



The Slow Control of g-2 Laser System

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MUSE General Meeting

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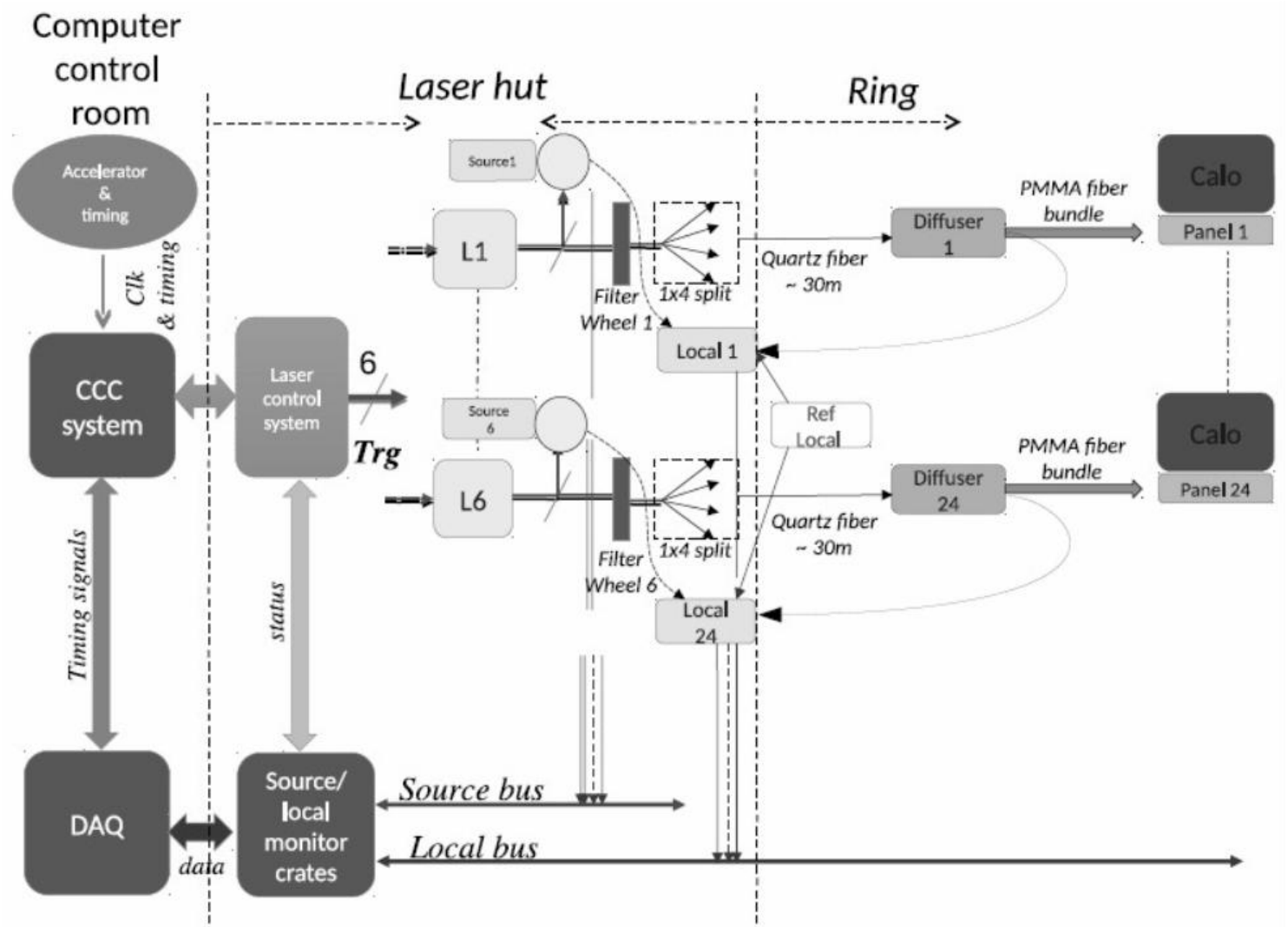
Laser Calibration System SLOW CONTROL and DB

Overview

- With Slow Control we monitor the Laser Calibration System hardware parameters and the environment conditions
- The total number of parameters monitored is less than one hundred, and the faster rate is less than 0.1 Hz
- Mostly informations of general hardware are statics or quasi statics

Laser Calibration System SLOW CONTROL and DB

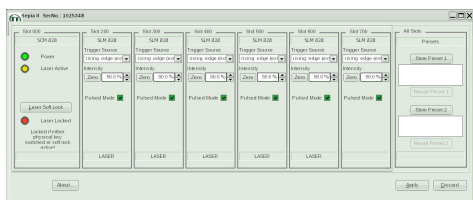
Overview



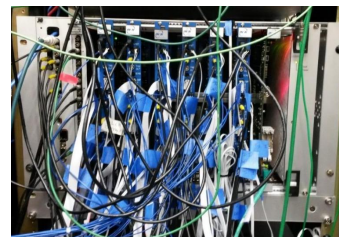
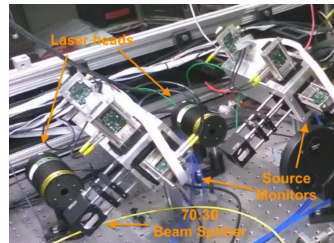
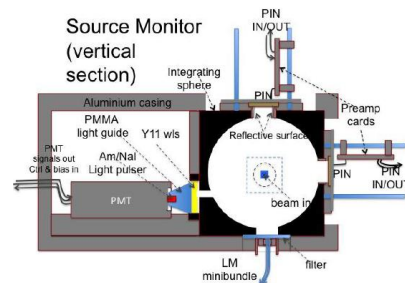
Laser Calibration System SLOW CONTROL and DB

Hardware overview

Laser Control System



Source Monitor



Transmission chain

Optical Fibers



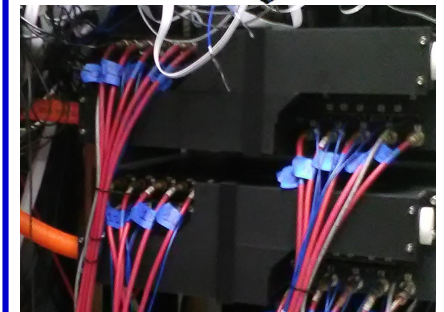
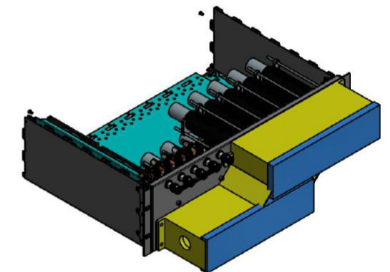
Filter wheel positions



Flip mirrors position



Local Monitor



Laser Calibration System SLOW CONTROL and DB

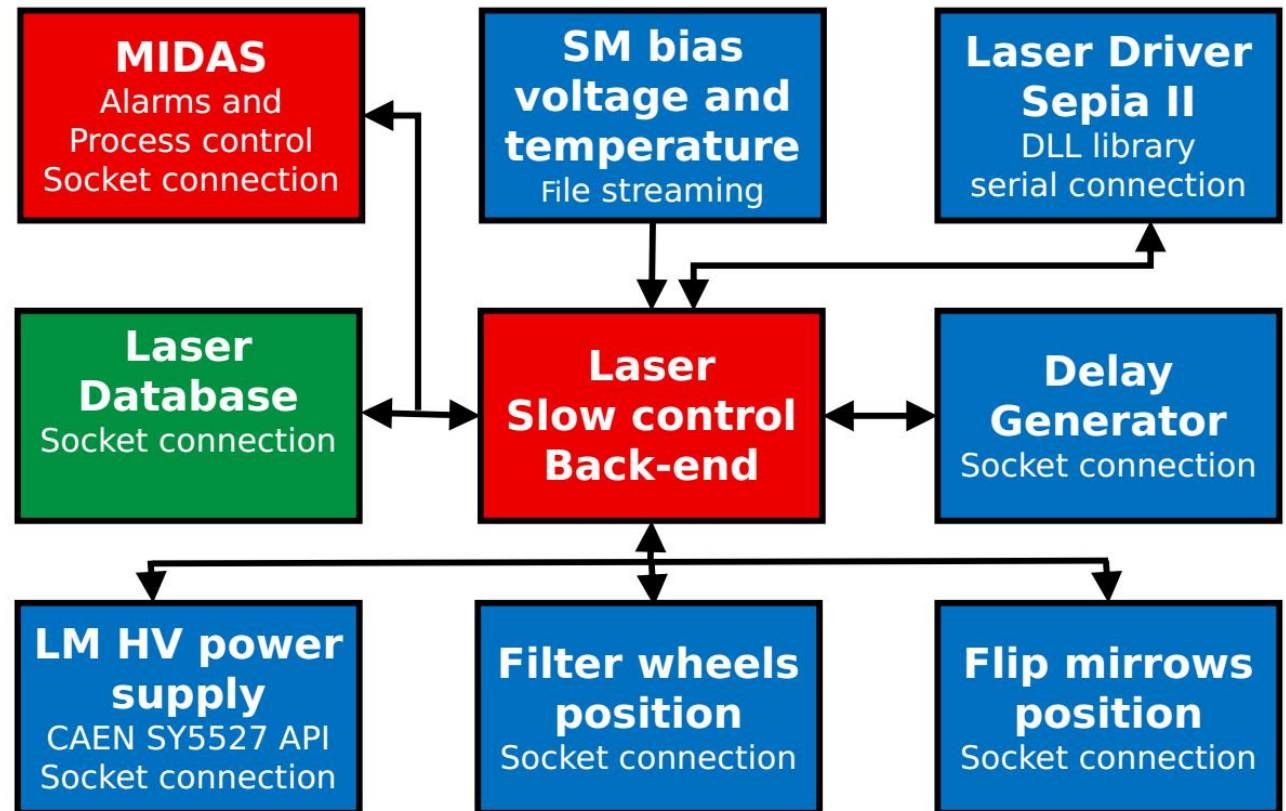
Settings & monitoring design (Data stored in the Online DB)

- Source Monitor (SM) power supply bias voltages and temperatures
- Local Monitor (LM) high voltage (HV) power supply hardware parameters
- Laser driver current and interlock status
- Filter wheels (fw) filters position
- Flip mirrors position
- Delay generator status
- Network devices status
- Last day and last week Laser Hut room temperatures

Layout of the Laser Slow Control

Back-end software

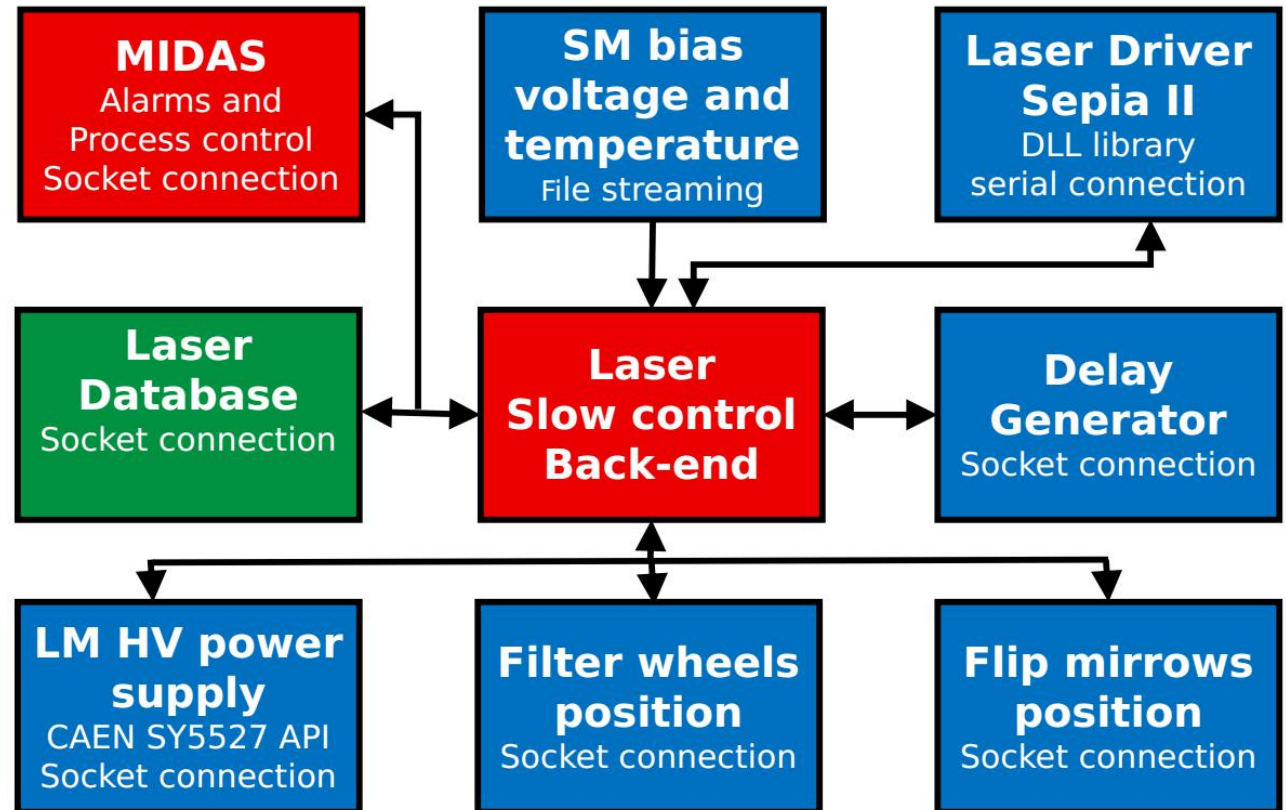
- Working on workstation inside laser hut
- manage the connections with the ODB (PostgreSQL database) and the Calibration System hardware



Layout of the Laser Slow Control

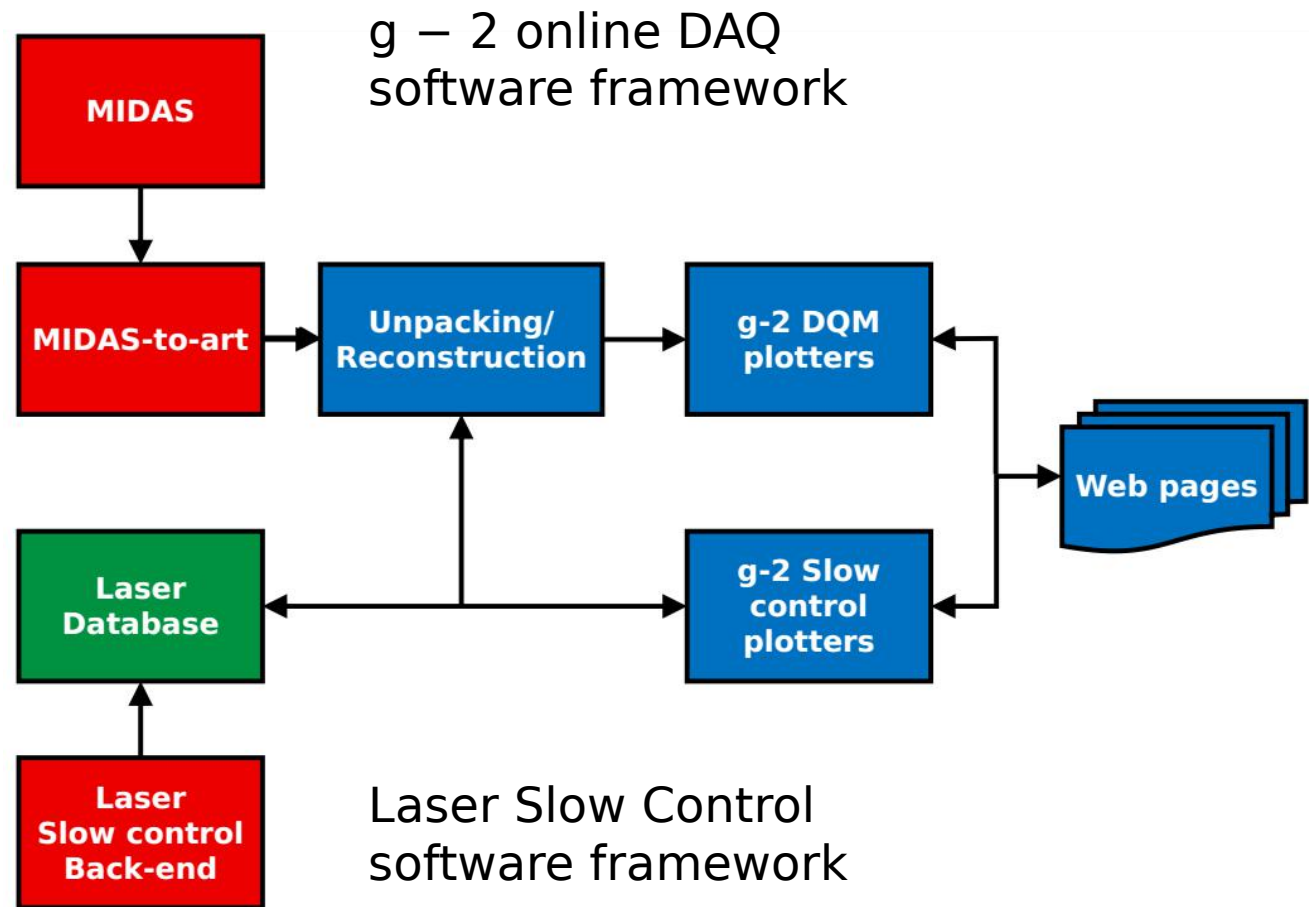
Back-end software

- Store the hardware status and parameters to the database and arises alarms on MIDAS after a quality check failed on status and data



Layout of the Online Laser System Monitoring

- A **Web Server**, integrated into Data Quality Monitor, provides a monitoring page where are shown the devices and the environment temperatures status



Laser Calibration System SLOW CONTROL Back-end software

- Developed in C++ language under Fermi Linux distribution
- Uses different API and software technologies to manage the hardware of the Calibration System

```
--- G-2 LASER SYSTEM SLOW CONTROL V 1.0 ---  
  
[a] START SLOW CONTROL                HV System[0]: 0 connected  
                                       DB System[0]: 0 connected  
  
[b] DB LOGIN  
[c] DB LOGOUT  
[d] HV CAEN LOGIN  
[e] HV CAEN LOGOUT  
[f] HV LIBRARYRELEASE  
[g] HV GETCRATEMAP  
[h] HV GETSYSPROP  
[i] HV FILE WRITE  
  
[r] Loop = Yes  
[x] Exit
```

Laser Calibration System SLOW CONTROL Back-end software

Laser Control System

- Laser Control Borad
- Trigger fan out
- Laser driver
- Delay generator and Double Pulse System

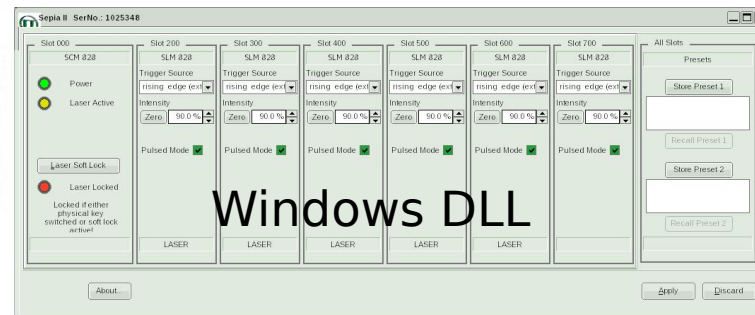
Laser Calibration System SLOW CONTROL Back-end software

Laser Control System

- Each laser head LDH-P-C-405M is coupled to its driver provided by SEPIA II Picoquant Laser Driver
- SEPIA II uses only a **Windows executable** for settings and monitoring
- developing under linux operating system needs to use **DLL libraries**



Laser Driver

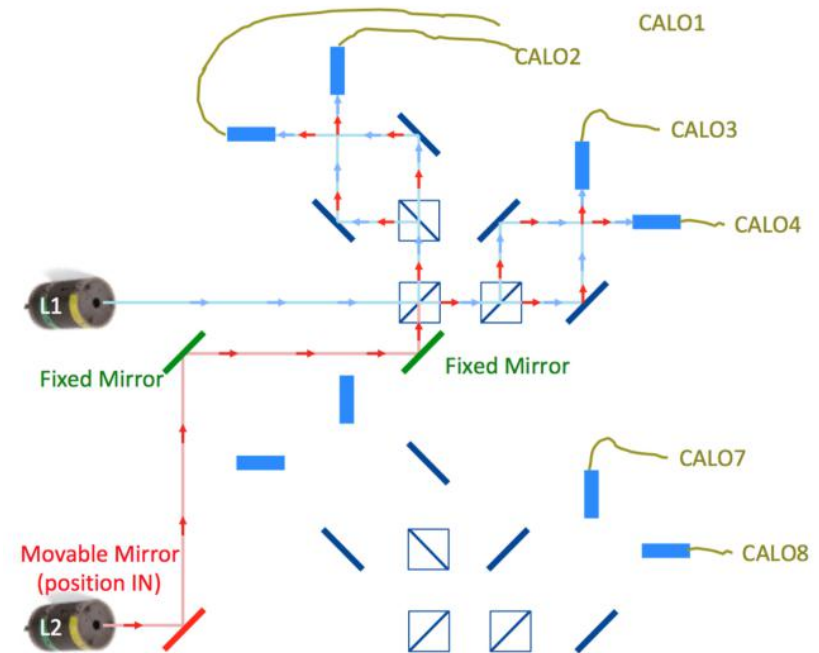


**Laser
Slow Control
Back-end
software**

Laser Calibration System SLOW CONTROL Back-end software

Double Pulse System

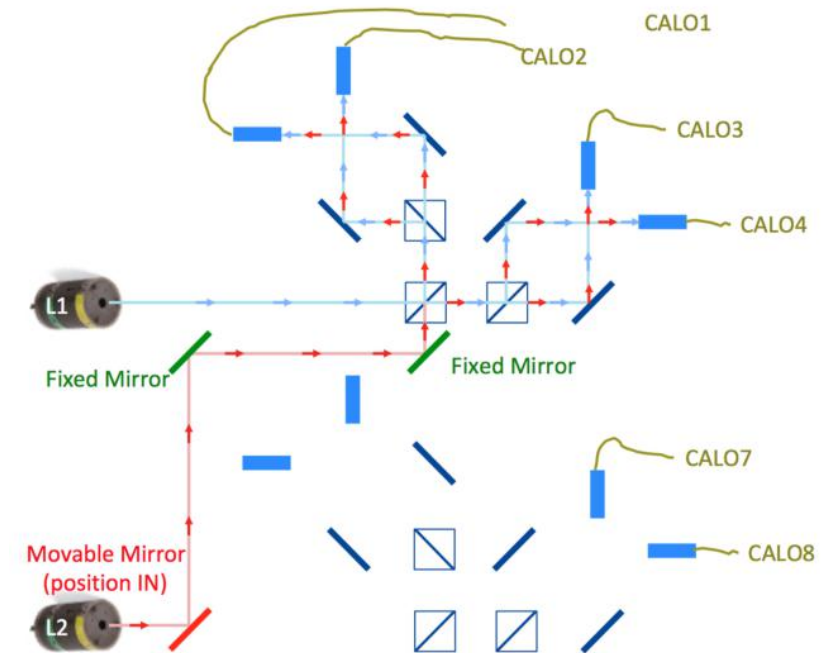
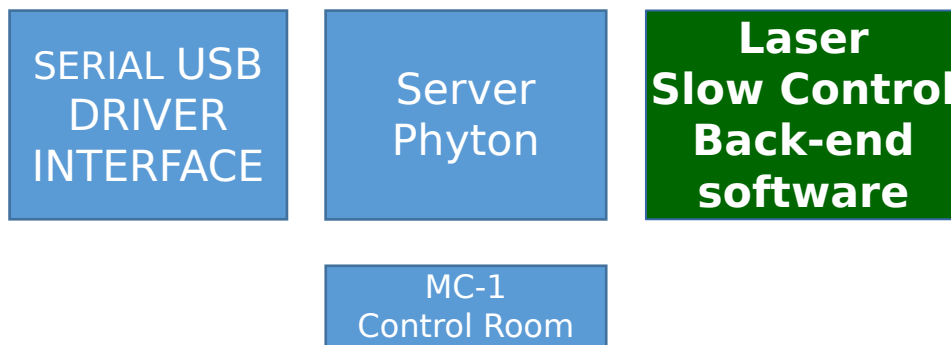
- SRS DG645 Delay Generator status reading over socket connection - **C++** code as been developed
- Flip Mirrors position reading over socket connection to a server developed in **Phyton**



Laser Calibration System SLOW CONTROL Back-end software

Double Pulse System

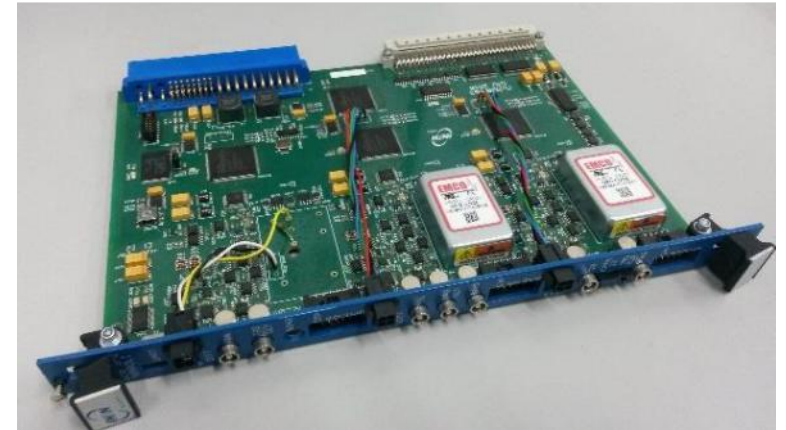
- Flip Mirrors position reading over socket connection to a server developed in **Phyton**



Laser Calibration System SLOW CONTROL Back-end software

SM power supply bias voltages and temperatures

- Six custom electronics (INFN Naples), monitoring board, manage the complete signal processing, data readout and configuration/control for three channels of source elements of the Calibration System - **C++** software as been developed
- write data in the laser slow control db



Laser Calibration System SLOW CONTROL Back-end software

Filter wheels position

- Filter wheels position reading over socket connection to a server developed in **Phyton**



SERIAL
USB
DRIVER
INTERFACE

Server
Phyton

**Laser
Slow Control
Back-end
software**

MC-1
Control Room

Laser Calibration System SLOW CONTROL Back-end software

- Software for electronic hardware setting CAEN SY5527
- CAEN_HVPSS_Channels Controller based on java libraries

	Name	I0Set	V0Set	IMon	VMon	Pw	Status	RUp	RDWn	Trip
06.000	FSMOD1	1500.0 uA	3000.0 V	0.0 uA	3000.5 V	On	On	500 V/s	500 V/s	10.0
06.001	FSMOD1	1500.0 uA	3000.0 V	0.0 uA	3000.0 V	On	On	500 V/s	500 V/s	10.0
06.002	FSMOD1	1500.0 uA	3000.0 V	0.0 uA	3000.0 V	On	On	500 V/s	500 V/s	10.0
06.003	FSMOD1	1500.0 uA	3000.0 V	0.5 uA	3000.0 V	On	On	500 V/s	500 V/s	10.0
06.004	FSMOD1	1500.0 uA	3000.0 V	0.0 uA	3000.0 V	On	On	500 V/s	500 V/s	10.0
06.005	FSMOD1	1500.0 uA	3000.0 V	0.0 uA	3000.5 V	On	On	500 V/s	500 V/s	10.0
06.006	FSMOD1	1500.0 uA	3000.0 V	0.0 uA	3000.0 V	On	On	500 V/s	500 V/s	10.0
06.007	FSMOD1	1500.0 uA	3000.0 V	0.0 uA	3000.5 V	On	On	500 V/s	500 V/s	10.0
06.008	FSMOD1	1500.0 uA	3000.0 V	0.5 uA	3000.5 V	On	On	500 V/s	500 V/s	10.0
06.009	FSMOD1	1500.0 uA	3000.0 V	0.5 uA	3000.0 V	On	On	500 V/s	500 V/s	10.0
06.010	FSMOD1	1500.0 uA	3000.0 V	0.0 uA	3000.0 V	On	On	500 V/s	500 V/s	10.0
06.011	FSMOD1	1500.0 uA	3000.0 V	0.0 uA	3000.0 V	On	On	500 V/s	500 V/s	10.0
06.012	FSMOD1	1500.0 uA	3000.0 V	0.5 uA	3000.0 V	On	On	500 V/s	500 V/s	10.0
06.013	FSMOD1	1500.0 uA	3000.0 V	0.0 uA	3000.0 V	On	On	500 V/s	500 V/s	10.0
06.014	FSMOD1	1500.0 uA	3000.0 V	0.0 uA	3000.0 V	On	On	500 V/s	500 V/s	10.0
06.015	FSMOD1	1500.0 uA	3000.0 V	0.5 uA	3000.5 V	On	On	500 V/s	500 V/s	10.0
06.016	FSMOD1	1500.0 uA	3000.0 V	0.0 uA	3000.5 V	On	On	500 V/s	500 V/s	10.0
06.017	FSMOD1	1500.0 uA	3000.0 V	0.5 uA	3000.0 V	On	On	500 V/s	500 V/s	10.0
06.018	FSMOD1	1500.0 uA	3000.0 V	0.5 uA	3000.5 V	On	On	500 V/s	500 V/s	10.0
06.019	FSMOD1	1500.0 uA	3000.0 V	0.0 uA	0.0 V	Off	Off	500 V/s	500 V/s	10.0
06.020	FSMOD1	1500.0 uA	3000.0 V	0.0 uA	0.0 V	Off	Off	500 V/s	500 V/s	10.0
06.021	FSMOD1	1500.0 uA	3000.0 V	0.0 uA	0.0 V	Off	Off	500 V/s	500 V/s	10.0
06.022	FSMOD1	1500.0 uA	3000.0 V	0.5 uA	0.0 V	Off	Off	500 V/s	500 V/s	10.0
06.023	FSMOD1	1500.0 uA	3000.0 V	0.5 uA	0.0 V	Off	Off	500 V/s	500 V/s	10.0



Laser Calibration System SLOW CONTROL Back-end software

- CAEN SY5527 **C++** API reading over socket connection to the high voltage (HV) power supply server
- write data in the laser slow control db

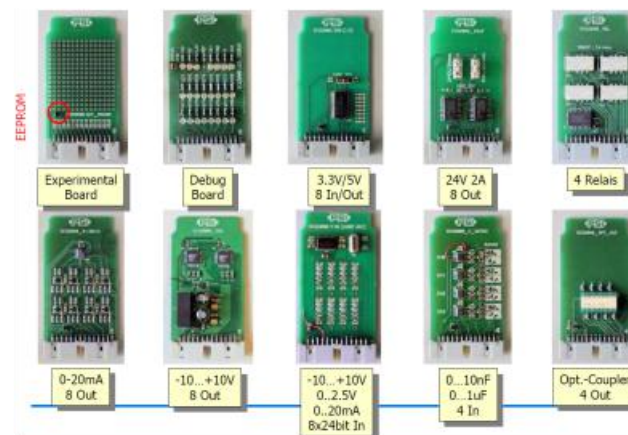
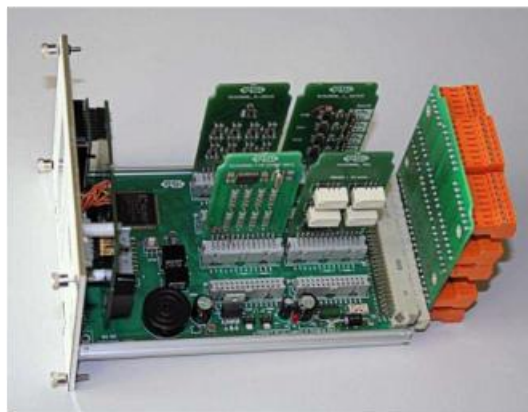
```
Slot: 0
PARAM VALUE
Slot Ch Ch Name V0Set VMon Status Pw Time
0 0 CHANNEL00 630.00 630.26 1 1 1512497764
0 1 CHANNEL01 580.00 580.26 1 1 1512497764
0 2 CHANNEL02 600.00 600.25 1 1 1512497764
0 3 CHANNEL03 570.00 570.22 1 1 1512497764
0 4 CHANNEL04 640.00 640.13 1 1 1512497764
0 5 CHANNEL05 560.00 560.20 1 1 1512497764
0 6 CHANNEL06 550.00 550.18 1 1 1512497764
0 7 CHANNEL07 520.00 520.21 1 1 1512497764
0 8 CHANNEL08 600.00 600.31 1 1 1512497764
0 9 CHANNEL09 600.00 600.20 1 1 1512497764
0 10 CHANNEL10 530.00 530.26 1 1 1512497764
0 11 CHANNEL11 540.00 540.20 1 1 1512497764
0 12 CHANNEL12 550.00 550.29 1 1 1512497764
0 13 CHANNEL13 560.00 560.36 1 1 1512497764
0 14 CHANNEL14 560.00 560.32 1 1 1512497764
0 15 CHANNEL15 540.00 540.34 1 1 1512497764
0 16 CHANNEL16 510.00 510.28 1 1 1512497764
0 17 CHANNEL17 520.00 520.27 1 1 1512497764
0 18 CHANNEL18 520.00 520.29 1 1 1512497764
0 19 CHANNEL19 510.00 510.27 1 1 1512497764
0 20 CHANNEL20 590.00 590.22 1 1 1512497764
0 21 CHANNEL21 550.00 550.38 1 1 1512497764
0 22 CHANNEL22 500.00 500.20 1 1 1512497764
0 23 CHANNEL23 600.00 600.29 1 1 1512497764
Slot: 2
PARAM VALUE
Slot Ch Ch Name V0Set VMon Status Pw Time
2 0 CHANNEL00 700.00 700.30 1 1 1512497765
2 1 CHANNEL01 700.00 700.25 0 0 1512497765
2 2 CHANNEL02 700.00 1018.63 0 0 1512497765
2 3 CHANNEL03 0.00 1022.34 0 0 1512497765
2 4 CHANNEL04 0.00 1.21 0 0 1512497765
2 5 CHANNEL05 0.00 1018.94 0 0 1512497765
2 6 CHANNEL06 0.00 1025.20 0 0 1512497765
2 7 CHANNEL07 0.00 1022.27 0 0 1512497765
2 8 CHANNEL08 0.00 1035.95 0 0 1512497765
2 9 CHANNEL09 0.00 1020.70 0 0 1512497765
2 10 CHANNEL10 0.00 1024.70 0 0 1512497765
2 11 CHANNEL11 0.00 1014.82 0 0 1512497765
2 12 CHANNEL12 0.00 3791.00 16384 0 1512497765
2 13 CHANNEL13 1100.00 1125.95 17 1 1512497765
2 14 CHANNEL14 1100.00 1125.85 17 1 1512497765
2 15 CHANNEL15 900.00 1003.70 17 1 1512497765
2 16 CHANNEL16 1000.00 1021.07 17 1 1512497765
2 17 CHANNEL17 1000.00 1018.92 17 1 1512497765
2 18 CHANNEL18 0.00 3786.16 16384 0 1512497765
2 19 CHANNEL19 0.00 23.61 0 0 1512497765
2 20 CHANNEL20 0.00 1.33 0 0 1512497765
2 21 CHANNEL21 0.00 2.44 0 0 1512497765
2 22 CHANNEL22 0.00 1.20 0 0 1512497765
2 23 CHANNEL23 0.00 1030.52 0 0 1512497765
```



Laser Calibration System SLOW CONTROL Back-end software

Environmental temperature monitoring in the laser hut

- Uses an MSCB node connected to Midas Servers
- The data are stored in the Online Database



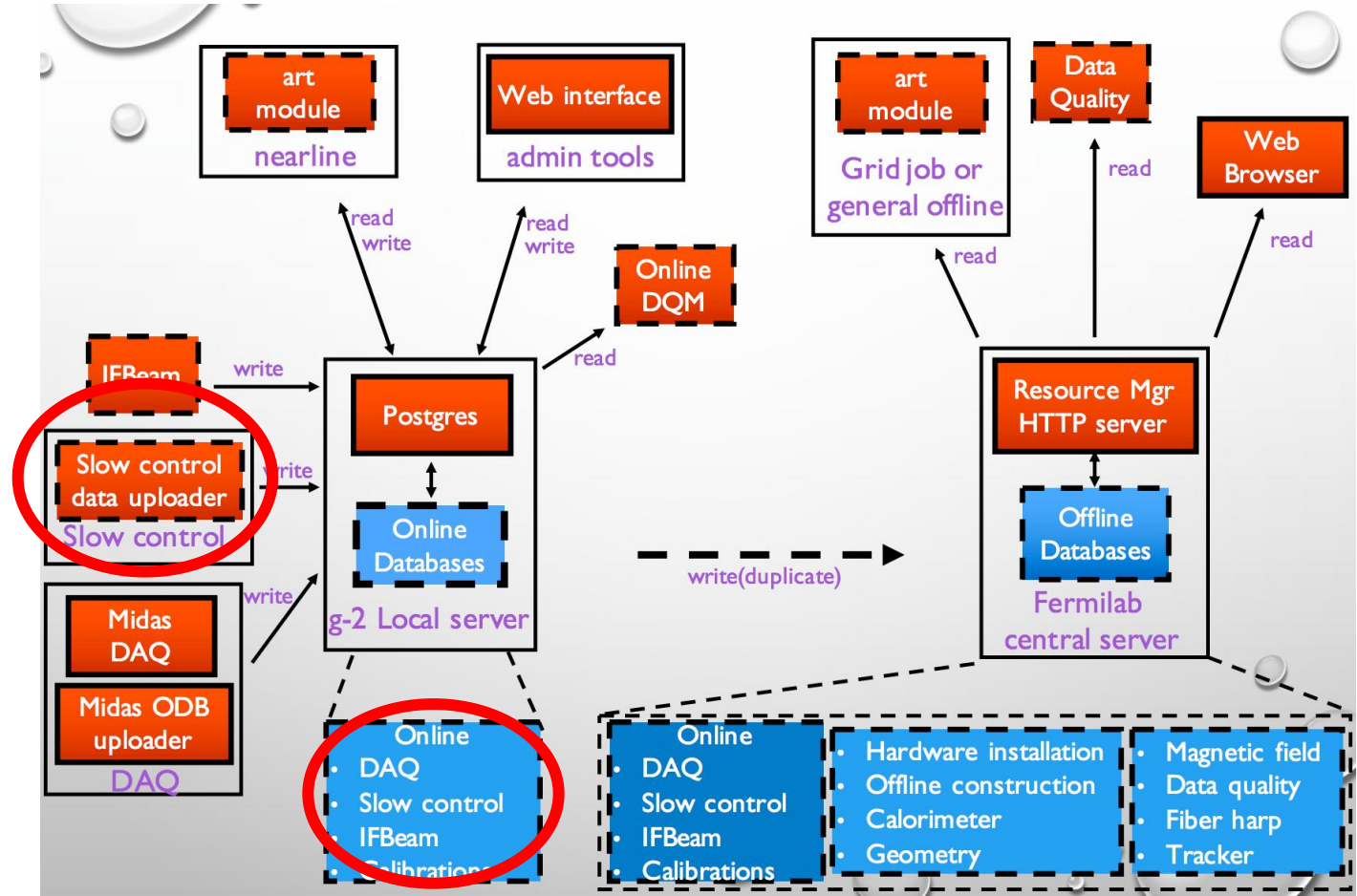
MIDAS SCS-2000 general purpose control unit and examples of available and installed SCS200 daughter cards

Example of pt100 temperature sensors

Laser Calibration System SLOW CONTROL Database

g-2 Database overview

- *Develop environment*
- *Production environment*



Laser Calibration System SLOW CONTROL Database

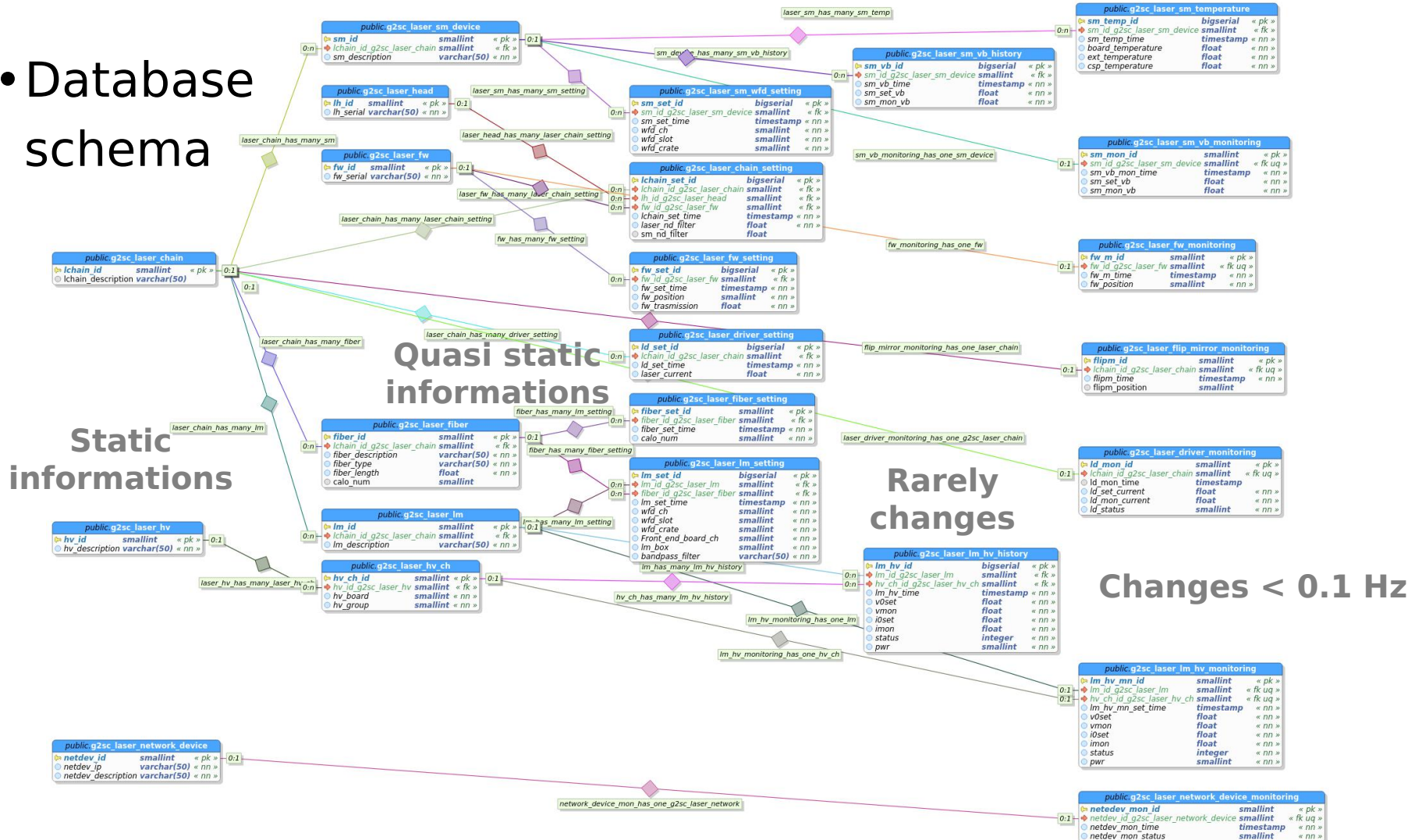
- A relational database scheme has been designed to define what data must be stored and how the data elements interrelate
- It involved classifying data and identifying interrelationships following the ontology theoretical representation
- The structure was optimized studying the organization of the application's data and the application's requirements, which included transaction rate (speed), reliability, maintainability, scalability

Laser Calibration System SLOW CONTROL Database

- Data relationships has been determined using the relational model approach
- The data has been arranged into a logical structure and mapped into the storage objects supported by the database management system
- The storage objects has been corresponded directly to the objects used by the Object-Oriented programming language adopted to write the slow control back-end software that manage and access the data
- The relationships was defined as attributes of the object classes involved

Laser Calibration System SLOW CONTROL Database

- Database schema



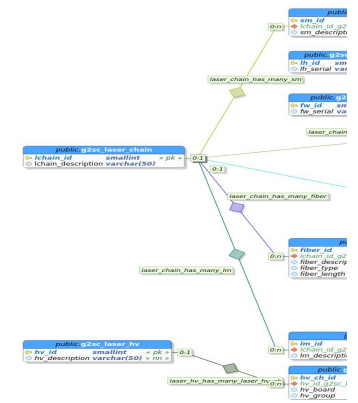
Laser Calibration System SLOW CONTROL Database

- Each table represents an implementation of either a logical object or a relationship joining one or more instances of one or more logical objects
- Relationships between tables may then be stored as links connecting child tables with parents
- Complex logical relationships involves tables they have links to more than one parent
- A normalization process has been performed to ensure that the database structure is suitable for generalpurpose querying and free of undesirable characteristics-insertion, update, and deletion anomalies that could lead to loss of data integrity

Laser Calibration System SLOW CONTROL Database

Tables list

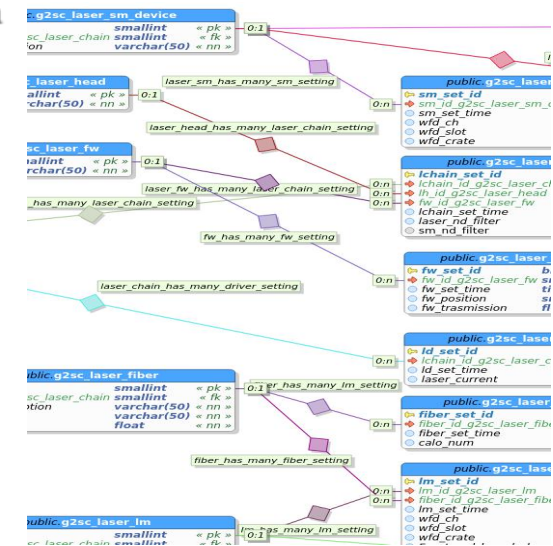
Table name	Description
<i>First level - Static informations</i>	
g2sc_laser_chain	Laser chains definition
g2sc_laser_hv	HV device definition
g2sc_laser_network_device	Network devices definition



Laser Calibration System SLOW CONTROL Database

Tables list

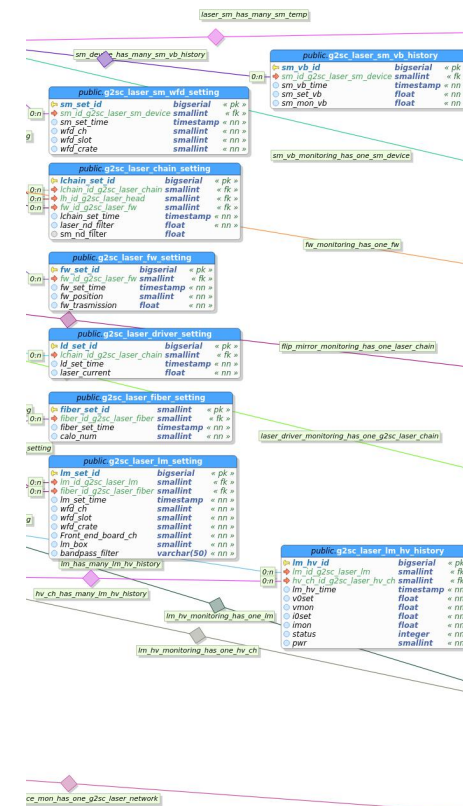
Table name	Description
<i>Second level - Quasi static informations</i>	
g2sc_laser_sm_device	Source Monitor devices definition
g2sc_laser_lm	Local Monitor devices definition
g2sc_laser_fiber	Fibers definition
g2sc_laser_head	Laser heads definition
g2sc_laser_fw	Filter wheels definition
g2sc_laser_hv_ch	HV device channels definition



Laser Calibration System SLOW CONTROL Database

Tables list

Table name	Description
<i>Third level - Informations with some changes in time</i>	
g2sc.laser_sm_wfd_setting	WFD channels of Source Monitor devices settings
g2sc.laser_chain_setting	Laser chain settings
g2sc.laser_fw_setting	filter wheels settings
g2sc.laser_driver_setting	Laser driver settings
g2sc.laser_fiber_setting	fibers settings
g2sc.laser_lm_setting	Local Monitor settings
g2sc.laser_sm_vb_setting	Source Monitor vbias settings
g2sc.laser_lm_hv_setting	Local Monitor HV settings



Laser Calibration System SLOW CONTROL Database

Tables list

Table name	Description
<i>Fourth level - informations rapidly changes in time</i>	
g2sc_laser_fw_monitoring	Filter wheels monitoring position
g2sc_laser_flip_mirror_monitoring	Flip mirrors monitoring position
g2sc_laser_network_device_monitoring	Network devices monitoring parameters
g2sc_laser_sm_vb_monitoring	Source Monitor vbias monitoring and time history storing
g2sc_laser_lm_hv_monitoring	Local Monitor HV monitoring parameters and time history storing
g2sc_laser_sm_temperature	Source Monitor temperatures monitoring and time history storing
g2sc_laser_driver_monitoring	Laser driver monitoring parameters and time history storing

```

public.g2sc_laser_sm_temperature
├─ sm_temp_id          bigserial  « pk »
├─ sm_id_g2sc_laser_sm_device smallint « fk »
├─ sm_temp_time       timestamp  « nn »
├─ board_temperature  float      « nn »
├─ ext_temperature    float      « nn »
├─ csp_temperature    float      « nn »

```

```

public.g2sc_laser_sm_vb_monitoring
├─ sm_mon_id          smallint  « pk »
├─ sm_id_g2sc_laser_sm_device smallint « fk uq »
├─ sm_vb_mon_time     timestamp  « nn »
├─ sm_set_vb         float      « nn »
├─ sm_mon_vb         float      « nn »

```

```

public.g2sc_laser_fw_monitoring
├─ fw_m_id           smallint  « pk »
├─ fw_id_g2sc_laser_fw smallint « fk uq »
├─ fw_m_time        timestamp  « nn »
├─ fw_position      smallint  « nn »

```

```

public.g2sc_laser_flip_mirror_monitoring
├─ flipm_id          smallint  « pk »
├─ lchain_id_g2sc_laser_chain smallint « fk uq »
├─ flipm_time        timestamp  « nn »
├─ flipm_position    smallint  « nn »

```

```

public.g2sc_laser_driver_monitoring
├─ ld_mon_id         smallint  « pk »
├─ lchain_id_g2sc_laser_chain smallint « fk uq »
├─ ld_mon_time       timestamp  « nn »
├─ ld_set_current    float      « nn »
├─ ld_mon_current    float      « nn »
├─ ld_status         smallint  « nn »

```

```

public.g2sc_laser_lm_hv_monitoring
├─ lm_hv_mon_id      smallint  « pk »
├─ lm_id_g2sc_laser_lm smallint « fk uq »
├─ hv_ch_id_g2sc_laser_hv_ch smallint « fk uq »
├─ lm_hv_mon_set_time timestamp  « nn »
├─ v0set             float      « nn »
├─ vmon              float      « nn »
├─ i0set             float      « nn »
├─ imon              float      « nn »
├─ status            integer   « nn »
├─ pwr               smallint  « nn »

```

```

public.g2sc_laser_network_device_monitoring
├─ netedev_mon_id    smallint  « pk »
├─ netedev_id_g2sc_laser_network_device smallint « fk uq »
├─ netedev_mon_time  timestamp  « nn »
├─ netedev_mon_status smallint  « nn »

```

Laser Calibration System SLOW CONTROL Web server and client

- **Web server side** of the Laser Slow Control is integrated into Data Quality Monitor web server and provides a monitoring page where are shown the devices and the environment temperatures status
- It works in asynchronous mode respect to the DQM (runs and MIDAS /art independent)
- Read the informations of slow control, stored in the database, using nodepostgres library



Laser Calibration System SLOW CONTROL Web server and client

Web server feature

- Event driven architecture
- Asynchronous, non-blocking IO
- Built for scalability and throughput
- Numerous mature open source plugins and libraries (Express.js, Socket.IO, PostgreSQL, etc.)
- Load distribution and modularity
- Parallelization through cluster of Node.js servers
- Independently instances can be run either independently or in concert
- A proxy provides single point of entry door connections to multiple clients

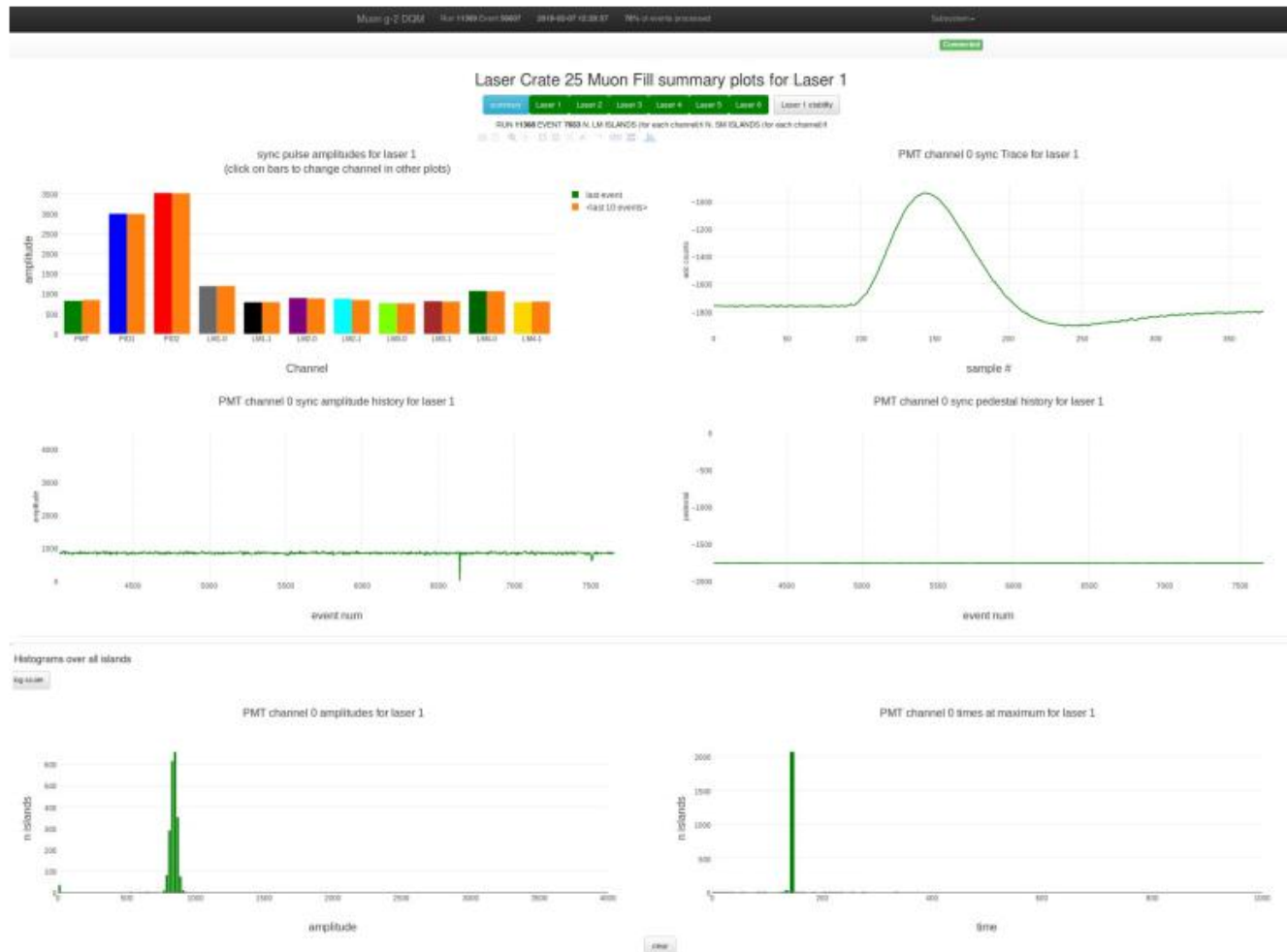


Laser Calibration System SLOW CONTROL Web server and client

- **The client side** shows hardware parameter information using HTML table views and shows the laser hut temperatures behavior using plotly library
- The following types of online structures and plots are available also for data quality
 - **Histogram**: A basic histogram (can also be used to store any x-y scatter plot)
 - **Running Average Histogram**: The data from the last event received as well as the average of data from the last n (specifiable) events received
 - **History**: The value of something for the last n (specifiable) events
 - **Histogram Collection**: A collection of histograms
 - **2D histogram**: A 2D histogram, with x and y projections pre-calculated

Laser Calibration System SLOW CONTROL Web server and client

- Client side example of DQM that shows laser chain signals of Source and Local Monitors



Laser Calibration System SLOW CONTROL Web server and client

- Client side web page example of Laser Slow Control

Machine 2 DCM Tue 19 Jun 2018 10:52:13 2018-06-07 10:52:13 80% of normal production [Subscribe](#)

[Continue](#)

Laser Slow Control

Last update Thu Jun 07 2018 10:52:13 GMT+0200 (CEST)

Source Monitor Bias Voltage

Last time Thu Jun 07 2018 10:51:29 GMT+0200 (CEST)

SM DEV	PMT SET	PMT MON	PID 1 SET	PID 1 MON	PID 2 SET	PID 2 MON
SM 1	0.63		49.14		7.90	
SM 2	0.54		49.14		49.14	
SM 3	0.60		49.14		49.14	
SM 4	0.69		49.14		49.14	
SM 5	0.65		49.14		70.00	
SM 6	0.20		49.14		49.14	

Devices reachable on network

Last time Thu Jun 07 2018 10:51:47 GMT+0200 (CEST)

DEVICE	NETWORK RESPONSE
LASER CONTROL BOARD	OK
SOURCE MONITOR BOARD CONTROLLER	OK
LOCAL MONITOR HV	OK
DELAY GENERATOR	OK
LASER HIT WORKSTATION	OK
SOURCE MONITOR WORKSTATION	OK

Laser Driver

Last time Thu Jun 07 2018 10:51:32 GMT+0200 (CEST)

LASER	CURRENT SETTING	CURRENT MONITORING	INTERLOCK STATUS
1	0.9	0.9	OK
2	0.9	0.9	OK
3	0.9	0.9	OK
4	0.9	0.9	OK
5	0.9	0.9	OK
6	0.9	0.9	OK

HV CH HV SET HV MONITOR | MON STATUS POWER

0	605	605.26	145.62	1	OK	
1	595	595.40	137.49	1	OK	
2	595	595.42	135.79	1	OK	
3	595	595.33	135.36	1	OK	
4	605	605.41	149.32	1	OK	
5	550	550.45	128.85	1	OK	
6	545	545.31	127.36	1	OK	
7	910	910.42	118.23	1	OK	
8	995	995.34	136.76	1	OK	
9	990	990.45	137.94	1	OK	
10	925	925.34	123.52	1	OK	
11	925	925.40	122.55	1	OK	
12	935	935.45	125.02	1	OK	
13	545	545.64	127.42	1	OK	
14	990	990.52	128.62	1	OK	
15	940	940.58	126.95	1	OK	
16	900	900.44	116.03	1	OK	
17	910	910.38	115.09	1	OK	
18	910	910.34	115.18	1	OK	
19	900	900.42	116.85	1	OK	
20	900	900.50	135.66	1	OK	
21	905	905.51	125.89	1	OK	
22	990	990.43	128.49	1	OK	
23	990	990.39	135.83	1	OK	
24	950	950.39	152.01	1	OK	
25	1100	1100.34	154.71	1	OK	
26	1100	1100.38	154.51	1	OK	
27	990	990.42	137.77	1	OK	
28	1000	1000.44	145.46	1	OK	
29	1000	1000.47	145.60	1	OK	
30	0	2.79	8.10	0	OFF	
31	0	2.50	8.05	0	OFF	
32	0	1.18	8.05	0	OFF	
33	0	2.29	8.02	0	OFF	
34	0	1.64	-0.01	0	OFF	
35	0	2.69	8.06	0	OFF	
36	0	1.16	8.10	0	OFF	

Filter wheels actual position

Last time Thu Jun 07 2018 23:42:30 GMT+0200 (CEST)

NUMBER	1	2	3	4	5	6
POSITION	6	6	6	6	6	6

TRANSMISSION 0.37 0.37 0.37 0.35 0.35 0.37

Rip Mirrors actual position

Last time Thu Jun 07 2018 10:51:47 GMT+0200 (CEST)

NUMBER	1	2	3	4	5	6
MIRROR POSITION	DOWN	DOWN	DOWN	DOWN	DOWN	DOWN

24h Temperature Monitor

Last time Thu Jun 07 2018 10:51:30 GMT+0200 (CEST)
Last 24 hours

1 week Temperature Monitor

Last 168 hours

Laser Calibration System SLOW CONTROL Alarm System

MIDAS ALARMS

- *Internal Alarm* checks run inside a process
- *Program Alarm* triggered when a Program is not running
- *Evaluated Alarm* on a threshold condition
- *Periodic Alarm* periodically activated according to a time interval



- **destination:** (to system message log, to DB system, to elog)
- **Alarm Alerts:** visual, audial, email, SMS

Laser Calibration System SLOW CONTROL Alarm System

- Slowcontrol Monitoring page example - Visual red Warnings

Laser Slow Control

THE MASTER PROGRAM HAS NOT BEEN OPERATING FOR MORE THAN 21 MINUTES

Laser traces - Moon Fill view Last update Thu May 17 2018 12:30:38 GMT+0200 (CEST)

Source Monitor Bias Voltage

SM DEV	PMT SET	PMT MON	PID 1 SET	PID 1 MON	PID 2 SET	PID 2 MON
SM 1	0.63	49.14	49.14	7.80		
SM 2	0.54	49.14	49.14			
SM 3	0.60	49.14	49.14			
SM 4	0.69	49.14	49.14			
SM 5	0.65	49.14	49.14	70.00		
SM 6	0.60	49.14	49.14			

Devices reachable on network

DEVICE	NETWORK RESPONSE
LASER CONTROL BOARD	OK
SOURCE MONITOR BOARDS CONTROLLER	OK
LOCAL MONITOR HV	OK
DELAY GENERATOR	OK
LASER HUT WORKSTATION	OK
SOURCE MONITOR WORKSTATION	OK

Laser Driver

LASER CURRENT SETTING	CURRENT MONITORING	INTERLOCK STATUS
1	0.9	OK
2	0.9	OK
3	0.9	OK
4	0.9	OK
5	0.9	OK
6	0.9	OK

Local Monitor High Voltage Power Supply

HV CH	HV SET	HV MONITOR	MON STATUS	POWER
0	635	635.31	148.59	
1	585	585.34	137.47	
2	585	585.38	135.79	
3	505	505.29	130.35	
4	635	635.32	149.29	
5	550	550.38	128.82	
6	545	545.28	127.34	
7	510	510.33	119.21	
8	565	565.35	136.78	
9	590	590.38	137.91	
10	525	525.36	123.50	
11	525	525.36	122.54	
12	535	535.37	125.00	
13	545	545.52	127.38	
14	550	550.46	128.60	
15	540	540.49	126.92	
16	500	500.39	116.82	
17	510	510.42	119.89	
18	510	510.27	119.16	
19	500	500.39	116.85	
20	580	580.45	135.64	
21	535	535.46	125.87	
22	550	550.38	128.47	
23	560	560.35	130.81	
24	650	650.42	152.00	
25	1100	1100.29	154.70	
26	1100	1100.34	154.50	
27	980	980.38	137.75	
28	1000	1000.38	140.46	
29	1000	1000.40	140.58	
30	0	2.69	0.08	0 OFF
31	0	2.57	0.03	0 OFF
32	0	1.15	0.03	0 OFF
33	0	2.28	0.01	0 OFF
34	0	1.64	-0.01	0 OFF
35	0	2.63	0.05	0 OFF
36	0	1.10	0.08	0 OFF
37	0	1.47	0.11	0 OFF
38	0	1.85	0.11	0 OFF

Filter wheels actual position

NUMBER	1	2	3	4	5	6
POSITION	6	6	6	6	6	6
TRANSMISSION	0.37	0.37	0.37	0.35	0.35	0.37

Flip Mirrors actual position

NUMBER	1	2	3	4	5	6
MIRROR POSITION	DOWN	DOWN	DOWN	DOWN	DOWN	DOWN

24h Temperature Monitor

1 week Temperature Monitor

Laser Calibration System SLOW CONTROL Alarm System

- DQM page example - Visual red Warnings

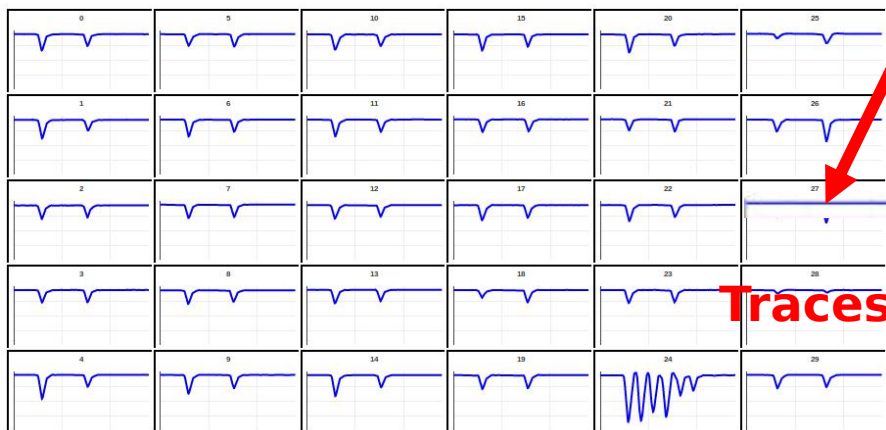
Laser Crate 25 Muon Fill summary plots

Single Laser Status Bar

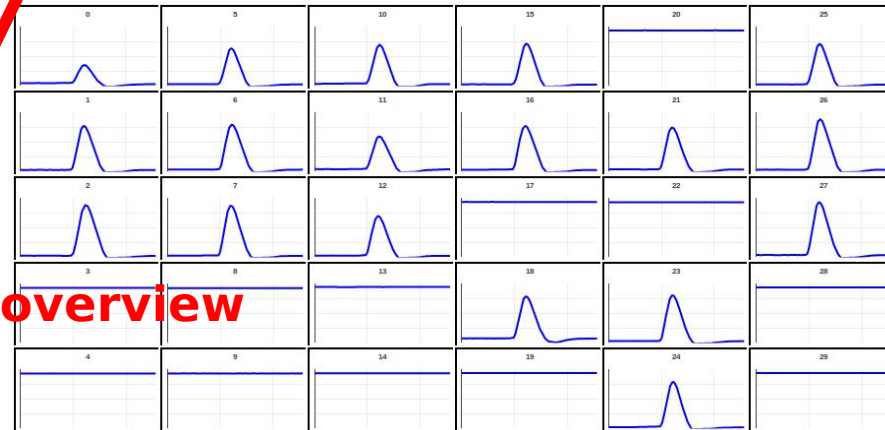


NUMBER 5269 EVENT 197 N. ISLANDS (for each channel)14

- **When one or more signals of a laser chain becomes null, the relative button becomes red**



Local Monitors



Source Monitors

Traces overview

Laser Calibration System SLOW CONTROL Alarm System

- Midas alarms are enabled in laser slow control software (LSC)
- At moment the LSC software sends the following warnings:
 - "Laser Slow Control DB CONNECTION FAILED"
 - "Laser Slow Control LOCAL MONITOR HV: DB DATA WRITE FAILED"
 - "Laser Slow Control NETWORK DEVICES PING: DB DATA WRITE FAILED"
 - "Laser Slow Control SOURCE MONITOR VBIAS: DB DATA WRITE FAILED"
 - "Laser Slow Control LASER DRIVER: DB DATA WRITE FAILED"
 - "Laser Slow Control LASER DRIVER LOCKED"
 - "Laser Slow Control LASER DRIVER NOT CONNECTED"
 - "Laser Slow Control FILTER WHEELS POSITIONS: DB DATA WRITE FAILED"
 - "Laser Slow Control FLIP MIRRORS POSITIONS: DB DATA WRITE FAILED"

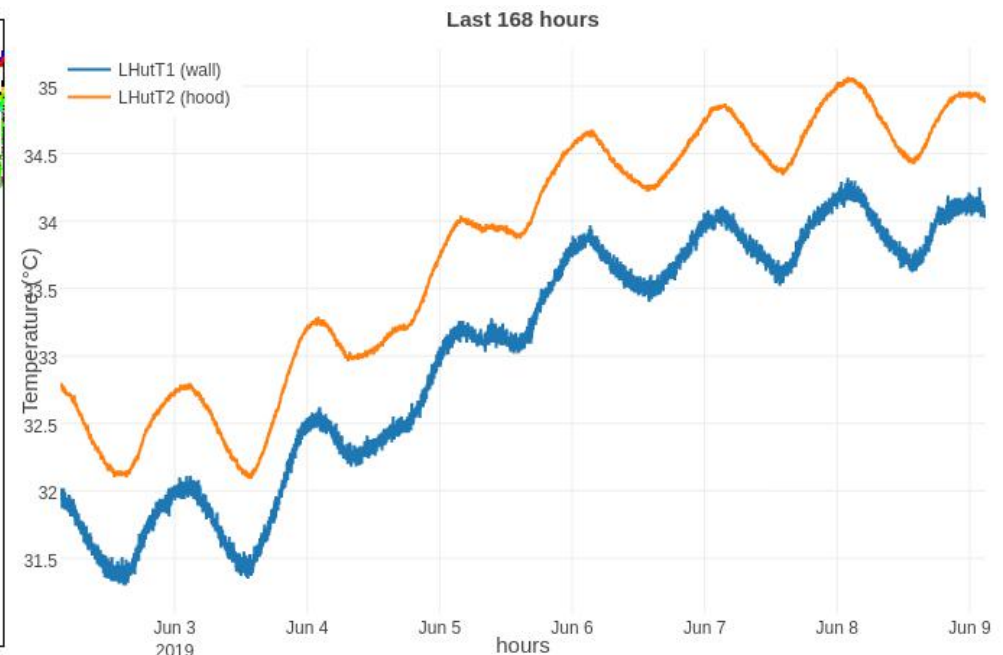
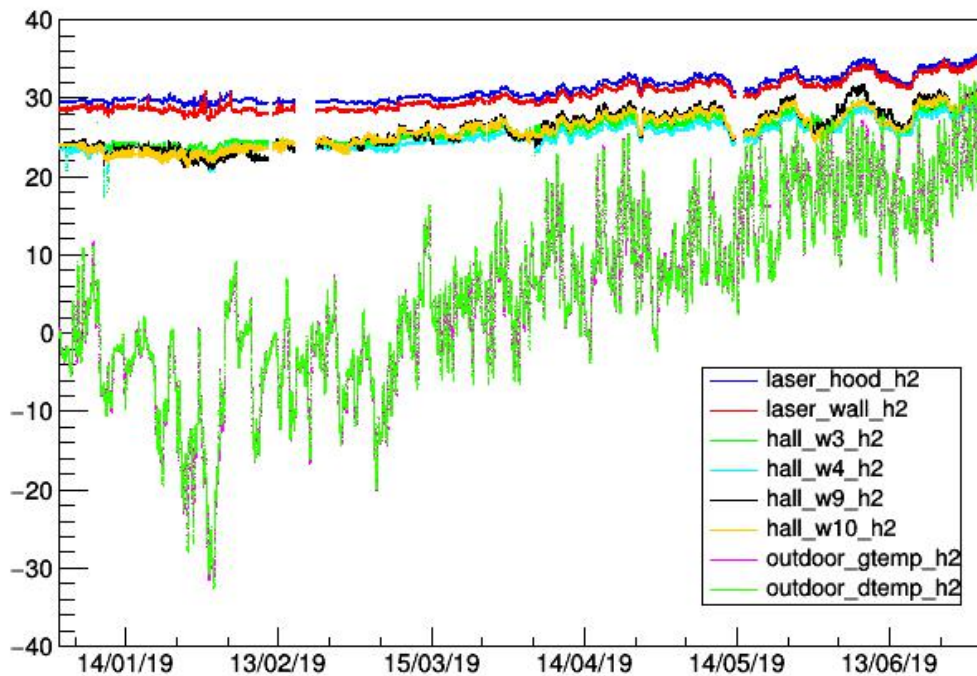
Laser Calibration System SLOW CONTROL Alarm System

The DQM Laser Monitors software (ART SIDE) check the quality of laser traces collected by DAQ

- Checks:
 - Alarm to MIDAS if pedestal $>$ pedestal threshold
 - Alarm to MIDAS if amplitude $>$ Upper Limit
 - Alarm to MIDAS if amplitude $<$ Lower Limit
- The thresholds for quality check are setted in the DQM fcl configuration file
- A failed quality check produces a MIDAS Alarm

Laser Calibration System SLOW CONTROL Alarm System

Example of environmental temperature monitoring during g-2 Run 2



Laser Calibration System SLOW CONTROL

Summary

- With Laser Slow Control System (LSC) we monitor laser chains parameters in “asynchronous” way to the beam fills
- The LSC back-end software is working on laser hut workstation
- The LSC Database is operative in dev and production environments
- The LSC Monitoring is integrated inside DQM web server
- Laser monitors and slow control Alarms works on MIDAS
- Visual warnings are available on DQM web pages for laser traces data quality monitors and slow control
- Upgrades on alarms and monitoring are under developing for Run 3