



DOOCS LLRF front-end server

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DESY - MCS

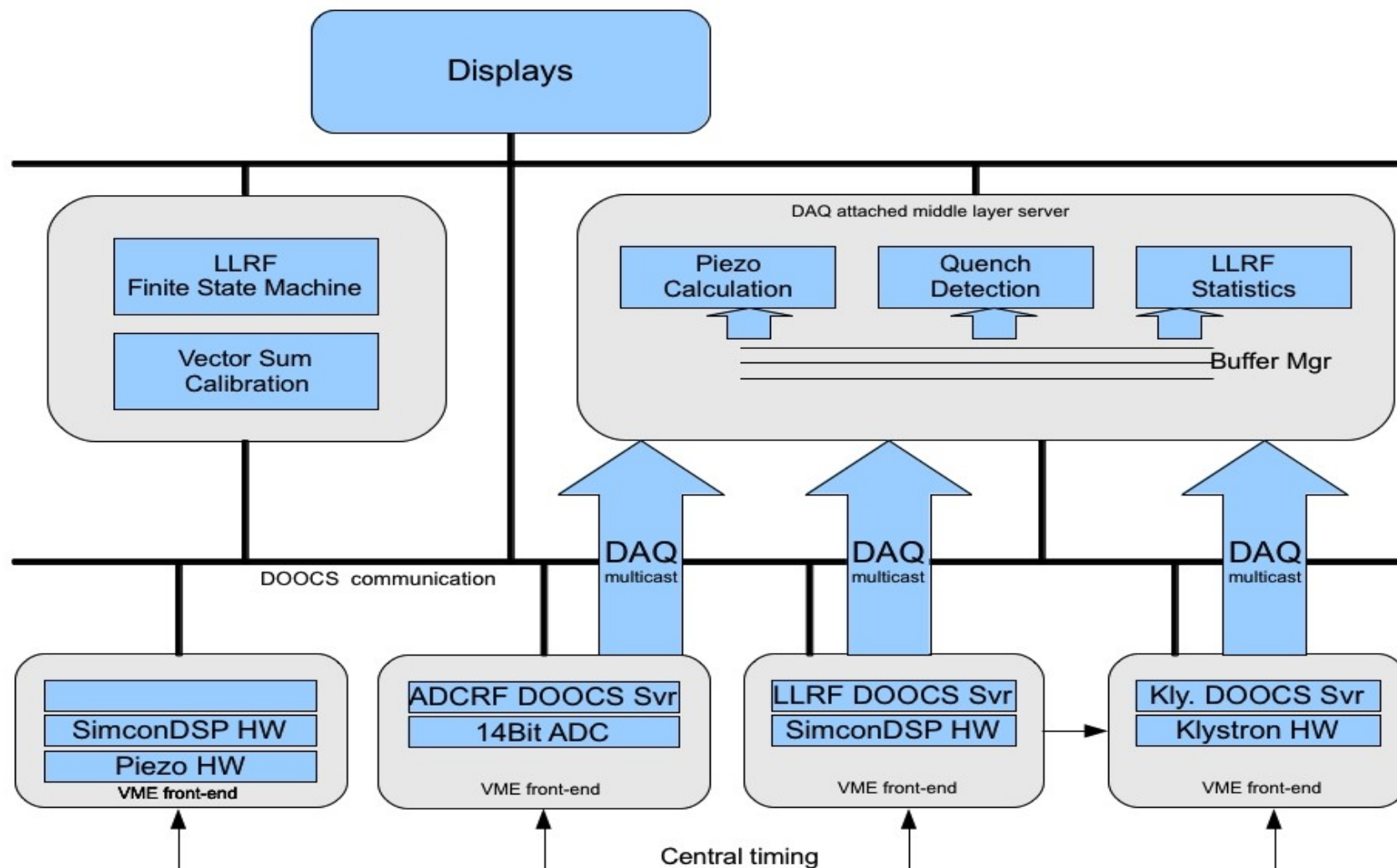




■ Overview

- Software Architecture
- LLRF controller front-end server

Software Architecture at FLASH





LLRF front-end controller server

Status of the LLRF controller server

■ Goals

- One server for all RF stations (GUN to ACC7)
 - Need to be flexible to configure
- Easier display/panel designs
- Easier high level automation
- XFEL in mind
- Automatic reload of the firmware and firmware settings
- Include basic automation
 - Output matrix correction and Flattop scaling
 - Learning Feed Forward (LFF)
 - Beam Compression Monitor (BCM)
 - Beam Loading Compensation (BLC)



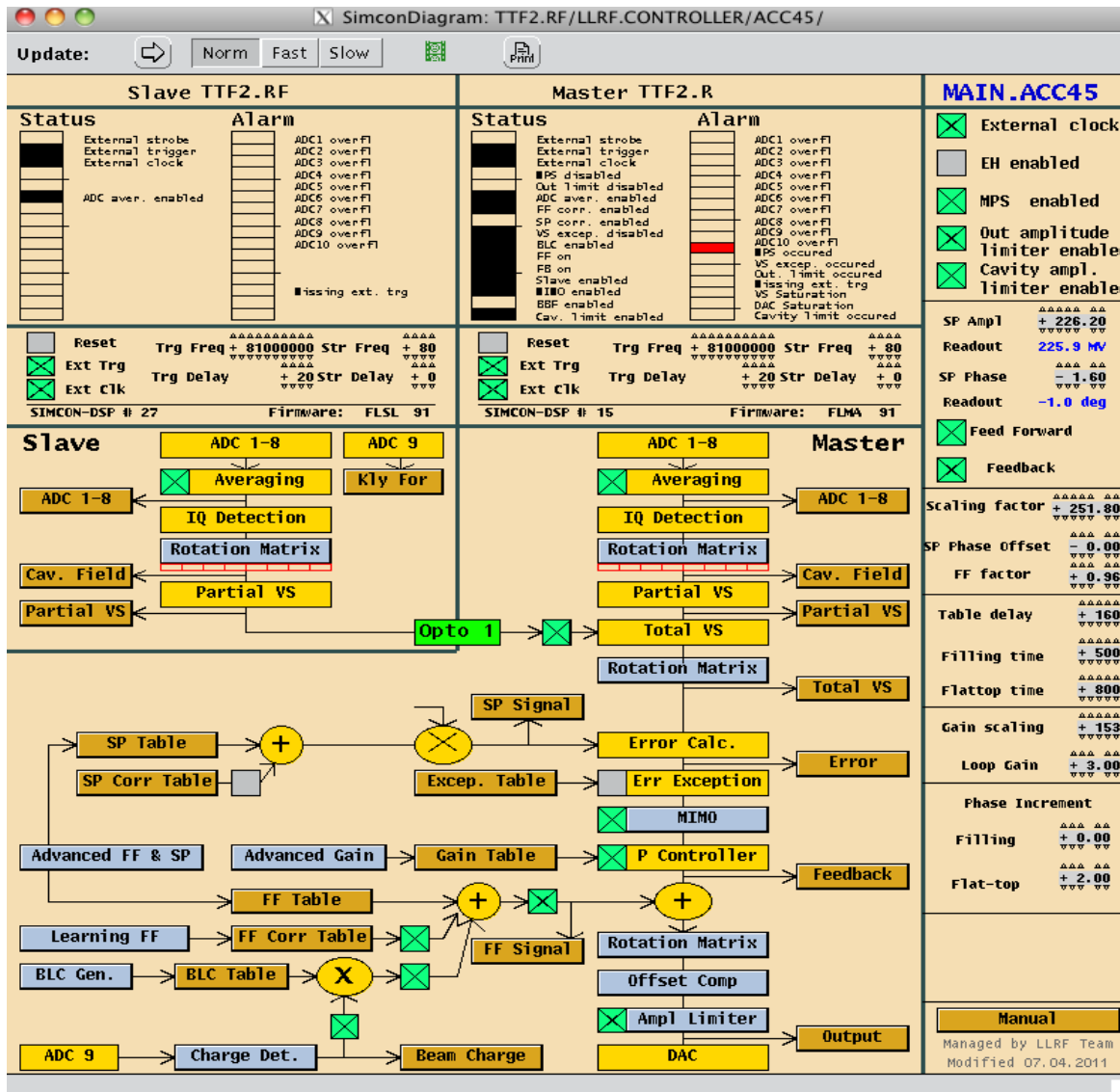
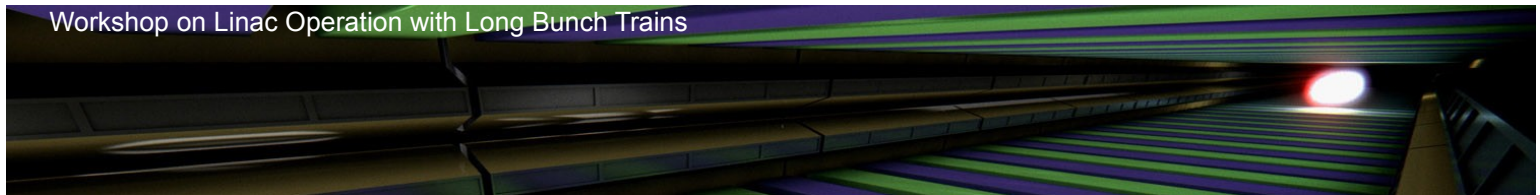
Available Classes for standard LLRF

- eq_llrf_main // has 90% of the main properties
 - eq_llrf_SCmain // Super Conducting Cavities
 - eq_llrf_gun // GUN part
- eq_llrf_board // manage one SimCON board
- eq_llrf_cav // needed per cavity
- eq_llrf_guncav // special for the GUN
- eq_llrf_VS // use for partial and total VS
- eq_llrf_lff // for Learning FeedForward



Available Classes for Beam Based Feedback

- eq_llrf_charge // Toroid readout
- eq_llrf_bcm // Beam Compression Monitor
- eq_llrf_bbf // Beam Based Feedback
- eq_llrf_acc1_39 // controls ACC1/39 together



Overview of

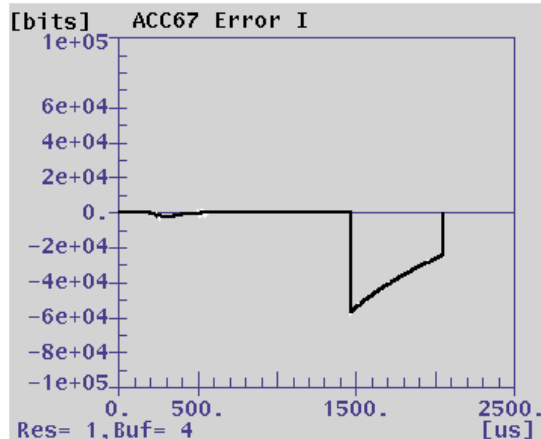
- 2 Board locations
- Shows many tables
- Set values

FeedBack controller and MIMO

FEEDBACK: TTF2.RF/LLRF.CONTROLLER/MAIN.ACC67/

Feedback settings

Controller Input



Control

☒ Feedback On

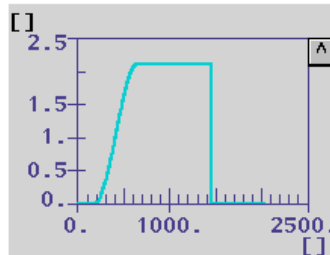
☒ MIMO On

▲▲▲▲▲
+ 3.00
▼▼▼▼▼ **H**

	11	12	21	22
A0	0.301	0.301	0.301	0.301
A1	-0.02	-0.02	-0.02	-0.02
B0	8.072	3.691	-3.36	8.554
B1	6.956	3.517	-3.66	6.613
B2	-1.45	0.024	-0.20	-1.58

Gain Scheduling

start ▲▲▲▲▲ **H** tau ▲▲▲▲▲ **H**
 stop ▲▲▲▲▲ **H** mode ▲▲▲▲▲ **H**
 Initial ▲▲▲▲▲ **H** phase ▲▲▲▲▲ **H**



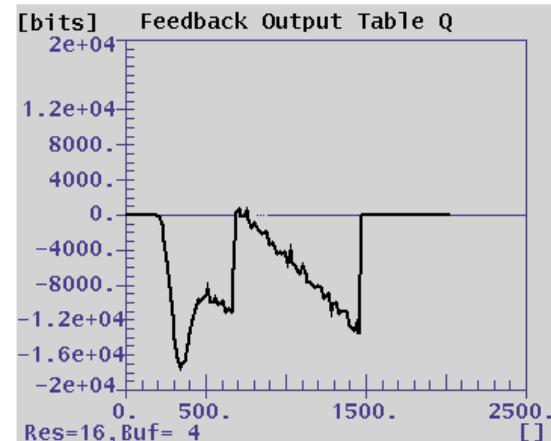
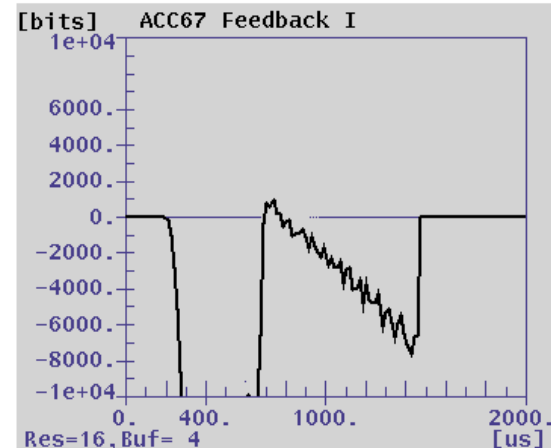
Matlab

Design

Set MIMO

Set P

Controller Output

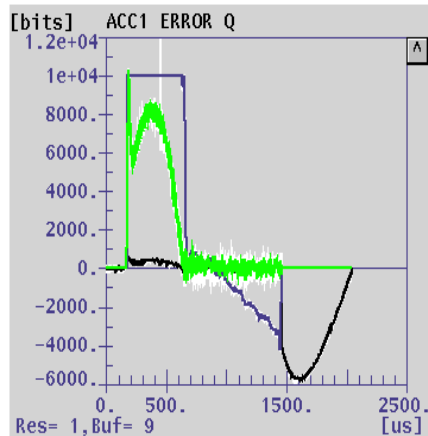
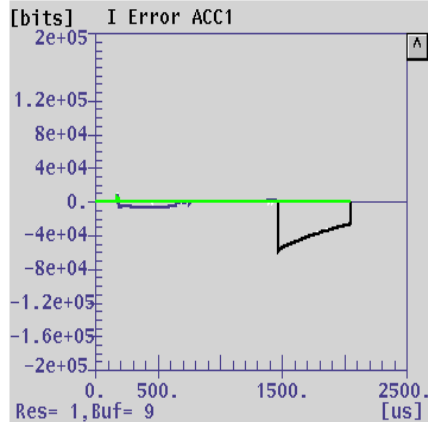


Output Rotation Matrix correction and Flattop scaling

ORC: TTF2.RF/LLRF.CONTROLLER/MAIN.ACC1/

Output Correction

Controller error signals



Control



Auto correction on

Mean-Err: 5.2 => < 10.0

Amplitude ± 0.5762 Max 0.8Phase ± 55.47

Limits 10 1000

max step FB mode FF mode

ampl sca 0.002 0.005

phase rot [deg] 0.5 5

Flattop scaling correction

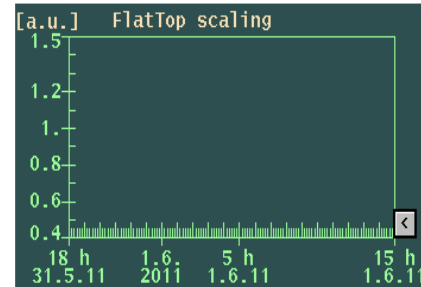
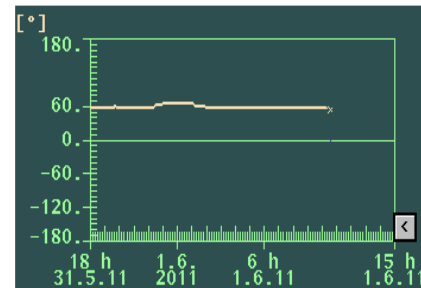
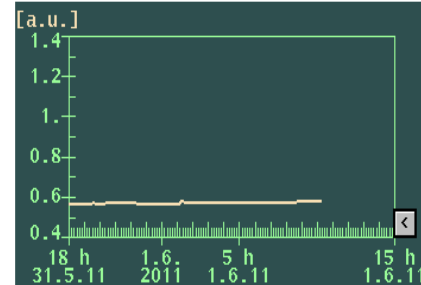
Flattop ± 0.81 0.01

Limits 20 2

Matlab

output_correction

Last adaptation steps



Using tables in

- Feed Forward

- Error signal

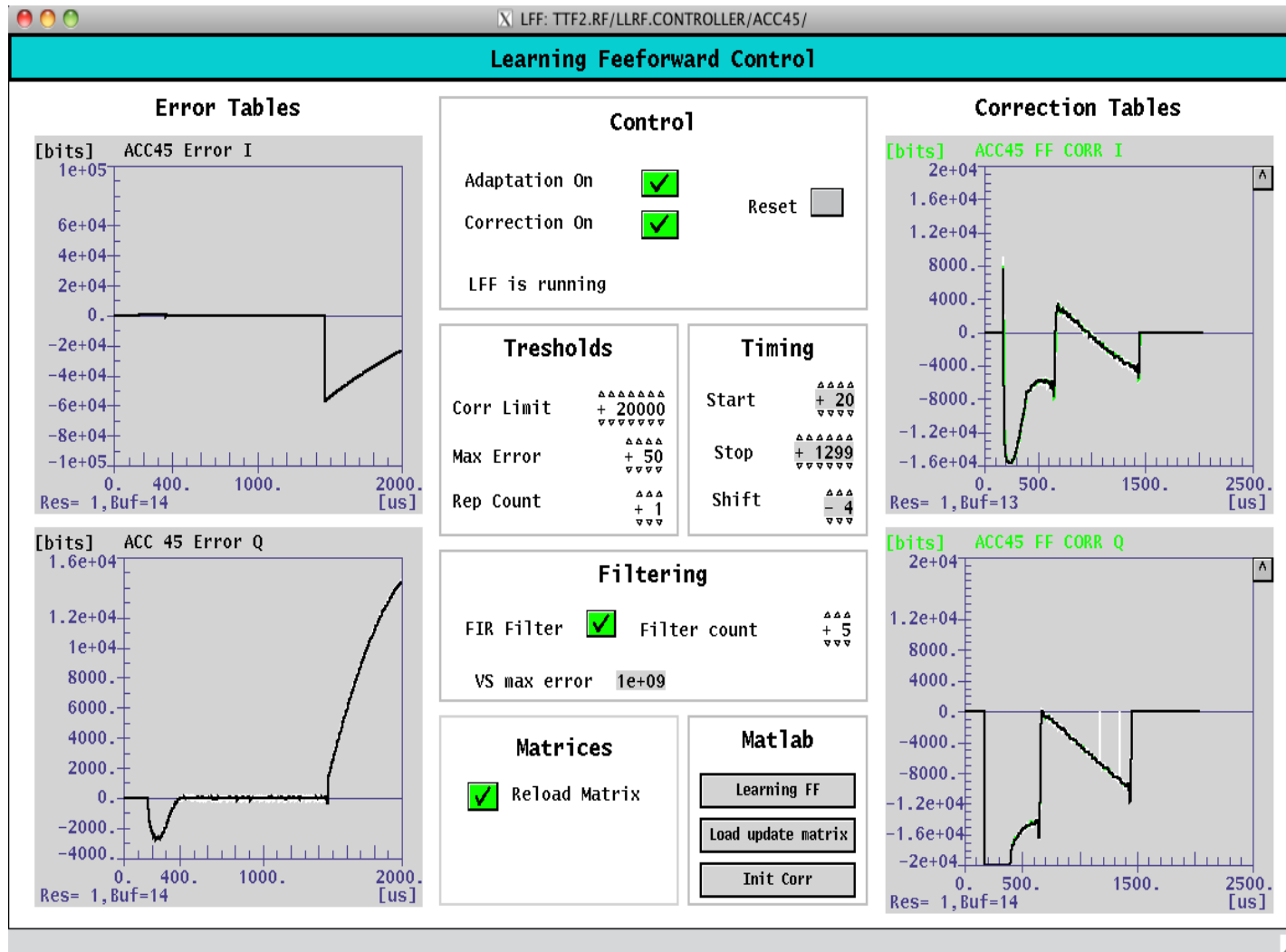
- Feed Back

- FeedBack

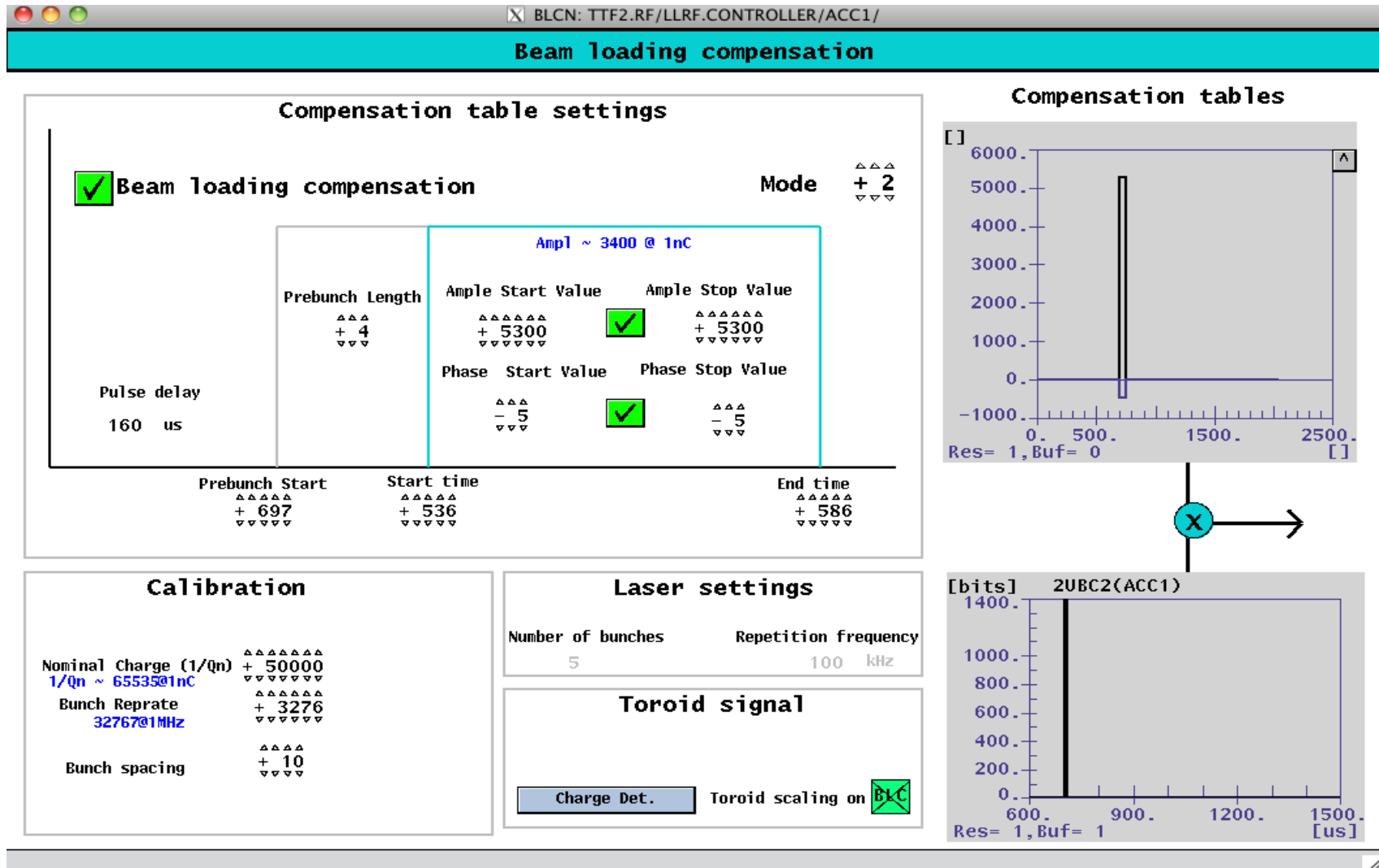
- LFF

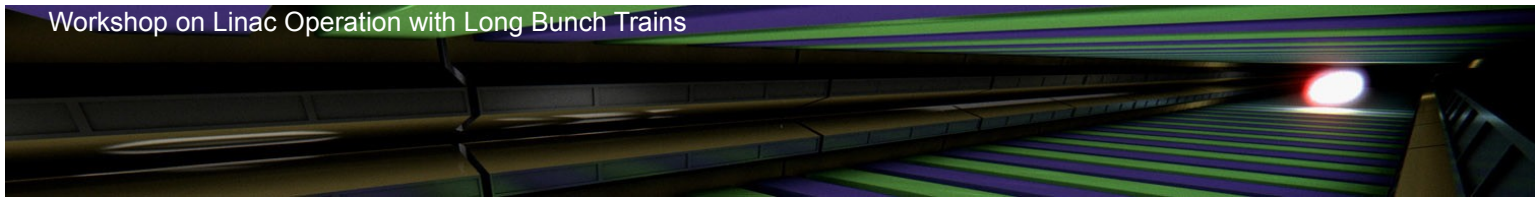
- FF correction

Learning Feed Forward (LFF)

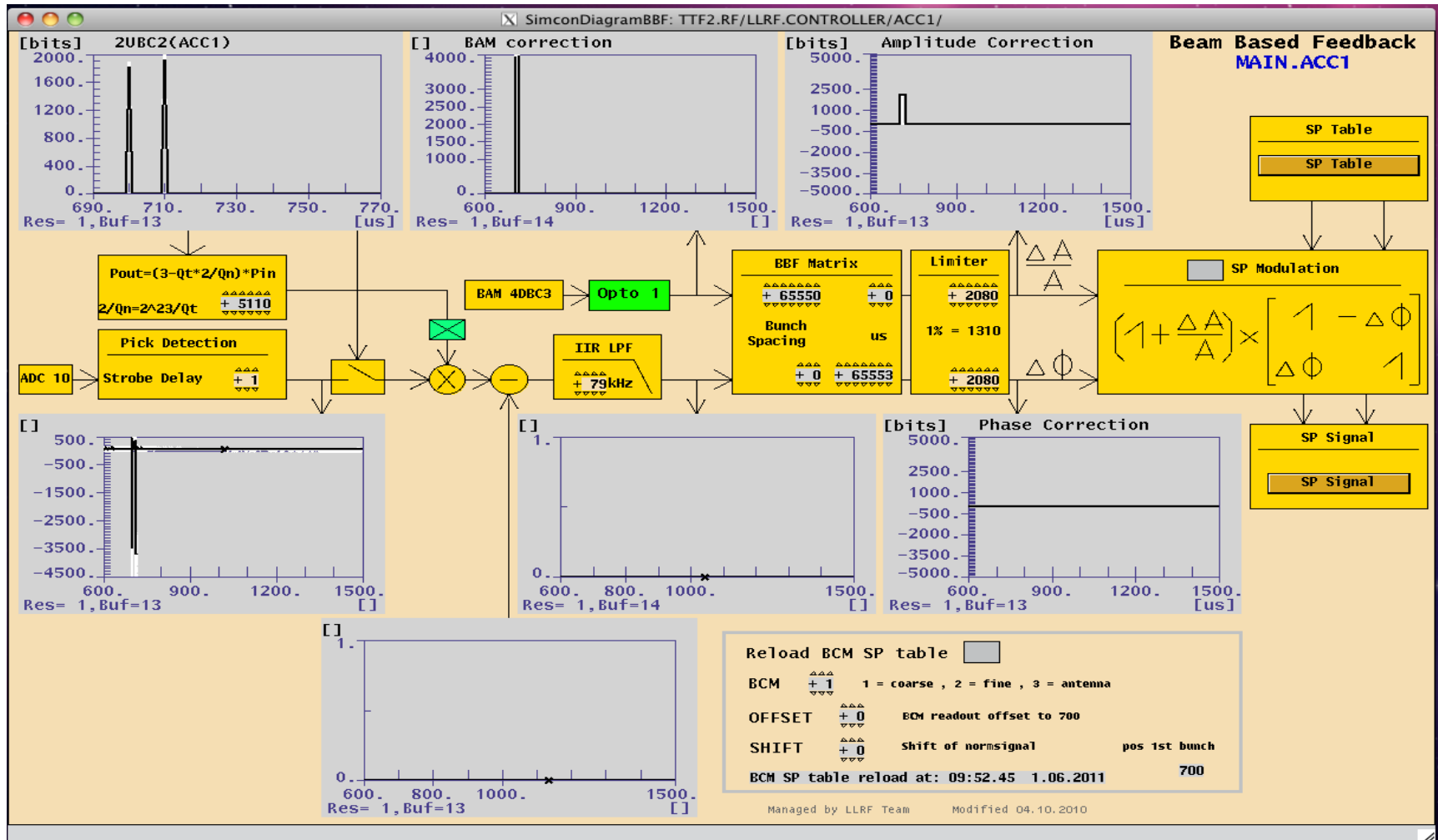


Beam Loading Compensation

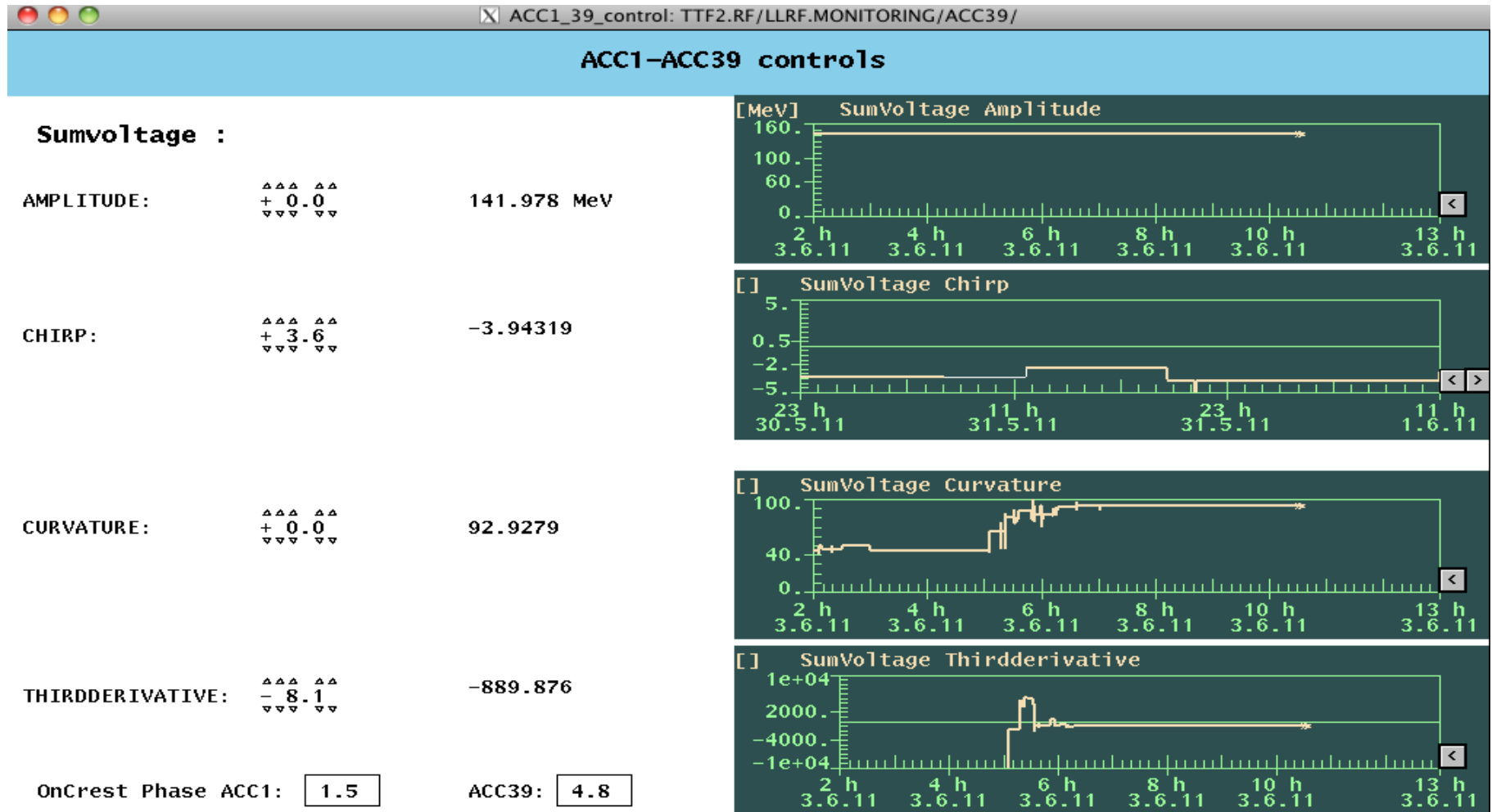




Beam Base Feedback (BBF) and Beam Arrival Monitor (BAM)



Simultaneous control of ACC1 and ACC39



Error messages in Alarm&Info

DOOCS Alarm and Info Server Display, Version 3.11 23.03.11

Menu View Help

Device Tree: **Filter ON**

- Device Tree
 - TTF2.SYSTEM
 - TTF2.FEL
 - TTF2.RF
 - TIMER
 - LLRF.WGMOTOR
 - KLY.PLC
 - KLY.ADC
 - CPL.S_ADC
 - ☒ KLY.INTERLOCK
 - ☒ MO_CONTROL
 - ☒ LLRF.MONITORING
 - LLRF.ADCDMA
 - ADCDMA
 - LLRF.ADC
 - CPL.DIO
 - CPL.TUNER
 - LLRF.CONTROLLER
 - VMEGUN1._SVR
 - BOARD.GUN
 - MAIN.GUN
 - VECTORSUM.GUN
 - PFOR.GUN
 - PREF.GUN
 - VMEGUN1.SND
 - VMEDSP1._SVR
 - BOARD.ACC1
 - BOARD.ACC39
 - MAIN.ACC1
 - MAIN.ACC39
 - VECTORSUM.ACC1
 - VECTORSUM.ACC39
 - C1.ACC1
 - C2.ACC1
 - C3.ACC1
 - C4.ACC1
 - C5.ACC1
 - C6.ACC1
 - C7.ACC1
 - C8.ACC1
 - C1.ACC39
 - C2.ACC39
 - C3.ACC39
 - C4.ACC39
 - VMEDSP1.SND
 - VMEDSP23._SVR
 - BOARD.ACC2
 - BOARD.ACC3

Pending Errors:

Location	Property	Time	Severity	Message
TTF2.RF/LLRF.CONTROLLER/MAIN.ACC39	ERROR	10:26:49,371 03.06.2011		output limiter reached ! Alarm reg: 0x1000
TTF2.DIAG/CAM.DOGLEG/68YP	ERROR	18:37:21,843 02.06.2011		Failed to capture
TTF2.RF/RF.START/ACC67	ERROR	08:04:22,973 02.06.2011		large amplitude or phase error
TTF2.DIAG/SCREEN.OPTIC/5ECOL	OUT.ERROR	08:18:14,213 24.05.2011		NTCAN_UNKNOWN(0x00000020)
TTF2.DIAG/SCREEN.OPTIC/5ECOL	IN1.ERROR	08:18:13,673 24.05.2011		NTCAN_UNKNOWN(0x00000020)
TTF2.DIAG/SCREEN.OPTIC/5ECOL	IN2.ERROR	08:18:13,126 24.05.2011		NTCAN_UNKNOWN(0x00000020)
TTF2.DIAG/SCREEN.OPTIC/5ECOL	ERROR	08:18:13,125 24.05.2011		NTCAN_UNKNOWN(0x00000020)
TTF2.DIAG/SCREEN.OPTIC/5ECOL	OUT2.ERROR	08:18:13,113 24.05.2011		NTCAN_UNKNOWN(0x00000020)
TTF2.RF/LLRF.ADC/ACC23.DAC.Q	CH00.ERROR	08:28:40,649 07.02.2011		unable to read raw value
TTF2.RF/LLRF.ADC/ACC23.DAC.I	CH00.ERROR	08:28:40,636 07.02.2011		unable to read raw value

Ticker Table History Table

History of selected location: [TTF2.SYSTEM/VMETOSY.WATCH](#)

Time	Name	Severity	Message
10:11:51,718 03.06.2011	TTF2.SYSTEM/VMETOSY.WA...		NO HISTORY FOUND !!

Conclusion

- The same server runs at all stations with
 - 1, 4, 8 and 16 cavities
- Supports
 - 1 master operation (GUN)
 - 2 master operation (ACC1/ACC39)
 - 1 master, 1 slave (ACC23/45/67)
- Firmware and settings reloaded automatically
- Many algorithms are included
- Will be the software base for XFEL design
- μ TCA port has started
 - VME hardware dependency is already separated



Thanks for your attention