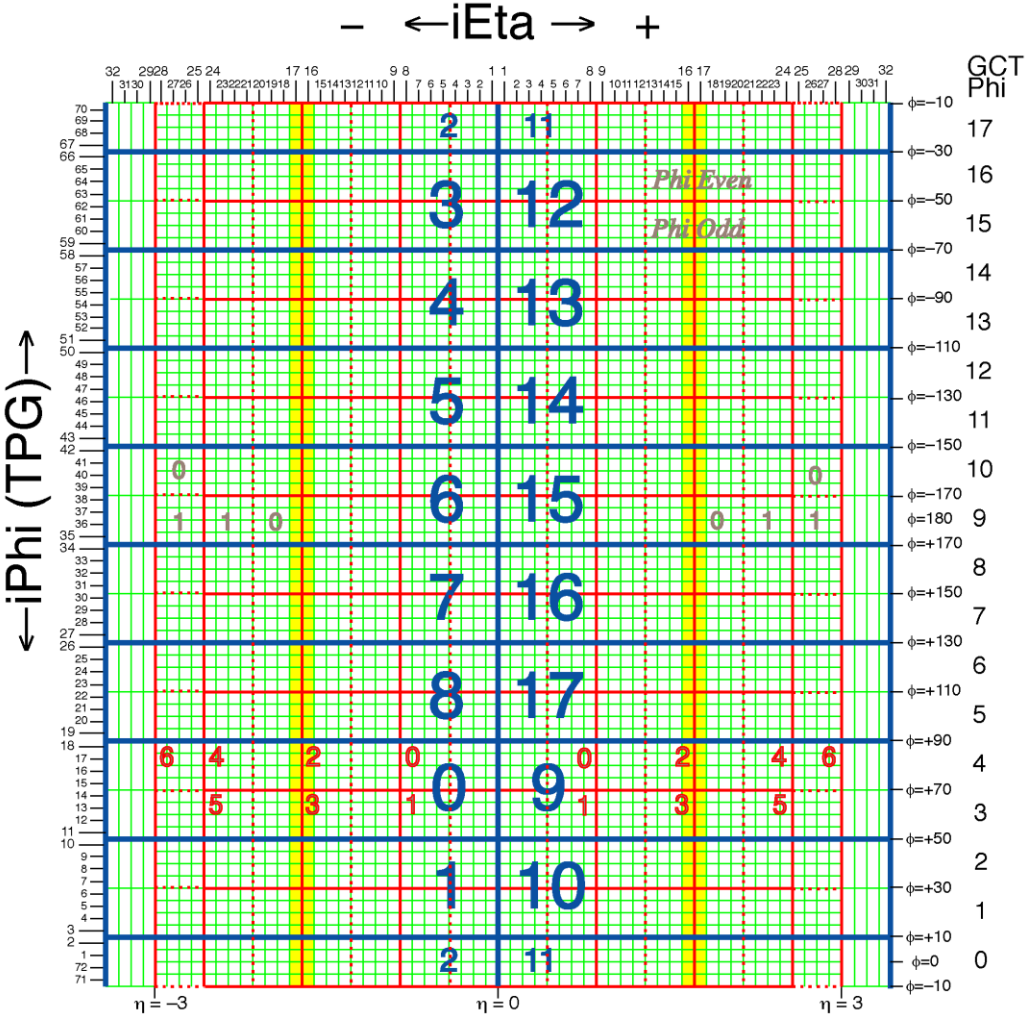
Specific link
ECAL: 00-15
HCAL: 00-13
HF: 00-01
Note leading 0!

Tower Masking

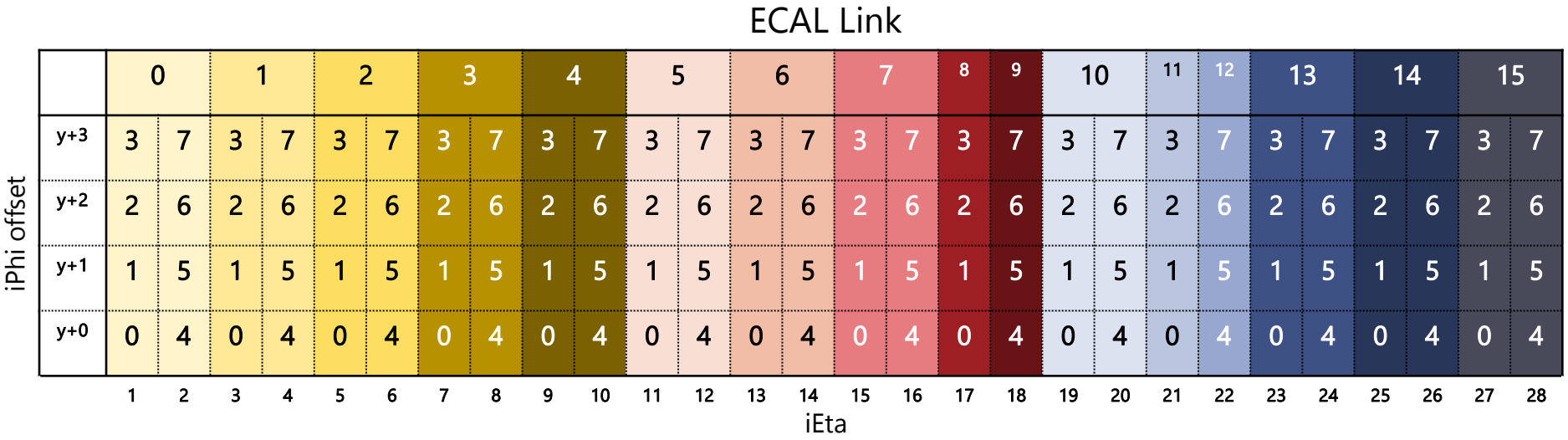
- **Maybe some day SWATCH will have a unified system for tower masking. Until then, masks are passed as parameters**
- **Each link's mask is an 8-bit (ECAL/HCAL) or 11-bit (HF) number where each bit is one tower**
  - … except for ECAL links 8, 9, 11, and 12, which cover only 4
- **Overall mask for a CTP7 is two vectors of 32 unsigned ints**
  - One for +eta, one for –eta
  - 16 ECAL links, then 14 HCAL links, then 2 HF links
- **Reminder: calo tower map here**

Reminder: Calo Tower Map

- CTP7 specified by "GCT Phi"
- Tower specified by iEta (plus or minus), iPhi
- Ignore blue, red, and gray numbers

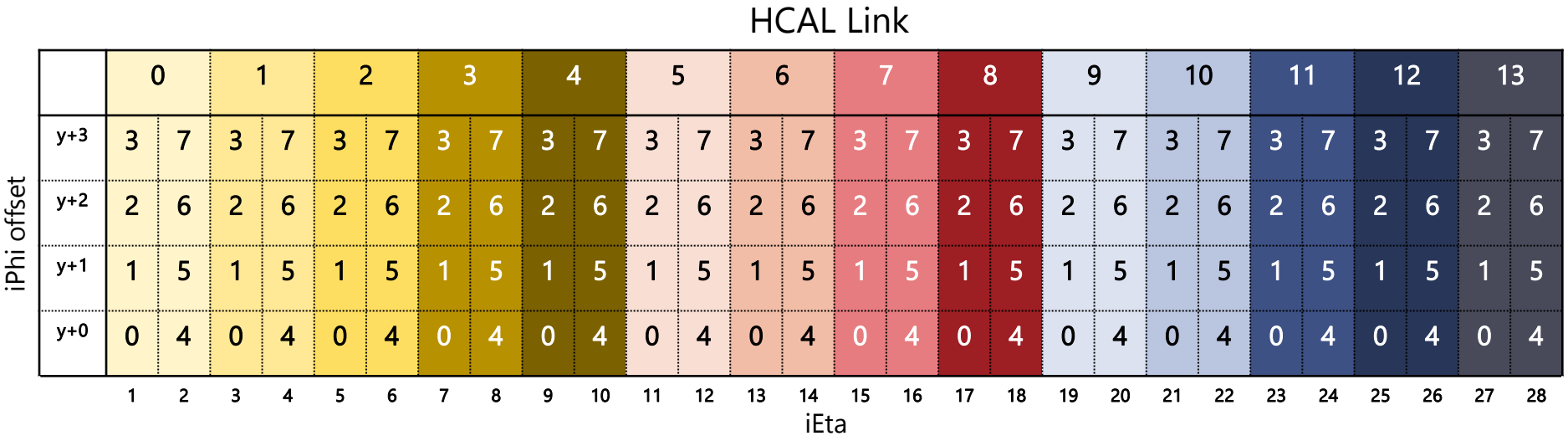


ECAL Link/Tower Mapping



Note pairs of 4-tower links
Links 9 and 13 still use towers 4-7

HCAL Link/Tower Mapping

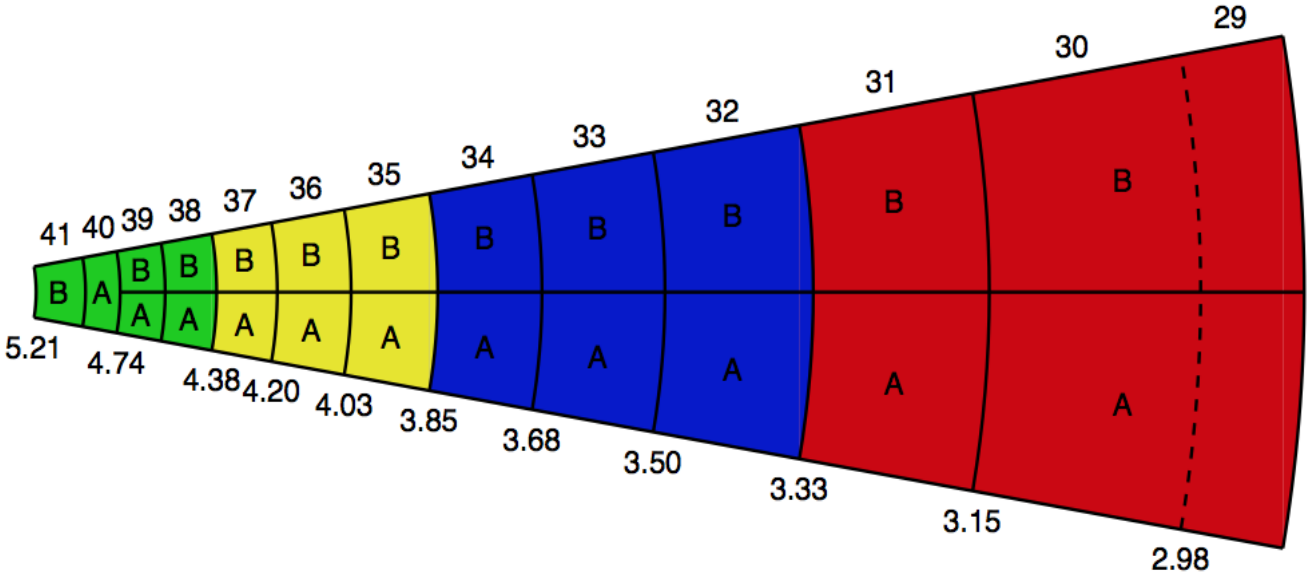


HCAL links are the 16th-29th items in the vector of tower masks
So HCAL link 7 is vector entry 23

HF Link/Tower Mapping

- **30th and 31st entries in vector**
  - Link 0 (30): A, link 1 (21): B
- **11 bits each**

Bit	iEta
0	30
1	31
2	32
3	33
4	34
5	35
6	36
7	37
8	38
9	39
10	40(A)/41(B)



Tower Mask XML Example 1

- Beam splash mask with all towers masked except iEta=±1

```
<run-settings id="calol1">
  <context id="processors">
    <param id="towerMaskPosEta" type="vector:uint">0xF0,
0xFF, 0xFF, 0xFF, 0xFF, 0xFF, 0xFF, 0xFF, 0xFF, 0xFF,
0xFF, 0xFF, 0xFF, 0xFF, 0xFF, 0xFF, 0xFF, 0xFF, 0xFF,
0xFF, 0xFF, 0xFF, 0xFF, 0xFF, 0xFF, 0xFF, 0xFF, 0xFF,
0xFF, 0xFF, 0x7FF, 0x7FF</param>
    <param id="towerMaskNegEta" type="vector:uint">0xF0,
0xFF, 0xFF, 0xFF, 0xFF, 0xFF, 0xFF, 0xFF, 0xFF, 0xFF,
0xFF, 0xFF, 0xFF, 0xFF, 0xFF, 0xFF, 0xFF, 0xFF, 0xFF,
0xFF, 0xFF, 0xFF, 0xFF, 0xFF, 0xFF, 0xFF, 0xFF, 0xFF,
0xFF, 0xFF, 0x7FF, 0x7FF</param>
  </context>
</run-settings>
```

Tower Mask XML Example 2

- Mask ECAL tower at iEta=-12, iPhi=53

```
<run-settings id="calol1">
  <context id="CTP7_Phi13">
    <param id="towerMaskPosEta" type="vector:uint">0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x000, 0x000</param>
    <param id="towerMaskNegEta" type="vector:uint">0x00,
0x00, 0x00, 0x00, 0x00, 0x40, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x000, 0x000</param>
  </context>
</run-settings>
```

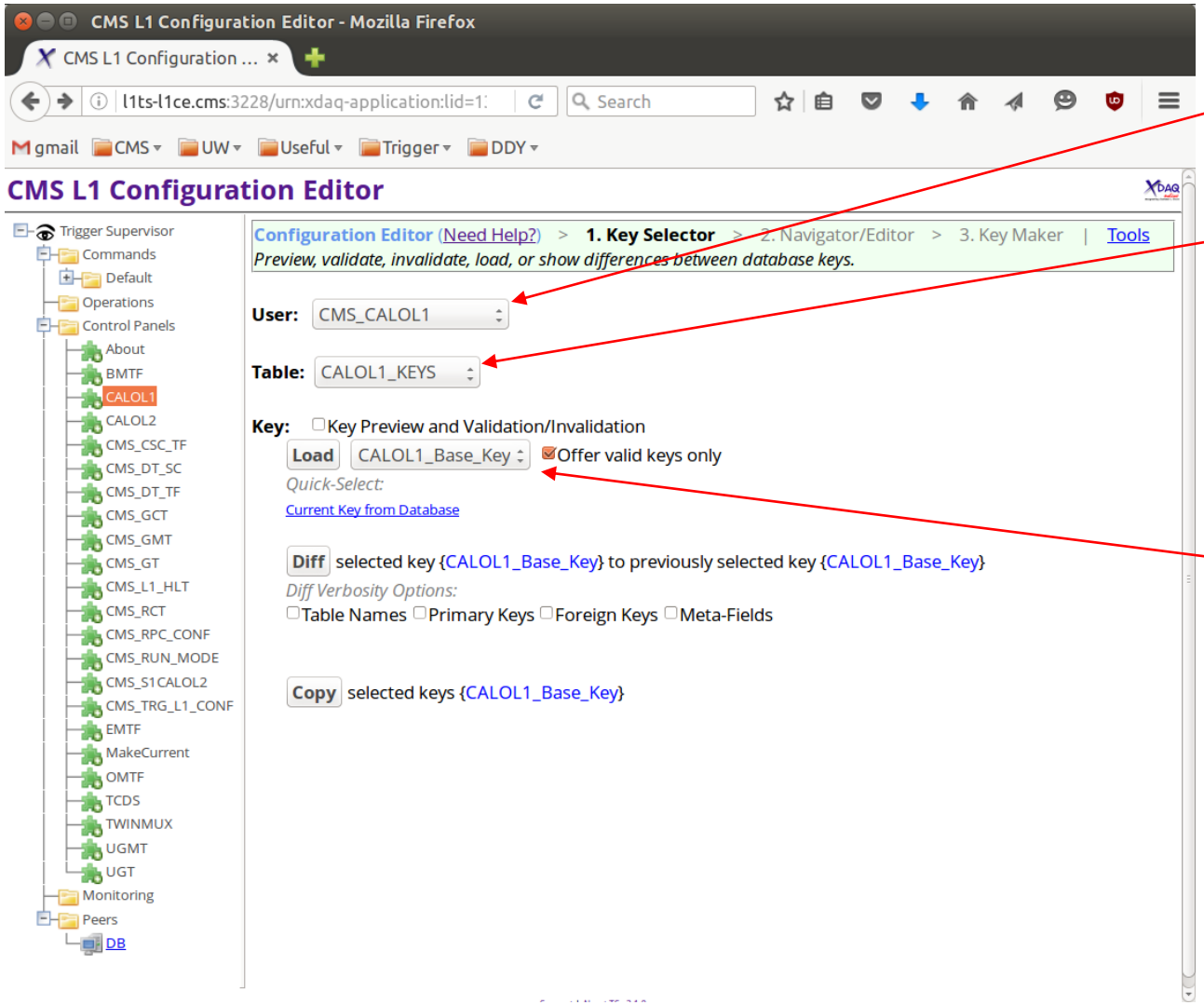
Tower Mask XML Example 2

- Mask ECAL tower at iEta=-12, iPhi=53

```
<run-settings id="calol1">
  <context id="CTP7_Phi13">
    <param id="towerMaskPosEta" type="vector:uint">0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x000, 0x000</param>
    <param id="towerMaskNegEta" type="vector:uint">0x00,
0x00, 0x00, 0x00, 0x00, 0x40, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x000, 0x000</param>
  </context>
</run-settings>
```

iPhi=53→CTP7_Phi13
iEta=±12→link 5 (zero-indexed!)
6th tower→binary mask 01000000→hex tower mask 0x40

L1CE

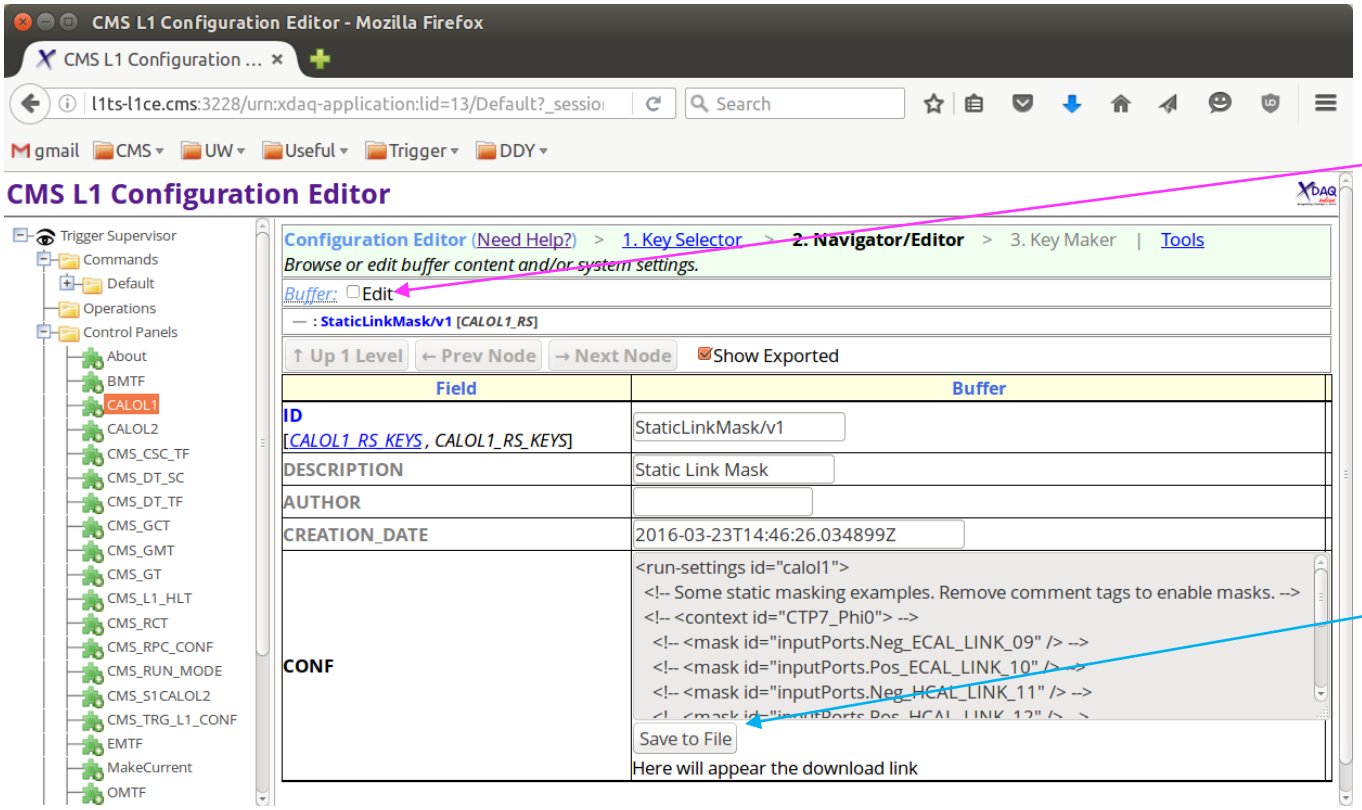


User: CMS_CALOL1

Table: module type

Select a current key to edit and click load

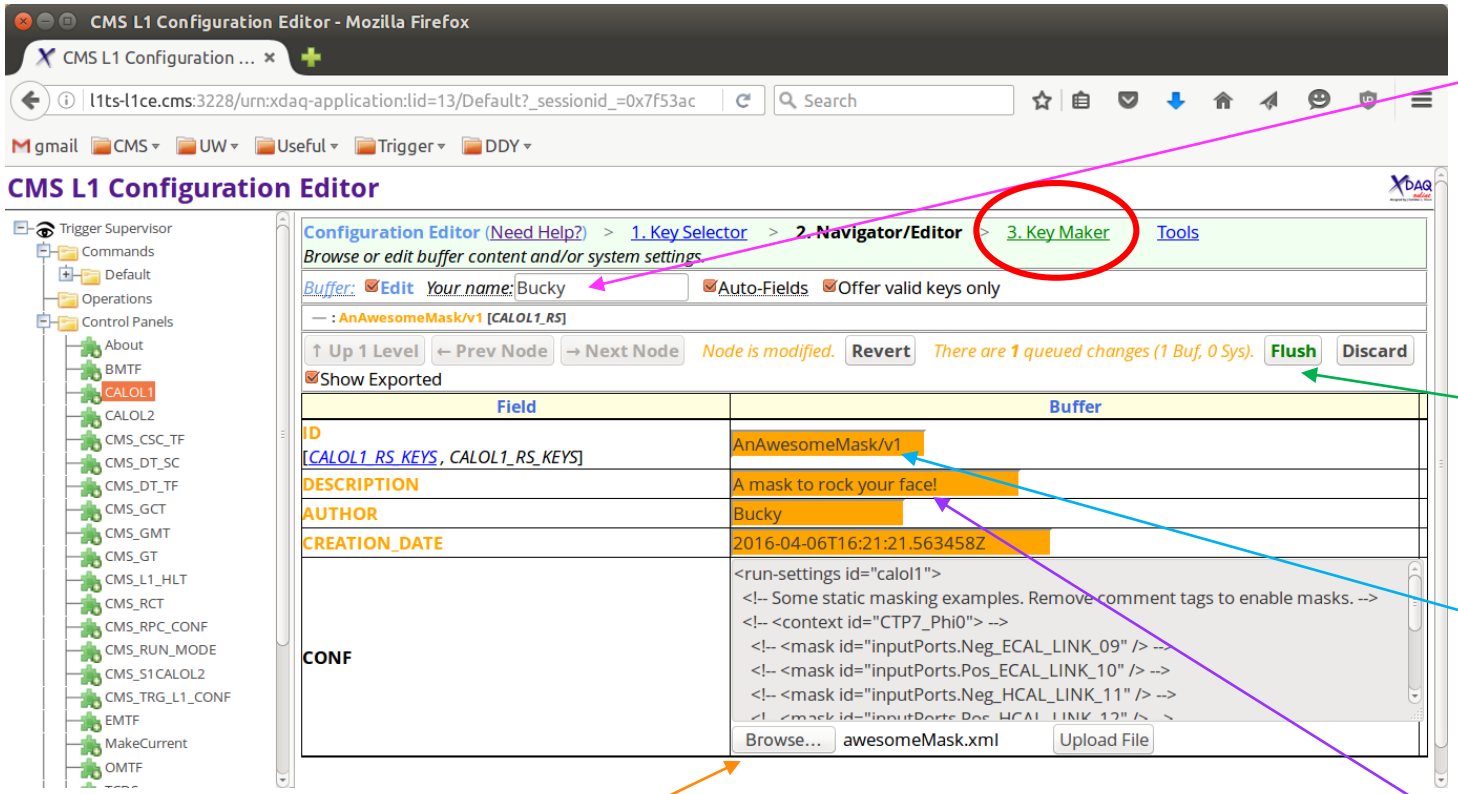
L1CE



Check box to edit

Click to save full XML

L1CE



Your name and press Enter

"Flush" anything typed into the form often

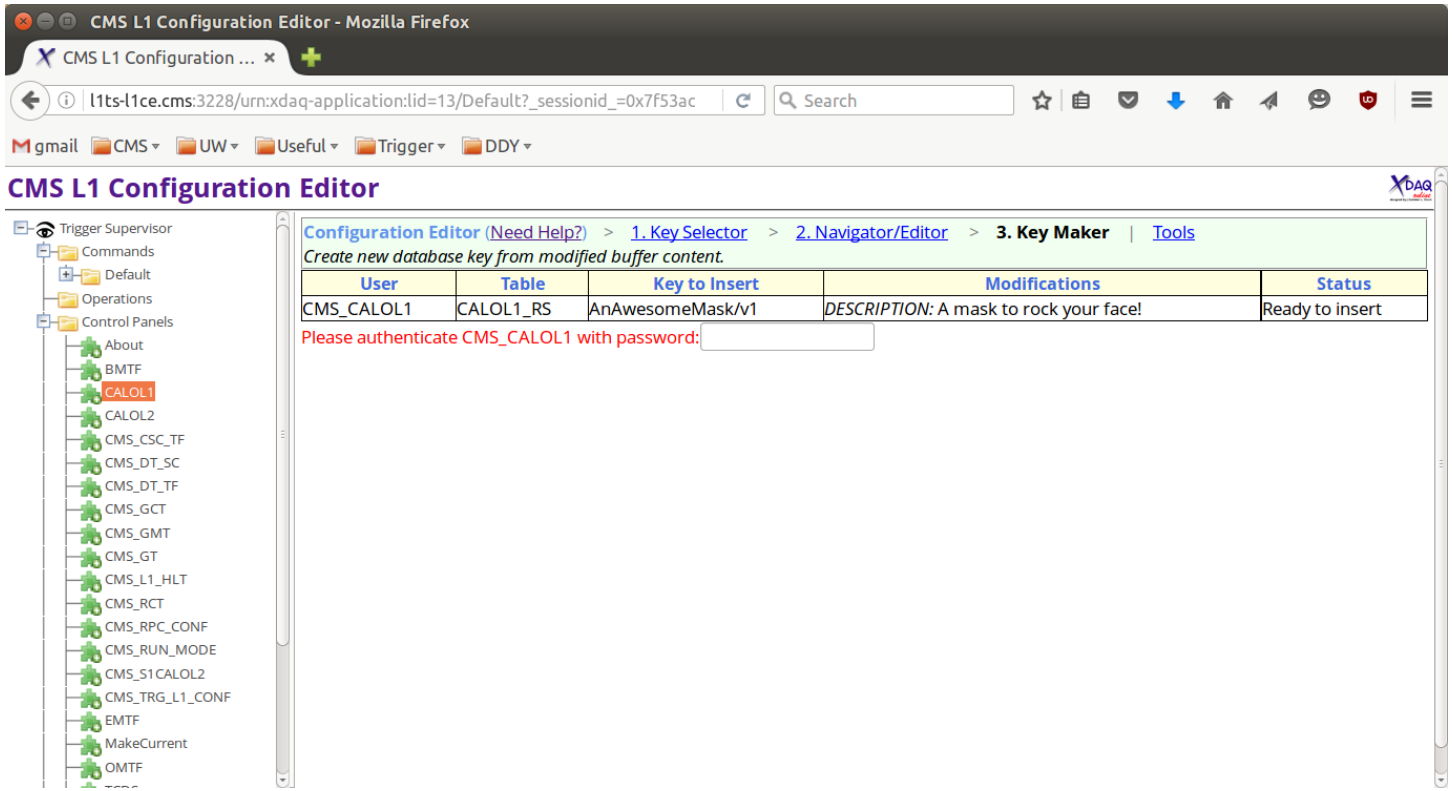
Name for module/key

Verbose description

Select and upload XML

Click "3. Key Maker" to continue

L1CE



Password can be found in /nfshome0/centraltspro/secure/cms_calol1.txt