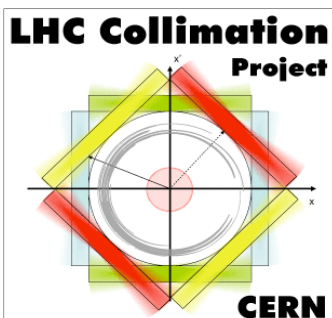


*51st meeting of the
LHC Commissioning Working Group
July 15th, 2008*

Remote Commissioning of the LHC Collimators

**S. Redaelli, AB / OP
for the Collimation Team**

Acknowledgments: F. Follin, D. Jacquet, M. Lamont, G. Kruk for the LSA team, E. Veyrunes, R. Billen's team, et al.



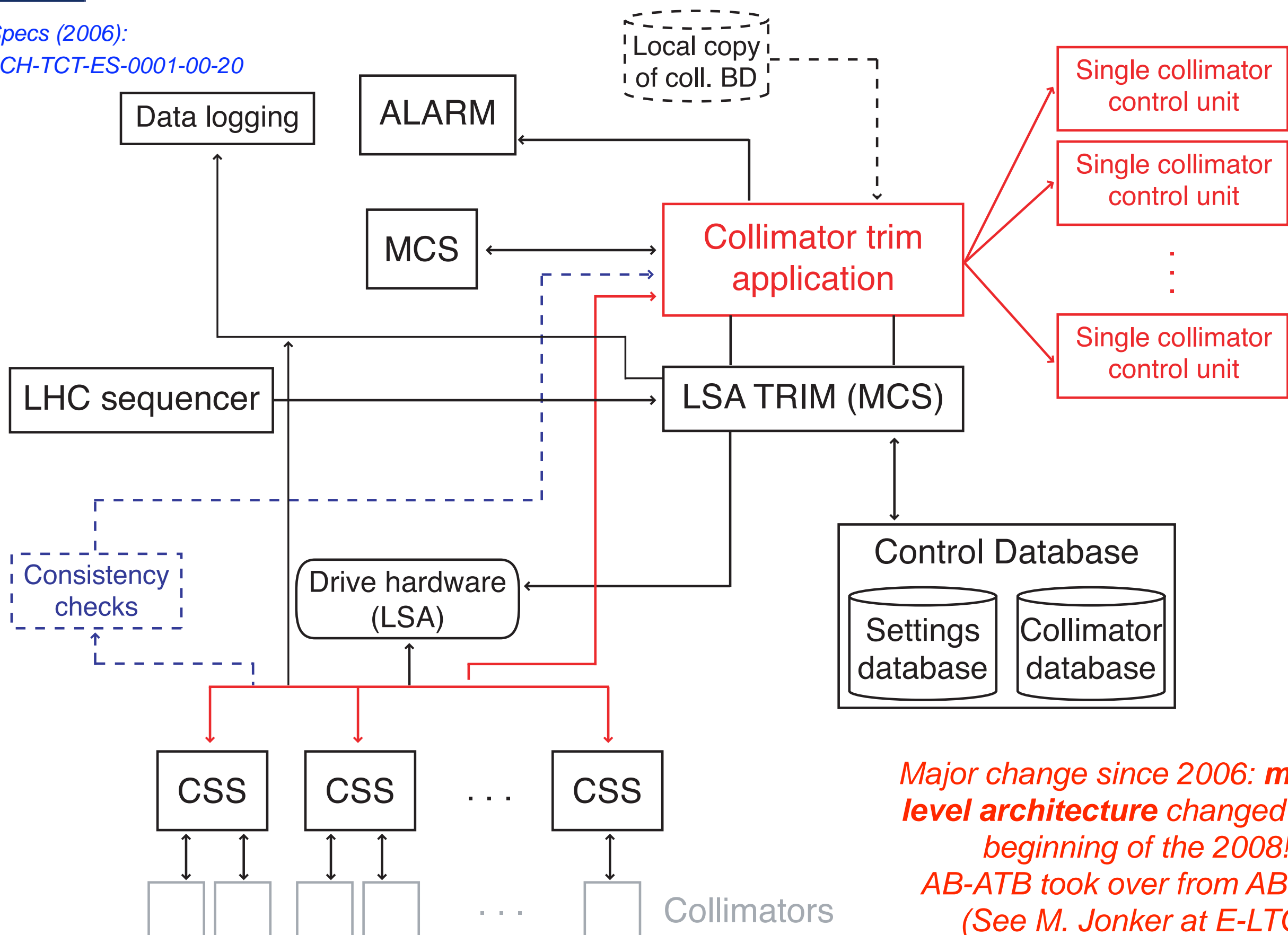
Outline

- **Status of collimator controls**
- **Result of remote commissioning**
- **Beam commissioning at TI2**
- **Open issues**
- **Conclusions**

*See also: Ralph's talk
OP Cold-checkout meeting of Nov. 2007
M. Jonker at the E-LTC of Feb. 2008*

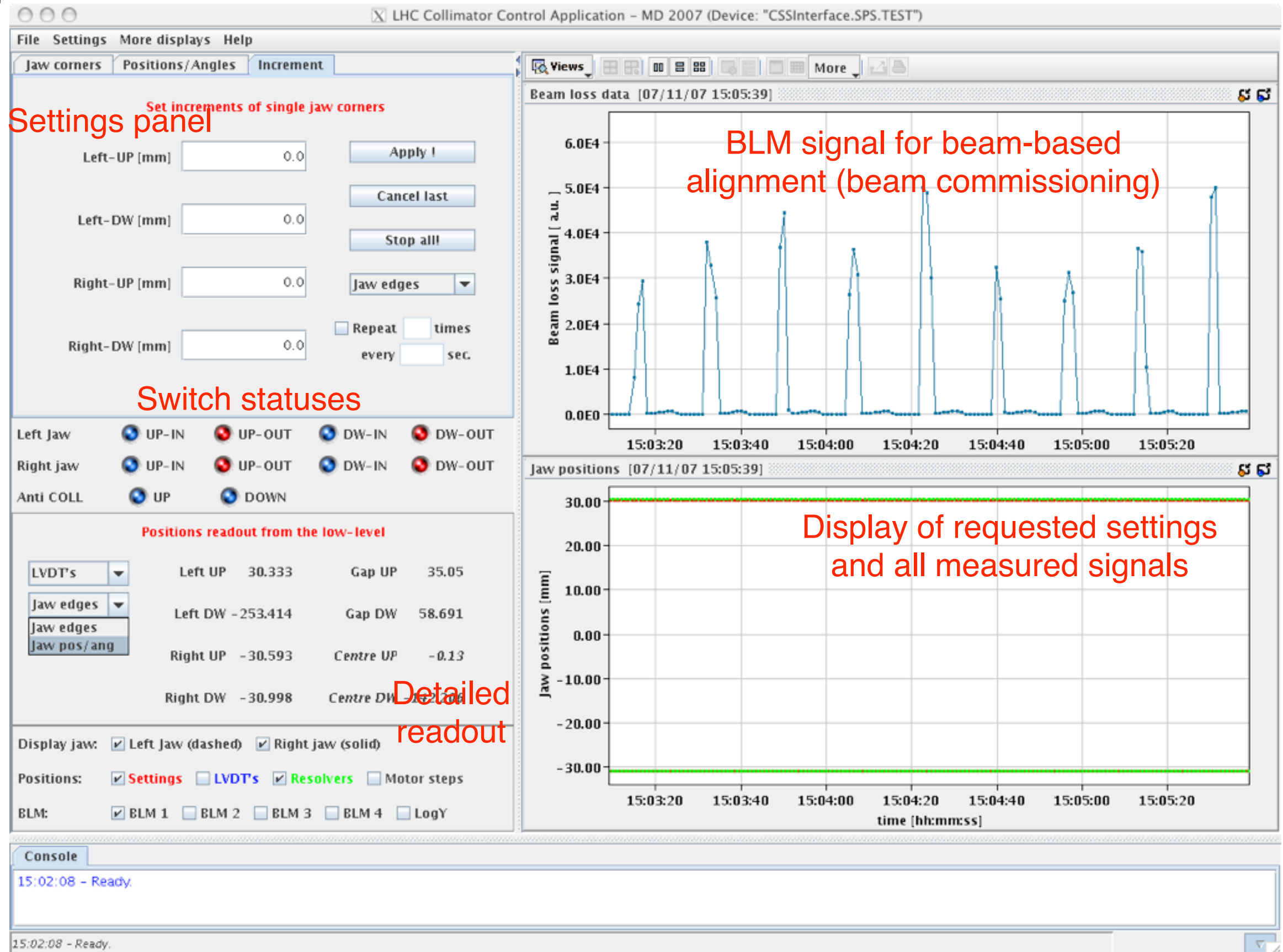
Top-level controls architecture

Specs (2006):
LCH-TCT-ES-0001-00-20

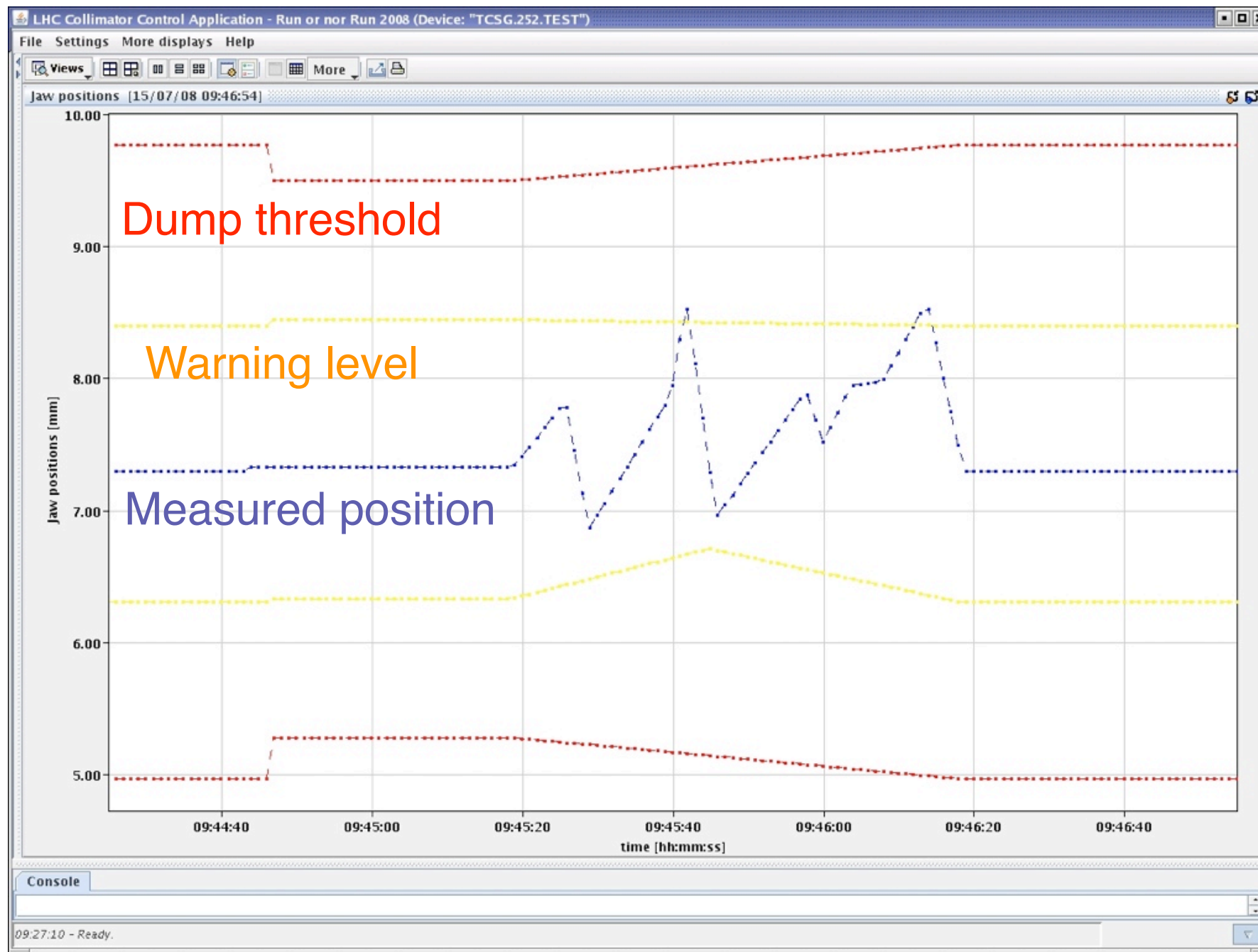


*Major change since 2006: **middle-level architecture** changed at the beginning of the 2008! AB-ATB took over from AB-CO. (See M. Jonker at E-LTC)*

Single collimator control unit



Updated version under construction



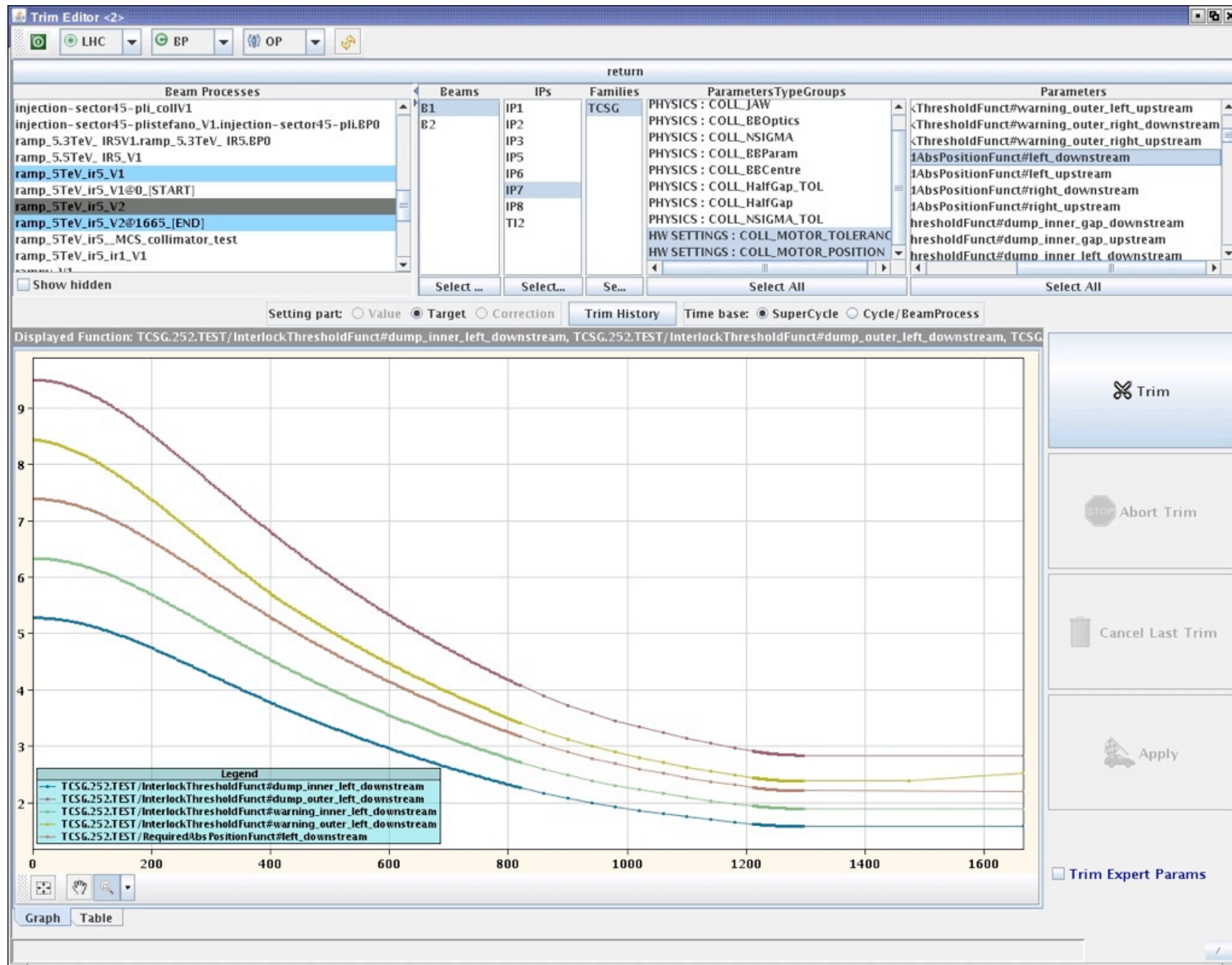
On-line display of interlock warning and dump levels
More automatic interface to the database for configuration
(E. Veyrunes)

Fixed-display tool

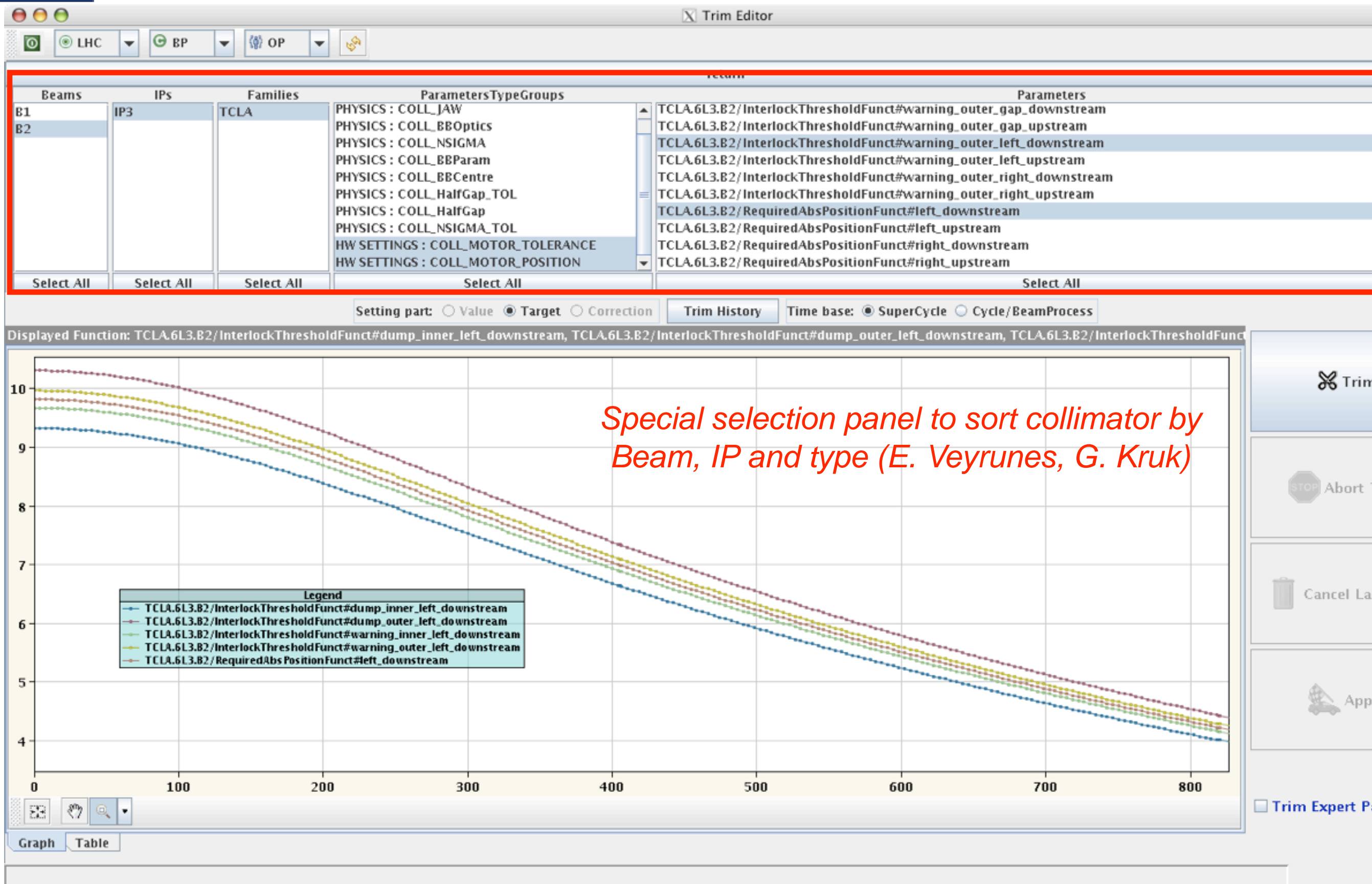
Available Collimators Group					
Unavailable Collimators Group					
Collimators in IP2		Collimators in IP3		Collimators in IP5	
●	● TCTH.4L2.B1 ●	●	● TCSG.5L3.B1 ●	●	● TCTH.4L5.B1 ●
●		●	● TCSG.B5R3.B1 ●	●	● TCTVA.4L5.B1 ●
		●	● TCSG.A5R3.B1 ●		
		●	● TCSG.4R3.B1 ●		
Collimators in IP6		Collimators in IP7			
●	● TCSG.4R6.B1 ●	●	● TCSG.A6L7.B1 ●		
		●	● TCSG.B4L7.B1 ●		
		●	● TCSG.A5L7.B1 ●		
		●	● TCSG.A4R7.B1 ●		
		●	● TCSG.252.TEST ●		
		●	● TCSG.6R7.B1 ●		
		●	● TCSG.A4L7.B1 ●		

First implementation by P. Nuno. Followed up by E. Veyrunes.

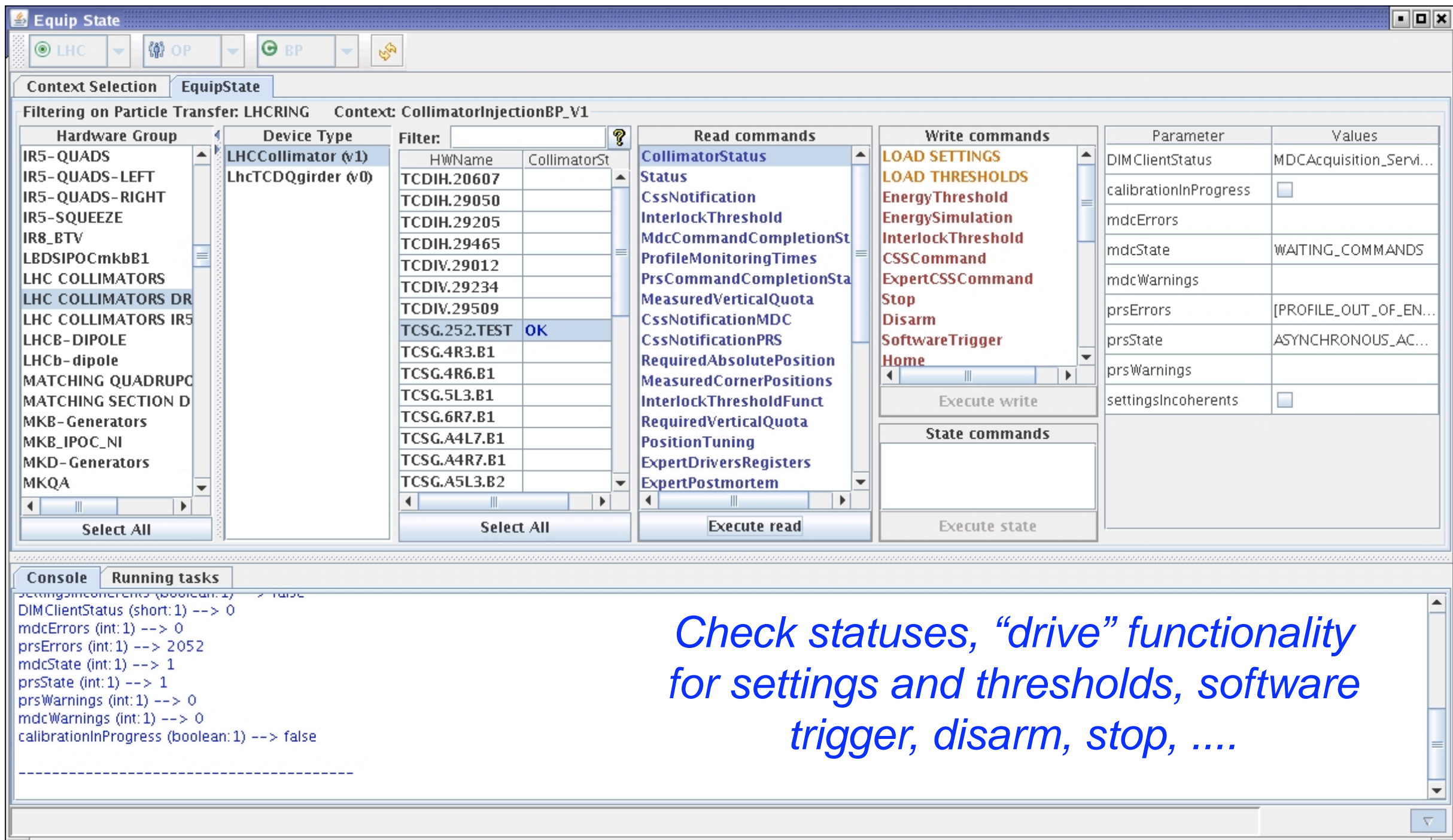
Function-based settings



Example:
Nominal ramp
functions for
the 5 TeV run



Special selection panel to sort collimator by Beam, IP and type (E. Veyrunes, G. Kruk)



Equip State

Context Selection: EquipState

Filtering on Particle Transfer: LHCRING Context: CollimatorInjectionBP_V1

Hardware Group	Device Type	Filter:	Read commands	Write commands	Parameter	Values
IR5-QUADS	LHCCollimator (v1)	HWName	CollimatorStatus	LOAD SETTINGS	DIMClientStatus	MDCAcquisition_Servi...
IR5-QUADS-LEFT	LhcTCDQgirdler (v0)	TCDIH.20607	Status	LOAD THRESHOLDS	calibrationInProgress	<input type="checkbox"/>
IR5-QUADS-RIGHT		TCDIH.29050	CssNotification	EnergyThreshold	mdcErrors	
IR5-SQUEEZE		TCDIH.29205	InterlockThreshold	EnergySimulation	mdcState	WAITING_COMMANDS
IR8_BTV		TCDIH.29465	MdcCommandCompletionSt	InterlockThreshold	mdcWarnings	
LBDSIPOCmkbB1		TCDIV.29012	ProfileMonitoringTimes	CSSCommand	prsErrors	[PROFILE_OUT_OF_EN...
LHC COLLIMATORS		TCDIV.29234	PrsCommandCompletionSta	ExpertCSSCommand	prsState	ASYNCHRONOUS_AC...
LHC COLLIMATORS DR		TCDIV.29509	MeasuredVerticalQuota	Stop	prsWarnings	
LHC COLLIMATORS IR5		TCSG.252.TEST OK	CssNotificationMDC	Disarm	settingsIncoherents	<input type="checkbox"/>
LHCB-DIPOLE		TCSG.4R3.B1	CssNotificationPRS	SoftwareTrigger		
LHCb-dipole		TCSG.4R6.B1	RequiredAbsolutePosition	Home		
MATCHING QUADRUPO		TCSG.5L3.B1	MeasuredCornerPositions			
MATCHING SECTION D		TCSG.6R7.B1	InterlockThresholdFunct			
MKB-Generators		TCSG.A4L7.B1	RequiredVerticalQuota			
MKB_IPOC_NI		TCSG.A4R7.B1	PositionTuning			
MKD-Generators		TCSG.A5L3.B2	ExpertDriversRegisters			
MKQA			ExpertPostmortem			

Console Running tasks

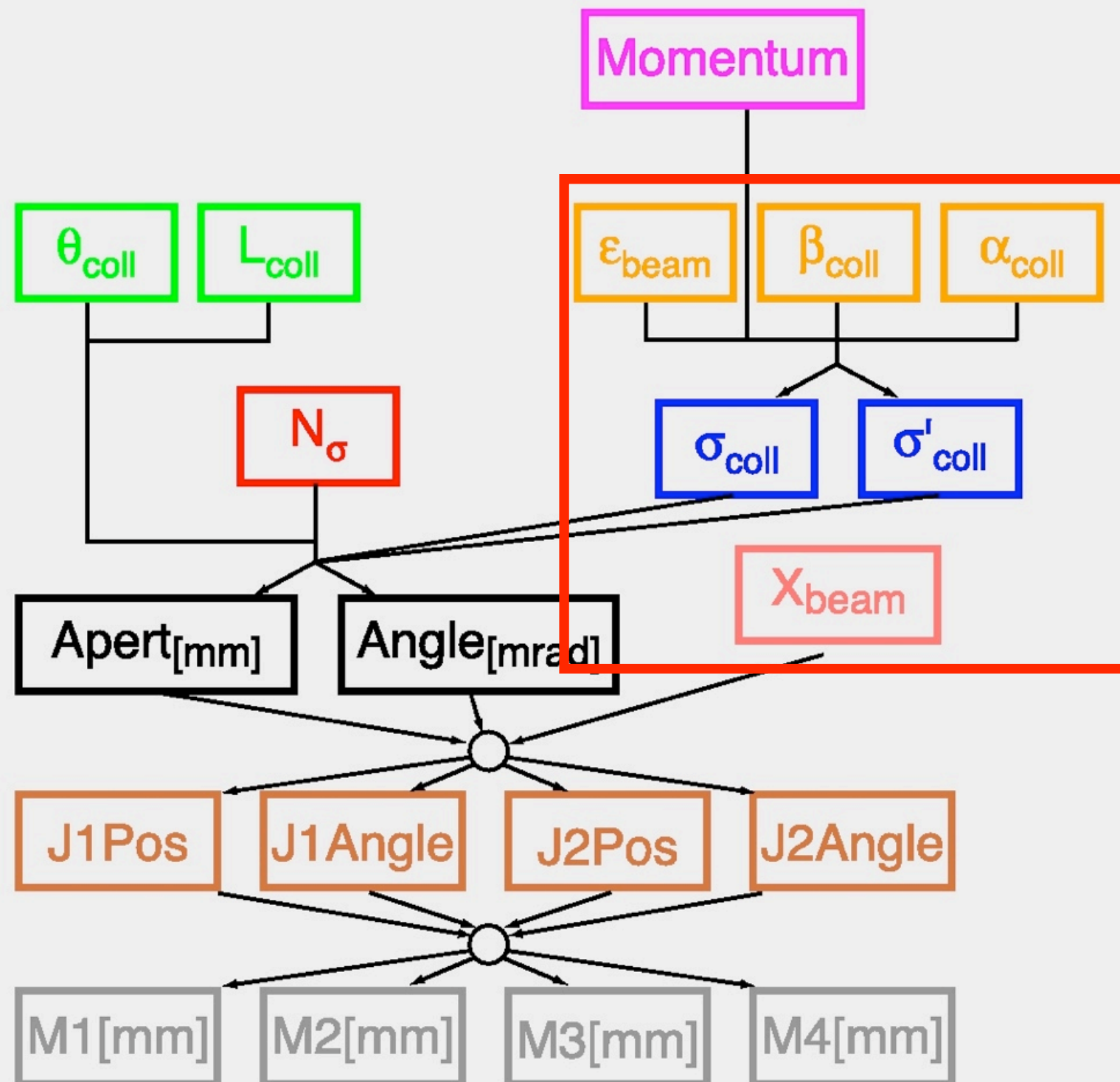
```

DIMClientStatus (short: 1) --> 0
mdcErrors (int: 1) --> 0
prsErrors (int: 1) --> 2052
mdcState (int: 1) --> 1
prsState (int: 1) --> 1
prsWarnings (int: 1) --> 0
mdcWarnings (int: 1) --> 0
calibrationInProgress (boolean: 1) --> false
  
```

Check statuses, “drive” functionality for settings and thresholds, software trigger, disarm, stop,

Looking forward to asses the operationability during the cold-checkout...

What is behind...

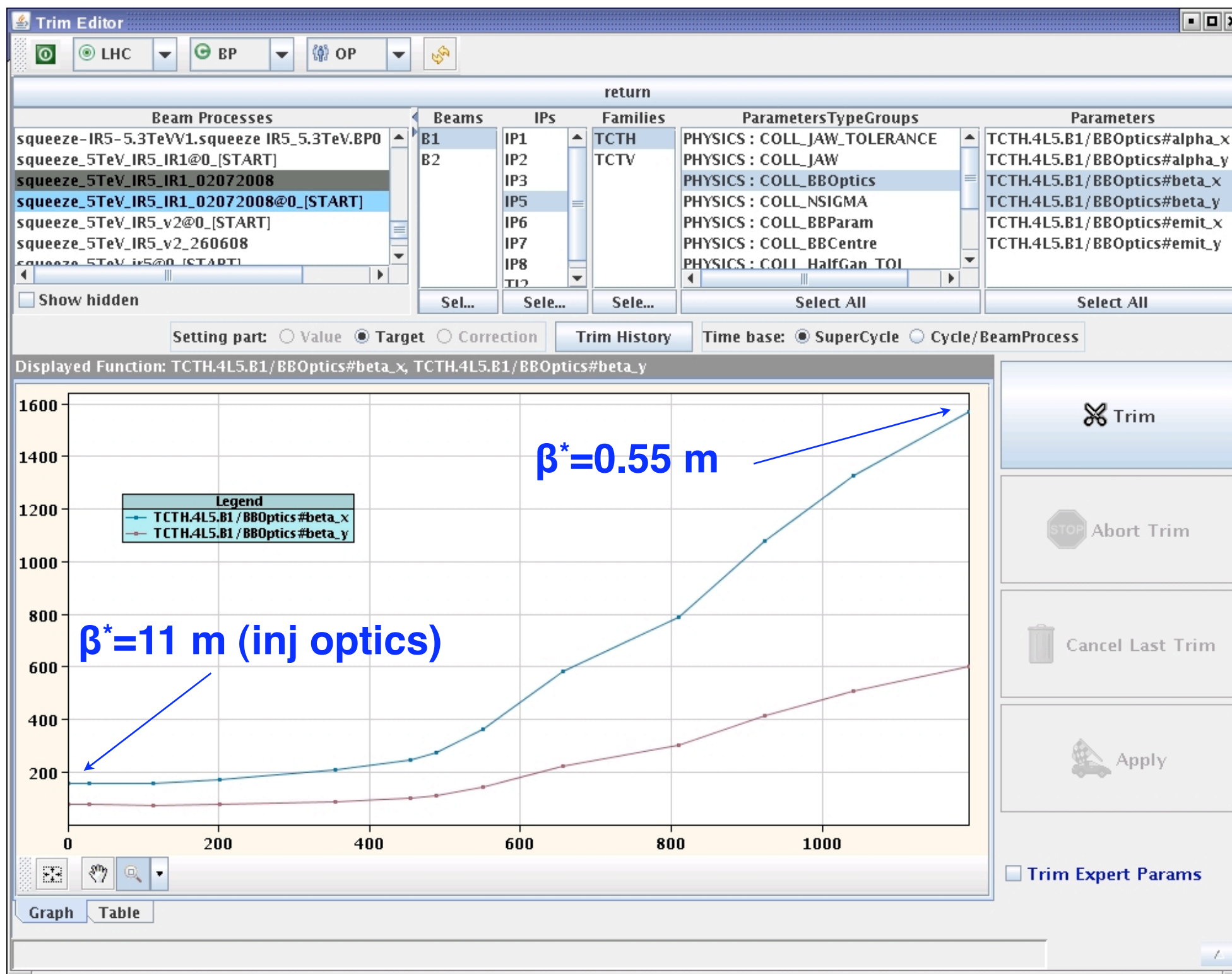


Parameter space for settings in **units sigma!**
(trims at all levels possible!)

Beam-based parameters will be determined for each collimator with beam and stored in the setting DB
(now: nominal values imported at the generation level)

Database definition of the parameter space and the associate makerules maintained by D. Jacquet, great support from LSA team!

Example: Optics values



*Nominal **beta functions** versus time at the tertiary collimators within a squeeze “beam process” at 5 TeV.*

Optics V6.503 used.

TCT s do not necessarily need to be moved (see Ralph s talk) but the information will be there!

Query Output Query Variable Hierarchies Variable Search Variable Lists About

Hierarchy Variable Selection

- ROOT
 - ADE
 - ATLAS
 - CNGS
 - CTF3
 - Fundamental Data
 - LEIR
 - LHC
 - BLM
 - BPM
 - Beam Instrumentation
 - Beam dump
 - Collimators
 - Positions
 - B1
 - IP1
 - IP2
 - IP3
 - IP5
 - IP6
 - IP7
 - TCLA
 - TCP
 - TCSG
 - DiscreteSettings
 - DiscreteThresholds
 - FunctionSettings
 - FunctionThresholds
 - MeasuredCornerPositions
 - MeasuredVerticalQuota
 - QuotaSettings
 - Status
 - expertMDCDiagnostics
 - expertPRSDiagnostics
 - IP8
 - B2
 - Kickers
 - MD
 - Power Converters
 - RF
 - Radiation
 - LHC HWC
 - LHCBLM
 - LHCBLMbeam1
 - LHCBLMbeam2
 - LINAC2
 - LINAC3
 - PS
 - PSB
 - SM 18
 - SPS
 - SPS-EA
 - SYSTEM
 - TI2
 - TI8

Variable Filters

Name: % Type: %

Search Results

Variable Name	Description	Unit	Datatype
TCSG.252.TEST:MEAS_LIMIT_DUMP_INNER_GD	Value of dump li...	mm	NUMERIC
TCSG.252.TEST:MEAS_LIMIT_DUMP_INNER_GU	Value of dump li...	mm	NUMERIC
TCSG.252.TEST:MEAS_LIMIT_DUMP_INNER_LD	Value of dump li...	mm	NUMERIC
TCSG.252.TEST:MEAS_LIMIT_DUMP_INNER_LU	Value of dump li...	mm	NUMERIC
TCSG.252.TEST:MEAS_LIMIT_DUMP_INNER_RD	Value of dump li...	mm	NUMERIC
TCSG.252.TEST:MEAS_LIMIT_DUMP_INNER_RU	Value of dump li...	mm	NUMERIC
TCSG.252.TEST:MEAS_LIMIT_DUMP_OUTER_GD	Value of dump li...	mm	NUMERIC
TCSG.252.TEST:MEAS_LIMIT_DUMP_OUTER_GU	Value of dump li...	mm	NUMERIC
TCSG.252.TEST:MEAS_LIMIT_DUMP_OUTER_LD	Value of dump li...	mm	NUMERIC
TCSG.252.TEST:MEAS_LIMIT_DUMP_OUTER_LU	Value of dump li...	mm	NUMERIC
TCSG.252.TEST:MEAS_LIMIT_DUMP_OUTER_RD	Value of dump li...	mm	NUMERIC
TCSG.252.TEST:MEAS_LIMIT_DUMP_OUTER_RU	Value of dump li...	mm	NUMERIC
TCSG.252.TEST:MEAS_LIMIT_WARN_INNER_GD	Value of warning...	mm	NUMERIC
TCSG.252.TEST:MEAS_LIMIT_WARN_INNER_GU	Value of warning...	mm	NUMERIC
TCSG.252.TEST:MEAS_LIMIT_WARN_INNER_LD	Value of warning...	mm	NUMERIC
TCSG.252.TEST:MEAS_LIMIT_WARN_INNER_LU	Value of warning...	mm	NUMERIC
TCSG.252.TEST:MEAS_LIMIT_WARN_INNER_RD	Value of warning...	mm	NUMERIC
TCSG.252.TEST:MEAS_LIMIT_WARN_INNER_RU	Value of warning...	mm	NUMERIC
TCSG.252.TEST:MEAS_LIMIT_WARN_OUTER_GD	Value of warning...	mm	NUMERIC
TCSG.252.TEST:MEAS_LIMIT_WARN_OUTER_GU	Value of warning...	mm	NUMERIC
TCSG.252.TEST:MEAS_LIMIT_WARN_OUTER_LD	Value of warning...	mm	NUMERIC
TCSG.252.TEST:MEAS_LIMIT_WARN_OUTER_LU	Value of warning...	mm	NUMERIC
TCSG.252.TEST:MEAS_LIMIT_WARN_OUTER_RD	Value of warning...	mm	NUMERIC
TCSG.252.TEST:MEAS_LIMIT_WARN_OUTER_RU	Value of warning...	mm	NUMERIC
TCSG.252.TEST:MEAS_LVDT_GD	LVDT position re...	mm	NUMERIC
TCSG.252.TEST:MEAS_LVDT_GU	LVDT position re...	mm	NUMERIC
TCSG.252.TEST:MEAS_LVDT_LD	LVDT position re...	mm	NUMERIC
TCSG.252.TEST:MEAS_LVDT_LU	LVDT position re...	mm	NUMERIC
TCSG.252.TEST:MEAS_LVDT_RD	LVDT position re...	mm	NUMERIC
TCSG.252.TEST:MEAS_LVDT_RU	LVDT position re...	mm	NUMERIC
TCSG.252.TEST:MEAS_MDCERRORS	Error state of M...		NUMERIC
TCSG.252.TEST:MEAS_MDCSTATE	State of MDC (pu...		NUMERIC
TCSG.252.TEST:MEAS_MDCWARNINGS	Warning state of ...		NUMERIC
TCSG.252.TEST:MEAS_MOTOR_LD	Motor position r...	mm	NUMERIC
TCSG.252.TEST:MEAS_MOTOR_LU	Motor position r...	mm	NUMERIC
TCSG.252.TEST:MEAS_MOTOR_RD	Motor position r...	mm	NUMERIC
TCSG.252.TEST:MEAS_MOTOR_RU	Motor position r...	mm	NUMERIC
TCSG.252.TEST:MEAS_PROFILE_TIME	Time stamp fro...	ns	NUMERIC
TCSG.252.TEST:MEAS_PRSEERRORS	Error state of PR...		NUMERIC
TCSG.252.TEST:MEAS_PRSTATE	State of PRS (pu...		NUMERIC
TCSG.252.TEST:MEAS_PRSWARNINGS	Warning state of ...		NUMERIC
TCSG.252.TEST:MEAS_RESOLVER_LD	Resolver positio...	mm	NUMERIC
TCSG.252.TEST:MEAS_RESOLVER_LU	Resolver positio...	mm	NUMERIC

Select All Select None Add Selected

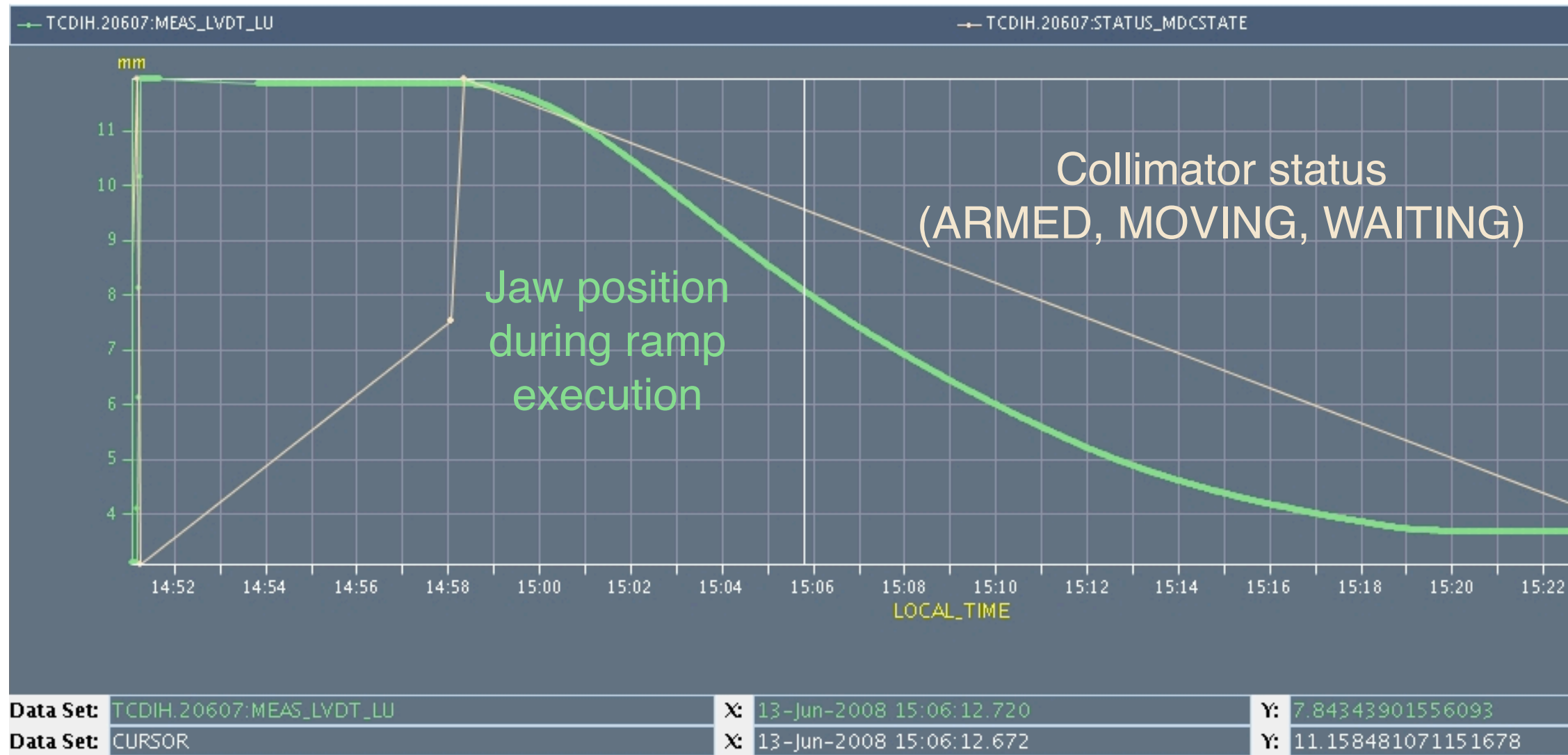
About **13'000 collimator logging variables** entered in the measurement and logging databases (LHC+TI2+TI8).

Temperature (+500 variables) will be added soon.

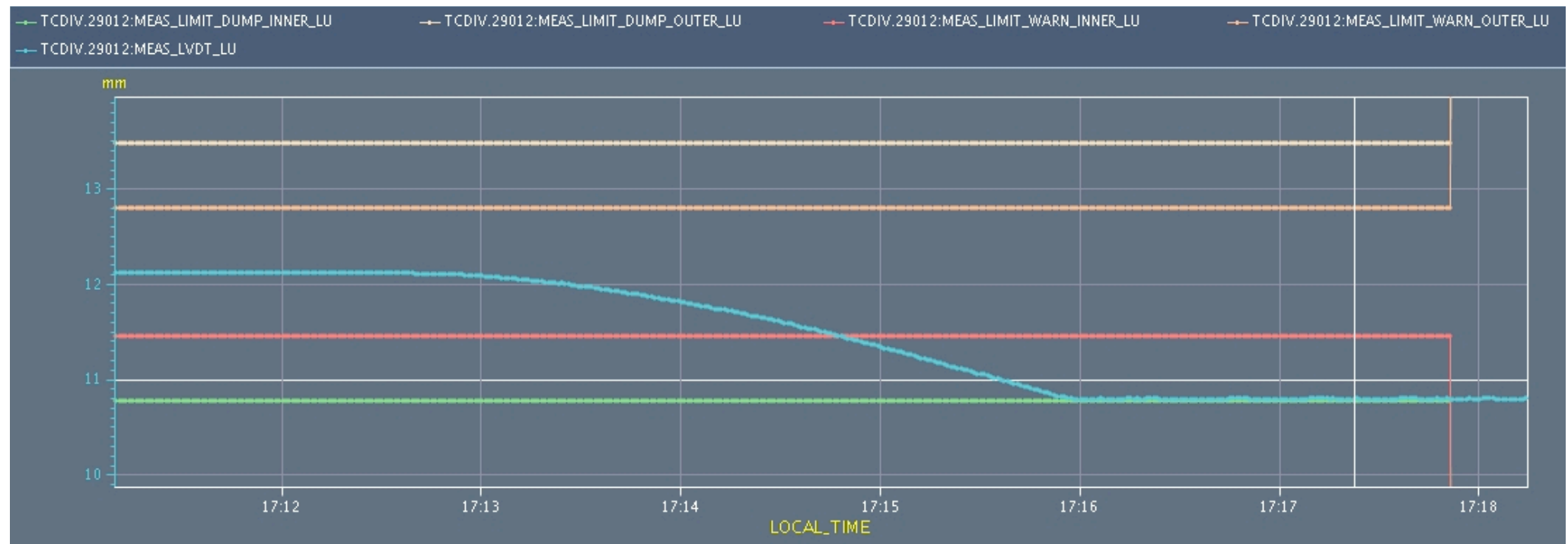
Special thanks to the work of R. Billen, C. Roderick.

Thanks also to M. Gourber-Pace, N. Hoibian

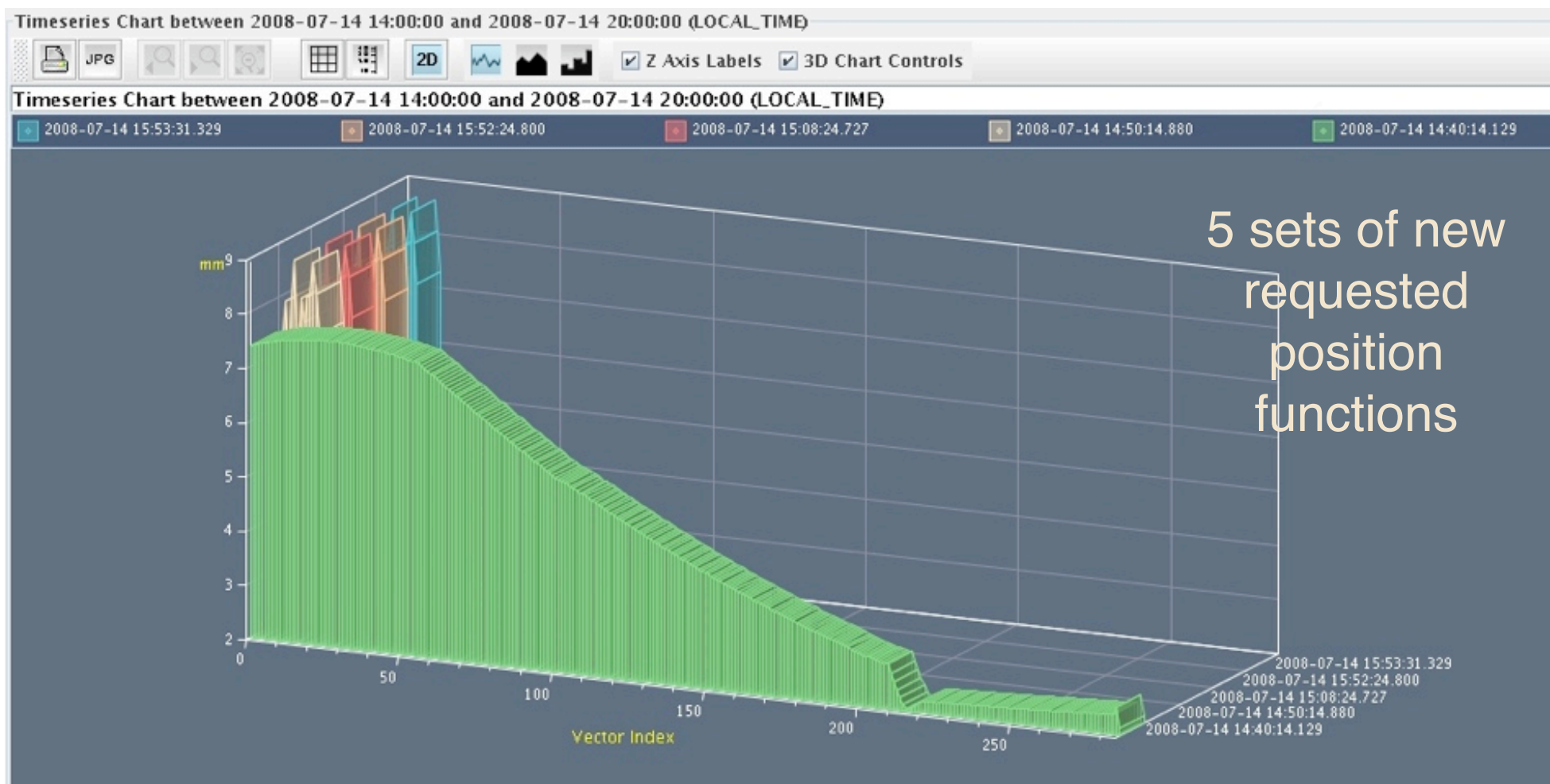
Examples



Limit functions
(dump+warning)
are also logged for
each degree of
freedom.

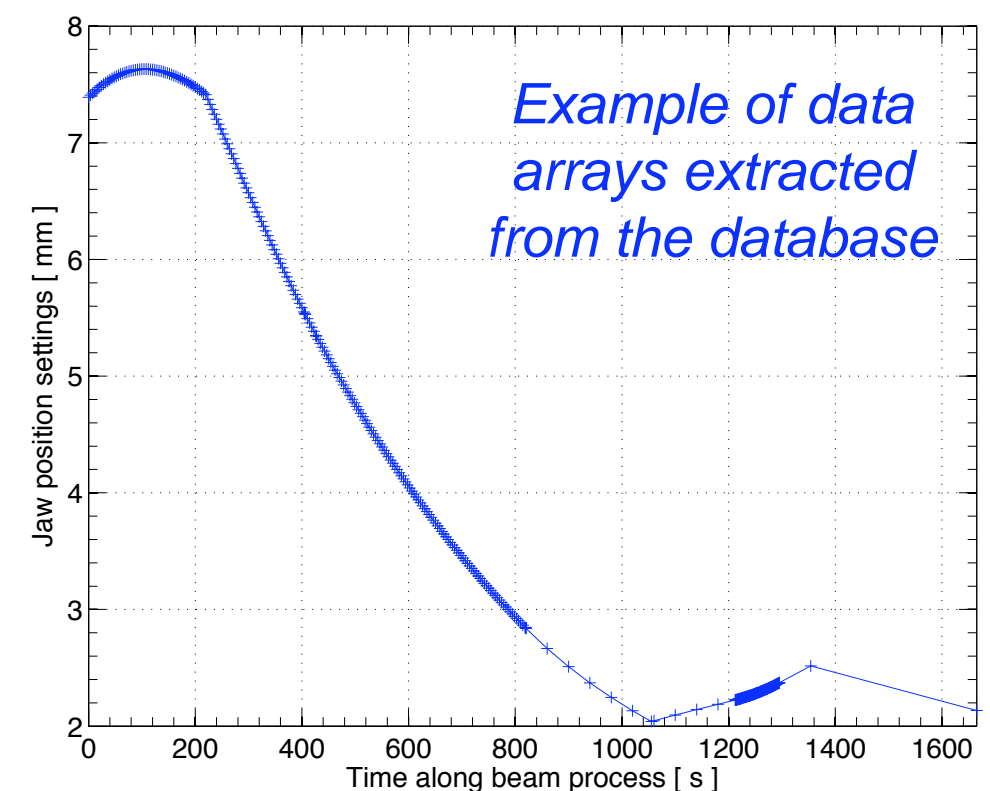
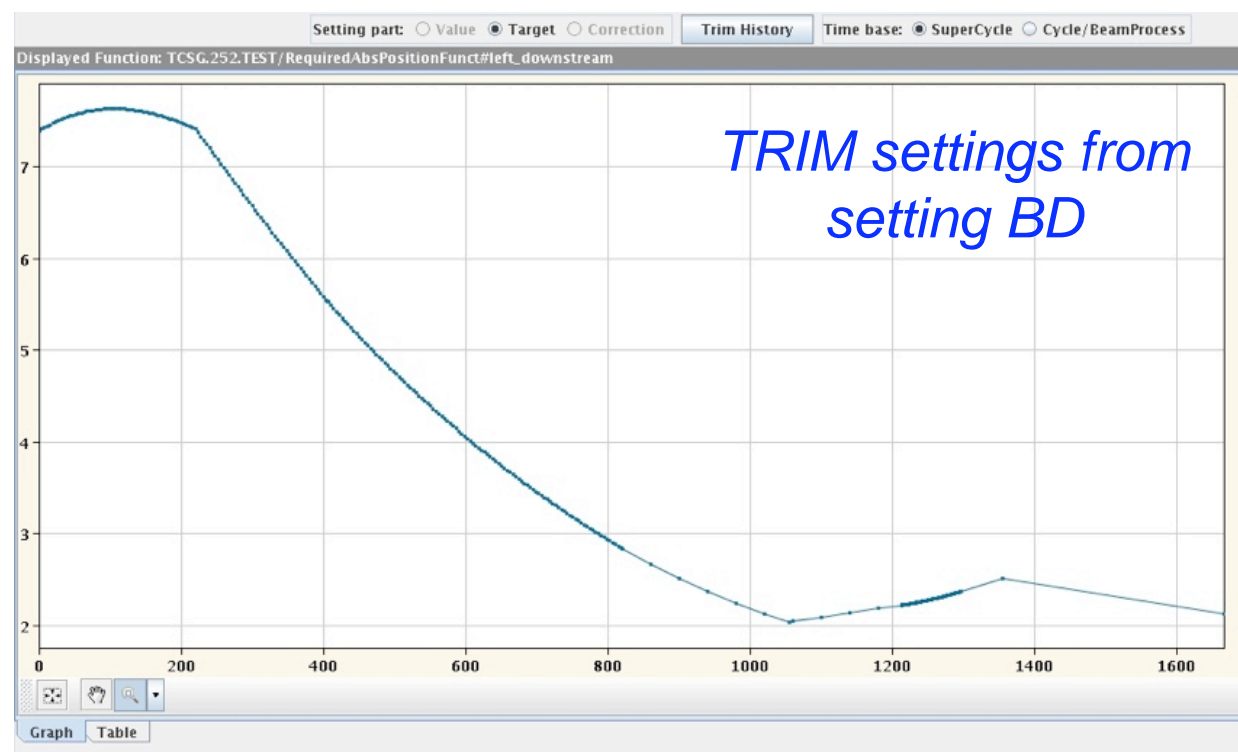


Special requirement for collimators



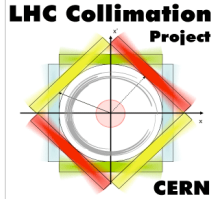
We requested to log also the **collimator settings (requested positions and thresholds)**. Sets of 2D arrays sent from LSA-TRIM are recorded for permanent storage.

Special thanks to N. Hoibian.





Collimator LSA database



Query1

```
select MADX_name, ANGLE, FAMILY, JAW_LEFT_UP, JAW_LEFT_DOWN,  
JAW_RIGHT_UP, JAW_RIGHT_DOWN, STOP_LEFT_UP_OUT, STOP_LEFT_UP_IN, STOP_LEFT_DOWN_OUT,  
STOP_LEFT_DOWN_IN from collimator_info;
```

#	MADX_NAME	ANGLE	FAMILY	JAW_	JAW_	JAW_	JAW_	STOP_A_OUT	STOP_A_IN	STOP_A_OUT	STOP_A_IN
1	TCTH.4R5.B2	0	TCTH	C	A	D	B	-30.0066941625263	6.00326475447175	-30.0066941625263	6.00326475447175
2	TCDIV.29012	90	TCDIV	B	D	A	C	-25.7317972605134	5.76275305801791	-25.7317972605134	5.76275305801791
3	TCDIH.20607	180	TCDIH	A	C	B	D	-25.7425287444619	5.58511057607411	-25.7425287444619	5.58511057607411
4	TCDIH.29050	180	TCDIH	A	C	B	D	-25.7410251869721	5.75247601777136	-25.7410251869721	5.75247601777136
5	TCDIH.29205	180	TCDIH	D	B	C	A	-25.97803638636	6.06275695577716	-25.97803638636	6.06275695577716
6	TCDIV.29234	90	TCDIV	B	D	A	C	-25.993482102623	5.97670326500856	-25.993482102623	5.97670326500856
7	TCSG.5R3.B2	0	TCS	B	D	A	C	-29.9847847218502	5.98354858197495	-29.9847847218502	5.98354858197495
8	TCSG.252.TEST	135	TCSG	D	B	C	A	-30.1137088173136	6.02989693753804	-30.1137088173136	6.02989693753804
9	TCSG.A5R7.B2	39.40021063703	TCS	D	B	C	A	-30.0025744723205	6.02923153623587	-30.0025744723205	6.02923153623587
10	TCDIV.87645	-90	TCDIV	D	B	C	A	-26.25255457	5.843151676	-26.25255457	5.843151676
11	TCSG.B4L7.B1	0	TCS	C	A	D	B	-30.004707605359	5.99232341695944	-30.004707605359	5.99232341695944
12	TCSG.D4R7.B2	-90	TCS	D	B	C	A	-30.000110580013	6.00883391849115	-30.000110580013	6.00883391849115
13	TCSG.D4L7.B1	-90	TCS	D	B	C	A	-29.9893152639636	5.98390110277465	-29.9893152639636	5.98390110277465
14	TCSG.B5L3.B2	0.800254438216	TCS	B	D	A	C	-29.9900255389444	6.0169679179833	-29.9900255389444	6.0169679179833
15	TCP.6L3.B1	0	TCP	B	D	A	C	-29.9979861403517	6.02281003059079	-29.9979861403517	6.02281003059079
16	TCSG.4R3.B1	0	TCS	B	D	A	C	-30.010883009438	6.00967458642566	-30.010883009438	6.00967458642566
17	TCDIV.87804	-90	TCDIV	D	B	C	A	-25.8185	5.932	-25.8185	5.932
18	TCDIH.88121	0	TCDIH	B	D	A	C	-26.04615302	6.086821694	-26.04615302	6.086821694
19	TCSG.A4L7.B1	.4122139237696	TCS	C	A	D	B	-29.9994209410164	6.03380997187762	-29.9994209410164	6.03380997187762
20	TCP.B6R7.B2	.4997018495379	TCP	C	A	D	B	-30.0059528491363	6.00070378576735	-30.0059528491363	6.00070378576735
21	TCSG.4L3.B2	0	TCSG	B	D	A	C	-29.9953526004488	6.0201060915818	-29.9953526004488	6.0201060915818
22	TCSG.A4R7.B2	.8988507546374	TCS	C	A	D	B	-30.0183546831154	6.00337299930464	-30.0183546831154	6.00337299930464
23	TCSG.A6R7.B2	.6971485648364	TCS	C	A	D	B	-30.0416250008385	6.01069464881458	-30.0416250008385	6.01069464881458
24	TCSG.A5R3.B1	-9.6	TCS	B	D	A	C	-30.0103212428684	6.01030563398841	-30.0103212428684	6.01030563398841
25	TCP.B6L7.B1	.0898483785227	TCP	C	A	D	B	-30.0077749588488	6.0071644795315	-30.0077749588488	6.0071644795315
26	TCSG.6R7.B1	15662015617741	TCS	C	A	D	B	-29.9897686661813	6.01081036691205	-29.9897686661813	6.01081036691205
27	TCSG.A6L7.B1	.8804950592782	TCS	C	A	D	B	-29.9881046548277	5.99176454095223	-29.9881046548277	5.99176454095223
28	TCP.6R3.B2	0	TCP	B	D	A	C	-29.99475942	6.032479307	-29.99475942	6.032479307
29	TCSG.A4R7.B1	33.70501015343	TCS	D	B	C	A	-30.004292223736	5.98068577324292	-30.004292223736	5.98068577324292
30	TCP.D6R7.B2	-90	TCP	D	B	C	A	-29.9953429176117	6.01861405152476	-29.9953429176117	6.01861405152476
31	TCP.C6R7.B2	0	TCP	C	A	D	B	-29.9923759247047	5.9933805668386	-29.9923759247047	5.9933805668386
32	TCSG.A4L7.B2	7.900207129377	TCS	D	B	C	A	-29.9967958928447	6.00071254658053	-29.9967958928447	6.00071254658053
33	TCDIV.88123	90	TCDIV	B	D	A	C	-25.93092618	6.248895266	-25.93092618	6.248895266

Done, ran 0 of 1 statements. Statement failed Script: 0.016 Secs

SQLBuilder

```
SELECT *  
FROM  
DISTINCT  
AND  
COUNT(*)  
WHERE  
ROWNUM < 10  
OR  
IS NOT NULL  
SELECT
```

User Objects All Objects DictObjects

- USERS_TIMING_EVENTS
- VISIBLE_PROPERTIES
- VISIBLE_PROPERTY_FIELDS
- Views
 - HWC_ELECTRICAL_CIRCUITS_HIST_V
 - POWERCONVERTER_OP_INFO_V
 - STAGE_BLM_APPLIED_THRESHOLDS_V
 - STAGE_BLM_MASTER_THRESHOLDS_V
 - V_ACTUAL_HARDWARE
 - V_ACTUAL_HARDWARE_GRP_DEVICES
 - V_BEAMPROCESS_TYPES
 - V_BEAM_MODES
 - V_BLM_INFO
 - V_CIRCUIT_POWERCONVERTERS
 - V_COLL_FLATNESS
 - V_COLL_PARAMS
 - V_CRITICAL_PROPERTIES
 - V_CYCLE_TIMING_USERS
 - V_DEVICES
 - V_ELEMENTS
 - V_ELEMENTS_LOGICAL_HARDWARE
 - V_FESA_DEVICES
 - V_FESA_DEVICE_TYPES
 - V_FESA_LSA_DEVICE_DIEFS

#	Name	Type
01	MADX_NAME	VARI
02	MTF_NAME	CHAI
03	CERCA_NAME	VARI
04	DEVICE_ID	NUM
05	ANGLE	NUM
06	MATERIAL	VARI
07	LENGTH	NUM
08	BEAM	CHAI
09	FAMILY	VARI
10	IP	VARI
11	BLMI	VARI
12	BLMS	VARI
13	STOP_LEFT_UP_OUT	NUM
14	STOP_LEFT_UP_IN	NUM
15	STOP_LEFT_DOWN_OUT	NUM
16	STOP_LEFT_DOWN_IN	NUM

Complete information on the 2008 system!

Common repository for all required **critical** configuration (BLM s), calibration data and operational data

Merges:
layout information +
production and CERN
measurements +
results of approval +
nominal optics...

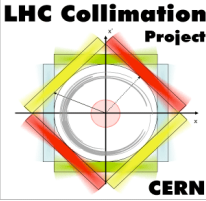
Being **updated** with outcome of the HW commissioning measurements in the tunnel (mechanical play, switch positions, ...).

Many thanks to Ronny and Chris!

Data are the outcome of the Collimation Production Steering approval procedure (thanks to T. Weiler, R. Chamizo, R. Losito s team ...)



Traceability, documentation



CERN
CH-1211 Geneva 23
Switzerland



LHC Project Document No. LHC-TC-ES-0001 rev 0.1
CERN Div./Group or Supplier/Contractor Document No. AB
EDMS Document No. 906937

Date: 2008-04-11

Engineering Specification

DOCUMENTATION OF HARDWARE PARAMETERS FOR THE 2008 LHC COLLIMATORS

Abstract

The LHC collimation system for the 2008 beam operation will comprehend 62 ring collimators and 13 transfer line collimators. The critical parameters for the configuration of the collimators controls, such as the collimator orientation, the number of motor axes and the mechanical reference positions, were measured during various phases of the collimator production and were reviewed before being stored in the LSA database, which will be used as a source of information during the hardware commissioning of the system. This paper summarizes the collimator hardware parameters for the devices of type TCP, TCGS, TCTH, TCTVA, TCLA, TCLIB and TCDI that will be installed in the LHC for the 2008 physics run.

Prepared by :
S. Redaelli,
R. Chamizo,
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J. Brahy, P. Gander,
S. Chemli, Y. Kadi,
M. Jonker, M. Lamont,
J. Lendaro, A. Masi,
S. Perrollaz

Approved by:
R. Assmann
B. Goddard
R. Losito

Static hardware parameters
(orientation and mechanical references
for sensor calibrations) documented for
“as-installed” system.

Versioning of LSA tables was put in
place (Thanks to Ronny) to trace the
changes of **dynamics values**
(mechanical plays, switch positions, ...)

Outlook

- Status of collimator controls
- **Result of remote commissioning**
 - Function driven motion*
 - Synchronized ramp functions*
 - Commissioning sequences for MP*
 - EMC results*
- Beam commissioning at TI2
- Open issues
- Conclusions

Preparation for beam operation

From OP cold-checkout meeting (Nov. 2007):

Cold checkout should be focused on

☒ **Perform global, simultaneous system checks**

Control an *ensemble* of collimators

Address timing and synchronization issue

Function-driven motion, “tracking” tests with other equipment

Establish full machine protection functionality without beam

☒ **Verify interfaces to other accelerator systems**

Beam loss monitors: configuration/acquisition of distributed systems

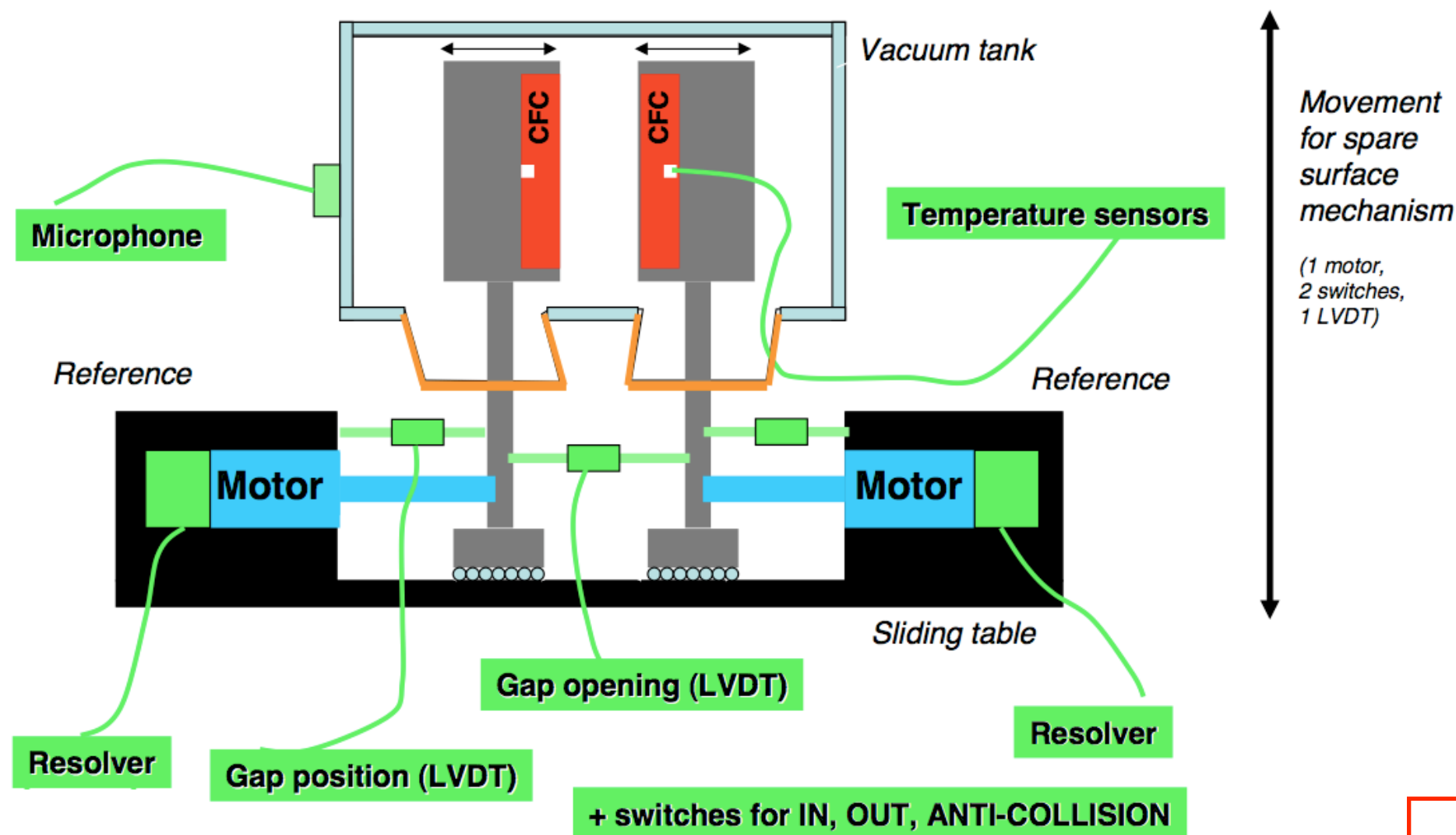
Sequencer driven commands, machine modes

☒ **Management/validation of measurement data**

Verify logging of distributed systems (big data sets!)

Consistency and sanity checks; global system status

Recap. of collimator hardware



~400 degrees of freedom
~2000 limit functions

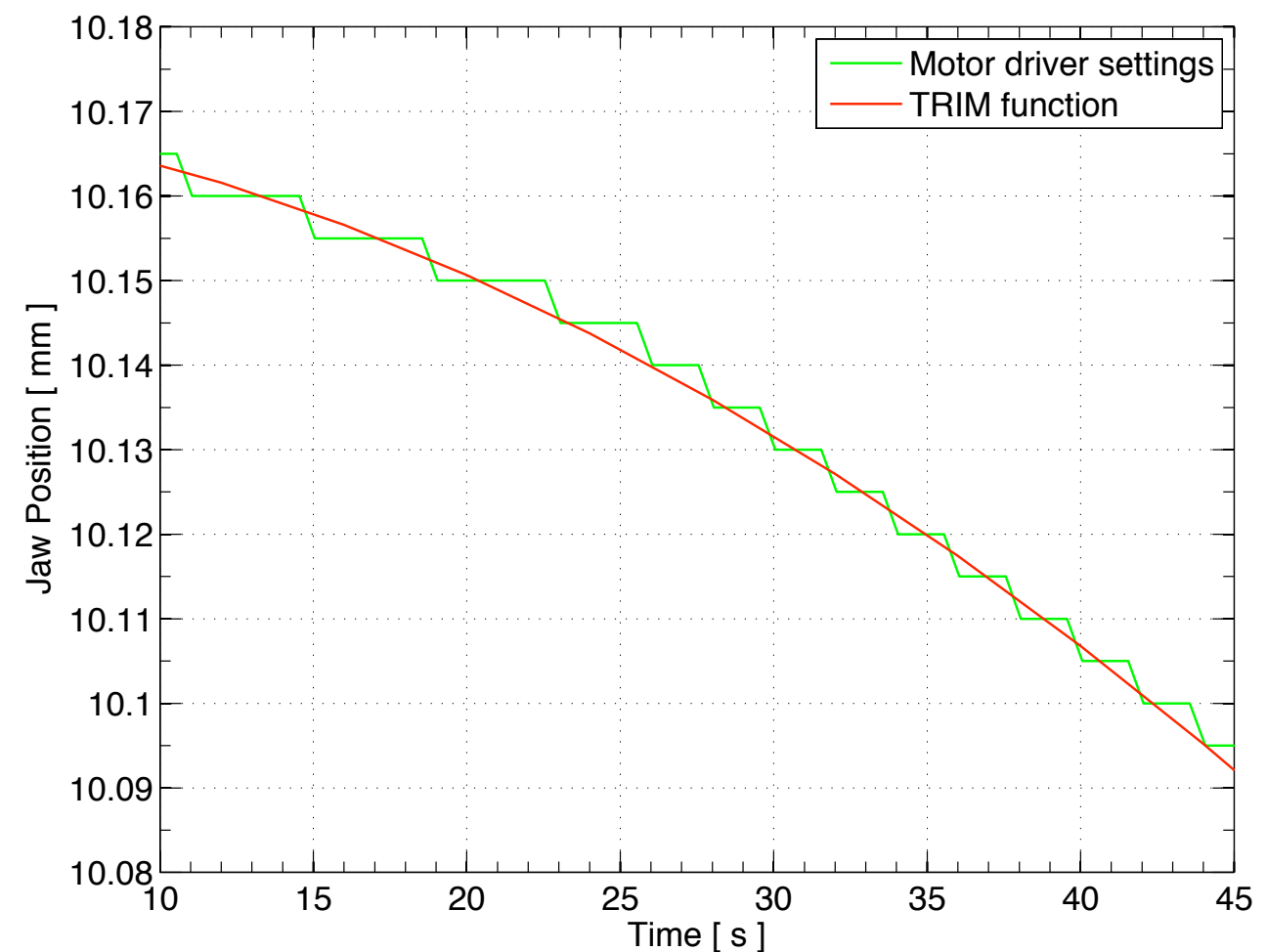
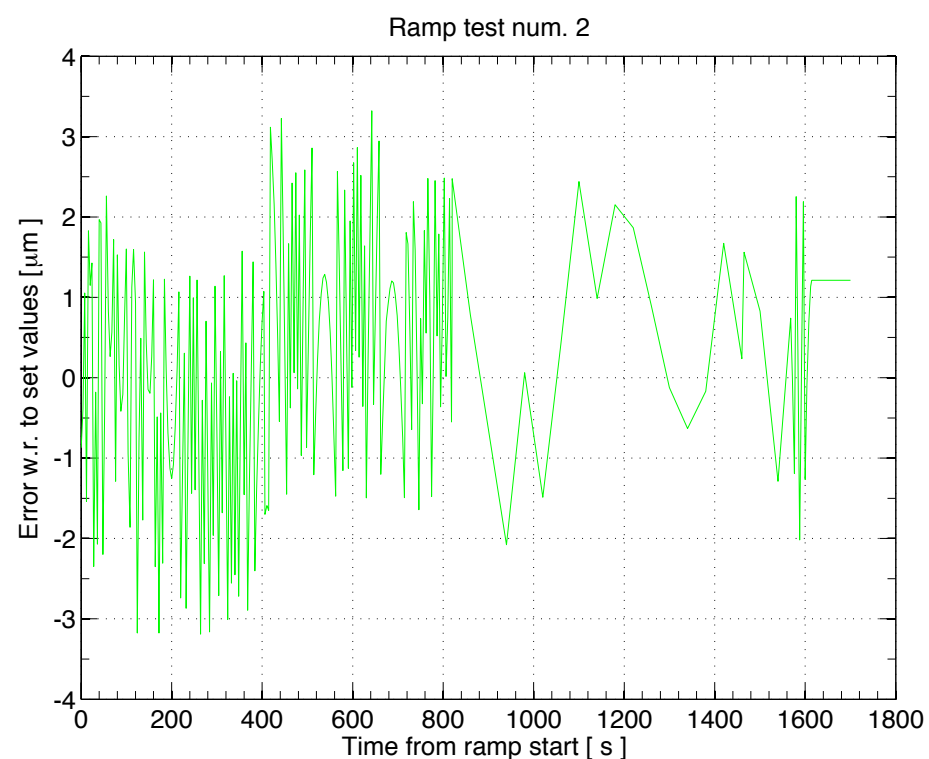
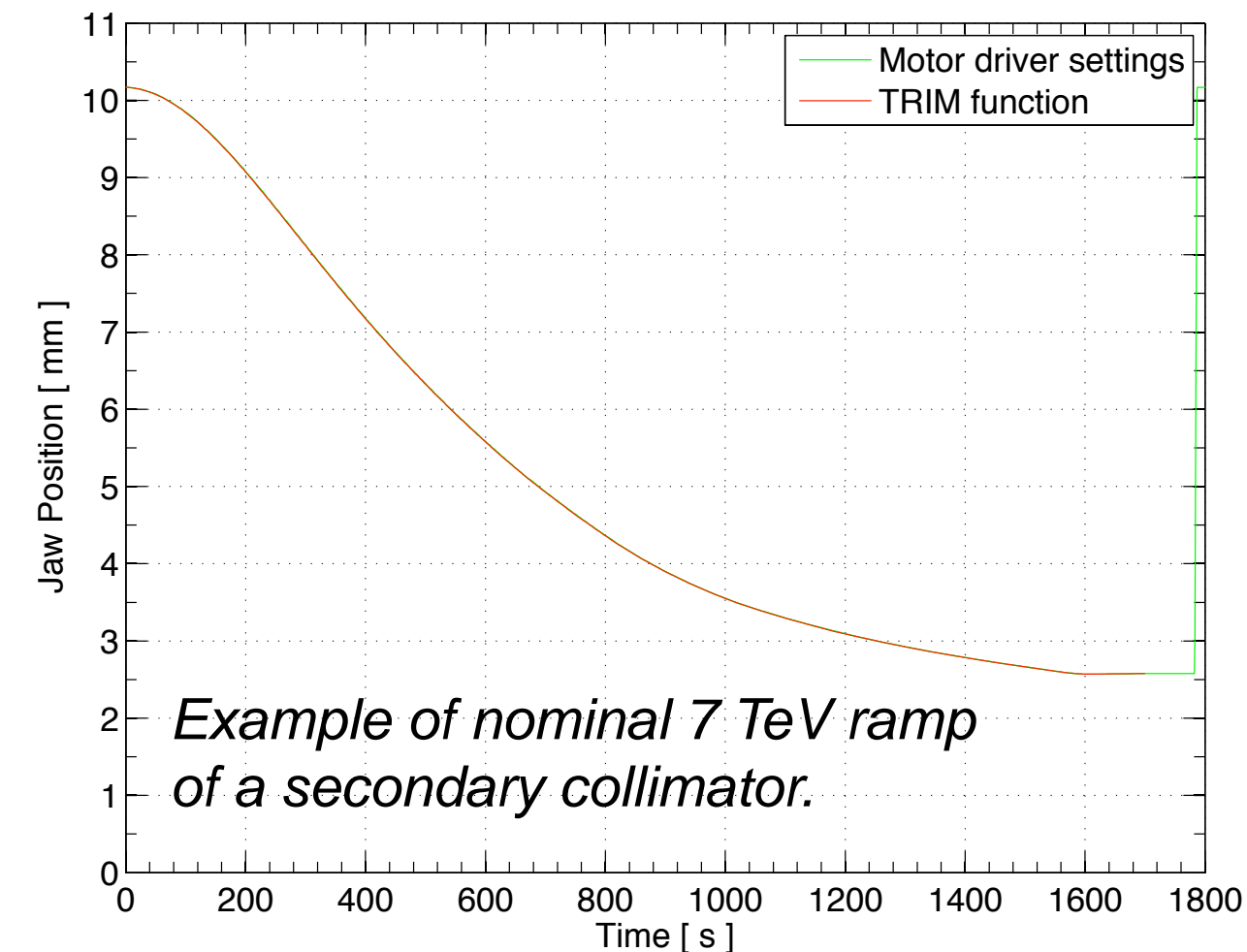
Settings: 2 jaws → 4 motor positions; 1 motor for tank position.
Survey: 7 position measurements (4 corners + 2 gaps + tank)
4 motor resolvers
10 switch statuses (full-in, full-out, anti-collision)

Dump thresholds (functions+discrete): 6 x 2 jaw positions/gaps; some gap values vs. energy and beta* factor; 5 temperatures; switch statuses vs. machine mode.

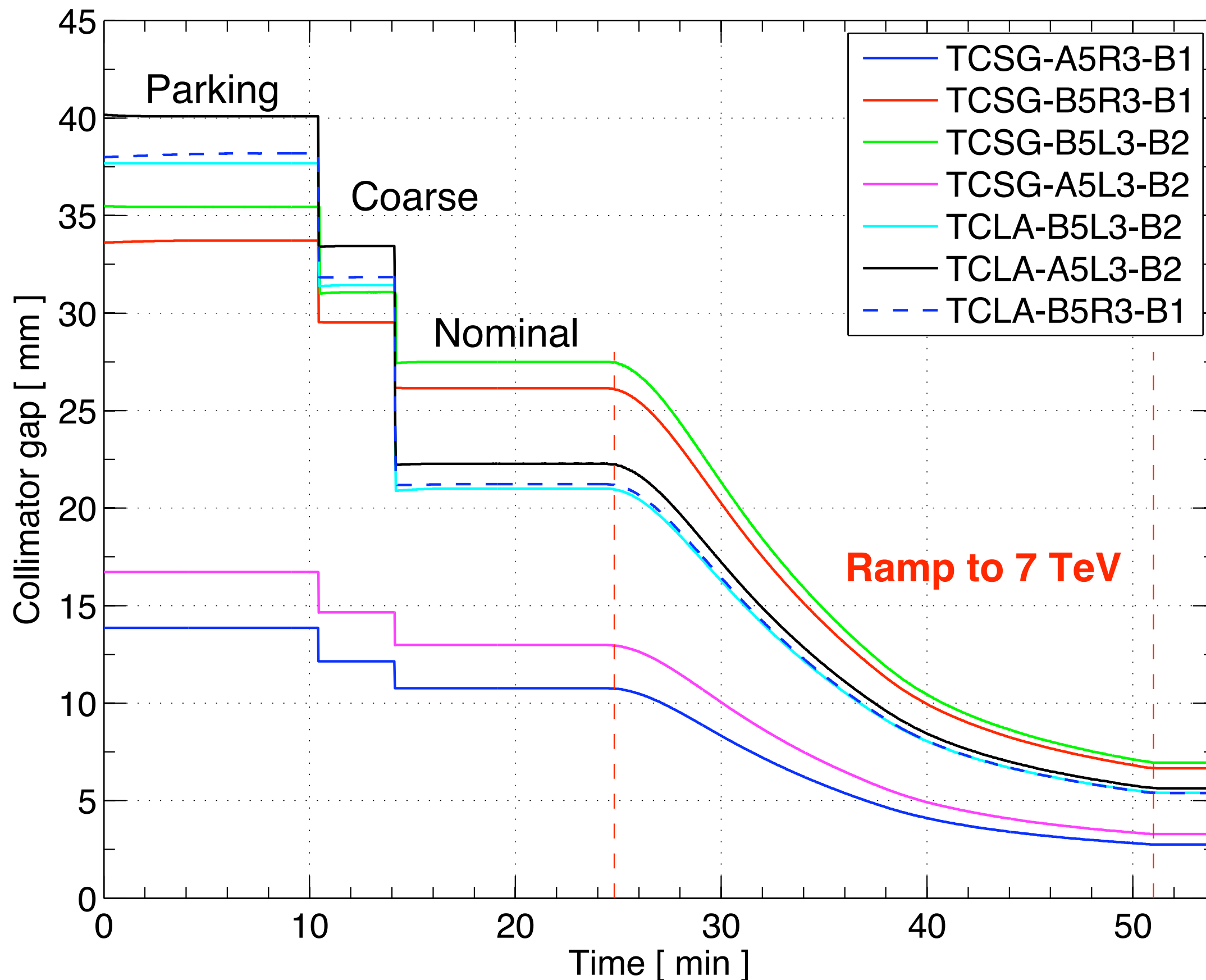
Function-driven motion

Motor Driver Controller (MDC) interpolates the functions and approximates them with small steps (A. Masi).

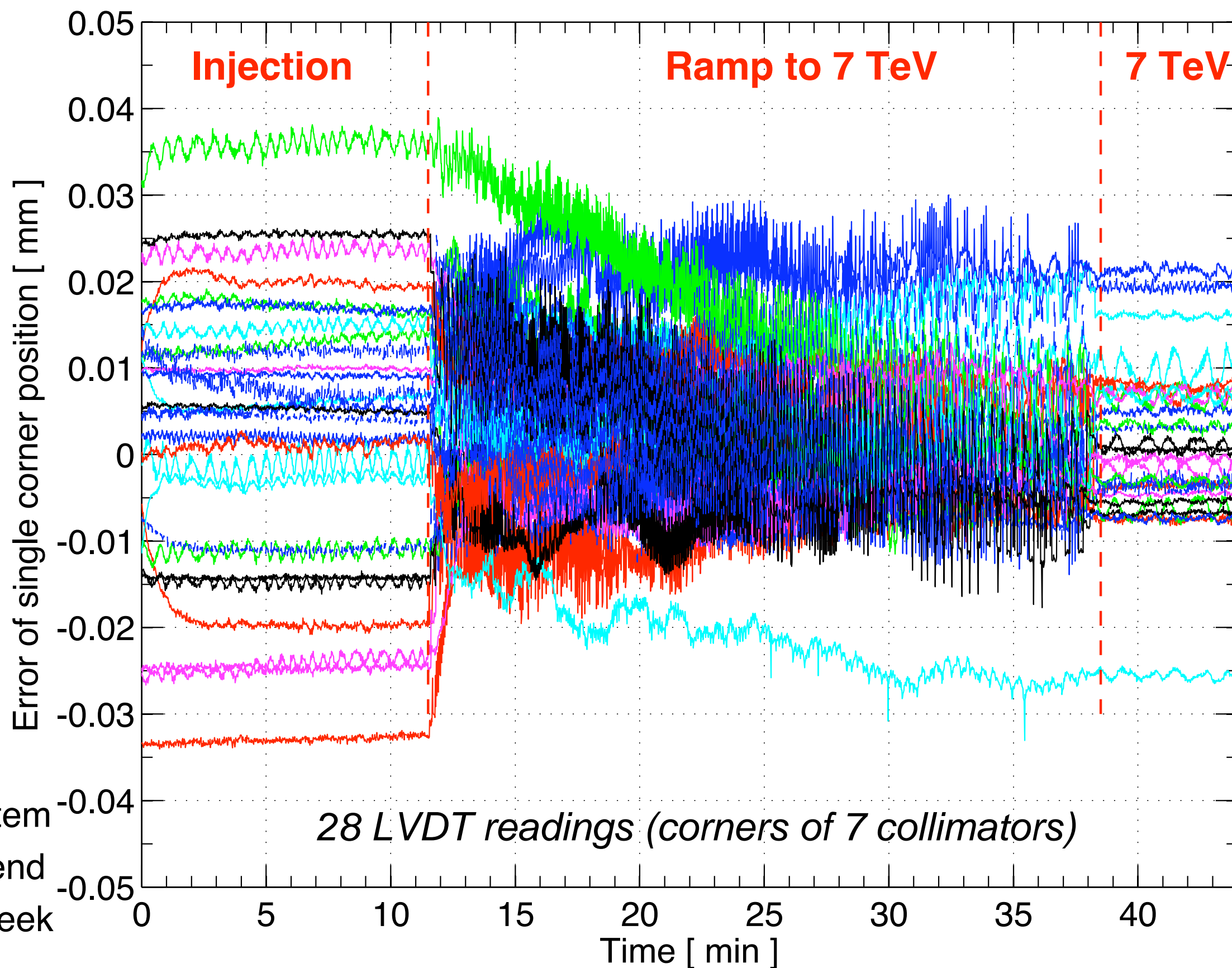
Error of settings below minimum step value of 5 microns



Operation of 7 LHC collimators

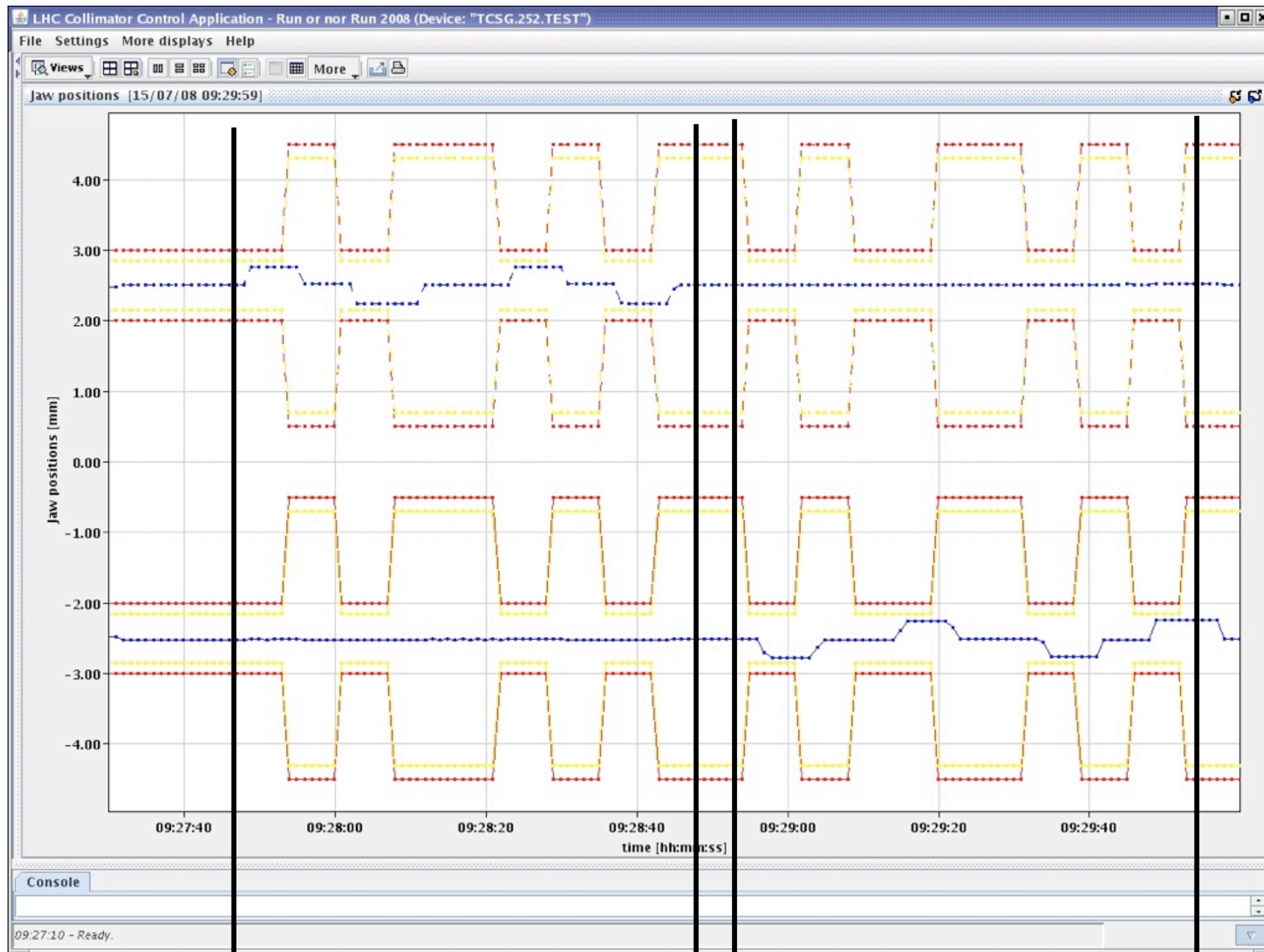


Positioning error for 7 collimators



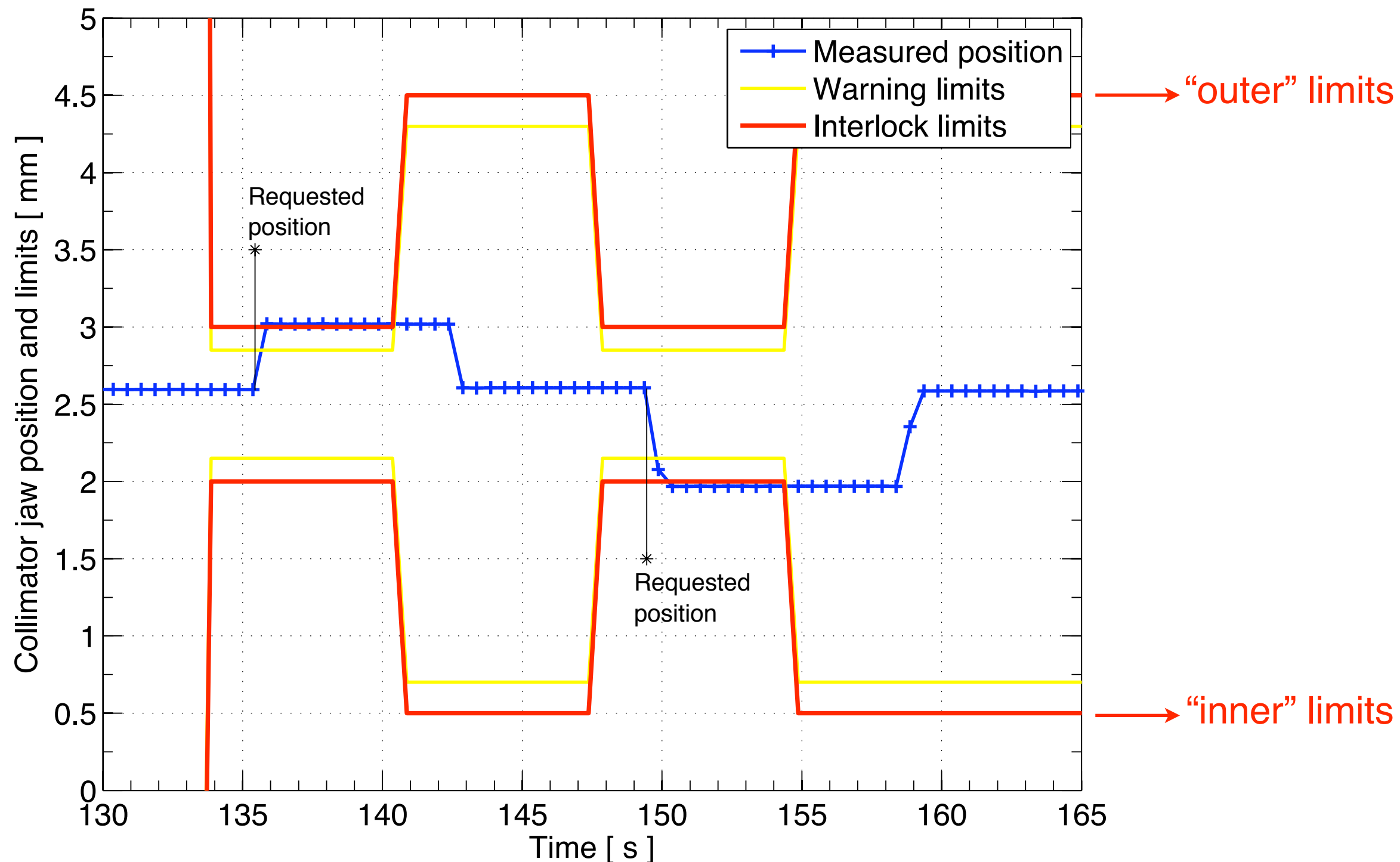
Full system
test by end
of the week

Sequences for MP commissioning



← Left jaw → ← Right jaw →

Detailed example (1 deg. of freedom)

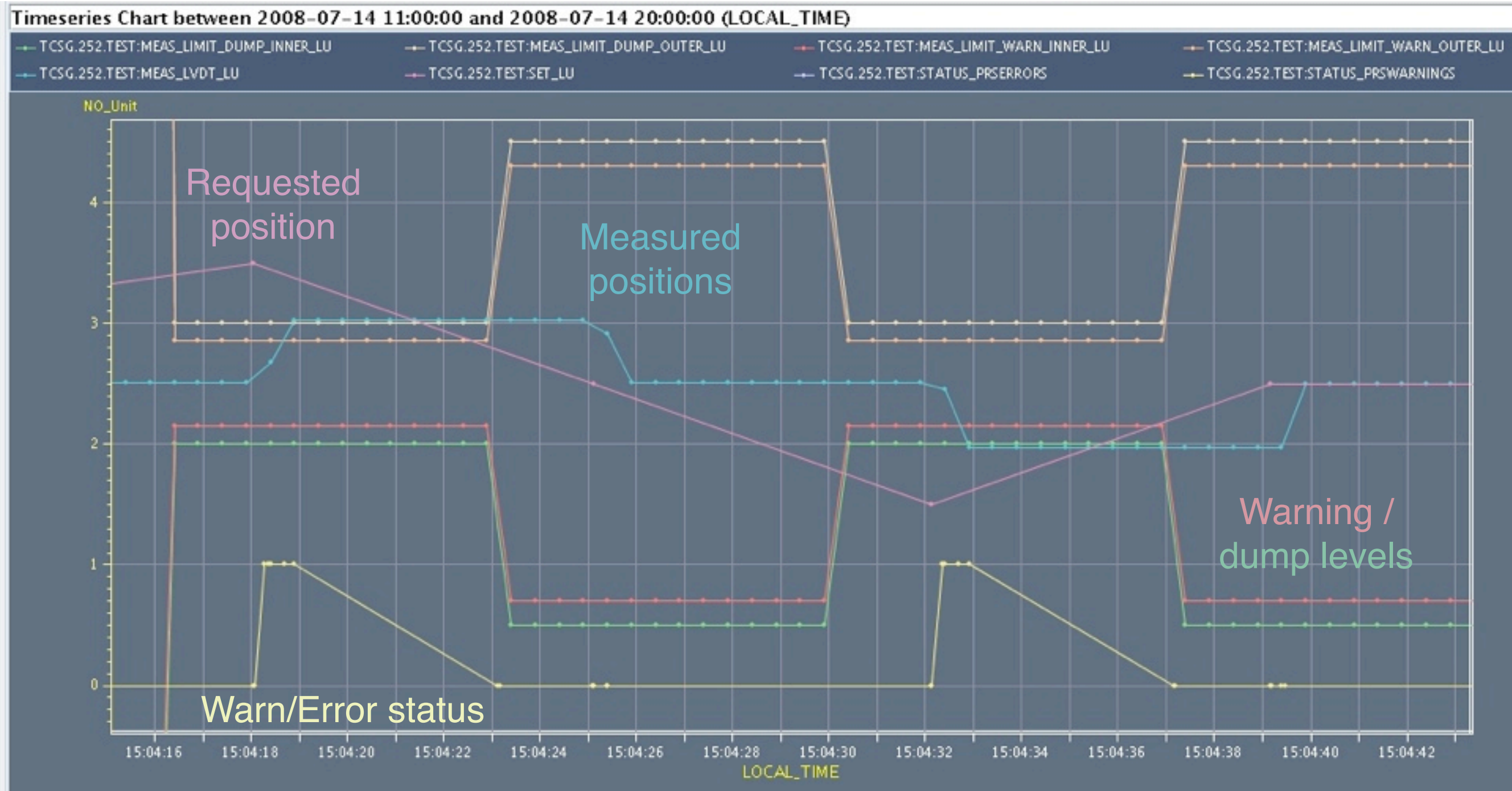


One sequence was prepared to tests 12 interlock functions
(+12 warning functions at the same time)

It takes less than 3 minutes; Can be applied to many collimator at the same time.

Will prepare similarly: (1) Verification of switch statuses; (2) Energy and beta* limits

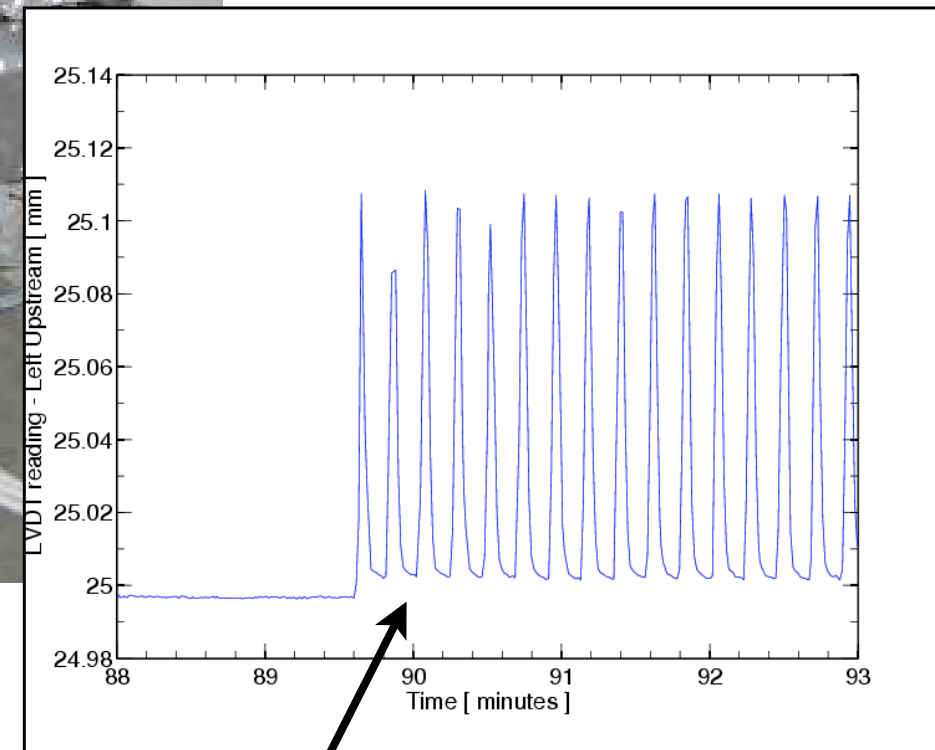
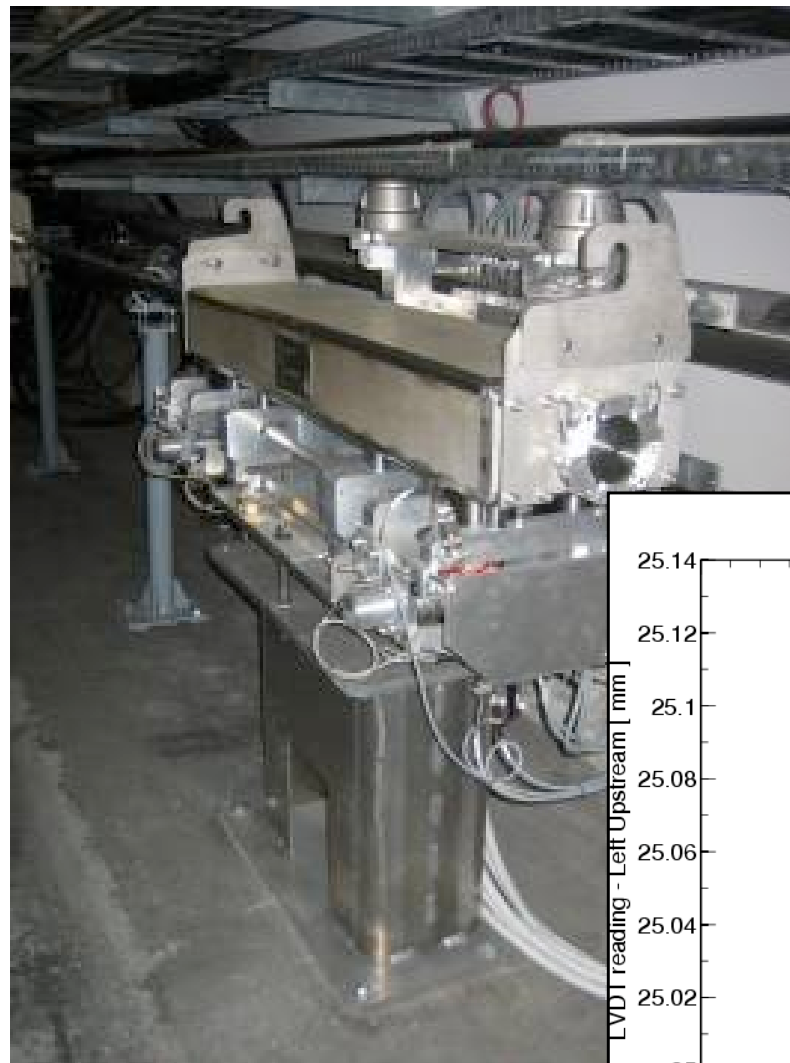
Sequence results in the logging



Simultaneously, the BIC status changes should also be logged to see if the beam permit is really removed!

Now: data at 1Hz. Later the *post-mortem* buffer at 100Hz will be used if necessary.

Magnetic interference in TI2



Magnetic field generated by the 5.3kA main circuits perturbs the LVDT reading!
First seen for two collimators in TI2 during the 2007 cold-checkout!

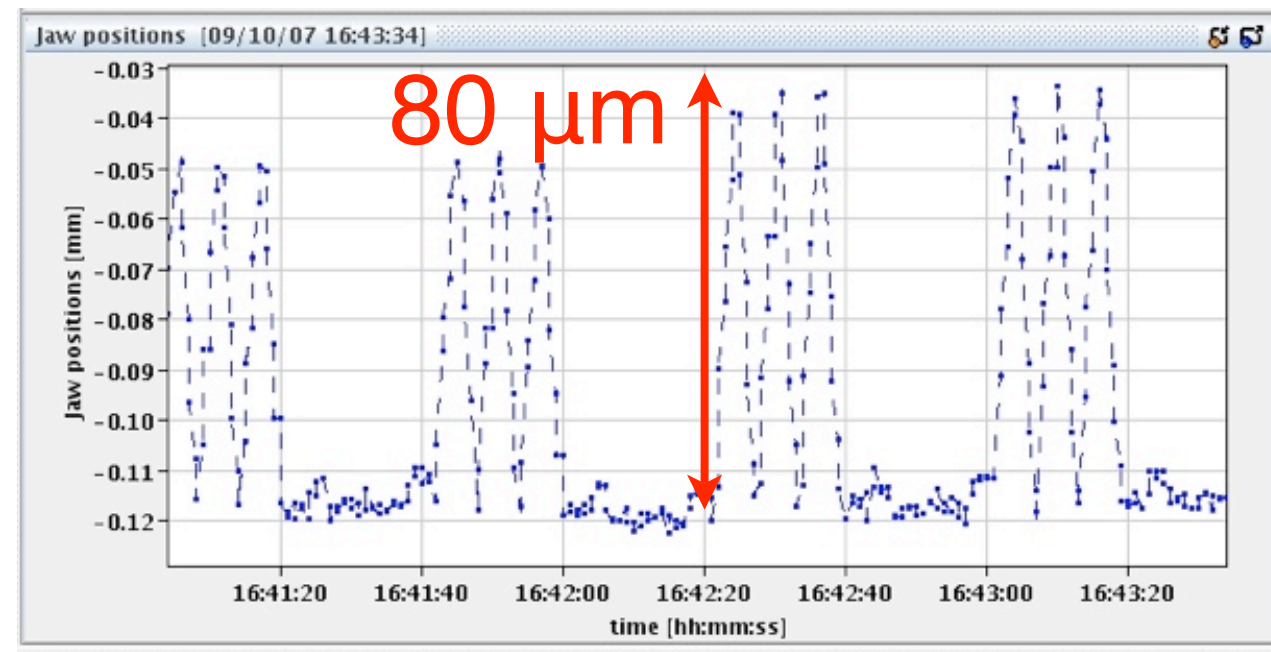
Follows the LHC/CNGS cycle...

Countermeasures

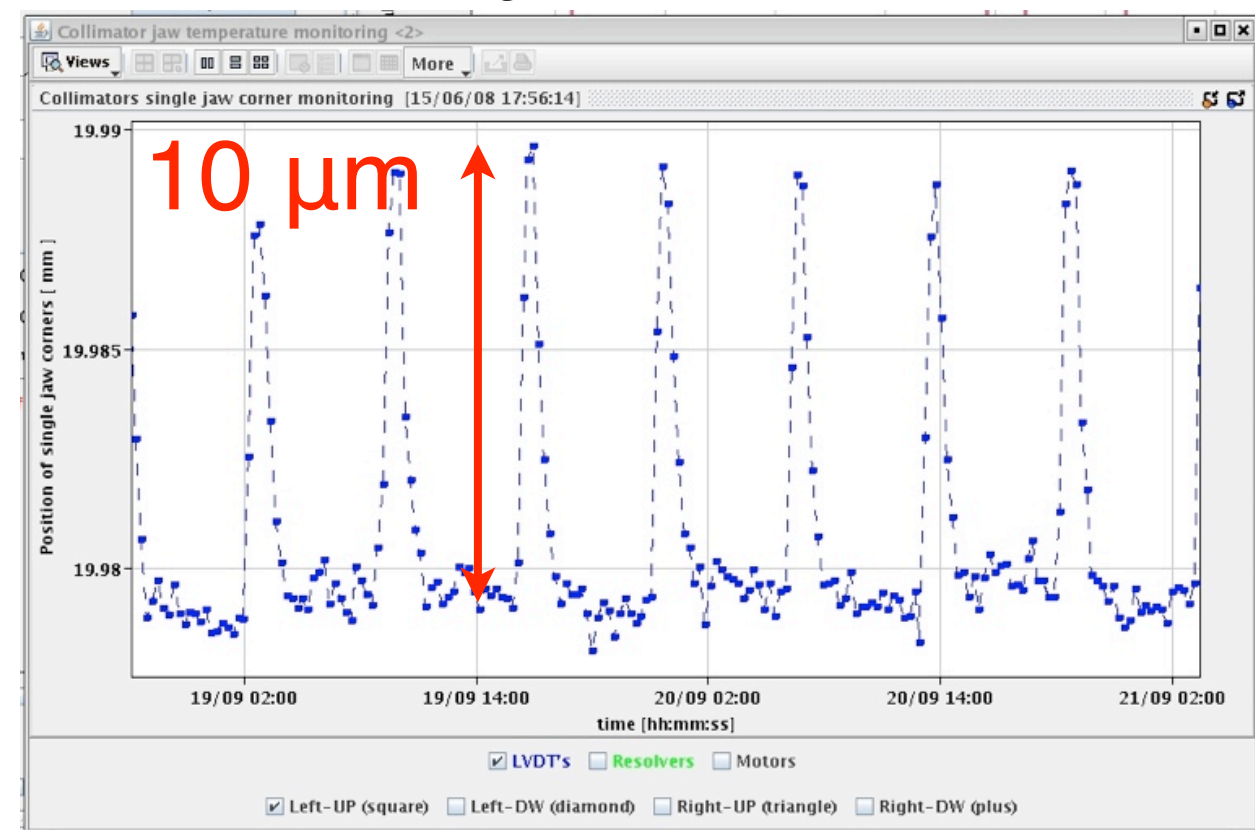


Magnetic screens installed to shield the collimators (A. Masi)
Significant reduction of the LVDT noise.

2007: TI2 pulsing, no beam

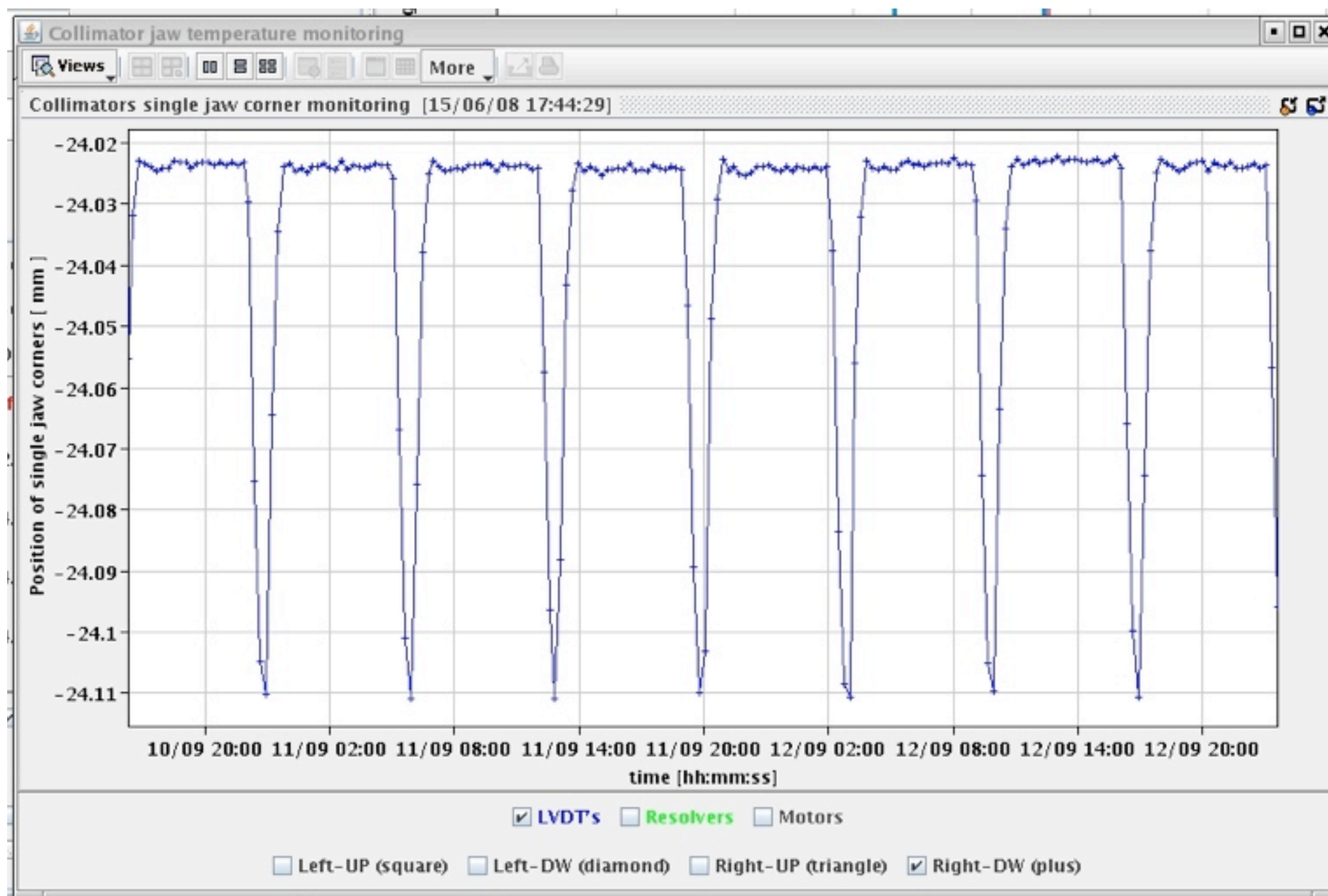


2008: TI2 pulsing, with beam



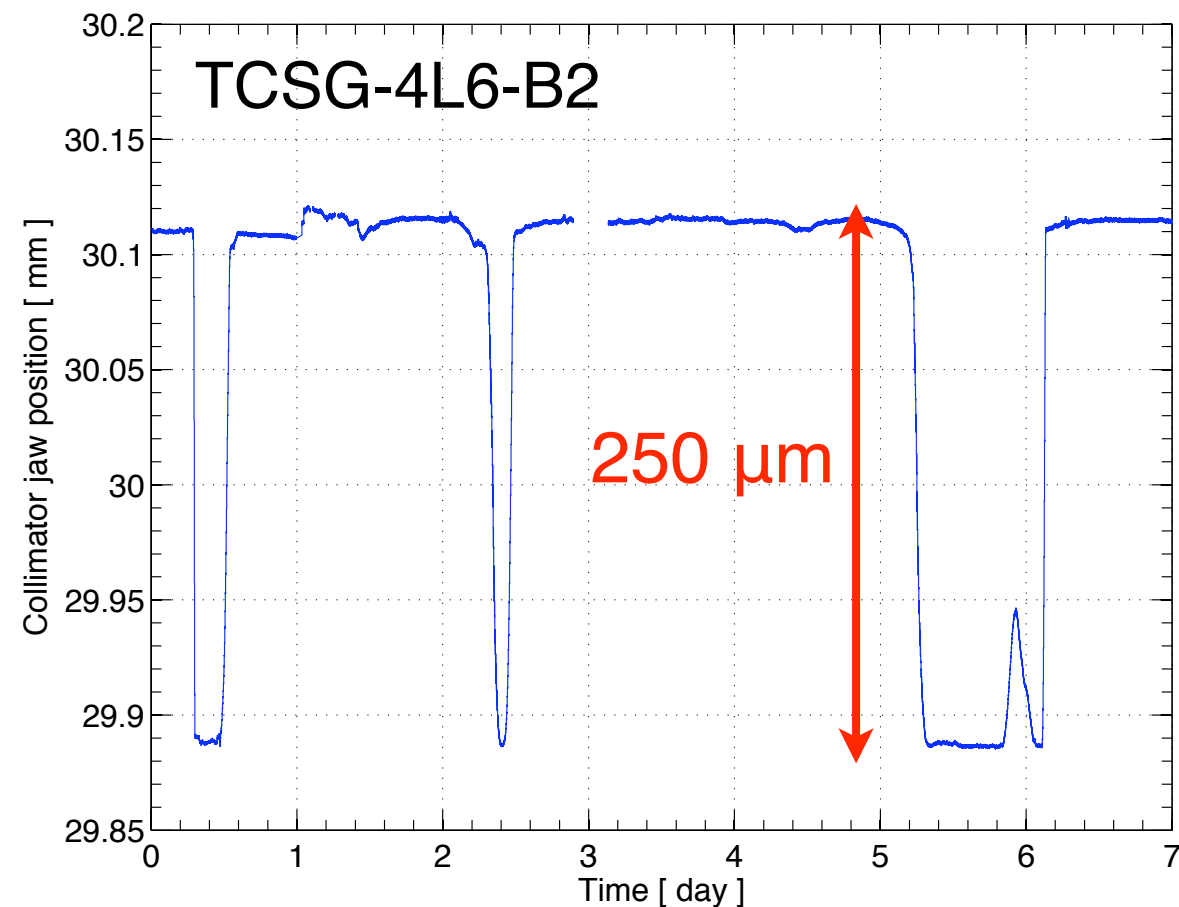
Still one bad guy...

LVDT Right-Downstream of TCDIH-29050



Probably it will be changed: it also caused other problems - see later

Results of EMC tests in the LHC

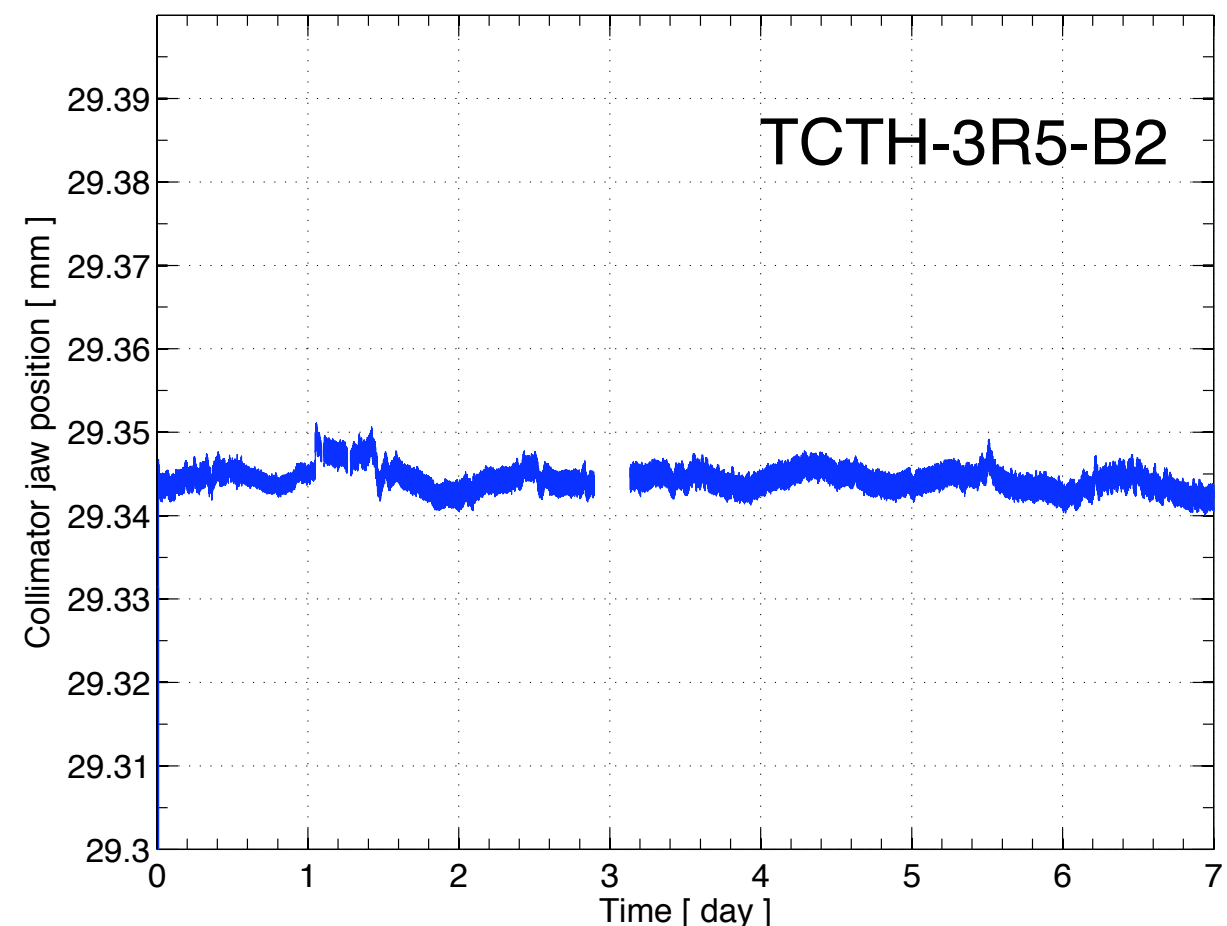


Not yet understood: does not seem to be correlated with septum magnet nor with powering of cold magnets.

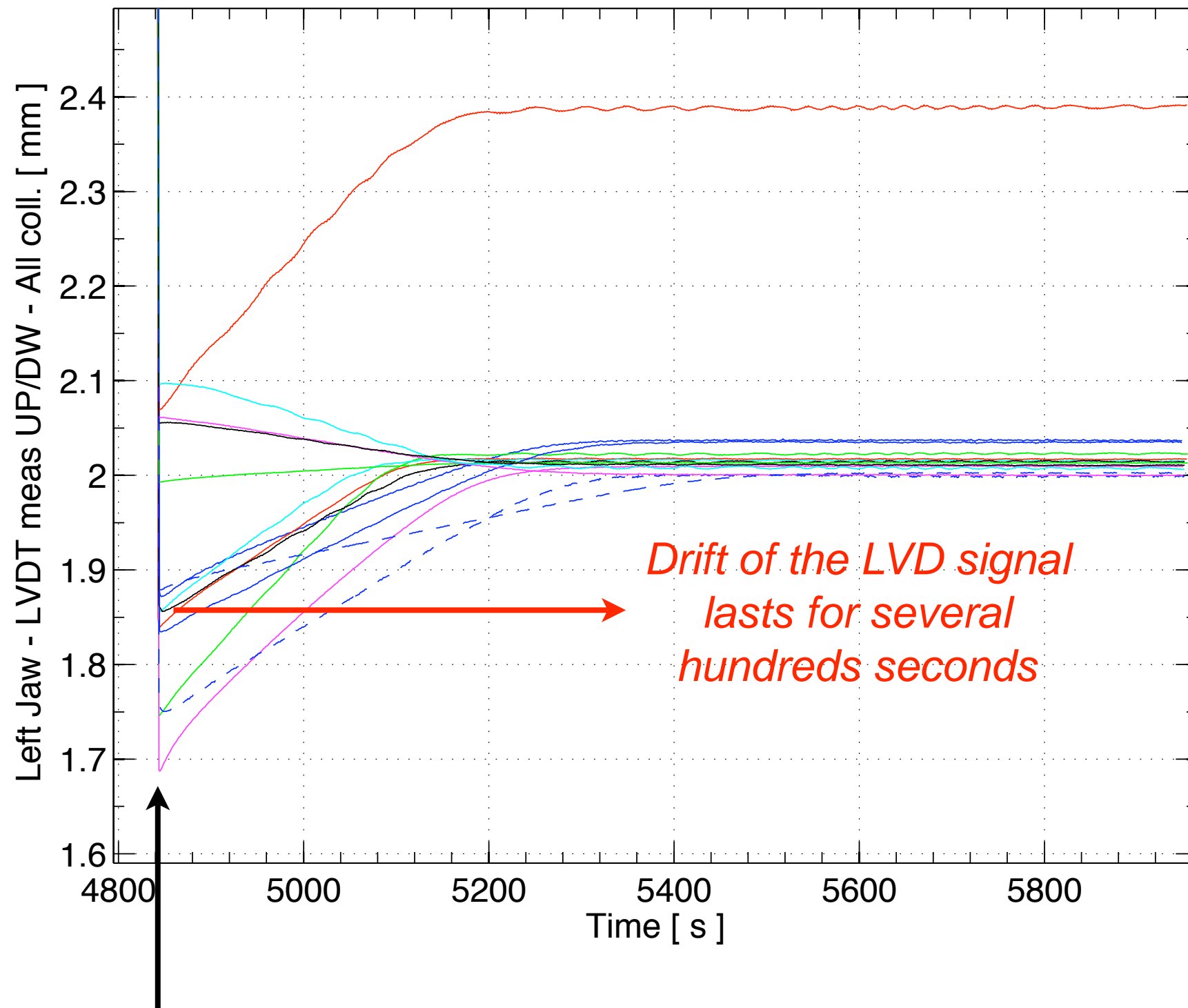
More EMC tests will take place following up the progress of HW commissioning.

Parasitic acquisitions of collimator signals during various tests:
cold/warm magnet powering, kickers pulsing, septum magnets, ...
Typically: noise below **10 microns**.

One exception: TCSG in IP6.



Over-shoot of LVDT signals




Fast motion of the jaw at the nominal speed of 2 mm/s

- Status of collimator controls
- Result of remote commissioning
- **Beam commissioning at TI2**
- Open issues
- Conclusions


TI2 - Hardware involved

Beam commissioning of **THREE TCDI collimators** in TI2
 Beams: single and multi-bunches, $\sim 5 \times 10^{10}$ p per bunch



LHC Collimation Project

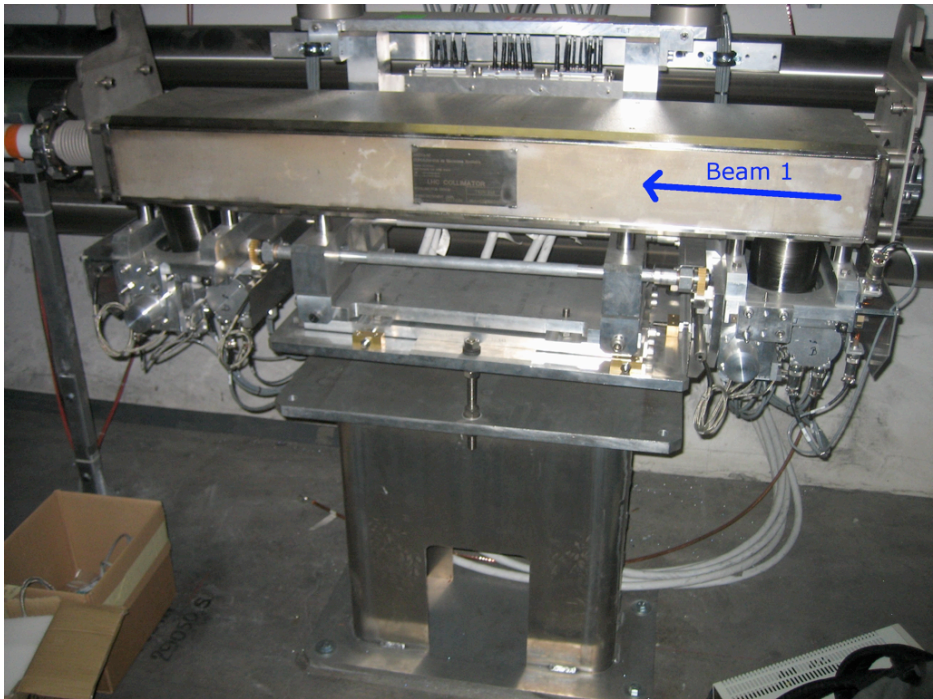
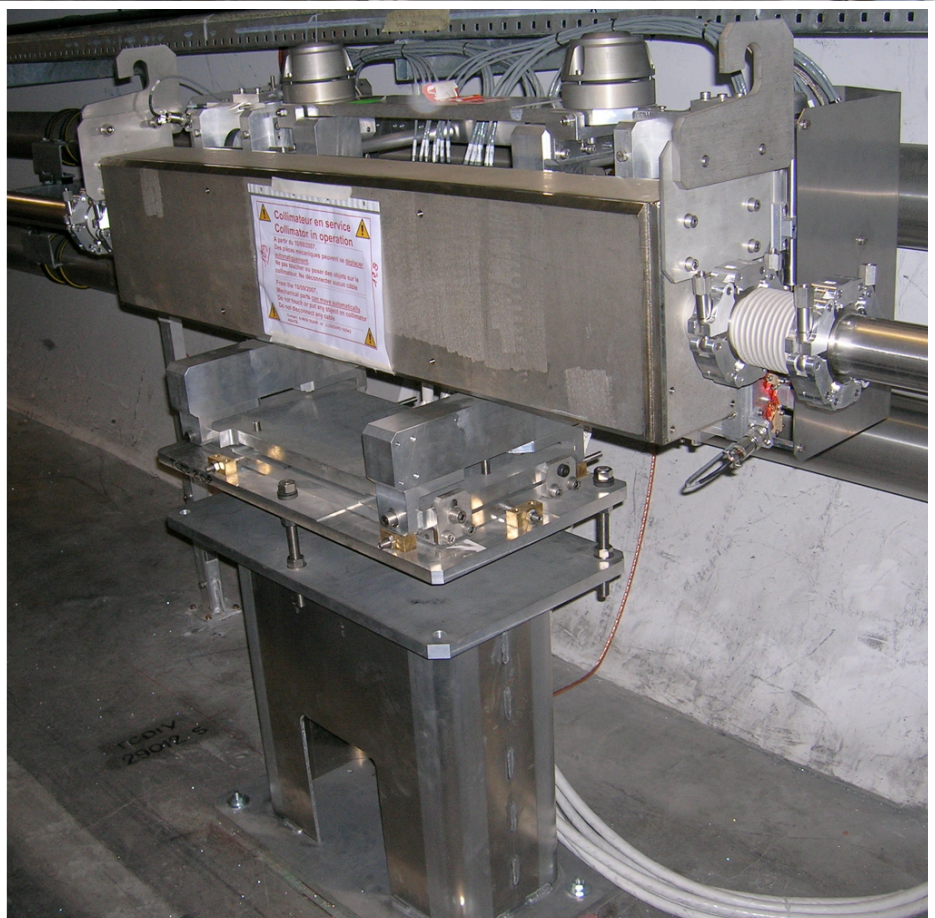
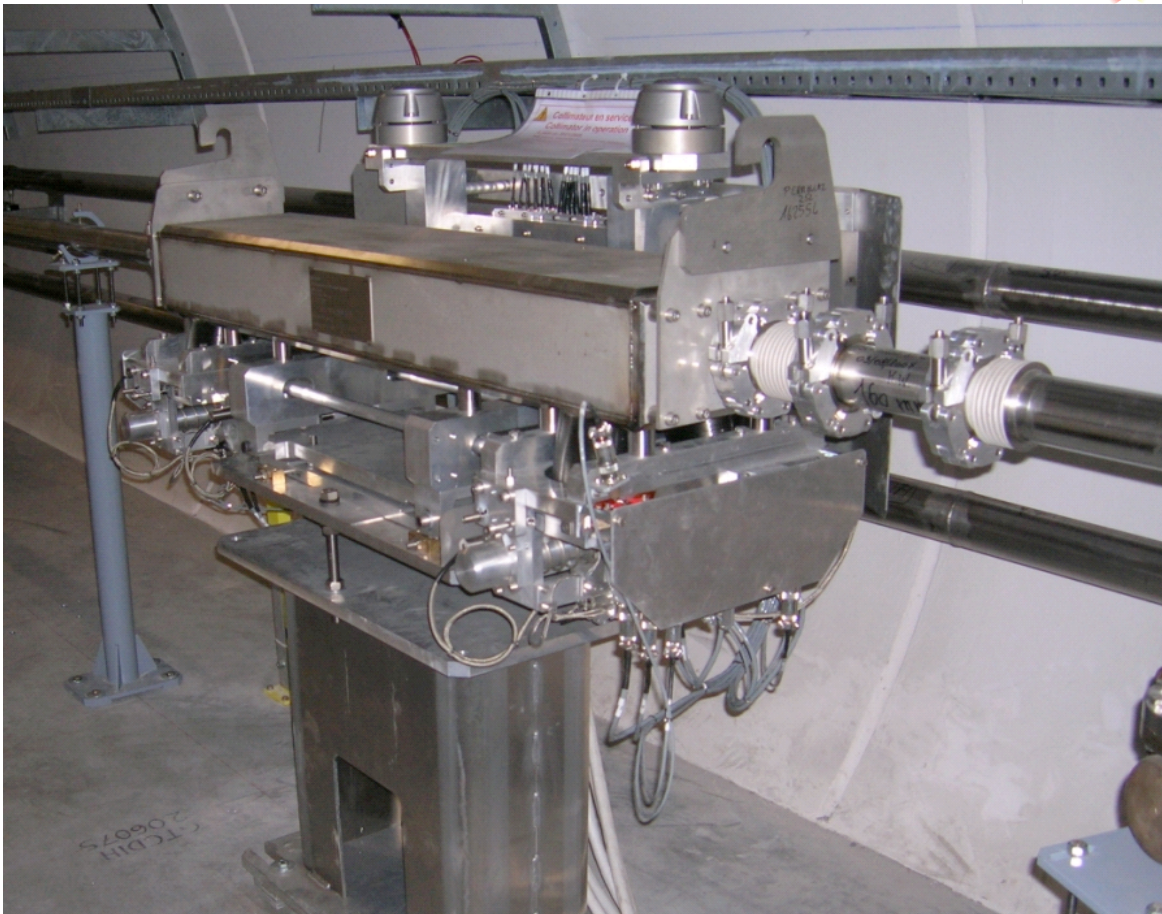
Home of the Project for the LHC Collimation System



Top	Project Team	Notes	Collimator List	Sounds/Movies	Meetings
Links	Papers	Talks (WG)	Layout IR3/7	AB Departm.	Pictures

Collimator operational information

NAME	MTF link	FAMILY	IP	BEAM	ANGLE	Install Angle	Jaw Orientation	Summary
TCDIH.20607	TCDI207 Acceptance (ProDB)	TCDIH	TI2	B1	180.0	180.0	A/C/B/D	xls/pdf
TCDIV.29012	TCDI208 Acceptance (ProDB)	TCDIV	TI2	B1	90.0	90.0	B/D/A/C	xls/pdf
TCDIH.29050	TCDI209 Acceptance (ProDB)	TCDIH	TI2	B1	180.0	180.0	A/C/B/D	xls/pdf

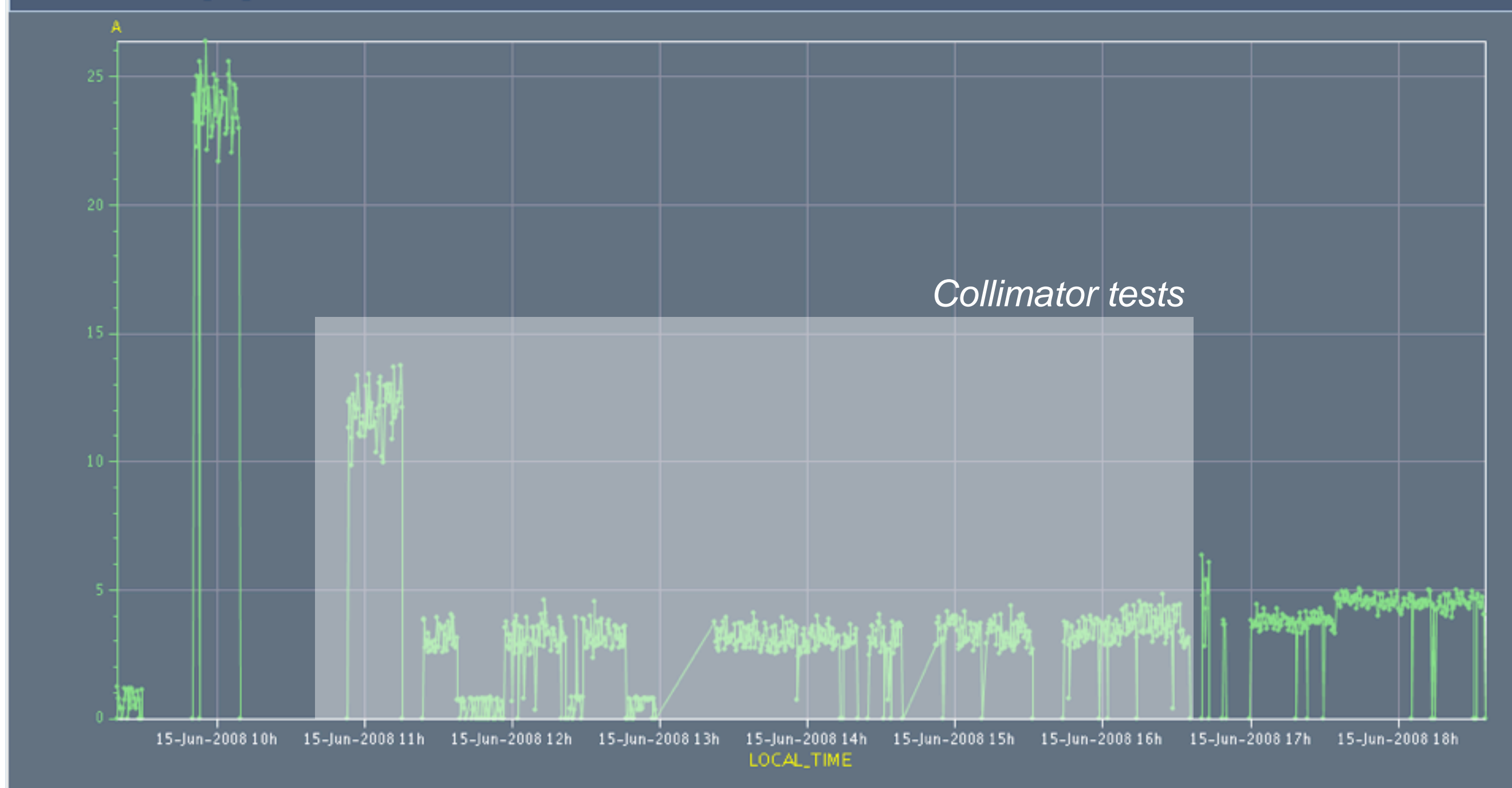


People who participated to the MD:
 O. Aberle, R. Assmann,
 M. Brugger, V. Kain,
 A. Masi, V. Previtali,
 S. Redaelli, T. Weiler,
 J. Uythoven ...

Beam availability - extracted intensity

Timeseries Chart between 2008-06-15 09:00:00 and 2008-06-15 19:00:00 (LOCAL_TIME)

→ TT60.BCTFI.610225:INT_HBW_EXTR1



Very good conditions for collimator set-up studies: stable orbit and optics.
 Extracted beam intensity stable to 10-20%
 Worked with single bunches to avoid irradiating too much the collimator

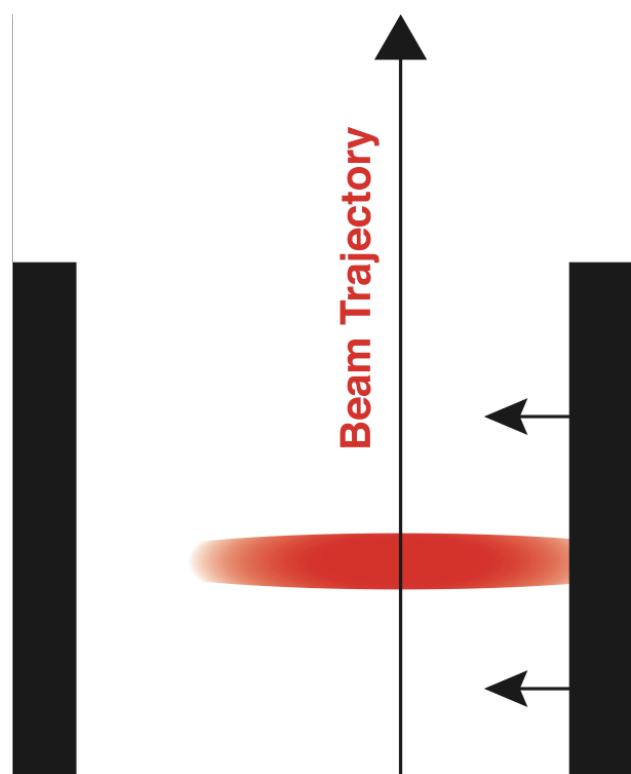
Beam-based set-up

Basic idea: **beam scans** with one jaw at a time through the beam while measuring beam losses (BLM's and/or intensity transmission).

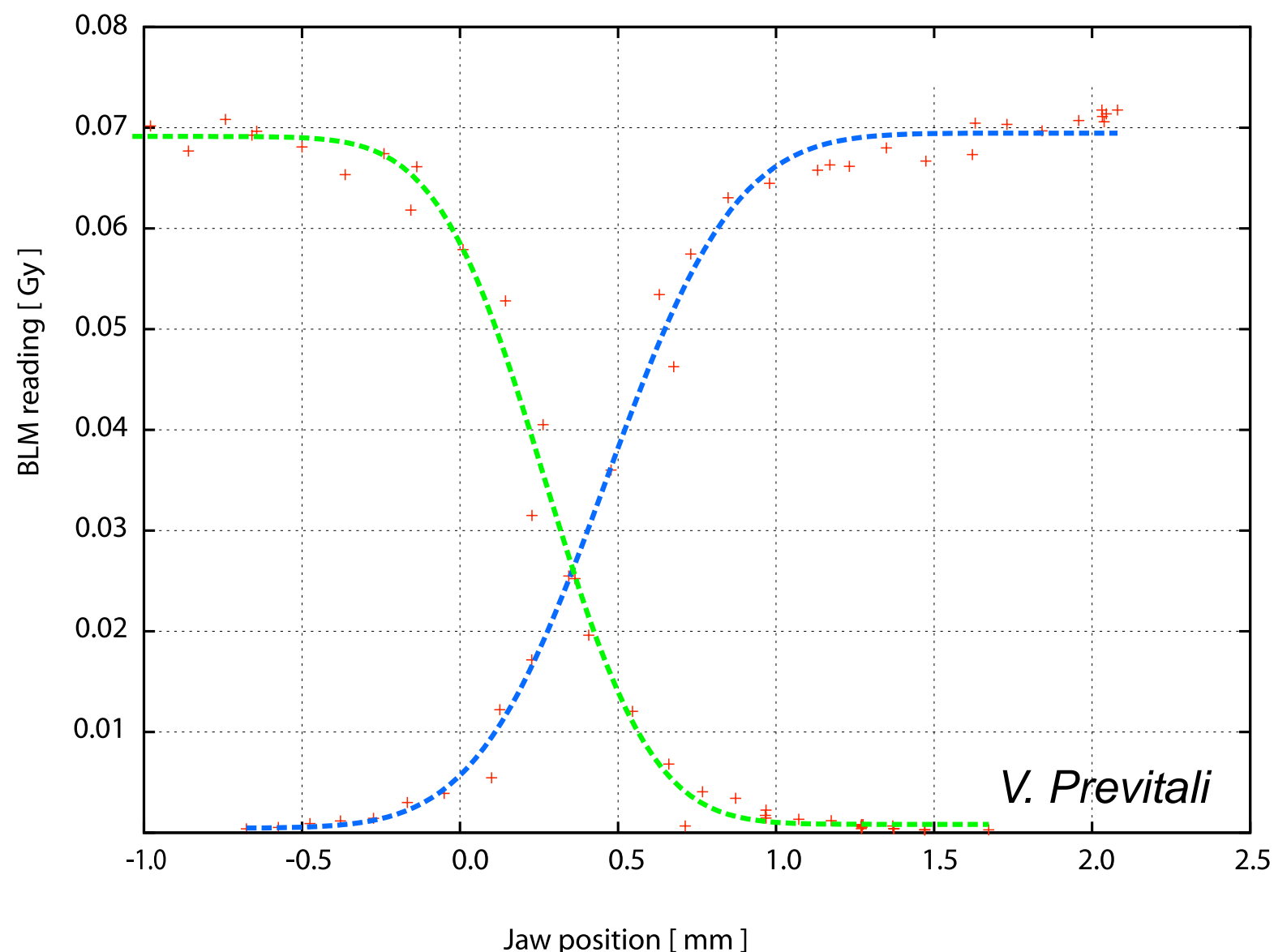
Gaussian fits give **beam centre** and **beam size**!

Results in good agreement with independent beam emittance measurements

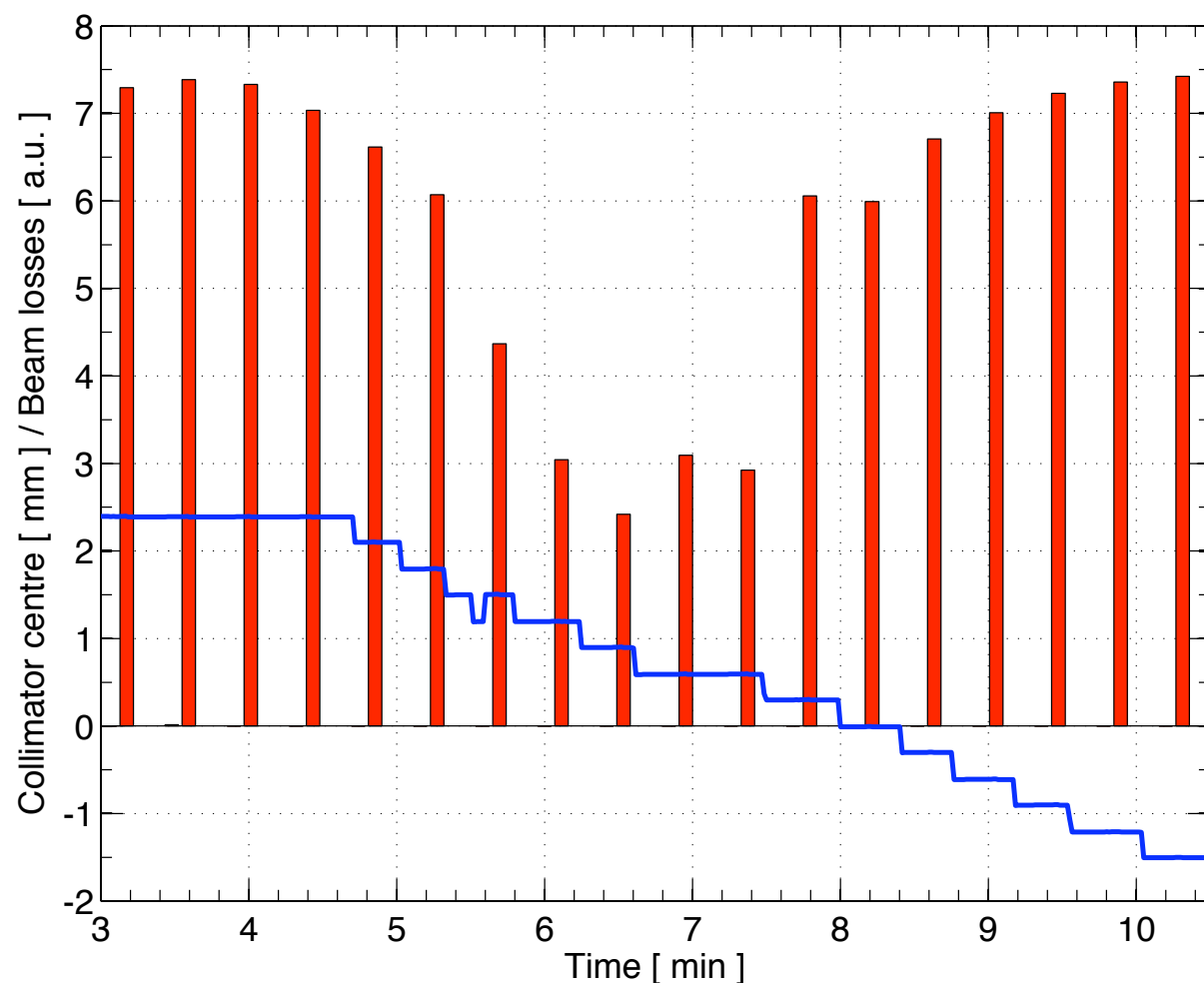
Analysis of beam intensity data (transmission / scale BLM reading) to be done.



Example: scans for the
vertical collimator
TCDIV-29012
($\sigma_y \approx 300 \mu\text{m}$)



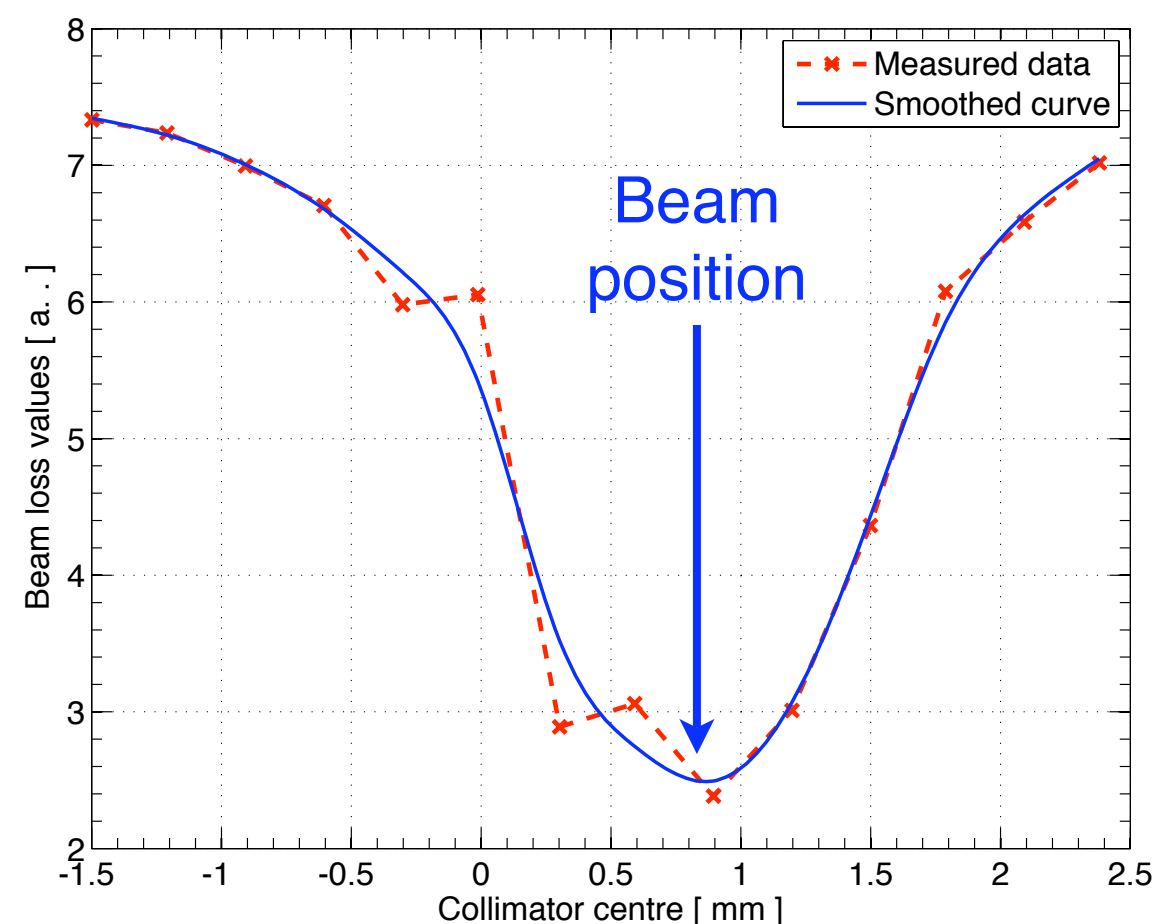
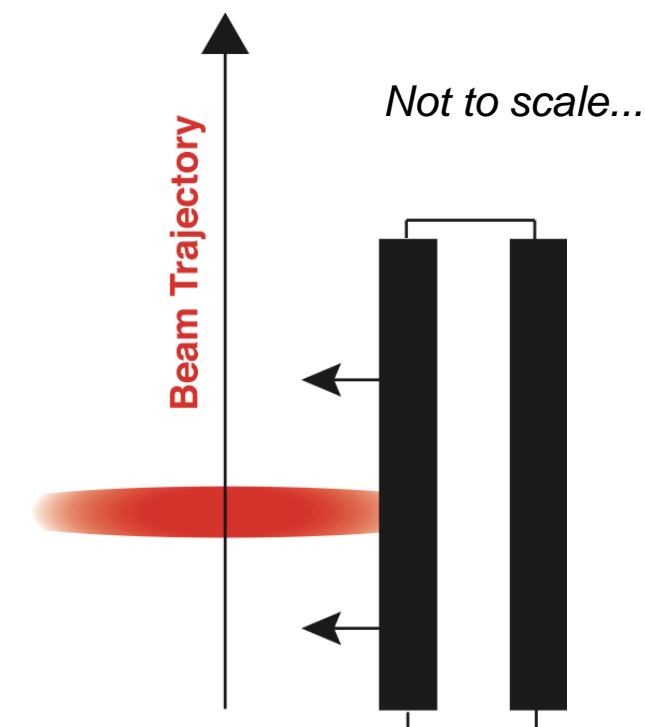
Beam-based set-up: beam centre



Preliminary data are consistent with the two scans done with one jaw at a time.

BLM data not yet corrected by intensity measurements.

Sliding gap
across the beam.
Record losses
and transmission.
*Cross check of previous
method.*



Beam-based settings in LSA

Trim Editor

LHC BP OP

return

Beams	IPs	Families	ParametersTypeGroups	Parameters
B1	TI2	TCDIH	PHYSICS : COLL_JAW_TOLERANCE	TCDIH.20607/BBCentre
B2		TCDIV	PHYSICS : COLL_JAW	TCDIH.20607/BBParam#sigma_x
			PHYSICS : COLL_BBOptics	TCDIH.20607/BBParam#sigma_xp
			PHYSICS : COLL_NSIGMA	TCDIH.20607/BBParam#sigma_y
			PHYSICS : COLL_BBParam	TCDIH.20607/BBParam#sigma_yp
			PHYSICS : COLL_BBCentre	TCDIH.20607/NSIGMA
			PHYSICS : COLL_HalfGap_TOL	TCDIH.29050/BBCentre
			PHYSICS : COLL_HalfGap	TCDIH.29050/BBParam#sigma_x

Select All Select All Select All Select All Select All

Setting part: ☐ Value ☒ Target ☐ Correction Trim History Time base: ☒ SuperCycle ☐ Cycle/BeamProcess

Parameter	ramp_5TeV_ir5@0_[START]
TCDIH.20607/BBCentre	0.85
sigma_x	0.62
TCDIH.20607/NSIGMA	4.5

Trim

return

Beam Processes	Beams	IPs	Families	ParametersTypeGroups	Parameters
_NON_MULTIPLEXED_LHC	B1	TI2	TCDIH	PHYSICS : COLL_JAW	TCDIH.29465/RequiredAbsPositionFunct#left_downstream
DISCRETE_LHCRING_INJ_KICKER_V1	B2		TCDIV	PHYSICS : COLL_BBOptics	TCDIH.29465/RequiredAbsPositionFunct#left_upstream
ramp_5TeV_ir5@0_[START]				PHYSICS : COLL_NSIGMA	TCDIH.29465/RequiredAbsPositionFunct#right_downstream
Collimator_testV1.TRACKING-TEST-7TeV.BP0				PHYSICS : COLL_BBParam	TCDIH.29465/RequiredAbsPositionFunct#right_upstream
PRECYCLE-TEST-V2_MIKE-V1				PHYSICS : COLL_BBCentre	TCDIH.20607/RequiredAbsPositionFunct#left_downstream
RAMP-IR5-4.135TeV@0_[START]				PHYSICS : COLL_HalfGap_TOL	TCDIH.20607/RequiredAbsPositionFunct#left_upstream
RAMP-IR5-4.135TeV_V1				PHYSICS : COLL_HalfGap	TCDIH.20607/RequiredAbsPositionFunct#right_downstream
RAMP-IR5-4.2TeV_V1				PHYSICS : COLL_NSIGMA_TOL	TCDIH.20607/RequiredAbsPositionFunct#right_upstream
RAMP-IR5@0_[START]				HW SETTINGS : COLL_MOTOR_TOLERANCE	TCDIH.29050/RequiredAbsPositionFunct#left_downstream
RAMP_IR5V1_RAMP_IR5_BP0				HW SETTINGS : COLL_MOTOR_POSITION	TCDIH.29050/RequiredAbsPositionFunct#left_upstream

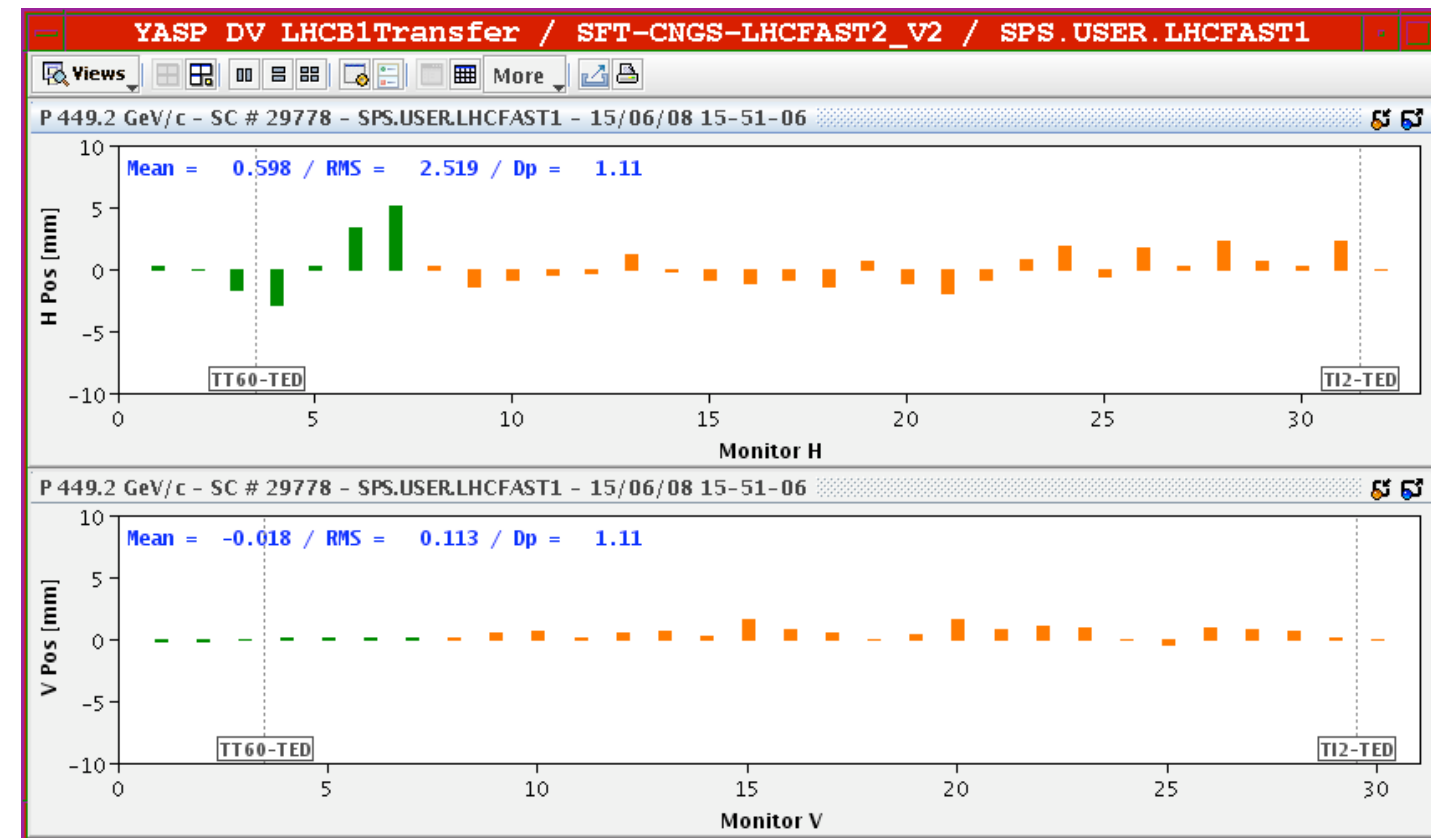
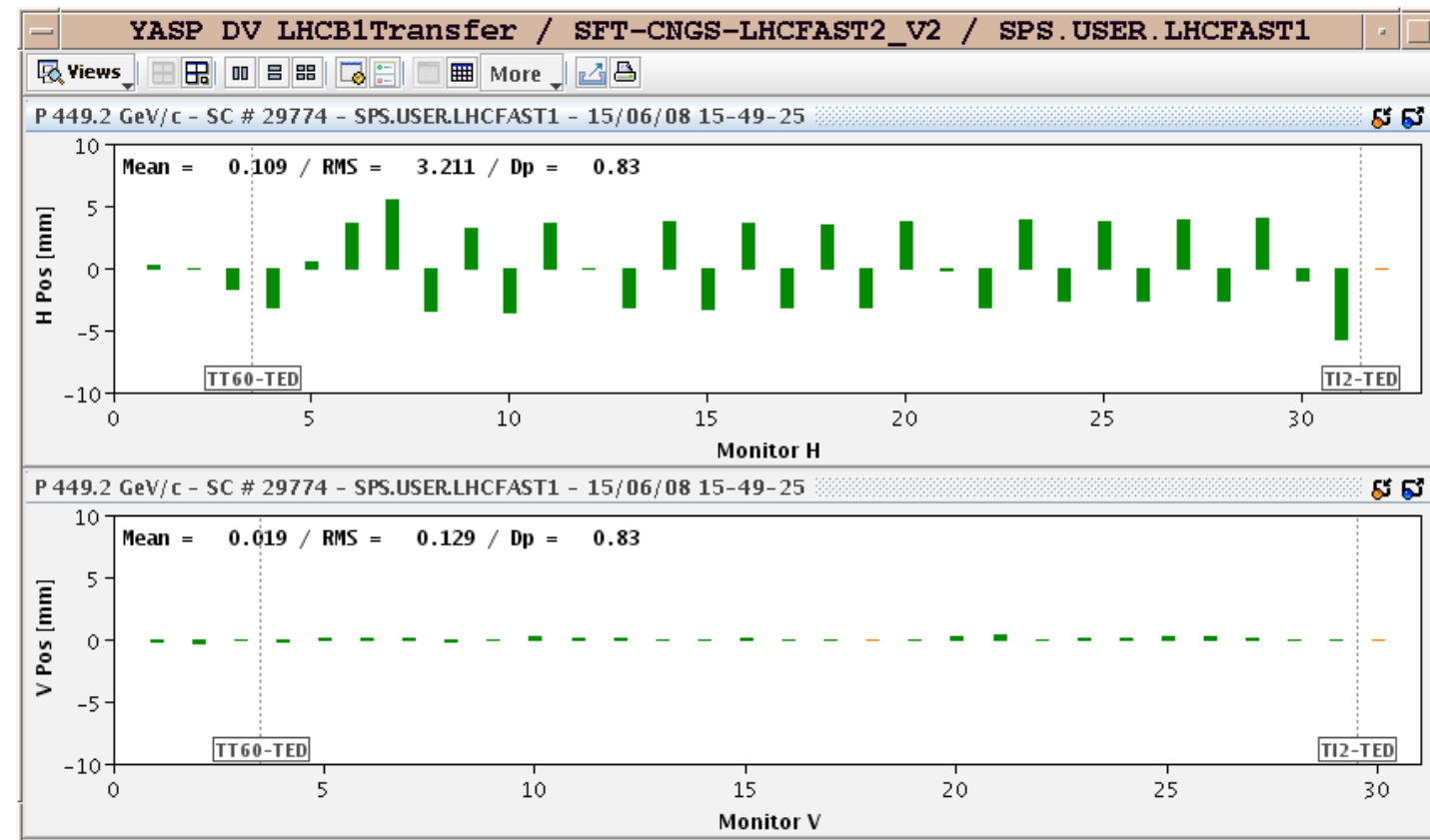
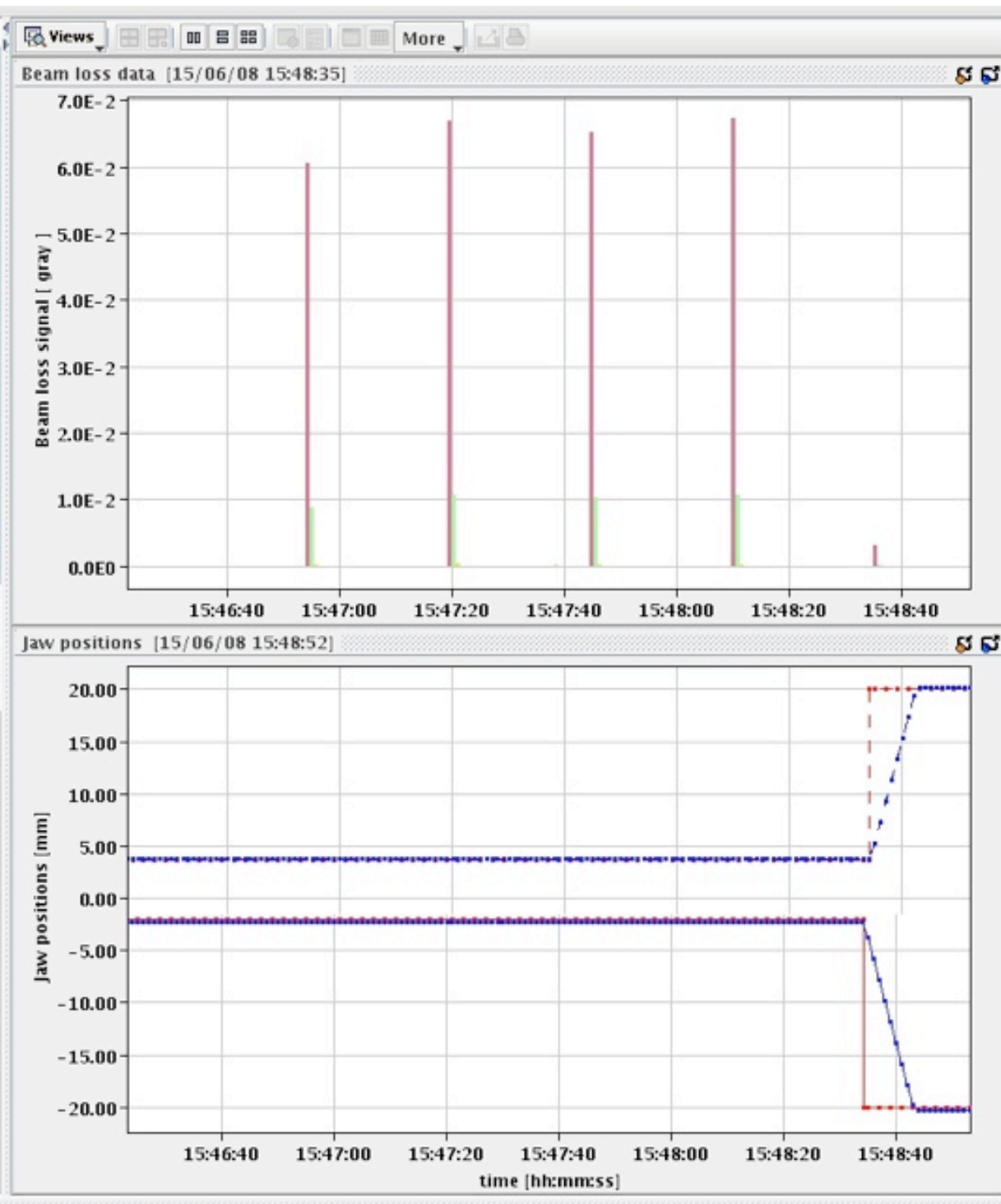
Show hidden Select All Select All Select All Select All Select All

Setting part: ☐ Value ☒ Target ☐ Correction Trim History Time base: ☒ SuperCycle ☐ Cycle/BeamProcess

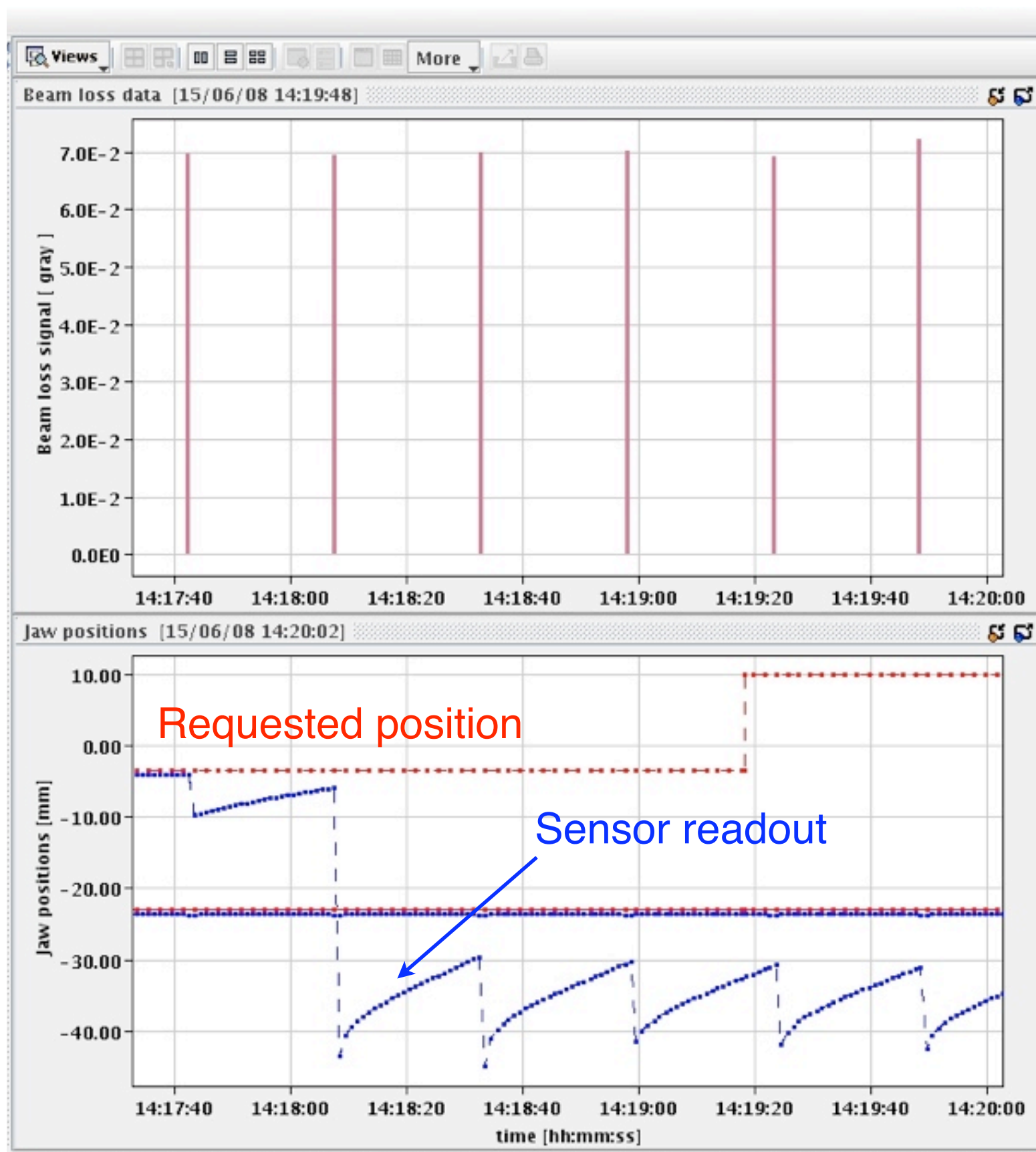
Parameter	ramp_5TeV_ir5@0_[START]
left_downstream	3.6399500556074607
left_upstream	3.6400499443925396
right_downstream	-1.9400499443925394
right_upstream	-1.9399500556074605

Trim

Verification of protection settings



LVDT noise induced by the beam



Drift of the LVDT read-out value when the beam impacted on the collimator jaw.

Signal goes back to the correct value if we switch the beam off.

Problem occurred systematically during 1h, then disappeared by itself!

Sensor will probably be replaced (see above).

Ongoing issues

- **Timing**

Preferred solution with static payload for the collimator gateways
(7 points in the ring) not supported by CO
Dynamic payloads and transactions are being implemented

- **ALARMS**

Warning/errors defined
Appropriate alarm property will be introduced in FESA

- ***Post-Mortem***

Requirements and FESA property defined.
PM buffer will be filled with position data at 100 Hz
Also available in the next release of our FESA class

- **MCS**

First version from VK is being tested

- **Temperature controls**

PVSS software ready to be deployed

- **BLM acquisition** for system set-up

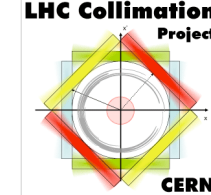
Configuration tests performed

Acquisition tests slowed down by the availability of BLM concentrator

- **Other movable devices**



Interface for movable devices



CERN
CH-1211 Geneva 23
Switzerland



LHC Project Document No. LHC-TC-xxx rev 0.1
CERN Div./Group or Supplier/Contractor Document No. AB
EDMS Document No. XXXXXX

Date: 2008-06-18

Engineering Specification

MIDDLE-LEVEL INTERFACE TO CONTROL MOVABLE DEVICES LIKE LHC COLLIMATORS

Abstract

This document describes the interface between the collimator middleware controls and the application for the collimator control from the control room. This interface is proposed as an easy way to extend the applications developed within the LHC Application Software (LSA) for the LHC collimator control to other movable devices. In particular, the cases of the beam dump diluter (TCDQ) and of the TOTEM Roman pots are considered in some details.

Prepared by:
S. Redaelli,
A. Masi

Checked by:
R. Bailey, C. Boucly,
E. Carlier, M. Deile,
M.P. Dutour, B. Goddard,
M. Jonker, P. Palazzi,
E. Radermacher,
F. Lucas Rodriguez

Approved by:
R. Assmann,
P. Collier,
M. Lamont,
R. Losito

Specs on FESA interface to control movable devices like collimators is under approval.

Follow-up a meeting with Roger, Paul, Mike, Ralph, Michel.

This formalizes previous agreement on the requirements to control movable devices from the CCC.

Mainly a concern for TCDQ and Roman pots. TDI under responsibility of ATB, minor impact expected.

First results on the TCDQ...

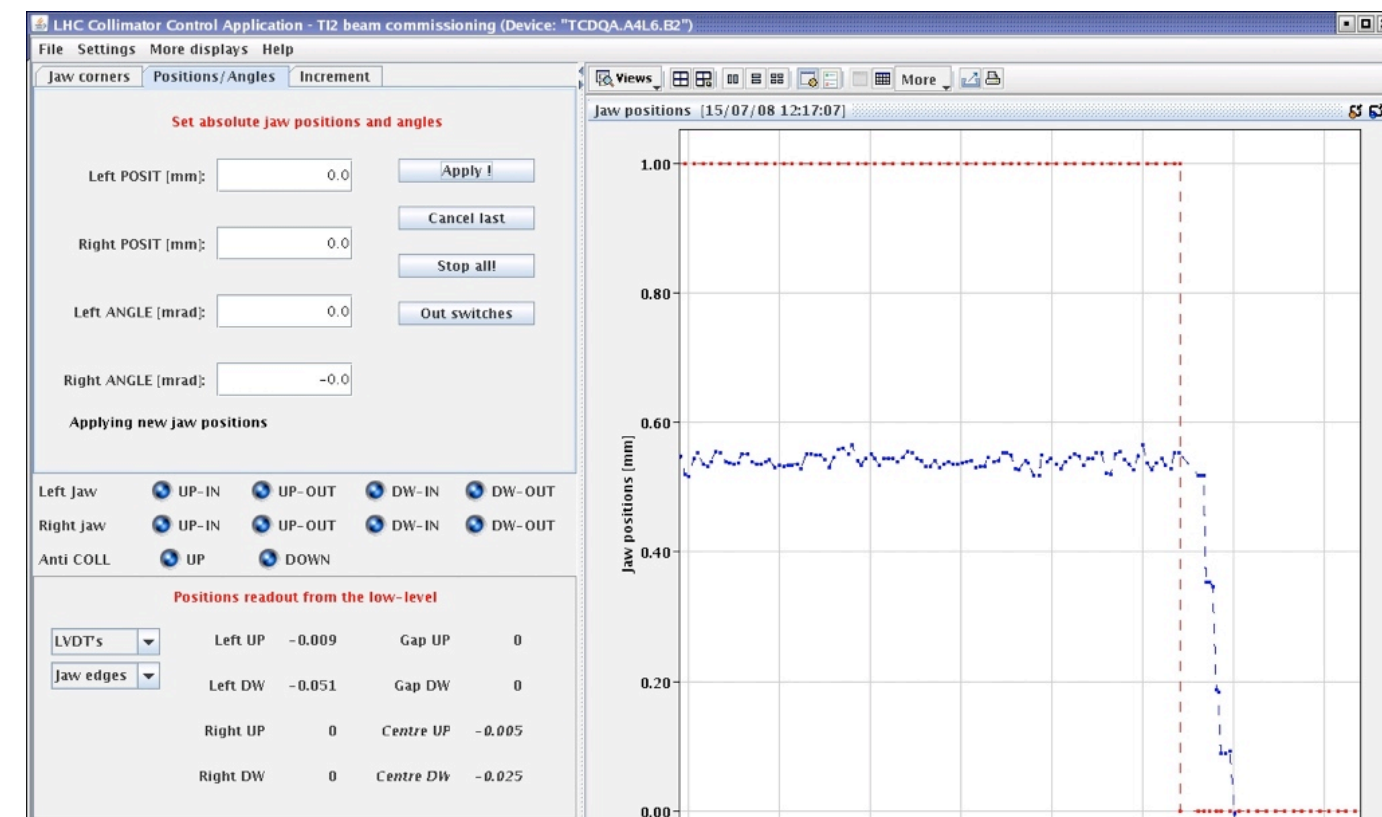
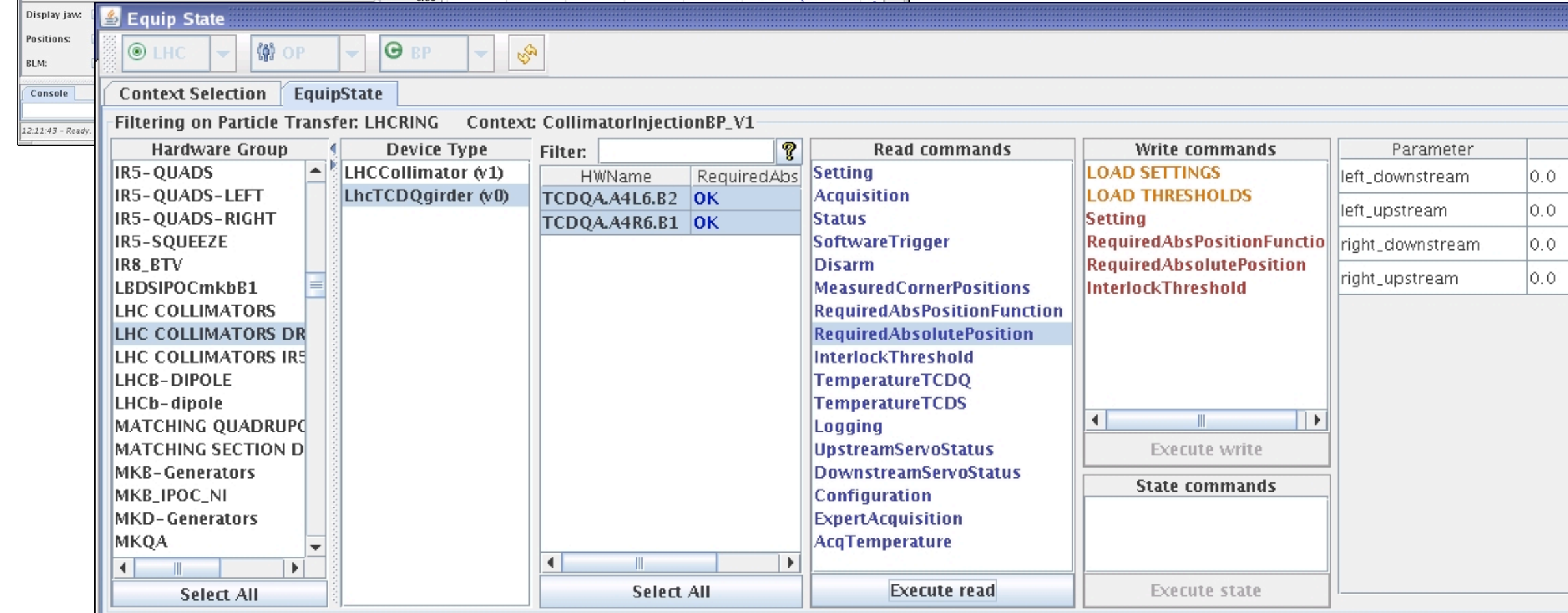
First results for TCDQ

FESA implementation by C. Boucly,
E. Carlier.

First movements from the collimator
application.

LSA implementation is ready!

More tests at the end of this week...

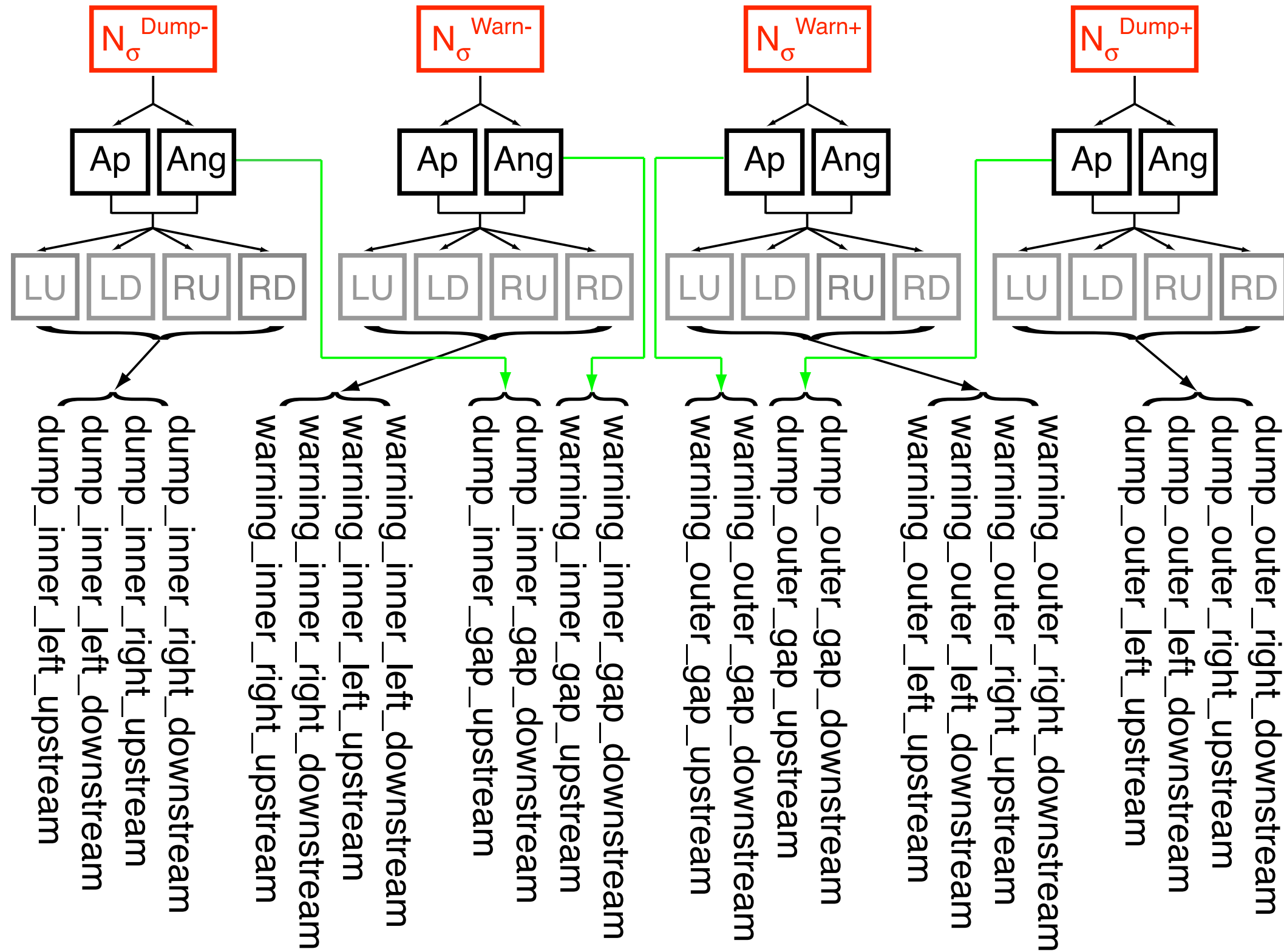
The screenshot shows the 'Equip State' application. The 'Context Selection' tab is active, showing 'Filtering on Particle Transfer: LHCRING' and 'Context: CollimatorInjectionBP_V1'. The 'Hardware Group' list includes 'IR5-QUADS', 'IR5-QUADS-LEFT', 'IR5-QUADS-RIGHT', 'IR5-SQUEEZE', 'IR8_BTV', 'LBDSIPOCmkbB1', 'LHC COLLIMATORS', 'LHC COLLIMATORS DR', 'LHC COLLIMATORS IR5', 'LHCB-DIPOLE', 'LHCB-dipole', 'MATCHING QUADRUPOLE', 'MATCHING SECTION D', 'MKB-Generators', 'MKB_IPOC_NI', 'MKD-Generators', and 'MKQA'. The 'Device Type' list includes 'LHCCollimator (v1)' and 'LhcTCDQgirder (v0)'. The 'Filter' section shows 'HWName' and 'RequiredAbs' for 'TCDQA.A4L6.B2' and 'TCDQA.A4R6.B1', both marked 'OK'. The 'Read commands' list includes 'Setting', 'Acquisition', 'Status', 'SoftwareTrigger', 'Disarm', 'MeasuredCornerPositions', 'RequiredAbsPositionFunction', 'RequiredAbsolutePosition', 'InterlockThreshold', 'TemperatureTCDQ', 'TemperatureTCDS', 'Logging', 'UpstreamServoStatus', 'DownstreamServoStatus', 'Configuration', 'ExpertAcquisition', and 'AcqTemperature'. The 'Write commands' list includes 'LOAD SETTINGS', 'LOAD THRESHOLDS', 'Setting', 'RequiredAbsPositionFunction', 'RequiredAbsolutePosition', and 'InterlockThreshold'. The 'Parameter' table shows values for 'left_downstream', 'left_upstream', 'right_downstream', and 'right_upstream', all set to 0.0.

Parameter	Value
left_downstream	0.0
left_upstream	0.0
right_downstream	0.0
right_upstream	0.0

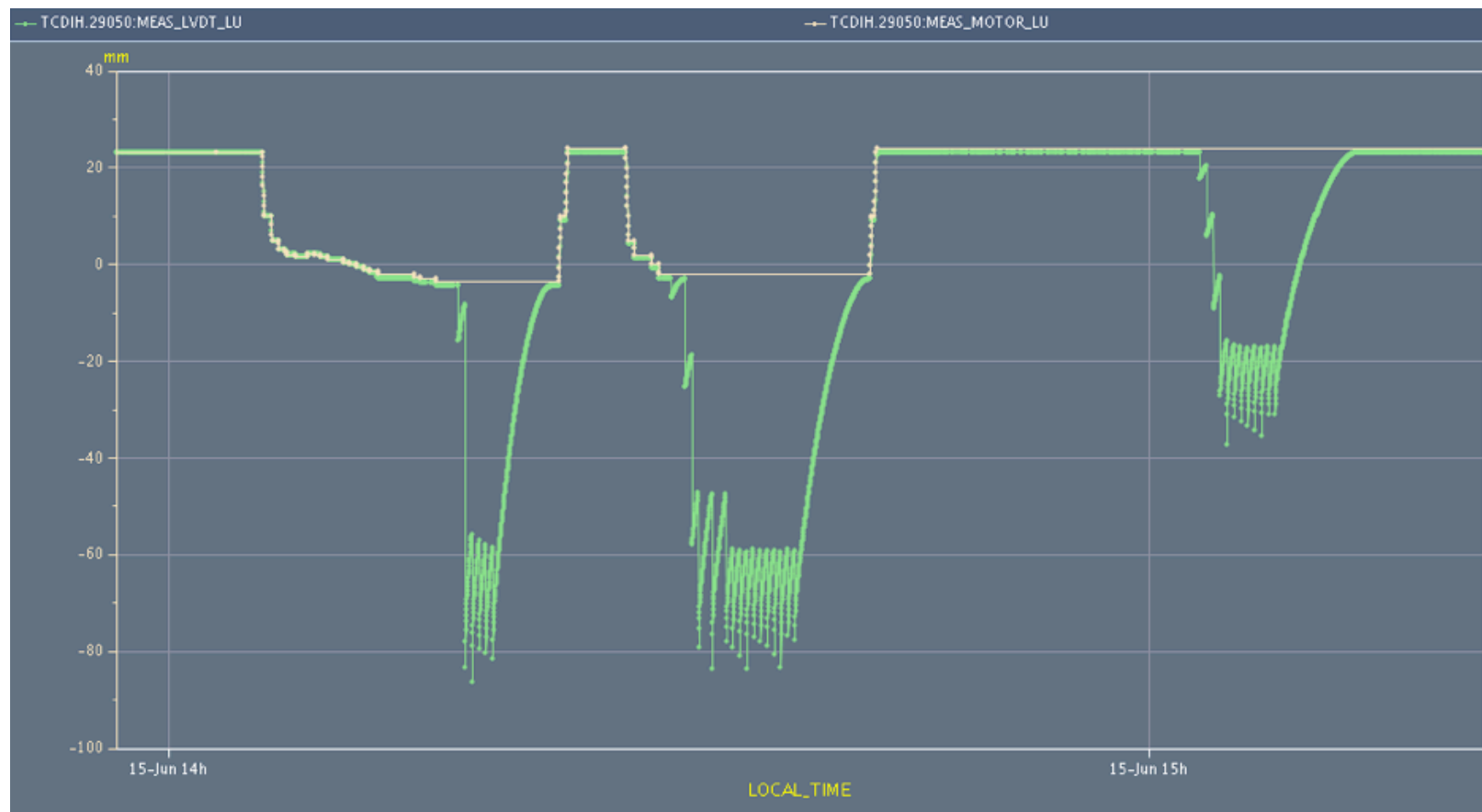
Conclusive remarks

- ✓ We looked at the **readiness** of collimator controls for remote commissioning without and with beam
- ✓ Collimator controls are basically **ready**!
 - Requirements specified are achieved
 - A few aspects are being worked on but tools are appropriate
 - Experience with beam will show new requirements...
- ✓ **Operational tests** have followed the hardware readiness after commissioning
 - Collimator movement with **time-functions** achieved
 - Position accuracy below **30 microns** for simultaneous movements of several devices in the tunnel
 - Machine protection** functionality from the CCC can be tested
 - Various encountered problems are being addressed
- ✓ **Successful beam tests** carried out during the TI2 commissioning
 - Ready for the transfer line collimation requirements..
- ✓ Next **milestone** (more details in Ralph's talk):
 - Move all the available collimators through a full nominal cycle (5 TeV)

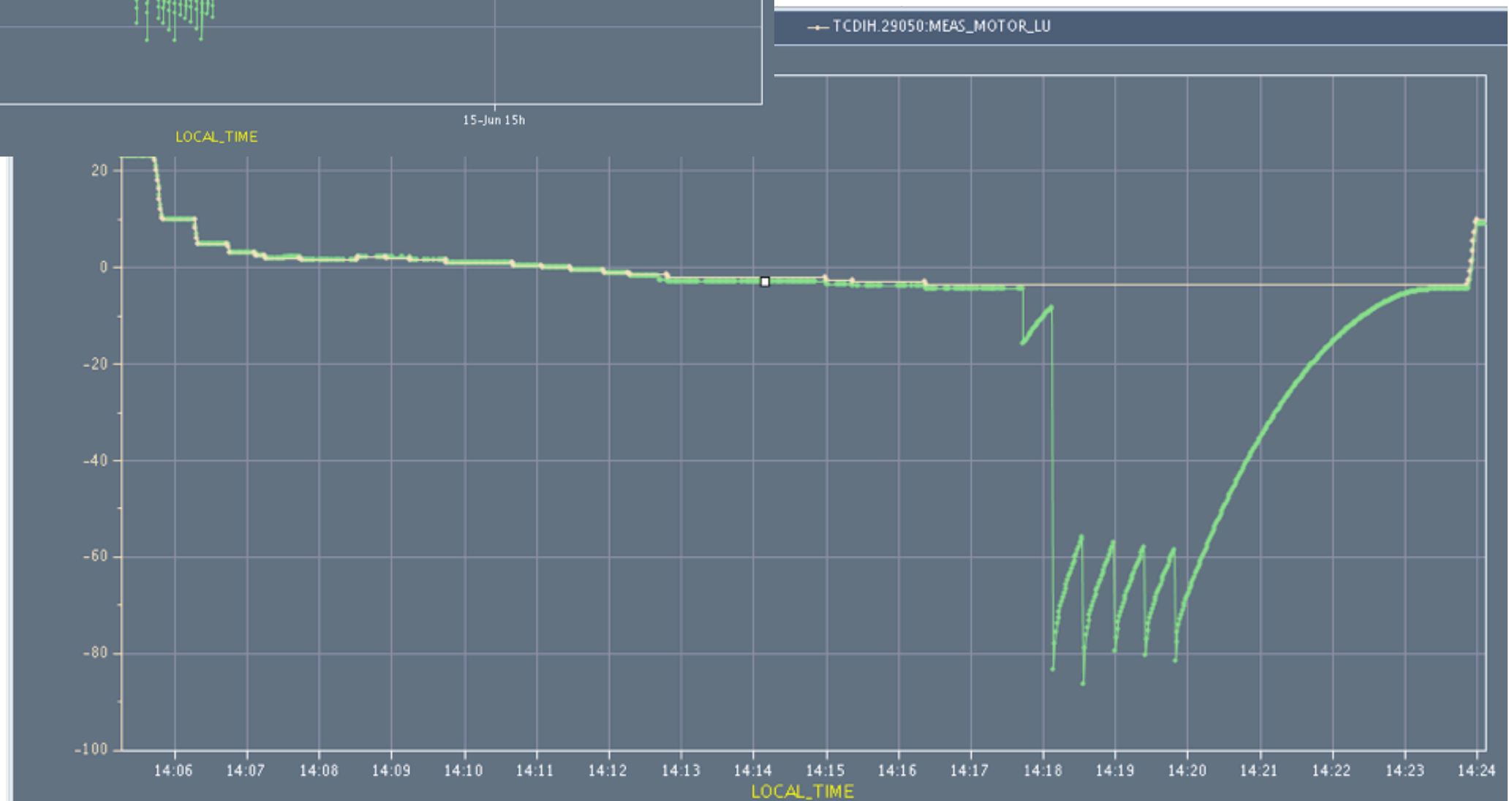
Dependency tree for thresholds



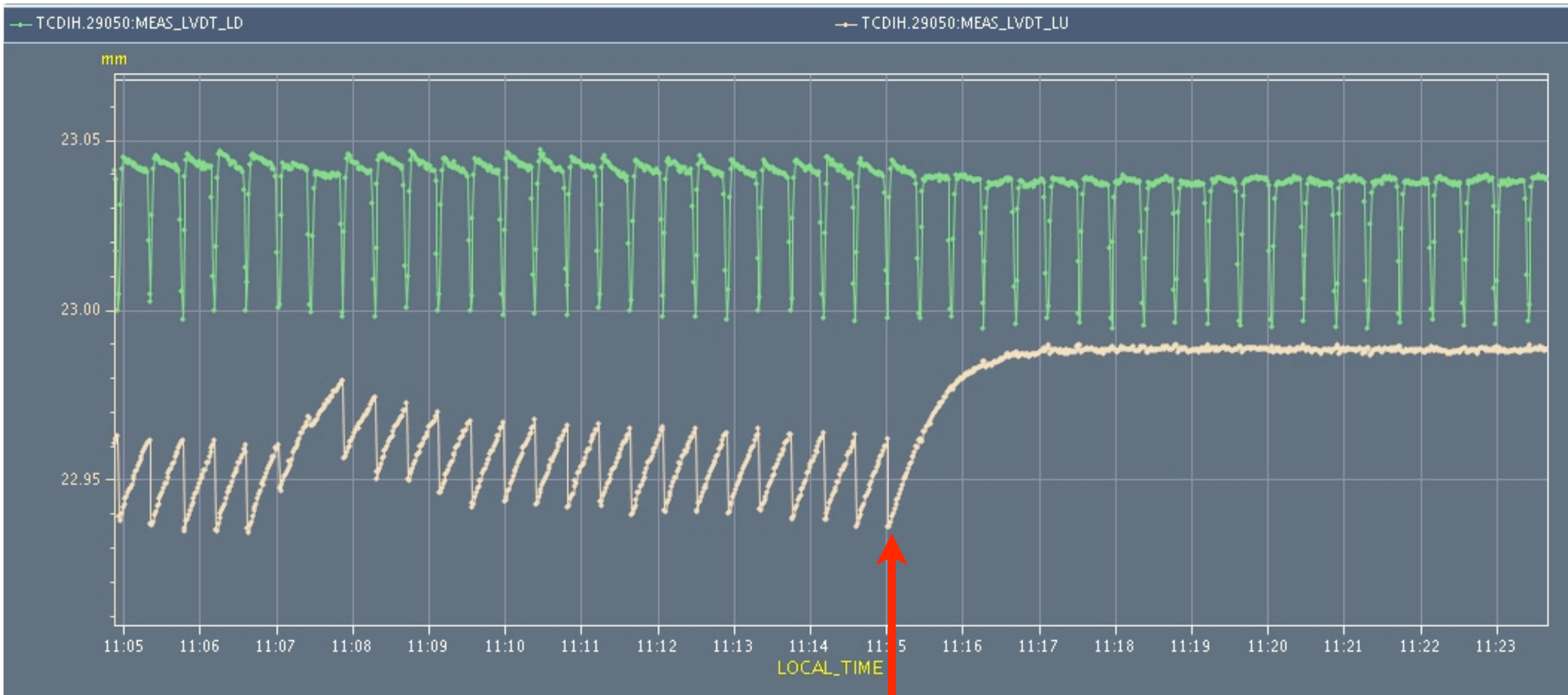
LVDT noise induced by the beam (II)



Could reproduce this effect three consecutive time, but ~1h later this feature disappeared!



Magnet versus beam noise



Last beam shot